Four Mile Run Restoration Master Plan

Prepared for

ARLINGTON COUNTY &

CITY OF ALEXANDRIA

Consultants

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WATERSCAPES / DREISEITL

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Four Mile Run Restoration Master Plan

Adopted by Arlington County Board on March 14, 2006

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MOUNT VERNON AVENUE PLAZA
AND VIEW NORTH TO ARLINGTON'S
WATER PLAY AREA: A VISION

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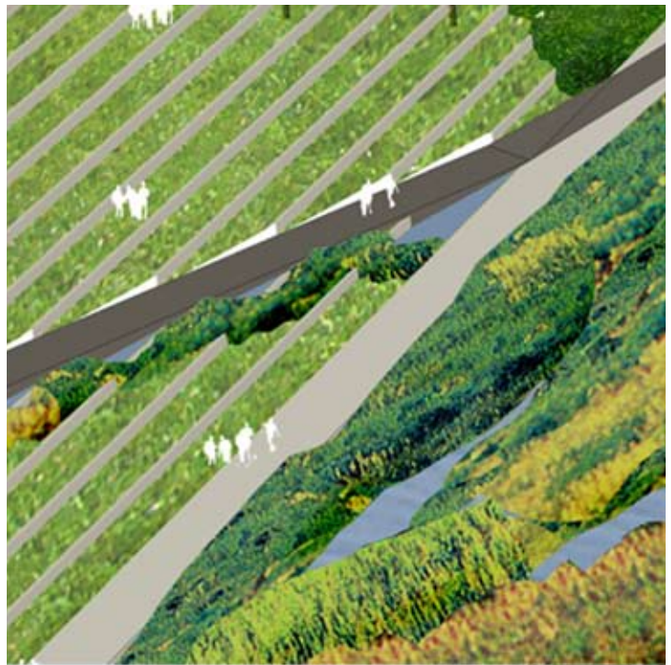

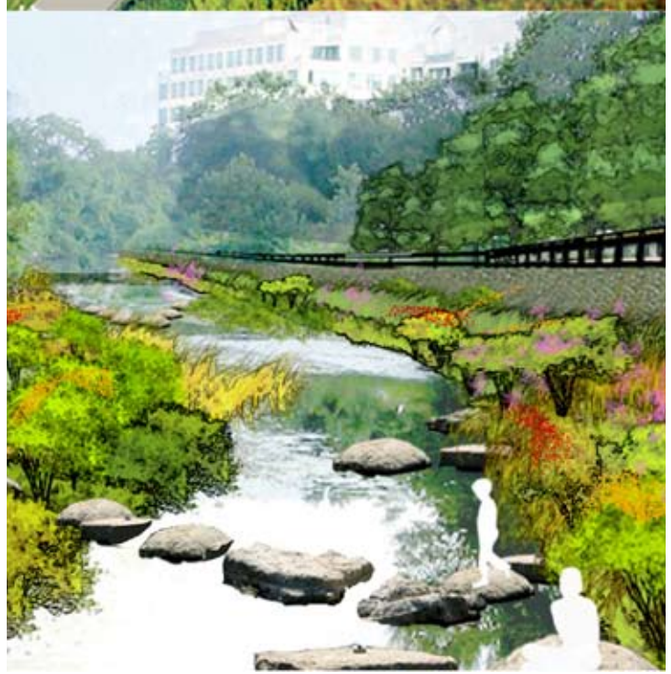

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PREFACE

Four Mile Run cuts through the heart of the Eighth Congressional District of Virginia, draining an area that encompasses parts of the cities of Alexandria and Falls Church and the counties of Arlington and Fairfax.

The lower part of the stream was once characterized by a broad flood plain, wetlands and abundant fish and wildlife. But settlement came to this area more than 250 years ago. As the area was built up, surfaces hardened and the flood plain filled, and, as a result, floods came more often and at higher levels.

The Corps of Engineers addressed the flooding issues in the lower section of the stream some 30 years ago. Even after this work, however, the area around Four Mile Run continued to be a place where much of the unsightly infrastructure necessary for urban life was located. In this sense, we turned our backs to the stream and ignored what it had become and its potential to be so much more.

But things change. In the late 1980s and early 1990s, the rail yard that crossed the stream at its eastern end was closed and the land sold for development. And, with the arrival of federal financial assistance, citizens from Alexandria and Arlington began to develop new concepts and designs that would transform the areas to the north and south of the stream's lowest section into a vibrant urban place to which people would be drawn by the water and its many possibilities.

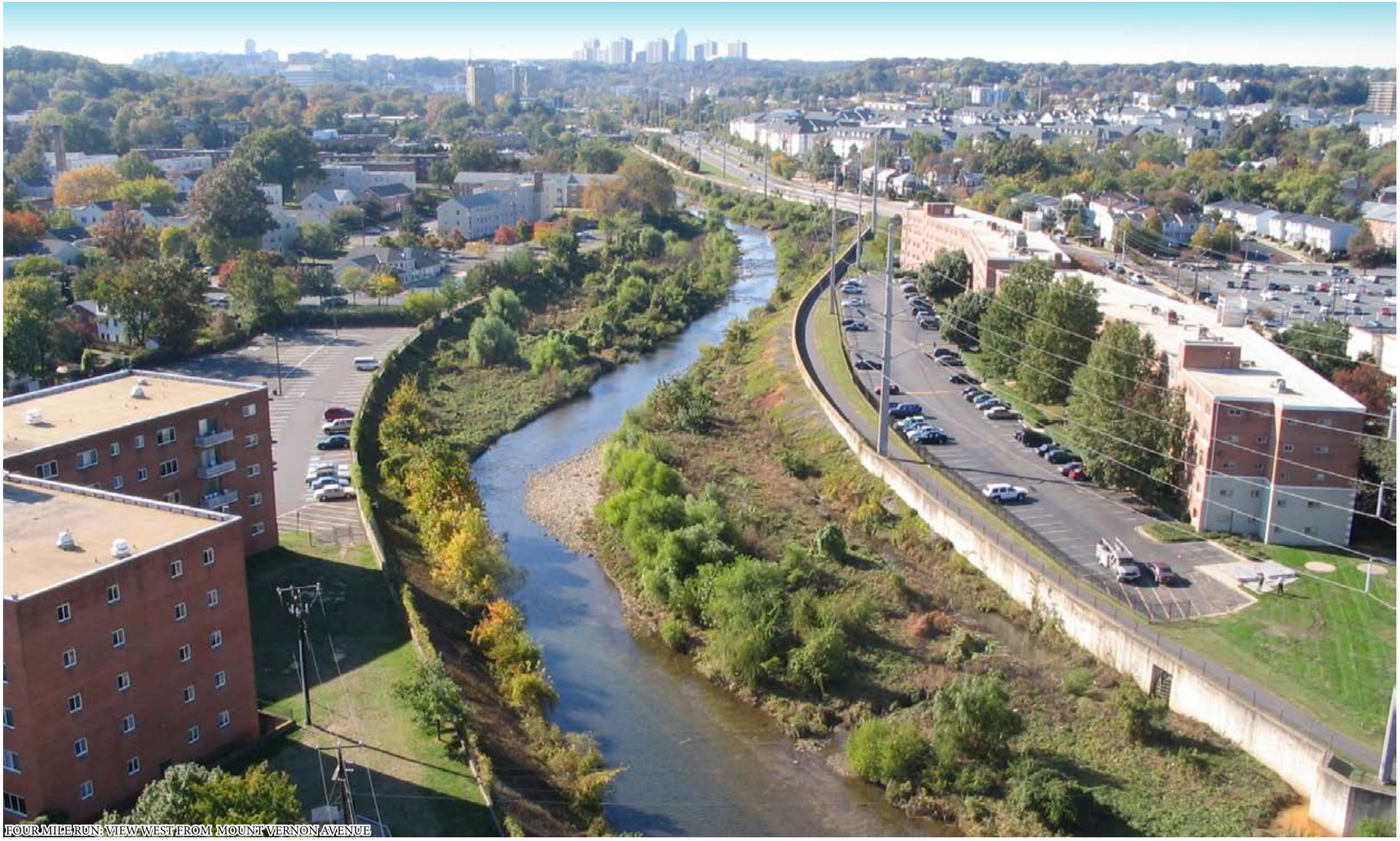
This was the beginning of the vision that you see before you in this remarkable Master Plan. Over the past five years, I have been proud to play a part in the major community effort to craft a hopeful vision for Four Mile Run and the communities that surround it.

The stream that once served literally to divide these communities is now seen as a means of uniting them. In the coming years, as the stream bed is re-naturalized and the banks landscaped, the lower two miles of the stream will become a place of community gathering, special events and sports venues. It will be a place where urban dwellers will be able to see wading birds, catch fish, ride a bike and touch the stream. Four Mile Run will become a place of renewal and of community celebration.

This Master Plan is just the beginning of making that dream come true. The plan itself is the result of unparalleled cooperation between the citizens and agencies of Arlington and Alexandria, as well as the Northern Virginia Regional Commission, the Corps of Engineers, the Environmental Protection Agency and a talented team of design professionals led by Rhodeside & Harwell, Incorporated. But now the real work of realizing this plan's dream must begin.

The dream is big. I will do my best to bring to bear the necessary federal resources. Arlington County and the City of Alexandria, in endorsing this Master Plan, will pledge their share as well. I am hopeful that, working together, we will be able to deliver what this Master Plan proposes, which is a wonderful future for Four Mile Run and the communities it will join together.

Congressman James P. Moran
Eight Congressional District
Virginia



FOUR MILE RUN: VIEW WEST FROM MOUNT VERNON AVENUE

1 INTRODUCTION

A. Overview

The lower Four Mile Run corridor—2.3 miles along the border of Alexandria and Arlington, from Shirlington to the confluence with the Potomac River—constitutes an untapped and largely forgotten resource. In spite of lingering natural beauty and the inherent attraction of water, the stream corridor functions primarily as a flood control channel—an in-between space defined by its concrete banks, the utility infrastructure lining its shore and the buildings that turn their backs to the stream. Rather than a gathering place, where surrounding neighborhoods of Alexandria and Arlington can celebrate their diversity and vitality, the stream has continued to defy its potential as a source of community pride. Yet Alexandria and Arlington have begun to rediscover the potential of the Four Mile Run corridor, as a new wave of development along the stream corridor and a committed and visionary group of community and elected leaders have sparked renewed energy and creativity in imagining the stream's glorious potential. This Master Plan report describes the exciting future of a restored Four Mile Run corridor.

FOUR MILE RUN: VIEW WEST FROM ARLINGTON WATER POLLUTION CONTROL PLANT

The lower Four Mile Run corridor—2.3 miles along the border of Alexandria and Arlington, from Shirlington to the confluence with the Potomac River— constitutes an untapped and largely forgotten resource.

"The City of Alexandria is pleased to work with Arlington County, the Joint Task Force and the U.S. Army Corps of Engineers on this innovative restoration project. This project will integrate the design of the channel with the surrounding communities, bringing both our communities closer together."

Mayor William D. Euille, *City of Alexandria*

FIGURE 1.1: CONTEXT MAP

Four Mile Run (9 miles long) and its watershed comprise one of the most heavily urbanized drainage basins in the Northern Virginia region. Although the watershed covers less than 20 square miles, it is home to approximately 183,000 people in adjacent portions of four localities: the counties of Arlington and Fairfax and the cities of Alexandria and Falls Church. Approximately 85 percent of the watershed's land area has been developed and nearly 40 percent of the watershed is covered with impervious surfaces associated with this development (i.e., buildings and pavement). Wherever present, these man-made impervious surfaces prevent the natural process of groundwater infiltration from occurring. As a result, there is a significant increase in the volume of surface water runoff that Four Mile Run and its few remaining tributaries must carry downstream. The urbanization process has replaced most of the watershed's natural stream channels with an elaborate network of storm drains. These drains carry the increased volume of surface runoff, along with the many pollutants generated by urban life, much more quickly downstream than would the natural channels that have been replaced. The resulting flows are "flashier" and larger than natural channel flows. Runoff from the Four Mile Run watershed quickly makes its way into the Potomac River, and eventually drains into the Chesapeake Bay.

FIGURE 1.2: WATERSHED AND LOCATION MAP

B. History of the Project

The Four Mile Run Restoration Project emerged through a combination of foresight and good fortune. The first seeds for the effort were planted when the Arlington County Board initiated a study of development options for the Arlington portion of Potomac Yard known as the "South Tract." Given that Four Mile Run divides the Arlington and Alexandria portions of Potomac Yard and could add great potential to any nearby development, the task force overseeing the project began to ponder the future of the stream. Community leaders from both jurisdictions soon focused their attention on the lower 2.3 miles of the stream, which forms the boundary between Alexandria and Arlington. In the process of sharing ideas and information about the stream's potential, the leaders were emboldened by data suggesting that physical, ecological and aesthetic improvements to the stream corridor need not compromise the level of flood protection called for as part of the flood control project implemented in the 1970s.

With this knowledge and a vision of Four Mile Run becoming a community amenity, the leaders began to explore funding opportunities to enable both jurisdictions to jointly study the corridor. These ambitions came to fruition through the interest and support of Congressman James Moran. Congressman Moran's efforts resulted in a $1 million grant from the U.S. Environmental Protection Agency for a joint Arlington-Alexandria study of the corridor. Following this grant, Congress appropriated funds for the U.S. Army Corps of Engineers to conduct a feasibility study for the entire Four Mile Run watershed and to participate in the Agency Coordinating Group overseeing this effort. This Master Plan will serve as a foundation for the more detailed feasibility study currently underway by the Corps of Engineers, which has authority over what happens within the flood control corridor.

C. Restoring our Waterways: National Trends

After years of emphasizing only flood control and erosion protection, communities across the United States have embarked on a new wave of river and stream restoration efforts that reflect a shift in approach and attitude in our relationship with waterways. Until recently, development trends created communities physically separated from their waterfronts, either by physical infrastructure, such as highways, or by the industrial uses and utilities that frequently lined—and isolated—waterways. Moreover, the prevailing approach to flood control left many streams and rivers straightened, deepened and stripped of their vegetation and natural character. An improved understanding of stream evolution in urban environments makes it possible to provide flood control in a more environmentally sensitive and aesthetically satisfying manner than had been possible in the past.

At a Glance

THE LEGACY OF THE FEDERAL FLOOD CONTROL PROJECT

In response to a history of flooding affecting adjacent communities, the U.S. Army Corps of Engineers partnered with Alexandria and Arlington to build a flood control channel in the lower portion of Four Mile Run. The flood control channel, constructed during the 1970s and early 1980s, has safely conveyed the high storm flows through the two jurisdictions. When the channelization project was conceived in the 1960s, the sole objective of the project was flood protection and, in this respect, the project has been a success; no floods have breached the banks along the 2.3-mile channel since its construction. Although successful in flood control, however, the channelized portion of Four Mile Run leaves much to be desired in terms of aesthetic and environmental attributes. The maintenance requirements for the channel include yearly thinning of vegetation and periodic excavation of the sediment that deposits on the channel bed. The nearly uniform trapezoidal shape of the channel does not offer many of the natural characteristics of streams—such as riffles, pools and shady areas—that are needed to sustain much of the aquatic life once found in Four Mile Run.

Congressman Moran's efforts resulted in a $1 million grant from the U.S. Environmental Protection Agency for a joint Arlington-Alexandria study of the corridor. Following this grant, Congress appropriated funds for the U.S. Army Corps of Engineers to conduct a feasibility study for the entire Four Mile Run watershed and to participate in the Agency Coordinating Group overseeing this effort.

Today, both the federal government and local communities are rediscovering the immense value of these neglected waterways and are undertaking efforts to reclaim rivers and streams as natural, recreational, social and economic assets that can significantly improve quality of life.

Case Study

SAMMAMISH RIVER (REDMOND, WA)

Once resembling an "irrigation ditch" as a result of past channelization, the Sammamish has been restored to its original form. By restoring meanders, riffles and native vegetation, the restoration reintroduced the sights, sounds, smells and habitats of a natural river environment. Regrading the steep banks also improved residents' access to river, and the new RiverWalk is now a popular destination. Although the community once turned its back on the Sammamish, the river has reclaimed its role as a central part of the City's identify. The project succeeded in building public support for continued restoration, and Redmond's City Hall is being re-sited to maximize its river views.

Today, both the federal government and local communities are rediscovering the immense value of these neglected waterways and are undertaking efforts to reclaim rivers and streams as natural, recreational, social and economic assets that can significantly improve quality of life. Many of these restoration efforts begin with a focus on returning streams—stream edges, alignments and overall behavior—to a condition more closely resembling their natural character. Common techniques include restoring the natural meandering pattern in which water tends to flow, as well as re-naturalizing and stabilizing banks with the addition of vegetation. An overarching goal is restoring the natural cycles and diversity of flows and habitats that support a variety of life in and along these waterways.

Restoring rivers and streams also presents opportunities to re-establish these waterways as community focal places. Improving the natural environment, building trails, creating parks, providing access to and connections across the water—all can bring people back to these important natural resources. Moreover, modifying the orientation of the built environment to the stream and designing new public places that celebrate the water can help make rivers and streams "front doors" to the community once again.

In the past decade, the number of river and stream restoration projects nationwide has increased dramatically with federal, state and local recognition of the benefits of restoration and the availability of funding for these types of activities. In turn, the first waves of restoration projects have produced some notable success stories, both across the United States and abroad. Arlington and Alexandria now have the opportunity to seize this momentum, while learning from—and building upon—the innovations of other communities. Some noteworthy local restoration efforts are highlighted as case studies throughout this report.

D. Four Mile Run and the Chesapeake Region

In addition to a wide range of benefits that can result from stream restoration, the redesign and naturalization of Four Mile Run will have broader significance because of its regional impact. Since the Four Mile Run watershed is part of both the Potomac River basin and the Chesapeake Bay watershed, this restoration will play a prominent role in regional efforts to protect both watersheds and especially the endangered Chesapeake Bay. What distinguishes this effort to restore Four Mile Run is how it serves as a model for intergovernmental cooperation that can inspire future efforts to improve the environmental quality of the Chesapeake region.

VIEWS OF THE FOUR MILE RUN STUDY CORRIDOR

"This Master Plan exemplifies our efforts to restore Arlington's streams and the Chesapeake Bay—and to work with our Four Mile Run watershed neighbor, Alexandria, to do so. We are excited to restore the beauty, environmental features and recreational opportunities along Four Mile Run."

Jay Fisette, *Arlington County Board Chairman 2005*

- The Stream : Alluvial Reach
- The Power Lines and Sub-Station
- The Stream : Tidal Reach
- Four Mile Run Wetland

In the process of sharing ideas and information about the stream's potential, the leaders were emboldened by data suggesting that physical, ecological and aesthetic improvements to the stream corridor need not compromise the level of flood protection called for as part of the flood control project implemented in the 1970s.

FIGURE 1.3: STUDY AREA


SOUTH GLEBE ROAD
WATER POLLUTION CONTROL PLANT
RONALD REAGAN WASHINGTON NATIONAL AIRPORT
MT. VERNON AVE
GEORGE WASHINGTON PARKWAY
FOUR MILE RUN PARK
ROUTE 1
POTOMAC YARD

Betty King has lived in Hume Springs, Alexandria for 21 years. Four Mile Run plays a significant role in her life. Her kitchen window overlooks Four Mile Run Park, and she walks the U.S. Route 1 to Mount Vernon Avenue loop most days, weather permitting. She is also an active member of the Citizen Joint Task Force, representing the Hume Springs community.

E. Master Plan Vision for Four Mile Run

The purpose of the Master Plan is to provide a framework and vision for future changes in the Four Mile Run corridor. It does not, however, represent a fiscal commitment; funding sources and a timetable for implementation will be determined at a later date.

The Master Plan envisions that the Four Mile Run corridor will become a model of urban ecological restoration. Through the sensitive and sustainable integration of natural areas with active urban nodes, the Four Mile Run corridor will be a place along which the communities of Arlington County and the City of Alexandria can gather, recreate and celebrate a shared waterfront legacy.

GUIDING PRINCIPLES

The guiding principles for the project, derived from community and governmental input, encompass eight key focus areas: flood protection, environment, aesthetics and design, recreation and urban life, integration and balance, access and connectivity, education and interaction, and the planning horizon.

Flood Protection

- Provide a minimum 100-year event flood protection.
- Examine the current extent of the 100-year flood-prone area.
- Consider flood protection for areas not currently protected.

Environment

- Create a "dynamically stable stream channel" using natural stream channel design techniques.
- Improve corridor habitat and ecology to support native terrestrial and aquatic plant and animal species.
- Develop upstream strategies to improve water quality in the stream and the environmental quality and long-term viability of a restored levee corridor.

Aesthetics and Design

- Improve overall corridor aesthetics and viewshed opportunities.
- Encourage urban design that develops the corridor's aesthetics and reflects the excitement of the watershed citizenry for this resource.
- Incorporate "green design" principles for all design and development activities within and adjacent to the corridor.
- Incorporate innovative and creative urban design and watershed solutions.

Recreation and Urban Life

- Enhance existing recreational opportunities.
- Create new recreational opportunities that afford interaction with the waters of Four Mile Run.
- Develop urban life opportunities along the Four Mile Run corridor.
- Encourage appropriate siting of recreational facilities in the context of the overall project goals.

Integration and Balance

- Connect the project to the efforts underway in the watershed to improve the water quality of Four Mile Run.
- Integrate the corridor with surrounding communities and proposed adjacent urban development efforts.
- Create a balance between the natural elements of a restored corridor and urban activity areas in order to generate a lively, safe and well-used public resource.
- Coordinate with other ongoing planning activities. Such activities include the Four Mile Run TMDL/Implementation Plan, the local Chesapeake Bay Preservation Act programs, the Potomac Tributary Strategies, affordable housing initiatives, master planning efforts such as the Arlandria and Shirlington planning efforts, and other planning and economic development initiatives.

Access and Connectivity

- Create a place for people to reconnect with water and nature within an urban context.
- Increase pedestrian and bicycle access and amenities.
- Ensure that Four Mile Run is accessible to all who wish to use it.

- Increase connectivity between the two communities.
- Enhance the corridor's effectiveness as a non-motorized and mass transit corridor.

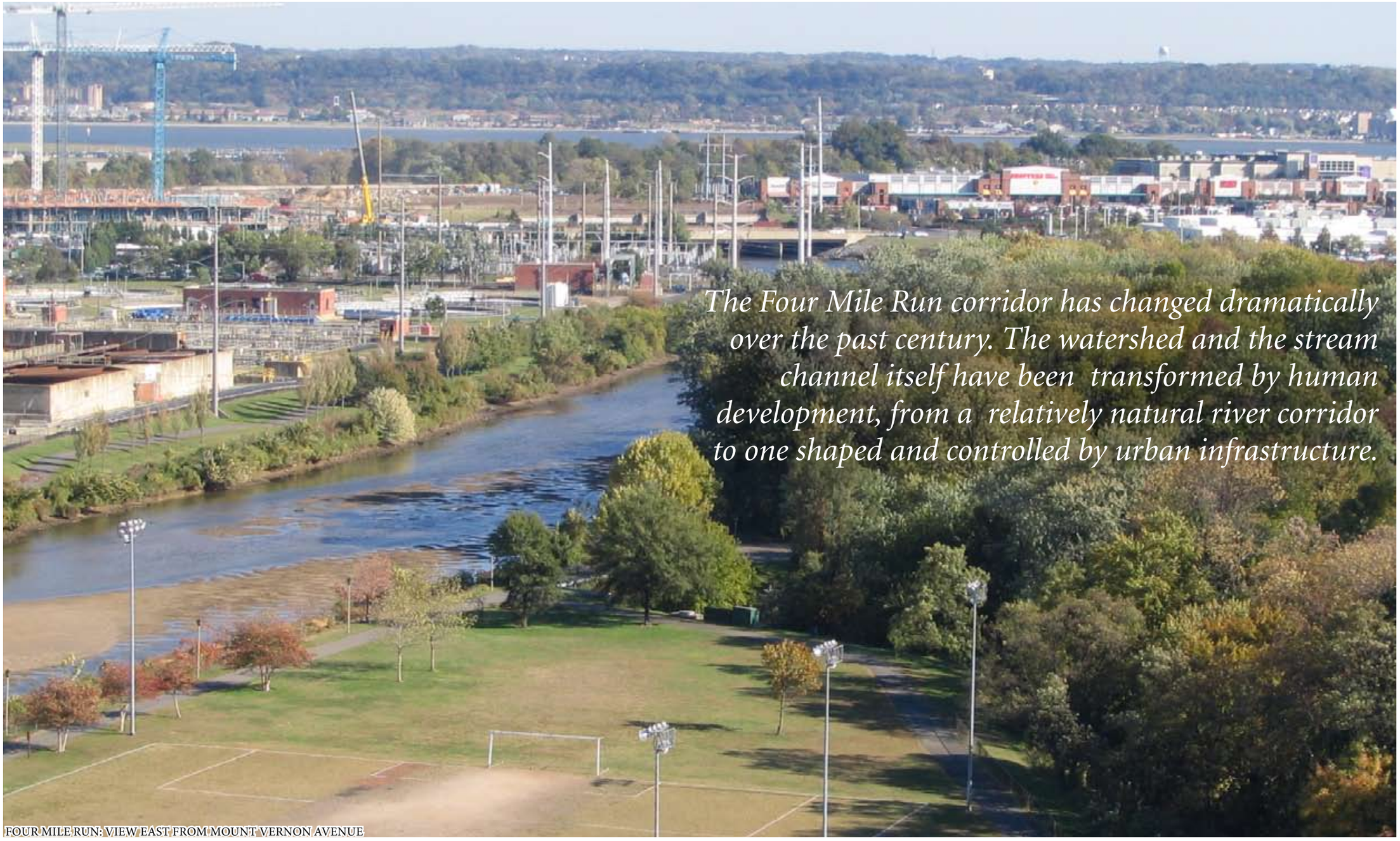
Education and Interaction

- Provide interpretive opportunities to educate and inform the public about the stream corridor.
- Stress the interrelatedness of positive individual, institutional, and political actions and behavior changes with improved water quality and habitat in the corridor.

Planning Horizon

- Think big—create a plan that provides the parameters for change over time as opportunities become available.
- Provide a mix of short-term discrete improvements blended with long-term large-scale corridor changes.

The remainder of the Master Plan describes the characteristics of the study corridor today (Chapter 2), the process for developing the Master Plan (Chapter 3), the components of the Master Plan (Chapter 4) and design approaches to help achieve the Master Plan vision (Chapter 5).



The Four Mile Run corridor has changed dramatically over the past century. The watershed and the stream channel itself have been transformed by human development, from a relatively natural river corridor to one shaped and controlled by urban infrastructure.

FOUR MILE RUN: VIEW EAST FROM MOUNT VERNON AVENUE

A. Community Profile

1. THE DEMOGRAPHICS OF A DIVERSE AREA[1]

The total population of the study area (according to the 2000 Census) is approximately 33,000, which comprises roughly 18 percent of the total population in the 20 square-mile Four Mile Run watershed. Currently, slightly more than half of the population falls between ages 18 and 44, with 25-34 year-olds comprising the largest segment of the population. Moreover, the population in general is aging: just under half of the current population will be age 55 or older within 20 years. (Figures 2.1 and 2.2)

The Four Mile Run corridor is diverse in terms of age, income, housing and cultural background, with some demographic characteristics concentrated in certain areas. While average annual incomes in the Four Mile Run corridor mirror those in Alexandria and Arlington and are considerably higher than the national average, mapping income statistics at the Census block group level (the smallest geographical unit used by the Census Bureau for Summary File 3) reveals a wide range of incomes in the corridor and a substantial gap between the highest-income block groups and the lowest-income block groups. (Figures 2.3, 2.4 and 2.5)

Analysis at the block group level also reveals the distribution of languages spoken. Aggregate information on languages spoken at home shows that a sizable percentage of the population speaks either Spanish (30%) or other languages (10%) while the majority (60%) speaks English. Viewed at the block group level, it is clear that the largest concentrations of non-English speakers reside in four block groups east of I-395 as well as in the Shirlington block group west of I-395. (Figures 2.8 and 2.9)

Population and housing types also vary by location. Not surprisingly, areas with the highest populations also include the highest concentrations of rental housing units. Overall, rental housing units constitute more than half of the total number of housing units (57%). (Figures 2.6 and 2.7)

The Four Mile Run corridor is diverse in terms of age, income, housing and cultural background...

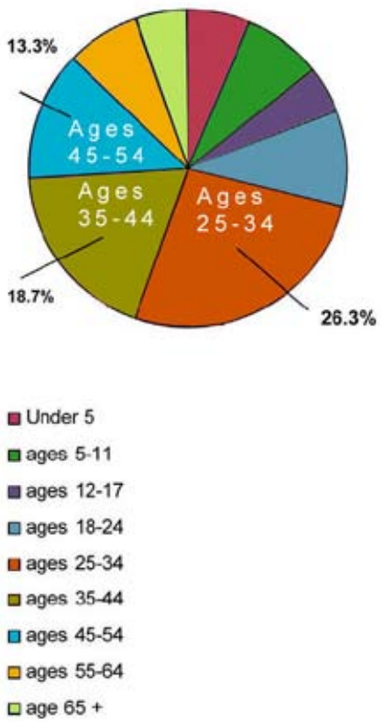


FIGURE 2.1: AGE BREAKDOWN

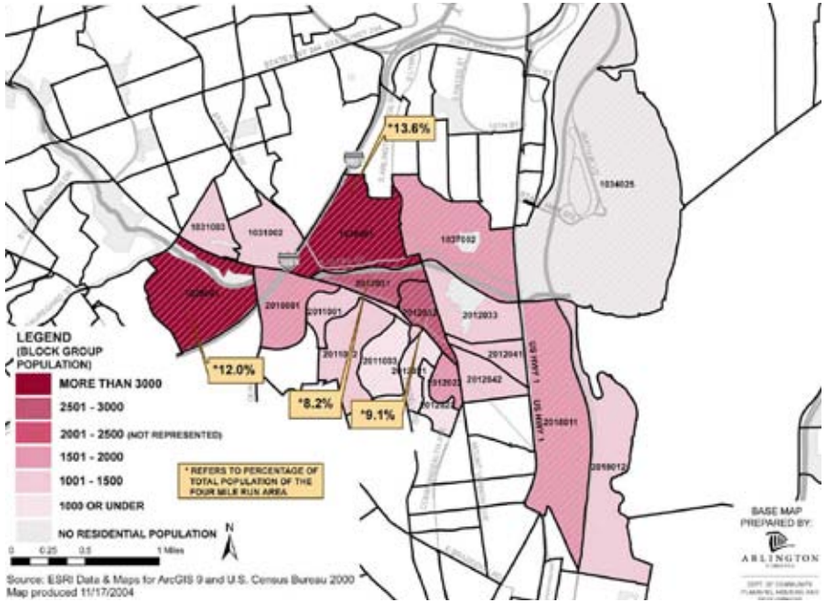


FIGURE 2.2: POPULATION

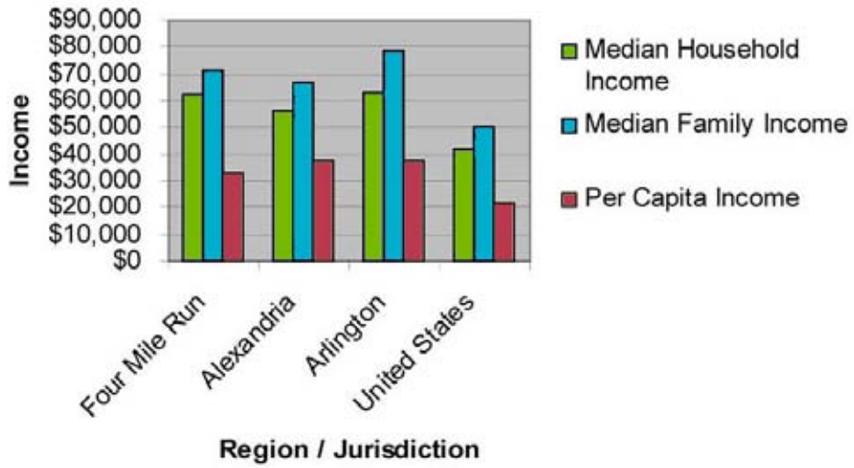


FIGURE 2.3: INCOME

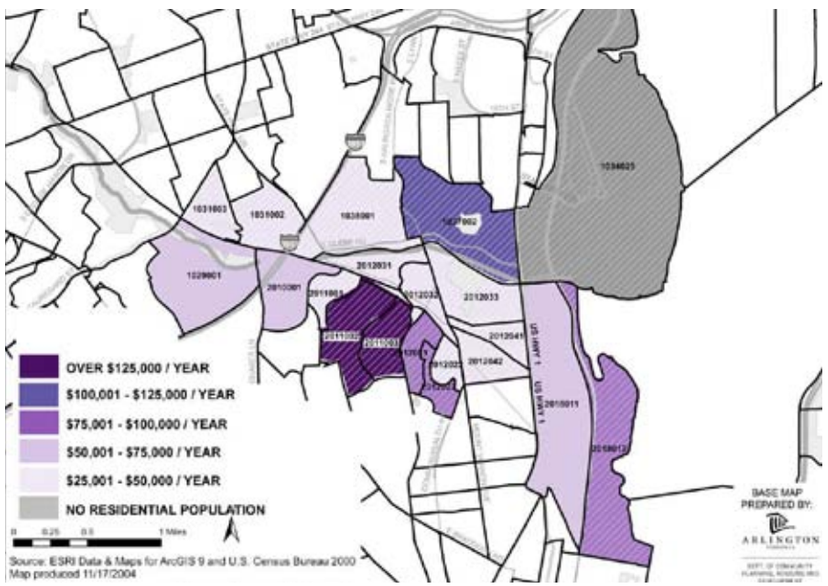


FIGURE 2.4: MEDIAN HOUSEHOLD INCOME

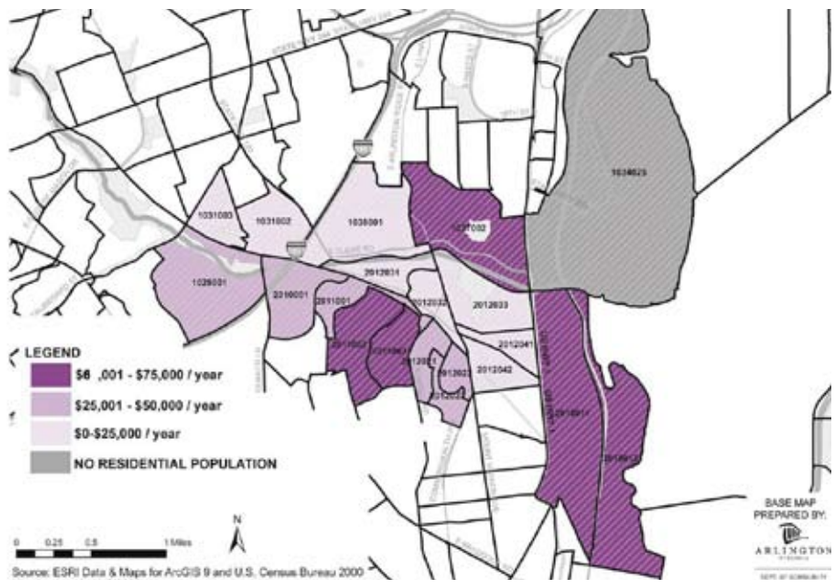


FIGURE 2.5: PER CAPITA INCOME

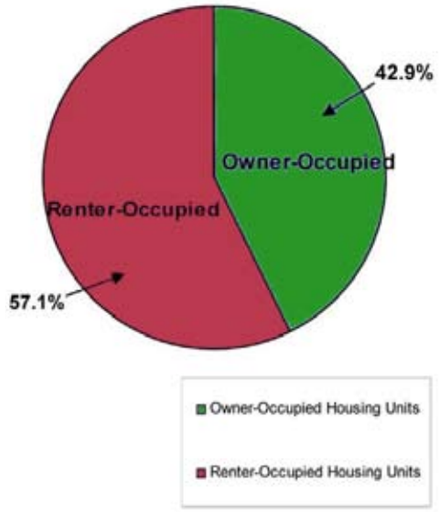


FIGURE 2.6: HOUSING UNITS (PERCENT OF TOTAL HOUSING UNITS)

