National Park Service
United States Department of the Interior

Environmental Assessment

The Arlington Memorial Bridge Rehabilitation

April 2016

This page left intentionally blank.

ENVIRONMENTAL ASSESSMENT

THE ARLINGTON MEMORIAL BRIDGE REHABILITATION

April 2016

This page left intentionally blank.

PROJECT SUMMARY

INTRODUCTION

Pursuant to Section 101(2)(C) of the National Environmental Policy Act of 1969, as amended, the National Park Service, in cooperation with the Federal Highway Administration, is evaluating the proposed rehabilitation of the Arlington Memorial Bridge. The US Coast Guard and National Capital Planning Commission are acting as cooperating agencies. The historic bridge spans the Potomac River between the National Mall in Washington, DC, and the Arlington National Cemetery in Virginia. The bridge is an important element of the George Washington Memorial Parkway, the regional transportation network, and the monumental core of Washington, DC.

The proposed Arlington Memorial Bridge project includes the rehabilitation or replacement of the steel draw span (technically referred to as the bascule span); repairs to the deteriorated portions of the abutments, piers, and concrete arch spans; replacement of the concrete bridge deck; resurfacing of the travel lanes; replacement of the concrete sidewalks and refitting of granite curbs; repairs to granite bridge railings; repairs to lamp posts; repairs to access panels; installation of an improved drainage system; and other minor nonstructural bridge improvements.

This Environmental Assessment analyzes the potential environmental impacts that would result from the implementation of the proposed action. This Environmental Assessment has been prepared in accordance with the National Environmental Policy Act, the regulations of the Council on Environmental Quality for implementing the National Environmental Policy Act (40 Code of Federal Regulations 1500-1508), and Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making (NPS 2011a). Section 106 of the National Historic Preservation Act of 1966, as amended, is being conducted as a separate but parallel process.

PURPOSE OF AND NEED FOR ACTION

The purpose of the project is to restore the structural integrity of the Arlington Memorial Bridge while protecting and preserving, to the extent feasible, its memorial character and significant design elements.

The Arlington Memorial Bridge is more than 80 years old and has never undergone a major rehabilitation. Several temporary repairs have kept it operational to meet the needs of the traveling public. However, like many other older highway bridges across the nation, this bridge needs comprehensive repair to ensure its ability to provide adequate traffic service for decades to come.

The Federal Highway Administration regularly inspects the bridge in accordance with generally recognized structural engineering guidelines and standards. These detailed structural inspections and studies have identified significant amounts of corroded steel and deteriorated concrete. The most critical elements needing repair are the concrete arch spans and the steel bascule (drawbridge) span. Therefore, the project is needed to address the ongoing corrosion of steel structural members

of the bascule span, deterioration of the concrete on the bridge's concrete arches, and deterioration of the sidewalks and wearing surface.

While the bridge is still considered safe for travel, the superstructure is deteriorating at an accelerated pace. The National Park Service, at the recommendation of the Federal Highway Administration, has posted a 10-ton load limit across the entire length of the bridge. The load restriction, which has eliminated most bus traffic, will remain in effect until the permanent rehabilitation project is completed. As the bridge continues to deteriorate, the National Park Service and the Federal Highway Administration may impose further weight restrictions and/or close the bridge.

OVERVIEW OF THE ALTERNATIVES

This Environmental Assessment analyzes the No-Action Alternative along with four Action Alternatives for rehabilitation of the Arlington Memorial Bridge. The No-Action Alternative provides a basis for comparing the management direction and environmental consequences of the other alternatives. Under all alternatives, including the No-Action Alternative, the trunnion posts would be reinforced with steel columns to provide additional strength in order to protect the integrity of the bascule span.

All Action Alternatives would include repairs to the concrete arch spans, concrete bridge piers, bridge railings and other non-structural bridge components, and replacement of expansion joints, bearings, bridge deck, and sidewalks. Under Alternative 1A the bascule span would be replaced with a new span comprised of precast concrete box girders. Under Alternative 1B the bascule span would be replaced with a new span comprised of variable depth steel girders. Two construction methods are being considered for Alternatives 1A and 1B. Construction Method A would require a temporary full closure of the bridge, sidewalks, and all vehicular travel lanes while the bascule span is replaced. Construction Method B would use a phased approach to replace the bascule span and would require partial closure of the bridge with the closure of three vehicular travel lanes and one sidewalk. Under Alternative 2 the bascule span would be replaced with a new span comprised of welded steel truss construction. Under Alternative 3 the existing bascule span would be completely rehabilitated in place.

Under all Action Alternatives, several land and river staging areas would be necessary. This Environmental Assessment analyzes two river staging areas which will be located on two temporary barges north and south of the Arlington Memorial Bridge. In addition, the impacts associated with the use of causeways or dock/work platforms have been assessed. Four land staging areas are also analyzed and are located on Memorial Circle, south of Memorial Circle, north of the Lincoln Memorial, and near the Watergate Steps.

The National Park Service, in cooperation with the Federal Highway Administration, has identified Alternative 1B: Replace the Bascule Span with a New Span Comprised of Variable Depth Steel Girders, as the Preferred Alternative for the rehabilitation and repair of the Arlington Memorial Bridge.

NOTE TO REVIEWERS AND RESPONDENTS

We value and welcome your input on this project. The public comment period closes on May 9, 2016. The preferred system for receiving public comments electronically is through the National Park Service Planning, Environment, and Public Comment (PEPC) website, where the Environmental Assessment is publicly posted on the internet. The PEPC database is a tool used by the National Park Service to manage official correspondence and analyze public comment in the planning process. The website address is http://parkplanning.nps.gov/memorialbridgeea. To complete a comment form online, from the list of projects, click on the Arlington Memorial Bridge Rehabilitation. In the left menu, click Document List, then Environmental Assessment, and Comment on Document.

You can also mail comments to:

Superintendent, George Washington Memorial Parkway
c/o Turkey Run Park
McLean, VA 22101

If you wish to comment on the Environmental Assessment, you may submit comments electronically or directly by mail. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you may request in your comment that your personal identifying information be withheld from public review, we cannot guarantee that we will be able to do so.

This page left intentionally blank.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIXES

CHAPTER 1: PURPOSE AND NEED

INTRODUCTION

Pursuant to Section 101(2)(C) of the National Environmental Policy Act (NEPA) of 1969, as amended, the National Park Service, in cooperation with the Federal Highway Administration, is evaluating the proposed rehabilitation of the Arlington Memorial Bridge. The US Coast Guard (USCG) and the National Capital Planning Commission are acting as cooperating agencies. The historic bridge spans the Potomac River between the National Mall in Washington, DC and the Arlington National Cemetery in Virginia. The bridge is an important element of the George Washington Memorial Parkway, the regional transportation network, and the monumental core of Washington, DC. The Arlington Memorial Bridge is shown in Figure 1 and Figure 2 along with other memorials and monuments surrounding the bridge.

Figure 1: View of the Arlington Memorial Bridge, Lincoln Memorial, and Washington Monument from the George Washington Memorial Parkway

The proposed Arlington Memorial Bridge project includes the rehabilitation or replacement of the steel draw span (technically referred to as the bascule span); repairs to the deteriorated portions of the abutments, piers, and concrete arch spans; replacement of the concrete bridge deck; resurfacing of the travel lanes; replacement of the concrete sidewalks and refitting of granite curbs; repairs to granite bridge railings; repairs to lamp posts; repairs to access panels; installation of an improved drainage system; and other minor nonstructural bridge improvements.

Figure 2: View of the Arlington Memorial Bridge, Women in Military Service for America Memorial, and Arlington House from the Lincoln Memorial

This Environmental Assessment analyzes the potential environmental impacts that would result from the implementation of the proposed action. This Environmental Assessment has been prepared in accordance with the National Environmental Policy Act, the regulations of the Council on Environmental Quality for implementing National Environmental Policy Act (40 Code of Federal

Regulations 1500-1508), and Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making (NPS 2011a). Consultation regarding Section 106 of the National Historic Preservation Act of 1966, as amended, is being conducted as a separate but parallel process.

PURPOSE OF AND NEED FOR ACTION

The purpose of the project is to restore the structural integrity of the Arlington Memorial Bridge while protecting and preserving, to the extent feasible, its memorial character and significant design elements.

The Arlington Memorial Bridge is more than 80 years old and has never undergone a major rehabilitation. Several temporary repairs have kept it operational to meet the needs of the traveling public. However, like many other older highway bridges across the nation, this bridge needs comprehensive repair to ensure its ability to provide adequate traffic service for decades to come.

The Federal Highway Administration regularly inspects the bridge in accordance with generally recognized structural engineering guidelines and standards. These detailed structural inspections and studies have identified significant amounts of corroded steel and deteriorated concrete. The most critical elements needing repair are the concrete arch spans and the steel bascule (drawbridge) span. Therefore, the project is needed to address the ongoing corrosion of steel structural members of the bascule span, deterioration of the concrete on the bridge's concrete arch spans, and deterioration of the sidewalks and wearing surface.

While the bridge is still considered safe for travel, the superstructure is deteriorating at an accelerated pace. The National Park Service, at the recommendation of the Federal Highway Administration has posted a 10-ton load limit across the entire length of the bridge. The load restriction, which has eliminated most bus traffic, will remain in effect until the permanent rehabilitation project is complete. As the bridge continues to deteriorate, the National Park Service and the Federal Highway Administration may impose further weight restrictions and/or close the bridge.

PROJECT OBJECTIVES

Objectives are generally defined as "what must be achieved to a large degree for the action to be considered a success" (NPS 2011a) and represent more specific statements of purpose and need. All alternatives selected for detailed analysis must meet all objectives to a large degree and must substantially address the purpose of and need for action. The following objectives were identified by the planning team for this project:

1. Address the structural deterioration of the bridge while preserving the Memorial's historic integrity to the extent feasible;

2. Minimize extent and duration of full bridge and /or partial lane closures and overall disruption to traffic during construction;
3. Avoid disruptions to utilities during construction; and
4. Minimize future maintenance requirements and associated costs.

PROJECT AREA

The Arlington Memorial Bridge spans the Potomac River, connecting Lincoln Memorial Circle with the Memorial Circle on Columbia Island (officially renamed Lady Bird Johnson Park in 1968) in Washington, DC. Further west, the bridge provides access to Memorial Avenue and the ceremonial entrance to Arlington National Cemetery within the Commonwealth of Virginia. The project area for the proposed rehabilitation of the Arlington Memorial Bridge consists of the bridge and surrounding roadways, construction staging areas in the vicinity of the bridge, and the Potomac River channel and shorelines, approximately 1,400 feet upstream and 2,100 feet downstream of the bridge (Figure 3).

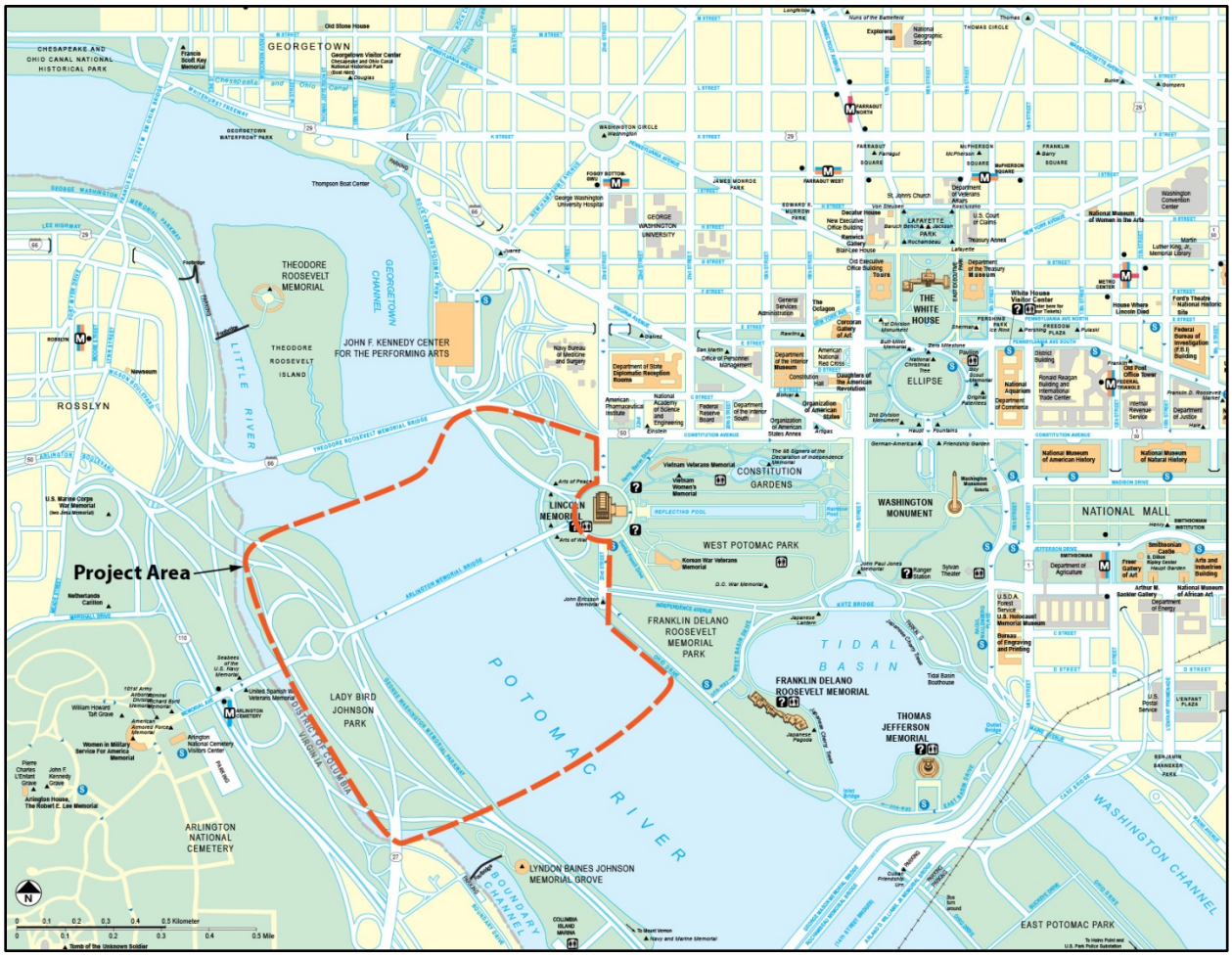


Figure 3: Project Area

DESCRIPTION OF THE ARLINGTON MEMORIAL BRIDGE

Figure 4: Arlington Memorial Bridge over the Potomac River

The Arlington Memorial Bridge serves as a memorial to the reconciliation between the Union and Confederacy following the Civil War. As the western link in the chain of monuments that starts at the Capitol building, the Arlington Memorial Bridge connects the National Mall in Washington, DC with Arlington National Cemetery in Virginia (Nolin 1988). The Memorial Bridge was designed by William Mitchell Kendall while employed by McKim, Mead & White, a prominent architectural firm based in New York City. The bridge reflects the original intention of the McMillan Commission, whose charge was to guide the development of the monumental core and the park system of Washington, DC by building a memorial bridge on this site which would join the North and South (Figure 4).

The bridge provides a physical and symbolic link between the North and the South, and was designed as an entryway and a grand approach to the monumental core of our nation's capital. The bridge and its associated architectural, engineering, sculptural, and landscape features are significant as important elements in the neoclassical urban design of the National Capital as it evolved during the first third of the 20th century. Specifically, the bridge's bascule span is recognized as an innovative engineering achievement.

The area between the southern terminus of the Rock Creek and Potomac Parkway and the bridge is the Watergate, a broad flight of steps leading to the water that represents a ceremonial river entrance to the District of Columbia. At its western end, the Arlington Memorial Bridge complex includes Memorial Circle and its surrounding landscapes, the circular plaza on Columbia Island; the Boundary Channel Bridge, which connects Columbia Island (now Lady Bird Johnson Park) with the Virginia shore; and Memorial Avenue and Hemicycle, the ceremonial entrance to Arlington Cemetery.

A bridge spanning the Potomac River in the location of the Arlington Memorial Bridge was first conceived in the 1830s. In 1832, Congress passed an act that funded the purchase of land for the bridge's approaches. In 1836, Congress passed an act to build a bridge across the Potomac; however, the bridge was never constructed.

Following a major flood in 1881, Congress appropriated funds to raise the tidal flat on the eastern side of the Potomac River. The US Army Corps of Engineers oversaw the dredging of the river to improve navigation while using the dredge spoils to reclaim the tidal flats. The reclaimed land was set aside for a public park and now includes Potomac Park and the western portion of the National Mall. The land on which the bridge abutments of the Arlington Memorial Bridge sit was also created during this time.

The Senate Park Commission, commonly known as the McMillan Commission, was formed in 1901 to study the conditions of the District's parks. The Commission ultimately developed the Senate Park Commission Plan of 1901 and included a memorial bridge in the location that the Arlington Memorial Bridge was ultimately constructed. The Arlington Memorial Bridge Commission was established in 1913 to oversee the planning and construction of the bridge. Plans were considered for the next decade, but Congress did not allocate any funds for the construction of the bridge until 1922. With the dedication of the Lincoln Memorial in 1922, the logic of a bridge connecting the Lincoln Memorial with the Arlington National Cemetery was evident. However, debate continued over the location and type of span that should be constructed. On December 18, 1922, a joint meeting of the Commission of Fine Arts and the Arlington Memorial Bridge Commission decided in favor of "a low bridge on the line connecting the Lincoln Memorial and Arlington House."

Figure 5: View looking to the south at the underpass of Ohio Drive, SW

Architects McKim, Mead & White were selected in early 1923 to design the bridge. William Mitchell Kendall, the lead architect, designed the bridge in the neoclassical style. The Arlington Memorial Bridge is 2,163 feet long and 94 feet wide. The bridge consists of 10 reinforced concrete arch spans and a double leaf bascule span at the bridge's center. Eight of the 10 concrete arch spans are situated over the Potomac River, while two smaller concrete arches span the George Washington Memorial Parkway and Ohio Drive, SW at each end of the bridge (Figure 5). The bridge has sidewalks on each side measuring 14 feet each, and the roadway measures 60 feet from curb to curb, providing six 10-foot-wide vehicle travel lanes. The bridge is supported by an abutment on each shore, six piers—three per side—and two abutments between the masonry and bascule spans.

The concrete arches are dressed with granite ashlar from the Mount Airy Quarry in North Carolina. Each side of each of the piers and central abutments feature sculpted granite, bas-relief eagle and fasces ornamentation designed by sculptor C. Paul Jennewein. The keystone of each concrete arch is decorated with an approximately 6-foot-tall bison head sculpted by Alexander Phimister Proctor, a renowned American western artist.

Two gilded-bronze equestrian statues entitled *The Arts of War: Sacrifice and Valor*, by American sculptor Leo Friedlander, are mounted on matching pedestals that flank the Washington entrance. These statues, along with the adjacent Rock Creek and Potomac Parkway terminus and the Watergate steps, join with the bridge in constituting a formal western terminus of the National Mall at the edge of the Potomac River.

The bridge's railing is comprised of ornate, granite balusters and railings. For structural reasons, the bascule span's railing consists of aluminum balusters, bases, and railings shaped to match those of granite on the fixed spans. The roadway and sidewalks are illuminated at night by 40 electric street lamps, four on each river span and two on each roadway span. The current lampposts are replicas of the original ones, which were a standard design by Francis D. Millet that is extensively used throughout Washington, DC (Figure 6).

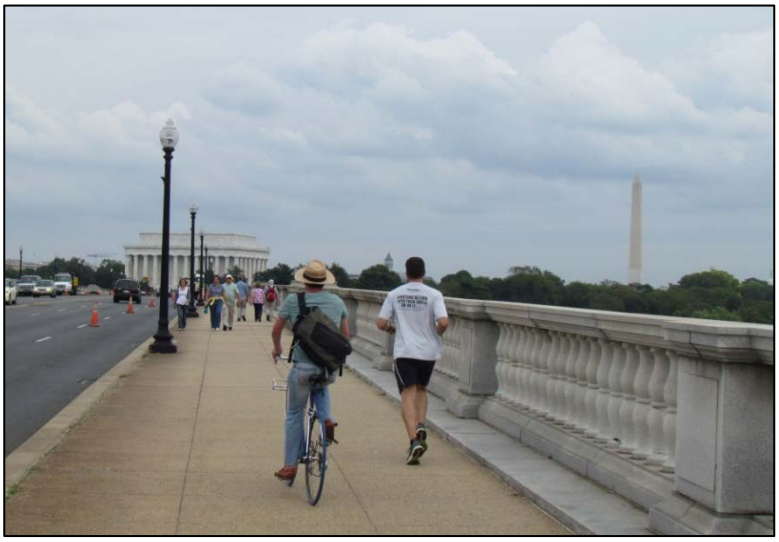


Figure 6: Bridge railings, sidewalks, and lampposts

The decision to include a draw span on the bridge was one of the most controversial aspects of the bridge design. Despite continual decreases in the amount of large ships navigating upriver to Georgetown and despite the fact that the US Army Corps of Engineers wanted to construct a higher bridge to allow large ships to pass without the need to open the bridge, the Arlington Memorial Bridge Commission decided that a draw span was necessary to maintain the bridge's aesthetics while allowing for the passage of ships. Following a design competition, the Arlington Memorial Bridge Commission selected the Strauss Engineering Company (formerly the J.B. Strauss Bascule Bridge Company) to design the bascule span with the Phoenix Bridge Company as the builder.

Figure 7: View of Arlington Memorial Bridge's bascule span

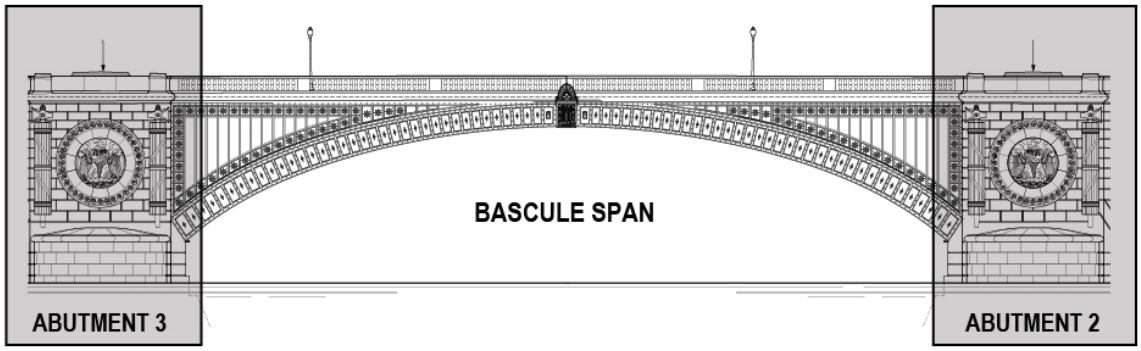
The Arlington Memorial Bridge's bascule span, or draw span, is a movable steel truss span with two leafs that meet centrally over the navigation channel. The bascule span is faced with pressed ornamental molybdenum steel and painted to blend with the concrete arch spans (Figure 7). At 216 feet, it was once the longest draw

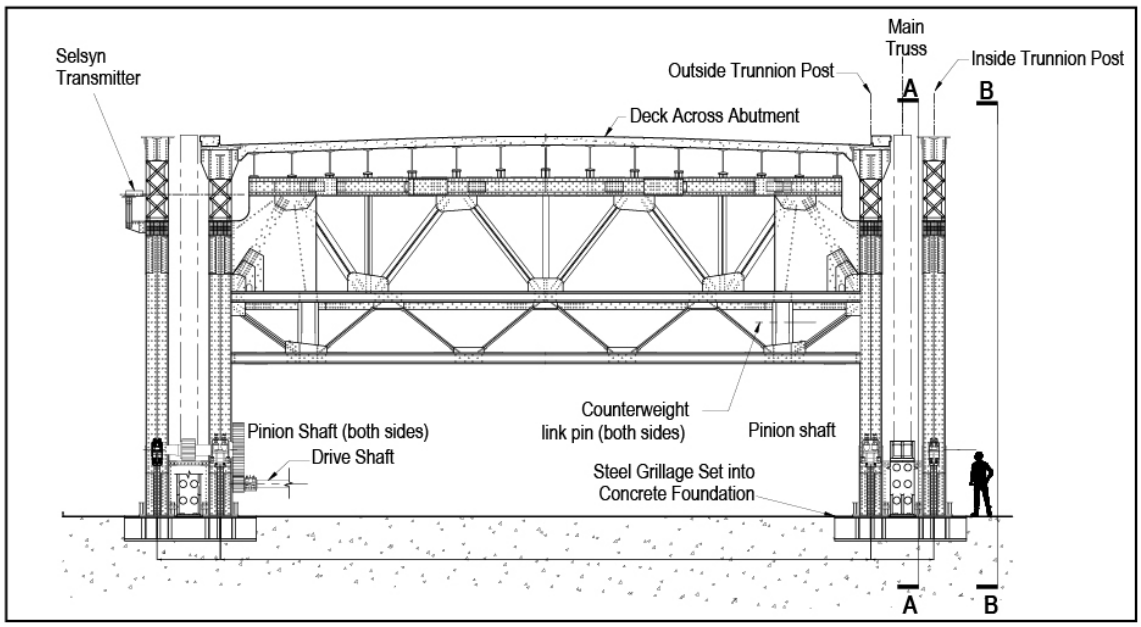
span in the world, as well as the heaviest and the fastest. Counterweights, each weighing 2,400 tons and consisting of concrete, iron ore, and steel punchings, are concealed in the abutments under the bridge. When the bascule span was operable, the counterweights were used to pivot each leaf upward. Each leaf consists of two main steel trusses that are supported by an axle, or trunnion, that rests on trunnion posts, which carry the load of the bridge down to the bridge abutments (Figure 8). The Arlington Memorial Bridge was the first of its kind to have all of the components of the bascule span that allowed it to rise concealed under the bridge and in the span's abutments.

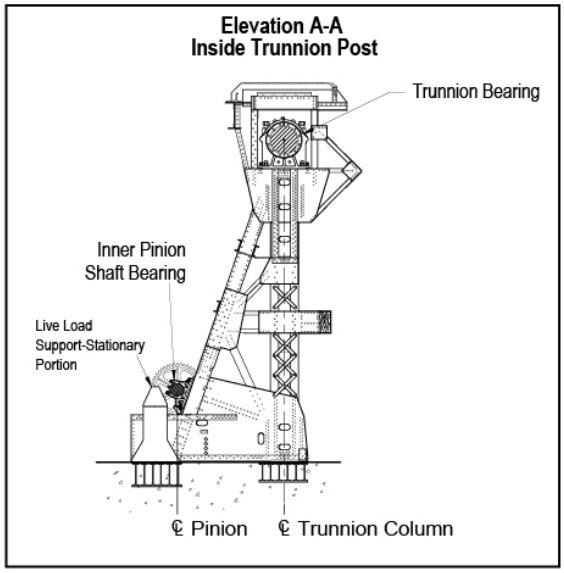
Two machinery rooms, one for each leaf, are located on the lowest floor of the bascule span abutments (Nolin 1988) (Figure 9). The control room is adjacent to the east side machinery room, rather than in a tower above the deck as is the case in many other bascule spans, which was an innovation created specifically for the Arlington Memorial Bridge. From this control room, the bascule span operator managed the machinery that raised and lowered the bridge. Because the operator was underneath the bridge, he had to rely on two other persons, known as an overseer and a guard, who were stationed in small cabins, integrated into the north balustrade and recessed approximately 3 feet below the sidewalk level, much like a baseball dugout, in order to operate the span. Two small, bronze-framed windows in each cabin furnished a limited view up the river and across the roadway in the downstream direction. When operable, the bascule span was able to open in 60 to 120 seconds.

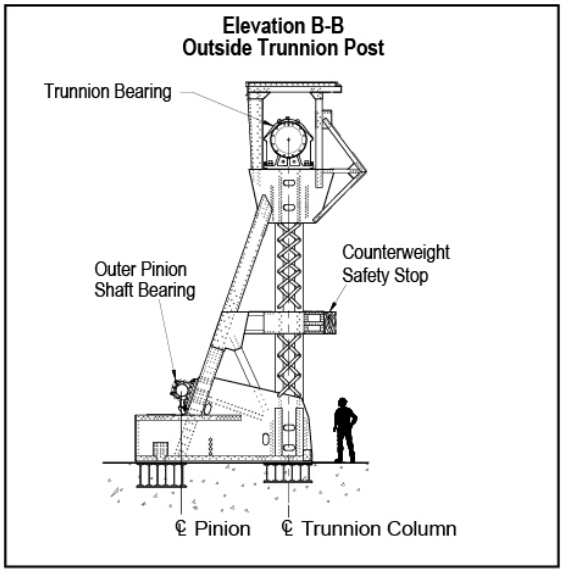
Rather than the typical gates with flashing lights on top of the bridge to stop traffic, the Arlington Memorial Bridge employed 12 lights mounted atop pickets that rose out of the pavement in the center of each lane on both sides of the bascule span. When the bascule span was in the closed position, the only visible parts were small iron disks flush with the roadway surface. In addition to these warning lights, a pair of fixed red lights and a gong were mounted on a lamppost on the sidewalk adjacent to on-coming traffic. When preparing to raise the bascule span, the overseer would raise the pickets 3 feet and two red lamps at the top of each one would alternately flash to warn motorists that the draw span was about to be opened. These warning lights are no longer present within the bascule span deck.

During its period of active operation between 1932 and 1961, the bascule span was opened to provide access for large ships to the Georgetown waterfront. Due to decreased shipping traffic on the Potomac River and the later downstream construction of a fixed, low-clearance bridge (currently the 14th Street Bridge Complex), the bascule span was permanently fastened in the closed position in 1965 (KressCox Associates, P.C. 1986). The USCG permit on file for the existing structure authorized a drawbridge at this site. Before 1966, the agency responsible for drawbridge operation regulations was the US Army Corps of Engineers. In July 1962, the Army Corps of Engineers published that the draw bridge need not open for the passage of vessels. The Coast Guard re-affirmed this authorization in 1968.



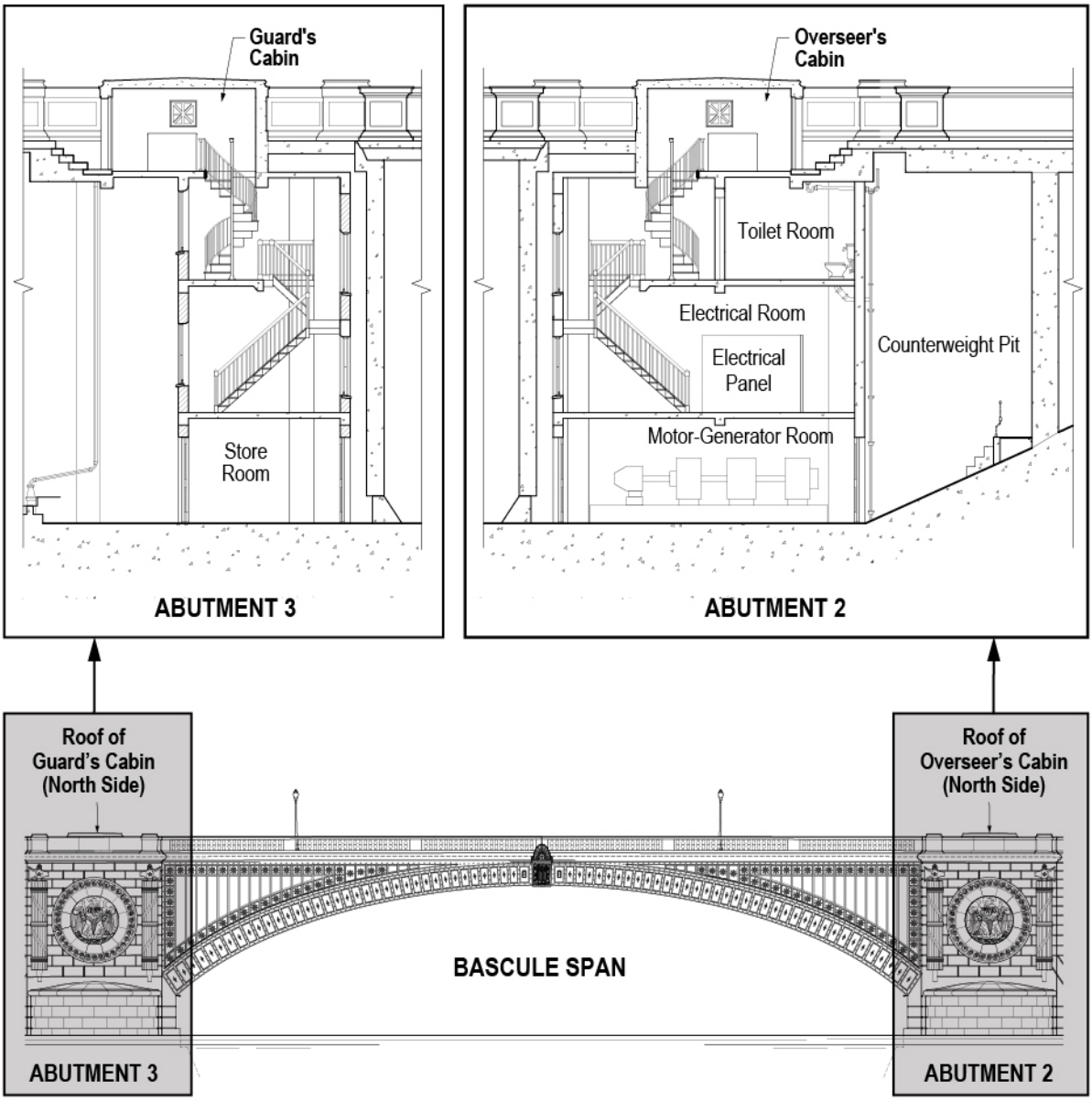






Source: NPS Historic American Engineering Record, HAER No. DC-7, 2014

Figure 8: Diagrams of machinery used to open the bascule span



Source: NPS Historic American Engineering Record, HAER No. DC-7, 2014

Figure 9: Diagrams of machinery and operator rooms located inside Abutments 2 and 3, south elevation (note – north elevation is mirror image; e.g. the motor-generator room in Abutment 3 is on the north side of the abutment)

Figure 10: View of Memorial Avenue and Arlington House from the Arlington Memorial Circle

The axis of the bridge, which is angled southwesterly from the east-west Mall axis, is carried on Memorial Avenue across the Boundary Channel Bridge to the Virginia shore where it terminates at the grand renaissance gateway to Arlington National Cemetery and now the location of the Women in Military Service for America Memorial (Figure 10). Several memorials such as the United Spanish War Veterans Memorial and the Seabees Memorial are situated along Memorial Avenue in proximity to the bridge. In addition, the Arlington National Cemetery and Arlington House, the Robert E. Lee Memorial, can be seen from the bridge. The bridge also crosses the Mount Vernon Trail and the George Washington Memorial Parkway on Columbia Island between the Potomac River and the Boundary Channel, which marks the boundary between the District of Columbia and the Commonwealth of Virginia.

The Arlington Memorial Bridge and Related Features (including the Watergate, Rock Creek and Potomac Parkway Terminus, Memorial Circle and its surrounding landscapes, Boundary Channel Bridge, the Arts of Peace, the Arts of War, and Memorial Avenue and Hemicycle) were listed in the DC Inventory of Historic Sites on November 8, 1964, and in the National Register of Historic Places on April 4, 1980 (NPS 1980).

The bridge continues to provide access across the Potomac River for vehicular travel with connections to several heavily traveled roadways in the area, including the George Washington Memorial Parkway. The bridge also provides a crossing for pedestrians and bicyclists on the bridge's wide sidewalks, provides access to the Mount Vernon Trail, and has been used for many large scale events throughout the years such as parades, marathons, and funeral processions. Ferries, water taxis, dinner cruises, tour boats, private recreational watercraft, and rowers on the Potomac River pass under the bridge to access areas upstream and downstream. In 2007, approximately 72,000 motor vehicles were carried across the Arlington Memorial Bridge each day. In 2011, an average of 54,212 vehicles per day traveled across the bridge. The variation in traffic volumes may be due to motorists avoiding construction activities on other Potomac River bridges.

PROJECT BACKGROUND

The Arlington Memorial Bridge is administered and maintained by the George Washington Memorial Parkway, a unit of the National Park Service. The Federal Highway Administration has performed scheduled routine inspections on the Arlington Memorial Bridge, including underwater

inspections on the bridge piers, since 1978. The full bridge is inspected every two years and the bascule span is inspected every year. Given the current condition of the bridge, additional inspections are being conducted including 6-month interim inspections on areas of concern on the bascule span and 6-month interim inspections of the underside of the concrete bridge deck over the concrete arch spans.

The most recent bridge inspection, performed in April 2015, determined that overall the Arlington Memorial Bridge is in poor condition with isolated areas of severe deterioration. The framing for the sidewalks over the bascule piers is significantly deteriorated but not posing any safety concerns to pedestrians at present due to temporary bridges constructed over the affected areas. The trunnion posts continue to exhibit significant and increased deterioration (Figure 11). The report makes several recommendations of actions that would slow the rate of deterioration while a major rehabilitation is planned. These actions include sealing the trunnion posts or diverting roadway drainage to prevent further deterioration; removing the debris from the base of the trunnion posts; reconfiguring the roadway/curb interface to address runoff draining under the curb and onto the superstructure; and cleaning and sealing the joints below the granite curb to help prevent drainage on the steel fascia truss below.

Figure 11: View of severe corrosion of the inner trunnion post of the bascule span

The progressive deterioration of steel and concrete structural components of the concrete arch spans has reduced the bridge's vehicle load carrying capacity. As a result of this deterioration, the National Park Service, at the recommendation of the Federal Highway Administration, has posted a 10-ton load limit across the entire length of the bridge. The load restriction, which has eliminated most bus traffic, will remain in effect until the permanent rehabilitation project is completed. As the bridge continues to deteriorate, the National Park Service and the Federal Highway Administration may impose further weight restrictions and/or close the bridge.

Structural Inspections, Studies, and Assessments

In addition to routine scheduled inspections, numerous other inspections, studies, and assessments have been conducted on the Arlington Memorial Bridge to further evaluate its structural integrity. These evaluations are listed and summarized in Table 1.

TABLE 1. INSPECTIONS, STUDIES AND ASSESSMENTS TO DATE

Inspection Type	Date Performed	Purpose	Findings
Utility Survey	February 2010	Identify utilities on and surrounding bridge	Utilities mapped.
Bridge Deck Study	September 2003	To assess the condition of the concrete deck	Core samples indicated moderate deterioration throughout the bridge deck with fracturing and water intrusion evident at various depths within the original concrete.
	June 2010	To assess the condition of the concrete deck	Core samples indicated moderate deterioration of the bridge deck concrete with fracturing, spalling, crumbling, and water intrusion evident.
	February 2013	Condition assessment of the bridge deck using a robotic system	The assessment was conducted using the RABIT™ Bridge Inspection Tool, a fully automated robotic system, as well as several other evaluation technologies such as ground-penetrating radar, impact echo, and ultrasonic surface wave testing. Results of the surveys indicated a high degree of deterioration, including severe delamination over the majority of the bridge deck.
	March 2015	Condition assessment of the bridge deck using a robotic system	The deck is in poor condition and is mostly delaminated or debonded.
Bascule Span	October 2009	Identify areas of deterioration and section loss throughout the bascule span	The sidewalks of this structure have widespread deterioration, including delamination and spalling of the concrete surface and displacement of the granite curbs. Additionally, there are issues which present a hazard for pedestrians on this highly traveled structure including misaligned sliding plate expansion joint covers and access hatches with severely corroded support framing.
	April 2011	Monitor deterioration and identify and map area of section loss or other deterioration throughout the superstructure of the bascule span	The inspection indicated that the superstructure of the bascule span was in fair condition overall with isolated areas of severe deterioration. These isolated areas include the framing for the fixed portions of the sidewalks over the bascule abutments, the bearing seats for the fixed stringers along the back of both bascule abutments, and the curb stringers on the south side of the west bascule leaf.

Inspection Type	Date Performed	Purpose	Findings
	April 2014	Monitor deterioration and identify and map area of section loss or other deterioration throughout the superstructure of the bascule span	Overall the superstructure of the bascule span was in fair to poor condition with isolated areas of severe deterioration. The deterioration of the structure continues to progress at a rapid pace.
	September 2014	Special inspection of catwalk system inside bascule span	The most severe deterioration was located in the areas adjacent to the inner trunnion posts in both leafs, where leakage occurs through the roadway/curb interface.
	April 2015	Foundation investigation of bascule span abutments	Concluded that the bascule span abutments are adequate to support the bascule span.
Trunnion Posts	February 2011	Obtain data to evaluate current condition of trunnion posts	Significant amount of visible corrosion was identified on the inner trunnion members as well as spalled concrete and poor drainage conditions at each trunnion post. Ultrasonic testing indicated severe section loss of the steel plates that make up the inner trunnion posts.
	January 2014	More in-depth study to evaluate current condition of trunnion posts	Findings from the 2011 were confirmed. Additional debris was cleaned from access points which indicate continuing deterioration.
Underwater inspection	December 2012	Examination of bridge substructure from waterline to channel bottom	Inspected substructures were found to be in fair condition. Several piers were observed to have vertical cracking, section loss mostly along construction joints, spalling, scaling, and impending mortar patch failure. Serious structural deficiencies observed included scour pockets, tremie seal undercutting and exposure at multiple piers and abutments, and larger than hairline cracks (greater than 1/8") on at least one abutment.
In-depth Inspection	April 2013	In-depth assessment of all portions of the bridge	Bridge is in poor condition overall. Interior trunnion posts exhibit significant corrosion. Sidewalks have widespread deterioration. Widespread deterioration of the superstructure and substructure concrete continues to be a problem and there are widespread areas of patching and rutting throughout the asphalt road surface.

Inspection Type	Date Performed	Purpose	Findings
	April 2015	In-depth assessment of all portions of the bridge	Bridge is in poor condition overall. Framing for sidewalks is severely deteriorated as are the inner trunnion posts. Several recommendations are made in order to slow the rate of deterioration.
Other Bridge Components	November 2013	Assess quality and monitor deterioration of other arches and underpasses of bridge	One of two cores was found to have inadequate compressive strength.
	August 2013	Assess quality and monitor deterioration of west abutment of bascule span	Compressive strength of core was acceptable.
	February 2014	Assess quality and monitor deterioration of east abutment wall of bascule span and abutment 1 - channel side	Two of five cores were found to have inadequate compressive strength.

Temporary Repairs

Recent emergency repairs include the construction of temporary bridges spanning over the deteriorated sidewalks areas in the fixed portion of the bascule span (Figure 12). Additional temporary repairs have been recently performed to the concrete bearing seats along the back edge of each bascule abutment, the stringers and truss members under the curbs, the steel columns that support the counterweights, and roadway and sidewalk decks. Emergency repair work is ongoing to shore corroded steel members within the bascule span.

Figure 12: View of temporary pedestrian bridge spanning deteriorated sidewalks over the bascule span abutments

Significance of the Arlington Memorial Bridge

The Arlington Memorial Bridge spans the Potomac River connecting Lincoln Memorial Circle with Memorial Circle on Columbia Island, providing access to Memorial Avenue and the ceremonial entrance to Arlington National Cemetery. An important element in the neoclassical urban design of the National Capital as it evolved during the early 20th century, the Arlington Memorial Bridge has been defined as the final link in the chain of monuments that begins at the Capitol building, and connects the National Mall in Washington, DC with Arlington National Cemetery in Virginia. The bridge was designed to connect, both physically and symbolically, the North and the South on the axis between the Lincoln Memorial and Arlington House, the Robert E. Lee Memorial.

The Arlington Memorial Bridge was designed by William Mitchell Kendall during the 1920s while employed by McKim, Mead & White, a prominent architectural firm based in New York City. The bridge is part of the larger McKim, Mead & White design for the Memorial Avenue corridor, which also includes the Watergate Steps, Columbia Island road connections, and Memorial Avenue. The bridge was intentionally designed in the neoclassical style to complement the other monumental buildings in Washington, DC such as the White House, the Lincoln Memorial, and the Jefferson Memorial and to preserve views to the Lincoln Memorial from the Virginia shore of the Potomac River. The uniquely disguised bascule span hid the working mechanisms of the draw span for aesthetic reasons, increasing cost, and making it one of the most controversial features of the bridge design.

Constructed between 1926 and 1932 by H.P Converse & Company (substructure), Hunkin-Conkey Construction Company (superstructure), and Phoenix Bridge Company (bascule span), the Arlington Memorial Bridge was once one of the longest (216 feet), heaviest (7,600 tons), and fastest (one minute) draw spans in the world and included design innovations developed by the Strauss Engineering Company such as concrete counterweights, a hinged counterweight arrangement, and center nose locks. No longer in operation, the average passerby is now unaware that the bridge was meant to open, which is exactly what its designers intended. The bridge was listed in the National Register of Historic Places in 1980 for its architectural characteristics and innovative engineering achievements, including the bascule span.

In addition to its significance as a memorial, the bridge is a vital link in the regional transportation network. Not only does it provide access across the Potomac River for approximately 55,000 vehicles each day, it also provides connections to several heavily traveled roadways by way of the George Washington Memorial Parkway. On its wide sidewalks, the bridge provides a crossing for pedestrians and bicyclists and access to the Mount Vernon Trail. The Arlington Memorial Bridge is used for many events including parades and marathons and is a dramatic and somber approach to Arlington Cemetery for funeral processions. Ferries, water taxis, dinner cruises, boats and rowers using the Potomac River routinely pass under the bridge.

Significance of the George Washington Memorial Parkway

The George Washington Memorial Parkway was developed as a scenic parkway to help preserve the Potomac River Gorge and shoreline while serving as a memorial to the first president of the United States, George Washington. The first section, called the Mount Vernon Memorial Highway, was authorized by legislation signed by President Calvin Coolidge on May 23, 1928, and was completed in 1932 to commemorate the bicentennial of George Washington's birth on February 22, 1732. As the Mount Vernon Memorial Highway was under construction, President Herbert Hoover signed what became known as the Capper-Cramton Act on May 29, 1930. This Act authorized appropriations for the George Washington Memorial Parkway, which was "to include the shores of the Potomac, and adjacent lands, from Mount Vernon to a point above the Great Falls on the Virginia side including the protection and preservation of the natural scenery of the Gorge and the Great Falls of the Potomac, the preservation of the historic Patowmack Canal, and the acquisition of that portion of the Chesapeake and Ohio Canal below Point of Rocks" (Public Law 71-284, as found in Mackintosh 1996). The Capper-Cramton Act included the Mount Vernon Memorial Highway as a part of the George Washington Memorial Parkway and proposed the protection of the northern and southern shores of the Potomac River. The George Washington Memorial Parkway was designated a National Park Unit in 1933.

Today, the Parkway extends from the Capital Beltway (I-495) to the north to the Mount Vernon estate to the south. The George Washington Memorial Parkway park unit administers the Parkway and a number of additional sites along the Potomac including Great Falls Park, Turkey Run Park, the U.S. Marine Corps War Memorial, Dyke Marsh Wildlife Preserve and others. Sites along the Parkway provide recreational and educational experiences to more than nine million people annually. The original section of the Parkway, the Mount Vernon Memorial Highway, was listed in the National Register of Historic Places in 1981 under criterion B for its commemoration of George Washington and under criterion C for landscape architecture (NPS 1981). In 1991, the Parkway was included in a multiple property listing under "Parkways of the National Capital," and in 1995, the Parkway was listed in its entirety.

RELATIONSHIP TO LAWS, EXECUTIVE ORDERS, POLICIES AND OTHER PLANS

The following are laws, regulations, and management plans applicable to the proposed action that govern the federal agencies involved in this analysis as required by the National Environmental Policy Act.

Applicable Federal Laws and Regulations

National Environmental Policy Act, as Amended. Section 102(2)(c) of the National Environmental Policy Act requires that an environmental impact statement be prepared for proposed major federal actions that may significantly affect the quality of the human environment. The National Environmental Policy Act was passed by Congress in 1969 and took effect on January 1, 1970. This legislation establishes this country's environmental policies, including the goal of

achieving productive harmony between human beings and the physical environment for present and future generations. The National Environmental Policy Act provides the tools to implement these goals by requiring that every federal agency prepare an in-depth study of the impacts of "major federal actions having a significant effect on the environment" and alternatives to those actions. The law also requires that each agency make that information a part of its decisions. The National Environmental Policy Act requires that agencies make a diligent effort to involve the interested members of the public before they make decisions affecting the environment.

The National Environmental Policy Act is implemented through regulations of the Council on Environmental Quality, effective 1978 (40 CFR 1500 – 1508). The National Park Service has in turn adopted procedures to comply with the act and Council regulations, as found in Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2011), and its accompanying handbook.

National Historic Preservation Act of 1966, as Amended. The National Historic Preservation Act protects buildings, sites, districts, structures, and objects that have significant scientific, historic, or cultural value. Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of their undertakings on properties listed, or potentially eligible for listing, in the National Register of Historic Places. All actions affecting the park's cultural resources must comply with this law, which is implemented through 36 CFR 800.

NPS (National Park Service) Organic Act. By enacting the Organic Act in 1916, Congress directed the US Department of the Interior and the National Park Service to manage units "to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). Despite these congressional mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions. Because conservation remains predominant, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. However, the Organic Act does give the Secretary of the Interior discretion to provide "for the destruction of such animal and of such plant life as may be detrimental to the use of any of said parks, monuments, or reservations" (16 USC 3).

Redwood National Park Expansion Act of 1978, as Amended. All NPS units are to be managed and protected as parks, whether established as a recreation area, historic site, or any other designation. This act states that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

National Parks Omnibus Management Act of 1998. National Parks Omnibus Management Act of 1998 (16 USC 5901 et seq.) directs the National Park Service to obtain scientific and technical information for analysis. Section 4.4 of the NPS handbook for Director's Order 12 states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected."

Americans with Disabilities and Architectural Barriers Act Guidelines. Pursuant to the Americans with Disabilities Act of 1990 and the Architectural Barriers Act of 1968, all public buildings, structures, and facilities must comply with specific requirements related to architectural standards, policies, practices, and procedures that accommodate people with hearing, vision, or other disabilities, and other access requirements. Public facilities and places must remove barriers in buildings and landscapes, as necessary and where appropriate. On September 15, 2010, the Department of Justice published revised regulations for Titles II and III of the Americans with Disabilities Act in the *Federal Register*. These regulations adopted revised, enforceable accessibility standards called the 2010 Americans with Disabilities Act Standards for Accessible Design. The National Park Service must comply with the Architectural Barriers Act Accessibility Standard as well as 2010 Americans with Disabilities Act standards for this project.

Endangered Species Act of 1973, as Amended. This Act requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals having potential impact on federally endangered and threatened plants and animals. NPS policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered candidate, rare, declining, and sensitive species. Section 7 of the Endangered Species Act requires federal agencies, through consultation with the US Fish and Wildlife Service and the National Marine Fisheries Service, to insure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Clean Air Act, as Amended. The Clean Air Act was enacted in 1970 to regulate and reduce air pollution from area, stationary and mobile sources and to protect the nation's air resources and public health. Under the Clean Air Act, the US Environmental Protection Agency must provide health-based air quality standards against a variety of pollutants, such as ozone, carbon monoxide, particulate matter, lead, nitrogen oxides and sulfur dioxides. National parks are designated as Class I air quality areas, meaning that they are allowed the smallest incremental pollution increases above baseline concentrations.

Clean Water Act. Section 404 of the Clean Water Act established a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry. The Clean Water Act authorizes the issuance of permits from the US Army Corps of Engineers for such discharges (EPA 2011a). Under Section 401 of the Clean Water act, a federal agency cannot issue a permit or license for an activity that may result in a discharge to waters of the US until the state or tribe where the discharge would originate has granted or waived a water quality certification.

Sections 9 and 10 of the Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 (33 USC 401, et seq.) prevents unauthorized obstruction or alteration of any navigable water of the United States. The geographic jurisdiction of the Rivers and Harbors Act includes all navigable waters of the United States, which are defined (33 CFR Part 329) as "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be

susceptible to use to transport interstate or foreign commerce" (EPA 2011b). Section 9 (33 USC 401) of the Rivers and Harbors Act prohibits the construction of any obstruction across any navigable water of the United States. The purpose of Section 9 is to preserve the public right of navigation and to prevent interference with interstate and foreign commerce. Section 9 of the Rivers and Harbors Act, as amended, requires the location and plans of bridges across the navigable waters of the United States be submitted to and approved by the US Coast Guard to prevent any interference with their navigability by bridges or other obstructions. Section 10 (33 USC 403) of the Rivers and Harbors Act requires authorization from the US Army Corps of Engineers for the construction, excavation, or deposition of materials in, over, or under navigable waters, or any work which would affect the course, location, condition, or capacity of those waters.

Historic Sites Act of 1935. The Historic Sites Act establishes "national policy to preserve for public use historic sites, buildings and objects of national significance." The Act gives the Secretary of the Interior broad powers to protect these properties, including the authority to establish and acquire nationally significant historic sites.

Energy Independence and Security Act of 2007. The Energy Independence and Security Act was enacted to increase energy efficiency and the availability of renewable energy. Provisions of the act performed various functions including increasing the renewable fuel standard, setting a target to raise fuel economy standards, providing a plan of efficiency standards for light bulbs and the eventual phasing out of most common incandescent light bulbs, implementing energy efficient technologies in federal buildings, investing in geothermal technology, increasing funding and research for carbon capture and sequestration technology, and providing stormwater runoff requirements for federal development projects (USSC-ENR 2013).

National Capital Memorials and Commemorative Works Act of 1986, as Amended. The National Capital Memorials and Commemorative Works Act provides guidance for the planning and design of projects within the Monumental Core of downtown Washington, DC. The intent of the legislation is to preserve the integrity of the comprehensive design of the L'Enfant Plan and McMillan Plan for the Nation's Capital; ensure the continued public use and enjoyment of open space in the District of Columbia and its environs; to encourage the location of commemorative works within the urban fabric of the District of Columbia; preserve, protect, and maintain the limited amount of open space available to residents of and visitors to the Nation's Capital; and ensure future commemorative works in areas administered by the National Park Service and the Administrator of General Services in the District of Columbia and its environs (NCPC 1986). The National Capital Memorials and Commemorative Works Act was amended in 2003 by Congress, who designated the east-west axis of the National Mall from the Lincoln Memorial to the US Capitol, and the north-south axis between the Jefferson Memorial and the White House to be a "substantially completed work of civic art" and prohibited new commemorative works or visitor centers in this area. Congress also directed the National Park Service to begin planning for the future of the National Mall to protect its character.

National Capital Planning Act of 1952. The National Capital Planning Act establishes the National Capital Planning Commission as the central planning agency in the Washington, DC region. The

purpose of the agency is to coordinate the developmental activities of Federal and District government so that the activities conform to general objectives. The Act outlines the functions of the National Capital Planning Commission, which include development of a Comprehensive Plan, review of Federal and District proposed projects, review of District zoning amendments, and review of Federal and District Capital Improvements Programs (40 USC §8701 et seq.).

Applicable State and Local Laws, Regulations, Policies, and Plans

The Comprehensive Plan for the National Capital Region: Federal Elements. Section 4(a) of the National Capital Planning Act requires that National Capital Planning Commission develop and implement a "comprehensive, consistent, and coordinated plan for the National Capital (NCPC 2004)." The Plan emphasizes three principles: accommodating Federal and National Capital activities, reinforcing "smart growth" and sustainable development planning principles, and supporting local and regional planning and development objectives.

The Comprehensive Plan for the National Capital Region: District Elements; Parks, Recreation, and Open Spaces: Section 1.1.2: Consideration of Federal Parkland. The District of Columbia will work with federal agencies to evaluate the role that federal lands play in meeting the recreational needs of District residents, particularly for regional parks and sports complexes. These federal resources are used by city residents, and therefore should be considered when assessing the need for local park improvements.

The L'Enfant & The McMillan Plans. In 1791, George Washington hired Pierre L'Enfant to design the city of Washington. L'Enfant developed a Baroque plan that features ceremonial spaces and grand radial avenues, while respecting natural contours of the land. The result was a system of intersecting diagonal avenues superimposed over a grid system. The avenues radiated from the two most significant building sites that were to be occupied by houses for Congress and the President (NPS 2015). The avenues were to be wide and lined with trees. Important structures, monuments, and fountains were to be erected to visually connect ideal topographical sites throughout the city.

The McMillan Commission was established in 1901. The commission focused upon restoring the Mall to the greensward envisioned by Pierre L'Enfant. The plans of the McMillan Commission called for the re-landscaping of the ceremonial core, consisting of the Capitol Grounds and Mall and including extensions west and south of the Washington Monument; consolidating city railways and alleviating at-grade crossings; clearing slums; designing a coordinated municipal office complex in the triangle formed by Pennsylvania Avenue, 15th Street, and the Mall; and establishing a comprehensive recreation and park system that would preserve the ring of Civil War fortifications around the city (NPS 2015).

Arlington County Comprehensive Plan. The Comprehensive Plan for Arlington County is reviewed every five years. The purpose of the plan is to guide development of the County through provision of high standards of public services and facilities. Goals and objectives incorporated into the plan include smart growth policies, mixed-use development, mixed-income housing, neighborhood conservation and commercial preservation. The Master Transportation Plan included

in the Comprehensive Plan is intended to facilitate high quality transportation services, move more people without more traffic, and promote safety (Arlington County 2011).

