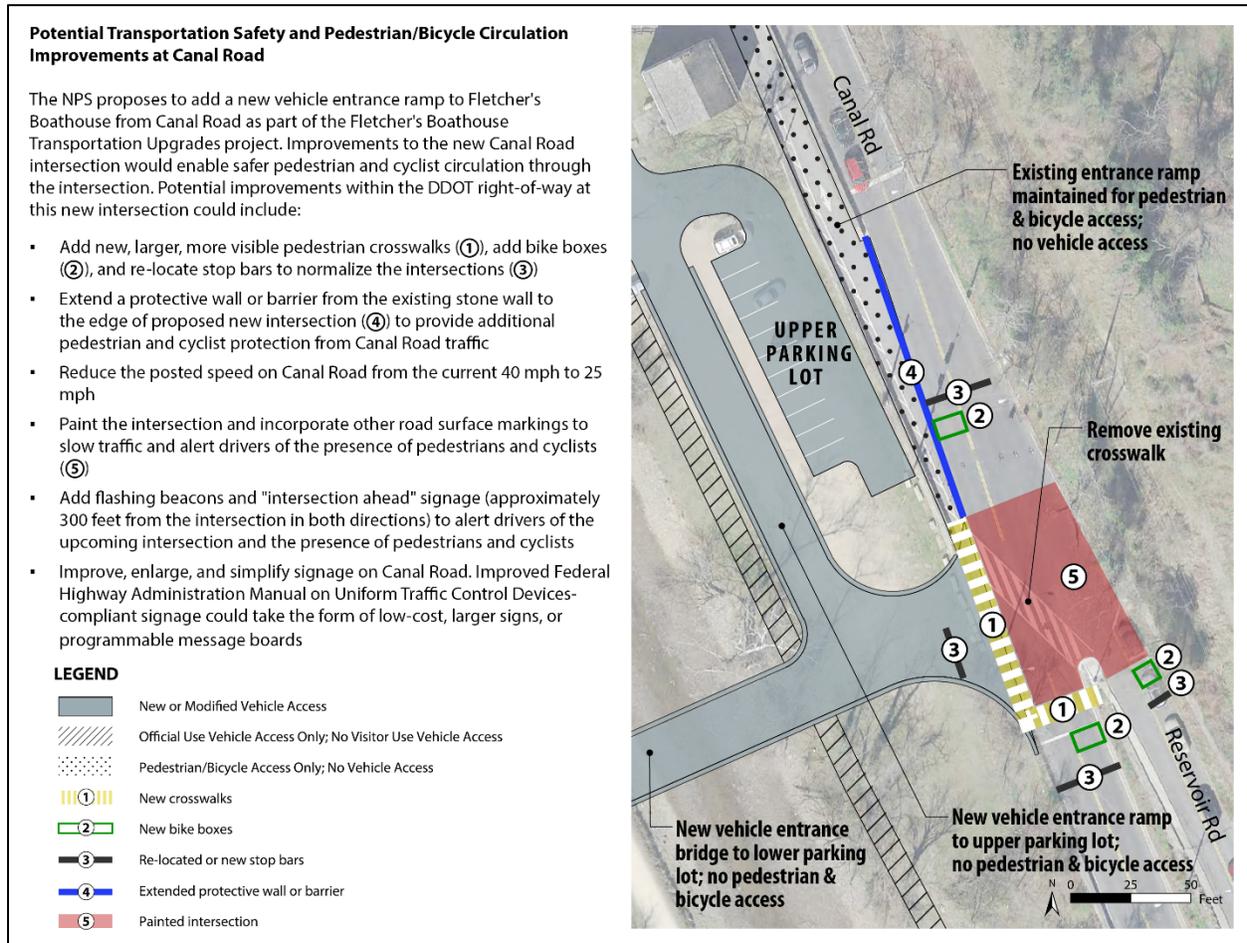


## APPENDIX A: CANAL ROAD INTERSECTION

Under Action Alternatives B and C, NPS would work with the District Department of Transportation (DDOT) to improve the functionality of and pedestrian and bicycle access routes at the intersection of Canal Road, Reservoir Road, and the new entrance ramp. **Figure A-1** illustrates potential improvements within the DDOT right-of-way at the new intersection.



**Figure A-1: Potential Transportation Safety and Pedestrian/Bicycle Circulation Improvements at Canal Road**

## **APPENDIX B: ALTERNATIVES CONSIDERED BUT DISMISSED**

The NPS considered a wide range of transportation upgrades at Fletcher's Boathouse during scoping. Some transportation upgrades were ultimately dismissed from further consideration.

### **IMPROVED CANAL BRIDGE ALTERNATIVE**

The Improved Canal Bridge alternative would improve the existing bridge over the C&O Canal and add a new ramp from the bridge to the lower parking lot to provide public vehicle access between the upper and lower parking lots (**Figure B-1**). The existing entrance ramp would be maintained for vehicle access between Canal Road and the project site. The towpath and Capital Crescent Trail at the project site are heavily used by pedestrians and cyclists, including cyclists traveling at high speeds. This alternative was dismissed from further consideration because it would create vehicle, pedestrian, and cyclist conflicts at the at-grade visitor use vehicle crossing of the towpath and Capital Crescent Trail. The alternative would also not provide a more direct and safer transportation connection between Canal Road and the upper parking lot.

### **RIVER ACCESS (EXISTING TUNNEL CLOSED) ALTERNATIVE**

The River Access (Existing Tunnel Closed) alternative would add a new entrance ramp for vehicle access between Canal Road and the lower parking lot (**Figure B-2**). The existing entrance ramp would be maintained for vehicle access to the upper parking lot. The existing road culvert (tunnel) would be closed to vehicle access. This alternative was dismissed from further consideration because the alternative would add a second entrance/exit point for vehicles accessing the project site and create a five-way intersection at Canal Road. The alternative would also not provide a more direct and safer transportation connection between Canal Road and the upper parking lot, maintaining the existing single lane access ramp and potential for vehicular conflicts with pedestrian and bicycle access to the site.

### **FULL CIRCULATION BELOW CANAL ALTERNATIVE**

The Full Circulation Below Canal alternative would add a new entrance ramp and tunnel under the C&O Canal for vehicle access between Canal Road and the lower parking lot (**Figure B-3**). The existing entrance ramp would be closed to vehicle access. The existing road culvert (tunnel) would be maintained for visitor use vehicle access between the upper and lower parking lots. This alternative was dismissed from further consideration because the new tunnel under the C&O Canal would likely experience flooding and drainage issues and would intersect with the mainline of the Potomac Interceptor, a sanitary sewer that runs from Washington Dulles International Airport to the Blue Plains Advanced Wastewater Treatment Plant, that traverses through the project site.

### **RIVER ACCESS BELOW CANAL ALTERNATIVE**

The River Access Below Canal (Existing Tunnel Closed) alternative is similar to the Full Circulation Below the Canal alternative, but would close the existing road culvert (tunnel) to vehicle access (**Figure B-4**). Two options were considered for vehicle access to the upper parking lot. In Option A, a second new ramp would connect the new entrance ramp to the upper parking lot. The existing entrance ramp would be closed to vehicle access. In Option B, the existing entrance ramp would be maintained for vehicle access to the upper parking lot. This alternative was dismissed from further consideration because the new tunnel under the C&O Canal would likely experience flooding and drainage issues and would intersect with the mainline of the

Potomac Interceptor. Furthermore, Option B would add a second entrance/exit point for vehicles accessing the project site and create a five-way intersection at Canal Road. Option B would also not provide a more direct and safer transportation connection between Canal Road and the upper parking lot.

#### **RIVER ACCESS DOWNSTREAM ALTERNATIVE**

The River Access Downstream alternative would add a new entrance ramp for vehicle access at Canal Road downstream of the project site (**Figure B-5**). The entrance ramp would connect to the lower parking lot. The existing entrance ramp would be closed to vehicle access. The existing road culvert (tunnel) would be maintained for visitor use vehicle access between the upper and lower parking lots. The area downstream of the project site between Canal Road and the Potomac River is predominately forest and contains habitat identified as highly or extremely significant for biodiversity conservation as defined in the 2015 District of Columbia Wildlife Action Plan. The River Access Downstream alternative was dismissed from further consideration because the alternative would result in greater adverse impacts on these resources than Alternatives B and C.

#### **RIVER ACCESS UPSTREAM ALTERNATIVE**

The River Access Upstream alternative would add a new entrance ramp for vehicle access at Canal Road upstream of the project site (**Figure B-6**). The entrance ramp would connect to the lower parking lot. The existing entrance ramp would be closed to vehicle access. The existing road culvert (tunnel) would be maintained for visitor use vehicle access between the upper and lower parking lots. The area upstream of the project site between Canal Road and the Potomac River is predominately forest and contains wetlands, habitats identified as highly or extremely significant or critical for biodiversity conservation as defined in the 2015 District of Columbia Wildlife Action Plan, and archeological sites. The River Access Upstream alternative was dismissed from further consideration because the alternative would result in greater adverse impacts on these resources than Alternatives B and C.

#### **SCOPING ALTERNATIVE 2**

Scoping Alternative 2 would add a new entrance ramp for vehicle access between Canal Road and the lower parking lot (**Figure B-7**). Official use vehicle access Option B as shown in **Figure B-7** is described in a latter section. The existing entrance ramp would be closed to vehicle access. The existing road culvert (tunnel) would be maintained for visitor use vehicle access between the upper and lower parking lots. This alternative was dismissed from further consideration because the alternative would not improve visitor use and official use vehicle access to the upper parking lot.

