The Committee of 100 on the Federal City

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Committee of 100 on the Federal City
Parks and Environment Subcommittee

Report #1: Recommended Amendments to the DC Comprehensive Plan

A. Planning for climate change, responding to rising water levels, increased flooding and higher stormwater loads

Introduction

DC Office of Planning (OP) and DC Department of Energy and Environment (DOEE) recommend that climate resilience be incorporated in the DC Comprehensive Plan. We commend them for this important forward-looking step. Climate change will cause rising water levels and increased flooding. To add to these challenges, there will be more people living in the city. DC's 2015 population was 672,228, and OP projects population will increase to 987,245 in 2045.[1]

Recommendations

To plan for climate change, we recommend that the Comprehensive Plan be amended to add the following provisions:

Policy

- Adopt the 2080 flood levels (the current 500-year floodplain) as the basis for climate change planning. Figure 1.

- Incorporate the 2080 500-year floodplain on the Generalized Policy Map and the Future Land Use Map.

- Adopt a goal to build, expand, or invest in DC government facilities (including government agencies, schools, libraries, recreation facilities, police and fire stations, public housing, senior centers, and homeless shelters) outside the 500-year flood plain whenever possible, and alternatively, develop adaptation or retirement plans for vulnerable facilities. See Figure 2, community resources most at risk for flooding.

[1]OP, Citywide Community Workshop #6, 3 Nov. 2016. DOEE, "Climate Ready DC: The District of Columbia's Plan to Adapt to a Changing Climate, draft for public comment" 10, 16 (2013). Rising temperatures caused by climate change and effects on other infrastructure such as Metro, communications, Metrorail, and utilities are beyond the scope of this report.

- Adopt zoning and building code changes to require private sector schools, childcare facilities, medical facilities, senior housing, and human resource services to be located outside the 500-year flood plain whenever possible, or, alternatively, require retrofitting of vulnerable buildings to withstand flooding, based on best practices.

- Study and adopt best zoning and building practices in other cities for new buildings, retrofitting existing buildings, and design standards for infrastructure in floodplains.

- Bioretention bulbouts can help reduce stormwater runoff, provide areas for new trees and native plants, and help restore environments that support birds and native fauna.[2] Explore bioretention bulbouts at intersections or along roadways where data indicates a strong positive stormwater retention effect, and work with communities, including ANCs, to evaluate whether these devices would be compatible with existing neighborhood patterns and an enhancement to the neighborhood.

- Build or expand roads outside the 500-year flood plain whenever possible, and avoid building new roads or expanding roads within the flood plain. Design new streets in the floodplain to accommodate low-level flooding.

- Reduce stormwater runoff, a threat to the rivers' ecosystem, and potential threat to the city's drinking water, by increasing the goal for tree coverage from the current 40 percent, increasing wetlands, and reducing areas with imperious surfaces.

- Study whether waste water treatment and stormwater management systems will need to be upgraded to handle the increased demands on sewers and water treatment resulting from: (1) a growing population and (2) from more numerous extreme rain events. Perform through study of the capacity of stormwater, sewer and combined wastewater system to handle extreme rain events and recommend needed upgrades. Include contributing drainage areas, outfalls, and the capacity of stormwater pipe capacity, and take appropriate action to upgrade these systems.

- Extend the stormwater retention requirements from the current level (projects over 5,000 square feet) to include smaller projects.[3]

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[2]See definitions of collector roads and local roads in DDOT, "District of Columbia Streetlight Policy and Design Guidelines," 10 (2013).

[3]Kat Friedrich, "D.C. stormwater credit could be a role model for other cities," *Green Biz*, www.greenbiz.com; Internet: accessed 31 Aug. 2016. Climate Ready DC," 2-3.

Incentives and resources

- Provide incentives to private property owners to provide nature-based flood-control measures such as increased pervious surfaces, restoring natural flood plains, and creating wetlands. Encourage or require these nature-based measures in planned unit developments and city-funded projects.

- Request the US Army Corps of Engineers to perform a technical engineering review of the Mall Underground Project.

- Provide incentives to private property owners to plant trees in the Public Parking and on private property in designated "tree desert" areas, increasing the goal for tree coverage from the current 40 percent. NOTE: There are areas of the District where no street trees exist, and where there is no room for street trees. These areas should be identified and designated as "tree desert" areas, with policies created to incentivize residents within these areas to plant trees in alternative spaces such as private property or the Public Parking.[4]

- Provide incentives to protect privately owned forest land, such as present-use value tax status, forest mitigation bank programs, or transfer of development rights.

- Explore public/private ventures to spur the clean up and preservation of land that is currently developed in the flood zone [development of a system where homeowners who want to add impervious space to their existing homes (throughout the city) and property owners that want to build in the flood zone would have to purchase credits to do so (the public side)]. On the private side, businesses would create the credits that they could then sell by purchasing property in the flood zone, cleaning it up of any contaminants and putting conservation easements on the land.

- Create a dedicated fund to pay for future needed changes in infrastructure to respond to climate change, such as rebuilding bridges, roads, the Anacostia Riverwalk, and bike paths above the higher future water levels. A fee on new development or redevelopment in 500-year flood plain area could be paid into this fund.

- Study a buyout program for properties in the most flood-prone areas.

- Study the impact upon historic resources located within the 500-year flood plain and consider, evaluate and implement mitigation strategies that afford the preservation of appropriate and significant historic and character-defining buildings, structures, landscapes, archeological sites and features.

[4]Public parking is defined in DDOT's "Public Realm Design Manual," 4-4.

Background

We urge that amendments to the Comprehensive Plan build on the recommendations from recent planning efforts. In 2010, CapitalSpace, a planning initiative of DC government, National Capital Planning Commission (NCPC) and National Park Service (NPS), adopted the goal to:

> Protect, Connect, and Restore Natural Resources
> Natural resources within the city's parks and open spaces, including wetlands, floodplains, wooded areas, and streams and rivers, offer natural habitats and beneficial ecological functions that support a sustainable and livable city.[5]

The "Sustainability DC Plan," (2013) adopted a goal to advance physical adaptation and human preparedness to increase the District's resilience to future climate change:

> **Target:** By 2032, require all new building and major infrastructure projects to undergo climate change impact analysis as part of the regulatory planning process. ...
>
> **Action 2.3:** Require adaptation solutions as part of planning consent for new developments. (Medium Term)
> The buildings we construct and sites we develop today will still be with us in 50 years. By then, the prevailing climate conditions may be very different. The District must ensure that new developments begin to integrate climate adaptation solutions to protect future residents and businesses from severe events and provide adaptive comfort for the long term. The City will adjust planning procedures and project review to require an evaluation of conditions related to climate change and implementation of adaptation solutions. Through this action, the District will ensure that cost-effective adaptation strategies are rolled out progressively throughout the city.[6]

DDOT released its "Climate Change Adaptation Plan" (2013) describing expected sea level rise, and offering planning recommendations. The challenges of climate change underscore the importance of meeting these goals. DOEE's 2016 report, "Vulnerability & Risk Assessment: Climate Change Adaptation Plan for the District of Columbia" considers the projected effects of climate change in 2020, 2050, and 2080, such as higher water levels and more frequent extreme rain events, and suggests solutions.