Executive Orders and Director's Orders

Executive Order 11593: Protection and Enhancement of the Cultural Environment. Executive Order 11593 directs the National Park Service to support the preservation of cultural properties and to identify and nominate to the National Register cultural properties within the park and to "exercise caution . . . to assure that any NPS owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

Executive Order 11988: Floodplain Management, as amended; and Executive Order 13690: Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input. These executive orders direct the National Park Service to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Executive Order 13690 amends the previous Order and provides three approaches that federal agencies can use now to establish the flood elevation and hazard area for consideration in their decision making: climate-informed science approach, adding 2 to 3 feet of elevation to the 100-year floodplain, and using the 500-year floodplain. The National Park Service complies with these Executive Orders through the guidance outlined in Director's Order 77-2: Floodplain Management, which applies to all proposed NPS actions that could adversely affect the natural resources and functions of floodplains or increase flood risks. Director's Order 77-2 and Procedural Manual 77-2 provide the National Park Service policies and procedures for complying with Executive Order 11988 that include the preparation of a separate "Floodplain Statement of Findings" if an Environmental Assessment identifies a Preferred Alternative that will require ground disturbance within a regulated 100-year floodplain. The procedural manual does not apply to historic structures whose location is integral to their significance. The Arlington Memorial Bridge is a historic structure and its location over the Potomac River is integral to its significance. Therefore, the procedures do not apply to the bridge.

Executive Order 11990: Protection of Wetlands. Executive Order 11990 directs the National Park Service to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. The National Park Service complies with this Executive Order through the guidance outlined in Director's Order 77-1: Wetland Protection, which establishes the policies, requirements, and standards through which the National Park Service will meet its responsibilities to protection and preserve wetlands (NPS 2012). Director's Order 77-1: Wetland Protection and Procedural Manual 77-1 (reissued January 2012) provide the NPS policies and procedures for complying with Executive Order 11990 that include the preparation of a separate "Wetland Statement of Findings" if an Environmental Assessment identifies a Preferred Alternative that will have adverse impacts on wetlands (NPS 2012).

Executive Order 12088: Federal Compliance with Pollution Control Standards. Executive Order 12088 requires federal agencies to take all necessary actions for the prevention, control and abatement of environmental pollution at facilities and activities undertaken by the federal agency. This order also mandates that federal agency programs and facilities are maintained and operated to avoid pollution of surface waters and groundwater.

Executive Order 13508: Chesapeake Bay Protection and Restoration. Executive Order 13508 recognizes the Chesapeake Bay as a national treasure and calls on the federal government to restore and protect it. The order established a Federal Leadership Committee chaired by the Administrator of the Environmental Protection Agency that oversees reporting, data management and other activities by agencies involved in the restoration of the Chesapeake Bay. The Federal Leadership Committee, consulting with state governments of the seven Bay jurisdictions, developed a coordinated strategy for the restoration of the Bay. The committee publishes an annual Chesapeake Bay Action Plan to describe funding allocation for this strategy, accompanied by an Annual Progress Report that assesses the implementation of the strategy (CBP 2013).

Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance. Executive Order 13514 seeks to make improvements in the overall sustainability of the federal government by requiring federal agencies to develop a plan to meet a wide range of goals for improving sustainability. Areas of focus include sustainable community planning, water efficiency, environmental management, high performance buildings and systems, and reduced greenhouse gas emissions.

Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making. Director's Order 12 directs the manner in which the National Park Service complies with The National Environmental Policy Act, including all aspects of environmental analysis, public involvement, and resource-based decisions. The National Park Service must follow all sources of the National Environmental Policy Act guidance, including but not limited to 40 CFR 1500-1508 and 516 Department Manual. Director's Order 12 and its technical manual outline the responsibilities of the parties accountable for ensuring compliance with the National Environmental Policy Act, from the director to project managers and contracting officers (NPS 2011).

Director's Order 17: NPS Tourism. Director's Order 17 promotes and supports sustainable, responsible, informed, and managed visitor use through cooperation and coordination with the tourism industry. Director's Order 17 provides guidance to the National Park Service to balance budgetary needs with resource management practices to keep key visitor attractions and services accessible to the public during peak visitation periods. When park resources must be closed due to construction, Director's Order 17 directs park superintendents to communicate these closures with the tourism industry. Park superintendents are responsible for informing visitors, state tourism offices, gateway communities, and tourism-related businesses about current conditions of key park resources including current protection, recovery, and restoration measures (NPS 1999a).

Director's Order 28: Cultural Resource Management. Director's Order 28 directs the National Park Service to protect and manage cultural resources in its custody through effective research,

planning, and stewardship in accordance with the policies and principals contained in the original NPS *Management Policies 2006* (NPS 1998a). This order also directs the National Park Service to comply with the substantive and procedural requirements described in the *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation*; the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Treatment of Cultural Landscapes*; and the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Building* (NPS 1998b).

Director's Order 53: Special Park Uses. Director's Order 53 sets forth the policies and procedures for administering Special Park Uses on NPS lands. Special Park Uses are identified as mandatory or discretionary based on whether they are a right or a privilege of citizens. Director's Order 53 specifies special uses compliance, permit terms and conditions, and guidelines for specific use rights, such as special events (NPS 2010a).

Director's Order 77: Natural Resources Management Guideline. Director's Order 77 provides guidance on implementing laws and regulations relevant to natural resources to park managers for all planned and ongoing natural resource management activities. Managers must follow all federal laws, regulations, and policies. Director's Order 77 provides the guidance for park management to design, implement, and evaluate a comprehensive natural resource management program in accordance with relevant laws (NPS 1991).

Director's Order 90: Value Analysis. Director's Order 90, Value Analysis, requires a value analysis be conducted for all construction programs and for administration and management programs. Value analysis is an organized team effort directed at analyzing the functions of facilities, processes, systems, equipment, services, and supplies for the purpose of achieving essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, safety, and achievement of NPS mission priorities such as resource protection, sustainability and quality visitor experience. Reference Manual 90, the Value Analysis Handbook provides guidance on conducting a value analysis (NPS 2002).

NPS Management Policies

The NPS *Management Policies 2006* is the basic NPS -wide policy document, adherence to which is mandatory unless specifically waived or modified by the NPS director or certain departmental officials, including the US Secretary of the Interior. Actions under this Environmental Assessment are in part guided by these management policies (NPS 2006).

OVERVIEW OF PUBLIC PARTICIPATION

The National Environmental Policy Act regulations require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). To determine the scope of issues to be addressed and analyzed in depth in this Environmental Assessment, both internal and public scoping was conducted, as well as

agency consultation/coordination. Public scoping included a 45-day public comment period from April 9 through May 24, 2013. The public comment period included two public open houses, in which the public, agencies, and stakeholders were invited to participate. Public open houses were held on April 23, 2013 at the Heritage Center of the United States Navy Memorial in Washington, DC, and on April 25, 2013 at Washington-Lee High School in Arlington, Virginia. In addition, the National Park Service conducted an additional public and agency review of preliminary alternatives proposed for analysis in the Environmental Assessment. The public review of the preliminary alternatives was conducted from October 30, 2013 through December 2, 2013. The public open house was held on November 13, 2013 at Washington-Lee High School in Arlington, Virginia in conjunction with the public review of the preliminary alternatives.

Agency consultation/coordination for the proposed action began in April 2013. Scoping newsletters were sent out to various regulatory agencies and interested parties to inform them of the proposed action and/or initiate consultation. Responses from the agencies, if applicable, can be found in Appendix A.

Eleven pieces of correspondence were received during the public scoping period. Two local government agencies provided comments on the project. The Arlington County Division of Transportation expressed a desire for the Arlington Memorial Bridge rehabilitation project to include permanent bicycle and pedestrian counting equipment. Similarly, the District Department of Transportation suggested a permanent traffic counting station be included as a part of the project. Correspondence from area residents and visitors made up the balance of comments received. Generally, the correspondence was in support of the project and included suggestions for pedestrian and bicycle improvements, lighting improvements, boat access, and rehabilitation of the bascule span and preservation of the historic features of the bridge. Further scoping information is detailed in "Chapter 5: Consultation and Coordination."

ISSUES AND IMPACT TOPICS

Issues

During the scoping process, specific issues and concerns were identified by project team specialists from the National Park Service and the Federal Highway Administration, and also through public scoping and agency consultation. These issues and concerns are analyzed in detail under the impact topics that are discussed in "Chapter 3: Affected Environment" and analyzed in "Chapter 4: Environmental Consequences." Along with the purpose of and need for the proposed action, issues and concerns raised during scoping helped to guide the development of project alternatives and contributed to the selection of impact topics analyzed in detail in this Environmental Assessment. The following issues and concerns were identified during internal and/or public scoping and agency consultation prior to the development of this Environmental Assessment.

Consideration of Historic Structures in Bridge Design. A primary concern associated with the proposed action is the potential effects that bridge rehabilitation would have on the historic integrity

of the Arlington Memorial Bridge, which is listed in the National Register of Historic Places and is a contributing element of the George Washington Memorial Parkway, Memorial Avenue Complex, and monumental core of Washington, DC. Many of the historic structural elements and components that contribute to the significance of the Arlington Memorial Bridge have deteriorated and need to be repaired or replaced. Rehabilitation of the bridge components will require conformity with the *Secretary of the Interior's Standards for the Treatment of Historic Properties.*

Impacts to Traffic on Detour Routes during Full or Partial Bridge Closures. The likelihood that substantial traffic flow issues would result from partial lane closures and/or a full bridge closure during construction is a concern. These closures are likely to temporarily increase vehicle congestion and delays throughout the regional transportation network during construction. Effects to traffic, particularly commuter traffic during peak travel periods, would likely be severe as commuters are detoured to other area bridges to cross the Potomac River.

Potential Presence of Federally Listed Endangered Species. Another primary concern identified during preliminary project scoping is the potential for the project to have an effect on protected species, particularly the federally listed shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrhinchus*). Both species have been documented to migrate upstream of the project area to spawn. As recent as 2009, the US Fish and Wildlife Service has tracked the movements of a telemetry tagged female shortnose sturgeon in the Potomac River to Fletcher's Boathouse, which is located approximately 4 miles upstream from the Arlington Memorial Bridge. Data collected from this study indicate that there is adequate habitat for foraging, wintering, and spawning in the Potomac River for shortnose sturgeon; however, it is currently unknown if the Potomac River supports a reproducing population.

Restricted Recreational Use of The Bridge During Construction. Another primary concern associated with the proposed action is that temporary partial lane and/or full bridge closures would reduce or completely restrict visitation and recreational uses of the bridge. Boating under the bridge may also be restricted during construction. For uses both on and under the bridge, access would be restricted to varying degrees for the duration of construction and may adversely impact tourists. Certain closures could severely limit pedestrian and bicycle access between the National Mall and the Arlington National Cemetery and access from the Mount Vernon Trail.

Temporary Degradation of Water Quality. Another concern associated with the rehabilitation of the Arlington Memorial Bridge is the anticipated need for repairs to the bridge piers below the surface of the Potomac River. In order to make these repairs, dewatering of the area surrounding the piers would likely occur by installing cofferdams. The proper installation of cofferdams requires sheet piles to be driven into the subsurface to ensure that water cannot enter the construction area around the pier. Pile driving activities can disturb river bottom sediments that would likely enter the water column, thus temporarily degrading the water quality of the Potomac River.

IMPACT TOPICS ANALYZED IN THIS ENVIRONMENTAL ASSESSMENT

Impact topics are resources of concern that would be affected, either beneficially or adversely, by the range of alternatives. Impact topics were identified based on federal laws, regulations, Executive Orders, NPS *Management Policies 2006* (NPS 2006), from Director's Order 12 (NPS 2011a), and from the NPS's knowledge of limited or easily impacted resources. Specific impact topics were developed to ensure the alternatives were compared based on the most relevant topics. As a means of evaluation, impact topics included in this document were analyzed in detail to compare the environmental consequences of the No-Action Alternative with the Action Alternatives.

Water Quality

NPS *Management Policies 2006* requires parks to "avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks" (NPS 2006). The National Park Service follows the standards established by the Clean Water Act, as well as other applicable federal, state, and District regulations, to best maintain the quality of surface waters and groundwater. Under the proposed Action Alternatives, construction activities within the Potomac River would be conducted that would disturb river bottom sediments, resulting in temporary impacts to water quality. For this reason, Water Quality has been retained for further analysis in this Environmental Assessment.

Riverine Wetlands

Wetlands and Waters of the US are regulated by the Environmental Protection Agency and the US Army Corps of Engineers under Section 404 of the Clean Water Act. In addition, NPS Director's Order 77-2 calls for no net loss of wetlands and strives for a longer-term goal of net gain of wetlands throughout NPS lands. The National Park Service has adopted the use "Classification of Wetlands and Deepwater Habitats of the United States" (USFWS 1979), commonly referred to as the Cowardin Classification System, as the standard for defining, classifying, and inventorying wetlands.

According to the Cowardin Classification System, the Potomac River is considered a riverine wetland. Rehabilitation of the Arlington Memorial Bridge would require construction activities within the River and along its banks; therefore, a Wetlands Statement of Findings has been prepared and is included as an appendix, and Wetlands are addressed as an impact topic in this Environmental Assessment.

Wildlife including Rare, Threatened, and Endangered Species

The Potomac River is suitable habitat for a wide variety of aquatic wildlife. In addition, numerous forms of terrestrial wildlife that are adapted to urban environments occur in the vicinity of the Arlington Memorial Bridge. Rehabilitation of the Arlington Memorial Bridge would result in temporary impacts to wildlife, particularly aquatic species, during construction.

Rare, threatened, and endangered species are protected by Section 7 of the Endangered Species Act. Section 7 requires federal agencies to coordinate with the US Fish and Wildlife Service and the National Marine Fisheries Service during project planning in an effort to preserve listed species and their critical habitats. Two federally listed species, the Atlantic sturgeon and the shortnose sturgeon, have been documented to occur in the Potomac River and are known to migrate through the project area. Although records of each sturgeon species within the Potomac are sparse, construction associated with rehabilitation of the Arlington Memorial Bridge could have impacts on the federally listed species. Based on these considerations, Wildlife including Rare, Threatened, and Endangered Species is analyzed in detail in this Environmental Assessment.

Cultural Resources

The National Historic Preservation Act requires the consideration of effects on any cultural resources that might be affected by a proposed federal action. Specifically, the National Historic Preservation Act requires the consideration of effects on cultural resources either listed in, or eligible to be listed in, the National Register of Historic Places. In addition, the National Environmental Policy Act, the NPS Organic Act, NPS *Management Policies 2006*, Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making, and Director's Order 28: Cultural Resources Management provide cultural resources related requirements for proposed federal actions. Cultural resources include historic structures and districts, cultural landscapes, archeological resources, ethnographic resources, and museum collections (prehistoric and historic objects, artifacts, works of art, archival documents, and natural history specimens) (NPS 2006). *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Building* provides best management practices for the treatment of historic properties. Historic Structures and Districts and Cultural Landscapes are analyzed in this Environmental Assessment.

Historic Structures and Districts. The Arlington Memorial Bridge, the Memorial Avenue Complex, and the George Washington Memorial Parkway are all listed in the National Register of Historic Places. The Arlington Memorial Bridge was listed in the National Register of Historic Places in 1980 for its architectural characteristics, innovative engineering achievements and its place in the Memorial Avenue corridor. Additionally, the project area is located in the vicinity of the East and West Potomac Parks Historic District, as well as several contributing features that are individually listed on the National Register of Historic Places, including the Lincoln Memorial and the Jefferson Memorial. Several other resources in the vicinity of the Arlington Memorial Bridge that are listed or are eligible for listing in the National Register of Historic Places include the Washington Monument, the National Mall, Arlington House, the Kennedy Center, Rock Creek Parkway, and Theodore Roosevelt Island; therefore, impacts to historic structures and districts have been assessed in this Environmental Assessment.

Cultural Landscapes . According to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*, cultural landscapes are defined as "a geographic area associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." Based on this criterion, the Arlington Memorial Bridge is a character-

defining feature of the cultural landscape of the George Washington Memorial Parkway and the Memorial Avenue Corridor. Lady Bird Johnson Park and the Lincoln Memorial Grounds are other significant cultural landscapes surrounding the bridge. Rehabilitation of the Arlington Memorial Bridge could result in effects to the cultural landscape; therefore, impacts to cultural landscapes have been assessed in this Environmental Assessment.

Visitor Use and Experience

The Arlington Memorial Bridge is a significant link between the National Mall and Arlington National Cemetery. The bridge is used for many large scale events such as parades, marathons, and funeral processions. From the Arlington Memorial Bridge, visitors are provided the opportunity for scenic views of the Potomac River, Lincoln Memorial, Washington Monument, Arlington House, the Kennedy Center, Theodore Roosevelt Island, Theodore Roosevelt Memorial Bridge, and others. Conversely, the Arlington Memorial Bridge itself is highly visible and is a prominent feature of the District of Columbia's monumental core, which can be observed from these resources and from numerous other vantage points in Arlington County and the District of Columbia. Beneath the bridge, the Potomac River is used by water taxis, cruise ships, and crew teams. Rehabilitation of the Arlington Memorial Bridge would require closures that would temporarily disrupt visitor use and experience. During construction, bridge closures would temporarily restrict pedestrian and bicycle access, which would disrupt the connectivity between the National Mall and the Arlington National Cemetery. Furthermore, construction activities would temporarily diminish the aesthetics of the bridge, scenic views to the bridge, and eliminate opportunities for scenic views from the bridge. Potomac River users would be required to maintain a safe distance from construction activities, and would be restricted from travel beneath the bridge. Based on these considerations, visitor use and experience is retained as an impact topic in this Environmental Assessment.

Transportation

The Arlington Memorial Bridge provides a connection between several heavily traveled roadways including the George Washington Memorial Parkway, Washington Boulevard (VA-27), Jefferson Davis Highway (VA-110), Independence Avenue, and others. On average, approximately 55,000 vehicles crossed the bridge each day in 2011. The bridge also provides a favorable route for pedestrians and bicyclists. Closures and detours would be required during rehabilitation of the bridge, which would be disruptive to local and regional traffic. Vehicles, pedestrians, and bicyclists would be required to use other bridges to cross the Potomac River. Consequently, traffic volumes and delay times, particularly during peak travel periods, are projected to increase along detour routes at the other Potomac River crossings. Due to the temporary impacts of construction on local and regional roadways and on pedestrians and bicyclists, Transportation is retained for further analysis in this Environmental Assessment.

Navigation

The Potomac River serves as an important recreational attraction in Washington, DC. Many recreational boaters, sightseeing cruises, and non-motorized vessels travel under the Arlington

Memorial Bridge. The rehabilitation of the Arlington Memorial Bridge would cause a temporary relocation of the navigation channel that is directed under the bascule span of the bridge. The navigation channel will be relocated to another depth appropriate span during construction and will return once construction has concluded. Due to the temporary impacts of the navigation channel relocation, navigation is retained for further analysis in this Environmental Assessment.

IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

The impact topics listed below would have no effect, a negligible effect, or in some specific cases, a minor effect for each alternative evaluated in this document. For specific definitions of negligible and minor impacts, please refer to "Chapter 4: Environmental Consequences." However, in general, negligible effects are effects that are localized and immeasurable. Topics that have either no, negligible, or minor effect are briefly discussed in this section and then dismissed from further consideration or evaluation.

Geology and Geologic Hazards

NPS *Management Policies 2006* states that the National Park Service will "protect geologic features from the unacceptable impacts of human activity while allowing natural processes to continue." The project area is located in the Atlantic Coastal Plain physiographic province; however, the surrounding area has been greatly urbanized and developed and bears little resemblance to typical landforms in this province. The proposed work on the bridge will mostly be contained to the bridge itself, except for possible staging areas adjacent to the bridge used to temporarily stage construction equipment. The bridge span itself will not be moved or rehabilitated in a way that will affect geology or create geologic hazards. The bridge piers, which sit on bedrock approximately 30 to 40 feet below the water surface, require only small scale repairs that would not involve work on subsurface formations. The driving of sheet piles may be needed to install cofferdams used to dewater the areas around the piers that need repairs; however, the sheet piling will not have a noticeable effect on geologic resources. Therefore, because the Arlington Memorial Bridge rehabilitation would have no noticeable effect on geologic resources, this impact topic was dismissed from further analysis.

Topography and Soils

According to NPS *Management Policies 2006*, the National Park Service "will actively seek to understand and preserve soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal or contamination of the soil or its contamination of other resources." As the majority of the project occurs on the Arlington Memorial Bridge itself, no soils will be immediately impacted. Soils may be impacted on both approaches to the bridge, as temporary staging of construction equipment will be required. Most of these soils are Udorthents; other soils in the area include sandy Udifluvents, Bibb sandy loams, and Lindside loams. Small disturbance to soils during construction would be minimized using best management practices and erosion and sediment control measures to reduce sediment transport into the Potomac River.

Topography around the Arlington Memorial Bridge has been altered by development of the surrounding area. Generally, most of the topography slopes towards the Potomac River. As there will be no ground disturbance aside from minimal impacts associated with construction staging, no impacts to topography are anticipated; therefore, Topography and Soils were dismissed from further analysis.

Floodplains

Floodplains are mapped by the Federal Emergency Management Agency in order to identify flood hazards, assess flood risks, and guide mitigation actions. Floodplain mapping involves delineation of the 1 percent annual chance (100-year) flood; a flood that has a 1 percent chance of being equaled or exceeded in any given year. For lands that are within the 100-year flood zone, floodplain management regulations are enforced. Executive Orders 11988 and 13690 require federal agencies to avoid development within the 100-year flood zone where practical alternatives exist. In addition, NPS Director's Order 77-2 encourages floodplain preservation, minimization of impacts, and adherence to federal floodplain management law. Procedural Manual 77-2, Floodplain Management does not apply to historic structures whose location is integral to their significance. The Arlington Memorial Bridge is a historic structure and its location over the Potomac River is integral to its significance. Therefore, the procedures do not apply to the bridge.

Based on a review of FEMA (Federal Emergency Management Agency) Flood Insurance Rate Maps, floodplains are found within 200 feet of Potomac River shores, and in low lying areas surrounding the Lincoln Memorial. The bridge is in Zone AE and is mapped on Flood Insurance Rate Map panel 1100010018C, effective September 27, 2010. The 100-year flood elevation is approximately 13 feet NAVD88 (North American Vertical Datum of 1988) and the 500 year is approximately 17 feet NAVD88. Figure 13 depicts the 100-year floodplain boundaries within 1 mile of the bridge. The Federal Emergency Management Agency has not mapped a floodway in this area of the Potomac River.

Under all alternatives, construction activities associated with the bridge rehabilitation would not have a measurable effect on the frequency, elevation, intensity, or duration of floods nor would it impact floodplain function. During construction there would be a slight temporary modification to the floodplain due to the addition of falsework adjacent to the bascule span, which would be in place for approximately two to three months. The addition of this structure would result in a negligible change to the ability of the floodplain to convey floodwaters and would not contribute to flooding. In addition, as described in "Chapter 2: Alternatives", construction causeways or work platforms would be constructed in the Potomac River on the north and south sides of the bridge. If causeways are constructed, appropriately sized pipes would be placed through the causeway to allow for the continued flow of the river. In the event of a flood event, floodwaters would flow through the pipes and over the causeway. If work platforms are constructed, they would be placed on pilings. Floodwaters would be able to flow around these piles and there would be a negligible impact on flooding. Following flood stage flows and other severe weather events, any accumulated debris in the construction zones would be removed.

Barges would be anchored and used for staging during the construction period. The anchoring method would be designed to allow the barge to rise to the historic flood elevation; therefore the barge would not impede river flows and/or cause flows to be diverted. The anchoring method would also prevent the barges from breaking away and becoming a hazard during a flood event. These construction activities would have only a negligible short-term impact to the floodplain. Following construction, there would be no permanent change to the floodplain. Therefore, Floodplains were not carried through for detailed analysis.

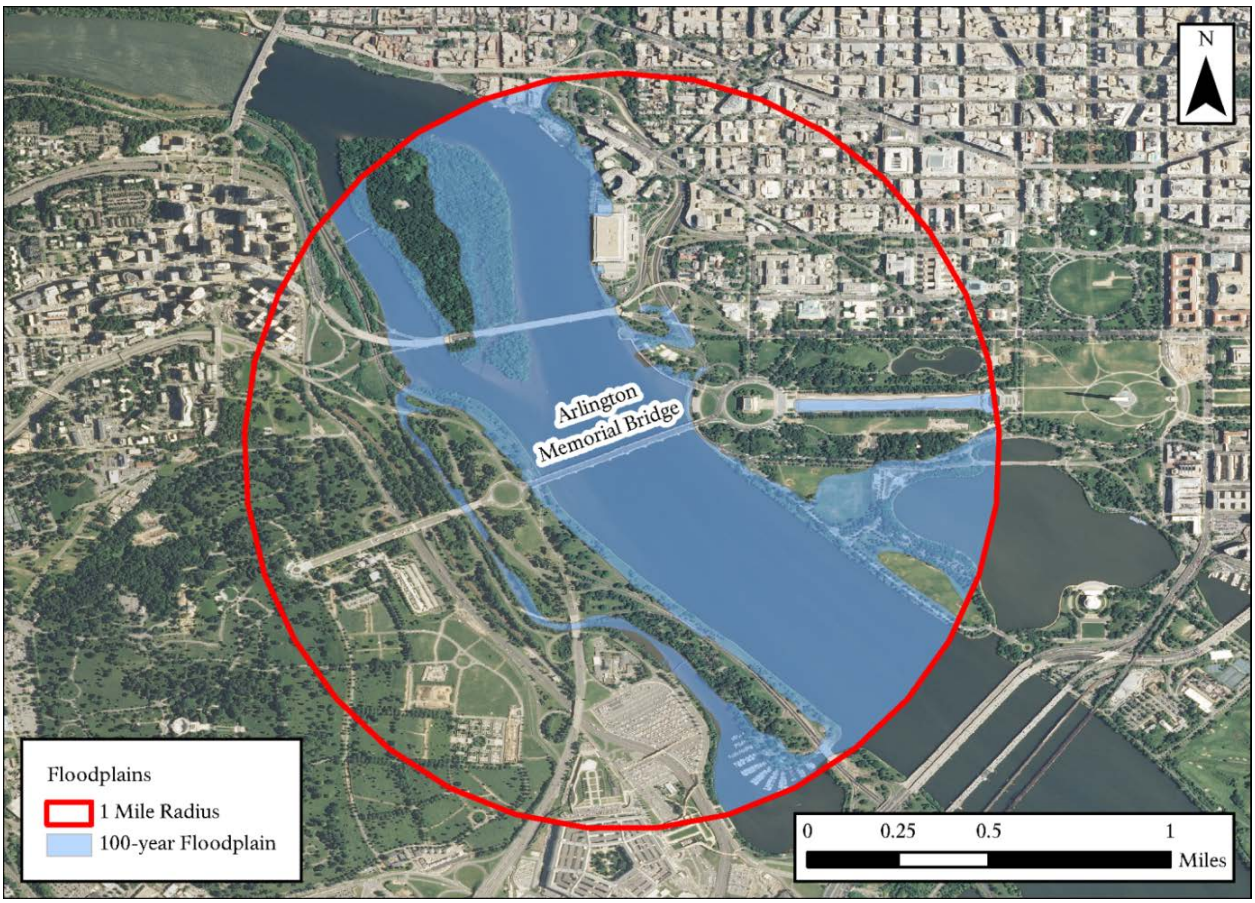


Figure 13: FEMA floodplains located within a one mile radius of the Arlington Memorial Bridge (Source: FEMA 2013)

Vegetation

Vegetation in the project area is landscaped and maintained by the National Park Service. Vegetation consists of individual trees and shrubs along the banks of the Potomac River and lawns aside roadways and trails. The proposed actions could require trimming and removal of trees and shrubs in order to accommodate construction equipment. Revegetation of the affected areas would be carried out once the bridge rehabilitation was complete. Re-establishment of the vegetation immediately after the use of the site would stabilize the soils as well as deter the establishment of

invasive species. Due to the regularly maintained nature of the sites, it is not anticipated that invasive species will be an issue after the re-establishment of the turf. New trees, shrubs and turf plantings are expected to be successful. Because the proposed actions would replace the existing landscaped area that would be disturbed with new landscaping, Vegetation was dismissed as an impact topic.

Air Quality

The Clean Air Act requires federal land managers to protect air quality. During rehabilitation of the Arlington Memorial Bridge, construction activities would generate emissions associated with hauling materials, operating power equipment, fugitive dust, and the application of hot mix asphalt paving. In addition, expected travel delays on detour routes during the full bridge closure period would increase travel time, delays, and congestion, subsequently increasing vehicle emissions. The Arlington Memorial Bridge is restricted for trucks over 10,000 pounds gross vehicle weight. This translates to very few diesel vehicles crossing the bridge, with the exception of smaller trucks and delivery vehicles, tour buses and charters, and public transportation vehicles. Construction therefore would not result in a significant increase in diesel traffic along detour routes. Although the impacts to air quality would be detectable, impacts to air quality during construction would be minor. Following the bridge rehabilitation, air quality in the area of the Arlington Memorial Bridge would return to preconstruction conditions. Based on these considerations, this impact topic was dismissed from further analysis.

Archeological Resources

During the late 19th century, the US Army Corps of Engineers began the long project of dredging the Potomac River and disposing of dredged materials in such a way to prevent siltation in what was then the Virginia-Georgetown shipping channel. By 1901, 31 acres adjacent to the Washington Monument had been filled and subsequently turned into Potomac Park (NPS 1999b). Similarly, the disposal of dredged materials was used to increase the size of Columbia Island during the late 1910s and this island was turned into parkland, eventually becoming part of the George Washington Memorial Parkway and Lady Bird Johnson Park. All the land on the east and west sides of the Arlington Memorial Bridge is reclaimed land from the Potomac River, and there is low potential for the presence of archeological sites. This same dredging of the Potomac River most likely destroyed any potential for submerged resources within the vicinity of the Arlington Memorial Bridge and Columbia Island.

There is a shipwreck designated on the 2014 National Oceanic and Atmospheric Administration (NOAA) navigational map (NOAA 2015). Dredging and construction activities for the Arlington Memorial Bridge project will be designed to avoid this feature.

As there is limited potential for the presence of terrestrial or submerged archeological resources in the vicinity of the Arlington Memorial Bridge within the proposed staging and construction areas, Archeological Resources has been dismissed from further analysis.

Museum Collections

According to Director's Order 24: Museum Collections, the National Park Service requires the consideration of impacts on museum collections (historic artifacts, natural specimens, and archival and manuscript material), and provides further policy guidance, standards, and requirements for preserving, protecting, documenting, and providing access to, and use of, NPS museum collections. None of the alternatives would have a direct effect on recognized museum collections (historic artifacts, natural specimens, and archival and manuscript material); therefore, this topic was dismissed from further analysis.

Ethnographic Resources

Ethnographic resources are defined in Director's Order 28: Cultural Resources Management Guidelines as any "site, structure, object, landscape or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it." According to Director's Order 28 and Executive Order 13007 on sacred sites, the National Park Service should try to preserve and protect ethnographic resources. No known properties meet the definition of an ethnographic resource in proximity to the Arlington Memorial Bridge; therefore, this impact topic was dismissed from further analysis.

Indian Trust Resources

Secretarial Order 3175 requires that any anticipated impacts to Indian Trust resources from a proposed action by Department of the Interior agencies be explicitly addressed in environmental documents. The Federal Indian Trust responsibility is a legally enforceable obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaskan native tribes. Based on consultation with the NPS Cultural Resources Manager, who is knowledgeable of the George Washington Memorial Parkway and surrounding areas, there are no known Indian Trust resources in proximity to the Arlington Memorial Bridge. The lands along the Potomac River where the Arlington Memorial Bridge is located are not held in trust by the Secretary of the Interior for the benefit of Indians; therefore, this impact topic was dismissed from further analysis.

Human Health and Safety

The Arlington Memorial Bridge is currently safe for vehicular, pedestrian, and bicycle use. The National Park Service has placed weight restrictions on the bridge to minimize the continued stress on the bridge deck. As described previously, the Federal Highway Administration is undertaking regular inspections of the bridge. If based on these inspections, the Federal Highway Administration recommends further restrictions or a full-bridge closure is required to keep the public safe, the National Park Service will act on those recommendations.

During construction activities under the Action Alternatives, an approved maintenance of traffic plan would be put in place to provide a safe working environment for construction workers and safe

passage for motorists during construction. Site workers would adhere to a health and safety plan that describes potential hazards and the controls and practices selected to minimize hazards. Signage and fencing would be used to keep passersby out of construction areas; appropriate distances would be maintained between construction workers and vehicle traffic; and lighting would be used on equipment, barges, and falsework. Notices of construction would be provided to boaters, and they would be rerouted through an adjacent bridge span, maintaining a safe distance from construction areas.

Because appropriate measures will be put in place to maximize the safety of works and the public, Human Health and Safety has been dismissed from further analysis.

Park Operations and Management

The National Park Service will continue to be responsible for maintenance and operation of the Arlington Memorial Bridge, and the Federal Highway Administration will continue to conduct regular inspections of the bridge. Funds for repair and rehabilitation of the Arlington Memorial Bridge are not anticipated to come from the NPS's general operating budget. Therefore, there would be a negligible impact on park operations and management and this topic has been dismissed from further analysis.

Land Use

Review of land use mapping arranged by the District of Columbia Office of Planning provides that land use in the project area consists of transportation rights-of-way and parks and open spaces (DCOP 2006). No permanent changes to these land uses would result from implementation of any of the proposed alternatives. The project is intended to maintain the Arlington Memorial Bridge as a Potomac River crossing for vehicles, pedestrians, bicyclists and others. During construction, open spaces adjacent to the bridge would be used for construction staging. At the completion of the proposed project, land use in the open spaces would return to preconstruction conditions. Because there would only be temporary changes in land use adjacent to the bridge under the proposed actions, this impact topic was dismissed from further analysis.

Socioeconomics

Rehabilitation of the Arlington Memorial Bridge would result in a short-term need for construction workers, but the number of workers would be minimal and most of them would already be employed, and there would be no permanent effect to the population, income, or employment base of the surrounding community. The need for construction workers would provide minimal increases in employment opportunities and revenues for local businesses, but any increases would be below the level of detection due to the scale of the local economy. Rehabilitation of the Arlington Memorial Bridge would result in temporary effects to tourist attractions, corporate institutions, Federal and local government, and local residents who use the bridge regularly. During bridge closure periods, these bridge users would be detoured until reopening of the bridge. Because the

proposed action would result in only short-term negligible impacts due to construction activities, Socioeconomics was dismissed from further analysis.

Environmental Justice

Executive Order 12898 requires all federal agencies to incorporate Environmental Justice into their programs and policies. The Order requires agencies to identify and address disproportionately high and adverse human health or environmental effects on minority and low-income populations and communities. Minority and low-income populations and communities are present in Washington, DC, and Northern Virginia; however, no racial, ethnic, or socioeconomic group would bear a disproportionate share of the effects resulting from bridge rehabilitation. All construction is proposed in park and roadway settings. As a result, all impacts, whether beneficial or adverse, would affect all populations equally. Because all users of the bridge and surrounding areas would be affected equally by the proposed actions, Environmental Justice was dismissed as an impact topic.

Climate Change

Climate change refers to any significant changes in average climatic conditions (such as mean temperature, precipitation, or wind) or variability (such as seasonality and storm frequency) lasting for an extended period (decades or longer). Recent reports by the US Climate Change Science Program, the National Academy of Sciences, and the United Nations Intergovernmental Panel on Climate Change provide evidence that climate change is occurring as a result of rising greenhouse gas emissions and could accelerate in the coming decades.

While climate change is a global phenomenon, it manifests differently depending on regional and local factors. General changes that are expected to occur in the future as a result of climate change include hotter, drier summers; warmer winters; warmer water; higher ocean levels; more severe wildfires; degraded air quality; more heavy downpours and flooding, and increased drought. Climate change is a far-reaching, long-term issue that could affect the park, its resources, visitors, and management. Although some effects of climate change are considered known or likely to occur, many potential impacts are unknown. Much depends on the rate at which the temperature would continue to rise and whether global emissions of greenhouse gases can be reduced or mitigated. Climate change science is a rapidly advancing field and new information is being collected and released continually.

Construction activities associated with the Arlington Memorial Bridge rehabilitation would contribute to an increase in greenhouse gas emissions, but such increases would be short-term, ending with the completion of construction. It is not possible to meaningfully link the greenhouse gas emissions of such individual project actions to quantitative effects on regional or global climatic patterns. Any effects on climate change would not be discernible at a regional scale; therefore, this impact topic was dismissed from further analysis.

This page intentionally left blank.

CHAPTER 2: ALTERNATIVES

INTRODUCTION

The National Environmental Policy Act requires that federal agencies explore a range of reasonable alternatives. The alternatives under consideration must include the "No Action" alternative as prescribed by 40 CFR 1502.14. Any alternative analyzed must meet the management objectives of the George Washington Memorial Parkway, either wholly or partially, while also meeting the purpose of and need for the project.

Project alternatives may originate from the proponent agency, local government officials, or members of the public. Alternatives may also be developed during the early stages of project development at public meetings or in response to agency comments. The alternatives analyzed in this document are the result of internal scoping, public scoping, and agency consultation. The components of the Action Alternatives represent the outcome of extensive collaboration between the National Park Service, Federal Highway Administration, the project consultant team, stakeholders, and state and local government agencies.

The National Park Service explored and evaluated a range of alternatives. After extensive collaboration between the National Park Service and the Federal Highway Administration, several alternatives were dismissed from consideration and five alternatives (the No-Action Alternative and four Action Alternatives) were carried forward for further analysis. These alternatives are described in this chapter.

DESCRIPTION OF ALTERNATIVES

No-Action Alternative

The No-Action Alternative describes the action of continuing present management operations and conditions. It does not imply or direct discontinuing the present action or removing current uses, development, or facilities. While the No-Action Alternative does not meet the purpose and need of the project, it provides a basis for comparing the management direction and environmental consequences of the Action Alternatives.

Under the No-Action Alternative, the National Park Service and Federal Highway Administration would not perform a major rehabilitation project on the Arlington Memorial Bridge. The National Park Service, at the recommendation of the Federal Highway Administration, has posted a 10-ton load limit across the entire length of the bridge. Under the No-Action Alternative the load restriction, which has eliminated most bus traffic, would remain in effect indefinitely as no major repairs would be made to the bridge.

The temporary trunnion shoring project which is described later in this chapter would be undertaken under the No-Action Alternative to strengthen the trunnion posts and prevent their collapse.

The concrete arch spans, bridge deck, sidewalks, and other structural and nonstructural components would be left in their existing condition and would continue to deteriorate. The Federal Highway Administration would perform routine inspections on the bridge to track the bridge's rate of deterioration, to determine if emergency repairs are needed to keep the bridge operational for vehicular traffic, and to allow for the sidewalks to continue to be used by pedestrians and bicyclists. As the bridge continues to deteriorate, the National Park Service and Federal Highway Administration would need to undertake additional maintenance and repair activities and may impose further weight restrictions and/or close the bridge.

Elements Common to the Action Alternatives

The following section provides descriptions of elements that would occur with the implementation of any of the Action Alternatives. The temporary trunnion shoring project which is described later in this chapter would be undertaken under each of the Action Alternatives to strengthen the trunnion posts and prevent their collapse until such time as permanent repairs could be made.

The Action Alternatives are specific to the treatment of the bascule span. The common elements described below are related mainly to the concrete arch spans, the driving surface, and other nonstructural bridge components. Elements common to all of the Action Alternatives include:

Repairs to the Concrete Arch Spans. The Arlington Memorial Bridge consists of 10 reinforced concrete arch spans that require varying levels of structural repair. The work needed to rehabilitate the concrete arch spans includes filling cracks with epoxy, patching concrete spalling with concrete repair compound, and replacing the concrete edge beams.

Repairs to the Concrete Bridge Piers. Several concrete bridge piers have cracking and scouring surrounding the piers that require repair below water. In order for structural repairs to occur, cofferdams would be installed to dewater the area around the bridge piers. Cofferdams are installed into the substrate and provide a barrier around the site to keep water from entering. This allows concrete repairs to be completed in a dry working environment. Cracks in the bridge piers/abutments would be filled using an epoxy suitable for underwater applications, and then wrapped with fiber reinforced polymer. Undermined footing areas would be filled with grout, and scouring would be addressed by placing scour countermeasures, such as stone (riprap) placed on or below the river bottom around the piers, for protection.

Replacement of Expansion Joints and Bearings. The bridge's expansion joints would be replaced to allow for expansion and contraction that results from changes in temperature and to minimize water intrusion at each joint. The bridge's bearings would also be replaced. Bridge bearings support the bridge superstructure, transfer loads from the superstructure to the substructure, and provide the ability for the superstructure to move and rotate.

Replacement of the Bridge Deck and Sidewalks. The existing concrete bridge deck would be replaced with concrete/polymer concrete deck designed to minimize water intrusion. A concrete/polymer concrete overlay would be installed on top of the deck that would serve as the road surface. In addition, the existing exposed aggregate sidewalks would be replaced with an exposed aggregate concrete/polymer concrete sidewalk.

Repair Bridge Railings and Other Nonstructural Bridge Components. Along with structural repairs described above, numerous other repair and rehabilitation activities would be performed on nonstructural bridge components, such as the following:

1) The balustrade railings, which are part of the original construction and important architectural features of the bridge, would be carefully removed, inspected for any needed repair or in-kind replacement, and put back in the original positions. When making an investment of this magnitude, current safety standards must be met to the extent practicable. Although the existing granite/aluminum bridge rail does not meet current crashworthiness standards, the 30 mile-per-hour posted speed, 10-inch curb and 17-foot wide sidewalks all contribute to the relatively low crash history related to the bridge rail and no known fatalities. Several bridge rail options have been analyzed, including retrofitting the existing granite/aluminum rail, adding a rail on the sidewalk adjacent to the travel lanes (similar to Kutz Bridge), and replacement of the existing rail with a crashworthy bridge rail. Further study showed that retrofitting the existing rail would destroy the rail. Adding a rail on the sidewalk would conflict with the light poles and replacement of the rail would alter a character defining feature of the historic structure. Therefore, the bridge railings would be repaired, as needed, and reset into place as part of the new sidewalk construction.
2) During construction, improvements would be made to the bridge's existing drainage system. The existing system includes pipes, drains, inlets, and grates that would be cleaned or repaired where feasible. Certain aspects of the drainage system may need to be replaced or upgraded where significant deterioration has occurred or to conform to current stormwater management guidelines.
3) The granite curbs that run along the roadside edge of the sidewalks would need to be removed to install the new bridge deck and sidewalks. As these structures are installed, the existing granite curbs would be reset into place. Some sections of granite curb are cracked or chipped and would need to be replaced.
4) The light poles would be removed prior to the removal of the existing bridge deck and sidewalks. Each light pole would be painted and reset as part of the new sidewalk construction. To conform to current electrical standards, an upgraded lighting system would be installed with conduits inside each arch span.
5) The stone façade that adorns each side of the concrete arch spans would be cleaned, repaired, or replaced in kind as needed.
6) Throughout the bridge, existing access hatches, ladders, and personnel platforms for inspections and maintenance access would be repaired or replaced as needed.

The following sections describe specific treatment of the bascule span. All bascule span and common repairs and rehabilitation would be done in accordance with Secretary of the Interior's Standards for Rehabilitation (codified as 36 CFR 67) to the extent feasible. Statuary on the bridge would be protected in place or removed and stored until completion of the bridge repairs. The original machinery and control rooms, as shown in Chapter 1, Figures 8 and 9 would be retained. Demolition shields would be used during construction of all alternatives.

Alternative 1A: Replace the Bascule Span with a New Span Comprised of Precast Concrete Box Girders (Beams)

As described in Elements Common to All Alternatives, Alternative 1A would include the rehabilitation and repair of the concrete arch spans and associated bridge features. Furthermore, Alternative 1A would include the replacement of the existing bascule span with a new fixed span comprised of precast concrete box girders (Figure 14). The top and sides of the replacement span would visually replicate the existing bascule span by repairing and/or refurbishing all original bridge components to the greatest extent feasible. To replicate the bascule span, the existing steel façade on the exterior face of the span would be removed at the beginning of construction, refurbished off-site, and reinstalled on the face of the new span (Figure 15). Statuary on the bridge would be protected in place or removed and stored until completion of the bridge repairs. The existing bridge railing would be removed, repaired, and reinstalled, along with the existing light poles and granite curbs. Exposed aggregate concrete/polymer concrete sidewalks would be constructed on the replacement span that would match the existing sidewalks in appearance. The concrete/polymer concrete overlay that would replace the existing asphalt road surface would be the only element on the top that would not

Figure 14: Conceptual rendering of the concrete box girder replacement structure proposed under Alternative 1A (Underside View)

Figure 15: Conceptual rendering of the existing steel facade planned for reuse under all alternatives

replicate the original bascule span due to the difference in color between the existing black asphalt surface and the traditional gray color of concrete.

The underside of the replacement structure would not replicate the existing structure because the new structure would consist of concrete, not steel, and would be a straight span, not an arch span like the existing bascule span; however, the guard's cabin, the overseer's cabin, and the machinery rooms would remain in place, and the bascule span abutments would remain as part of the new design. Also, as previously mentioned, reinstalling the existing steel façade on the face of the span would give it the appearance of being a bascule span from most vantage points.

In order to rehabilitate the Arlington Memorial Bridge and replace the bascule span under Alternative 1A, full and/or partial closures of the bridge and its vehicular travel surface would be necessary. As described below, vehicular travel lane closure periods would vary depending on the construction method used.

The Federal Highway Administration estimates that the precast concrete replacement span would have a design life of 75 to 100 years. During this time, minimal maintenance activities would be required but would likely include the installation of new expansion joints and bearings approximately every 20 years and a new concrete/polymer concrete overlay approximately 40 years into the life of the structure. Other than scheduled routine inspections of the structure, no additional work would be expected.

The Federal Highway Administration has analyzed two possible methods of construction to accomplish the project under Alternative 1A. These methods are as follows:

Alternative 1A, Construction Method A – Temporary Full Closure of the Bridge, Sidewalks and All Vehicular Travel Lanes. Method A uses a phased approach to replace the bascule span that requires a full closure of the bridge and its vehicular travel surface for a temporary period while the existing bascule span is removed and the new substructure and superstructure are installed. Prior to this full closure period, the bridge would remain open to vehicular traffic while various construction-related activities are conducted to prepare for the work to be conducted during the full closure and to reduce the duration of the full closure. [1]

Prior to the full closure period and the associated removal of the bascule span, the navigation channel, which is currently directed under the bascule span, would be relocated to convey river traffic under an adjacent span. Temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. In addition, construction activities would be coordinated with the US Army Corps of Engineers in accordance with Section 10 of the Rivers and Harbors Act of 1899.

[1] Under all alternatives and construction methods, short-term closures of the vehicular travel lanes and sidewalks may be necessary.

Other work that would be conducted prior to the full bridge closure period would include: removing the existing steel façade on the exterior faces of the span; relocating utilities; modifying and strengthening existing structural steel as needed; and other miscellaneous construction-related activities.

During the full closure period, the existing bascule span would be demolished. Concurrent to the removal of the bascule span, the replacement structure comprised of precast concrete box girders would be constructed on falsework (temporary support structures) in the Potomac River directly upstream of the bridge. The replacement structure would be installed by sliding it into place using cranes or another method determined by the contractor. Placement of the new superstructure would require repairs to the existing abutments, removal of the stone walls of the bascule abutments as needed, replacement of the expansion joints at the abutments, construction of new girder seats/substructure, and repairs or replacement of the existing drainage system.

Other work involved in replacing the bascule span would include removing, repainting, and resetting light poles; constructing new exposed aggregate concrete/polymer concrete sidewalks; resetting granite curbs; removing, repairing, and resetting the existing bridge railing; cleaning, repairing, or replacing stone work as needed; installing an upgraded lighting system inside the span; installing new inspection/maintenance access platforms; and refurbishing and reinstalling the existing steel façade on the exterior faces of the new span.

The navigation channel would be relocated back under the new span after it has been installed and is safe for river traffic. Furthermore, the bridge would be open to vehicular traffic after the installation of the new span is complete; however, two and/or three lane closures would be needed for the duration of construction.

Under Construction Method A, the Federal Highway Administration has estimated that the total construction duration would be approximately 700 calendar days, or just less than two years. During this time, it is estimated that the bridge would need to be completely closed to vehicle traffic, pedestrians, and bicyclists for up to 70 consecutive days to remove the existing bascule span and install the new concrete span. During this full closure period, no vehicular traffic, pedestrians, or bicyclists would be allowed on the bridge. Traffic would be required to use other routes or alternative means of transportation. Immediately following the full closure period, it is estimated that closure of three vehicular travel lanes and one sidewalk would be necessary for approximately 490 days. The total traffic impact duration would be 560 calendar days.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 1A – Construction Method A would cost an estimated $236 million. Long-term maintenance would be required over the next 75 years including replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $16 million.

Alternative 1A, Construction Method B – Partial Bridge Closure with Closure of Three Vehicular Travel Lanes. Method B uses a phased approach to replace the bascule span that does not require a full closure of the bridge and its vehicular travel surface. Instead, the bascule span would be removed and the new span installed while a partial bridge closure is implemented. During this partial closure, half the bridge (three vehicular travel lanes) would be closed, while the other half remains open to accommodate three lanes of vehicle traffic.

Prior to the partial bridge closure and the associated removal of the bascule span, the navigation channel, which is currently directed under the bascule span, would be relocated to convey river traffic under an adjacent span. Temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. In addition, construction activities would be coordinated with the US Army Corps of Engineers in accordance with Section 10 of the Rivers and Harbors Act of 1899.

Other work that would be conducted prior to the partial bridge closure period would include: removing the existing steel façade on the exterior faces of the span; relocating utilities; modifying and strengthening existing structural steel as needed; and other miscellaneous construction-related activities. In addition, while this work is being conducted, extensive falsework (temporary support structures) would be built in the Potomac River under the existing bascule span to support half of the structure. Extensive falsework would also be installed inside the abutments of the bascule span. After the supports are in place, the contractor can then begin to remove sections of the concrete counterweights for demolition and removal off-site.

After these activities are completed and the maintenance of traffic plan is implemented, the partial bridge closure period would begin, closing half the bridge and three lanes of vehicle traffic. At this time, half the existing bascule span would be demolished.

After the first half of the bascule span has been removed, piers would be installed in the Potomac River as temporary support for the precast concrete span section to be installed. The concrete span would be floated to the site on barges and lifted into place by cranes or another method determined by the contractor. Placement of the new superstructure would require repairs to the existing abutments, removal of the stone walls of the bascule abutments as needed, replacement of the expansion joints at the abutments, construction of new girder seats, and repairs or replacement of the existing drainage system. With one half of the concrete span in place, remaining work would include installing an concrete/polymer concrete deck along with a concrete deck overlay for the road surface; constructing new exposed aggregate concrete/polymer concrete sidewalks; removing, repainting, and resetting light poles; resetting granite curbs; removing, repairing, and resetting the existing bridge railing; cleaning, repairing, or replacing stone work as needed; installing an upgraded lighting system inside the span; installing new inspection/maintenance access platforms; and refurbishing and reinstalling the existing steel façade on the exterior faces of the new span.

Once this phase of construction is complete, vehicle traffic would be diverted onto the newly constructed portion of the bridge. At this time, work would commence on the other half of the bridge, generally following the same procedures described above.

After construction of the replacement span is complete and it is safe for river traffic, the navigation channel would be relocated back under the new span. Furthermore, after the installation of the new span is complete, two and/or three lane closures would continue for the duration of construction. The Federal Highway Administration has estimated that the total construction duration under Construction Method B would be approximately 700 calendar days, or just less than 2 years. During this time, it is estimated three vehicular travel lanes and one sidewalk would be closed for approximately 560 days.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 1A – Construction Method B would cost an estimated $241 million. Long-term maintenance would be required over the next 75 years including replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $16 million.

Alternative 1B: Replace the Bascule Span with a New Span Comprised of Variable Depth Steel Girders

As described in Elements Common to All Alternatives, Alternative 1B would include the rehabilitation and repair of the concrete arch spans and associated bridge features. Furthermore, Alternative 1B would include the replacement of the existing bascule span with a new fixed span comprised of variable depth steel girders (Figure 16). The top of the replacement span would visually replicate the existing bascule span by repairing and/or refurbishing all original bridge components to the greatest extent feasible. To replicate the bascule span, the existing steel façade on the exterior face of the span would be removed at the beginning of construction, refurbished off-site, and reinstalled on the face of the new span. Statuary on the bridge would be protected in place or removed and stored until completion of the bridge repairs. The existing bridge railing would be removed, repaired, and reinstalled, along with the existing light poles and granite curbs. Exposed aggregate concrete/polymer concrete sidewalks would be constructed on the replacement span that would match the existing sidewalks in appearance. The concrete/polymer concrete overlay that would replace the existing asphalt road surface would be the only element on the top of the replacement span that would not replicate the

Figure 16: Conceptual rendering of the variable depth steel girder replacement structure proposed under Alternative 1B (Underside View)

original bascule span due to the difference in color between the existing black asphalt surface and the traditional gray color of concrete.

The underside of the replacement structure would be arched to mimic the current bascule span arch; however, the bridge would no longer have the appearance of the truss construction. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place, and the bascule span abutments would remain as part of the new design. Also, as previously mentioned, reinstalling the existing steel façade on the face of the span would give it the appearance of being an arch span from most vantage points (Figure 15).

In order to rehabilitate the Arlington Memorial Bridge and replace the bascule span under Alternative 1B, full and/or partial closures of the bridge and its vehicular travel surface would be necessary. As described below, vehicular travel lane closure periods would vary depending on the construction method used.

The Federal Highway Administration estimates that the variable depth steel girder replacement span would have a design life of 75 years. During this time, maintenance activities would be required including repainting the structural steel approximately every 25 years, installing new expansion joints and bearings approximately every 20 years, and installing a new concrete/polymer concrete overlay approximately 40 years into the life of the structure. Other than scheduled routine inspections of the structure, no additional work would be expected.

The Federal Highway Administration has analyzed two possible methods of construction to accomplish the project under Alternative 1B. These methods are as follows:

Alternative 1B, Construction Method A – Temporary Full Closure of the Bridge, Sidewalks and All Vehicular Travel Lanes. Alternative 1B - Construction Method A uses a phased approach to replace the bascule span that requires a full closure of the bridge and its vehicular travel surface for a temporary period while the existing bascule span is removed and the new substructure and superstructure are installed. Construction Method A under Alternative 1B is the same as described under Alternative 1A - Construction Method A.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 1B – Construction Method A would cost an estimated $245 million. Long-term maintenance would be required over the next 75 years including repainting structural steel every 25 years, replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $20 million.

Alternative 1B, Construction Method B – Partial Bridge Closure with Closure of Three Vehicular Travel Lanes. Alternative 1B – Construction Method B uses a phased approach to replace the bascule span that does not require a full closure of the bridge and its vehicular travel surface. Construction Method B under Alternative 1B is the same as described under Alternative 1A - Construction Method B.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 1B – Construction Method B would cost an estimated $250 million. Long-term maintenance would be required over the next 75 years including repainting structural steel every 25 years, replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $20 million.

Alternative 2: Replace the Bascule Span with a New Span Comprised of Welded Steel Truss Construction

As described in Elements Common to All Alternatives, Alternative 2 would include the rehabilitation and repair of the concrete arch spans and associated bridge features. In addition, Alternative 2 consists of replacing the existing bascule span with a new fixed arch span of welded steel truss construction that would visually replicate the construction of the existing span (Figure 17). The top and sides of the replacement span would visually replicate the existing bascule span by repairing and/or refurbishing all original bridge components to the greatest extent feasible. To replicate the bascule span, the existing steel façade on the exterior face of the span would be removed at the beginning of construction, refurbished off-site, and reinstalled on the face of the new span. Statuary on the bridge would be protected in place or removed and stored until completion of the bridge repairs. The existing bridge railing would be removed, repaired, and reinstalled, along with the existing light poles and granite curbs. Exposed aggregate concrete/polymer concrete sidewalks would be constructed on the replacement span that would match the existing sidewalks in appearance. The concrete/polymer concrete overlay that would replace the existing asphalt road surface would be the only element on the top and sides of the replacement span that would not replicate the original bascule span due to the difference in color between the existing black asphalt surface and the traditional gray color of concrete.

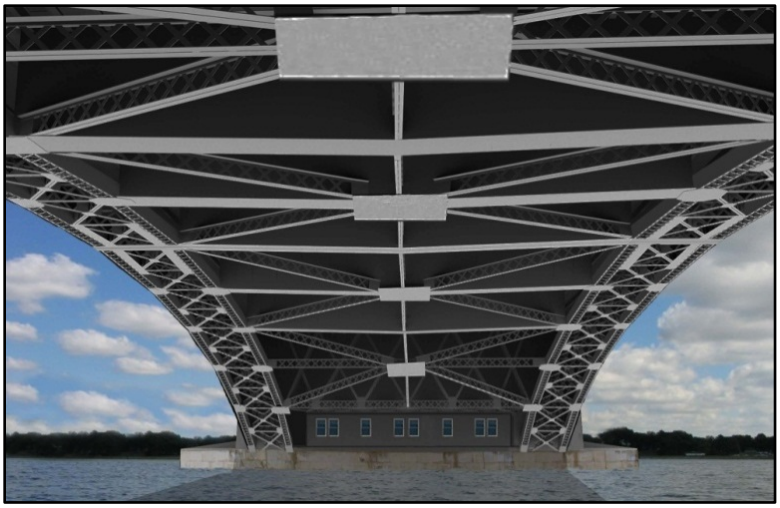


Figure 17: Conceptual rendering of the welded steel truss replacement structure proposed under Alternative 2 (Underside View)

Under Alternative 2, the underside of the replacement structure would visually replicate the existing structure, with a few exceptions. Primarily, the National Park Service proposes to weld, rather than rivet, structural steel components of the new structure together. Riveting the steel components of the new structure would be prohibitively costly for a project of this scale. Under Alternative 2, the guard's cabin, the overseer's cabin, and the machinery rooms would remain in place.