#### **SCOPING ALTERNATIVE 4**

Scoping Alternative 4 would add a new entrance ramp/bridge for vehicle access between Canal Road and the lower parking lot (**Figure B-8**). Official use vehicle access Option A as shown in **Figure B-8** is described in a latter section. The new bridge over the C&O Canal would be located farther downstream than the new bridge in Alternative C. The existing entrance ramp would be closed to vehicle access. The existing road culvert (tunnel) would be maintained for visitor use vehicle access between the upper and lower parking lots. This alternative was dismissed from further consideration because the landing of the new entrance ramp/bridge in the lower parking lot would face upstream. An upstream-facing landing would be prone to flooding

and flood-debris build up because the project area west of the C&O Canal is located in the 100-year floodplain.

### **ALTERNATIVE 1B**

Alternative 1B is similar to Alternative B, but the upper parking lot would be re-located south of the Abner Cloud House, all vehicle circulation areas, except the towpath, would be paved, and both parking lots would be paved and striped (**Figure B-9**). This alternative was dismissed from further consideration because the alternative would provide the same vehicle, official use vehicle, pedestrian, and bicycle access to/from the project area and circulation through the project area as Alternative B, but would result in greater adverse impacts on historic resources.

### **OFFICIAL USE VEHICLE ACCESS RAMPS**

Two options for new ramps to provide official use vehicle access, including access for emergency vehicles, between the towpath and lower parking lot were considered. In Option A, the C&O Canal bridge landing to the west of the canal would be modified to accommodate official use vehicle turn movements to/from the towpath (**Figure B-8**). A new accessible ramp would provide official use vehicle, pedestrian, and bicycle access between the modified landing and the lower parking lot. The existing stairs and accessible ramp connecting the towpath, Capital Crescent Trail, and boathouse and concessions would be removed. Option A was dismissed from further consideration because it would result in the removal of existing vegetation and increase the distance pedestrians and cyclists would need to travel from the canal to access the boathouse, concessions, and boat launch at the Potomac River.

In Option B, two new ramps would provide upstream and downstream official use vehicle access between the towpath and lower parking lot (**Figure B-7**). Option B was dismissed from further consideration because it would result in the removal of more existing vegetation between the towpath and lower parking lot than in Alternative B.

### **OTHER PEDESTRIAN IMPROVEMENTS**

Pedestrian access improvements to the Maddox Branch culvert under Canal Road and the existing bridge over the Maddox Branch were considered. Pedestrians living in the vicinity of Fletcher's Boathouse informally use the culvert to access the project area. Pedestrians enter the culvert to the east of Canal Road and exit west of Canal Road by climbing through the railing on the existing bridge over the Maddox Branch. Pedestrian access improvements to the culvert and bridge were dismissed from further consideration because the culvert is not intended, designed, or safe for pedestrian use.

### Improved Canal Bridge Alternative



#### KEY FEATURES

- Existing entrance ramp maintained for vehicle access between Canal Road and upper lot
- Existing canal bridge improved and new ramp added to provide public vehicle access between the upper and lower lots
- Existing tunnel closed to vehicles, but maintained for pedestrian and bicycle access

#### LEGEND

- A Abner Cloud House
  - R Restrooms
  - B Boathouse
  - C Concessions
  - ▲ Building Access Point
  - Capital Crescent Trail
  - - - Chesapeake & Ohio Canal Towpath
  - Existing Bridge
  - Existing Entrance Ramp
- Transportation Upgrades**
- Improved Bridge
  - New Ramp
  - Existing Tunnel Closed to Vehicles (Ped/Bike Access Allowed)

Figure B-1: Improved Canal Bridge Alternative

### River Access (Existing Tunnel Closed) Alternative



#### KEY FEATURES

- Existing entrance ramp maintained for vehicle access between Canal Road and upper lot
- New ramp provides vehicle access between Canal Road and lower lot (Options A & B intersect Canal Road at different locations)
- Existing tunnel closed to vehicles, but maintained for pedestrian and bicycle access



#### LEGEND

- A Abner Cloud House
  - R Restrooms
  - B Boathouse
  - C Concessions
  - ▲ Building Access Point
  - Capital Crescent Trail
  - - - Chesapeake & Ohio Canal Towpath
  - P Culvert used by pedestrians to access project area
  - Existing Bridge
  - Existing Entrance Ramp
- Transportation Upgrades**
- New Entrance Ramp
  - Existing Tunnel Closed to Vehicles (Ped/Bike Access Allowed)

Figure B-2: River Access (Existing Tunnel Closed) Alternative

### Full Circulation Below Canal Alternative



#### KEY FEATURES

- New ramp and tunnel provides vehicle access between Canal Road and lower lot
- Existing tunnel maintained for vehicle access to upper lot
- Existing entrance ramp closed

#### LEGEND

- A Abner Cloud House
- R Restrooms
- B Boathouse
- C Concessions
- ▲ Building Access Point
- Capital Crescent Trail
- - - Chesapeake & Ohio Canal Towpath
- P Culvert used by pedestrians to access project area
- Existing Tunnel
- Existing Bridge

#### Transportation Upgrades

- New Tunnel
- ↔ New Entrance Ramp
- ▨ Closed Existing Entrance Ramp

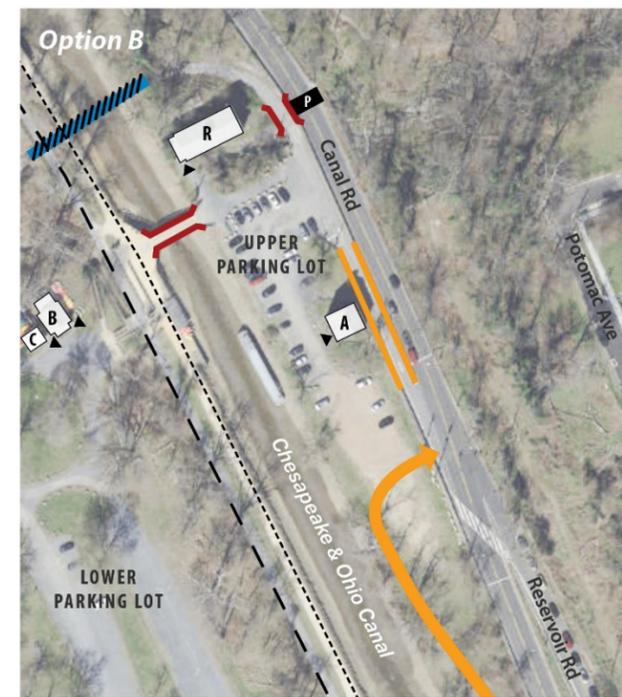
Figure B-3: Full Circulation Below Canal Alternative

### River Access Below Canal Alternative



#### KEY FEATURES

- New ramp provides vehicle access between Canal Road and lower lot
- Existing tunnel closed to vehicles, but maintained for pedestrian and bicycle access
- Option A:
  - Existing entrance ramp closed
  - New ramp provides vehicle access between Canal Road and upper lot
- Option B:
  - Existing entrance ramp maintained for vehicle access between Canal Road and upper lot



#### LEGEND

- A Abner Cloud House
  - R Restrooms
  - B Boathouse
  - C Concessions
  - ▲ Building Access Point
  - Capital Crescent Trail
  - - - Chesapeake & Ohio Canal Towpath
  - P Culvert used by pedestrians to access project area
  - Existing Tunnel
  - Existing Bridge
  - Existing Entrance Ramp
- Transportation Upgrades**
- New Tunnel
  - New Entrance Ramp
  - Existing Tunnel Closed to Vehicles (Ped/Bike Access Allowed)
  - Closed Existing Entrance Ramp (Option A Only)

