



Federal Triangle Area Flood Charrette

Hosted by the DC Silver Jackets Team

February 21, 2020 at the DC Water Headquarters



General Overview

Purpose of Charrette

The Federal Triangle Area (FTA) experienced severe flooding in June 2006 resulting in millions of dollars in damages to buildings, utilities and the Metro system. It also caused major disruption in operations to agencies and businesses. The area also flooded again in July 2019. The DC Silver Jackets interagency flood risk management team has hosted a number of events focused on this interior flooding risk for the FTA. These events included two workshops (June and September 2018), a number of working group meetings, and a May 2019 stakeholder leadership meeting. The leadership meeting assembled leaders from across the multiple agencies associated with the FTA with the goal of building consensus towards a comprehensive solution to address the FTA flooding issue and to gain funding for the next short term tasks.

One of those follow-on tasks from the stakeholder leadership meeting was to host a multi-agency charrette to identify the most effective and plausible comprehensive options that should be considered further to address the FTA interior flooding. The public agency charrette attendees included District of Columbia (District), federal, and regional agencies with facility management and/or operational responsibilities in the study area. The charrette was held on February 21, 2020 and the agenda is included as Attachment 1. This report is a summary of the charrette.

Executive Summary of the Charrette

The charrette was attended by facility managers, planners, engineers, historic and cultural specialists, environmental specialists, emergency managers and more representing thirteen different agencies. A list of participants is included as Attachment 2. Prior to the charrette, the multi-agency planning group had narrowed down 13 potential options down to a list of five for the charrette. Many of the options had been reviewed in an earlier study and lacked the ability to control the significant stormwater volumes equal to the 2006 flood event and other options have been precluded by other development activities. All options to be pursued must address the unique cultural and historic resources, dense urban environment, and operational issues in this area of the nation's capital. The workshop was intended to consider system-wide solutions and did not address the status quo option of continuing to implement individual flood risk management measures.

The 44 persons in attendance were split by discipline into seven to eight person working tables for the first half of the day. Using a set of 16 criteria, each of the five potential options were evaluated by the attendees at each table. For the second half of the day, the teams were re-arranged to achieve multi-discipline groups which then summarized the results of the first half of the day, and further elaborated on the strengths, weaknesses of the top options identified and listed additional considerations.

A clear consensus was reached during the charrette. The option which achieved the most sweeping support was a new pumping station serving the National Mall and FTA. The second highest ranked option was the option for passive water storage beneath the Mall (with no parking included).

The Progression of the Workshop

After welcoming comments from Stacey Underwood, U.S. Army Corps of Engineers (USACE), Baltimore District, and the facilitator Kevin Bluhm, USACE New Orleans District, John Cassidy, DC Water and Julia Koster, National Capital Planning Commission, presented background information on the FTA flooding issues. They presented the 13 initial flood risk management concepts and how and why they were screened down to five concepts by the charrette's multi agency planning group. Below is a list of the original 13 concepts. Attachment 3 provides the table that summarizes which concepts were eliminated and which remained to be evaluated and why. The July 2011 study referenced below is the "Federal Triangle Stormwater Drainage Study" funded by multiple agencies and conducted by DC Water and their consultant Greeley and Hansen.

- 1) **Flood-proofing Buildings and Facilities** – Noted as a viable option, but not included in this discussion of system-wide solutions (does not reduce flooding, only reduces consequences to hardened buildings and facilities),
- 2) **Low Impact Development Strategies/GI** – Eliminated pre-charrette from further consideration (2011 study found insufficient space within urban watershed to provide adequate capacity, although is a best management practice wherever feasible),
- 3) **Storage Upstream of Federal Triangle Area** – Eliminated pre-charrette from further consideration (2011 study found there was insufficient space for construction of multiple large reservoirs within the highly urbanized Federal Triangle watershed),
- 4) **Storage Beneath National Mall** – Included for charrette evaluation,
- 5) **Storage Beneath National Mall with Parking (DC Underground)** – Included for charrette evaluation,
- 6) **Storage as Part of Penn Avenue Revitalization** – Eliminated pre-charrette from further consideration (insufficient space and multiple underground infrastructure conflicts for construction of multiple large reservoirs),
- 7) **Use CSO Tunnels as Storage** – Eliminated pre-charrette from further consideration (2011 Study determined that the CSO control tunnels are full during the types of anticipated major rain events that cause FTA flooding),
- 8) **Utilize GSA Condensate Line** – Eliminated pre-charrette from further consideration (the pipe has insufficient conveyance capacity as determined by the 2011 study),
- 9) **Restoration of Natural Drainage and Stormwater Storage Near Constitution Avenue and on the National Mall** – Included for charrette evaluation,
- 10) **New Pumping Station Serving National Mall** – Included for charrette evaluation,
- 11) **New Tunnel to Existing O Street Pumping Station** – Eliminated pre-charrette from further consideration (recent development in the Navy Yard neighborhood, including the new DC Water Headquarters, makes construction of this alternative now infeasible),
- 12) **Use of Road Tunnels (3rd, 9th, 12th Street) for Storage** – Eliminated pre-charrette from further consideration (tunnels already flood during heavy rain events, including the 2006 storm), and
- 13) **Storage and/or Pump Station at Northern Pond of Tidal Basin** – Included for charrette evaluation.

A description of the screening criteria is included as Attachment 3. The five remaining flood risk management concepts for the FTA are presented below and the single page fact sheets for each are included as Attachment 4.

Concept Screening Criteria and Matrix

The evaluation matrix criteria that the teams would use to evaluate each concept were then presented by Kevin Bluhm. The 16 criteria were as follows and fit into 4 overall categories:

Effectiveness

- 1) **Reduction in Flood Impacts** - *To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?*
- 2) **Deployment Reaction Time** - *Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?*
- 3) **Reliability and Resilience to Climate Change** - *Ability to perform intended function now and into the future, including expandability/adaptability.*
- 4) **Risk to Public Safety** - *To what degree does the concept reduce or create risk of loss of life and injury during flood?*

Implementability

- 5) **Capital Cost** - *Magnitude of capital costs (real estate acquisition, permitting, design, and construction).*
- 6) **Operation and Maintenance Costs** - *Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.*
- 7) **Construction Impacts and Duration** - *Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.*
- 8) **Real Estate, Permitting, and Regulatory Boundaries** - *Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.*

Impacts (Long-Term)

- 9) **Historic / Cultural Impacts** - *To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic settings, other cultural assets and resources?*
- 10) **Environmental Impacts** - *Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.*
- 11) **Safety and Security Impacts** - *Significance of impacts to health, safety, and security in the Federal Triangle/ National Mall area.*
- 12) **Viewshed Impacts** - *Significance of impacts to viewsheds in the Federal Triangle/National Mall area.*
- 13) **Use and Program Impacts** - *Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, recreation, access etc.*
- 14) **Potential for Co-Benefits** - *Potential for benefits other than flood risk mitigation.*

Qualitative Assessment

15) **Supports Agency Missions** - *How does this concept align with the missions of the agencies involved in its implementation and long term operation?*

16) **Notes and Considerations** – *Any other pertinent information the attendees wanted to include.*

For a given concept, each criteria was evaluated by the team and pros/cons/considerations were documented. Based on that criteria evaluation, each concept received a numerical rating. The ratings were not intended to be added to create an overall score. The various criteria were not weighted and for some criteria and concepts, limited information was available. This preliminary exercise was intended to provide relative comparisons across the options. The rating scale was from 1 to 5, with 1 representing the worst case and 5 representing the best case for each criteria. For instance, a concept that produced a maximum reduction in flooding impacts would likely receive a 5 for the reduction in flood impacts criteria. Conversely, a concept that was expected to produce a minimal reduction to flood impacts would likely be scored as a 1. See Attachment 5 for ratings, along with notes and justification for each rating assigned.

Overview of Potential Concepts

Storage Beneath the National Mall - New underground storage tank(s) would be constructed beneath the National Mall to store excess flows during heavy rain events. A series of new catch basins and storm sewers would be constructed at the low points along Constitution Avenue to capture flow and deliver it to the tank(s). The size of the tank(s) would be determined based on the required level of protection; approximate volumes required for events of various return frequency are listed in Attachment 4. The storage tanks, which would require more than 200,000 square feet of area, would encompass approximately 2.5 panels along the Mall. A small underground pumping station would be constructed to dewater the tank(s) after rain events, so that the tanks would be empty for the next rain event. This water would be pumped to the Tidal Basin, Potomac River, or to the existing sewer system when capacity becomes available. As with other options in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept was reviewed in the 2011 study.

Storage Beneath the National Mall with Parking (National Mall Coalition's National Mall Underground Concept or Similar) - As proposed, the National Mall Underground would be a multi-purpose flood storage facility, car and tour bus parking garage and National Mall visitor center with access to the Smithsonian museums, national monuments, and other cultural attractions. The existing storm drain system would need to be modified to allow flood waters to enter the storage structure. During heavy rain events, the bottom level of the underground parking structure (where tour buses would park) would function as a stormwater retention reservoir to minimize impacts from stormwater flooding and store water potentially for National Mall irrigation. Vehicles and people would have to be evacuated from the lower level before flood waters entered, or not allowed to park there if significant rainfall is expected that day. It would have the capacity to hold 30 million gallons of water (equivalent to a 200 year flood). The flood waters would need to be pumped out of the storage facility following the storm and the facility would have to be cleaned. Access ramps/roads for vehicles to enter and exit the parking garage would be needed at 9th and 12th Streets. As with other proposals in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept was not reviewed in the 2011 study.

Restoration of Natural Drainage and Stormwater Storage near Constitution Avenue (Karolina Kawiaka, Dartmouth College, Concept or Similar) - Consisting of multiple bio swales and retention areas, this concept seeks to mimic that of the Tiber Creek that once flowed through the Federal Triangle area near Constitution Avenue. Tiber Creek was incorporated into the DC design earlier in history as a canal. This green infrastructure concept would restore the natural hydrologic pattern in the landscape and provide a natural habitat. It is expected to have a capacity to hold 35 million gallons (no detailed hydraulic computations have been conducted). The canal would typically be dry and only filled with water during heavy rain events. Pump stations would be needed. As with other proposals in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept was not reviewed in the 2011 study.

New Pumping Station Serving National Mall - A new underground pumping station would be constructed to pump excess water from the Federal Triangle to the Tidal Basin or the Potomac River during storm events. A series of new catch basins and storm sewers would be constructed at the low points along Constitution Avenue to capture flow and deliver it to the pumping station. The pumping station would discharge via a new force main to the Tidal Basin or the Potomac River. The pumping capacity would be determined based on the required level of protection; a chart of required pumping capacity based on event return period and maximum water level at 15th St NW and Constitution Ave is shown in Attachment 4. Two potential locations for the pumping station have been identified, and are also shown on Attachment 4. As with other options in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept was reviewed in the 2011 study.