The Federal Highway Administration estimates that the welded steel truss replacement span would have a design life of 75 years. During this time, maintenance activities would be required including repainting the structural steel approximately every 25 years, installing new expansion joints and bearings approximately every 20 years, and installing a new concrete/polymer concrete overlay approximately 40 years into the life of the structure. Other than scheduled routine inspections of the structure, no additional work would be expected.

Alternative 2 uses a phased approach to replace the bascule span that requires a full closure of the bridge and its vehicular travel surface for a temporary period while the existing bascule span is removed and the new superstructure is installed. Prior to the full closure period and the associated removal of the bascule span, the navigation channel, which is currently directed under the bascule span, would be relocated to convey river traffic under an adjacent span. Temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. In addition, construction activities would be coordinated with the US Army Corps of Engineers in accordance with Section 10 of the Rivers and Harbors Act of 1899.

During the full closure period, the existing bascule span would be demolished. Concurrent to the removal of the bascule span and counterweights, the replacement structure comprised of welded steel trusses would be constructed on falsework (temporary support structures) in the Potomac River directly upstream of the bridge. The replacement structure would be installed by sliding it into place using cranes or another method determined by the contractor. Placement of the new superstructure would require repairs to the existing abutments, removal of the stone walls of the bascule abutments as needed, replacement of the expansion joints at the abutments, construction of new girder seats/substructure, and repairs or replacement of the existing drainage system.

Other work involved in replacing the bascule span would include removing, repainting, and resetting light poles; constructing new exposed aggregate concrete/polymer concrete sidewalks; resetting granite curbs; removing, repairing, and resetting the existing bridge railing; cleaning, repairing, or replacing stone work as needed; installing an upgraded lighting system inside the span; installing new inspection/maintenance access platforms; and refurbishing and reinstalling the existing steel façade on the exterior faces of the new span. Additionally, the navigation channel would be relocated back under the new span after it has been installed and is safe for river traffic. Furthermore, the bridge would be open to vehicular traffic after the installation of the new span is complete; however, two and/or three lane closures would be needed for the duration of construction.

Under Alternative 2, the Federal Highway Administration has estimated that the total construction duration would be approximately 700 calendar days, or just less than 2 years. During this time, it is estimated that the bridge would need to be completely closed to vehicle traffic, pedestrians, and bicyclists for up to 80 consecutive days to remove the existing bascule span and install the replacement span. During this full closure period, no vehicular traffic, pedestrians, or bicyclists would be allowed on the bridge. Traffic would be required to use other routes or alternative means of transportation. Immediately following the full closure period, it is estimated that closure of three

vehicular travel lanes and one sidewalk would be necessary for approximately 480 days. The total traffic impact duration would be 560 calendar days.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 2 would cost an estimated $331 million. Long-term maintenance would be required over the next 75 years including repainting structural steel every 25 years, replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $51 million.

Alternative 3: Rehabilitate the Existing Bascule Span in Place

As described in Elements Common to All Alternatives, Alternative 3 would include the rehabilitation and repair of the concrete arch spans and associated bridge features. Furthermore, Alternative 3 consists of repairing/rehabilitating all necessary elements of the existing bascule span in place. Under this alternative lead paint would be removed from steel components of the bascule span would be repaired as necessary and repainted (Figure 18). Due to extensive deterioration, some steel members would need to be replaced including the steel members under the curb line including gusset plates, and some steel members in the fixed portion of the bascule span. Elements that are replaced would be bolted in place rather than riveted as are the current members. The trunnion posts, shown in Chapter 1, Figure 8, would be partially or totally replaced due to extensive deterioration. As the current trunnion posts are susceptible to rust from water infiltration, the design of the trunnion posts would be altered to minimize deterioration while also allowing for access for inspections. In addition, the center lock that holds the two halves of the bascule span together would be retrofitted/rehabilitated to limit the amount of deflection (movement) of the bridge deck.

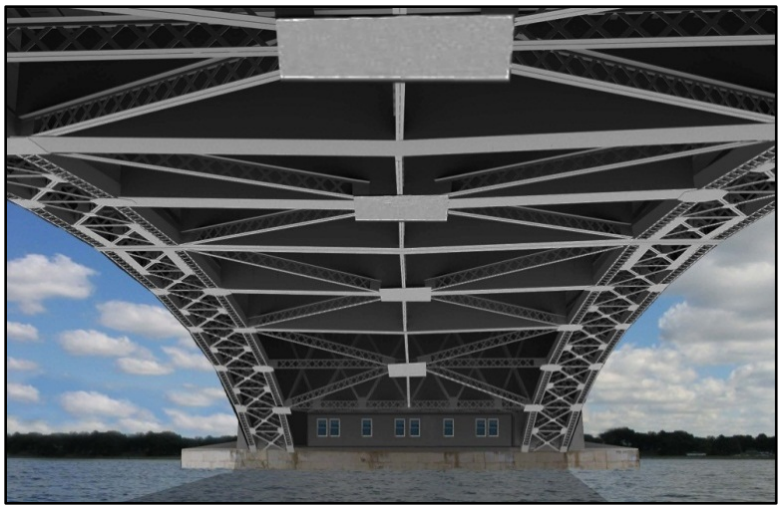


Figure 18: Conceptual rendering of the rehabilitated bascule span proposed under Alternative 3 (Underside View)

Statuary on the bridge would be protected in place or removed and stored until completion of the bridge repairs. The existing bridge railing would be removed, repaired, and reinstalled, along with the existing light poles and granite curbs. Exposed aggregate concrete/polymer concrete sidewalks would be constructed on the replacement span that would match the existing sidewalks in appearance. The concrete/polymer concrete overlay that would replace the existing asphalt road surface would be the only element on the top and sides of the replacement span that would not

replicate the original bascule span due to the difference in color between the existing black asphalt surface and the traditional gray color of concrete.

The Federal Highway Administration estimates that repair/rehabilitation of the existing bascule span would extend the design life of the structure by 75 years. During this time, maintenance activities would be required including repainting the structural steel approximately every 20 years, installing new expansion joints and bearings approximately every 20 years, and installing a new concrete/polymer concrete overlay approximately 40 years into the life of the structure. Furthermore, due to the continued aging of the steel, it is anticipated that additional rehabilitation efforts would likely be needed to rehabilitate or repair structural or nonstructural components of the bridge as needed.
Alternative 3 uses a phased approach to replace the bascule span that requires a full closure of the bridge and its vehicular travel surface for a temporary period while the trunnion posts are being rehabilitated or replaced. Falsework (temporary support structures) inside the abutments and in the water would be constructed to support the bascule span during trunnion post repair or replacement.

Prior to the full bridge closure and the associated repairs to the existing bascule span, the navigation channel, which is currently directed under the bascule span, would be relocated to convey river traffic under an adjacent span. Temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. In addition, construction activities would be coordinated with the US Army Corps of Engineers in accordance with Section 10 of the Rivers and Harbors Act of 1899. After repair/rehabilitation of the existing bascule span is complete and it is safe for river traffic, the navigation channel would be relocated back under the bascule span.

All other work on the bridge would be conducted while a partial bridge closure is implemented. During this partial closure, half the bridge (three vehicular travel lanes) would be closed, while the other half remains open to accommodate three lanes of vehicle traffic.

Under Alternative 3, the Federal Highway Administration has estimated that the total construction duration would be approximately 640 calendar days. During this time, it is estimated that the bridge would need to be completely closed to vehicle traffic, pedestrians, and bicyclists for up to 30 days (non-consecutive) to rehabilitate the trunnion posts. During full closure periods, no vehicular traffic, pedestrians, or bicyclists would be allowed on the bridge. Traffic would be required to use other routes or alternative means of transportation. Immediately following the full closure period, it is estimated that closure of three vehicular travel lanes and one sidewalk would be necessary for approximately 570 days resulting in total traffic impact duration of 600 calendar days.

The Federal Highway Administration estimates that rehabilitation of the Arlington Memorial Bridge under Alternative 3 would cost an estimated $320 million. Long-term maintenance would be required over the next 75 years including repainting structural steel every 20 years, replacement of expansion joints and bearings every 20 years and replacement of the concrete/polymer concrete overlay every 40 years. Estimated long-term maintenance costs under this alternative, in 2019 dollars, would be $60 million.

TABLE 2. SUMMARY OF ACTION ALTERNATIVES

Alternative		1A		1B		2	3
		Method A	Method B	Method A	Method B		
Cost Estimate (Millions)	Initial Construction Cost	$220	$225	$225	$230	$280	$260
	Future Maintenance/ Rehabilitation Cost	$16	$16	$20	$20	$51	$60
	Total Lifecycle Cost	$236	$241	$245	$250	$331	$320
	Total Construction Duration (Days)	700	700	700	700	700	640
Lane Closure Duration (calendar days)	Full Closure	70	0	70	0	80	30
	Three Lane Closure	490	560	490	560	480	570
	Total Traffic Impact Duration	560	560	560	560	560	600
	Pedestrian /Bicycle Width Available During Construction	One 13-foot sidewalk for 490 days	One 13-foot sidewalk for 560 days	One 13-foot sidewalk for 490 days	One 13-foot sidewalk for 560 days	One 13-foot sidewalk for 480 days	One 13-foot sidewalk for 570 days
	New Design Life (Years)	75	75	75	75	75	75
	Maintenance Life Cycle (Years)	20 years- Replace expansion joints and bearings; 40 years- Replace concrete/polymer overlay		20 years- Replace expansion joints and bearings; 40 years- Replace concrete/polymer overlay; 25 years – Repaint structural steel		20 years- Replace expansion joints and bearings; 40 years- Replace concrete/ polymer overlay; 20 years- Repaint structural steel	20 years- Replace expansion joints and bearings; 40 years- Replace concrete/ polymer overlay; 20 years- Repaint structural steel

Temporary Trunnion Shoring

Each leaf of the bascule span consists of two main steel trusses that are supported by an axle, or trunnion, that rests on trunnion posts, which carry the load of the bridge down to the bridge abutments (these elements are shown in Chapter 1, Figure 8). Because the trunnion posts are critical to the structural integrity of the bascule span and due to the continuing deterioration of steel within the trunnion posts, temporary repairs to the posts will be needed by approximately 2017 regardless of which alternative is selected for the proposed action (including the No-Action Alternative). Under this action, Federal Highway Administration would install steel columns on all four sides of each trunnion post to provide additional strength to each trunnion.

Installation of the additional steel beams would extend approximately 6 feet on each side of the trunnion posts and would require removal of a portion of the machine rooms under the bascule span. Depending on design, pilings may need to be placed in the Potomac River to support the bascule span.

Construction Phasing

The main objective of construction phasing is to optimize construction activities while minimizing duration and impacts. The Arlington Memorial Bridge rehabilitation would be phased in order to reduce bridge closure durations and allow for continued traffic flow and sidewalk usage on a limited basis during construction. To reduce construction duration, it is anticipated that crews would work in shifts 24 hours a day, seven days a week. The rehabilitation of the concrete arch spans would most likely progress from the bascule span to the abutments with both sides of the bridge completed concurrently. Furthermore, the replacement or rehabilitation of the bascule span would be conducted concurrently with the concrete arch spans to further reduce construction duration.

Construction Staging

Potential construction staging areas have been identified for all Action Alternatives. One or more of these areas would be used to hold construction equipment, materials, and offices for the duration of the construction period. The staging areas were selected in an effort to protect park resources, to meet the needs of the contractor, and to minimize disruptions to visitor use and experience.

To reduce the area needed for construction staging, barges would be used to deliver materials to the site and to store equipment and materials where practicable. Cranes would also be used from barges directly upstream and downstream of the bridge on the Potomac River to install new bridge deck panels. Therefore, the Potomac River should also be considered an area where active construction would occur and where equipment and materials would be stored throughout the rehabilitation project.

Numerous site constraints and logistical considerations were taken into account when identifying the sites proposed for construction staging. Many of those restraints/considerations are listed below:

1) Approximately 7.5 acres would be needed to accommodate construction equipment and vehicle staging and temporary materials storage. These staging areas would be made up of land-based and in-water staging areas.
2) River crossings downstream from Arlington Memorial Bridge, including the 14th Street Bridge Complex, have a maximum vertical clearance of 18 feet. Large equipment such as cranes and pre-cast structural components needed for the bridge rehabilitation would need to be loaded on barges and delivered to the construction site. The low clearance of downstream river crossings greatly reduces the effectiveness of potential construction staging areas downstream.
3) Water depths surrounding the Arlington Memorial Bridge, particularly near shore, are generally very shallow and are insufficient to provide river access to the bridge without the need for extensive dredging.
4) River access to the bridge from the District-side of the Potomac River would impact the use of West Potomac Park and would impact cherry trees along the river.
5) Commercial vehicles are restricted from using the George Washington Memorial Parkway. Construction staging areas are limited to areas that minimize use of the Parkway.
6) Available area for barges on the Potomac River may be subject to limitations related to navigational needs.

Potential construction staging and materials storage areas being considered for use during the rehabilitation of the Arlington Memorial Bridge are shown on Figure 19. Staging areas would be temporary and would remain in place for the duration of the construction period. Fencing would be installed around all staging areas to protect drivers, bicyclists and pedestrians in the area. When construction activities are complete, staging areas would be restored to their current use.

Figure 19: Proposed construction staging area locations

Land-Based Staging Areas

Four potential land-based staging areas, two on the west side of the bridge and two on the east side of the bridge are considered in this Environmental Assessment. As noted previously, one or more of these staging areas would be used under any of the Action Alternatives.

Construction Staging Area A, Memorial Circle. Staging Area A consists of Memorial Circle at the west end of the Arlington Memorial Bridge (Figure 20). The area is currently a grass-covered circle with low curbs separating it from the vehicular and bicycle travel lanes. The Circle is approximately 1.6 acres. Under Staging Area A, the grass-covered circle would be fenced and used for the storage of construction materials and equipment for the duration of the Memorial Bridge rehabilitation, up to 700 days.

Figure 20: Construction Staging Area A

Construction Staging Area B, South Of Memorial Circle. Staging Area B consists of approximately 2.4 acres of land on Columbia Island between Washington Boulevard and South Washington Boulevard (Figure 21). Under Staging Area B, the grass-covered area would be fenced and used for the storage of construction materials and equipment for the duration of the Memorial Bridge rehabilitation, up to 700 days.

Figure 21: Construction Staging Area B

Construction Staging Area C, North of Lincoln Memorial. Staging Area C consists of a grass-covered area north of the Lincoln Memorial between the Rock Creek and Potomac Parkway and 23rd Street, SW (Figure 22). The area is approximately 2.7 acres. Under Staging Area C, the grass-covered area would be fenced and used for the storage of construction materials and equipment for the duration of the Memorial Bridge rehabilitation, up to 700 days.

Figure 22: Construction Staging Area C

Construction Staging Area D, Watergate Steps. Staging area D consists of the grassed area at the top of the Watergate steps (Figure 23). The area is approximately 1.3 acres. The area would be fenced and used for storage of construction materials and equipment for the duration of the memorial bridge rehabilitation, up to 700 days.

Figure 23: Construction Staging Area D

Off-Site Staging Areas. Off-site staging, particularly outside of NPS jurisdiction, may also be used, but would be the responsibility of the contractor.

River-Based Staging Areas

Access to the bridge via the Potomac River would be necessary to remove sections of the bascule span and other debris from the site, assist with falsework installation, assist with cofferdam installation and dewatering activities, deliver and install precast concrete bridge deck sections, and various other construction-related activities. Options considered in this Environmental Assessment for providing river access to the bridge include construction of causeways or dock/work platforms from the east and west shore of the Potomac River into the river and the use of barge staging areas. One or more of these options would be used under each of the Action Alternatives.

The use of river-based staging would reduce the area needed on land for construction staging and would also improve the efficiency of construction. Each river-based staging area would be located near shore so equipment and materials could be moved from shore to the river for use at the site.

Construction Causeway. Under this option, up to four temporary causeways would be constructed from the east and west shores of the Potomac River. The causeways would extend between 250 and 750 feet into the river parallel to the north and south sides of the bridge. A filter fabric would be laid on the bottom of the river and the causeway built on top of the fabric. Appropriately sized pipes would be placed through the causeway to allow the river to continue to flow through the area. When construction activities are complete, the causeways would be removed and the river bottom restored to its current condition. Figure 24 provides an example of a temporary construction causeway.

Figure 24: Example of Temporary Construction Causeway

Construction Dock/Work Platform. Under this option, up to four temporary docks would be constructed from the east and west shores of the Potomac River to be used as work platforms. The docks would be built on temporary pilings and would extend approximately 250 to 750 feet into the river parallel to the north and south sides of the bridge. When construction activities are complete, the dock/work platforms would be removed and the river bottom restored to its current condition. Figure 25 provides an example of a temporary dock/work platform.

Figure 25: Example of a Dock/Work Platform

Barge Staging Area 1. Barge Staging Area 1 would be used under all of the Action Alternatives and is located downstream from the bridge along the west bank of the Potomac River and the George Washington Memorial Parkway (Figure 26). Approximately 225,000 square feet (5.2 acres) of area would be needed to accommodate the barges that would access this staging area location. Barges would be held in place at the barge staging areas with the use of spud anchors. Pilings may need to be placed in the river to anchor a temporary platform to access the barges from land.

Figure 26: View of Barge Staging Area 1 (Looking south from the Arlington Memorial Bridge)

Due to the shallow depths of the Potomac River within the barge staging area access route, dredging of river sediment would be necessary. To access and store barges in Barge Staging Area 1, approximately 10,000 cubic yards of dredge material over an 11.2-acre area would need to be removed from the Potomac River to a depth of approximately 15 feet. Dredging activities would avoid areas where underwater cables are located. In addition, dredging activities would avoid the area marked on navigation maps as a potential wreck. Dredge material would be tested for contaminants and properly disposed of at an appropriate location determined by the contractor and with the approval of the Federal Highway Administration.

The barge staging area may be accessed via the Potomac River or from the George Washington Memorial Parkway. If access from the Parkway is required, a temporary access road would need to be constructed from the Parkway, across the Mount Vernon Trail, to the barges.

Barge Staging Area 2. Barge Staging Area 2 would be used under Alternative 1A – Construction Method B and Alternative 1B – Construction Method B and is located upstream from the bridge, also along the west bank of the Potomac River (Figure 27). Approximately 100,000 square feet (2.3 acres) of area would be needed to accommodate the barges that would access Barge Staging Area 2. As with Barge Staging Area 1, barges

Figure 27: View of Barge Staging Area 2 (Looking north from the Arlington Memorial Bridge)

would be held in place at the barge staging areas with the use of spud anchors. Pilings may need to be placed in the river to anchor a temporary platform to access the barges from land.

Due to the shallow depths of the Potomac River within the barge staging area access routes, dredging of river sediment would be necessary. To access and store barges in Barge Staging Area 2, approximately 80,000 cubic yards of dredge material over a 6.2-acre area would need to be removed from the Potomac River to a depth of approximately 15 feet. Dredging activities would avoid areas where underwater cables are located. Dredge material would be tested for contaminants and properly disposed of at an appropriate location determined by the contractor and with the approval of the Federal Highway Administration.

The barge staging area may be accessed via the Potomac River or from the George Washington Memorial Parkway. If access from the Parkway is required, a temporary access road would need to be constructed from the Parkway, across the Mount Vernon Trail, to the barges.

MITIGATION MEASURES OF THE ACTION ALTERNATIVES

The National Park Service places a strong emphasis on avoiding, minimizing, and mitigating potentially adverse environmental impacts. To help ensure the protection of natural and cultural resources and the quality of the visitor experience, the following protective measures would be implemented as part of the selected Action Alternative. The National Park Service would implement an appropriate level of monitoring throughout the construction process to help ensure that protective measures are being properly implemented and are achieving their intended results.

Water Quality

Various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams. Erosion and sediment control measures would be put in place at the land-based staging areas to minimize runoff of sediments from the site into the Potomac River.

Riverine

Erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams.

Mitigation would be undertaken for impacts to submerged aquatic vegetation and to unconsolidated bottom wetlands. Mitigation for temporary impacts to unconsolidated bottom wetland areas will include restoration of the river bottom to existing elevations. Mitigation measures for temporary impacts to submerged aquatic vegetation will include restoration of the areas to pre-construction elevations and re-establishing submerged aquatic vegetation in the areas previously colonized. In

addition, compensatory mitigation will be undertaken for impacts to submerged aquatic vegetation at a 2:1 ratio for all temporary and permanent impacts. The preferred alternative requires compensatory mitigation for 1.4 acres of temporary impacts and 6.0 acres of permanent impacts within the causeway/platform areas, Barge Staging Areas 1 and 2, and associated dredging area.

Wildlife including Rare, Threatened, and Endangered Species

Construction fencing would be used to separate wildlife from construction zones and staging areas. Best management practices such as turbidity curtains and cofferdams can act as exclusionary devices to reduce the direct effects of the construction on fish. This includes the sound attenuation provided by cofferdams thereby reducing the decibels associated with the piling installation within the water column. In-water work would not occur between February 15th and July 1st when the Atlantic and shortnose sturgeon and other anadromous fish are in the area.

Historic Structures and Districts/Cultural Landscapes

Repairs and rehabilitation would be done in accordance with Secretary of the Interior's Standards for Rehabilitation (codified as 36 CFR 67). The machine rooms may be rehabilitated to fix the damage caused by the temporary trunion repairs. The guard's cabin, the overseer's cabin, and the machinery rooms may be mothballed or be rehabilitated as mitigation for project impacts.

Visitor Use and Experience

Maintenance of traffic plans would be instituted to provide a safe working environment for construction workers and safe passage for motorists during construction. Signage and fencing would be used to keep passersby out of construction areas; appropriate distances would be maintained between construction workers and vehicle traffic; and lighting would be used on equipment, barges, and falsework. Notices of construction would be provided to boaters, and they would be rerouted through an adjacent bridge span, maintaining a safe distance from construction areas.

Transportation

Maintenance of traffic plans would be instituted to provide a safe working environment for construction workers and safe passage for motorists during construction. Signage and fencing would be used to keep passersby out of construction areas, and appropriate distances would be maintained between construction workers and vehicle traffic. Detours and notifications to drivers would be coordinated with local agencies including the District Department of Transportation, Arlington County, and the Virginia Department of Transportation, and the Washington Metropolitan Area Transit Authority.

Notices of construction would be provided to boaters, and they would be rerouted through an adjacent bridge span, maintaining a safe distance from construction areas, and lighting would be used on equipment, barges, and falsework.

Navigation

Currently, a federal navigation channel is directed under the bascule span of the Arlington Memorial Bridge. During the time that the falsework (temporary support structures) is in place, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the falsework has been removed. The temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. An update would be posted to the USCG District 5's Local Notice to Mariners to advise mariners of the change to the navigation channel and to any hazards associated with the bridge construction. Notices would also be provided to marinas and local rowing organizations on the Potomac River and Anacostia River within the District of Columbia. In addition, construction activities would be coordinated with the US Army Corps of Engineers in accordance with Section 10 of the Rivers and Harbors Act of 1899.

ALTERNATIVES CONSIDERED BUT DISMISSED

Several alternatives or alternative elements were identified during the design process and internal, public, and agency scoping. Some of these were determined to be unreasonable, or much less desirable than similar options included in the analysis, and were therefore not carried forward for analysis in this Environmental Assessment. Justification for eliminating alternatives from further analysis was based on factors relating to:

1) Unnecessary impacts to environmental or historic resources;
2) Unreasonably high costs as compared to other alternatives;
3) Use of outdated and prohibitively costly construction methods and materials; and
4) Complexity that significantly increases construction duration.

Replace the Existing Bascule Span with a New Concrete Arch Span to Match the Existing Concrete Spans. Under this alternative, the existing bascule span would be replaced with a fixed concrete arch span to match the existing concrete arch spans (Figure 28 and Figure 29). This alternative was dismissed from further development for several reasons. In November 2014, the National Park Service contracted Quinn Evans Architects to conduct a Historic Preservation Study to evaluate each alternative proposed for analysis in this Environmental Assessment. The purpose of the Historic Preservation Study was to determine the potential effects that each alternative may have on character-defining features that make the Arlington Memorial Bridge historically significant. An assessment of each alternative's effect on the historic integrity of the Arlington Memorial Bridge was conducted. The results of the assessment for this particular alternative are as follows, taken directly from the Historic Preservation Study:

> "Of all of the alternatives under consideration, [the concrete arch alternative] requires the most change and removes the greatest amount of historic fabric. From a cultural resource protection perspective, [the concrete arch alternative] should be viewed as the least desirable not only because of the amount of loss of original materials but because this alternative would create an appearance that never existed. Retaining the original cast aluminum fascia should be viewed as critical to the preservation of the original design, which includes a different exterior appearance in the center span where the original bascule span is located. Tempting as it might be to "complete" the bridge with another fixed concrete arch span clad with granite to match the other eight spans, this approach would create a false appearance and would severely compromise the historic design. Not only would the exterior faces of the span be changed, but the underside of the span would lose its association with the engineering features that made the opening of the span possible" (Quinn Evans Architects 2014).

In addition to the effects this particular alternative would have on the historic integrity of the bridge, another reason for its dismissal was the duration of the full closure period needed to remove the existing bascule span and construct a new fixed concrete arch span. The Federal Highway Administration estimated that a full closure of the bridge and all vehicular travel lanes would be required for up to 120 consecutive days. During the full closure period, no vehicular traffic, pedestrians, or bicyclists would be allowed on the bridge. It was also estimated that no pedestrian access would be available on the bridge for approximately 416 days during the total construction duration of 693 days. The duration of the full closure period and restricted pedestrian access were the highest among all alternatives.

Figure 28: Conceptual rendering of the concrete arch replacement structure proposed under a dismissed alternative

Cost estimates for this alternative were comparable to other alternatives evaluated. Rehabilitation of the Arlington Memorial Bridge under this alternative would cost an estimated $202 to $254 million.

Provide a Temporary Bridge During Construction. Under this alternative, a temporary bridge would be constructed adjacent to the Arlington Memorial Bridge. The temporary bridge would allow traffic to be maintained throughout the duration of construction. This alternative was dismissed from further development by the Federal Highway Administration due to unnecessary impacts to the Potomac River that would result from the construction of the temporary bridge and because of the substantial cost of constructing the temporary bridge when combined with the cost of repairing/rehabilitating the Arlington Memorial Bridge.

Remove Arlington Memorial Bridge and Construct a New Bridge. Under this alternative, the Federal Highway Administration would completely remove the Arlington Memorial Bridge and replace it with a new, modern structure. This alternative was dismissed from further consideration by the Federal Highway Administration due to the potential to conflict with NPS historic preservation policy and because of the substantial cost associated with the bridge's removal and construction of a new structure.

Replace the Existing Bascule Span with a New Bascule Span of Identical Construction. Under this alternative, the existing bascule span would be replaced with a bascule span of identical construction. This alternative was dismissed from further development because the techniques used to construct the existing bascule span are not routinely used today. For instance, the steel members of the existing bascule span are riveted together, which was a common construction method in the 1920s. This is not a common practice today as other methods such as welding or bolting are now the most common methods. Designing and constructing an identical structure would therefore likely come at a prohibitive cost. In addition, a functioning bascule span may no longer be needed due to other navigational restrictions along the Potomac River.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The National Park Service is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. The National Park Service, in accordance with the Department of the Interior policies contained in the Departmental Manual (516 DM 4.10) and CEQ's *NEPA's Forty Most Asked Questions*, defines the environmentally preferable alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in the National Environmental Policy Act (Section 101(b) (516 DM 4.10). In their *Forty Most Asked Questions*, the Council on Environmental Quality further clarifies the identification of the environmentally preferable alternative, stating: "Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources."

Based on the analysis described in the environmental consequences chapter of this Environmental Assessment, the National Park Service has determined that Alternative 3 is the environmentally preferable alternative because, while it does result in short-term adverse impact to environmental resources, it minimizes long-term impacts while protecting a cultural resource of national importance.

When compared to the No-Action Alternative and Alternative 1A, 1B, and 2, Alternative 3 best meets national environmental policy as expressed in the National Environmental Policy Act, Section 101 for the reasons described above; thus, Alternative 3 is the environmentally preferable alternative.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

After careful consideration, the National Park Service has identified Alternative 1B as the preferred alternative for the following reasons:

- The initial construction costs investment of Alternative 1B is $30-35 million dollars less than the rehabilitation of the existing bascule span (Alternative 3).
- Operation and maintenance costs over the life span of the bridge are $40 million less than if the existing bascule span is retained (Alternative 3).
- Alternative 1B would require painting every 25 years; however, painting the variable depth steel girders would require significantly less effort than painting the existing bridge's truss system.
- There is also substantial risk that if the existing bascule span is retained under Alternative 3, deferred or inadequate maintenance of the existing bascule span in the future could lead to further deterioration of the bridge components and the need for additional replacement of portions or the entire bascule span in the future.
- Alternative 1B provides for some opportunities for cultural resource preservation. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place, and the bascule span abutments would remain as part of the new design.
- Historic views, significant visitor experience and continued ceremonial uses would be maintained under Alternative 1B. Only the limited views and visitor experience from beneath the bridge would be diminished.
- Opportunities exist to provide an alternative interpretive experience for the structure and engineering of the original bridge.

HOW THE ALTERNATIVES MEET THE OBJECTIVES

The project objectives as described in Chapter 1 must be achieved to a large degree for the action to be considered a success. The alternatives considered in detail need to meet the project's purpose of and need for the action as well as meet the project objectives either partially or fully. This information in combination with the assessment of resource impacts is used by the National Park Service in its selection of a Preferred Alternative. A summary of the effects of the alternatives towards the project objectives can be found in Table 3 below.

TABLE 3. HOW THE ALTERNATIVES MEET THE PROJECT OBJECTIVES

Objective	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3
Address the structural deterioration of the bridge while preserving the Memorial's historic integrity to the extent feasible.	Does not address the long-term rehabilitation needs. Retains the bridge's historic integrity.	Full rehabilitation addresses the structural deterioration. Replacement of bascule span has adverse impact on the Memorial's historic integrity.			Full rehabilitation addresses the structural deterioration. Rehabilitation of bascule span preserves the Memorial's historic integrity.
Minimize extent and duration of full bridge and/or partial lane closures and overall disruption to traffic during construction.	Intermittent road closures required for emergency repairs. May necessitate further weight restrictions or full closure if the bridge continues to deteriorate.	May require full bridge closure for up to 70 days and partial bridge closure for an additional 490 days.		Requires full bridge closure for up to 80 days and partial bridge closure for an additional 480 days.	Requires full bridge closure for up to 30 days and partial bridge closure for an additional 570 days.
Avoid disruptions to utilities during construction.	Avoids disruption of utilities.				

Objective	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3
Minimize future maintenance requirements and associated costs.	May require emergency repairs throughout the lifespan of the bridge.	Future maintenance includes replacement of expansion joints and bearings every 20 years and replacement of concrete/polymer overlay every 40 years. Lifecycle maintenance costs: $30 million.	Future maintenance includes replacement of expansion joints and bearings every 20 years; replacement of concrete/polymer overlay every 40 years, and painting/rehabilitation of structural steel every 25 years. Lifecycle maintenance costs: $40 million.	Future maintenance includes replacement of expansion joints and bearings every 20 years; replacement of concrete/polymer overlay every 40 years; and painting of structural steel every 20 years. Lifecycle maintenance costs: $50 million.	Future maintenance includes replacement of expansion joints and bearings every 20 years; replacement of concrete/polymer overlay every 40 years; and painting/rehabilitation of structural steel every 20 years. Lifecycle maintenance costs: $60 million.

SUMMARY OF IMPACTS

A summary of the environmental consequences of each alternative and option is presented in Table 4.

TABLE 4. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Water Quality	There would be short- term negligible adverse impacts to water quality under the No-Action Alternative from emergency bridge repairs. The No-Action Alternative would contribute a minor amount to the adverse cumulative impacts of past, present, and future projects in the vicinity of the Arlington Memorial Bridge.	The Action Alternative would result in short-term minor adverse impacts to water. The Action Alternative would result in long-term beneficial impacts from the removal of the lead paint source. The Action Alternative would add a minor amount to short-term cumulative adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.				Temporary shoring of the trunnion post may result in short-term minor adverse impacts to water quality. Activities associated with the trunnion post shoring project would contribute negligibly to overall short-term adverse cumulative impacts to water quality and would not contribute to the long-term beneficial cumulative impacts to water quality.	Use of the land staging areas would result in short-term negligible impacts to water quality. The use of Barge Staging Areas 1 and 2 and the associated dredge activities would result in short-term minor adverse impacts to water quality. There would be no long-term impacts from the use of the barge staging areas. The use of Barge Staging Areas 1 and 2 and associated dredge activities would add a moderate amount to the short-term adverse cumulative impacts to water quality. The use of the staging areas would not contribute to long-term cumulative impacts.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Riverine	The No-Action Alternative could have short-term minor adverse impacts to riverine habitat from emergency repairs on the bridge piers. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of past, present, and future projects in the area.	The Action Alternatives would result in short-term minor adverse impacts to riverine deep-water habitat. The Action Alternatives would result in short-term minor adverse impacts to the riverine habitat from work on the bridge piers. Once construction is complete, riverine habitats would be restored within the project area. Therefore, there would be no long-term impacts. The Action Alternatives would contribute a minor amount to the adverse cumulative impacts on riverine habitat of past, present, and future projects in the area.				Temporary trunnion post shoring may result in short-term negligible impacts to the riverine habitat should pilings be installed. All impacts to the riverine system would be related to construction activities; therefore there would be no long-term impacts to the riverine habitat. Trunnion post shoring could add negligibly to overall adverse cumulative impacts.	Use of the land staging areas would result in short-term negligible adverse impacts to riverine habitats. Use of the barge staging areas would have a range of short-term impacts from minor to moderate. Barge Staging Area 1 would result in minor long-term impacts. Barge Staging Area 2 would result in moderate long-term impacts to riverine habitat. The use of land staging areas would not contribute to cumulative adverse impacts. Use of Barge Staging Area 1 and Barge Staging Area 2 and associated dredge activities would add a moderate amount to adverse cumulative impacts.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Wildlife including Rare, Threatened, and Endangered Species	The No-Action Alternative could result in short-term minor adverse impacts to wildlife from emergency repairs to the bridge piers. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of past, present, and future projects on wildlife.	Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, the Action Alternatives would result in short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected under the Action Alternative. When added to the short-term minor impacts of the Action Alternatives, the cumulative adverse impact would be short-term and minor.				Temporary trunnion post shoring would result in short-term negligible adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. When added to the short-term negligible impacts of the trunnion post shoring, the cumulative adverse impact would be short-term and minor.	Use of the land staging areas would result in negligible short-term impacts to wildlife. Use of the barge staging areas would have short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. Use of the land staging areas would add a negligible amount to the adverse cumulative impacts of past, present, and future projects on terrestrial wildlife. Use of the barge staging areas and associated dredge activities would add a moderate amount to the adverse cumulative impacts to riverine habitat and wildlife.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Cultural Resources	Under the No-Action Alternative, existing damage present on the bridge, the continued deterioration of the Arlington Memorial Bridge, stopgap repairs, and major emergency repairs would affect the character defining features of the bridge and would result in a long-term moderate adverse impact to the historic structure. If major emergency repairs consist of extensive shoring or falsework to support the bridge, they may be visible from other resources resulting in short-term minor adverse impacts to the views from these historic resources. The No-Action Alternative would contribute a minor amount to the adverse cumulative impacts to cultural resources.	Construction activities under Alternatives 1A, 1B, and 2 would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect. Repairs to the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge. The replacement of the center bascule span with a concrete box girder span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge. If Alternative 1A, 1B, or 2 are under construction at the same time as other projects in the area, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources. Alternative 1A, 1B, or 2 would contribute a moderate amount to the long-term cumulative impacts to permanent changes to cultural resources from other past, present, and future projects.			Bridge closures would result in a short-term moderate adverse impact to the historic circulation features. Construction activities would result in short-term moderate adverse impacts to the views and vistas of other cultural resources. Repairs bridge features would result in short-term minor adverse and long-term beneficial impacts. Construction would add a moderate amount to short-term and long-term cumulative impacts.	Construction activities associated with the temporary trunnion post shoring would have short-term minor and adverse on the views of the Arlington Memorial Bridge. Repair of the trunnion posts would require the permanent removal of historic features that would affect the integrity of the historic resource and result in long-term moderate adverse impacts to cultural resources. The trunnion post shoring would contribute a minor amount to the long-term cumulative impacts to cultural resources of other past, present, and future projects.	Use of the proposed staging areas would have short-term minor to moderate adverse impacts on historic resources and viewsheds. If the repair and rehabilitation of the Arlington Memorial Bridge is under construction at the same time as any of these projects, use of the proposed land-based and barge staging areas would add a minor amount to the short-term adverse cumulative impacts to cultural resources. Use of the staging areas would not contribute to long-term cumulative impacts.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Visitor Use and Experience	Access to the bridge would be restricted during emergency repairs causing short-term minor adverse impacts to visitor use. Long-term minor to moderate adverse impacts would occur from imposing weight restrictions and/or closing the bridge and from the use of pedestrian ramps to provide safe crossing. The No-Action Alternative would slightly contribute to the short-term adverse cumulative impacts and would slightly lessen the overall long-term beneficial cumulative impacts of past, present, and future impacts on visitor use and experience.	Under Alternative 1A, 1B, and 2, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters. There would be long-term beneficial impacts to visitor use and experience. Once construction is complete, the view of the new precast concrete box girder span from the underside of the bridge would be different than existing conditions, which would in turn affect the visitor experience of the boating community resulting in long-term moderate adverse impacts. Construction activities under Alternative 1A, 1B, and 2 would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience. The overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.			Under Alternative 3, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters. There would be long-term beneficial impacts. Construction activities under Alternative 3 would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience.	The construction activities and reduction in access and capacity that would occur with the temporary trunnion post shoring would result in short-term moderate adverse impacts to visitor use and experience. If pilings are required in the Potomac River for the trunnion post shoring, there would be a short-term negligible adverse impact to boaters. This action would contribute a negligible amount to the adverse cumulative impacts. The overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.	Use of the land staging areas would result in short-term negligible to minor adverse impacts associated with maneuvering around staging areas and changes in views. Use of the staging areas would contribute a minor amount to these short-term adverse cumulative impacts of past, present, and future projects in the area. There would be no long-term impacts.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Transportation	Weight restrictions that would be implemented under the No-Action Alternative would result in long-term minor adverse impacts to traffic and transportation. Lane closures for emergency repairs would result in short-term minor adverse impacts to traffic and transportation. If emergency repairs are needed on the Arlington Memorial Bridge at the same time other projects in the area are under construction, the No-Action Alternative would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. The No-Action Alternative would not contribute to long-term beneficial cumulative impacts.	Travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. Sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists. Once construction is completed, rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years which would result in a long-term beneficial impact to traffic and transportation. If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, the Action Alternatives would contribute a moderate amount to the adverse cumulative impacts to traffic and transportation. The Action Alternatives would contribute a minor amount to long-term beneficial cumulative impacts to traffic and transportation.				Due to temporary lane closures, temporary trunnion post shoring would have a short-term minor adverse impact on traffic and transportation. If trunnion post shoring on the Arlington Memorial Bridge occurs at the same time other projects in the area are under construction, the repairs would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. The trunnion post shoring on the Arlington Memorial Bridge would contribute a minor amount to long-term beneficial cumulative impacts.	Use of the land and barge staging areas would have short-term minor adverse impacts to traffic and transportation from construction vehicles entering and exiting the sites. Use of the land and barge staging areas for the Arlington Memorial Bridge, if at the same time as other projects in the area, would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. Use of the land and barge staging areas for the Arlington Memorial Bridge project would not contribute to long-term beneficial cumulative impacts.

Impacted Resource	No-Action Alternative	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3	Trunnion shoring	Staging Areas
Navigation	Under the No-Action Alternative in-water construction activities would have a short-term negligible adverse impact to navigation. Emergency repairs to the Arlington Memorial Bridge under the No Action Alterative would contribute a negligible amount to the short-term adverse cumulative impacts to navigation. The No-Action Alternative would not contribute to long-term cumulative impacts.	Temporary relocation of the navigation channel would result in short-term minor adverse impacts. The replacement/rehabilitation of the bascule span with a fixed span would not result in long-term adverse impacts to navigation. If construction were under construction at the same time as other projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. The Action Alternatives would not contribute to long-term cumulative impacts.				Temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation. No long-term impacts to navigation would occur. Repairs to the trunnions, if under construction at the same time as other projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Trunnion shoring would not contribute to long-term cumulative impacts to navigation.	Both barge staging areas would result in short-term minor adverse impacts to navigation as boaters would have to maneuver around the barges as they travel on the river. Use of the barge staging areas, if at the same time as other projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Use of the barge staging areas for the Arlington Memorial Bridge would not contribute to long-term cumulative impacts to navigation.

This page intentionally left blank.

CHAPTER 3: AFFECTED ENVIRONMENT

This "Affected Environment" chapter of the Environmental Assessment describes environmental conditions in the project area. These conditions serve as a baseline for understanding the resources that could be impacted by implementation of the proposed action. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in "Chapter 4: Environmental Consequences."

WATER QUALITY

The Arlington Memorial Bridge spans the Potomac River approximately 113 miles from its confluence with the Chesapeake Bay. The river forms in Fairfax Stone, West Virginia and runs for over 383 miles to Point Lookout, Maryland. Five geological provinces are crossed by the river: the Appalachian Plateau, the Ridge and Valley, the Blue Ridge, the Piedmont Plateau, and the Coastal Plain. Within the Coastal Plain, the Potomac River is influenced by the tides of the Chesapeake (ICPRB 2012).

The Potomac River watershed encompasses 14,670 square miles in four states and the District of Columbia. Approximately 6.11 million people populate the watershed. As a result, water quality of the Potomac River is affected by a variety of human processes. Major land uses in the Potomac River watershed include agriculture, forestry, coal mining, chemical production, military and urban land use. The Potomac River functions as a water supply source for Washington, DC, as well as a discharge point for regional wastewater treatment facilities (ICPRB 2012).

The Potomac River is a traditional navigable waterway and is, by definition, protected by the Clean Water Act. Section 303(d) of the Clean Water Act and regulations developed by the Environmental Protection Agency require states and the District to prepare a list of waterbodies or waterbody segments that do not meet water quality standards. The Section 303(d) list of impaired waters in the District of Columbia includes the Potomac River. For listed waters, the District is required to develop Total Maximum Daily Loads (TMDLs). Total Maximum Daily Loads specify the maximum amount of a pollutant that a water body can receive while still meeting water quality standards. Pollutant constituents of the Potomac River with TMDL status include organics, metals, fecal coliform bacteria, and Polychlorinated Biphenyls (USEPA 2013).

In the District of Columbia, 32.1 miles out of the 45 miles of Potomac River watershed streams and rivers were assessed for water quality as part of the 2002 National Water Quality Inventory. Of the streams and rivers assessed in the watershed, 100 percent were found to be impaired (Potomac Conservancy 2013).

In addition to pollutants of the Potomac River with TMDL status, excess sediment is a pollutant of concern. Sources of excessive sediments include eroded land and stream banks within the watershed. Erosion hazard increases where vegetation is cleared for agriculture and development. Excess sediments cause poor water quality conditions by burying bottom dwelling plants and

animals, preventing underwater grass growth, transporting nutrients and pathogens, and elevating water temperature (USGS 2005). In order to limit the transport of sediments to open waters, the District requires approval of an erosion and sediment control plan for all projects requiring 50 square feet or more of land disturbance (DCMR Title 21, Chapter 5).

RIVERINE

Riverine is a type of wetland system and refers to wetlands and deepwater habitats contained within a channel. Wetlands are generally described as areas of transition between terrestrial and aquatic systems. Within wetlands, the water table persists at or near the ground surface, or the land is covered by shallow waters (Cowardin, et. al 1979). Actions that may reduce or degrade wetlands are governed by Section 404 of the Clean Water Act and Section 10 of the Rivers and the Harbors Act. At the federal level, the US Army Corps of Engineers regulates activities in navigable waters of the United States, which includes jurisdictional wetlands. *Executive Order 11990* directs federal agencies to avoid development within wetlands where practical alternatives exist. In addition, NPS *Director's Order 77-1* establishes a "no net loss of wetlands" policy. Per Director's Order 77-1, where impacts to wetlands cannot be avoided, development plans must include compensatory mitigation to restore wetlands.

Wetlands are mapped by the US Fish and Wildlife Service in order to aid wetland conservation efforts. To classify wetlands the National Park Service uses the system established by Cowardin et al. in *The Classification of Wetlands and Deepwater Habitats of the United States* (1979). Based on a review of geospatial data developed by the National Wetlands Inventory, wetlands are located in the vicinity of the Arlington Memorial Bridge (Figure 30). Under the Cowardin system, the Potomac River is considered a riverine wetland, specifically Riverine Tidal Unconsolidated Bottom vegetated (R1UBV). The riverine system includes both wetland and deepwater habitat. The boundary between wetland and deepwater habitat in the Riverine Systems lies at a depth of 6.6 feet below low water (USFWS 2015).

Deepwater and wetland habitats occur within the mile radius around the Arlington Memorial Bridge. By definition, the wetland habitat is located along both the eastern and western shoreline in areas less than 6.6 feet in depth. Within the wetland habitat, the Potomac River contains soft bottom habitat and submerged aquatic vegetation.

Soft sediment habitat is typically the most common habitat type in bays and estuaries. Soft bottom habitats include environments where the bottom consists of fine grain sediments, sand and mud. Their biodiversity and productivity vary depending upon depth, light exposure, temperature, sediment grain size and abundance of microalgae and bacteria (Ocean Health Index 2015). This habitat typically supports high densities of clams, worms, crustaceans, and other benthic invertebrates. Benthic microalgae are also present in this habitat when shallow enough that light can penetrate to the bottom (VIMS 2015). The organisms that dwell in this habitat are important to the overall food chain and diversity of the system.

Along the western shoreline of the river there is an established submerged aquatic vegetation bed (Figure 31). The extent of this bed has been mapped by the Virginia Institute of Marine Science (VIMS) most recently in 2014. During a previous survey in 2013 the bed was characterized as having 70 to 100% coverage. According to the Department of Natural Resources Hydrilla, coontail and watermilfoil were the most frequently reported of the eight common species found during ground-truthing by citizens and the US Geological Survey (MDDNR 2015). Submerged aquatic vegetation provides a series of functions including habitat sediment stability and nutrient buffering. Submerged aquatic vegetation beds provide habitat for a number of species, investigators at the Virginia Institute of Marine Science found up to 33,000 animals among submerged aquatic vegetation beds in the lower Chesapeake Bay. The structure is most often used for shelter, breeding and feeding activities. Submerged aquatic vegetation beds also reduce current and wave action thereby reducing the velocity of the water. This action decreases the amount of turbidity in the water column and can benefit the animals in the area as well the submerged aquatic vegetation itself. Lastly, submerged aquatic plants utilize dissolved nitrogen and phosphorus in the water for their growth thereby reducing nutrients which has led to a bay-wide impairment.

WILDLIFE INCLUDING RARE, THREATENED, AND ENDANGERED SPECIES

Primarily, wildlife habitat in the project area is provided by the Potomac River. At the Arlington Memorial Bridge, the Potomac River consists of a deep freshwater channel with shallow flanks and embayments. Spawning activities of several anadromous fish species including white perch (*Morone americana*), and herring (*Alosa spp.*) have been documented in the vicinity of the bridge. Historical records also indicate the presence of yellow perch (*Perca flavescens*) in the area. Additional resident populations include gamefish such as largemouth bass (*Micropterus salmoides*), sunfish (*Lepomis spp.*), and catfish (*Ictaluridae spp.*)(FHWA-EFL 2012).

At the east and west approaches of the Arlington Memorial Bridge, the land is densely developed with roads. Outside of the roads, lands are maintained as open space. Due to disturbances brought about by roads and open space maintenance, suitable habitat for wildlife in these areas is limited. Birds and small mammals are likely to pass through the areas, but disturbances are too frequent to provide sites for nesting or foraging. More favorable habitats for terrestrial species are located upstream from the bridge at Theodore Roosevelt Island. Songbirds such as warblers are known to use the island during migratory periods, as well as heron, osprey and terns (TNC 2013).

Coordination with federal and state agencies was conducted to investigate the presence of rare, threatened and endangered species in the vicinity of the project area. Details of agency coordination efforts are provided in Chapter 5 of this Environmental Assessment. Based on consultation with the agencies, suitable habitat for two federally listed fish species can be found in the vicinity of the Arlington Memorial Bridge. Descriptions of the two listed species are provided as follows.

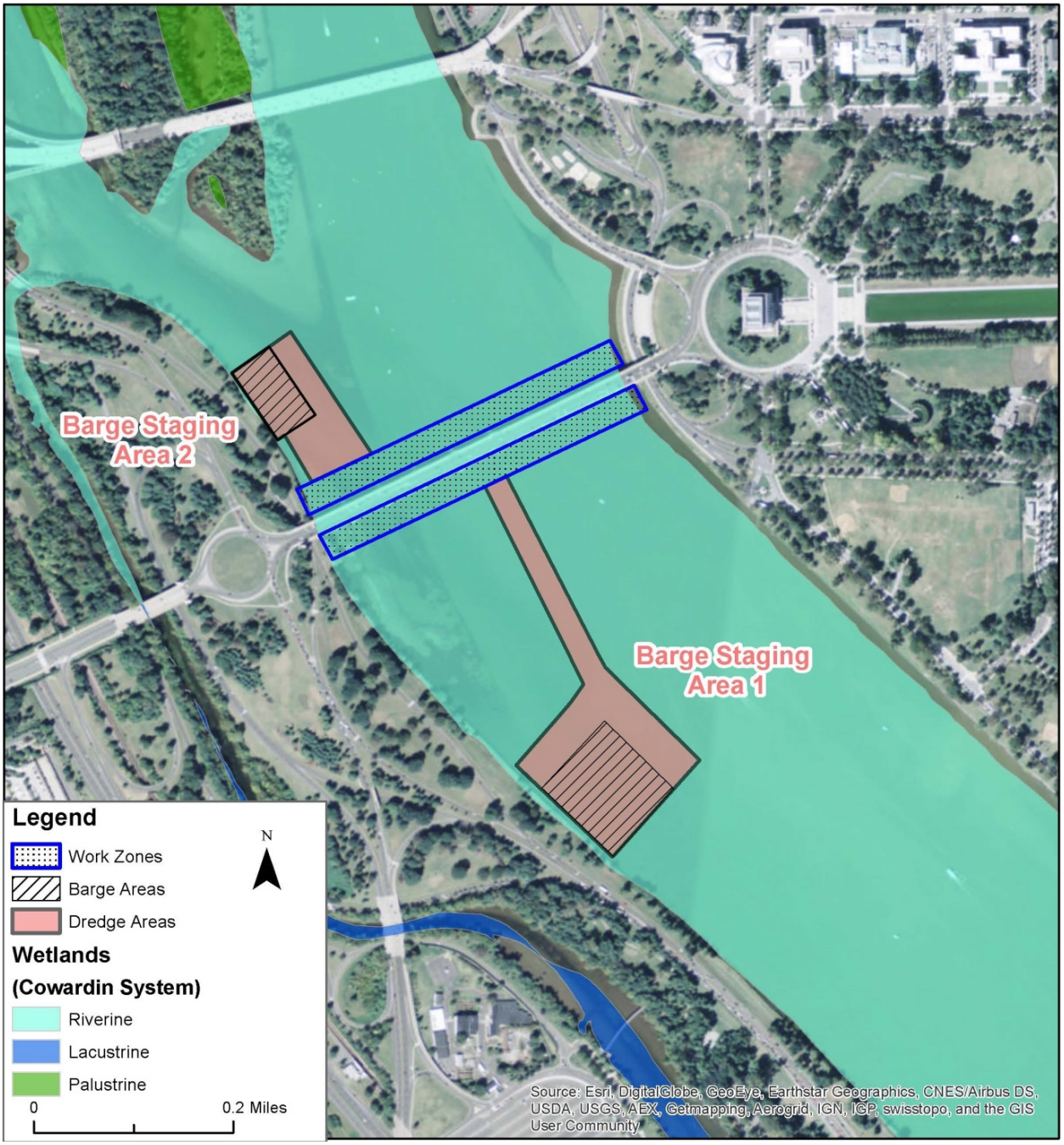


Figure 30: Wetlands near the Arlington Memorial Bridge

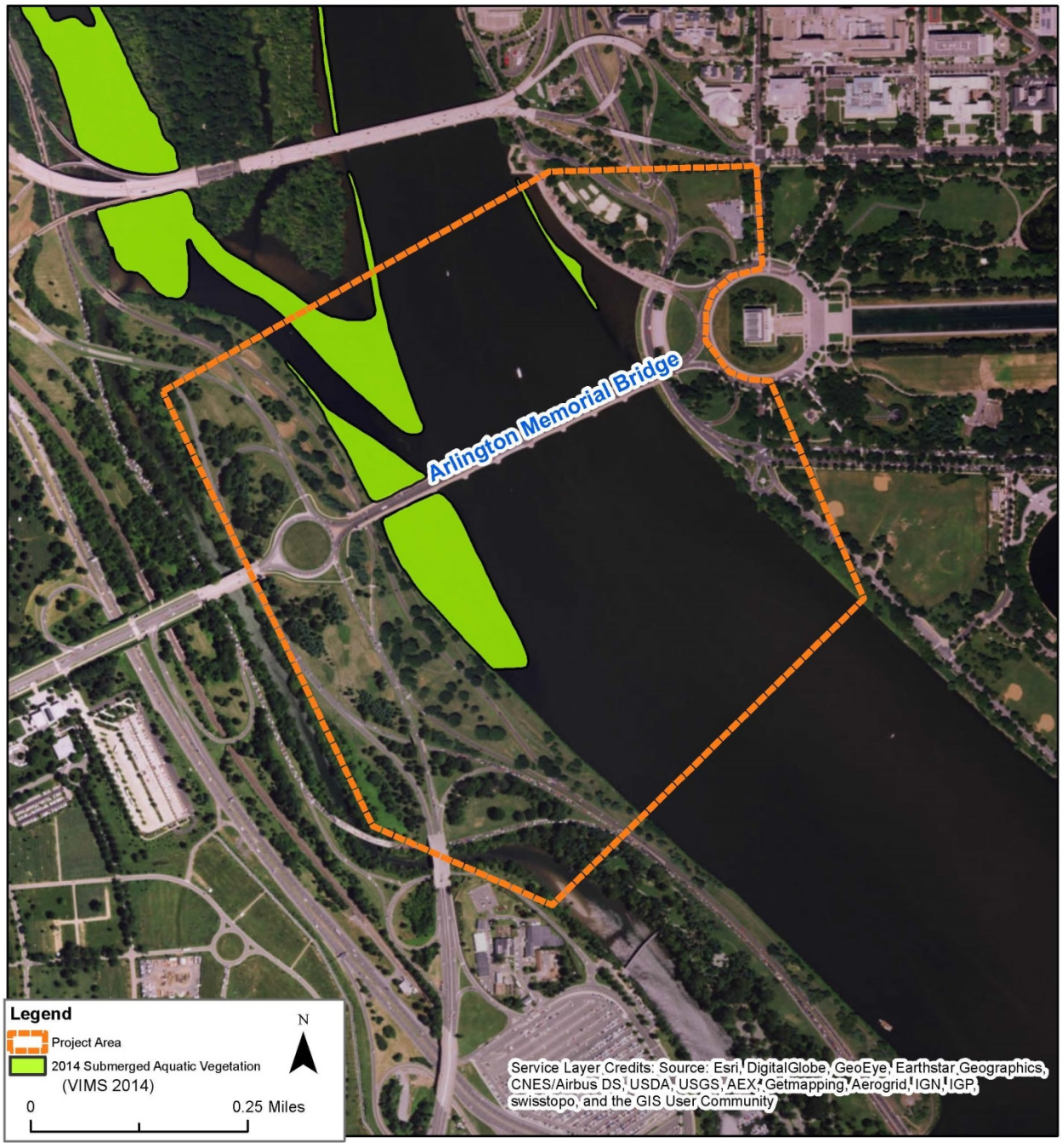


Figure 31: Submerged Aquatic Vegetation near the Arlington Memorial Bridge

Atlantic Sturgeon (*Acipenser oxyrhynchus*). Sturgeons are known for their distinct appearance, which includes a dense skull of bone and five rows of bony plates along the body (Figure 32). They possess a toothless mouth on the underside of their head designed to take in prey by suction. Atlantic sturgeons feed largely on aquatic insects, amphipods, isopods, shrimp, and mollusks. They can grow to a length of 14 feet and weigh over 600 pounds. Their lifespan can reach 60 years. For most of their life, Atlantic sturgeons live in lower estuarine and marine waters. During spawning season, they migrate to upper estuarine waters at the freshwater-saltwater interface to spawn over rocky substrate. In the mid-Atlantic region, adult Atlantic sturgeons migrate up river to spawn between April and May. Every two to six years, female Atlantic sturgeons can produce from 400,000 to 8 million eggs in a year depending upon the age and body size of the fish (NOAA 2012a). Larvae and juveniles live in the freshwater riverine habitats before migrating to marine environments at between 2 and 6 years of age, depending on sex (males leaving the rivers earlier) and location (VIMS 2013b).