Figure B-4: River Access Below Canal Alternative

### River Access Downstream Alternative



#### KEY FEATURES

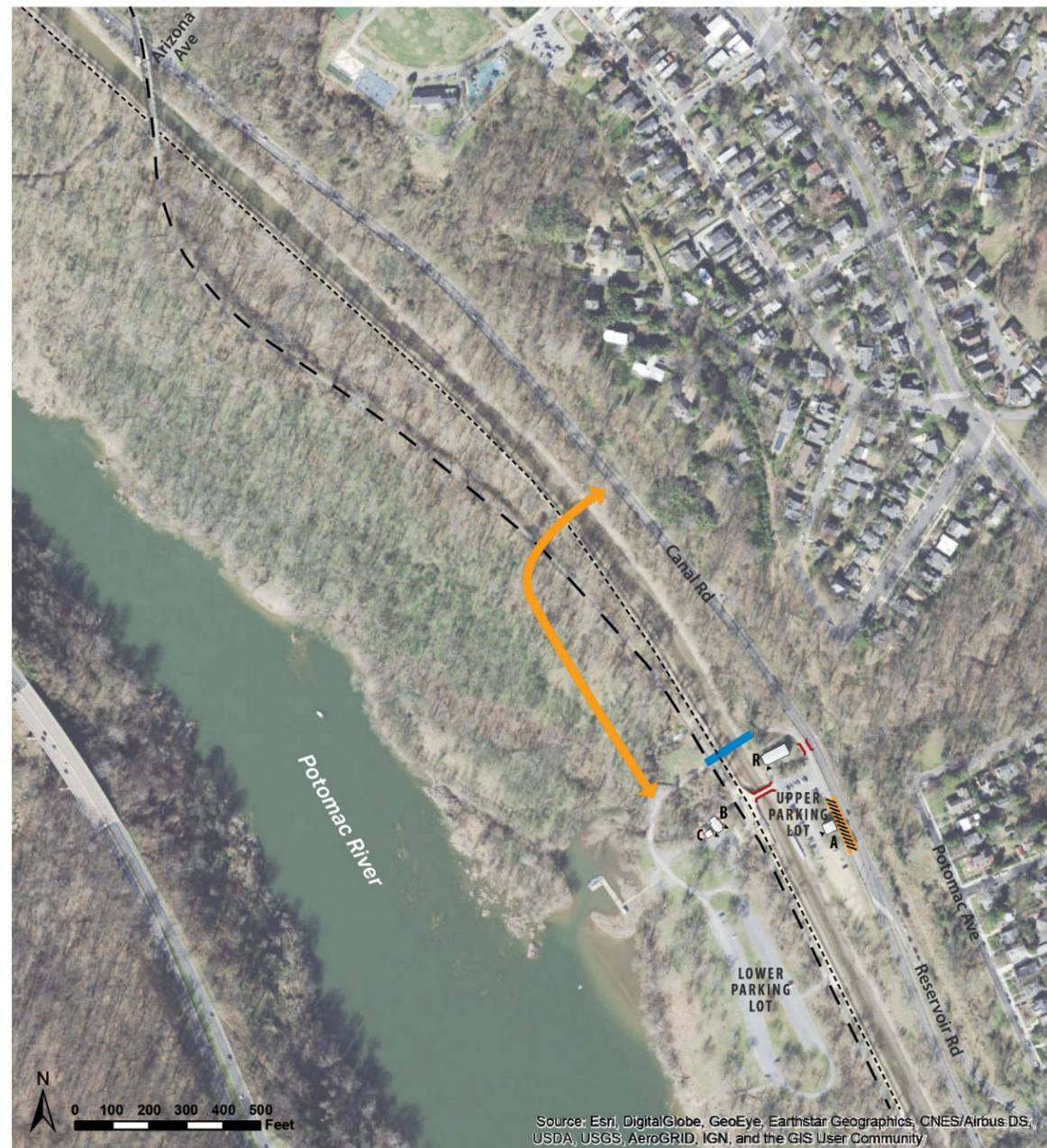
- New ramp downstream provides vehicle access between Canal Road and lower lot
- Existing tunnel maintained for vehicle access to upper lot
- Existing entrance ramp closed to vehicles

#### LEGEND

- A Abner Cloud House
  - R Restrooms
  - B Boathouse
  - C Concessions
  - ▲ Building Access Point
  - Capital Crescent Trail
  - - - Chesapeake & Ohio Canal Towpath
  - Existing Tunnel
  - Existing Bridge
- Transportation Upgrades**
- ↔ New Entrance Ramp
  - ▨ Closed Existing Entrance Ramp

Figure B-5: River Access Downstream Alternative

### River Access Upstream Alternative



#### KEY FEATURES

- New ramp upstream provides vehicle access between Canal Road and lower lot
- Existing tunnel maintained for vehicle access to upper lot
- Existing entrance ramp closed to vehicles

#### LEGEND

- A Abner Cloud House
  - R Restrooms
  - B Boathouse
  - C Concessions
  - ▲ Building Access Point
  - Capital Crescent Trail
  - - - Chesapeake & Ohio Canal Towpath
  - Existing Tunnel
  - Existing Bridge
- Transportation Upgrades**
- ↔ New Entrance Ramp
  - Closed Existing Entrance Ramp

Figure B-6: River Access Upstream Alternative

### Scoping Alternative 2 with Official Use Vehicle Access Option B (Alternative 2 could use Official Use Vehicle Access Option A or B)



#### KEY FEATURES

- New entrance ramp provides vehicle access between Canal Road and the lower parking lot; pedestrians and bicyclists prohibited on new entrance ramp
- Existing entrance ramp maintained for pedestrian and bicycle access, but closed to vehicles
- Existing culvert bridge updated to latest standards
- Existing road culvert (tunnel) maintained for visitor use vehicle, pedestrian, and bicycle access between the lower and upper parking lots
- Visitor use vehicle parking provided in the upper and lower parking lots
- Lower parking lot reconfigured; upper parking lot moved
- **Official Use Vehicle Access Option B:**
  - Official use vehicle (maintenance and emergency) access to the upper parking lot provided via two new ramps to the towpath and a modified bridge and landing
  - Existing stairs and accessible ramp maintained

#### LEGEND

- Project Area
- A Abner Cloud House
- B Boathouse
- C Concessions
- DC Water Restrooms/DC Water Odor Abatement Facility
- Building Access Point
- Existing Entrance Ramp
- Bridge
- Existing Road Culvert (Tunnel)
- Existing Access/Circulation Routes
- New or Modified Vehicle Access
- New Abner Cloud House Buffer
- Official Use Vehicle Access Only; No Visitor Use Vehicle Access
- Pedestrian/Bicycle Access Only; No Vehicle Access
- Canal Road Intersection Improvements

Figure B-7: Scoping Alternative 2 with Official Use Vehicle Access Option B

### Scoping Alternative 4 with Official Use Vehicle Access Option A (Alternative 4 could use Official Use Vehicle Access Option A or B)



#### KEY FEATURES

- New entrance ramp provides vehicle access between Canal Road and the lower parking lot; pedestrians and bicyclists prohibited on new entrance ramp
- Existing entrance ramp maintained for pedestrian and bicycle access, but closed to vehicles
- Existing culvert bridge updated to latest standards
- Existing road culvert (tunnel) maintained for visitor use vehicle, pedestrian, and bicycle access between the lower and upper parking lots
- Visitor use vehicle parking provided in the upper and lower parking lots
- Lower parking lot reconfigured; upper parking lot moved
- **Official Use Vehicle Access Option A:**
  - Official use vehicle (maintenance and emergency) access to the upper parking lot provided via a new accessible ramp, a modified bridge landing, and the existing canal bridge
  - New accessible ramp provides pedestrian and bicycle access between the canal and lower parking lot; existing stairs and accessible ramp removed

#### LEGEND

- Project Area
- A Abner Cloud House
- B Boathouse
- C Concessions
- DC Water Restrooms/DC Water Odor Abatement Facility
- Building Access Point
- Existing Entrance Ramp
- Bridge
- Existing Road Culvert (Tunnel)
- Existing Access/Circulation Routes
- New or Modified Vehicle Access
- New Abner Cloud House Buffer
- Official Use Vehicle Access Only; No Visitor Use Vehicle Access
- Pedestrian/Bicycle Access Only; No Vehicle Access
- Canal Road Intersection Improvements

Figure B-8: Scoping Alternative 4 with Official Use Vehicle Access Option A

### Alternative 1B



#### KEY FEATURES

- New entrance ramp provides vehicle access between Canal Road and the upper parking lot; pedestrians and bicyclists prohibited on new entrance ramp
- Existing entrance ramp maintained for pedestrian and bicycle access, but closed to vehicles
- Existing culvert bridge updated to latest standards
- Existing road culvert (tunnel) maintained for visitor use vehicle, pedestrian, and bicycle access between the lower and upper parking lots
- All vehicle circulation areas paved
- Visitor use vehicle parking provided in paved and striped upper and lower parking lots
- Official use vehicle (maintenance and emergency) access to the lower parking lot provided via a modified bridge and landing, the towpath, and an improved access ramp between the towpath and lower parking lot
- Landing area by the boathouse and concessions updated to be fully accessible; new stairs and accessible ramps provide pedestrian and bicycle access between canal and the lower parking lot; existing stairs and accessible ramp maintained

#### LEGEND

- Project Area
- A Abner Cloud House
- B Boathouse
- C Concessions
- DC Water Restrooms/DC Water Odor Abatement Facility
- Building Access Point
- Existing Entrance Ramp
- Bridge
- Existing Road Culvert (Tunnel)
- Existing Access/Circulation Routes
- New or Modified Vehicle Access
- New or Modified Pedestrian Circulation
- New Accessible Ramps
- New Abner Cloud House Buffer
- Official Use Vehicle Access Only; No Visitor Use Vehicle Access
- Pedestrian/Bicycle Access Only; No Vehicle Access
- Canal Road Intersection Improvements

Figure B-9: Alternative 1B

## **APPENDIX D: STORMWATER MANAGEMENT MEMO**



AECOM  
3101 Wilson Boulevard  
Arlington, VA 22201  
aecom.com

**Project name:**  
Fletchers Boathouse

**Project ref:**  
-

**From:**  
Eliana Rios

**Date:**  
September 25, 2019

**To:**  
Claire Sale

**CC:**  
-

## Memo

Subject: Stormwater Management for Fletchers Alternatives  
Fletchers Boathouse Alternatives

### Stormwater Management Strategy

The purpose of this memo is to document and inform of stormwater management compliance implications related to this project as well as strategies developed for each alternative currently under evaluation.

This project disturbs over 5,000 SF of land area, and hence is considered a "major land disturbing activity" as defined per the District of Columbia Department of Energy and Environment (DOEE) Stormwater Water Rule (2013). No water quality treatment volume is required for this site because the project area is not located within the Anacostia Waterfront Development Zone as determined by DOEE. However, there are storm water retention and Total Suspended Solids (TSS) requirements that shall be met to meet DOEE's SWM requirements. Provided the project is categorized as a "major land disturbance", 80 percent of Total Suspended Solids (TSS) should be removed, and the storm water retention volume (SWRV) shall be based on the 90th percentile event (1.2 in).