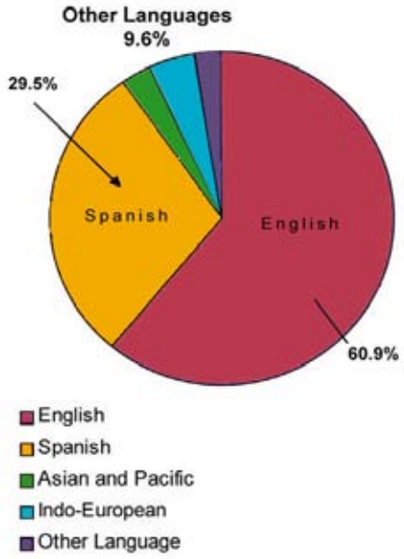


FIGURE 2.8: LANGUAGES

FIGURE 2.7: RENTER-OCCUPIED HOUSING UNITS

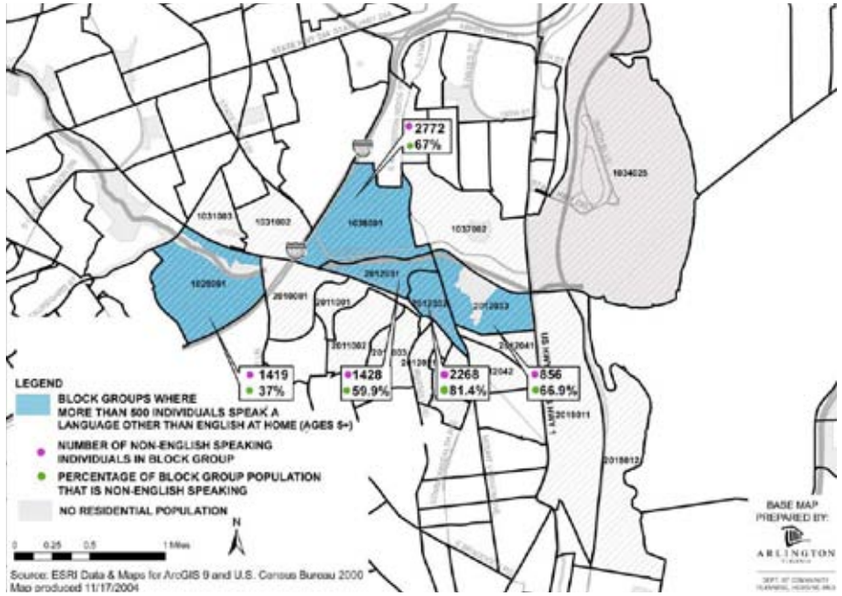


FIGURE 2.9: LANGUAGES

Jinda has lived near Four Mile Run for 20 years and uses the park every day. Here she swings a golf club in Four Mile Run Park to keep her joints moving in the cold weather.

Over time, urban development spread to land adjacent to the stream, as vegetated riparian zones gave way to the buildings, roads and parking lots that line the stream today. With these changes in land use, the shape and dynamics of the stream channel was altered.

2. THE EVOLUTION OF THE FOUR MILE RUN CORRIDOR

A Brief History of Four Mile Run

A source of abundant natural resources and a natural transportation corridor, Four Mile Run attracted residents centuries ago. Native Americans were the first to arrive, developing settlements along its banks. Some of these settlements were visited and recorded by Captain John Smith during his voyage up the Potomac in 1608. By the late 17th century, private landowners began to divide the land surrounding the stream into large parcels. Land ownership maps from 1760 show the subdivision of vast land areas to the north and south of Four Mile Run. Large plantations owned by Gerrard and John Alexander, sons of John Alexander (namesake of the City of Alexandria), were well-positioned on the north and south sides of Four Mile Run, with smaller adjacent parcels owned by John Carlyle and Nathaniel Chapman.

Beginning in the early 19th century, transportation and defense left their mark on the landscape. Several forts, constructed during the Civil War, dominated the ridge lines above Four Mile Run. Meanwhile, railroad lines and the Alexandria Canal established transportation routes through the region. By the early 20th century, and accelerating in the decades that followed (especially after World War II), urban development began to encroach on the Four Mile Run watershed. The combination of rapid development near the stream and a period of major flooding prompted the U.S. Congress to authorize the construction of the Four Mile Run flood control project by the U.S. Army Corps of Engineers in the 1970s. Four Mile Run Park was constructed as part of this project on both sides of the stream.

Traces of the Past

While most of the earliest physical structures in the corridor are now gone, some traces remain in the landscape. The family home of Gerrard Alexander, built during the 1740s, is now an archeological interpretive site located near the main terminal of Ronald Reagan Washington National Airport. The structure at Fort Scott (circa 1864) no longer exists, but its prominent ridgetop location is marked by a park bearing the same name. The railroad lines established major transportation routes still used today, and Potomac Yard—a railroad facility established in 1906 that eventually occupied 526 acres—is now a major regional commercial, entertainment and residential development of the same name.

The Alexandria Canal, completed in 1843, had a brief but interesting history. The original stone viaduct structures are gone, but the Washington Metropolitan Area Transit Authority (WMATA) Metrorail system now follows the canal's route into the District of Columbia. The location where the canal crossed over Four Mile Run is still marked by a series of modern, concrete bridge structures. This location also marks the site of an explosive train wreck that occurred in 1885 where the canal, train tracks and wagon road (now U.S. Route 1) intersected at the Four Mile Run crossing.

Luna Park, a popular amusement park with an exuberant and exotic architectural style, was once situated prominently on the northern bank of Four Mile Run near the mouth of the Potomac. Four Mile Run's amusement era was short-lived: the park opened in 1906, only to close for good in 1915. None of the park's structures remain today, but the construction of Four Mile Run Park in Alexandria and Arlington restored this portion of the stream as a place for public congregation.

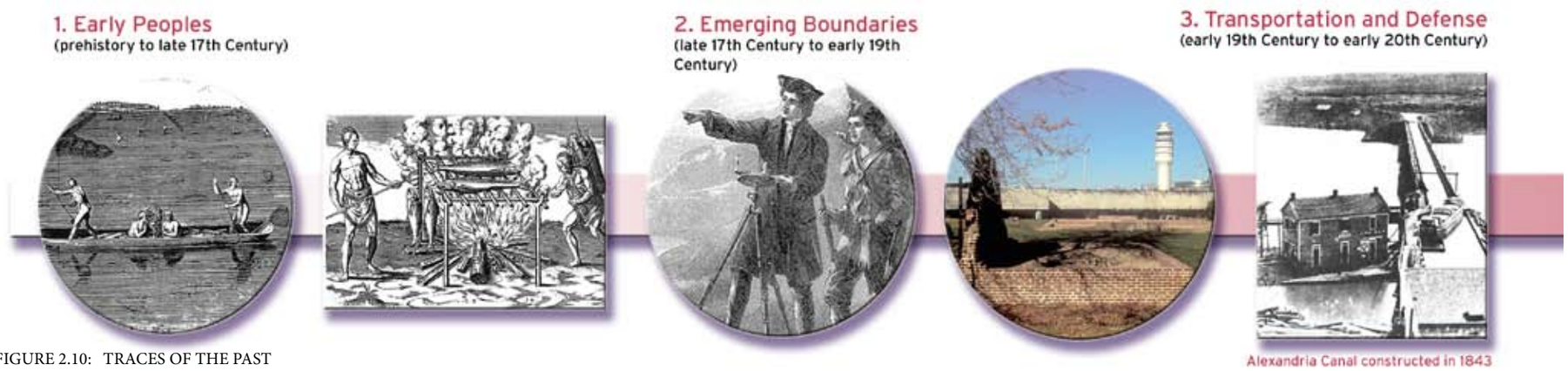


FIGURE 2.10: TRACES OF THE PAST

Finally, the flood control alterations carried out by the U.S. Army Corps of Engineers, as well as the development of Four Mile Run Park, had direct impacts on the stream corridor. As the rest of this document illustrates, the impacts of the flood project and the years of development that preceded it have left lasting and notable traces on the corridor, even as the restoration of Four Mile Run becomes a reality.

B. In-Stream Conditions

1. STREAM DYNAMICS

The Four Mile Run corridor has changed dramatically over the past century. The watershed and the stream channel itself have been transformed by human development, from a relatively natural river corridor to one shaped and controlled by urban infrastructure. These changes, along with further modifications as part of the 1970s flood control project, have affected not only the shape and physical characteristics of the stream but the manner in which it flows. The existing conditions are summarized below.

General Characteristics: Upstream and Downstream

The lower portion of Four Mile Run includes both tidal areas—where the stream approaches the Potomac and is controlled by backwater effects from the river—and non-tidal areas further upstream. To analyze the changes in character along the stream, it is helpful to divide the stream into "reaches"—areas that share similar conditions. While the four upper reaches share many of the same "alluvial" characteristics, the reach farthest downstream is distinguished by tidal processes. (Figure 2.11)

The Stream That Lost Its Meander

A glance at historic aerial photographs of Four Mile Run illustrates the changes in the alignment of the stream corridor. Over time, urban development spread to land adjacent to the stream, as vegetated riparian zones gave way to the buildings, roads and parking lots that line the stream today. With these changes in land use, the shape and dynamics of the stream channel was altered. It lost its sinuosity—or degree of meandering—and over time adopted its straighter configuration and narrower floodplain boundaries, including thinner buffers and diminished wetland areas. The U.S. Army Corps of Engineers levee construction project in the 1970s changed the stream even more dramatically with the construction of floodwalls, gabion embankments and stretches of large riprap. (Figure 2.12)

One of the pivotal challenges of the Master Plan process stems from the fact that it is no longer possible to restore the stream completely to its most natural form given today's watershed characteristics and the infringement of urban development into what was once the original alignment of the stream. Quite simply, the "most natural" channel alignment will not fit into the space left by urban development. As a result, while there are certainly ample opportunities to achieve river restoration goals within the flood control system, the significant changes to the landscape necessitate a compromise between what existed prior to urban development and the shape and character of the stream today. (Figures 2.13 and 2.14)

"The Four Mile Run master planning effort is a model of successful inter-jurisdictional collaboration. By working in concert with citizens, Arlington County and the City of Alexandria have developed a long-term vision focusing on environmental and community enhancement that exemplifies the strength of regional approaches to improve our communities. I am very proud that local leaders in Northern Virginia understand the value of regional cooperation."

Barbara Favola Chair, *Northern Virginia Regional Commission*

IMPERVIOUS SURFACES ALONG THE FOUR MILE RUN CORRIDOR

FIGURE 2.11: REACHES OF THE STREAM

FIGURE 2.12: THE "MOST NATURAL" CHANNEL ALIGNMENT

Changes in Hydrology: An Opportunity for Restoration with Flood Protection

The changes in hydrology that have occurred during the urbanization of the Four Mile Run watershed are tightly linked with the changes in channel form. Currently, Four Mile Run experiences high peak stormwater discharges that occur very rapidly, even during relatively moderate rainfall. The short "lag time" between rainfall and rising water levels in the stream channel is due to the extent of urban development surrounding the stream and the amount of impervious surfaces—roads, parking lots, rooftops—that prevent stormwater from infiltrating into the ground. Rather, water is delivered quickly and efficiently to the stream by means of underground storm drains. Prior to the development of the watershed, peak flows would have been of a much smaller magnitude and the lag time to that peak would have been longer. The increased quantity and velocity of water flowing through Four Mile Run in turn exerts a significant amount of wear and tear on its bed and banks.

At the same time, since the completion of the flood control channel in 1980, peak storm events have been less severe. While there were several large "flow events" in the 21 years prior to the flood control project, no events of this size have occurred since 1972. In essence, the flood control channel was designed using data from an exceptionally "wet" period in time. The three large events that occurred during the relatively short 21-year-long record worked to skew the flood control project design statistics upward, thereby predicting a larger magnitude flood event for which to size the levee. The 100-year event (or one-percent probability event) based on the data available in 2004 is 29 percent smaller than the similarly probable event predicted in 1972, based on the data available to project designers. The result of this update in the statistical analysis of stream flow is that the existing channel has been designed for significantly more than the 100-year flood event, the level of protection intended to be provided by the flood control project.

What does this mean for Four Mile Run? As noted in a recent Northern Virginia Regional Commission analysis, "[t]he decrease in predicted 100-year event flows offers promise that opportunities exist to enhance the environmental viability of the channel without diminishing perceived flood protection."[2] In essence, this means that the stream has the potential to become "more natural," with improved ecology and aesthetics, without increasing the intended probability of flooding. Moreover, the addition of vegetation and pervious surfaces that can absorb rainwater throughout the project area and watershed—as well as greater attention to environmentally sensitive means of stormwater management—has the potential over the long-term to affect both the quality and quantity of water entering into the stream.

How the Stream Has Adjusted

The configuration and characteristics of Four Mile Run have been altered significantly from their pristine state, both by development that has occurred along its banks and in its watershed and by maintenance conducted on the flood control system. However, in much of the project area, the stream channel has adjusted to its new constraints and has reestablished some of the features found in more natural rivers (floodplain terraces, natural bedforms such as riffles and pools, riparian vegetation, etc.). Consequently, opportunities exist to take advantage of the natural stream processes that are occurring and to call attention to interesting geomorphic aspects of the stream. For example, the restoration can take advantage of the relatively stable slope and pattern that the channel has formed and perhaps attempt to naturalize portions of the channel bed that have been severely impacted over the years.

FIGURE 2.13: STREAM ALIGNMENT CHANGES OVER TIME

FIGURE 2.14: HISTORIC AERIAL PHOTOGRAPHS

"The Corps of Engineers embraces this opportunity to marry our traditional focus of flood protection with the evolving mission of ecosystem restoration. This Four Mile Run Master Plan establishes a new benchmark for transforming a local flood protection project into a vibrant community asset."

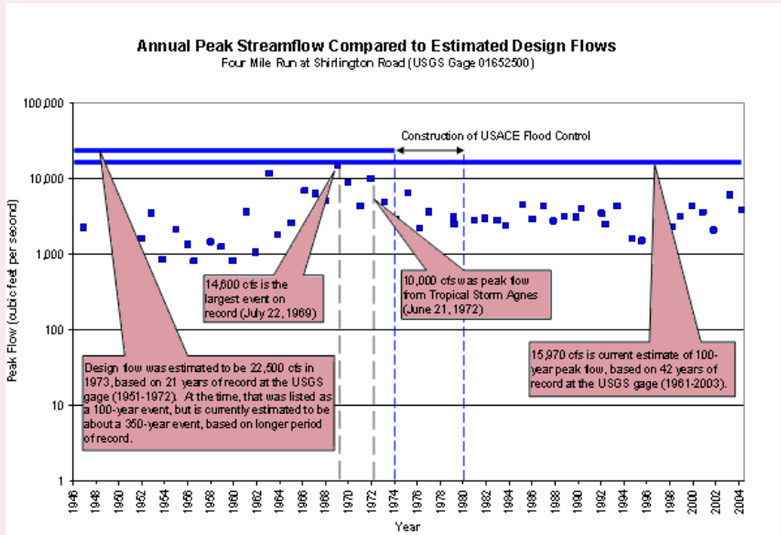
LTC Joseph T. Hand, *Deputy District Engineer, U.S. Army Corps of Engineers, Baltimore District*

Key refers to photographs on opposite page

- Trash at the Mouth of Four Mile Run
- Existing Gabions
- Existing Concrete Walls at Mount Vernon Avenue
- Existing Gabions and Concrete Walls at Potomac Yard Bridges
- Existing Power Lines
- Existing Concrete Walls at Mount Vernon Avenue and Significant Areas of Impervious Surfaces

AT A GLANCE

THE 100-YEAR STORM



Using a longer period of record, the statistical analyses to predict the magnitude of the 100-year storm flow (the storm flow with a 1% chance of occuring in a given year) are more precise and, in the case of Four Mile Run, predict a smaller magnitude event. This chart shows the magnitude of peak flows in Four Mile Run over the entire period of record, compared to the 100-year design flow. The design flow used by the U.S. Army Corps of Engineers in 1973 to determine flood control needs was 22,500 cubic feet per second (cfs). A more recent analysis by the Northern Virginia Regional Commission has lowered the design storm estimate to 15,970 cfs, which is more statistically robust because of the longer historical record (42 versus 21 years). Note that no measured flows, neither the 1973 estimate nor the revised estimate of 15,970 cfs., have exceeded the 100-year design storm in Four Mile Run.

In-Stream Opportunities and Challenges

In summary, the current shape and character of the stream presents both opportunities and challenges that can influence the ways in which restoration can occur in the stream corridor. In particular, changes in hydrology now justify rethinking the character of the stream within the flood conveyance channel. Specific opportunities include:

- Replacement of hard bank protection with bioengineered bank protection
- Regrading of the banks to a more natural slope
- Removal of barriers restricting the passage of fish
- Enlargement of riparian buffer areas and the creation of a continuous riparian corridor
- Control of invasive vegetation
- Removal of concrete walls, fences, and barriers that limit both visual and recreational access
- Establishment of native vegetation on banks and floodplain terraces
- Control of urban debris and litter

At the same time, the restoration design faces a number of general constraints or challenges along the length of the Four Mile Run project area. These factors include:

- Utilities (i.e., sewer lines, power transmission lines and towers, stormwater drainage piping, highways, and local roads) run along and through the entire length of the project area, increasing the expense and decreasing the feasibility of ecological restoration.
- Private property on both sides of the stream may limit the potential to increase the width of the channel and riparian areas in order to make the stream more stable and ecologically functional.

Restoration will entail reconciling these competing factors. Challenges aside, there are ample opportunities for substantial and positive changes to Four Mile Run.

EXISTING CHALLENGES IN THE CORRIDOR

- The Stream and Remnant Vegetation in Four Mile Run Park
- Part of the Alluvial Reach at the End of Summer
- Existing Community Revegetation Project
- Existing Vegetation in Four Mile Run Park

NATURAL AREAS ALONG THE STREAM

C. Natural Environment

1. VEGETATION AND WETLANDS[3]

In the Four Mile Run corridor, a variety of native plants and ecosystems—some of them rare and valuable—compete for space with invasive species and the maintenance requirements of structures such as gabion walls. In general, the riparian corridor adjacent to Four Mile Run contains limited vegetation. Any woody vegetation that grows along the gabion walls is removed to ensure the integrity of the structures. Invasive and non-invasive vines—including grape, honeysuckle, and tearthumb—grow in spots along the gabions and throughout the levee corridor. The floodplain bench that has formed inside the levee walls has been colonized by a variety of herbaceous plants, including grasses, goldenrod, aster, black-eyed susan, and prickly dewberry. Moreover, portions of the bench and portions of the walls where riprap was used for stabilization are beginning to be colonized by a variety of tree species, including sweet gum, sycamore, black walnut, black oak, silver maple, cottonwood, black locust, and cedar. Trees near the edge of the stream channel also include several willows. These trees and shrubs are generally small because they are removed during periodic maintenance of the channel.

Other invasive species observed along the Four Mile Run project area by the Virginia Native Plant Society include: English ivy (*Hedera helix*), Japanese knotweed (*Polygonum cuspidatum*), white mulberry (*Morus alba*), marsh marigold (*Caltha palustris*), purple loosestrife (*Lythrum salicaria*), tree of heaven (*Ailanthus*), paulonia (*Paulownia tomentosa*), mile a minute weed (*Polygonum perfoliatum*), porcelain berry (*Ampelopsis brevipedunculata*) and other species.[4]

While wetlands are limited within the project area, there is one large wetland area preserved as a wildlife sanctuary within Four Mile Run Park in Alexandria. Unique assemblages of wetland vegetation that are very rare in Alexandria and Arlington are currently flourishing in this wetland area. The most ecologically-rich communities of vegetation are clustered in the eastern and south-central portions of the wetland, in the open areas and along the fringe of the open and wooded areas. Approximately two-thirds of the wetland is forested, with the remaining area occupied by emergent vegetation. This wildlife sanctuary retains a brackish tidal marsh, which is comprised of semi-permanently flooded herbaceous vegetation. The area, partly wooded and partly open, constitutes a habitat that is fairly uncommon in Virginia.

The wetlands have numerous native Virginia species, including wild rice (*Zizania aquatica*), cattail (*Typha latifolia*), large colonies of yellow flag (*Acorus calumus*), pickerelweed, several uncommon sedges, and river bulrush (*Schoenopletus fluviatilis* or

CASE STUDY

ROUGE RIVER & OXBOW RESTORATION (DETROIT, MI)

The Rouge River Gateway Restoration is transforming what was one of the country's most polluted rivers during the 1980s into a "magnet of community activity" and model of sustainability principles. The project includes removing portions of a concrete channel and naturalizing the bank along an 8-mile section of the river in Detroit and five neighboring communities, as well as creating a new greenway system along the river. The Ford Motor Company is supplementing these efforts by building a new eco-frieldly plant on the Rouge. The Oxbow Restoration Demonstration Project, already completed, restored the original Rouge River channel to its historic conditions and created a wetland edge for wildlife habitat.

INVASIVE SPECIES

REFORESTATION EFFORTS ALONG THE STREAM

THE FOUR MILE RUN WETLAND

SURROUNDING LAND USES

Scirpus fluviatilis), which is a rare plant categorized by the Commonwealth of Virginia as "very rare or imperiled" (S2 category). Woodlands observed within the wildlife sanctuary contain oaks, maples, box elder, green ash, alder thickets, and arrowwood, among other species.

In the western portion of the wildlife sanctuary, upland vegetation includes heavy infestation of invasive exotics, including the species listed above. These exotics also extend along the southern perimeter of the wildlife sanctuary, bordering the mowed lawn and the playing fields. At the encouragement of the City, the Woodrow Wilson Bridge project incorporated wetlands mitigation in the form of phragmites eradication, wetland enhancement, the creation of fresh water wetlands and stream bank bioengineering at Four Mile Run Park.

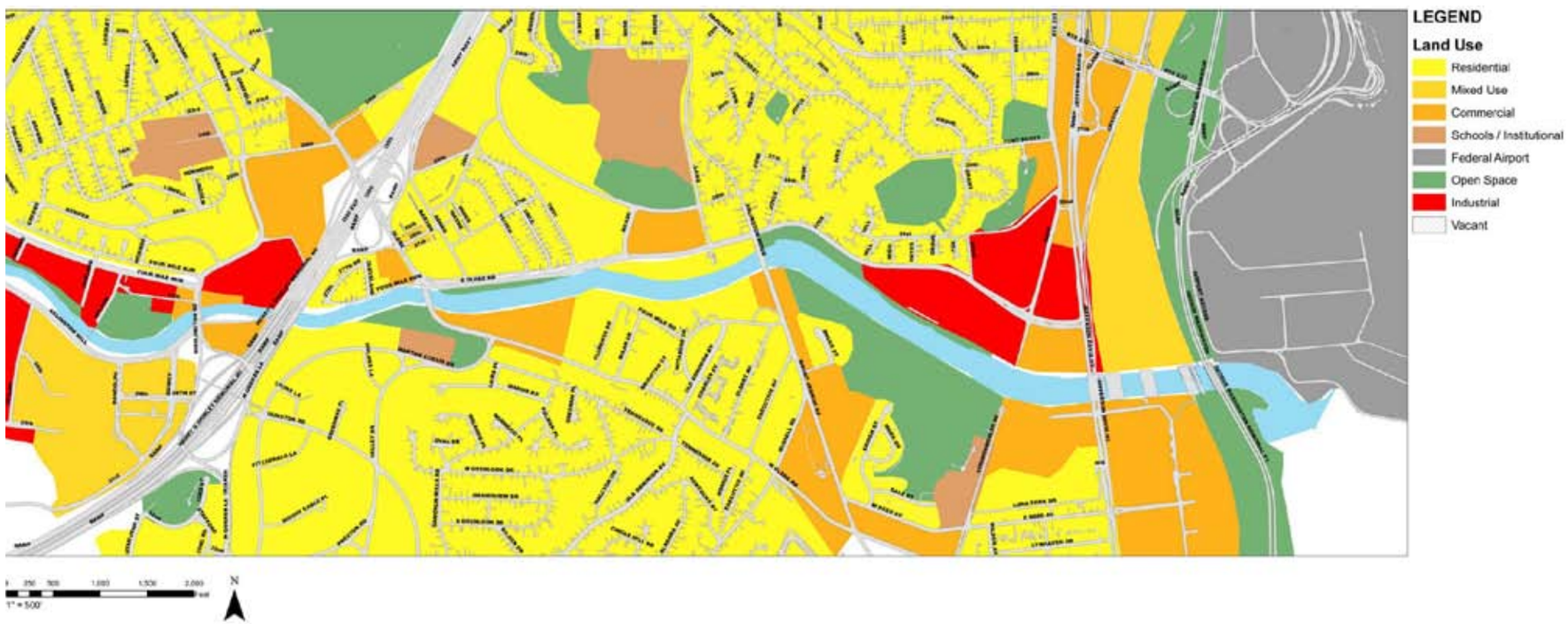
2. WILDLIFE AND ENDANGERED SPECIES

Through the United States Department of Agriculture (USDA), the Metropolitan Washington Airports Authority has conducted bird surveys at Ronald Reagan Washington National Airport, located at the downstream end of the study area. The surveys have been conducted once a month for the past five years. The most commonly observed species during this time include : mourning dove (*Zenaida macroura*), mallard (*Anas-platyrhynchos*), ring-billed gull (*Larus delawarensis*), great blue heron (*Ardea herodias*), double-crested cormorant (*Phalacrocorax auritus*), brown-headed cowbird (*Molothrusater*), European starling (*Sturnus vulgaris*), pied-billed grebe (*Podilymbus podiceps*), herring gull (*Larus argentatus*), rock dove (*Columba livia*) and American crow (*Cornus brachyrhynchos*). Raptors were also observed in flight: osprey (*Pandion haliaetus*), sharpshinned hawk (*Accipiter striatus*) and American kestrel (*Falco sparverius*). Although this survey is not necessarily representative of the entire project reach, it is the only known wildlife study conducted within the study area.[5]

D. Near-Stream Conditions

1. LAND USE

Residential uses constitute the primary land use in the area surrounding the Four Mile Run corridor. Located between residential areas, centers of mixed-use activity sit adjacent to Four Mile Run in three primary nodes: at Potomac Yard, along Mount Vernon Avenue and in the Shirlington area. Additional areas have an industrial character, especially around the Virginia Concrete plant, Arlington County Water Pollution



Control Plant, the Dominion Virginia Power substation and the Washington Metropolitan Area Transit Authority (WMATA) bus depot. The Four Mile Run corridor is also home to a number of schools and other institutional facilities, including the Charles E. Barrett Elementary School and the Cora Kelly Elementary School in Alexandria as well as the Gunston Middle School, Drew Model School and Oakridge Elementary School in Arlington. The remaining land without buildings includes both open space, such as Four Mile Run Park and other parks scattered throughout the study area, and quite a few parking lots and other open and paved areas. (Figure 2.15)

Whether looking at a map or exploring on foot, what is most striking about Four Mile Run is how past land use decisions have reinforced the current "utility corridor" character of stream. The stream has become a place to house the variety of infrastructure and activities that we prefer to hide from our daily lives. In turn, Four Mile Run itself does not figure prominently on what the urban designer Kevin Lynch would describe as the "mental maps" of the sizable numbers of people who either live in surrounding areas or frequent the businesses and offices located there. Consequently, one goal of this Master Plan is to elevate the image of Four Mile Run in the minds of residents and visitors.

In some locations, vacant or underutilized land—potential development opportunities as development pressures increase—currently function as barriers, separating surrounding neighborhoods from their stream. Moreover, the orientation of existing buildings away from the stream also contributes to the perception of the stream corridor as a barrier. These areas underscore the significant amount of land close to the stream that is paved or otherwise impervious to rainwater. In addition to their negative impact on urban design and character, these areas also impact environmental quality in the stream itself. While ample parks and recreational facilities do exist along the corridor, these green spaces do not yet comprise a coherent open space network. In the future, Four Mile Run can function as a vital link in such a network.

2. ZONING AND PROPERTY OWNERSHIP

The future potential of the corridor hinges in part on the land use policies, regulations and property ownership that ultimately dictate development. As in the case of overall land use patterns, the largest zoning designation is also residential; however, in both Alexandria and Arlington, zoning designations do not always reflect actual land use. On the Alexandria side of the stream, the majority of the residential zones allow multi-family residences, with the exception of a single-family district in the area bounded by

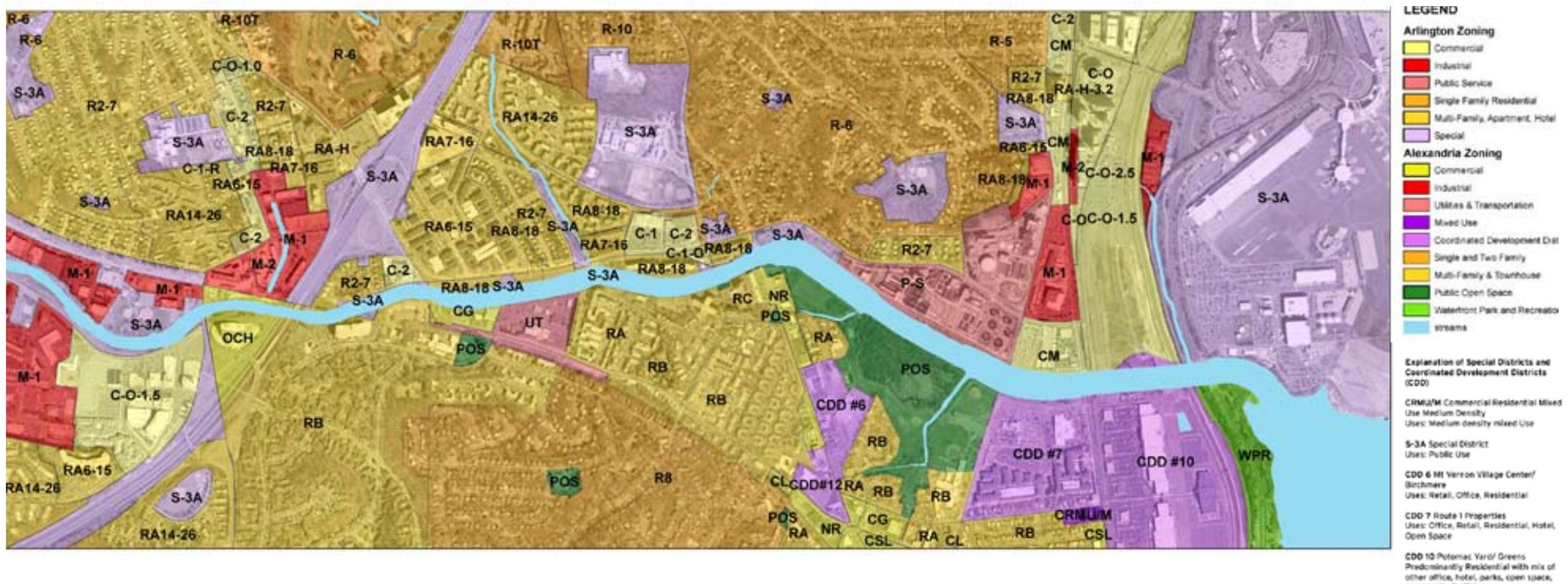


FIGURE 2.16: ZONING

SURROUNDING LAND USES

A variety of new development has been approved or proposed in the corridor. Many of these ongoing and future projects create potential opportunities for coordinating future development projects so that they contribute to the overall character of the corridor.