Figure 32: Atlantic sturgeon (*Acipenser oxyrhynchus*)

National Marine Fisheries Service investigation into the Chesapeake Bay population indicates that there has been little recovery of the species since conservation began in 1998. The National Marine Fisheries Service has identified the James River as the only current area of spawning. Spawning may have occurred historically in the Potomac, Susquehanna, and Rappahannock Rivers but current evidence of spawning in these locations is lacking (ASSRT 2007).

Shortnose Sturgeon (Acipenser brevirostrum). Shortnose sturgeons resemble Atlantic sturgeons on a smaller scale (Figure 33). Adult shortnose sturgeons have a blunt snout, which differentiates it from the elongated snout of the Atlantic sturgeon. Shortnose sturgeon can reach lengths of 4.7 feet and weigh up to 50.7 pounds. The lifespan of the species is typically 30 years, but can last up to 67 years (NOAA 2012b). Like the Atlantic sturgeon, the shortnose sturgeon is a benthic feeder, eating aquatic insects, amphipods, isopods, shrimp, and mollusks. In contrast with the Atlantic sturgeon, the shortnose sturgeon prefers near

Figure 33: Shortnose sturgeon (*Acipenser brevirostrum*)

shore marine, estuarine, and riverine habitats and typically spends most of its life in the lower reaches of rivers. During spawning, they migrate upstream to cooler, faster-moving waters. Shortnose sturgeons are rarely found in ocean areas, and rarely stray from their native rivers (MDDNR 2013).

The first record of shortnose sturgeon in the Potomac River dates back to March 1876 (USFWS 2009). Recent studies to determine the status of the shortnose sturgeon in the Potomac River include a three year field study (2004-2007) conducted for the National Park Service. The study was conducted for a 100 km length of the Potomac River from the Little Falls Dam just north of Washington, DC to the Port Tobacco River. Unrelated to the NPS efforts, two sturgeons were captured and tagged through the US Fish and Wildlife Sturgeon Reward Program. One of the sturgeons was tracked by the National Park Service/US Geological Survey Natural Resources Protection Program and was observed traveling up to Little Falls in 2006 to spawn. Both fish stayed in Mattawoman Creek in excess of one year. It was later determined through DNA testing that both two captured fish were part of the Chesapeake Bay Distinct Population Segment.

CULTURAL RESOURCES

Guiding Regulations and Policies

The National Historic Preservation Act of 1966 governs federal agencies in their handling of historic properties (54 USC 306108). Section 106 of the Act requires that Federal agencies take into account the effects of their actions on cultural resources. Under this provision, the National Park Service must evaluate impacts to any district, site, building, structure, or object listed in or eligible for listing in the National Register of Historic Places. Cultural resources are characterized as archeological resources, historic structures, cultural landscapes, museum collections, and ethnographic resources. "Historic properties" as defined by the implementing regulations of the National Historic Preservation Act (36 CFR 800) are any prehistoric or historic districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the National Register of Historic Places. This term includes artifacts, records, and remains that are related to and located within such properties, as well as traditional and culturally significant Native American sites and historic landscapes.

To be eligible for listing in the National Register of Historic Places, a property must meet at least one of four Criteria for Evaluation issued by the US Department of the Interior. The National Register of Historic Places Criteria are defined as follows:

- Criterion A: Properties associated with events that have made a significant contribution to the broad patterns of our history;
- Criterion B: Properties associated with the lives of persons significant in our past;
- Criterion C: Properties that embody the distinctive characteristics of a type, period, or method of construction or represent the work of a master, or possess high artistic values, or

represent a significant and distinguishable entity whose components lack individual distinction; and

- Criterion D: Properties that have yielded, or are likely to yield, information important in prehistory or history.

Historic properties may meet these criteria at the national, state, or local levels. Additionally, in order for a property to be listed in the National Register of Historic Places, it must possess integrity, or the ability to convey its significance. The National Register of Historic Places recognizes seven qualities that, in various combinations, define integrity: location, design, setting, materials, workmanship, feeling, and association.

Section 106 of the National Historic Preservation Act also requires federal agencies to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment if an undertaking will have an adverse impact on a cultural resource. Additionally, the agencies must consult with the District Historic Preservation Office and other interested parties to avoid, minimize or mitigate the adverse impacts.

As indicated in "Chapter 1: Purpose and Need," the rehabilitation and repair of the Arlington Memorial Bridge has been evaluated as having no potential to impact museum objects or ethnographic resources. The project area consists of reclaimed land and as such does not have any potential for archeological or Native American resources. In addition, there is little to no potential for archeological resources within the Potomac River due to past dredging/filling operations, natural river scouring, and construction activities associated with the Arlington Memorial Bridge.

Area of Potential Effect

An Area of Potential Effect, as defined in 36 CFR Part 800.16, is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties. An Area of Potential Effect for this undertaking was delineated by the National Park Service, in consultation with the District Historic Preservation Office and the Virginia State Historic Preservation Office. The Area of Potential Effect includes the cultural resources that could be impacted as a result of the undertaking, as well as the area from which the project site is readily visible. These include the Arlington Memorial Bridge and Related Features, the Memorial Avenue Corridor, George Washington Memorial Parkway, Lady Bird Johnson Park, Arlington House: The Robert E. Lee Memorial, Theodore Roosevelt Island, the Georgetown Historic District, the Rock Creek and Potomac Parkway Historic District, the John F. Kennedy Center for the Performing Arts, the East and West Potomac Parks Historic District, and the Lincoln Memorial grounds.

Figure 34 provides the Area of Potential Effect boundary for rehabilitation of the Arlington Memorial Bridge. Cultural resources located within the Area of Potential Effect are described in detail in the following sections of this Environmental Assessment.

Figure 34: Area of Potential Effect

HISTORIC STRUCTURES AND DISTRICTS, INCLUDING CULTURAL LANDSCAPES

This section addresses historic properties that have been included in or have been determined eligible for the National Register of Historic Places as buildings, sites, objects or historic districts.

Arlington Memorial Bridge and Related Features

Figure 35: Northeastern view of the Arlington Memorial Bridge from the Mount Vernon Trail

Spanning the Potomac River and connecting Lincoln Memorial Circle with the Memorial Circle on Columbia Island, the Arlington Memorial Bridge (Figure 35) was authorized by Congress in 1916 and constructed between 1926 and 1932. The bridge consists of two segmented arch spans (one on the east side of the river which spans Ohio Drive, SW, and one on the west side which spans the George Washington Memorial Parkway), eight concrete arch spans built of reinforced concrete faced with dressed North Carolina granite ashlar, and a bascule span, or draw span, located at the bridge's center. The bridge is 2,163 feet long, carrying a 60-foot-wide roadway and 14-foot sidewalks. Architects McKim, Mead & White designed the bridge complex in the neoclassical style and artists Alexander P. Proctor, Carl Paul Jennewein, and Leo Friedlander incorporated sculptural elements into the design. The area between the southern terminus of the Rock Creek and Potomac Parkway and the bridge is the Watergate, a broad flight of steps leading to the water that represents a ceremonial river entrance to the District of Columbia. At its western end, the Arlington Memorial Bridge complex includes Memorial Circle, the circular plaza on Columbia Island, the Boundary Channel Bridge, which connects Columbia Island with the Virginia shore, and Memorial Avenue and Hemicycle, the ceremonial entrance to Arlington Cemetery. The bridge provides a physical and symbolic link between the North and the South, and was designed as an entryway and a grand approach to the monumental core of our nation's capital. The bridge and its associated architectural, engineering, sculptural, and landscape features are significant as important elements in the neoclassical urban design of the National Capital as it evolved during the first third of the 20th century. Specifically, the bridge's bascule span is recognized as an innovative engineering achievement.

Following a design competition, the Arlington Memorial Bridge Commission selected Strauss Engineering Corporation to design the bascule span with the Phoenix Bridge Company as the builder. The bascule span (Figure 36) is a double leaf, underneath counterweight type designed to blend with the overall style of the bridge. The fascia is composed of ornamental pressed metal and originally was painted to match the granite of the adjacent spans, thus effectively hiding the draw span. At 216 feet, it was once the longest draw span in the world, as well as the heaviest and the fastest. The counterweights that allowed the span to operate weigh 4,800 tons and the span was able

to open in 60 to 120 seconds. Due to decreased shipping traffic on the Potomac, and the later down river construction of a fixed, low-clearance bridge, opening of the bridge was no longer needed and the bascule span was permanently fastened in the closed position (Nolin 1988).

Figure 36: View of the bascule span, south side of the Arlington Memorial Bridge

The Arlington Memorial Bridge and Related Features (including the Watergate, Rock Creek and Potomac Parkway Terminus, Memorial Circle, Boundary Channel Bridge, the Arts of Peace, the Arts of War, and Memorial Avenue and Hemicycle) were listed in the DC Inventory of Historic Sites on November 8, 1964, and in the National Register of Historic Places on April 4, 1980 (NPS 1980).

Memorial Avenue Corridor

The Memorial Avenue Corridor (Figure 37) is a mile-long axial landscape that includes the Arlington Memorial Bridge, Memorial Circle, Memorial Avenue Bridge (over Boundary Channel), Memorial Avenue, and the entrance to Arlington National Cemetery. Basic elements of the Memorial Avenue Corridor were first articulated in the 1901 Senate Park Commission (McMillan) Plan of 1901-02. With the exception of Memorial Circle, the work of parkway designer Gilmore D. Clarke, the Corridor was designed by McKim, Mead & White under project architect William Mitchell Kendall. Conceived as a grand entryway to Arlington National Cemetery, it is a major element of the system of public buildings, parks, memorials, bridges, and drives that constitute the monumental core of Washington, DC. The composition is neoclassical in design, and landscape features are, for the most part, formal in style. The Corridor is significant for its embodiment of the ideals of the City Beautiful Movement. The bridge and its features also represent the work of several masters, particularly the architects William Mitchell Kendall and Charles Follen McKim.

Figure 37: Eastern view of the Memorial Avenue Corridor from the entrance to the Arlington National Cemetery

Contributing buildings and structures of the Memorial Avenue Corridor within the Area of Potential Effect include: the Arlington Memorial Bridge; the Arts of War (Sacrifice) and the Arts of War (Valor); the Memorial Avenue (Boundary Channel) Bridge; and the Memorial Circle Pylons. Contributing circulation features within the Area of Potential Effect include: Memorial Circle; the pedestrian system on the two bridges and avenue; and the pedestrian walks around Memorial Circle. Contributing small-scale features within the Area of Potential Effect include: the granite block "Durax" or "Belgian Block" centerline of Memorial Avenue and both bridges; the original cast-iron inlet grates along both bridges and Memorial Avenue; the granite block "Durax" surface of the Memorial Avenue Bridge; the granite curbstones; the granite header stones at the ends of bridges; the granite lamp post bases, the sidewalk paving on the two bridges and avenue, the triangular "islands" of granite blocks at the east and west ends of Memorial Circle; and the Washington standard lamp posts. Contributing vegetation features within the Area of Potential Effect include the white pines at the four pylons near Memorial Circle and the holly hedge and flanking rows of white oak trees along Memorial Avenue. Contributing views and vistas include views of the green parkland along both sides of the Potomac from Arlington Memorial Bridge and views to the river, Capitol dome, and other landmarks of the Capital from Memorial Circle. Contributing constructed water features within the Area of Potential Effect include the Boundary Channel (NPS 2004).

George Washington Memorial Parkway

The George Washington Memorial Parkway (Figure 38) is a national parkway of over 7,000 acres traversed by a planned and landscaped roadway system that extends 38.3 miles along the Potomac River through the District, Virginia, and Maryland. Initially conceived as a memorial to George Washington, the Mount Vernon Memorial Highway was authorized by Congress in 1928 and its construction began in 1929 on the segment which runs from the Arlington Memorial Bridge to the gateway to George Washington's home at Mount Vernon. In May 1930, the Capper-Cramton Act authorized federal acquisition of additional lands on both sides of the Potomac for the development of the George Washington Memorial Parkway extending to Great Falls. The completed Mount Vernon Memorial Highway became a component of the larger parkway.

Figure 38: View of the underpass for the George Washington Memorial Parkway and Mount Vernon Trail

The parkway serves as a grand entryway to the nation's capital and preserves the Potomac River and the gorge. The parkway is comprised of 27 sites replete with natural and cultural resources. While some of these sites were included in the original parkway authorization, others such as Theodore Roosevelt Island and the Arlington House were legislated and incorporated separately.

Approximately nine million visitors use the parks of the George Washington Memorial Parkway annually, which include national and international monuments and memorials, recreational areas, trails, historic homes, a living history farm, and an arts and crafts park. These sites, while each possessing a distinct history and individual merits, are united by the parkway and together represent broad themes in the nation's history. The Mount Vernon Memorial Highway was listed in the National Register of Historic Places on May 18, 1981, and the George Washington Memorial Parkway was listed in the National Register of Historic Places on June 2, 1995 (NPS 1995). In addition, the property was included in a multiple property listing for "Parkways of the National Capitol" in 1991.

Contributing buildings and structures within the Area of Potential Effect include: Arlington Memorial Bridge; Arlington Memorial Bridge Boundary Channel Extension; the Humpback Bridge; Little River Inlet Bridge; the four pylons of Memorial Circle; the Navy-Marine Memorial (Figure 39); the westbound US Route 50 overpass; and the Mount Vernon Trail. Contributing views and vistas include: views from George Washington Memorial Parkway and Washington/Arlington Boulevard to daffodil beds and flowering dogwoods; views from Memorial Circle east to the Lincoln Memorial, west to Arlington House and Arlington National Cemetery, north up the island, and south down the island; and views along the Mount Vernon Trail (Figure 40) and George Washington Memorial Parkway near the Potomac River shore. The following are contributing views and vistas from the northbound George Washington Memorial Parkway: views north along the Virginia Shore and the Virginia corridor of the George Washington Memorial Parkway; views north of Arlington Memorial Bridge to Theodore Roosevelt Island, the Washington, DC shoreline, and the Kennedy Center; and views to the Washington shoreline and the National Mall. The following are contributing views and vistas from the southbound George Washington Memorial Parkway: views to the island's shoreline and river and views of the Washington shoreline. In addition, the following small-scale structures within the Area of Potential Effect are contributing features: the GWMP wooden guardrails and the Mount

Figure 39: View of the Navy-Marine Memorial

Figure 40: View of the Arlington Memorial Bridge from the Mount Vernon Trail

Vernon Trail NPS benches. Contributing constructed water features within the Area of Potential Effect include the Boundary Channel (NPS 2004).

Lady Bird Johnson Park

Lady Bird Johnson Park is a 157-acre island located along the Virginia shore of the Potomac River, directly across from West Potomac Park in Washington, DC. The park, originally known as Columbia Island, was created from material dredged from the Potomac River to fulfill the design needs of the Arlington Memorial Bridge and Mount Vernon Memorial Highway. Columbia Island was added to the capital's park system in 1922. Early landscaping plans for the island proposed combining the formal, ceremonial elements of the Arlington Memorial Bridge composition with naturalistic park-like treatment in the surrounding areas and the shoreline. Later, a revised landscape plan was conceived under the Johnson administration's Beautification Program. The landscape was developed by landscape architect Edward D. Stone, Jr., and followed a simple, modern design based on picturesque landscape aesthetics. Today the park is traversed by a complex system of roadways, and two monuments are located at the park's southern end – the Navy-Marine Memorial and the Lyndon Baines Johnson Memorial Grove. Lady Bird Johnson Park has a period of significance from 1915 to 1979.

Contributing circulation features of Lady Bird Johnson Park within the Area of Potential Effect include Memorial Circle and the George Washington Memorial Parkway. Contributing vegetation features include: all of the Stone planting plan; cottonwood, crabapple, pear and elm trees remaining from the 1932 planting; daffodils; dogwoods; and large white pines near the pylons.

Arlington House: The Robert E. Lee Memorial

Figure 41: View of Arlington House: The Robert E. Lee Memorial

Arlington House: The Robert E. Lee Memorial is a 16 acre site located within Arlington National Cemetery. The site is a memorial to Robert E. Lee and is the remains of a 1,100 acre estate on the banks of the Potomac River that was inherited by George Washington Parke Custis, step-grandson of George Washington. Arlington Estate, first known as Mount Washington, was one of several estates owned by Custis and run by his slaves. The focal point of the estate, Arlington House (Figure 41), was set upon the highest topographic point of the estate and was designed and built between the years of 1803-1818 by English architect George Hadfield. The house is notable for being the first temple-form residence built in the United States and was purposefully set in a prominent position overlooking the growing capital city of Washington, DC. Arlington

House: The Robert E. Lee Memorial was listed on the National Register of Historic Places for its significance for its association with Robert E. Lee, the leader of the Confederate Army during the Civil War, its prior association with George Washington Parke Custis, its architectural significance as the work of the famous architect George Hadfield, and for its role as the Civil War headquarters of the Army of the Potomac. The Arlington House: The Robert E. Lee Memorial was listed in the National Register of Historic Places in 1966 (NPS 2009). Contributing structures on the site include Arlington House, the North Slave Quarters, the South Slave Quarters, the Potting Shed, and a below-ground section of a well. Contributing landscapes include: Arlington Woods; the Flower and Vegetable Gardens; the spatial organization of the building locations, yard, garden terraces, and Arlington Woods; the building and structure locations; circulation features including Trace Road at the north end of Arlington Woods, flower garden central path, kitchen garden central path; east/west oriented road connecting Lee Drive and Sherman Avenue between yard and flower garden, the potting shed access road, and the north/south section of Custis Walk on NPS property; and trees in the mixed hardwood forest of Arlington Woods ravine. Contributing views and vistas include views from Arlington House east toward Washington, DC along the Arlington Memorial Bridge corridor.

Theodore Roosevelt Island

Historically, Theodore Roosevelt Island was a natural passage across the Potomac River and a locus of commercial and transportation activity. In 1932 the island, which measures approximately 90 acres, was transferred to the federal government to serve as a national memorial to President Theodore Roosevelt. Landscape architect Frederick Law Olmsted, Jr. and architect John Russell Pope prepared plans for the memorial. The overall goal of the plan was the establishment of native woodlands which would memorialize Theodore Roosevelt for his achievements as a leader in conservation policy and commemorate the primeval forest of the Potomac River valley. In 1967, a large open-air architectural monument commemorating Roosevelt was completed on the northern end of the island. Theodore Roosevelt Island is unique among presidential memorials in its commemoration of a specific area of presidential achievement and in its development primarily as a living landscape memorial. The island has multiple periods of significance (1749-1833, 1861-1865, and 1931-present) and is important as a cultural landscape design of famed landscape architect Frederick Law Olmsted, Jr., as an integral part of the Senate Park Commission (McMillan) Plan of 1901-02, and as an addition to the landscape setting of the National Mall. Theodore Roosevelt Island was listed in the DC Inventory of Historic Sites on November 8, 1964, and in the National Register of Historic Places on October 15, 1966 (NPS 1967).

Contributing circulation features of Theodore Roosevelt Island include the Woods Trail, the Upland Trail, the Swamp Trail, the North Transverse Trail, and Remnants of the Mason's Causeway. Contributing buildings and structures include the Theodore Roosevelt Memorial; the monoliths "Youth," "Manhood," "The State," and "Nature"; pools of the memorial plaza; the Mason House and Mason Ice House ruins; the wharf ruins on north shore; the ruin of a boat or scow on the east side of the island; foot bridges around the memorial; and fountains on the island. Contributing small scale features include two low stone retaining walls and the benches of the memorial plaza. Contributing vegetation features include the plants associated with the Olmsted Jr. plan and the plants associated with the original memorial plaza. Contributing land use features include the use of

the site as a presidential memorial and the use of the site to experience nature. Contributing topographic features include the topography dating back to Olmsted. Contributing views and vistas include views within and across the memorial plaza. Contributing constructed water features include the large moats and pools adjacent to the memorial plaza (NPS 2010b).

Georgetown Historic District

Established by the Old Georgetown Act of September 22, 1950, the Georgetown Historic District represents a remarkably intact example of a complete historic town. The historic district encompasses approximately 340 contributing buildings dating from the period of significance, which extends nearly 200 years from 1751 to 1950. Building stock dates from several historical periods, including Early Georgetown (1751-1829), when the area flourished as a tobacco port town and shipping center; Early to Mid-Victorian Georgetown (1830-1869), when extensive industrial and commercial growth occurred along the waterfront; Late Victorian Georgetown (1870-1899), the period following the consolidation of Georgetown into the city of Washington when vast infrastructure improvements were made; and Early 20th Century Georgetown (1900-1949), which saw the first housing restoration efforts and culminated in the passage of the Old Georgetown Act. The historic district includes representative samples of residential, commercial, institutional, and industrial buildings from all periods and contains many of the city's oldest buildings. The Georgetown Historic District was listed in the DC Inventory of Historic Sites on November 8, 1964. The Georgetown Historic District was designated a National Historic Landmark and listed in the National Register of Historic Places on May 28, 1967 (amended 2003) (NPS 2003b).

Rock Creek and Potomac Parkway Historic District

The Rock Creek and Potomac Parkway Historic District, US Reservation 360, occupies the gorge and rim of the lower Rock Creek Valley and a stretch of land along the Potomac River waterfront. Comprised of approximately 180 acres in the northwest quadrant of Washington, DC, the park's dominant feature is the Rock Creek and Potomac Parkway, a designed linear landscape dedicated to scenic driving. Officially authorized in 1913 to provide a landscaped roadway connection between the Mall and Potomac Park (later renamed East and West Potomac Parks) and the already established Rock Creek Park and National Zoo, the Rock Creek and Potomac Parkway comprised a major component of the District's comprehensive park system developed following City Beautiful ideals during the early 20th century. The Rock Creek and Potomac Parkway was the first parkway in the metropolitan region and one of the earliest parkways in the nation. It is significant in the areas of community planning and development, engineering, recreation, and landscape architecture during the period 1828 to 1951.

Contributing features of the Rock Creek and Potomac Parkway Historic District include The Arts of Peace, the Roadway, the Millet Lampposts, the Trail Network, the Stone Seawall, the Sycamore Allee, Rock Creek, the Chesapeake & Ohio Canal, the K Street Bridge, the Sewer Pumping Station, Culverts (that incorporate headwalls), the Godey Lime Kilns, the Pennsylvania Avenue Bridge, the M Street Bridge, P Street Beach, P Street Bridge, the P Street Road Bridge, Dumbarton Bridge, the Median, Lyons Mill Footbridge, South Waterside Drive Overpass, the Washington City Tunnel

Storage Shed, the Massachusetts Avenue Bridge, North Waterside Drive, Saddle Club Footbridge, Shoreham Hill, Shoreham Hill Road Bridge, the Quarry, the Connecticut Avenue Bridge, the Woodley Lane Bridge Abutments, the Calvert Street Bridge, and the Parkway Ending. The Rock Creek Park and Potomac Parkway was listed in the DC Inventory of Historic Sites on November 8, 1964, and in the National Register of Historic Places on May 4, 2005, under the multiple property listing "Parkways of the National Capital Region, 1913-1965" (NPS 2005a).

John F. Kennedy Center for the Performing Arts

The John F. Kennedy Center for the Performing Arts (Figure 42) has the unique distinction of serving as both a national performing arts center and as the only presidential memorial to John F. Kennedy in the Nation's Capital. It is situated on an eminent site overlooking the Potomac River at the western edge of the monumental core of Washington, DC. The Kennedy Center is one of the nation's busiest arts facilities, producing and presenting a wide variety of performances and leading the nation in arts education and accessibility. It was designed by 20th-century master architect Edward Durell Stone and was constructed between 1964 and 1971. The Kennedy Center possesses exceptional significance as the sole national memorial to President John F. Kennedy within the National Capital and its environs. The Kennedy Center is an important landmark that, more than any other memorial constructed in Kennedy's honor, successfully embodies his passion and appreciation for the arts and culture and symbolizes his belief that a civilization's legacy is shaped by the quality of its artistic contributions. By promoting the arts on a national level and making culture accessible to all, the Kennedy Center is widely recognized as a reminder of Kennedy's enduring values and convictions. The Kennedy Center also possesses exceptional significance as an important example of the work of Edward Durell Stone, a nationally recognized master architect of the Modern Movement, and as a public monument to President John F. Kennedy that is immediately recognizable as one of the nation's most iconic memorials. The Kennedy Center was determined eligible for the National Register of Historic Places by the District Historic Preservation Office on October 27, 2011.

Figure 42: View of the Kennedy Center from the Arlington Memorial Bridge

East and West Potomac Parks Historic District

The East and West Potomac Parks Historic District encompasses approximately 730 acres of parkland, including a large portion of the District's monumental core. Situated roughly between the Potomac River and the grounds of the Washington Monument, the East and West Potomac Parks Historic District is characterized by broad expanses of open space framed by mature landscape

plantings and views of major memorials that have become part of the American collective memory. The parks provide the setting for nationally recognized memorials such as the Lincoln Memorial and Reflecting Pool, the Jefferson Memorial, the Franklin Delano Roosevelt Memorial, and the Vietnam Veterans and Women's Memorials, among others. The large land masses that are today East and West Potomac Parks were sculpted from tidal flats by the US Army Corps of Engineers in an ambitious reclamation project that lasted over 30 years. The reclaimed land became parkland that has been shaped by a number of development plans – most notably the Senate Park Commission (McMillan) Plan of 1901-02, the nation's first major manifestation of the City Beautiful movement. The East and West Potomac Parks Historic District includes three contributing buildings, eleven contributing sites, eleven contributing structures, and ten contributing objects. The East and West Potomac Parks Historic District was listed in the DC Inventory of Historic Sites on November 8, 1964, and in the National Register of Historic Places on November 30, 1973 (revised 2001) (NPS 2001).

Lincoln Memorial Grounds

The Lincoln Memorial Grounds (Figure 43) encompass 94 acres of West Potomac Park and are a major element of the system of public buildings, parks, memorials, bridges, and drives that constitutes the monumental core of Washington, DC. The Senate Park Commission (McMillan) Plan of 1901-02 defined a vision for the area that included parks and memorials to great men and important events in American history. The Lincoln Memorial, built between 1914 and 1922, was the first such memorial to be constructed. It was sited along the major east-west axis that extends from the Capitol to the Washington Monument as laid out in the L'Enfant Plan. The park-like grounds of the commemorative landscape surrounding the Lincoln Memorial were mostly designed to be used for passive recreation. The Lincoln Memorial Grounds have national significance as an essential part of the Senate Park Commission (McMillan) Plan, one of the most successful implementations of the City Beautiful movement. The Lincoln Memorial is significant for its association with Abraham Lincoln and Martin Luther King, Jr., and as an important example of the classicism of the Beaux Arts style.

Figure 43: View of the Lincoln Memorial from the eastern end of the Arlington Memorial Bridge

Contributing views and vistas of the Lincoln Memorial Grounds within the Area of Potential Effect include: the reciprocal vista between the Lincoln Memorial and Arlington House across the Arlington Memorial Bridge; the vista from and to Parkway Drive; the fan-shaped vista from the Lincoln Memorial west to the Virginia shoreline; and the opposite vista from the shoreline to the Lincoln Memorial. Contributing vegetation features include: Watergate area planting on both sides

of each approach road; the row of American elms on the northeast side of Parkway Drive; the intact planting bed at the Constitution Avenue terminus; riparian plantings along the Potomac shoreline; and the grass strip along the Potomac River shoreline. Contributing circulation features include: Arlington Memorial Bridge; Parkway Drive; Ohio Drive; the remnant Constitution Avenue terminus; sidewalks on both sides of Arlington Memorial Bridge and Parkway Drive; the sidewalk at top of Watergate steps; and the paths on both sides of Ohio Drive at base of Watergate steps. Contributing structures of the Lincoln Memorial Grounds within the Area of Potential Effect include: the Arlington Memorial Bridge abutment; the Watergate steps; the Parkway Drive abutment; and the statuary on the approach pedestals (Valor, Sacrifice, Music and Harvest, and Aspiration and Literature). Contributing small-scale features include: the Washington Globe lampposts on Arlington Memorial Bridge, Parkway Drive, and Ohio Drive; and the granite block pavers at the base of the Watergate steps (NPS 1999b).

VISITOR USE AND EXPERIENCE

Visitor use of the Arlington Memorial Bridge often coincides with tourism of Washington, DC's numerous attractions. Washington, DC features bus tours (Open Top Sightseeing, Old Town Trolley, Signature Tours, et al.), many of which carry sightseers across the Potomac River to visit Arlington National Cemetery. The bridge also conveys bicycle and pedestrian tourists via two 14-foot sidewalks. Separation between the bridge sidewalks and roadway consists of curbs at the road edge and light poles spaced at a 100-foot interval.

From the Arlington Memorial Bridge, visitors are provided the opportunity for scenic views of the Potomac River, Lincoln Memorial, Washington Monument, Arlington House, The Robert E. Lee Memorial, the Kennedy Center, Theodore Roosevelt Island, Theodore Roosevelt Memorial Bridge, and others. In the same manner, the bridge is an element of scenic views from these resources. The Arlington Memorial Bridge is highly visible and is a prominent feature of the District of Columbia's monumental core, which can be seen from numerous vantage points in Arlington County, Virginia, and the District of Columbia.

The Arlington Memorial Bridge also serves as a prominent feature in funeral processions. On average, there are 27 funerals held at Arlington National Cemetery every weekday (Fodor's 2013). A few of the Country's most notable public figures have been carried across the bridge to rest at Arlington including President John F. Kennedy on November 25, 1963, and Justice Thurgood Marshall on January 28, 1993.

In addition to commuter and tourist uses, the bridge plays a prominent role in several nationally recognized running events and demonstrations. Typically the bridge will be closed to vehicular traffic during these special events due to substantial numbers of visitors. Table 5 provides a list of some of the events that have utilized the Arlington Memorial Bridge in the past.

Table 5. Special Events Utilizing The Arlington Memorial Bridge

Event	Promoter	Notes
Cherry Blossom Ten Mile Run	Nationwide group of Credit Unions	Annual race belonging to the Professional Road Running Organization Circuit, a nationwide series. 17,532 total finishers in 2013. Benefits Children's Hospitals (CUCB 2012).
Police Unity Tour	Police Unity Tour	250-mile bike ride beginning in Portsmouth, Virginia and ending at the National Law Enforcement Officer's Memorial in Washington, DC (PUT 2013).
Rolling Thunder	Rolling Thunder	Annual motorcycle demonstration in Washington, DC originally intended to raise POW/MIA awareness. World's largest single-day motorcycle event (RTR 2013).
Navy-Air Force Half Marathon and Navy 5-Miler	Joint Base Anacostia-Bolling Morale, Welfare and Recreation	Approximately 3,200 participants in 2012. Proceeds benefit active duty military and their families (NAVY 2013).
Marine Corps Marathon	Marine Corps Marathon	Fourth largest US marathon accepting up to 30,000 participants. Event weekend featuring conferences and festivals takes place in support of the Marathon (MCM 2013).
Army Ten-Miler	Military District of Washington	Third largest ten-mile race in the world, in its 29th year. Benefits Army Morale, Welfare, and Recreation programs (ARMY 2013).
Capital Challenge Walk MS	National Multiple Sclerosis Society	Fundraising event taking place in the metropolitan Washington area. Participants walk a total of 50 kilometers over 2 days (CCWMS 2013).
Rock 'n' Roll Marathon	Competitor Group	Marathon featuring live music as participants run the course. Approximately 30,000 runners competed in 2013 at the second annual Rock 'n' Roll Marathon (RNR 2013).
Nike Women's Half-marathon	Nike et al.	Race draws approximately 15,000 participants, to benefit the Leukemia & Lymphoma Society (NIKE 2013).

In addition to the activities taking place on the bridge, waters beneath the bridge provide functional and recreational space. Water taxis and charter boats operate between the Georgetown Waterfront, the Southwest Waterfront, and the National Harbor. Sightseeing of the District's monuments and memorials is a popular activity from the water during day and night. Uses of the Potomac in the vicinity of the Arlington Memorial Bridge also include kayaking, canoeing, rowing, and motorized recreational boating. Boathouses north of the bridge provide public access to the water, and community based organizations such as the Potomac Boat Club offer training and competitive programs. A federal navigation channel maintained by the US Army Corps of Engineers runs through the Potomac and is directed under the bascule span of the Arlington Memorial Bridge. The bridge has a vertical clearance of 30 feet.

TRANSPORTATION

Roadways and Ramps

The roadway across the Arlington Memorial Bridge consists of six 10-foot wide vehicle travel lanes and two 14-foot wide sidewalks. Traveling westbound on the bridge, vehicle traffic is carried to a circle with ramps to the George Washington Memorial Parkway, Arlington Boulevard, and Washington Boulevard. Continuing west past the roundabout, a roadway provides access to Jefferson Davis Highway and Arlington National Cemetery. The traffic pattern at the west end of the bridge is displayed in Figure 44.

Traveling eastbound on the bridge, vehicle traffic is carried to Lincoln Memorial Circle. Average daily traffic at the Circle is 60,000 vehicles per day (FHWA 2011). A ramp is provided to convey traffic to the Rock Creek and Potomac Parkway, Route 66 and E Street, NW via Ohio Drive, SW. Access to Independence Avenue, SW is provided by southbound 23rd Street, NW. Access to Constitution Avenue is provided by northbound 23rd Street, NW and Henry Bacon Drive, NW. The circle is partially blocked by bollards to provide space for visitors to the Lincoln Memorial. The traffic pattern at the east end of the bridge is displayed in Figure 45.

Figure 44: Traffic Pattern Along the Roadways and Ramps at the western approach to the Arlington Memorial Bridge

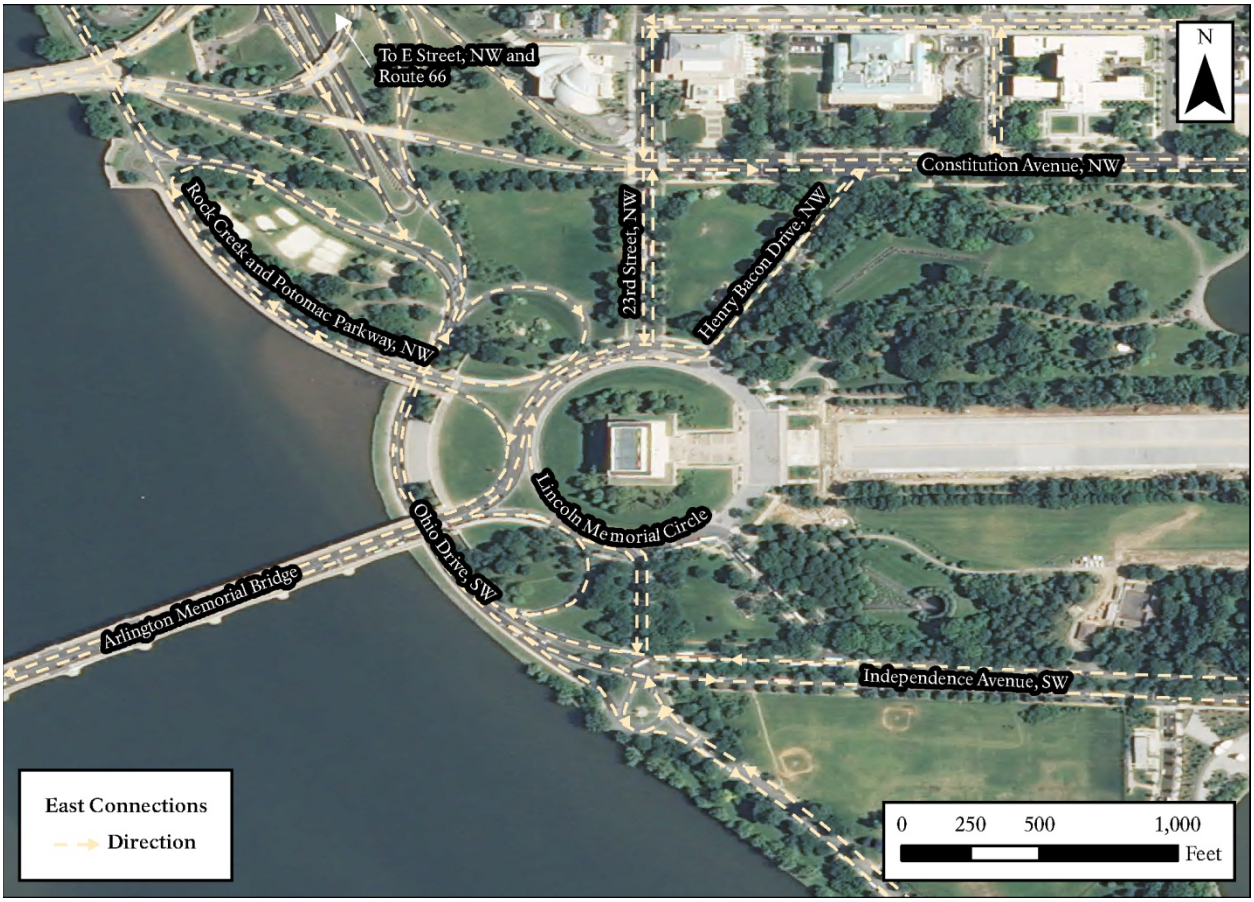


Figure 45: Traffic pattern along the roadways and ramps at the eastern approach to the Arlington Memorial Bridge

Traffic Data

In order to analyze traffic conditions at crossings of the Potomac River, traffic data was compiled by the Metropolitan Washington Council of Governments. Field observations were conducted at four bridges in the Arlington/Washington, DC area to describe daily bridge traffic. Given the total amount of crossings observed between the four bridges, the Arlington Memorial Bridge conveys roughly 16 percent of all traffic across the Potomac River. Table 6 provides the Metropolitan Washington Council of Governments 2007 data.

TABLE 6. DAILY TRAFFIC - POTOMAC RIVER CROSSINGS

Bridge	Field Observation Count
Arlington Memorial Bridge	71,732 (16%)
14th Street Bridge	212,000 (47%)
Roosevelt Bridge	108,818 (24%)
Key Bridge	61,100 (13%)
Total	**453,650**

*parentheses indicate percent of total crossings

Weekday use of the Arlington Memorial Bridge is highest during morning and evening rush hour periods. The Metropolitan Washington Council of Governments counts of eastbound vehicles on the bridge from 8:00 a.m. to 9:00 a.m. reached as many as 4,500 vehicles; counts of westbound vehicles from 6:00 p.m. to 7:00 p.m. reached as many as 2,500 vehicles. Conversely, the bridge carries little to no traffic between the hours of 12 a.m. and 5 a.m. In congruence with heavy congestion on the bridge, average vehicle speeds can drop 10 to15 miles per hour during rush hours. Metropolitan Washington Council of Governments documented similar conditions on the 14th Street Bridge and the Theodore Roosevelt Memorial Bridge, with considerably lower vehicle speeds during rush hour periods.

Regional Delays. A regional traffic survey conducted by Metropolitan Washington Council of Governments in 2011 identified the top ten corridors in the Washington metropolitan area with the longest delays during rush hour periods. Although the Arlington Memorial Bridge was not included within the most congested corridors, several routes in the vicinity of the bridge were identified. The survey found that during morning peak periods, an 18-mile segment of Interstate 395 from Route 1 to the George Washington Memorial Parkway results in delays of up to 45 minutes, which ranked as the most congested. During evening peak periods, a 4-mile segment of Interstate 395 from Pennsylvania Avenue to Jefferson Davis Highway results in delays of up to 15 minutes. This segment was ranked second among the most congested corridors. Figure 46 displays long delay corridors in the vicinity of the Arlington Memorial Bridge.

Pedestrians and Bicyclists

A high volume of pedestrians and bicyclists use the Arlington Memorial Bridge and connecting pathways. Pedestrian and bicycle counts obtained in October and November 2012 indicate that approximately 2,000 bicyclists and pedestrians used the sidewalks on the Arlington Memorial Bridge each day. The bridge and its connections support both commuter and recreational uses. Sidewalks and crossings at both ends of the bridge connect with regional trail networks. On the west side of the bridge, access is provided to the Mount Vernon Trail, and on the east side of the bridge, access is provided to the Rock Creek Trail. Highly visible road markings and signs are in place to enhance safety at road crossings. However, based on a 2011 road safety audit conducted by the National Park Service and Federal Highway Administration, collisions between pedestrians and vehicles are a concern on the west side of the bridge (NPS 2011b). Observations described in the road safety audit involved driver aggressiveness and driver confusion at the approaches to Memorial Circle. To reduce the likelihood of collisions, a range of recommendations were presented including additional warning signs, restriping, and realignment of the existing ramps. Pedestrian access improvements on both sides of the bridge are also recommended in the District of Columbia Bicycle Master Plan (DDOT 2005).

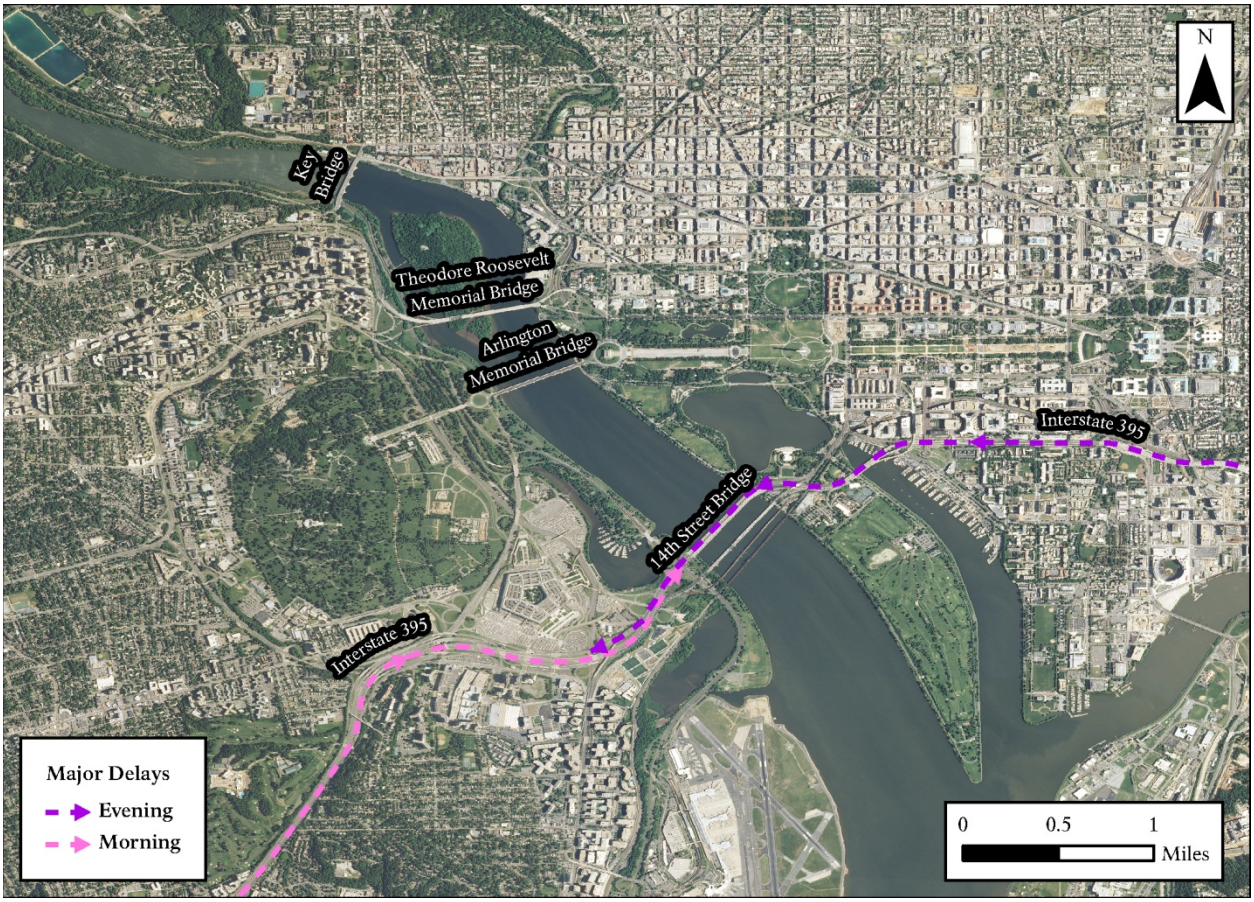


Figure 46: Long delay corridors in the vicinity of the Arlington Memorial Bridge

Emergency Evacuation

As part of the District's emergency preparedness plan, the District Department of Transportation has identified 19 roads to be used as evacuation routes during an emergency event. The 22 routes radiate from the downtown area to the Washington, DC beltway (I-495) and beyond as shown in Figure 47. The Arlington Memorial Bridge has been identified as a roadway that would be used to evacuate citizens located south of Pennsylvania Avenue, NW. Bridges upstream and downstream of the Arlington Memorial Bridge, including the Theodore Roosevelt Memorial Bridge and the 14th Street Bridges are also designated as emergency evacuation routes (DDOT 2011)

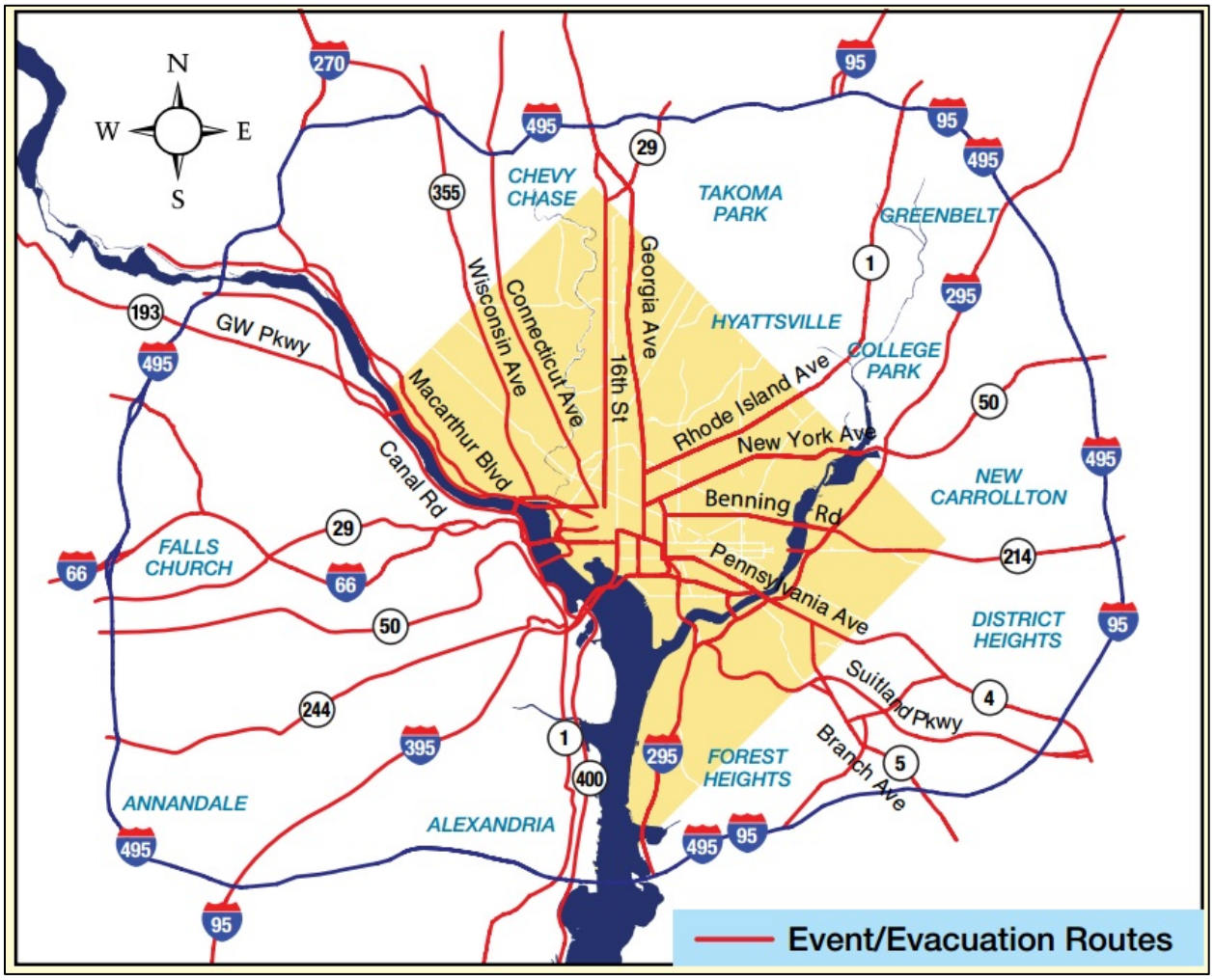


Figure 47: Emergency evacuation routes in Washington, DC (DDOT, 2011)

NAVIGATION

The Potomac River is considered a traditional navigable water of the US as defined by the US Army Corps of Engineers (33 CFR 329). Navigation on the Potomac River is regulated by the US Coast Guard. In accordance with Section 9 of the Rivers and Harbors Act of 1899, the US Coast Guard is responsible for ensuring "No bridge shall at any time unreasonably obstruct the free navigation of any navigable water of the United States" (33 USC 401, et seq). A federal navigation channel maintained by the US Army Corps of Engineers runs through the Potomac River and is directed under the bascule span of the Arlington Memorial Bridge (Figure 48). At the time of construction, the Arlington Memorial Bridge featured a center bascule span that could be opened for tall vessels. At this time the bascule span is sealed and has not had a request for opening from river traffic since the 1960s. It should be noted that the bridge remains permitted as a drawbridge by the US Coast Guard.

Within the study area, there are four bridges or bridge complexes that restrict navigation on the Potomac River: the 14th Street Bridge Complex, the Arlington Memorial Bridge, the Theodore Roosevelt Memorial Bridge, and the Francis Scott Key Bridge (Figure 49). Table 7 provides the navigational clearances for each of the bridges in the study area.

The first navigational restriction that is encountered is a set of five bridges collectively known as the 14th Street Bridge Complex which includes the George Mason Memorial Bridge, the Rochambeau Bridge, the Arland D. Williams, Jr. Memorial Bridge, the Charles R. Fenwick Bridge, and the Long Bridge. The Long Bridge and the Charles R. Fenwick Bridge carry rail traffic over the Potomac River. The Long Bridge carries freight trains, Amtrak and Virginia Railway Express (VRE) commuter trains while the Charles R. Fenwick Bridge carries the Washington Metropolitan Area Transit Authority Metrorail Yellow line. The George Mason Memorial Bridge, Rochambeau Bridge, and the Arland D. Williams, Jr. Memorial Bridge carry highway traffic travelling on US Interstate 395 and US Route 1. According to National Oceanic and Atmospheric Administration navigational charts, the vertical clearance height for the 14th Street Bridge complex is 18 feet. All of the bridges in the complex are considered fixed span bridges which do not open to allow taller boating traffic to continue along the Potomac River. The 14th Street Bridge Complex, specifically the Long Bridge, is the navigational limiting factor on the river. Because the Long Bridge is a fixed span bridge, any vessels taller than 18 feet have a destination in the Anacostia River or the Washington Channel rather than locations north of the Long Bridge (Smith 2015).

Continuing north, past the 14th Street Bridge Complex, is the Arlington Memorial Bridge. The Arlington Memorial Bridge connects the Arlington National Cemetery in Virginia to the Lincoln Memorial in Washington, DC. The NOAA navigational maps designate the Arlington Memorial Bridge as a fixed span bridge with a vertical clearance of the 30 feet (Figure 50). Just upstream of the Arlington Memorial Bridge, the Theodore Roosevelt Memorial Bridge carries US Interstate 66 and 50 over the Potomac River. The Theodore Roosevelt Memorial Bridge was opened in 1964 and, as a fixed span bridge, effectively eliminated large vessel travel to Georgetown and points north with a 24 foot vertical clearance limitation (29 feet at center of main span) (NPS 2014). The final crossing of the Potomac River in Washington, DC is the Francis Scott Key Bridge which carries US Route 29. Completed in 1923, the Key Bridge is the oldest existing bridge in Washington, DC. The vertical clearance of the bridge is 61 feet. North of the Key Bridge, the Potomac River begins to narrow and eventually becomes non-navigable. The Three Sisters geologic formation is part of the fall line and is widely regarded as the northern most navigable point for motorized vessels. Smaller crafts able to navigate under the 14th Street Bridge Complex can travel past the Arlington Memorial Bridge and north to Georgetown. Water taxis and sightseeing cruises also travel up and down the Potomac River carrying tourists to popular Washington, DC destinations.

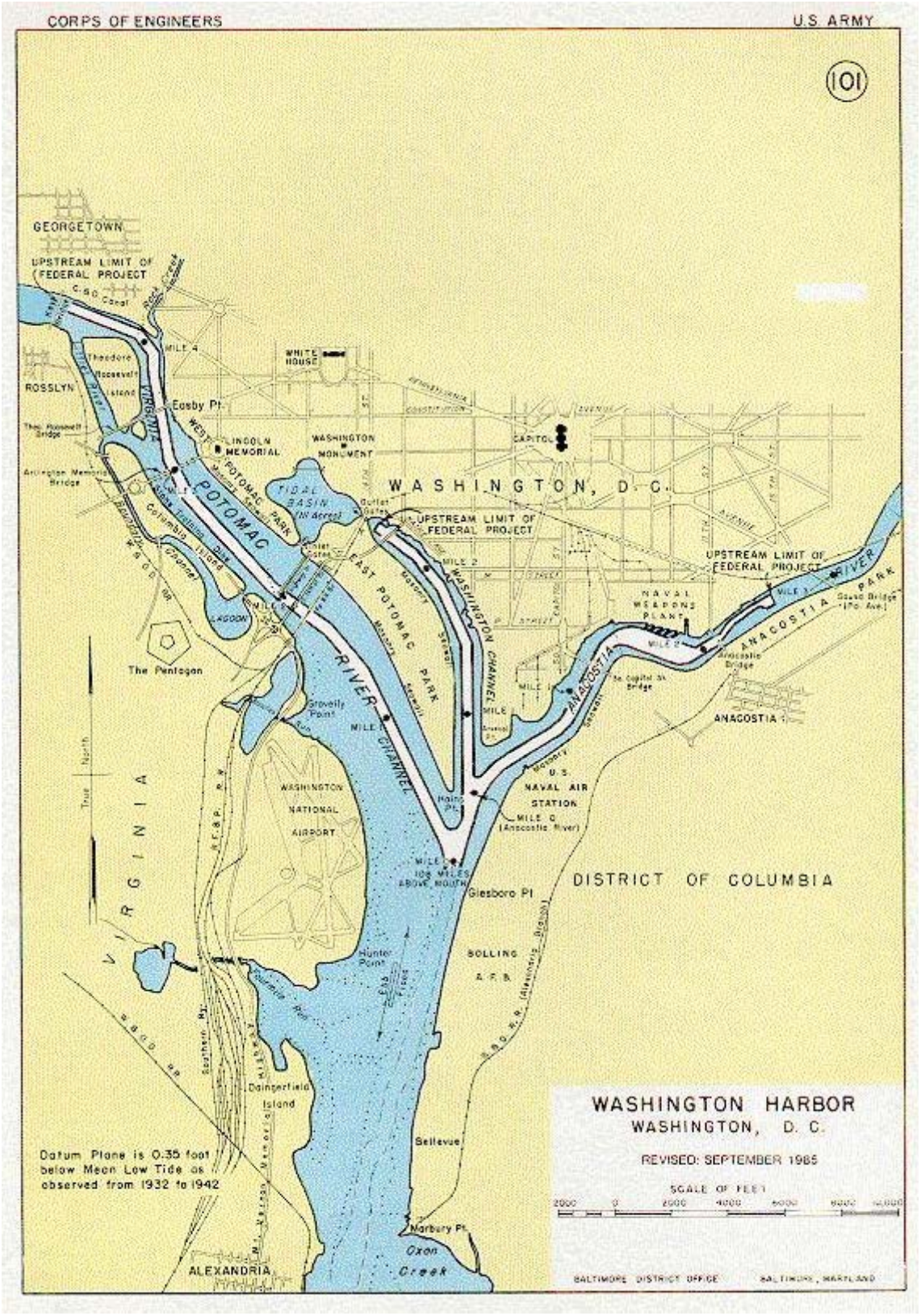


Figure 48: Federal Navigation Channel (USACE, 2007)

Figure 49: Navigational restrictions along the Potomac River

TABLE 7. NAVIGATIONAL CLEARANCES OF BRIDGES ALONG THE POTOMAC RIVER (NOAA, 2010)

Bridge	Roadway	Vertical Clearance
Long Bridge	Amtrak Freight VRE	18 feet
Charles R. Fenwick Bridge	WMATA Yellow Line	18 feet
George Mason Arlington Memorial Bridge Rochambeau Bridge Arland D. Williams Arlington Memorial Bridge	US 1 I-395	18 feet
Arlington Memorial Bridge	Memorial Avenue	30 feet
Theodore Roosevelt Memorial Bridge	US 50	24 feet
Francis Scott Key Bridge	US 29	61 feet

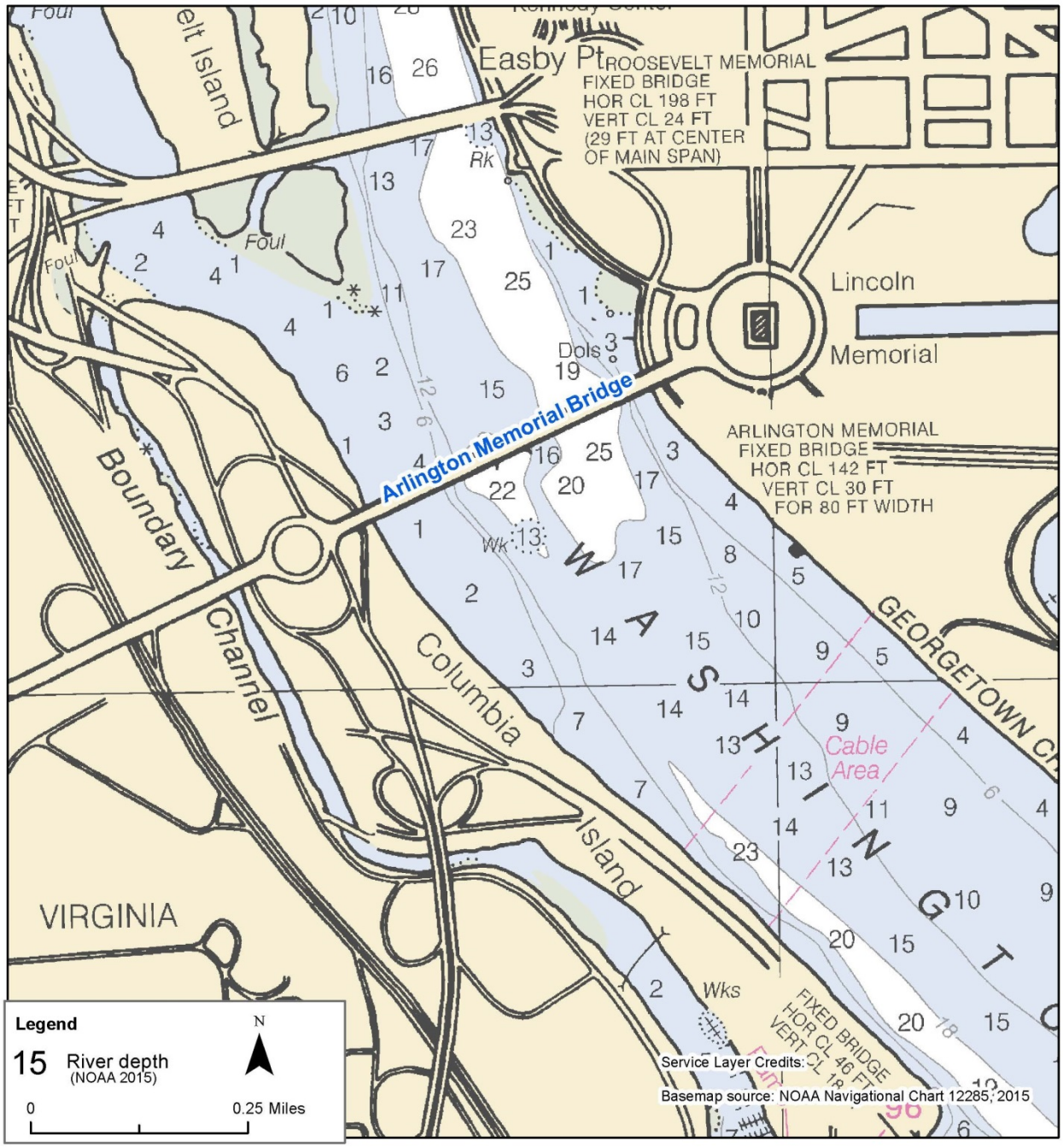


Figure 50: NOAA Navigation map showing the Arlington Memorial Bridge as a fixed span bridge

No commercial facilities receive barge deliveries along the Potomac River in this area of study (Smith 2015). Any vessels able to travel under the 14th Street Bridge Complex are also able to travel under the Arlington Memorial Bridge as the vertical clearance of the Arlington Memorial Bridge is substantially higher.