[5]DC government, National Capital Planning Commission, National Park Service, "CapitalSpace: A park system for the Nation's Capital, " 3, 51, 58 (2010).
[6]DC government, "Sustainability DC Plan," 42.

Rising water levels in the Potomac and Anacostia rivers: the 500-year flood plain standard

The 2080 flood levels (500-year floodplain) should be the basis for climate change planning.

- Scientists predict temperature warming by two degrees Centigrade (C) by 2040, causing a global sea rise of 20 cm (7.8 inches), with even higher rises in more than 90 percent of coastal areas.[7] If warming exceeds two degrees C, by 2100 the sea level rise is estimated to exceed 1.8 meters (5.94 feet) for 80 percent of coastal areas.

- Other predictions are similar: By 2100, estimates of sea level rise range from three feet (Intergovernmental Panel on Climate Change), to five feet (US Army Corps of Engineers (USACE)), to 6.5 feet (National Oceanic and Atmospheric Administration (NOAA)).[8] Figure 3.

The Potomac and Anacostia rivers are tidal, and therefore sea level rise will raise the water level in the rivers, exposing DC to the same risks of increased storm surge flooding as New York and Miami.

- In the last 90 years, the water level in the rivers has already increased 11 inches, and nuisance flooding has already increased 300%.[9] Nuisance flooding is flooding experienced at high tide (as established by the National Weather Service).

- NOAA has been monitoring sea levels and flooding in DC since 1924, and the mean sea level has been increasing at the rate of 3.21 mm (0.126 inches) per year. Nuisance flood level is 0.31 meters (1.22 feet) above mean high higher water.[10] Flooding is already increasing. Figures 4 - 5.

- By 2080, the water level in the rivers is expected to rise an additional 3.4 feet.

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[7]Svetlana Jevrejeva et al., "Coastal sea level rise with warming above 2◦ C," *Proceedings of the National Academy of Sciences*, www.pnas.org/cgi/doi/10.1073/pnas.1605312113. National Aeronautics and Space Administration, "Adapting to a Changing Climate: Federal Agencies in the Washington, DC Metro Area," (2012) www.mwcog.org. Internet; accessed 13 Nov. 2016. Authorities cited in DOEE, "Wildlife Action Plan," 114-117 (2015).

[8]Cited in Elizabeth Kolbert, "The Siege of Miami," *The New Yorker*, Dec. 21 and 28 (2015), 42-50, 42.

[9]NOAA, William Sweet, et al., "Sea Level Rise and Nuisance Flood Frequency Changes Around the United States." NOAA Technical Report NOS CO-OPS 073, vi (2014).

[10]NOAA, "Sea Level Rise and Nuisance Flood Frequency Changes Around the United States.".

- Sea levels (and river water levels) may rise higher and faster, if the rates of ice loss accelerate, as reflected in USACE's estimate of a five-foot sea level rise, and NOAA's estimate of a 6.5 foot rise.[11]

For these reasons, we believe that the 500-year flood plain (2080) based on a four feet above the 100-year flood level, is a conservative estimate, not the worst-case scenario, and that the 500-year flood plain should be adopted for planning. Figure 1.

Wetlands and marshes are priority habitats, offering submerged aquatic plants necessary for many species. Sea level rise can inundate marshes, transitioning them to shallow open water, and also raise water salinity, damaging habitats for plants and wildlife. Some fish, wildlife and plant species need marshes to thrive and do not tolerate higher salinity levels. DOEE applied the Sea Level Affecting Marshes Model to predict changes in tidal and non-tidal wetlands and Rock Creek, predicting a 2.3 ft. rise in tidal marshes at the National Arboretum, Kenilworth Park, Anacostia Park, and lower Rock Creek by 2100.[12]

More frequent extreme rain events

As a result of climate change, a 100-year rain event is projected to occur once in 25 years by 2050 and once in 15 years by 2080. (A 15-year rain event is 5.2 inches of rain during a 24-hour storm.[13] An extreme rain event, eight inches of rain, is a "100 year rain event.")

Annual precipitation is expected to remain approximately the same, but concentrated in fewer events, and coastal storms will be more intense.[14] Figure 5, showing the storm surge flooding today from a category 1, 2, or 3 storm, illustrates that even at the current sea level/river level, multiple areas in the city are already vulnerable to flooding. Figure 6.

In the future, fewer, more intense precipitation events, combined with more intense coastal storms, when added to the predicted rise in the rivers' water levels is expected to further increase the risk of flooding in more areas. (For precipitation, the 2080 higher scenario is 14 inches for the 100-year, 24-hour storm, and the lower scenario is five inches for a 15-year, six-hour storm.)[15]

Heavy rains cause flooding and pollution from storm water runoff. Stormwater and sewer systems, designed for historic rainfall events, will be strained by more

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[11]DOEE, "Climate Ready DC," 2-3. DOEE, "Vulnerability & Risk Assessment," 19. See Elizabeth Kolbert, "A Letter from Greenland: A Song of Ice: What happens when a country starts to melt?" *The New Yorker*, 24 Oct. 2016, 50-61.
[12]DOEE, "Wildlife Action Plan," 122, 125.
[13]DOEE, "Vulnerability & Risk Assessment," 38.
[14]NASA, "Adapting to a Changing Climate: Federal Agencies in the Washington, DC Metro Area." Virginia Institute of Marine Science (2013) cited in DOEE, Wildlife Action Plan, 122. In 2006, the city experienced 16 inches of rain, a 200-year storm that flooded the Federal Triangle, and in 2012, a derecho. DOEE, "Climate Ready DC," 3. NCPC, "Washington, DC Flooding Protection," (2011).
[15]DOEE, "Vulnerability & Risk Assessment," 20.

frequent extreme rain events. DC must take effective measures to reduce these effects and upgrade the capacity of these systems.[16] DOEE's maps, based on data from the USACE and the Federal Emergency Management Agency (FEMA), show areas in 2020, 2050, and 2080, areas of known flood risk, a proxy for priority risk areas.[17] Figure 2.

