ABSTRACT

Title of Document:	THE PURPOSEFUL EDGE: DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER
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As urbanization increases, many cities will reassess their land use policies and practices to establish a balance between densification and ecological sustainability. Creating and improving urban wildlife habitat can increase biodiversity and provide places for people to experience native vegetation and animals.

Among the inspiring collection of culturally significant places, Washington, DC has many small reserve parks. For wildlife habitat to be sufficient, larger tracts are often needed. This thesis project capitalizes on one such expanse along the Anacostia River by proposing the area surrounding Robert F. Kennedy stadium and its parking lots become places where habitat is integrated into the urban fabric. Integration means creating spaces where humans and wildlife coexist, each enhancing the lives of the other by their interactions.

Healthy ecosystems are a piece of the sustainability puzzle, and the future of the world's cities must include the application of ecological knowledge in designing urban spaces.

THE PURPOSEFUL EDGE:
DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER

By

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
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Preface

I am inspired by words and nature. Thus it is, perhaps, natural that I find guidance in the words of landscape architect and poet Grant Jones. In a recent interview, Jones intimated that "Poetry allows me to listen to the voice of the Earth."[1] It is this voice that I aspire to hear in all my projects and that desire to communicate with wildlife has provided a special emphasis for this thesis given its focus on creating new wildlife habitat.

Dedication

This project is for the birds. Namely, my parakeets. Jackson and Queequeg, who, although they are presumably unaware of it, have an incredible ability to improve my mood on stressful days just by being themselves. And my late Frost, who will always be missed.

Acknowledgements

First and foremost I must thank my wonderful committee members and advisors. Their collective expertise provided essential criticism and reality to the project and their enthusiasm throughout the process helped nurture my quiet passion for wildlife into a boldly vocal design. Jack, Caren, Maile, Jennifer, and Peter: I walked away from nearly every committee meeting and individual conversation with a smile on my face because of all of your thoughtful collaboration and welcoming spirits. Again, thank you.

My gratitude goes to Allison Palmer Jensen for her expert assistance on some important details in the final hours.

I also want to thank my fellow third year MLA students for their constant assistance, camaraderie, and of course, humor.

Finally, to my parents and grandparents, all of whom have supported my education through the years. I may not have made it this far without each and every one of them. And though I wish that Nanny and Grandpap could be here to share this moment, I know that they would have been proud.

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[1] Beatty, Frances G. “Interview: The Farmer Bard.” *Landscape Architecture Magazine*, July 2012. Print. p 36.

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Chapter 1: Introduction

Full Abstract

As urbanization increases throughout the world, many cities will have to reassess their land use policies and practices to establish a balance between densification and ecological sustainability. Creating and improving wildlife habitat in cities can increase urban biodiversity as well as provide places for people to experience native vegetation and animals. Emphasizing vegetated environments over impervious and native species over non-native has potential also to improve urban ecosystem function.

People in cities need places where they can experience the cycles and elements of the natural world, such as streams, plants in bloom, and native wildlife, and America's capital should be a model of ecological urbanism.[1] Among the inspiring collection of monuments and culturally significant places available to people, Washington, DC has many small reserve parks in the leftover spaces where the diagonal avenues meet the grid streets. For wildlife habitat to be sufficient, larger tracts are often needed. This thesis project capitalizes on one such expanse, along the western bank of the Anacostia River where the underutilized Robert F. Kennedy (RFK) stadium currently sits, by proposing the existing parking lots and stadium area become places where wildlife habitat is integrated into the urban fabric. Integration means creating spaces where humans and wildlife can coexist, each enhancing the lives of the other by their interactions.

[1] Hough, Michael. *Cities and Natural Process: A Basis for Sustainability*. Psychology Press, 2004. Print. p 23.

The Anacostia River is highly polluted and although initiatives to clean it are underway, there is still much to do. Re-development of riverfront land can assist in this endeavor by utilizing vegetation that responds to local physiological conditions, filters stormwater runoff, and adds greater diversity to the city. An ecologically sensitive transformation of the RFK stadium site would create a unique place in the city. It would revitalize the adjacent, historic neighborhoods and be an example of sustainable development for the nation. Healthy ecosystems are a piece of the sustainability puzzle, and the future of the world's cities must include the application of ecological knowledge and ethics in the design of urban spaces.

Mission Statement

This project emerges from the need for urban design to hear the voice of wildlife. Humans can no longer afford to relegate the needs of all other species as inferior to their own needs. To find balance in nature, they must recognize the city as a novel ecotone full of literal and figurative over-lapping edges that are the sites of intra- and inter-species conflicts and compromise. This project serves as an example of integrating wildlife habitat into cities in an ecological way, resulting in both vibrant cityscapes and successful habitat improvement. Such habitats increase biodiversity and restore ecosystem health, thus improving the quality of life for humans and animals alike. The voice of wildlife must be allowed to sing with human voices to create a monumental chorus, a chorus which commemorates the full web of ecology in our nation's capital.

Themes

Voice, ecotone, and commemoration are themes that recur like a poetic refrain throughout this project and document. Voice (or language) is the idea behind the project. It is for the wildlife. Ecotone (or connectivity, edge, transition) is the ways in which the habitats fit into the city. Commemoration (or celebration, monument) is the human experience. The experience of sharing a place with other living creatures.

Question

The broad question this thesis asks is how wildlife habitat can be integrated into urban areas. More specifically, it asks how can disturbances to animals, their habitats, and bioecological activities at the RFK stadium site be resolved through innovative design within the urban context?

Project Goals

Concrete goals focus and organize the design process. There are five major goals for this thesis. Overarching the project is the need to provide a variety of native Mid-Atlantic coastal plain habitat types to improve biodiversity while building upon recent restoration projects near the site (Kingman Marsh). In order to increase the survival rate of wildlife, prioritizing the mitigation of typical urban disturbances to wildlife, such as road crossings, can increase the potential of new, native species inhabiting the area. Thirdly, creating a variety of separate pockets of seclusion and gathering places appropriate for humans and wildlife offers choices to a diversity of visitors. Including opportunities to access and view the water is necessary for wildlife and a key amenity for people. And finally, as any waterfront project should, it is desirable

to contribute to the remediation of pollution in the Anacostia River by significantly reducing impervious surfaces and capturing/filtering stormwater onsite.

Chapter 2: Theoretical Context

In generating an approach to wildlife habitat design in DC, research on several relevant topics was conducted. The fullest appreciation of the proposed design comes with an understanding of these topics, as discussed below.

The Tao of Dwelling

The concepts of balance and harmony guide practitioners of Taoism through attention to the cycles and systems of the natural world. One fundamental assertion of this thesis project is that humans are never separate from nature, even when they are in cities. Because biogeochemical (often called "natural") processes are subdued and shrouded in various ways in urban areas, they can be overlooked or forgotten. Through this thesis, I investigate wildlife habitat in cities, and aim to bring what industrial humans call "nature"[2] (namely, native flora and fauna and biogeochemical cycles) back into the consciousness of urban dwellers and visitors. Historically, much building by humans has been an attempt to force these natural processes into engineered solutions such as constructed river bulkheads that prevent flooding but

[2] Industrial humans, as opposed to indigenous humans. "Industrial" meaning those who function within the industrial (including agriculture) paradigm and structure, where food is owned by someone and you need money to buy it; "indigenous" meaning those who still—as industrial humans phrase it—"live off the land" in tribal societies, of which there are now of course very few remaining, their populations having been decimated by industrial humans through extermination or conversion to the industrial culture. ("Industrial" and "indigenous" are used as parallel terms to Daniel Quinn's "taker" and "leaver," but as the former two are more familiar, I use them. For in-depth discussion of these ideas and terms, see Quinn's writings.) Based on personal readings in the past ten years, it seems that often indigenous groups do not have a word for "nature" the way industrial humans do because they do not perceive they are outside of or separate from non-human living species or biogeochemical processes.

disrupt shore habitats. This thesis project will be an example of one way to design habitats that can fulfill the needs of humans and wildlife while allowing biogeochemical systems to function more effectively.

Carl Fingerhuth discusses the effects of Modernism on scientific thought and cities.[3] Within Modernism, notes Fingerhuth, came an overemphasis on rational thinking to the exclusion of other ways of knowing, thus creating "disdain for all other aspects of human existence."[4] Fingerhuth does not then assert that we should simply abandon rationality for "emotion, sensory perception, and intuition" as I do not assert that all humans should abandon cities for back-to-the-land homesteading. Rather, the goal should be to create balance, to provide "the city with sensual, emotional, and spiritual qualities to balance out its intense rationality,"[5] or to create cities (and homesteads) which both meet the needs of humans and wildlife as well as treading lightly on ecological processes. Human exploration of the physical world is not about one opposite threatening the other, as Fingerhuth explains, but "it requires the development of equal parts, of the delicate balance between the many aspects of human potential."[6] Thus, planners and designers can aim to develop cities with the "equal parts" of habitat for wildlife and habitat for humans, acknowledging that these habitats will overlap. Likewise, for this thesis, cities and wildlife habitat are not considered mutually exclusive.

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[3] Fingerhuth, Carl. *Learning from China: The Tao of the City*. Birkhauser Boston, 2004. Print. p 90.
[4] Ibid.
[5] Ibid.
[6] Ibid.

Urban Wildlife

My goal in this thesis project is to integrate wildlife habitats within an urban setting. Some people have negative views or have had negative experiences with wildlife, but this does not constitute grounds for removing all wildlife from cities simply to avoid "nuisance issues." The health of the overall ecosystem must always be considered, and the more credence it is given, the healthier the ecosystem can become. It is the stance of this thesis that because biodiversity improves the health of ecosystems globally, increasing biodiversity should be one component of improving the health of our cities.

The RFK stadium site on the Anacostia River is a zone of transition. Anyone passing through the site is transitioning through an ecotone from land to water or from water to land. This physical ecotone is a transitional zone between ecological communities containing the characteristic species of each.[7] For the RFK site, the physical ecotone is riparian. There is also a figurative ecotone running through this site: the human-animal ecotone. Currently the site is human-dominated although there are the occasional groups of common urban exploitative species congregating in the parking lots such as gulls and Canada geese. The design portion of this project will counterbalance the human-dominated condition of the site and its surroundings with new wildlife-dominated spaces.

Urbanization is associated with changes in wildlife behavior. This "synurbization" is "the response of wildlife to the ecological changes associated with

[7] http://www.thefreedictionary.com/ecotone

urban development."[8] The differences can be general or species-specific and fall in these basic categories: movement and activity, reproduction, tolerance of humans, diet and nutrition, and survival and mortality.[9] As urban parks used by wildlife are typically very small and fragmented, one aim of this project is to maximize the space available on the site towards creation of native habitats, selected in response to the site and its contexts.

Embracing Natural Change

In emphasizing wildlife and habitat, ecological and biogeochemical processes are essential considerations. For this thesis those considerations involve discovering ways for the site design to embrace changes inherent in the various cycles of nature. Using design to highlight such changes and cycles in a non-didactic but informative way provides entertainment, insight, and experiential learning for human users. As emphasized by Michael Hough, the "tendency to view natural phenomena as static events, frozen in time, is a root cause of the aesthetic dilemmas that we face."[10] A site design that allows such change through biogeochemical processes will provide healthy habitats where human disturbance is still limited, and the result is higher quality habitat for urban wildlife. If "health can be described as the ability to withstand stress, then diversity from an ecological perspective also implies health."[11] This approach does not ignore the human element. Improved ecological health can

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[8] Adams, Clark E., and Kieran J. Lindsey. *Urban Wildlife Management*. Boca Raton, FL: CRC Press, 2010. Print. p 9.
[9] Ibid. p 9-10.
[10] Hough, Michael. *Cities and Natural Process: A Basis for Sustainability*. Psychology Press, 2004. Print. p 8-19.
[11] Hough, Michael. *Cities and Natural Process: A Basis for Sustainability*. Psychology Press, 2004. Print. p 23.

improve conditions for people (e.g., reduced air pollution will result in a reduction of lung-related illnesses). The emphasis on diversity for this project comes from the understanding that "diversity makes social as well as biological sense in the urban setting since the requirements of an infinitely diverse urban society implies choice."[12]

Connectivity and Corridors

The concepts of connectivity and corridors are important to ecology. The overall landscape is composed of patches, corridors, and matrix. Patches can be connected by corridors, both natural (e.g., stream-side vegetation strips) and human-created (e.g., transportation routes like highways). This composition is heavily influenced by human development, where increasing and widespread urbanization has fragmented natural habitats into smaller patches that are farther apart. The impacts of fragmentation on wildlife include the decline of grassland and woodland species, an increase of monocultures (flora and fauna) that degrades habitats, the disruption of "the functions of natural areas," and the inhibiting of "wildlife interaction and gene flow among habitats."[13] Corridors are important in part because they facilitate gene flow between habitat patches by providing routes for movement between patches. In some instances, the corridors themselves are habitats, particularly for species that thrive in edge conditions and do not require large, interior habitat areas. Corridors in cities, such as along rivers like the Anacostia, "have greatly influenced the migration

[12] Ibid.
[13] Hough, Michael. *Cities and Natural Process: A Basis for Sustainability*. Psychology Press, 2004. Print. p 168-169.

and perpetuation of wildlife."[14] By maintaining "links between natural habitats…[they] have increased uncommon or non-tolerant species."[15] Incorporating such links within the project design can assist in meeting the goal of increasing biodiversity.

Extending L'Enfant's Vision

On the human-dominated end of the figurative ecotone, the District of Columbia's (DC) National Capital Planning Commission (NCPC) has an extensive plan to build upon and extend L'Enfant's vision ("Extending the Legacy: Planning America's Capital for the 21st Century"). Within the Legacy Plan, developing the city's waterfronts is one of five main themes. As NCPC plans on "integrating the Potomac and Anacostia rivers into the city's public life,"[16] this thesis responds by providing needed habitat for wildlife on the underutilized land surrounding RFK stadium where East Capitol Street meets the Anacostia River. This area is "the eastern gateway to the city's monumental core and is a direct link between the Capitol Hill neighborhood and the Anacostia River's western banks,"[17] as well as the portion of the city east of the river.

NCPC's Legacy Plan mentions an innovative idea for a new type of monument or commemorative experience: one that celebrates the natural world within which humans live. Creating this experience must be done in a historically

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[14] Hough, Michael. *Cities and Natural Process: A Basis for Sustainability*. Psychology Press, 2004. Print. p 172.
[15] Ibid.
[16] National Capital Planning Commission (NCPC). 1997. http://www.ncpc.gov/ncpc/Main%28T2%29/Publications%28Tr2%29/iframpages/monumental_core_framework_plan_a.html#LegacyPub. Ch. 1, p 10.
[17] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 3.

sensitive way given the site's position on a key axis (East Capitol Street) critical to L'Enfant's vision of a city divided into quadrants. It is clear the city government believes that such a monument is possible, as the Legacy plan plainly proposes that "the Anacostia waterfront near East Capitol Street become a living environmental memorial in which enjoyment of the river and nature becomes itself an act of commemoration."[18]

[18] NCPC. *Extending the Legacy: Planning America's Capital for the 21st Century*. 1997. Print. Ch. 4, p 26.

Chapter 3: Site Context

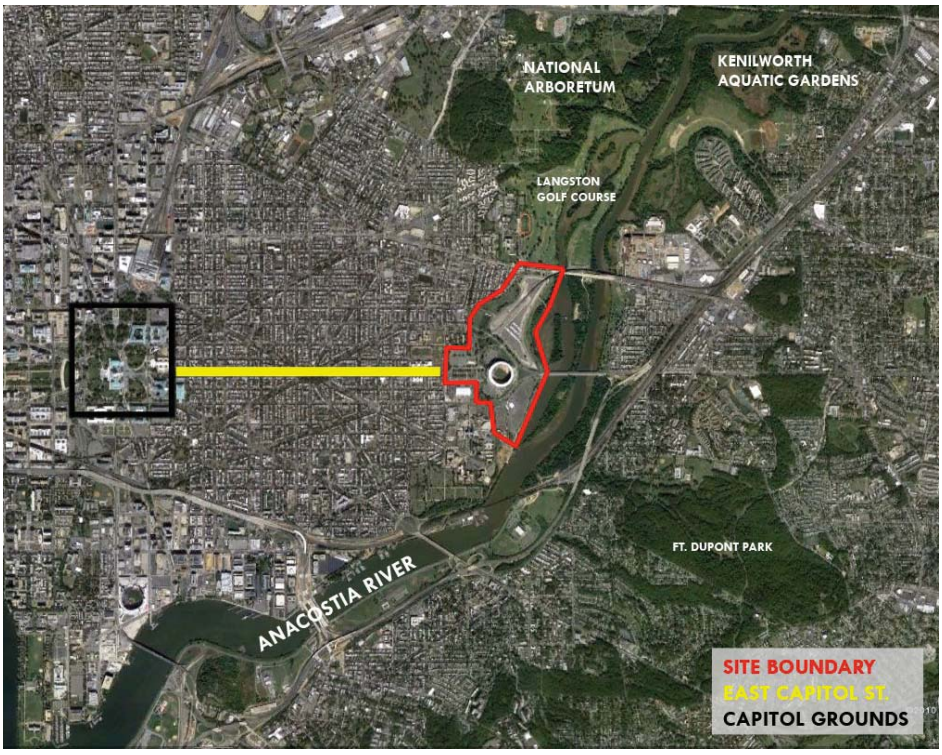
Figure 3.1: Chesapeake Bay context

(Image Source: Google Earth)

Figure 3.2: DC metro region context

(Image Source: Google Earth)

Figure 3.3: Eastern DC context



(Image Source: Google Earth)

Historic Condition

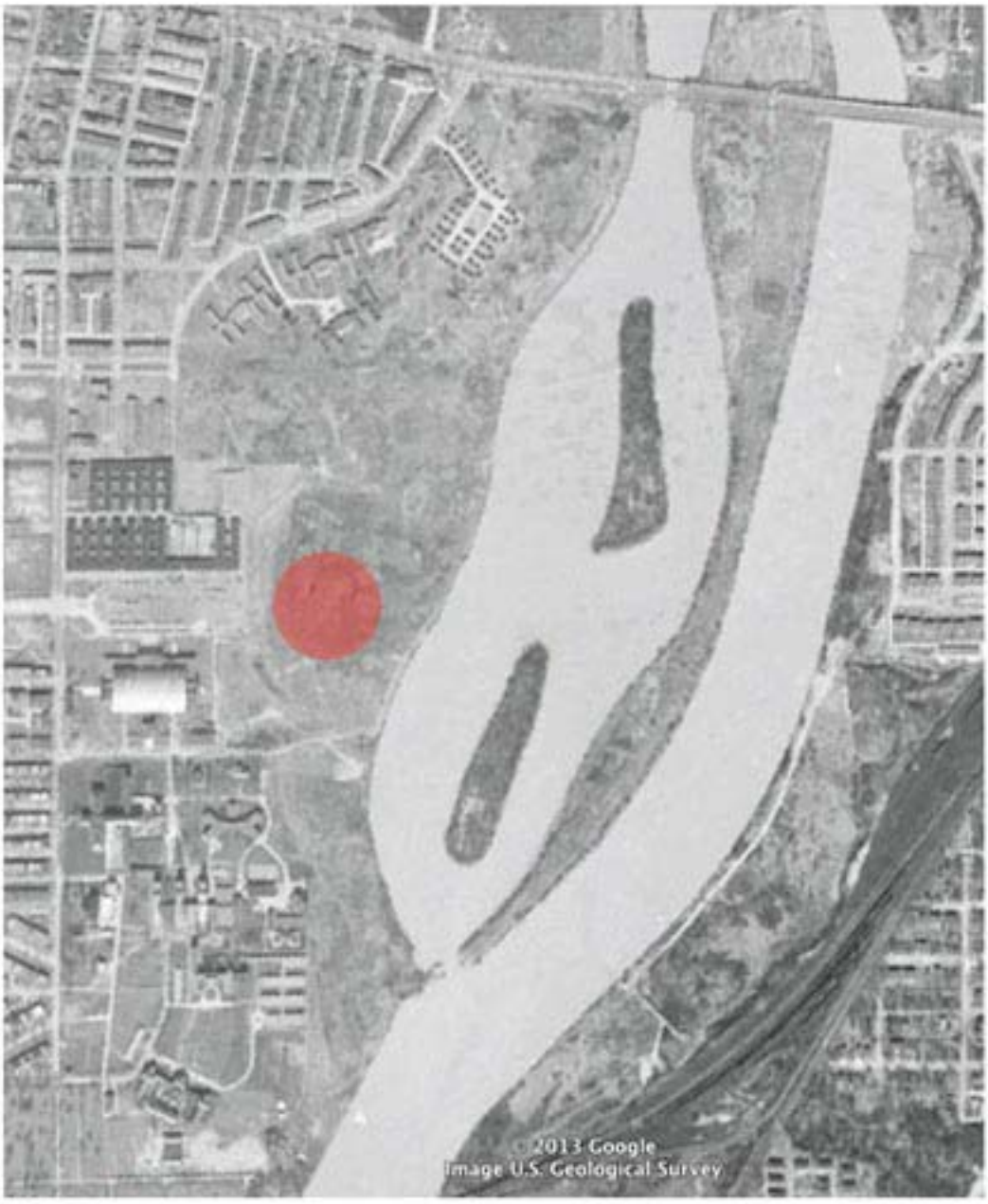
Figure 3.4: L'Enfant's Plan of Washington. Red dot indicates future RFK stadium.

(Image Source: thedctraveler.com)

Figure 3.5: Historic map from the 1880's by Glumer showing wetlands around the Anacostia River (the "Eastern Branch"). Red dot indicates future RFK stadium.

(Image Source: Library of Congress)

Figure 3.6: Historic aerial photo. The Armory, built in 1941, appears along with a third island, now gone. Red dot indicates future RFK stadium.



(Image Source: Google Earth)

Existing Condition

Figure 3.7: Main western entrance of RFK stadium

Figure 3.8: Large north parking lot with Metro rail bridge in the distance

Figure 3.9: Large south parking lot with stadium and Armory in distance

Figure 3.10: Existing underpass

Figure 3.11: Existing vegetation

Figure 3.12: Anacostia Riverfront Trail (ART) with parking on one side and riparian buffer on the other.

Figure 3.13: Existing restored marsh (Kingman Marsh)

Figure 3.14: View underneath Young bridge looking east from shore

Abiotic

Watershed

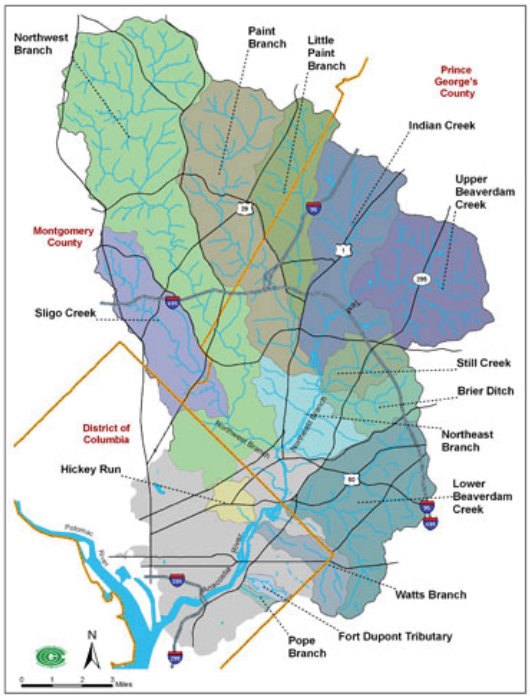
The Anacostia River and its 14 subwatersheds are within the watershed of the nation's largest estuary, the Chesapeake Bay, which makes it ecologically and legislatively important.[19] Encompassing 176 square miles, the Anacostia watershed includes roughly the eastern half of DC. The entire stretch of the river that is in DC, which includes the project site, is tidal.[20]

Figure 3.15: Anacostia Watershed Map

(Source: Anacostia Watershed Society, http://www.anacostiaws.org)

[19] http://www.anacostia.net/subwatershed.html#
[20] http://green.dc.gov/service/anacostia-river-initiatives

Figure 3.16: Anacostia SubWatersheds Map



(Source: Anacostia Watershed Restoration Partnership, http://www.anacostia.net/)

Tidal range at Kingman Island, which is adjacent to the east edge of the site, is 2.84 feet and the mean tide level is 1.60 feet.[21] At Benning Bridge on the northern edge of the site, the mean range is 2.9 feet, and the mean tide level is 1.2.[22] According to a Metropolitan Washington Council of Governments (MWCOG) report the entire project site is within FEMA's 100 year flood-prone areas.[23]

[21] http://tidesandcurrents.noaa.gov/tides09/tab2ec2c.html
[22] http://tidesandcurrents.noaa.gov/tides05/tab2ec2c.html
[23] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Fig. 30, p 28.

The Anacostia is one of the nation's most polluted rivers and is an EPA "Targeted Watershed,"[24] meaning it is eligible for grants for protection and restoration efforts. Upstream pollution, largely from agricultural run-off and industrial waste, and habitat destruction have degraded the Anacostia's health. Significant sedimentation has occurred. Historically, the river was as deep as 40 feet in some spots, especially near Bladensburg, Maryland, once one of the deepest ports in the area, however current depths average a mere 3 feet. The shallow and languid nature of the water further exacerbates issues as the water does not flow fast enough to flush toxins out of the system.[25]

Initiatives to clean the river are underway, organized by various partnerships and agencies, such as the Anacostia Watershed Restoration Partnership and the Anacostia Watershed Society. Additionally, according to the District Department of the Environment's (DDOE) Watershed Implementation Plan,[26] some milestones relating to nutrient and sedimentation reduction have been reached and even exceeded.[27]

The various programs and projects to restore the Anacostia watershed began nearly three decades ago, and "formal cooperation between government agencies came with the 1987 signing of the Anacostia Watershed Agreement and the formation of the Anacostia Watershed Restoration Committee (AWRC)."[28] In the early 2000s, many stakeholders met to discuss the challenging nature of ecosystem

[24] http://www.epa.gov/reg3wapd/anacostia.htm
[25] Ibid.
[26] http://ddoe.dc.gov/service/watershed-implementation-plans-chesapeake-bay
[27] http://ddoe.dc.gov/publication/chesapeake-bay-tmdl-two-year-milestones
[28] http://www.anacostia.net/about.html

reestablishment projects.[29] Eventually a comprehensive watershed restoration plan was defined as a key goal.[30] Additionally, a new governance structure was recommended for restoration efforts, which resulted in the formation of the Anacostia Watershed Restoration Partnership (AWRP) in June of 2006.[31] Participants in the partnership include DC, state and county-level environmental departments (Maryland and Virginia), the National Park Service, the Army Corps of Engineers, non-governmental organizations, and the University of Maryland. The AWRP has six major, long-term goals for 2010, and by 2005 they were "on track to meet the 2010 targets for four out of the six goals."[32] For further information, see plans and reports produced by the AWRP, such as the Anacostia River Watershed: Environmental Conditions and Restoration Overview (2007), Anacostia River Watershed Restoration Plan (2008-2010), and Anacostia Trash TMDL (2010).[33]

Another major initiative is the Anacostia Waterfront Initiative (AWI), begun in 2000 and led by the DC government. This all-encompassing city waterfront improvement endeavor includes environmental, recreational, economic, and transportation projects.[34] The city of DC also has its own Plan for a Fishable and Swimmable Anacostia River by 2032, which was initiated by the Mayor in 2007, because "although restoration efforts to attain Clean Water Act goals in the Anacostia River have been ongoing for more than twenty years, there is still a long way to go

[29] Ibid.
[30] Ibid.
[31] Ibid.
[32] http://www.anacostia.net/restoration.html#progress
[33] http://www.anacostia.net/restoration/progress_reports.html
[34] http://www.anacostiawaterfront.org/awi-vision/

before the river can be considered fishable and swimmable."[35] And although these largely government-led initiatives are extensive, other organizations, such as the Anacostia Watershed Society[36] and the Anacostia Riverkeeper[37] provide additional efforts and other avenues towards improving the river. These organizations offer educational outreach programs for adults and children, stewardship and volunteer opportunities, advocacy, and public awareness.

Topography

The elevation along the shoreline is two feet above sea level; the elevation at the DC Armory, a high point adjacent to the site, is over thirty feet above sea level. The steep areas identified by contour lines that are in close proximity to each other indicate a human-made structured landscape that was built to accommodate roads and underpasses.

Biotic

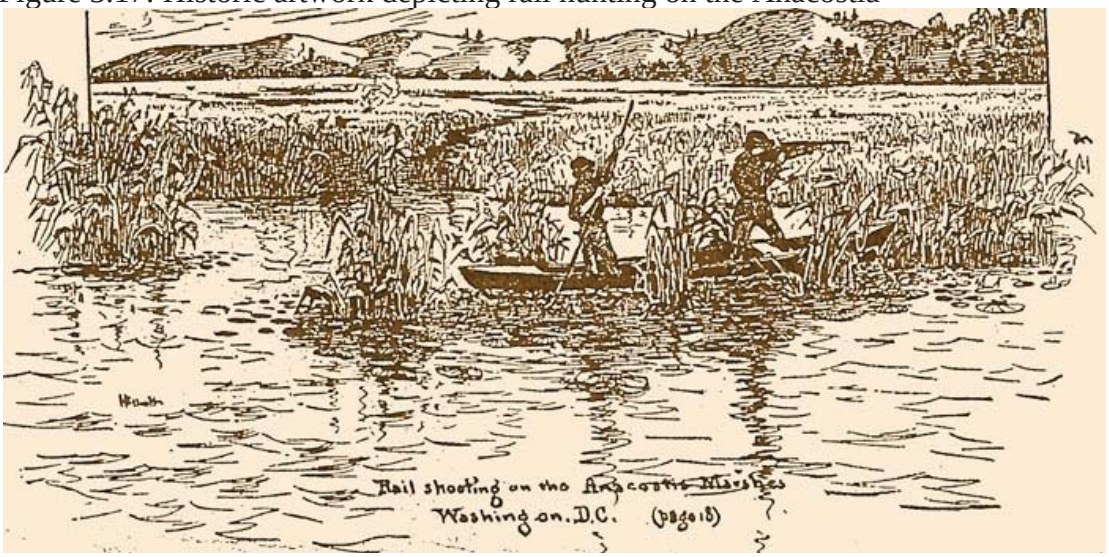
Historic Habitat

Before development the RFK stadium site and its surroundings were emergent tidal freshwater wetlands.[38] "As late as the early 20th century, the Anacostia River and its extensive tidal marshes (featuring vast amounts of wild rice, duck potato, and several

[35] http://ddoe.dc.gov/service/anacostia-river-initiatives
[36] http://www.anacostiaws.org/
[37] http://www.anacostiariverkeeper.org/
[38] May, Peter I. "Alternate State Theory and Tidal Freshwater Mudflat Experimental Ecology on Anacostia River." Doctor of Philosophy University of Maryland, College Park, 2007. Print. p 2.

other emergent wetland plant species) supported both abundant numbers of birds and other wildlife."[39]

Figure 3.17: Historic artwork depicting rail hunting on the Anacostia



(Source: May dissertation)

In the late 1800s, wetlands (aka, swamps or marshes) were considered breeding grounds for diseases such as malaria. In the 1890s, the Anacostia was mapped and reclamation plans were created. "Sewage pollution" and "agriculturally derived sediments" filled in the shipping channel, creating pressure to "remove the problematic wetlands."[40] Much of the region's wetlands were destroyed by filling them in the years that followed. Dredging and straightening the river during the first half of the 20th century removed what was emergent marshlands, and "in their place

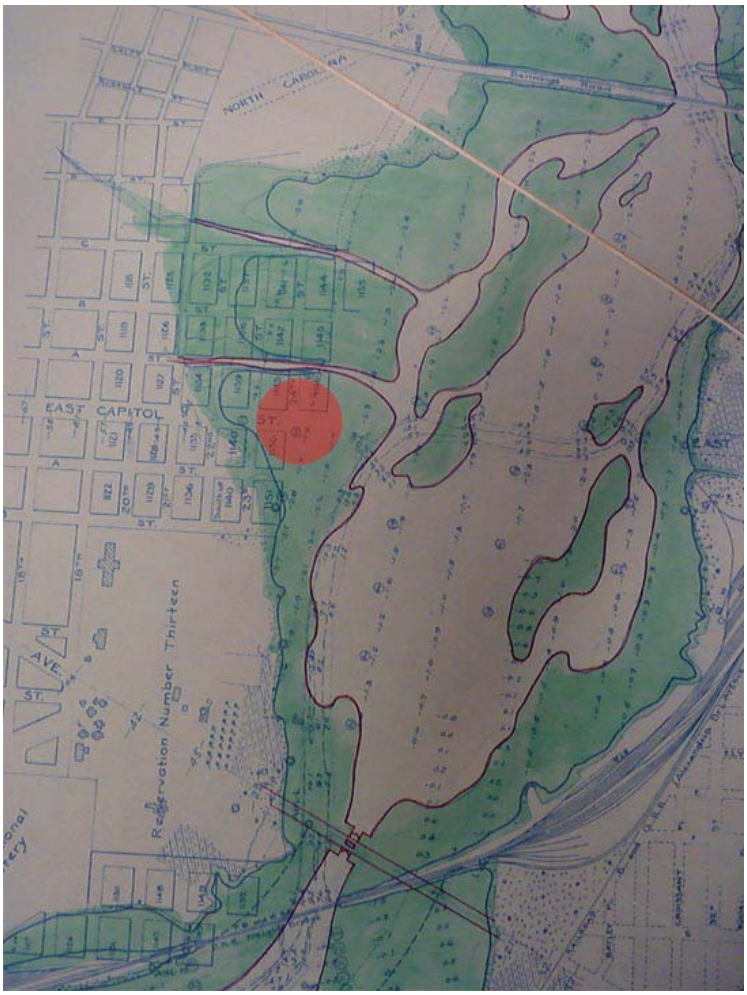
[39] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 51.