Larger vessels that may launch or dock at the marinas in the Washington Channel are unable to travel north of the 14th Street bridge complex due to height restrictions. The Columbia Island Marina

is the northern-most motorized boat marina located along the Potomac River. Vessels that launch or dock at the Columbia Island Marina must be able to travel under the George Washington Memorial Parkway which crosses the opening to the Pentagon Lagoon, where the Columbia Island Marina is located. This overpass has a vertical clearance of 18 feet. North of the Columbia Island Marina, there are no marinas or facilities that support launching larger motorized vessels. Therefore, only vessels that can pass under the 14th street bridge complex (18 foot clearance) or the George Washington Memorial overpass (18 foot clearance) are found in the area of the Arlington Memorial Bridge.

The largest vessel known to navigate the Potomac River in Washington, DC is the Odyssey, run by the Spirit Cruises of Washington, which feature dinner and sightseeing cruises. This vessel was specifically designed to travel under the 14th Street Bridge Complex. The Odyssey is 240 feet long and 63.5 feet wide with an air draft of approximately 17 feet. The Odyssey can only safely navigate under the bridges at low tide when the vertical clearance is about 20 feet. If the ship is travelling at high tide an alternate route is necessary (Smith 2015).

The Potomac River attracts many types of recreational boaters (Figure 51). Sailboats, personal yachts, small power boats, and non-motorized vessels all frequent the Potomac River in Washington, DC. Several marinas located along the Potomac River serve the recreational boating community. The Old Dominion Boat Club and Washington Sailing Marina located in Alexandria, Virginia, host vessels averaging 35 feet in length and can occasionally accommodate larger vessels. Taller boat traffic such as sailboats and personal yachts may travel up the Anacostia River to the James Creek Marina or up the Washington Channel to the Gangplank Marina and the Washington Marina. As noted previously, these larger vessels cannot reach the Arlington Memorial Bridge because they cannot clear the 14th Street bridge complex.

Figure 51: Recreational boaters near the Arlington Memorial Bridge

Several non-motorized boat houses are located north of the Theodore Roosevelt Memorial Bridge. The Washington Canoe Club and the Potomac Boat Club operate on the Potomac River north of the Francis Scott Key Bridge. The Key Bridge Boathouse and Thompson Boat Center offer canoe and kayak rentals and serve several rowing clubs in the area. Figure 52 shows marinas that serve recreational boaters along the Potomac River.

The Potomac River Safety Committee made up of representatives from local boating organizations and boating centers works to educate non-motorized boaters on the safe usage of the Potomac River between National Airport and Fletcher's Cove. According to the Safety Committee's Safety Rules & Guidelines Safety Rules and Guidelines, when traveling down-stream, non-motorized boaters are

advised to use arches 3 and 4 on the west side of the Arlington Memorial Bridge and when traveling up stream, to use arches 7 and 8 on the east side of the bridge (Figure 53).

Figure 52: Marinas along the Potomac River

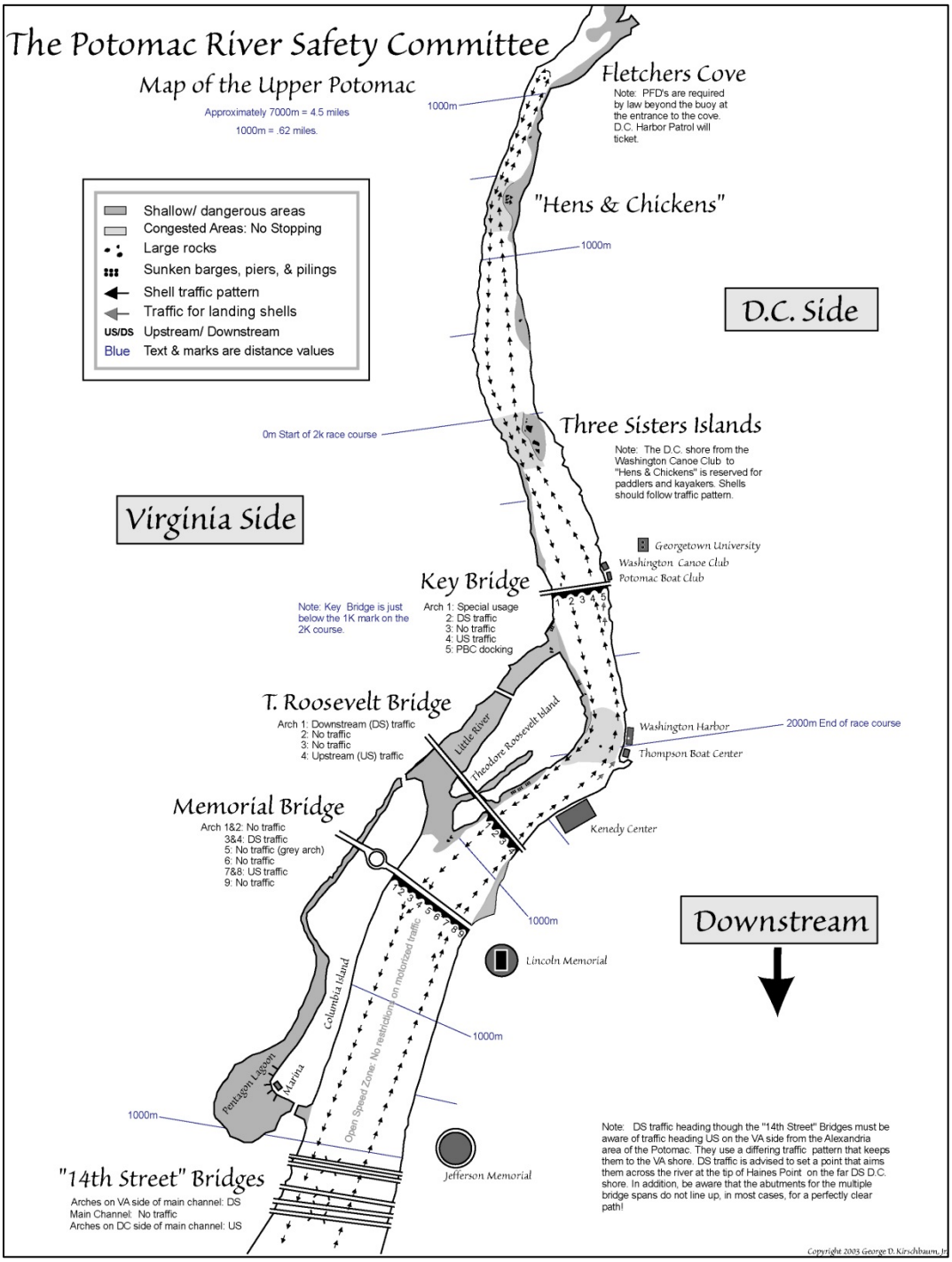


Figure 53: Non-Motorized Boat Navigation

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this Environmental Assessment. This chapter also includes definitions of impact thresholds (e.g., negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the Council on Environmental Quality (CEQ) regulations on implementing the National Environmental Policy Act, a summary of the environmental consequences for each alternative is provided in, which can be found in "Chapter 2: Alternatives." The resource topics presented in this chapter and the organization of the topics correspond to the resource discussions contained in "Chapter 3: Affected Environment."

It should be noted that the temporary trunnion shoring project would be undertaken under the No - Action Alternative and the Action Alternatives. Therefore, the impacts of the trunnion shoring must be added to the impacts of each of the alternatives. Likewise, the impacts associated with the potential land-based and river-based staging areas would occur under each of the Action Alternatives and must be added to the impacts described for each alternative.

GENERAL METHODOLOGY FOR ASSESSING IMPACTS

The following elements were used in the general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource category:

- general analysis methods as described in guiding regulations, including the context and duration of environmental effects;
- basic assumptions used to formulate the specific methods used in this analysis;
- thresholds used to define the level of impact resulting from each alternative;
- methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources; and
- methods and thresholds used to determine if impairment of specific resources would occur under any alternative.

These elements are described in the following sections.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures (NPS 2011a). This analysis incorporates the best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives.

As described in Chapter 1, the National Park Service created an interdisciplinary team to provide important input to the impact analysis. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity thresholds.

IMPACT THRESHOLDS

Determining impact thresholds is a key component in applying NPS Management Policies and Director's Order 12. These thresholds provide the reader with an idea of the intensity of a given impact on a specific topic. The impact threshold is determined primarily by comparing the effect to a relevant standard based on applicable or relevant/appropriate regulations or guidance, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. In all cases, the impact thresholds are defined for adverse impacts. Beneficial impacts are addressed qualitatively. Potential impacts of all alternatives are described in terms of type (beneficial or adverse); context; duration (short- or long-term); and intensity (negligible, minor, moderate, major). Definitions of these descriptors include:

Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

Adverse: A change that declines, degrades, and/or moves the resource away from a desired condition or detracts from its appearance or condition.

Context: Context is the affected environment within which an impact would occur, such as local, park-wide, regional, global, affected interests, society as whole, or any combination of these. Context is variable and depends on the circumstances involved with each impact topic. As such, the impact analysis determines the context, not vice versa.

Duration: The duration of the impact is described as short-term or long-term. Short-term –Impacts would not be measurable or measurable only during the construction period; Long-term –Impacts would be measurable following project construction.

Intensity: Intensity is the severity of the impact in the context in which it occurs. Because definitions of impact intensity (negligible, minor, moderate, and major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed.

CUMULATIVE IMPACTS ANALYSIS METHOD

The CEQ regulations to implement the National Environmental Policy Act require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). As stated in the CEQ handbook, "Considering Cumulative Effects" (CEQ 1997), cumulative impacts need to

be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts are considered for all alternatives, including the No-Action Alternative.

The methodology for determining cumulative effects is derived from using an "X+Y=Z" analysis where "X" represents the impacts of the alternative and "Y" is other past, present, and reasonably foreseeable future actions. When considered relative to each other, their combined contribution to the overall cumulative effect is "Z." It is important to note that, due to the disparate scale and location of the proposed actions, effects from certain proposed actions could be moderate; but, when considered in the overall context, could constitute a relatively small incremental portion of the project area and contribute to a collective minor effect. The analysis of cumulative impacts was accomplished using four steps:

Step 1 – Identify Resources Affected - Fully identify resources affected by any of the alternatives. These include the resources addressed as impact topics in Chapters 3 and 4 of the document.

Step 2 –Boundaries - Identify an appropriate spatial and temporal boundary for each resource. The spatial boundary for each resource topic is listed under each topic.

Step 3 – Identify Cumulative Action Scenario - Determine which past, present, and reasonably foreseeable future actions to include with each resource. These are described in the table.

Step 4 – Cumulative Impact Analysis - Summarize impacts of these other actions (X) plus impacts of the proposed action (Y), to arrive at the total cumulative impact (Z). This analysis is included for each resource in Chapter 4.

Figure 54 provides mapping identifying the location of each of the projects identified for cumulative impact analysis in this document, and is followed by Table 8 which provides a brief description of each of these projects.

Figure 54: Cumulative Projects

TABLE 8. CUMULATIVE IMPACTS PROJECTS OR ACTIONS

Type of Action	Cumulative Impacts Project	Description	Status
Museums and Memorials	Kennedy Center Expansion	The John F. Kennedy Center for the Performing Arts is proposing to expand their facilities to add approximately 60,000 square feet of space for classrooms, rehearsal rooms, event space and offices. Affected Resources: Water Quality; Floodplains; Wildlife; Cultural Resources; Visitor Use and Experience; Traffic and Transportation	Present
	Vietnam Veterans Memorial Visitor Center	NPS is proposing to construct a visitor center to enhance the understanding of the Vietnam Veterans Memorial and the Vietnam War. Affected Resources: Cultural Resources; Visitor Use and Experience; Transportation	Future
Civil Works Projects	Georgetown Waterfront Park Improvements	Construction began in 2008 and finished for this multi-phased project to redevelop the waterfront in Georgetown, making the Potomac River accessible to citizens for recreational and educational uses. Affected Resources: Water Quality; Floodplains; Cultural Resources; Visitor Use and Experience	Past
	DC Clean Rivers Project Potomac River Tunnel	Construction of a tunnel and supporting infrastructure for conveyance and storage of combined sewer overflows mandated by a Federal Consent Decree between DC Water, US Environmental Protection Agency and the US Department of Justice. Affected Resources: Water Quality; Floodplains; Cultural Resources; Visitor Use and Experience; Traffic and Transportation	Present
	Memorial Circle Transportation Plan	The Memorial Circle Transportation Plan was developed in an effort to reduce conflicts between trail, walkway, and roadway users and to increase overall visitor safety, while maintaining the memorial character of the area and improving mobility for vehicles, pedestrians, and bicycles. Affected Resources: Water Quality; Cultural Resources; Visitor Use and Experience; Traffic and Transportation	Future
	Theodore Roosevelt Memorial Bridge (Interstate 66 Bridge)	This project involves the rehabilitation of the Theodore Roosevelt Memorial Bridge from Constitution Avenue to the Virginia state line. The bridge superstructure and substructure and other bridge damage will be repaired. In addition, pedestrian and bicycle access will be improved. Affected Resources: Water Quality; Floodplains; Rare, Threatened and Endangered Species; Cultural Resources; Traffic and Transportation	Future
	Arlington County and Vicinity Non-Motorized Boathouse Facility	The National Park Service is studying potential sites for a boathouse facility, including indoor storage space and floating docks, for non-motorized boats within Arlington County along the Potomac River on parkland administered by George Washington Memorial Parkway. Affected Resources: Soils; Water Quality; Wildlife; Cultural Resources; Visitor Use and Experience; Traffic and Transportation	Future

WATER QUALITY

Methodology and Assumptions

Potential impacts to water quality were analyzed using professional judgment considering the proposed construction related activities, assessment of ground disturbance, and the regulations enacted to protect water quality during construction activities.

Study Area

The Potomac River is the only water body within the project area; therefore, the study area for impacts to water quality consists of the portion of the Potomac River in the immediate vicinity of the Arlington Memorial Bridge and staging areas.

Impact Thresholds

Negligible: Impacts are chemical, physical, or biological effects that would not be detectable, well below water quality standards or criteria, and within historical or desired water quality conditions.

Minor: Impacts (chemical, physical or biological effects) would be detectable but well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Impacts (chemical, physical, or biological effects) would be detectable but at or below water quality standards or criteria; however, historical baseline or desired water quality conditions would be temporarily altered.

Major: Impacts (chemical, physical, or biological effects) would be detectable and frequently altered from the historical baseline or desired water quality conditions; chemical, physical or biological water quality standards or criteria would temporarily be slightly and singularly exceeded.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the concrete and steel structural components of the Arlington Memorial Bridge would continue to deteriorate. Emergency repairs would be necessary from time to time to rehabilitate deteriorated bridge components to keep the bridge operational and safe for vehicles and pedestrians. Any required repairs to the bridge piers could require in-water work, including the removal of river bottom sediments, and impact water quality. Any repairs to the bridge that would require rehabilitation or replacement of steel components would include the use of a debris shield or some other containment system to ensure that construction debris, including lead-containing paints, do not fall into the Potomac River. Therefore, there would be short- term negligible adverse impacts to water quality under the No-Action Alternative from emergency repairs.

Under the No-Action Alternative, stormwater discharges including pollutants such as oil, road salts, and sediment would continue to run off of the bridge into the Potomac River. Therefore, there would be no change in long-term water quality impacts.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to water quality impacts. These projects include the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Vietnam Veterans Memorial Visitor Center, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary construction activities that could result in sedimentation and water quality impacts. The No-Action Alternative would contribute a negligible amount to these adverse cumulative impacts.

Conclusion. There would be short-term negligible adverse impacts to water quality under the No-Action Alternative from emergency bridge repairs. The No-Action Alternative would contribute a minor amount to the adverse cumulative impacts of past, present, and future projects in the vicinity of the Arlington Memorial Bridge. These impacts are in addition to the water quality impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

Alternative 1A would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of precast concrete box girders. Water quality impacts would be temporary and would result from suspension of sediment into the water column during the installation and removal of falsework and cofferdams. Falsework, or temporary support structures, would be placed on pilings in the river to support existing bridge components as they are removed or new bridge components as they are put in place. The placement and amount of falsework required is dependent on the construction method. Cofferdams would be installed into the bottom sediment to isolate construction activities, such as repairs to the bridge piers, from the surrounding water. Once in place the water and sediments would be pumped out of the work area formed by the cofferdam completely isolating the area from the surrounding waters.

Under Alternative 1A, Construction Method A uses a phased approach to replace the bascule span that requires full closure of the bridge to vehicles, pedestrians, and bicyclists. With this construction method, the complete removal of the bascule span alleviates the need for the installation of falsework under the bridge to support the structure during construction. Falsework would be necessary directly upstream of the bascule span within the deepest portion of the river for a temporary platform on which the replacement span would be assembled. Temporary water quality impacts associated with Construction Method A would be caused by the disturbance of river bottom sediments from the installation of pilings for falsework and from the installation of cofferdams around the bridge supports and dewatering activities that would be associated with the installation of the cofferdams. Construction Method A requires the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern

barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

Construction Method B uses a phased approach to replace the bascule span that does not require full closure of the bridge to vehicles, pedestrians, and bicyclists. In order for a portion of the bridge to remain open to vehicular traffic extensive falsework would be placed in the Potomac River under the existing bascule span and inside the abutments of the bascule span. Temporary water quality impacts associated with this method would be caused by the disturbance of river bottom sediments from the installation of pilings for falsework and from the installation of cofferdams around the bridge supports and dewatering activities that would be associated with the installation of the cofferdams. Construction Method B requires the installation of a floating barge north and south of the bridge (Barge Staging Area 2 and 1, respectively) along the western shoreline for use as construction staging areas. The use of the barge staging areas and the associated dredge activities are discussed separately below.

Erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams. Floating turbidity curtains would be installed around the work area while construction activities would be taking place (Figure 55). Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area. Floating turbidity barriers would be installed around the cofferdam during installation and removal to minimize the impacts to the surrounding water column.

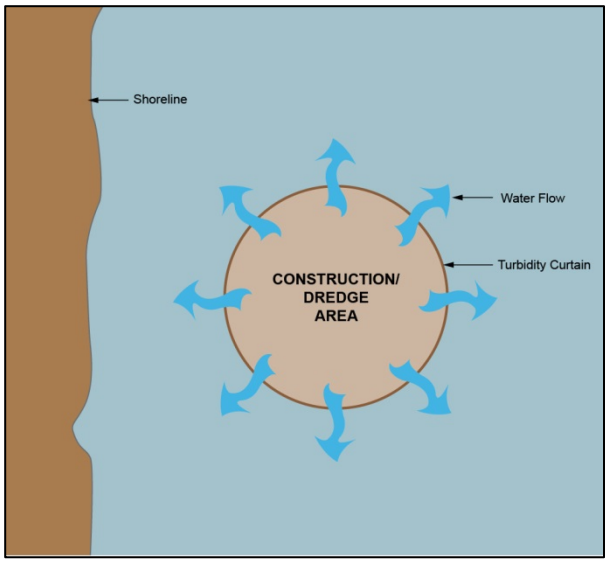


Figure 55: Typical Installation Layout of Floating Turbidity Barriers

Minor suspension of river bottom sediments into the Potomac River during installation of the temporary piles and the cofferdam would be unavoidable. However, the use of erosion and sediment controls and other best management practices would limit water quality impacts during the construction period. Alternative 1A would therefore result in minor short-term adverse impacts to water quality.

Removal of the bascule span under Alternative 1A would eliminate the potential for lead paint to flake off and enter the Potomac River. The steel bascule span was painted to match the concrete arch spans with what can be assumed to be a lead based paint due to the time of construction. Under Alternative 1A, the existing bascule span would be removed and taken off-site for disposal. A debris shield or some other containment system to ensure that construction debris, including lead-

containing paints, do not fall into the Potomac River. After the bascule span is removed, the lead paint would be properly removed from the steel components prior to their disposal or recycling. Removal of lead paint from the bascule span would result in a negligible short-term adverse impact to water quality and a long-term beneficial impact to water quality from the removal of lead paint.

Also under Alternative 1A, stormwater discharges from the bridge to the river would continue as is the current condition. Repairs would be made to the bridge's existing drainage system, and there would not be an increase in impervious area or stormwater treatment. Runoff from the bridge could include road debris, oils and other pollutants which can impact the local water quality. However, the runoff would disperse quickly due to size and current of the Potomac River. Alternative 1A would not cause an increase or decrease in the amount of runoff or associated pollutants, and therefore would not result in new adverse impacts to water quality.

Cumulative Impacts. Past, present, and future projects including the Georgetown Waterfront Park, Rehabilitation of the Lincoln Memorial Reflecting Pool, the Kennedy Center, and DC Water Clean Rivers Program would result in short-term adverse impacts and long-term beneficial impacts to water quality. During construction of these projects, minor adverse impacts to water quality could occur from earth disturbance causing sediment loss into nearby waterways. These impacts would be minimized through use of appropriate sediment and erosion control measures. Use of long-term stormwater management controls for these projects would result in beneficial impacts to water quality.

Alternative 1A would contribute a minor amount to the short-term adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.

Conclusion. Alternative 1A would result in short-term minor adverse impacts to water quality due to the installation of the spud anchors and pilings at the staging barges and falsework under and adjacent to the bridge, and the installation and dewatering of cofferdams. Alternative 1A would result in long-term beneficial impacts from the removal of lead paint. Alternative 1A would add a minor amount to short-term cumulative adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality. These impacts are in addition to the water quality impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

Alternative 1B would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of variable depth steel girders. Water quality impacts would be the same as those described under Alternative 1A. The impacts would be temporary and would result from suspension of sediment into the water column during the installation and removal of falsework and cofferdams.

The construction methods under Alternative 1B are the same as those described under Alternative 1A and would result in similar impacts to water quality.

As with Alternative 1A, under Alternative 1B, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams. Minor suspension of river bottom sediments into the Potomac River during installation of the temporary piles and the cofferdam would be unavoidable. However, the use of erosion and sediment controls and other best management practices would limit water quality impacts during the construction period. Alternative 1B would therefore result in minor short-term adverse impacts to water quality.

Removal of the bascule span under Alternative 1B would eliminate the potential for lead paint to flake off and enter the Potomac River as described under Alternative 1A. After the bascule span is removed, the lead paint would be properly removed from the steel components prior to their disposal or recycling. Removal of lead paint from the bascule span would result in a negligible short-term adverse impact to water quality and a long-term beneficial impact to water quality from the removal of lead paint.

Under Alternative 1B, impacts from stormwater discharges would be the same as those described under Alternative 1A.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Alternative 1B would contribute a minor amount to the short-term adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.

Conclusion. Alternative 1B would result in short-term minor adverse impacts to water quality due to the installation of spud anchors and pilings at the staging barges and falsework under and adjacent to the bridge, and the installation and dewatering of the cofferdams. Alternative 1B would result in long-term beneficial impacts from the removal of lead paint. Alternative 1B would add a minor amount to short-term cumulative adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality. These impacts are in addition to the water quality impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 2

Alternative 2 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of a welded steel truss. Water quality impacts would be the same as those described under Alternative 1A. The impacts would be temporary and would result from suspension of sediment into the water column during the installation and removal of falsework and cofferdams.

Under Alternative 2, a phased approach would be used to replace the bascule span. Under this alternative, complete removal of the bascule span alleviates the need for the installation of falsework

under and adjacent to the bridge to support the structure during construction. Falsework would be necessary directly upstream of the bascule span within the deepest portion of the river for a temporary platform on which the replacement span would be assembled. Temporary water quality impacts associated with Alternative 2 would be caused by the disturbance of river bottom sediments from the installation of pilings for falsework and from the installation of cofferdams around the bridge supports and dewatering activities that would be associated with the installation of the cofferdams. Alternative 2 requires the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

As with Alternative 1A, under Alternative 2, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams.

Minor suspension of river bottom sediments into the Potomac River during installation of the temporary piles and the cofferdam would be unavoidable. However, the use of erosion and sediment controls and other best management practices would limit water quality impacts during the construction period. Alternative 2 would therefore result in minor short-term adverse impacts to water quality.

Removal of the bascule span under Alternative 2 would eliminate the potential for lead paint to flake off and enter the Potomac River as described under Alternative 1A. After the bascule span is removed, the lead paint would be properly removed from the steel components prior to their disposal or recycling. Removal of lead paint from the bascule span would result in a negligible short-term adverse impact to water quality and a long-term beneficial impact to water quality from the removal of lead paint.

Under Alternative 2, impacts from stormwater discharges would be the same as those described under Alternative 1A.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. Alternative 2 would contribute a minor amount to the short-term adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.

Conclusion. Alternative 2 would result in short-term minor adverse impacts to water quality due to the installation of the spud anchors and pilings at the staging barges and falsework under and adjacent to the bridge, and the installation and dewatering of the cofferdams. Alternative 2 would result in long-term beneficial impacts from the removal of lead paint. Alternative 2 would add a minor amount to short-term cumulative adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality. These impacts are in addition to the water quality impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

Alternative 3 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the repair/rehabilitation of all necessary elements of the existing bascule span in place, with the exception of the rehabilitation trunnion posts which may need to be completely replaced. Water quality impacts would be similar to Alternative 1A. Impacts would be temporary and would result from suspension of sediment into the water column during the installation and removal of falsework and cofferdams.

Under Alternative 3 rehabilitation of the bascule span would require falsework under and adjacent to the bridge to support the structure during construction. Temporary water quality impacts associated with Alternative 3 would be caused by the disturbance of river bottom sediments from the installation of pilings for falsework and from the installation of cofferdams around the bridge supports and dewatering activities that would be associated with the installation of the cofferdams. Alternative 3 requires the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

As with Alternative 1A, under Alternative 3, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams.

Minor suspension of river bottom sediments into the Potomac River during installation of the temporary piles and the cofferdam would be unavoidable. However, the use of erosion and sediment controls and other best management practices would limit water quality impacts during the construction period. Alternative 3 would therefore result in minor short-term adverse impacts to water quality.

Rehabilitation of the bascule span under Alternative 3 would include the removal of lead paint. A containment system would be used during the paint removal process to prevent lead paint from entering the Potomac River. As part of the rehabilitation, the bascule span would be repainted

Removal of lead paint from the bascule span would result in a negligible short-term adverse impact to water quality and a long-term beneficial impact to water quality from the removal of lead paint.

Under Alternative 3, impacts from stormwater discharges would be the same as those described under Alternative 1A.

Cumulative Impacts. As described for Alternative 1A, Alternative 3 would contribute a minor amount to the short-term adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.

Conclusion. Alternative 3 would result in short-term minor adverse impacts to water quality due to the installation of spud anchors and pilings at the staging barges and falsework under and adjacent to the bridge, and the installation and dewatering of the cofferdams. Alternative 3 would result in long-term beneficial impacts from the removal of lead paint. Alternative 3 would add a minor amount to short-term cumulative adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality. These impacts are in addition to the water quality impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. Depending on design, pilings may need to be placed in the Potomac River to support the steel beams. Should pilings be used for construction, temporary water quality impacts associated with this alternative could include bottom sediment disturbance from the installation and removal of the pilings.

Erosion and sediment controls and various best management practices such as the use of floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings. Floating turbidity curtains would be installed around the work area while construction activities would be taking place. Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area. The trunnion post shoring project would cause a short-term negligible adverse impact to water quality. No long-term impacts to water quality would occur.

Cumulative Impacts. Past, present, and future projects including the Georgetown Waterfront Park, Rehabilitation of the Lincoln Memorial Reflecting Pool, the Kennedy Center, and DC Water Clean Rivers Program would result in short-term adverse impacts and long-term beneficial impacts to water quality. During construction of these projects, minor adverse impacts to water quality could occur from earth disturbance causing sediment loss into nearby waterways. These impacts would be minimized through use of appropriate sediment and erosion control measures. Use of long-term stormwater management controls for these projects would result in beneficial impacts to water quality.

Shoring of the trunnion posts would contribute a minor amount to the short-term adverse impacts and a negligible amount to the long-term beneficial cumulative impacts to water quality.

Conclusion. In addition to the impacts of the Action Alternatives on water quality, temporary shoring of the trunnion post may result in short-term minor adverse impacts to water quality due to the possible installation of pilings under the bridge. Activities associated with the trunnion post shoring project would contribute negligibly to overall short-term adverse cumulative impacts to water quality and would not contribute to the long-term beneficial cumulative impacts to water quality.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Areas A, B, C, and D. Erosion and sediment controls and various other best management practices such as silt fencing, sediment traps, and vegetative stabilization would be employed as needed during use of the staging areas to minimize soil erosion and release of sediments into the Potomac River in accordance with the District Department of the Environment's 2013 Rule on Stormwater Management and Soil Erosion and Sediment Control. After completion of construction activities, the staging areas would be restored to a grassed area. Therefore, use of Staging Areas A, B, C and D would result in short-term negligible adverse impacts to water quality.

Construction Causeways. Up to four construction causeways may be constructed on the north and south side of the bridge from the east and west shores. These causeways would be constructed by placing a filter fabric on the bottom of the river and then constructing the causeway on top of the fabric. The installation of the filter fabric and causeway materials in the river would result in a temporary impact to water quality. Turbidity would result from the fill materials being placed within the river and would be minimized with the use of floating turbidity barriers. Water quality impacts would be temporary and limited to the periods of installation and removal of the construction causeways. After construction is complete, the area would be restored to its current condition; therefore, there would be no long-term impacts to water quality.

Dock/Work Platforms. Placement of dock/work platforms in the Potomac River would require the installation of temporary pilings in the river bottom. The installation of the pilings would result in temporary water quality impacts from bottom sediment disturbance. Once construction is complete, the pilings would be removed resulting in additional disturbance of the river bottom sediment. Placement and removal of the dock/work platform would result in short-term minor adverse impacts to water quality. After construction is complete, the area would be restored to its current condition; therefore, there would be no long-term impacts to water quality.

Barge Staging Areas 1 and 2. Use of Barge Staging Areas 1 and 2 would require the installation of temporary spud anchors into the Potomac River bottom to anchor barges which would be used to store construction materials. Pilings may also need to be placed in the river to hold a temporary platform to access the barges from land. The installation of the spud anchors and pilings would result in temporary water quality impacts from bottom sediment disturbance. In addition, to move

construction materials between the barge staging areas and the bridge, dredging would need to occur under and adjacent to the barge and within a dredge channel extending north to the bridge (Figure 56). Barge Staging Area 1 is located within water ranging from 7 to 22 feet in depth Barge Staging Area 1 and the associated dredge footprint would require the removal of 10,000 cubic yards of sediment. Barge Staging Area 2 is located within water ranging from 1 to 6 feet in depth. To utilize the barge and to access the bridge, dredging would need to occur under and adjacent to the barge, and within a dredge channel extending south to the bridge. The barge staging area and the associated dredge footprint would require the removal of 80,000 cubic yards of sediment. In addition, 100 square feet of spud anchors would be needed to support the barges. Mechanical dredge techniques (as opposed to hydraulic dredging techniques) would be employed to minimize impacts to federally listed species as discussed in the wildlife section. Water quality impacts of dredging include turbidity/siltation effects and potential contaminant suspension.

Erosion and sediment controls and various best management practices such as floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings. Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area. Figure 55 is a typical plan view of how a floating turbidity curtain would be placed around the barge during operation. This curtain moves as the barge moves to isolate the sediment within an immediate work area.

Suspension of river bottom sediments into the Potomac River during installation of the temporary piles and dredging would be unavoidable. However the use of erosion and sediment controls and other best management practices would limit water quality impacts during construction period. Barge Staging Areas 1 and 2 and the associated dredge activities would result in short-term minor adverse impacts to water quality.

After construction is complete, the staging barges, spud anchors, and pilings would be removed. Therefore, there would be no long-term impacts to water quality from the use of Barge Staging Areas 1 and 2.

Cumulative Impacts. Past, present, and future projects including the Georgetown Waterfront Park, Rehabilitation of the Lincoln Memorial Reflecting Pool, the Kennedy Center, and DC Water Clean Rivers Program would result in short-term adverse impacts and long-term beneficial impacts to water quality. During construction of these projects, minor adverse impacts to water quality could occur from earth disturbance causing sediment loss into nearby waterways. These impacts would be minimized through use of appropriate sediment and erosion control measures. Use of long-term stormwater management controls for these projects would result in beneficial impacts to water quality.

The use of Barge Staging Areas 1 and 2 and associated dredge activities would add a moderate amount to the short-term adverse cumulative impacts to water quality. The use of the staging areas would not contribute to long-term cumulative impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, with proper sediment and erosion control, use of the land staging areas would result in short-term negligible impacts to water quality. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, the use of Barge Staging Areas 1 and 2 and the associated dredge activities would result in short-term minor adverse impacts to water quality. There would be no long-term impacts from the use of the barge staging areas. The use of Barge Staging Areas 1 and 2 and associated dredge activities would add a moderate amount to the short-term adverse cumulative impacts to water quality. The use of the staging areas would not contribute to long-term cumulative impacts.

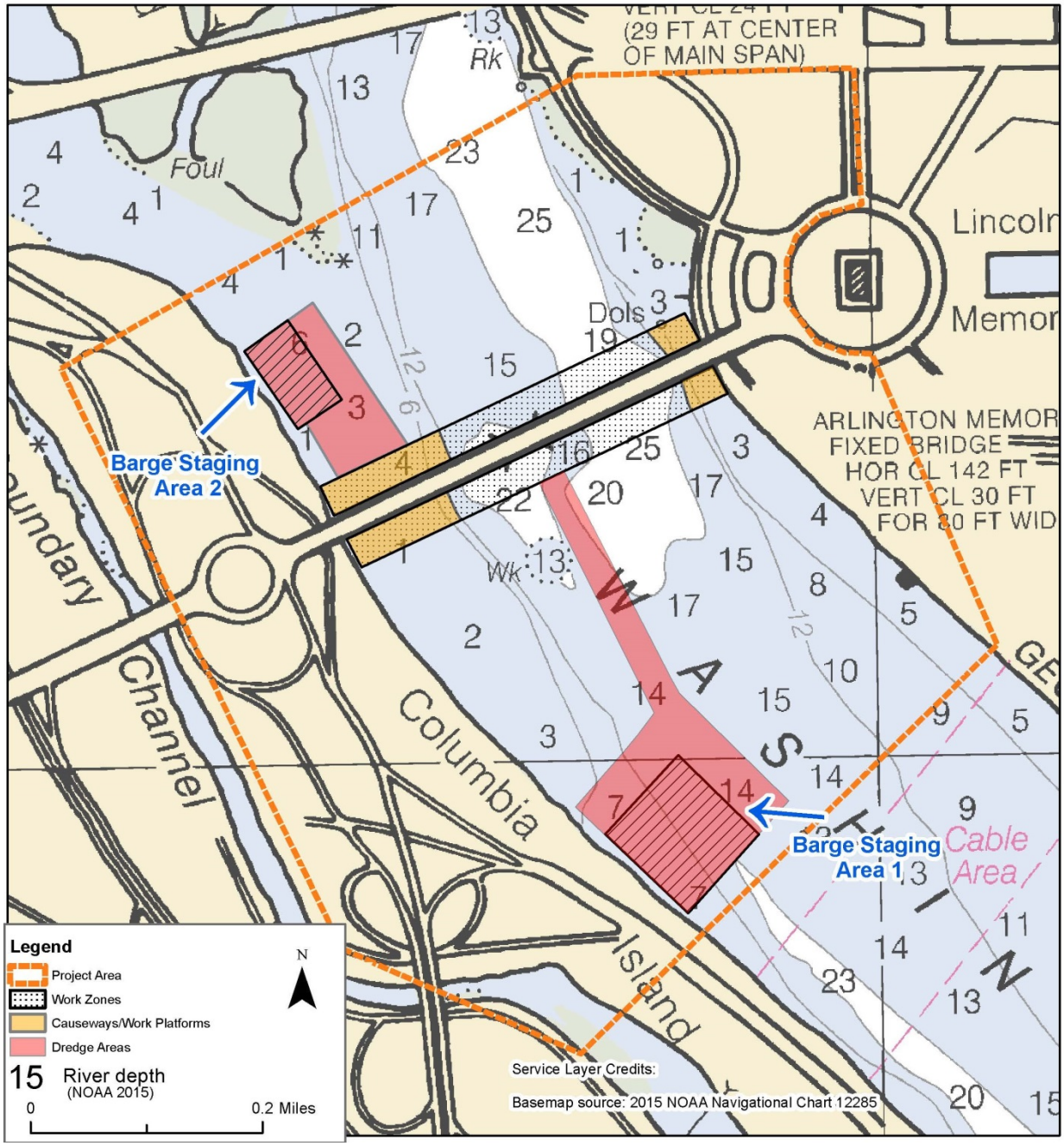


Figure 56: Barge Staging Areas 1 and 2

RIVERINE

Methodology and Assumptions

Potential impacts to riverine systems were analyzed using professional judgment considering the proposed construction related activities, the area of disturbance, and the regulations enacted to protect wetlands during construction activities. The National Park Service protects and preserves wetlands and water resources under Executive Order 11990, Director's Order 77-1, 2002 and the NPS Procedural Manual 77-1: Wetland Protection, 2011. According to NPS Director's Order 77-1, a statement of findings is required when the proposed action would occur in a wetland, unless the action qualifies for an exemption.

Study Area

The study area for riverine impacts consists of the portion of the Potomac River adjacent to the Arlington Memorial Bridge, the barge staging areas and the dredge areas. The Potomac River study area contains both wetland and deepwater habitat.

Impact Thresholds

Negligible: The action would result in a change to the riverine system, but the change would be so small it would not be of any measurable or perceptible consequence.

Minor: The action would result in a change to the riverine system, but the change would be small and localized and of little consequence. Mitigation would be needed to offset adverse impacts. The mitigation would be relatively simple to implement and would likely be successful.

Moderate: The action would result in a change to the riverine system. The change would be measurable and of consequence. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

Major: The action would result in a noticeable change to the riverine system. The change would be measurable and result in severely adverse impact. Mitigation measures necessary to offset adverse impacts would be needed and extensive, and their success would not be guaranteed.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the concrete and steel structural components of the Arlington Memorial Bridge would continue to deteriorate. Emergency repairs would be necessary from time to time to rehabilitate deteriorated bridge components to keep the bridge operational and safe for vehicles and pedestrians. Any required repairs to the bridge piers could impact wetlands including unconsolidated bottom habitat and submerged aquatic vegetation. Therefore, the No-Action Alternative could have short-term minor adverse impacts to riverine systems.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine systems. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine systems from in-water work. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of these projects.

Conclusion. The No-Action Alternative could have short-term minor adverse impacts to riverine systems from emergency repairs on the bridge piers. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of past, present, and future projects in the area. These impacts are in addition to the riverine impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

Alternative 1A would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of precast concrete box girders.

Under Alternative 1A, the unconsolidated bottom of the deepwater riverine system would be impacted by the installation and removal of falsework and cofferdams. Falsework, or temporary support structures, would be placed on pilings in the river to support existing bridge components as they are removed or new bridge components as they are put in place. The placement and amount of falsework required is dependent on the construction method. Cofferdams would be installed to isolate construction activities, such as repairs to the bridge piers, from the surrounding water. Once in place the water and sediment would be pumped out of the work area formed by the cofferdam completely isolating the area from the surrounding waters. The installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams under Alternative 1A would result in short-term minor adverse impacts to riverine deepwater habitat.

Under Alternative 1A, Construction Method A uses a phased approach to replace the bascule span that requires full closure of the bridge to vehicles, pedestrians, and bicyclists. With this construction method, the complete removal of the bascule span alleviates the need for the installation of falsework under and adjacent to the bridge to support the structure during construction. Falsework would be necessary directly upstream of the bascule span within the deepest portion of the river for a temporary platform on which the replacement span would be assembled. Construction Method A requires the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

Construction Method B uses a phased approach to replace the bascule span that does not require full closure of the bridge to vehicles, pedestrians, and bicyclists. In order for a portion of the bridge to

remain open to vehicular traffic extensive falsework would be placed in the Potomac River under the existing bascule span and inside the abutments of the bascule span. Construction Method B requires the installation of a floating barge north and south of the bridge (Barge Staging Area 2 and 1, respectively) along the western shoreline for use as construction staging areas. The use of the barge staging areas and the associated dredge activities are discussed separately below.

Temporary and permanent impacts to wetlands, as defined by the National Park Service, would also occur from repairs to the bridge piers. Temporary impacts to submerged aquatic vegetation would result from the use of the cofferdams to repair to the concrete bridge piers along the western shoreline. This impact would result from the placement of the cofferdam directly onto the vegetation as well as the removal of the vegetation and sediments within the cofferdam so that the pier foundations can be repaired. If the footings of piers at the western side of the bridge are undermined, scour countermeasures such as riprap would be placed on the river bottom around the piers for protection. These countermeasures would result in approximately 1.4 acres of permanent impact to submerged aquatic vegetation.

Therefore, there would be long-term minor adverse impact to riverine systems under Alternative 1A. A Wetland Statement of Findings has been prepared for the proposed project and is included in Appendix B.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine systems. Projects including the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine systems from in-water work. Alternative 1A would contribute a minor amount to the adverse cumulative impacts of these projects.

Conclusion. Alternative 1A would result in short-term minor adverse impacts to riverine deep-water habitat due to the installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams. Alternative 1A would result in long-term minor adverse impacts to riverine systems from the placement of scour countermeasures around bridge piers near the western shore. Once construction is complete, riverine habitats would be restored within the project area. Alternative 1A would contribute a minor amount to the adverse cumulative impacts on riverine systems of past, present, and future projects in the area. These impacts are in addition to the riverine impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

Alternative 1B would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of variable depth steel girders. Impacts to riverine systems would be the same as those described under Alternative 1A. The unconsolidated bottom of the deepwater riverine habitat would be impacted by the installation and removal of falsework and cofferdams. The installation of the pilings for the

falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams under Alternative 1B would result in short-term minor adverse impacts to riverine deepwater habitat.

The construction methods under Alternative 1B are the same as those described under Alternative 1A and would result in similar impacts to riverine systems. As with Alternative 1A, under Alternative 1B, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams. As with Alternative 1A, if the footings of piers at the western side of the bridge are undermined, scour countermeasures such as riprap would be placed on the river bottom around the piers for protection. These countermeasures would result in approximately 1.4 acres of permanent impact to submerged aquatic vegetation. Therefore, there would be long-term minor adverse impact to riverine systems under Alternative 1B.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Alternative 1B would contribute a minor amount to the adverse cumulative impacts of these projects.

Conclusion. Alternative 1B would result in short-term minor adverse impacts to riverine deepwater habitat due to the installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams. Alternative 1B would result in long-term minor adverse impacts to riverine systems from the placement of countermeasures around the bridge piers near the western shore. Alternative 1B would contribute a minor amount to the adverse cumulative impacts on riverine systems of past, present, and future projects in the area. These impacts are in addition to the riverine impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 2

Alternative 2 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of a welded steel truss. Impacts to riverine systems would be the same as those described under Alternative 1A. The unconsolidated bottom of the deepwater riverine habitat would be impacted by the installation and removal of falsework and cofferdams. The installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams under Alternative 1B would result in short-term minor adverse impacts to riverine deepwater habitat.

The construction methods under Alternative 2 are the same as those described under Alternative 1A-Method A, and would result in similar impacts to riverine systems. As with Alternative 1A, under Alternative 2, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams. As with Alternative 1A, if the footings of piers at the western side of the bridge are

undermined, scour countermeasures such as riprap would be placed on the river bottom around the piers for protection. These countermeasures would result in approximately 1.4 acres of permanent impact to submerged aquatic vegetation. Therefore, there would be long-term minor adverse impact to riverine systems under Alternative 2.

Construction of Alternative 2 would require the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. Alternative 2 would contribute a minor amount to the adverse cumulative impacts of these projects.

Conclusion. Alternative 2 would result in short-term minor adverse impacts to riverine deepwater habitat due to the installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams. Alternative 2 would result in short-term minor adverse impacts to the riverine systems from work on the bridge piers. Once construction is complete, riverine habitats would be restored within the project area. Therefore, there would be no long-term impacts. Alternative 2 would contribute a minor amount to the adverse cumulative impacts on riverine systems of past, present, and future projects in the area. These impacts are in addition to the riverine impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

Alternative 3 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the repair/rehabilitation of all necessary elements of the existing bascule span in place, with the exception of the rehabilitation trunnion posts which may need to be completely replaced. The unconsolidated bottom of the deepwater riverine habitat would be impacted by the installation and removal of falsework and cofferdams. The installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams under Alternative 3 would result in short-term minor adverse impacts to riverine deepwater habitat.

Under Alternative 3, a phased approach would be used to repair the bascule span. Under this alternative, repair or replacement of the trunnion posts would require the installation of falsework under and adjacent to the bridge to support the structure during construction. As with Alternative 1A, under Alternative 3, erosion and sediment controls and various best management practices such as the use of cofferdams and floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and cofferdams.

As with Alternative 1A, if the footings of piers at the western side of the bridge are undermined, scour countermeasures such as riprap would be placed on the river bottom around the piers for protection. These countermeasures would result in approximately 1.4 acres of permanent impact to

submerged aquatic vegetation. Therefore, there would be long-term minor adverse impact to riverine systems under Alternative 1B.

Alternative 3 requires the installation of a floating barge south of the bridge along the western shoreline for use as a construction staging area. The use of the southern barge staging area, Barge Staging Area 1 and the associated dredge activities are discussed separately below.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A. Alternative 3 would contribute a minor amount to the adverse cumulative impacts of these projects.

Conclusion. Alternative 3 would result in short-term minor adverse impacts to riverine deepwater systems due to the installation of the pilings for the falsework under and adjacent to the bridge and the installation and dewatering of the cofferdams. Alternative 3 would result in short-term minor adverse impacts to the riverine systems from work on the bridge piers. Once construction is complete, riverine habitats would be restored within the project area. Therefore, there would be no long-term impacts. Alternative 3 would contribute a minor amount to the adverse cumulative impacts on riverine systems of past, present, and future projects in the area. These impacts are in addition to the riverine impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. Depending on design, pilings may need to be placed in the Potomac River to support the steel beams. Should pilings be used for construction, temporary impact to the deep water riverine bottom would occur from the installation of the pilings.

Erosion and sediment controls and various best management practices such as the use of floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings. Floating turbidity curtains would be installed around the work area while construction activities would be taking place. Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area. This would minimize the amount of sediment that could affect other wetlands immediately downstream. In

addition, the proposed turbidity barriers would eliminate the potential for the sediment to travel downstream and possibly settle out on the areas with submerged aquatic vegetation beds.

Trunnion post shoring may result in short-term negligible impacts to the riverine systems should pilings be installed. All impacts to the riverine system would be related to construction activities; therefore there would be no long-term impacts to the riverine systems.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine systems. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine systems from in-water work. If the trunnion post shoring is undertaken at the same time as these projects, it could add a negligible amount to these adverse cumulative impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives, temporary trunnion post shoring may result in short-term negligible impacts to the riverine systems should pilings be installed. All impacts to the riverine system would be related to construction activities; therefore there would be no long-term impacts to the riverine systems. If the trunnion post shoring is undertaken at the same time as other projects, it could add negligibly to overall adverse cumulative impacts.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Areas A, B, C and D. Erosion and sediment controls and various other best management practices such as silt fencing, sediment traps, and vegetative stabilization would be employed as needed during use of the staging areas to minimize soil erosion and release of sediments into the Potomac River in accordance with the District Department of the Environment's 2013 Rule on Stormwater Management and Soil Erosion and Sediment Control. After completion of construction activities, the staging areas would be restored to a grassed area. Therefore, use of Staging Area A, B, C and D would result in short-term negligible adverse impacts to riverine systems.

Construction Causeways. Up to four construction causeways may be constructed on the north and south side of the bridge from the east and west shores. These causeways would be constructed by placing a filter fabric on the bottom of the river and then constructing the causeway on top of the fabric. The installation of the filter fabric and causeway materials would result in a temporary impact to the riverine bottom resulting from the placement of the fill material and the compaction caused by the weight of the material. The placement of the causeway in areas with submerged aquatic vegetation would result in temporary elimination of approximately 2.7 acres of vegetation until the causeway is removed and the bottom is returned to the original depth. The causeways would impact

approximately 2.5 acres of unconsolidated bottom wetlands as defined by the National Park Service. After construction is complete the causeways would be removed. Placement of filter fabric on the river bottom prior to placement of the causeway material would ensure that the bottom sediment composition would remain the intact. Submerged aquatic vegetation would be re-established within the impact areas; therefore there would be no long-term impacts to riverine systems.

Dock/Work Platforms. Placement of dock/work platforms in the Potomac River would require the installation of temporary pilings in the river bottom. The installation of these pilings would result in temporary riverine impacts from bottom sediment disturbance and to submerged aquatic vegetation on the west side of the river. Once construction is complete, the pilings would be removed resulting in additional disturbance of the river bottom sediment. Placement and removal of the dock/work platform would result in short-term minor adverse impacts to the riverine bottom. After construction is complete the bottom would be returned to the original depth and submerged aquatic vegetation would be re-established within the impact areas; therefore there would be no long-term impacts to riverine systems.

Barge Staging Area 1. Use of Barge Staging Area 1 would require the installation of temporary spud anchors into the Potomac River bottom to anchor barges which would store construction materials. Pilings may also need to be placed in the river to hold a temporary platform to access the barges from land. The installation of the spud anchors and pilings would result in temporary water quality impacts from bottom sediment disturbance. The impact to the bottom would have temporary impact to the macroinvertebrate species within the impact footprint. Erosion and sediment controls and various best management practices such as the use floating turbidity curtains would be employed as needed during construction to limit the areas affected by sediment suspension to a limited work area around the pilings and staging barges. Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area and minimizing impacts to macroinvertebrate species.

In addition, to move construction materials between the barge staging area and the bridge, dredging would need to occur under and adjacent to the barge and within a dredge channel extending north to the bridge (Figure 57). Barge Staging Area 1 and the associated dredge footprint would require the removal of 10,000 cubic yards of sediment and impact approximately 2.6 acres of unconsolidated bottom wetlands as defined by the National Park Service and 12 acres of deep water river bottom. Use of Barge Staging Area 1 would not impact submerged aquatic vegetation. Mechanical dredge techniques would be employed to minimize impacts to federally listed species as discussed in the wildlife section. Dredging activities may impact aquatic ecosystems by removing, disturbing, disposing, and suspending bottom sediments, modifying substrate and impacting the community structure of benthic macrofauna. Environmental impacts of dredging include direct removal/burial of organisms, turbidity/siltation effects, contaminant suspension, noise/disturbance, alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat (ASSRT 2007).

After construction is complete the bottom would be returned to the original depth; therefore there would be no long-term impacts to riverine systems from the use of Barge Staging Area 1.

Barge Staging Area 2. Like Barge Staging Area 1, use of Barge Staging Area 2 would require the installation of temporary spud anchors into the Potomac River bottom to anchor barges which would store construction materials. Pilings may also need to be placed in the river to hold a temporary platform to access the barges from land. Impacts associated with Barge Staging Area 2 would be similar to those of Barge Staging Area 1. However, Barge Staging Area 2 and portions of the dredge footprint are currently mapped as being 70 to 100% colonized with submerged aquatic vegetation. Dredge operations would temporarily remove approximately 3.3 acres of submerged aquatic vegetation and approximately 2.9 acres of unconsolidated bottom wetlands within the dredge footprint. Removal of this vegetation would have a short-term moderate adverse impact on various fish and crab species that use it for habitat, food and shelter. After construction is complete the bottom would be returned to the original depth and submerged aquatic vegetation would be re-established within the impact areas; therefore there would be a negligible long-term impact to riverine systems.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine systems. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine systems from in-water work. The use of land staging areas would not contribute to the cumulative adverse impacts of these projects. Use of Barge Staging Area 1 and Barge Staging Area 2 and associated dredge activities add a moderate amount to the adverse cumulative impacts to riverine systems.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the land staging areas would result in short-term negligible adverse impacts to riverine systems. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the barge staging areas would have a range of short-term impacts from minor to moderate attributed to the dredging activities and removal of submerged aquatic vegetation. Use of Barge Staging Area 1 and Barge Staging Area 2 and associated dredge activities would result in short-term moderate impacts. Staging areas would be restored following construction. Therefore, there would be negligible to no long-term impacts to riverine systems.

The use of land staging areas would not contribute to the cumulative adverse impacts. Use of Barge Staging Area 1 and Barge Staging Area 2 and associated dredge activities would add a moderate amount to the adverse cumulative impacts to riverine systems.