For example, Watts Branch in Ward 7 frequently floods, causing risk to nearby public housing, schools, and medical facilities. Downtown DC, including the Federal Triangle, Southwest's public housing, police, fire and other DC agencies, and Buzzard's Point are at risk to future flooding.[18]

Threats to drinking water supply, wildlife habitat, stormwater and sewer systems

All of the city's drinking water comes from the Potomac River. Although studies suggest that the availability of water appears adequate through 2040, extreme rain events and stormwater runoff could contaminate the water supply by releasing pollutants into the river. The drinking water supply's critical components, including pumping stations, raw water reservoirs, finished water storage, buildings, and access roads should be flood-proofed.[19] Pollutants running into the river also adversely affect wildlife by degrading the quality of the rivers' water, and changing hydrology, habitat structure, and biodiversity.[20]

Current storm sewer capacity is designed only to handle a 15-year, 24-hour storm, 5.2 inches of rain, and not the eight inches of rain from a 100-year rain event, which would overwhelm the system's capacity, causing flooding. Water backflowing from overwhelmed stormwater pipes interacting with higher river water levels can also flood into the interior of the city. Other cities are already experiencing this problem.[21]

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[16]DOEE, "Climate Ready DC," 2-3. Stormwater runoff is the second largest contributor to pollution in the Chesapeake Bay. Friedrich, "D.C. stormwater credit could be a role model for other cities."
[17]DOEE, "Vulnerability & Risk Assessment," 20.
[18]DOEE, "Climate Ready DC," 6. DOEE, "Vulnerability & Risk Assessment," 9.
[19]"The District of Columbia Water Quality Assessment Integrated Report to the US EPA and Congress (2014) (http://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Integrated%20Report%20to%20EPA%20and%20US%20Congress%20regarding%20DC%E2%80%99s%20Water%20Quality%20%E2%80%93%202014_0.pdf) DOEE, "Climate Ready DC," 14.
[20]NOAA, "Sea Level Rise and Nuisance Flood Frequency Changes Around the United States," vi. DOEE, "Wildlife Action Plan," 119-120. .
[21]Kolbert, "The Siege of Miami," 45. The Blue Plains Advanced Wastewater Treatment Plant will be protected by as seawall against a 500-year flood plus three feet for sea level rise. DOEE, "Vulnerability & Risk Assessment," 38, 39.

Decrease stormwater runoff by deceasing impervious surfaces, increasing tree canopy, and protecting forests

A higher frequency of extreme rain events interacts with large areas of impervious surface in areas of the city, especially in Wards 5, 6, 7, and 8, to increase stormwater runoff and pollutants entering the rivers. Figure 7. Decreasing impervious surfaces will improve water quality and DC should provide incentives to encourage more rain gardens, green roofs, cisterns, pervious pavement and other measures to reduce runoff. For example, the city's Municipal Separate Stormwater Sewer Systems Permit (MS4) already reduces stormwater runoff and requires on-site stormwater management. For example, bio-engineered embankments such as the one on the Georgetown Waterfront Park can reduce runoff. [22]

The city's 40 percent tree canopy goal is also designed to reduce runoff. Because of damage from runoff and because climate change will also threaten hardwood forests in the city, we suggest promoting the protection and management of forests, re-establishing forests where appropriate, and providing incentives for protection of forests on private land (e.g., present use value tax status, forest mitigation bank programs, or transfer of development rights).[23]

Build or expand roads and DC government facilities outside the 500-year flood plain

Other cities contending with rising water levels have had to completely rebuild roads in flood zones. For example, some streets in Miami have been raised three feet above their prior grade to be safe from everyday flooding.[24] Road rebuilding to cope with rising water levels will become necessary in Washington, and when it does, it will be expensive. For this reason, in the interim, the city should invest only in essential roads in the 500-year floodplain, non-essential roads in the flood plain should not be expanded, and new non-essential roads should never be built. An example of non-essential road in a floodplain is DC Department of Transportation's proposed new Park Drive running along the Anacostia River from Benning Road to Barney Circle, in the flood plain, not needed to develop the Hill East Waterfront, and therefore should never be built.[25] See Figures 1 and 8A- 8B.

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[22]DC government, "Sustainability DC Plan," 40. DOEE, "Vulnerability & Risk Assessment," 39. DOEE, Climate Ready DC," 14. DC government, NCPC, NPS, "CapitalSpace Progress Report," 13 (2012).

[23]DOEE, "Trees in the District." DOEE, "Wildlife Action Plan," 124-125, 129. M. Davis and A. Campbell. Summary of Potential Climate Change Impacts, Vulnerabilities, and Adaptation Strategies in the Metropolitan Washington Region: A synopsis of lessons learned from the Metropolitan Washington Council of Governments' climate adaptation planning initiatives from 2010–2012. 2013. Metropolitan Washington Council of Governments, Washington, (2013) cited in DOEE, "Wildlife Action Plan," 129.

[24]Kolbert, "The Siege of Miami," 49-50.

[25]DDOT, "Middle Anacostia Crossings Study," p. 7-1 (2005). In 2008, five development teams competed to develop the entire Hill East Waterfront (also known as Reservation 13 or DC General Campus), without the Park Drive. Events DC plans a road on the same or similar route at the RFK site, as discussed at a public meeting on January 5, 2017. www.rfkcampus future.com.

Key roads in the floodplain should be redesigned to accommodate low-level flooding in order to reduce the impact on surrounding buildings by channeling rainwater. Copenhagen, New Orleans and other cities are designing these "cloudburst boulevards."[26]

A number of DC government facilities (including government agencies, schools, libraries, recreation facilities, police and fire stations, public housing, senior centers, homeless shelters) will be vulnerable to flooding by 2020, and even more will be vulnerable by 2080.[27] Figure 2. For example, by 2050, the First District Police Station at 101 M Street, SW will be vulnerable to flooding. In the intervening years, the police station should be relocated outside the 500-year floodplain, or alternatively adapted to withstand flooding, including having back-up power. DC residents depend on these facilities, and taxpayers have invested substantial sums to construct and maintain them. For this reason, as new or replacement facilities are planned, they should be outside the 500-year flood plain whenever possible, or alternatively, retrofitted to withstand flooding.