Based on SWM regulations a site may achieve on-site retention by directly conveying volume from the regulated site to a shared BMP with available retention capacity; or a site may achieve the SWRV through a combination of on-site retention and off-site retention under specific conditions. SWM regulations also state that the site shall retain "on site" a minimum of 50 percent of the SWRV calculated for the entire site, unless DDOE approves an application for relief from extraordinarily difficult site conditions. Projects requesting relief from compliance with the minimum on-site retention obligation (50% of the SWRV) and claiming extraordinarily difficult site conditions will follow the submission and evaluation process detailed in DOEE's SWM Manual Appendix E. Sites approved for "relief from extraordinarily difficult site conditions" are still responsible for the entire SWRV but will be allowed to use off-site retention to achieve more than 50percent of the SWRV.

Geotechnical borings results show the presence of fill soils throughout the site. Hence, no infiltration SWM facilities are recommended for this site. This results in very little to no on-site retention compliance potential. Nevertheless, there are opportunities to provide TSS removal since no water tables conflicts are anticipated based on the borings. The geotechnical report states that ground water measurements in the borings can be at depths of between 9 ft to 18 ft below existing grades. While fluctuations in groundwater levels may occur as a result of seasonal variations in rainfall, proximity of the site to the large bodies of water, tidal fluctuations, evaporation, construction activity, pump tests, surface runoff, and other site-specific factors, water surface elevations are not anticipated to increase to a depth that could compromise any proposed SWM facility installation or performance.

As an alternative for partial retention mitigation the site could incorporate rain water barrels to collect rainwater from the rooftop of existing buildings and reuse it on-site for plant/grass watering. Yet, it is my recommendation that the site uses off-site retention for the portion of the SWRv that is not retained on site (Refer to DOEE SWM Manual Chapter 6 and its associated Appendix C). The table below contains SWM strategies to meet TSS requirements. The strategy includes rainwater harvesting, permeable pavement systems, bioretention, wet swales and tree planting and protection.

Table D-1: Stormwater Management Strategies

Code	BMP	SWRv Storage	TSS Removal
R-1	Rainwater Harvesting	Partial	N/A
P-1, P-2, P-3	Porous Pavement	Yes	Yes *
B-1	Traditional Bioretention	Yes	Yes *
O-3	Wet Swale	No	Yes
TP-1 and TP-2	Tree Preservation and Planting	Partial	No

Project area features an existing impervious area of 3.13 acres. While one of the alternatives presented herein results in a reduction of impervious areas, SWM compliance is still required. The exhibits presented in the appendix show the strategy for each alternative. Below there is a summary for each of them:

- Alternative B: This alternative decreases the impervious area to 3.04 acres (2.9% reduction). The SWM strategy for this alternative includes permeable pavers for some parking lot areas, proposed trails/sidewalks, and other pedestrian areas. Appendix 1 shows a map with potential locations for SWM facilities that will help mitigate TSS requirements.
- Alternative C: This alternative increases the impervious area to 3.41 acres (9.1% increase). The SWM strategy for this alternative includes permeable pavers for some parking lot areas, proposed trails/sidewalks, and other pedestrian areas, as well as bioretention areas, wet swales as well as tree preservation and planting. Appendix 1b shows a map with potential locations for SWM facilities that will help mitigate TSS requirements.

It is important to note that by Chapter 4 of DOEE's Stormwater Manual "grading and fill for BMP construction is strongly discouraged within the 100-year floodplain, as delineated by FEMA Flood Insurance Rate Maps (FIRM). Based on FEMA's map the entire site falls within the floodplain.

Given all the facts stated herein, it is my recommendation for retention requirements to be achieved through off-site facilities, RCS credits, or the combination of the two, and TSS requirement to be met on-site. Furthermore, early coordination should take place between FEMA's representative and NPS to discuss any potential conflicts or permits required associated to any SWM grading.