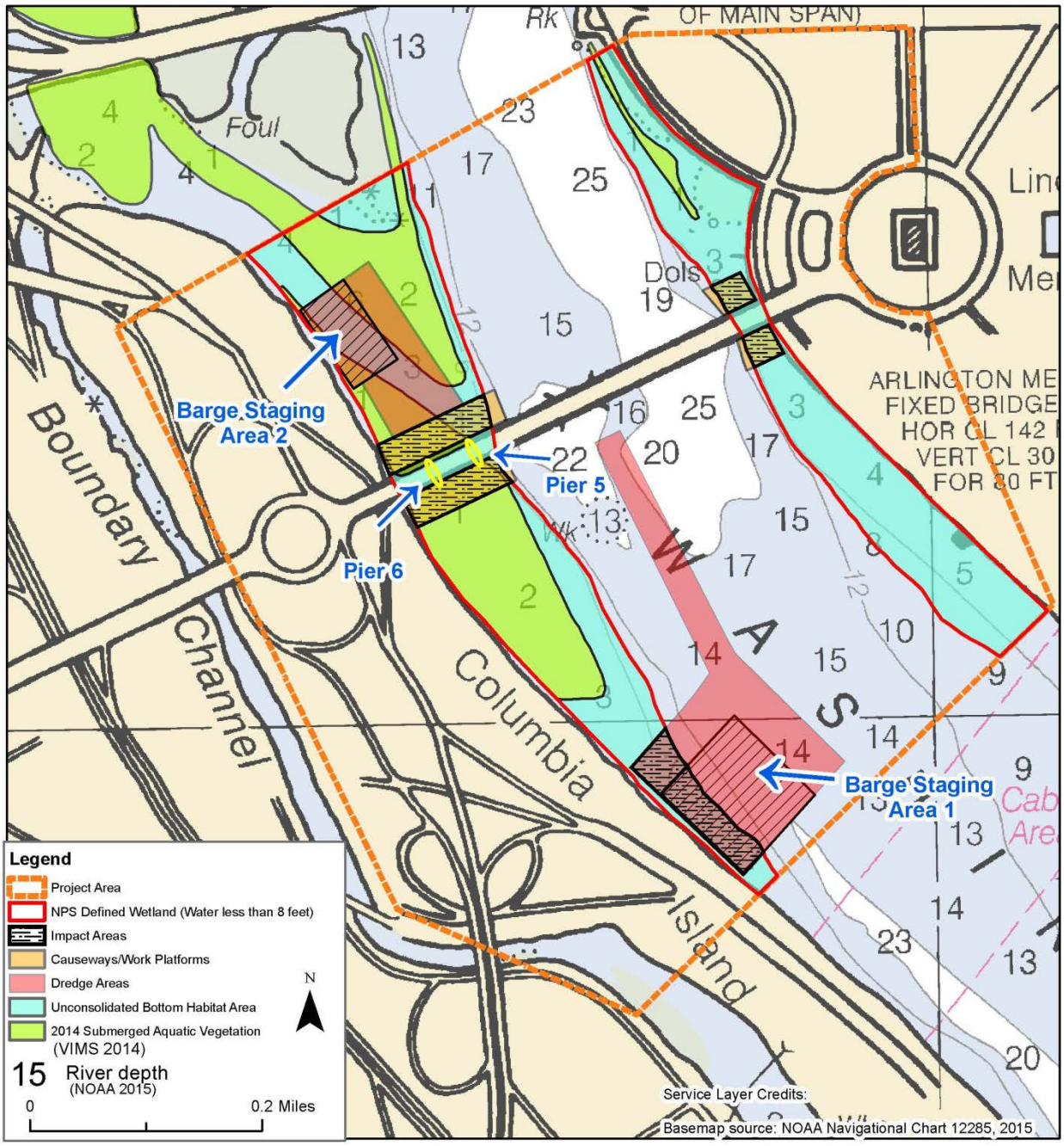


Figure 57: Barge Staging Areas and Associated Dredging with Submerged Aquatic Vegetation

WILDLIFE INCLUDING RARE, THREATENED, AND ENDANGERED SPECIES

Methodology and Assumptions

Potential impacts to wildlife, including threatened and endangered species and migrating anadromous fish, were analyzed based on review of technical documents regarding species habitats and life histories, and using professional judgment. The proposed in-water construction activities and best management practices for reducing risk of impacts during construction activities were considered.

Study Area

The study area for rare, threatened, and endangered species is the area of proposed activities within the Potomac River and the proposed staging areas.

Impact Thresholds

Negligible: No observable or measurable impacts to native species and/or federally listed species would be affected, or the action would affect an individual of a listed species or its habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. For federally listed species, negligible effect would equate with a "no effect" determination by the National Marine Fisheries Service.

Minor: The action would result in detectable impacts to an individual (or individuals) of native species and/or a federally listed species or its habitat, but would not be expected to result in substantial population fluctuations and would not be expected to have any measurable long-term effects on species, habitats, or natural processes sustaining them. For federally listed species, minor effects would equate with a "may affect but not likely to adversely affect" determination by the National Marine Fisheries Service. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: The action would result in detectable impacts on individuals or populations of a native species and/or a federally listed species, habitat, or the natural processes sustaining them. Key ecosystem processes would experience disruptions that may result in population or habitat condition fluctuations that would be outside the range of natural variation, but which would be expected to return to natural conditions. For federally listed species, moderate adverse effects would equate with a "may affect / adversely modify critical habitat" determination by the National Marine Fisheries Service. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Populations of native species and/or federally listed species, habitat, or the natural processes sustaining them would be measurably affected. Key ecosystem processes would be permanently altered, resulting in changes in populations that could affect the vitality of the population and permanently modify habitat. For federally listed species, major adverse effects would equate with a

"may affect / likely to adversely affect/adversely modify habitat" determination by the National Marine Fisheries Service. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the concrete and steel structural components of the Arlington Memorial Bridge would continue to deteriorate. Emergency repairs would be necessary from time to time to rehabilitate deteriorated bridge components to keep the bridge operational and safe for vehicles and pedestrians. Any required repairs to the bridge piers could require work in the Potomac River and therefore affect fish species, including the federally listed shortnose and Atlantic sturgeons.

Emergency repairs could require work within the water including the installation of falsework and the use of construction barges. The installation of the pilings would require disturbance to the river bottom. Fish species would be affected by disturbed sediments and disturbed surface waters, as well as underwater construction noise and vibration from pile installation and shock waves produced by pile driving if piling driving is used. Pile driving has been known to produce shock waves in the water column that disturb, and in extreme cases, kill nearby fish. Based on information obtained from the "Biological Assessment of Impacts to the Shortnose Sturgeon" prepared for the South Capitol Street project, fish kills would be associated with shock waves above six pounds per square inch. Shock waves of this magnitude are normally associated with piles larger than 66 inches in diameter. The piles needed for the trunnion post shoring would be less than 24 inches in diameter and would not result in shock waves of this magnitude. Therefore, these activities would not be expected to result in fish mortality.

Should pilings be needed, they would not be installed between February 15th and July 1st to avoid impacts to migrating anadromous fish. Floating turbidity curtains or barriers would be used to minimize the disturbances and to prevent fish from entering the construction areas. Floating turbidity barriers extend from the surface of the water and would be anchored to the river bottom and do not allow the sediment to pass through, thereby trapping the sediment within the work area. The noise and disturbance to the water column during construction would cause fish species, including sturgeons or other anadromous fish species, to temporarily avoid the construction area and relocate to similar nearby habitat. Exclusionary devices such as cofferdams and visual deterrents such as turbidity curtains would serve to limit potential direct affects with the fish in addition to limiting the amount of noise generated into the water column from any pile driving activities. Based on the short duration of the in-water work, repairs to the trunnion posts may result in short-term negligible adverse impacts to native fish species.

Activities associated with emergency repairs would result in short-term minor adverse impacts to wildlife and/or federally listed species from the construction activities. These repairs would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species are not expected under the No-Action Alternative.

Atlantic and Shortnose Sturgeon. Based on available information, the shortnose sturgeon has been documented in the Potomac River upstream to Little Falls. Suitable spawning habitat is thought to exist in the area downstream of Little Falls and in the Fletchers-Chain Bridge reach. The portion of the Potomac River adjacent to the Arlington Memorial Bridge is not identified as suitable spawning habitat, but serves as a migratory route to the upstream spawning areas. If emergency repairs are required, construction activities would not take place during the migration period of the sturgeon (February 15 through June 15 time-of-year restriction). In the event that sturgeons or other anadromous fish species would be present in the project vicinity during construction, best management practices would limit their exposure to potentially harmful activities including turbidity curtains and coffer dams.

Emergency activities within the river could result in suspension of sediments into the water column which could impact the sturgeon if they are present. The construction activity could lead to potential boat strikes from the use of barges, and the piling installation would create acoustical noise which could impact the fish's swim bladder. The use of turbidity barriers and cofferdams as well as time of the year restrictions would limit the impact of construction activities on the sturgeon. Therefore, activities associated with emergency repairs, including trunnion post shoring, would result in short-term minor impacts to the Atlantic and shortnose sturgeon from construction activities. Long-term effects on sturgeon are not expected under the No-Action Alternative. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015 (see Appendix A, Consultation Letters).

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine systems. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact fish species from in-water work. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of these projects.

Conclusion. The No-Action Alternative could result in short-term minor adverse impacts to wildlife from in-water work for emergency repairs to the bridge piers. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. The No-Action Alternative would contribute a negligible amount to the adverse cumulative impacts of past, present, and future projects on wildlife. These impacts are in addition to the wildlife impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

Alternative 1A would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of precast concrete box girders. Impacts under Alternative 1A would be limited to the deepwater riverine habitat. The riverine impacts would be construction-related temporary impacts and limited to the bridge and adjacent work areas. No terrestrial habitat would be impacted under Alternative 1A. No impacts are anticipated to native birds as they are either not nesting in the immediate area, as is the case with the eagles and osprey species, or would be local native species, such as pigeons, which are habituated to the urban environment.

Under Alternative 1A, both Construction Methods A and B would require the installation of temporary falsework and associated pilings within the deepwater portion of the Potomac River and construction work on the bridge piers. This construction work could affect the native fish species. The installation of the pilings for falsework and cofferdams around the bridge piers would require disturbance to the river bottom. Fish species would be affected by disturbed sediments and disturbed surface waters, underwater construction noise and vibration from pile installation, and shock waves produced by pile driving if piling driving is used. Pile driving has been known to produce shock waves in the water column that disturb, and in extreme cases, kill nearby fish. Based on information obtained from the "Biological Assessment of Impacts to the Shortnose Sturgeon" prepared for the South Capitol Street project, fish kills would be associated with shock waves above 6 pounds per square inch. Shock waves of this magnitude are normally associated with piles larger than 66 inches in diameter. The piles needed for the falsework would be less than 24 inches in diameter and would not result in shock waves of this magnitude. Therefore, installation of pilings under Alternative 1A would not be expected to result in fish mortality.

The bridge rehabilitation work would require the installation of cofferdams around bridge piers. Once in place the water and sediments would be pumped out of the work area formed by the cofferdam completely isolating the area from the surrounding waters. The installation of cofferdams would have a short-term temporary impact to the fish during installation and dewatering which would cause disturbances to the water column. Once installed, the cofferdams would provide noise attenuation to minimize impacts to fish.

Direct temporary impacts to submerged aquatic vegetation which provide fish habitat would result from the use of the cofferdams to repair to the concrete bridge piers along the western shoreline. This impact would result from the placement of the cofferdam directly onto the vegetation as well as the stress of the vegetation within the cofferdam while dewatered. There is no proposed change in elevation of the river bottom; therefore the vegetation is expected to recover once the cofferdam is removed. This temporary impact would reduce potential habitat for fish and other marine species during and after construction until the submerged aquatic vegetation recolonizes.

Turbidity curtains would be used to minimize the disturbances and visually deter fish from entering the construction areas. Floating turbidity curtains would be installed around the work area while construction activities are taking place. Floating turbidity barriers extend from the surface of the

water and would be anchored to the river bottom and do not allow the sediment to pass through thereby trapping the sediment within the work area. The noise and disturbance to the water column during construction would cause fish species, including sturgeons and migrating anadromous fish, to temporarily avoid the construction area and relocate to similar nearby habitat. Exclusionary devices such cofferdams and visual deterrents such as turbidity curtains would serve to limit potential direct affects with the fish in addition to limiting the amount of noise generated into the water column from pile driving activities. Based on nature of the proposed activities, Alternative 1A would result in short-term minor adverse impacts to native fish species.

The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species and their habitat are not expected under Alternative 1A.

Atlantic and Shortnose Sturgeon. Based on available information, the shortnose sturgeon has been documented in the Potomac River upstream to Little Falls. Suitable spawning habitat is thought to exist in the area downstream of Little Falls and in the Fletchers-Chain Bridge reach. The portion of the Potomac River adjacent to the Arlington Memorial Bridge is not identified as suitable spawning habitat, but serves as a migratory route to the upstream spawning areas. In-water construction activities under Alternative 1A, including placement of cofferdams, turbidity curtains and pilings for falsework, would not take place during the migration period of the sturgeon and anadromous fish species (February 15 through June 15 time-of-year restriction). In the event that sturgeons would be present in the project vicinity during construction, best management practices would limit their exposure to potentially harmful activities including turbidity curtains and coffer dams.

Activities within the river including the installation of the pilings, falsework and/or trunnions repair could result in suspension of sediments into the water column which can impact the sturgeon. The construction activity could lead to potential boat strikes and the piling installation creates acoustical noise which can impact the fish's swim bladder. The use of turbidity barriers and cofferdams as well as time of the year restrictions would limit the impact on the Atlantic and shortnose sturgeon.

The bridge rehabilitation efforts including the temporary placement of falsework in the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on the shortnose and Atlantic sturgeon and their habitat are not expected under Alternative 1A. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine habitat. Projects including the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine habitat from in-water work. Alternative 1A would contribute a minor amount to

the adverse cumulative impacts of these projects. When added to the short-term minor impacts of Alternative 1A, the cumulative adverse impact would be short-term and minor.

Conclusion. Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, Alternative 1A would result in short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected under Alternative 1A. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. When added to the short-term minor impacts of Alternative 1A, the cumulative adverse impact would be short-term and minor. These impacts are in addition to the wildlife impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

Alternative 1B would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of variable depth steel girders. Impacts under Alternative 1B would be the same as those described under Alternative 1A and would be limited to the deepwater riverine habitat. No terrestrial habitat would be impacted under Alternative 1B.

The construction methods under Alternative 1B are the same as those described under Alternative1A and would result in similar impacts to wildlife including rare, threatened, and endangered species. Both Construction Methods A and B would require the installation of temporary falsework and associated pilings within the deepwater portion of the Potomac River and would require construction work on the bridge piers. As with Alternative 1A, the bridge rehabilitation work associated with Alternative 1B would require the installation of cofferdams around bridge piers, and turbidity curtains would be used to minimize the disturbances and to prevent fish from entering the construction areas. Therefore, Alternative 1B would result in short-term minor adverse impacts to native fish species.

The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species or their habitat is not expected under Alternative 1B.

Atlantic and Shortnose Sturgeon. As with Alternative 1A, the bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on the shortnose and Atlantic sturgeon and their habitat are not expected under Alternative 1B. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to

adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15. 2015.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Alternative 1B would contribute a minor amount to the adverse cumulative impacts of these projects. When added to the short-term minor impacts of Alternative 1B, the cumulative adverse impact would be short-term and minor.

Conclusion. Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, Alternative 1B would result in short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected under Alternative 1B. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. When added to the short-term minor impacts of Alternative 1B, the cumulative adverse impact would be short-term and minor. These impacts are in addition to the wildlife impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 2

Alternative 2 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of welded steel truss. Impacts under Alternative 2 would be similar to those described under Alternative 1A and would be limited to the deepwater riverine habitat. No terrestrial habitat would be impacted under Alternative 2.

The construction methods under Alternative 2 are the same as those described under Alternative 1A – Construction Method A and would result in similar impacts to wildlife including rare, threatened, and endangered species. Construction of Alternative 2 would require the installation of temporary falsework and associated pilings within the deepwater portion of the Potomac River and would require construction work on the bridge piers. As with Alternative 1A, the bridge rehabilitation work associated with Alternative 2 would require the installation of cofferdams around bridge piers, and turbidity curtains would be used to minimize the disturbances and to prevent fish from entering the construction areas. Therefore, Alternative 2 would result in short-term minor adverse impacts to native fish species.

The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species or their habitat is not expected under Alternative 2.

Atlantic and Shortnose Sturgeon. As with Alternative 1A, the bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on the shortnose and Atlantic sturgeon and their habitat are not expected under Alternative 2. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. When added to the short-term minor impacts of Alternative 2, the cumulative adverse impact would be short-term and minor.

Conclusion. Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, Alternative 2 would result in short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected under Alternative 2. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. When added to the short-term minor impacts of Alternative 2, the cumulative adverse impact would be short-term and minor. These impacts are in addition to the wildlife impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

Alternative 3 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the repair/rehabilitation of all necessary elements of the existing bascule span in place, with the exception of the rehabilitation trunnion posts which may need to be completely replaced. Impacts under Alternative 3 would be similar to Alternative 1A and would be limited to the deepwater riverine habitat. No terrestrial habitat would be impacted under Alternative 3.

The construction methods under Alternative 3 are the same as those described under Alternative 1A – Construction Method A and would result in similar impacts to fish species. Rehabilitation of the bascule span would require the installation of temporary falsework and associated pilings during repair or replacement of the trunnion posts within the deepwater portion of the Potomac River and would require construction work on the bridge piers. As with Alternative 1A, the bridge rehabilitation work associated with Alternative 3 would require the installation of cofferdams around bridge piers, and turbidity curtains would be used to minimize the disturbances and to prevent fish from entering the construction areas. Therefore, Alternative 3 would result in short-term minor adverse impacts to native fish species.

The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species or their habitat is not expected under Alternative 3.

Atlantic and Shortnose Sturgeon. As with Alternative 1A, the bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on the shortnose and Atlantic sturgeon and their habitat are not expected under Alternative 3. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A. When added to the short-term minor impacts of Alternative 3, the cumulative adverse impact would be short-term and minor.

Conclusion. Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, Alternative 3 would result in short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected under Alternative 3. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. When added to the short-term minor impacts of Alternative3, the cumulative adverse impact would be short-term and minor. These impacts are in addition to the wildlife impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. Depending on design, pilings may need to be placed in the Potomac River to support the steel beams. Impacts associated with trunnion post shoring would be limited to the deepwater riverine habitat.

Installation of pilings in the Potomac River for the trunnion post shoring could affect the native fish species including Atlantic and shortnose sturgeons. The installation of the pilings around the bridge piers would require disturbance to the river bottom. Fish species would be affected by disturbed sediments and disturbed surface waters, underwater construction noise and vibration from pile installation, and shock waves produced by pile driving if piling driving is used. Pile driving has been known to produce shock waves in the water column that disturb, and in extreme cases, kill nearby fish. The piles needed for the falsework would be less than 24 inches in diameter and would not result in shock waves of this magnitude. Therefore, installation of pilings for the trunnion post shoring would not be expected to result in fish mortality.

The bridge rehabilitation work would require the installation of cofferdams around bridge piers. The installation of cofferdams would have a short-term temporary impact to the fish during installation and dewatering which would cause disturbances to the water column. Once installed, the cofferdams would provide noise attenuation to minimize impacts to fish.

As with Alternative 1A, for the trunnion post repair, turbidity curtains would be used to minimize the disturbances and to prevent fish from entering the construction areas. Based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, the trunnion post shoring would result in short-term minor adverse impacts to native fish species.

The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on fish species, including the shortnose sturgeon and Atlantic sturgeon, and their habitat is not expected with the trunnion post shoring.

Atlantic and Shortnose Sturgeon. Based on available information, the shortnose sturgeon has been documented in the Potomac River upstream to Little Falls. Suitable spawning habitat is thought to exist in the area downstream of Little Falls and in the Fletchers-Chain Bridge reach. The portion of the Potomac River adjacent to the Arlington Memorial Bridge is not identified as suitable spawning habitat, but serves as a migratory route to the upstream spawning areas. Construction activities for the trunnion post shoring would not take place during the migration period of the sturgeon (February 15 through June 15 time-of-year restriction).

As with Alternative 1A, the trunnion post shoring would not result in the permanent loss or degradation of aquatic habitat. Therefore, long-term effects on the shortnose and Atlantic sturgeon and their habitat are not expected. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine habitat. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the

Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine habitat from in-water work. The trunnion post shoring on the Arlington Memorial Bridge would contribute a minor amount to the adverse cumulative impacts of these projects. When added to the short-term negligible impacts of the trunnion post shoring, the cumulative adverse impact would be short-term and minor.

Conclusion. In addition to the impacts associated with the Action Alternatives, based on the unlikely potential for occurrence of sturgeons in the project area during construction and the nature of the proposed activities, temporary trunnion post shoring on the Arlington Memorial Bridge would result in short-term negligible adverse impacts to native fish species including the shortnose and Atlantic sturgeons. The bridge rehabilitation efforts including the falsework on the Potomac River would not result in the permanent loss or degradation of aquatic habitat. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. When added to the short-term negligible impacts of the trunnion post shoring, the cumulative adverse impact would be short-term and minor.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Areas A and D. Under Staging Area A, Memorial Circle would be used for storage of construction materials and equipment. Under Staging Area D, the grassed area at the top of the Watergate Steps would be used for storage of construction materials and equipment. Staging Areas A and D are isolated grass circles surrounded by roadways. These areas provide limited habitat for wildlife. Use of Staging Area A or D would not result in short-term or long-term impacts to wildlife.

Staging Area B and C. Under Staging Area B, an area between Washington Boulevard and South Washington Boulevard would be used for storage of construction materials and equipment. Under Staging Area C, an area between 23rd Street, SW and Rock Creek and Potomac Parkway would be used for storage of construction materials and equipment. Use of these staging areas would result in temporary displacement of urban wildlife, primarily small mammals such as mice, rabbits, fox, opossums, and raccoons, and native birds. Staging Area B is bordered by additional undeveloped land including Lady Bird Johnson Park that could accommodate displaced wildlife. Staging Area C is bordered by additional undeveloped land on the National Mall and West Potomac Park that could accommodate displaced wildlife. Therefore, use of Staging Areas B or C would result in negligible short-term adverse impacts to wildlife.

Construction Causeways. As described under riverine impacts, placement of construction causeways in the Potomac River would result in temporary impacts to submerged aquatic vegetation. This temporary removal of the submerged aquatic vegetation would result in habitat loss for the

aquatic species that utilize the vegetation beds. The installation of causeway would have a short-term temporary impact to fish during installation due to the disturbances to the water column. The installation of the materials needed for the causeway would result in temporary turbidity which would be limited to the area within the floating turbidity barriers. The barriers limit the impact of the turbidity on fish species to the area within the turbidity barrier, thereby limiting the impacts on fish. No in-water work would occur between February 15th and July 1st to protect sturgeon and migrating anadromous fish. After construction is complete, the area would be restored to its current condition; therefore, there would be no long-term impacts to aquatic species.

Dock/Work Platforms. Placement of dock/work platforms in the Potomac River would require the installation of temporary pilings in the river bottom. No in-water work would occur between February 15th and July 1st to protect sturgeon and migrating anadromous fish. The installation of the pilings would result in temporary water quality impacts from bottom sediment disturbance. The impact to the bottom would have temporary impact to the macroinvertebrate species within the impact footprint. Fish species would be affected by disturbed sediments and underwater construction noise and vibration from pile installation, and shock waves produced by pile driving if piling driving is used. Once construction is complete, the pilings would be removed resulting in additional disturbance of the river bottom sediment. Placement and removal of the dock/work platform would result in short-term minor adverse impacts to aquatic species. After construction is complete, the area would be restored to its current condition; therefore, there would be no long-term impacts to aquatic species.

Barge Staging Area 1. Use of Barge Staging Area 1 would require the installation of temporary pilings into the Potomac River bottom to anchor barges for storage of construction materials. Pilings may also need to be placed in the river to hold a temporary platform to access the barges from land. No in-water work would occur between February 15th and July 1st to protect sturgeon and migrating anadromous fish. The installation of the pilings would result in temporary water quality impacts from bottom sediment disturbance. The impact to the bottom would have temporary impact to the macroinvertebrate species within the impact footprint. Fish species would be affected by disturbed sediments and underwater construction noise and vibration from pile installation, and shock waves produced by pile driving if piling driving is used. In addition, to move construction materials between the barge staging area and the bridge, dredging would need to occur under and adjacent to the barge and within a dredge channel extending north to the bridge (Figure 56). The Barge Staging Area 1 and the associated dredge footprint would require the removal of 10,000 cubic yards of sediment.

Mechanical dredge techniques would be employed to minimize impacts to federally listed species. Temporary wildlife impacts associated with this method would include bottom disturbance from the installation of the pilings for the staging barge and suspension of sediment which could impact habitat downstream. Dredging activities could pose impacts to aquatic ecosystems by removing, disturbing, disposing, and suspending bottom sediments, modifying substrate and impacting the community structure of benthic macrofauna. Environmental impacts of dredging include direct removal/burial of organisms, turbidity/siltation effects, contaminant suspension, noise/disturbance, alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat (ASSRT

2007). Dredge operations under Barge Staging Area 1 would not directly impact submerged aquatic vegetation beds.

The installation of the pilings to hold the staging barge would require disturbance to the river bottom and would result in impacts similar to those described under Alternative 1A. Use of Barge Staging Area 1 would result in short-term moderate impacts to wildlife due to the construction related impacts resulting from the piling installation and dredge activities. Long-term minor impacts would result from the permanent alteration of the wildlife habitat from the permanent change in the bottom elevation.

As with native fish species, Atlantic and shortnose sturgeon could be affected by the dredging activities as well as the piling driving. They would be affected by disturbed sediments and disturbed surface waters, as well as underwater construction noise and vibration from pile installation, and shock waves produced by pile driving. Mechanical dredge techniques would be employed to minimize impacts to the Atlantic and shortnose sturgeon. Hydraulic dredging operations have been shown to directly cause mortality of Atlantic sturgeon from entrainment and entrapment (ASSRT 2007). Dredging would be limited to avoid the spawning season (February 15 through June 15 time-of-year restriction). In addition, appropriate dredging techniques would be used and agreed to between all appropriate regulatory agencies. Therefore, use of Barge Staging Area 1 would result in short-term negligible impacts to federally listed species due to the construction related impacts resulting from the piling installation and dredge activities. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge rehabilitation "may affect, but is not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Barge Staging Area 2. Impacts to wildlife from the use of Barge Staging Area 2 would be similar to those described under Barge Staging Area 1. However, dredging for Barge Staging Area 2 would permanently remove submerged aquatic vegetation within the dredge footprint. Submerged aquatic vegetation provides habitat, food and shelter for various fish and crab species.

Use of Barge Staging Area 2 would result in short-term moderate impacts to wildlife and/or federally listed species due to the construction related impacts resulting from the piling installation and dredge activities. Long-term minor impacts would result from the permanent alteration of the wildlife habitat from the permanent change in the bottom elevation and the removal of submerged aquatic vegetation.

Impacts to Atlantic and shortnose sturgeon from the use of Barge Staging Area 2 would be similar to those described under Barge Staging Area 1. However, dredging for Barge Staging Area 2 would permanently remove submerged aquatic vegetation within the dredge footprint. Sturgeon are known to use rubble, cobble, and gravel size rock, as well as shell, forest litter, and submerged vegetation provide substrate for egg attachment. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge Rehabilitation "may affect, but not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015.

Cumulative Impacts. Past, present, and reasonably foreseeable future action in the vicinity of the Arlington Memorial Bridge have and continue to contribute to impacts to riverine habitat. Projects including the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility have the potential to impact riverine habitat from in-water work. Use of Barge Staging Areas 1 and 2 and associated dredge activities would add a moderate amount to the adverse cumulative impacts to riverine habitat and wildlife.

The Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Arlington County and Vicinity Non-Motorized Boathouse Facility, and the Vietnam Veterans Memorial Visitor Center have the potential to result in the removal of terrestrial wildlife habitat. Use of Staging Areas A, B, C, and D would add a negligible amount to the adverse cumulative impacts of these projects on terrestrial wildlife.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the land staging areas would result in negligible short-term impacts to wildlife. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the barge staging areas would have short-term minor adverse impacts to native fish species including the shortnose and Atlantic sturgeons. Use of Barge Staging Areas 1 and 2 and associated dredge activities would add a moderate amount to the adverse cumulative impacts to riverine habitat and wildlife. Under the Endangered Species Act, it has been determined that the Arlington Memorial Bridge Rehabilitation "may affect, but not likely to adversely affect" the Atlantic and shortnose sturgeon. The National Marine Fisheries Service concurred with this finding in a letter dated October 15, 2015. Use of Staging Areas A, B, C, and D would add a negligible amount to the adverse cumulative impacts of past, present, and future projects on terrestrial wildlife.

CULTURAL RESOURCES

The National Historic Preservation Act of 1966 (54 USC 300101) governs federal agencies in their handling of historic properties. Under Section 106 of the Act and its implementing regulations (36 CFR Part 800), federal agencies must take into account the effects of their actions on any prehistoric or historic district, site, building, structure, or object included in, or eligible for listing in, the National Register of Historic Places. This includes artifacts, records, and remains that are related to and located within such properties, as well as culturally significant Native American sites and historic landscapes. In addition, Section 106 requires federal agencies to consult with the State Historic Preservation Officer and other interested parties to avoid, minimize, or mitigate adverse impacts. Federal agencies are also required to afford the Advisory Council for Historic Preservation a reasonable opportunity to comment if an undertaking would have an adverse impact on a cultural resource. Additionally, Section 106 requires coordination with federally recognized Indian tribes who may have potential religious or cultural interest in the project area. Section 106 acknowledges that tribes may have interest in geographic locations other than their seat of governments. As such the Delaware Nation was invited to participate in Section 106 consultation for the Arlington

Memorial Bridge Repair and Rehabilitation project. This Environmental Assessment considers impacts to cultural resources in accordance with the National Environmental Policy Act. Section 106 compliance is being conducted as a separate, but parallel, process.

In addition to the National Historic Preservation Act, the protection and management of cultural resources held by the National Park Service is governed by Director's Order 28: Cultural Resources Management, the 2006 NPS Management Policies, and the 2008 NPS -wide Programmatic Agreement with the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers. These documents require that NPS managers avoid or minimize adverse impacts on Park resources to the greatest extent possible. The Secretary of Interior's Standards for Rehabilitation (codified as 36 CFR 67) provide a framework for preservation principals to guide repair, alterations, and additions to historic properties, including the repair or replacement of deteriorated features, while preserving those features which convey its historical, cultural, or architectural values.

General Methodology and Assumptions

The National Park Service categorizes their cultural resources as archeological resources, cultural landscapes, historic districts and structures, museum objects, and ethnographic resources. Only potential impacts on cultural landscapes and historic properties, including buildings, sites, structures, and districts, have been retained for detailed study for this project.

The NPS guide for evaluating impacts, Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision Making*, requires that impact assessment be scientific, accurate, and quantified to the greatest extent possible. For cultural resources, it is rarely possible to measure impacts in quantifiable terms; therefore, impact thresholds must rely on the professional judgment of resource experts. The following impact analysis is an assessment of the effects of the undertaking on historic properties and cultural resources included in, or eligible for inclusion in, the National Register of Historic Places and is based upon the Section 106 criteria of adverse effect (36 CFR Part 800.5).

Area of Potential Effects

An Area of Potential Affect for this undertaking was delineated by the National Park Service, in consultation with the DC Historic Preservation Office and the Virginia State Historic Preservation Office. The Area of Potential Affect includes cultural resources that could potentially be directly or indirectly affected by the undertaking. These include the Arlington Memorial Bridge and Related Features, the Memorial Avenue Corridor, the George Washington Memorial Parkway, Lady Bird Johnson Park, Arlington House: The Robert E. Lee Memorial, Theodore Roosevelt Island, the Georgetown Historic District, the Rock Creek and Potomac Parkway Historic District, the John F. Kennedy Center for the Performing Arts, the East and West Potomac Parks Historic District, and the Lincoln Memorial grounds. The project area consists of reclaimed land and as such does not have any archeological or Native American resources. In addition, there is little to no potential for archeological resources within the Potomac River due to past dredging/filling operations, Natural

River scouring, and construction activities associated with the Arlington Memorial Bridge. Figure 34 in" Chapter 3: Affected Environment" provides the Area of Potential Affect boundary for rehabilitation of the Arlington Memorial Bridge.

Impact Thresholds

For a cultural resource to be listed in or eligible for listing in the National Register of Historic Places it must possess significance, and the features which convey its significance must have integrity. For purposes of evaluating potential impacts on cultural resources, the thresholds of change are defined as follows:

Negligible: The impact is at the lowest level of detection with neither adverse nor beneficial consequences.

Minor: Adverse Impact – The project would alter the patterns or features of a cultural resource but would not diminish the integrity of character-defining features or the overall integrity of the historic resource.

Moderate: Adverse Impact – The project would alter the character-defining features of the cultural resource and diminish its integrity.

Major: Adverse Impact – The project would alter the character-defining features of the cultural resource and severely diminish the integrity of the features and the overall integrity of the historic property.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the Arlington Memorial Bridge Rehabilitation project would not be implemented. Only routine maintenance and emergency repairs to the bridge would be undertaken. Without a comprehensive rehabilitation, existing damage to bridge features would not be repaired and the condition of the bridge could be expected to decline resulting in deterioration of the historic fabric of the bridge. Federal Highway Administration inspections have identified corrosion of the steel structural components of the bascule span, deterioration of the concrete in the arch spans and deterioration of the sidewalks and road surface. There is currently minor to moderate corrosion of the steel throughout the bascule span and more severe corrosion, including areas where the steel is rusted through, in the stringers and associated framing that support the fixed portion of the sidewalks and the edges of the roadway over the bascule span abutments. In addition, the interior trunnion posts also exhibit significant corrosion. Without repairs to the bridge, under the No-Action Alternative, this corrosion would be expected to worsen over time. Widespread deterioration of the superstructure and substructure concrete, including the concrete arch spans, would also continue. The widespread deterioration of the bridge's sidewalk, damage to the granite railings, displacement of the granite curbs, misaligned sliding plate expansion joint covers, and corroded access hatches would not be repaired under the No-Action Alternative, and the condition of these features would be expected to continue to deteriorate.

The Arlington Memorial Bridge was designed to create a formal connection and entrance to Arlington National Cemetery and Washington, DC. Stopgap repairs have altered the appearance of the bridge and detract from its intended appearance. If the bridge deteriorates to a point where public safety is compromised, emergency repairs may be needed that could require the removal of historic fabric such as steel girders within the bascule span. New materials may need to be added to the bridge to strengthen portions of the bascule span including the addition of shoring to the steel girders and trunnion posts.

Under the No-Action Alternative, existing damage present on the bridge, the continued deterioration of the Arlington Memorial Bridge, stopgap repairs, and major emergency repairs would affect the character defining features of the bridge and would result in a long-term moderate adverse impact to the historic structure.

General deterioration of the Arlington Memorial Bridge would not be visible from other cultural resources within the Area of Potential Affect. However, if major emergency repairs consist of extensive shoring or falsework to support the bridge, they may be visible from locations within the Area of Potential Affect including from Arlington House, the George Washington Memorial Parkway, Lady Bird Johnson Park, Theodore Roosevelt Island, Rock Creek and Potomac Parkway Historic District, and East and West Potomac Parks Historic District. Overall, the No-Action Alternative would have short-term minor adverse impacts to the views from these historic resources.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on cultural resources in the vicinity of the Arlington Memorial Bridge. These projects include the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary construction activities that could impact the views of cultural resources and landscapes. Projects including the Kennedy Center Expansion and the Vietnam Veterans Memorial Visitor Center would result in long-term changes to cultural resources. The No-Action Alternative would contribute a minor amount to these adverse cumulative impacts.

Conclusion. Under the No-Action Alternative, existing damage present on the bridge, the continued deterioration of the Arlington Memorial Bridge, stopgap repairs, and major emergency repairs would affect the character defining features of the bridge and would result in a long-term moderate adverse impact to the historic structure. General deterioration of the Arlington Memorial Bridge would not be visible from other cultural resources within the Area of Potential Affect. However, if major emergency repairs consist of extensive shoring or falsework to support the bridge, they may be visible from other resources resulting in short-term minor adverse impacts to the views from these historic resources. The No-Action Alternative would contribute a minor amount to the adverse cumulative impacts to cultural resources. These impacts are in addition to the cultural resource impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

Alternative 1A would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of precast concrete box girders (Figure 58).

Figure 58: Conceptual rendering of the concrete box girder replacement structure proposed under Alternative 1A (Underside View)

Under Alternative 1A, temporary impacts to cultural resources would occur for the duration of the construction period. Replacement of the bascule span would require construction of falsework (temporary support structures) in the Potomac River on both sides of the bridge. Under Construction Method A, the replacement span comprised of precast concrete box girders would be constructed on falsework in the Potomac River directly upstream of the bridge. The replacement structure would be installed by sliding it into place using cranes or another method determined by the contractor. The falsework, which would support the bridge during demolition of the existing bascule span, would impact views of the bridge and thus adversely affect the aesthetics of the bridge.

Under Construction Method B, extensive falsework would be built in the Potomac River under the existing bascule span to support half of the structure. Extensive falsework would also be installed inside the abutments of the bascule span. After the supports are in place, the contractor can then begin to remove sections of the concrete counterweights for demolition and removal off-site. After the first half of the bascule span has been removed, piers would be installed in the Potomac River as temporary support for the precast concrete span section to be installed. The concrete span would be floated to the site on barges and lifted into place by cranes or another method determined by the contractor. Once this phase of construction is complete, vehicle traffic would be diverted onto the new portion of the bridge. At this time, work would commence on the other half of the bridge, generally following the same procedures described above. The falsework, which would support the bridge during demolition of the existing bascule span, would impact views of the bridge and thus adversely affect the aesthetics of the bridge.

Under both construction methods, placement of the new span would require repairs to the existing abutments, removal of the stone walls of the bascule abutments as needed, replacement of the expansion joints at the abutments, construction of new girder seats/substructure, and repairs or replacement of the existing drainage system. Construction activities on the bridge piers would require the temporary installation of cofferdams around each pier to allow for the removal of water while work is being done to repair the piers. In addition, construction activities on the top of the

bridge would entail the use of large machinery, such as cranes, and traffic control devices, such as jersey barriers. Under Alternative 1A, the presence of construction equipment would affect the appearance of the bridge for approximately 700 days or approximately 2 years.

Under Alternative 1A, either method of construction would result in a short-term moderate adverse impact to the historic features of the Arlington Memorial Bridge.

Circulation features, including roadways and sidewalks, of the Arlington Memorial Bridge, Memorial Circle, and the Memorial Avenue Corridor contribute to the historic significance of these resources. Construction activities to rehabilitate the Arlington Memorial Bridge would adversely affect the traffic, pedestrian, and bicycle circulation of the bridge, circle, and Memorial Avenue Corridor. Under Construction Method A, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 70 days and vehicular traffic would be restricted to three lanes for approximately 490 days. Under Construction Method A, one sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 490 days. Under Construction Method B, the bridge would not be closed, and vehicular traffic would be restricted to three lanes for approximately 560 days. Under Construction Method B, one sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 560 days. The travel lane and sidewalk closures would result in a short-term moderate adverse impact to the historic circulation features.

Falsework, cofferdams, and construction equipment would also result in adverse impacts to other cultural resources within the Area of Potential Affect. The views and vistas to and from Arlington National Cemetery, along the Memorial Avenue Corridor, to the Lincoln Memorial would be interrupted by the presence of construction equipment on and around the Arlington Memorial Bridge for approximately 700 days under Alternative 1A. In addition, views from the George Washington Memorial Parkway and the Mount Vernon Trail, the Navy-Marine Memorial, Lady Bird Johnson Park, Theodore Roosevelt Island, the Georgetown Historic District, Rock Creek and Potomac Parkway Historic District, the John F. Kennedy Center for the Performing Arts, and the East and West Potomac Parks Historic District would be affected by views of the falsework in the river, cofferdams while the bridge piers are being repaired, and large machinery on the bridge for the duration of construction. A view of the Arlington Memorial Bridge from the Navy-Marine Memorial is shown in Figure 59. Construction activities under Alternative 1A

Figure 59: View of the Arlington Memorial Bridge from the Navy-Marine Memorial

would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect.

Under Alternative 1A, the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting would be repaired. The steel fascia on the bascule span along with the fascia truss would be removed and rehabilitated offsite. Following completion of construction of the new bascule span, the fascia truss and fascia would be reattached to the bascule span. These repairs would be done in accordance with the Secretary of the Interior's Standards for Rehabilitation. The Arts of War statuary and the eagle sculptures located on the ends of the bridge would be removed during construction and stored until they could be returned following the bridge rehabilitation. These rehabilitation efforts would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge.

Most of the historic features of the bascule span would be permanently removed under Alternative 1A. Features that would be removed include the bridge deck; steel members such as the main truss, counterweight truss, lateral bracing, and floor beams; the concrete counterweights and associated gears; and the trunnion posts. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place under this alternative. The unique design of the bascule span is a contributing feature to the Arlington Memorial Bridge. Previous to the construction of the Arlington Memorial Bridge, no other Chicago-style drawbridge had all of its operating components below the deck level, and the design and construction of the draw span were engineering innovations. Removal of these character defining features of the bridge would permanently affect the integrity of the historic resource and the new bascule span would not be in keeping with the Secretary of the Interior Standard's for Rehabilitation. Introduction of precast concrete box girders to the center span of the Arlington Memorial Bridge would introduce a new element that would not be in keeping with the historic design of the bridge. In addition, the underside of the new span would be flat, concrete box girders rather than arched, built-up truss members like the current bascule span (Figure 58). The flat, precast concrete girders would be visible to boaters on the river and may be visible from the George Washington Memorial Parkway and the Rock Creek and Potomac Parkway. The replacement of the center bascule span with a concrete box girder span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

Cumulative Impacts. Construction activities during present and future projects within the Area of Potential Affect, including those associated with the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge, and the Arlington Non-Motorized Boathouse Facility, would have short-term impacts to the views and vistas of cultural resources. If Alternative 1A is under construction at the same time as any of these projects, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources.

Future projects such as the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitor Center, the Memorial Circle Transportation Plan, may have minor to moderate impacts on cultural resources from permanent changes to individual resources as well as permanent changes to cultural

resources. Alternative 1A would contribute a moderate amount to the long-term cumulative impacts to cultural resources.

Conclusion. Under Alternative 1A, either method of construction would result in a short-term moderate adverse impact to the historic features of the Arlington Memorial Bridge. The travel lane and sidewalk closures would result in a short-term moderate adverse impact to the historic circulation features. Construction activities under Alternative 1A would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect.

Repairs to the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge. The replacement of the center bascule span with a concrete box girder span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

If Alternative 1A is under construction at the same time as other projects in the area, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources. Alternative 1A would contribute a moderate amount to the long-term cumulative impacts to permanent changes to cultural resources from other past, present, and future projects.

These impacts are in addition to the cultural resource impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

National Park Service is coordinating the findings of this Environmental Assessment with the District Historic Preservation Office and the Virginia State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act through the preparation of an Assessment of Effects. A Memorandum of Agreement detailing the necessary mitigation and minimization measures would be completed with and signed by the necessary parties prior to the final decision document.

Impacts of Alternative 1B

Alternative 1B would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of variable depth steel girders (Figure 60). Impacts to cultural resources would be similar to those described under Alternative 1A and include visual impacts to the Arlington Memorial Bridge and surrounding cultural resources during the construction period from the presence of construction equipment on and around the bridge and falsework (temporary support structures) in the Potomac River on both sides of the bridge. Temporary changes to circulation features, including roadways and sidewalks, of the Arlington Memorial Bridge, Memorial Circle, and the Memorial Avenue Corridor would result in short-term moderate adverse impacts.

Rehabilitation of the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards for Rehabilitation would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge.

Figure 60: Conceptual rendering of the variable depth steel girder replacement structure proposed under Alternative 1B (Underside View)

As with Alternative 1A, most of the historic features of the bascule span would be permanently removed under Alternative 1B. Features that would be removed include the bridge deck; steel members such as the main truss, counterweight truss, lateral bracing, and floor beams; the concrete counterweights and associated gears; and the trunnion posts. Removal of these character defining features of the bridge would permanently affect the integrity of the historic resource and the new bascule span would not be in keeping with the Secretary of the Interior Standard's for Rehabilitation. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place under this alternative. Impacts of this replacement would be similar to Alternative 1A. Under Alternative 1B, the underside of the new span would be comprised of variable depth steel girders, which would be curved to mimic the current arch of the bascule span (Figure 60). However, the new span would not be a truss construction like the current span. The replacement of the center bascule span with a variable depth steel girder span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Alternative 1B would contribute a moderate amount to the long-term cumulative impacts to cultural resources.

Conclusion. Under Alternative 1B, either method of construction would result in a short-term moderate adverse impact to the historic features of the Arlington Memorial Bridge. The travel lane and sidewalk closures would result in a short-term moderate adverse impact to the historic circulation features. Construction activities under Alternative 1B would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect.

Repairs to the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge. The replacement of the center bascule span with a variable depth steel girder span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

If Alternative 1B is under construction at the same time as other projects in the area, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources. Alternative 1B would contribute a moderate amount to the long-term cumulative impacts to permanent changes to cultural resources from other past, present, and future projects.

These impacts are in addition to the cultural resource impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

National Park Service is coordinating the findings of this Environmental Assessment with the District Historic Preservation Office and the Virginia State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act through the preparation of an Assessment of Effects. A Memorandum of Agreement detailing the necessary mitigation and minimization measures would be completed with and signed by the necessary parties prior to the final decision document.

Impacts of Alternative 2

Alternative 2 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the replacement of the bascule span with a new fixed span comprised of welded trusses (Figure 61). Impacts to cultural resources would be similar to those described under Alternative 1A and include visual impacts to the Arlington Memorial Bridge and surrounding cultural resources during the construction period from the presence of construction equipment on and around the bridge and falsework (temporary support structures) in the Potomac River on both sides of the bridge.

Construction activities to rehabilitate the Arlington Memorial Bridge would adversely affect the traffic, pedestrian, and bicycle circulation of the bridge, circle, and Memorial Avenue Corridor. Under Alternative 2, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 80 days and vehicular traffic would be restricted to three lanes for approximately 480 days. One sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 480 days. Temporary changes to circulation features, including roadways and sidewalks, of the Arlington Memorial Bridge, Memorial Circle, and the Memorial Avenue Corridor would result in short-term moderate adverse impacts.

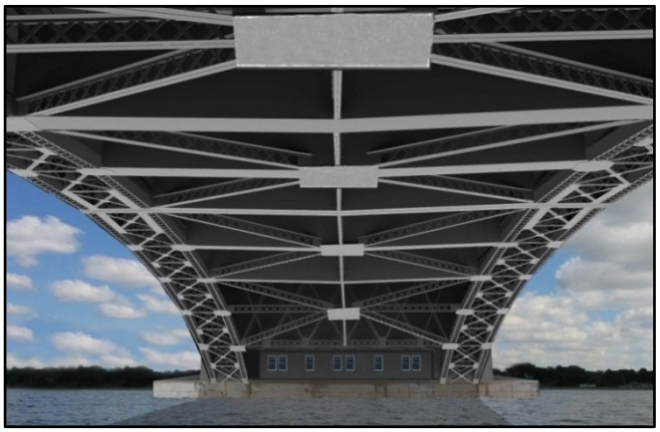


Figure 61: Conceptual rendering of the welded steel truss replacement structure proposed under Alternative 2 (Underside View)

Rehabilitation of the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards for Rehabilitation

would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge.

As with Alternative 1A, most of the historic features of the bascule span would be permanently removed under Alternative 2. Features that would be removed include the bridge deck; steel members such as the main truss, counterweight truss, lateral bracing, and floor beams; the concrete counterweights and associated gears; and the trunnion posts. Removal of these character defining features of the bridge would permanently affect the integrity of the historic resource and the new bascule span would not be in keeping with the Secretary of the Interior Standard's for Rehabilitation. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place under this alternative. Impacts of this replacement would be similar to Alternative 1A. The new welded steel truss span would be arched in a similar manner to the current bascule span (Figure 61). The arched steel truss would be visible to boaters on the river and may be visible from the George Washington Memorial Parkway, the Mount Vernon Trail, and the Rock Creek and Potomac Parkway, and would appear very similar to the existing bascule span such that from a distance it would not be obvious that the bascule span had been replaced. The replacement of the center bascule span with a welded steel truss span would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. Alternative 2 would contribute a moderate amount to the long-term cumulative impacts to cultural resources.

Conclusion. Under Alternative 2 construction activities would result in a short-term moderate adverse impact to the historic features of the Arlington Memorial Bridge. The travel lane and sidewalk closures would result in a short-term moderate adverse impact to the historic circulation features. Construction activities under Alternative 2 would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect.

Repairs to the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge. The replacement of the center bascule span with a new fixed span comprised of a welded steel truss would have a long-term moderate adverse impact on both the materials and aesthetics of the Arlington Memorial Bridge.

If Alternative 2 is under construction at the same time as other projects in the area, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources. Alternative 2 would contribute a moderate amount to the long-term cumulative impacts to permanent changes to cultural resources from other past, present, and future projects.

These impacts are in addition to the cultural resource impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

National Park Service is coordinating the findings of this Environmental Assessment with the District Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act through the preparation of an Assessment of Effects. A Memorandum of Agreement detailing the necessary mitigation and minimization measures would be completed with and signed by the necessary parties prior to the final decision document.

Impacts of Alternative 3

Alternative 3 would include the rehabilitation and repair of the concrete arch spans and bridge features as well as the repair/rehabilitation of all necessary elements of the bascule span in place (Figure 62). Impacts to cultural resources would be similar to those described under Alternative 1A and include visual impacts to the Arlington Memorial Bridge and surrounding cultural resources during the construction period from the presence of construction equipment on and around the bridge and falsework (temporary support structures) in the Potomac River on both sides of the bridge.

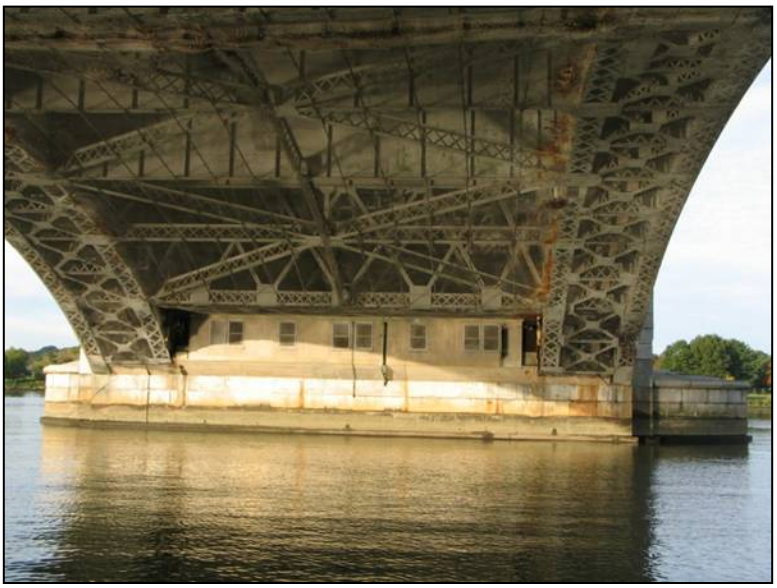


Figure 62: Steel truss bascule span that would be rehabilitated in place under Alternative 3

Construction activities to rehabilitate the Arlington Memorial Bridge would adversely affect the traffic, pedestrian, and bicycle circulation of the bridge, circle, and Memorial Avenue Corridor. Under Alternative 1, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 30 non-consecutive days and vehicular traffic would be restricted to three lanes for approximately 570 days. One sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 570 days. Temporary changes to circulation features, including roadways and sidewalks, of the Arlington Memorial Bridge, Memorial Circle, and the Memorial Avenue Corridor would result in short-term moderate adverse impacts.

Rehabilitation of the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards for Rehabilitation would result in short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge.

Under Alternative 3, the bascule span would be rehabilitated in accordance with the Secretary of Interior's Standards for Rehabilitation. Steel that has minor deterioration may be shored to provide additional strength. Where there is substantial deterioration of steel, bridge elements may be removed and replaced. Elements that may need to be partially or completely replaced because of deterioration include the trunnion posts and steel elements especially under the curblines (Figure 63). Replacement of historic fabric under Alternative 3 would have a long-term minor adverse impact on the historic resource. The remainder of the bascule span elements would be repaired, cleaned, and repainted as needed.

Figure 63: Example of steel truss under sidewalk with severe corrosion that may require replacement

The operating components of the bascule span including the counterweights and associated gears would remain in place; however, the trunnion post would be replaced. The guard's cabin, the overseer's cabin, and the machinery rooms would remain in place under Alternative 3. The steel truss of the bascule span would continue to be visible to boaters on the river and from the George Washington Memorial Parkway, the Mount Vernon Trail, and the Rock Creek and Potomac Parkway. Although the bascule span has not been operational since the 1960s, the operational features are important contributing elements to the Arlington Memorial Bridge. Previous to the construction of the Arlington Memorial Bridge, no other Chicago-style drawbridge had all of its operating components below the deck level, and the design and construction of the draw span were engineering innovations. Retention and rehabilitation of these character defining features of the bridge would have a long-term beneficial impact on the historic resource and its viewsheds.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A. Alternative 3 would contribute negligibly to the long-term cumulative impacts to cultural resources.

Conclusion. Alternative 3would result in a short-term moderate adverse impact to the historic features of the Arlington Memorial Bridge. The travel lane and sidewalk closures would result in a short-term moderate adverse impact to the historic circulation features. Construction activities under Alternative 3 would result in short-term moderate adverse impacts to the views and vistas of other cultural resources within the Area of Potential Affect.

Repairs to the concrete arch spans, bridge piers, bridge deck, sidewalks, granite curbs, bridge railings, and lighting in accordance with the Secretary of the Interior's Standards would result in

short-term minor adverse and long-term beneficial impacts to the Arlington Memorial Bridge. Replacement of historic fabric under Alternative 3 would have a long-term minor adverse impact on the historic resource, while retention and rehabilitation of character defining features of the bridge, including the bascule span, would have a long-term beneficial impact on the historic resource and its viewsheds.

If Alternative 3 is under construction at the same time as other projects in the area, it would add a moderate amount to the short-term adverse cumulative impacts to cultural resources. Alternative 3 would contribute a moderate amount to the long-term cumulative impacts to permanent changes to cultural resources from other past, present, and future projects.

These impacts are in addition to the cultural resource impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

National Park Service is coordinating the findings of this Environmental Assessment with the District Historic Preservation Office and the Virginia State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act through the preparation of an Assessment of Effects. A Memorandum of Agreement detailing the necessary mitigation and minimization measures would be completed with and signed by the necessary parties prior to the final decision document.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel stairs on all four sides of each trunnion post to provide additional strength to each trunnion. These repairs would be done in accordance with the Secretary of the Interior's Standards for Rehabilitation. If pilings are required in the river to support the trunnion post shoring, they would impact views of the bridge and thus adversely affect the aesthetics of the bridge. These impacts would be short-term minor and adverse.

The Federal Highway Administration estimates that an area approximately 6 feet wide on each side of each trunnion posts would be impacted by construction. The construction would require the permanent removal of historic features including steel beams and up to 6 feet of the machinery rooms at the base of the bascule span. Removal of these character defining features of the bridge would permanently affect the integrity of the historic resource and result in long-term moderate adverse impacts to cultural resources.

Cumulative Impact. Construction activities during present and future projects within the Area of Potential Affect, including those associated with the National Mall Plan, the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge, and the Arlington Non-Motorized Boathouse Facility, would have short-term impacts to the views and vistas of cultural resources. If trunnion post shoring area under construction at the same time as any of these projects, it would add a minor amount to the short-term adverse cumulative impacts to cultural resources.

Future projects such as the National Mall Plan, the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitor Center, the Memorial Circle Transportation Plan, may have minor to moderate impacts on cultural resources from permanent changes to individual resources as well as permanent changes to cultural resources. The trunnion post shoring would contribute a minor amount to the long-term cumulative impacts to cultural resources.

Conclusion. In addition to the impacts associated with the Action Alternatives, construction activities associated with the temporary trunnion post shoring would have short-term minor and adverse on the views of the Arlington Memorial Bridge. Repair of the trunnion posts would require the permanent removal of historic features that would affect the integrity of the historic resource and result in long-term moderate adverse impacts to cultural resources. The trunnion post shoring would contribute a minor amount to the long-term cumulative impacts to cultural resources of other past, present, and future projects.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Area A. Staging Area A consists of Memorial Circle which was designed by landscape architect Gilmore D. Clarke. The circle is a contributing feature of the Memorial Avenue Corridor. Under Staging Area A, the grass-covered circle would be fenced and used for the storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Use of the circle could damage the grass in the circle. The use of construction matting would minimize this damage. The grass would be restored at the conclusion of the construction period. Use of the circle for construction staging would affect viewsheds from Arlington House: The Robert E. Lee Memorial, Arlington National Cemetery, along the Memorial Avenue Corridor, the George Washington Memorial Parkway and Lady Bird Johnson Park. Therefore, there would be a short-term moderate adverse impact to cultural resources from the use of Memorial Circle for construction staging.

Staging Area B. Staging Area B consists of land on Columbia Island between Washington Boulevard and South Washington Boulevard. Under Staging Area B, the grass-covered area would be fenced and used for the storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Use of this area for construction staging

would affect viewsheds from Arlington House, Arlington National Cemetery, along the Memorial Avenue Corridor, the George Washington Memorial Parkway and Lady Bird Johnson Park. Therefore, there would be a short-term minor adverse impact to cultural resources from the use of Staging Area B for construction staging.

Staging Area C. Under Staging Area C, the grass-covered area north of the Lincoln Memorial would be fenced and used for storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. This land is part of the National Mall Historic District. Use of Staging Area C could damage the grass in the area. The use of construction matting would minimize this damage. The grass would be restored at the conclusion of the construction period. Use of the area for construction staging would affect viewsheds from the Lincoln Memorial and the National Mall. Therefore, there would be a short-term minor adverse impact to cultural resources from the use of Staging Area C for construction staging.

Staging Area D. Staging Area D consists of the grassed area at the top of the Watergate Steps. The area would be fenced and used for storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. This land is part of the National Mall Historic District. Use of Staging Area D could damage the grass in the area. The use of construction matting would minimize this damage. The grass would be restored at the conclusion of the construction period. Use of the area for construction staging would affect viewsheds from the Watergate Steps, the Lincoln Memorial, and the National Mall. Therefore, there would be a short-term moderate adverse impact to cultural resources from the use of Staging Area D for construction staging.

Construction Causeways and Dock/Work Platforms. Placement of temporary construction causeways or dock/work platforms in the Potomac River parallel to the north and south sides of the Arlington Memorial Bridge would intrude on views from the George Washington Memorial Parkway and Mount Vernon Trail, Roosevelt Island, the Watergate Steps, the Lincoln Memorial, and West Potomac Park. Views from these historic properties and landscapes would be affected for the duration of construction, approximately 700 days resulting in short-term minor adverse impacts. At the conclusion of construction, the causeways or dock/work platforms would be removed; therefore, there would be no long-term impacts on cultural resources.