Storage or Pumping Station at Northern End of Tidal Basin - This concept proposes to repurpose the section of the Tidal Basin north of Kutz Bridge as a covered storage area 15-20 feet deep and approximately 6 acres in size, with a pumping station. As with the other storage options, it would need to be pumped to ensure storage capacity for back to back events. Alternatively, it could also serve as a pump station location for the concept described above (Pump Station for the National Mall). It is within the 100-year flood plain. As with other proposals in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept has not been studied in detail.

Breakout Session #1 – Evaluation of Concepts

Following the presentation of the material above, each table was asked to evaluate all five concepts using the evaluation criteria assigned to their respective table. For Breakout #1, the tables were comprised of individuals from similar disciplines and the evaluation criteria assigned to each table was linked to that particular type of discipline. For example, those with an engineering discipline evaluated all five concepts using criteria such as: reduction in flood impacts, deployment reaction time, reliability and resilience to climate change, and risk to public safety. The tables with a planning and/or cultural discipline evaluated the five concepts based on criteria such as: cultural / historical impacts, environmental impacts, viewshed impacts, and use and program impacts.

For each of the five concepts, a scribe at each table recorded the table discussion around how each concept addressed each criteria, including key takeaways, assigning scores, and justification for how that score was assigned. Additionally, for each concept the scribe recorded notes on more qualitative topics

such as whether each concept supports the FTA agencies' missions and any other additional notes or considerations.

The evaluation matrix for each concept can be found in Attachment 5.

The charrette attendees broke for lunch and then returned for Breakout Session #2. During lunch, a presentation on the National Archives and Records Administration (NARA) experience during the July 2019 flood was given. While recently installed flood risk management measures and barriers worked successfully to reduce their flood risk, NARA still experienced some flooding through underground utility lines.

Breakout Session #2 – Interdisciplinary Review of Concepts

The scribe from each table for breakout session #1 presented on the strengths and weaknesses identified for each concept. Then, the attendees were split into interdisciplinary groups to review the results of the first breakout session and to further discuss and refine which concepts rise to the top. They were asked to identify the top one or two concepts that would provide effective flood risk management and would likely be supported by agencies and the public. Key advantages and challenges for the top two concepts were recorded (see Attachment 6 for the detailed notes from this breakout session).

Overall, the interdisciplinary review concurred with the first breakout groups' assessment of each of the concepts based on the criteria. The new pumping station serving the National Mall received the strongest support as the top option based on the evaluation criteria used. In particular, a pumping station was found to be best suited to reduce flooding impacts on the FTA, is resilient to back-to-back storm events, could have capacity expanded in the future to address climate change, has minimal risk to public safety (and actually reduces risk by effectively removing flood waters from the streets), and would have low viewshed impacts, among others. The main challenges for the pumping station concept were associated with construction, cost (estimated to be \$360M in the July 2011 study), environmental impacts (potentially discharging surface runoff and combined sewage overflow to the Potomac), and limited co-benefits.

During the second breakout session, the interdisciplinary teams also almost unanimously decided that the storage beneath the Mall with no parking would be the second-best option. This option has a large capacity requiring no pre-flood actions, has limited impacts to the viewshed once constructed, has little risk to health or safety, could filter out large debris and could have less impact on outgoing infrastructure. However, some of the main disadvantages would be: the construction impacts to a large portion of the Mall; it would not have the capacity to handle back-to-back heavy rain events; and the high construction cost (estimated to be \$400M in the July 2011 study). Although the storage or pumping station at the Tidal Basin option scored well in the evaluation matrix, it was thought that this concept would require permanent changes to the Tidal Basin, a fact that many felt would be harder to gain approval/acceptance for, although it could be considered in ongoing evaluations of the Basin's future.

Storage under the National Mall with Parking was seen as the least acceptable option for various reasons. Numerous pre-flood actions would be required such as evacuating vehicles and people from the storage area with extremely limited flood response time. This would be a direct risk to public safety. There would also be public health concerns as the storage area would need to be cleaned following flood events due to potential inclusion of sewage in the flood waters from the combined sewer overflow. Negative historic/cultural, environmental and viewshed impacts were identified due to above grade infrastructure, new exit and entrance ramps, and increased traffic. Security impacts related to having a large number of

visitors and vehicles in a facility under the National Mall was also raised. Multiple agencies also said this option did not align with their agency's mission.

Conclusion

After a full day of 44 multi-disciplinary stakeholders discussing and evaluating various flood risk management concepts for the Federal Triangle area, the new pumping station serving the National Mall concept was identified as the widely preferred solution that would provide effective flood risk management and would likely be supported by agencies and the public. While the location of a pump station and designs that would minimize impacts on views and the historic landscapes in the area were identified as a high priority going forward, this option was seen as having few health, safety or security issues, fewer short or long term impacts to historic and cultural landscapes and viewsheds, fewer impacts to surrounding uses and operations, and straightforward maintenance, and expandability.

Other options had less support, with the next option being the storage under the National Mall with no ancillary uses such as parking. While the upstream green infrastructure solution did not provide enough capacity to address flood mitigation needs, many participants thought it was important to encourage green infrastructure measures within the watershed.

The workshop participants only considered system-wide solutions and did not discuss the status quo option of continuing to implement individual flood risk management measures.

Looking Forward

The completion of the charrette marks the beginning of a more public process. As almost every system wide solution will require action on federal land, the next step before anything can be built is to conduct a NEPA process and other required reviews, possibly in conjunction with additional feasibility studies. The results of this charrette will be used to inform the alternatives selected for inclusion in the NEPA process, if funded. The NEPA process allows for public comment from all stakeholders including the general public prior to any final decision on what will be constructed. Before the NEPA process can begin, the following steps must be taken.

The next steps include the following:

- 1) Hold funding and implementation meetings with key stakeholder leaders to determine how best to fund the next phases (NEPA, Section 106, feasibility study?) and fund the implementation of a project. There are many stakeholders impacted by the flooding in FTA, however, no one agency has the sole responsibility to solve the flooding problem, and solutions involve multiple agencies; therefore we must decide together how to pursue and fund such a project.
- 2) Complete the Federal Triangle building inventory (Spring 2020).
- 3) Conduct preliminary flood damage and impact assessment (Spring/Summer 2020).
- 4) Meet with stakeholder agency leaders to determine path forward.

If you wish to access the presentation from the charrette please follow this link: <https://silverjackets.nfrmp.us/State-Teams/Washington-DC>.

Attachments

- 1) Charrette Agenda
- 2) Charrette Attendees List

- 3) Charrette Screening of Initial Concepts
- 4) FTA Concept Sheets
- 5) Charrette Breakout Session #1 Results: Concept Evaluation Matrix Results
- 6) Charrette Breakout Session #2 Results: Interdisciplinary Review of Concepts

Attachment 1

This page left blank intentionally



Federal Triangle Area Flood Charrette Agenda

DC Water Headquarters; 125 O Street, SE
Board Room
February 21, 2020



- 9:00 - 9:20 **Welcome and Purpose**
Stacey Underwood, Silver Jackets Coordinator
U.S. Army Corps of Engineers, Baltimore District
- Kevin Bluhm, Facilitator*
U.S. Army Corps of Engineers, New Orleans District
- 9:20 – 10:15 **Overview of Potential Concepts**
John Cassidy, DC Water
Julia Koster, National Capital Planning Commission
- 10:15-10:45 **Review Concept Evaluation Matrix and Criterion**
Kevin Bluhm
- 10:45 -11:00 **Break**
- 11:00-12:15 **Breakout Session #1 – Evaluation of Concepts**
- 12:15-1:00 **Lunch** (*provided at the facility*)
- 12:45-1:00 **Special Lunch Topic: NARA’s Experience During the July 2019 Flood**
Tim Edwards, Acting Chief of Facilities, National Archives and Records Administration (NARA)
- 1:00 – 2:30 **Breakout Session #2 – Interdisciplinary Review of Concepts**
- 2:30-2:45 **Break**
- 2:45 – 3:15 **Report Out from Breakout Session**
- 3:15 – 3:30 **Wrap-Up and Next Steps**
Stacey Underwood, Silver Jackets Coordinator
- 3:30 – 4:00 **Optional Tour of DC Water HQ Building Green Technologies**

Members of the DC Silver Jackets Team Who Helped Plan this Charrette:



This page left blank intentionally

Attachment 2

This page left blank intentionally



Federal Triangle Area Charrette

February 21, 2020

List of Attendees



Agency/Organization	Representative/Name
Homeland Security Emergency Management Agency	Vermecia Alsop
WMATA	Jim Ashe
National Archives and Records Administration	John Bartell
Commission of Fine Arts	Sarah Batcheler
US Army Corps of Engineers	Kevin (Facilitator) Bluhm
DC Dept. of Energy and Environment	Nick Bonard
Homeland Security Emergency Management Agency	Nickea Bradley
Smithsonian Institution	Michael J. Carrancho
DC Water	John Cassidy
US Army Corps of Engineers	Brittany Crissman
National Gallery of Art	Samantha Dennison
National Gallery of Art	Alan Dirican
DC Dept. of Energy and Environment	James Dunbar
National Archives and Records Administration	Tim Edwards
National Park Service	Nathan Epling
DC Water	Gordon Evans
DC Water	Brandon Flora
Commission of Fine Arts	Dan Fox
National Archives and Records Administration	James Garvin
General Services Administration	Paul Gyamfi
DC Dept. of Planning	Stephen Gyor
National Capital Planning Commission	Jamie Herr
National Park Service	Sean Kennealy
National Capital Planning Commission	Julia Koster
Smithsonian Institution	Jaime Kurry
US Army Corps of Engineers	Andy Layman
DC Dept. of Planning	Andrew Lewis
DC Dept. of Planning	Andrea Limauro
Smithsonian Institution	Helen Maib
General Services Administration	Harvey Maruya
National Park Service	Peter May
General Services Administration	Anthony Mondy
Smithsonian Institution	Van Nguyen
Smithsonian Institution	Jane Passman
General Services Administration	Shawn Proctor
General Services Administration	Kevin Rattliff
DC Water	Carlton Ray
National Capital Planning Commission	Sarah Ridgely
WMATA	Thomas Robinson

Agency/Organization	Representative/Name
General Services Administration	Thomas Terrio
General Services Administration	Kristi Tunstall
US Army Corps of Engineers	Stacey Underwood
National Capital Planning Commission	Garrett Wolf
WMATA	Anthony Zarrella