Study where additional levees or other flood control measures may be needed

There are levees at the National Mall, Bolling AFB, Naval Station Anacostia, Poplar Point, and floodgates at Washington Harbour.[28] We recommend studying where other flood control measures, such as nature-based measures including wetlands and living shorelines may be needed and identifying the design best practices. In addition, the Mall Underground Project has the potential to alleviate flooding on the National Mall and should be studied.[29]

S**tudy a buyout program for properties in the most flood-prone areas**

FEMA offers buyout programs for properties that have repeatedly flooded. If there are areas in a city that have repeatedly flooded, the city prepares a flood mitigation plan, which, if FEMA approves, allows the purchase of properties using federal and state funds. There may be areas in DC that would qualify for buyouts.[30]

Protect historic resources

As both our Nation's Capital and a historic city in its own right, the District of Columbia's consideration of impacts upon our historic resources during every phase of resiliency planning is paramount. There will be considerable pressures upon historic buildings, structures, features, landscapes and archaeological sites located

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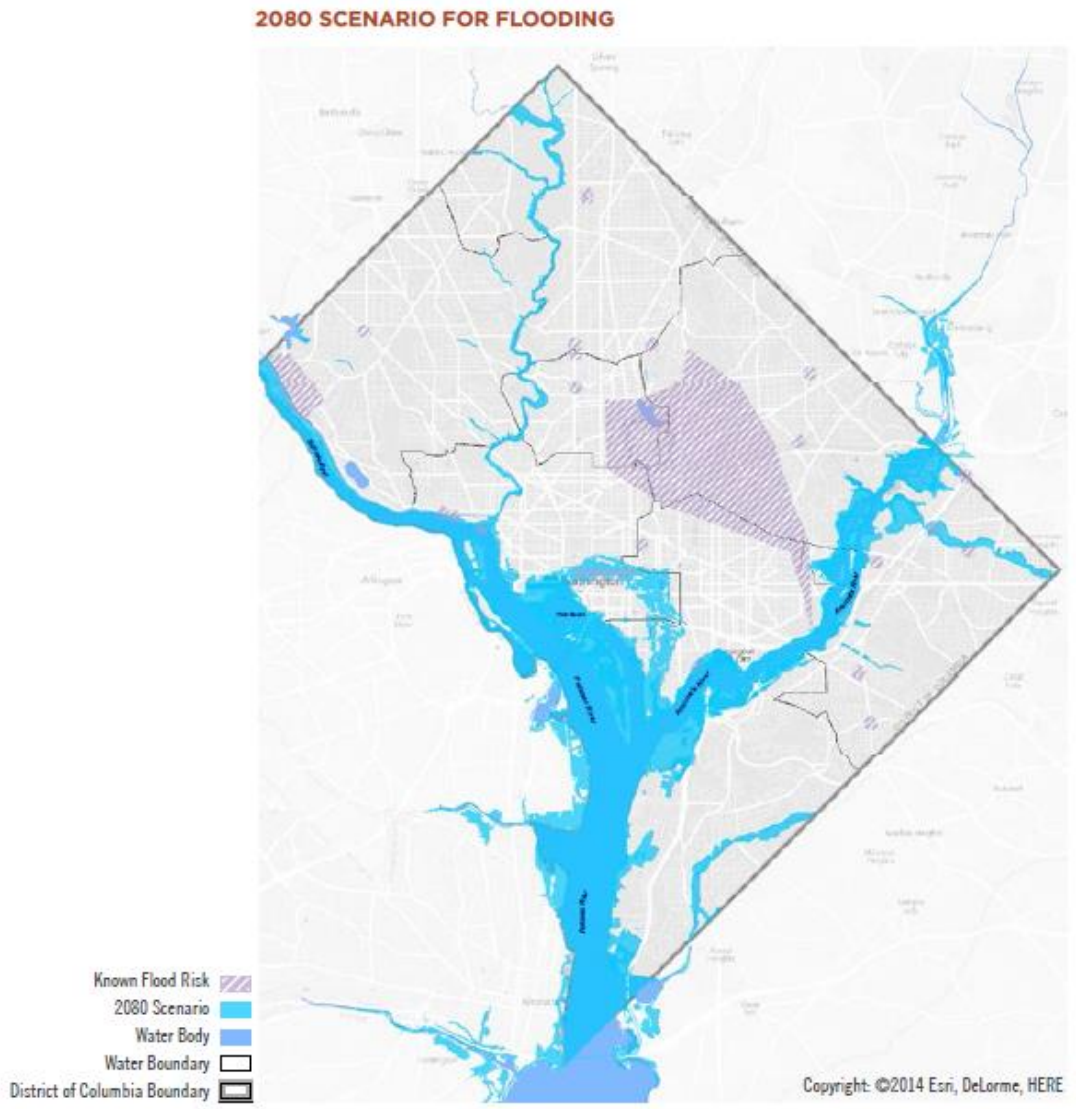
[26]"Copenhagen unveils first city- wide masterplan for cloudburst." TheSourceMagazine.org. Internet; accessed 13 Dec. 2016.
[27]DOEE, "Vulnerability & Risk Assessment," 47. DOEE, Climate Ready DC," 15.
[28]NCPC, "Washington, DC Flooding Protection." "Washington Harbour," wikipedia.org. Internet; accessed 14 Nov. 2016. Justin Gillis, "Global Warming's Mark: Coastal Inundation," *New York Times*, 4 Sept., 2016, 1. Brady Dennis, "City Weighs choices against rising seas," [Hoboken, NJ] *Washington Post*, 14 Aug. 2016.
[29]http://www.nationalmallcoalition.org/innovation/resilience-to-ensure-the-future.
[30]DOEE, "Climate Ready DC," 17. FEMA, "For Communities Plagued by Repeated Flooding, Property Acquisition May Be The Answer," 28 May 2014. www. fema.gov/news-release/2014. Internet; accessed 14 Nov. 2016.