[40] USGS Patuxent Wildlife Research Center and University of Maryland Dept of Biological Resources Engineering. *Final Report: Five Years of Monitoring Reconstructed Freshwater Tidal Wetlands in the Urban Anacostia River (2000-2004).* United States Geological Survey. Print. p 10.

shallow water boating and recreational areas were envisioned" as the U.S. Army Corps of Engineers (ACE) completed its directive to improve navigability, especially to maintain access to the Navy Yard, and to fill the unsanitary Anacostia marshes.[41] Some of the dredge material was used to fill portions of the western bank of the Anacostia near East Capitol Street, including the land currently underneath RFK stadium.

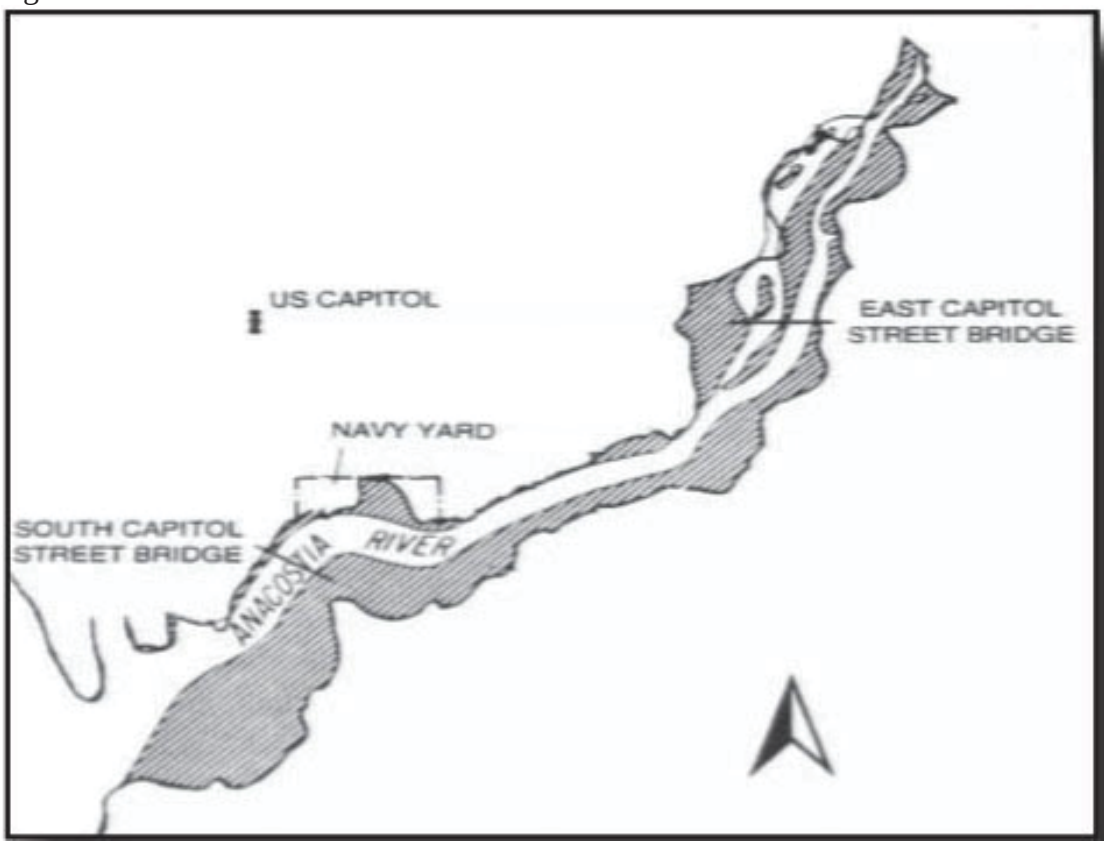
[41] May, Peter I. "Alternate State Theory and Tidal Freshwater Mudflat Experimental Ecology on Anacostia River." Doctor of Philosophy University of Maryland, College Park, 2007. Print. pp 2, 18.

Figure 3.18: Historic map by Hains from 1891 showing wetlands to be dredged and proposed city blocks. Benning Road cuts across the top. The red dot indicates the future RFK stadium.



(Source: Library of Congress)

Figure 3.19: Tidal Anacostia wetlands filled from 1902 to 1959.



(Source: Anacostia Watershed Environmental Baseline Conditions and Restoration Report)

In the latter half of the 20th century, rapid development in the watershed caused extensive sedimentation and many areas around Kingman and Kenilworth lakes became intertidal mudflats. Eventually, "large-scale wetland restoration projects at Kenilworth in 1993 and Kingman Lake in 2000 converted large areas of mudflats [back to] to emergent marsh".[42]

[42] May, Peter I. "Alternate State Theory and Tidal Freshwater Mudflat Experimental Ecology on Anacostia River." Doctor of Philosophy University of Maryland, College Park, 2007. Print. p 3.

Existing Habitat

About 50 percent of the ground plane is asphalt parking lot, which does not provide much for wildlife. There is a vegetated riparian buffer running the length of the shoreline of the site that the NCPC recommends "should be maintained to a minimum of 200 feet in width."[43] The buffer, which may provide habitat for small, edge utilizing species, is part of the Anacostia Waterfront Initiative, although its performance is not monitored.[44]

Priority Habitat Types

In DC's Wildlife Action Plan (WAP), DDOE's Fisheries and Wildlife Division has identified 13 habitat types as priorities for conservation. Prioritization was made based first on the number of "Species of Greatest Conservation Need" in the habitat type.

Threats to habitats were prioritized in the WAP as well, and "invasive/alien species" were the single highest threat to both terrestrial and aquatic habitats.[45] Other top threats to terrestrial habitats are recreation, fragmentation, dumping, and contaminants.[46] For aquatic habitats, other high-ranked threats are sedimentation, changes to hydrologic regimes, stormwater erosion, and pollution.[47]

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[43] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 14.
[44] Personal communication. Damien Ossi & David Zaidan.
[45] District Department of the Environment (DDOE). *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 4, Tables 10 & 11, pp 72-3.
[46] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 4, Table 10, p 72.
[47] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 4, Table 11, p 73.

Vegetation

The only existing element on the site that could be described as useable habitat is the riparian buffer made up of woody plants and a nearby, small meadow area. Plant material elsewhere on the site is turf with occasional trees. There are a few clusters and rows of trees of reasonable size and stateliness—they were possibly planted around the time of stadium construction so they are potentially over 50 years old.

Aquatic vegetation has suffered greatly from the Anacostia's poor water quality. In the late 20th century, some submerged aquatic vegetation (SAV) beds grew downstream of the East Capitol Street bridge, where "SAV species such as wild celery, coon-tail, hydrilla, water stargrass and milfoil were observed," however both hydrilla and milfoil are invasive, and recent decline has left less than an acre of SAV beds.[48]

Additionally, according to the aforementioned MWCOG report,[49] there was forest cover in the 1930s between C Street NE and Independence Avenue SE where the stadium building currently sits.

Wildlife

In DC in general, native wildlife species richness and populations have declined due to the typical factors such as habitat destruction and fragmentation, pollution, and competition with invasive exotic species. According to DDOE, progress on

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[48] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.3, p 21.

[49] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Fig. 10, p 15.

implementing the WAP is on-going and they are currently in the monitoring stages, thus no formal data for DC or the site itself are available at this time.[50]

There are no historic data that list species occurrence and abundance prior to development on the project site, however, it can be assumed that species common in freshwater tidal wetlands—which was the major historic vegetation of the site—were present in the area. Heritage and Kingman Islands are both home to species that have the potential to disperse to this site. Some general information on species by taxonomic group is given below.

Aquatic

The Anacostia watershed fish community includes approximately 93 species, and those with significant declines are the brown trout and blue-spotted sunfish.[51] One invasive species of concern in the introduced northern snakehead.[52]

Herpetofauna

Current numbers for amphibian and reptile species in the Anacostia watershed are "approximately 24 amphibian and 31 reptile species, respectively."[53] Critical habitat factors for these types of species to thrive are "streams and wetlands, woody and

[50] Personal communication with Damien Ossi, DDOE.
[51] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 49.
[52] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, Fig. 54, p 49.
[53] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 50.

herbaceous vegetation, downed logs and snags and direct connection to relatively large forested areas."[54]

Birds

Data for bird species are not as comprehensive as other groups of species, but what has been compiled suggests that "approximately 225 resident (breeding) and non-resident (migratory) species" exist in the watershed.[55]

Mammals

Given that mammalian predators and game species were decimated for the expected reasons, only "30 [mammal] species are now believed present," most of which are small rodents.[56] There has been some success in re-establishing two species: "river otters and wild turkeys have returned to the Anacostia" through US Fish and Wildlife Service efforts.[57] And, interestingly, by 1918, white-tailed deer and beavers were locally extirpated, whereas now deer are overabundant in many areas and beaver have "returned to almost every major Anacostia subwatershed."[58]

Species of Greatest Conservation Need

The 2006 DDOE Wildlife Action Plan provides distribution and abundance information for Species of Greatest Conservation Need (SGCN), which are

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[54] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 49.
[55] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 50.
[56] Galli, John, et al. ***Anacostia Watershed Environmental Baseline Conditions and Restoration Report***. Metropolitan Washington Council of Governments, 2010. Print. Sec. 5.16, p 51.
[57] Ibid.
[58] Ibid.

"indicative of the diversity and health of the District's wildlife."[59] Because these species are associated with ecological health in DC, their conservation is prioritized.

Figure 3.20: Summary Statistics of DC Wildlife by Taxa

Taxa	Total # species in DC	Total # SGCN	% SGCN
Birds	249	35	14
Mammals	53	11	21
Reptiles	47	23	49
Amphibians	29	16	55
Fish	90	12	13
Invertebrates	314	51	16
Total	**782**	**148**	**19**

(Source: DC WAP)

Kingman and Heritage Islands

Kingman and Heritage Islands, within the Anacostia River near the project site, currently provide wildlife habitat and species lists have been made.[60]

[59] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 3, p 44.
[60] http://www.kingmanisland.org/?page_id=106

Cultural

Pre-development

Figure 3.21: The site prior to stadium construction

(Source: Washington Post, http://www.washingtonpost.com/sports/slug-spredskins-d/2011/09/22/AFDMFb1G_gallery.html#photo=1)

As the project site was previously covered by or adjacent to wetlands prior to development, the cultural functions were likely to have been hunting (e.g., for waterfowl) and fishing (in the once abundant fisheries). The site "was primarily used as park and open space from the early 1900s until 1957 when Congress authorized construction of the stadium."[61] In an interview done by the Earth Conservation Corps, Julius Lowry reminisces about growing up on the Anacostia decades ago when

[61] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 4.

the river meant fishing, swimming, and a view across the water to a vegetated shoreline.[62]

Army Corps of Engineers Dredging

In the early 20th century, the Army Corps of Engineers (ACE) used gathered sediment from dredging the Anacostia to fill wetlands and create the land where the stadium and parking lots now sit. Kingman and Heritage Islands, also created with fill in 1916, overlook the project site and offer recreational opportunities such as birding, biking, picnicking, and outdoor classrooms.

Stadium Statistics and Use

Construction of RFK stadium, originally called District of Columbia stadium, started at the beginning of the 1960 and was completed in 1961 for an October opening. Designed by architect George L. Dahl, it was the first stadium designed specifically for multiple sports (baseball and football).[63] The stadium is owned and operated by DC, but the land is federally owned and leased to the city.[64] Many types of events have been held at RFK over the years, and the major uses are sports and concerts. The stadium was built before the Metro opened in 1976[65] and provided expansive parking lots to accommodate spectator vehicles.

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[62] Excerpt from the "Endangered Species" documentary by the Earth Conservation Corps. http://www.youtube.com/watch?v=ZYB80wSzUP0
[63] http://en.wikipedia.org/wiki/Robert_F._Kennedy_Memorial_Stadium
[64] Personal communication with David Zaidan, NCPC. 11/2013
[65] http://chnm.gmu.edu/metro/

Figure 3.22: Major uses for RFK stadium

(Data Source: Wikipedia, Comcast SportsNet Washington)

Layout

The stadium's location due east of the Capitol building, situated on East Capitol Street, is significant to L'Enfant's visionary urban design for the city. L'Enfant's plan was rooted in symbolizing democracy by linking intersecting squares representing individual states visually. He ranked the importance and size of the public space by the number of diagonal avenues that led to it. The most important public place was the Congress House (now called the Capitol) that was linked to the President's House (now called the White House) by Pennsylvania Avenue honoring the previous seat of the federal government. Because the Capitol building represents the people, it can be argued that the quadrants dividing the city into four parts would have its nexus here. NCPC names the RFK site as a key location in the Extending the

Legacy Plan.[66] This river edge location was previously the terminus of East Capitol Street, but the Whitney Young bridge, constructed in the 1950's to alleviate traffic, extends this axis.[67]

Infrastructure

Major city infrastructure makes the project site very accessible. Transit stops within two blocks of the site include the Stadium-Armory Metro station and MetroBus stops B2, D6, E32, 96, and 97.

Figure 3.23: Proximity of Stadium-Armory Metro station and MetroBus bay

(Source: Google Maps)

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[66] NCPC. *Extending the Legacy: Planning America's Capital for the 21st Century*. 1997. Print. "Map of Key Locations." p 66. http://www.ncpc.gov/DocumentDepot/Publications/Legacy/Legacy_Map_of_Key_Locations.pdf

[67] http://en.wikipedia.org/wiki/Whitney_Young_Memorial_Bridge

Recreational opportunities in or near the project site other than at the stadium and islands include the Maloof Skate Park, events held at the DC Armory such as the one-time or occasional Washington Auto Show and the Annual Summer Fancy Food Show, and recurring events such as DC Rollergirls bouts,[68] hiking or biking along the Anacostia Riverfront Trail, and fishing in the river.

Development Plans

There have been plans for redevelopment of the project site put forward, largely in response to an assumption that DC United would soon build a new stadium elsewhere and therefore vacate RFK.[69] United's move to another location would allow the sizable area to be redeveloped to suit both local and federal needs. The main elements of NCPC's plan are mixed use, commemorative facilities, a monument, and park space; the plan identifies the terminus of East Capitol Street to be ideal for a cultural work with "signature architecture."[70] Wildlife are briefly mentioned among the energy and stormwater focused environmental recommendations where it is asserted that the riparian buffer should be maintained at a minimum width of 200 feet.[71] It should be noted that this buffer, which is a part of the Anacostia Watershed Initiative, is not a part of the lease agreement (where the city agrees to use the land for stadium related purposes only) and remains parkland.[72]

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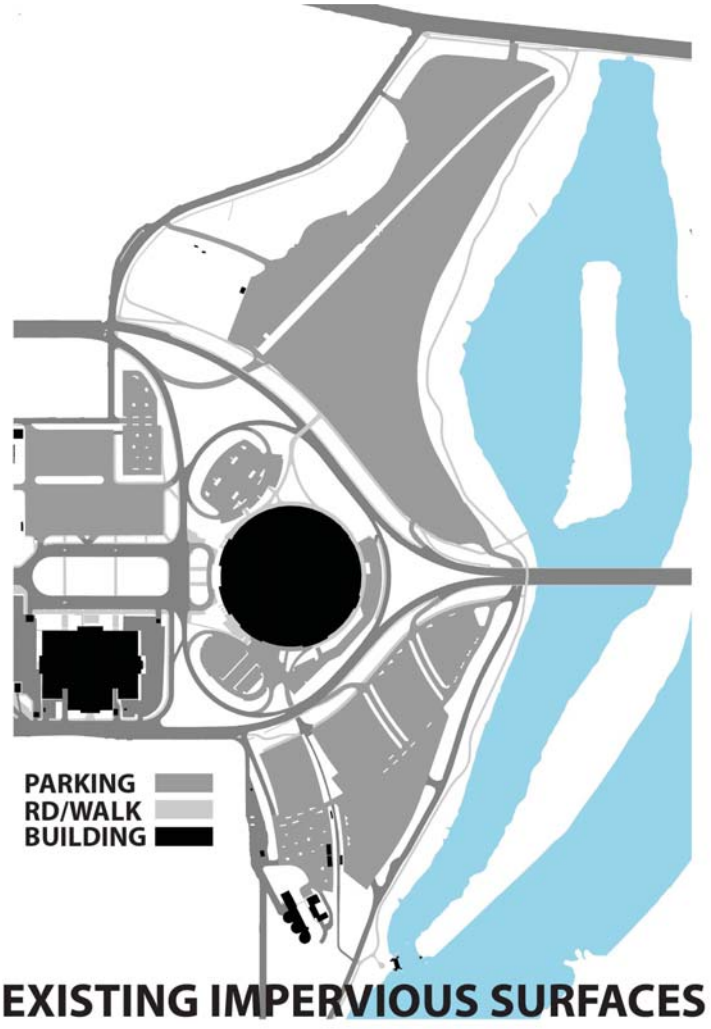
[68] http://www.dcsportsent.com/AboutUs/EventsInReview.aspx
[69] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 3
[70] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 11.
[71] NCPC. *RFK Stadium Site Redevelopment Study*. 2006. Print. p 14.
[72] Personal communication with Stephen Syphax. National Park Service. 2/1/2013.

Chapter 4: Site Analysis

Introduction

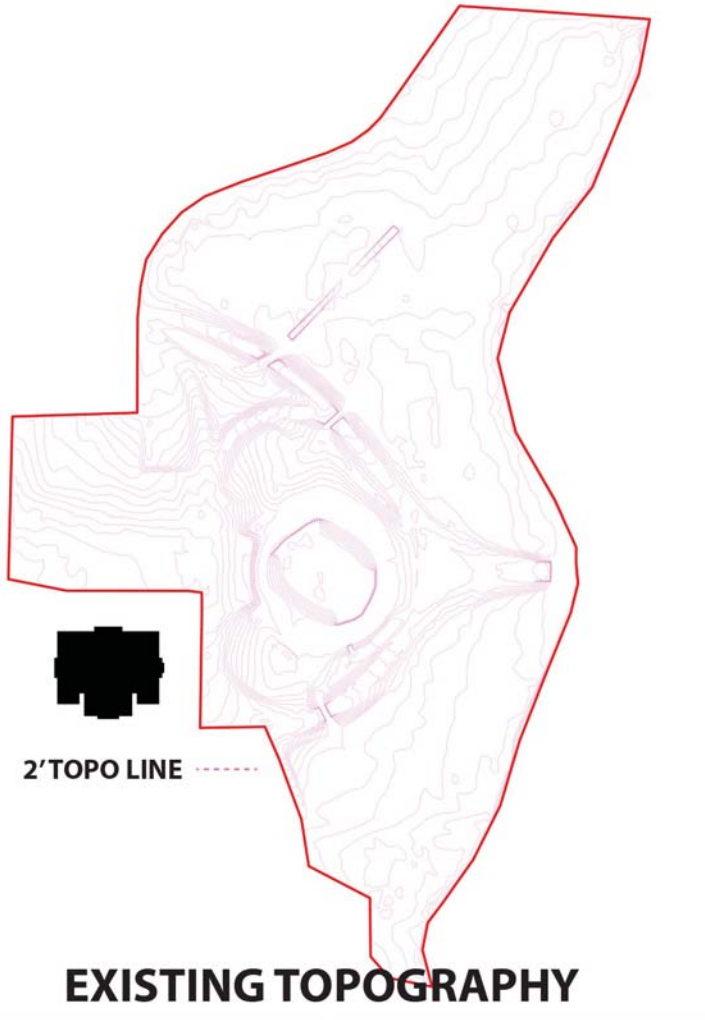
The site and its context were examined in many layers, and these layers are shown in the following diagrams. Significant elements of opportunity and constraint are discussed in further detail below the diagrams.

Figure 4.1: Existing Impervious Surfaces



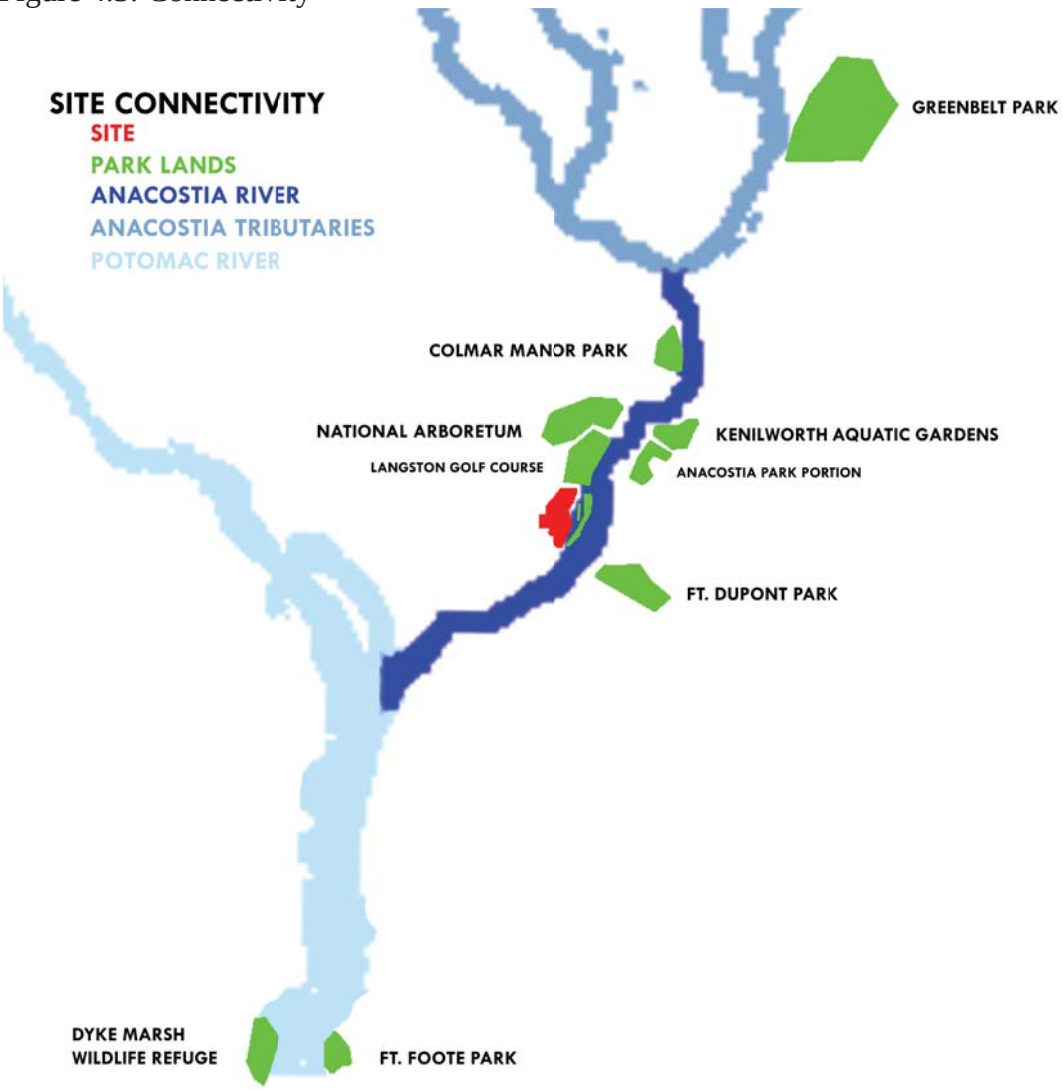
(Data Source: DC GIS)

Figure 4.2: Existing Topography



(Data Source: DC GIS)

Figure 4.3: Connectivity



Opportunities

Wildlife

Designing space for wildlife in the DC will offer a place for some of the species which were evicted decades ago from the site and its surrounding areas due to human development and may also provide places for species in nearby areas who are currently being displaced, also due to human development. The site can potentially

serve as a connection or stop-off point for species with larger ranges or migratory needs.

People have a natural affinity for wildlife (also known as biophilia). Bringing urban dwellers and visitors to our nation's capital into an immersive wildlife habitat experience can both educate and inspire: to teach people about the wildlife themselves and the many impacts of human development on different species and habitats, and to bridge the gap from interest to action because people are often passionate about causes which relate to their own experience. If people witness first-hand how wildlife and humans can coexist in urban realms, perhaps attitudes will change and thus future development could be more easily made less harmful to animals and more sustainable in general.

Parking Lots & Infrastructure

Of the nearly 180 acres (over 70 hectares) of the site, about 74 acres (30 hectares), or over 40 percent of the site, are currently parking lot, most of which is quite flat. Adding in the stadium, the impermeable area increases to 84 acres (34 hectares), which is over 46 percent of the site, not including roads and sidewalks. Removing the current impervious asphalt in these areas to create habitat will drastically reduce runoff to the Anacostia. Habitat creation, which requires a much higher diversity of plants and healthier soils than exists onsite, will automatically provide natural remediation of pollutants.

Much of DC's green space is in small parcels (and many typical urban parks are largely trees and turf, which serves only a subset of species), and often wildlife species require larger tracts. Although there are species that cannot be

accommodated on the site in this regard, there are many that can who may not otherwise find appropriate conditions so close to a city center.

Materials recycling and/or reuse is practical for the site and would contribute to reducing the wasteload in landfills and a more sustainable project. Lacking construction drawings of the stadium, it is difficult to make a reasonable estimate of the amount of materials. The intent, however, would be to reuse as much material as possible through recycling on-site with portable recycling machines.

The existing roads sit on some of the higher elevations in the site, offering places for overlooking the lower elevations and river. Additionally, the underpasses that were constructed originally for pedestrians to go to and from the stadium and parking lots can be retained for wildlife use. As it occurs in Central Park, this means there is already built into the site some means for wildlife to cross road boundaries without the threat of vehicle collision.

Location

Heritage and Kingman Islands, home to successful marsh restoration projects and many wildlife species, are adjacent to the site, which means there is potential natural dispersal of wildlife to the site. Habitats created on site will support the species already residing on the islands. Additionally, the National Arboretum is less than a mile up the river and the Kenilworth Aquatic Garden just over a mile, so the proposed wildlife habitats on the RFK site extend an already strong natural riparian condition on the lower Anacostia. There is an opportunity through the proposal of creating habitat to decrease some of the pollutant levels in the Anacostia, although certainly this one site cannot singly clean the river.

The site can support walkability, being Metro accessible and with the Anacostia Riverwalk Trail (ART) running the length of the eastern edge of the site.

The Whitney Young Bridge, under which the ART crosses, was designed primarily for function. Although it was clearly not designed to be visually iconic, it has an intriguing view when standing on the path underneath it, looking straight out to the water toward the bridge supports. This view, as a geometrically formal visual, can potentially provide an aesthetic foil to the much less structured look of any of the variety of habitat types. The view to the site from the bridge when traveling west may also be significant, in that the Capitol building could potentially be seen in the distance.

Riverfront access is important and there is potential on the site to not only give people a chance to experience a river's edge, but also the uncommon experience of being in a natural setting on an urban river's edge. This is also in line with overall plans by DC to improve the waterfront along the river (Anacostia Waterfront Initiative).

Being adjacent to the Armory offers the potential for spontaneous visits by people who attend Armory events.

The playground equipment along Oklahoma Avenue indicates a need to provide recreational amenities for neighborhood youth. This can be accommodated in the western, "more urban" edges of the site where there is likely to be new development for mixed use and institutional buildings.

There is potential to partner with local schools, such as Eastern High School and Eliot-Hine Middle School (located one block west of the site) or the Living

Classrooms DC program, which already has invasive species management programs on Heritage and Kingman Islands.

Constraints

Wildlife

Due to the extreme difficulty of creating and preserving habitat for species with special conservation status in the first place, it is improbable to impossible that endangered, critically imperiled, and rare species would naturally migrate to the site. This improbability is unfortunate, as one goal of this project is to find ways to increase urban wildlife biodiversity, and it means that those species which especially need habitat will not be able to be accommodated on this site. Additionally, unless an introduction program for some of the hoped for species were to be created in conjunction with this project, I can design with the best available knowledge and intentions but can only hope that species will make the site their home, due to the variability of species needs and behavior, and the unpredictable way some species can or cannot adapt in certain urban situations.

Because the site is in a city, there is a high risk of invasive plants and animals, as well as aggressive native species that are considered nuisances, colonizing the site. Invasives and aggressive natives have multiple options for dispersal onto the site, including flight (Canada geese, starlings, etc), ambulation (rats, etc), wind and water (plant seeds, northern snakehead, etc). These types of species can outcompete more rare and sensitive species in urbanized areas. This means that successful habitat design relies partially upon programs to manage for invasive and nuisance species.

Parking Lots & Infrastructure

Although the parking lots and stadium will be removed, there will still be quite a bit of edge habitat, mainly on the western side, where the site meets the typical urban condition.

As this project assumes existing major road routes cannot be changed, there will be some mitigation of road conflicts by removal of smaller roads, but disturbance of habitats will persist where major roads run through them. The main disturbance factors to wildlife regarding roads are noise, pollution, and both injury and fatality to wildlife struck by vehicles. (Of course, vehicle collisions also can cause property damage, injury, and death to humans.)

Although there are three large, existing underpasses for two roads (C Street and Independence Avenue), the more options for wildlife to cross over or under traffic, the better. Additional crossings will be necessary to accommodate species of different sizes and to provide all species with numerous options to travel across the site. These options are necessary so that prey species are not funneled into only a few places, which would create a sink[73] from which predators could easily pick off prey. It is most likely some parking will be needed for people visiting the site; at a minimum, compliance with the needs of handicapped visitors and maintenance vehicles must be met.