Attachment 3

This page left blank intentionally

Screening of Concepts

21 February 2020

Concept	Category	Description	Would it work?	Could you build it?	Discuss in charrette?
1	Flood Hardening	Flood-proofing buildings and facilities	Yes, to a point. While this strategy would not reduce the likelihood of flooding, it would reduce the consequences, thereby reducing flood risk. It leaves unprotected buildings and facilities (roads, Metro) still at risk. Reliability of solutions and the intended level of flood risk protection must be considered.	Yes; each individual stakeholder within the Federal Triangle would be responsible for protecting their own assets. Coordination is needed to ensure similar levels of flood protection and that strategies do not inadvertently increase flood risk to adjacent sites.	Yes, although the charette will focus more on the discussion of system-wide alternatives.
2	Flood Storage	Low Impact Development Strategies/GI	No. The 2011 study found that in this urbanized watershed, there was insufficient capacity for the large storms that cause flooding in Federal Triangle.	No - insufficient space to provide adequate capacity. However, installing LID and GI where feasible is a best management practice for stormwater management generally.	No
3		Storage Upstream of Federal Triangle Area	Yes; however, upstream watershed storage is less effective than storage within the Federal Triangle.	No. The 2011 study found there was insufficient space for construction of multiple large reservoirs within the highly urbanized Federal Triangle watershed.	No
4		Storage Beneath National Mall	Yes. The 2011 study found that storage would generally require a space 15 feet deep and occupying two panels. Note that all storage options must address flood volumes equal to the 2006 flood, and the prospect of back-to-back flood events.	Yes, although there are permitting, construction, cultural, historical, environmental, operational, security, health, safety and other issues.	Yes
5		Storage Beneath National Mall with Parking (DC Underground)	Yes. The proposal uses greater depth and covers generally one panel on the Mall.	Yes, although there are permitting, construction, cultural, historical, environmental, operational, security, health, safety and other issues.	Yes
6		Storage as Part of Penn Ave Revitalization	Yes; however, upstream watershed storage is less effective than at the most downstream location.	No - insufficient space and multiple underground infrastructure conflicts for construction of multiple large reservoirs. However, stormwater storage, including LID and GI approaches, is a best management practice for any right of way revitalization.	No
7		Use CSO Tunnels as Storage	No. This was evaluated in the 2011 study and the CSO control tunnels are full during the types of anticipated major rain events that cause flooding in Federal Triangle.	Existing system is built but lacks sufficient capacity.	No
8		Gravity Conveyance	Utilize GSA Condensate Line	No - the pipe has insufficient conveyance capacity as determined by the 2011 Study	Existing system is built but lacks sufficient capacity.
9	Restoration of natural drainage and stormwater storage near Constitution Avenue and on the National Mall		Maybe. The low elevations within the Federal Triangle relative to the Potomac River limit the effectiveness of gravity drainage directly to the River, likely requiring pumping. This option has not been studied at the same level of detail as others.	Yes, although there are permitting, construction, cultural, historical, environmental, operational, security, health, safety and other issues.	Yes
10	Pumped Conveyance	New Pumping Station Serving National Mall	Yes. This option was considered in the 2011 study and was sufficient to handle the anticipated major rain events. Pump station locations and designs have not been evaluated in detail.	Yes. Various permitting, construction, cultural, historical, environmental, operational and other issues may be influenced by location and design.	Yes
11		New Tunnel to Existing O Street Pumping Station	Yes. This option was considered in the 2011 study and was sufficient to handle the anticipated major rain events.	No - recent development in the Navy Yard neighborhood, including the new DC Water Headquarters, makes construction of this alternative now infeasible.	No
12	Other options	Use road tunnels (3rd, 9th, 12th Street) for storage	These tunnels already flood during heavy rain events, including the 2006 storm. While not studied at the same level of detail as other options, it does not appear that this option provides sufficient capacity.	No - there are significant transportation impacts, along with permitting, construction, operational, environmental, security/safety and other issues.	No
13		Storage and/or pump station at Northern Pond of Tidal Basin	Maybe. This option could provide appropriate storage capacity (a 6 acre, 15 foot deep facility) or be a potential site for a pump station if redevelopment of this site were ever considered. Area is within the 100-year floodplain, and thus is vulnerable to river flooding.	Yes, although there are permitting, construction, cultural, historical, environmental, operational, security/safety and other issues. This concept has not been studied in detail.	Yes. This option may be appropriate to consider when looking at either storage or potential pump station sites.

This page left blank intentionally

Attachment 4

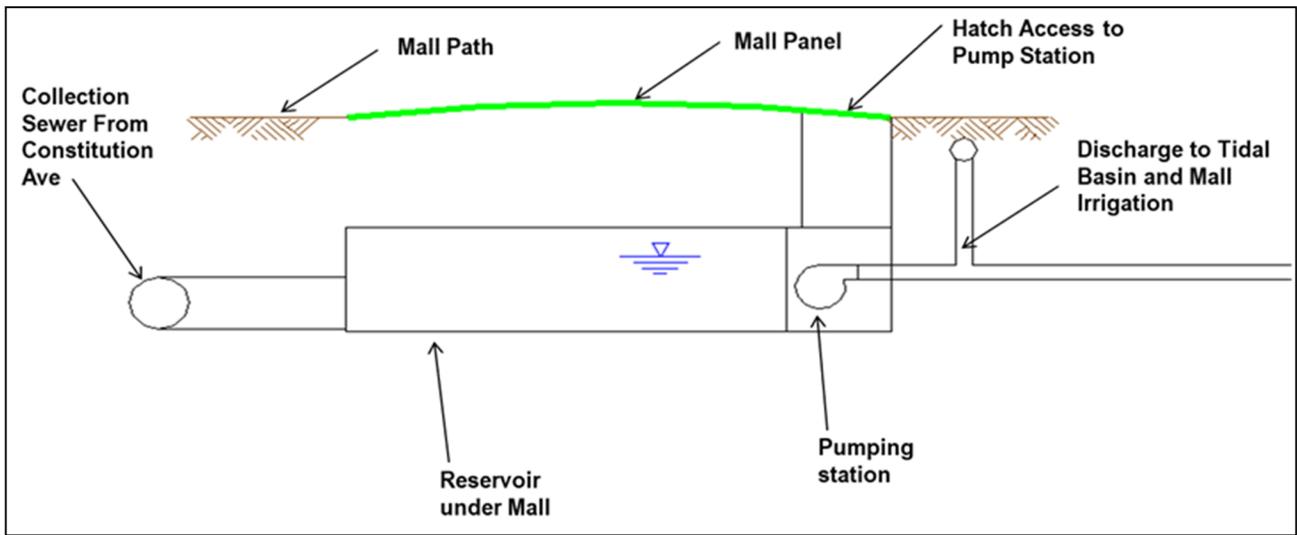
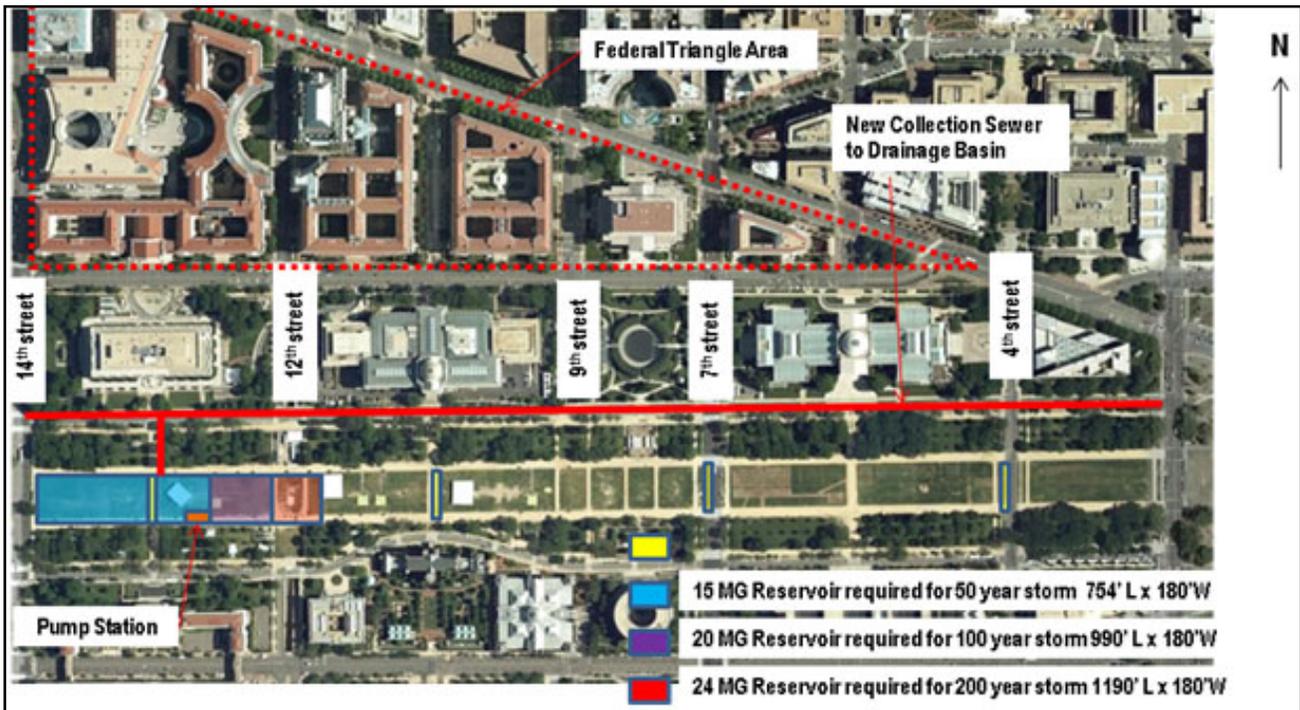
This page left blank intentionally

Federal Triangle Area Flood Risk Management Charrette Concepts

Concept Name: Storage Beneath National Mall

Description: New underground storage tank(s) would be constructed beneath the National Mall to store excess flows during heavy rain events. A series of new catch basins and storm sewers would be constructed at the low points along Constitution Avenue to capture flow and deliver it to the tank(s). The size of the tank(s) would be determined based on the required level of protection; approximate volumes required for events of various return frequency are listed on the figure below. A small underground pumping station would be constructed to dewater the tank(s) after rain events, maintaining them empty between events. This water would be pumped to the Tidal Basin, Potomac River, or to the existing sewer system when capacity becomes available. This concept was reviewed in the 2011 study.