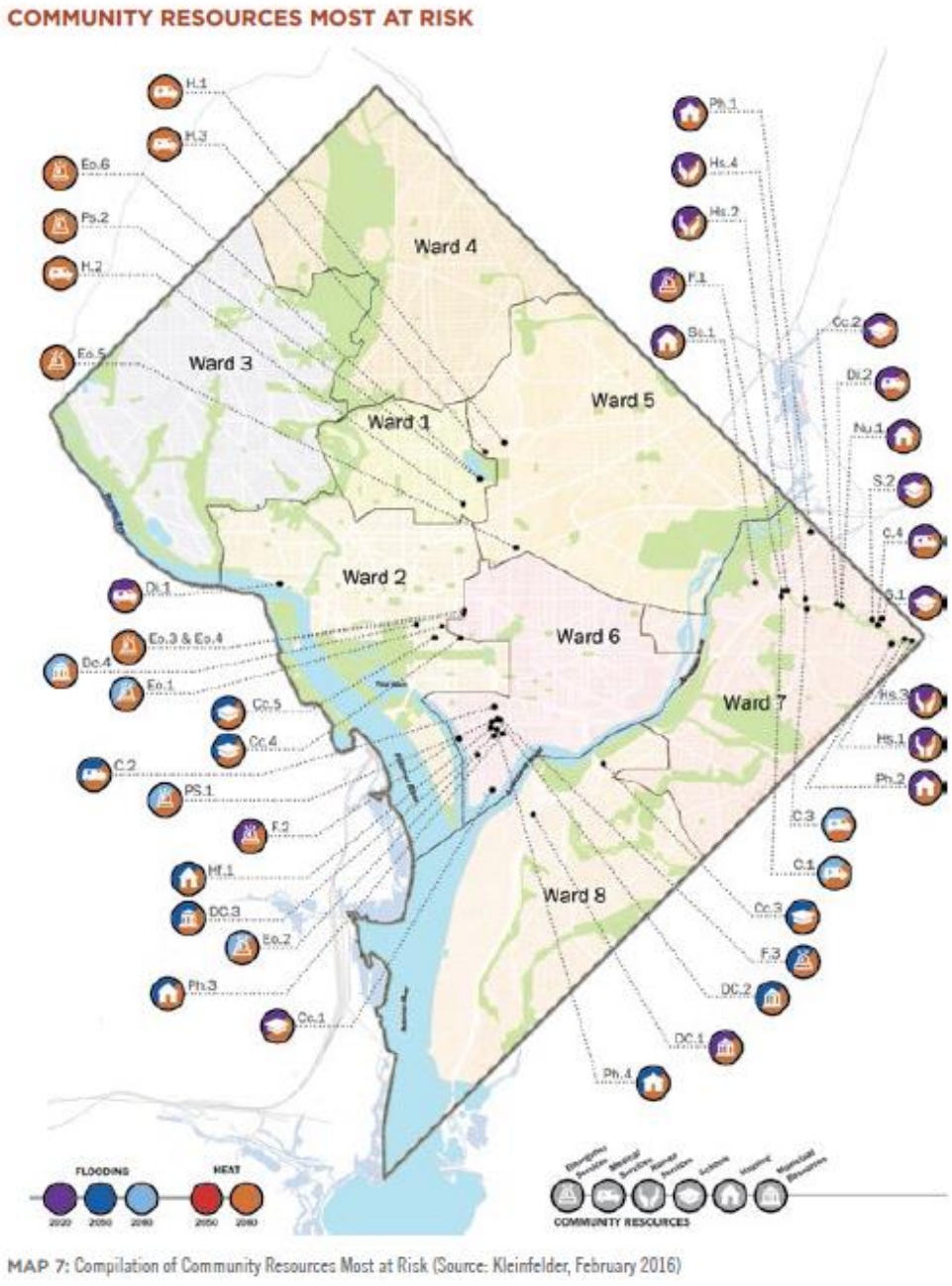
within the 500-year flood plain. There must be an evaluation of the resources that may be impacted and careful consideration of what measures are appropriate to assure the preservation of the most significant. In some cases DC can employ minor strategies to enable the resource to withstand flooding events as-is (grading, hardscaping, elevations, relocation of HVAC and other mechanical systems to upper floors, etc.) More extreme situations concerning highly significant resources may require broader thinking. Planning for this should begin now.

Figure 1. DOEE, "Vulnerability & Risk Assessment: Climate Change Adaptation Plan for the District of Columbia" (2016), Map 4 (500-year flood plain, 2080).



MAP 4: 2080 Scenario based on current FEMA 500-year floodplain as a proxy for the current FEMA 100-year base flood elevation + 4 feet of sea level rise. (Source: NACCS map and historic flooding as identified by stakeholders overlaid on GIS map base, Kleinfelder, 2015)

Figure 2. DOEE, "Vulnerability & Risk Assessment: Climate Change Adaptation Plan for the District of Columbia" (2016), Map 7, "Compilation of Community Resources Most at Risk.."



MAP 7: Compilation of Community Resources Most at Risk (Source: Kleinfelder, February 2016)

Figure 3. "Relative Sea Level Rise inundation predictions in Washington, DC for 2018, 2068, and 2100. " US Army Corps of Engineers, from DOEE, "Wildlife Action Plan," 124 (2015).