Thank you,

Eliana Rios, PE

Project Engineer, Transportation

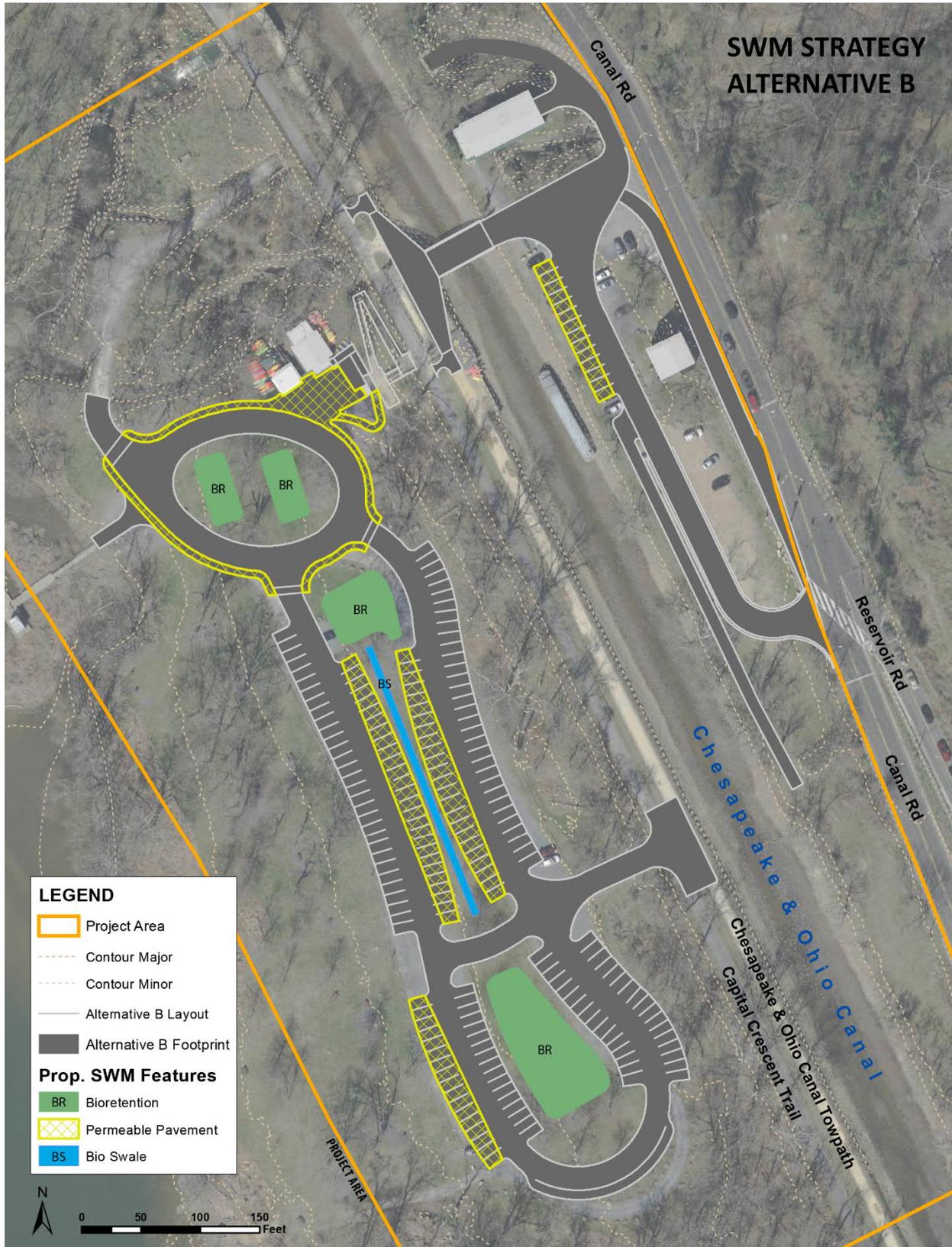


Figure D-1: Stormwater Management Strategy for Alternative B

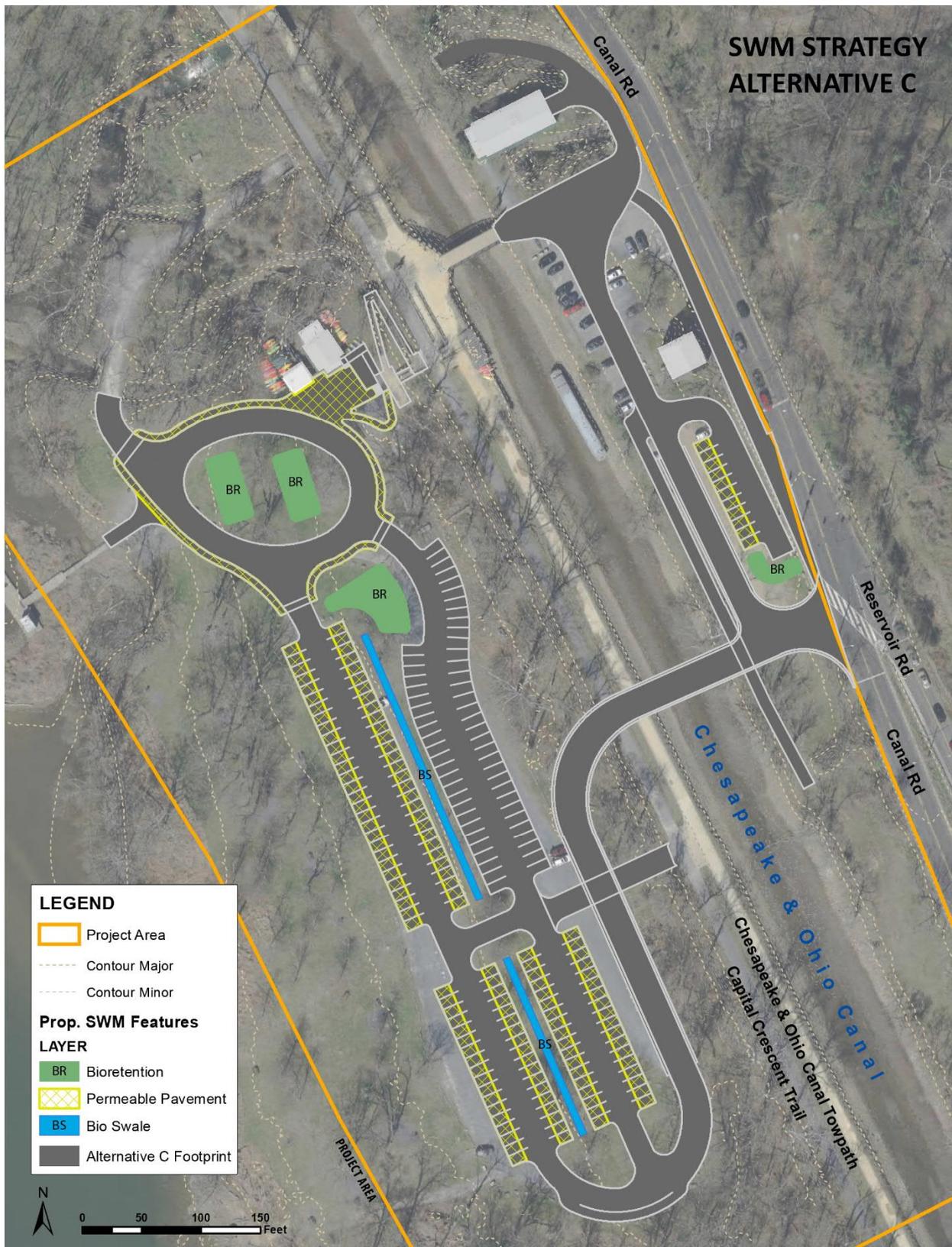


Figure D-2: Stormwater Management Strategy for Alternative C

## APPENDIX E: CIRCULATION

Visitor use vehicle, official use vehicle, and pedestrian and bicycle circulation at Fletcher's Boathouse under Alternatives A, B, and C are illustrated in the following figures.