Location:

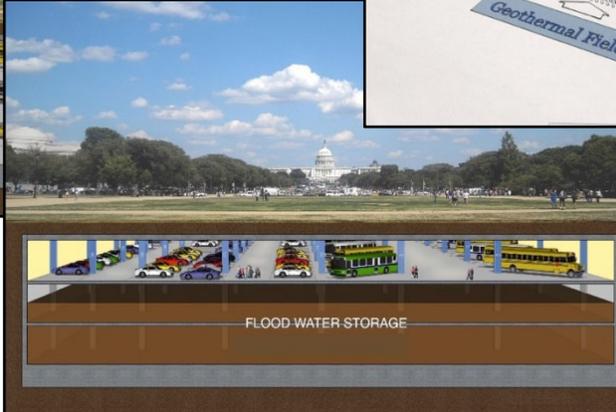
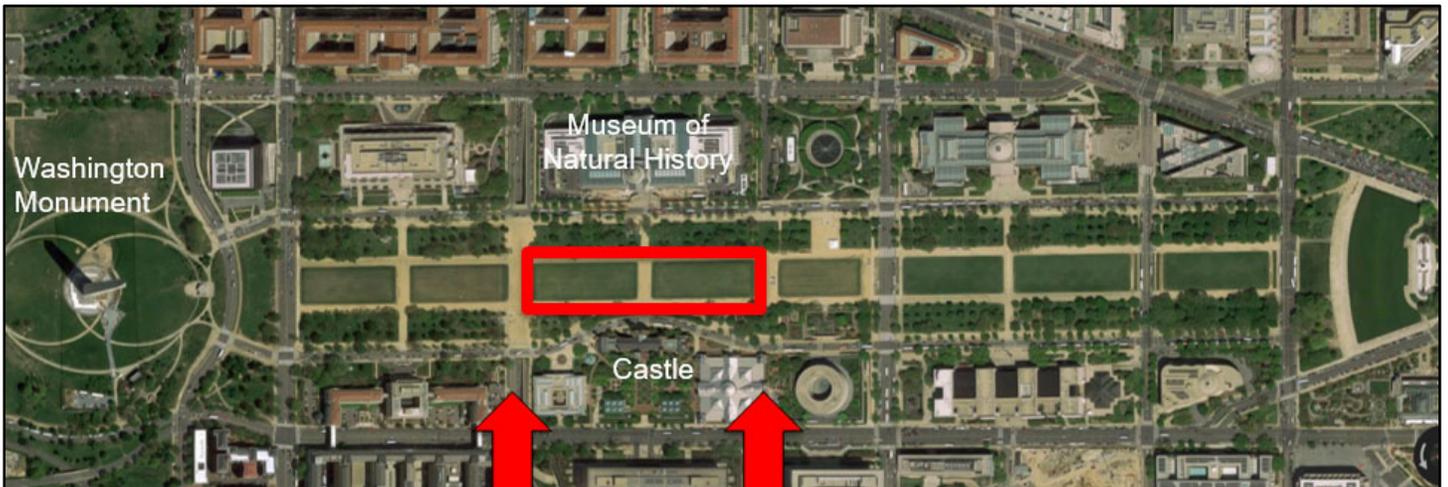


Federal Triangle Area Flood Risk Management Charrette Concepts

Concept Name: Underground Parking and Storage on the National Mall (National Mall Underground Concept or Similar)

Description: As proposed, the National Mall Underground, would be a multi-purpose flood storage facility, car and tour bus parking garage and National Mall visitor center with access to the Smithsonian museums, national monuments, and other cultural attractions. The existing storm drain system would need to be modified to allow flood waters to enter the storage structure. During heavy rain events, the bottom level of the underground parking structure (where tour buses would park) would function as a stormwater retention reservoir to minimize impacts from stormwater flooding and store water potentially for National Mall irrigation. Buses would have to be evacuated from the lower level before flood waters entered, or not allowed to park there if significant rainfall is expected that day. It would have the capacity to hold 30 million gallons of water (equivalent to a 200 year flood). The flood waters would need to be pumped out of the storage facility following the storm and the facility would have to be cleaned. Access ramps/roads for vehicles to enter and exit the parking garage would be needed at 9th and 12th Streets.

Location:



Federal Triangle Area Flood Risk Management Charrette Concepts

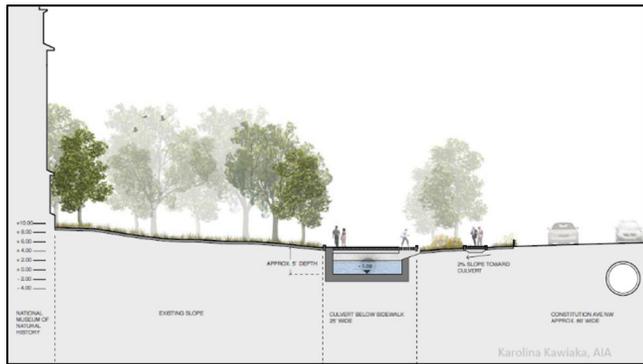
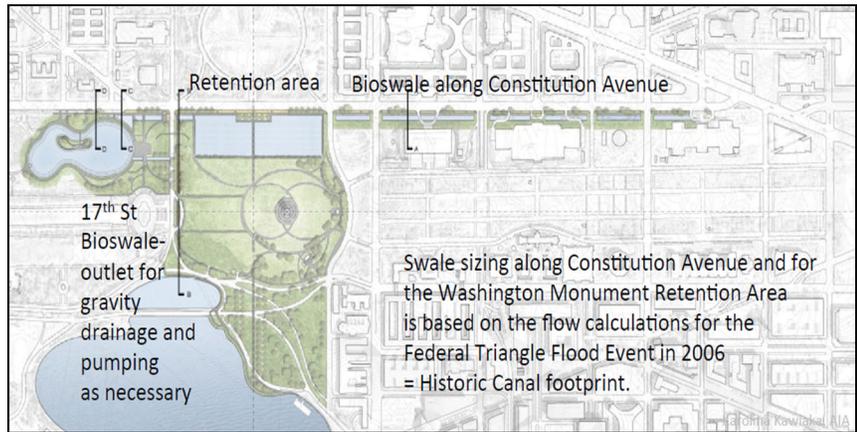
Concept Name: Restoring the Role of Tiber Creek (Concept Developed by Karolina Kawiaka, Dartmouth College or similar)

Description: Consisting of multiple bio swales and retention areas, this concept seeks to mimic that of the Tiber Creek that once flowed through the Federal Triangle area near Constitution Avenue. Tiber Creek was incorporated into the DC design earlier in history as a canal. This green infrastructure concept would restore the natural hydrologic pattern in the landscape and provide a natural habitat. Among all of the components, it has the capacity to hold 35 million gallons (no detailed hydraulic computations have been conducted). The canal would typically be dry and only filled with water during heavy rain events. Pump stations would likely be needed.

Location:



Bioswale Cross Section



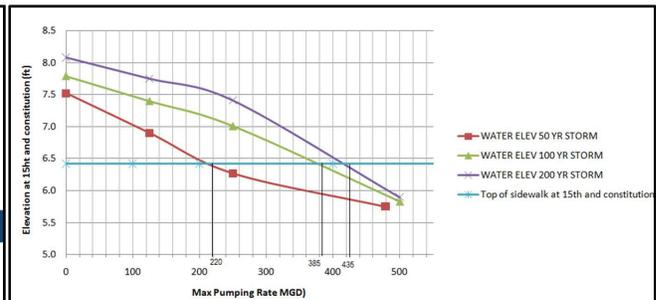
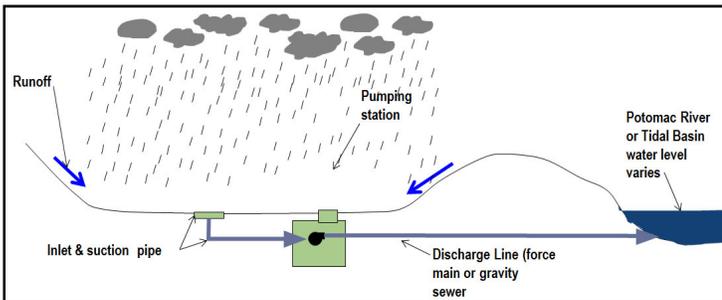
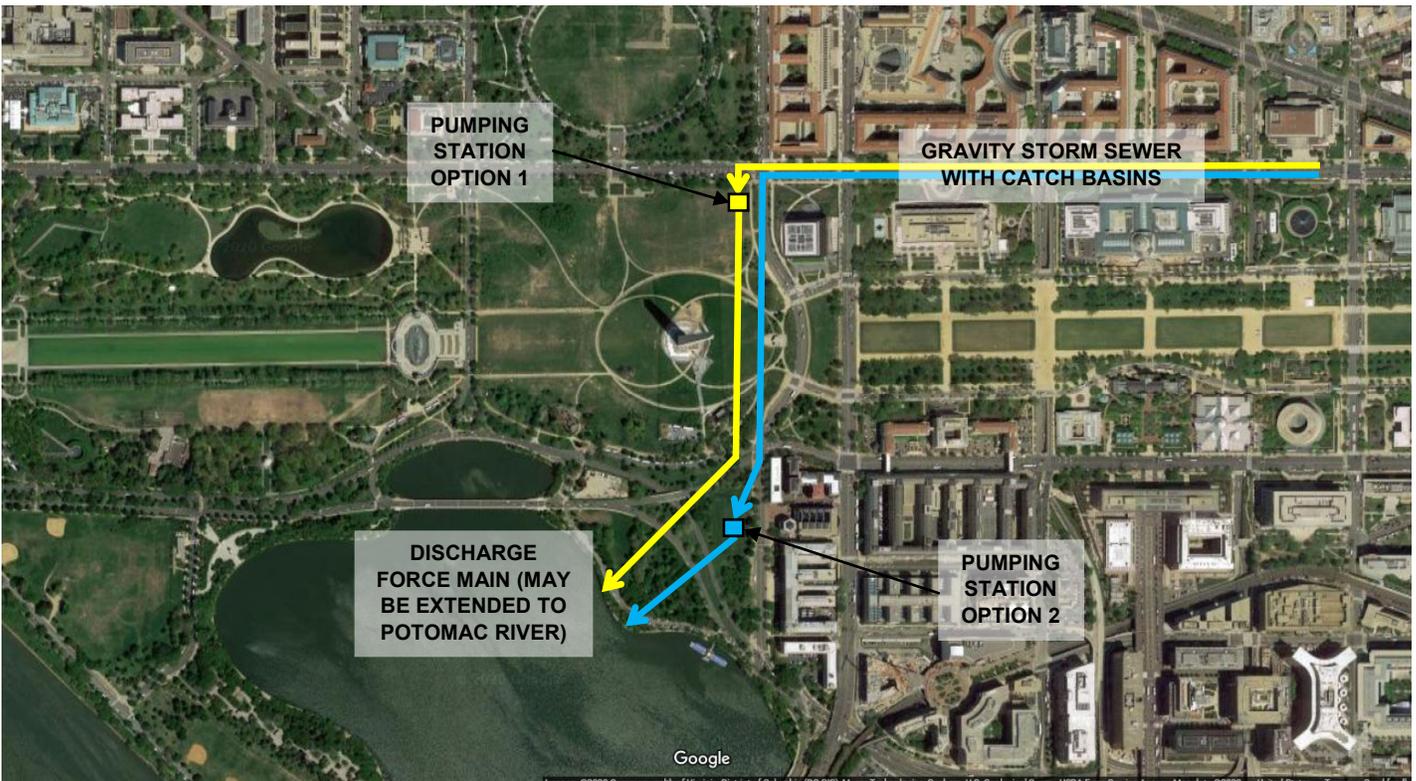
Storage Areas Must Remain Empty Between Events

Federal Triangle Area Flood Risk Management Charrette Concepts

Concept Name: New Pumping Station Serving National Mall

Description: A new underground pumping station would be constructed to pump excess water from the Federal Triangle to the Tidal Basin or the Potomac River during storm events. A series of new catch basins and storm sewers would be constructed at the low points along Constitution Avenue to capture flow and deliver it to the pumping station. The pumping station would discharge via a new force main to the Tidal Basin or the Potomac River. The pumping capacity would be determined based on the required level of protection; a chart of required pumping capacity based on event return period and maximum water level at 15th St NW and Constitution Ave is shown below. Two potential locations for the pumping station have been identified, as shown in the figure below. This concept was reviewed in the 2011 study.