[73] The ecological meaning of the word "sink" is basically a population in which there is a net excess of mortality/emigration over reproduction/immigration. If left alone, the population would eventually go extinct.

Location

The pollution (mainly excess nitrogen, phosphorus, and sediment) in the Anacostia River may hinder the site's attraction for wildlife, as certain water-dependent species simply cannot survive in such waters. If many plant and aquatic species cannot survive in the river, those species which prey on them will be disinclined to come to or stay in the site. However, there are recently completed and future, planned projects that deal with some of the pollution, so there is an expectation that the water quality will improve in the future.

The proximity to the river's edge means riparian and wetland habitat types are suitable, not to mention historic, and will add diversity to the more common upland forest, which is suited to the western part of the site and exists elsewhere in DC (e.g. in the over 1,000 acre expanse of Rock Creek Park).

Although the site is close to Heritage and Kingman Islands, some species may be unable or have difficulty in travelling to the site, especially if they are incapable or disinclined to swim. Additionally, the connections from other areas of the city where wildlife may be are quite narrow—mainly this refers to the corridor along the river where the existing buffer likely provides the opportunity for some species to travel. The narrowness of this corridor may limit species ability to get to the site or slow their progress given that some predator and prey species may need to both use these same narrow corridors.

The Metro rail track running through the northern half of the site is noisy and dirty, and this will deter more sensitive species from inhabiting that part of the site, if not the entire site. There is a noticeable physical barrier in the concrete wall

surrounding where the rail track emerges from underground, however there are ways to go around it. The rail track could potentially be a safety hazard for wildlife, but the concrete wall does provide a barrier from the track itself.

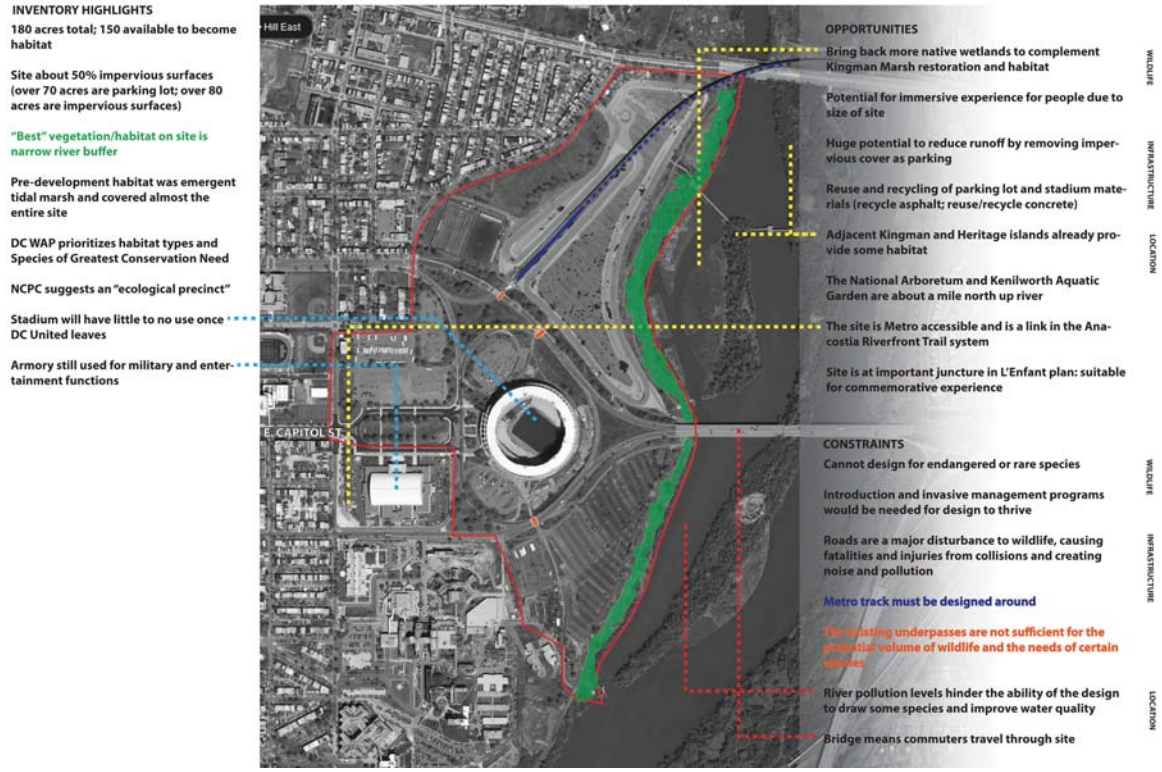
Being adjacent to the Armory does mean there is inflexibility in that particular side of the site as it is unlikely the Armory will be removed and the building blocks key views to the site from the Metro exit at 19th and Independence. Potential unification of the streetscapes that the Armory property and the site share also seem unlikely as it would require Federal resources and time.

The Whitney Young Bridge will remain, and its traffic and noise may deter some species. The area between the river's edge and where the bridge meets the ground on site (the only place wildlife can cross) is a relatively thin corridor, which is not the optimal situation for a wildlife corridor. Additionally, the area currently under the bridge is rather unpleasant for people, given the random hodgepodge of surface materials (mostly asphalt), along with an assortment of orange construction barrels and jersey wall sections.

The Langston Golf Course's proximity to the site may mean that Canada geese are frequently nearby and efforts must be made in design to deter geese, as they can easily decimate vegetation, especially in newly established wetlands.

Major conclusions from the opportunity and constraint analysis are visually illustrated in Figure 4.4.

Figure 4.4: Inventory and Analysis Summary



(Image Source: Google Earth)

City Planning Efforts

Several recent planning projects and studies are relevant to the site. The following are brief descriptions of these efforts and my project response. The most significant is NCPC's 2006 "RFK Stadium Site Redevelopment Study,"[74] which assumes that DC United will discontinue using the RFK stadium, as has been noted in major media numerous times in recent years. Additionally, through a conversation with an NCPC representative where it was explained that the stadium building itself has been determined to have little or no redevelopment value,[75] and as it also does not fit the intent or character of my proposal, I have concluded that the building is not

[74] http://www.ncpc.gov/DocumentDepot/Publications/RFKStadiumStudy.pdf
[75] Personal communication with David Zaidan, NCPC

worth keeping. There is great potential for repurposing materials, namely the extensive concrete needed for a building of such scale.

Making the RFK site an "ecological precinct" is mentioned early in the NCPC study, along with the desire to ensure "that the site is developed as an ecological site, as envisioned in NCPC's Legacy Plan." The RFK study itself does not go into extensive detail regarding what the ecological precinct means, providing instead some key high level environmental recommendations, such as constructing green/LEED buildings, stormwater management cisterns, and wetland and rock gardens along the shore for stabilization. These points are important, but an ecological precinct should include wildlife if by "ecological" they mean "of or relating to ecology," because ecology is the relationship between organisms and their environment. The term "organisms" clearly includes wildlife, however wildlife are only referenced in the study in the context of maintaining the riparian buffer. On a finer detail, the study lists the main portion of their site (about 80 acres) as being "active recreation," and much of that type of amenity, like ballfields and community centers, may not provide adequate habitat for wildlife, and indeed some infrastructure can be detrimental. Although I believe this NCPC study is a starting point for considerations and context of the site, this thesis takes a much stronger stance on developing the full potential of this site to be a complete ecological precinct. This stance means an approach to ecology that does not function mainly for humans (such as cleaning the water supply and preventing erosion so we can keep the same amount of waterfront to visit/develop), but includes thorough accommodation for the spaces and elements that other species need.

A related document is NCPC's "Extending the Legacy" plan. Although this largely regards the framework of L'Enfant's vision for DC and the network of commemorative spaces throughout the city, there is a key section in this Legacy plan with some language that fits surprising well with my proposal for the site:

> "East Capitol Street will become the link between the traditional Monumental Core and the Anacostia River. While the existing Capitol Hill neighborhood of quiet streets and historic row houses will remain undisturbed, the Anacostia waterfront will be transformed into a new ecological precinct, with the river and parks as the centerpieces and environmental stewardship as the theme. The area will celebrate parks, islands and wetlands; an aquarium is proposed for Kingman Island. The RFK Stadium site, now mostly parking lots, will contain a major memorial, surrounded by new housing and commercial development. This proposal for the Anacostia waterfront would not only increase total park acreage in the District, but also make it more accessible to more people for more activities."[76]

There is no better way to celebrate parks, islands, and wetlands than to design a place that whole-heartedly welcomes wildlife, includes new wetlands and other native habitats, which anyone can visit.

Smaller scale projects proposed for nearby areas are also relevant. There have been several iterations of mixed use development plans for the area known as Hill East, or Reservation 13, which is south of the Armory and west of the large southern RFK parking lot. According to the DC Government's website, "the District plans to redevelop 50 acres at Hill East into a vibrant, mixed-use urban waterfront community in accordance with the Hill East Master Plan approved by the DC Council in 2002."[77] The plan will include up to 16 acres of park space. The Washington Examiner

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[76] NCPC. *Extending the Legacy: Planning America's Capital for the 21st Century*. 1997. Print. "Unifying the City and Core," p 20.

[77] http://dmped.dc.gov/DC/DMPED/Projects/Anacostia+Waterfront+Initiative/Anacostia+Waterfront+Neighborhood+Projects/Hill+East+Waterfront+Redevelopment

reported in October 2012 that the city is following a phased approach and requesting interest from developers for two parcels closest to the Stadium-Armory Metro station.[78] Although it may take time and look different than the initial plan iterations, my approach to Hill East is that mixed use development will occur and my proposal will respond to this as appropriate where the sites share a border.

Another smaller plan has been proposed by Demian Wilbur Architects regarding roughly the northern half of the RFK site.[79] This proposal takes NCPC's suggestion to develop the large northern parking lot area for active recreation. Thus there are numerous sports fields and facilities, as well as a pavilion for a farmer's market, a Capitol BikeShare station, and educational facilities. The educational facilities have a clever green roof that people can access and the parking area includes solar shade structures.[80] Similar to the RFK study and NCPC Legacy plan, I commend the environmental interventions, however much of the Demian Wilbur plan does not fit the intent of my project. Additionally it is unclear from the sources if the project has been approved or is likely to be in the future.

This thesis includes some facilities for the active recreational needs for the neighborhood, however these facilities will not take up nearly the space as these other studies use. I note the potential too for the nearby high school and middle school to provide some active recreation facilities, although I am aware that perhaps these

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[78] http://washingtonexaminer.com/d.c.-seeks-developers-for-east-capitol-hill-near-rfk/article/2510149#.UKElRIV1R0w\

[79] Capitol Riverside Youth Sports Park. Demian Wilbur Architects. http://www.capitolriverside.org/ & https://docs.google.com/file/d/0B9hnbEr_VomARy1hTnIwZ2ZrQVk/edit?pli=1

[80] https://docs.google.com/file/d/0B9hnbEr_VomARy1hTnIwZ2ZrQVk/edit?pli=1

conversations have already occurred and this avenue perhaps did not provide what was deemed adequate.

Chapter 5: Precedents & Inspiration

Pairing background research and analysis of the site with relevant precedent projects and inspirational work and images is the legwork for an informed and interesting design. Three projects in particular spoke the language I began to hear from the site during inventory and analysis.

Red Ribbon Park

Red Ribbon Park (2008) by Turenscape exemplifies the minimalist touch in a natural area in a city. The Red Ribbon is a 20 hectare park (about 5 times smaller than my site) in Qinhuangdao City, Hebei Province, China. According to Turenscape, the "major design challenge was how to preserve the natural habitats along the river while creating the new urban uses of recreation and education."[81] And although this project had existing habitat, my site is essentially a "clean slate" to begun anew as habitat. Turenscape found an elegantly simple answer to its need to merge preservation of habitat with urban recreation. That answer is the "red ribbon" bench that inspired the park's name.

Figure 5.1: The red ribbon in the woods

(Source: Turenscape, http://www.turenscape.com)

[81] http://www.turenscape.com/english/projects/project.php?id=336

Figure 5.2: The red ribbon along the Tanghe River

(Source: Turenscape, http://www.turenscape.com)

The ribbon itself is elegant in its simplicity yet multifunctionality: running the length of the park, it provides visual continuity and a sense of place to visitors, as well as seating, lighting, and even small planting openings within it. Created with fiberglass, the bench was made at a local airplane manufacturing plant that was no longer in operation, thereby reusing existing infrastructure. The continuity of form and its vivid red color provide a cue to sighted visitors that this is where people are allowed and encouraged to be in the park. This cue is important in an urban park with habitat where it is best to keep human travel only in particular areas of the site in order to minimize trampling and disturbance to sensitive flora and fauna.

Zhongshan Shipyard Park

Another Turenscape project, Zhongshan Shipyard Park in the city of Zhongshan, Guangdong Province, China is 11 hectares (26 acres) built on the site of an abandoned shipyard. Important environmental principles were followed such as preserving existing vegetation, planting only natives, and reusing or recycling old

industrial remnants from the shipyard such as docks and machinery.[82] The park celebrates the commonplace by referencing the old industrial uses and by saying that "Weeds are beautiful" too.[83] This nod to previous uses on a site with preserved and native vegetation "demonstrates how landscape architects can create environmentally friendly public places full of cultural and historical meaning."[84]

Figure 5.3: Native flora and reused industrial structure paired in the city

(Source: Turenscape, http://www.turenscape.com)

[82] http://www.turenscape.com/english/projects/project.php?id=71
[83] Ibid.
[84] Ibid.

Baltimore National Aquarium

The landscape around the National Aquarium in Baltimore's Inner Harbor by Rhodeside & Harwell (2008) showcases the importance of native plant species for native wildlife. There are instances where it seems you aren't in a city, and there are views where the cityscape is unmistakable. Educational elements include extensive descriptive signage with images and speakers embedded within the planting areas that emit sounds such as croaking frogs and chirping birds. The focus of the design is on the habitat types and species associated with the Chesapeake Bay watershed.

The potential for this area to be beneficial to wildlife is minimal given the small size of the planting areas—the largest being roughly 70 by 25 feet. The only probable (vertebrate) wildlife to utilize these areas are small birds, and likely those already common in urban areas or this area in particular. Regardless, the plantings will be welcomed by any wildlife that use them and the clear aim for human users of the site is education, which is perfect for the streetscape in front of an institution such as the National Aquarium.

Figure 5.4: A habitat patch in the cityscape

Figure 5.5: A moment of natural immersion on Baltimore’s built-up waterfront

Several other projects and places offered intriguing and inspiring images and ideas.

Shangri La Botanical Garden in Orange, Texas (Jeffrey Carbo L.A.)

This simple building and path are clearly manmade but do not overstate their importance in the landscape.

Figure 5.6: Outpost building for rest and education

(Source: ASLA Awards 2012, http://www.asla.org/2012awards)

An observational structure offers vantage points, resting spots, and information for people while minimizing disturbance to sensitive animals (such as the nearby heronry on this site).

Figure 5.7: Observation bird blind for park visitors

(Source: ASLA Awards 2012, http://www.asla.org/2012awards)

Yongsan Park in Seoul, South Korea (West 8 and Iroje)

As described by the project team this "park shall regain the respect for nature and reclaims (sic) the lost and damaged ecological system. It will eventually become a park of new urban culture for the preservation of green spaces and a sustainable future."[85]

The small platform provides a space for people visiting while blending into the habitat.

Figure 5.8: Mandang meadow with a small gathering space

(Source: Bustler, http://www.bustler.net)

Observation areas from above provide a different vantage point from those on the ground.

85 http://www.bustler.net/index.php/article/yongsan_park_master_plan_by_west_8_and_iroje/

Figure 5.9: Observatory platform

(Source: Bustler, http://www.bustler.net)

Kenilworth Aquatic Gardens, Washington, DC

Even in mid-November, the Kenilworth Aquatic Gardens are full of life. Here are some of the most interesting moments from a visit in the fall of 2012. These moments inspired in me a desire to design a place where people can be just as excited as I was in my encounters with wildlife.

Figure 5.10: Great Blue Heron

Figure 5.11: Many fishes in a shallow pool.

Figure 5.12: A snake basks near the trail.

Figure 5.13: Presumed beaver tracks based on scale compared to my foot.

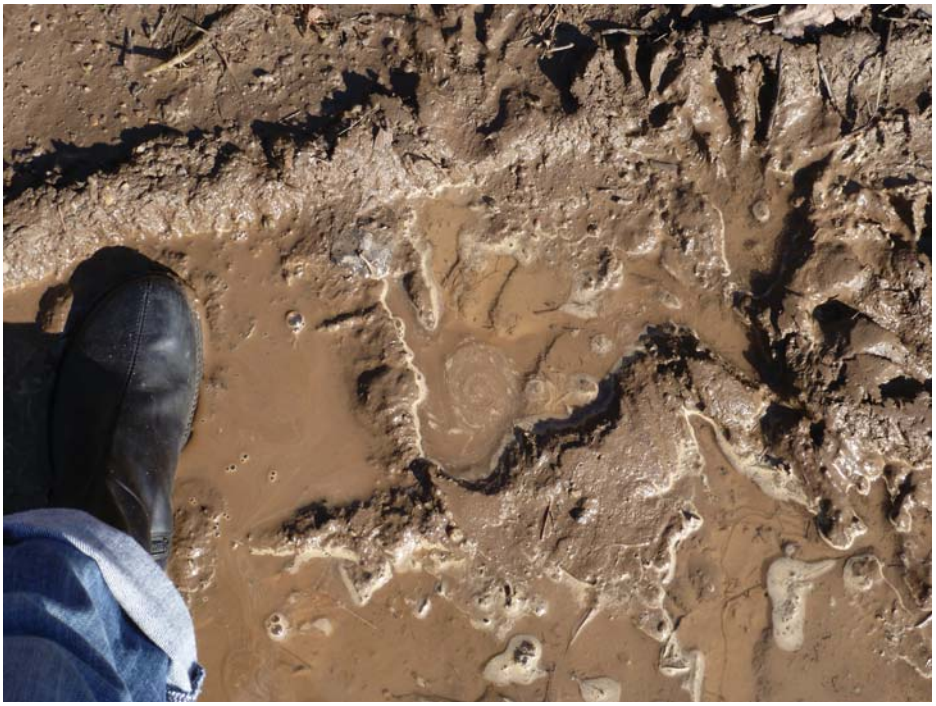


Figure 5.14: Downy woodpecker.

Figure 5.15: Trail-side grasses wave in the wind.

Fair Park Lagoon, Dallas, Texas (Patricia Johanson)

Within Johanson's work at Fair Park Lagoon, I saw organic shapes, although man-made, that seemed to grow from the surroundings. I knew I could learn from this project because it has achieved the goal of a beautiful space that is utilized simultaneously by people and animals.

Figure 5.16: A boy and a turtle.

(Source: Open Places, http://openplac.es)

Figure 5.17: A reptilian basker.

(Source: Patricia Johanson, http://patriciajohanson.com)

"What Rocks Know" by Grant Jones

An undergraduate degree in poetry allowed me to study the words that inspired me and to find new language. When I discovered Grant Jones' work, I knew that it would be important to my thesis even if only as an ineffable opportunity for contemplation.

Figure 5.18: Jones' poem

What Rocks Know

What rocks know,
Winds have forgotten,
But eagles see
Marks of love on the ledges.

What rocks feel,
Rivers remember;
And kingfishers taste
The kisses that drive cutthroat wild.

What rocks say,
Trees witness;
Peregrines in their spring
Courting, understand.

What rocks smell,
Clouds carry away
As swallows swirl higher
Among rising fires from your heart.

What the rócks hear
And the birds know
Cools your tongue
And springs breathing from the land.

Notes:
Sleeping Lady Mountain, Icicle River, August 1998; West Seattle, 2 January 2005.
Five measured stanzas of nine beats each (2,2,2,3) tap out the rhythms of the land without a break, like a drum. I call these nine-beat poems "novos".

(Source: Grant Jones self-published manuscript)

Wildlife-specific Structures

For wildlife species to thrive in the city, implementation of a few types of structures in the design will be required. Specifically, various types of crossings for roadways and elements for the breeding cycle such as nest boxes.

Wildlife-Vehicle Collision Mitigation

Collisions between wildlife and vehicles occur frequently, causing injury and death to many individual animals. If the rate of collisions with threatened and endangered species is high, there may be conservation implications. For the safety of wildlife and people traveling through the site, mitigation strategies for reducing collisions, based on the Federal Highway Administration's guidelines, were necessary for the design.

Figure 5.19: Large-scale underpass for larger animals, typically mammals such as deer.

(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

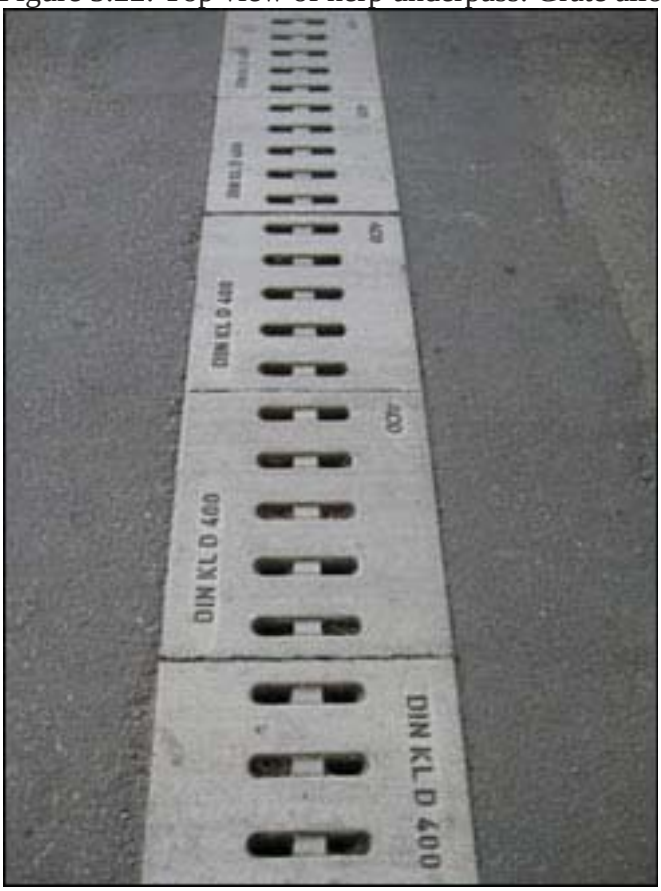
Figure 5.20: Short amphibian fence guides animals toward underpass.

(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.21: Typical herptofauna underpass. Set in ground to retain moisture.

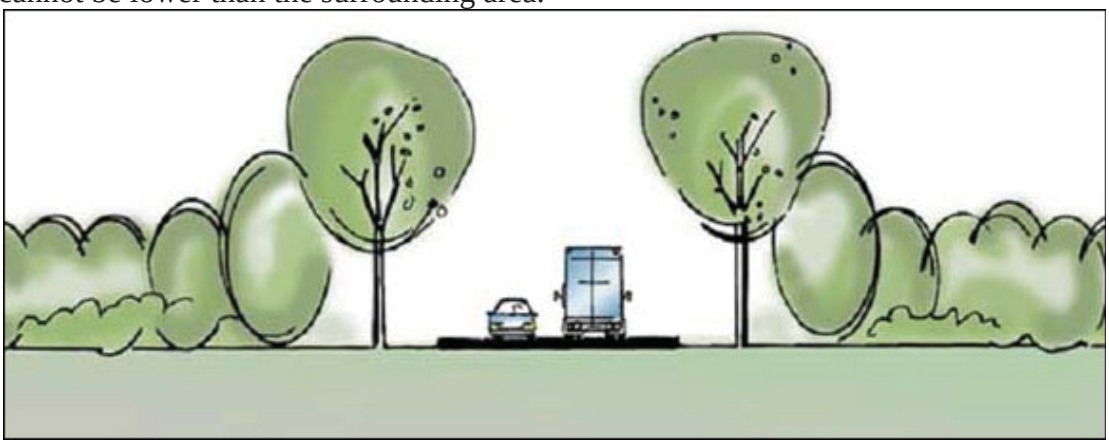
(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.22: Top view of herp underpass. Grate allows light and leaf litter to enter.



(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.23: “Hop-over” planting encourages birds to fly over traffic where roads cannot be lower than the surrounding area.



(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.24: Manmade structures such as poles placed along roads can also encourage above-traffic flyover.

(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.25: Speed bumps slow traffic, allowing drivers to see and evade wildlife more easily.

(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Figure 5.26: Wildlife crossing signs and reduced speed limits encourage attentive driving.

(Source: Federal Highway Administration, http://www.environment.fhwa.dot.gov)

Nesting Structures

Some species can benefit from man-made nesting structures such as nest boxes and platforms, in addition to the naturally occurring materials and cavities. Man-made structures do not replace natural structures; they can, however, supplement natural structures by providing additional resources in a limited area.[86] Although the scope of the design for the project cannot get into fine details, such as choice of materials or predator guards, and exact placement of boxes, I suggest that for decisions regarding these elements, the current guidelines of appropriate organizations and experts can be followed, such as the Wildlife Habitat Council and Bat Conservation International.

[86] http://www.wildlifehc.org/new/wp-content/uploads/2010/10/Artificial-Nesting-Structures.pdf

Chapter 6: Methodology

In designing for wildlife, two major elements to study and consider are the habitat types and the wildlife species. First, I had to decide which habitat types were appropriate for the site and what species for which to design. The DC WAP[87] describes the city's needs and intent for conserving wildlife and natural areas. Wildlife Action Plans are required by Congress of each state and territory (which includes DC) in order to receive certain federal funds. These "proactive plans, known technically as "comprehensive wildlife conservation strategies," assess the health of each state's wildlife and habitats, identify the problems they face, and outline the actions that are needed to conserve them over the long term."[88] Focusing on the Species of Greatest Conservation Need (SGCN), the WAP defines the selection criteria for determining the SGCN and provides information on each individual species.[89] Additionally, the species were divided into their habitats and the habitats were prioritized. As mentioned earlier, the major factor in ranking was the number of SGCN utilizing the habitat. (For more details on selection and prioritization of species and habitats, see the DC WAP.[90])

As a part of the WAP process, DDOE conducted a study of the city's habitats and wildlife species, which is on-going. The data include distribution, abundance, status, and trend for each species and the condition of habitats. (For more details on

[87] http://green.dc.gov/publication/wildlife-action-plan
[88] http://www.wildlifeactionplan.org/about/index.html
[89] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 1, pp 33-34
[90] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 1, pp 33-36

SGCN, related considerations, and a list of the species, see the DC WAP.[91]) In sum, the DC WAP determines that, as of completion of the plan in 2006, 148 of DC's 782 known species are considered SGCN.[92] The WAP lists the status and trend of all SGCN, which refer to how commonplace or rare a species is (status) and whether the population is declining or increasing (trend). In instances where these data are described as "undetermined," the term means "the status and trend is less understood, research and monitoring will be undertaken […] until populations, threats and effective actions can be identified."[93]

Which Habitats?

The DC WAP identifies 13 priority habitat types for conservation in DC as "habitat types that house greater numbers of species of greatest conservation need, as well as a larger acreage of land area."[94] Of the 13 habitat types listed in the WAP, nine are appropriate for the project site.

Decision Path

To determine which habitats to include on the site, I followed the decision process below.

[91] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 3, pp 44-49
[92] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 3, p 45
[93] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 3, p 49
[94] DDOE. *District of Columbia Wildlife Action Plan*. The District of Columbia Government, 2006. Print. Ch. 3, p 55

1. List DC WAP priority habitats (Rank)
2. Consider the history of the site landscape and ecology (the site was largely wetland prior to development)
3. Consider current site elevations, topography, and hydrology
4. Consider what habitats could benefit a wide variety of species and the WAP prioritization

The table below lists the decisions and reasoning for habitat inclusion, including which step(s) in the decision path were major determining factors.

Table 6.1: Decision Reasoning

Rank (STEP 1)	Habitat	Decision & Reasoning
1	**Rivers and Streams**	**No. The Anacostia River extends much farther than along the project site and the ability of the site to provide healthy river habitat is too impacted by upstream conditions. The project alone cannot solve the river's pollution.**
2	**Hardwood Forests**	**Yes. STEP 4: Canopy is very important to many wildlife species. In DC WAP top 5. Possibly STEP 2: Areas of higher elevation on and adjacent to the site are likely to have had upland forest cover prior to development.**
3	**Emergent Non-tidal Wetlands**	**No. STEPS 2 & 3: The Anacostia River is tidal.**
4	**Grasslands/ Managed Meadows**	**Yes. There is not much of this habitat type in the DC metro region. STEP 4: Meadows and grasslands provide habitat for myriad species, some of which also need forest cover and some of which need mostly/only open areas. In DC WAP top 5.**
5	**Forested Wetlands/ Riparian Woodlands/ Floodplains**	**Yes. STEP 2: Much of the site used to be wetland and certainly some of the entire river's edge prior to development would have been this habitat type. STEP 3: The site is a riparian ecotone and in the 100 year floodplain. STEP 4: Lowland and wetland areas serve a multitude of species native to the Chesapeake watershed, and canopy is important to many. In DC WAP top 5.**

6	**Early successional/ Shrub-scrub/ Edge**	**Yes. Site will be designed with numerous habitats and so succession will naturally occur. STEP 4: Highest ranked of those outside WAP top 5.**
7	**Emergent Tidal Wetlands**	**Yes. STEP 2: The historic wetland condition was largely emergent tidal. STEP 3: The site is currently quite flat and low in elevation, and most of it was fill (so it used to be lower). The site is adjacent to a river affected by the tides. STEP 4: Second highest ranked of those outside WAP top 5.**
8	**Urban Landscapes**	**N/A. There are plenty of this type already. Because the site is within a city, some portions of the site will have elements of urban design, but this type will not be included in the final ranking.**
9	**Tidal Mudflats**	**Yes. STEP 2: Low-lying areas can go back and forth between being emergent tidal wetland and mudflat, so this is also a natural condition for the area. STEP 3: The site is currently quite flat and low in elevation, which is conducive to mudflats. STEP 4: This type can benefit species which may not otherwise have much habitat in DC.**
10	**Springs and Seeps**	**No. My assumption is that these habitats are difficult to impossible to construct. STEP 4: Does not provide for a large number of species and ranked low by WAP.**
11	**Submerged Aquatic Vegetation (SAV)**	**No. While there was potentially historic SAV beds nearby, current ones are only in the Potomac River and the degraded water quality of the Anacostia is such that it seems difficult to establish healthy beds on site.**
12	**Vernal Pools**	**Yes. STEP 3: Elevation is low and site is near a river, thus created depressions could easily become vernal. STEP 4: All species need a water source; some SGCN are obligate vernal species.**
13	**Ponds and Pools**	**Yes. STEP 3: Ponds could easily be constructed on site. STEP 4: All species need a water source.**

From this table it was determined that eight habitats would be designed on the site. Initially, eight seemed like a lot of habitats even for a large site, however it is important to note that both the Vernal Pools and the Ponds and Pools habitats are really sub-habitats because they exist within other habitats. Given this, the result was a list of six major habitats and two sub-habitats to include in the site design.

Which Species?