CASE STUDY

RIVER SKERNE (DARLINGTON, ENGLAND)

The Skerne is a living example of the full range of restoration techniques available. Envisioned as a medium for increasing our understanding of river restoration, the project employed a variety of restoration techniques and monitored the results of each approach. The project was shaped by a comprehensive public outreach process that included a follow-up survey evaluating public perceptions upon completion of the project. The restoration achieved its goal of "bringing the countryside into the town."

West Glebe Road to the north and east and Cameron Mills Drive and North Overlook Drive to the west. Commercial districts include the area along the northwestern border with Arlington, east of the bridge connecting West Glebe Road with South Glebe Road, the Mount Vernon Avenue commercial district and the area at the southeastern edge of the study area. Special use districts ("Coordinated Development Districts") encompass the Birchmere and Safeway/Datatel properties along Mount Vernon Avenue as well as the eastern portion of the study area. These special districts have site-specific standards and all allow for a mix of uses. The open space along the George Washington Memorial Parkway is designated as public open space and waterfront park and recreation. Finally, the Dominion Power property on West Glebe Road is zoned for utilities and transportation. (Figure 2.16)

On the Arlington side of the stream, single-family residential zoning (primarily east of I-395 and north of South Glebe Road) is mixed with multi-family residential zones west of Lang Street and along the northwestern edge of the Water Pollution Control Plant. Interspersed throughout the residential zones are special districts (S-3A) that allow for public uses such as parks, schools and places of worship. In addition, commercial zones include the area along Shirlington Road (north of Four Mile Run), the Village at Shirlington, two clusters of parcels along South Glebe Road, and the eastern portion of the study area at Potomac Yard and adjacent parcels. Industrial zones are located at the eastern and western ends of the corridor, while the Water Pollution Control Plant property is zoned as a "Public Service" district.

Both the City of Alexandria and Arlington County own land within the study area. In addition to the existing open space and park areas, these publicly-owned properties include the Alexandria Redevelopment and Housing Authority (ARHA) housing between the stream and West Glebe Road, and the County-owned parcels north of Jennie Dean Park. Other publicly-owned land includes the Ronald Reagan Washington National Airport and the National Park Service land along the George Washington Memorial Parkway, as well as public open space and the five school properties located in the vicinity of Four Mile Run. In addition, public/private utility land includes the Dominion Power facilities and transmission line rights-of-way, the Arlington County Water Pollution Control Plant, the WMATA bus depot and the CSX-owned rail line. It is important to note the high level of public utility land concentration along the stream. (Figure 2.17)

The importance of these operations, and the significant investments in upgrades to these facilities, makes these properties unlikely to change hands in the foreseeable future. The publicly-owned school and park lands are also unlikely to change hands, and these form the foundation of a network of public open space in the vicinity of the stream corridor. The greatest potential for change, therefore, is on privately-owned properties in response to pressures for both public acquisition and development, most

notably at Potomac Yard and the Village at Shirlington. In addition, there exists the possibility of acquiring easements for public access on privately-owned land adjacent to Four Mile Run.

3. A CORRIDOR IN TRANSITION: PLANS FOR FUTURE DEVELOPMENT

A variety of new development has been approved or proposed in the corridor. Many of these ongoing and future projects create potential opportunities for coordinating future development projects so that they contribute to the overall character of the corridor. In particular, substantial changes will occur at both Potomac Yard and the Village at Shirlington, further developing these areas as nodes of urban activity in the corridor.

Approved development at Potomac Yard includes two mixed residential and retail complexes, along with additional open space, just north of Four Mile Run on the Arlington side of the stream. The remaining South Tract parcels are designated for mixed-use development around a central park. In addition, developers have proposed new projects on the Alexandria side of Potomac Yard, including a "town center" development to the south of the study area. At Shirlington, approved development includes new apartments and condominiums, a new building that will house both a public library and a relocated Signature Theatre, and two new parking structures. In

FIGURE 2.18: FUTURE DEVELOPMENT OPPORTUNITIES: EXAMPLES FROM PREVIOUS PLANNING EFFORTS

FIGURE 2.17: OWNERSHIP

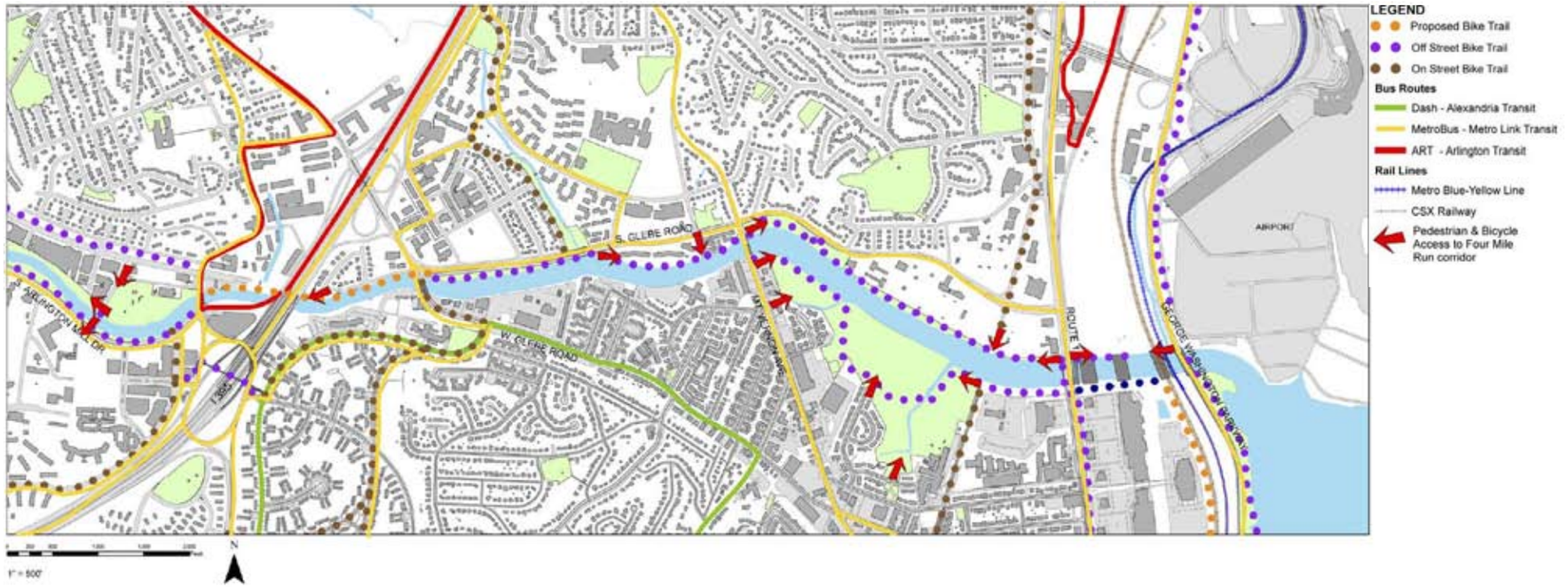


FIGURE 2.19: TRANSPORTATION AND ACCESS

addition, a new transit center will be constructed at the southeastern edge of Shirlington. Additional proposed development includes hotel, office and parking structures.

Elsewhere in the corridor, approved development includes new townhouses on West Glebe Road, the Alexan residential development east of South Glebe between 24th Street and I-395, and the mixed-use Renaissance Center on Shirlington Road. Moreover, a hotel has been proposed for the site adjacent to the Alexan residential development. While not a significant change in land use, the substantial upgrades planned for the Water Pollution Control Plant, as well as the new natural gas line serving the WMATA bus depot, increase the likelihood that these facilities will remain in their current locations for the foreseeable future.

In Alexandria, the Arlandria Neighborhood Plan suggests that redevelopment on the Safeway/Datatel and Birchmere sites is likely within the next 5-10 years and 10-15 years, respectively. It also notes the importance of Four Mile Run and Four Mile Run Park and strongly encourages redevelopment activities to include visual and physical access to these assets. The City also expects some infill development to occur along Mount Vernon Avenue in the shorter term.

In Arlington, the Nauck Neighborhood Action Plan suggests a possible redevelopment opportunity on the site currently occupied by the Dunbar Homes, while ongoing planning and design work is studying alternatives for a new town center development in the neighborhood. Moreover, the Potomac Yard Design Guidelines for Arlington and Alexandria anticipate future uses for three former railroad bridges on the eastern edge of the study area. The easternmost bridge is intended to carry Potomac Avenue, while the other two bridges could be partially or wholly removed or used as open space, pedestrian crossings and venues for community activities.

4. TRANSPORTATION AND ACCESS

The study area is served by public transportation to a limited extent. Metrobus and local bus service (DASH Bus in Alexandria; Arlington Transit in Arlington) all have stops in the area, while Metrorail serves nearby stations at Reagan National Airport (a mile to the north), Crystal City (further away, but more accessible) and Braddock Road (over 2 miles to the south). (Figure 2.19)

On foot and on bicycle, access to the stream from surrounding neighborhoods varies depending on the location, with some areas entirely cut off from the stream by the lack of through streets. As a general rule, even those pedestrian connections that do exist

would benefit from some form of traffic calming, since streets such as South Glebe Road are difficult and potentially dangerous to cross due to multiple lanes and fast-moving traffic. A few areas—south of the stream between Mount Vernon Avenue and Shirlington Road, north of the stream between I-395 and Shirlington Road and portions of U.S. Route 1—currently lack direct pedestrian connections to the stream.

Off-road trail connections alongside the stream are not yet continuous. Trail connections along the stream on the Arlington side of the stream will connect with the Washington & Old Dominion trail once the planned bicycle trail under I-395 is completed. The trail on the Alexandria side currently occupies the eastern half of the corridor, but stops just short of Mount Vernon Avenue, with off-road bicycle routes veering away from the stream at this point.

Surrounding roads impact the stream corridor to a significant degree. This impact includes bridge crossings as well as areas along South Glebe Road and South Arlington Mill Drive where the road runs parallel to the stream at a distance that is sometimes less than 30 feet. Traffic at a number of the major intersections—especially on South Glebe Road when approaching the bridge crossing—will be an additional consideration impacting Master Plan decisions.

5. INFRASTRUCTURE

Bridges

There are eleven bridges crossing the stream in the study corridor. These include six road bridges, two rail bridges and three inactive bridges. Of the six road bridges, four represent segments of arterial roads and two are controlled access and facilities. Decisions regarding the future of the inactive bridges, which present both opportunities and obstacles for achieving the Master Plan goals, will play a significant role in shaping the future plans for the eastern end of the corridor.

Utilities

The Four Mile Run watershed, including the project area, is criss-crossed by a variety of underground and above-ground utilities. The utilities most likely to impact the Master Plan include stormwater drainage infrastructure, sanitary sewers, water mains and the two power transmission lines that run above ground both along and across Four Mile Run. A large sanitary sewer underlies portions of Four Mile Run and is exposed in areas from I-395 east to West Glebe Road. Moreover, Washington Gas recently constructed a natural gas line in the corridor to supply the WMATA bus depot.

6. RECREATION FACILITIES

Although the corridor is relatively well-served by parks and open space, there remains a need for additional recreational facilities and greater continuity to connect recreational

AT A GLANCE

POTOMAC YARD BRIDGES

One of the decisions required as part of the master planning process concerned whether or not to retain two abandoned railroad bridges in the vicinity of Potomac Yard. Options included retaining both bridges, removing both bridges or removing one of the bridges. After analyzing these options, the JTF and ACG agreed that removing the westernmost bridge and retaining the easternmost provided the most desirable outcome. Key advantages of this option included maximizing visibility from U.S. Route 1, opening up a portion of the stream to sunlight (thus enabling an additional wetland bar in this location), and retaining one bridge as a future public open space above Four Mile Run.


EXISTING BRIDGES AND STORMWATER DRAINAGE INFRASTRUCTURE


POWER LINES

1	Hillside Park
2	Hume Spring Park
3	Four Mile Run Park (includes school yard)
4	Le Bosquet at Sunnyside
5	Ebert Triangle
6	Four Mile Run Park North
7	Fort Scott Park
8	Eads Park
9	Park between S. Inge St & S. Ives St.
10	Oakcrest Park
11	Community Gardens (South Glebe Rd)
12	Gunston Community Center
13	Haley Park
14	Fraser Park
15	Troy Park
16	Charles Barrett Recreation Center
17	Utar Field Park
18	Jennie Dean Park
19	Shirlington Park (south)
20	Shirlington Park (north)
21	Fort Barnard Heights Park
22	Charles Drew Community Center
23	Cora Kelly Recreation Center
24	Beverley Park
25	Fort Barnard Park

PARK NAMES

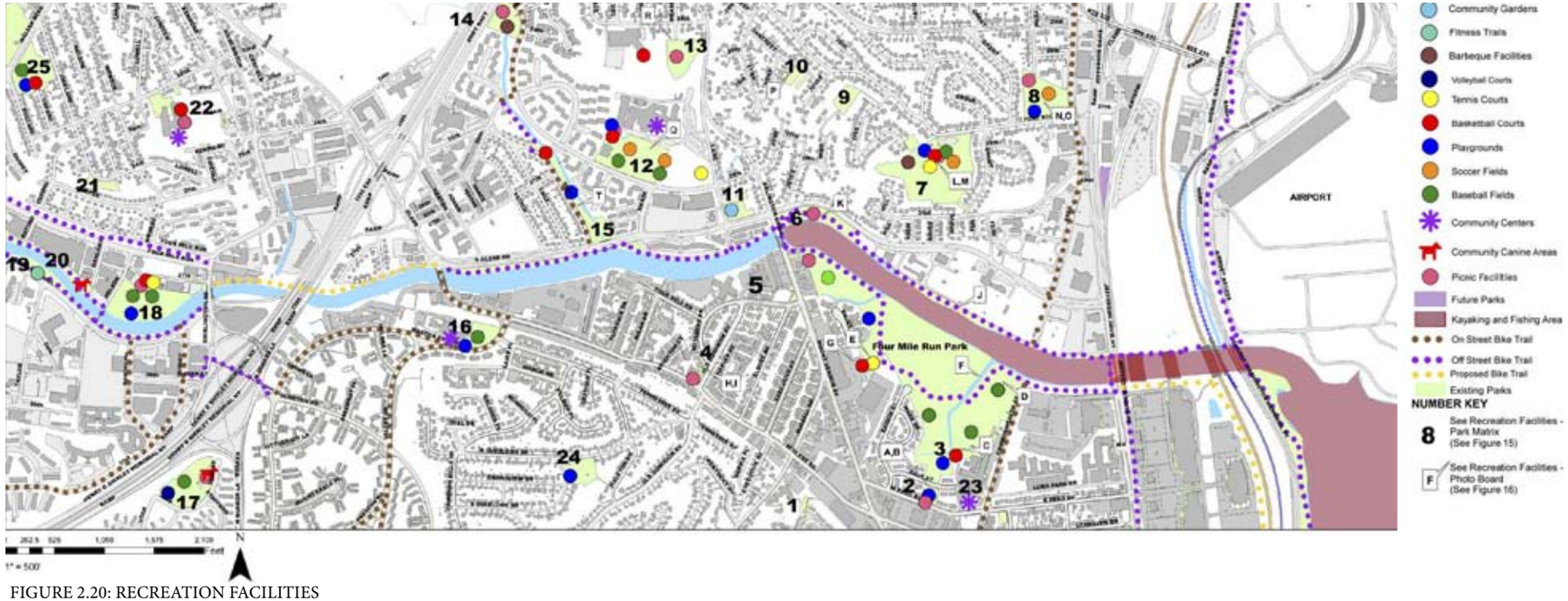


FIGURE 2.20: RECREATION FACILITIES

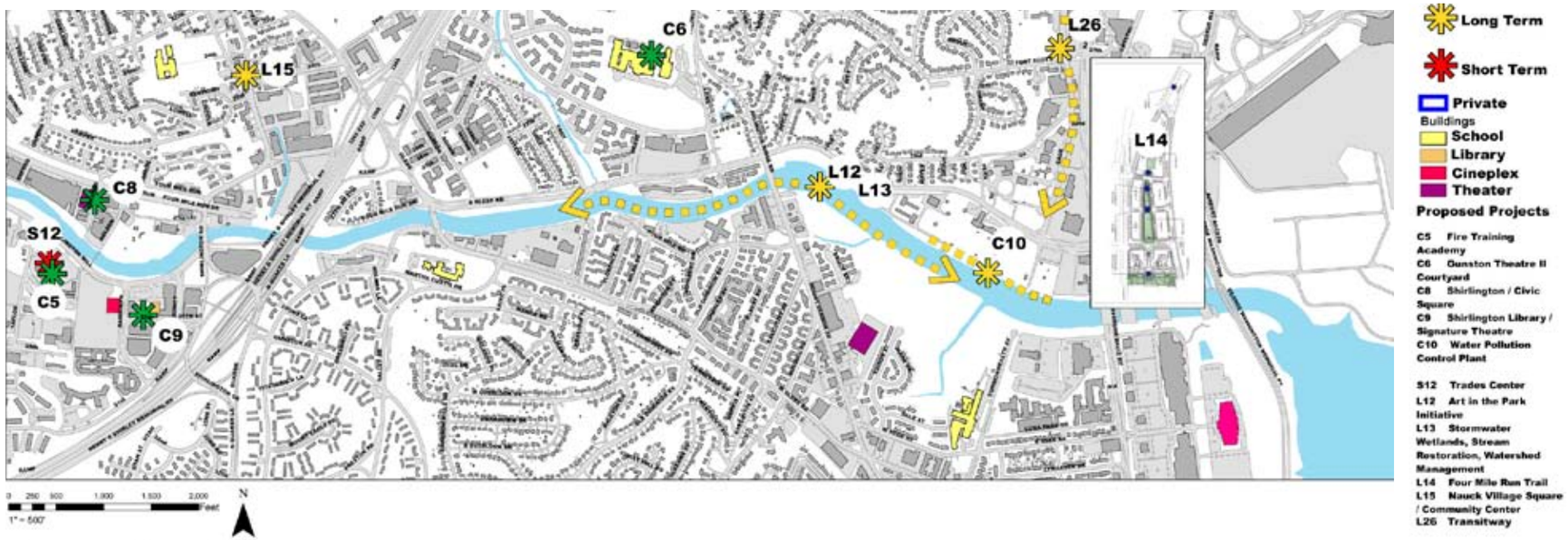


FIGURE 2.21: ARTS AND CULTURE

facilities as part of a cohesive open space network. The study corridor includes twenty-five parks located within or adjacent to the study area, of which five—Four Mile Run Park (South) in Alexandria and Fort Scott Park, Gunston Community Center and Jennie Dean Park in Arlington and Troy Park along lower Long Branch—contain the majority of the recreational facilities. Facilities in the corridor include 11 baseball fields, 7 basketball courts and 5 soccer fields, as well as 4 locations with tennis courts and a volleyball facility. Despite multiple park facilities in the area, both jurisdictions have a need for additional recreational facilities to meet demand. (Figure 2.20)

Recreation facilities also include one community garden on South Glebe Road in Arlington and two dog parks in Arlington. Moreover, the 11 playgrounds in the study area sometimes include picnic shelters, barbecues and seating. Four community centers in the area offer both indoor and outdoor facilities for sports and public gatherings.

There are currently eight on-street and off-street bike trails accessing the Four Mile Run trail. Moreover, the stream is also used for kayaking and fishing, most often in the area below the Mount Vernon Avenue bridge crossing.

7. ARTS AND CULTURE

The neighborhoods around Four Mile Run are increasingly becoming centers of arts and culture, with multiple libraries, movie theaters and performing arts venues within close proximity to Four Mile Run. The Village at Shirlington includes a concentration of movie theaters, restaurants and a public library that attracts many visitors from around the region. The Signature Theatre, a live theater venue just to the north, will soon relocate to a new facility in Shirlington. Other destinations in the corridor include the Birchmere, a nationally-renowned venue for live music, and Potomac Yard, which includes a large multi-screen movie theater in addition to shopping attractions. The presence of so many educational and entertainment venues within walking or biking distance of Four Mile Run presents a variety of opportunities to attract visitors to Four Mile Run as part of the arts and culture experience. (Figure 2.21)

Public art and other artistic and educational enhancements have the potential to transform the stream corridor into a more engaging landscape. The Arlington County Public Art Master Plan proposes future art installations for a number of locations in the corridor. In addition, long-range proposals to address stream restoration and stormwater management themes as part of interpretive and artistic installations in public places represent another opportunity to incorporate art and culture into the Four Mile Run landscape.

CASE STUDY

SOUTH PLATTE RIVER (DENVER, CO)

The author James Michener once described the South Platte as "a sad, bewildered nothing of a rive. .too thick to drink, too thin to plow." This once-neglected riverfront has since been transformed into a well-used greenway system, 17 parks and a waterway with rapids that support recreational rafting and kayaking in the heart of the city. The city reclaimed river banks and adjacent areas, replanted native vegetation and eliminated 250 direct sources of pollution. In the process, the revitalized riverfront helped spur nearby development, including a flagship REI store, professional sports facilities, museums, and an aquarium.

Public art and other artistic and educational enhancements have the potential to transform the stream corridor into a more engaging landscape.

At the outset, the JTF and ACG began with the shared conviction that broad community participation at every stage of the master planning process was essential to achieving a restored and revitalized Four Mile Run corridor.

VISIONING WORKSHOP: FEBRUARY 2005

VISIONING WORKSHOP

A. Two Communities Working Together

The master planning process is noteworthy as a model of collaboration across jurisdictions, between agencies and different levels of government, and across multiple professional disciplines. In the summer of 2003, the City Manager of Alexandria and the County Manager of Arlington appointed an eighteen-member citizen task force comprised of citizens from both jurisdictions. Meeting regularly to oversee the progress of the project, this Joint Task Force (JTF) made recommendations to the City and County through a separate collaborative body, the Agency Coordination Group (ACG), which consisted of multidisciplinary staff from both jurisdictions as well as representatives from the Northern Virginia Regional Commission and U.S. Army Corps of Engineers. The two co-chairs of the JTF—one from Alexandria and one from Arlington—served as liaisons to the ACG and fully participated in ACG meetings.

B. Envisioning the Corridor

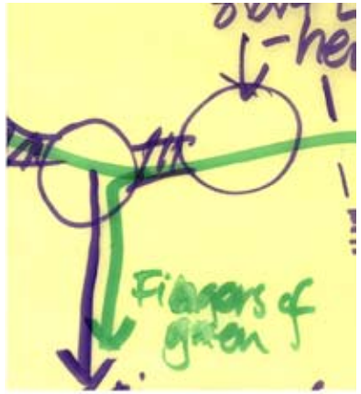
1. PUBLIC OUTREACH

At the outset, the JTF and ACG began with the shared conviction that broad community participation at every stage of the master planning process was essential to achieving a restored and revitalized Four Mile Run corridor. Moreover, the process required both bold thinking and realism; an understanding of the constraints imposed by current conditions in the stream corridor but also a willingness to think beyond these constraints and perhaps even dream a little. The process also required a long-term vision accompanied by short-term strategies to achieve incremental improvements on the way to a broader transformation of the corridor.

To begin the brainstorming and information-gathering, the JTF and ACG organized a series of initial public-outreach opportunities. The JTF sponsored several roundtable discussions, which brought together individuals representing environmental and community groups and local businesses. Additional meetings with civic associations in both jurisdictions and a roundtable discussion with members of the Latino community gathered further input. The centerpiece of these efforts was a major public event to bring together the Arlington and Alexandria communities for a one-day visioning workshop.

The Four Mile Run Restoration visioning workshop took place on Saturday, February 5, 2005 at the Charles Barrett School in Alexandria. The approximately 150 individuals who attended the event were asked to complete and return an eight-question survey to gauge the level of importance that participants assigned to particular goals for Four Mile Run. Next, the consultant team presented an analysis of existing conditions and

3 A PLAN EVOLVES



COMMUNITY DRAWINGS FROM THE VISIONING WORKSHOP

SCENES FROM THE VISIONING WORKSHOP

highlighted potential opportunities throughout the project study area. These presentations included a discussion and demonstration on the nature, characteristics and properties of water that would be important to consider in developing options for the Four Mile Run corridor.

Following the presentations, the group convened for a water-themed "warm-up" drawing exercise in which they were asked to imagine the various meandering patterns that flowing water might produce, the artistic qualities of those patterns, and the opportunities that such patterns presented for the Four Mile Run experience. Participants then divided into smaller, facilitated groups and were asked to respond to four key questions:

- What are the positive features and qualities of the Four Mile Run corridor today?
- What are the negative aspects and features of the corridor that should be changed?
- How do you envision the Four Mile Run corridor in 25 years?
- Specifically, how do you think Four Mile Run can achieve this vision?

For the final session of the day, each group presented a short summary of its discussion and the key ideas identified.

2. COMMUNITY INSIGHTS

Participants offered a wealth of insights and a high degree of passion in outlining their vision for the future of Four Mile Run. From the perspectives articulated, a number of key themes emerged. These themes, which would drive the next stage of the master plan process, included the following:

Bridges

Community members frequently identified the bridges that span Four Mile Run as opportunities. In some cases, participants envisioned ways to reuse existing bridges. In other instances, participants identified bridges that should be removed or locations where new bridges should be constructed. Many participants noted how existing bridges, particularly those near Potomac Yard, could serve as focal points, activity centers and gathering places, or venues for public art. Participants also envisioned that some bridges throughout the corridor would serve as open space links or "green bridges" with environmental or natural elements. In addition, participants identified opportunities to use and improve the undersides of existing bridges, such as illuminating the space underneath the bridges by adding "skylights" and adding sculptural features, art, lighting and other amenities.

Green Corridors and Other Environmental Elements

Participants embraced the idea of "green corridors" of some form along Four Mile Run. Some participants imagined an "emerald necklace" or "spine of green" or "green fingers" that would provide continuous networks of green space along the stream and into surrounding communities. Moreover, they suggested creating continuous green edges along both sides of the stream. In addition, many participants imagined a mix of urban space and natural space with repeated transitions between urban and natural character along the corridor. Common to all of these visions, however, was the idea of a sustainable stream corridor that includes some green and natural elements to create a balance with urban characteristics.

In addition to green corridors, participants envisioned other environmental and natural elements in the stream corridor. They noted the need to improve water quality by incorporating stormwater management and other green design techniques into the plan for the corridor. Participants also suggested that the plan should increase the amount of pervious surfaces adjacent to the stream.

Focal Points and Activity Centers

Many participants expressed a desire for a stream corridor that generates activity 24 hours a day, 7 days a week and at all times of the year. In general, activity would center around a few focal points along the stream corridor. Possible focal points included the U.S. Route 1 / Potomac Yard area, the Shirlington area and the Mount Vernon Avenue corridor. In addition, participants identified other locations—play areas, public spaces, bridges and nature centers—that also could function as focal points and activity centers.

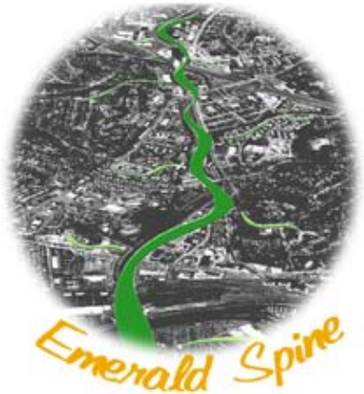
Pedestrian and Bicycle Connections

Participants emphasized the need for non-motorized transportation connections throughout the corridor. They suggested maximizing pedestrian connections in general, as well as adding pedestrian crossings at appropriate locations (for example, at the confluence of lower Long Branch and Four Mile Run). Participants also wished to see continuous trails on one or both sides of Four Mile Run and trail extensions that connect pedestrians and bicyclists to focal points and to the area west of I-395. Some participants expressed a desire for wider trails, with some suggesting the separation of pedestrians and bicyclists on these trails. Many participants also embraced the idea of providing bicycle facilities, such as bicycle rentals and showers for bicyclists, at highly traveled locations such as at the bridges near Potomac Yard.

Access

Participants frequently cited the need for better access to Four Mile Run. They defined "access" broadly to include both transportation access (public, private and multi-modal) and physical access to the stream. From a transportation standpoint, participants were

HERBERT DREISEITL LEADS A DRAWING EXERCISE AT THE VISIONING WORKSHOP



COMMUNITY DREAMS: PHRASES HEARD AT THE VISIONING WORKSHOP

in favor of adding a Metrorail and/or light rail stop near Four Mile Run and suggested providing sufficient parking throughout the corridor. Participants also envisioned formal access points to the stream's edge that would enable them to reach and touch the water. Participants also underscored the need to provide easy access to the stream from all surrounding communities.

Boating

Many participants noted opportunities for boating activities, including kayaking and canoeing, along Four Mile Run. To support boating, participants envisioned boat houses and boat rental operations at certain locations, such as near Potomac Yard and at Four Mile Run Park. A number of participants suggested that boating would be one way to foster a better connection and seamless transition between Four Mile Run and the Potomac River.

Aesthetics

Many participants complained that Four Mile Run is currently "ugly" and "smelly" and poorly maintained. They viewed the restoration project as an opportunity to make Four Mile Run beautiful, reduce unpleasant odors and develop new strategies for keeping the stream corridor clean and attractive. In addition, participants identified specific elements of the corridor that they would like to see removed, such as the power transmission lines and other elements that currently contribute to the "utility corridor" feel of Four Mile Run.

Culture and Interpretation

Participants viewed Four Mile Run as a corridor with art and culture and a story to tell. Participants identified opportunities for visual and public art, as well as the performing arts and festivals. In addition, participants suggested maximizing interpretive and educational opportunities along the corridor by highlighting environmental and historic features and the extent to which Four Mile Run could serve as a "confluence of cultures."

Safety and Security

In general, participants felt that safety and security along Four Mile Run could be improved. Due to the lack of specific examples of safety concerns, it was not clear whether this feeling was a reflection of reality or perception. They felt that adding features such as call-boxes and lighting, as well as improving police access, would contribute to a feeling of safety in the corridor. In addition, they noted that improving the appearance of Four Mile Run and increasing the number of "eyes on the corridor" would further address safety concerns.