Location:



Federal Triangle Area Flood Risk Management Charrette Concepts

Concept Name: Storage or Pumping Station at Northern End of Tidal Basin

Description: This concept proposes to repurpose the section of the Tidal Basin north of Kutz Bridge as a covered storage area 15-20 feet deep and approximately 6 acres in size, with a pumping station. As with the other storage options, it would need to be pumped to ensure storage capacity for back to back events. Alternatively, it could also serve as a pump station location for the concept described above (Pump Station for the National Mall). It is within the 100-year flood plain. As with other proposals in and around the National Mall, there are historic, cultural, environmental, viewshed, safety, and operational issues. This concept has not been studied in detail.



This page left blank intentionally

Attachment 5

This page left blank intentionally

Criteria	Reduction in Flood Impacts		Deployment Reaction Time		Reliability and Resilience to Climate Change		Risk to Public Safety		Capital Cost		Operation and Maintenance Cost		Construction Impacts and Duration		
Criteria Description	To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?		Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?		Ability to perform intended function now and into the future, including expandability/ adaptability.		To what degree does the concept reduce or create risk of loss of life and injury during flood?		Magnitude of capital costs (real estate acquisition, permitting, design, and construction).		Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.		Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.		
Impact Rating	1 = Minimum reduction to flood impacts 3 = Moderate reduction to flood impacts 5 = Maximum reduction of flood impacts	Impact Rating Assigned	1 = Maximum amount of deployment actions 3 = Moderate deployment actions 5 = No deployment actions	Impact Rating Assigned	1 = Low reliability/adaptability 3 = Moderate reliability/adaptability 5 = High reliability/adaptability	Impact Rating Assigned	1 = Maximum risk to public safety 3 = Moderate risk to public safety 5 = Minimum risk to public safety	Impact Rating Assigned	1 = Significant initial construction costs 3 = Moderate initial construction costs 5 = Minimal initial construction costs	Impact Rating Assigned	1 = Significant O&M costs 3 = Moderate O&M costs 5 = Minimal O&M costs	Impact Rating Assigned	1 = Significant construction impacts 3 = Moderate construction impacts 5 = Minimal construction impacts	Impact Rating Assigned	
Storage Beneath the National Mall	<ul style="list-style-type: none"> •During large or back to back storm events, storage will be expended quickly, after which the measure is no longer functional. •Would require additional systems to reduce flooding •Would ease pressure off of other systems if built in combination. •Could be sized to handle any large event; can extend storage facility laterally if needed; 		2.5	<ul style="list-style-type: none"> •Passive measure, no pre-flood actions required. 	5	<ul style="list-style-type: none"> •Always functioning (now and into future). •Could be built far enough below grade to allow room for future expansion above. •Lateral expansion challenging •Pumping still required to empty structure after storm; would be offline for some number of days after large events. •Not as reliable as pump station as it cannot handle back-to-back storms 	3	<ul style="list-style-type: none"> •Passive storage below Mall has minimal risk to public safety. •Can keep the flood waters off the roads. 	5	<ul style="list-style-type: none"> •Smaller pump station needed here than in Tidal Basin. 	3	<ul style="list-style-type: none"> •Will require routine cleaning, maintenance is not that expensive. •Will have to maintain pumps. 	3	<ul style="list-style-type: none"> •Vibration impacts and traffic impacts 	2

Criteria	Real Estate, Permitting, and Regulatory Barriers		Historic/Cultural Impacts		Environmental Impacts		Safety and Security Impacts		Viewshed Impacts		Use and Program Impacts		Potential for Co Benefits		
Criteria Description	Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.		To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic setting, recreation?		Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.		Significance of impacts to safety and security in the Federal Triangle/ National Mall area.		Significance of impacts to viewsheds in the Federal Triangle/National Mall area.		Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, access etc.		Potential for benefits other than flood risk mitigation.		
Impact Rating	1 = Significant challenges 3 = Moderate challenges 5 = Minimal challenges	Impact Rating Assigned	1 = Negative historic/cultural impacts 3 = Neutral historic/cultural impacts 5 = Positive historic/cultural impacts	Impact Rating Assigned	1 = Negative impact to environment 3 = Neutral impacts to environment 5 = Positive impacts to environment	Impact Rating Assigned	1 = Negative impact to security 3 = Neutral impacts to security 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to viewshed 3 = Neutral impacts to viewshed 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to existing uses 3 = Neutral impacts to existing uses 5 = Positive impacts to existing uses	Impact Rating Assigned	1 = Low potential for co-benefits 3 = Moderate potential for co-benefits 5 = High potential for co-benefits	Impact Rating Assigned	
Storage Beneath the National Mall	•No additional notes.		3	<p>Negative:</p> <ul style="list-style-type: none"> •Possible archeological impacts •Not giving additional benefits <p>Positive:</p> <ul style="list-style-type: none"> •Largely not visible •Federal Triangle gets protected <p>Summary:</p> <ul style="list-style-type: none"> •No impact- neutral •Beneath the National Mall is efficient 	3	<p>Negative:</p> <ul style="list-style-type: none"> •Untreated sewage going into the Tidal Basin <p>Positive:</p> <ul style="list-style-type: none"> • Would have to treat for litigation (could store it and doesn't have to be kicked out) •NPS: reduction of water use •If water is treated, this would be a benefit because it would not go into Potomac River <p>Summary:</p> <ul style="list-style-type: none"> •No impact- neutral •Beneath the National Mall is efficient 	3	<ul style="list-style-type: none"> • NPS Cisterns/pump are already on the mall. Opportunities to learn from these existing cisterns re. safety, security, water re-use. •Solution is outside the floodplain – good. •Can't re-use water without treating; otherwise discharges as untreated to env. •Need to restrict access to below ground space. •Could return to treatment system •Mechanical option has a possibility of failure but storage results in lower flood consequences. 	4	<ul style="list-style-type: none"> •Any above-ground features have some impact. Could station be below ground with electrical above flood elev.? •Generally, not a large impact. Assumes Mall panels could be restored to existing conditions or better. •Short term impacts. •Would have a long term impact of restricting what could be built above ground on the panels, or below ground (memorial or museum) but probably not a restriction on above ground activities and programming. This is likely a positive viewshed preservation feature. 	3	<ul style="list-style-type: none"> •Appropriate design would have neutral impacts. •Type of above grade infrastructure associated with design could have negative impacts. •Possible irrigation for mall could be positive impact. •Ongoing maintenance processes, such as, cleaning, could have negative impacts. 	3	•No co-benefits identified.	1

Supports Agency Missions	
How does this concept align with the missions of the agencies involved in its implementation and long term operation?	
Storage Beneath the National Mall	<ul style="list-style-type: none"> •WMATA: concerns regarding increased groundwater infiltration in metro tunnels due to displacement of groundwater from underground storage. Concerned with storage facility next to Metro Rail tunnel (at 7th and 12th ave); Metro already has to pump out routinely already. •GSA: similar to DC Metro concerns that additional dewatering of subfloors might be required as a result •NPS: Adverse impacts to cultural and natural resources; not compatible with NPS values and mission •Positive: This option allows stormwater to be treated before going into the river. Negative (NGA) - could change water table for buildings close by. •Negative (NPS): Not particularly aligned with mission, but wouldn't have a huge negative impact.

Notes/Considerations
Additional notes and/or considerations.
<ul style="list-style-type: none"> •Who would pay for maintenance?

Criteria	Reduction in Flood Impacts		Deployment Reaction Time		Reliability and Resilience to Climate Change		Risk to Public Safety		Capital Cost		Operation and Maintenance Cost		Construction Impacts and Duration	
Criteria Description	To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?		Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?		Ability to perform intended function now and into the future, including expandability/ adaptability.		To what degree does the concept reduce or create risk of loss of life and injury during flood?		Magnitude of capital costs (real estate acquisition, permitting, design, and construction).		Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.		Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.	
Impact Rating	1 = Minimal reduction to flood impacts 3 = Moderate reduction to flood impacts 5 = Maximum reduction of flood impacts	Impact Rating Assigned	1 = Maximum amount of deployment actions 3 = Moderate deployment actions 5 = No deployment actions	Impact Rating Assigned	1 = Low reliability/adaptability 3 = Moderate reliability/adaptability 5 = High reliability/adaptability	Impact Rating Assigned	1 = Maximum risk to public safety 3 = Moderate risk to public safety 5 = Minimum risk to public safety	Impact Rating Assigned	1 = Significant initial construction costs 3 = Moderate initial construction costs 5 = Minimal initial construction costs	Impact Rating Assigned	1 = Significant O&M costs 3 = Moderate O&M costs 5 = Minimal O&M costs	Impact Rating Assigned	1 = Significant construction impacts 3 = Moderate construction impacts 5 = Minimal construction impacts	Impact Rating Assigned
Storage Beneath the National Mall with Parking	<ul style="list-style-type: none"> Because of human factors (timely evacuation, decision to open valve to let water in), this measure may be unavailable to store water at time of event. Could be sized to handle any large event Can extend storage facility laterally if needed; If a second storm occurs before the facility is pumped out, it will not reduce flooding for that event (reason for 3) 	2.5	<ul style="list-style-type: none"> Human factors (evacuation time, opening valve) could take significant time. Numerous pre-flood actions that would require significant time; notify bus drivers and evacuate buses (out on to busy streets); someone must manually activate switch to allow floodwaters from starting to enter facility 	1	<ul style="list-style-type: none"> Similar to above but the added human factor (evacuation and decision to open valve) greatly reduces reliability. Can expand the storage facility laterally, but would be even more challenging with the parking facility; not as reliable as pump station as it cannot handle back-to-back storms. 	1.5	<ul style="list-style-type: none"> Direct risk to public due to evacuation issues. Public health issues after draining, as likely to contain combined sewer overflow. If filled while vehicles present, petroleum components of vehicles may result in required environmental remediation of storm water. Can keep the flood waters off the roads but major public safety concern with buses and people in the storage facility and need to evacuate 	1	<ul style="list-style-type: none"> Negative - depth of excavation, and extra facilities other than storage will be expensive 	1	<ul style="list-style-type: none"> Negative - will have to sanitize and clean garage, will have many more moving parts 	1	<ul style="list-style-type: none"> Same as above, but longer duration for fit-out. Would include utility interruption as well as construction of entrances, ramps, etc. 	1.5