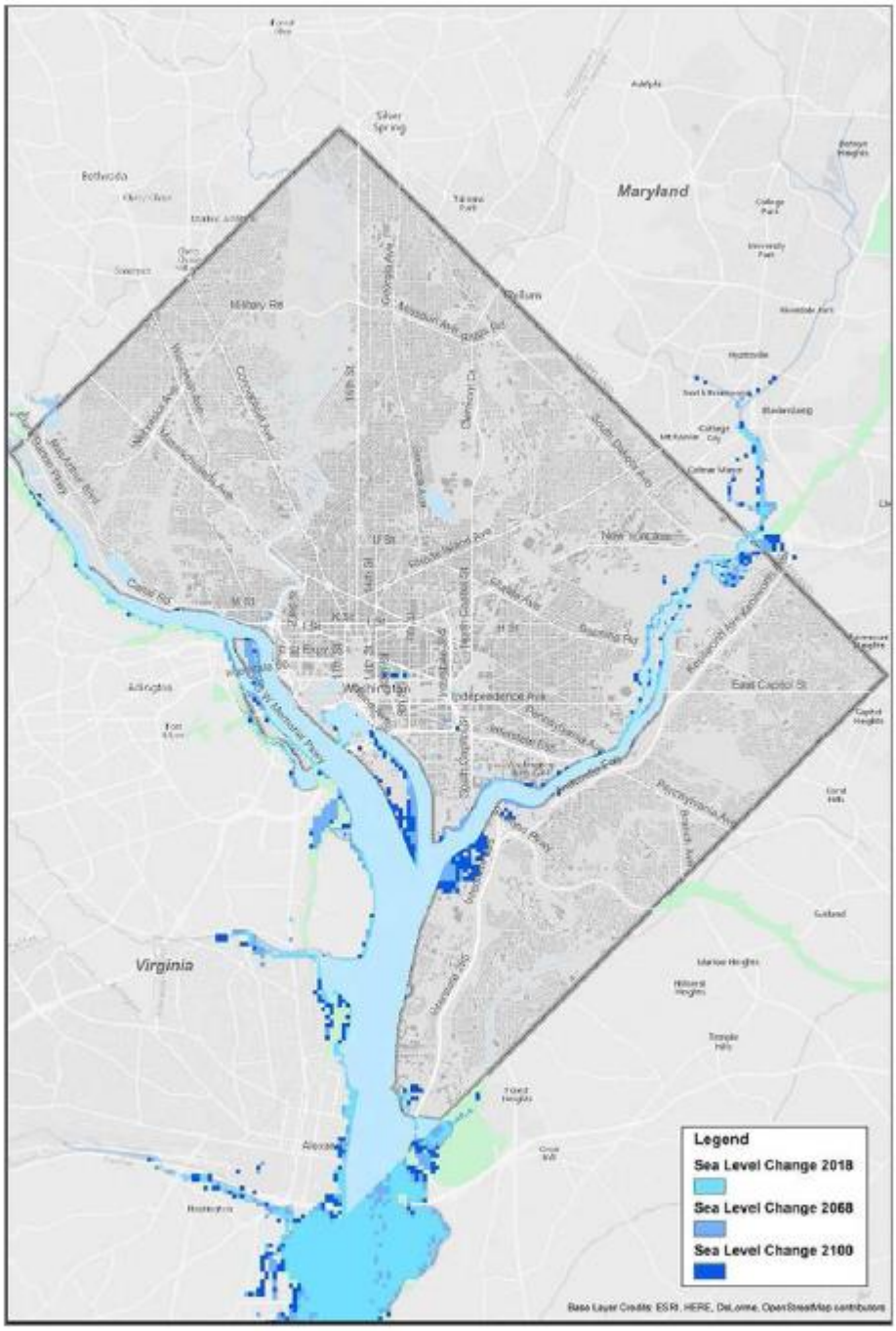


Figure 25 Relative sea level rise inundation predictions in Washington, DC from the North Atlantic Coast Comprehensive Study (U.S. Army Corps of Engineers). High sea level rise scenario for years 2018, 2068, and 2100.

Figure 4. Coastal flooding in Washington, DC. Climate Central, www.climatecentral.org. Internet; accessed 2 Nov. 2016.

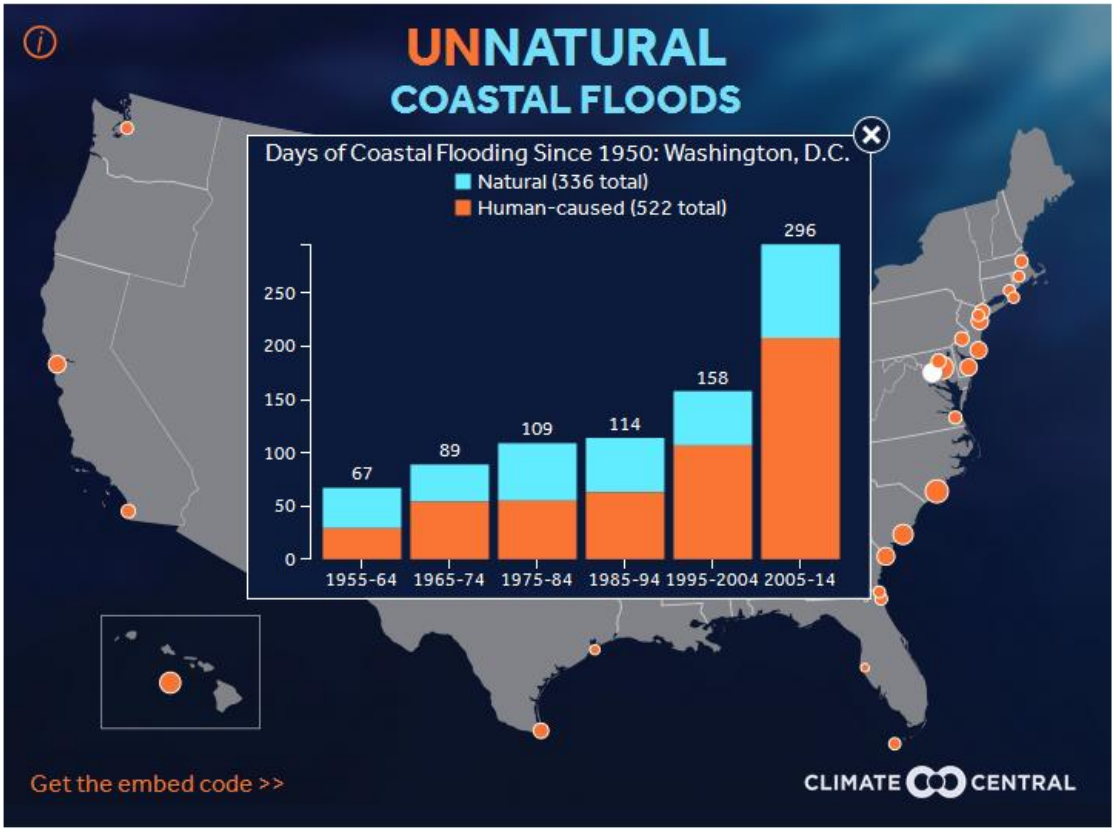


Figure 5. Present-day Storm Surge From Category 1, 2, and 3 Storms. DOEE, "Climate Ready DC," 4.