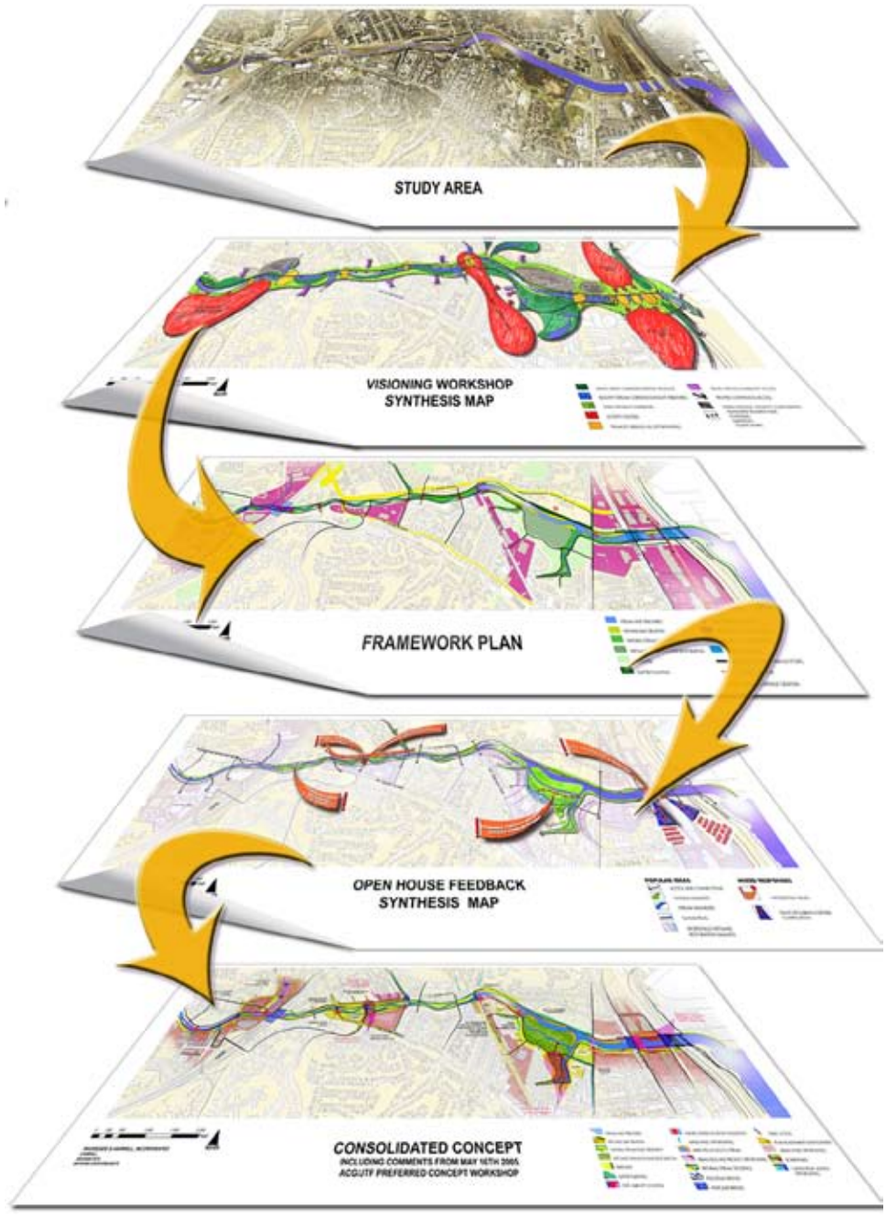


FIGURE 3.1: PLAN PROGRESSION

FIGURE 3.2: VISIONING WORKSHOP: SYNTHESIS MAP

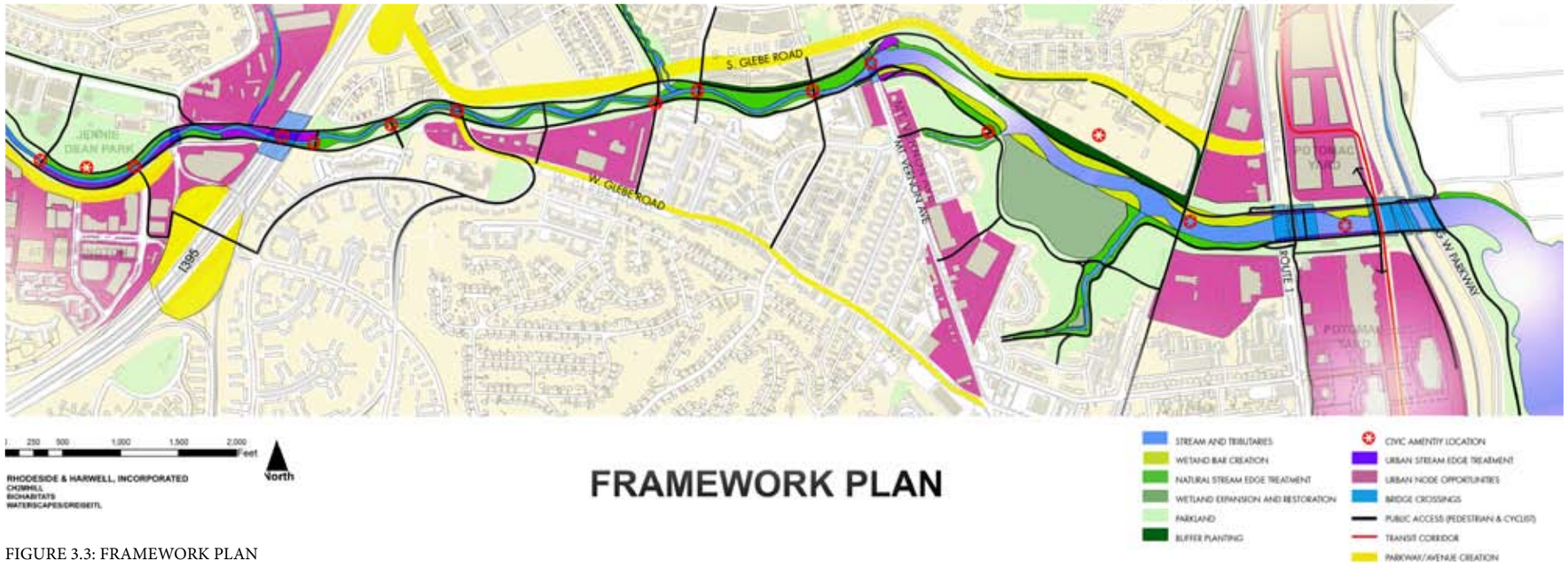


FIGURE 3.3: FRAMEWORK PLAN

VISIONING WORKSHOP

OPEN HOUSES: APRIL, SEPTEMBER AND DECEMBER

Amenities

Some participants mentioned the need for additional amenities along Four Mile Run. Desired amenities included water fountains, bathrooms and urban design features that comply with the Americans with Disabilities Act.

Land Ownership

Participants frequently mentioned the need to increase the amount of land in the corridor that is publicly owned. Some mentioned purchasing easements along Four Mile Run as one possible strategy for achieving this goal.

Equity

Some participants felt strongly that improvements to Four Mile Run should promote social equity. They suggested that the restoration project would be equitable if it provided access for all groups and communities that might use the stream corridor and provided facilities for a wide range of community uses.

Implementation

Many participants viewed the project as a long-term effort and suggested a variety of strategies for ensuring successful implementation of each subsequent phase of the project. Central to these strategies are educating and engaging both community members and government leaders in order to build support for the goals of the project. Other suggestions included seeking out creative funding from a variety of sources and continuing formal community involvement well into the future.

3. FRAMEWORK PLAN AND GUIDING PRINCIPLES

During the visioning session and other public outreach, community members had the opportunity to respond to and comment on the proposed vision statement for the restoration project. Based on these comments and subsequent revisions, the JTF, ACG and the master planning team refined the document that would become the project's "Vision and Guiding Principles." [See the vision statement and guiding principles at the end of Chapter 1]

The input received from the public, the JTF and the ACG underscored the many issues that the Four Mile Run Master Plan must address. (Figure 3.2) Due to the variety and complexity of issues to be addressed in the corridor, the master planning team sought to communicate proposals for the corridor as a series of layers, each exploring a particular issue. This approach would allow the planning team to thoroughly explore each issue on its own and in conjunction with other issues. It also would help the community understand the various components of an illustrative plan and how these features relate to one another.

Based on the strong feedback and direction from the community, the JTF and the ACG, the master planning team developed a basic conceptual framework—the "Framework Plan"—for both in-stream and near stream areas of the stream corridor. (Figure 3.3) The Framework Plan would serve as the underlying "base" plan for all proposals and included those elements that the master planning team considered to be the essential components of any Master Plan concept. These components comprise a variety of layers within the Framework Plan.

The public outreach process also identified other issues and opportunities that required further exploration and public feedback before the planning team could make any further decisions. These areas of exploration are expressed as a series of alternatives, showing a variety of options at key locations along the corridor. The alternatives sought to gauge community sentiments on the spectrum of possible approaches, from those emphasizing a more natural stream corridor to those emphasizing more recreational amenities or a more urban character.

4. MASTER PLAN DEVELOPMENT

Just as the planning team had reached out to the Arlington and Alexandria communities earlier in the Master Planning process, the team once again called upon members of the community to review and comment on the Framework Plan and alternatives during two Open House events in April of 2005. (Figure 3.4) The planning team also met with the JTF and the ACG in a single workshop session to refine the preferred concept for the corridor based on the feedback received from the public.

The input received during these events, along with analysis of the stream corridor, allowed the master planning team to begin the design phase of the Master Plan. (See Figure 3.1 for Progression of Plans) Also critical to the development of the Master Plan was the outcome of the first round of hydrologic and hydraulic modeling (H & H modeling) being undertaken by the Northern Virginia Regional Commission and the U.S. Army Corps of Engineers, the findings of which would determine the necessary channel capacity, level of flood protection and the associated opportunities and constraints.

The master planning team completed draft designs for the Master Plan in the fall of 2005 and further refined these designs based on feedback received at two more public Open House events in September and December. By the end of 2005, the Master Plan was ready to be presented to the Alexandria City Council and Arlington County Board. The Master Plan detailed in the following chapter reflects the final concept that emerged out of this process.

Conceptual Alternatives

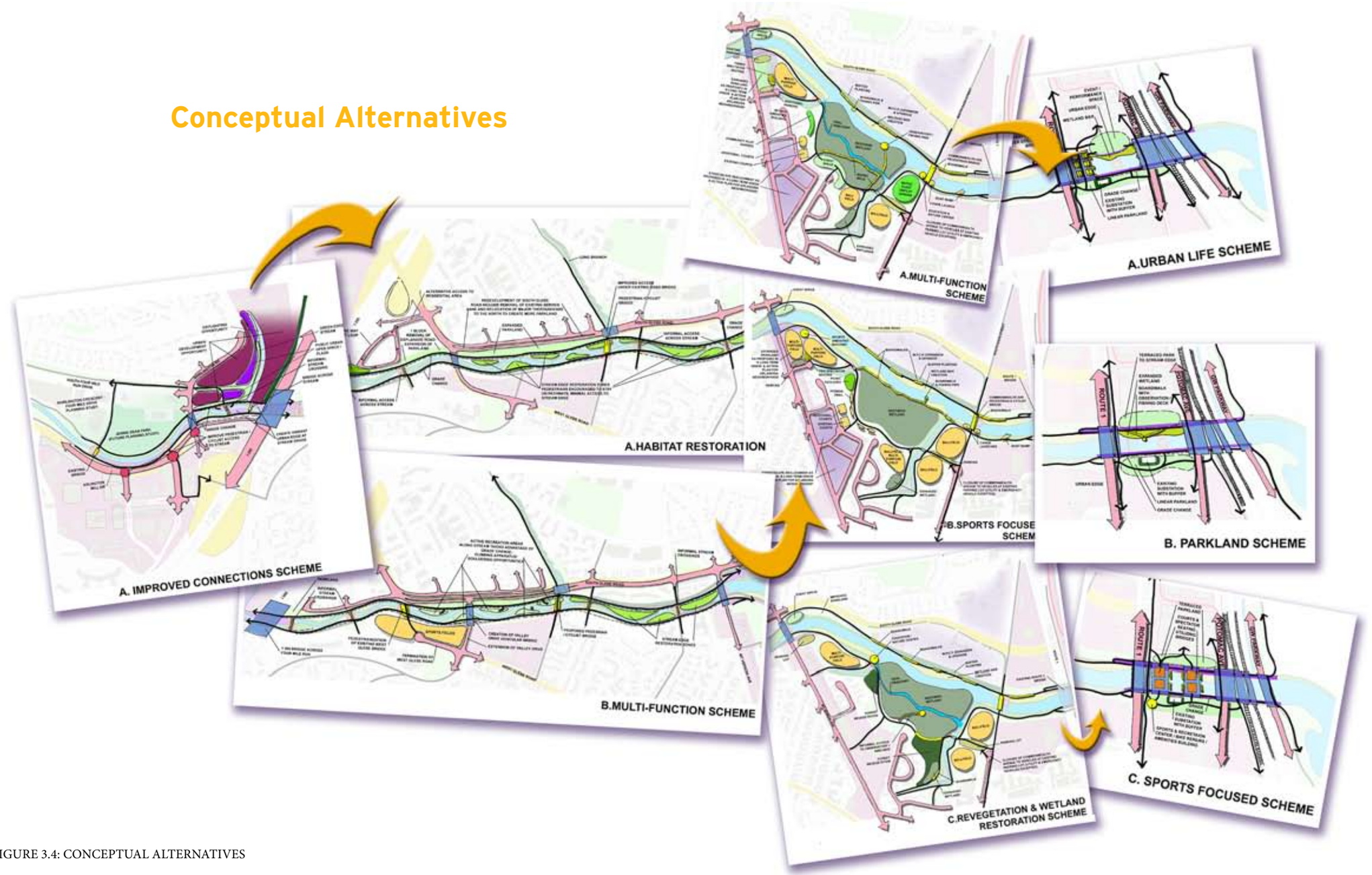


FIGURE 3.4: CONCEPTUAL ALTERNATIVES

In this vision of the future, everyone can find something to celebrate at Four Mile Run. . .

TIDAL REACH LOOKING WEST: AFTER

TIDAL REACH LOOKING WEST: BEFORE

A. The Vision: Celebrating a Restored Four Mile Run

Once a forgotten place and in-between space lined with utilities and concrete, Four Mile Run is on the threshold of becoming the place where residents of Alexandria and Arlington come together to spend their time. Imagine the day when the stream no longer functions as a barrier between neighborhoods, but rather serves as the bridge that brings communities together.

In this vision of the future, everyone can find something to celebrate at Four Mile Run: We can celebrate the wonders of water, ecological renewal and the respite that nature provides. Celebrate the way that Potomac Yard, Shirlington and Mount Vernon Avenue brim with urban vitality, or the latest bird-watching discovery at Four Mile Run Park. Celebrate a community festival, or trying out a new kayak for the first time. We can celebrate the confluence of cultures that makes Alexandria and Arlington such special places to live, or the season's first ripe tomato in the new community gardens. Meeting neighbors on the promenade, or the exhilaration of a crisp pass of the soccer ball and thunderous shot on goal. Celebrate the trails that enable us to bike to work or meander our way to nowhere in particular. Celebrate finding the perfect skipping stone, or realizing how much fun science class can be when the stream becomes an outdoor classroom. Or we might choose to celebrate a simple, quiet epiphany during an early-morning stroll.

In this vision, the Master Plan for Four Mile Run transforms the corridor in a variety of ways. Most notably, the vision (see Figure 4.1) includes improvements in environmental quality, open space amenities, transportation options and overall quality of urban life, as well as the creation of many new destinations and activities to explore.

Imagine the day when the stream no longer functions as a barrier between neighborhoods, but rather serves as the bridge that brings communities together.

4 THE PLAN

Illustrative Plan

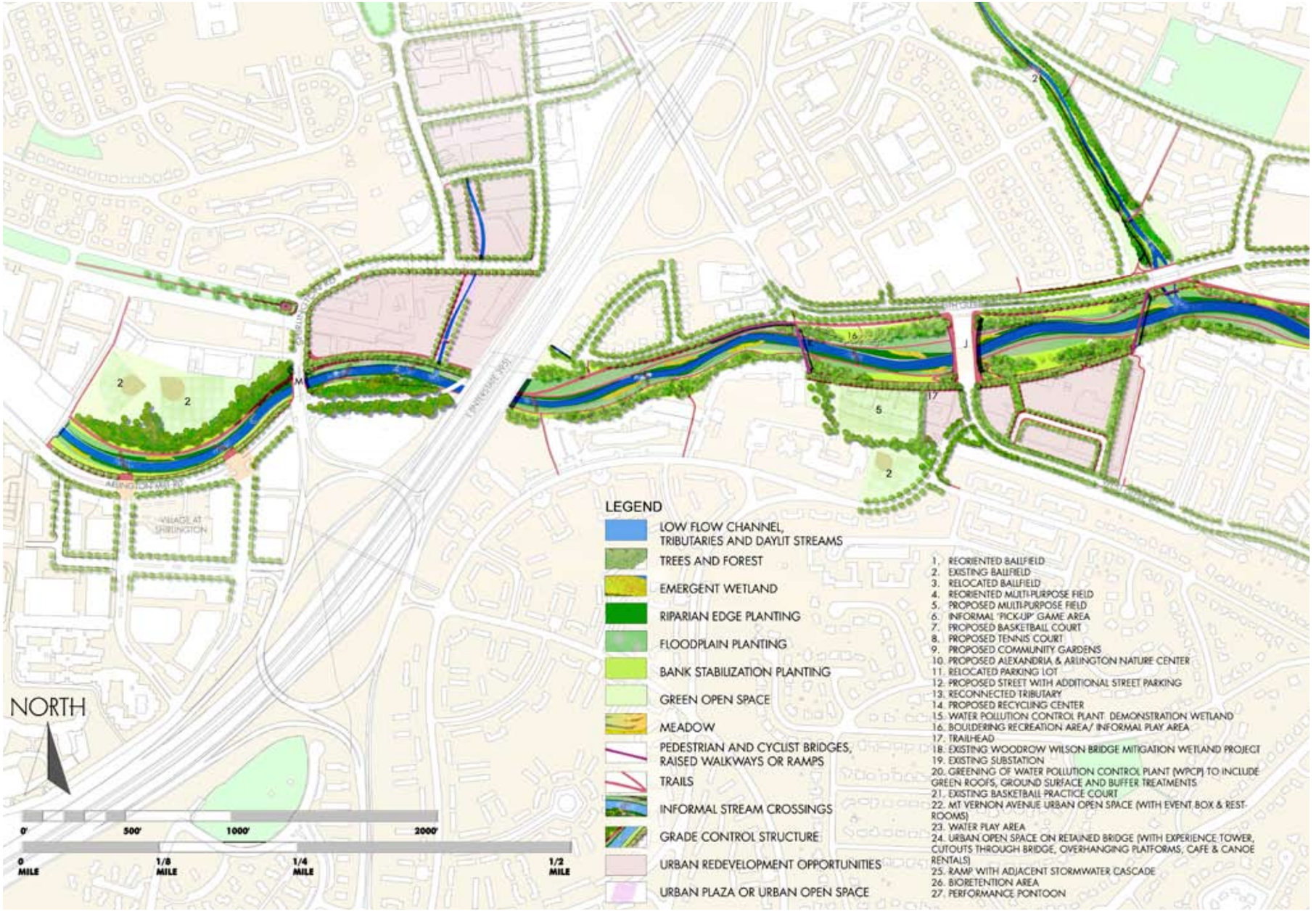


FIGURE 4.1: ILLUSTRATIVE PLAN


BRIDGES
A. GEORGE WASHINGTON MEMORIAL PARKWAY
B. METRO
C. CSX RAIL
D. POTOMAC AVE (ROAD CURRENTLY UNDER CONSTRUCTION)
E. REUTILIZATION OF DISUSED BRIDGE AS GREEN OPEN SPACE WITH EXPERIENCE TOWER AND STORMWATER PLANTERS
F. REMOVAL OF DISUSED BRIDGE
G. EXISTING PEDESTRIAN/CYCLIST BRIDGE
H. ROUTE 1
I. MT VERNON AVE
J. PROPOSED WEST GLEBE ROAD VEHICULAR BRIDGE REALIGNMENT
K. REMOVAL OF EXISTING WEST GLEBE ROAD VEHICULAR BRIDGE
L. I395
POTOMAC YARD

Where a straightened and channelized stream once rushed along concrete flumes and gabions, the restored stream now meanders gracefully around bars of wetlands and past green and stabilized stream banks.

Environment

The Master Plan emphasizes the "greening" of the Four Mile Run corridor. It envisions restoring the balance between nature and people, ecology and urban places. Flood protection remains the paramount concern, but this time with nature and people in mind. The stream shoreline no longer serves as a barrier, but now invites visitors down to the water's edge. Where a straightened and channelized stream once rushed along concrete flumes and gabions, the restored stream now meanders gracefully around bars of wetlands and past green and stabilized stream banks. The litter and debris that once collected along the stream are now distant memories, thanks to innovative new approaches to keep the stream clean. Elsewhere, the fragments of existing wetlands have been reconnected and enhanced to form a healthy and better-functioning ecological system. At Four Mile Run Park, a tributary through the wetlands has been reconnected to the stream and provides a cleansing function that improves water quality. Along lower Long Branch, which flows into Four Mile Run, the banks are now less steep than they used to be and lined with native vegetation; meanwhile, the concrete weir that once blocked fish passage has been removed.

Water flows in new places. Hidden pieces of the region's hydrology have been "daylighted" and waterways, once enclosed underground, now enhance the community and its landscape. In addition to being pleasant and interesting to look at, these uncovered streams also provide valuable environmental benefits by providing places for stormwater runoff to infiltrate the ground. Many of the paved surfaces that once surrounded the stream—parking lots and other expanses of concrete and blacktop—have become distant memories, replaced by attractive and permeable surfaces that are able to absorb harmful runoff. Stormwater management can be fun, too: water features scattered throughout the corridor enliven the landscape in unique, artistic and environmentally-responsible ways while teaching us about water, ecology and the community's history.

Finally, given the time and space to grow and revitalize, new and expanded habitat areas have gradually become home to all sorts of wildlife and plants. These areas recall the natural conditions that once existed along the stream, teaching us about nature and offering refuge for wildlife and humans alike.

Open Space

From its parks, plazas and public greens to its promenades and secluded pockets of nature, Four Mile Run offers open spaces for all moods and experiences. You can meet your neighbors on the terraced banks near Potomac Yard or escape upstream with a book; play volleyball or basketball at the new courts while other family members tend to the family's plot in the community garden and the kids try out their favorite playground equipment. You can stroll along the verdant pathways or relax on the banks of the stream. Or you can play soccer or baseball on the upgraded and reconfigured sports fields at Four Mile Run Park in Alexandria.

From the new park atop the remaining railroad bridge, you can look down and see how the sunlight shimmers on the water as it passes through new openings in the bridges and how, at night, the lighting casts artful reflections on the water. The end of Mount Vernon Avenue is now the neighborhood's open space hub and the place to be for festivals and on balmy nights. Thanks to all the vegetation and landscaping, it is possible to forget that Four Mile Run once felt like a utility corridor.

Transportation

Transportation improvements make it easier to access Four Mile Run and move around and through the area using a broad range of transportation modes. The multi-lane roads with speeding vehicles have given way to traffic-calmed and tree-lined boulevards that are safer and easier to get across on foot. In fact, you no longer need a car at all when you visit or live in the vicinity of Four Mile Run. Rapid transit vehicles may one day stop in the vicinity of the corridor. Meanwhile, new roads with street parking around Potomac Yard make it easier to navigate by car and to stop for a quick stroll by the stream. For bicyclists, a commuter trail on the north side of the stream maintains a fast and efficient commuting route that now connects with the Washington & Old Dominion trailhead. For a more leisurely experience, the trail on the southern side of the stream offers an unhurried route for walking, bicycling or roller-blading. It's now a lot easier to move back and forth between Alexandria and Arlington, thanks to the addition of artistic new pedestrian/bicyclist bridges and informal stepping-stone crossings at frequent intervals along the corridor.

Quality of Urban Life

Today, the stream has become a front door to both communities, rather than a forgotten corridor. You might not recognize Potomac Yard now—a vibrant urban node that is home to thousands of new residents and workers while offering terrific shopping. On nice days, it's great to relax on the terraced banks that lead down to the water, on benches along the stream or in the elevated park. Shirlington is even better than you remember it, and shoppers and diners now spill down to the stream's edge to relax and socialize. The new road configuration at West Glebe Road has enabled the creation of a small shopping village while leaving room for a new sports field and beautiful open space. Meanwhile, Arlandria is thriving as trail users stop at its restaurants and attend the events on Mount Vernon Avenue.

STREAM AT POTOMAC YARD VIEW WEST: A VISION

For solitude, escape the hubbub of the city by finding one of the many natural nooks where you can forget where you live and perhaps spot a heron or osprey.

In the evenings, people gather for performances and events at Potomac Yard and Mount Vernon Avenue, while at Shirlington they enjoy theater, cinema, restaurants and strolling along the stream. The stream at night is illuminated by low-level light that glows beneath all of the bridges, protecting the night sky within the habitat areas while offering beauty and security to those who wish to enjoy the waterfront experience.

Destinations and Activities

So much to do, so many places to go. Start at the education center to learn about the history of Four Mile Run and the creatures that reside in the stream and wetlands. After that, stop by the farmer's market in the park atop the former railroad bridge, and perhaps do a little shopping while you're there. On the way home, stop to watch the little league baseball games in progress. Or go bouldering or biking, play basketball, rent a canoe or kayak at the boat launch or try some fishing by the bridges. Perhaps you would prefer a picnic or some people-watching on the promenade, or a maybe a leisurely lunch in Shirlington Village. For solitude, escape the hubbub of the city by finding one of the many natural nooks where you can forget where you live and perhaps spot a heron or osprey. Stick around long enough, and you can catch the jazz concert at sunset on the green at Potomac Yard.

Such is the vision for the future of Four Mile Run. The remainder of this chapter, building on the guiding principles identified in Chapter 1, describes each of the components of the Master Plan.

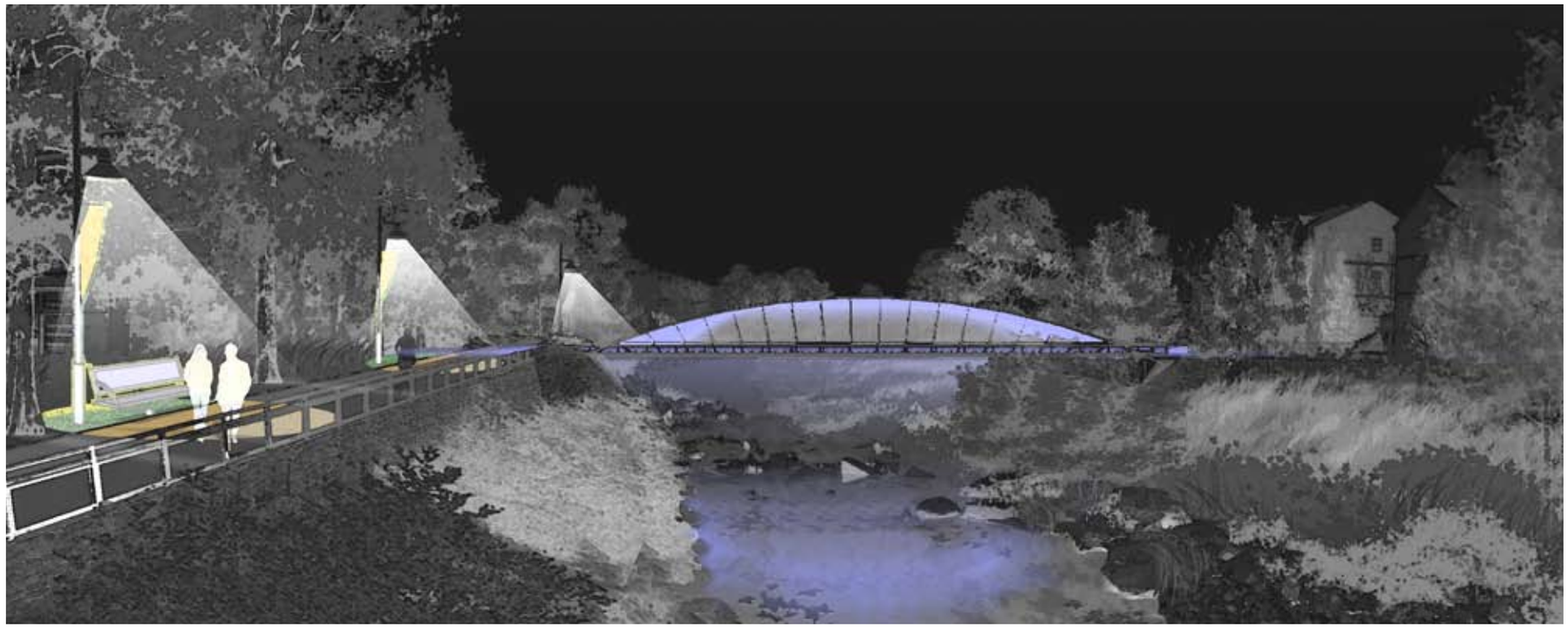
B. The In-Stream Plan

1. HYDROLOGY AND FLOOD CONTROL: THE CORE OF THE PLAN

Create a "dynamically stable stream channel" using natural stream channel design techniques.

The design approach for the in-stream portion of Four Mile Run creates river channel characteristics that are more natural and more stable when exposed to the current range of flows generated by the urbanized Four Mile Run watershed. Like a natural river channel, the in-stream design creates multiple "surfaces" at different elevations within the larger Four Mile Run flood control corridor. The surface at the lowest elevation is the "low-flow channel" (one could also call this the "active channel"). The low-flow channel will convey flowing water, even during times of limited flow, and may also shift laterally at some locations in response to high flows. The higher surfaces in this design, the equivalent floodplains in natural rivers, are intended to convey flowing water only during higher flows. In addition to adding habitat diversity to the Four Mile Run corridor, these floodplain surfaces provide a "release valve" for the low-flow channel so that it is not damaged by high flows. By mimicking a natural channel—albeit modified in order to minimize common problems in urban channels—the Four Mile Run corridor will be dynamically stable and will provide continued protection from floods.

SECTION THROUGH SOUTH GLEBE ROAD, STREAM AND NEW MULTIPURPOSE FIELD: VIEW EAST



PEDESTRIAN AND CYCLIST PATHS AND BRIDGE AT NIGHT: VIEW TO WEST FROM MOUNT VERNON AVENUE

- Avalon Apartments
- Realigned South Glebe Road
- Expanded Parkland and Commuter Trail
- Bank Stabilization Treatment and Bouldering Opportunity
- Wetland Cell and Floodplain Planting
- Proposed West Glebe Road Bridge
- Low-Flow Channel
- Bank Stabilization Planting
- Pedestrian and Bicyclist Promenade
- Redevelopment Opportunity and Trailhead
- Proposed Multipurpose Field over Existing West Glebe Road

- Proposed West Glebe Road Vehicular Bridge
- Proposed Urban Redevelopment Opportunity
- Realigned South Glebe Road
- New West Glebe Road Intersection
- Proposed Multipurpose Field
- Proposed Pedestrian/ Bicyclist Bridge to Replace Existing West Glebe Road Vehicular Bridge

THE ALLUVIAL REACH LOOKING EAST: BEFORE

THE ALLUVIAL REACH LOOKING EAST : AFTER

The in-stream design shown on the HYDROLOGY AND FLOOD CONTROL PLAN was developed to specifically address the following guiding principles:

- Provide a minimum 100-year event flood protection.
- Consider flood protection for areas not currently protected.
- Create a "dynamically stable stream channel" using natural stream channel design techniques.
- Improve corridor habitat and ecology to support native terrestrial and aquatic plant and animal species.

To achieve a minimum of 100-year event flood protection, all changes to the cross-sectional configuration—such as any changes to channel materials or vegetation that could increase "roughness" or changes that reduce cross-sectional-area—will be modeled to verify that the 100-year flood event will be contained within the flood control channel. Where modeling indicates that the 100-year (or 1 percent probability) flood event would extend outside the flood control channel under current conditions, the channel and levee design will ensure that the extent and frequency of flooding of private properties will not be increased by this project. For those areas outside the levee corridor that are already subject to 100-year event flooding in the channel's current condition, configuration and mitigation options to minimize the risk and impact of flooding will be considered.

Within the flood control project lateral limits (the blue line on the hydrology and flood control layer), a multistage channel configuration was developed to achieve the second goal of creating a "dynamically stable stream channel" through natural stream channel design techniques. A dynamically stable channel is defined as a channel that has an appropriate channel cross-section to transport sediment during normal flow conditions; however, it is designed to adjust laterally within this basic form in response to large flows in order to minimize hard stabilization and maintenance. Under a natural condition, storm flows would typically have access to a wide floodplain so that the high energy from large events could be dissipated. In an urban setting, such as Four Mile Run, the limited floodplain area and high storm-related discharge result in high flow velocity and sheer stress. In the proposed dynamically stable channel, the low-flow channel and inset floodplain could adjust to a moderate extent in response to the high flows. The flood control levee walls, however, will be stabilized in place to prevent adjustment.

While some refinement to the dimensions of each channel stage is still required, the overall intent of the design is to create a low-flow channel with an "inset floodplain" that

QUESTIONS & ANSWERS

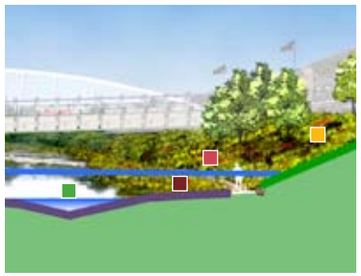
WHAT ABOUT FLOODING?

Thanks to a new understanding of Four Mile Run's hydrology and the history of flooding in the stream corridor, we now know that the U.S. Army Corps of Engineers' flood control project was designed in the 1970s for a higher flow than the current 100-year flood event. As a result, it is possible to reintroduce many of the natural characteristics of the stream without compromising protection against a 100-year flood event, the level of protection for which the flood control project was originally intended.

As the restoration effort moves forward, much of the stream corridor can be naturalized through partial removal of the existing gabions and flood walls. The actual extent of these changes will be determined by the outcomes of the Hydrologic and Hydraulic (H & H) modeling study being conducted simultaneously with this master planning effort.

Through modeling efforts with the US Army Corps of Engineers that examine various conditions of the channel, including existing and proposed conditions, it was evidenced that the channel condition proposed by the Master Plan shows elevated water levels of 12 inches or less in certain areas. However, as implementation of the plan proceeds, changes in the project area topography can work to mitigate these elevated water levels to not appreciably affect potential overbank flooding along Four Mile Run to what it is today.

What does significantly impact flooding potential on Four Mile Run is the 30 percent reduction in flood magnitude discovered through the statistical flood frequency analysis undertaken in 2004. This type of analysis will be ongoing throughout the implementation phase of the project to ensure that when the details of construction designs are available, the associated flood impacts are appropriately addressed, including potential flood mitigation. Such efforts will be coordinated with the US Army Corps of Engineers and the Federal Emergency Management Agency. Additionally, through this detailed analysis, a public outreach process will be conducted as part of the implementation phase for the Master Plan to determine whether the risk of flooding is acceptable to all stakeholders and whether any additional flood mitigation is required.



- Low-Flow Channel
- Vegetated Inset Floodplain
- Bioengineered Protection
- Vegetative Bank Stabilization
- High Flow Event
- Will Not Adjust
- Dynamically Stable - May Adjust Laterally

is inundated during relatively small storm flow events that mobilize sediment. The inset floodplain acts as a release valve for forces in the low-flow channel. As flow increases, water will spread laterally onto the floodplain surfaces, limiting the forces that develop in the low-flow channel and protecting the low-flow channel (and stream habitat) from damage.

The multistage channel design also minimizes the amount of local maintenance required to achieve the goals described above. The final dimensions selected for the channel will ensure efficient sediment transport through the low-flow channel, thereby minimizing the need for frequent maintenance. Due to the nature of the tidal portion of the channel, however, maintenance in that reach will likely be more frequent.