Barge Staging Areas 1 and 2. Under Barge Staging Area 1, a construction staging barge would be located downstream from the Arlington Memorial Bridge along the west bank of the Potomac River and the George Washington Memorial Parkway. Under Barge Staging Area 2, a construction staging barge would be located upstream of the Arlington Memorial Bridge between the west bank of the Potomac River and Roosevelt Island. Construction materials would be stored on the barges for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days.

Construction of access roads from the George Washington Memorial Parkway to the barge staging areas, if needed, would impact grass areas between the parkway and the river and would require crossing the Mount Vernon Trail. These areas would be restored following completion of construction.

Barge Staging Area 1 would affect viewsheds from the George Washington Memorial Parkway, Lady Bird Johnson Park, and the East and West Potomac Parks Historic District. Barge Staging Area 2 would affect viewsheds from the George Washington Memorial Parkway and Mount Vernon Trail, Roosevelt Island, the Watergate Steps, and the Lincoln Memorial.

Therefore, there would be short-term minor adverse impacts to cultural resources from the use of Barge Staging Areas 1 and 2.

Cumulative Impacts. Construction activities during present and future projects within the Area of Potential Affect, including those associated the Kennedy Center Expansion, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge, and the Arlington Non-Motorized Boathouse Facility, would have short-term impacts to the views and vistas of cultural resources. If the repair and rehabilitation of the Arlington Memorial Bridge is under construction at the same time as any of these projects, use of the proposed land-based and barge staging areas would add a minor amount to the short-term adverse cumulative impacts to cultural resources.

Future projects such as the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitor Center, and the Memorial Circle Transportation Plan, may have minor to moderate impacts on cultural resources from permanent changes to individual resources as well as permanent changes to views and vistas. Use of the proposed staging areas would not add to these long-term impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the proposed staging areas would have short-term minor to moderate adverse impacts on historic resources and viewsheds. If the repair and rehabilitation of the Arlington Memorial Bridge is under construction at the same time as any of these projects, use of the proposed land-based and barge staging areas would add a minor amount to the short-term adverse cumulative impacts to cultural resources. Use of the staging areas would not contribute to long-term cumulative impacts.

VISITOR USE AND EXPERIENCE

Methodology and Assumptions

The purpose of this impact analysis is to assess the effects of the proposed bridge repair and rehabilitation on visitor use and experience of the Arlington Memorial Bridge and surrounding visitor destinations including the Arlington National Cemetery, the Women in Military Service Memorial, the George Washington Memorial Parkway, the Lincoln Memorial, and other museums and memorials on the National Mall. To determine impacts, current use of the areas was considered and the temporary effects of construction were analyzed. Potential impacts to visitor's ability to experience the Arlington Memorial Bridge and surrounding visitor destinations were analyzed by

examining existing resources. The reasons for visiting the Arlington Memorial Bridge were considered, as well as the reasons for visiting surrounding areas.

Analyses of potential impacts were derived from professional judgment and took into consideration visitation patterns and activities available to visitors. The potential change in visitor use and experience proposed by the alternatives was evaluated by identifying projected increases or decreases in recreational use, access to the site, and whether or how the projected changes would affect the desired visitor experience, to what degree, and for how long.

Study Area

The study area for visitor use and experience includes the Arlington Memorial Bridge and surrounding visitor destinations including the Arlington National Cemetery, the Women in Military Service Memorial, the George Washington Memorial Parkway, the Lincoln Memorial, and other museums and memorials on the National Mall.

Impact Thresholds

Negligible: Changes in visitor use and/or experience would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative.

Minor: Changes in visitor use and/or experience would be detectable, although the changes would be slight. The visitor would be aware of the effects associated with the alternative, but the effects would be slight.

Moderate: Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.

Major: Changes in visitor use and/or experience would be readily apparent and severely adverse. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the Arlington Memorial Bridge would continue to deteriorate. The pedestrian ramps located on the bridge would continue to be used to provide safe crossing over deteriorating sidewalk areas. These ramps would result in long-term negligible adverse impacts to visitor use and experience. The National Park Service and the Federal Highway Administration would perform routine inspections on the bridge and determine if emergency repairs are needed. If emergency repairs are needed to keep the bridge operational for vehicular traffic and to allow for the sidewalks to continue to be used by bicyclists and pedestrians, access to the bridge would be restricted during the emergency repairs causing short-term minor adverse impacts to visitor use. National Park Service, at the recommendation of the Federal Highway Administration, has posted a

10-ton load limit across the entire length of the bridge. The load restriction, which would eliminate most bus traffic, would remain in effect indefinitely. These weight restrictions exclude busses, including tour buses, from using the bridge and traveling directly between the memorials and monuments on the east side of the bridge and attractions on the west side of the bridge including the Women in Military Service Memorial, Arlington National Cemetery, and the George Washington Memorial Parkway. As the bridge continues to deteriorate the National Park Service and the Federal Highway Administration may impose further weight restrictions and/or close the bridge. Current and potential further weight restrictions would result in long-term moderate adverse impacts to visitor use and experience.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on visitor use and experience in the vicinity of the Arlington Memorial Bridge. Construction activities associated with projects include the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitors Center, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge repairs, and the Arlington County and Vicinity Non-Motorized Boathouse Facility all affect visitors ability to move around area roadways, memorials, monuments, and recreational spots and their ability to enjoy these sites. Emergency repairs under the No-Action Alternative would contribute a negligible amount to these short-term adverse cumulative impacts.

Projects including the Georgetown Waterfront Park improvements, the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitors Center, and the Arlington County and Vicinity Non-Motorized Boathouse Facility would all enhance visitor use and experience in the area. The No-Action Alternative would not add to these long-term beneficial cumulative impacts to visitor use and experience.

Conclusion. Under the No-Action Alternative, access to the bridge would be restricted during emergency repairs causing short-term minor adverse impacts to visitor use. The bridge would continue to deteriorate at an accelerated rate and long-term minor to moderate adverse impacts would occur from imposing weight restrictions and/or closing the bridge and from the use of pedestrian ramps to provide safe crossing over deteriorating bridge decking. The No-Action Alternative would slightly contribute to the short-term adverse cumulative impacts and would slightly lessen the overall long-term beneficial cumulative impacts of past, present, and future impacts on visitor use and experience. These impacts are in addition to the visitor use and experience impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

During construction of Alternative 1A, the National Park Service and the Federal Highway Administration would implement either a full closure of the Arlington Memorial Bridge or two partial closures of the bridge. Under Construction Method A, the bridge would be completely closed to vehicular, pedestrian, and bicycle traffic for a period of 70 consecutive days to remove the existing bascule span and install the new concrete span. In addition to the full closure period, three

traffic lanes would be closed on the bridge for approximately 490 days under Construction Method A. These closures would affect drivers, pedestrians, and bicyclists ability to travel directly between roadways, memorials, monuments, and recreational spots on the east and west sides of the Potomac River including the Lincoln Memorial, the National Mall, the Rock Creek and Potomac Parkway, West Potomac Park, and the Women in Military Service for America Memorial, Arlington National Cemetery, the George Washington Memorial Parkway, and the Mount Vernon Trail. Visitors would be required to take longer alternate routes including using the Rock Creek and Potomac Parkway, the Rock Creek Multi-Use Trail, the Theodore Roosevelt Memorial Bridge, the George Washington Memorial Parkway, and the Mount Vernon Trail to travel across the river.

Under Construction Method B, three vehicular travel lanes would be closed for approximately 560 days. During this time, visitors traveling by car or bus would be subject to traffic delays which would affect their ability to easily visit sites on either side of the river and affect the experience of traveling between the Lincoln Memorial and Arlington National Cemetery.

Sidewalk usage would also be limited to one sidewalk for approximately 490 days under Construction Method A, and 560 days under Construction Method B. During this time, pedestrians and bicyclists may tax the capacity of the sidewalk. The construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience.

Either method of construction would impact the use of the bridge for special events. Due to safety concerns, events on the bridge may be limited during the construction period. This would result in a short-term moderate adverse impact.

Under either method of construction, the boating community would not have access to the navigation channel beneath the bascule span of the bridge. Boaters would be directed under an adjacent span that is able to support boating traffic. This would have a short-term negligible adverse impact to boaters.

Construction activities on the bridge would affect visitors' ability to experience the bridge as a symbolic connection between the north and the south and as a ceremonial connection between the Lincoln Memorial and Arlington National Cemetery and to view the statuary and other bridge features.

After rehabilitation of the Arlington Memorial Bridge under Alternative 1A, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new precast concrete box girder span from the underside of the bridge would be different than existing conditions, which would in turn affect the visitor experience of the boating community resulting in long-term moderate adverse impacts.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on visitor use and experience in the vicinity of the Arlington Memorial Bridge. Construction activities associated with projects include the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitors Center, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge repairs, and the Arlington County and Vicinity Non-Motorized Boathouse Facility all affect visitors ability to move around area roadways, memorials, monuments, and recreational spots and their ability to enjoy these sites. Construction activities under Alternative 1A would contribute a minor amount to these short-term adverse cumulative impacts.

The Kennedy Center Expansion Project, the Vietnam Veterans Memorial Visitor Center, and the Georgetown Waterfront Park, contribute cumulatively to the visitor experience by enhancing existing resources at these parks and adding new visitor destinations. However, additional visitation results in more intensive use within the project area. Despite the disruption from construction activities under Alternative 1A and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Conclusion. Under Alternative 1A, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

After rehabilitation of the Arlington Memorial Bridge under Alternative 1A, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new precast concrete box girder span from the underside of the bridge would be different than existing conditions, which would in turn affect the visitor experience of the boating community resulting in long-term moderate adverse impacts.

Construction activities under Alternative 1A would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience. Despite the disruption from construction activities under Alternative 1A and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

These impacts are in addition to the visitor use and experience impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

During construction of Alternative 1B, the National Park Service and the Federal Highway Administration would implement either a full closure of the Arlington Memorial Bridge or two

partial closures of the bridge. Impacts to visitor use and experience would be similar to those described under Alternative 1A. The construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience.

Under either method of construction, the boating community would not have access to the navigation channel beneath the bascule span of the bridge. Boaters would be directed under an adjacent span that is able to support boating traffic. This would have a short-term negligible adverse impact to boaters.

Construction activities on the bridge would affect visitors' ability to experience the bridge as a symbolic connection between the north and the south and as a ceremonial connection between the Lincoln Memorial and Arlington National Cemetery and to view the statuary and other bridge features.

After rehabilitation of the Arlington Memorial Bridge under Alternative 1B, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new variable depth steel girder span from the underside of the bridge would be different than existing conditions, which would in turn affect the visitor experience of the boating community resulting in long-term moderate adverse impacts.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Construction activities under Alternative 1B would contribute a minor amount to short-term adverse cumulative impacts. The overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Conclusion. Under Alternative 1B, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

After rehabilitation of the Arlington Memorial Bridge under Alternative 1B, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new variable depth steel girder span from the underside of the bridge would be different than existing conditions, which would in turn affect the visitor experience of the boating community resulting in long-term moderate adverse impacts.

Construction activities under Alternative 1B would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience. Despite the disruption from construction activities under Alternative 1B and the increase in visitation and more intensive use of these

resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

These impacts are in addition to the visitor use and experience impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 2

During construction of Alternative 2, the Arlington Memorial Bridge would be closed for 80 days and have restricted lanes for approximately 480 days. Impacts to visitor use and experience would be similar to those described under Alternative 1A - Construction Method A. Under Alternative 2, the bridge would be completely closed to vehicular traffic for a period of 80 consecutive days to remove the existing bascule span and install the new welded steel truss span. In addition to the full closure period, three traffic lanes would be closed on the bridge for approximately 480 days. Sidewalk usage would also be limited to one sidewalk for approximately 480 days during construction. The construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience.

The boating community would not have access to the navigation channel beneath the bascule span of the bridge. Boaters would be directed under an adjacent span that is able to support boating traffic. This would have a short-term negligible adverse impact to boaters.

Construction activities on the bridge would affect visitors' ability to experience the bridge as a symbolic connection between the north and the south and as a ceremonial connection between the Lincoln Memorial and Arlington National Cemetery and to view the statuary and other bridge features.

After rehabilitation of the Arlington Memorial Bridge under Alternative 2, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new welded steel truss span from the underside of the bridge would be visually similar to the existing truss system which and would minimally affect the visitor experience of the boating community resulting in long-term minor adverse impact.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. Construction activities under Alternative 2 would contribute a minor amount to short-term adverse cumulative impacts. The overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Conclusion. Under Alternative 2, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

After rehabilitation of the Arlington Memorial Bridge under Alternative 2, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots. Once construction is complete, the view of the new welded steel truss span from the underside of the bridge would be visually similar to the existing truss system and would minimally affect the visitor experience of the boating community resulting in long-term minor adverse impact.

Construction activities under Alternative 2 would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience. Despite the disruption from construction activities under Alternative 2 and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

These impacts are in addition to the visitor use and experience impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

During construction of Alternative 3, the Arlington Memorial Bridge would be closed for 30 days and have restricted lanes for approximately 570 days. Impacts to visitor use and experience would be similar to those described under Alternative 1A, Construction Method A. Under Alternative 3, the bridge would be completely closed to vehicular traffic for 30 non-consecutive days to repair the trunnion posts which support the bascule span. In addition to the full closure period, three traffic lanes would be closed on the bridge for approximately 570 days. Sidewalk usage would also be limited to one sidewalk for approximately 570 days during construction. The construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience.

The boating community would not have access to the navigation channel beneath the bascule span of the bridge. Boaters would be directed under an adjacent span that is able to support boating traffic. This would have a short-term negligible adverse impact to boaters.

Construction activities on the bridge would affect visitors' ability to experience the bridge as a symbolic connection between the north and the south and as a ceremonial connection between the Lincoln Memorial and Arlington National Cemetery and to view the statuary and other bridge features.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A. Construction activities under Alternative 3 would contribute a minor amount to short-term adverse cumulative impacts. The overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Conclusion. Under Alternative 3, construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience. In-water construction activities would have a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

After rehabilitation of the Arlington Memorial Bridge under Alternative 3, there would be long-term beneficial impacts to visitor use and experience by providing a continued and open passage across the Potomac River providing access to area roadways, memorials, monuments, and recreational spots.

Construction activities under Alternative 3 would contribute a minor amount to the short-term adverse cumulative impacts on visitor use and experience. Despite the disruption from construction activities under Alternative 3 and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

These impacts are in addition to the visitor use and experience impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. Depending on construction techniques used, the National Park Service and the Federal Highway Administration may implement partial lane closures on the bridge to conduct work necessary for the trunnion post shoring. During this time, visitors traveling by car or bus would be subject to traffic delays which would affect their ability to easily visit sites on either side of the river and affect the experience of traveling between the Lincoln Memorial and Arlington National Cemetery. Sidewalk usage may also be limited to one sidewalk during construction. During this time, pedestrians and bicyclists may tax the capacity of the sidewalk. The construction activities and reduction in access and capacity would result in short-term moderate adverse impacts to visitor use and experience.

If pilings are required in the Potomac River for the trunnion post shoring, the boating community would not have access to the navigation channel beneath the bascule span of the bridge. This would have a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on visitor use and experience in the vicinity of the Arlington Memorial Bridge. Construction activities associated with projects include the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitors Center, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge repairs, and the Arlington County and Vicinity Non-Motorized Boathouse Facility all affect visitors ability to move around area roadways, memorials, monuments, and recreational spots and their ability to enjoy these sites. If the trunnion post shoring occurs at the same time other projects in the area are under construction, this action would contribute a negligible amount to the adverse cumulative impacts.

The Kennedy Center Expansion Project, the Vietnam Veterans Memorial Visitor Center, and the Georgetown Waterfront Park, contribute cumulatively to the visitor experience by enhancing existing resources at these parks and adding new visitor destinations. However, additional visitation results in more intensive use within the project area. Despite the disruption from construction activities under the trunnion post repair alternative and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Conclusion. In addition to the impacts associated with the Action Alternatives, the construction activities and reduction in access and capacity that would occur with the temporary trunnion post shoring would result in short-term moderate adverse impacts to visitor use and experience. If pilings are required in the Potomac River for the trunnion post shoring, there would be a short-term negligible adverse impact to boaters as they would have to use the other spans of the bridge to navigate up and down the river.

If the trunnion post shoring occurs at the same time as other projects in the area are under construction, this action would contribute a negligible amount to the adverse cumulative impacts. Despite the disruption from construction activities under the trunnion post repair alternative and the increase in visitation and more intensive use of these resources, the overall cumulative impact of these past, present, and reasonably foreseeable future actions would be long-term and beneficial.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Area A. Under construction Staging Area A, the grass-covered lawn of Memorial Circle would be fenced to protect drivers, bicyclists and pedestrians in the area. While the land within Memorial Circle is not typically used by visitors, it does contribute to the visitor experience by providing part of the gateway to Arlington National Cemetery. Use of the area for construction staging would detract from the visitor experience. NPS maintenance crews, construction workers, and visitors to the memorials would be required to maneuver around active construction and

construction staging areas. As a result, a short-term moderate adverse impact to visitor use and experience would result from the use of Memorial Circle for construction staging. Upon conclusion of construction, Memorial Circle would be landscaped and returned to open-space befitting the overall aesthetics of the area. Therefore, there would be no long term impacts to visitor use and experience.

Staging Area B. Under construction Staging Area B, the grass-covered lawn between Washington Boulevard and South Washington Boulevard south of Memorial Circle would be used for storage of construction materials and equipment. The area would be fenced to protect drivers, bicyclists and pedestrians in the area. This area is not typically used by visitors; however use of the area for construction staging would detract from views from Lady Bird Johnson Park, the George Washington Memorial Parkway, and the Mount Vernon Trail. NPS maintenance crews, construction workers, and visitors to the memorials would be required to maneuver around active construction and construction staging areas. As a result, a short-term negligible adverse impact to visitor use and experience would result from the use of this for construction staging. Upon conclusion of construction, Staging Area B would be landscaped and returned to open-space befitting the overall aesthetics of the area. Therefore, there would be no long term impacts to visitor use and experience.

Staging Area C. Under construction Staging Area C, the grass-covered area north of the Lincoln Memorial would be used for storage of construction materials and equipment. The area would be fenced to protect drivers, bicyclists and pedestrians in the area. This area not typically used by visitors; however use of the area for construction staging would detract from views the Lincoln Memorial and the Rock Creek and Potomac Parkway. NPS maintenance crews, construction workers, and visitors to the Lincoln Memorial, would be required to maneuver around active construction and construction staging areas. As a result, a short-term negligible adverse impact to visitor use and experience would result from the use of this area for construction staging. Upon conclusion of construction, Staging Area C would be landscaped and returned to open-space befitting the overall aesthetics of the area. Therefore, there would be no long term impacts to visitor use and experience.

Staging Area D. Under construction Staging Area D, the grass-covered area above the Watergate Steps would be used for the storage of construction materials and equipment. The area would be fenced to protect drivers, bicyclists and pedestrians in the area. This area not typically used by visitors; however use of the area for construction staging would detract from views the Lincoln Memorial and the Watergate Steps. NPS maintenance crews, construction workers, and visitors to the area would be required to maneuver around active construction and construction staging areas. As a result, a short-term moderate adverse impact to visitor use and experience would result from the use of Staging Area D. Upon conclusion of construction, this area would be landscaped and returned to open-space befitting the overall aesthetics of the area. Therefore, there would be no long term impacts to visitor use and experience.

Construction Causeways and Dock/Work Platforms. Under this option, temporary causeways or dock/work platforms would be constructed from the west and east shores of the Potomac River.

Access to these construction areas would be fenced to protect the public. The causeways or dock/work platforms would be visible from the George Washington Memorial Parkway, the Mount Vernon Trail, Theodore Roosevelt Island on the west side of the Potomac River, and from attractions on the eastern shore including the Lincoln Memorial, the Watergate steps, and West Potomac Park. Aids to navigation would be put in place to keep boaters away from the area and non-motorized boaters would need to navigate along the eastern shore of the river; however, the presence of the causeway or dock/work platform on the river would also detract from the visitor experience for boaters on the river. The causeway or dock/work platform would result in short-term minor adverse impacts to boaters. When construction is complete, the causeway or dock/work platform would be removed and the area restored; therefore, there would be no long term impacts to visitor use and experience.

Barge Staging Area 1. Under Barge Staging Area 1, barges would be located downstream from the Arlington Memorial Bridge along the west bank of the Potomac River and the George Washington Memorial Parkway to store construction materials. A temporary access road to the barge staging area may be needed from the George Washington Memorial Parkway which would require crossing the Mount Vernon Trail. The temporary access road would result in short-term minor impact to visitor use and experience as the condition of the trail would be modified and visitors would be required to stop when trucks are traveling across the trail.

Aids to navigation would be put in place to keep boaters away from the barge staging area and boaters would need to navigate the river further to the east. The presence of barges on the river would also detract from the visitor experience for boaters on the river. This would result in short-term minor adverse impacts to boaters.

When construction is complete, the barge staging area would be removed and the area restored; therefore, there would be no long term impacts to visitor use and experience.

Barge Staging Area 2. Under Barge Staging Area 2, barges would be located upstream of the Arlington Memorial Bridge along the west bank of the Potomac River and the George Washington Memorial Parkway to store construction materials. A temporary access road to the barge staging area may be needed from the George Washington Memorial Parkway which would require crossing the Mount Vernon Trail. The temporary access road would result in short-term minor impact to visitor use and experience as the condition of the trail would be modified and visitors would be required to stop when trucks are traveling across the trail.

Aids to navigation would be put in place to keep boaters away from the barge staging area. Boaters would be unable to access the shallow waters on the west side of Theodore Roosevelt Island would need to navigate the river further to the east. The presence of barges on the river would also detract from the visitor experience for boaters on the river. This would result in short-term minor adverse impacts to boaters.

When construction is complete, the barge staging area would be removed and the area restored; therefore, there would be no long term impacts to visitor use and experience.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on visitor use and experience in the vicinity of the Arlington Memorial Bridge. Construction activities associated with projects include the Kennedy Center Expansion, the Vietnam Veterans Memorial Visitors Center, the DC Clean Rivers Potomac River Tunnel, the Memorial Circle Transportation Plan, the Theodore Roosevelt Memorial Bridge repairs, and the Arlington County and Vicinity Non-Motorized Boathouse Facility all affect visitors ability to move around area roadways, memorials, monuments, and recreational spots and their ability to enjoy these sites. Use of the staging areas would contribute a minor amount to these short-term adverse cumulative impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the land staging areas would result in short-term negligible to minor adverse impacts associated with maneuvering around staging areas and changes in views. Use of the staging areas would contribute a minor amount to these short-term adverse cumulative impacts of past, present, and future projects in the area. There would be no long-term impacts.

TRANSPORTATION

Methodology and Assumptions

For the proposed Arlington Memorial Bridge Repair and Rehabilitation, impacts to traffic and transportation in at Potomac River crossings as well as the Metropolitan Washington Area were analyzed. Current traffic conditions on the Arlington Memorial Bridge, the Theodore Roosevelt Memorial Bridge, the Key Bridge, and the 14th Street Bridge were considered, in addition to an assessment of construction methodologies for the Arlington Memorial Bridge Rehabilitation. For the proposed Action Alternatives, the impacts resulting from short-term road and lane closures are due to construction.

To assist in this analysis, the Metropolitan Washington Council of Governments Transportation Planning Board, in consultation with the Federal Highway Administration Eastern Federal Lands Highway Division, modeled travel impacts of various construction methods including:

- Full Bridge Closure: All vehicular travel lanes would be closed on the bridge and all traffic rerouted to other Potomac River crossings
- Two-Lane Closure: Two lanes on the bridge would be closed to traffic while four vehicular travel lanes would remain open. The lanes closed would shift during the construction period.
- Three-Lane Closure, Scenario A: The "Reversible Lanes Concept" under which three travel lanes would remain open with two travel lanes eastbound and one travel lane westbound during the AM Peak Period and two travel lanes westbound with one travel lane eastbound during the PM Peak Period

- Three-Lane Closure, Scenario B: "The Inbound Lanes Concept" under which there would be three travel lanes eastbound (inbound to the city) and no travel lanes westbound during the AM Peak Period and three travel lanes westbound (outbound from the city) and no travel lanes eastbound during the PM Peak Period

The Metropolitan Washington Council of Governments Transportation Planning Board also developed a Baseline (i.e., No Build) alternative for the year 2017 as the planning horizon year for travel demand modeling purposes. In this framework the Metropolitan Washington Council of Governments Transportation Planning Board staff validated the regional travel demand model for year 2007 – the year of the most recent regional Household Travel Survey in the region -- and calibrated it for year 2010 traffic volumes in the study area. The validated/calibrated model basis was used for developing year 2017 travel demand projections.

Study Area

The study area for traffic and transportation impacts includes the four Potomac River crossings closes to the proposed action: the Arlington Memorial Bridge, the George Washington Memorial Parkway, the 14th Street Bridge, the Roosevelt Bridge, and the Key Bridge; and three bridges further from the project area but which also provide crossings of the Potomac River: the Woodrow Wilson Bridge, the Chain Bridge, and the American Legion Bridge. The study area also includes the George Washington Memorial Parkway and pedestrian and bicycle routes in the vicinity of the Arlington Memorial Bridge.

Impact Thresholds

Negligible: The impact would be a change that would not be perceptible or would be barely perceptible by transportation system users.

Minor: The impact would cause a change to travel times or transportation system utility. The impact would be noticeable, but would result in short-term or little inconvenience to transportation system users.

Moderate: The impact would result in a change to the travel time or system utility of a large number of transportation system users and would result in a noticeable change in travel time or convenience. A moderate increase in delay may be anticipated, but it is not expected to cause failure of nearby facilities that cannot be mitigated through proactive management.

Major: There would be a substantial impact on the travel time or system utility of a large number of transportation system users. This would result in a highly noticeable change in travel times or convenience, leading to failure or near-failure of nearby facilities with little or no potential for mitigation.

Impacts of the No-Action Alternative

Under the No-Action Alternative, major rehabilitation of the Arlington Memorial Bridge would not occur, and the bridge would remain open to traffic as long as the condition of the bridge permits. It is estimated that the Arlington Memorial Bridge would carry approximately 67,682 vehicles per day in the year 2017.

Because the Arlington Memorial Bridge would not undergo a complete rehabilitation under the No-Action Alternative, the bridge would continue to deteriorate. National Park Service, at the recommendation of the Federal Highway Administration, has posted a 10-ton load limit across the entire length of the bridge. The load restriction, which would eliminate most bus traffic, would remain in effect indefinitely. As the bridge continues to deteriorate the National Park Service and The Federal Highway Administration may impose further weight restrictions and/or close the bridge. Because the bridge is part of the George Washington Memorial Parkway, large trucks are already prohibited from using the bridge. The weight restrictions implemented under the No-Action Alternative would result in long-term minor adverse impacts to buses and small trucks. With weight restrictions, drivers of cars and motorcycles would not have to share the road with buses and small trucks resulting in beneficial impacts for these drivers.

Without rehabilitation, emergency repairs would continue to be needed on the bridge. Emergency repairs may consist of replacement of portions of the deck or shoring of steel trusses in the bascule span. To implement emergency repairs, intermittent closure of vehicular travel lanes and/or sidewalks would be required. These lane closures for emergency repairs would result in short-term minor adverse impacts to traffic and transportation.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on traffic and transportation in the vicinity of the Arlington Memorial Bridge. These projects include the Memorial Circle Transportation Plan, and construction activities associated with the Kennedy Center Expansion the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary construction activities that could impact traffic. If emergency repairs are needed on the Arlington Memorial Bridge at the same time other projects in the area are under construction, the No-Action Alternative would contribute a minor amount to the adverse cumulative impacts to traffic and transportation.

The Memorial Circle Transportation Plan and the Theodore Roosevelt Memorial Bridge repairs would result in long-term beneficial impacts to traffic and transportation by enhancing transportation facilities. The No-Action Alternative would not contribute to these long-term beneficial cumulative impacts.

Conclusion. The weight restrictions that would be implemented under the No-Action Alternative would result in long-term minor adverse impacts to traffic and transportation. Lane closures for emergency repairs would result in short-term minor adverse impacts to traffic and transportation. If

emergency repairs are needed on the Arlington Memorial Bridge at the same time other projects in the area are under construction, the No-Action Alternative would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. The No-Action Alternative would not contribute to long-term beneficial cumulative impacts. These impacts are in addition to the transportation impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

Under Alternative 1A, the Arlington Memorial Bridge would undergo a major rehabilitation that would affect traffic for approximately 560 calendar days, or approximately 1.5 years. Closures, as outlined below, are anticipated to be 24-hours per day, 7 days per week for the duration of the construction. Barriers would be used to block lanes and separate traffic from construction activities. Signage and flaggers would be used to safely direct vehicles through the construction zone and into proper lanes on the bridge and the circles at either end of the bridge.

Under Construction Method A, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 70 days and vehicular traffic would be restricted to three lanes for approximately 490 days. Under Construction Method A, one sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 490 days.

Under Construction Method B, the bridge would not be closed, and vehicular traffic would be restricted to three lanes for approximately 560 days. Under Construction Method B, one sidewalk would be closed and one sidewalk would remain open for pedestrians and bicyclists approximately 560 days.

Full or partial closure of the bridge's vehicular travel lanes would diminish the overall vehicle capacity of the bridge during the construction period resulting in traffic delays on the bridge and on roadways surrounding the bridge. As vehicles attempt to cross the Arlington Memorial Bridge, eastbound traffic would back up onto the George Washington Memorial Parkway and Memorial Avenue, while westbound traffic would back up onto the Rock Creek and Potomac Parkway and Ohio Drive, SW.

Lane closures and diminished capacity would also increase the likelihood that drivers would utilize other Potomac River crossings. Due to the temporary nature of the project, it was assumed that drivers in the study area would not change their overall trips including where they leave from (trip origins) or where they are going (trip destinations) during the project duration. This means that the total number of vehicles crossing the Potomac River would remain the same as the current condition with all of the travel lanes open to traffic, but some drivers would divert from the Arlington Memorial Bridge to upstream or downstream bridges due to increased congestion during the bridge construction period.

The Metropolitan Washington Council of Governments models indicate that traffic would primarily be diverted to the three Potomac River crossings closest to the Arlington Memorial Bridge: the

Theodore Roosevelt Memorial Bridge, the Key Bridge, and the 14th Street Bridge; while the Woodrow Wilson Bridge, the Chain Bridge, and the American Legion Bridge would see a smaller increase in traffic volumes. Table 9 provides daily traffic volumes that would occur on each of the Potomac River crossings under each of the lane closure scenarios.

TABLE 9. FORECASTED DAILY VOLUMES OVER THE POTOMAC RIVER (YEAR 2017)

	Baseline	Full Closure	Three-Lane Closure Scenario A	Three-Lane Closure Scenario B
14th St. Bridge	257,492	284,188	264,342	269,829
Arlington Memorial Bridge	**67,682**	**0**	**48,034**	**38,125**
Roosevelt Bridge	108,811	122,653	113,458	114,759
Key Bridge	74,534	82,573	77,232	78,325
Four-Bridge Total	**508,519**	**489,414**	**503,066**	**501,038**
Woodrow Wilson Bridge	299,141	300,395	301,238	302,003
Chain Bridge	43,229	43,630	43,706	43,592
American Legion Bridge	346,881	346,960	347,455	347,696
Three-Bridge Total	**689,251**	**690,985**	**692,399**	**693,291**
Seven-Bridge Total	**1,197,770**	**1,196,625**	**1,195,465**	**1,194,329**

Figure 64, Figure 65, and Figure 66 illustrate the increases and decreases in traffic volumes that would occur on each of the closest Potomac River crossings and area roadways under each of the travel lane closure scenarios for Alternative 1A. Some area roadways and bridges would see increases in traffic volumes, while other roadways would see decreases in traffic. For instance as shown in Figure 64, when the Arlington Memorial Bridge is completely closed, traffic volumes would increase on the Theodore Roosevelt Memorial Bridge, the 14th Street Bridge, and the Key Bridge. However, during the full closure, traffic volumes would decrease on the George Washington Memorial Parkway, Ohio Drive, SW, and the Rock Creek and Potomac Parkway as drivers who would normally use these roads to access the Arlington Memorial Bridge travel on other roadway segments to reach the other river crossings.

The diversion of traffic under each of the lane-closure scenarios would result in travel delays for motorists. As shown in Table 10, the study area would see a daily increase of up to 14,881 additional vehicle hours of delay during the full bridge closure period (approximately 70 days), and between 4,464 and 5,754 additional vehicle during the partial closure periods under Construction Method A. Vehicle hours of delay represent the additional time that drivers are on the road because of construction delays versus the time they would be on the road if the construction was not taking

place. Additional delays during the morning (AM) and evening (PM) rush hours under Construction Method A would range from 12,489 vehicle hours of delay during the full closure period to 3,801 to 4,779 vehicle hours of delay during the partial closure periods. Under Construction Method B, there would be no full bridge closure. Therefore, the vehicle hours of delay would range from 4,464 and 5,754 vehicle hours of delay per day with peak hour delays ranging from 3,801 to 4,779 vehicle hours of delay during partial closure periods. It should be noted that these delays would be spread out over the entire study area and among the approximately 1.2 million drivers using the seven Potomac River bridge crossings.

Under both construction methods, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area.

TABLE 10. CONGESTION LEVELS (VEHICLE HOURS OF DELAY) IN THE STUDY AREA (YEAR 2017)

	Baseline	Full Closure	Three-Lane Closure Scenario A	Three-Lane Closure Scenario B
Daily VHD	63,473	78,354	67,937	69,226
Comparisons to Baseline	0	14,881	4,464	5,754
Comparisons to Baseline (%)	0	23.4%	7.0%	8.3%
Peak Period VHD	55,427	67,916	59,229	60,206
Comparisons to Baseline	0	12,489	3,801	4,779
Comparisons to Baseline (%)	0	22.5%	6.9%	7.9%

Note: The Peak Period vehicle hours of delay includes both AM and PM peak period data.

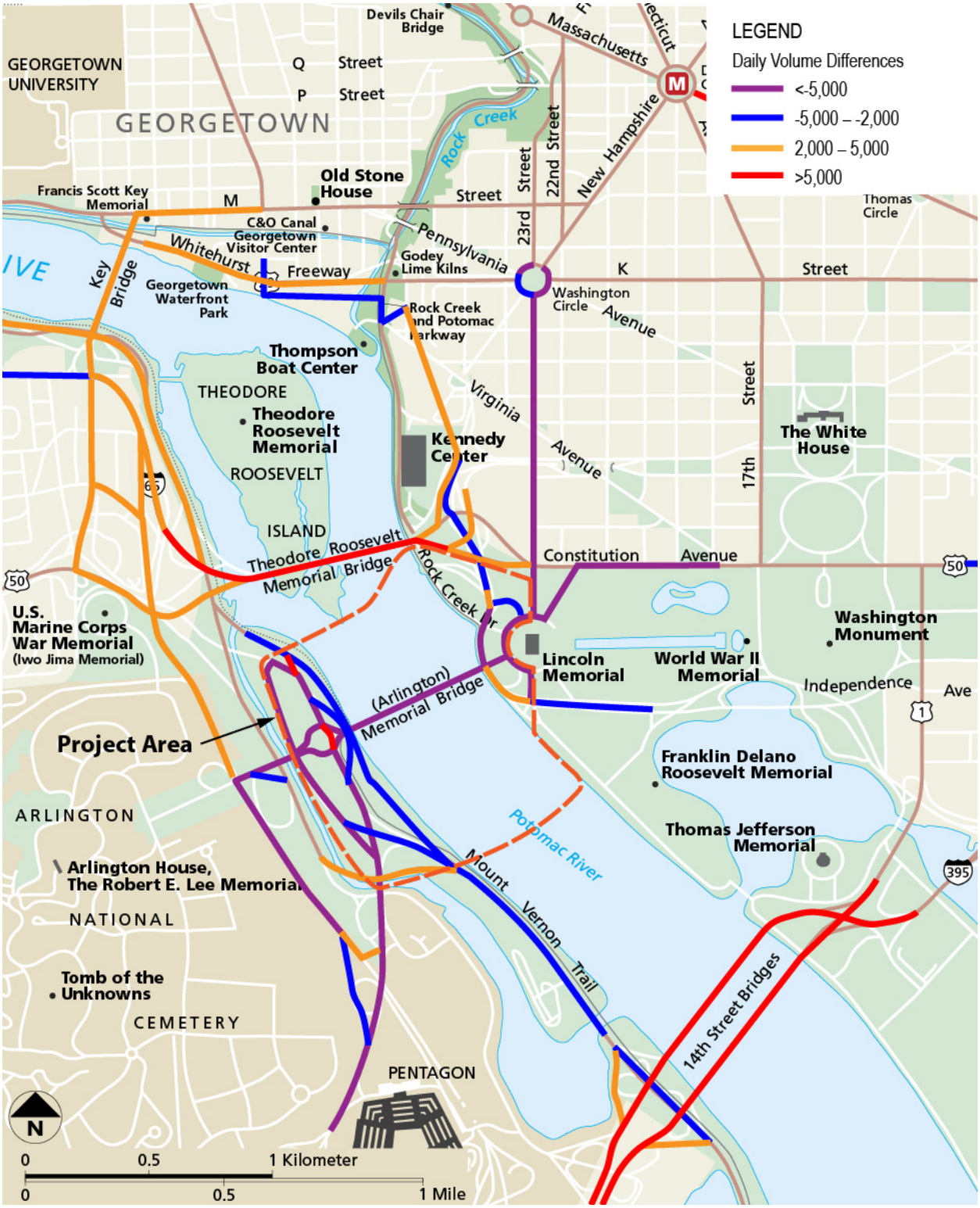


Figure 64: Full Closure Scenario - Changes in Traffic Volumes

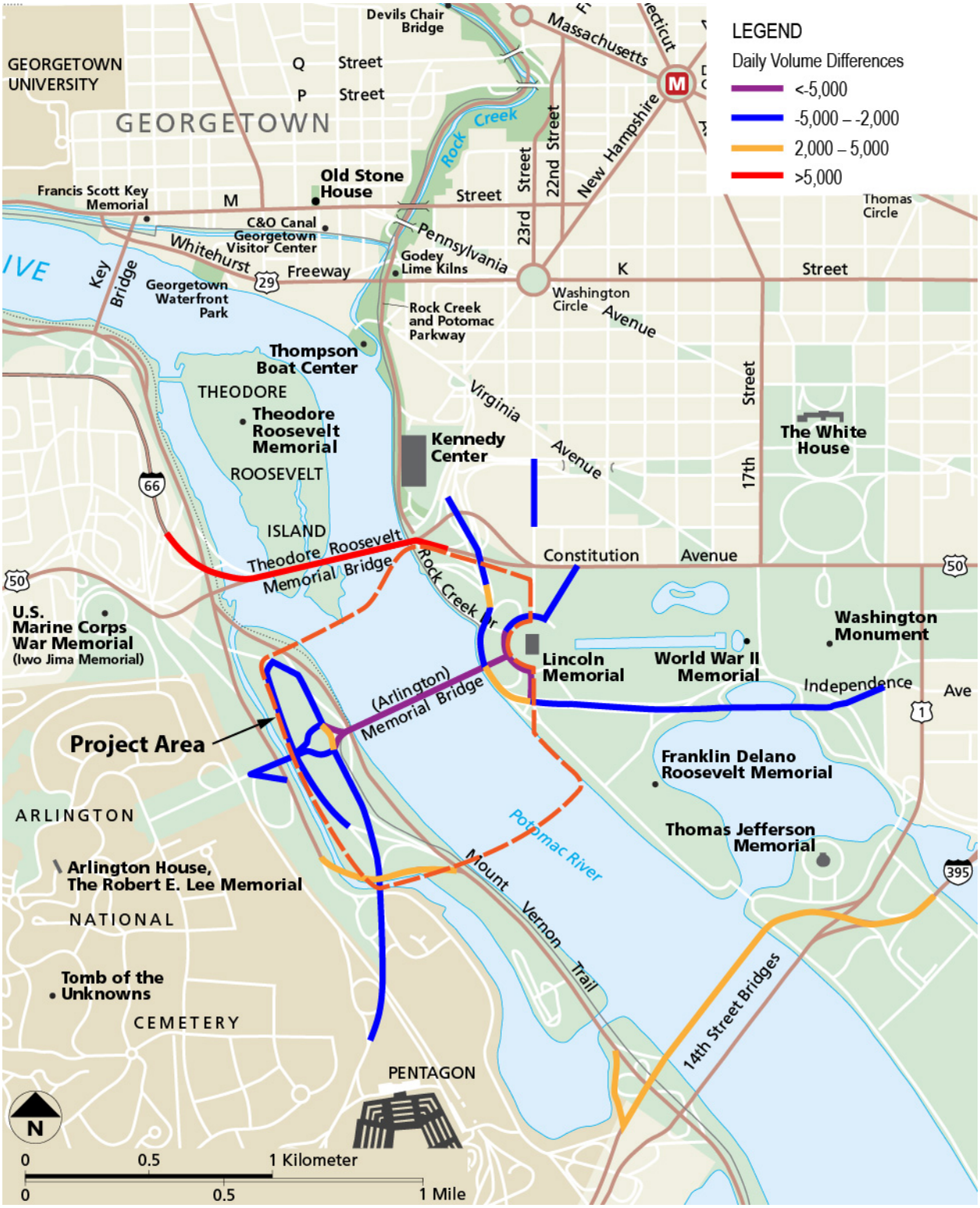


Figure 65: Three-Lane Closure Scenario A - Changes in Traffic Volumes

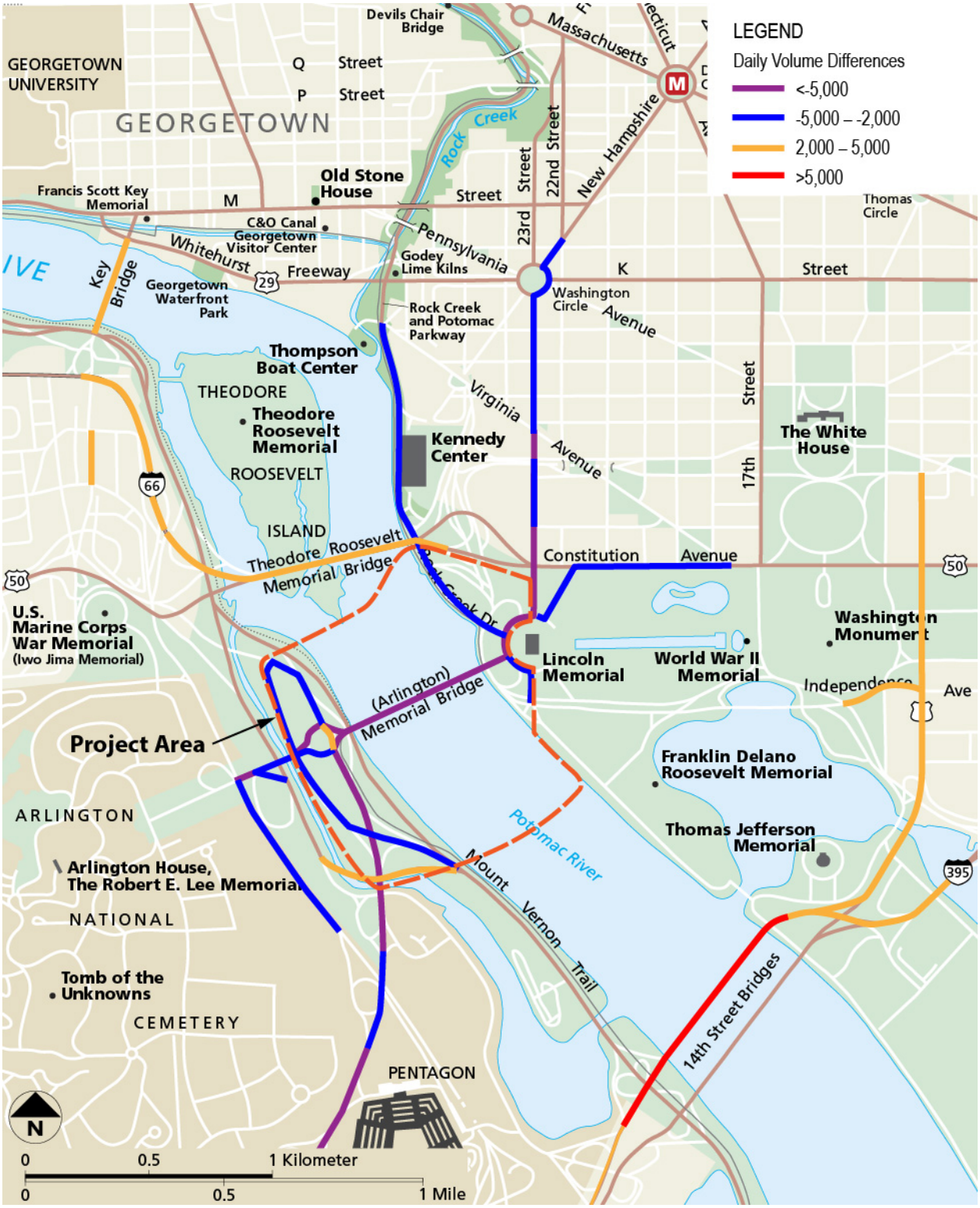


Figure 66: Three-Lane Closure Scenario B - Changes in Traffic Volumes

Pedestrians and bicyclists would also be affected during the construction period with the closure of sidewalks on the Arlington Memorial Bridge. Under Construction Method A, the bridge would be completely closed to pedestrians and bicycles for approximately 70 days and one sidewalk would remain open for pedestrians and bicyclists for approximately 490 days. During the full closure period, pedestrians and bicyclists would be unable to cross the Arlington Memorial Bridge to travel between the Mount Vernon Trail and the Rock Creek Multi-Use Trail or the remainder of Washington, DC. Alternate routes include traveling north and south on Ohio Drive and the Mount Vernon Trail to cross the Potomac River on the Theodore Roosevelt Memorial Bridge. The pedestrian/bicycle detour would add approximately 2.5 miles to the normal 1.1 mile trip (Figure 67).

Under Construction Method B, one sidewalk would remain open for pedestrians and bicyclists for approximately 560 days. The sidewalk closures may tax the sidewalk capacity and affect pedestrian and bicycle access to destinations including Arlington National Cemetery, the Lincoln Memorial, and the National Mall. The sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists.

The District Department of Transportation has identified the Arlington Memorial Bridge as an emergency evacuation route. During construction of Alternative 1A, the Arlington Memorial Bridge would be completely or partially closed to vehicular, pedestrian, and bicycle traffic. During the full closure period, the Arlington Memorial Bridge would not be usable as an emergency evacuation route for vehicles, pedestrians or bicyclists and use would be limited during the partial closure period, causing delays exiting the city. During an emergency event, the District Department of Transportation, through the use of overhead signs and emergency personnel would inform evacuees of the status of the Arlington Memorial Bridge. Evacuees would be required to use alternative routes such as the Theodore Roosevelt Memorial Bridge and the 14th Street Bridges in order to evacuate south of the city. This would result in a short-term adverse impact to traffic and transportation.

Once construction is completed, the bridge's vehicular capacity would return to its current level with six travel lanes in place. Sidewalks on both sides of the bridge would also be reopened. Rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years. Therefore, Alternative 1A would have a long-term beneficial impact to traffic and transportation.

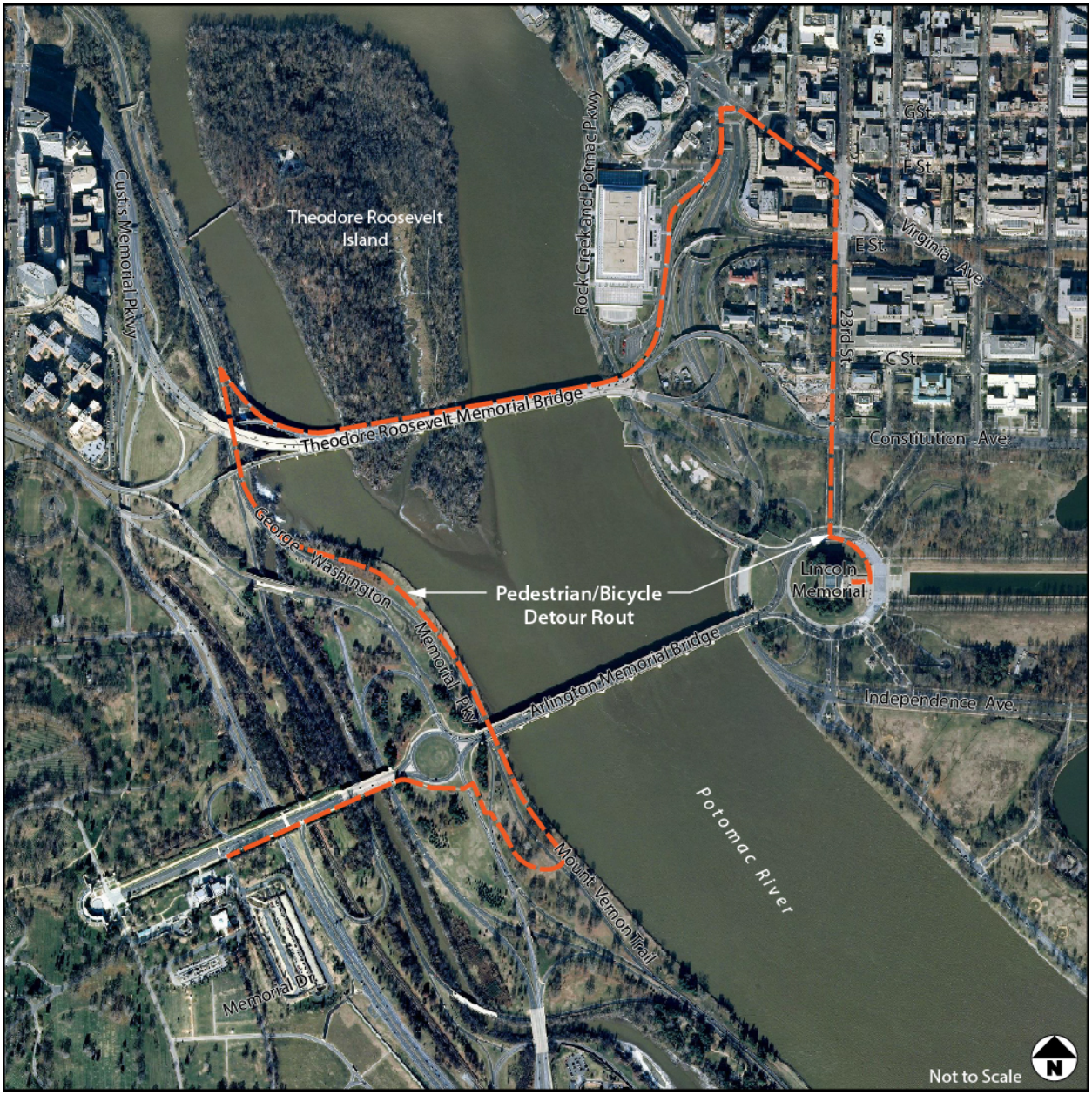


Figure 67: Pedestrian/bicycle detour route between the Lincoln Memorial and the Arlington National Cemetery

Cumulative Impacts. Past, present, and reasonably foreseeable future actions have and continue to contribute to cumulative impacts on traffic and transportation in the vicinity of the Arlington Memorial Bridge. These projects include the Memorial Circle Transportation Plan, and construction activities associated with the Kennedy Center Expansion the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary construction activities that could impact traffic. If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, Alternative 1A would contribute a moderate amount to the adverse cumulative impacts to traffic and transportation. Due

to the required closures of the Arlington Memorial Bridge under Construction Method A, it would result in a greater adverse cumulative impact to traffic and transportation than Construction Method B, under which the bridge would remain open throughout the construction period.

The Memorial Circle Transportation Plan and the Theodore Roosevelt Memorial Bridge repairs would result in long-term beneficial impacts to traffic and transportation by enhancing transportation facilities. Alternative 1A would contribute a minor amount to these long-term beneficial cumulative impacts by eliminating weight restrictions and the need for emergency bridge repairs.

Conclusion. Under both construction methods for Alternative 1A, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. Sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists. Once construction is completed, rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years which would result in a long-term beneficial impact to traffic and transportation.

If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, Alternative 1A would contribute a moderate amount to the adverse cumulative impacts to traffic and transportation. Alternative 1A would contribute a minor amount to long-term beneficial cumulative impacts to traffic and transportation.

These impacts are in addition to the transportation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

Under Alternative 1B, the Arlington Memorial Bridge would undergo a major rehabilitation that would affect traffic for approximately 560 calendar days, or approximately 1.5 years. Impacts to traffic and transportation would be similar to those described under Alternative 1A.

Under Alternative 1B, travel lanes and sidewalks would be closed or restricted for the same duration as described under Alternative 1A. Impacts from these closures on traffic diversion, and travel delays would be the same as those described under Alternative 1A. Under Alternative 1B, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. The sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists.

During the full closure period, the Arlington Memorial Bridge would not be usable as an emergency evacuation route for vehicles, pedestrians or bicyclists and use would be limited during the partial closure periods. During the partial closure periods, lane restrictions would restrict traffic and may cause delays exiting the city. During an emergency event, the District Department of Transportation, through the use of overhead signs and emergency personnel would inform evacuees of the status of the Arlington Memorial Bridge. Evacuees would be required to use alternative routes such as the

Theodore Roosevelt Memorial Bridge and the 14th Street Bridges in order to evacuate south of the city. This would result in a short-term adverse impact to traffic and transportation.

Once construction is completed, the bridge's vehicular capacity would return to its current level with six travel lanes in place. Sidewalks on both sides of the bridge would also be reopened. Rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years. Therefore, Alternative 1B would have a long-term beneficial impact to traffic and transportation.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A. Alternative 1B would contribute a minor amount to these long-term beneficial cumulative impacts by eliminating weight restrictions and the need for emergency bridge repairs.

Conclusion. Under both construction methods for Alternative 1B, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. Sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists. Once construction is completed, rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years which would result in a long-term beneficial impact to traffic and transportation.

If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, Alternative 1B would contribute a moderate amount to the adverse cumulative impacts to traffic and transportation. Alternative 1B would contribute a minor amount to long-term beneficial cumulative impacts to traffic and transportation.

These impacts are in addition to the transportation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 2

Under Alternative 2, the Arlington Memorial Bridge would undergo a major rehabilitation that would affect traffic for approximately 560 calendar days, or approximately 1.5 years. Vehicular travel lanes and sidewalks would be closed to allow for construction activities. Closures, as outlined below, are anticipated to be 24-hours per day, 7 days per week for the duration of the construction. Barriers would be used to block lanes and separate traffic from construction activities. Signage and flaggers would be used to safely direct vehicles through the construction zone and into proper lanes on the bridge and the circles at either end of the bridge.

Under Alternative 2, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 80 days and vehicular traffic would be restricted to three lanes for approximately 480 days. One sidewalk on the bridge would be closed to pedestrian and bicycles for approximately 480. The traffic diversions and travel delays from these lane and sidewalk closures would be the same as those described under Alternative 1A. Under Alternative 2, travel delays would

result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. The sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists.

During the full closure period, the Arlington Memorial Bridge would not be usable as an emergency evacuation route for vehicles, pedestrians or bicyclists and use would be limited during the partial closure periods. During the partial closure periods, lane restrictions would restrict traffic and may cause delays exiting the city. During an emergency event, the District Department of Transportation, through the use of overhead signs and emergency personnel would inform evacuees of the status of the Arlington Memorial Bridge. Evacuees would be required to use alternative routes such as the Theodore Roosevelt Memorial Bridge and the 14th Street Bridges in order to evacuate south of the city. This would result in a short-term adverse impact to traffic and transportation.

Once construction is completed, the bridge's vehicular capacity would return to its current level with six travel lanes in place. Sidewalks on both sides of the bridge would also be reopened. Rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 additional years. Therefore, Alternative 2 would have a long-term beneficial impact to traffic and transportation.

Cumulative Impacts Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A. Alternative 2 would contribute a minor amount to these long-term beneficial cumulative impacts by eliminating weight restrictions and the need for emergency bridge repairs.

Conclusion. Under both construction methods for Alternative 2, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. Sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists. Once construction is completed, rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years which would result in a long-term beneficial impact to traffic and transportation.

If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, Alternative 2 would contribute a moderate amount to the adverse cumulative impacts to traffic and transportation. Alternative 2 would contribute a minor amount to long-term beneficial cumulative impacts to traffic and transportation.

These impacts are in addition to the transportation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

Under Alternative 3, the Arlington Memorial Bridge would undergo a major rehabilitation that would affect traffic for approximately 600 calendar days, or approximately 1.6 years. Vehicular travel lanes and sidewalks would be closed to allow for construction activities. Closures, as outlined below, are anticipated to be 24-hours per day, 7 days per week for the duration of the construction.

Barriers would be used to block lanes and separate traffic from construction activities. Signage and flaggers would be used to safely direct vehicles through the construction zone and into proper lanes on the bridge and the circles at either end of the bridge.

Under Alternative 3, the Arlington Memorial Bridge would be closed to vehicles, pedestrians, and bicyclists for approximately 30 non-consecutive days and vehicular traffic would be restricted to three lanes for approximately 570 days. One sidewalk on the bridge would be closed to pedestrian and bicycles for approximately 570.

The traffic diversions and travel delays from these lane and sidewalk closures would be the same as those described under Alternative 1A. Under Alternative 3, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. The sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists.