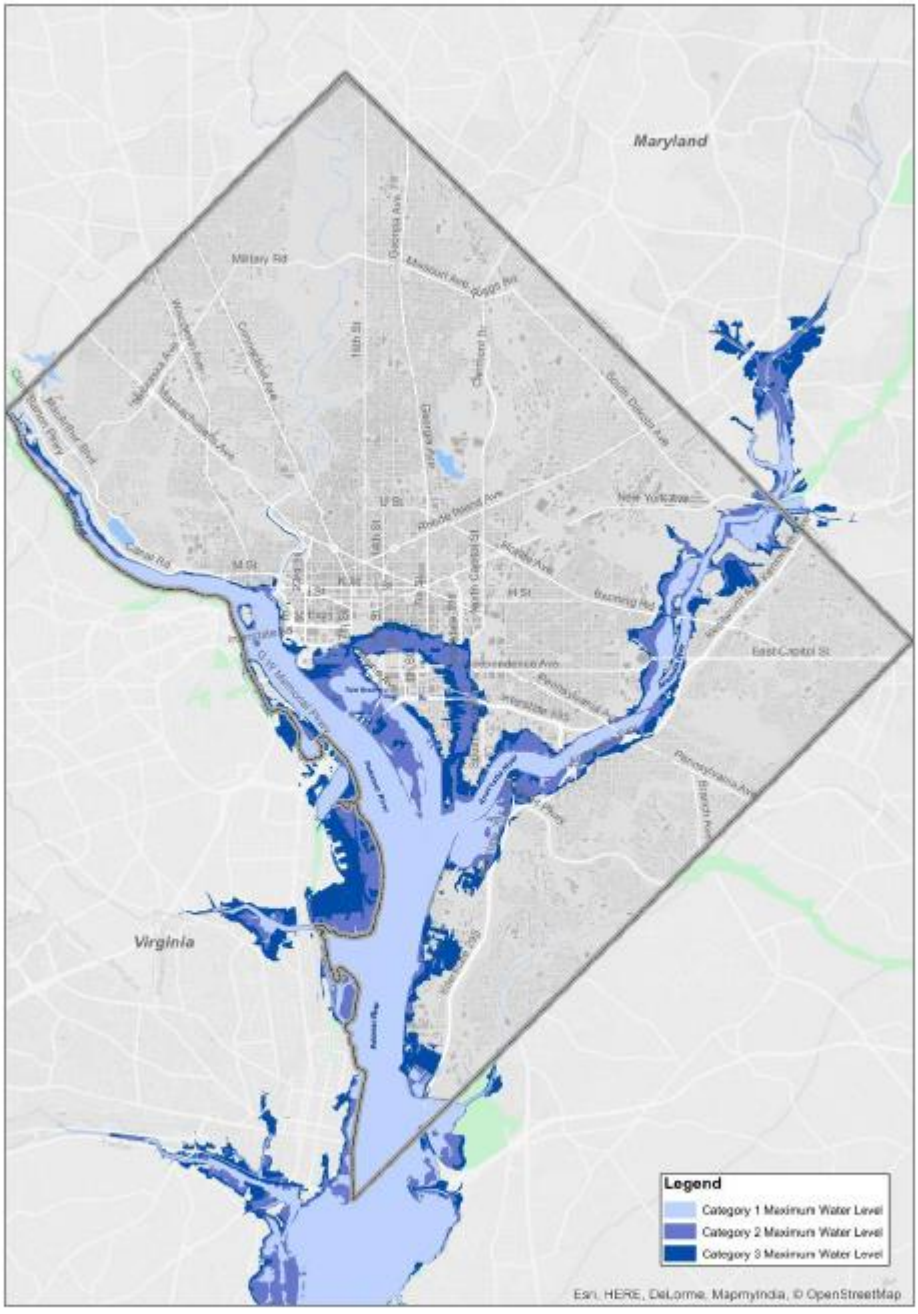


Figure 24 Sea, Lake, and Overland Surges from Hurricanes (SLOSH) hurricane storm surge inundation predictions for Washington, DC for present-day Category 1, 2, and 3 storms (North Atlantic Coast Comprehensive Study data).

Figure 6. NOAA, William Sweet, et al., "Sea Level Rise and Nuisance Flood Frequency Changes Around the United States." NOAA Technical Report NOS CO-OPS 073, 44 (2014). Clockwise from upper right:

(1) Maximum observed water levels per calendar day 1980-2009 decomposed into a low frequency mean sea level (MSL in meters) cycle and remaining nontidal residual (NTR), all smoothed by a 30-day running filter. This graph is relative to the DC station MSL level and plotted with the nuisance flood level (yellow-magenta line) and mean higher high water (MHHW datum elevation, black dot-dash).
(2) This graph shows the number of nuisance flood hours and days (shared y-axis) are averaged by calendar month between 1980 and 2009.
(3) The graph or return period (years) shows the probabilities of nuisance flooding in 1950 and 2012.
(4) This graph shows the actual and estimated days and hours of nuisance flooding from 1924 (start of NOAA monitoring in DC) to 2020.