Finally, within the geometric constraints required to achieve the other project goals, the project seeks to maximize other benefits of the restoration. By ensuring the greatest possible variety of aquatic and riparian habitats as part of the channel redesign, the project will transform what is now a relatively homogeneous aquatic and riparian environment into a corridor with diverse microhabitats. Moreover, the project aims to maximize both recreational opportunities in, and public access to, the stream.

One of the aims of the restoration effort is to remove as many of the existing gabions and flood walls as possible without compromising flood control and bank protection. In place of the gabions, the Master Plan recommends more natural stabilization solutions, including a variety of bioengineering techniques and appropriate bank reconfiguration. Some of these techniques are discussed later in this chapter, while Chapter 5 outlines relevant techniques in greater detail. The outcome of the Hydrologic and Hydraulic (H & H) modeling study being conducted simultaneously with this Master Planning effort will determine the extent to which the gabion and floodwall replacement can occur.

The following elements are illustrated in the Flood Control and Hydrology plan in Figure 4.2. The location of the features are shown on the cross-section provided.

Low-Flow Channel

The low-flow channel is the area within the Four Mile Run corridor that will convey water during both low-flow and high flow conditions. The design of the low-flow channel will be refined based on sediment transport analyses to ensure that the dimensions are appropriate for the channel-forming flows that occur in this reach of Four Mile Run. Because of the limited floodplain access and high storm-related discharge common to this type of urban channel the channel is intended to be a dynamically stable channel. This will allow the restoration to include more natural elements, and less

- Low-Flow Channel
- Existing Profile
- Proposed Profile with Vegetative Bank Stabilization

SECTION THROUGH LONG BRANCH: VIEW SOUTH

hard stabilization. Therefore, to the extent possible given the flow characteristics and lateral constraints, the low-flow channel may change position and configuration in response to sediment delivery and flow from upstream. These adjustments will take place within the inset floodplain, which is described below. In locations where adjustment is not desirable because of the location of amenities, facilities or utilities, various channel and bank stability measures (also described below) will be employed to maintain a relatively fixed channel.

Extent of Inset Floodplain / Vegetated Inset Floodplain

In Figure 4.2, the vegetated inset floodplain is the area adjacent to the low-flow channel bounded by the lines labeled "extent of inset floodplain." This design feature is tightly linked with the low-flow channel and contributes to the ability of the low-flow channel to be dynamically stable. This area will be inundated relatively frequently during flows greater than the determined channel-forming flow for the low-flow channel. This area will be vegetated and outfitted with bioengineered erosion control measures to prevent excessive erosion during the early phases of the project development. The vegetation and grading in this area will provide diverse in-stream habitats as well as pocket wetlands, vegetated riparian zones, upland areas with tree cover, and grassy upland areas.

Bioengineered Toe Protection

Bioengineered toe protection will protect the bottom (i.e., the "toe") of the slope that connects the low-flow channel to the inset floodplain and the slope at the lateral limits of the inset floodplains. Toe protection may also be used to stabilize the low-flow channel in places where channel adjustments would compromise project amenities. These measures will protect these sensitive areas from excessive erosion during high flows and moderate flows in the low-flow channel. A wide variety of bioengineering approaches could be applied. It is likely that some combination of native rock and vegetation will be used in some places to provide this protection. Bioengineered toe protection blends much better into the natural stream environment than traditionally engineered toe protection methods, and also provides much better wildlife habitat.

Bioengineered Bank Stabilization

Stream banks will be stabilized using similar bioengineering approaches in areas where the erosion risk is relatively high. In Four Mile Run, high risk areas for erosion will occur where the corridor is most confined, and where structures such as bridge piers and utility line crossings present obstructions to flow that could induce significant local bed scour and bank erosion. Since the forces that act on stream banks during high flows

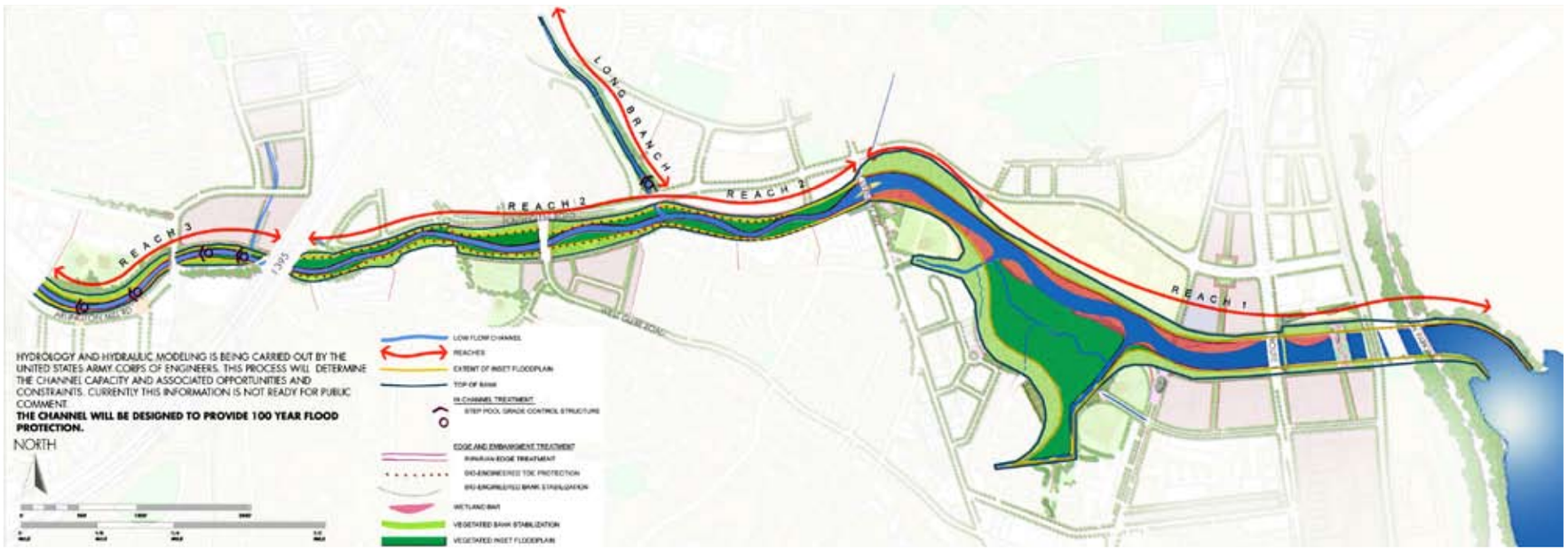


FIGURE 4.2: FLOOD CONTROL AND HYDROLOGY

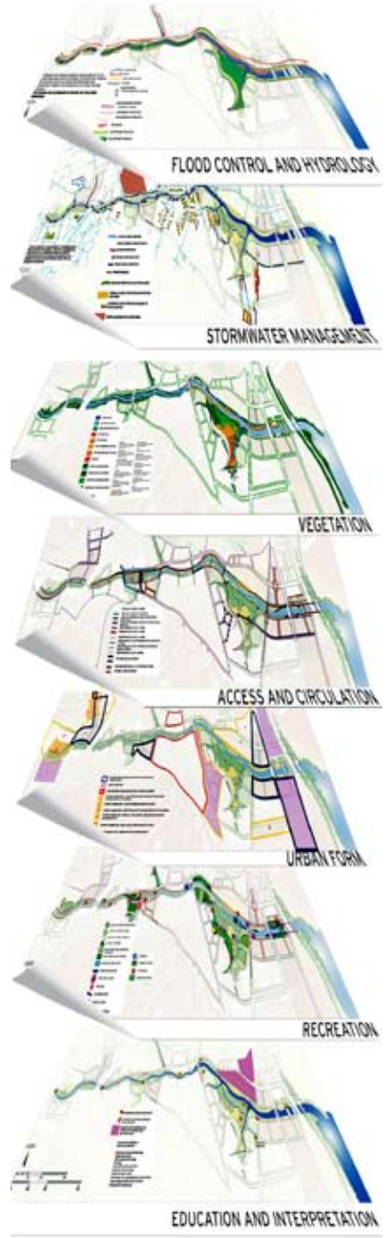


FIGURE 4.3: MASTER PLAN LAYERS

A step-pool grade control structure is a naturally inspired design that mimics the rock jams and plunge pool sequences typical of steep rivers to maintain bed elevations in impaired systems.

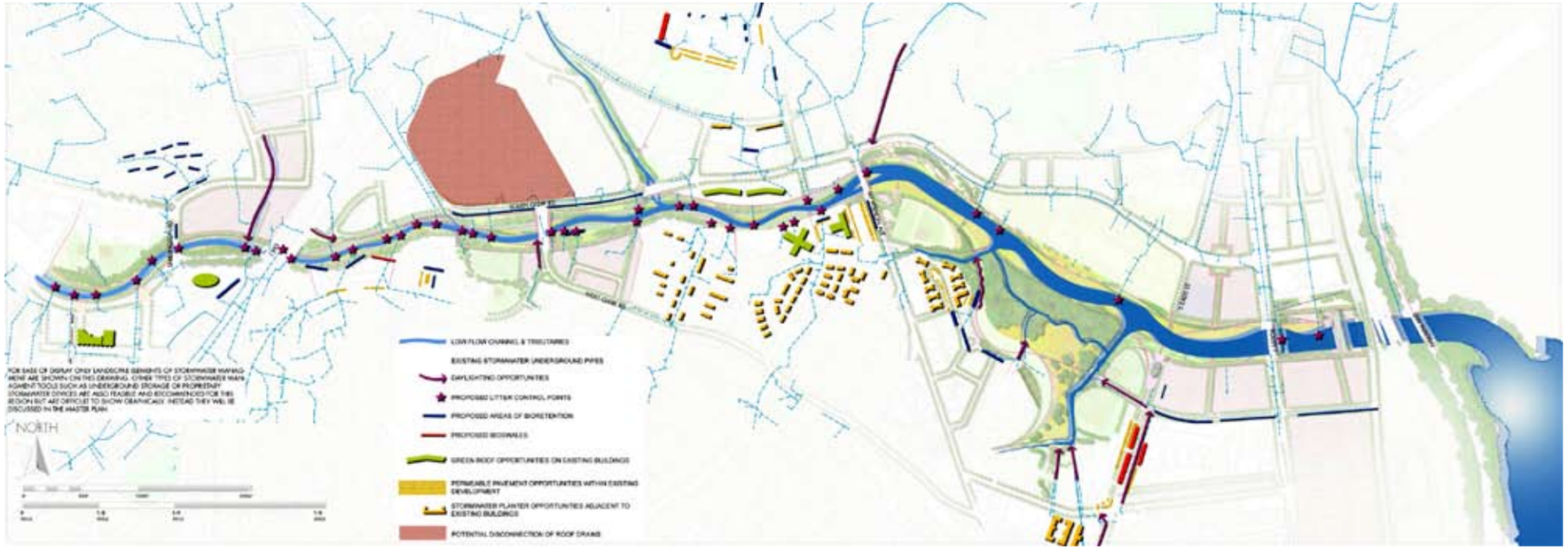


FIGURE 4.4 STORMWATER MANAGEMENT

FIGURE 4.5 VEGETATION

are greatest where water depth is greatest, the bioengineered bank stabilization designs include gradients of strength, with the most robust approaches (i.e., those with more rock or hardscape) applied near the bottom of the bank and more flexible approaches (i.e., those with more vegetation) applied near the top of the bank. Again, some mixture of vegetation and structural stabilization is likely in all of these areas.

Vegetated Bank Stabilization

Vegetated bank stabilization will be applied in areas with relatively low risk of excessive erosion. These areas are generally where the flood corridor is at its widest. Some temporary, biodegradable erosion control fabrics may be used to prevent erosion during project establishment, but long-term erosion protection in these areas will be provided by the root structure and soil coverage of vegetation. These areas will also offer significantly improved habitat compared to the existing conditions in Four Mile Run. Figure 4.2 shows what vegetated bank stabilization will look like in practice along lower Long Branch.

Step-Pool Grade Control

These features will provide several ecological and aesthetic benefits to the Four Mile Run project area. A step-pool grade control structure is a naturally inspired design that mimics the rock jams and plunge pool sequences typical of steep rivers to maintain bed elevations in impaired systems. These structures will replace the unnatural grade control structures in Four Mile Run and will likely be constructed of large rock native to the area. These structures will allow easier upstream and downstream movement of fish and other aquatic organisms, and will also aerate the water in visually appealing small waterfalls.

2. STORMWATER MANAGEMENT: IMPACTING THE WATER THAT FLOWS IN FOUR MILE RUN

Incorporate "green design" principles.

A successful and truly sustainable restoration of Four Mile Run will focus not only on the immediate stream channel, but also on the surrounding watershed and its impact on the stream. Incorporating a range of "green design" principles, such as stormwater management, can help to minimize the impact of surrounding land use. A variety of effective, sustainable and minimally impacting stormwater management techniques, when incorporated into new development and as retrofits to existing land use, can affect both the quality and quantity of water that flows in Four Mile Run while also improving aesthetics in the surrounding landscape. Alexandria and Arlington already recommend or require many of these techniques as part of existing stormwater management programs.

The Master Plan builds on stormwater management practices already in place by identifying locations throughout the corridor where one or more of a range of stormwater management techniques—daylighting, bioretention, permeable pavement, green roofs, stormwater planters, litter control, underground storage—could improve ecology and aesthetics while providing a stormwater management model for other communities. The variety of available stormwater management techniques and strategies for implementation are described in greater detail in Chapter 5.

The STORMWATER MANAGEMENT PLAN responds to the following guiding principles:

- Incorporate "green design" principles for all design and development activities within and adjacent to the corridor.
- Develop upstream strategies to improve environmental quality and maintain the long-term viability of a restored levee corridor.
- Incorporate innovative and creative urban designs and watershed solutions.

Identifying Opportunities in Alexandria and Arlington

Public facilities, such as schools, are very attractive sites for stormwater management retrofits. Potential options at these sites include rain gardens, green roofs, foundation planters, and permeable pavers in certain areas of the property. Underground storage can be placed under basketball courts, tennis courts or other impervious recreational surfaces. Some artificial turf surfaces, such as soccer fields, may be able to provide greater infiltration and underground storage. Moreover, public schools can take advantage of stormwater retrofit projects as educational opportunities for their students. A site visit to Gunston Middle School and Charles Barrett Elementary School, for example, identified several potential sites for bioretention, stormwater planters, and permeable pavement, as noted in Figure 4.4.

Commonwealth Avenue in the City of Alexandria is a long, divided boulevard that is bounded by residential neighborhoods. The median is currently the standard curb-and-gutter structure with storm drains. The current design of the median makes it difficult to install curb cuts and provide water quality benefits through bioretention in the median; however, this potential should be looked at again if and when the street undergoes renovations and road work. This area was identified in the Alexandria Open Space Plan as a major thoroughfare that should serve as a model for streetscape enhancements.

Other commercial properties, such as the Dominion Virginia Power dispatch and storage facility, are also potential sites for retrofits such as bioretention, bioswales, and

A major objective of the Master Plan is to reestablish the vegetation that once lined the stream and existed in the lowland wetlands areas but has since disappeared or been colonized by invasive species.

disconnection of pervious surfaces such as roofs through the use of stormwater planters or rain barrels (These techniques are described in detail in Chapter 5). In addition, other commercial properties that include large parking lots are candidates for bioretention and permeable pavement retrofits.

3. VEGETATION AND HABITAT: ENRICHING LIFE ALONG FOUR MILE RUN

Improve the stream corridor ecosystem.

A major objective of the Master Plan is to reestablish the vegetation that once lined the stream and existed in the lowland wetlands areas but has since disappeared or been colonized by invasive species. Ecosystem restoration—including the preservation and enhancement of existing vegetation and the introduction, where feasible, of new vegetative communities—benefits the stream corridor by providing additional flood and erosion control, stabilizing stream banks, filtering and removing pollutants from water entering the channel, regulating temperatures, and providing habitat for aquatic, terrestrial, and avian organisms.

The restoration proposals in the VEGETATION AND HABITAT PLAN respond to the following overall guiding principles:

- Improve corridor habitat and ecology to support native terrestrial and aquatic plant and animal species.
- Create a "dynamically stable stream channel" using natural stream channel design techniques.

The vegetative communities described in Figure 4.5 are divided between "existing" and "proposed" status. It is intended that existing vegetative communities be preserved and/or enhanced according to their current location and composition. Invasive species management will occur throughout the project area. Within "existing" vegetation communities, this will involve the inventory and eradication of invasive species that currently thrive in these areas. In "proposed" vegetative communities, invasive species management will prevent the colonization of undesirable species.

Hydraulic models of the flood control channel enable an analysis of the effects of the increase in vegetation within the active channel and riparian / wetlands areas adjacent to the channel. These models will be used to ensure that proposed plantings do not lead to a net increase in the risk of flooding along any portion of the project area. The following plant communities and their specific placement in or along the channel were selected, in part, to not hinder flood conveyance potential. In addition, it is intended that these vegetative communities, even when fully mature, will require a low degree of maintenance for flood protection purposes.

Additional flood protection is achieved by the restoration of the marshlands in Alexandria's Four Mile Run Park to a condition more closely resembling historic conditions. The restoration will entail excavating areas previously filled to establish a connection to

- Water Pollution Control Plant
- Demonstration Wetland
- Commuter Trail
- Wetland Bars
- Low-Flow Channel
- Proposed West Glebe Road Bridge
- Low-Flow Channel
- Pedestrian / Bicyclist Bridge Connecting South Eads Street to Commonwealth Avenue
- Alexandria / Arlington Nature-Cultural Center
- Trail
- Existing Upland and Floodplain Forest
- Reconnected Tributary
- Existing Emergent Wetland
- Raised Walkway through Wetland
- Meadow

SECTION THROUGH STREAM AND FOUR MILE RUN PARK AND WETLANDS LOOKING EAST

marshlands in Hume Springs Creek. This will allow for a greater volume of floodwaters to be contained within the channel and wetlands areas proximate to the channel, and increase flood protection for the neighboring communities.

The stream corridor restoration focuses on the vegetation and habitat categories described below. The representative species listed for each category will be verified for appropriateness during the specific design phase.

EXISTING VEGETATIVE COMMUNITIES

Existing Emergent Tidal Vegetation

Emergent tidal wetland communities are currently established within Four Mile Run Park. These wetland communities are comprised of herbaceous hydrophytes that are present for most of the growing season. Because the majority of wetlands areas in Arlington and Alexandria have been filled, altered, or degraded, this area remains one of the largest intact and functional wetland ecosystems within these jurisdictions. It provides valuable habitat for migrating waterfowl, resident bird species and a host of insects and mammals. In addition, the wetland ecosystem is a natural filter of pollutants found in the waters of Four Mile Run.

Representative species:

River Bulrush (*Schoenoplectus fluviatilis*)

Cattails (*Typha spp.*)

Halberd-leaved Tearthumb (*Polygonum arifolium*)

Dotted Smartweed (*Polygonum punctatum*)

Pennsylvania Smartweed (*Polygonum pensylvanicum*)

Arrow-leaved Tearthumb (*Polygonum sagittatum*)

Water Hemp (*Amaranthus cannabinus*)

Rice Cutgrass *(Leersia oryzoides)*

Nodding Burr-marigold (*Bidens cernuua*)

Smooth Beggarticks (*Bidens laevis*)

Halberd-leaved Rose Mallow (*Hibiscus laevis*)

Crimson-eyed Rose Mallow (*Hibiscus moscheutos ssp. moscheutos*)

Bearded Sedge (*Carex comosa*)

Climbing Hempvine (*Mikania scandens*)

Cap Dodder (*Cuscuta gronovii*)

Orange Jewelweed (*Impatiens capensis*)

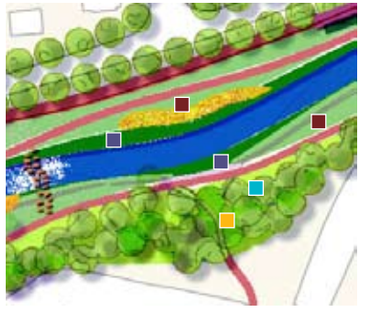
Wild Rice (*Zizania aquatica*)

Arrow Arum (*Peltandra virginica*)

Common Arrowhead (*Sagittaria latifolia*)

Pickerelweed (*Pontederia cordata*)

Sweetflag (*Acorus calamus*)



- Riparian Edge
- Freshwater Floodplain Planting
- Freshwater Wetland Cells
- Bank Stabilization Planting

- Tidal Wetland Bars
- Existing Emergent Tidal Vegetation
- Proposed Emergent Tidal Vegetation
- Existing Floodplain Forest

"I want to see Four Mile Run meet its potential to be a healthy natural area that serves as habitat for a diverse array of species and as a place where people can enjoy the setting, learn, and participate in a variety of recreational opportunities."

Neal Sigmon, *Co-Chair, Joint Task Force*

Existing Floodplain Forest

Swamp or floodplain forest communities that are currently intact will remain within Four Mile Run Park. Floodplain forests are vegetative communities neighboring a stream or river channel subject to periodic inundation. They are composed of woody trees and shrubs, and generally exist at the upper limits of the mean high tide.

Representative species:

Green Ash (*Fraxinus pennsylvanica*)
Silver Maple (*Acer saccharinum*)
Silky Dogwood (*Cornus amomum*)
Poison Ivy (*Toxicodendron radicans*)
Halberd-leaved Tearthumb (*Polygonum arifolium*)
Orange Jewelweed (*Impatiens capensis*)
Awl-fruited Sedge (*Carex stipata var. maxima*)
Blunt Broom Sedge (*Carex tribuloides*)
Fringed Sedge (*Carex crinita var. crinita*)
Cap Dodder (*Cuscuta gronovii*)
Cardinal Flower (*Lobelia cardinalis*).

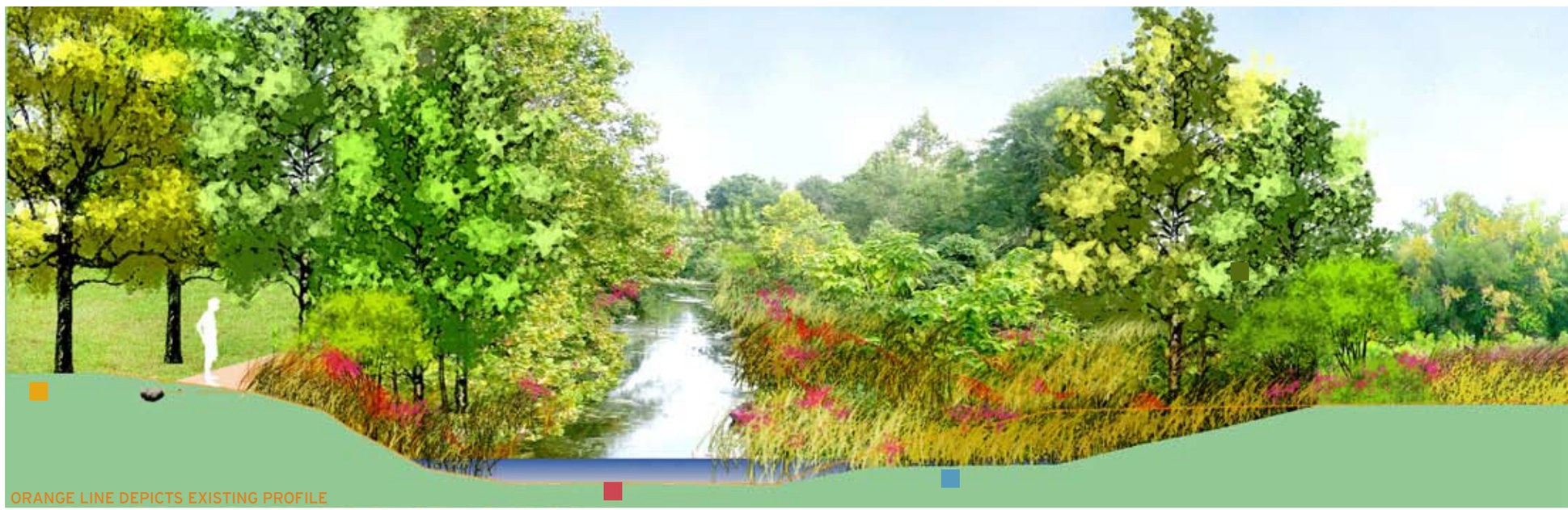
Existing Upland Forest

This mixed upland hardwood community includes moderately mature trees and shrubs. These woodland communities are rare in the Four Mile Run corridor, and many of these areas are highly invaded with exotic vegetation. Nevertheless, they represent an ecosystem that historically was widespread throughout the watershed and provide essential habitat for the remaining large mammals, as well as rodents, birds and insects. In addition, the upland forest communities present opportunities for recreation.

PROPOSED VEGETATIVE COMMUNITIES

Riparian edge

Riparian plantings along the banks of the inset, low-flow channel will provide bank stability and in-stream cover. This will aid the river channel in maintaining a stable geometry, the vegetative rootmass serving to armor the banks against erosive flows. In addition, overhanging branches and leaves provide shade, protection and organic matter—all of which are essential for many species of fish and aquatic insects.



SECTION THROUGH FOUR MILE RUN PARK, CONNECTED WETLAND, COMMUNITY GARDEN AND HUME SPRINGS NEIGHBORHOOD

Representative species:

Black Willow (*Salix nigra*)

Smooth Alder (*Alnus serrulata*)

Silky Dogwood (*Cornus amomum*)

Red Osier Dogwood (*Cornus sericea*)

Marsh Mallow (*Hibiscus moscheutos*)

Freshwater Floodplain Planting

Native shrubs and grasses will be planted on the inset floodplain along the alluvial reach. These communities are able to tolerate periodic flooding, while providing erosion-control and habitat benefits. This vegetation will stabilize the floodplain benches that are immediately adjacent to the channel and are inundated during higher flows. In addition, the vegetative communities of shrubs and grasses will provide nesting and forage habitat for birds and small mammals.

Representative species:

Soft Rush (*Juncus effusus*)

Switchgrass (*Panicum vergatum*)

Cardinal Flower (*Lobelia cardenalis*)

Tickseed Sunflower (*Bidesn polyepsis*)

Black-eyed Susan (*Rudbeckia hirta*)

Spotted Joe-Pye Weed (*Eupatorium maculatum*)

Broom Sedge (*Andropogon girardia*)

Fox Sedge (*Carix volpinoidia*)

Freshwater Wetland Cells

Emergent freshwater wetland vegetation will be planted in permanently flooded pockets (cells) within the inset floodplain. These wetland cells are typically productive, nutrient-rich ecosystems that provide natural filtration of nitrogen, phosphorous, and pathogens in the water of Four Mile Run. They also allow for a large diversity of habitat types (and thus an increase in species diversity) along the channel.

Representative species:

Duck Potato (*Sagittaria latifolia*)

Soft Stem Bulrush (*Scirpus validus*)

Blue Joint Grass (*Calamagrostis canadensis*)

Three-sided Sedge (*Dulichium arundinaceum*)

- Adjacent Ballfield
- Existing Tributary
- Connected Wetland
- Proposed Meadow
- Green Open Space
- Community Gardens
- Hume Springs Neighborhood

One of the major objectives of the plan, as envisioned by those community members who participated in the planning process, was to provide a greater range of enjoyable, safe, easy-to-use and beautiful connections to and across the stream corridor.

Lizard Tail (*Saururus cernuus*)
Bur-reed (*Sparganium americanum*)

Bank Stabilization Planting

Woody trees, shrubs, and herbaceous plants will be planted on the banks of the flood control channel. This vegetation will provide bank stability during higher-flow events, as well as a tree canopy for temperature regulation and avian habitat. In addition, the trees and shrubs of this community will provide a continuous woodland corridor along the banks of Four Mile Run, providing higher-quality habitat for mammals and birds and allowing them more access along the channel.

Representative species:
Cherry (*Prunus avium*)
Red Maple (*Acer rubrum*)
Box-elder Maple (*Acer negundo*)
Tulip Poplar (*Lirodendron tulipifera*)
Sassafras (*Sassafras albidum*)
Black Haw (*Viburnum prunifolium*)
Silky Dogwood (*Cornus amomum*)
Red Osier Dogwood (*Cornus sericea*)

Tidal Wetland Bars

Emergent tidal wetland vegetation will be planted on alternating wetland bars in the tidal reach (below Mount Vernon Avenue). These "wetland bars" represent a significant enhancement of the wetland ecosystem in Four Mile Run. They provide additional habitat for the insects, birds and mammals that currently inhabit the wetland area in Four Mile Run Park and also promote the expansion of rare and endangered vegetation, such as wild rice and river bulrush.

Representative species:
Water Hemp (*Amaranthus cannabinus*)
Nodding Burr-marigold (*Bidens cernuua*)
Smooth Beggarticks (*Bidens laevis*)
Halberd-leaved Rose Mallow (*Hibiscus laevis*)
Crimson-eyed Rose Mallow (*Hibiscus moscheutos ssp. moscheutos*)
Bearded Sedge (*Carex comosa*)
Orange Jewelweed (*Impatiens capensis*)
Wild Rice (*Zizania aquatica*)
Arrow Arum (*Peltandra virginica*)
Common Arrowhead (*Sagittaria latifolia*)
Pickerelweed (*Pontederia cordata*)
Sweetflag (*Acorus calamus*)

Proposed Emergent Tidal Vegetation

Areas of emergent tidal wetland vegetation are proposed within Four Mile Run Park. This vegetation will be planted as part of the reconnection of the wetland areas in Four Mile Run Park to the Hume Springs wetlands, substantially increasing and enriching the total area of emergent tidal wetland vegetation.

Representative species:
Water Hemp (*Amaranthus cannabinus*)
Nodding Burr-marigold (*Bidens cernuua*)
Smooth Beggarticks (*Bidens laevis*)
Halberd-leaved Rose Mallow (*Hibiscus laevis*)
Crimson-eyed Rose Mallow (*Hibiscus moscheutos ssp. moscheutos*)
Bearded Sedge (*Carex comosa*)
Orange Jewelweed (*Impatiens capensis*)
Wild Rice (*Zizania aquatica*)
Arrow Arum (*Peltandra virginica*)
Common Arrowhead (*Sagittaria latifolia*)
Pickerelweed (*Pontederia cordata*)
Sweetflag (*Acorus calamus*)

Proposed Floodplain Forest

Areas of proposed floodplain forest within Four Mile Run Park will be planted as part of reconnecting the Four Mile Run Park wetlands to the Hume Springs wetlands.

Representative species:
Green Ash (*Fraxinus pennsylvanica*)
Silver Maple (*Acer saccharinum*)
Silky Dogwood (*Cornus amomum*)
Halberd-leaved Tearthumb (*Polygonum arifolium*)

Orange Jewelweed (*Impatiens capensis*)
Awl-fruited Sedge (*Carex stipata var. maxima*)
Blunt Broom Sedge (*Carex tribuloides*)
Fringed Sedge (*Carex crinita var. crinita*)
Cardinal Flower (*Lobelia cardinalis*)

Proposed Upland Forest

Planting of native hardwood trees and shrubs above the floodplain.

Representative species:
Cherry (*Prunus avium*)
Sassafras (*Sassasfras albidum*)
Eastern Red Cedar (*Juniperus virginiana*)
Virginia Pine (*Pinus virginiana*)
Pin Oak (*Quercus palustris)*
Red Oak (*Quercus rubra*)
White Oak (*Quercus alba*)
White Ash (*Fraxinus americana*)

Street Trees

Native hardwood trees will be planted along selected streets within the watershed. These trees will increase the amount of tree canopy available to provide shade and habitat. In addition, they will add to the visual appeal of the communities adjacent to Four Mile Run, and link them via a "green corridor" to the creek.

C. The Near-Stream Plan

1. CIRCULATION AND CONNECTION: MAKING THE CORRIDOR ACCESSIBLE

Create a place for people to reconnect with water and nature within an urban context.

Another major objective of the Master Plan, as envisioned by those community members who participated in the planning process, was to provide a greater range of enjoyable, safe, easy-to-use and beautiful connections to and across the stream corridor. The concept of "accessibility," as defined by the community, included a range of improvements: the creation of a continuous and connected trail system along the stream; a series of bridges that would connect the communities of Arlington and Alexandria; safe and convenient routes to bring people to the area via alternative modes of transportation (walking and bicycling); and road improvements to "calm" and clarify traffic impacts throughout the corridor.

The CIRCULATION AND CONNECTION PLAN (Figure 4.6) responds to the following guiding principles:

- Create a place for people to reconnect with water and nature within an urban context.
- Increase pedestrian and bicycle access and amenities.
- Ensure that Four Mile Run is accessible to all who wish to use it.
- Increase connectivity between the two communities.
- Enhance the corridor's effectiveness as a non-motorized and mass transit corridor.

Non-Motorized Access

As a way to establish the stream corridor as both an environmental resource and a destination, the Master Plan calls for the development of a non-motorized corridor that emphasizes pedestrians, bicycles and certain types of boats. It also recommends a broad range of opportunities to accommodate these users.

A continuous and linked trail system.

Scenic, attractive and continuous trail systems—accommodating pedestrians, joggers and bicyclists—line both sides of the stream corridor. On the Arlington side, this trail is

Pablo, Cynthia and friends grew up in the Arlandria area. Now they all go to different high schools. They use the park and basketball courts as a place to catch up with their old friends after school.

While Four Mile Run currently serves as a barrier between Arlington and Alexandria, with limited points of connection, the Master Plan creates multiple opportunities for linking these communities through the creation of a series of new pedestrian/ bicyclist bridges all along the corridor.

already in place and will continue to function as a "commuter" trail for bicyclists. The trail on the Alexandria side, currently not continuous, will be extended and converted into a more casual, meandering path that could be used by walkers, joggers and bike riders who wish to travel at a slower, leisurely pace. The trail passes in and out of green, vegetated areas and along the shoreline, becoming a raised walkway as it passes through wetland areas. As both trails pass through the corridor's several urban nodes, they become wider, with special paving and trees lining the route in the style of elegant and beautiful urban promenades.