Clients

As the focus of this project was creating wildlife habitat, my main clientele were the animals themselves. Designing for this voiceless population included the challenge of discerning in different ways what the clients needed on the site because the typical interview was impossible. Early in the process before design began, I endeavored to get to know my clients through existing scientific information. As I conducted research on each SGCN, I created a table to collect and organize basic information about each species, including what was potentially relevant to the design or just interesting to know. The DC WAP had much of the needed information and was supplemented by the Encyclopedia of Life website.[95]

I believe that building a rapport with clients can allow for better design by virtue of having a connection with them, and perhaps discovering a shared passion. So although some of what I read about would indirectly influence design decisions, I found that even something as simple as looking up images of the species allowed me to feel more connected to my clients and thus even more excited to assist them by designing a place from them in DC. It is hard not to want to learn more when you discover, for example, that common musk turtles are quite good at climbing trees.

Optimism

Certainly not all SGCN would actually inhabit the site, however the intent of determining a list of species to have in mind for design was to be optimistic towards

[95] http://eol.org/

what could *potentially* inhabit the site once the habitats were established. Further consideration included determining if either animal movement was possible to the site or introduction programs should be administered for the site. (For the purposes of the project, I assumed that introduction programs for some species would be possible.) In a sense, the list of species I studied is a "wish list" of what I hoped could utilize the site, in which I acknowledge some species are likely to come and some are not. The species that are less likely to come are still included because, philosophically speaking, if we ever want to increase biodiversity in more built-up areas, we must always consider the rarer cases and do our best to accommodate them—they surely will *never* come if we never design with them in mind.

Species Matrix[96]

The species matrix, a spreadsheet compiled to organize the information learned from the SGCN research, includes an extensive amount of information and details decision processes and criteria. Columns include Status, Trend, Territory Size, Migration Distance, Habitat Type, Feeding, Resting, Breeding, Nesting, and Notable Characteristics, as well as columns related to DDOE's species counts on Kingman and Heritage Islands, and ranking systems. Using information from the WAP, the Encyclopedia of Life website, and DDOE species counts, I determined which habitat types each species uses.

[96] See Appendix 2.

Decision Path

Initially, part of the intent for the Species Matrix was to have a system for determining which SGCN to design for and which to exclude from design consideration. However, once the appropriate habitats were chosen, there was less of an imperative for narrowing down a sub-list of species. If I was going to include certain habitats in the design, I surely should not exclude from consideration any species that technically may utilize any of the chosen habitats. Given my aim at optimistic design, this seems appropriate. The only species excluded from design consideration were common urban species (as explained in the so-titled section below), fish, and invertebrates. (It should be noted that the DC WAP included six major taxonomic groups of wildlife: Birds, Mammals, Reptiles, Amphibians, Fish, and Invertebrates.) Fish were excluded essentially for the same reason that Rivers and Streams were excluded from the habitat list. Invertebrates were not excluded because they are not important, being a major food source for a vast number of other species, including many SGCN. Rather, information on specific invertebrate species was minimal in the DC WAP and it is beyond the scope of this thesis project to become an expert on invertebrates. Aside from that, designing *for* invertebrates is different than other types of wildlife, largely due to the much smaller size of most of the species; such design may not be possible for many invertebrates. Thus, for this project's design, "wildlife" refers to vertebrate, terrestrial and semi-aquatic species.

Common Urban Species

The list of SGCN in the DC WAP includes species needing conservation and therefore it does not include common urban species. Such common species were also

added to the Species Matrix (and noted as being non-SGCN), based on Table 3.6 from Adams and Lindsey.[97] As the major intent is to design for increasing biodiversity, the main focus needed to be on SGCN. Species that are common in typical urban areas are there because they have adapted to places with extensive human impacts and presence, and therefore do not need special consideration. Their lack of import in methodology does not mean they were wholly ignored in design. In acknowledging that species such as white tail deer and raccoons are likely to utilize the site, I had these species in mind while designing elements such as the wildlife road crossings. Additionally, nuisance issues regarding common urban species were considered. For example, in design there was a strong desire to avoid large, open areas of lawn or groundcover vegetation as this could attract Canada geese, which have been known to decimate wetland flora.

Umbrella Species

Early in the research phase, I did create a ranking system to determine a sub-list of umbrella species, which was to be a group that included at least 1 or 2 species from each of the four taxonomic groups. Eventually, it began to feel as if designing with only certain species in mind would mean ignoring the other SGCN, which did not fit with the idea of designing for biodiversity or the character of the thesis project. The real next step was *how* to design for myriad species and habitat types. Therefore, the idea of using exclusively umbrella species in design thinking was abandoned for an approach that included flexible and sometimes overlapping grouping of species based

[97] Adams, Clark E., and Kieran J. Lindsey. *Urban Wildlife Management*. Boca Raton, FL: CRC Press, 2010. Print. Table 3.6. p 61.

on several factors: taxonomic groups, physical size, and general habitat needs. This approach was realistic given that decisions would soon need to be made considering how wildlife would travel across and utilize the site, such as the size of road crossing structures.

Habitat Use By Species

Ecotone Graphs

Species matrix data were used to create four graphs showing which habitats each species uses along the gradient, or ecotone, from the upland, terrestrial side to the lowland, semi-aquatic. Each graph represented one taxonomic group. The ecotone graphs visually organized information from the species matrix and offered a quick view of which species use many habitats, which use only one or a few, as well as which habitats are used more or less than others. Other more specific data shown on the graphs, depending on taxon, include indications of nesting circumstance (terrestrial or submerged) and range type (resident or migrant).

Figure 6.1: Ecotone Graph for Amphibians

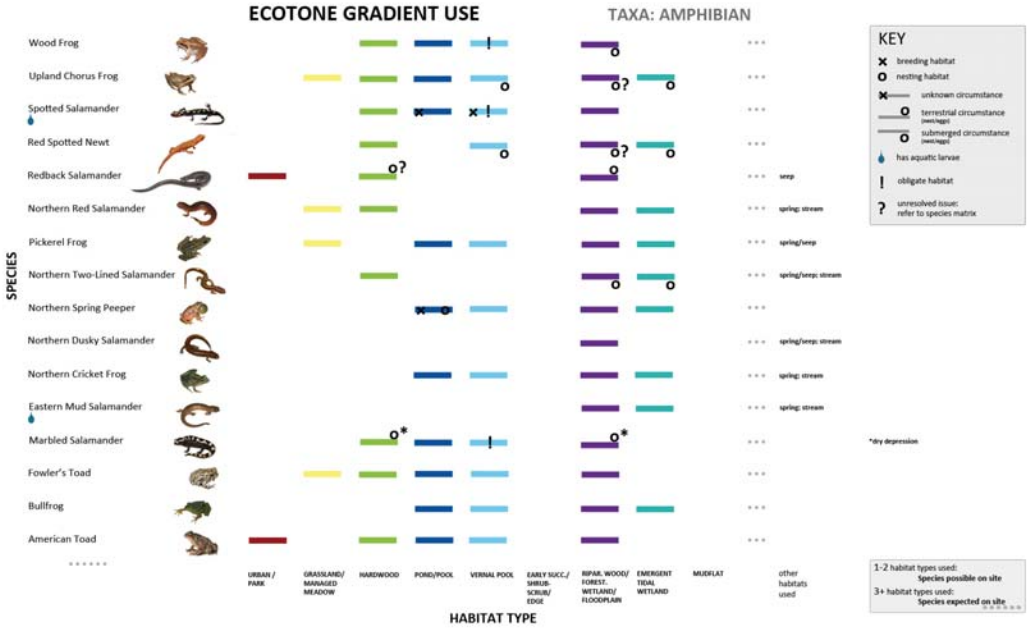


Figure 6.2: Ecotone Graph for Birds

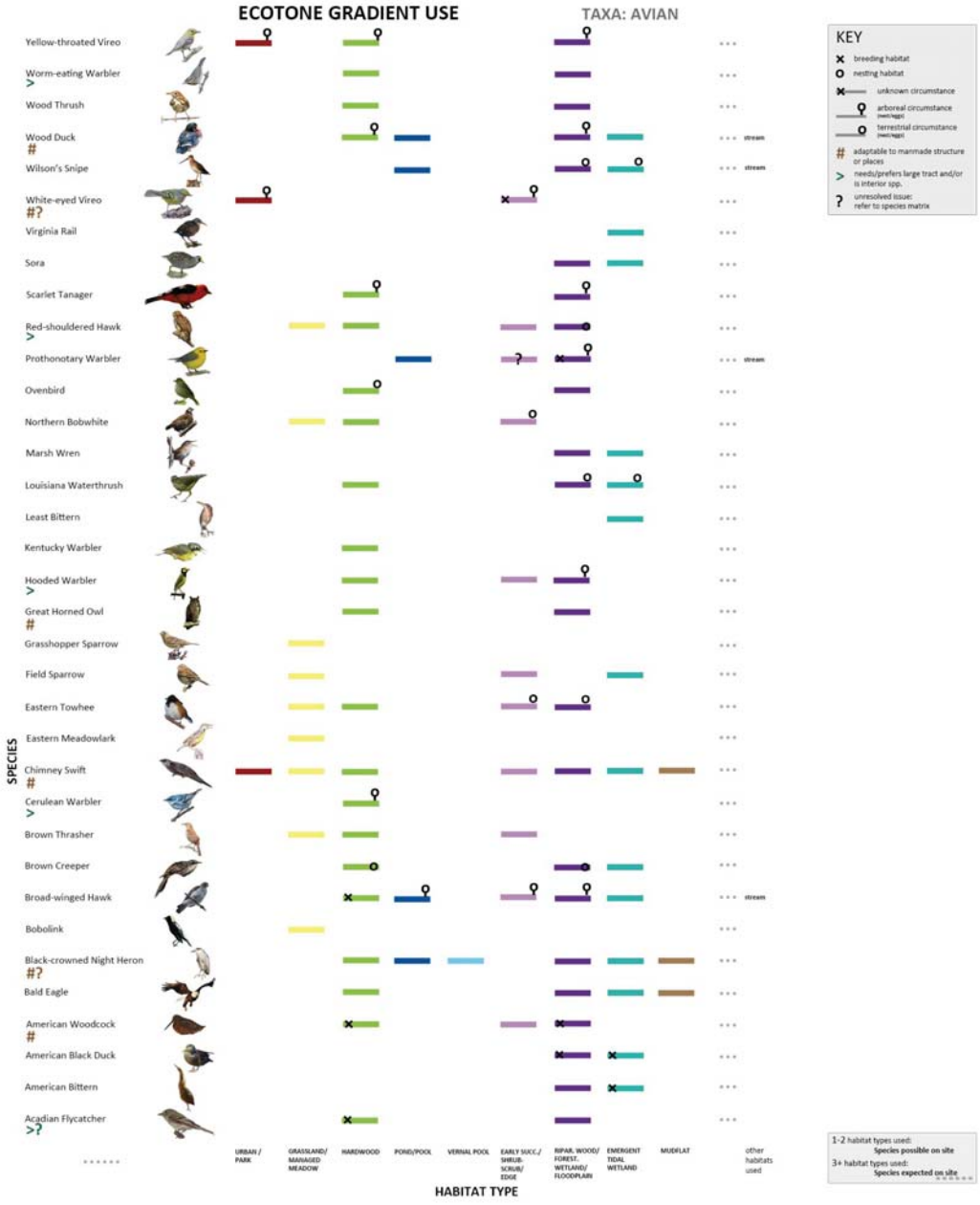


Figure 6.3: Ecotone Graph for Mammals

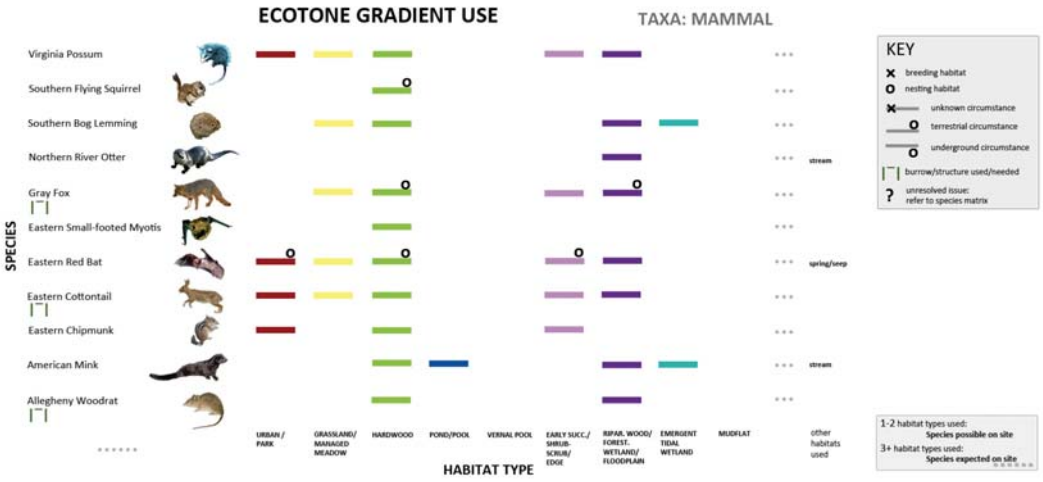
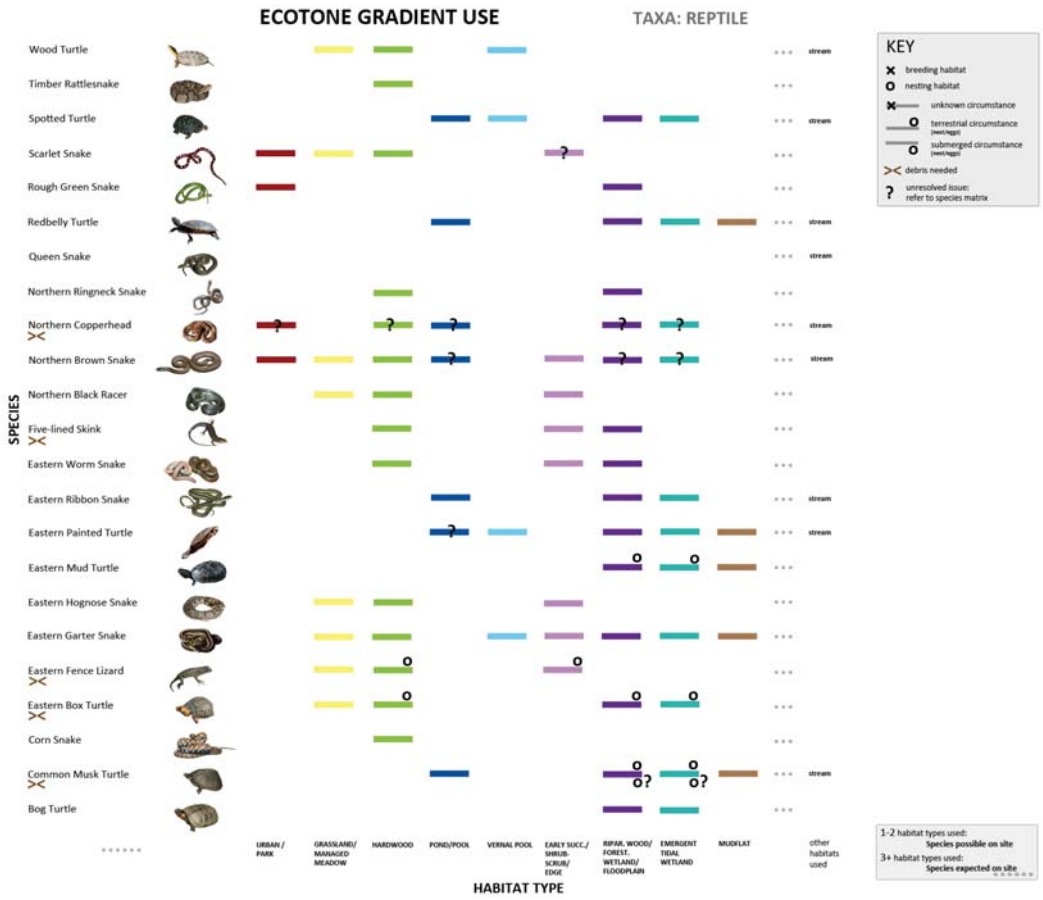


Figure 6.4: Ecotone Graph for Reptiles



The order of the habitats along the x-axis of the graphs was intentional, with the left-most habitats being upland, the central habitats being edge habitats or sub-habitats (those which are within other habitats), and the right-most being lowland or semi-aquatic. In this way, the order of the habitats from left to right roughly mirrors the site grade condition from west (higher elevations) to east (lower elevations down to the river). The Urban/Park habitat type is included on the far left because the western edge of the site is clearly the transition area from the urban grid to the habitat areas. This transition, the urban-habitat or human-wildlife ecotone, became

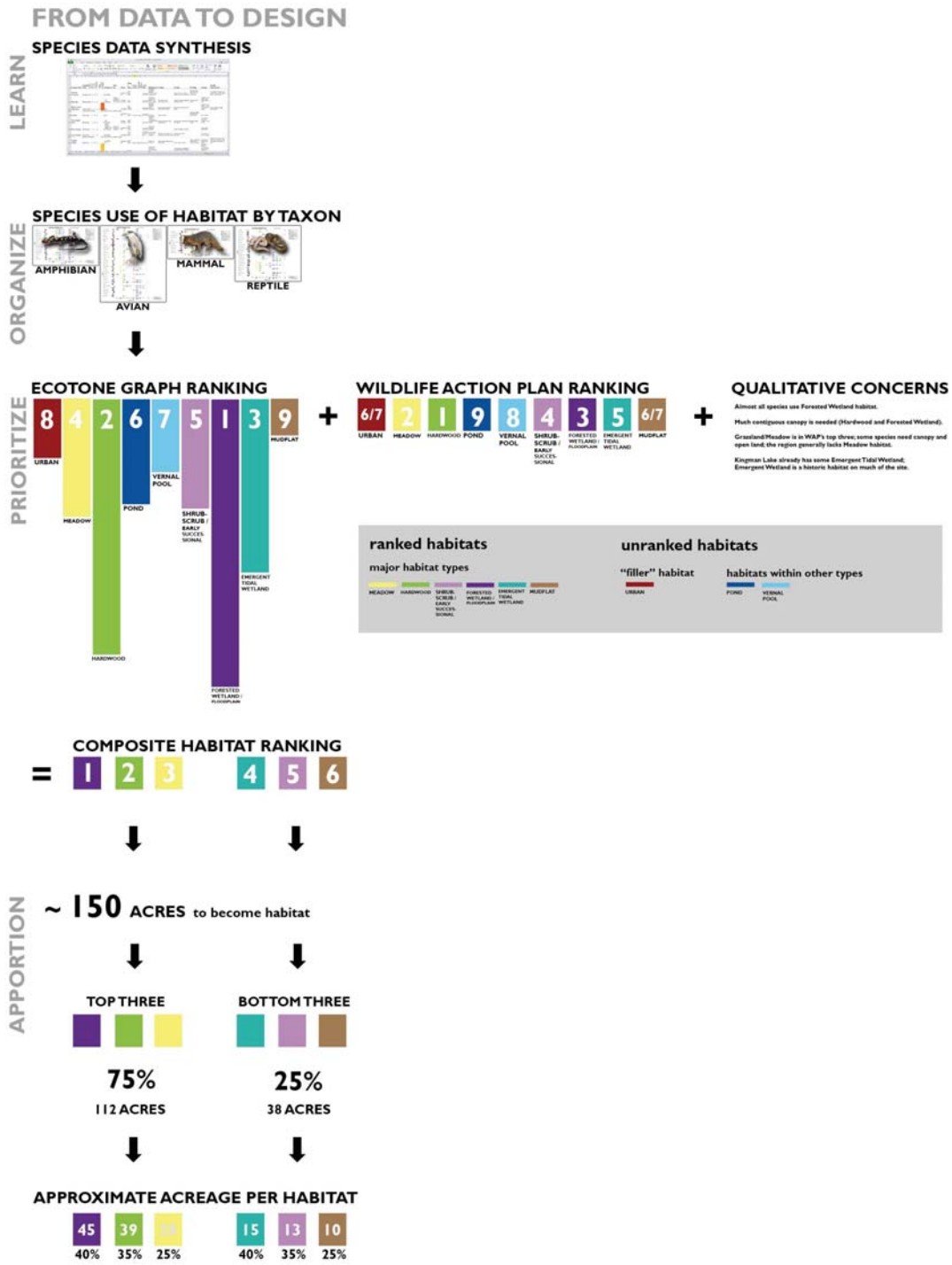
important in the design solution and is discussed in more detail later in this document.

The ecotone graphs also facilitated the prioritization of habitat types so that a hierarchy in design of the site could be easily accomplished.

From Data to Design

With approximately 150 acres of site to become habitat and six major habitat types chosen, it was necessary to prioritize the habitats as a way to organize the site design. The diagram below illustrates the process of how I went from data gathering on individual species to determining the rough amount of acreage per habitat type, which would guide the design process.

Figure 6.5: Design Logic



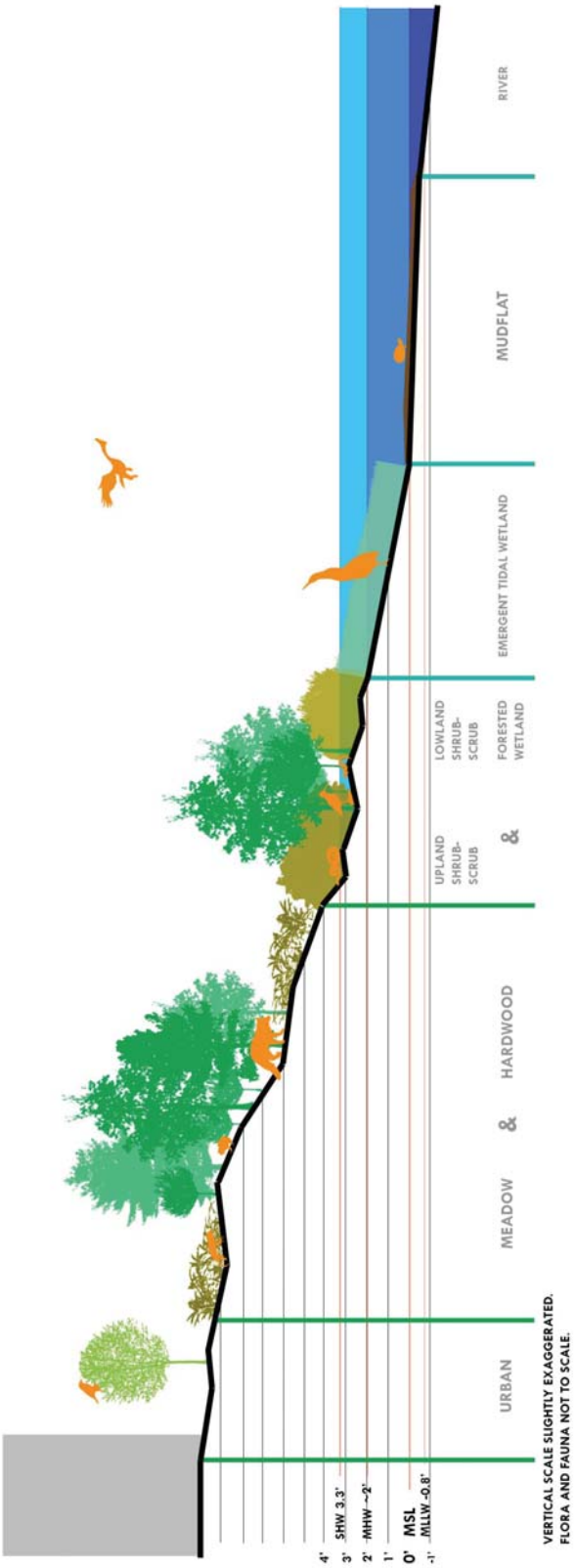
I ranked the habitat types the same way the DC WAP ranked them, by the number of SGCN that use the habitat. Because I had supplemental data (EOL website and DDOE species lists), some of the SGCNs in the ecotone graphs had slightly different habitat use listed than what was listed in the WAP. Also, because I excluded fish and invertebrates, my counts of species per habitat (in real numbers and proportional amongst habitats) were again different from the WAP. I include two rankings, mine and the DC WAP's, which I compiled with the addition of qualitative concerns to create a composite ranking.

The "Apportion" stage is meant to be a guideline for the proportion of the site allotted per habitat type. Exact numbers were calculated based on the estimate of about 150 acres of the site (of the total 180 acres) being suitable for habitat. Three different percentages were attempted, and 75 percent for the top three habitats and 25 percent for the bottom three habitats was chosen because the resulting acreage seemed most appropriately weighted. And whereas exact numbers were calculated, it is important to keep in mind that these numbers were meant as a guideline only. The apportioning was done to ensure that the higher priority habitats received more space, as more species could potentially use them.

Habitat Elevations

After habitat types and areas were determined, it was necessary to understand how the habitats functioned in relation to elevation and the river. Because this portion of the Anacostia River is tidal (affected by the Bay's tides), elevation calculations such as mean sea level (MSL), mean high water (MHW), and spring high water (SHW) were needed to analyze both habitat arrangement and the need for re-grading. In Figure 6.6, these data are illustrated. The area between 2 and 4 feet of elevation are of note because that is the transition zone between upland and lowland habitat types.

Figure 6.6: Riverfront habitats and elevation



Chapter 7: Design Approach

The process of designing the site, as with many landscape architectural projects, was at once objective and subjective. Principles, strategies, and interventions applied to the design grew from both scientific and artistic ways of knowing. Practical and poetic understandings are needed for a balanced design, as discussed in the Tao of Dwelling section of this document.

Goals Become Design Principles

The concrete goals I established early in the project led to governing design principles, which came in the form of a poem that can be read both across and down. This movement from the practical to the poetic embodies a balanced design approach.

Figure 7.1: Poetic Principles

Sound Principles for Urban Design

(VOICE	ECOTONE	COMMEMORATION)
Inhabitants	meeting	through diverse experience
abundant voices quiet	conflicted crossings	undisturbing the peace
a silence of salamanders	separating	as night falls on the city
a chorus of Nycticorax	gathering	then the sun rises
the sound of	waves	reminding us we are
animals	too	creating memories
the plants	are restorative	of the earth
also		
This is heard		This is celebration
	a purposeful edge	
	can move	

The three poetic themes of voice, ecotone, and commemoration gave rise to the three major design components of habitat, edge, and connection.

Program

Table 7.1: Program

Elements	Where	What/Why
ENTRY		
• MAIN ENTRY	• Where East Capitol Street splits	• Gateway emphasizes threshold; pedestrian access prioritized; Metro rail and Metro bus stations a block away; vehicular drop-off
• SECONDARY ENTRY	• From Anacostia Riverwalk Trail (A.R.T.)	• Some boardwalks and paths through habitats connect to A.R.T.
PARKING		
• MAIN PARKING	• Across from the Armory (behind hall/museum)	• Some of existing parking retained; stormwater mitigation added (bioretention/vegetation)
• SUPPLEMENTAL PARKING	• Southeast of the Armory	• Additional small lots created in places where wildlife should not be encouraged
EXHIBIT HALL / MUSEUM *(assumed development in future)*		
• PUBLIC AMENITY BUILDING(S)	• Across from the Armory	• Can provide indoor opportunities for site interpretation and education and allied uses; potential museum (on ecology, biodiversity, etc); potential space for art exhibits; potential space for scientific labs
WILDLIFE USE & HABITATS		
• EARLY SUCCESSIONAL/SHRUB-SCRUB/EDGE	• Between other habitat types; in leftover spots where other habitats may not thrive	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided
• EMERGENT TIDAL WETLAND	• Near the river; eastern edge of site	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided where needed to water, other habitat
• GRASSLAND/ MEADOW	• At higher elevations; where distant views are desired	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided where needed to water, other habitat
• HARDWOOD FOREST	• At higher elevations; often providing buffer to traffic/noise	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided where needed to water, other habitat
• MUDFLAT	• By the river; eastern edge of site	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided where needed to water, other habitat
• RIPARIAN WOODLAND/ FORESTED WETLAND/FLOODPLAIN	• Near the river; eastern edge; relatively flatter areas	• Food naturally occurring; water source within or near, shelter/rest natural (e.g., tree branch) or provided (e.g., nest box), connections provided where needed to water, other habitat

• PONDS AND POOLS	• Within other habitats (more upland)	• One of the provided water sources
• VERNAL POOLS	• Within other habitats (more lowland)	• One of the provided water sources
• CONNECTIONS/EDGES	• Throughout site	• Existing barriers to wildlife within the site (e.g. roads) will be mitigated; in areas where wildlife should be discouraged (largely from traveling to the west off the site) barriers will be created to the extent possible
HUMAN USE & CONNECTIONS		
• ENTRY OVERLOOK	• Just east of where East Capitol Street splits	• Introduces/orients visitor to site; panorama view of site; main connection to boardwalks; trash & recycling
• PATHS/BOARDWALKS	• In all habitat types	• Allows visitors to experience each habitat in less invasive way than traditional at-grade, asphalt paths; gathering places and areas of retreat and contemplation are needed; boardwalk height and width may vary to allow wildlife of different sizes and needs to cross; some areas may include on-ground paths of pervious material; trash & recycling
• HABITAT	•	•
• EXHIBIT HALL/MUSEUM	• Across from the Armory	• Space set aside for assumed eventual development of cultural, public amenity building, such as a museum; potential orientation materials available (maps of site); potential comfort amenities available (restroom, food, etc)
CITY CONTEXT & ROADS		
• NEIGHBORHOOD	• North and west of site	• Residents nearby will have improved views into the site
• ROADS	• Throughout and on site edges	• Vehicular routes will not be changed; mitigation for wildlife travel (under/over-passes improved or created)
PUBLIC ACCESS		
• ACCESS & RESTRICTIONS	•	• Various measures, as in physical or perceived barriers and information/rules, will be used to encourage people to stay on paths/boardwalks, to not physically or aurally disturb wildlife
INTERPRETATION		
• EXPERIENTIAL LEARNING	• In habitats/on boardwalks	• The act of simply being in and moving through the site is another way for people to learn about wildlife and habitat
• TRADITIONAL INTERPRETATION	• In museum/hall; at entry overlook; at edges of site	• Typical signage will be needed to orient visitors to basics of site and provide information on wildlife species and habitat types
• ART	• In museum/hall; at entry overlook	• Artworks related to wildlife and habitat provides contemplative feature(s)
• EDUCATION	• In museum/hall	• Potential to have classroom space and more in-depth interpretation materials, including information on wildlife and habitat types

MATERIALS REUSE		
• PARKING	• Asphalt, substrate (gravel)	• Asphalt can be recycled on-site and used as fill material for the entry overlook; any asphalt leftover can be recycled for use elsewhere or potentially used by artists • Substrate can be reused where fill material is needed (e.g., as paving aggregate, in berm creation)
• STADIUM	• Concrete, steel, stone (granite veneers)	• Concrete can be recycled onsite by breaking it into slabs for paving or crushing it into smaller pieces for aggregate; various sizes could be used to provide cover for smaller wildlife; any concrete leftover can be recycled for use elsewhere or potentially used by artists • Steel can be returned to steel mills for recycling • Granite can be reused as paving or wall material at entries; potential to reuse all in artistic or sculptural capacity

Chapter 8: Design Solutions

Identity

The solution to the site's complexity is a new type of monument or commemorative experience: the Capital Faunarium Sanctuary and Exhibit Hall.

FAUNA: the animals of a region considered as a group
+
-ARIUM: a place for or associated with something
=
FAUNARIUM: a place for wildlife

A dual "monument to ecology," the sanctuary and exhibit hall provide a multitude of meanings and amenities. The focus of the design, this place for animals, is the Faunarium Sanctuary. It includes habitat for a wide variety of native Mid-Atlantic wildlife species and opportunities for human visitors—tourists and residents alike—to experience the cycles of nature and to see wildlife.