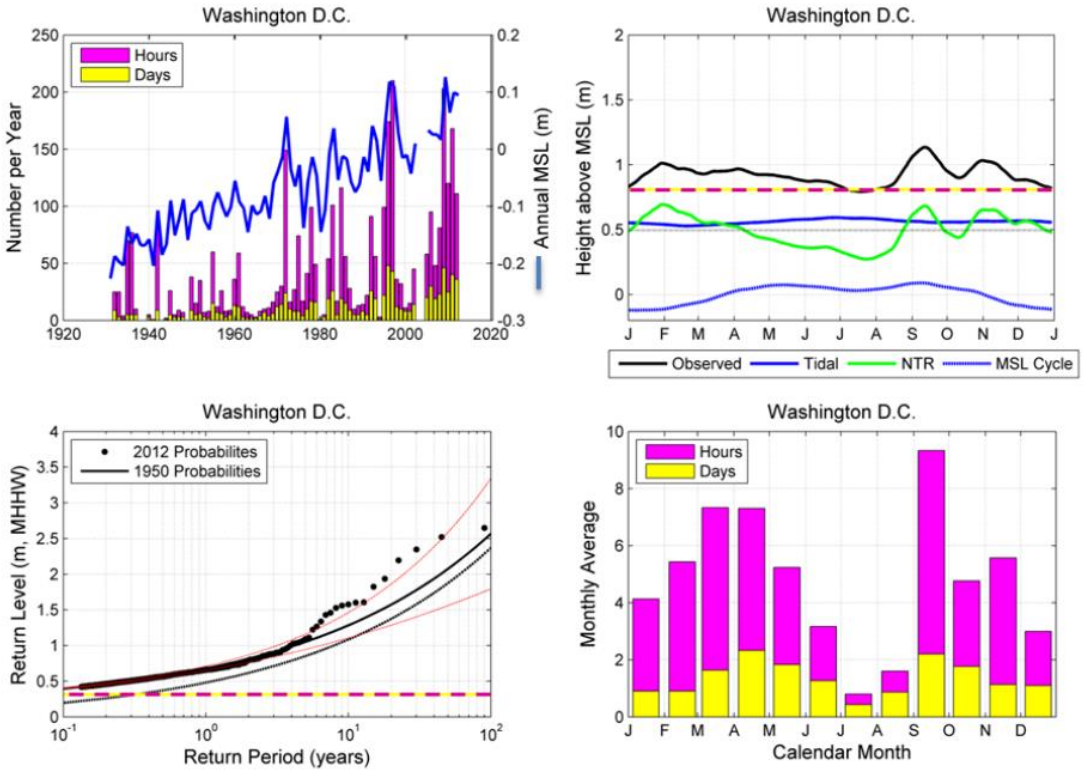
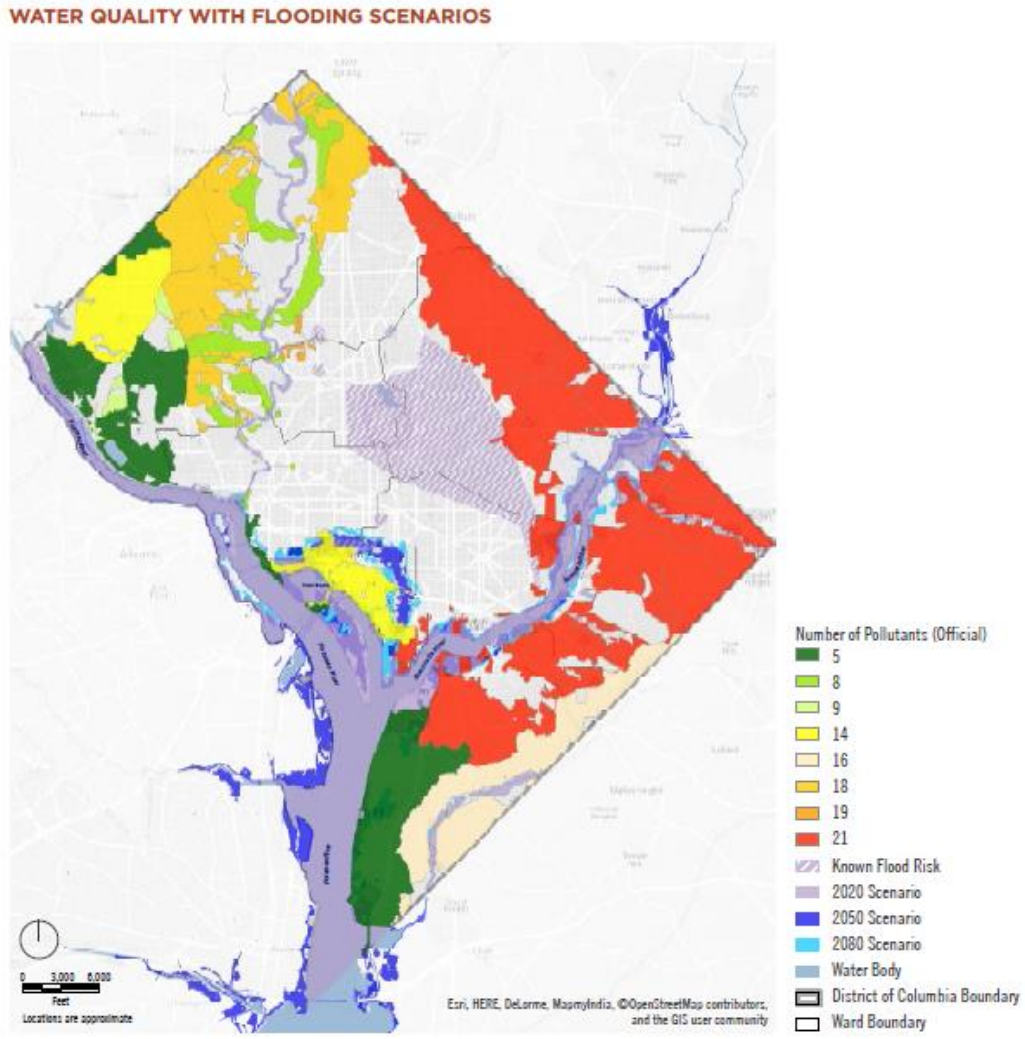


Figure 7. DOEE, "Vulnerability & Risk Assessment: Climate Change Adaptation Plan for the District of Columbia" (2016), Map 6 (Water quality map with flooding scenarios 2020, 2050 and 2080). Areas in red, orange, and yellow are most impaired in terms of water quality and pollutant loading.



MAP 6: Water Quality with flooding scenarios 2020, 2050 and 2080 (Source: Kleinfelder and DDOE DC, November 2015)

Figure 8A. DC Department of Transportation's s proposed Park Drive, DDOT, "Middle Anacostia Crossings Study," p. 7-1 (2005).

Chapter 7: LONG-TERM IMPROVEMENTS (2005 – 2025)

The long-term improvements address the missing movements at the key interchanges and provide relief to congestion within the study area and possibly beyond. The next phase of environmental analysis and engineering design of the long-term improvement options could commence at any time. However, the complexity of these options could result in construction starting around 2010 or possibly later. Long-term improvements are focused on the following interchanges and major roadways within the Middle Anacostia River region:

- Pennsylvania Avenue/Anacostia Freeway Interchange,
- Barney Circle improvements,
- 11th Street Bridges/Anacostia Freeway Interchange,
- 11th Street/Southeast Freeway Interchange,
- Boulevard along Southeast Freeway, and
- Park Drive Connector Road.

Among the six locations identified for long-term improvements, there are a total of twenty options discussed in this chapter. A synopsis of how each are defined is as follows:

- The **Pennsylvania Avenue/Anacostia Freeway Interchange** contains six options using the **"P"** designation.
- **Barney Circle improvements** include two long-term options and are identified using the **"BC"** designation.
- The **11th Street/Anacostia Freeway Interchange** contains four options and is identified with the **"A"** designation.
- The **11th Street/Southeast Freeway Interchange** contains three options identified using the **"SE"** designation.
- **Four boulevard options** along the Southeast Freeway are presented using the **"Boulevard"** designation. Three typical sections have been developed to illustrate opportunities for the boulevard concepts. The feasibility of which typical sections may be developed is dependent on the option.
- Finally, there is one option for the **Park Drive alignment** and it is identified using the **"R"** designation.

Figure 38 provides an index of the locations for the various long-term improvement options. **Appendix M** contains the geometric data associated with each long-term option.

Figure 38. Location of Long-Term Improvement Options

Figure 8B. DC Department of Transportation's s proposed Park Drive, DDOT, "Middle Anacostia Crossings Study," p. 7-47 (2005).