The trails on both the Arlington and Alexandria sides link with existing trails to create a continuous trail network. On the eastern end of the corridor, the trails link with the Mount Vernon Trail, a National Park Service trail that runs along the Potomac River. On the western end, the trails link to the Washington and Old Dominion (W & OD) Trail, which is owned and maintained by the Northern Virginia Regional Park Authority.

It is recommended that all new trail construction include either porous, permeable materials or adjacent filtration strips in order to reduce runoff into Four Mile Run. This topic is covered in greater detail in Chapter 5.

Multiple opportunities for physically linking the communities.

While Four Mile Run currently serves as a barrier between Arlington and Alexandria, with limited points of connection, the Master Plan creates multiple opportunities for linking these communities through the creation of a series of new pedestrian/bicyclist bridges all along the corridor. These bridges include the reuse of a now-defunct railroad bridge at the eastern end of the corridor for plantings, passive recreational uses and perhaps even for informal events and for temporary retail amenities, such as vendor carts. In addition, a proposed bicycle facility provides a venue for bicycle rentals and a place at which bicyclists stop to eat, rest, shower and buy supplies. The specific uses for this bridge will evolve over time as the Potomac Yard development nears completion.

In addition, new pedestrian/bicyclist bridges are proposed at other key locations: the extension of Commonwealth Avenue and the site of a new environmental center; at the site of the new community plaza and recreational facility on Mount Vernon Avenue that links to Arlington's Four Mile Run Park; west of the existing Mount Vernon Avenue bridge to provide safe and convenient pedestrian and bicycle access for Alexandrians wishing to shop at the stores along South Glebe Road; and at the place where lower Long Branch meets Four Mile Run in Arlington and where new development has been proposed on the Alexandria side. In addition, with the creation of a new bridge and intersection proposed for traffic traveling on South and West Glebe Roads, the existing

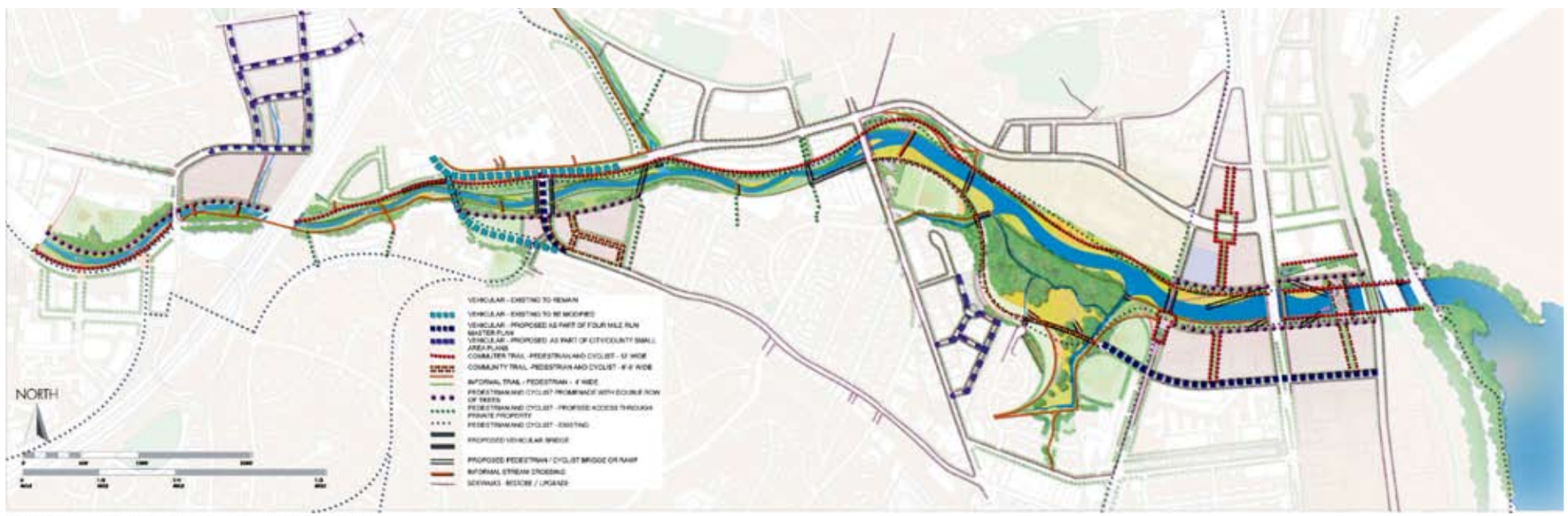


FIGURE 4.6 CIRCULATION AND CONNECTION

MOUTH OF LONG BRANCH: A VISION

- Proposed Pedestrian / Bicyclist Bridge Across the Stream
- Proposed Connection Under South Glebe Road to Lower Long Branch
- Small Bridge Across the Mouth of Long Branch
- Informal Trails
- Sitting Nook

Lighting plays a key role in fostering a sense of security along all streets and trails in the corridor.

Questions & Answers

WHAT ARE THE PROPOSED CHANGES TO SOUTH AND WEST GLEBE ROADS?

The changes proposed for South Glebe and West Glebe Roads consist of two primary components. First, a new vehicular bridge at West Glebe Road will create a much-improved intersection and eliminate some of the existing traffic problems by creating additional space for vehicle "stacking" at the traffic signal and getting rid of the awkward one-lane turn from South Glebe to West Glebe. This realignment will have the added benefit of freeing up land for additional open space. Meanwhile, the original bridge will serve as a pedestrian- and bicycle-only crossing.

Second, South Glebe Road will shift 30 feet to the north by removing an existing service lane. As a result, Arlington County will be able to expand the adjacent parkland into the newly-created space. This proposal will provide an opportunity to maximize public open space on the northern side of the stream, which has relatively limited open space at this time.

Any improvements will be subject to additional traffic studies and community outreach before any design would occur.

bridge would be converted to, or possibly replaced by, a pedestrian- and bicycle-only bridge. All of the existing bridges will be of a consistent design theme that will identify them as a distinctive collection of bridges unique to Four Mile Run (see Chapter 5 for a discussion of potential design approaches). Moreover, all of these new bridges should be designed as span structures in order to minimize or eliminate any new structures directly within the stream itself.

Finally, the Master Plan recommends a series of informal crossing opportunities. These crossings might consist of rocks or stepping stones that traverse the stream at its shallower points and provide casual, almost recreational, linkages between the two communities.

An emphasis on safe and secure access.

Community members emphasized the need for both safe and secure access along the Four Mile Run corridor. Several factors will ensure that this occurs. The redesign of South Glebe Road as a parkway, described below, introduces a median to this thoroughfare to provide a safer means of crossing this heavily-trafficked street. Moreover, the addition of trees along the South Glebe parkway will serve to calm traffic to some extent, reducing vehicle speeds to allow for more comfortable pedestrian crossings.

Lighting plays a key role in fostering a sense of security along all streets and trails in the corridor. It is critical to design new lighting such that it is focused on the trails and streets themselves while minimizing spillover into the habitat areas being created, preserved and enhanced along the stream.

Finally, the Master Plan seeks to bring a significantly greater number of people down to the stream corridor, and for greater periods of time, than currently occurs. Increased activity along the corridor—both during the day and in the evening—will provide an additional measure of security by providing "eyes on the corridor." Emergency call boxes, placed at regular intervals along the corridor, will contribute to a greater sense of security during quieter periods.

Motorized Access

The Four Mile Run corridor currently functions as a place that people pass through. While the Master Plan provides opportunities for the corridor to become a destination point, the roads that run adjacent to it, and bring people to and through the corridor, will remain. The challenge is to identify ways that these access roads can become assets to the corridor rather than obstacles or detractors.

A parkway system that is compatible with the corridor.

The Four Mile Run corridor is surrounded by heavily traveled roads, from U.S. Route 1 on the east to I-395 on the west, and South Glebe Road running almost the entire length of the corridor on the north. The thoroughfare with the greatest continuous impact on the corridor is South Glebe Road, a busy street that divides the corridor from the residential areas to the north. The Master Plan calls for improvements to South Glebe Road that, while retaining its current capacity, will transform it to an attractive and more appropriate parkway setting. This would be accomplished through the addition of consistent rows of street trees on both sides of the road as well as the addition of a landscaped median down the center. In addition, street crossing demarcations and special streetscape paving, signage and lighting will further establish the road as a place for pedestrians, bicycles and vehicles. All of these new amenities serve the dual purpose of making South Glebe Road more attractive and calming traffic as it moves through the corridor.

On the eastern end of the corridor, South Glebe Road crosses U.S. Route 1 and intersects with a newly-created thoroughfare within the Potomac Yard development (Potomac Avenue). This street is also envisioned as a parkway setting that would be wholly compatible with the improvements recommended for South Glebe Road.

On the western end of the corridor, the I-395 overpass creates a dark, tunnel-like barrier between the Village at Shirlington and the remainder of the corridor. With the walking and biking trails passing through this underpass, the Master Plan transforms this dreary and forbidding area into a well-lit jewel by creating a special setting of reflective surface art and lighting. This area will welcome visitors and serve as a gateway between the urban node of Shirlington and the more naturalized shoreline to the east.

New intersections to increase access and traffic flow.

The current intersection of West and South Glebe Roads, with its required turns and bottle-neck bridge access, presents frequent traffic back-ups and resulting pollution problems. For this reason, the Master Plan recommends a new intersection configuration at this location. This solution relocates and straightens the West/South Glebe Road intersection to the east and creates a new, more direct bridge crossing. The existing bridge would be replaced with a pedestrian- and bicycle-only span bridge in keeping with the design language of other bridges within the corridor. Further study of the impacts of these improvements and additional community input will be necessary before any design process can begin.

The new intersection offers an added benefit to the community by opening up new green spaces along the stream for public use. The proposal to shift South Glebe Road to the north by removing a service lane will result in an opportunity to expand fairly limited parkland between Long Branch and the existing West Glebe Road.

THE TUNNEL UNDER I-395 BEFORE AND AFTER

A balanced solution to parking.

In keeping with the goal of creating a more natural setting and an enriched habitat along the Four Mile Run corridor, the approach to vehicular parking seeks to minimize the impact of parking lots along the stream corridor while, at the same time, providing parking for activities that are traditionally accessed by cars. Part of this approach involves providing for, and encouraging, visitors to travel to the corridor via non-motorized modes of travel or via public transit (see below).

A need for vehicular access, however, will remain, necessitating a variety of parking solutions. The Master Plan recommends several discrete parking areas located at various activity nodes along the corridor. These parking areas include the following: a parking area adjacent to the new green space created by the relocated intersection of West and South Glebe Roads; a parking area off Mount Vernon Avenue at the new plaza and sports area; and parking along the redesigned Commonwealth Avenue and its adjoining streets to accommodate visitors to the environmental center and to the remainder of the

On the western end of the corridor, the I-395 overpass creates a dark, tunnel-like barrier between the Village at Shirlington and the remainder of the corridor. With the walking and biking trails passing through this underpass, the Master Plan transforms this dreary and forbidding area into a well-lit jewel by creating a special setting of reflective surface art and lighting.

Questions & Answers

CAN THE POWER LINES BE MOVED UNDERGROUND?

Yes, it's possible. Moving the power lines underground will remove the visual blight of the power lines and will significantly improve the overall aesthetic appeal of the corridor. It also would free up the utility right-of-way for other purposes, such as reforestation.

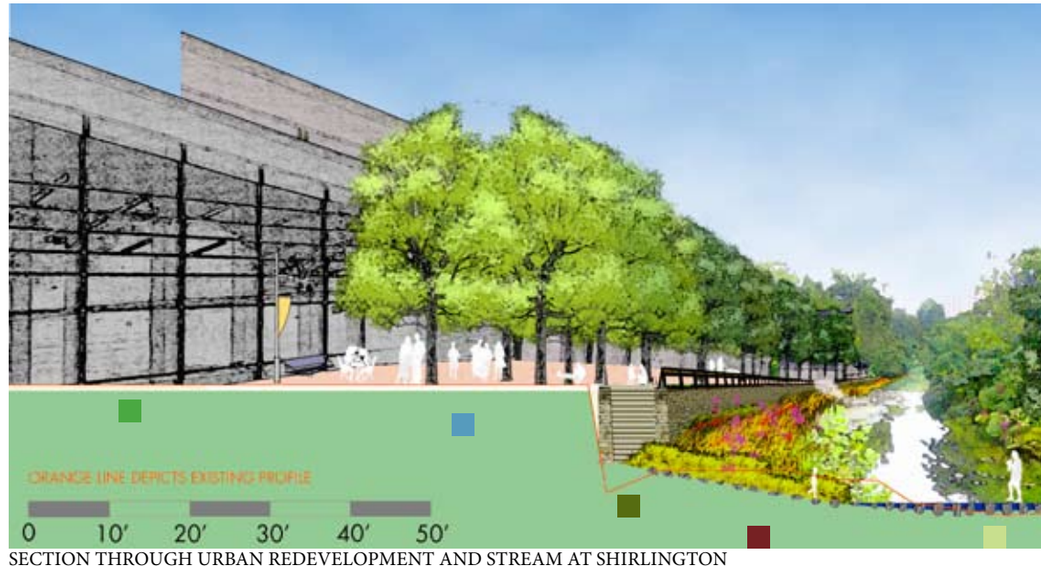
What are the challenges? Above all, moving power lines underground is a very expensive undertaking. For this reason, this is not a project that is likely to happen in the short-term. While the Master Plan considers this a desirable long-term outcome, the vision can accommodate above-ground power lines as long as necessary. Nevertheless, other elements in the surrounding environment need to be designed in a way that will divert attention from the current visual dominance of the power lines, both in the stream and alongside it.

corridor. Shared parking opportunities will also be available in each of the corridor's urban nodes, particularly at the Village at Shirlington and at Potomac Yard. Finally, the Master Plan recommends the inclusion of shared parking opportunities at each of the identified redevelopment sites along the corridor in order to minimize parking facilities along the banks of the stream.

All parking surfaces within the stream corridor and its vicinity should be surfaced with permeable, functional and maintainable materials or designed with biofiltration areas to treat runoff from paved areas. These areas should be buffered by planting in order to minimize runoff and visual impacts on the stream.

Transit Access

At present, transit service to this area is provided via a Metro stop in Crystal City, less than two miles north of the corridor, and bus service that travels along U.S. Route 1, South Glebe Road and to the Village at Shirlington, as well as along the Arlington Ridge Road and Mount Vernon Avenue corridors. In conjunction with the development of the Potomac Yard site, however, both Arlington County and the City of Alexandria are exploring possible transit opportunities that would offer more convenient service to the Four Mile Run corridor. While there are no immediate plans or funding in place for transit improvements, convenient mass transit service would provide excellent access



SECTION THROUGH URBAN REDEVELOPMENT AND STREAM AT SHIRLINGTON

opportunities to the corridor on a regional level and would encourage its use as a destination. Such improvements should not be precluded in the future and are compatible with the Master Plan.

Boat Access

Another way to experience Four Mile Run is by boat. The use of non-motorized boats is encouraged within the corridor through the provision of canoe and kayak launching areas near the new environmental education center on the Alexandria side and almost directly across the way on the Arlington side. A boat ramp is also provided at the same location in Alexandria.

The boating experience will be greatly enhanced by the naturalization of the stream itself and through the design of a series of bridges that will reflect natural light and will be lit at night in order to create a lovely on-water boating opportunity.

2. URBAN FORM AND NEIGHBORHOODS: BUILDING COMMUNITY AROUND THE STREAM

Develop urban life opportunities along the Four Mile Run corridor.

During the visioning process, community members imagined how the urban and built portions of the corridor might evolve over time and could contribute to the character of the stream corridor. The vision for urban form that emerged included both "big picture" land use concepts and more fine-grain design details. The big-picture concepts centered on the idea of urban nodes, interspersed with natural areas to achieve a balance between the natural and the urban throughout the corridor. Participants envisioned the urban nodes functioning as the main centers of activity in the corridor. Another concept involved reorienting existing and future development towards the stream in order to transform Four Mile Run into a front door to both jurisdictions. Community members also noted the need to reconnect Four Mile Run – physically and psychologically – to surrounding neighborhoods. Specific design details related to these strategies are discussed in Chapter 5.

The URBAN FORM PLAN (Figure 4.7) responds to the following guiding principles:

- Encourage urban designs that develop the corridor's aesthetics and reflect the excitement of the watershed citizenry for this resource.
- Incorporate innovative and creative urban designs and watershed solutions.
- Develop urban life opportunities along the Four Mile Run corridor.
- Integrate the corridor with surrounding communities and proposed adjacent urban development efforts.

The big picture concepts centered around the idea of urban nodes, interspersed with natural areas to achieve a balance between the natural and urban throughout the corridor.

- Redevelopment Opportunity
- Pedestrian and Bicyclist Promenade
- Steps to Informal Stream Crossing
- Floodplain
- Informal Stream Crossing and Low-Flow Channel
- Informal Trail
- Bank Stabilization Treatment
- Interstate 395 Off-Ramp
- Shirlington Gateway Building

Central to the strategy of establishing urban nodes is improving the physical relationship between the built environment and the stream by creating urban edges that engage the stream rather than shield it.

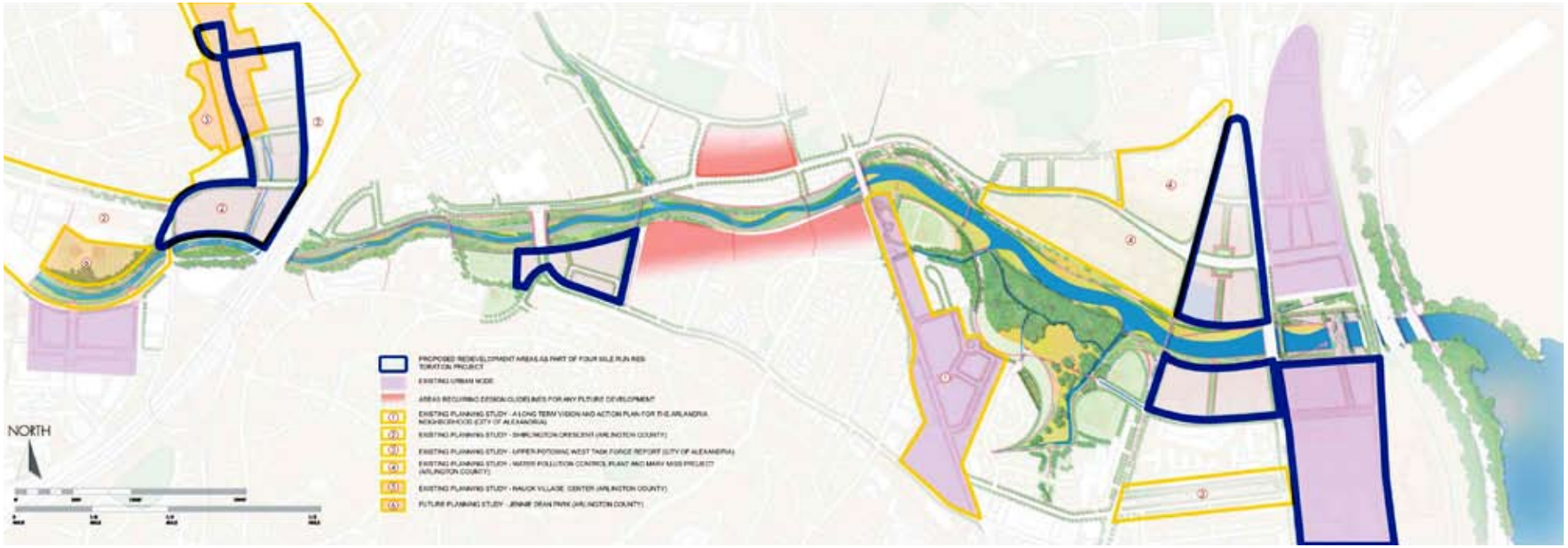


FIGURE 4.7 URBAN FORM

- Create a balance between the natural elements of a restored corridor and urban activity areas in order to generate a lively, safe and well-used public resource.
- Coordinate with other ongoing planning activities. Such activities include affordable housing initiatives, master planning efforts like the Arlandria and Shirlington planning efforts, and other planning and economic development initiatives.

From "Utility Corridor" to Front Door and Focal Place

Establish a balance between natural and urban areas.

The Master Plan consolidates urban activity in existing urban nodes and proposed redevelopment areas. These areas will constitute the activity centers of the Four Mile Run corridor while surrounding areas will be returned to nature. Central to the strategy of establishing urban nodes is improving the physical relationship between the built environment and the stream by creating urban edges that engage the stream rather than shield it. Strategies for engaging the stream include adapting existing buildings in ways that reorient them to the stream and ensuring that all new development occurs with the stream in mind. Key opportunities to establish vibrant urban nodes and urban edges include ongoing and proposed development at Potomac Yard and the Village at Shirlington, as well as redevelopment opportunities in the Nauck neighborhood and in the vicinity of West Glebe Road.

Improve the quality of the built landscape along Four Mile Run.

The Master Plan seeks to transform Four Mile Run from a "utility corridor" to a gathering place and community asset that hosts a variety of uses and activities and lures people to the stream. Achieving this vision requires improving the aesthetics of the corridor by enhancing both the natural and built character of the stream edges. This involves improving the quality of building design and orientation, adjacent public spaces, other elements of the built landscape such as lighting, fencing, bridge crossings and walkways. Design strategies for the corridor are described in greater detail in Chapter 5.

Remove barriers and foster connections between the stream and the community

In addition to improvements to transportation and pedestrian and bicycle circulation, larger changes in land use and configuration will be necessary to repair the urban fabric

in a way that improves both physical access to the stream and a perceptual connection between nearby neighborhoods and Four Mile Run. The Master Plan envisions these connections between stream and community as a key consideration in guiding future development along the corridor. In the long run, improving access to Four Mile Run and expanding the stream's sphere of influence will establish the stream corridor as a preeminent gathering place, natural oasis and recreational amenity.

Coordination with Other Planning Initiatives and Priorities

Connect the Master Plan to the goals of prior planning efforts.

The Master Plan presents an opportunity to reinforce and advance the goals articulated as part of prior planning efforts. In Alexandria, these efforts include the *Long-Term Vision and Action Plan for the Arlandria Neighborhood* (City of Alexandria) and recommendations of the *Upper Potomac West Task Force Report*. In Arlington, development at the western end of the study area will require coordination with existing and ongoing planning studies for the Shirlington Crescent, the Nauck Village Center and Jennie Dean Park. In addition, ongoing efforts to upgrade the Water Pollution Control Plant provide an opportunity to enhance the physical relationship between this facility and a restored Four Mile Run.

Establish additional guidelines for design and development.

To provide direction for new construction along the corridor, Alexandria and Arlington should consider establishing design guidelines to ensure that development fits within the character of the Master Plan and prior planning visions. Some areas within the stream corridor currently lack a formal planning vision to guide future development. For this reason, it is especially important to monitor any development decisions in these areas and to guide them in ways that will be compatible with the Four Mile Run restoration strategy. In Alexandria, for example, the area west of Mount Vernon Avenue contains a residential mix that ought to be preserved. In Arlington, the existing Giant shopping center property offers a prime opportunity to reshape the character of the Four Mile Run corridor, and any effort to redevelop this property should be carefully considered. Specific recommendations for design guidelines are described in Chapter 5.

Promote equity and preserve diversity by increasing the supply of affordable housing.

It is vitally important that the restored Four Mile Run remains a community asset that is enjoyed by all walks of life, regardless of income, race, ethnicity, age and ability. Achieving this goal requires an ongoing commitment to providing sufficient affordable housing opportunities in the neighborhoods surrounding Four Mile Run. The areas for

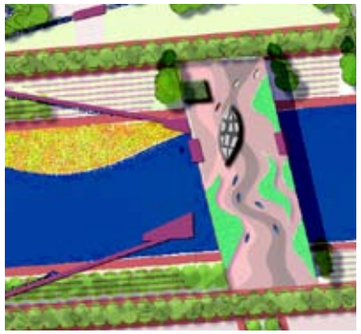
QUESTIONS & ANSWERS

DOES THE MASTER PLAN IMPACT AFFORDABLE HOUSING?

The Master Plan recognizes the importance of providing affordable housing to ensure that the surrounding community maintains its diverse character and that the restored Four Mile Run is a community asset that serves all walks of life, regardless of income, race, ethnicity, age and ability. As a minimum, the Master Plan recommends actions on the part of both the County and the City to assure that there is a "no net loss" situation with regard to affordable housing units in the residential areas adjacent to the stream corridor. More optimistically, by identifying areas where redevelopment might take place, the Master Plan accommodates the possible construction of new affordable housing within the Four Mile Run corridor. While more in-depth attention to affordable housing does not fall within the scope of this planning effort, there are a variety of programs, policies, initiatives and staff discussions that are currently focusing on this issue in both Alexandria and Arlington. The Four Mile Run Restoration project anticipates that the availability of affordable housing adjacent to the corridor will benefit positively from these local efforts.

Community Garden

A place for "digging in" and creating community gardens



RECYCLED RAILROAD BRIDGE

The recycled railroad bridge will become a recreational asset in and of itself.

possible redevelopment and new development already proposed present the opportunity to reinforce the commitment to equity by developing housing for all income levels.

3. RECREATION: CREATING A BALANCE THAT WORKS

Create a balance between the natural elements of a restored corridor and urban activity areas in order to generate a lively, safe and well-used public resource.

The lower Four Mile Run corridor currently provides important, but limited, recreational opportunities for the communities of Arlington and Alexandria. Bicyclists ride the trail daily on the Arlington side, both for recreational and commuting purposes. Children and adults play on Alexandria's ball fields and courts. People stroll through the habitat preserve at Four Mile Run Park in Alexandria to spot their favorite resident and migrating birds, and people fish from the stream embankments at select locations.

One of the major opportunities in restoring the stream corridor, however, has been to create a setting that will attract people to it—a setting for people to spend leisure time, to relax, to recreate, and simply to have fun. This purpose must be in balance with the environmental restoration goals for the corridor. Certainly, the result of restoring the environmental qualities of the stream and its edges will, in and of itself, produce a much more beautiful corridor that people will want to visit and learn from. In addition, the Master Plan retains existing recreational resources currently available in the corridor and enriches these through both the enhancement of those resources and the addition of new recreational opportunities that are appropriate to their stream corridor setting.

Thus, the RECREATION PLAN (Figure 4.8) responds to the following guiding principles:

- Enhance existing recreational opportunities.
- Create new recreational opportunities that afford interaction with the waters of Four Mile Run.
- Develop urban life opportunities along the Four Mile Run corridor.
- Encourage appropriate siting of recreational facilities in the context of the overall project goals.

FIGURE 4.8 RECREATION

The More Subdued Side of Recreation

The Master Plan offers a wide range of less active recreational pursuits, ranging from the simple enjoyment of nature to appreciating the natural setting of the corridor as a lovely backdrop to more contemplative activities. Such opportunities include:

The enjoyment of natural habitat areas within an urban context

With the exception of its urban nodes, the Master Plan transforms the Four Mile Run corridor into a natural habitat community with settings that vary from wetlands to upland and floodplain forests. The Master Plan dramatically improves and expands the existing habitat area throughout the corridor. This change provides a wealth of opportunities for visitors to stroll along the continuous trails and walkways, to access the edge of the water in many locations and appreciate the range and beauty of the habitat settings that have been created. Opportunities for bird watching, habitat interpretation and education, and quiet enjoyment will be found along the entire 2-mile stretch of the stream corridor.

A place for contemplation, views and passing time

Along the length of the corridor, small seating areas and overlooks provide opportunities for contemplation, reading, enjoying nature and appreciating the views up and down stream. In addition, the Master Plan includes picnic areas on both sides of the stream in order to encourage visitors to approach the stream and spend time there. Most importantly, the Master Plan provides for over 14 acres of passive, green open space on both sides of the stream to be used for gathering, relaxing and informal play.

A place for "digging in" and creating community gardens.

Both Arlington and Alexandria have a long and active history in community gardening—a practice that entails setting aside plots of land that residents can lease annually for establishing and maintaining gardens for private use. The Master Plan proposes the creation of a section of community gardens at the edge of the Hume Springs community in Alexandria. These gardens could serve members of that community and others and would provide an additional green buffer between the residential area and the enhanced, reconnected Four Mile Run Park.

Responding to the Need for More Active Pursuits

Meeting active recreational needs within the dense urban communities of Alexandria and Arlington presents an ongoing challenge. For Alexandria's residents, the Four Mile Run corridor already includes several important active recreational amenities, including a soccer field in the area behind Mount Vernon Avenue, three ball fields adjacent to Four Mile Run Park, and one adjacent to the Charles Barrett Elementary School. Given the fact that the City is under continuous pressure to provide adequate field space to meet the needs of its growing community, it was critical for the Master Plan—at a minimum—to retain the fields currently located within the corridor. In addition, the planning process explored possible opportunities for providing additional active recreational space where feasible, while still providing sufficient habitat area and passive recreational opportunities.

Other active recreational pursuits recommended by the Master Plan include the creation of new trails and trailheads as well as new recreational courts, opportunities for bouldering and climbing and places for fishing and boating, and areas simply for play.

Meeting the recreational needs of a growing and diverse community.

The fields at Four Mile Run Park are well-used and respond to growing recreational needs in the City of Alexandria and surrounding communities. Existing facilities within Four Mile Run Park include one multipurpose field, one baseball field, one softball field and a T-ball field. The Master Plan retains yet reconfigures these fields. It reorients one ballfield in order to enhance the functionality of the proposed nature-cultural center and associated boat access. The realization of the Arlandria neighborhood plan will enable the reorientation of the existing multipurpose field to make room for an adjacent ballfield, relocated in order to create an opportunity to connect and enhance the wetland areas in the southern section of Four Mile Run Park. The Master Plan further recommends the creation of one additional multipurpose field on land that becomes available for such use with the relocation of the South and West Glebe Road intersection. This is an appropriate area for a field because it lies adjacent to the Charles Barrett School and is within walking distance of a dense residential community that could make good use of such facilities.

The Master Plan also recommends that all ball fields—whether existing, new or revamped—be surrounded by edge plantings that will help absorb runoff and will increase the attractiveness of these facilities and their compatibility with adjacent habitat areas.

At the rear of several stores along the east side of Mount Vernon Avenue, and beyond the large parking lots, is an informal open space for the community. The space currently includes two basketball/tennis courts, which receive heavy use; however, the Master Plan proposes expanding this area through the creation of an additional court.

Finally, the creation of multiple linkages between the north and south sides of the stream—via proposed pedestrian/bicyclist bridges—will provide residents living in both jurisdictions with convenient and walkable access to recreational facilities on both sides of the corridor.

. . . the Master Plan proposes a series of walkways and promenades that will invite those visiting Shirlington to stroll or bike along the water and to sit under the trees.

Bringing people down to the water to have fun: walking, biking, fishing, boating and climbing.

The continuous trail system created on both sides of the stream, including the maintenance and enhancement of the trail on the north side and the creation of a continuous trail on the south, will attract visitors from the City and County as well as from the surrounding region. The hope is that, once there, these visitors will stop and linger or will decide to return to spend more time at Four Mile Run. In addition to the passive and active open spaces noted above, the stream corridor will offer numerous opportunities for a variety of other recreational pursuits: fishing, kayaking and canoeing (boats can be launched and rented on-site) or climbing boulders that have been placed along the northern edge of the stream, within a new shoreline park created through the realignment of South Glebe Road.

But what about the kids?

The Four Mile Run corridor will offer a rich variety of family-oriented recreational facilities, ranging from biking and walking to ball-playing, picnicking, boating, touring and more. In addition, the Master Plan provides for several playground areas, including one in the new park near the South and West Glebe bridge and one in the enlarged Four Mile Run Park on the north side of the stream. The latter facility will feature the creation of an exciting water park experience that includes water-art features and a water playground, with stepping stones leading across the stream to an urban plaza area on the south side (see below).

The Urban Recreational Experience

As a stream corridor within an urban context, the recreational opportunities presented by the Four Mile Run area include those that celebrate and welcome the urban community.

Incorporating community vitality into the life of the stream corridor.

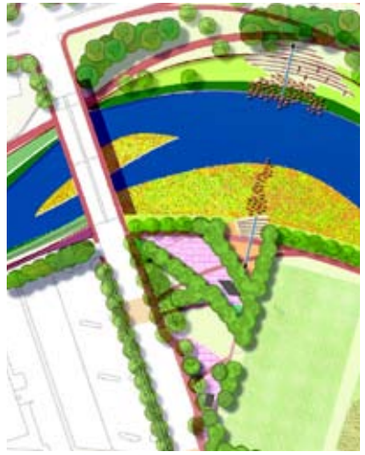
Two urban nodes comprise the "bookends" of the stream corridor and offer a variety of recreational experiences. On the eastern end, the Master Plan proposes the creation of a park on both sides of the stream at Potomac Yard, linked by an adaptively-reused "green" bridge that echoes the theme of water. On both sides, the park brings visitors down to the water through a series of pervious grassy steps that also function as seating. The design of this park celebrates stormwater treatment as a key element with visible storm drains bringing runoff from the developed portions of the site down to a series of biofiltration areas that are green, usable and heavily planted. Filtered water cascades down the steps and into the stream. The grassy steps also serve as seating from which it is possible to watch performances taking place on a "performance pontoon" tethered to the shoreline.