This project also suggests the future commemorative facilities[98] to be an exhibit hall which can function as a visitor's center to the Sanctuary and include display space for creative works from traditional drawings and words to modern, digital media, all showcasing many of the beautiful ways that humans conceptualize and paint a picture of the life around them. Additional to this gallery space, the exhibit hall can provide more traditional interpretive materials related to the Sanctuary and its wildlife, classroom space, and typical amenities such as restrooms and concessions. Potential art work includes such things as sculptures made with leftover parking lot and stadium materials or impressionistic visions of the habitat

[98] "Commemorative facilities" is what the proposed institutional building is called in NCPC's *Extending the Legacy* Plan. This project assumes that DC will develop an institutional building to be a museum or function of similar cultural capacity.

types, as with Rebecca Haseltine's tidal mudflat paintings in her Estuary series,[99] which was part of the inspiration for including space to display art.

Figure 8.1: Tidal Mud Flat #3 by Rebecca Haseltine

(Source: http://rebeccahaseltine.com)

The outdoor park space is a sanctuary for all. It is like America's balcony—the porch overlooking the river and the wonders housed in the out-of-doors—a place to witness great beauty and music. As a whole, the Capital Faunarium, this "place for wildlife," offers the unique opportunity for people to be immersed in the diverse chorus of wildlife in our nation's capital.

[99] http://rebeccahaseltine.com/aw/estuary-series-2/mud-estuary-phase-v-2007/tidal-mud-flats/

Overall Plan

Site analysis, precedents, design principles, program, and inspiration all combined to become an overall plan for re-designing the majority of the RFK stadium site into the Capital Faunarium Sanctuary.

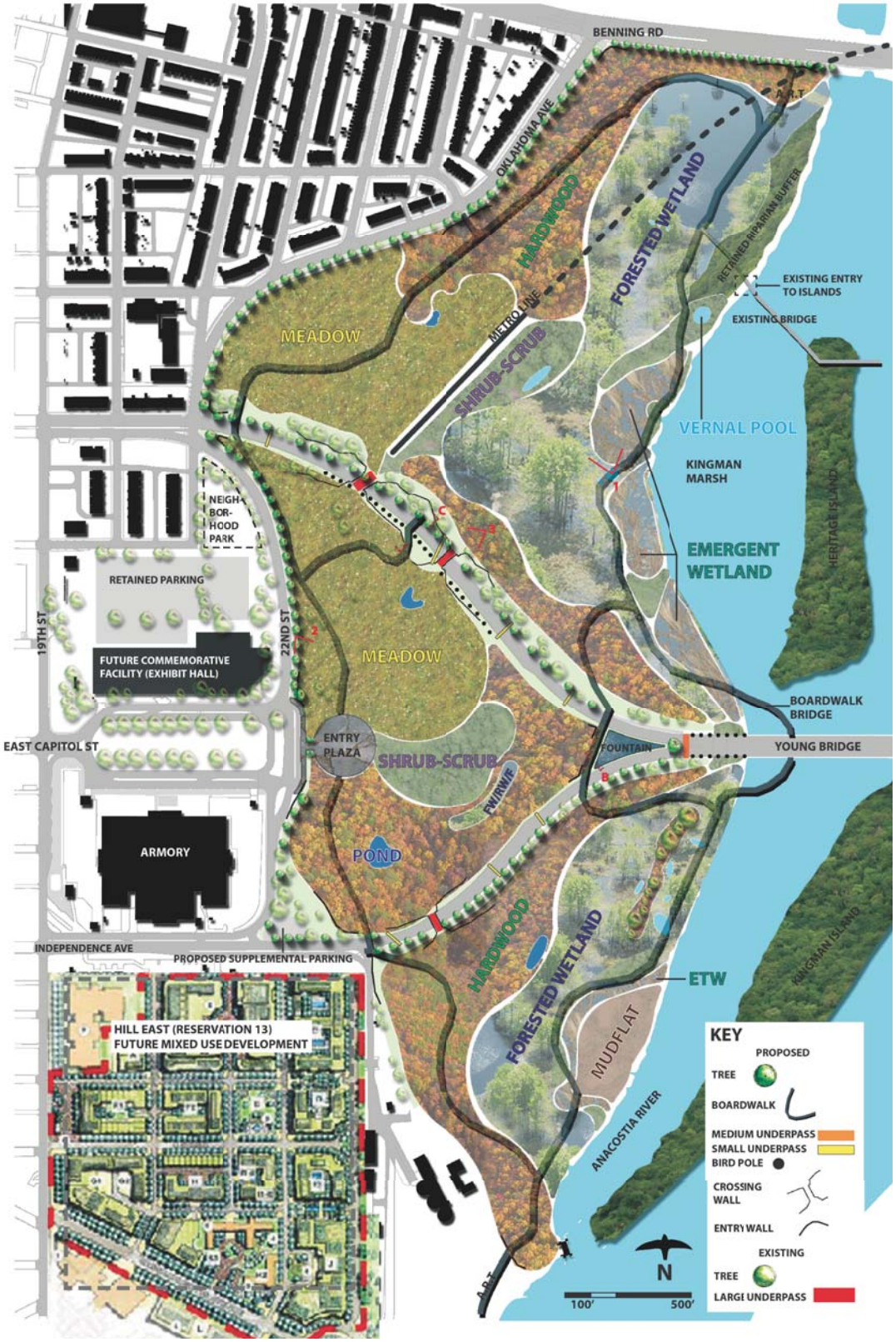
The largest moves include completely removing the stadium building and all parking lots east of Oklahoma Avenue and 22nd Street to allow the largest possible area for habitat. In total, the area to convert to habitat is about 150 acres of the total 180 acres of the site (the remaining 30 acres, north of the Armory, will include some retained parking, an area set aside for future neighborhood use such as a playground, and a place set aside for a future institutional building, potentially associated with the Faunarium Sanctuary).

Additionally, there are many manmade perils to wildlife traveling across the site, mostly in the form of roadways which are the source of vehicle collision related injuries and fatalities. The proposal therefore includes removing three smaller roads as they were meant for automobile traffic around the stadium and are no longer relevant.

The proposed design solution integrates wildlife considerations and human considerations through a variety of strategies and interventions. The proposed solutions can be organized into three main categories: Habitats, Edges, and Connections.

The complete site plan is shown in Illustration 8.1.

Illustration 8.1: Site Plan

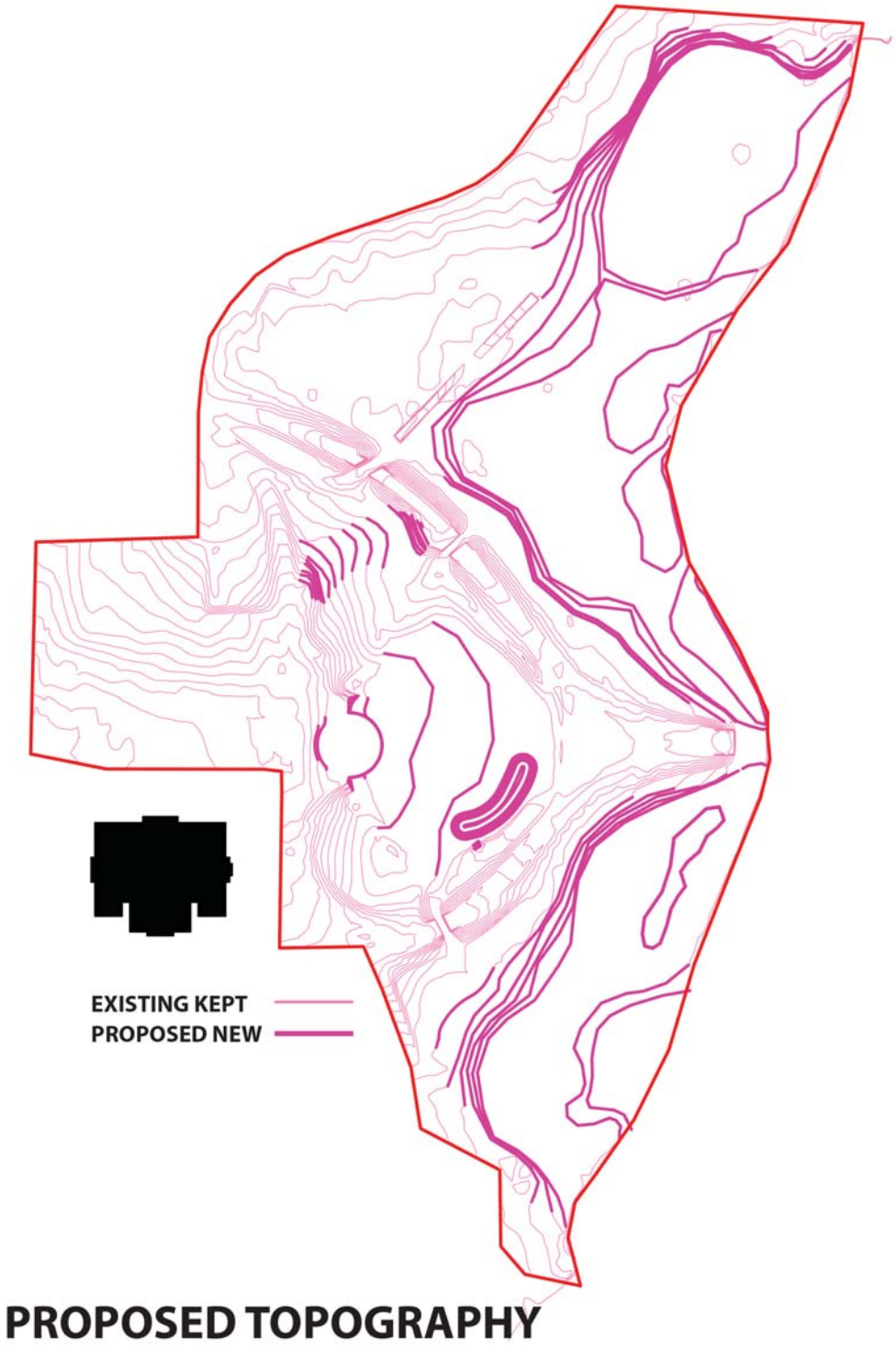


Habitats

Tidal elevations, topography, major urban infrastructure such as roads, and existing vegetation influenced the arrangement of the six major habitat types. It is desired that the arrangement and proportion of the habitats will largely stay the same, however the ideas noted in the Embracing Natural Change section of this document must not be forgotten.

Lowland habitats (i.e., Forested Wetland, Lowland Shrub-Scrub, Emergent Wetlands, Mudflats) are all less than 4 foot in elevation, and the area currently on-site between 0-4 feet is a narrow strip along the shoreline, so significant re-grading was required on the eastern half of the site in order to make a large amount of area low enough to accommodate lowland plant regimes. Forested Wetland and Lowland Shrub-Scrub in particular fall between about 2 and 4 feet elevation (as shown earlier in Figure 6.6), and as Forested Wetland/Riparian Woodland is the number one habitat in terms of acreage, much of the re-graded area needed to fall between 2 and 4 feet. Illustration 8.2 shows how the grade was pulled back into the site to create space for lowland habitats. This was done with inlets, as seen in the teardrop shapes along the eastern edge on the northern half of the site. These inlets provided for re-grading while retaining some of the northernmost existing riparian buffer, as well as minimizing disturbance to the existing restored wetland (Kingman Marsh).

Illustration 8.2: Proposed topography

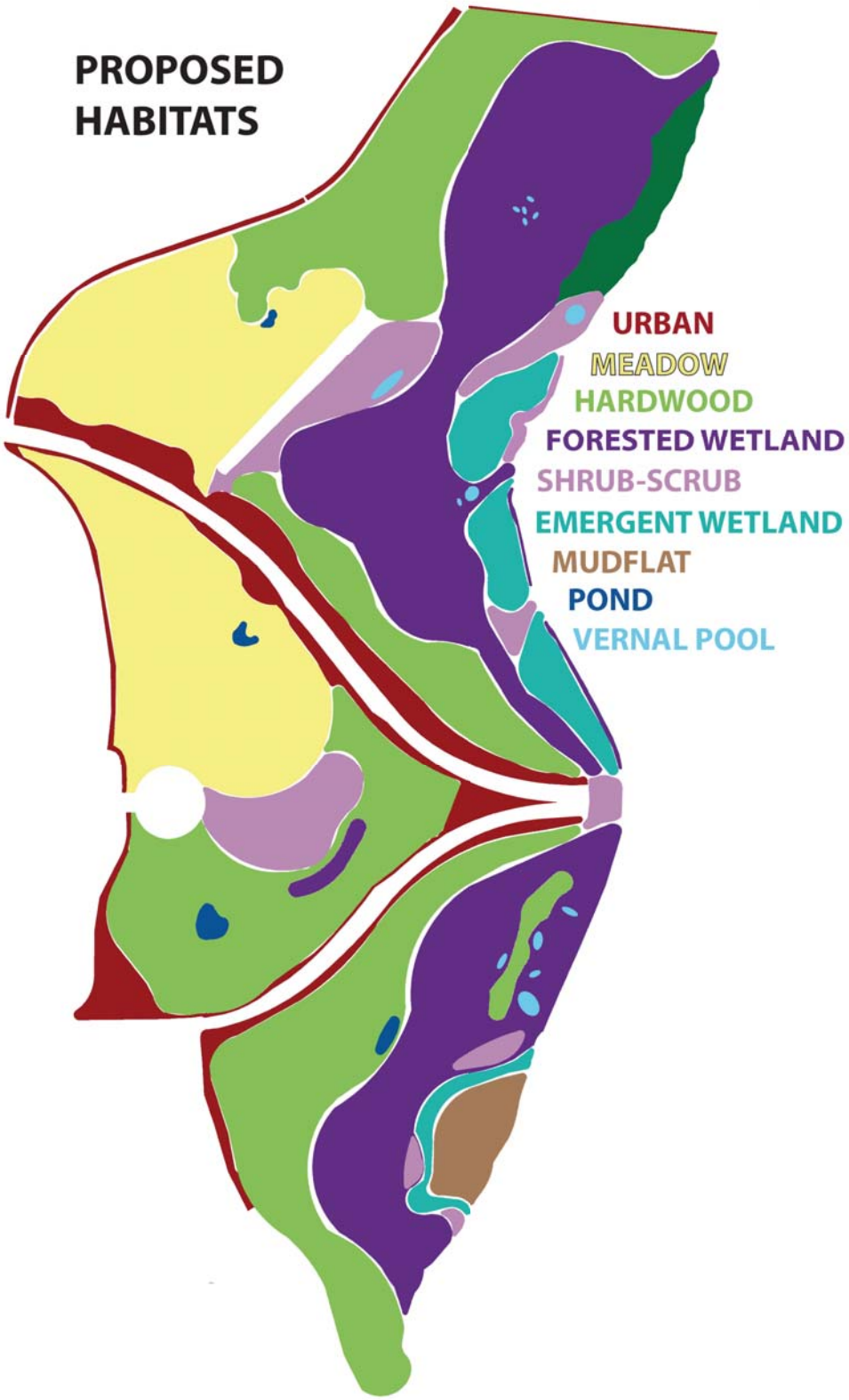


In determining habitat layout, road infrastructure especially created automatic borders to change from one habitat to another, although in some instances it was desirable to let the habitat unfold across the land itself and not heed the roads as barriers to its continuation (in particular regarding canopy).

Continuous canopy coverage is important to many species for shelter and territory, most particularly interior habitat species, such as the Yellow-Throated Vireo, some of which cannot survive in typically small urban parks. In order to create the largest contiguous area with canopy, the Hardwood and Forested Wetland habitat types were often adjacent, and where it was desired to keep existing trees, one of these habitats covered that area.

As shown in Illustration 8.3, the majority of the site is made up of the top three habitat types: Forested Wetland, Hardwood, and Meadow.

Illustration 8.3: Proposed habitat layout



The design resulted in the habitat apportioning guidelines being roughly met, which means the goal of prioritizing habitats was reached.

Table 8.1: Guideline Acreages

Habitat Type	**Guideline Acreage**	**Proposed Design Acreage**
MEADOW	28	27.7
HARDWOOD	39	45
SHRUB-SCRUB	13	9.3
FORESTED WETLAND	45	43.1
EMERGENT WETLAND	15	5.7
MUDFLAT	10	2.7
URBAN	N/A	11*

Clearly, for the top three major habitats (Meadow, Hardwood, and Forested Wetland), the proposed acreage was quite close to the guideline.

*The Urban habitat type did not receive a guideline acreage; although this type was needed to provide the ecotone between the urban fabric and the major habitat types, the less of it there was, the better. The results for Shrub-Scrub, Emergent Wetland, and Mudflat were lower than the guidelines by wider margins than the top three, because the 11 acres of Urban type needed along the borders of the site meant there was less acreage available for the bottom three habitat types.

Edges

As time went on, it became more and more clear how important the edges were. Site context, urban infrastructure, and habitat arrangement largely determined where the edges and transitional zones would be.

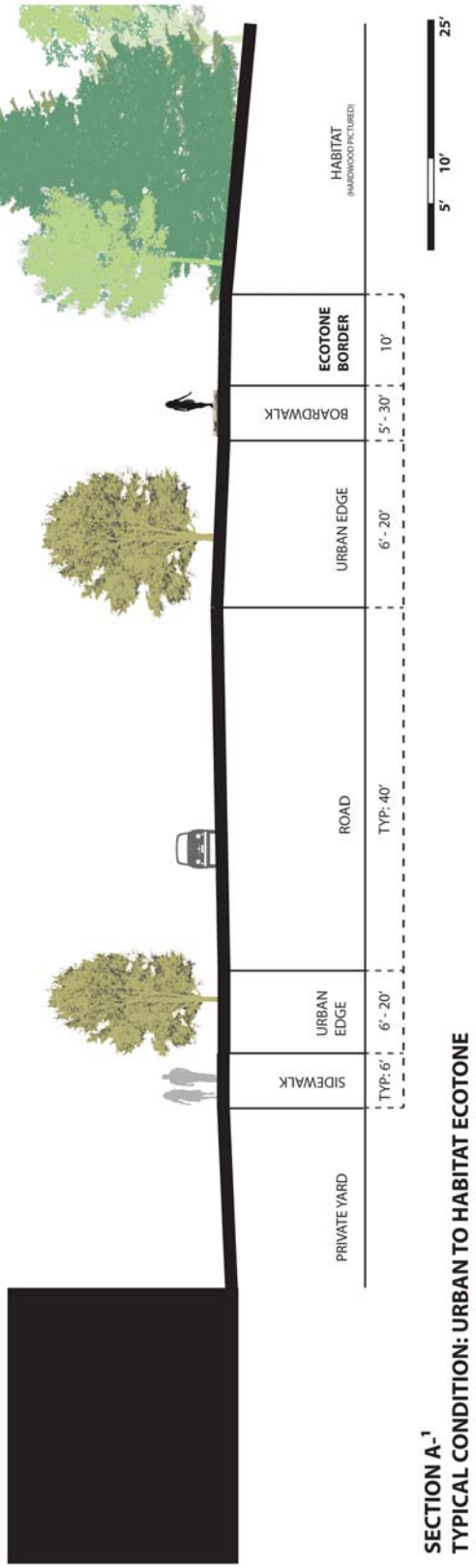
The edges, or perhaps more accurately, the transitional zones between habitats can be described as hard or soft. Hard meaning an abrupt clear line between habitats, and soft meaning a slow gradient from one habitat into the next. As in nature there are both hard and soft edges between habitat types and areas, so on the site there are both types of edges. Hard edges often occur between forest and grassland as well as between upland and lowland areas. Non-gradation causes of hard edges are drastic changes in soil or water.[100]

There is a clear edge on the western side of the site between the typical urban fabric and the beginning of the Faunarium. As the intent of the project is to both provide as much space as possible for habitat while creating a place that people—both residents and visitors—recognize as a managed city park, the typical streetscape will be kept or mirrored on the site. Especially due to the populated area to the west of the site, it is important for that western edge to have consistent visual cues that the park is one whole piece and it is well taken care of. Particularly this is most necessary along Oklahoma Avenue and 22nd Street where there is some existing sidewalk on the site side of the roads. Illustration 8.4 shows the proposed typical condition along this edge. These pathways will be enhanced with additional and

[100] Personal communication with Maile Neel, UMD PSLA

strategic plantings and elements that provide visual continuity and signal the border of the park, such as the benches and bollards seen in Illustration 8.5.

Illustration 8.4: Proposed Urban-Habitat ecotone typical condition



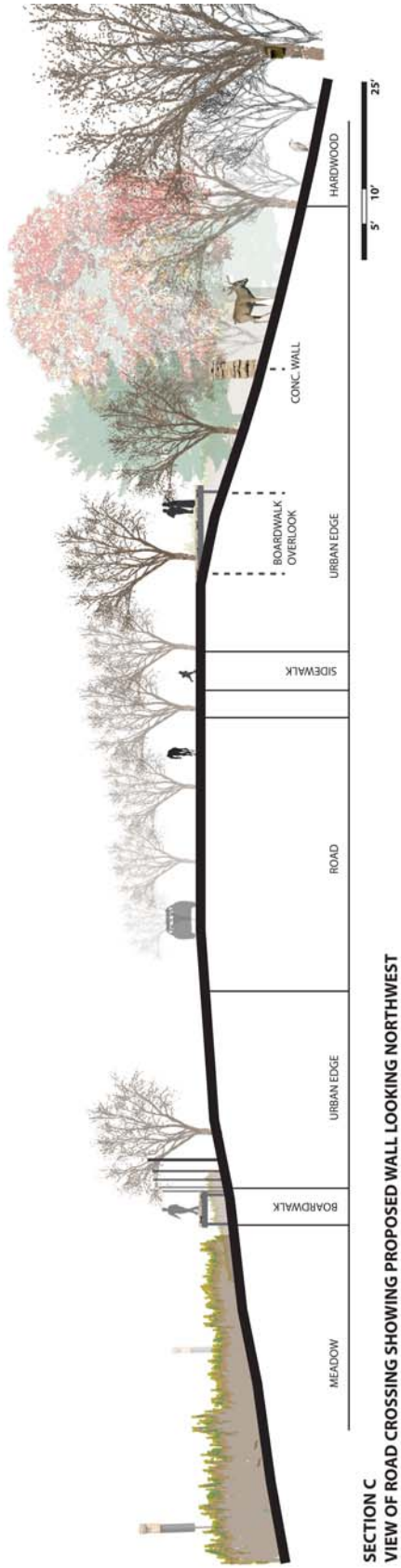
SECTION A-1
TYPICAL CONDITION: URBAN TO HABITAT ECOTONE

Illustration 8.5: Closer view of the proposed “ecotone border”

In order not to install a high fence to keep people from walking directly into the habitats anywhere, clear and accessible entries will be created along the entire Faunarium. Strategies to encourage people to follow boardwalks and stay on paths were important: a huge fence would be unsightly but people walking through the habitats off the paths would create extensive disturbance to many wildlife, including the trampling of eggs and young, as many wildlife species nest on the ground. Directive signage along with the strategic border elements will both literally and physically tell people where they are allowed to access the site.

Mitigation of wildlife-vehicle collision was a high priority for the design, and various types of wildlife crossings were placed along all roads cutting across the habitats, which are explained in more detail in the Connections section. Walls made with concrete recycled from the stadium were placed at strategic points near major roads and intersections in order to either funnel wildlife toward crossings or to deter them from certain areas or lengths of road. Illustration 8.6 offers a winter section view of the proposed edge condition, showing both sides of C Street as it cuts across the middle of the site. Some of the wildlife-vehicle collision mitigation strategies, as discussed at the end of Chapter 5, are incorporated, such as bird poles and walls. All walls are created with concrete recycled from the stadium.

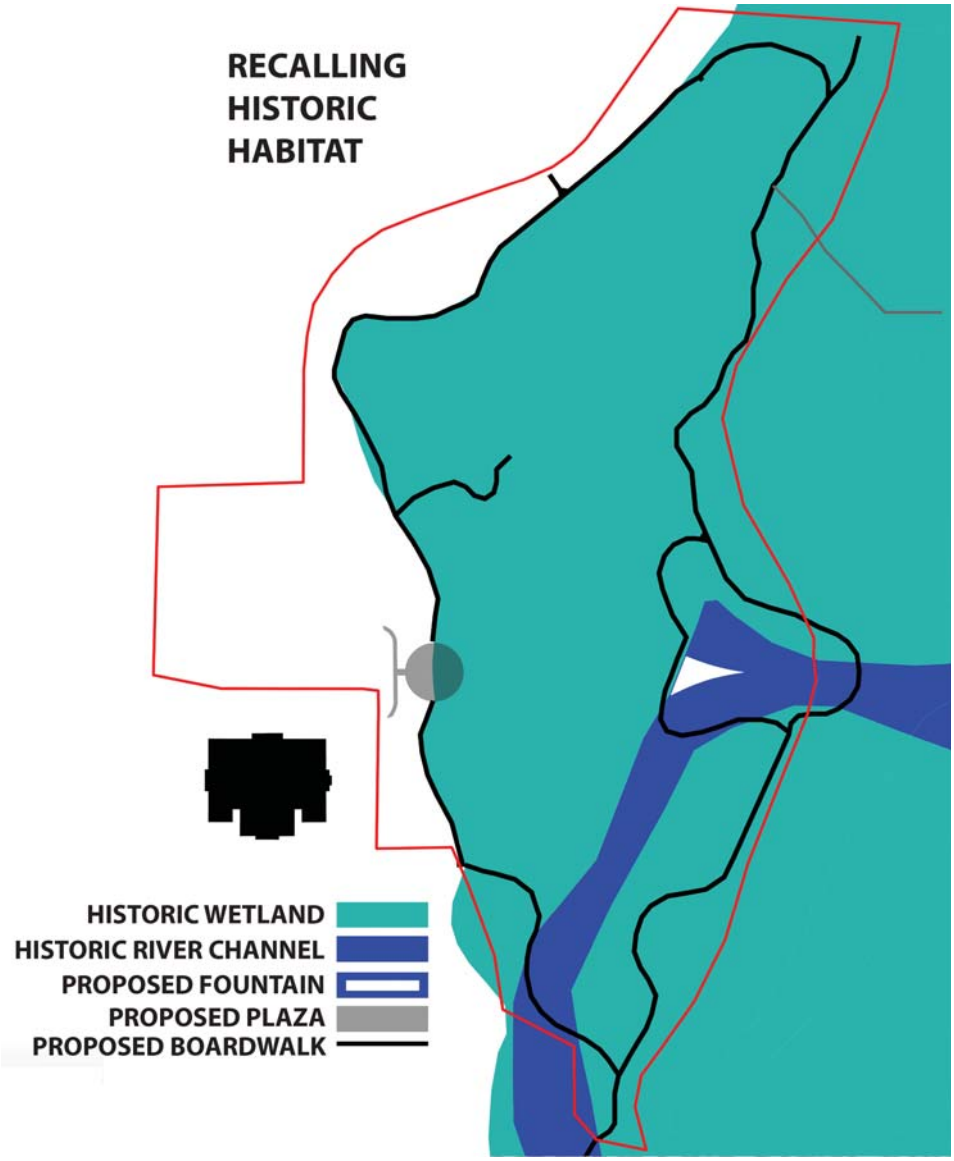
Illustration 8.6: View of road crossing looking northwest



SECTION C
VIEW OF ROAD CROSSING SHOWING PROPOSED WALL LOOKING NORTHWEST

Elements at important junctures for people are also needed, so an entry plaza and fountain are proposed. Recalling history is needed when designing in the nation's capital. Since the site's major historic condition was emergent wetlands (indicated in Illustration 8.7), and the layout of the proposed habitats is different than the historic, it was important for the design to reference the earlier condition. That is accomplished in a few ways.

Illustration 8.7: How proposed design elements reference site history



The historic condition is highlighted in the entry plaza through a simple change in ground plane and materials, as well as signage showing maps of historic and current conditions. The ramp from the upper plaza to the lower plaza reflects the natural change in grade from upland habitats to lowland areas where wetlands occur. While offering ADA accessibility, the ramp also includes a seat wall of varying heights for rest and observation. The plaza itself is also replete with repurposed materials from the stadium. Paving is recycled concrete. The seat wall cap along the ramp is granite taken from veneered walls that used to flank the main stadium entrance, the use of which recalls the common urban element in DC of granite curbs. Thus the plaza serves as the main visual and physical entry, an educational and gathering space, and possibly the best spot in the Faunarium for views toward the river. Additionally, the plaza's location in line with the Capitol building recalls the cultural and political importance of gathering places for people. As seen in Illustration 8.8, the entry plaza is kept simple so that the main entrance for humans does not overshadow the habitats themselves.

Illustration 8.8: View of main entry plaza looking southeast

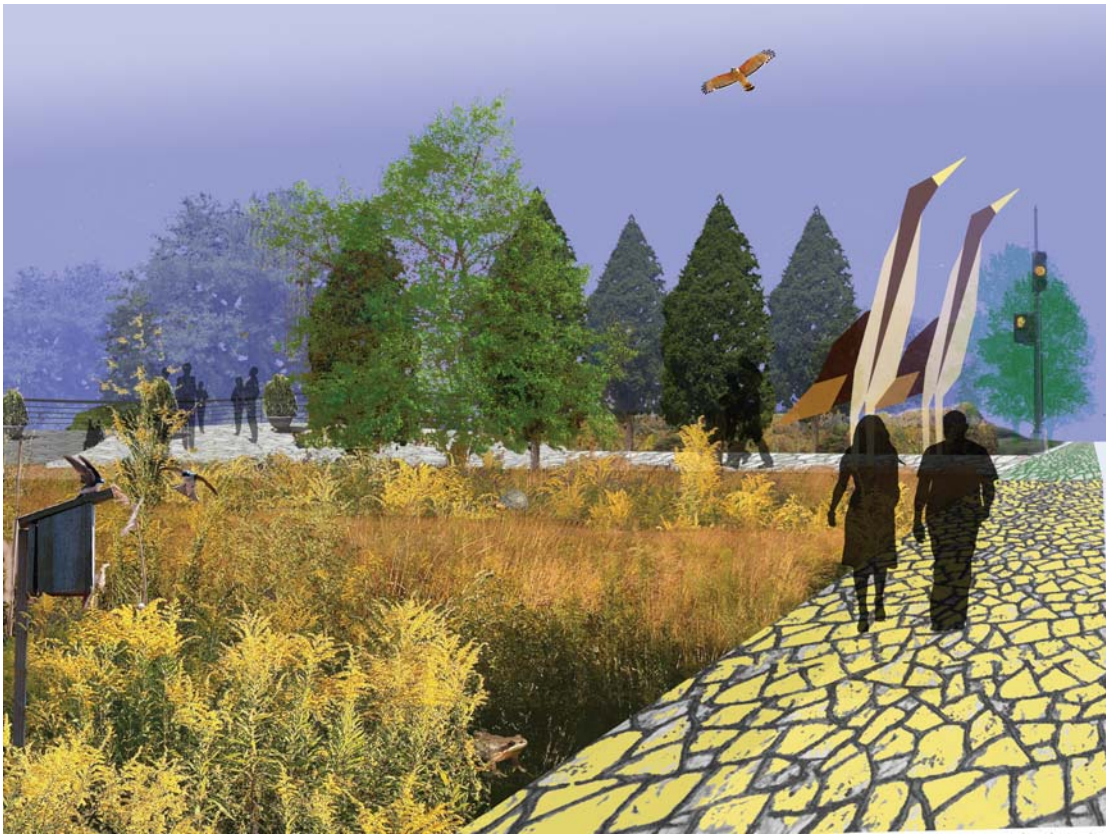
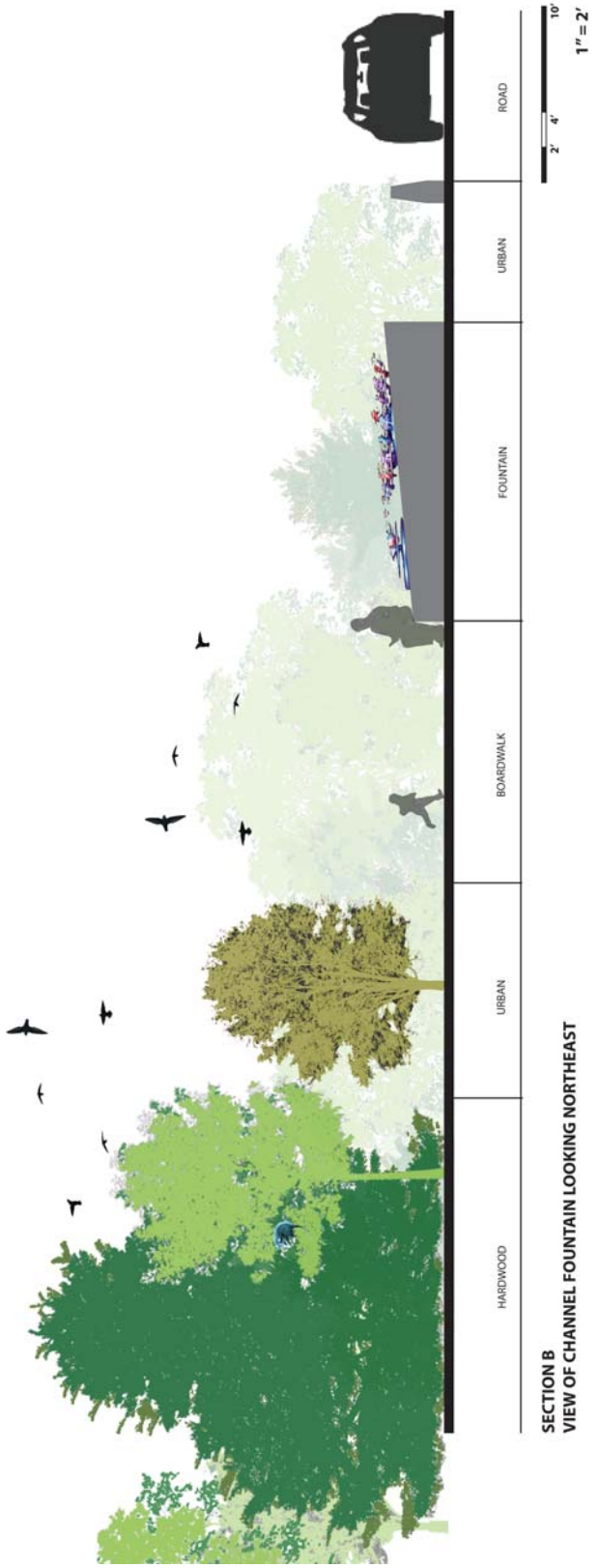


Figure 8.2: Existing condition for Illustration 8.8

On the eastern side of the site, existing roads and the old river channel create a triangular shape in line with East Capitol Street. The proposed Channel Fountain, seen in Illustration 8.9, here resolved that leftover space stuck between roads, where it was best not to encourage wildlife.