Criteria	Real Estate, Permitting, and Regulatory Barriers		Historic/Cultural Impacts		Environmental Impacts		Safety and Security Impacts		Viewshed Impacts		Use and Program Impacts		Potential for Co Benefits		
Criteria Description	Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.		To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic setting, recreation		Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.		Significance of impacts to safety and security in the Federal Triangle/ National Mall area.		Significance of impacts to viewsheds in the Federal Triangle/National Mall area.		Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, access etc.		Potential for benefits other than flood risk mitigation.		
Impact Rating	1 = Significant challenges 3 = Moderate challenges 5 = Minimal challenges	Impact Rating Assigned	1 = Negative historic/cultural impacts 3 = Neutral historic/cultural impacts 5 = Positive historic/cultural impacts	Impact Rating Assigned	1 = Negative impact to environment 3 = Neutral impacts to environment 5 = Positive impacts to environment	Impact Rating Assigned	1 = Negative impact to security 3 = Neutral impacts to security 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to viewshed 3 = Neutral impacts to viewshed 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to existing uses 3 = Neutral impacts to existing uses 5 = Positive impacts to existing uses	Impact Rating Assigned	1 = Low potential for co-benefits 3 = Moderate potential for co-benefits 5 = High potential for co-benefits	Impact Rating Assigned	
Storage Beneath the National Mall with Parking	No additional notes.		2	<p>Negative:</p> <ul style="list-style-type: none"> Above grade infrastructure Vehicle traffic around/toward the National Mall, which is already busy <p>Summary:</p> <ul style="list-style-type: none"> Very inefficient due to high volume traffic 	1	<p>Negative:</p> <ul style="list-style-type: none"> Inducing vehicle traffic Fumes would come out of vents onto sidewalk- bad for health Cleaning runoff impact; where does the storage go? <p>Summary: see left box</p>	1	<ul style="list-style-type: none"> Limited response/warning time for flooding; evacuation issues Potential sewage, road runoff creates human health/env. risks. Need to treat water, clean up facility. Security – allows potentially unsupervised, unsecured access to a national destination below-grade. Bombs, chemical weapon threats, etc. Screening of vehicles for access creates sig. queuing issues Exhaust venting Liability issues for any owner/operator Buoyant vehicles could float into structures/damage other vehicles. 	1	<p>Negative: Above grade infrastructure, including: entry, exit points, security, ventilation, vehicle queuing</p> <p>Very hard to locate these features away from the Mall panels.</p> <p>Very big impact on viewshed of the Mall and views to/from the Mall along streets</p>	1	<p>Negative:</p> <ul style="list-style-type: none"> Safety concerns Need for an evacuation plan Potential congestion and delay from entry and exit Screening process is negative impact. Traffic <p>Positive:</p> <ul style="list-style-type: none"> Potential to remove buses from roadways Potential revenue source i 	2	<ul style="list-style-type: none"> Increased access Additional revenue source 	3

Supports Agency Missions	
How does this concept align with the missions of the agencies involved in its implementation and long term operation?	
Storage Beneath the National Mall with Parking	<ul style="list-style-type: none"> •WMATA: concerns regarding increased groundwater infiltration in metro tunnels due to displacement of groundwater from underground storage. Concerned with storage facility next to Metro Rail tunnel (at 7th and 12th ave); Metro already has to pump out routinely already. •NPS - Adverse impacts to cultural and natural resources; not compatible with NPS values and mission •General concerns (DC Dept. of Planning, Smithsonian) that addition of parking will cause reduction in use of public transit. •Potential benefit of removing standing busses from the Mall area; however the increased in parking might result in increased volume of tour buses. •SI - proposal eliminates SI loading/delivery area access •OP, NCPC, NARA, CFA: No •GSA: Neutral; potential strain on finite financial resources. HSEMA-would require coordination of events, attendees, traffic impacts, safety, parking distribution, they should focus on moving buses to RFK parking. •SI-Creates additional complications and risks. •SHPO-Potential adverse effects, above grade entry/exit, traffic

Notes/Considerations
Additional notes and/or considerations.
<ul style="list-style-type: none"> •Concern that flood waters may rise to upper levels of facility where cars and visitors may be. •Who would make the determination as to when to open the valve to fill the underground area? The storage is only hydraulically available when the valve is open, so this becomes a less reliable option due to the reliance on human factors. •There is very large degree of liability associated with opening the valve, and therefore a high potential for delay in action. •Overall the representatives for the agencies present (Smithsonian, WMATA, DC Dept. of Planning, GSA, National Archives, DC Water) were strongly opposed to this option. •City needs to be advocating for transit, not more parking. If busses have to evacuate all at once, it would significantly impact traffic, WMATA bus routes etc. If more folks are brought to the mall, NPS would need to build more tourist infrastructure. •Where do you hide vents? •Underground storage options in this area have to take into account existing utilities, metro, tunnels, etc. •Parking garage precludes other future underground uses.

Criteria	Reduction in Flood Impacts		Deployment Reaction Time		Reliability and Resilience to Climate Change		Risk to Public Safety		Capital Cost		Operation and Maintenance Cost		Construction Impacts and Duration	
Criteria Description	To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?		Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?		Ability to perform intended function now and into the future, including expandability/ adaptability.		To what degree does the concept reduce or create risk of loss of life and injury during flood?		Magnitude of capital costs (real estate acquisition, permitting, design, and construction).		Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.		Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.	
Impact Rating	1 = Minimal reduction to flood impacts 3 = Moderate reduction to flood impacts 5 = Maximum reduction of flood impacts	Impact Rating Assigned	1 = Maximum amount of deployment actions 3 = Moderate deployment actions 5 = No deployment actions	Impact Rating Assigned	1 = Low reliability/adaptability 3 = Moderate reliability/adaptability 5 = High reliability/adaptability	Impact Rating Assigned	1 = Maximum risk to public safety 3 = Moderate risk to public safety 5 = Minimum risk to public safety	Impact Rating Assigned	1 = Significant initial construction costs 3 = Moderate initial construction costs 5 = Minimal initial construction costs	Impact Rating Assigned	1 = Significant O&M costs 3 = Moderate O&M costs 5 = Minimal O&M costs	Impact Rating Assigned	1 = Significant construction impacts 3 = Moderate construction impacts 5 = Minimal construction impacts	Impact Rating Assigned
Restoration of Natural Drainage and Stormwater Storage near Constitution Ave, on the National Mall	<ul style="list-style-type: none"> Flood storage / conveyance limited by space. Similar to other storage options, during large storm events the system will fill and no longer function. Likely not enough capacity with a surface pond to handle large flood Shallow water table/groundwater; pond can't be deep Unlikely able to convey water from Fed Triangle to canal due to little difference in grade; will need one or more pumps 	1	<ul style="list-style-type: none"> Measure itself is passive and will begin function right away. No pre-flood actions required. Actions would likely be required by public agencies (Park Service or others) once flooding starts to deploy signage/barriers to restrict public access to the newly ponded areas. 	3.5	<ul style="list-style-type: none"> Debris could be a factor which reduces reliability. Due to space constraints, limited ability for measure to handle large floods and limited ability to expand further; could add more pumps in future. Could be tied to other systems to increase reliability/adaptability 	2	<ul style="list-style-type: none"> Puts flood waters on the Mall and adjacent to museums; people would need to evacuate those areas. Ponded areas could include combined sewer overflow resulting in sewage (albeit diluted) on the Mall. 	1.5	<ul style="list-style-type: none"> Costly to relocate utilities (Pepco, sewer, roads). Still requires a pumping component. Construction on bioswale and retention is relatively cheap 	1	<ul style="list-style-type: none"> Landscape maintenance to ensure the infrastructure works well is one thing, but will also need aesthetic maintenance Will require clean up after flood (sewage, debris) and resodding. 	1	<ul style="list-style-type: none"> No additional notes. 	3

Criteria	Real Estate, Permitting, and Regulatory Barriers		Historic/Cultural Impacts		Environmental Impacts		Safety and Security Impacts		Viewshed Impacts		Use and Program Impacts		Potential for Co Benefits	
Criteria Description	Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.		To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic setting, recreation		Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.		Significance of impacts to safety and security in the Federal Triangle/ National Mall area.		Significance of impacts to viewsheds in the Federal Triangle/National Mall area.		Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, access etc.		Potential for benefits other than flood risk mitigation.	
Impact Rating	1 = Significant challenges 3 = Moderate challenges 5 = Minimal challenges	Impact Rating Assigned	1 = Negative historic/cultural impacts 3 = Neutral historic/cultural impacts 5 = Positive historic/cultural impacts	Impact Rating Assigned	1 = Negative impact to environment 3 = Neutral impacts to environment 5 = Positive impacts to environment	Impact Rating Assigned	1 = Negative impact to security 3 = Neutral impacts to security 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to viewshed 3 = Neutral impacts to viewshed 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to existing uses 3 = Neutral impacts to existing uses 5 = Positive impacts to existing uses	Impact Rating Assigned	1 = Low potential for co-benefits 3 = Moderate potential for co-benefits 5 = High potential for co-benefits	Impact Rating Assigned
Restoration of Natural Drainage and Stormwater Storage near Constitution Ave, on the National Mall	<ul style="list-style-type: none"> Environmental permitting (life safety) 	1	<p>Negative:</p> <ul style="list-style-type: none"> Retention area (depth and unusable otherwise) Building infrastructure Minor impact on pumping station It would surface the CSO drainage <p>Positive:</p> <ul style="list-style-type: none"> Optional Underground storage, daylighting stream <p>Summary: From a cultural/historical standpoint, this is a major negative impact. To be positive, would need to ped. friendly and aesthetically pleasing.</p>	1.5	<p>Negative:</p> <ul style="list-style-type: none"> Some runoff would be untreated during large events It would surface the CSO drainage <p>Positive:</p> <ul style="list-style-type: none"> Potential for increased habitat. Natural water quality improvements Prevents all the runoff from entering Potomac River. Question is: how fast would it filter and move out? <p>Summary: see left box</p>	4	<ul style="list-style-type: none"> Daylighting the groundwater may not have stormwater env./health risks (unclear if this is dry swale of permanent stream) Along Constitution, this concept could restrict/limit entry to buildings On Constitution and the Mall, flood and standing water creates human health exposures to sewage and street runoff Possible cleaning O&M to reduce exposure to contamination or runoff Possibility for injury or drowning. This might be addressed through design. 	3	<p>Negative:</p> <ul style="list-style-type: none"> Depending on reception, could be negative impact to White House Could, however, it would be a barrier/trench Major changes to panel area on Mall (could be addressed partially through design) This option has the most above ground viewshed changes Could impact tree viability <p>Positive:</p> <ul style="list-style-type: none"> If along Constitution ave. could be positive if consistent Much more positive if retention area is underground. 	2	<p>Negative:</p> <ul style="list-style-type: none"> Potential smell Required cleanup post-flood Standing water post flood It is not technically restoring, since that would actually transform Constitution Avenue to a creek. Requires constant water for aesthetics Changes the Mall design Loss of space <p>Positive:</p> <ul style="list-style-type: none"> Design mitigates small storms Could be a partial solution 	3	<ul style="list-style-type: none"> A good design could include additional program and uses that produce co-benefits. 	1

Supports Agency Missions	
How does this concept align with the missions of the agencies involved in its implementation and long term operation?	
<p>Restoration of Natural Drainage and Stormwater Storage near Constitution Ave, on the National Mall</p>	<ul style="list-style-type: none"> •Smithsonian: Opposition expressed as this measures would result in ponds filled with water on the Mall which would likely contain combined sewer overflow, serving as a potential public health risk. In conflict with long-term plans for Smithsonian. Disruptive o use, access and facility design. SI already uses bioswales. O&M onus on SI and NPS. Berming could create protection (not permanent storage) •GSA: Concern that limestone building facades if inundated with water would result in bacterial growth in limestone pour space - results in discoloring requires O&M. Also concerned regarding adverse impacts to groundwater requiring more basement pumping. •DC Dept. of Planning: Cobenefits of open park space and ecosystem restoration. •NPS - Adverse impacts to cultural and natural resources; not compatible with NPS values and mission; Smithsonian - Adverse cultural and historical impacts and does not align with their mission and operations (impacts to utilities, gardens, etc.) •DOEE - supports LID/GI type projects in DC, but understands there are too many challenges with this concept •OP: Neutral; •CFA: Possible positive. Depends on the design (below grade tank with expansion of canal at surface water feature); •NARA: Neutral; •NCPC: No- funding would be too high •HSEMA-Educational opportunity with DOEE, PSA, tourism •SHPO-negatives outweigh positives, especially on Washington Monument grounds, there is a benefit to acknowledging Tiber Creek and the canal.