The recycled railroad bridge will become a recreational asset in and of itself. Retained as a green open space, the Master Plan suggests modifying the bridge surface by cutting holes to allow light to reach the water below and adding paving that creates a "wave pattern," in keeping with the water-related theme of the corridor. At least one structural

SECTION THROUGH STREAM AND ARLINGTON MILL ROAD AT SHIRLINGTON

- Existing Bank Vegetation
- Trail
- Floodplain
- Informal Crossing and Low-Flow Channel
- Floodplain
- Wall and Steps
- Promenade along Arlington Mill Road

URBAN OPEN SPACE ON MOUNT VERNON AVENUE AND REORIENTED MULTIPURPOSE FIELD: A VISION



URBAN OPEN SPACE ON MOUNT VERNON AVENUE AND REORIENTED MULTIPURPOSE FIELD

- Realigned Flood Wall
- Water Play Area - Arlington
- Water Play Area - Alexandria
- Reoriented Multipurpose Field
- Arlandria Market in Urban Open Space / Plaza
- Drop-off Zone on Mount Vernon Avenue

Neal Sigmon and Mary Ann Lawler live within a couple of minutes' walk of Four Mile Run. They both take advantage of all that the corridor has to offer—from an ideal setting for a morning walk to a place for bird-watching. Mary Ann played a key role in creating the native plant meadow on the banks of the stream, just off U.S. Route 1, and loves to see the pollinators that are already attracted to the plants. Neal, an avid bicyclist, considers the Four Mile Run Trail his gateway to the area's extensive trail system.

element is proposed for the bridge: an "experience tower" that affords visitors a spectacular view of the stream, the Potomac River and surroundings and might be lit at night as a focal point element of the Four Mile Run corridor. It also might include interpretive elements and other features, such as a café and a canoe/kayak and bike rental facility.

On the western end of the corridor, the Village at Shirlington presents an urban edge to the stream. In response, the Master Plan proposes a series of walkways and promenades that will invite those visiting Shirlington to stroll or bike along the water and to sit under the trees. Jennie Dean Park, on the north side of the stream, offers additional recreational open space along the water's edge.

A third, and important, community space is centrally located within the corridor at the end of Mount Vernon Avenue. At this location, the Master Plan calls for the creation of recreational amenities on both sides of the stream. On the southern side, in addition to the multipurpose fields described above, the Master Plan includes the creation of an urban open space with lawn and trees, a plaza area for gatherings and events, and a playground facility. It is envisioned that this space will be used for community festivals, farmers' markets, concerts, family gatherings and other community-related activities. By crossing the stream either via a stepping-stone trail or a new pedestrian/bicyclist bridge, visitors enter an exciting water park comprised of water-art sculpture, a water playground and extensive green open space areas. This community node maximizes the pleasure of the waterside experience and teaches both young and old about the many properties of water to be celebrated within the Four Mile Run corridor.

4. INTERPRETATION AND EDUCATION: LESSONS FROM FOUR MILE RUN

Stress the interrelatedness of positive individual, institutional, and political actions and behavior changes with improved water quality and habitat in the corridor.

The Four Mile Run corridor will provide both the community and the region with a living classroom in which to learn about ecology, stream geomorphology, water quality, habitat protection and restoration, recycling and other topics. Given the length of the corridor and the diversity of those likely to use it, it is important to create interpretive opportunities in a variety of formats and languages. The learning approach will emphasize a hands-on approach to learning: less of an emphasis on "here's something to learn" and more on "here's something to do."

In this regard, the EDUCATION AND INTERPRETATION PLAN (Figure 4.9) will:

- Provide interpretive opportunities to educate and inform the public about the stream corridor.

FIGURE 4.9 EDUCATION AND INTERPRETATION

- Create a place for people to understand their connection with water and nature within an urban context.
- Interpret the principles of "green design" in ways that underscore the important linkages between design, use and sustainability.

Opportunities for a Continuous "Stream of Learning"

The Master Plan recognizes that people will enter the corridor at many different locations and might remain within a limited area throughout their stay. For this reason, the Master Plan envisions multiple opportunity points, and a wide range of interpretive possibilities, for explaining the various elements that comprise the restored stream corridor—its wetlands, wildlife/habitat areas, stream banks, channel character, storm-water management strategies, and so on. Such opportunities include:

Create a learning environment along the full extent of the Four Mile Run corridor.

The Master Plan outlines opportunities for learning at points along the entire corridor, particularly at its primary entrances and in places where people will stay awhile. Such places include trailheads, parks, overlooks, urban nodes, and natural/habitat areas. Interpretive elements might consist of signs, display boards, pavement markings, art pieces, water features, play structures, tour brochures, and guided tours. A specific interpretive program for the Four Mile Run corridor will be developed in conjunction with the design of the various corridor elements.

Emphasize the joy of learning about the corridor and the community.

In addition to the interpretive sites throughout the corridor, several proposed facilities are dedicated to interpreting the corridor and to having fun while learning. The first of these sites is the proposed nature-cultural center, located at the end of Commonwealth Avenue as it meets Four Mile Run. This facility will be easily accessible from both Alexandria and Arlington through the installation of a new pedestrian/bicyclist bridge in this location. While the exact program for the center still needs to be defined, several themes have been suggested, including the environment of the corridor and the restoration project, the history of the corridor area, and the cultural diversity of the corridor community. In addition, the City has requested that the Master Plan consider locating a small recycling deposit center at this location. This concept provides the opportunity for a creative, attractive and educational facility that can incorporate recycling as one of the interpretive "lessons" for the center.

The second location comprises the community open space area adjacent to Mount Vernon Avenue. This site provides an excellent venue for educational and interpretive programs, including those that can be incorporated into festivals and events, and those that might be located in the "event/information box" recommended as part of this space. This latter structure would supply power, water and storage space for events, and could also serve as an information display space reporting on topics that may include: updates on the restoration activities at Four Mile Run; upcoming events in the corridor; upcoming events in the community; stream "facts," and so on.

A third location, the demonstration wetland created between the Water Pollution Control Plant and the stream, will provide cleansing for some of the plant's discharge. While the new wetland will not be large enough to cleanse all of the discharge, it will serve as a valuable opportunity to explain wetland functions and processes to students and visitors.

Finally, the experience tower and "performance pontoon," both located at the Potomac Yard site, provide additional opportunities for interpretation through exhibits, programs, view interpretation, experiments and performances.

Establishing a partnership with local schools.

As noted previously, the Four Mile Run corridor includes numerous schools within walking distance and additional schools within a short driving distance to the corridor. The corridor therefore constitutes an excellent "laboratory" in which to explore environmental, cultural, historic and social issues that are part of the school curriculum for both the City and County. Not only can schools make use of the extensive interpretive elements located throughout the stream corridor, but they can develop programs tailored specifically to their students' needs. This could, perhaps, occur in conjunction with the nature-cultural center staff once that facility is constructed. Prior to that time, however, the restoration activities within the corridor offer outstanding opportunities for students to understand the scope and significance of the changes occurring in corridor.

This chapter described the overall Master Plan vision. The next chapter (Chapter 5) builds on this vision by establishing a design language, or set of design principles, for realizing key themes of the Master Plan. These themes include "green" design principles to ensure an environmentally sustainable stream corridor, the design of public spaces, and the design of built features such as buildings, bridges and furnishings for trails and streetscapes.

THE ALLUVIAL REACH: VIEW TO WEST FROM MOUNT VERNON AVENUE: A VISION

THE STREAM AND TERRACES AT POTOMAC YARD WITH EXPERIENCE TOWER ON BRIDGE IN THE BACKGROUND

5 DESIGN LANGUAGE

This chapter adds a more detailed layer of information to the Master Plan vision described in Chapter 4. While this chapter stops short of establishing specific design guidelines, a future task that will address many of the same themes in greater specificity, it seeks to provide a flavor for the future character of the restored Four Mile Run. The basic design language established here can inform future efforts to define the character of the corridor.

In particular, this chapter expands on three design themes that are central to the Master Plan vision. First, the Master Plan includes a variety of "green principles" that will make Four Mile Fun a model of environmental responsibility with a healthy ecosystem. Second, the Master Plan envisions a vibrant public realm that functions as a destination for nearby residents and visitors. Third, the Master Plan envisions a built environment that both acknowledges and respects the stream and contributes positively to the public realm. This chapter outlines some of the design tools and elements that will help to achieve these three overarching visions and provides some imagery to illustrate the design language for the corridor.

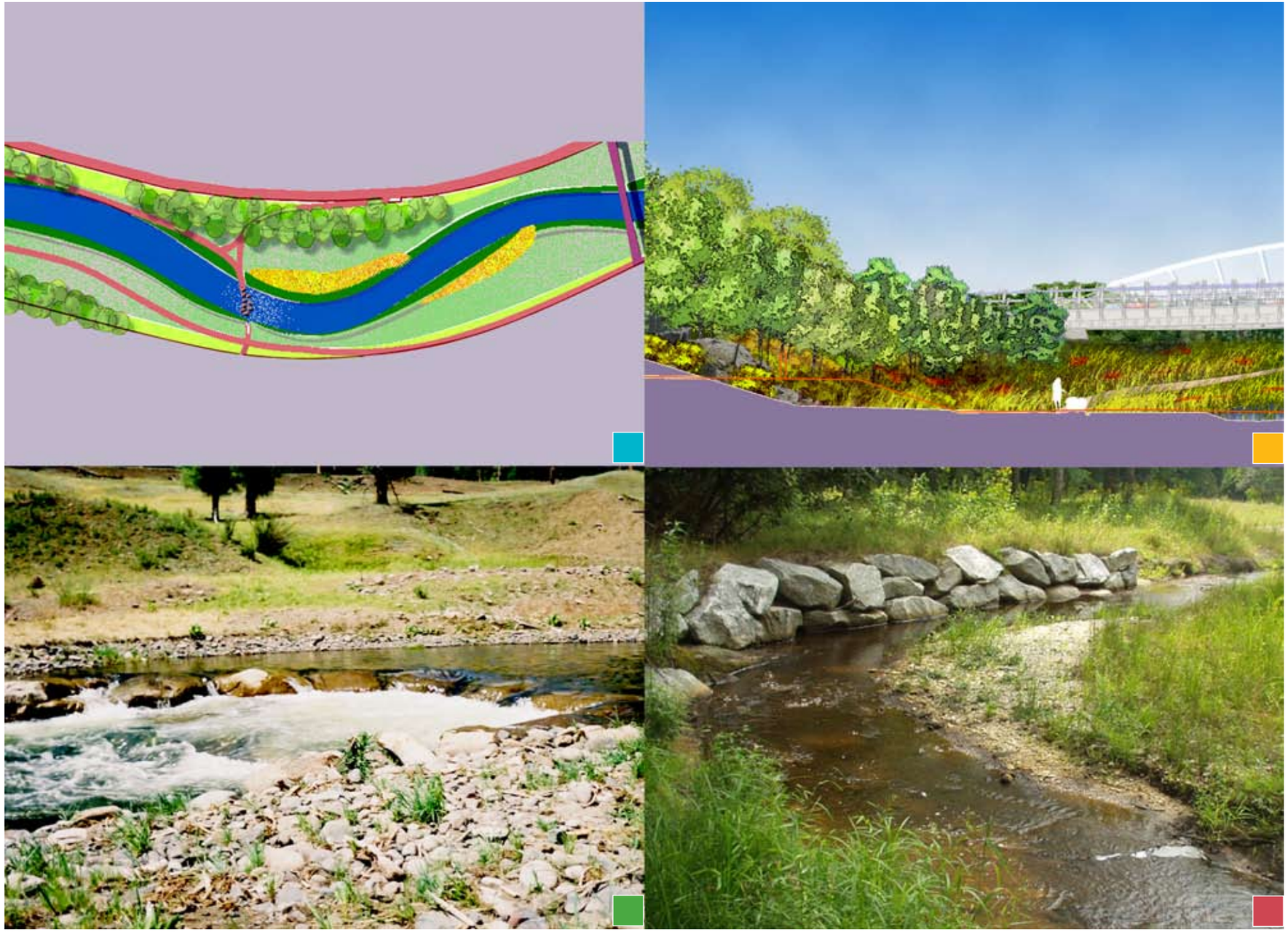
A. Green Principles

A variety of design approaches and considerations will make Four Mile Run a model of "green" design. Design principles range from the channel restoration techniques and habitat restoration approaches described in Chapter 4 to a variety of stormwater management techniques to control runoff and "green" design elements to improve the energy-efficiency of buildings. Also critical to these efforts is establishing an overall culture of environmental stewardship by educating residents and business about the restoration and how they can support these efforts.

1. CHANNEL RESTORATION AND STABILIZATION

The stream will be restored using natural channel design principles to create a stable system with a functioning ecosystem. As recommended by the Master Plan, the following approaches will contribute to this end goal:

- Creation of a more natural meandering stream alignment
- Partial removal of floodwalls, gabions and riprap
- Regrading of banks to more natural and functional slopes
- Re-establishment and stabilization of stream banks and floodplain through bio-engineering techniques (layered clumps of plant material, rootwad revetment, rock-toe protection)



- 'Natural', Meandering Stream Alignment
- Expanded Vegetative Stream Edge
- Step-Pool Grade Control
- Stabilization of Stream Banks

- Expansion and enhancement of vegetative stream edge – riparian edge treatment, floodplain planting, bank stabilization planting
- Wetland creation to filter stormwater, reduce flooding and create habitat
- Vegetation management (removal of exotics; planting of natives)
- Step-pool grade control

2. HABITAT RESTORATION

As proposed by the Master Plan, the ecological character of the corridor will be restored with the creation of new habitat areas and significant improvements to existing habitat areas. The following techniques will be used to create and improve habitat throughout the floodplains, embankments, forests and wetlands of the Four Mile Run Stream corridor.

- Reconnection of tidal tributary through the Four Mile Run wetlands
- Extensive re-vegetation
- Wetlands creation
- Restoring connectivity between valuable habitat areas (for example, the two existing areas of wetland in Four Mile Run Park will be connected to create greater habitat capacity)
- Creation and enhancement of riparian and wetland buffers
- Use of native species
- Control of invasive species
- Removal of existing fish passage barriers (i.e., via weirs)
- Restocking the stream with fish
- The placement of structures (boulders, logs, vegetation, etc.) to enhance in-stream and riparian habitat
- Maintenance of existing "bird-hide" structures and the addition of new structures

3. COMPREHENSIVE STORMWATER MANAGEMENT

As noted in Chapter 4, a variety of comprehensive stormwater management techniques could be applied throughout the corridor to reduce, retain, slow down and filter stormwater before it reaches the stream. While both Arlington and Alexandria are already national leaders in their efforts to manage stormwater runoff, the restoration of Four Mile Run presents the opportunity to take this leadership a step forward by exploring additional stormwater management innovations that showcase both jurisdictions' commitments to watershed management and support the goals of the restoration. Moreover, stormwater management techniques can be applied in creative ways such that they also benefit the public by improving the appeal of the built environment and educating the community about the stormwater management process.

Stormwater and its impact on the environment are far-reaching, and the application of stormwater controls and the achievement of stormwater management goals will be a considerable challenge. Since virtually the entire watershed was built out prior to any stormwater management controls, stormwater runoff from most of the development in the City and County, and in the portions of Falls Church and Fairfax County in the watershed, remains uncontrolled. Given the limited space available for facilities that filter, store, and infiltrate stormwater, improving the water quality and hydrology of the watershed will be dependent on several strategies. These strategies will take many years to be implemented at a scale where water quality and hydrologic effects will actually be seen in the levee corridor and upstream in the watershed.

Nevertheless, the reality that watershed restoration in an urban area is a long-term process does not mean that the restoration of the levee corridor cannot be successful in the near term. To provide a primer on potential approaches to stormwater management in the vicinity of Four Mile Run, the accompanying text and illustrations explain the techniques most likely to be applied in the corridor.

Daylighting

Numerous tributaries and stormwater outfalls drain into Four Mile Run but are currently hidden in underground pipes. It is likely, however, that some of these outfalls could be revealed or recreated and integrated back into the landscape through the process of "daylighting." The opened waterways provide several important benefits. Daylighting can improve aquatic habitat in the stream. Exposure to sunlight, air, and soil allows growth of aquatic and streamside vegetation that can improve water quality by taking up organic and inorganic pollutants. Daylighted, open waterways may have greater stormwater carrying capacity than culverts. They can slow down and infiltrate runoff, possibly benefiting downstream residents by preventing flooding or erosion. At the same time, this process can result in community benefits by creating aesthetically

Nora Partlow is a community activist and owner of St. Elmo's Coffee Pub on Mount Vernon Avenue in Alexandria. She lives in Arlington and crosses Four Mile Run every day on her way to work. She remembers her son visiting Four Mile Run for school projects, such as tree-planting and stream clean-up events.

Key refers to photographs on this page

- Wetlands Creation in the Tidal Reach
- Removal of existing fish passage barriers
- Existing Bird House in Four Mile Run Park

Key refers to photographs on opposite page

- A Daylighted Stream: Before and After
- Stormwater Management in an Urban Context
- Bioretention
- Stormwater Management in an Urban Context
- Stormwater Management in an Urban Context
- Bioretention

appealing water features, adding new natural elements to the landscape and re-connecting surrounding communities to the natural stream.

While daylighting these piped streams will not always result in a stream that looks natural, these waterways can be designed in ways that fit a highly urbanized context, such as next to sidewalks and as part of the streetscape. And while some of the benefits will be minor, they are still an improvement over the current pipe configuration.

In Figure 4.4, the Master Plan identifies areas where daylighting appears to be feasible. Criteria for determining feasibility include surrounding grade and elevation, the elevation of the existing stormwater drainage system, public access and safety, and surrounding land ownership.

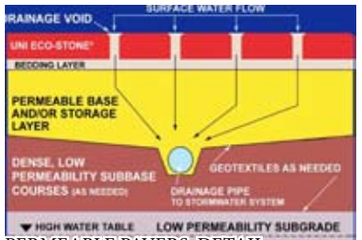
Bioretention

Bioretention facilities are small landscaped basins that infiltrate stormwater through plants and soil. This technique manages both the quantity and the quality of runoff before it is released into the storm drain system. Bioretention is an efficient method for removing a variety of pollutants, such as suspended solids (i.e., eroding soil) and metals (such as particles from cars). The plants and soils remove pollutants from stormwater runoff by filtering them from the water so that they attach themselves to the surface of soil particles or are absorbed up into the plants. Bioretention also can be effective in reducing the peak surface runoff rates during smaller storms and in recharging groundwater, by detaining the water sufficiently to infiltrate into the ground rather than sending it directly to the storm drain system.

A bioretention facility is typically comprised of a depression in the ground that is filled with a soil mixture that supports various types of water-tolerant vegetation. In addition, the facility includes an entrance where water flows in, a ponding area where the water is captured, an underdrain to collect treated runoff, and a place for excess water to overflow. The natural layers of the facility include an engineered soil mixture that serves as both planting soil and filter in combination with an organic layer or mulch and plants.

These facilities can be used successfully in a wide variety of locations, including residential lots, median strips, traffic loops and parking lot traffic islands. Typically, they are used to drain small areas of less than one acre, although several bioretention facilities can be distributed across a larger site.

The Master Plan also incorporates bioswales – long, narrow, vegetated swales – which carry stormwater overland to a bioretention area or water body during which additional infiltration occurs.



PERMEABLE PAVERS: DETAIL


PERMEABLE PAVERS


PERMEABLE PAVERS


PERMEABLE PAVERS: ENLARGEMENT

Permeable Pavement

Permeable pavement systems are hard surfaces—frequently used for walkways, driveways and parking areas—that allow water to infiltrate and soak into the ground, thereby reducing surface runoff. Typically, permeable pavement can be effective in reducing peak surface runoff rates that flow directly into streams. Moreover, permeable pavement increases the amount of water available for recharging groundwater at developed sites.

Common examples of permeable pavements include porous asphalt or porous concrete. In other cases, pavement may be comprised of interlocking pavers with openings that allow runoff to pass to the subsurface, where the water is stored in a gravel layer and then further conveyed to the storm drain system.

The restoration of Four Mile Run should adhere to the following guidelines:

- Additional impervious surfaces should be minimized to the extent possible within the study area.
- Compliance with Alexandria's Environmental Management Ordinance and Arlington's Chesapeake Bay Preservation Ordinance.
- Chesapeake Bay Preservation Ordinances for Resource Protection Areas
- All new areas of hardscape within the study site should utilize pervious materials, to the maximum extent practicable and appropriate for the type of use, including:

►*Plazas and Promenades* - Interlocking permeable pavers and/or harvesting of rainwater for later irrigation of landscape features

►*Parking Lots* - Permeable asphalt or interlocking permeable pavers for parking stalls and other lower-traffic areas (or for the entire lot if use is limited).

►*Trails* - Graded to utilize infiltration zone along edge or pervious recycled stone

At present, given issues related to appearance, function and maintenance, totally pervious hard surfacing is not recommended for trails at this time. However, edge-located infiltration zones will perform the same functions. As technologies for permeable surfaces improve, they may become suitable for trails in the future.

Green Roofs

Green roofs are vegetated surfaces placed on building rooftops to help mitigate the effects of urbanization on water quality by filtering, absorbing and detaining rainfall that would otherwise run off the impervious roofs. They are particularly useful in highly urbanized areas, where space for other types of stormwater management is limited. Green roofs are constructed of lightweight soils, with a drainage layer underneath and an impermeable membrane at the bottom that protects the building structure from moisture. The soil is planted with a specialized mix of plants that can thrive in rooftop conditions that may include high winds and low moisture. Green roofs attenuate peak flows by slowing down stormwater and reducing the runoff volume. The plants and soil in a green roof also capture airborne pollutants and prevent them from entering into contact with the stormwater. In addition to the stormwater management benefits of green roofs, other benefits include increased building insulation (which reduces energy heating and cooling costs) and improved aesthetic value (which could translate into increased property values).

All new buildings within the study site should be designed with green roofs. Developers in neighboring areas should be encouraged by local authorities to incorporate green roofs. Retrofitting existing privately owned buildings adjacent to the study site with green roofs should be encouraged via incentives by local authorities (See "Built Features" section below).

Stormwater Planters

A stormwater planter is a landscaping box, placed either above-ground or at ground level, that receives roof runoff from downspouts. In essence, a stormwater planter is a "bioretention facility in a box" and provides the same functions as bioretention facilities previously described. A stormwater planter includes many of the same components as a biorention facility: a ponding area where the water is captured, an engineered soil mixture that serves as planting soil and filter, an organic layer or mulch, plants, an underdrain to collect treated runoff and an overflow for excess water. In addition, it typically also includes a downspout bringing in the water (in this case, from the roof).

Stormwater planters can be used around the perimeter of buildings and can be part of landscaping plans for multi-family residential as well as non-residential developments. They also can be applied as retrofits where the downspouts can be accessed and redirected to a planter. Like bioretention, stormwater planters remove a variety of pollutants that are typically found on rooftops. Stormwater planters can also reduce the peak runoff rates during storms by slowing down runoff prior to sending it to the storm drain system. However, their capability in providing these benefits is not as high as other stormwater management techniques

Stormwater planters should be considered for existing buildings in neighboring properties as a cost-effective technique.

Litter Control / Other Stormwater Proprietary Devices

Litter has been a major issue in Four Mile Run. The presence of trash compromises the aesthetics and appeal of the corridor and reinforces the perception that the stream is an appropriate place for dumping. At the same time, the build-up of debris in catch basin inlets can pose a safety hazard by causing flooding in adjacent areas, especially streets, if left unattended.

There are several stormwater management facilities that can be installed to help control trash entering the stream and many different devices that can be employed to collect large items such as leaves, bottles, plastic bags, and other litter. Generally, these devices operate through a combination of processes to:

- Screen out litter
- Collect sediments at the bottom
- Remove floating debris
- Separate oil and gasoline from the water

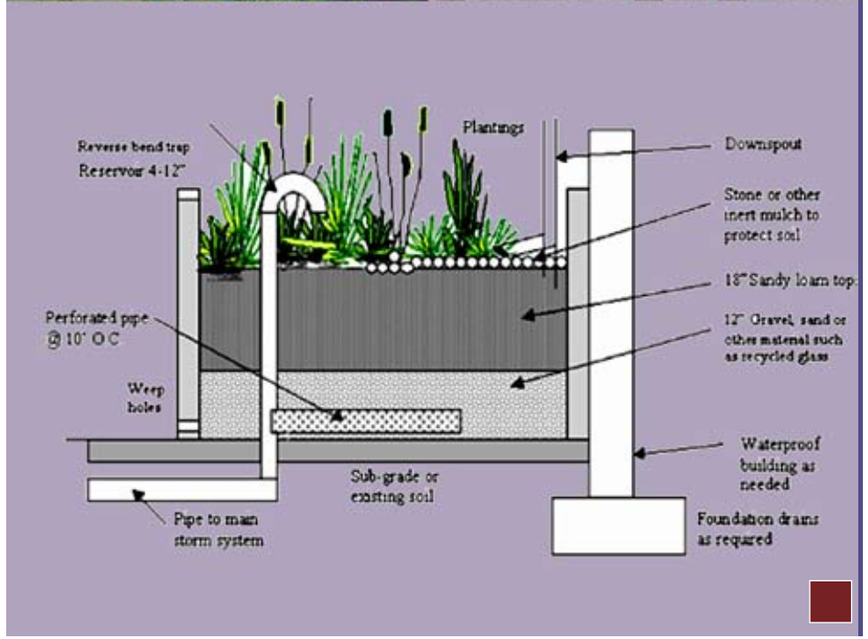
Chemicals, heavy metals, nutrients and bacteria are not collected directly by these devices; however, some of these pollutants may be attached to the larger items (leaves, etc.) that are trapped in the devices and thus prevented from reaching the waterway. Some designs can also be outfitted with filtering elements to better capture pollutants.

All litter control devices and stormwater management facilities require regular maintenance. The collected items are either stored above standing water levels (dry) or below standing water levels (wet). Dry material can be easily removed and delivered to a landfill. Wet materials require suction equipment for cleaning, and the wet wastes may have to be de-watered before disposal.

Traps can be small devices, such as a basket in a catch basin, or very large devices installed within a storm drain. The effectiveness of these devices depends on site-specific factors, such as site use, the size of particles to be caught, space availability, flows into the device and expected maintenance.

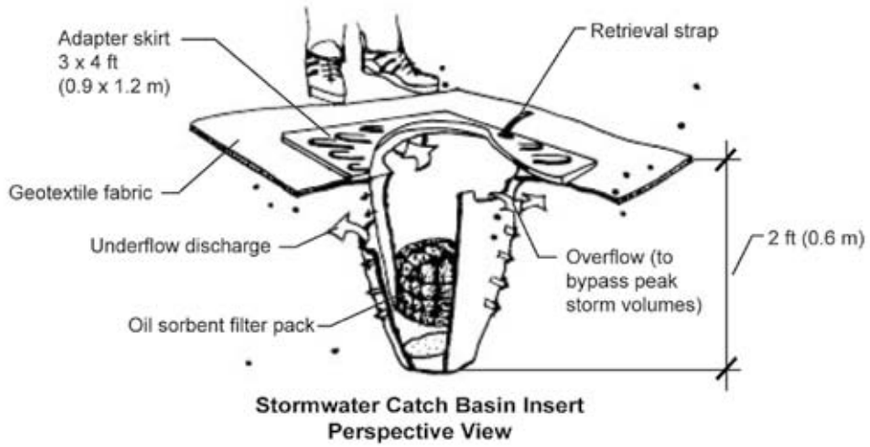
Types of litter control devices include:

- Catch basin and curb inlet inserts
- Trash racks
- Catch basin sumps

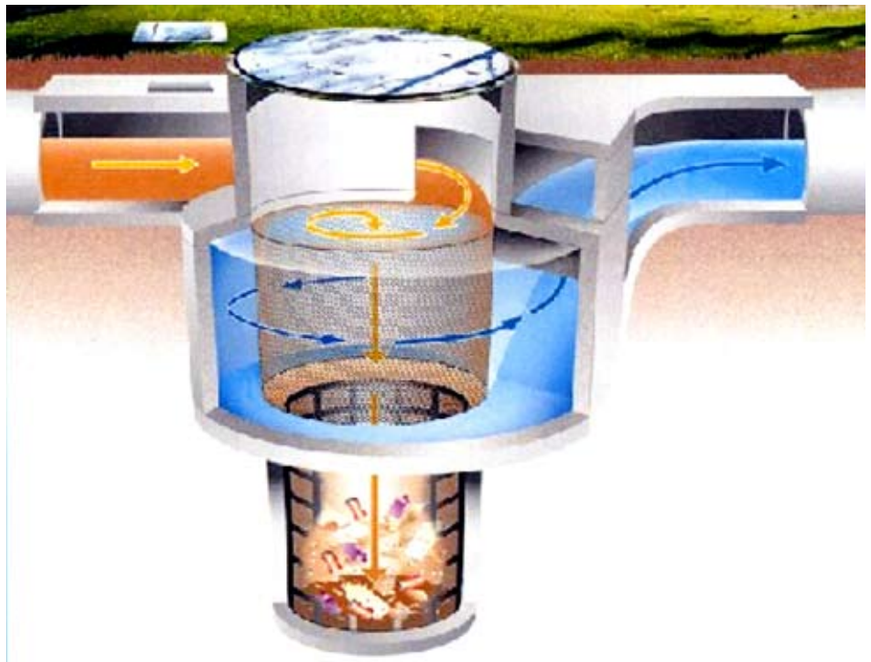


Key refers to photographs on this page

- Green Roof
- Green Roof
- Stormwater Planter



STORMWATER CATCH BASIN INSERT



LITTER CONTROL DEVICE

- Floating booms
- Hydrodynamic separation units
- Oil/grit separators

Finally, other practices such as regular street-sweeping and modifying littering behavior can supplement the litter control benefits of the devices described above.

Underground Storage

Underground storage, also called "detention," is often used in highly urbanized areas to store stormwater runoff until it can be released more slowly. Storage is achieved by a number of means that include vaults, cisterns, chambers, and pipes to create underground void spaces that fill with stormwater. The system releases the water at a slower rate, either through an outlet or as infiltration when the chamber has an open bottom. The main advantage of underground storage is that it allows use of the space above it for other purposes. Parking lots, sports fields, and recreational areas can be placed over underground storage. A disadvantage of this approach is the difficulty in conducting inspection and maintenance due to the confined space requirements.

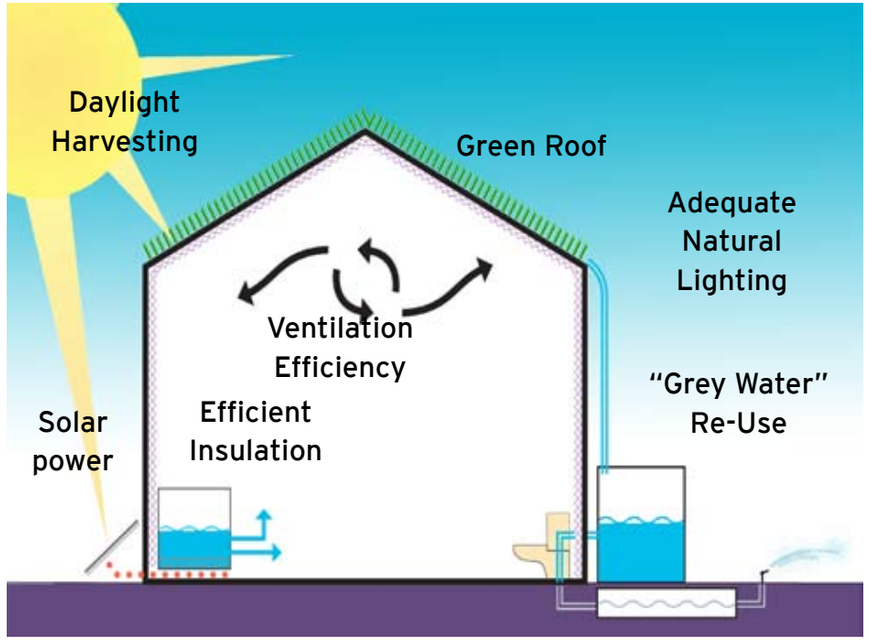
4. BUILDING GREEN

Buildings

There are a variety of reasons to construct green buildings. As the U.S. Green Building Council notes, building green results in environmental benefits, economic benefits and health and community benefits and can improve overall quality of life.[6] For these reasons, it is important to approach any new construction in the Four Mile Run corridor with the assumption that new buildings can and should use substantially less energy, create less pollution and utilize renewable resources. Both Alexandria and Arlington have requirements in place that encourage developers to look at the possibility of incorporating green technologies into new development projects.

A variety of "green" design techniques can contribute to the energy efficiency and environmental responsibility of new structures. These techniques include:

- Green roofs (see description under "Low-Impact Stormwater Management")
- Ventilation efficiency and good indoor air-quality
- Lighting control that allows for natural lighting (i.e., skylights)
- Daylight harvesting by using a solar hot water system



GREEN DESIGN TECHNIQUES IN BUILDINGS

- High-tech glazing to ensure temperature control
- Efficient insulation
- "Grey water" re-use
- Rainwater harvesting
- Use of energy-efficient appliances (for example, those with Energy Star certification)
- Use of non-toxic and recycled-content building materials
- Use of rapidly renewable materials
- For new development in the corridor, waste management practices should be incorporated into the construction process.