Illustration 8.9: View of Channel Fountain looking northeast



When there are barriers and edges such as those created by roads, connections need to be made for animals and people.

Connections

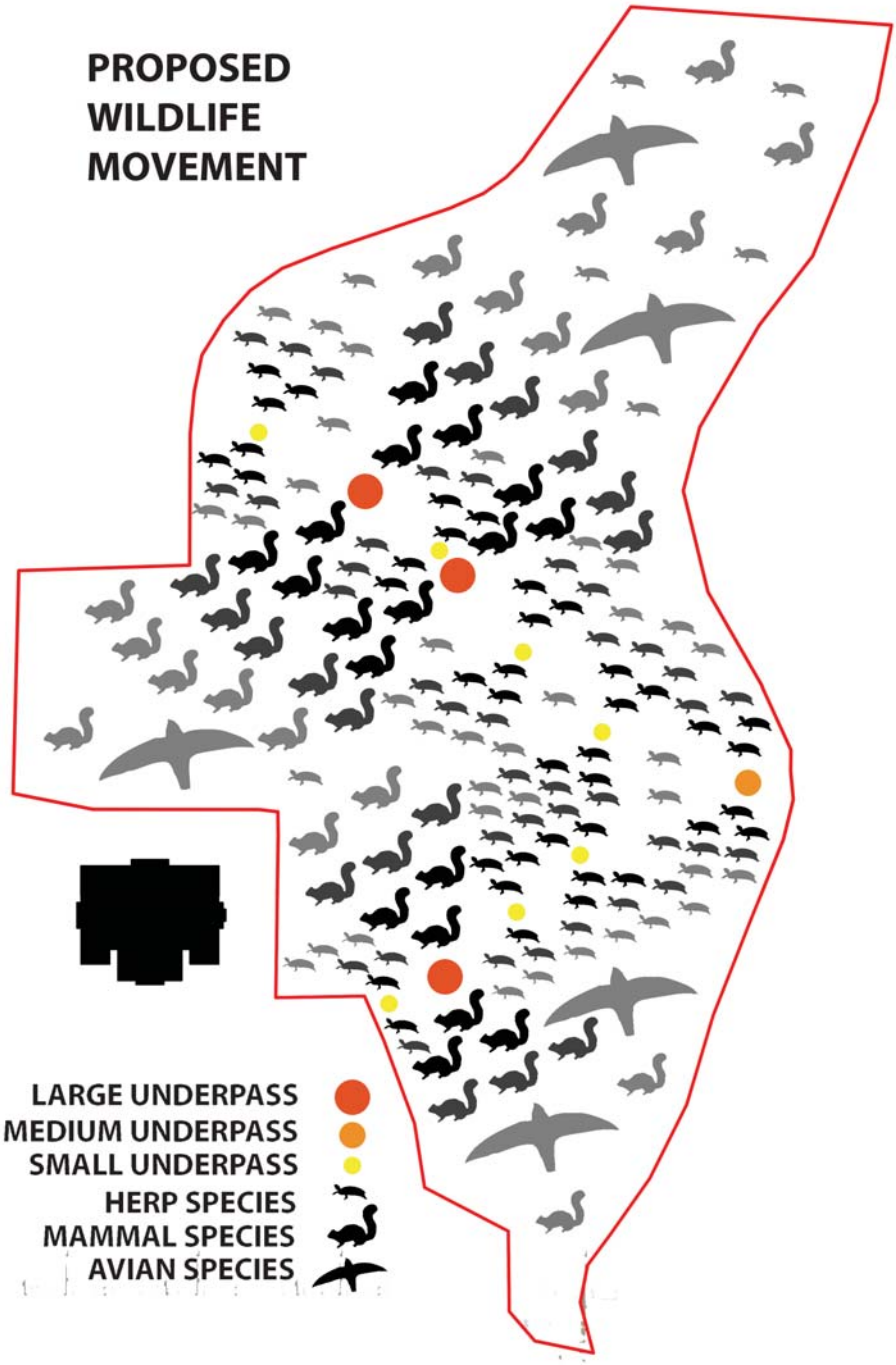
Connectivity is imperative in cities for clear and efficient movement. For this project, this movement refers of course to both human and animal travel to, within, and through the site. Existing road, sidewalk, and trail infrastructure (including existing underpasses), habitat arrangement, and topography were major factors in creating a variety of connections for all types of site users.

Connectivity for people isn't just about hardscape for visitors to travel along. The recycled concrete walls mentioned in the previous Edges section also provide visual continuity throughout the site so that people entering both from the city grid and bridge, and from the Anacostia Riverfront Trail, which is largely on-grade asphalt, have a clear indication of the places where they are invited to enter the Sanctuary and when they are in it. The proposed site plan, shown earlier in Illustration 8.1, indicates the locations of all walls, both the wildlife directing walls and the site entry walls.

The majority of connections involve infrastructure and paths for people and wildlife. Connections for wildlife are in the system of underpasses of varying sizes spread across the site. Certainly it is not possible to truly keep all wildlife in the major habitat areas of the site nor to keep them from crossing roads at grade, unless you fence the entire site like a zoo. However the variety of types and sizes of mitigation strategies will combine to encourage both wildlife to utilize the site in ways that are safer for them and people traveling through or visiting to adjust their

behavior to be more sensitive to the wildlife inhabiting the area. As indicated by Illustration 8.10, wildlife are given numerous options for travel across the site, which increases their chances of survival.

Illustration 8.10: Proposed wildlife movement via underpass system



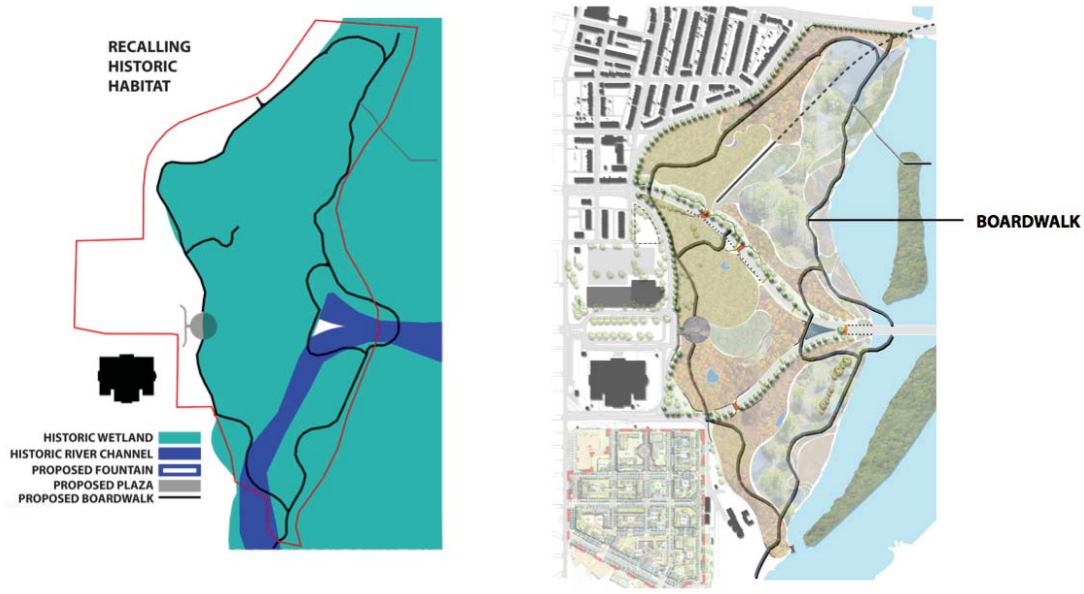
In Illustration 8.11, old underpass infrastructure is shown to provide a new type of connection for wildlife while travel and views for people are still available.

Illustration 8.11: View of large underpass looking southwest toward meadow and Armory

Figure 8.3: Existing condition for Illustration 8.11

Human movement throughout the site can of course be more prescribed. As in many sensitive habitats with paths through them, such as National Refuges, pathways are often elevated boardwalks in order to minimize disturbance to the habitat (during and after construction). Since the project site was substantially demolished by removing the asphalt parking lots and lawn areas, boardwalks could be built prior to seeding and planting of native flora. Elevated boardwalks are proposed as the predominant pathway type. Although the ART was removed and the path trajectory adjusted based on the habitat arrangement, the connections to the off-site portions of the ART remain the same. The proposed boardwalk is, in fact, the major experience for people visiting the Faunarium Sanctuary. As seen in Illustration 8.12, history is again reflected with the alignment of the boardwalk, which parallels the wetland extent line for much of the western portion.

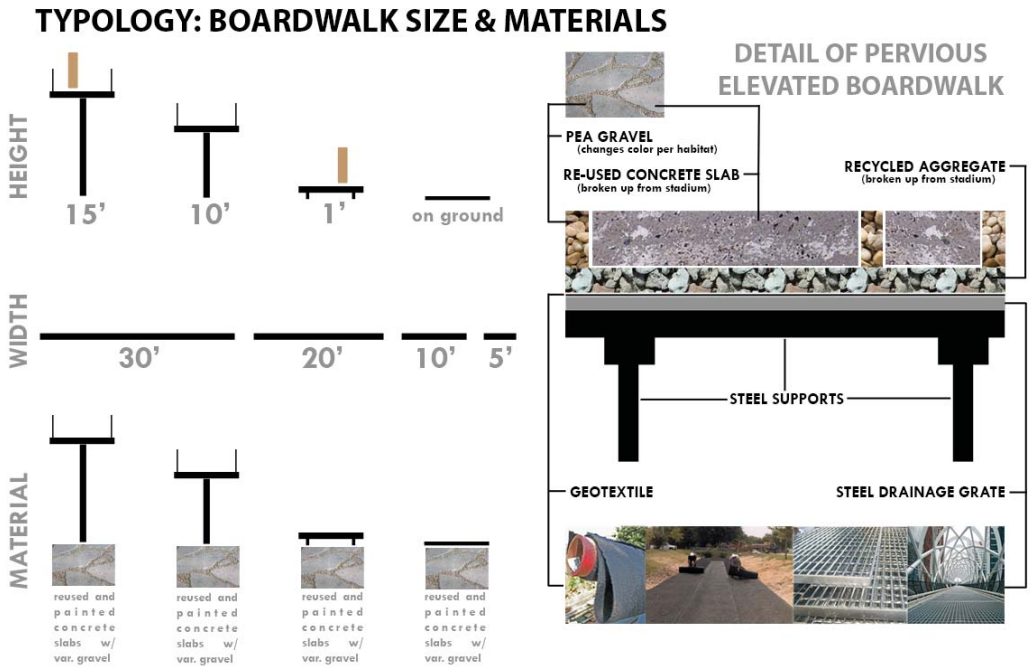
Illustration 8.12: Recalling historic habitat through boardwalk alignment



The boardwalk itself is both a way of experiencing the site from different angles and, similarly to the recycled concrete walls, a consistent visual cue to people that they are within the borders of the Faunarium. But because the boardwalk is the major experience for people, it needed to be unique and site-specific. Thus the proposed boardwalk is elevated, pervious, of varying heights and widths, and created with concrete and aggregate also repurposed from the stadium building.[101] This is not only a one-of-a-kind boardwalk, it is an example of reuse and recycling in what is potentially a high-profile park. In concert with that example, as the boardwalk is pervious, it serves to educate on the new ways of thinking required to improve environmental conditions. The boardwalk showcases an important stormwater management technique that is necessary for increasing the water quality of the Anacostia River instead of degrading it further due to polluted urban runoff. The size and materials of the boardwalk are detailed in Illustration 8.13.

[101] Because there is no practical way to recycle steel on-site (lack of portable machines and the necessity for very high temperatures needed in the steel recycling process), it is unlikely the stadium steel will be repurposed directly on the site. However, the steel manufacturing process in general includes repurposing and recycling old steel, and if an electric arc furnace is used, nearly 100% of the material is recovered steel, according to http://www.epa.gov/osw/conserve/materials/steel.htm.

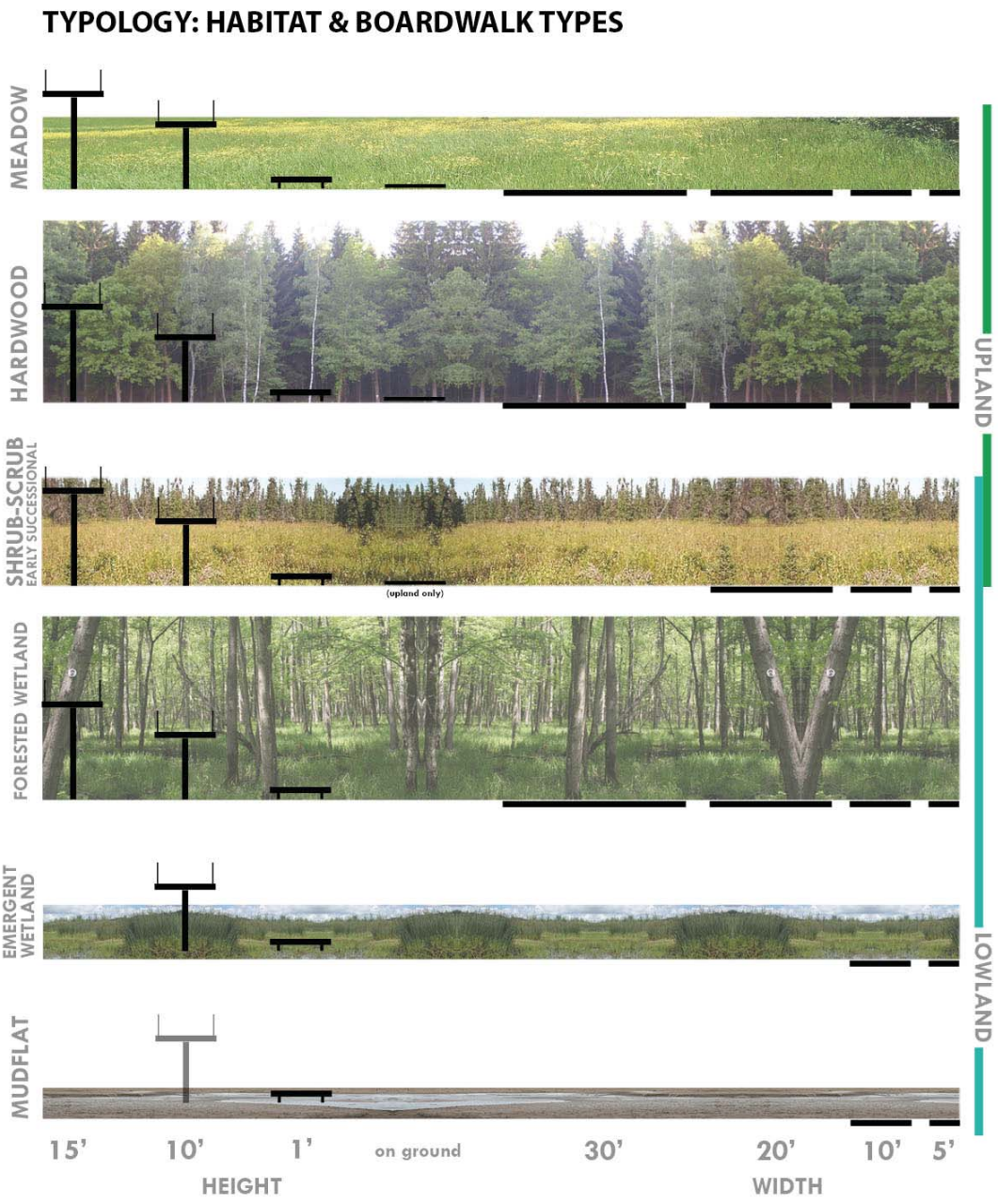
Illustration 8.13: Typology for boardwalk sizing and materials



The varied heights and widths of the boardwalk in the different habitat types allow people to have a multitude of experiences within the habitats, such as being up in the canopy as well as on ground level. This provides myriad physical views and allows visitors to sometimes feel they are within the habitat and sometimes above or near. Additionally, the varying heights make sure that if any particular height is a deterrent to an animal traveling across the site, the frequently changing nature of the boardwalk height means that wildlife need not go far to find a place to either cross over or under the boardwalk.

Illustration 8.14 indicates which boardwalk heights and widths occur in which habitats. Lowland habitats do not have the on-grade height due to the previously mentioned sensitive nature of those habitats. Habitats with low or few plants do not have the tallest height (15 feet), as there is no need to create a feeling of being within canopy, but animals still need an option to travel underneath the (10 foot) boardwalk. Finally, the wider widths are not included in the habitat types that are typically narrower or have less acreage, and this is simply to minimize disturbance to wildlife and not physically or visually overwhelm those smaller habitats with too much boardwalk.

Illustration 8.14: Typology for boardwalk sizing in habitat types



The recycled concrete paving on the boardwalk will be painted different colors based on what habitat the path is moving through. This offers an immediate experiential learning opportunity through providing a visual cue when visitors transition from one habitat to the next. Over time this will provide another experiential lesson when habitat borders shift and the boardwalk concrete color indicates how far the border has moved. There is a potential opportunity to have re-painting days at regular intervals (e.g., every 10 years) where volunteers re-paint the boardwalk concrete to match where the habitat borders have shifted, adding yet another layer of learning. Some iterations of the painted concrete boardwalk are showcased in Illustrations 8.8 and 8.15.

Illustration 8.15: View of boardwalk within forested wetland looking north

Figure 8.4: Existing condition for Illustration 8.15

There is also a figurative ecotone between humans and wildlife, which could be said to include connections between people and animals that are emotional or spiritual in nature. On the practical side for wildlife, areas of respite and retreat from people and other animals are provided by vegetative cover, rocky slopes, and man-made nest boxes (on poles and in trees for birds and on large underpass walls as well as under the Young bridge for bats). Some of these elements are seen in Illustrations 8.5, 8.6, 8.8, 8.11, and 8.15. Although it is impossible to say if there are any positive effects on wildlife when humans feel emotionally or spiritually connected to other species, it is certain that when people feel that connection, they can express it with care toward animals in their decisions. Those decisions can and do have effects on wildlife. This is the integration mentioned at the outset of this thesis, providing places for interaction, and that interaction between people and wildlife occurs anywhere on the site that is accessible to people. These are the places that encourage

positive connections with wildlife and inspire people to see the beauty of the natural world in new places and forms.

Chapter 9: Conclusions

Through the process of this design thesis project, a multitude of things were learned. Perhaps the most important to draw out and summarize are those which can be applied to other urban wildlife habitat design projects. The following points are hopefully only the beginning of the contributions to the design and urban ecology fields that this project can make.

- Essentially retrofitting habitat into existing urban fabric, whether sites are abandoned brownfields or re-developed greenfields, requires particular attention to edges and transitions, both inter- and intra-site.
- An attitude must be determined, based on the site and the project parameters, that guides decisions about priorities and accessibility (where people are allowed).
- Elevations, historic condition on-site, and common habitat types in the general region, as well as desired wildlife are important considerations for deciding what habitat types to include.
- It must be decided early in the process whether design will be species-specific or biodiversity focused.
- Mitigation of traffic and other common urban disturbances like sound and light are a high priority in order to minimize negative impacts on wildlife (such as vehicle collision injuries and fatalities, species more sensitive to sounds not colonizing the site, and changes in breeding and migratory behavior in birds due to urban lights).

These practical points all have their home in the metaphor and language of this thesis project. With the interplay of the design elements, in ecotones of species and habitats, the Capital Faunarium Sanctuary and Exhibit Hall give voice and witness to animals and a place for people to experience and exalt the diverse chorus of wildlife in our nation's capital. The Faunarium Sanctuary, using the principles of voice, ecotone, and commemoration, provides functional and beautiful habitats, edges, and connections for a variety of visitors, from tourists to turtles. The Sanctuary itself is a purposeful edge, and therefore is a successful design. As expressed in the poetic principles, the edges must all be purposeful, for in that purpose, there is the ability for edges to both move and be moving.

Appendices

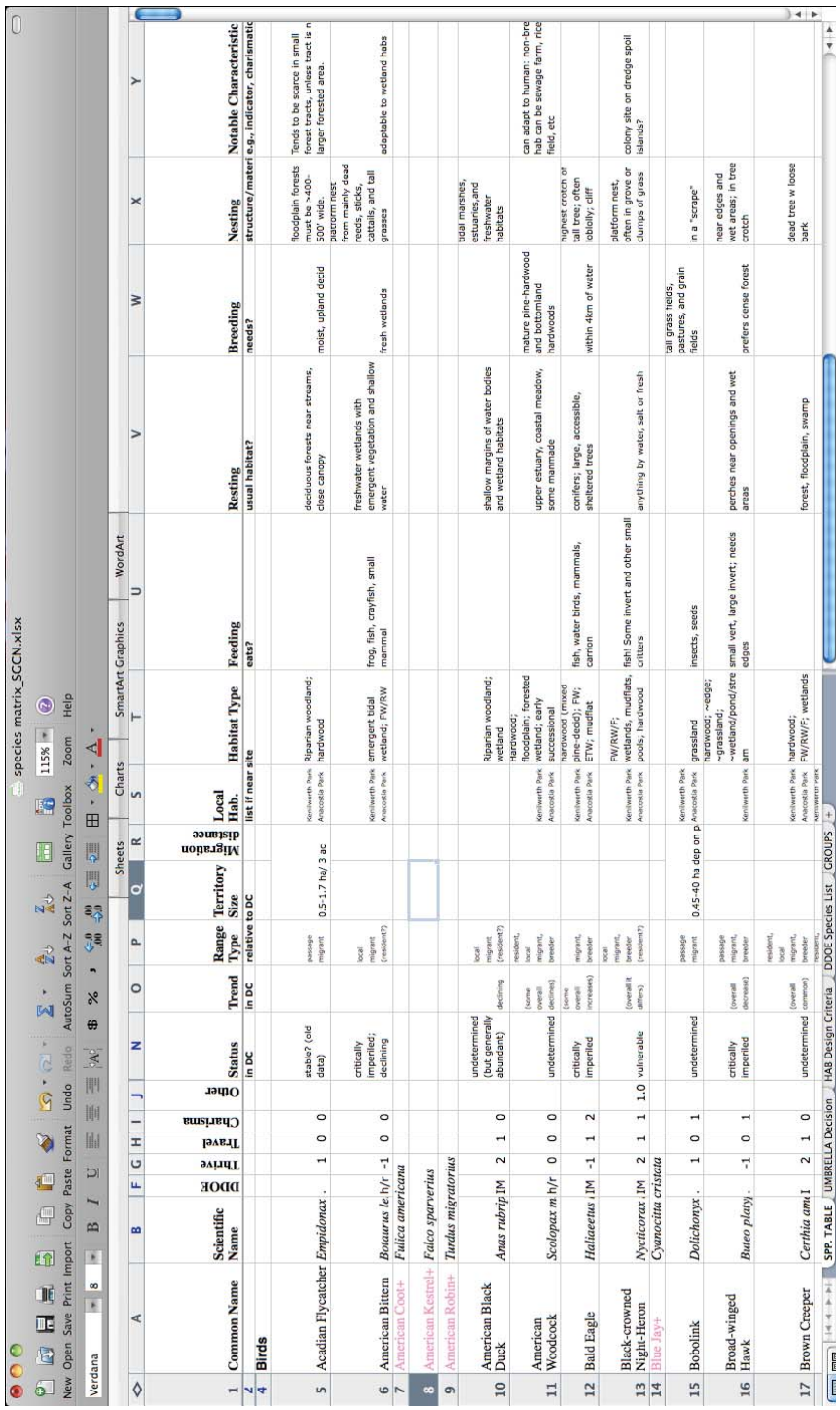
Appendix 1: Species Information

Table 10.1: Common urban species included on Species Matrix

Latin Name	**Common Name**
BIRDS	
American Coot	*Fulica americana*
American Kestrel	*Falco sparverius*
American Robin	*Turdus migratorius*
Blue Jay	*Cyanocitta cristata*
Canada Goose	*Branta canadensis*
European Starling	*Sturnus vulgarus*
Great Blue Heron	*Ardea herodias*
Killdeer	*Charadrius vociferus*
Mallard	*Anas platyrhynchos*
Mourning Dove	*Zenaida macorura*
Peregrine Falcon	*Falco peregrinus*
Purple Martin	*Progne subis*
Ruby-throated Hummingbird	*Archilochus colubris*
Vulture	*Carthartes aura*
Vulture	*Coragyps atratus*
MAMMALS	
American Beaver	*Castor canadensis*
Coyote	*Canis latrans*
Eastern Mole	*Scalopus aquaticus*
House Mouse	*Mus musculus*
Little Brown Bat	*Myotis lucifugus*
Mountain Lio	*Felis concolor*
Norway Rat	*Rattus norvegicus*
Nutria	*Myocastor coypus*
Raccoon	*Procyon lotor*
Red Fox	*Vulpes vulpes*
Striped Skunk	*Mephitis mephitis*
Tree Squirrel	*Sciurus spp.*
White-tailed Deer	*Odocoileus virginianus*
REPTILES	
Gopher Snake	*Pituophis catenifer*
Green Anole	*Anolis carolinensis*
Mediterranean Gecko	*Hemidactylus turcicus*
Red-eared slider	*Trachemys scripta*
Snapping Turtle	*Chelydra serpentina*
AMPHIBIANS	
Green Frog	*Rana clamitans*
Leopard Frog	*Rana pipiens*
Woodhouse's toad	*Bufo woodhouseii*

Appendix 2: Species Matrix

The species matrix, as described in Chapter 6, included an extensive amount of information on species of greatest conservation need. Below is a screenshot showing the layout of the matrix. If there are any questions regarding it, please email lkendric@umd.edu.



Appendix 3: Habitat Type Definitions

PRIMARY HABITATS

UPLAND

MEADOW / GRASSLAND

Historically "there were extensive areas of grassland [in the forest-dominated Mid-Atlantic]"

HARDWOOD FOREST

(OAK-HICKORY-PINE Sub-Type)

Dry-Mesic Oak-Hickory Forest was historically found throughout the Piedmont and Coastal Plain. In very dry settings, post oak and blackjack oak may dominate. This habitat category also includes closed canopy mixed hardwood/pine stands with crowded midstory development and low understory species diversity.

SHRUB-SCRUB / EARLY SUCCESSIONAL / EDGE

(UPLAND & LOWLAND)

Coastal Plain early successional and scrub-shrub habitats are characterized by low woody vegetation and herbaceous plants. This habitat can contain a diverse assemblage of plants and is of associated with human activity. Successional nature may require active management.

RIPARIAN WOODLAND / FORESTED WETLAND / FLOODPLAIN

The Coastal Plain floodplain forest habitat includes levee forest, cypress-gum swamps, bottomland hardwoods, and alluvial floodplains with small poorly defined fluvial features. Bottomland Hardwoods in blackwater systems are dominated by laurel oak, water oak, willow oak, overcup oak, red maple, sweetgum, loblolly pine, and occasionally Atlantic white cedar. Shrub layers and vines can be dense and the herb layer is usually sparse.

EMERGENT TIDAL WETLAND

"Lakes, ponds, impoundments, river, and marshes. The defining characteristic is the presence of fresh water, which stimulates the growth of such plants as cattails, sedges, and bulrushes."

MUDFLAT

Intertidal mud flats can be defined as non-vegetated, shallow-sloped shorelines, with expanses of fine sediment that are flooded with each high tide. They are often components of estuaries, forming the basic structure upon which coastal wetlands build, and are revealed when the tide goes out. Despite their empty appearance, mud flats are valuable as habitat and feeding grounds for many species of wildlife including micro-organisms and shorebirds.

SUB HABITATS

PONDS

Small Depression Ponds are on sites with permanently flooded sinkholes and other upland depressions that have complex and irregular zones of vegetation. Scattered trees (pond cypress and swamp blackgum) may be present in both deep and shallow water zones and most ponds are surrounded by a dense shrub layer. They provide breeding, nesting, and foraging habitat to many species.

VERNAL POOLS

Vernal Pools are small sites that flood seasonally and occur throughout the Coastal Plain and Sandhills. They are dominated by a dense to sparse herb layer and when dry are subject to fires spreading from adjacent uplands. They are almost always key amphibian breeding sites because they contain no fish.