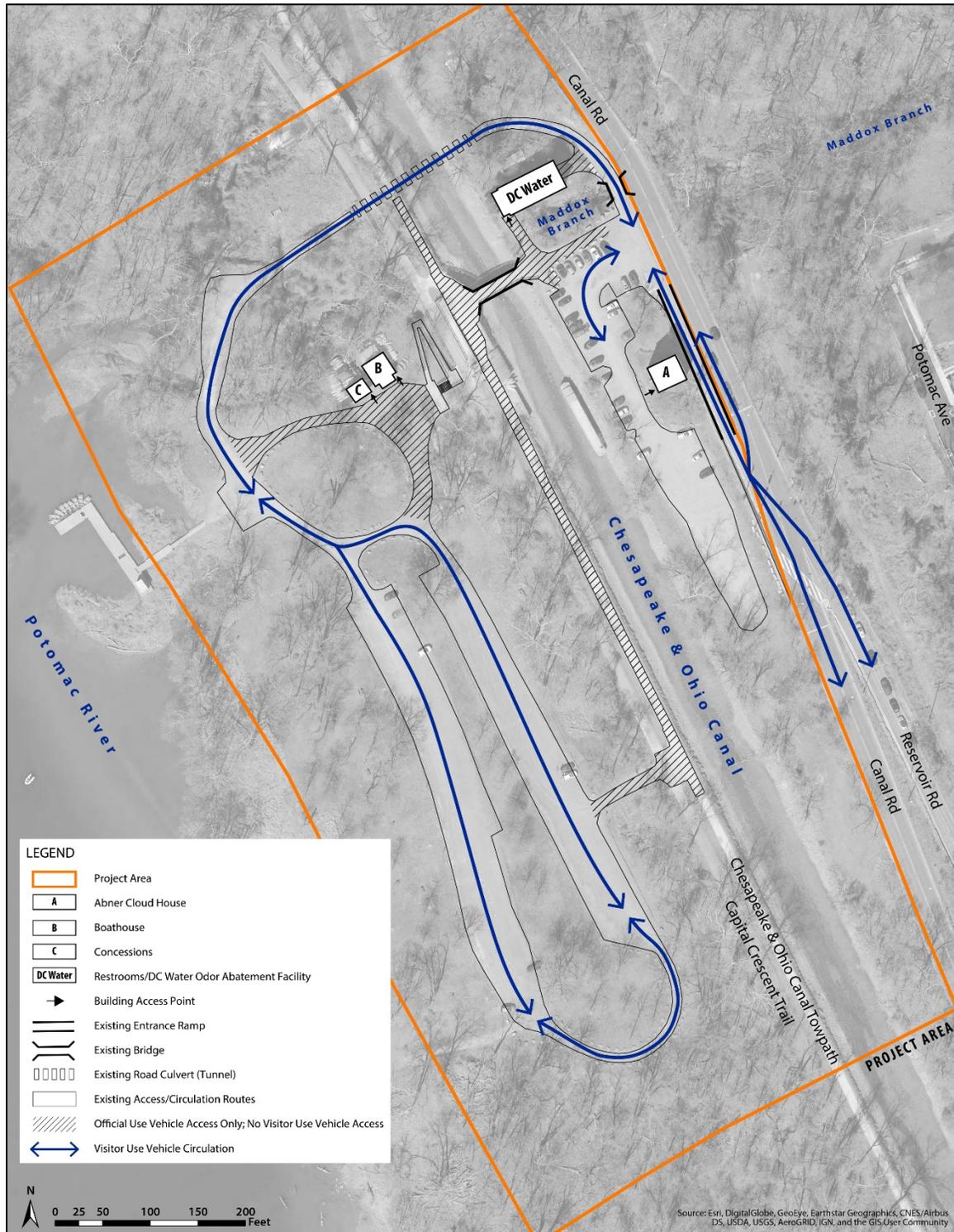


Figure E-1: Alternative A: No Action - Visitor Use Vehicle Circulation

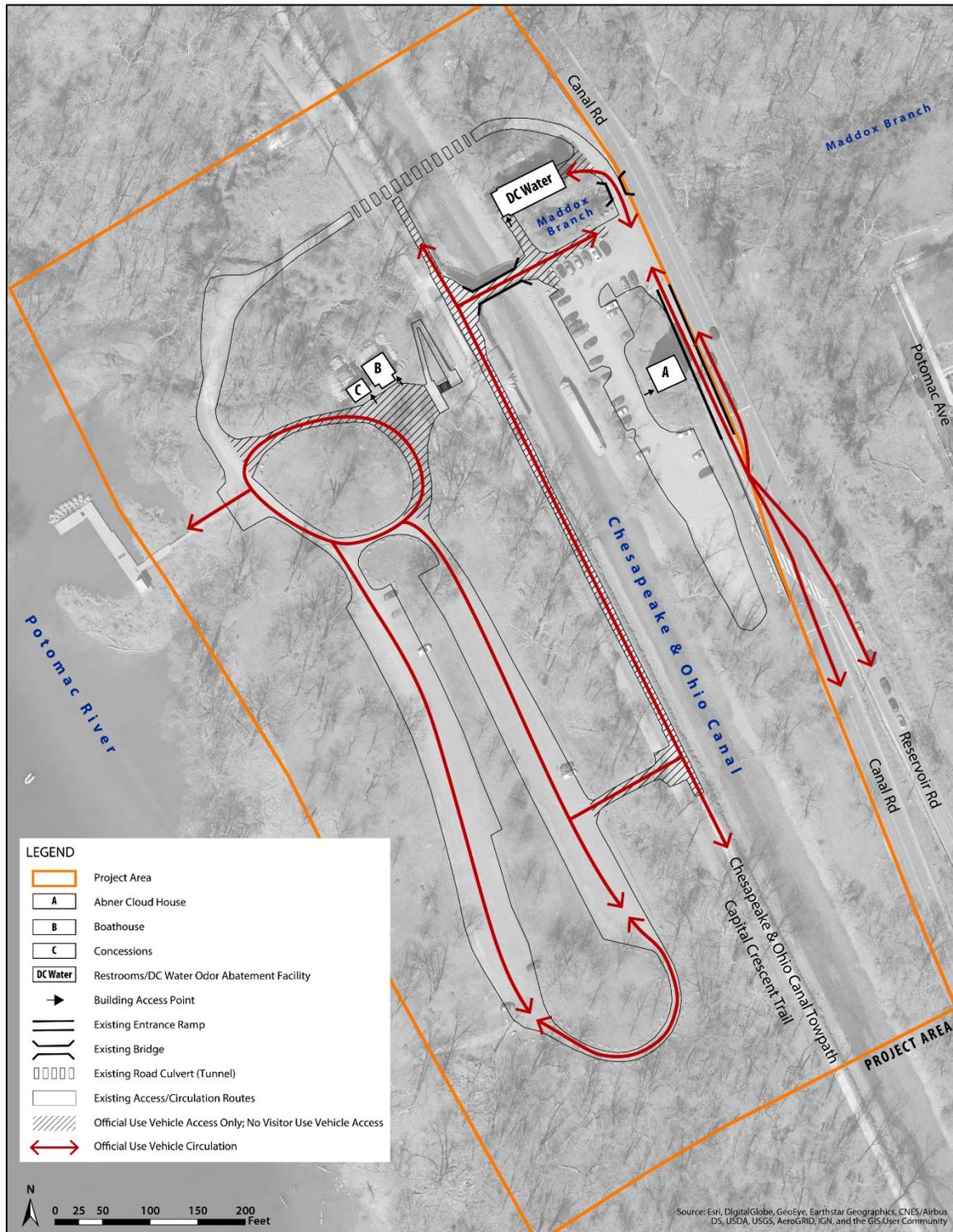


Figure E-2: Alternative A: No Action - Official Use Vehicle Circulation

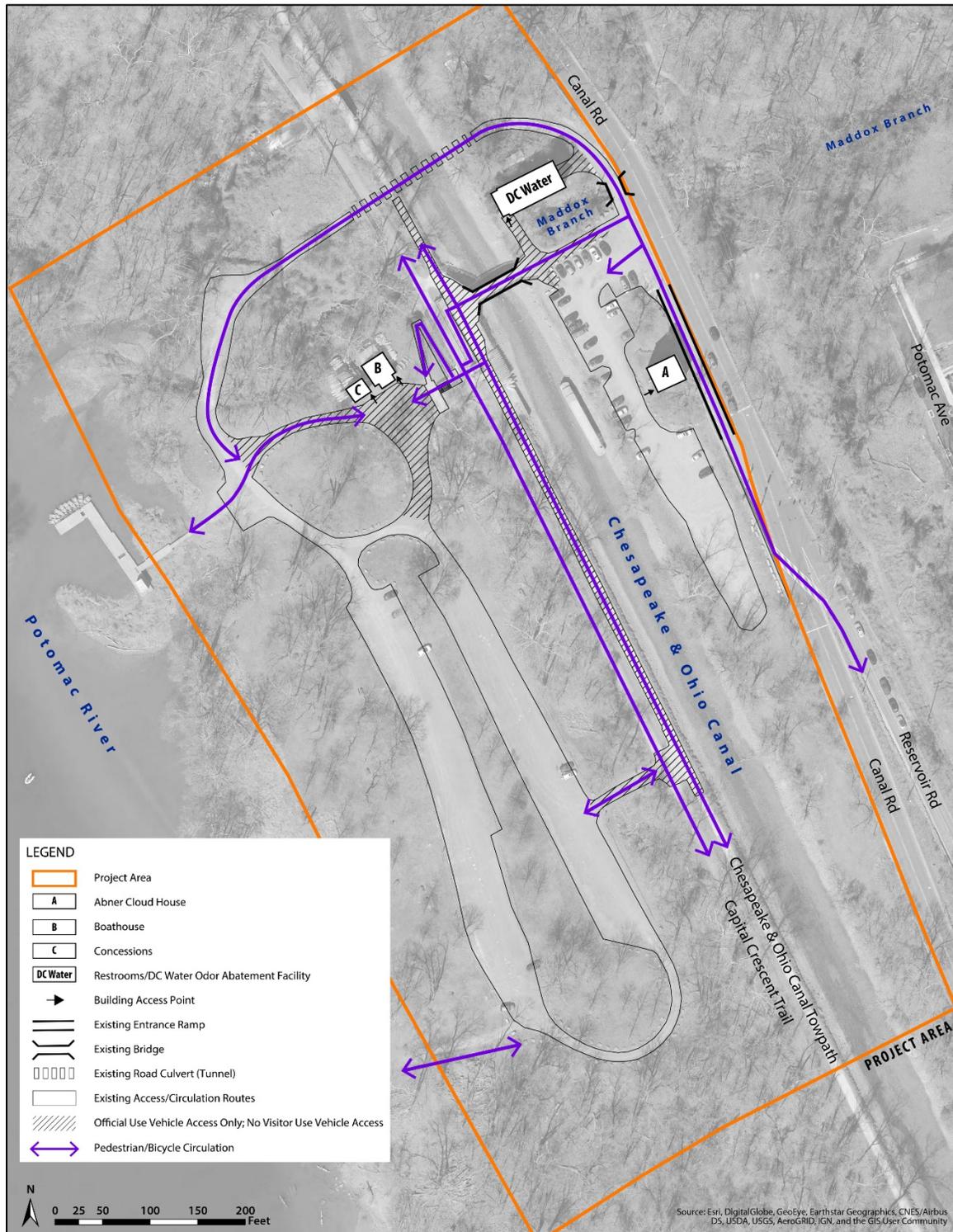


Figure E-3: Alternative A: No Action - Pedestrian and Bicycle Circulation

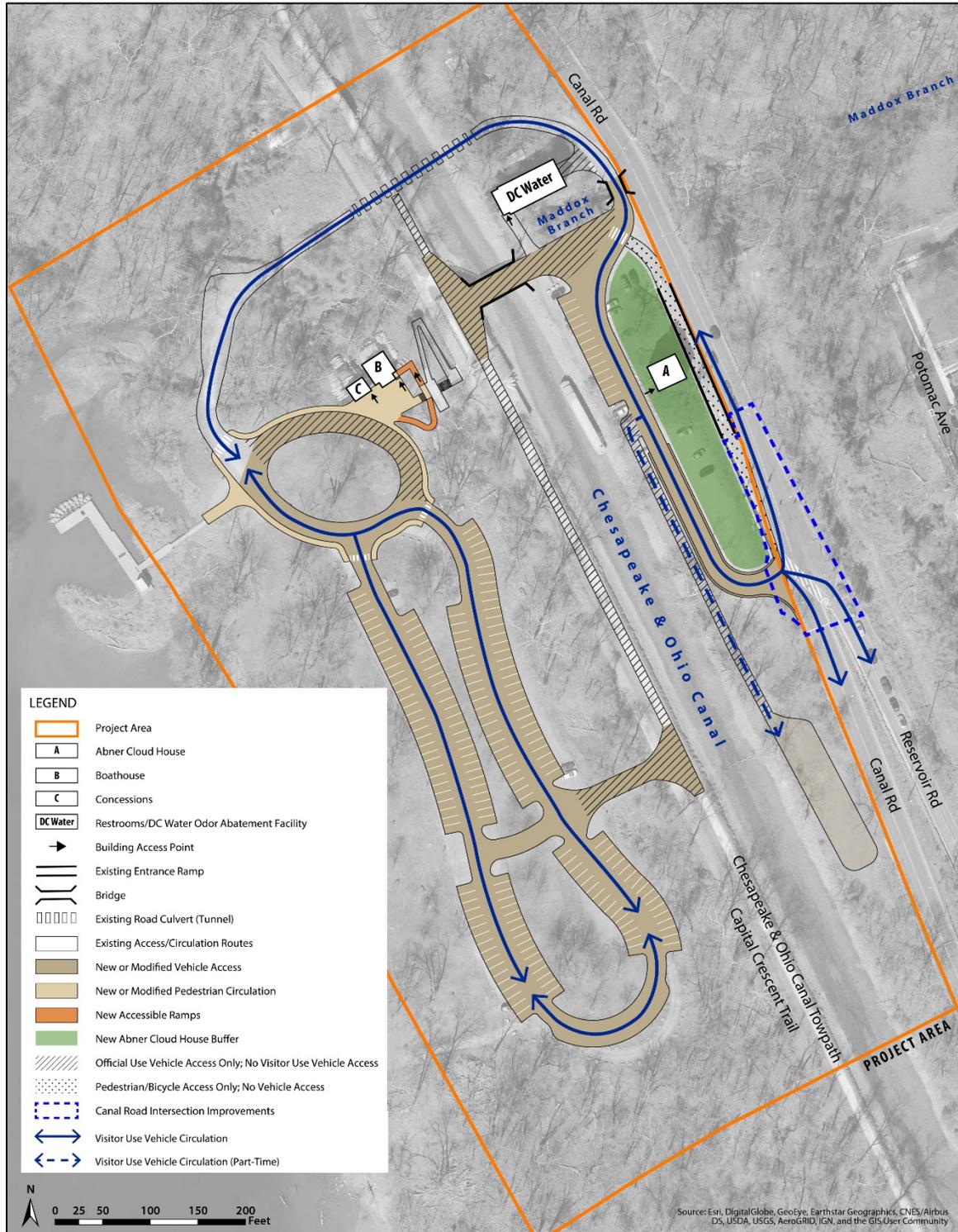


Figure E-4: Alternative B: Upper Parking Lot Access Alternative - Visitor Use Vehicle Circulation