Notes/Considerations
Additional notes and/or considerations.
<ul style="list-style-type: none"> •Concern that flood waters may rise to upper levels of facility where cars and visitors may be. •Who would make the determination as to when to open the valve to fill the underground area? The storage is only hydraulically available when the valve is open, so this becomes a less reliable option due to the reliance on human factors. •There is very large degree of liability associated with opening the valve, and therefore a high potential for delay in action. •Overall the representatives for the agencies present (Smithsonian, WMATA, DC Dept. of Planning, GSA, National Archives, DC Water) were strongly opposed to this option. •City needs to be advocating for transit, not more parking. If busses have to evacuate all at once, it would significantly impact traffic, WMATA bus routes etc. If more folks are brought to the mall, NPS would need to build more tourist infrastructure. Where do you hide vents? •Underground storage options in this area have to take into account existing utilities, metro, tunnels, etc. •Parking garage precludes other future underground uses.

Criteria	Reduction in Flood Impacts		Deployment Reaction Time		Reliability and Resilience to Climate Change		Risk to Public Safety		Capital Cost		Operation and Maintenance Cost		Construction Impacts and Duration	
Criteria Description	To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?		Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?		Ability to perform intended function now and into the future, including expandability/ adaptability.		To what degree does the concept reduce or create risk of loss of life and injury during flood?		Magnitude of capital costs (real estate acquisition, permitting, design, and construction).		Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.		Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.	
Impact Rating	1 = Minimal reduction to flood impacts 3 = Moderate reduction to flood impacts 5 = Maximum reduction of flood impacts	Impact Rating Assigned	1 = Maximum amount of deployment actions 3 = Moderate deployment actions 5 = No deployment actions	Impact Rating Assigned	1 = Low reliability/adaptability 3 = Moderate reliability/adaptability 5 = High reliability/adaptability	Impact Rating Assigned	1 = Maximum risk to public safety 3 = Moderate risk to public safety 5 = Minimum risk to public safety	Impact Rating Assigned	1 = Significant initial construction costs 3 = Moderate initial construction costs 5 = Minimal initial construction costs	Impact Rating Assigned	1 = Significant O&M costs 3 = Moderate O&M costs 5 = Minimal O&M costs	Impact Rating Assigned	1 = Significant construction impacts 3 = Moderate construction impacts 5 = Minimal construction impacts	Impact Rating Assigned
New Pumping Station Serving Federal Triangle and the National Mall	<ul style="list-style-type: none"> Can build pump station large enough to handle any storm event Additional pumps can be added in future; can handle back-to-back flood events 	5	<ul style="list-style-type: none"> No pre-flood actions required. 	5	<ul style="list-style-type: none"> Pumping stations can be made highly reliable with redundant systems (back up pumps and power sources). Can readily be designed to allow for expansion (staged pumps or leave room to add additional pumps later on and/or leave room to expand pipe/tunnel system) 	5	<ul style="list-style-type: none"> Minimum risk to public safety; maximum benefits by rapidly removing water from the area. Can keep the flood waters off the roads. 	5	<ul style="list-style-type: none"> Will require additional sewer. This will be a much smaller footprint than any other option and least costly. 	5	<ul style="list-style-type: none"> Unmanned, Negative, will need to maintain pumps and facility (more expensive than storage option). 	3	<ul style="list-style-type: none"> No additional notes 	5

Criteria	Real Estate, Permitting, and Regulatory Barriers		Historic/Cultural Impacts		Environmental Impacts		Safety and Security Impacts		Viewshed Impacts		Use and Program Impacts		Potential for Co Benefits	
Criteria Description	Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.		To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic setting, recreation		Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.		Significance of impacts to safety and security in the Federal Triangle/ National Mall area.		Significance of impacts to viewsheds in the Federal Triangle/National Mall area.		Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, access etc.		Potential for benefits other than flood risk mitigation.	
Impact Rating	1 = Significant challenges 3 = Moderate challenges 5 = Minimal challenges	Impact Rating Assigned	1 = Negative historic/cultural impacts 3 = Neutral historic/cultural impacts 5 = Positive historic/cultural impacts	Impact Rating Assigned	1 = Negative impact to environment 3 = Neutral impacts to environment 5 = Positive impacts to environment	Impact Rating Assigned	1 = Negative impact to security 3 = Neutral impacts to security 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to viewshed 3 = Neutral impacts to viewshed 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to existing uses 3 = Neutral impacts to existing uses 5 = Positive impacts to existing uses	Impact Rating Assigned	1 = Low potential for co-benefits 3 = Moderate potential for co-benefits 5 = High potential for co-benefits	Impact Rating Assigned
New Pumping Station Serving Federal Triangle and the National Mall	<ul style="list-style-type: none"> Potential impact to cherry trees 	4	<p>Negative:</p> <ul style="list-style-type: none"> Possible impacts to setting depending on siting <p>Positive:</p> <ul style="list-style-type: none"> Below grade pumping station could avoid impacts (although may be archaeological impacts) Least impact if not by the National Mall and/or below grade <p>Summary:</p> <ul style="list-style-type: none"> Assuming overall positive, if away from the National Mall Find an underground facility that can filter out with litigation 	3	<p>Negative:</p> <ul style="list-style-type: none"> There would not be time to get the untreated sewage water out by the time it gets to the Potomac River from the Tidal Basin <p>Possible Positive:</p> <ul style="list-style-type: none"> There is a treatment facility to treat rainwater/sewage <p>Summary: see left box</p>	1	<ul style="list-style-type: none"> No sig. health, safety, or security issues. Would need to be secured / monitored to restrict access Requires system to effectively collect water along feeder streets and Constitution to prevent flooding happening before pump station kicks in fully. Moves water away from this area faster. Pumped water is not treated and released to the Potomac and/or Tidal Basin, so env. concerns downstream. Mechanical option has a possibility of system failure, with bigger flood consequences. 	5	<ul style="list-style-type: none"> No impact if underground and away from the National Mall. Location and design is critical. All locations on the Mall are scrutinized, and the size, and above ground components could be large. What are the opportunities to locate all/part of pump station underground? Out of the floodplain? What about sites where there are other projects existing/planned (horse stables, toilets, kiosks etc.) so that the pump station could be co-located. 	2.75	<ul style="list-style-type: none"> Below grade design is a neutral impact. Using existing technology is positive, reduces construction. Failure of mechanical systems is potential negative. Location has potential negative impacts. Potential negative impacts on use and preservation. 	4	<ul style="list-style-type: none"> No co-benefits identified. 	1

Supports Agency Missions	
How does this concept align with the missions of the agencies involved in its implementation and long term operation?	
<p>New Pumping Station Serving Federal Triangle and the National Mall</p>	<ul style="list-style-type: none"> •General support from all agencies; viewed as adding significant flood risk reduction which adds protection to existing flood proofing (where present). •WMATA: Does not foresee negative impacts; high benefits expected. In support. •GSA: Will wait on NCPD decision, but in general supportive of this measure. •NPS: Could support. •Positives - can build totally underground, in a small footprint, reducing visual and historic impact. •Negatives, depending on location (near monument) could still have impact. Will require some disruption around the facility during maintenance. •All: Neutral •GSA-aligns with mission. SI-aligns with mission. HSEMA-possible funding source. SHPO-Potential for minor impacts, benefits for this alternative outweigh negatives, quickest option.

Notes/Considerations
Additional notes and/or considerations.
<ul style="list-style-type: none"> •Question: Could the metro drainage system tie into this new system? •Comments: Pump(s) could be well hidden below ground and made secure. •Known, reliable technology; easy to sell to managers, public. •Pump station option could be collocated with other needed uses, such as restrooms.

Criteria	Reduction in Flood Impacts		Deployment Reaction Time		Reliability and Resilience to Climate Change		Risk to Public Safety		Capital Cost		Operation and Maintenance Cost		Construction Impacts and Duration	
Criteria Description	To what degree can the concept reduce flood impacts during a significant flood (50 year or higher)?		Must equipment be deployed/actions taken in advance? How long will it take to deploy flood risk measures/take actions prior to flooding?		Ability to perform intended function now and into the future, including expandability/ adaptability.		To what degree does the concept reduce or create risk of loss of life and injury during flood?		Magnitude of capital costs (real estate acquisition, permitting, design, and construction).		Magnitude of operations and maintenance (O&M) costs associated with concept, including considerations for manpower and frequency of O&M efforts.		Significance of impacts to area, accessibility (including facility closure), utilities during construction, including construction duration.	
Impact Rating	1 = Minimal reduction to flood impacts 3 = Moderate reduction to flood impacts 5 = Maximum reduction of flood impacts	Impact Rating Assigned	1 = Maximum amount of deployment actions 3 = Moderate deployment actions 5 = No deployment actions	Impact Rating Assigned	1 = Low reliability/adaptability 3 = Moderate reliability/adaptability 5 = High reliability/adaptability	Impact Rating Assigned	1 = Maximum risk to public safety 3 = Moderate risk to public safety 5 = Minimum risk to public safety	Impact Rating Assigned	1 = Significant initial construction costs 3 = Moderate initial construction costs 5 = Minimal initial construction costs	Impact Rating Assigned	1 = Significant O&M costs 3 = Moderate O&M costs 5 = Minimal O&M costs	Impact Rating Assigned	1 = Significant construction impacts 3 = Moderate construction impacts 5 = Minimal construction impacts	Impact Rating Assigned
Storage at Northern Pond of Tidal Basin	<ul style="list-style-type: none"> Similar to other storage options, will fill quickly during multi-day storm events. Located within floodplain, so if pumps are required they could be impacted during flood events. Could be sized to handle any large event; Would have to extend storage facility deeper if needed (not enough lateral space); if a second storm occurs before the facility is pumped out, it will not reduce flooding for that event (reason for 3) 	4	No pre-flood actions required.	5	<ul style="list-style-type: none"> Functionality lost during large storm events after storage capacity reached. Limited capacity as proposed, would be limited opportunity to expand for future. Located in flood plain and would require small pump(s) to drain, which could be impacted by flood event. Can expand the storage facility, but would be more challenging than storage on Mall due to space constraints; might have to go deeper; not as reliable as pump station as it cannot handle back-to-back storms 	1.5	<ul style="list-style-type: none"> Similar to storage tank beneath the mall; closed storage has minimum risk to public safety and can keep flood waters off the roads. 	5	<ul style="list-style-type: none"> Less costly excavation compared to national mall options. Would have to run a pipe further, cost to floodproof in floodplain, gravity pipe to basin might be 10% more than a smaller pipe needed for Option 1. 	3	<ul style="list-style-type: none"> Will require routine cleaning, and still requires pump maintenance. 	5	No additional notes	4