SOURCES:
http://www.ncwildlife.org/Learning/Habitats/Coastal.aspx
Wildlife of the Mid-Atlantic: A Complete Reference Manual By John H. Rappole
http://www.sms.si.edu/irlspec/Tidal_Flats.htm
http://www.crd.bc.ca/watersheds/ecosystems/intertidalmudflats.htm

Appendix 4: Management Plan

Although it is out of the scope of this design thesis to create a complete management plan, issues of management were considered throughout the process of the research and design phases. Designed wildlife habitat anywhere will be most successful when management issues are taken seriously. Collaboration with management professionals such as wildlife biologists and urban ecologists should begin at least as early as the design concept phase. Common issues should be managed for, such as invasive flora removal and invasive/nuisance fauna mitigation. The National Park Service has initiatives to deal with these issues in DC, and these types of initiatives are needed on the project site also.

One issue of management specific to the project design is worth pointing out. In keeping with the idea of embracing change and allowing the site to have biogeochemical processes, the edges between habitats should not over-managed. Given the nature of the Early Successional / Edge habitat, this is the habitat type that may need consistent management to ensure that these areas neither begin to take over adjacent habitat types nor within themselves become overrun with succeeding plants. Generally speaking, however, if habitat borders want to shift a little, that should be allowed as a part of the natural processes within the Faunarium.

Appendix 5: Literature Review

A literature review was completed early in the fall of 2012 on urban ecology and habitat design. It proved difficult to find sources that discussed both of these topics. Often, literature on urban ecology was more about the science and less (or none) about design, or when ecology and design were discussed, it was largely theoretical. I did not feel the literature directly affected the design for the thesis project, however it did provide solid background research on relevant topics, thus the review is included as an appendix.

Urban ecology and implications for wildlife habitat design in landscape architecture

In this literature review I will examine several articles and books which discuss issues and implications of design and ecology as it relates to creating urban wildlife habitat. Each work has a section explaining and examining issues relevant to my thesis topic and site.

COLLINGE: Ecological consequences of habitat fragmentation: Implications for landscape architecture and planning.

Collinge (1996, 59-61) provides good summary of the effects of fragmentation on the landscape and calls habitat loss the greatest extant threat to biodiversity. The paper discusses landscape ecological concepts and their relevance to landscape architecture and planning, and there is emphasis on spatiality. The main negative ecological effects of anthropomorphic land transformation are “loss of native

species, invasion of exotic species, pronounced soil erosion, and decreased water quality" (Collinge 1996, 60). Two basic ecological theories are introduced and described: island biogeography and metapopulation dynamics. Island biogeography states that at equilibrium, the size of an island and its distance from the original source population of species which colonized the island will determine how many species are on the island. (Collinge 1996, 61-62) This idea about physical, literal islands can be applied to the concept of habitat fragments, which can be seen as *islands* of habitat in a sea of land uses. In metapopulation dynamics local populations of a species will expand or disappear and be recolonized but the overall metapopulation continues to persist. The idea of flux within metapopulations can also be applied to the fragmented landscape where local populations exist in patches.

The main attributes of habitat fragments discussed by Collinge (1996, 62-69) are the edge phenomenon, fragment size/area, fragment connectivity, fragment shape, fragment context, and fragment heterogeneity.

Some important points and conclusions relevant to landscape architecture and urban habitat design are mentioned. Collinge (1996, 70) refers to an Andropogon project which restored wooded areas and connected them within New York City's Central Park. Although not all cities will have such a large tract of land available, especially one which includes patches of second-growth woods such as Central Park, it is useful to note the success of the project in providing habitat and connectivity. Bird species such as the woodthrush (a forest interior species) were observed. The corridors in the forest network of Central Park were designed at 100 feet wide to reduce edge effects, so this may be a good benchmark size of urban forested

corridors. Other conclusions draw out the relativity of different attributes: although both fragment size and connectivity are important, “Fragment size may exert a much greater influence on species richness than fragment connectivity” (Collinge, 1996, 71). Further consideration on corridors is that not all species will be affected by them in the same way, which presumably goes for the other attributes as well, so corridors “should be viewed as one of a suite of strategies” (Collinge, 1996, 66, 71).

For designing urban habitat, these ideas must be considered, as urban landscapes are clearly fragmented and so it must be determined how the areas to be designed fit into the overall matrix of the city and how the areas can function as habitats for local populations.

Different habitat types can be measured as locally or generally more or less important, and there is some consensus that riparian areas are considered highly. DC’s Wildlife Action Plan (2006) reports “Rivers and Streams” as the highest priority habitat type, and Collinge (1996, 71) notes that “riparian vegetation along streams and rivers is critically important” to avoid some of the main negative ecological effects of land transformation which were listed at the beginning of the paper.

What seems perhaps the most significant implication for urban habitat design comes out of Collinge’s list of critical research needs. Briefly speaking, the research topics are habitat boundary permeability, edge effects on non-forest habitats, species perception of spatial structure, fragment context and matrix heterogeneity, and spatial arrangements of native and disturbed habitats. (Collinge, 1996, 72) If all of these topics (and presumably there are others related to urban ecology) are not yet well-understood, the implication for landscape architects is this: how do they create

informed and intelligent design in the meantime? What process must a designer go through to create the best possible project when the scientific research which could inform and hold up the design is incomplete? For example, if I want to design an emergent tidal wetland but there are no studies on how the attributes of designed wetlands in urban areas effect local species or improve biodiversity, how do I make my decisions?

THEOBALD: Estimating the cumulative effects of development on wildlife habitat.

Modeling the cumulative effects of development on wildlife habitat is discussed by Theobald et al. (1997 *LUP*). Distance from development is a main factor used in determining effects, for which the authors take a conservation planning approach. The first two sections of the article provide a good overview and explanation of the effects of development, such as alteration of vegetation type and structure, impeding movement of species, altered wildlife behavior, and disturbed food chains. As Collinge (1996, 66) concludes that corridors do not affect all species in the same way, Theobald et al. (1997, 27) also brings to light the importance of relativity: "Development does not affect all species equally."

Theobald et al. (1997, 25) introduce the notion of the "cumulative effects problem" and apply it to planning, wherein it is pointed out that often, in land use decision-making, small, singular decisions are seen as benign if the impact on habitat is small, but the reality may be that numerous such small decisions combined may create a serious problem. This is important for all designs that consider habitat. As Collinge (1996, 65-68) notes that fragment connectivity and context are important,

habitat cannot be looked at in isolation. One small patch may not be enough to sustain a species, but numerous, small patches might if they are connected. This example also illuminates the fact that cumulative effects can be seen in a negative or positive light.

Because the focus of Theobald et al.'s (1997, 29-33, 26-27 & 33-34) dataset is on residential development in a rural area, the analysis portion of the paper is not a good fit for the overall topic of my thesis, however the summary points on fragmentation can be useful for introductory sections of the thesis document in which I will explain the scientific foundation for design decisions made. The paper does provide food for thought in terms of design if the distance from disturbance is an important factor. (Theobald et al., 27-28) Of course, major cities are full of development, so it may be—under the definition of a paper such as this—that the entire city of DC would be considered a zone of "disturbance". However, if there are areas where habitat is preserved and development mitigated, distance from disturbance may need to be a design consideration. It would all depend on how disturbance is defined for a highly developed area.

CHACE & WALSH: Urban effects on native avifauna: A review.

Chace & Walsh (2006 *LUP*) describe the effects of urbanization on birds and make conclusions about important factors for successful bird habitat in cities. Because birds are easy to monitor, the bulk of studies on habitat center around avian species, communities, and habitats. As I plan to choose either a habitat type or a suite of species from various families on which to focus the design of my thesis, there is a

limitation to how useful this article can be. However, as there is high avian biomass in urban areas, it is an important piece of the puzzle.

Factors for success of bird species in urban areas and processes contributing to impacts are described. (Chace & Walsh, 2006, 47-51) They are organized by particular habitats, and as none of those are likely to be involved with my thesis (desert scrub, closed canopy forests, grasslands, habitats particular to Australia, coastal sage-scrub, oak woodlands), this section in unfortunately limited in providing details for my topic. Raptors are discussed separately as urban areas tend to select for them, due to availability of food and lack of persecution. Vegetation is critical: birds "respond to…composition and structure" and areas with native plants have more native birds (Chace & Walsh, 2006, 46). Largely, it seems Chace & Walsh (2006) refer to remnants of these habitat types, and as far as I'm aware my site does not include any remnants.

In a significant portion of the paper, processes impacting bird communities are discussed, many of which apply to wildlife in general, such as vegetation changes, fragmentation, exotic plants, nest predation, brood parasitism, collision, changes in food supply, and changes in predator assemblage. (Chace & Walsh, 2006, 55-61) Once I decide upon a particular habitat and group of species and therefore know which avian species are of import to my project, this section could prove quite useful for detailed and species-specific considerations.

As with other authors, Chace & Walsh (2006, 61) mention the complexity and precarious nature of the urban situation, acknowledging that the "effect of urbanization can be immense, yet our understanding is rudimentary." In this context,

designers must make decisions, as noted by the questions Collinge's (1996) paper prompted.

LOVELL & JOHNSTON:

Designing landscapes for performance based on emerging principles in landscape ecology (E&S)

Creating multifunctional landscapes: How can the field of ecology inform the design of the landscape? (FEE)

Lovell & Johnston's papers (2009 *E&S* and 2009 *FEE)* address the scholarly relation of landscape architecture and ecology. There is conversation on frameworks and guidelines, and Lovell & Johnston (2009 *FEE,* 213) briefly discuss some previous papers, focusing on multifunctional landscape design using a multi-scale approach. Included in the discussion are process steps and guidelines with the addition of modeling, but the defining feature of Lovell & Johnston's (2009 *FEE,* 213) work is the emphasis on "extending the role of the ecologist through the entire process" of design. An area of concern is the "absence of applied research" leading to specific design guidelines (Lovell & Johnston, 2009 *FEE,* 219*),* which is a problem I hope my thesis can address. It is, in fact, part of the reason for conducting the practitioner survey. The lack of involvement from the field of ecology means that design projects are rarely published in scientific literature (Lovell & Johnston, 2009 *FEE*, 219).

Thus Lovell & Johnston (2009 *E&S*) record the gap between the knowledge in landscape ecology research and its application to ecologically based landscape design, with an emphasis on looking at recent developments to create specific guidelines. Potential applications and methods for evaluation of and monitoring

performance are included (Lovell & Johnston, 2009 *E&S*). Although Lovell & Johnston's (2009 *E&S*, 17-18) review shows a "very wide range of studies demonstrating opportunities for individual landscape elements to provide important ecosystem services…more research is needed to develop a better understanding of the performance of the landscape as influenced by the sum of the individual landscape elements."

Although my project is unlikely to be built, there is value in describing what monitoring plans would be appropriate and feasible for the type of design which results from my research. Habitat design cannot be done in a vacuum if we are to achieve functioning ecosystems in our cities.

AHERN, LEDUC, YORK: *Biodiversity planning and design: Sustainable practices*

Ahern et al. (2006) review and analyze several landscape architecture projects using a case study method, which is described at the beginning of the book. There are public and private projects, and fine to broad scale, all in the U.S. The projects all address biodiversity from the perspectives of planning, design, restoration, and management.

Concepts of basic biodiversity issues, including definitions, importance, and trends/status are discussed early on. As with other papers, Ahern et al. (2006, 3) express the significance of fragmentation: "Considerable agreement exists among scientists that habitat loss and degradation are among the leading causes of global biodiversity decline." They go on to place design and landscape architecture in an important role, for if "habitat loss is the leading cause of biodiversity decline, it

follows that planning and design will be essential in any viable solution by directly conserving, protecting, or managing landscapes and habitats" (Ahern et al., 2006, 3). In describing why landscape architects should be concerned with biodiversity, points relevant to the potential framework of my project and answers to the question "why urban wildlife" are given. Included in an answer is the fact that "…habitat loss has affected 90 percent of bird species, 94 percent of fish, 87 percent of amphibians, 97 percent of reptiles, and 89 percent of mammals in the US" (Ahern et al., 2006, 18).

Outcomes are addressed as the dearth of data is highlighted: "Data for planning and designing biodiversity projects are often incomplete for explicitly supporting planning and design decisions—an inherent problem related to the site- and species-specific nature of the data required" (Ahern et al., 2006, 4). The authors point out that monitoring is rarely done, citing issues of cost and convenience, and so designers are rarely able to learn if "the intended results were achieved" (Ahern et al., 2006, 4). The ideal in biodiversity planning is inclusivity, but considering more and more species takes detailed knowledge, information (which doesn't always yet exist), or time. One way this has manifested itself is in using indicator species as representatives to gauge a certain habitat or ecosystem a method which has its value but is not unproblematic, in that it has a level of efficiency, but by having that is ignores the complexity of the issues. Ahern et al. (2006, 14) note further that "there appears to be little consensus in the literature regarding methods of selection for indicator fauna." Though there seems not to be an agreed-upon set of guidelines for professionals to reference, there are different approaches, which Ahern et al. (2006, 15) list in a table titled "Examples of Species Selection Approaches for Biodiversity

Planning." This table may help me in choosing a suite of species toward which to design.

Strategies for assessing and conserving biodiversity play a role in planning, design, and data, and it's best to have a combination of proactive and reactive approaches. (Ahern et al., 2006, 11) One proactive approach is the Gap Analysis Program (GAP), run by the Biological Resources Division of the USGS, which assessed gaps of what species were 'missing' from already protected areas across the U.S. (FYI, unfortunately this program was eliminated due to budget cuts.) The GAP was necessary, however, it was not a complete dataset because it focused on "protected areas." My thesis project, being pointedly about redeveloping/redesigning an urbanized site, may bolster the idea that data must also be collected on urban species, which could help facilitate the healing of fragmentation-caused wounds through designing for habitat.

The most relevant project example discussed by Ahern et al. (2006, 23-36) is the 90-acre Woodland Park Zoo in Seattle, which was re-designed in 1976 by Jones & Jones, and includes the "seminal" biocentric exhibit for lowland gorillas. The Jones & Jones team were the "first designers to describe the animals as clients," something which has been an intention of mine from the first conception of this project, although my conception is to see all species of potential users as clients, which of course includes humans (Ahern et al., 2006, 24). Landscape architect Grant Jones coined the term "landscape immersion" through the Woodland Zoo project, which "emphasizes that animals in zoos should be exhibited in their natural environment (or the closest facsimile possible)" and the visitors should feel they are

"in" the landscape too—not just looking "at" it (Ahern et al., 2006, 24). Landscape immersion principles include views and unseen barriers as particularly important, and the intent is for the animals to be able to engage in natural behavior, including social behavior. Previously, zoos often housed individuals of what we now know as "social species" separately (e.g. a single gorilla in a barred cage). Landscape immersion allows and designs for exhibits with space for multiple animals. In this way, Ahern et al. (2006, 36) assert, immersion exhibits are "the only way that zoos will truly fulfill their obligations to the species they house." The language here is important and telling, and I think that a project founded on the belief that the designers have an obligation to species that will use the space they are creating is the fundamental backbone of any project which makes claims about improving biodiversity and habitat. Further, Grant Jones established a very basic set of guidelines with a list of "Do's and Don'ts of Zoo Design" (Ahern et al., 2006, Table 2.1, 30), which was originally presented at the American Association of Zoological Parks and Aquariums annual conference of 1982. Those items in the list of suggestions that are appropriate to urban habitat could be reinterpreted toward my final design, e.g., "Put viewing areas on secondary paths so that primary paths are not distracting to either people or animals" (Ahern et al., 2006, 30). Some suggestions are certainly too focused on zoo exhibits to make sense for urban wildlife who are not contained within a park as zoo animals are confined to the zoo, but they still may provide interesting points or embody a way of thinking that enable an appropriately biocentric framework for my project. For instance, the suggestion, "Keep the animals only as close as their natural flight distances allows. Provide "alternative locations" within the exhibit so animals

may chose where they want to be," clearly relates zoo animals' confinement, but it also brings up flight distances, which should probably be a consideration for designing with wildlife in mind (Ahern et al., 2006, 30).

Jones & Jones created a multipurpose, interdisciplinary design framework for the Woodland Park Zoo, which Ahern et al. (2006) explain. The design team took what was then a new approach for zoos—organizing around bioclimatic regions instead of continents or countries. The "bioclimatology of plants" (Ahern et al., 2006, 26) became the organizing principle for the individual exhibits. A graphic which illustrates the framework shows basic elements and steps of the process around a final, central "long range plan". This graphic (Figure 2.5, 25, which I can add in later) may be useful as a model for my own project process. An approach like this may now seem anything but novel given that restoration projects are clearly based on ecological communities and ecosystem processes (as opposed to ecologically arbitrary human political boundaries). However this example shows that, in an "artificial" setting such as a zoo, innovation and creativity can lead to better application of ecological knowledge by designers.

Education was an important component of the zoo design. One study describes how landscape immersion can change human attitudes toward wild animals.

> …people surveyed after visiting a conventional zoo where animals are kept behind bars had only negative comments to make about the animals, describing them as dirty and aggressive. People surveyed after visiting a zoo based on landscape immersion, however, described the animals as beautiful, strong, and interesting. These latter individuals also said they were more likely to contribute to an environmental cause after visiting the zoo. (Ahern et al., 2006, 29)

My hope for my project is to teach visitors in a passive way such as this, as opposed to relying solely on conventional signage.

What if I could get people to feel this way after being in an urban park? Could they get that feeling of wonder and 'communing with nature' even in the city? Could they have the opportunity to see interesting animals and feel a connection with them (as opposed to annoyance, as with too many pigeons, etc)? Grant Jones said that he wanted visitors to feel as they do when they are in the wilderness—as if they are small in a big world. Perhaps my project can posit the question of how to create this feeling in an urban park.

The other major component of Jones & Jones' Woodland Park Zoo design, which also is educational, was "cultural resonance." It wasn't only about immersing visitors in the animal's habitat, but about how the visitors could relate that animal back to their own life and experience. Ahern et al. (2006, 34) explain that a "…zoo visitor can experience a deeper appreciation for the intrinsic role animals play in human existence" by the inclusion of additional exhibits and information on how a species is important to culture, religion, etc. This begs a similar question as the theme of landscape immersion: how can I create cultural resonance in an urban park? Because my project is about integrating human and animal user concerns in the same space, attending to human culture is also an important part of the design process.

On evaluation, Ahern et al. (2006, 36) conclude that zoos must change their philosophies, citing David Hancocks—first the design coordinator for Woodland Park Zoo and later the zoo director (Ahern et al., 2006, 26)—because "people no longer need to visit a zoo to see what a camel looks like" (Ahern et al., 2006, 36). The

experience has gone beyond that. For urban habitat, a human visitor would not go to a park to see what a pigeon looks like—they go for a deeper experience. What sort of experience can my design inspire? What could the design teach humans while providing for animals?

Conclusions relevant to my project include the "common lack of good data for planning and design" (Ahern et al., 2006, 79). Monitoring again was brought up as needed in order to assess impact. The authors point out that "reliable information about the effectiveness of various restoration approaches is lacking" (Ahern et al., 2006, 87). One implication of this is that I will need to make some semblance of educated guesses on effectiveness, as I will be unlikely to find specific data to guide my decisions in a traditional scientific manner. Additionally, my project must consider how monitoring could be done, either in terms of planning and/or in physical elements designed on the site which would accommodate monitoring activities.

JOHNSON & HILL (Eds.): *Ecology and design: Frameworks for learning*

The overall theme of the book is, of course, the confluence of ecology and design. More specifically, it examines ecological knowledge as it relates to design and planning as well as collaboration between designers and scientists. Johnson & Hill (2001, 7, 12) see these two fields as inextricably entwined: "In essence, all landscape design is ecological, whether by intent or default, because every landscape place, no matter how large or small, includes multiple species and biophysical processes that will be affected by human actions." The focus is on education, teaching, and curriculum, so many of the chapters were only peripherally useful for

my project. In this section, I will discuss those topics which are relevant. These include the traditional theory of ecology was that of equilibrium—the so-called "balance of nature." An updated conception, one of change and flux, is discussed. Additionally, spatial patterns are of special concern.

Johnson & Hill (2001, 3-6, 8-11) include definitions of subfields which are involved in the confluence of ecology and design, which may be informative for introductory sections of my thesis document. The subfields include: Conservation biology, Landscape ecology, Restoration ecology, Ecosystem management, Landscape architecture, Civil engineering, Planning, and Architecture.

In chapter three, Pulliam & Johnson (in Johnson & Hill, 2001, 51) relate ecology's paradigm shift and implications for designers and planners. The authors explain:

> "the paradigm shift involves two primary changes: (1) a shift from an equilibrium point of view where local populations and ecosystems are viewed as in balance with local resources and conditions, to a disequilibrium point of view where history matters and populations and ecosystems are continually being influenced by disturbances; and (2) a shift from considering populations and ecosystems as relatively closed or autonomous systems independent of their surroundings, to considering both populations and ecosystems as "open" and strongly influenced by the input and output or "flux" of material and individuals across system borders".

It is stressed that disturbance and unpredictable events are important, and this leads me to ask, what if I designed *for* disturbance? How can one design for disturbance—whether it is an expectation of change or somehow actually creating disturbance?

Similar to the idea of an ecosystem's surroundings having an effect on its flux, Pulliam & Johnson (in Johnson & Hill, 2001, 72) assert that "landscape memory" is also a factor. This is the idea that what happened previously on a site can

significantly effect the existing ecosystem. Consider two woodlots of the same size, with the same type of trees and amount of canopy. They would seem to have the same health, but imagine that one was used for crops and the other for occasional timber harvest. This means there will be significant differences in the soil, probably structurally and nutrient-wise, which results in different ecological health between the two woodlot sites. “More and more studies are showing that past land-use changes and management practices have left a long-lasting legacy or landscape memory” (Pulliam & Johnson in Johnson & Hill, 2001, 73).

Autonomy of an ecosystem or landscape is described. “As open, flow-through systems, all ecosystems are dependent on their surroundings. But…some ecosystems are more independent of their inputs and surroundings than others” (Pulliam & Johnson in Johnson & Hill, 2001, 73-4). Relativity in natural systems has come up at different points from Collinge (1996, 66, 71) and Theobald et al. (1997, 27). An implication from this for planning and design is that “Landscape designers and managers can directly influence the flow of materials across a landscape and therefore influence its degree of autonomy” (Pulliam & Johnson in Johnson & Hill, 2001, 79).

Spatiality is important in landscape design, as explained in chapter four by Forman (in Johnson & Hill, 2001, 90-95). Landscape patterns derive from natural processes or human intervention and they are distinct from each other. The patterns of nature are “are primarily aggregated, curvy, convoluted with lobes and coves, elongated, variable in size, irregular, fractal or dendritic, and richly textured” (Forman in Johnson & Hill, 2001, 92). Whereas human patterns “seem limited by

Euclidean geometry": squares, grids, parallel lines, etc (Forman in Johnson & Hill, 2001, 94).

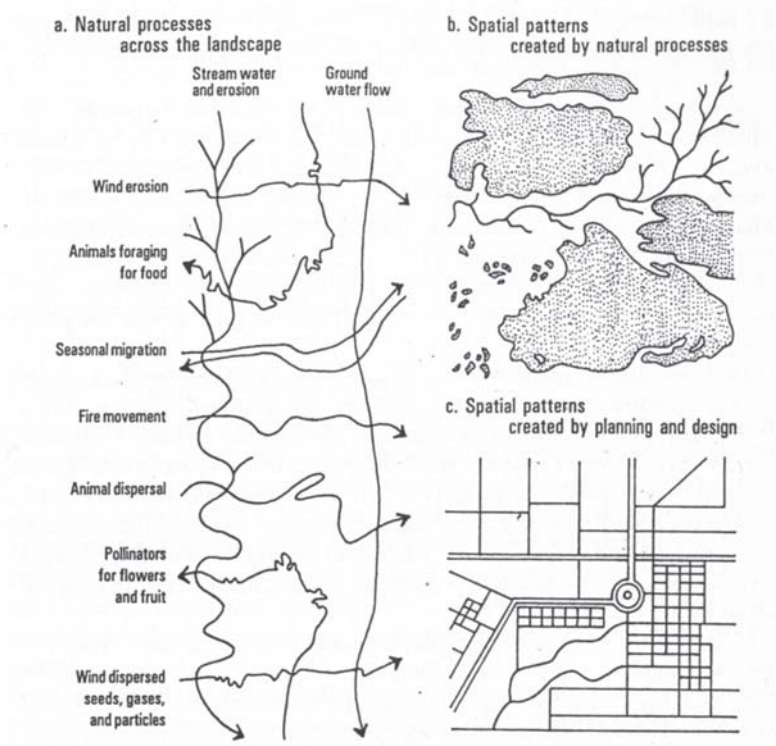


FIGURE 4-2.
Common ecological flows and spatial patterns in landscapes. (a) Typical trajectories for ecological flows or natural processes across a landscape. For illustration, routes are superimposed on but independent of one another. (b) Spatial patterns resulting from natural processes illustrated. (c) Spatial patterns resulting from design and planning illustrated. (d) Summary list of common spatial patterns produced by the two processes. See Forman and Hersperger 1997; Forman 1999a.

(Forman in Johnson & Hill, 93.)

The visual distinction is clear and the impacts are different, as "areas with mainly natural patterns function differently from planned and designed areas" (Forman, in Johnson & Hill, 2001, 94). This leads to the question of, if an area was designed with

natural forms and patterns, would it function "naturally" (because that's what the patterns reflect) or would it function artificially (because humans still designed it)? If "forms determine functions" we would have to conclude the former (Forman in Johnson & Hill, 2001, 94). Also, I begin to wonder if designing with natural forms as a guide, as opposed to using typical Euclidean forms, would that automatically lead to improved habitat, given that animals obviously evolved in natural forms? Forman (in Johnson & Hill, 2001, 99) asserts that "Creating anthropogenic spatial patterns that mimic those produced by nature, rather than the rather rigid geometric patterns characteristic of planning and design, should, for example, increase protection of streams, aquifers, and habitats for biological diversity…ecological flows should be enhanced." If flows such as groundwater, seed dispersal, and animal movement are enhanced, then this is a necessity for habitat design.

Another book with potential for further review and/or as a guideline for design, which I recently discovered, is Natural Pattern Forms: A Practical Sourcebook for Landscape Design by Richard L. Dubé, as it includes basically a glossary, both written and visual, of different patterns that occur naturally in the landscape.

Forman (in Johnson & Hill, 2001, 95) reflects on the integration of ecology and human concerns in design in a different way than Lovell & Johnston's (2009) focus on scientific procedure:

> "Imagine designing a city plaza as a meeting place for local artisans and shoppers, which also attracts the sequential waves of migrating songbirds in season. The design of a beautiful garden can also provide habitat interspersion and convergency points (junctures of three or more habitats) for key wildlife. A park can be designed for both intensive recreation and no increased soil deposition into an adjacent stream with threatened snails or fish. Each

> example combines a key cultural and ecological objective. Successfully combining two or more such objectives should be easy and the norm."

Perhaps it is simply in the language which seems to leave room for inspiration and playfulness which Lovell & Johnston (2009) do not. Both views are necessary, however I am not sure one can create inspired design if the data and procedure overrun the process.

Going further than simply pointing out natural and human patterns, Forman (in Johnson & Hill, 2001, 97) prioritizes four "indispensable spatial patterns" which should be in nearly every project in Figure 4-3.

- a few large natural-vegetation patches
- connectivity among the patches
- vegetation along major streams
- "bits of nature" scattered over a less hospitable matrix

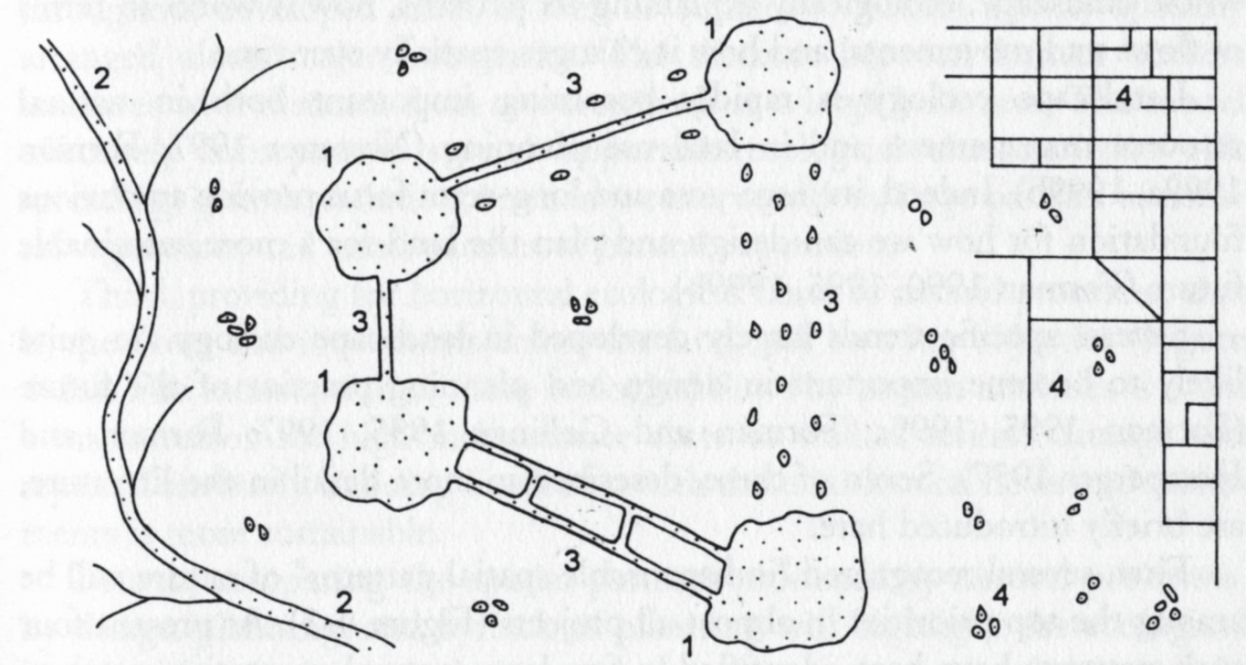


FIGURE 4-3.
Top-priority "indispensable patterns" in planning a landscape based on landscape ecology. 1 = a few large patches of natural vegetation; 2 = major vegetated stream or river corridor; 3 = connectivity with corridors and stepping-stones between large patches; 4 = heterogeneous "bits of nature" across the matrix. See Forman 1995; Forman and Collinge 1995, 1997; Forman and Hersperger 1997.

These particular patterns are deemed indispensable because "no known or technologically feasible alternative exists to provide the ecological benefits each provides" (Forman, in Johnson & Hill, 2001, 98). If it is true that these patterns definitively provide the ecological services which no other patterns provide, they must be included in habitat design considerations.

One more specific, but broader scale, point which could inform master planning is the landscape ecology trend of using the "aggregate-with-outlier" model, shown in Figure 4-4. This says that "one should aggregate land uses, yet maintain

small patches and corridors of nature throughout developed areas, as well as outliers of human activity spatially arranged along major boundaries" (Forman, in Johnson & Hill, 2001, 98-9).