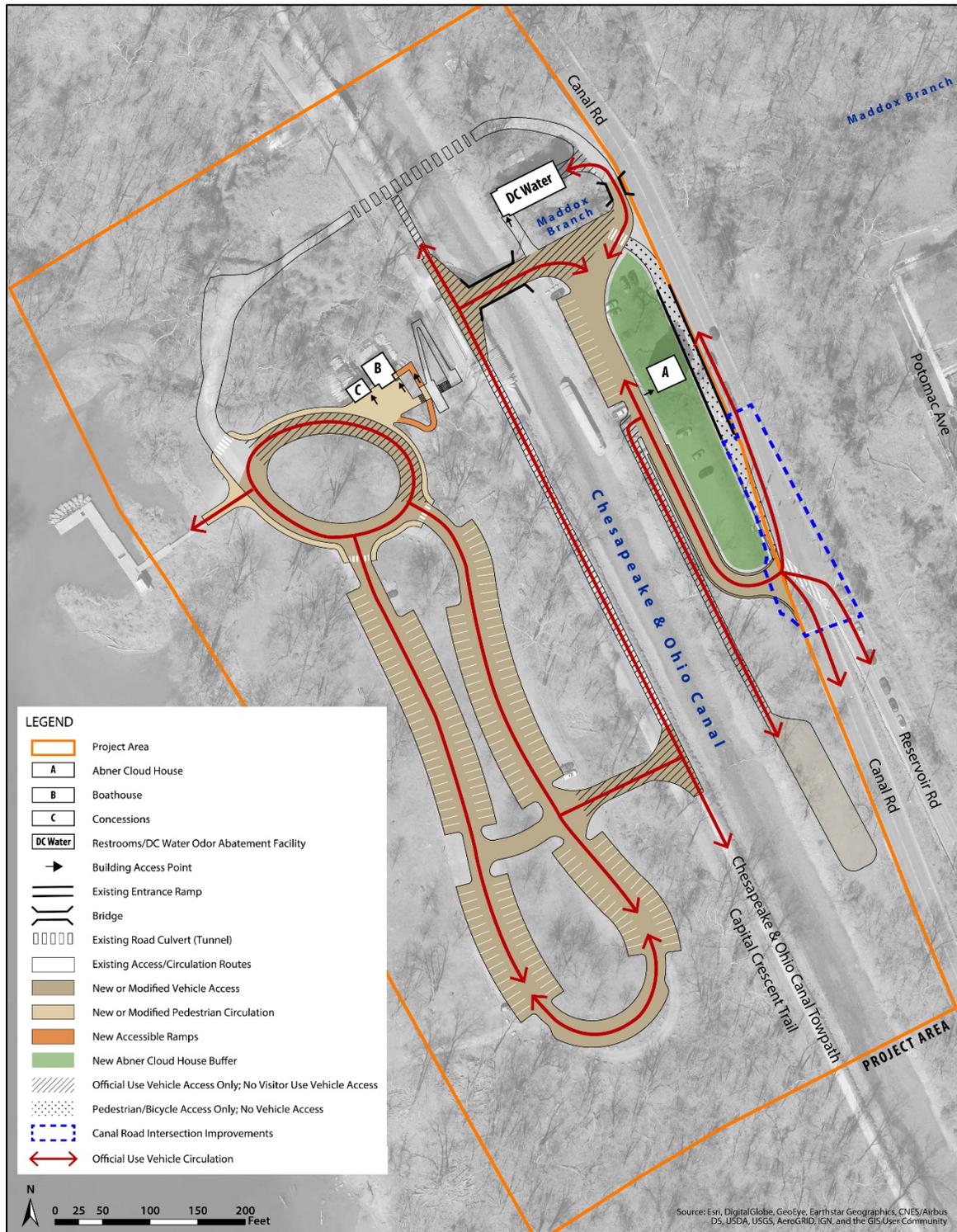


Figure E-5: Alternative B: Upper Parking Lot Access Alternative - Official Use Vehicle Circulation

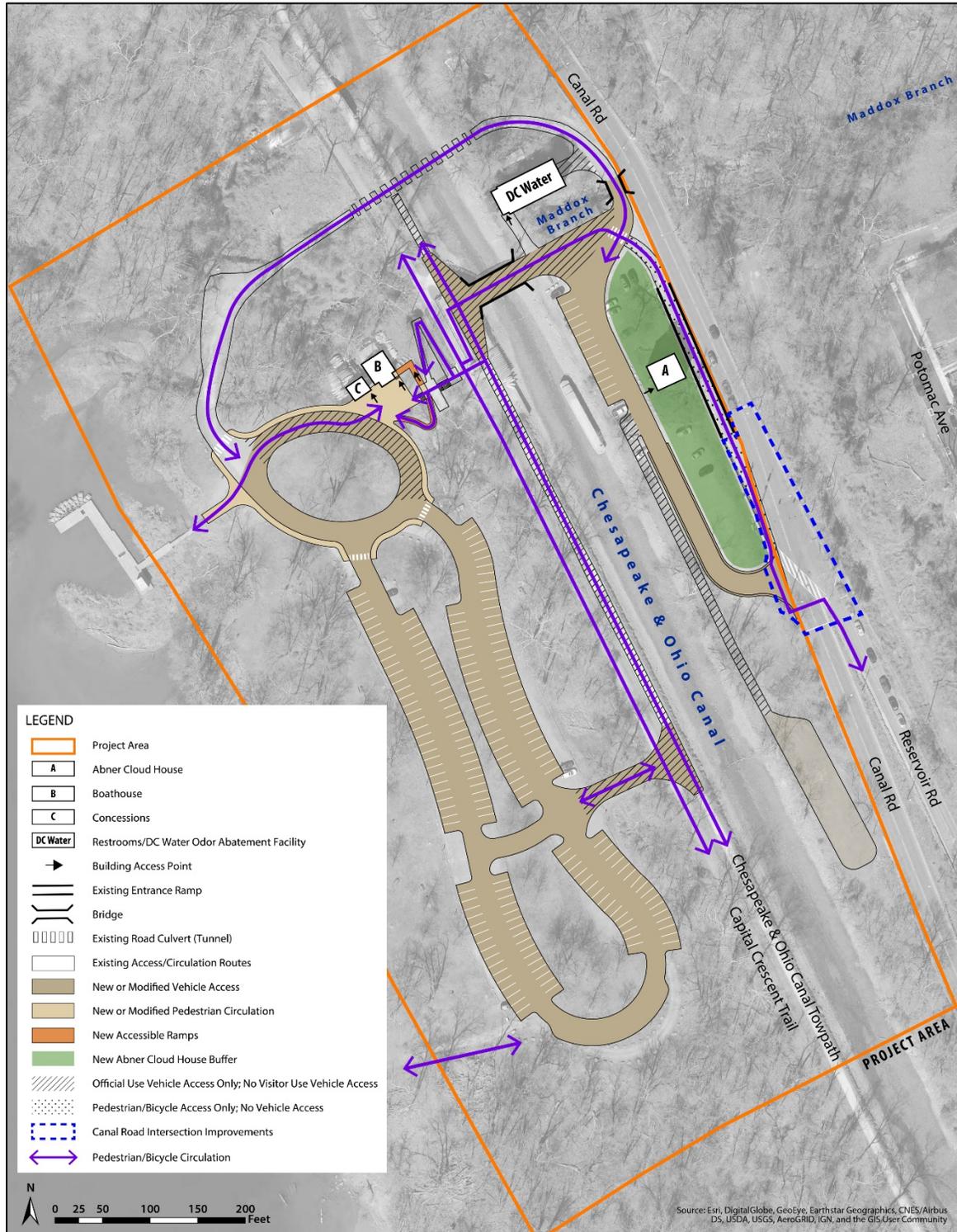


Figure E-6: Alternative B: Upper Parking Lot Access Alternative - Pedestrian and Bicycle Circulation