During the full closure period, the Arlington Memorial Bridge would not be usable as an emergency evacuation route for vehicles, pedestrians or bicyclists and use would be limited during the partial closure periods. During the partial closure periods, lane restrictions would restrict traffic and may cause delays exiting the city. During an emergency event, the District Department of Transportation, through the use of overhead signs and emergency personnel would inform evacuees of the status of the Arlington Memorial Bridge. Evacuees would be required to use alternative routes such as the Theodore Roosevelt Memorial Bridge and the 14th Street Bridges in order to evacuate south of the city. This would result in a short-term adverse impact to traffic and transportation.

Once construction is completed, the bridge's vehicular capacity would return to its current level with six travel lanes in place. Sidewalks on both sides of the bridge would also be reopened. Rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 additional years. Therefore, Alternative 3 would have a long-term beneficial impact to traffic and transportation.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A. Alternative 3 would contribute a moderate amount to these long-term beneficial cumulative impacts by eliminating weight restrictions and the need for emergency bridge repairs.

Conclusion. Under both construction methods for Alternative 3, travel delays would result in short-term moderate adverse impacts to vehicular traffic, including cars and buses, within the study area. Sidewalk closures would result in short-term moderate adverse impacts to pedestrians and bicyclists. Once construction is completed, rehabilitation of the bridge would ensure that the bridge is available for vehicles, pedestrians, and bicycles for 75 to 100 additional years which would result in a long-term beneficial impact to traffic and transportation.

If the Arlington Memorial Bridge rehabilitation occurs at the same time other projects in the area are under construction, Alternative 3 would contribute a moderate amount to the adverse cumulative

impacts to traffic and transportation. Alternative 3 would contribute a moderate amount to long-term beneficial cumulative impacts to traffic and transportation.

These impacts are in addition to the transportation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, FHWA would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. During the trunnion post shoring, the National Park Service and the Federal Highway Administration would implement a partial closure of the bridge that would diminish the overall vehicle capacity of the bridge resulting in traffic delays on the bridge and on roadways surrounding the bridge. As vehicles attempt to cross the Arlington Memorial Bridge, traffic would back up onto approach roadways including the George Washington Memorial Parkway, Memorial Avenue, the Rock Creek and Potomac Parkway, and Ohio Drive. In addition, sidewalk usage may be restricted to one side of the bridge during the construction period.

Barriers would be used to block lanes and separate traffic from construction activities. Signage and flaggers would be used to safety direct vehicles through the construction zone and into proper lanes on the bridge and the circles at either end of the bridge.

Due to temporary lane closures, trunnion post shoring would have a short-term minor adverse impact on traffic and transportation.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on traffic and transportation in the vicinity of the Arlington Memorial Bridge. These projects include the Memorial Circle Transportation Plan, and construction activities associated with the Kennedy Center Expansion the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary construction activities that could impact traffic. If trunnion post shoring on the Arlington Memorial Bridge occurs at the same time other projects in the area are under construction, the repairs would contribute a minor amount to the adverse cumulative impacts to traffic and transportation.

The Memorial Circle Transportation Plan and the Theodore Roosevelt Memorial Bridge repairs would result in long-term beneficial impacts to traffic and transportation by enhancing

transportation facilities. The trunnion post shoring on the Arlington Memorial Bridge would contribute a minor amount to these long-term beneficial cumulative impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives, due to temporary lane closures, temporary trunnion post shoring would have a short-term minor adverse impact on traffic and transportation. If trunnion post shoring on the Arlington Memorial Bridge occurs at the same time other projects in the area are under construction, the repairs would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. The trunnion post shoring on the Arlington Memorial Bridge would contribute a minor amount to long-term beneficial cumulative impacts.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Area A. Under construction Staging Area A, the grass-covered lawn of Memorial Circle would be used to store construction materials and equipment. Construction materials would be brought to the staging area via the George Washington Memorial Parkway. Under normal circumstances, trucks are prohibited from using the Parkway. Therefore, permits would be needed to allow construction trucks to move materials and equipment to the site. The movement of construction materials to Staging Area A would result in short-term minor adverse impacts to traffic and transportation.

Intermittent traffic delays would occur as construction vehicles enter and exit the staging area into Memorial Circle. Signage would be put in place to alert drivers to construction vehicles entering the roadway, and flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Memorial Circle for construction staging.

Staging Area B. Staging Area B consists of land on Columbia Island between Washington Boulevard and South Washington Boulevard. Under Staging Area B, the grass-covered area would be fenced and used for the storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Construction materials would be brought to Staging Area B via roadways that may include Interstate 66, US 50, Interstate 395, Arlington Boulevard or Washington Boulevard. The movement of construction materials to Staging Area B would result in short-term minor adverse impacts to traffic and transportation.

Intermittent traffic delays would occur as construction vehicles enter and exit the staging area onto Washington Boulevard and onto the Arlington Memorial Bridge. Signage would be put in place to alert drivers to construction vehicles entering the roadway, and flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As

a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Staging Area B for construction staging.

Staging Area C. Under Staging Area C, the grass-covered area north of the Lincoln Memorial would be fenced and used for storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Construction materials would be brought to Staging Area C via roadways that may include US 66, US 50, and 23rd Street, NW. The movement of construction materials to Staging Area C would result in short-term minor adverse impacts to traffic and transportation.

Intermittent traffic delays would occur as construction vehicles enter and exit the staging area onto 23rd Street, NW, around the Lincoln Memorial Circle and onto the Arlington Memorial Bridge. Signage would be put in place to alert drivers to construction vehicles entering the roadway, and flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Staging Area C for construction staging.

Staging Area D. Staging Area D consists of the grassed area at the top of the Watergate Steps. The area would be fenced and used for storage of construction materials and equipment for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Construction materials would be brought to Staging Area D via roadways that may include US 66, US 50, 23rd Street, NW, and the Lincoln Memorial Circle. The movement of construction materials to Staging Area D would result in short-term minor adverse impacts to traffic and transportation.

Intermittent traffic delays would occur as construction vehicles enter and exit the staging area onto the Lincoln Memorial Circle and onto the Arlington Memorial Bridge. Signage would be put in place to alert drivers to construction vehicles entering the roadway, and flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Staging Area D for construction staging.

Construction Causeways and Dock/Work Platforms. Under this option, temporary causeways or dock/work platforms would be constructed from the west and east shores of the Potomac River. Construction materials would be brought to the causeways or dock/work platforms on trucks via the George Washington Memorial Parkway and Ohio Drive. Under normal circumstances, trucks are prohibited from using the Parkway. Therefore, permits would be needed to allow construction trucks to move materials and equipment to the site. Signage would be put in place to alert drivers on the George Washington Memorial Parkway and Ohio drive and pedestrians and bikers on the Mount Vernon Trail to construction vehicles entering and exiting the area. Flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of causeways or dock/work platforms.

Barge Staging Area 1. Under Barge Staging Area 1, a construction staging barge would be located downstream from the Arlington Memorial Bridge along the west bank of the Potomac River and the George Washington Memorial Parkway. Under all of the rehabilitation alternatives, construction materials would be stored on the barge for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Construction of an access road from the George Washington Memorial Parkway to the barge staging area, if needed, would impact grass areas between the parkway and the river and would require crossing the Mount Vernon Trail. This area would be restored following completion of construction.

Construction materials would be brought to Barge Staging Area 1 on barges traveling up the Potomac River or on trucks via the George Washington Memorial Parkway. Under normal circumstances, trucks are prohibited from using the Parkway. Therefore, permits would be needed to allow construction trucks to move materials and equipment to the site. Signage would be put in place to alert drivers on the George Washington Memorial Parkway and pedestrians and bikers on the Mount Vernon Trail to construction vehicles entering and exiting the area. Flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Barge Staging Area 1 for construction staging.

Barge Staging Area 2. Under Barge Staging Area 2, a construction staging barge would be located upstream of the Arlington Memorial Bridge between the west bank of the Potomac River and Roosevelt Island. Barge Staging Area 2 would be used under Construction Method B for Alternatives 1A and 1B, and may be used to store construction materials for the duration of the Arlington Memorial Bridge rehabilitation, up to 700 days. Construction of an access road from the George Washington Memorial Parkway to the barge staging area, if needed, would impact grass areas between the parkway and the river and would require crossing the Mount Vernon Trail. This area would be restored following completion of construction.

Construction materials would be brought to Barge Staging Area 2 on barges traveling up the Potomac River or on trucks via the George Washington Memorial Parkway. Under normal circumstances, trucks are prohibited from using the Parkway. Therefore, permits would be needed to allow construction trucks to move materials and equipment to the site. Signage would be put in place to alert drivers on the George Washington Memorial Parkway and pedestrians and bikers on the Mount Vernon Trail to construction vehicles entering and exiting the area. Flaggers would be used to stop vehicles, pedestrians, and bikers as necessary to allow for the movement of construction vehicles. As a result, there would be a short-term minor adverse impact to traffic and transportation from the use of Barge Staging Area 2 for construction staging.

Cumulative Impacts. Past, present, and reasonably foreseeable future action have and continue to contribute to cumulative impacts on traffic and transportation in the vicinity of the Arlington Memorial Bridge. These projects include the Memorial Circle Transportation Plan, and construction activities associated with the Kennedy Center Expansion the DC Clean Rivers Potomac River Tunnel, repairs to the Theodore Roosevelt Memorial Bridge, and the Arlington County and Vicinity Non-Motorized Boathouse Facility. All of these projects would involve temporary

construction activities that could impact traffic. Use of the land and barge staging areas for the Arlington Memorial Bridge, if at the same time as other projects in the area, would contribute a minor amount to the adverse cumulative impacts to traffic and transportation.

The Memorial Circle Transportation Plan and the Theodore Roosevelt Memorial Bridge repairs would result in long-term beneficial impacts to traffic and transportation by enhancing transportation facilities. Use of the land and barge staging areas for the Arlington Memorial Bridge project would not contribute to these long-term beneficial cumulative impacts.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, use of the land and barge staging areas would have short-term minor adverse impacts to traffic and transportation from construction vehicles entering and exiting the sites. Use of the land and barge staging areas for the Arlington Memorial Bridge, if at the same time as other projects in the area, would contribute a minor amount to the adverse cumulative impacts to traffic and transportation. Use of the land and barge staging areas for the Arlington Memorial Bridge project would not contribute to long-term beneficial cumulative impacts.

NAVIGATION

Methodology and Assumptions

The purpose of this analysis is to assess the effects of the proposed rehabilitation on navigation along the Potomac River in the area of the Arlington Memorial Bridge. To determine impacts, current users of the river were considered and the temporary effects of construction were analyzed. Analyses of potential impacts were derived from professional judgment and took into consideration frequent users of the Potomac River and their navigational needs.

Study Area

The study area for navigation is the Potomac River in the vicinity of the proposed bridge rehabilitation and the proposed staging areas.

Impact Thresholds

Negligible: Impacts to navigation would be at or below user detection level. The user would likely not be aware of the effects associated with the alternative.

Minor: Impacts to navigation would be detectable, although changes would be slight. The user would be aware of the effects associated with the alternative, but the effects would be slight.

Moderate: Impacts to navigation would be readily apparent. The user would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.

Major: Impacts to navigation would be readily apparent and severely adverse. The user would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.

Impacts of the No-Action Alternative

Under the No-Action Alternative, the concrete and steel structural components of the Arlington Memorial Bridge would continue to deteriorate. Emergency repairs would be necessary from time to time to rehabilitate deteriorated bridge components to keep the bridge operational and safe for vehicles and pedestrians. Any required repairs to the bridge piers could require in-water work and temporarily impact navigation on the river.

Currently, a federal navigation channel is directed under the bascule span of the Arlington Memorial Bridge. During emergency in-water repairs to the bridge, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the construction has been completed. Any temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. An update would be posted to the USCG District 5's Local Notice to Mariners. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation.

Under the No-Action Alternative, the bascule span would remain inoperable, and the bridge would continue to be permitted as a drawbridge by the US Coast Guard.

Cumulative Impacts. Future projects including the Arlington County and Vicinity Non-Motorized Boathouse Facility and the Theodore Roosevelt Memorial Bridge repairs may have short-term impacts to navigation of the Potomac River from construction activities in the Potomac River. Emergency repairs to the Arlington Memorial Bridge under the No Action Alterative would contribute a negligible amount to the short-term adverse cumulative impacts to navigation. There would be no long-term cumulative impacts under the No-Action Alternative.

Conclusion. Therefore, there would be short- term negligible adverse impacts to navigation under the No-Action Alternative. Emergency repairs to the Arlington Memorial Bridge under the No Action Alterative would contribute a negligible amount to the short-term adverse cumulative impacts to navigation. The No-Action Alternative would not contribute to long-term cumulative impacts. These impacts are in addition to the navigation impacts that would occur with the temporary trunnion shoring described later in this section.

Impacts of Alternative 1A

During construction of Alternative 1A, the bascule span would be removed and replaced. Concurrent to the removal of the bascule span, the replacement structure comprised of precast concrete box girders would be constructed on falsework (temporary support structures) in the Potomac River directly upstream of the bridge. Currently, a federal navigation channel is directed

under the bascule span of the Arlington Memorial Bridge. During the time that the falsework is in place, the navigation channel would be temporarily relocated under an adjacent span and boaters would be restricted from boating around or under the bascule span. According to the National Oceanic and Atmospheric Administration's navigation map, the water depth under the bascule span is approximately 16 to 22 feet. Water depths under the adjacent spans range from 22 to 25 feet. The navigation channel would return to its original span after the falsework has been removed.

The USCG Bridge Program has authority to approve the location and plans of all new bridges and modifications of existing bridges, including international bridges and causeways in or over navigable waterways of the United States. In accordance with 33 CFR 116.01, "[a]ll bridges are obstructions to navigation and are tolerated only as long as they serve the needs of land transportation while allowing for the reasonable needs of navigation." Pursuant to the Rivers and Harbors Act, "No bridge shall at any time unreasonably obstruct the free navigation of any navigable waterway of the Unites States." In addition, per the International Bridge Act of 1972, "No bridge erected or maintained under the provisions of sections 491 to 498 of this title, shall at any time unreasonably obstruct the free navigation of the waterway over which it is constructed."

Under either method of construction, the temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that navigation on the Potomac River is not restricted. The adjacent span which would be used for navigation would provide boaters with similar water depth and height clearance and would not restrict the types of boats currently using the river in the vicinity of the Arlington Memorial Bridge. The National Park Service and the Federal Highway Administration would coordinate installation of required lighting and signage to protect boaters, and an update would be posted to the USCG District 5's Local Notice to Mariners to notify boaters of the change in navigation. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation.

Alternative 1A would include repairs to all of the bridge piers. Non-motorized boaters, including canoes, kayaks, and crews, would be affected by repairs to the bridge piers and in-water staging areas as discussed later in this section. Non-motorized boaters currently use arches 3 and 4 on the west side of the river to travel downstream and arches 7 and 8 on the east side of the river to travel upstream. Construction activities and staging areas would restrict boater access, and non-motorized boaters may need to use arches used by motorized boats. This could result in increased boat congestion and possible boating conflicts on this portion of the river. The National Park Service and the Federal Highway Administration would coordinate with the Potomac River Safety Committee and local marinas and rowing clubs regarding access restrictions and hazards during construction. The restriction of non-motorized boats to the east side of the river during construction activities would result in short-term moderate adverse impacts to non-motorized boaters. Once construction activities are completed, temporary spud anchors, pilings, and staging barges would be removed, and there would be no long-term impacts to non-motorized boaters.

Under both methods of construction under Alternative 1A, the existing bascule span would be replaced with a fixed span. Although the bascule span of the Arlington Memorial Bridge was originally designed to open for large boats, the construction of other, lower, bridges in the area

negated the need to open the span. Measures were put in place to seal the span, and it has not opened since the 1960s. The Arlington Memorial Bride is listed on National Oceanic and Atmospheric Administration navigation maps as a fixed span bridge with a vertical clearance of 30 feet. The new fixed span would have the same vertical and horizontal clearance as the existing bascule span. Large vessels traveling from the south cannot navigate past the 14th Street Bridge Complex due to height restrictions which are lower than the Arlington Memorial Bridge. The vertical clearance of the 14th Street Bridge Complex is 18 feet. There are no marinas for motorized boats up-river of the 14th Street Bridge Complex, and there are no locations to dock or launch a large vessel between the 14th Street Bridge Complex and the Arlington Memorial Bridge. Therefore, vessels traveling on this portion of the Potomac River, and under the Arlington Memorial Bridge, are limited to those with a height under 18 feet. Given that there have been no requests for an opening since the 1960s and because vessels that require a greater vertical clearance than what is available when the bascule span is in the closed position cannot reach the Arlington Memorial Bridge, it appears that replacing the bascule span with a fixed span that provides the same vertical clearance may not result in any long-term impacts to navigation. Under Alternative 1A, the National Park Service would seek a new bridge permit from the US Coast Guard designating the bridge as a fixed-span bridge.

Cumulative Impacts. Future projects including the Arlington County and Vicinity Non-Motorized Boathouse Facility and the Theodore Roosevelt Memorial Bridge repairs may have short-term impacts to navigation of the Potomac River from construction activities in the Potomac River. If Alternative 1A is under construction at the same time as these projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. There would be no long-term cumulative impacts under the Alternative 1A.

Conclusion. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation. Because the bascule span has not opened since the 1960s and because other bridges downstream do not allow large boats to reach the Arlington Memorial Bridge, the replacement of the bascule span with a fixed span would not result in long-term impacts to navigation. If Alternative 1A is under construction at the same time as these projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Alternative 1A would not contribute to long-term cumulative impacts. These impacts are in addition to the navigation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 1B

During construction of Alternative 1B, the bascule span would be removed and replaced. Concurrent to the removal of the bascule span, the replacement structure comprised of variable depth steel girders would be constructed on falsework (temporary support structures) in the Potomac River directly upstream of the bridge. During the time that the falsework is in place, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the falsework has been removed. The temporary relocation of the navigation channel, during construction, would result in short-term minor adverse impacts to

navigation, and impacts to boaters navigating the Potomac River would be the same as those described under Alternative 1A. Under Alternative 1B, the National Park Service would seek a new bridge permit from the US Coast Guard designating the bridge as a fixed-span bridge.

Cumulative Impacts. Cumulative impacts under Alternative 1B would be the same as those described under Alternative 1A.

Conclusion. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation. Because the bascule span has not opened since the 1960s and because other bridges downstream do not allow large boats to reach the Arlington Memorial Bridge, the replacement of the bascule span with a fixed span would not result in long-term impacts to navigation. If Alternative 1B is under construction at the same time as these projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Alternative 1B would not contribute to long-term cumulative impacts.

Impacts of Alternative 2

During construction of Alternative 2, the bascule span would be removed and replaced. Concurrent to the removal of the bascule span, the replacement structure comprised of welded steel trusses would be constructed on falsework (temporary support structures) in the Potomac River directly upstream of the bridge. During the time that the falsework is in place, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the falsework has been removed. The temporary relocation of the navigation channel, during construction, would result in short-term minor adverse impacts to navigation, and impacts to boaters navigating the Potomac River would be the same as those described under Alternative 1A. Under Alternative 2, the National Park Service would seek a new bridge permit from the US Coast Guard designating the bridge as a fixed-span bridge.

Cumulative Impacts. Cumulative impacts under Alternative 2 would be the same as those described under Alternative 1A.

Conclusion. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation. Because the bascule span has not opened since the 1960s and because other bridges downstream do not allow large boats to reach the Arlington Memorial Bridge, the replacement of the bascule span with a fixed span would not result in long-term impacts to navigation. If Alternative 2 is under construction at the same time as these projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Alternative 2 would not contribute to long-term cumulative impacts. These impacts are in addition to the navigation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Alternative 3

During construction of Alternative 3, the bascule span would be repaired/rehabilitated. Falsework (temporary support structures) would be constructed at each trunnion post on the half of the bascule span that is being repaired/rehabilitated. During the time that the falsework is in place, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the falsework has been removed. The temporary relocation of the navigation channel, during construction, would result in short-term minor adverse impacts to navigation, and impacts to boaters navigating the Potomac River would be the same as those described under Alternative 1A.

Under Alternative 3, the bascule span would remain inoperable, and National Park Service would seek a new bridge permit from the US Coast Guard designating the bridge as a fixed-span bridge.

Cumulative Impacts. Cumulative impacts under Alternative 3 would be the same as those described under Alternative 1A.

Conclusion. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation. Because the bascule span has not opened since the 1960s and because other bridges downstream do not allow large boats to reach the Arlington Memorial Bridge, rehabilitation of the bascule span in a manner that would not allow it to open span would not result in long-term impacts to navigation. If Alternative 3 is under construction at the same time as these projects, it would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Alternative 3 would not contribute to long-term cumulative impacts. These impacts are in addition to the navigation impacts that would occur with the temporary trunnion shoring and use of staging areas described later in this section.

Impacts of Temporary Trunnion Post Shoring

Impacts associated with the temporary trunnion post shoring would occur under the No-Action Alternative and all of the Action Alternatives.

Due to the continuing deterioration of steel within the trunnion posts which support the bascule span, temporary shoring may need to be added to the posts by 2017. *Note – these repairs would occur regardless of which alternative assessed above is selected for the proposed action.*

For these repairs, the Federal Highway Administration would install steel beams on all four sides of each trunnion post to provide additional strength to each trunnion. Depending on design, pilings may need to be placed in the Potomac River to support the steel beams. During the time that the pilings are in place, should they be required, the navigation channel would be temporarily relocated under an adjacent span. The navigation channel would return to its original span after the pilings have been removed. The temporary relocation of the navigation channel would be closely coordinated with the US Coast Guard to ensure that all required lighting and signage is installed. An

update would be posted to the USCG District 5's Local Notice to Mariners. The temporary relocation of the navigation channel would result in short-term minor adverse impacts to navigation.

After the trunnion posts are repaired, the bascule span would return to its previous operating capacity and the bridge would continue to operate as a fixed span bridge; therefore no long-term impacts to navigation would occur.

Cumulative Impacts. Future projects including the Arlington County and Vicinity Non-Motorized Boathouse Facility and the Theodore Roosevelt Memorial Bridge repairs may have short-term impacts to navigation of the Potomac River from construction activities in the Potomac River. Repairs to the trunnion posts on the Arlington Memorial Bridge, if under construction at the same time as these projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. There would be no long-term cumulative impacts to navigation from the temporary trunnion post shoring.

Conclusion. In addition to the impacts associated with the Action Alternatives, temporary trunnion post shoring would require the temporary relocation of the navigation channel, which would result in short-term minor adverse impacts to navigation. After the trunnion posts are repaired, the bascule span would return to its previous operating capacity and the bridge would continue to operate as a fixed span bridge and no long-term impacts to navigation would occur. Repairs to the trunnion posts on the Arlington Memorial Bridge, if under construction at the same time as these projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Trunnion post shoring on the Arlington Memorial Bridge would not contribute to long-term cumulative impacts to navigation.

Impacts of Staging Areas

Use of the one or more of the staging areas would occur under any of the Action Alternatives. Therefore, the impacts described below would occur in addition to the impacts described for each of the Action Alternatives.

Staging Areas A, B, C and D. Staging Areas A, B, C, and D are located on land. No impacts to navigation would result from the use of these areas for construction staging.

River-Based Staging Areas (Causeways, Dock/Work Platforms, Barge Staging Area 1, and Barge Staging Area 2). River-based staging may consist of temporary causeways or dock/work platforms constructed from the east and west shores of the Potomac River and barge staging areas north and south of the Arlington Memorial Bridge. The causeways or dock/work platforms would extend approximately 250 to 750 feet into the river blocking arches 1, 2, and 3. Barge Staging Areas 1 and 2 would be located in shallow waters along the west side of the river. The installment of the barge would be closely coordinated with the US Coast Guard. An update would be posted to the USCG District 5's Local Notice to Mariners to inform the boating community of the barge installment.

Because of the current shallow water depths, motorized boats cannot access areas where causeways, work platforms, or barges staging areas would be placed. Therefore, river-based construction staging would not impact motorized boats using this portion of the Potomac River.

Non-motorized boaters currently use arches 3 and 4 of the Arlington Memorial Bridge on the west side of the river to travel downstream and arches 7 and 8 on the east side of the river to travel upstream. No boats would be allowed in the vicinity of the causeways or dock/work platforms thereby preventing non-motorized boaters traveling both upstream and downstream through arches 3, 4, 7 or 8. These restrictions would force non-motorized boaters to use arches that may be used by motorized boats adding to boat congestion and possible boating conflicts on this portion of the river. Staging areas would be clearly marked and lighted to prevent collisions with non-motorized boats. The National Park Service and the Federal Highway Administration would coordinate with the Potomac River Safety Committee and local marinas and rowing clubs regarding restricted use and hazards during construction. The restrictions use of arches 3, 4, 7, or 8 during construction activities would result in short-term moderate adverse impacts to non-motorized boaters. Once construction activities are completed, temporary spud anchors, pilings, and staging barges would be removed, and there would be no long-term impacts to non-motorized boaters.

Cumulative Impacts. Future projects including the Arlington County and Vicinity Non-Motorized Boathouse Facility and the Theodore Roosevelt Memorial Bridge repairs may have short-term impacts to navigation of the Potomac River from construction activities in the Potomac River. Use of the barge staging areas for the Arlington Memorial Bridge, if at the same time as these projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. There would be no long-term cumulative impacts from the construction staging areas.

Conclusion. In addition to the impacts associated with the Action Alternatives and trunnion post shoring, both barge staging areas would result in short-term minor adverse impacts to navigation due to the temporary relocation of the navigation channel. Use of the barge staging areas for the Arlington Memorial Bridge, if at the same time as these projects, would contribute a minor amount to the short-term adverse cumulative impacts to navigation. Use of the barge staging areas for the Arlington Memorial Bridge would not contribute to long-term cumulative impacts to navigation.

CHAPTER 5: CONSULTATION AND COORDINATION

The National Park Service places a high priority on public involvement in the National Environmental Policy Act process and on giving the public an opportunity to comment on the proposed action. Consultation and coordination with federal, state, and local agencies, and American Indian tribes was also conducted to identify issues and/or concerns related to natural and cultural resources in the vicinity of the Arlington Memorial Bridge. Chapter 5 provides a summary of the public involvement and agency consultation that occurred during the preparation of the Environmental Assessment. Copies of agency correspondence are included in Appendix A.

AGENCY COORDINATION

The National Park Service initiated scoping with multiple relevant agencies early in the National Environmental Policy Act planning process and in consideration of the National Historic Preservation Act. Scoping newsletters were distributed on April 8, 2013 to the US Fish and Wildlife Service, the US Army Corp of Engineers, the US Coast Guard, the National Capital Planning Commission, the DC Historic Preservation Office, the Virginia Department of Historic Resources, the Virginia Department of Conservation and Recreation, the National Marine Fisheries Service, the Commission of Fine Arts, the Advisory Council on Historic Preservation, the District Department of Energy and Environment, the District Department of Transportation, the Virginia Department of Transportation, the Arlington County Transportation Planning Division, and many others. This consultation is discussed in detail below.

SECTION 7 CONSULTATION

National Marine Fisheries Service – Office of Protected Resources

On November 6, 2012, the National Park Service consulted with the National Marine Fisheries Service Office of Protected Resources via teleconference to obtain guidance in regards to the shortnose sturgeon (*Acipenser brevirotrum*) and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) as it pertains to compliance with Section 7 of the Endangered Species Act for the Arlington Memorial Bridge project. The meeting included members of the National Park Service, Federal Highway Administration, and the National Marine Fisheries Service Office of Protected Resources. The National Oceanic and Atmospheric Administration indicated that the federally listed endangered shortnose sturgeon and the Chesapeake Bay Distinct Population Segments of the Atlantic sturgeon are known to occur in the Potomac River. The National Oceanic and Atmospheric Administration provided the National Park Service with valuable technical assistance and species information that helped the team to identify appropriate conservation measures to avoid and/or minimize impacts to the shortnose and Atlantic sturgeon during the proposed rehabilitation of the Arlington Memorial Bridge.

On June 18, 2015, the National Park Service sent a letter to the Office of Protected Resources to request concurrence that the proposed rehabilitation of the Arlington Memorial Bridge is not likely to adversely affect either the shortnose or Atlantic sturgeon based on the implementation of

appropriate mitigation measures. The letter provided details regarding the proposed methods to be used during construction, particularly those methods that would affect the Potomac River and the sturgeons' ability to migrate through the project area. The letter also detailed the National Park Service's proposed measures to avoid and/or minimize potential impacts to the shortnose and Atlantic sturgeon. In a response letter dated October 15, 2015, the Office of Protected Resources concurred with the National Park Service's finding that, with the implementation of appropriate mitigation measures, the proposed rehabilitation of the Arlington Memorial Bridge is not likely to adversely affect either the shortnose or Atlantic sturgeon.

U.S. Fish and Wildlife Service

On February 19, 2016, the National Park Service requested a project review by the US Fish and Wildlife Service Chesapeake Bay and Virginia Field Offices using the Information, Planning, and Conservation (IPaC) System to initiate informal consultation in accordance with Section 7 of the Endangered Species Act. Both field offices identified no federally listed species within the project area.

Virginia Department of Conservation and Recreation – Natural Heritage Program

To comply with Virginia's endangered species regulations, the National Park Service submitted an Information Services Order Form to the Virginia Department of Conservation and Recreation's Natural Heritage Program on March 4, 2015 to request a project review for natural heritage occurrences including state-listed rare plants, animals, and significant communities, etc. in the vicinity of the Arlington Memorial Bridge. In a letter dated August 7, 2015, the Virginia Department of Conservation and Recreation responded stating there was a potential for the Northern Long-eared bat (*Myotis septentrionalis)* to occur within the project area and recommended consultation with the US Fish and Wildlife Service to determine potential impacts. Ongoing consultation with US Fish and Wildlife Service has revealed no potential for the project to impact the Northern Long-eared bat.

District Department of Energy and Environment

On June 18, 2015, the National Park Service sent a letter to the District Department of Energy and Environment to request a project review to determine the potential for any plant or animal species of concern and/or any unique habitat that may occur in the project area. In a letter dated September 2, 2015, District Department of the Environment responded that "the proposed project area does not harbor any species listed by the federal Endangered Species Act, any species classified by NatureServe as G1 (critically imperiled), any species classified by NatureServe as G2 (imperiled), nor any ecologically sensitive communities."

SECTION 106 CONSULTATION

In accordance with Section 106 of the National Historic Preservation Act, consultation letters were sent to the Advisory Council on Historic Preservation, the District of Columbia Historic Preservation Office, and the Virginia Department of Historic Resources on December 6, 2012. The DC State Historic Preservation Officer provided a written response on January 15, 2015, and a written response was received from the Virginia Department of Historic Resources on December 17, 2012. Copies of these correspondences are provided in Appendix A.

Understanding that consultation is of critical importance to the success of the project, the National Park Service scheduled a meeting with the Advisory Council on Historic Preservation and the State Historic Preservation Offices of Washington, DC and Virginia on March 14, 2013. This meeting began with a presentation by Federal Highway Administration staff to provide the group with an understanding of the deterioration issues of the bridge structure. Following the presentation, topics of discussion included the delineation of the Area of Potential Effect, the need to fully consider all options for the project from preservation to replacement, and the need to ensure public participation in the planning process. Meeting attendees also discussed the project schedule and acknowledged that the National Environmental Policy Act and Section 106 compliance would follow two separate but parallel paths.

On August 8, 2013, the National Park Service sent letters to potential consulting parties inviting them to participate in the Section 106 process for the proposed rehabilitation of the Arlington Memorial Bridge. Approximately 50 consulting party invitation letters were sent to agencies, organizations, and individuals whom the National Park Service identified as having a potential interest in the project. Twelve responses were received accepting the National Park Service's invitation. Agencies and organizations who accepted the invitation to participate as consulting parties include the National Trust for Historic Preservation; the DC Historic Preservation Office; the Arlington County Department of Community Planning, Housing & Development; the Arlington County Manager's Office; the Virginia Department of Historic Resources; the US Commission of Fine Arts; the Arlington Historical Society; the National Capital Planning Commission; the American Institute of Architects, Northern Virginia Chapter; the Arlington National Cemetery; and the Virginia Department of Planning and Zoning. The National Park Service hosted a meeting with the consulting parties at the George Washington Memorial Parkway headquarters on September 26, 2013. The meeting included an overview of the project planning status, discussion of the project purpose and need, refined alternative concepts, and significance of the historic property. Meeting participants were also invited to tour the bridge's bascule span and operator's area. In August 2015, the National Park Service sent a letter to all consulting parties providing an update on the Arlington Memorial Bridge project and studies that had been conducted since the 2013 consulting parties' meeting.

The National Park Service will coordinate the findings of this Environmental Assessment with the District Historic Preservation Office and the Virginia State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act through the preparation of an Assessment of Effects. A Memorandum of Agreement detailing the necessary mitigation and

minimization measures will be completed with and signed by the necessary parties prior to the final decision document.

TRIBAL CONSULTATION

The National Park Service sent a letter to the Delaware Nation on May 8, 2014 to initiate consultation with the Indian tribe. In a letter dated September 17, 2014, the Delaware Nation Cultural Preservation Office stated that the location of the project does not endanger cultural or religious sites and that the project should continue as planned; however, if archaeological sites or objects are uncovered, construction should stop until the appropriate state agencies and tribal organizations are consulted.

SECTION 401/404 AND SECTION 10 CONSULTATION

On April 8, 2013, the NPS initiated consultation with the US Army Corps of Engineers through the project scoping process. On January 15, 2015, the National Park Service and Federal Highway Administration held a conference call with the US Army Corps of Engineers and the US Coast Guard to discuss project approvals and permitting. The US Army Corps of Engineers indicated that a permit would be needed for any dredging activities greater than 500 square feet. The US Army Corps of Engineers will provide a formal determination on their decision to issue permits once they receive a permit application.

The National Park Service and Federal Highway Administration will continue consultation with the US Army Corps of Engineers and the District Department of Energy and Environment on potential permit and mitigation requirements for impacts to the Potomac River as a result of the Arlington Memorial Bridge rehabilitation.

US COAST GUARD CONSULTATION

On April 8, 2013, the National Park Service initiated consultation with the US Coast Guard through the project scoping process. On January 15, 2014, the National Park Service and Federal Highway Administration held a conference call with the US Coast Guard and US Army Corps of Engineers to discuss project approvals and permitting. The US Coast Guard informed the National Park Service that, despite the fact that the Arlington Memorial Bridge has not opened since the 1960s and cannot presently open, the bridge is currently permitted as a drawbridge. Any rehabilitation efforts which resulted in the bridge becoming a permanently fixed bridge would require a US Coast Guard permit. In addition, any construction activities that could impact navigation on the Potomac River must be coordinated with the US Coast Guard.

On June 12, 2014, the National Park Service invited the US Coast Guard to participate as a cooperating agency in the National Environmental Policy Act and Section 106 processes for the

Arlington Memorial Bridge rehabilitation. The US Coast Guard accepted this invitation in a letter dated July 18, 2014.

The National Park Service and Federal Highway Administration will continue consultation with the US Coast Guard on potential permit and mitigation requirements for impacts to the Arlington Memorial Bridge and navigation of the Potomac River.

TRANSPORTATION PLANNING

The National Park Service and Federal Highway Administration have conducted on-going coordination with local and regional transportation authorities including the Metropolitan Washington Council of Governments Transportation Planning Board, the DC Department of Transportation, the Virginia Department of Transportation, Arlington County, and the Washington Metropolitan Area Transit Authority.

The Federal Highway Administration engaged the Metropolitan Washington Council of Governments Transportation Planning Board to assess the impacts to regional traffic from full and partial bridge closures during the rehabilitation of the Arlington Memorial Bridge. The Transportation Planning Board provided analysis of various closure scenarios as well as no action scenarios. This analysis was used to inform the impact analysis in this Environmental Assessment.

On October 23, 2012, Federal Highway Administration hosted a meeting with the transportation departments to introduce the project, discuss the bridge condition, provide an overview of alternatives, and begin discussions on transportation impacts from construction activities. On May 5, 2015, Federal Highway Administration hosted a second meeting to discuss construction impacts and maintenance of traffic during construction, including impacts to emergency evacuation routes and methods for informing the public about on-going construction and detours. Lastly, on June 2, 2015, Federal Highway Administration met with the Washington Metropolitan Area Transit Authority to discuss the implementation of weight restrictions on the bridge and detours to be used by the Washington Metropolitan Area Transit Authority buses until the rehabilitation of the bridge is complete.

This page intentionally left blank.

CHAPTER 6: LIST OF PREPARERS

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Denver Service Center
12795 W Alameda Parkway
Lakewood, Colorado 80228

Karen Arey, Project Manager
Charles Borders, Transportation Branch Chief
Steve Culver, Natural Resource Specialist

National Capital Region
1100 Ohio Drive Southwest
Washington, DC 20242

Catherine Dewey, Chief, Division of Resource Management
Joel Gorder, Regional Environmental Coordinator
Doug Jacobs, Deputy Associate Regional Director, Lands, Planning, & Design
Diane Pavek, Threatened and Endangered Species Coordinator
James Pieper, Natural Resource Specialist
Makayah Royal, Federal Lands Highway Program Coordinator
Perry Wheelock, Associate Regional Director for Resources

George Washington Memorial Parkway
700 George Washington Memorial Parkway
McLean, Virginia 22101

Alexcy Romero, Superintendent
Greg Anderson, Cultural Resource Specialist (Former)
Bradley Krueger, Cultural Resource Specialist
Simone Monteleone, Chief of Resource Management
Thomas Sheffer, Acting Community Planner (Former)
Luis Teran, Civil Infrastructure Engineer
Brenda Wasler, Environmental Protection Specialist
Matt Virta, Cultural Resources Program Manager

UNITED STATES FEDERAL HIGHWAY ADMINISTRATION – EASTERN FEDERAL LANDS DIVISION
21400 Ridgetop Circle
Sterling, Virginia 20166

George Choubah, PE, Bridge Design Team Leader
Rich Pakhchanian, PE, Bridge Engineer
Jack VanDop, Senior Environmental Specialist
Ramanik Satasiya, PE, Design Project Manager
Lewis Grimm, PE, Planning Team Leader

UNITED STATES COAST GUARD

431 Crawford Street
Portsmouth, Virginia 23704

Jessica Shea, Bridge Specialist, Fifth Coast Guard District

NATIONAL CAPITAL PLANNING COMMISSION

401 9th St NW #500, Washington, DC 20004

Mathew Flis, Senior Urban Designer

STANTEC CONSULTING SERVICES, INC.

6110 Frost Place
Laurel, MD 20707

Joan Glynn, Project Manager
Melissa Blair, Architectural Historian
Harry Canfield, Environmental Scientist
Laura Cooper, Environmental Scientist
Jessica Davis, Environmental Scientist
Elizabeth Estes, NEPA Specialist
Robin Griffin, Environmental Planner
Gerri Knight-Iske, Cultural Resource Specialist
Amy Krebs, Environmental Scientist
Paul Kriesa, Archaeologist
Julie Liptak, Graphic Artist
Nancy Powell, Cultural Resource Specialist
Brett Schrader, Environmental Scientist

GLOSSARY AND ACRONYMS

GLOSSARY OF TERMS

Affected Environment — The existing environment to be affected by a proposed action and alternatives.

Bascule Span – A moveable portion of a bridge with a counterweight that continuously balances a span, or "leaf", throughout its upward swing to provide clearance for boat traffic.

Best Management Practices — Methods that have been determined to be the most effective, practical means of preventing or reducing pollution or other adverse environmental impacts.

Contributing Resource — A building, site, structure, or object that adds to the historic significance of a property or district.

Council on Environmental Quality — Established by Congress within the Executive Office of the President with passage of the *National Environmental Policy Act* of 1969. CEQ coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives.

Counter Weight – An equivalent counterbalancing weight that balances a load.

Cultural Landscape – Environments that include natural and cultural resources associated with a historical context.

Cultural Resources — Prehistoric and historic districts, sites, buildings, objects, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reason.

Cumulative Impacts — Under NEPA regulations, the incremental environmental impact or effect of an action together with the effects of past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR Part 1508.7).

Endangered Species — Any species that is in danger of extinction throughout all or a significant portion of its range. The lead federal agency for the listing of a species as endangered is the U.S. Fish and Wildlife Service, and it is responsible for reviewing the status of the species on a five-year basis.

Endangered Species Act (16 U.S.C. 1531 et seq.) — An Act which provides a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and which provides a program for the conservation of such endangered species and threatened species.

Environmental Assessment — An environmental analysis prepared pursuant to the *National Environmental Policy Act* to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement (EIS).

Executive Order — Official proclamation issued by the President that may set forth policy or direction or establish specific duties in connection with the execution of federal laws and programs.

Falsework – Temporary support structures that will support the bridge while the bascule span is removed and replaced.

Fiber Reinforced Polymer – A composite material made of a polymer matrix reinforced with fibers.

Floodplain — The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.

High Performance Concrete – A concrete meeting special combination of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices.

Impairment— Within this document, the term impairment has two separate definitions. The NPS requires an analysis of potential effects to determine whether actions would impact or impair Park resources. NPS is empowered with the management discretion to allow impacts on Park resources and values (when necessary and appropriate) to fulfill the purposes of a Park, as long as the impact does not constitute impairment of the affected resources and values. Impairment is also a classification of poor water quality for a surface water body under the U.S. Clean Water Act.

Level of Service – A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience.

Maintenance of Traffic – A traffic control plan developed to be used in a roadwork zone area which utilizes safety cones, signs, flaggers and other tools to ensure the safety of workers and commuters.

NAVD88 – The North American Vertical Datum of 1988 is the vertical control datum of orthometric height established for vertical control surveying in the United States of America.

Peak Hour – The part of the day during which traffic congestion on roads is at its highest.

Scoping — Scoping, as part of NEPA, requires examining a proposed action and its possible effects; establishing the depth of environmental analysis needed; and determining analysis procedures, data needed, and task assignments. The public is encouraged to participate and submit comments on proposed projects during the scoping period.

Staging Area – Areas on land or water where construction equipment, vehicles and materials are stored for the duration of the project.

Submerged Aquatic Vegetation– Grasses that grow to the surface of, but do not emerge from, shallow water.

Threatened Species — Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Total Maximum Daily Load – A regulatory term in the U.S. Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.

Tremie Seal – Concrete seal that sits on the bottom of the river bed to provide stabilization and water protection for the bridge foundation.

Trunnion – The axle upon which the bascule leaf pivots in order to open and close.

Trunnion Pin – Connects the counterweight to the trunnion.

Trunnion Post – Carries the load of the bascule span down to the bridge abutments.

Turbidity Curtains – Floating barriers designed specifically to contain and control the dispersion of floating turbidity or silt in a water body.

Navigation Channel – A deeper channel cut into the sea or river bed, to enable larger ships to pass through to a port.

Vehicle Hours of Delay – The difference between the estimated travel time under actual (often congested) conditions and under uncongested condition, for each highway segment and each hour of the day. These hourly delays per vehicle are multiplied by the annual average hourly traffic for each hour and summed to get total daily vehicle hours of delay.

ACRONYMS

ACHP	American Council for Historic Preservation
AMBC	Arlington Memorial Bridge Commission
APE	Area of Potential Effect
ASSRT	Atlantic Sturgeon Status Review Team
BMP	Best Management Practice
CBP	Chesapeake Bay Plan
CEQ	Council on Environmental Quality
CFA	Commission of Fine Arts
CFR	Code of Federal Regulations
DPS	Distinct Population Segment
DC HPO	District of Columbia Historic Preservation Office
DCOP	District of Columbia Office of Planning
DCMR	District of Columbia Municipal Regulations
DDOT	District of Columbia Department of Transportation
DPS	Distinct Population Segments
DM	Departmental Manual
DO	Director's Order
EA	Environmental Assessment
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FHWA	Federal Highway Administration
FRP	Fiber Reinforced Polymer
GWMP	George Washington Memorial Parkway
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Report
HPC	High Performance Concrete
ICPRB	Interstate Commission on the Potomac River Basin
IPaC	Information Planning and Conservation
LNMs	Local Notice to Mariners
MDDNR	Maryland Department of Natural Resources
MOT	Maintenance of Traffic
MWCOG	Metropolitan Washington Council of Governments
NAMA	National Mall and Memorial Parks
NAVD88	North American Vertical Datum of 1988
NCPC	National Capital Planning Commission
NCR	National Capital Region
NEPA	National Environmental Policy Act of 1969, as amended
NHPA	National Historic Preservation Act of 1966, as amended
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NRCS	Natural Resources Conservation Service

NRHP	National Register of Historic Places
PEPC	Planning, Environment, and Public Comment
PL	Public Law
RDG	Roadside Design Guidelines
SAV	Submerged Aquatic Vegetation
SOF	Statement of Findings
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TPB	Transportation Planning Board
USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VASHPO	Virginia State Historic Preservation Office
VDCR	Virginia Department of Conservation and Recreation
VHD	Vehicle Hours of Delay
VIMS	Virginia Institute of Marine Science
VRE	Virginia Railway Express

This page intentionally left blank.

REFERENCES

Arlington County

2011 *Arlington County Comprehensive Plan: Master Transportation Plan.* Accessed August 26, 2013. http://projects.arlingtonva.us/plans-studies/transportation/master-transportation-plan.

2011 *Arlington Remains #1 Virginia Destination for Tourism Economic Impact.* Released October 12, 2011. Accessed May 7, 2013. http://news.arlingtonva.us/releases/arlington-remains-1-virginia-destination-217291.

Army Ten-Miler (ARMY)

2013 Army Ten-Miler Home Page. Accessed May 23, 2009. http://www.armytenmiler.com.

Atlantic Sturgeon Status Review Team (ASSRT)

2007 *Status Review of Atlantic Sturgeon (Acipenser oxyrinchus oxyrichus)*. Report to National Marine Fisheries Service, Northeast Regional Office. Accessed July 12, 2013. http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/AtlSturgeonStatusReviewReport.pdf.

Capital Challenge Walk MS (CCWMS)

2013 Capital Challenge Walk MS: Frequently Asked Questions. Accessed May 23, 2013. http://challengedcw.nationalmssociety.org/site/PageServer?pagename=CW_DCW_FAQ.

Chesapeake Bay Program

2013 "About the Executive Order." Accessed July 12, 2013. http://executiveorder.chesapeakebay.net/page/About-the-Executive-Order.aspx.

Council on Environmental Quality (CEQ)

1997 *Considering Cumulative Effects Under the National Environmental Policy Act.* Accessed June 16, 2013. http://ceq.hss.doe.gov/nepa/ccenepa/exec.pdf .

Cowardin, Lewis M., Virginia Carter, Francis C. Golet, and Edward T. LaRoe

1979 *Classification of Wetlands and Deepwater Habitats of the United States*. FWS/OBS-79/31, USFWS, Office of Biological Services. Washington, DC.

Credit Union Cherry Blossom (CUCB)

2012 Credit Union Cherry Blossom Ten Mile Run Home Page. Accessed May 23, 2013. http://www.cherryblossom.org.

Destination DC

2012 *Record Number of Travelers Visit Washington, DC in 2011*. Released May 22, 2012. Accessed May 7, 2013. http://washington.org/press/record-number-travelers-visit-washington-dc-2011.

District of Columbia Department of Environment (DDOE)

2012 *The District of Columbia Water Quality Assessment: 2012 Integrated Report to the US Environmental Protection Agency and Congress Pursuant to Sections 305(b) and 303(d) Clean Water Act (P.L. 97-117)*. Prepared by the DDOE Natural Resources Administration, Water Quality Division. Accessed August 20, 2013. http://ddoe.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/2012%20IR%206-19-2012.2.pdf.

District of Columbia Department of Transportation (DDOT)

2005 *DC Bicycle Master Plan*. Accessed August 27, 2013. http://ddot.dc.gov/node/477162.

2011 *Transportation Tips During an Emergency Incident.* Accessed July 14, 2015. http://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/emergency_preparedness_2011.pdf.

District of Columbia Office of Planning (DCOP)

2006 *Existing Land Use Map Tile 10*. Accessed October 22, 2012. http://planning.dc.gov/node/623232.

Federal Emergency Management Agency (FEMA)

2010 *Executive Order 11988 – Floodplain Management*. Accessed July 11, 2013. http://www.fema.gov/plan/prevent/floodplain/eo_11988.shtm

2013 Firm Panels 1100010018C, 1100010014C , 1100010056C. Accessed July 11, 2013. https://msc.fema.gov/portal.

Federal Highway Administration (FHWA)

2011 *Bridge Inspection Report – Arlington Memorial Bridge. Memorial Avenue over GWMP (WB) & Potomac River*. George Washington Memorial Parkway. Prepared by FHWA; Sterling, Virginia.

Federal Highway Administration, Eastern Federal Lands Highway Division (FHWA-EFL)

2012 *14th Street Bridge Corridor Environmental Assessment.* Accessed July 17, 2013. http://www.14thstreetbridgecorridoreis.com/project_documents.html.

Fodor's

2013 "Northern Virginia Sites: Arlington National Cemetery." Accessed May 23, 2013. http://www.fodors.com/world/north-america/usa/virginia/northern-virginia/review-580116.html.

Greater Washington Initiative (GWI)

2012 *Greater Washington 2011-2012 Regional Report.* Accessed May 7, 2013. http://www.greaterwashington.org/services-resources/publications/regional-report.aspx.

Interstate Commission on the Potomac River Basin (ICPRB)

2012 "Facts and FAQs." Accessed August 13, 2013. http://www.potomacriver.org/cms/index.php?option=com_content&view=article&id=70&Itemid=159.

KressCox Associates, PC

1986 *Historic Structures Report: Arlington Memorial Bridge.* Prepared for the National Park Service.

Marine Corps Marathon (MCM)

2013 Marine Corps Marathon Home Page. Accessed May 23, 2013. http://www.marinemarathon.com.

Maryland Department of Natural Resources (MDDNR)

2013 "Shortnose Sturgeon." Accessed July 12, 2013. http://www.dnr.state.md.us/wildlife/Plants_Wildlife/rte/rtesnsturgeon.asp.

2015 *Potomac River SAV Distribution Habitat Status*. Accessed March 4, 2015. http://www.dnr.state.md.us/bay/sav/restoration/pot_sum07.pdf.

Metropolitan Washington Council of Governments (MWCOG)

2007 Annual Average Daily Traffic. Accessed May 7, 2013. https://gis.mwcog.org/webmaps/rtdc

National Capitol Planning Commission (NCPC)

2004 *The Comprehensive Plan for the National Capital Region.* Accessed August 26, 2013 http://planning.dc.gov/node/636812.

1986 *National Capital Memorials and Commemorative Works Act of 1986, as Amended*. Accessed August 26, 2013. http://www.ncpc.gov/ncpc/Main(T2)/Planning(Tr2)/2MPlan.html.

National Oceanic and Atmospheric Administration (NOAA)

2012a "NOAA Fisheries Office of Protected Resources: Atlantic Sturgeon." Accessed July 12, 2013. http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm.

2012b "NOAA Fisheries Office of Protected Resources: Shortnose Sturgeon." Accessed July 12, 2013. http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm.

2010 NOAA Office of Coast Survey- Navigation Chart 12289*:* Potomac River Mattawoman Creek to Georgetown. Accessed December 3, 2014. http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml.

Navy-Air Force (NAVY)

2013 Navy Air-Force Half Marathon and Navy 5-Miler. Accessed may 23, 2013. http://www.navy5miler.com.

Nike

2013 Nike Women Half Marathon D.C. Accessed May 23, 2013. http://www.nike.com/nwmhalfdc/#general-faq.

Nolin, Elizabeth M.

1988 *Historic American Engineering Record No. DC-7: Arlington Memorial Bridge.* Prepared for the National Park Service.

Ocean Health Index

2015 *Soft Bottom Habitats (subtidal)*. Accessed March 2, 2016, from http://www.oceanhealthindex.org/methodology/components/soft-bottom-habitats

Osmond, D.L., D.E. Line, J.A. Gale, R.W. Gannon, C.B. Knott, K.A. Bartenhagen, M.H. Turner, S.W. Coffey, J. Spooner, J. Wells, J.C. Walker, L.L. Hargrove, M.A. Foster, P.D. Robillard, and D.W. Lehning

1995 *WATERSHEDS: Water, Soil and Hydro-Environmental Decision Support System.* Accessed July 12, 2013. http://www.water.ncsu.edu/watershedss/info/wetlands/class.html.

Police Unity Tour (PUT)

2013 Police Unity Tour Home Page. Accessed May 23, 2013. http://www.policeunitytourviii.org.

Potomac Conservancy

2013 *Find Out About Potomac Water Quality*. Accessed August 14, 2013. http://www.potomac.org/site/water-quality.

Rock 'n' Roll Marathon Series (RNR)

2013 Rock 'n' Roll Marathon USA: Nation's Capital. Accessed May 23, 2013. http://runrocknroll.competitor.com/usa.

Rolling Thunder Run (RTR)

2013 Rolling Thunder Run XXVI Event Site. Accessed May 23, 2013. http://rollingthunderrun.com.

Smith, Andrew

2015 Telephone conversion between Mr. Smith and Stantec, February 6, 2015, regarding navigation along the Potomac River and the Spirit Cruise of Washington

The Nature Conservancy (TNC)

2013 *Bird Walk – Theodore Roosevelt Island Field Trip Information Sheet.* Accessed July 17, 2013. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/maryland_dc/explore/tr-island-bird-walk-13.pdf.

U.S. Army Corps of Engineers (USACE)

2007 USACE Baltimore District Washington Harbor Fact Sheet. Accessed December 4, 2014. http://www.nab.usace.army.mil/Portals/63/docs/Navigation/101WashingtonChannel/MAP/factsheetJan07.pdf.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS)

2009 *Shortnose Sturgeon in the Potomac River.* Accessed July 16, 2013. http://www.fws.gov/northeast/marylandfisheries/reports/shortnose_fact_sheet_7_21_09.pdf.

2015 National Wetlands Inventory Mapper. Accessed March 24, 2015. http://www.fws.gov/wetlands/data/mapper.HTML

U.S. Department of the Interior, National Park Service (NPS)

1967 *Theodore Roosevelt Island.* National Register of Historic Places Inventory - Nomination Form.

1980 *Arlington Memorial Bridge and Related Features.* National Register of Historic Places Inventory - Nomination Form.

1981 *Mount Vernon Memorial Parkway*. National Register of Historic Places – Nomination Form.

1991 *Director's Order 77: Natural Resources Management Guideline*. Accessed August 26, 2013. http://www.nature.nps.gov/rm77.

1994 *GWMP Resource Management Plan.*

1995 *George Washington Memorial Parkway*. National Register of Historic Places – Nomination Form.

1998a *Director's Order 28: Cultural Resource Management*. Accessed August 26, 2013. http://www.nps.gov/policy/DOrders/DOrder28.html.

1998b *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. Washington, DC

1999a *Director's Order 17: National Park Service Tourism*. Accessed August 26, 2013. http://www.nps.gov/policy/DOrders/DOrder17.html.

1999b *Cultural Landscape Report: Lincoln Memorial Grounds*.

2001 *East and West Potomac Parks Historic District.* National Register of Historic Places Inventory – Nomination Form.

2003b *Georgetown Historic District.* National Register of Historic Places – Nomination Form.

2004 *Cultural Landscapes Inventory: Memorial Avenue Corridor*.

2005a *Rock Creek and Potomac Parkway Historic District.* National Register of Historic Places – Nomination Form.

2005b *Long Range Interpretive Plan for the George Washington Memorial Parkway*.

2006 *Management Policies 2006*. Accessed August 26, 2013. http://www.nps.gov/policy/MP2006.pdf.

2009 *Cultural Landscapes Inventory: Arlington House, The Robert E. Lee Memorial.*

2010a *Director's Order 53: Special Park Uses*. Accessed August 26, 2013. http://www.nps.gov/policy/DOrders/DO53.htm.

2010b *Cultural Landscapes Inventory: Theodore Roosevelt Island*.

2011a *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making and Handbook.*

2011b *Road Safety Audit*.

2012 *Director's Order 77-1: Wetland Protection and Procedural Manual.*

2014 Addendum to Historic American Engineering Record No. DC-7: Arlington Memorial Bridge, and accompanying drawings.

2015 "The L'Enfant and McMillan Plans" Accessed August 5, 2015. http://www.nps.gov/nr/travel/wash/lenfant.htm.

U.S. Environmental Protection Agency (USEPA)

2011a *Clean Water Act*. Accessed August 26, 2013. http://www.epa.gov/oecaagct/lcwa.html.

2011b *Section 10 of the Rivers and Harbors Appropriation Act of 1899*. Accessed August 26, 2013. http://water.epa.gov/lawsregs/guidance/wetlands/sect10.cfm .

2013 *Total Maximum Daily Loads (TMDL)*. Accessed August 26, 2013. http://www.epa.gov/reg3wapd/tmdl/index.htm.

U.S. Geological Survey (USGS)

2005 *The Impact of Sediment on the Chesapeake Bay and its Watershed*. Accessed August 26, 2013. http://chesapeake.usgs.gov/SedimentBay605.pdf.

Virginia Institute of Marine Science

2013a *Submerged Aquatic Vegetation Beds in the Chesapeake Bay*. Accessed December 22, 2014. http://web.vims.edu/bio/sav/gis_data.html

2013b "The Atlantic Sturgeon." Accessed July 12, 2013. http://www.vims.edu/features/research/sturgeon_restoration.php

2015 *Shallow Water Habitats*. Accessed December 9, 2015, from http://web.vims.edu/bio/shallowwater/physical_characteristics/habitat_types.html

This page intentionally left blank.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

GWMP 850/131908 April 2016