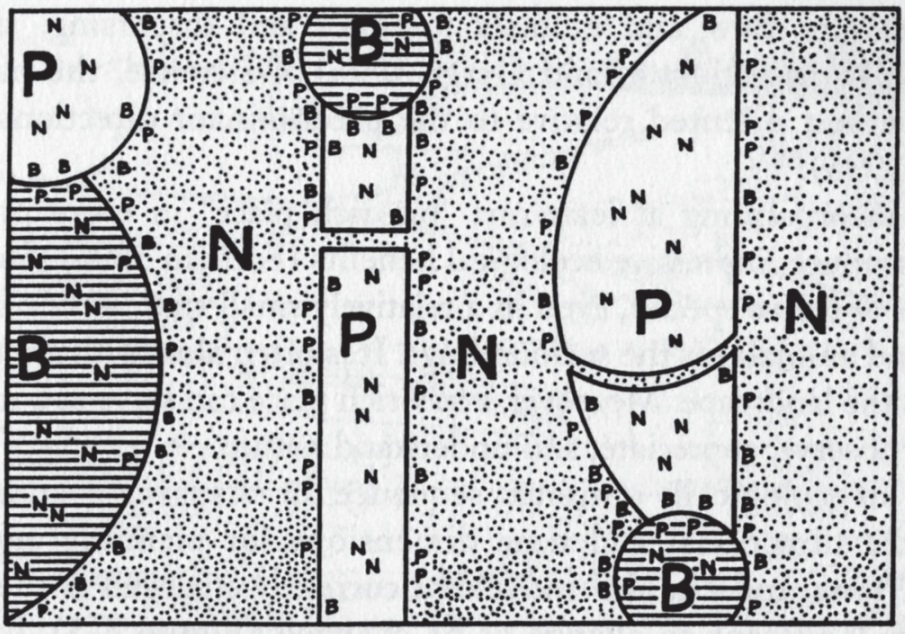


FIGURE 4-4.
Aggregate-with-outlier model for ecologically meshing land uses. N = natural vegetation; P = pasture; B = built area; large letters indicate a large patch; small letters indicate locations of small patches. See Forman 1995; Forman and Collinge 1995; Forman and Hersperger 1997.

Urban ecology is a relatively young field, but this is clearly where I should derive much of my foundational knowledge. Chapter eleven, by Michael Hough, links urbanism to nature in a nicely integrative conclusion:

> "While still in its beginnings, urban ecology will have major implications for how designers contribute to urban health and sustainability. Ecological restoration, designing with climate and energy conservation, the role of vegetation and soils in ameliorating air pollution, storm drainage systems, and the value of urban wilderness to cities are all roles for design that will increasingly preoccupy teaching, practice, and research." (Hough in Johnson & Hill, 2001, 256)

Although this focuses on education, the role of the designer in improving ecological health is clear.

SYNTHESIS

There are some common themes running through these myriad works. First, it is clear that fragmentation of habitat is a huge issue and is frequently mentioned and summarized in articles or books which relate to that process, such as Collinge, Theobald et al., and Ahern.

Relativity comes up numerous times, although it is not named as such. The idea that certain processes do not affect all species in the same way or the same amount is not a surprising one, given how the complexity of biology and ecology. Collinge, Theobald et al., and Pulliam & Johnson all bring this up in various ways, such as the latter's point that "some ecosystems are more independent of their inputs and surroundings than others" (in Johnson & Hill, 2001, 73-4). This complexity is an important notion, because it requires the decision making process to be difficult or at least difficult to quantify.

Speaking of quantifying, the lack of studies on certain topics or data came up repeatedly. Chace & Walsh call our current understanding "rudimentary" and Collinge simply points out what research is next needed. This is why I believe it may be important for my project to address the lack of data. By this I don't necessarily mean that a part of my project will be gathering data, but that the design will consider what processes and physical apparatuses are required for monitoring (apparatuses for

testing water quality; ways for bioblitz participants to access areas of the site where species are likely to be found; etc).

The application of ecological principles in design is obviously a big theme here, which are widely discussed. Collinge and Theobald et al. explain basic ecological theories, Ahern defines biodiversity concepts, and Pulliam & Johnson discuss a new paradigm in ecological thinking. While it may be that I will lack specific data to back up my decision making, principles of ecology can always be applied broadly, and there may be some level of extrapolation required, especially given the previously mentioned complexities.

Spatial patterns, although only explicitly mentioned by Forman (in Johnson & Hill, 2001), are clearly imperative considerations for landscape designing. Additionally, the book by Dubé could potentially be in a later draft of the literature review or it could be its own study which may guide my design.

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Appendix 6: Presentation Boards

ANALYZING

3/8

INVENTORY HIGHLIGHTS

180 acres total; 150 available to become habitat

Site about 50% impervious surfaces (over 70 acres are parking lot; over 80 acres are impervious surfaces)

"Best" vegetation/habitat on site is narrow river buffer

Pre-development habitat was emergent tidal marsh and covered almost the entire site

DC WAP prioritizes habitat types and Species of Greatest Conservation Need

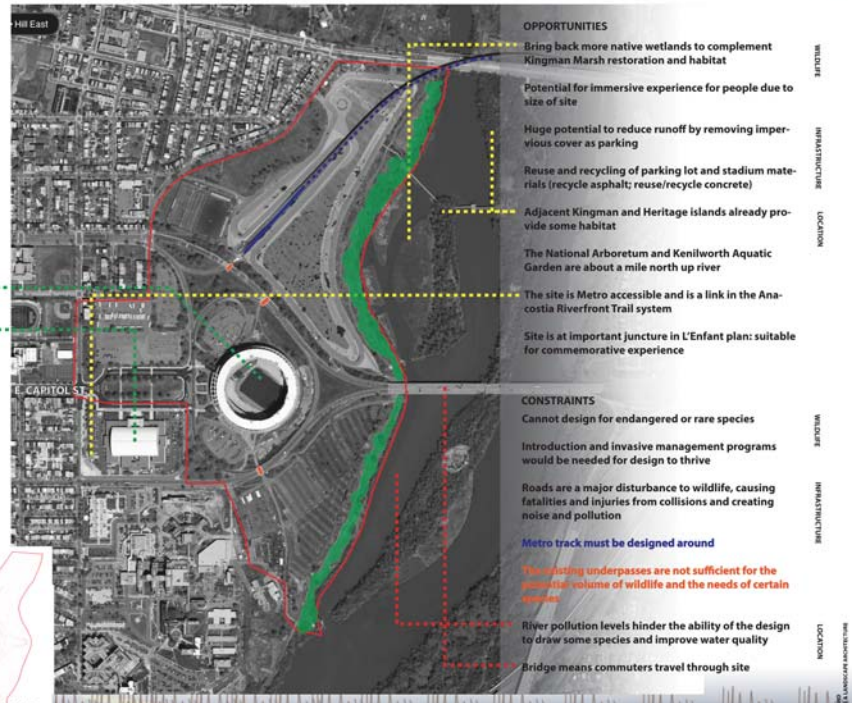
NCPC suggests an "ecological precinct"

Stadium will have little to no use once DC United leaves

Armory still used for military and entertainment functions

GOALS

- **Provide a variety of native Mid-Atlantic coastal plain habitat types** to improve biodiversity while building upon recent restoration projects near the site (Kingman marsh)
- **Prioritize the mitigation of typical urban disturbances to wildlife,** such as road crossings, to maximize the potential of new, native species inhabiting the area
- Create a variety of separate **pockets of seclusion and gathering** appropriate for humans and wildlife
- Include **access** and viewing opportunities **to the water**
- Bioremediate pollution in the Anacostia River to the extent possible by significantly **reducing impervious surfaces** and capturing/filtering stormwater onsite



OPPORTUNITIES

Bring back more native wetlands to complement Kingman Marsh restoration and habitat — WILDLIFE

Potential for immersive experience for people due to size of site

Huge potential to reduce runoff by removing impervious cover as parking — INFRASTRUCTURE

Reuse and recycling of parking lot and stadium materials (recycle asphalt; reuse/recycle concrete)

Adjacent Kingman and Heritage islands already provide some habitat — LOCATION

The National Arboretum and Kenilworth Aquatic Garden are about a mile north up river

The site is Metro accessible and is a link in the Anacostia Riverfront Trail system

Site is at important juncture in L'Enfant plan: suitable for commemorative experience

CONSTRAINTS

Cannot design for endangered or rare species — WILDLIFE

Introduction and invasive management programs would be needed for design to thrive

Roads are a major disturbance to wildlife, causing fatalities and injuries from collisions and creating noise and pollution — INFRASTRUCTURE

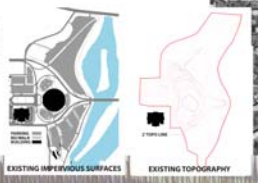
Metro track must be designed around

The existing underpasses are not sufficient for the potential volume of wildlife and the needs of certain species

River pollution levels hinder the ability of the design to draw some species and improve water quality — LOCATION

Bridge means commuters travel through site

DIAGRAMS

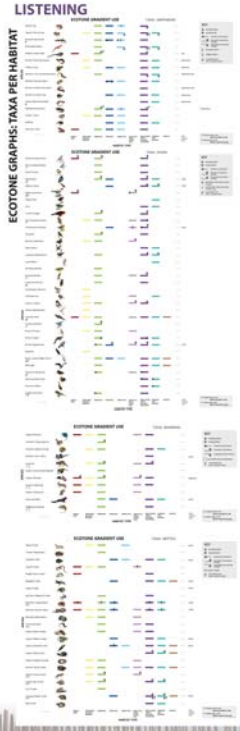


THE PURPOSEFUL EDGE:

DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER

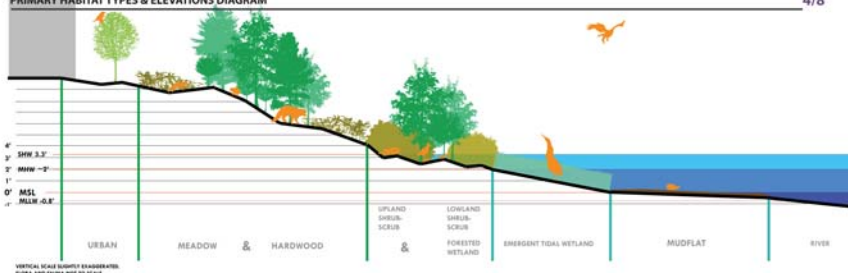
LISTENING

ECOTONE GRAPHS: TAXA PER HABITAT



PRIMARY HABITAT TYPES & ELEVATIONS DIAGRAM

4/8

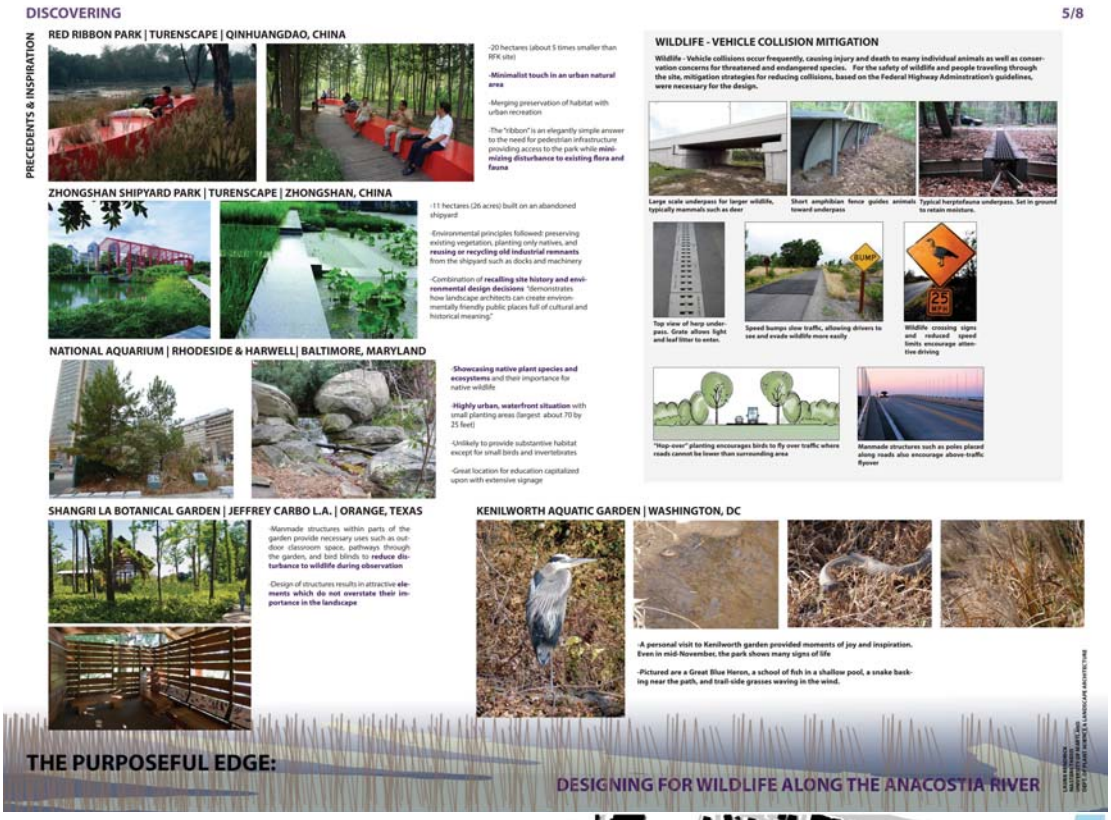


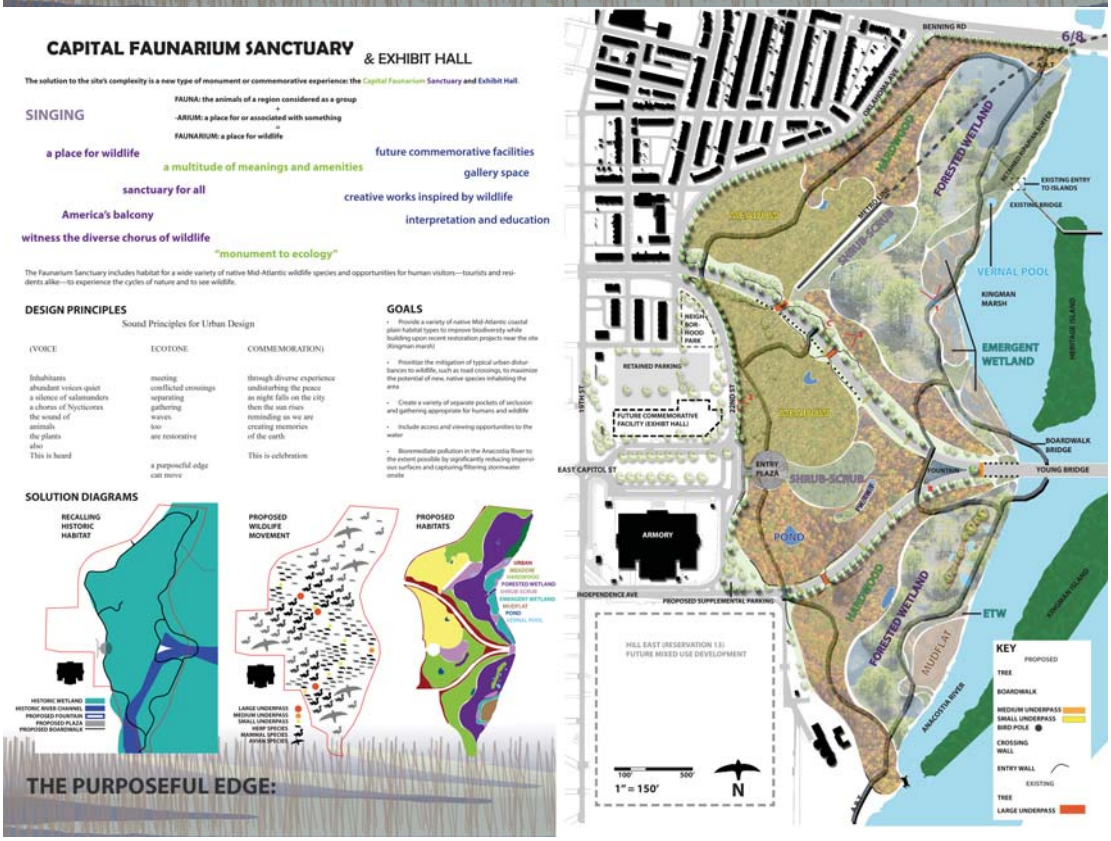
HABITAT TYPE DEFINITIONS

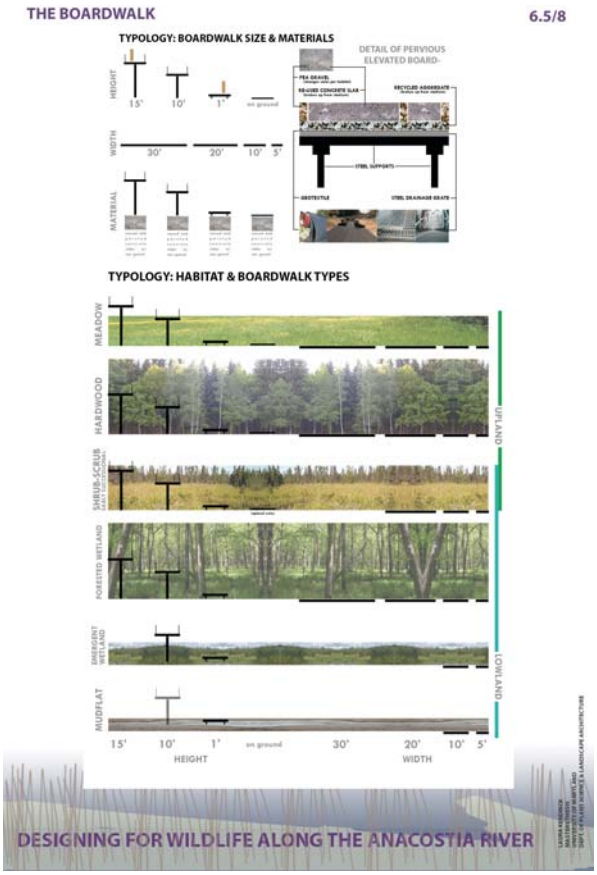
FROM DATA TO DESIGN DECISIONS

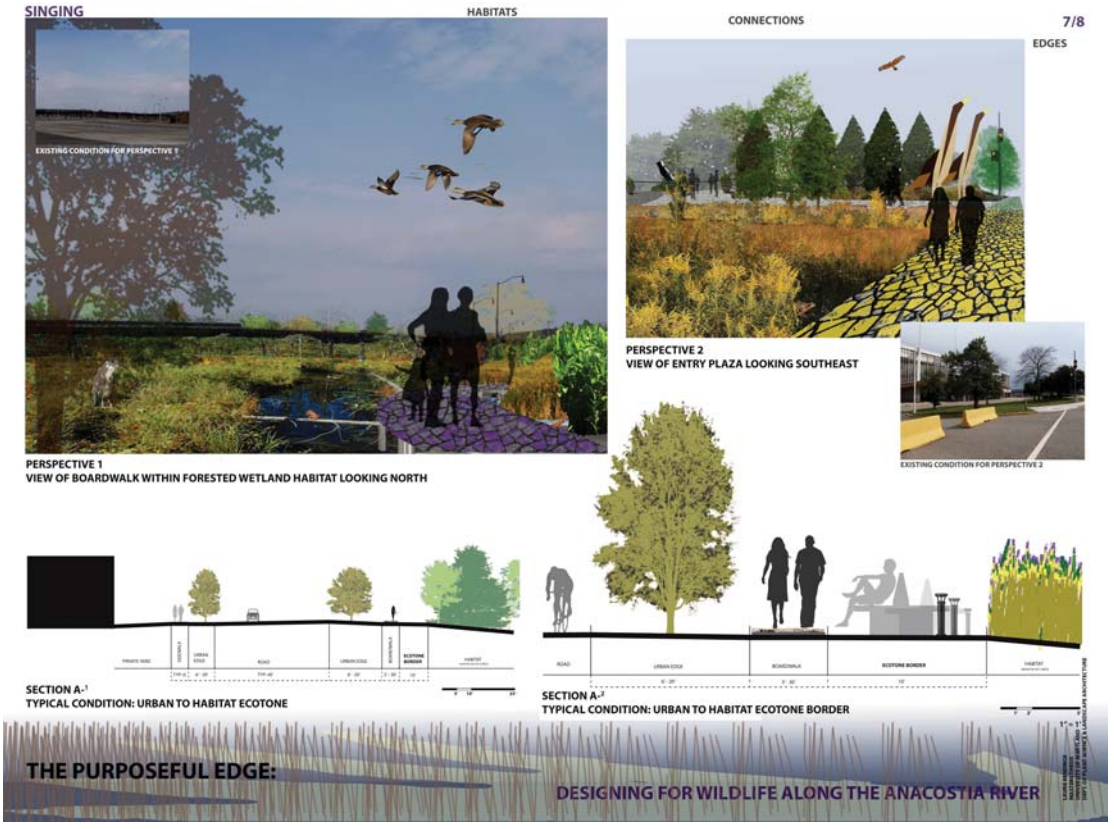
THE PURPOSEFUL EDGE:

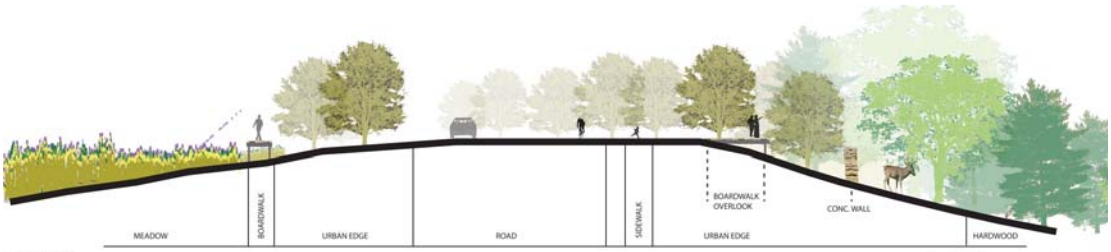
DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER


DISCOVERING
5/8
PRECEDENTS & INSPIRATION
RED RIBBON PARK | TURENSCAPE | QINHUANGDAO, CHINA
-20 hectares (about 5 times smaller than RFK site)
-Minimalist touch in an urban natural area
-Merging preservation of habitat with urban recreation
-The "ribbon" is an elegantly simple answer to the need for pedestrian infrastructure providing access to the park while minimizing disturbance to existing flora and fauna
ZHONGSHAN SHIPYARD PARK | TURENSCAPE | ZHONGSHAN, CHINA
-11 hectares (26 acres) built on an abandoned shipyard
-Environmental principles followed: preserving existing vegetation, planting only natives, and reusing or recycling old industrial remnants from the shipyard such as docks and machinery
-Combination of recalling site history and environmental design decisions "demonstrates how landscape architects can create environmentally friendly public places full of cultural and historical meaning."
NATIONAL AQUARIUM | RHODESIDE & HARWELL| BALTIMORE, MARYLAND
-Showcasing native plant species and ecosystems and their importance for native wildlife
-Highly urban, waterfront situation with small planting areas (largest about 70 by 25 feet)
-Unlikely to provide substantive habitat except for small birds and invertebrates
-Great location for education capitalized upon with extensive signage
SHANGRI LA BOTANICAL GARDEN | JEFFREY CARBO L.A. | ORANGE, TEXAS
-Manmade structures within parts of the garden provide necessary uses such as outdoor classroom space, pathways through the garden, and bird blinds to reduce disturbance to wildlife during observation
-Design of structures results in attractive elements which do not overstate their importance in the landscape
WILDLIFE - VEHICLE COLLISION MITIGATION
Wildlife - Vehicle collisions occur frequently, causing injury and death to many individual animals as well as conservation concerns for threatened and endangered species. For the safety of wildlife and people traveling through the site, mitigation strategies for reducing collisions, based on the Federal Highway Administration's guidelines, were necessary for the design.
Large scale underpass for larger wildlife, typically mammals such as deer
Short amphibian fence guides animals toward underpass
Typical herpetofauna underpass. Set in ground to retain moisture.
Top view of herp underpass. Grate allows light and leaf litter to enter.
Speed bumps slow traffic, allowing drivers to see and evade wildlife more easily
Wildlife crossing signs and reduced speed limits encourage attentive driving
"Hop-over" planting encourages birds to fly over traffic where roads cannot be lower than surrounding area
Manmade structures such as poles placed along roads also encourage above-traffic flyover
KENILWORTH AQUATIC GARDEN | WASHINGTON, DC
-A personal visit to Kenilworth garden provided moments of joy and inspiration. Even in mid-November, the park shows many signs of life
-Pictured are a Great Blue Heron, a school of fish in a shallow pool, a snake backing near the path, and trail-side grasses waving in the wind.
THE PURPOSEFUL EDGE:
DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER


CAPITAL FAUNARIUM SANCTUARY & EXHIBIT HALL
The solution to the site's complexity is a new type of monument or commemorative experience: the Capital Faunarium Sanctuary and Exhibit Hall.
FAUNA: the animals of a region considered as a group
+
-ARIUM: a place for or associated with something
=
FAUNARIUM: a place for wildlife
SINGING
a place for wildlife
a multitude of meanings and amenities
sanctuary for all
America's balcony
witness the diverse chorus of wildlife
"monument to ecology"
future commemorative facilities
gallery space
creative works inspired by wildlife
interpretation and education
The Faunarium Sanctuary includes habitat for a wide variety of native Mid-Atlantic wildlife species and opportunities for human visitors—tourists and residents alike—to experience the cycles of nature and to see wildlife.
DESIGN PRINCIPLES
Sound Principles for Urban Design
(VOICE
Inhabitants
abundant voices quiet
a silence of salamanders
a chorus of Nycticorax
the sound of
animals
the plants
also
This is heard
ECOTONE
meeting
conflicted crossings
separating
gathering
waves
too
are restorative
a purposeful edge
can move
COMMEMORATION)
through diverse experience
undisturbing the peace
as night falls on the city
then the sun rises
reminding us we are
creating memories
of the earth
This is celebration
GOALS
• Provide a variety of native Mid-Atlantic coastal plain habitat types to improve biodiversity while building upon recent restoration projects near the site (Kingman marsh)
• Prioritize the mitigation of typical urban disturbances to wildlife, such as road crossings, to maximize the potential of new, native species inhabiting the area
• Create a variety of separate pockets of seclusion and gathering appropriate for humans and wildlife
• Include access and viewing opportunities to the water
• Bioremediate pollution in the Anacostia River to the extent possible by significantly reducing impervious surfaces and capturing/filtering stormwater onsite
SOLUTION DIAGRAMS
RECALLING HISTORIC HABITAT
PROPOSED WILDLIFE MOVEMENT
PROPOSED HABITATS
THE PURPOSEFUL EDGE:
BENNING RD
6/8
MEADOW
SHRUB-SCRUB
FORESTED WETLAND
EXISTING ENTRY TO ISLANDS
EXISTING BRIDGE
VERNAL POOL
KINGMAN MARSH
EMERGENT WETLAND
HERITAGE ISLAND
NEIGHBORHOOD PARK
RETAINED PARKING
FUTURE COMMEMORATIVE FACILITY (EXHIBIT HALL)
BOARDWALK BRIDGE
YOUNG BRIDGE
EAST CAPITOL ST
ENTRY PLAZA
FOUNTAIN
ARMORY
POND
INDEPENDENCE AVE
PROPOSED SUPPLEMENTAL PARKING
HILL EAST (RESERVATION 13) FUTURE MIXED USE DEVELOPMENT
ETW
MUDFLAT
ANACOSTIA RIVER
KEY
PROPOSED
TREE
BOARDWALK
MEDIUM UNDERPASS
SMALL UNDERPASS
BIRD POLE
CROSSING WALL
ENTRY WALL
EXISTING
TREE
LARGE UNDERPASS
1" = 150'
N

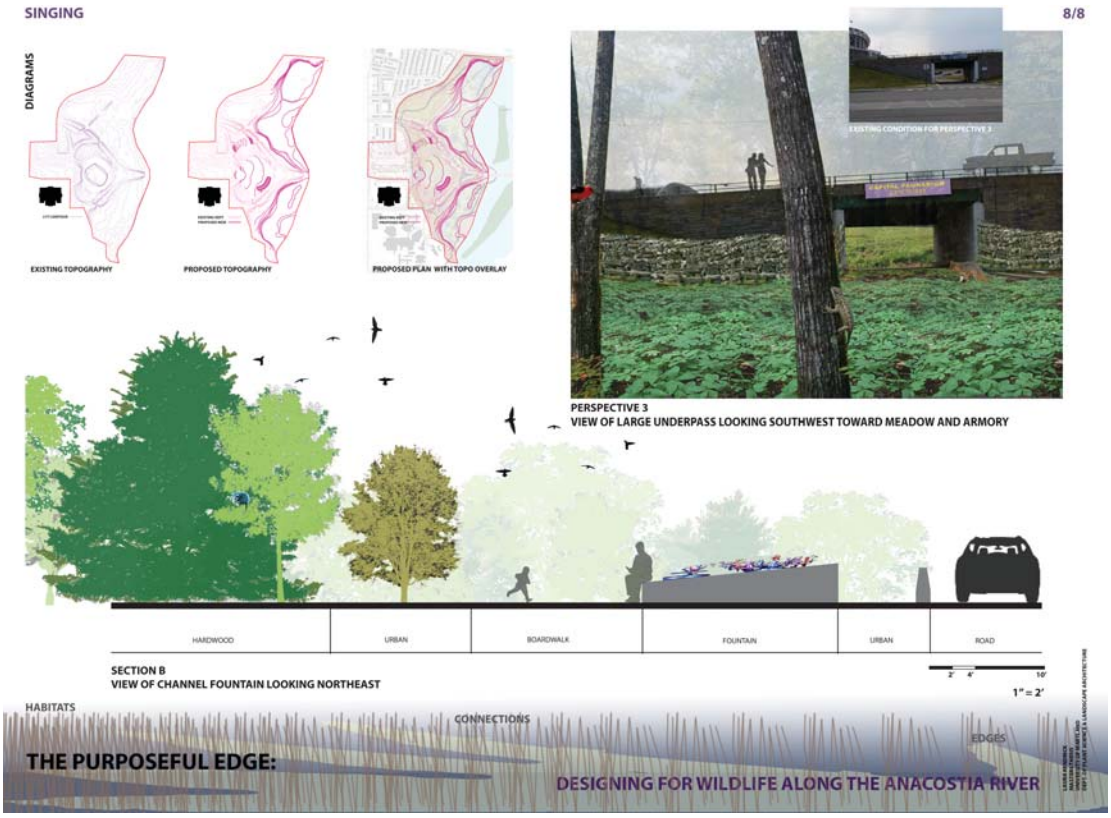

THE BOARDWALK
6.5/8
TYPOLOGY: BOARDWALK SIZE & MATERIALS
DETAIL OF PERVIOUS ELEVATED BOARD-
HEIGHT
WIDTH
MATERIAL
15'
10'
1'
on ground
30'
20'
10'
5'
TYPOLOGY: HABITAT & BOARDWALK TYPES
MEADOW
HARDWOOD
SHRUB-SCRUB
FORESTED WETLAND
EMERGENT WETLAND
MUDFLAT
UPLAND
LOWLAND
HEIGHT
WIDTH
DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER


SINGING
HABITATS
CONNECTIONS
7/8
EDGES
EXISTING CONDITION FOR PERSPECTIVE 1
PERSPECTIVE 1
VIEW OF BOARDWALK WITHIN FORESTED WETLAND HABITAT LOOKING NORTH
PERSPECTIVE 2
VIEW OF ENTRY PLAZA LOOKING SOUTHEAST
EXISTING CONDITION FOR PERSPECTIVE 2
SECTION A-1
TYPICAL CONDITION: URBAN TO HABITAT ECOTONE
SECTION A-2
TYPICAL CONDITION: URBAN TO HABITAT ECOTONE BORDER
THE PURPOSEFUL EDGE:
DESIGNING FOR WILDLIFE ALONG THE ANACOSTIA RIVER



SECTION C
VIEW OF ROAD CROSSING SHOWING PROPOSED WALL LOOKING NORTHWEST

1" = 5'



PERSPECTIVE 3
VIEW OF LARGE UNDERPASS LOOKING SOUTHWEST TOWARD MEADOW AND ARMORY

SECTION B
VIEW OF CHANNEL FOUNTAIN LOOKING NORTHEAST

1" = 2'

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