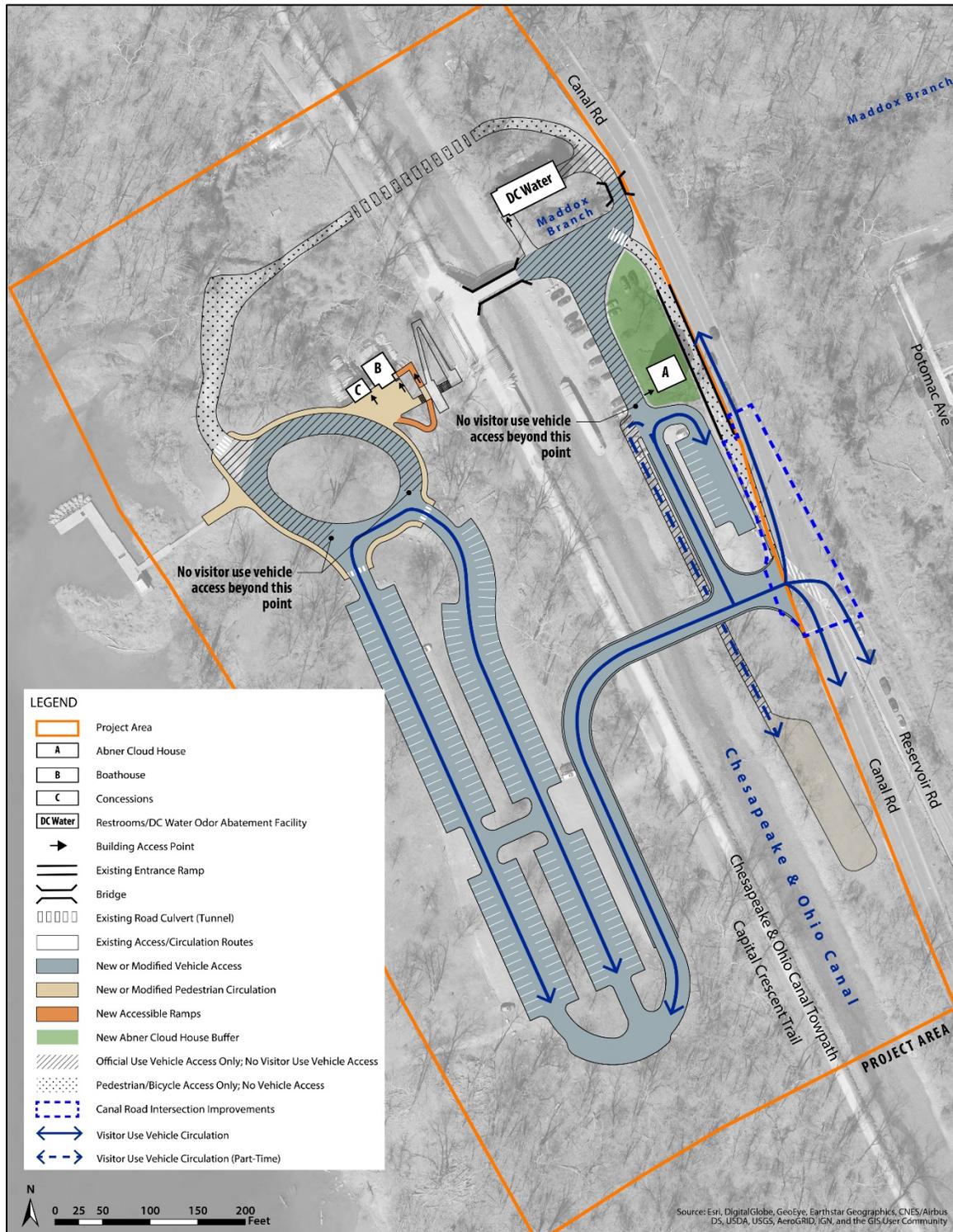
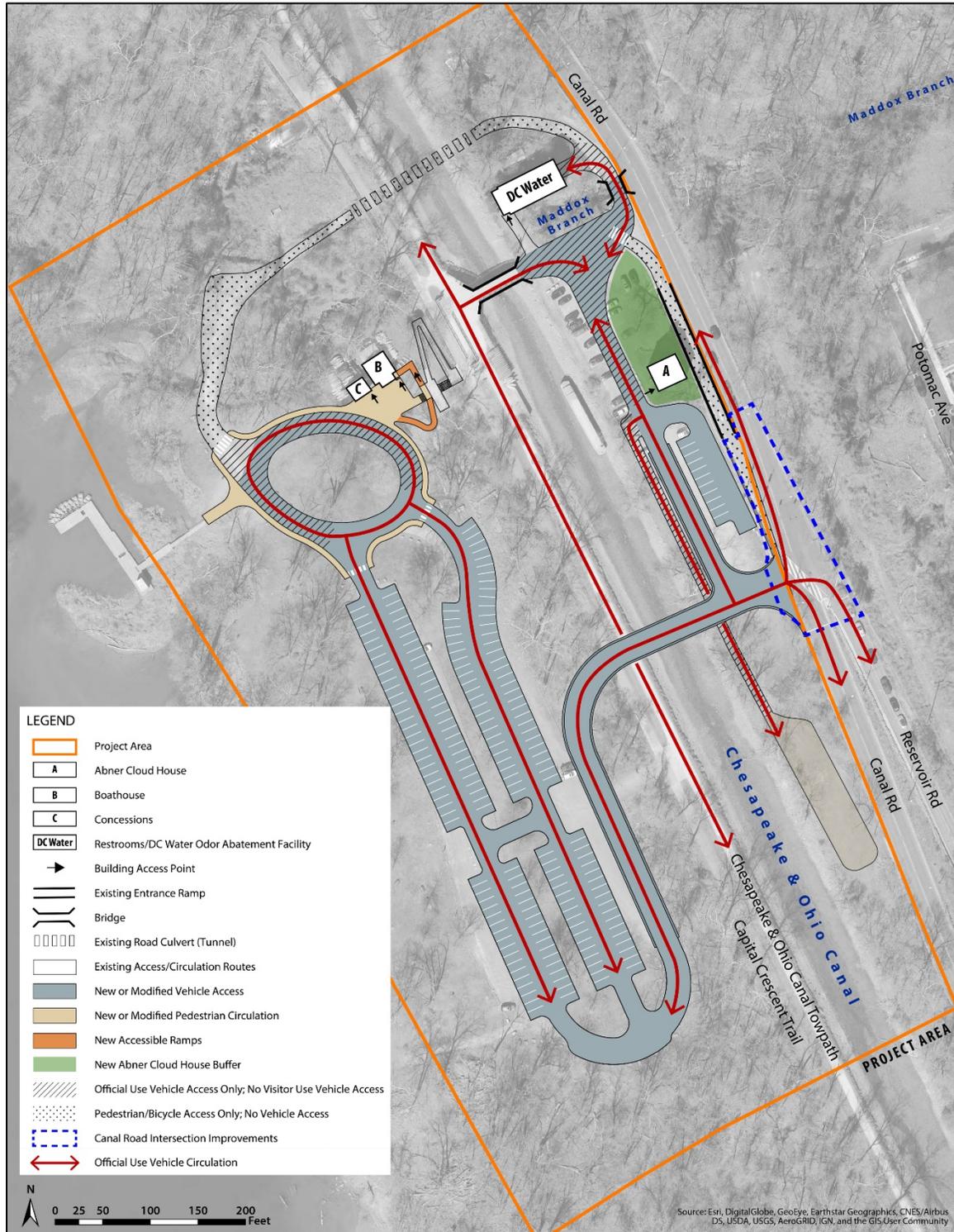


Figure E-7: Alternative C: Upper and Lower Parking Lot Access Alternative - Visitor Use Vehicle Circulation



**Figure E-8: Alternative C: Upper and Lower Parking Lot Access Alternative - Official Use Vehicle Circulation**

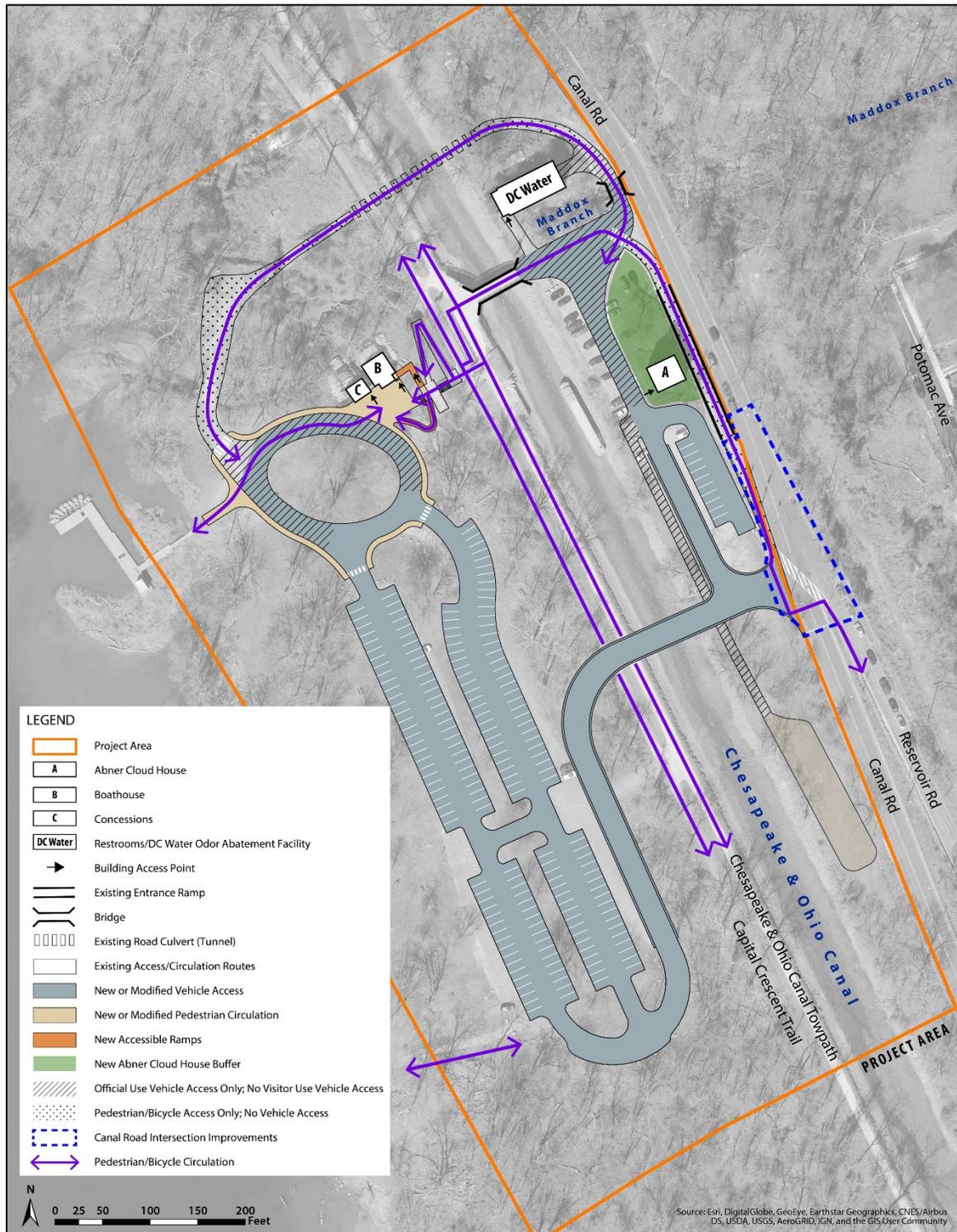


Figure E-9: Alternative C: Upper and Lower Parking Lot Access Alternative - Pedestrian and Bicycle Circulation