Criteria	Real Estate, Permitting, and Regulatory Barriers		Historic/Cultural Impacts		Environmental Impacts		Safety and Security Impacts		Viewshed Impacts		Use and Program Impacts		Potential for Co Benefits	
Criteria Description	Significance of time and challenges associated with obtaining necessary reviews, permits, easements, and other regulatory approvals.		To what extent does the concept impact: historic preservation, integrity of cultural/historic aspects of buildings, land, historic setting, recreation		Significance of impacts to one or more of the following: habitat (riverine and riparian), aquatic species, water quality, groundwater impacts, etc.		Significance of impacts to safety and security in the Federal Triangle/ National Mall area.		Significance of impacts to viewsheds in the Federal Triangle/National Mall area.		Significance of impacts to existing and planned uses, operations and programming, including ability to hold events, accommodate visitors, access etc.		Potential for benefits other than flood risk mitigation.	
Impact Rating	1 = Significant challenges 3 = Moderate challenges 5 = Minimal challenges	Impact Rating Assigned	1 = Negative historic/cultural impacts 3 = Neutral historic/cultural impacts 5 = Positive historic/cultural impacts	Impact Rating Assigned	1 = Negative impact to environment 3 = Neutral impacts to environment 5 = Positive impacts to environment	Impact Rating Assigned	1 = Negative impact to security 3 = Neutral impacts to security 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to viewshed 3 = Neutral impacts to viewshed 5 = Positive impacts to security	Impact Rating Assigned	1 = Negative impact to existing uses 3 = Neutral impacts to existing uses 5 = Positive impacts to existing uses	Impact Rating Assigned	1 = Low potential for co-benefits 3 = Moderate potential for co-benefits 5 = High potential for co-benefits	Impact Rating Assigned
Storage at Northern Pond of Tidal Basin	<ul style="list-style-type: none"> Environmental permitting Change in landscape character Potential impacts to cherry trees Proximity to Washington Monument 	1	<p>Negative:</p> <ul style="list-style-type: none"> Eliminating part of the Tidal Basin, which has to be emptied <p>Summary:</p> <ul style="list-style-type: none"> There needs to be a major change with the Tidal Basin, especially if storage water isn't filtered since this would go into the Potomac River; does not want to eliminate the Tidal Basin. 	1	<p>Negative:</p> <ul style="list-style-type: none"> Minor negative impact for aquatic life. Would there be vegetation? <p>Possible Positive:</p> <ul style="list-style-type: none"> If this is planted on top of a park, possible rating of a 4 if it benefits habitat <p>Summary: see left box</p>	2	<ul style="list-style-type: none"> If it is a pump station only option, similar issues to pump station option, above. If it is a storage facility, same issues as Mall storage. Concern that these facilities are located in an area subject to river flooding, so effectiveness or compromised system seems like a stronger possibility. 	4	<ul style="list-style-type: none"> As a pump station, similar impacts to concept 4. This location is not as directly on the axis of the Mall and our understanding is that it may not be part of the historic Tidal Basin, so it may have fewer viewshed impacts. 	1.75	<ul style="list-style-type: none"> Below grade design is a neutral impact. Using existing technology is positive, reduces construction. Failure of mechanical systems is potential negative. Location has potential negative impacts. Potential negative impacts on use and preservation. 	4	<ul style="list-style-type: none"> If the NPS plan is to close it than this is a synergy. Creation of potential monument space. Educational opportunity. 	3

Supports Agency Missions	
How does this concept align with the missions of the agencies involved in its implementation and long term operation?	
<p>Storage at Northern Pond of Tidal Basin</p>	<ul style="list-style-type: none"> •WMATA - likely far enough away from tunnels such that there are no hydrologic impacts. •DC Water - neutral on this measure •NPS - could support; •DOEE concerned this will not align with their missions - may cause loss of habitat, increased stormwater runoff and sedimentation •Positive- could create new land / park space as an amenity. For NPS very similar to underground storage option 1, but potentially in a less trafficked area. •NCPC, CFA: No •GSA, OP, NARA: Neutral •SHPO-minimum impacts on cultural resources, would result in change to Kutz bridge and design of Tidal Basin.

Notes/Considerations
Additional notes and/or considerations.
<ul style="list-style-type: none"> •Pump station option could be collocated with other needed uses, such as restrooms. This might create new space for other uses – green space, memorials, better pedestrian circulation. There is an initiative to look at the Tidal Basin and its future reuse, so perhaps this can be rolled in to that effort. •Definitely changes the viewshed, but impacts depend on the design. As a storage facility with pump station, it will definitely change the character of the bridge and surrounding area – it would no longer be water, so that changes the context. Plus, it might incorporate other features (co-located facilities, green space, memorial, different circulation.

Attachment 6

This page left blank intentionally

Federal Triangle Area Flood Charrette Breakout Session #2 Feedback Form

All Table Results Combined

What are the top 1 or 2 concepts that would provide effective flood risk management and would likely be supported by agencies and the public? And why?

#1 Top Choice – Pumping Station serving National Mall (preferably at 14th Street)

#2 Choice – Storage beneath the National Mall

Both of the above would be effective and have very limited impacts to viewscape once constructed. Likely both options would be supported by multiple agencies on the Mall (including National Park Service).

What are the main advantages of the top 1-2 concepts?

#1 Pumping Station:

- Could be mostly or entirely hidden from view (small footprint after construction). Construction, permitting, viewshed impacts less than other concepts
- Effective with no delay between storms; not stuck with finite storage
- Readily expandable; adaptive to climate change as space can be left to add additional pumps / replace with upsized pumps after their useful life. Cost for a pump that can take care of 500-year flood is only marginally more expensive than a smaller pump that only does 100 year. So can easily upsize for climate change, or account for water that was stored in buildings during 2006 flood.
- Some flexibility for siting
- Up to moderate sized storms could potentially have water routed to sewer system for treatment
- Minimal risk to public safety
- Development upstream could tap into new feeder storm drain system

#2 Storage beneath the National Mall:

- Would provide benefits up to design storm
- Could filter out large debris
- Could slowly pump out to Blue Plains and avoid CSO into Potomac River
- No pre-flood actions
- Less impact on outgoing infrastructure
- No conveyance requirement
- Some level of expandability

What are the main challenges or data gaps that must be addressed with the top 1-2 concepts?

#1 Pumping Station:

- Significant construction and O&M costs
- Determining how to size it – how many and what capacity pumps
- Need to extend feeder system up north above Penn Ave; according to NARA, you cannot wait for floodwaters to reach Fed Triangle before handling/pumping the water; larger stormwater system are needed to collect water so it doesn't flow down roads to the buildings before being pumped
- CSO waters will flow directly into Potomac River – any other option for discharge?
- Would this system connect into the new CSO system or existing sewer system in general?
- Selecting site location and designing (partially above ground / how large of a structure)
- How to handle debris before getting to pump station; need catch basin; there is significant debris with these storms and do not want the pump station to get clogged and not function

- Viewshed implications (assuming partially above ground) / impacts to historic structures / archaeological impacts during construction
- Need to talk to Pepco well in advance to figure out how to route two different power lines for redundancy.
- Security of station and coordination with US park police
- Access and disruption during maintenance
- Located in the floodplain

#2 Storage beneath National Mall

- O&M from sediment clearing; CSO impacts
- Potential buoyancy issue with design due to high groundwater
- Timing of construction would be challenging; would need to occur in-between inaugurations
- Major construction impacts on Mall
- Existing tunnels cross the Mall, so construction challenges would exist
- Once the storage capacity is reached, this measure is no longer effective which is an issue for large or back-to-back storm events
- Displacement of groundwater could impact Metro tunnels; Metro already pumps out routinely
- Other conflicts with Metro tracks: space constraints

What are the most significant criterion that should be considered when selecting a Federal Triangle flood risk management project for implementation? (Select 3-5)

In priority order:

1. Reduction in flooding
2. O & M / Construction Costs
3. Reliability and resilience
4. Viewshed impacts
5. Historic/Cultural impacts

Are there other criterion or factors that should be considered?

#1 Pumping Station:

- If located off the Mall, this is much easier from a Planning perspective (South or SE of the Monument). Could be integrated into landscape in the area south of the Monument
- Should be located outside of floodplain
- Could be designed to connect to the new CSO tunnel system
- For the pump, expandability is a huge advantage with relatively small impact The station should be outside of the 500 year flood plain, and/or located where it minimizes impacts to views, and/or designed to minimize above-ground volume and bulk. Possible for station (except electrical components, that have to be above the floodplain elevation) to be largely underground with a smaller above-ground box and in a less intrusive location.

#2 Storage beneath National Mall

- Any Mall construction could be used as an education opportunity
- It could provide water to meet the needs of the Mall - there are already cisterns there that could provide lessons learned
- For the mall storage, there is some level of expandability (but not that much)

General Comments

- A multi-layered approach should be considered. In particular, opportunities to incorporate upstream green infrastructure and storage should be encouraged and included as part of the proposed solution. These could be useful in reducing stormwater and could be beneficial in either reducing the volume needed for any systemic solution and/or providing additional protection against larger storms.
- A lead agency should be identified to champion this (GSA, Smithsonian, NARA?)

- Separation of storm/sewer possible, but estimated to be 4-5x the cost
- Who pays for it? What's the mechanism for funding?
- What are the conflicts with underground utilities, uses, groundwater?
- Actual costs need to be computed
- The \$\$/risk of doing nothing needs to be calculated
- Need to get better cost estimates for concepts
- Need to determine potential damages/benefits for a project
- Anything that takes water off the streets will be beneficial
- NARA – Above ground water storage is a non-starter (clean up, non-hygienic)
- NARA (John Bartell) – issue of needing feeder systems to handle flows before floodwaters can reach the Federal Triangle
- If new infrastructure is developed within existing corridors, this could result in greater ease of getting permission.
- There is potential to combine these solutions at the Tidal Basin site.
- It might be possible to repurpose existing and underused infrastructure by constructing two pumps at appropriate locations.