TWO EXAMPLES OF LIGHTING: ONE COMPLIES WITH "DARK SKIES" STANDARDS, THE OTHER DOES NOT COMPLY

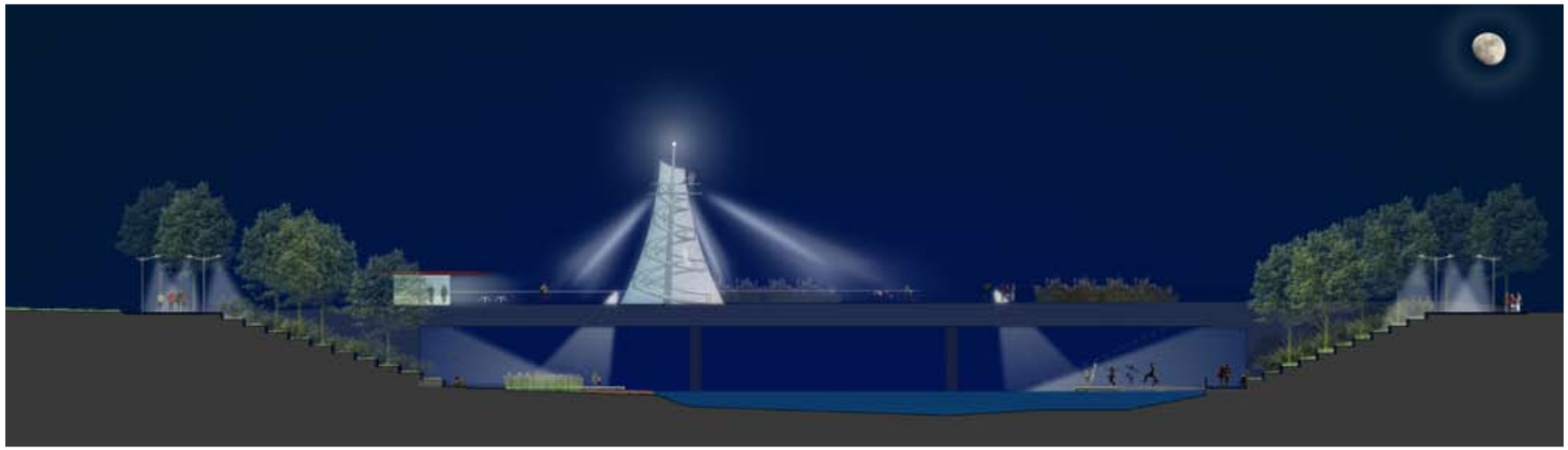
External Lighting Requirements

Decisions regarding the choice and placement of outdoor lighting can contribute to the goal of building green by incorporating lighting that respects its surroundings and conserves energy where possible. For example, external lighting should comply with accepted "Dark Skies" standards to minimize the impact of light pollution on the night sky.[7] All external lighting fixtures, including street lighting, park lighting and lighting external to any buildings will utilize full "cut-off fixtures" that direct light downward. Uplighting should be considered only for lighting the undersides of pedestrian and vehicular bridges; in such cases, the undersides of the bridges will block any potential sky glare. Moreover, to the extent possible, new lighting should minimize the spillover of light into natural habitat areas. Finally, solar-powered lighting should be considered for use in parks.

Recycling Station

Recycling is another way to protect the environment and foster an environmental ethos. The City of Alexandria has proposed constructing a small, state-of-the-art recycling station in Four Mile Run Park, adjacent to and in conjunction with the proposed

YOUNGER MEMBERS OF THE FOUR MILE RUN COMMUNITY



NIGHT CROSS-SECTION THROUGH POTOMAC YARD/BRIDGE AREA: VIEW EAST

nature-cultural center. The design of the recycling station should enable use of the facility for educational purposes so that students can learn about how and why we recycle. The Four Mile Run corridor can contribute to this cause by providing informal facilities throughout the corridor.

5. COMMUNITY AWARENESS

Throughout the restoration process, the neighboring communities in Arlington and Alexandria should understand the restoration process and be made aware of pertinent environmental issues and available green design techniques. There are a variety of ways to educate the public, including:

- Educational signage throughout the corridor explaining restoration techniques and procedures
- Construction of a joint Alexandria and Arlington nature-cultural center, which could house interpretive exhibits about the Four Mile Run watershed.
- Construction of a recycling station in Four Mile Run Park near Common wealth Avenue in Alexandria
- Informational and educational signage at intervals throughout the corridor detailing proposed construction and/or restoration activities
- Regular updates in local newspapers
- Local school involvement in revegetation projects
- Use of the corridor as a "living laboratory" for school classes
- Public service announcements, media campaigns or features on local or public access television stations and radio stations
- Online newsletters
- Informational materials in both Spanish and English

B. Public Spaces

The Master Plan recognizes the importance of accessibility. All designs should meet or exceed the requirements of the American Disabilities Act (ADA).

1. TRAILS AND PEDESTRIAN BRIDGES

The proposed network of trails provides significantly improved access to almost all parts of the corridor. The following hierarchy of trail types should be observed during detail design.

Commuter Trail:

- 12-foot wide asphalt trail with a filtration strip

Community Trails:

- 6-foot - 9-foot asphalt trail with a filtration strip

Informal Trails:

- 4-foot trail made from recycled gabion stones

Ramps:

- 6-foot -10-foot asphalt trail with a filtration strip and balustrading

Pedestrian/Cyclist Bridges:

- 10-foot to 20-foot wide, composed of varying materials

Informal Stream Crossings:

- Boulders or logs placed in or over stream

2. PROMENADES AND PLAZAS

Promenades

A promenade is an approximately 30-foot wide pedestrian and cyclist corridor used in areas that attract a significant amount of activity and visitors. As proposed in the Master Plan, the promenade will be lined on one side by the restored stream and on the other side by urban redevelopment with ground floor retail and commercial uses. An avenue of trees should line the promenade to provide shade and give the route the feel of a classic urban promenade. Moreover, facilities such as benches, trash receptacles and drinking fountains should appear at intervals along the walk, and wayfinding signage should direct people to other parts of the corridor.

Plazas

The Master Plan recommends plazas of varying sizes throughout the corridor. Plazas should function as primary open gathering spaces and should generate a level of vibrancy, interest and activity not found in the other, more "natural" parts of the corridor. Spaces within these plazas should be flexible enough to accommodate events such as markets and festivals. Plazas also should include basic public amenities and street furniture, such as benches, trash receptacles, drinking fountains and signage. The Master Plan proposes that some of the larger plazas incorporate additional features, which may include play areas, public art, restrooms, sports facilities, information kiosks, performance spaces, cafes and canoe/kayak rental facilities. Stormwater management should be an integral part of plaza design. All surface materials should be interlocking permeable pavers or materials with similar permeable qualities.

3. GREEN OPEN SPACE

Green open spaces are exactly as the name suggests. Open lawn areas suitable for 'pick-up' games should be the primary emphasis of these spaces, but benches, picnic tables, trash receptacles, play areas and other amenities should be included as well. Sufficient shaded areas should be incorporated into all green open spaces.

4. SPORTS FACILITIES

Sports facilities include multipurpose fields, ball fields and courts – the locations of which are identified on the Illustrative Plan described in Chapter 4. Flood lights should be considered only at the re-oriented multipurpose field on Mount Vernon Avenue. Lighting should be designed to avoid any adverse effects on the neighboring Four Mile Run Park forest and wetlands as well as neighboring private property and adjacent public rights-of-way. Artificial turf, engineered to promote infiltration, should be considered only at the re-oriented multipurpose field at Mount Vernon Avenue.

5. PUBLIC ART

Art of a public or private nature will add character and meaning to a variety of spaces along the corridor, from high-profile public plazas to the undersides and tops of bridges and throughout the network of trails. Art installations should appeal to a variety of ages and cover a spectrum of styles, from playful to contemplative to educational. Art that addresses that history and ecology of the area or in some way has a relationship to a particular place, would be especially appropriate. In addition, art created by local talent can inspire community pride and foster a sense of ownership. Both Alexandria and Arlington have existing public art approval processes in place.

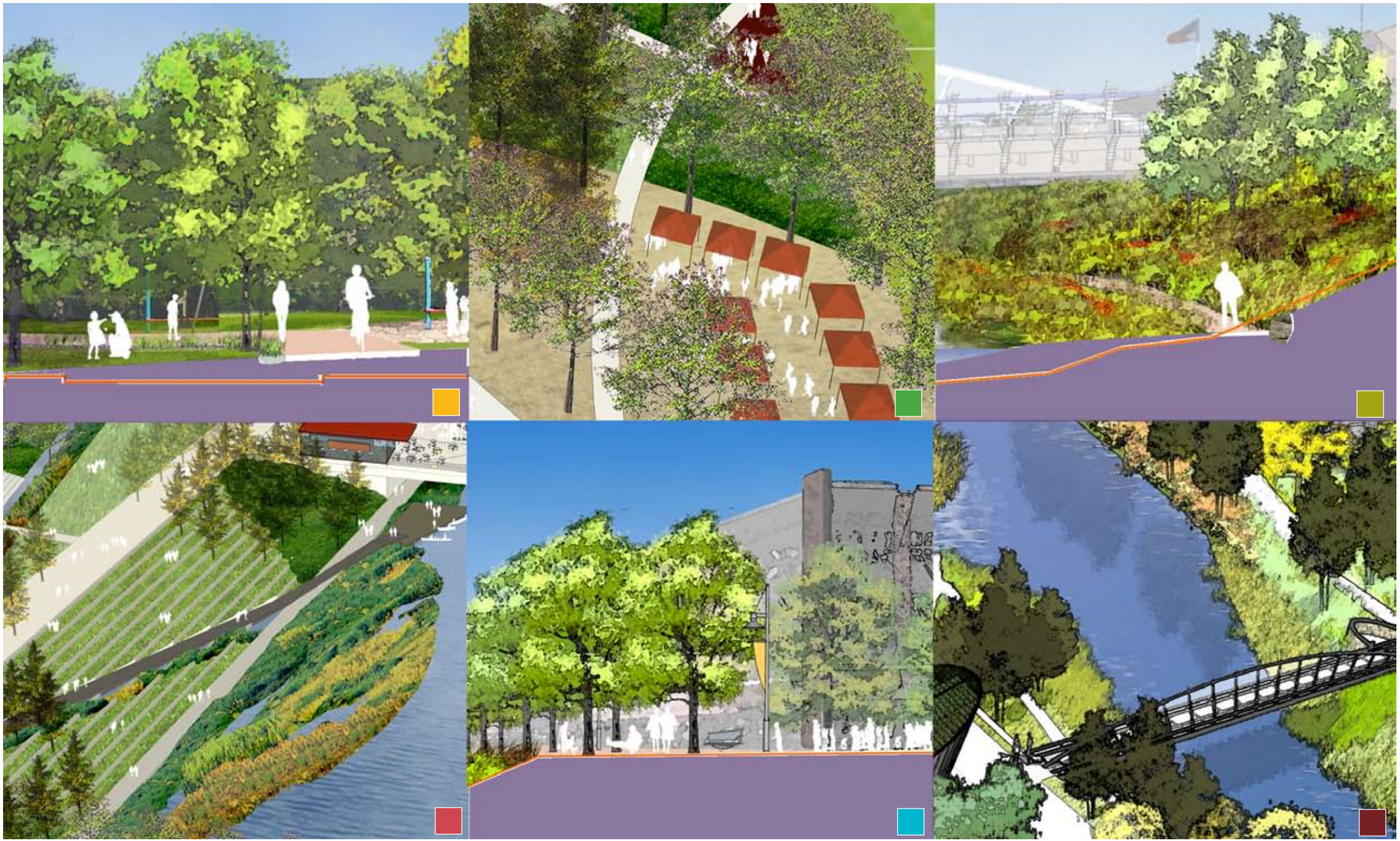
C. Built Features

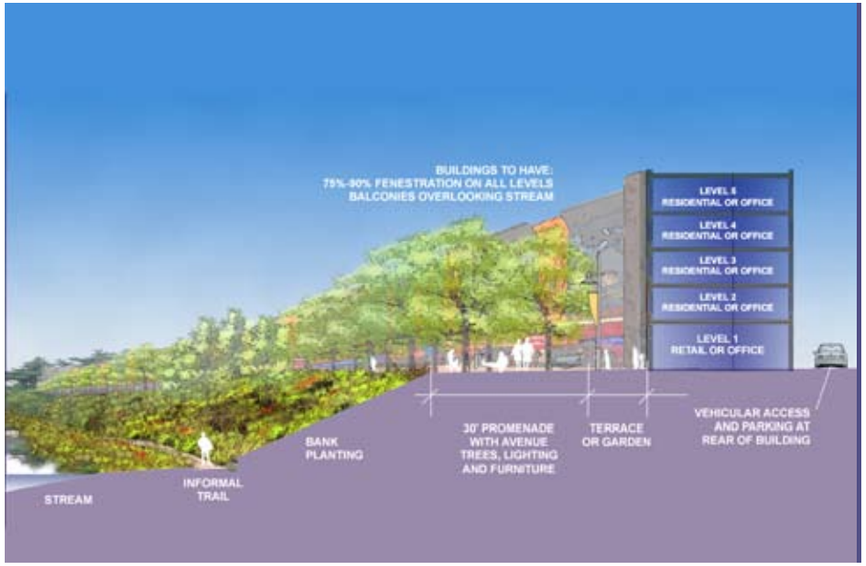
Achieving a high quality built environment requires paying attention to the form, orientation and placement of buildings as well as to design elements that help to unify the public realm and influence how people experience the corridor. The remainder of this chapter provides recommended guidelines for future development that would help achieve the Master Plan vision. It also suggests a design approach for bridges, site furnishings and signage, fencing and lighting that would animate the public realm and establish a distinctive design identity for the corridor.

OPEN SPACE IN FOUR MILE RUN PARK

OPEN SPACE ON MOUNT VERNON AVENUE

OPEN SPACE ALONG SOUTH GLEBE ROAD



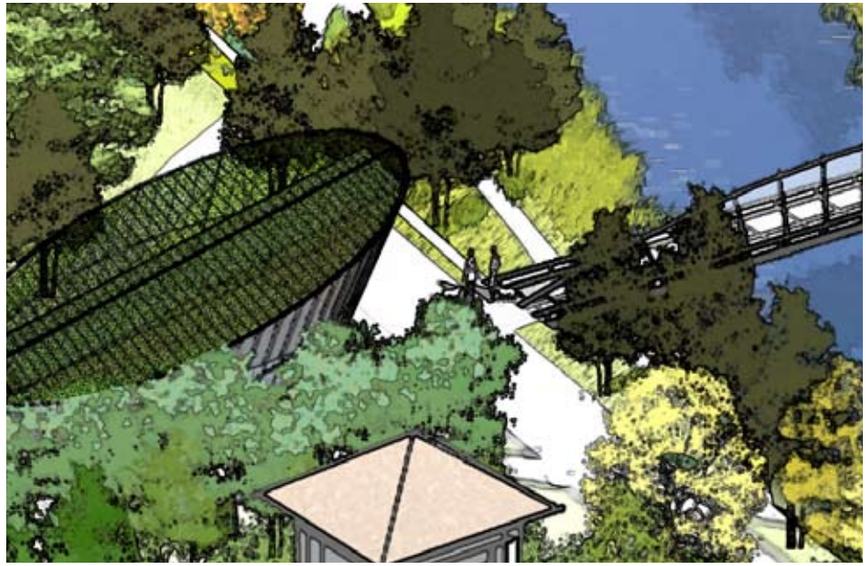


CONCEPTUAL BUILDING FORM IN URBAN REDEVELOPMENT OPPORTUNITY AREAS (2-5 LEVELS)

1. BUILDING FORM, ORIENTATION AND SETBACKS

Currently, much of the development in the corridor turns its back on the stream. As the stream is restored and becomes a visual asset and destination, urban redevelopment will inevitably follow. The Master Plan notes several urban redevelopment opportunities, and new development in these locations should conform to the following broad guidelines for form, orientation and setbacks to ensure development of the highest quality that support the Master Plan and vision for Four Mile Run. Prior to construction, a detailed set of design guidelines should be developed to clearly articulate the preferred design approach to expedite the development approval process.

- New development should engage and open up to the stream.
- New development should extend to within 10 feet to 15 feet of public promenades, or as close as the Resource Protection Area boundary permits; the available space would be appropriate for terraces or gardens.
- Interpretation of RPA boundaries vary between Arlington and Alexandria. Development opportunities should be reviewed on a case-by-case basis.
- Buildings in urban redevelopment areas should be 2 to 5 levels, depending on use and location. The first level should be devoted to retail or office use with



PROPOSED NATURE-CULTURAL CENTER

75-90 percent fenestration and functioning doors at approximately 60-foot-minimum intervals. The remaining levels should consist of residential or office uses with functioning doors and 40-80 percent fenestration. Balconies are encouraged.

- Vehicles will not be permitted to access the edge of the stream
- Parking facilities will be located at the rear of buildings, away from the edge of the stream

2. ARCHITECTURAL COMPONENTS

The Master Plan envisions the Four Mile Run corridor as a restored stream corridor punctuated by modern built elements. These architectural components will assist in creating a unique identity for Four Mile Run and a strong link between two cosmopolitan communities.

Buildings, Bridges, Raised and Cantilevered Walkways

Designs should embrace modern technology and materials. Designers should consider arches, suspension, asymmetry and verticality as potential themes. These elements should be designed to complement each other and the remaining built components throughout the corridor. Materials should be chosen from a predetermined family of

Key refers to photographs on opposite page

- Commuter Trail with Adjacent Filtration Strip
- Mount Vernon Avenue Plaza
- Informal Trails
- Ramps
- Promenades
- Pedestrian/Bicyclist Bridges

EXAMPLE OF FURNITURE: FAMILY OF ELEMENTS

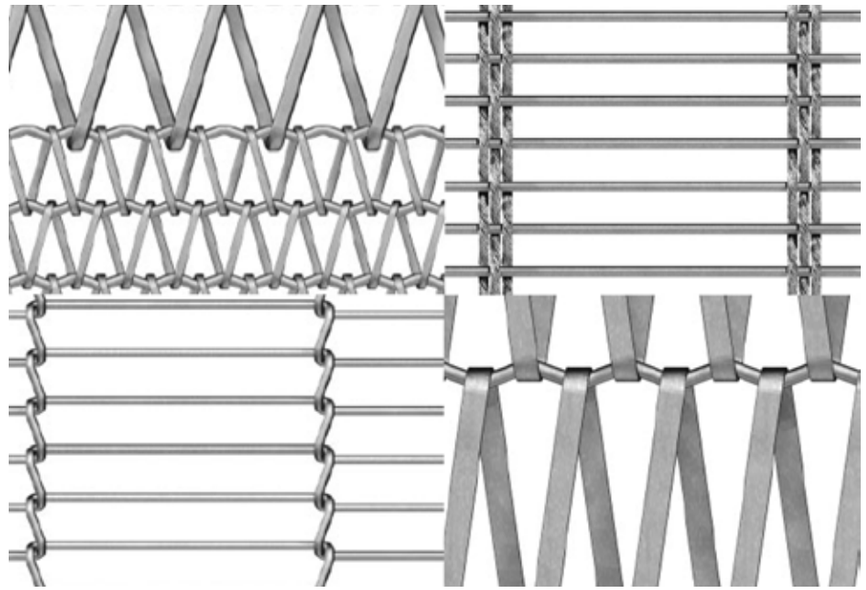
materials. The quality of detail should be of a similar standard throughout the corridor. Materials for consideration include glass, steel, steel cable and architectural mesh. Buildings, bridges and raised and cantilevered walkways should be considered the highlights of built form in the corridor and should not be undertaken until sufficient funds become available in order to sustain a strong, beautiful and consistent identity for the Four Mile Run corridor.

Site Furnishings and Signage

Benches, trash cans, drinking fountains and picnic tables in public spaces should be considered essential parts of the Four Mile Run family of elements with a common design style. Design and materials should complement the buildings, bridges and raised walkways. Interpretive, wayfinding and other types of signage also should establish a common design style and contribute to a distinctive sense of place throughout the corridor.

Fencing

Fencing should be used sparingly. When fencing is necessary—for example, to screen certain elements that may detract from the aesthetic character of the corridor—local officials should encourage attractive and inviting fencing that is sympathetic to both the stream corridor and other built components in the corridor.



EXAMPLES OF POSSIBLE FENCING MATERIALS

Lighting

Lighting in the Four Mile Run corridor serves a dual purpose – security and aesthetics. When lighting is being designed, the following hierarchy of lighting elements should be considered (see the "Building Green" section above for lighting requirements):

Continuous Lighting:

- Commuter trail and promenades

Partial Trail Lighting:

- Main connections through Four Mile Run Park

Feature Lighting:

- Bridge entrances, informal crossings, plazas, potential gathering places

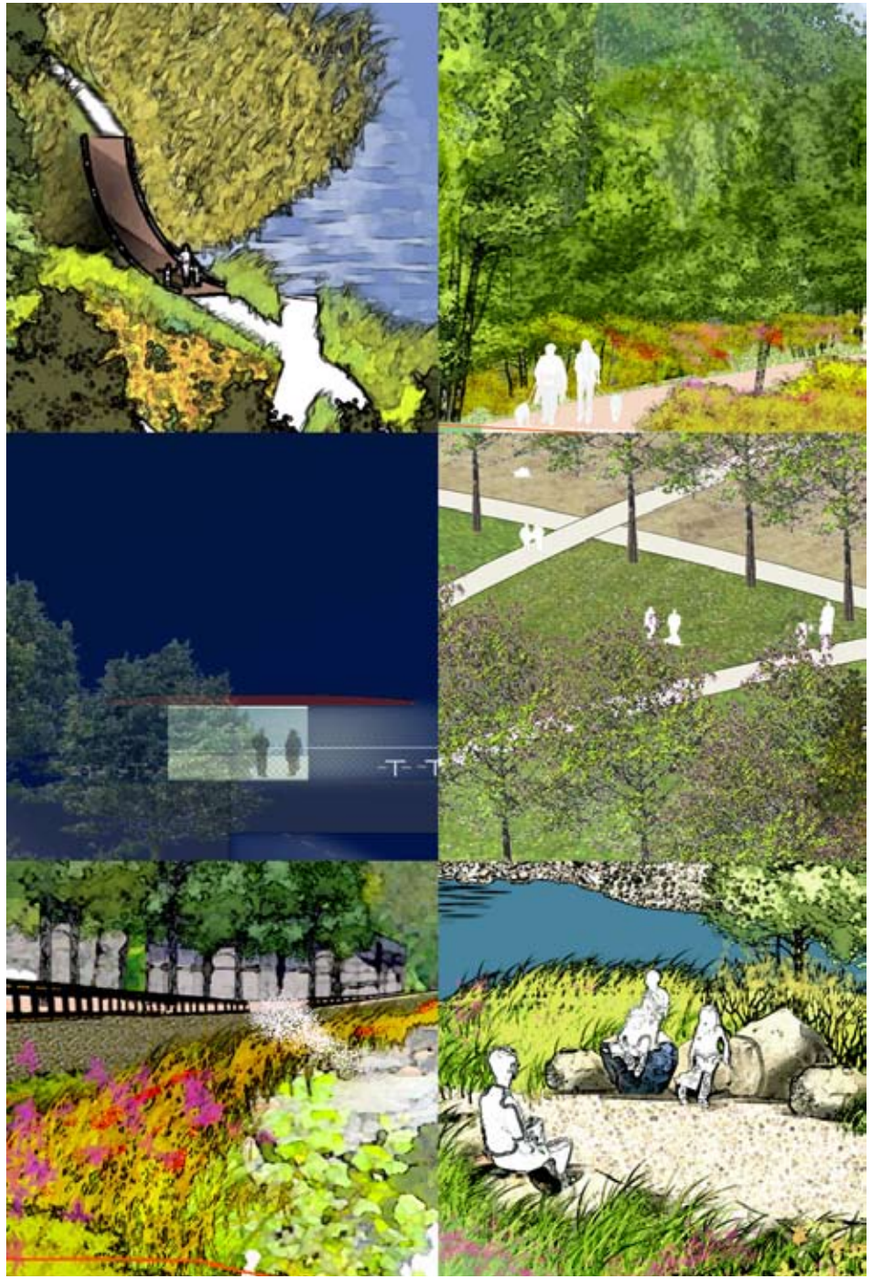
Uplighting:

- Underside of bridges. To be considered an integral part of bridge design.

Sports Lighting:

- Detailed design should consider and avoid adverse effects on Four Mile Run Park forests and wetlands, neighboring private property and public rights-of-way.

This chapter concludes the description of the Master Plan, a discussion that began in Chapter 4 with an overview of the plan's main components and continued in this chapter with a more in-depth look at the general design character of the corridor. The next and last chapter (Chapter 6) explains the strategy for turning the Master Plan vision into reality. Topics include the ongoing demonstration project and Corps of Engineers feasibility study, as well as management, policy and cost considerations for implementing the Master Plan.




ARLINGTON
23
22
4
SOUTH GLEBE RD

"For decades we all treated this stream as a threat, a problem, as our back alley. Finally, a handful of folks decided that it didn't have to be that way - that with vision, creativity and cooperation it could become a beautiful front door that united our communities. That vision of a hopeful future for this place has been painted. Now we need to find the collective will to make it real."

Judy Guse-Noritake, *Co-Chair, Joint Task Force*

6 IMPLEMENTATION FRAMEWORK

The purpose of the Four Mile Run Restoration Master Plan is to provide a vision for the future of the lower 2.3 miles of Four Mile Run and a road map for achieving this vision. It does not, however, constitute a fiscal commitment; as such, implementation will occur in phases and will require the identification of a variety of funding sources. Given the scope and breadth of the effort, implementation of the Master Plan vision will occur over an extended period of time, and will require the establishment of an effective management structure that can "champion" all phases of this effort and can ensure that the vision and goals established for the stream corridor are, indeed, brought to fruition. This management structure may include the continued involvement of the JTF as appropriate, particularly during the planning and design of the demonstration project. As the first step in the strategy for implementing the Master Plan, the demonstration project will begin to improve the corridor immediately while, at the same time, providing a glimpse of the longer-range potential for this area.

This chapter describes both the demonstration project and the Corps of Engineers' forthcoming feasibility study. It also suggests possible management strategies and addresses regulatory and policy changes that might need to occur in order to implement the Master Plan. Finally, this chapter presents a cost estimate for the Master Plan and outlines potential sources of funding.

A. Next Steps

THE DEMONSTRATION PROJECT

Funding for the master planning effort has included a reserve fund of approximately $3.3 million that has been earmarked for the completion of a demonstration project that will implement a representative segment of the Master Plan. The process of identifying a preferred demonstration project began with an initial decision to limit the area considered for the demonstration project to the tidal portion of the corridor from Mount Vernon Avenue to Potomac Yard. This decision reflected the importance of integrating urban and recreational amenities with in-stream restoration in the upstream tidal reaches. The ACG and JTF then identified five possible options within the tidal reach and evaluated each potential project based on a number of criteria established for the demonstration project. These criteria included:

- A project that ties together Arlington's and Alexandria's communities
- A project that demonstrates visible environmental, engineering and design improvements

- The "Aha!" factor: a visible project that will be noted as a significant, positive change for the corridor
- A project that is located east of the Mount Vernon Avenue bridge
- A project that will be sustainable, involving limited risks of failure (or "blow out") of the in-stream restoration work
- A project that can either meet the anticipated budget, or that identifies feasible alternative strategies for meeting that budget, including flood protection methods
- A project that does not require private land acquisition at this time
- A project that can work with the existing transmission lines in place

After considerable discussion and analysis, the ACG and JTF agreed on a preferred option for the demonstration project that met all of the above criteria. (Figure 6.1) The preferred project would occur on both sides of the stream, in the area bounded by Route 1 to the east and an area just west of the proposed Commonwealth Avenue pedestrian/bicyclist bridge. Components of this project include:

- The removal of gabions on both sides of the stream
- Restoration of stream banks on both sides of the stream
- Creation of a tidal bar
- The construction of the Commonwealth Avenue pedestrian/bicyclist bridge
- Litter control
- Information box (signage explaining the project)

Potential costs for the demonstration project are outlined in Figure 6.1.

THE U.S. ARMY CORPS OF ENGINEERS' FEASIBILITY STUDY

While the master planning project will go a long way to improving the ecology, aesthetics and function of lower Four Mile Run, it does not address other aspects of concern on a watershed-wide scale. Fortunately, the master planning effort is paired with a broader watershed-scale effort in partnership with the U.S. Army Corps of Engineers. The Corps of Engineers has provided a substantial amount of support for the master planning effort as part of the agency coordination effort. In addition, the Corps of Engineers has joined with the local jurisdictions to conduct a feasibility study for environmental enhancements and flood protection in the Four Mile Run watershed. Ultimately, when the feasibility study document reaches completion, it will provide a road map for enhancing water quality, ecology, and stream and watershed functions throughout the Four Mile Run drainage area.

The feasibility study is the second phase of the Corps of Engineers' planning process; the first phase included a favorable reconnaissance report and the execution of a feasibility cost-sharing agreement (FCSA) between the Corps of Engineers and the City of Alexandria and Arlington County. The feasibility study lays the necessary groundwork to allow cost-sharing during the implementation of project elements.

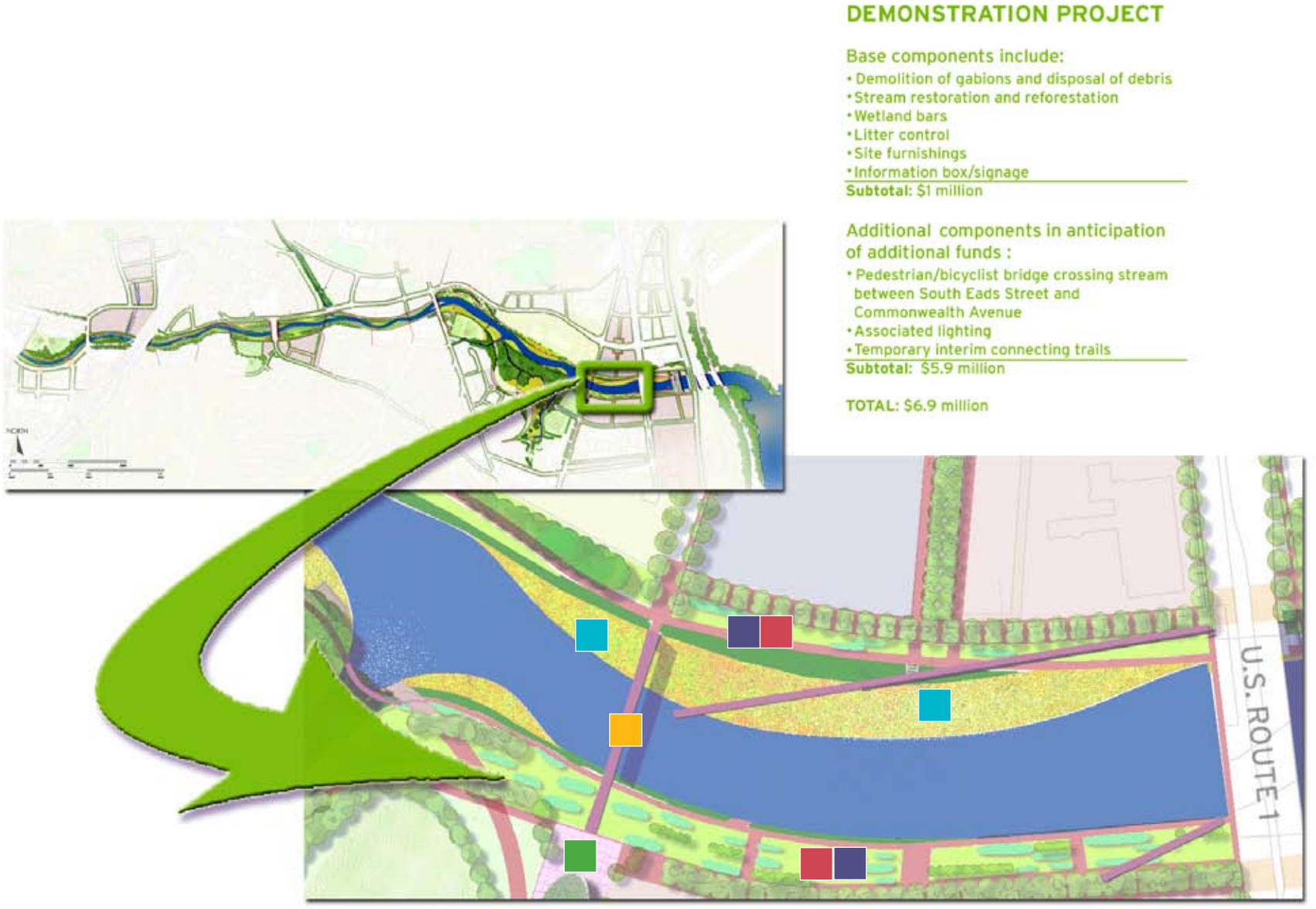
The identified study goals for the watershed are: 1) restore the historic natural infrastructure; 2) enhance, restore and create aquatic habitat and improve nutrient removal functions; 3) restore natural stream channels and remove fish blockages; 4) reduce incidental flood damages in conjunction with habitat improvement; 5) maintain the authorized level of flood protection provided by the existing Corps project; and 6) determine the need, if any, for additional flood protection on Four Mile Run.

The feasibility study follows a planning process that includes the following six steps:

- Specify problems and opportunities related to water and related land resources
- Inventory, forecast, and analyze water and related land resource conditions within the planning area as relevant to the identified problems and opportunities
- Formulate alternative plans
- Evaluate effects of the alternative plans
- Compare alternative plans
- Select a recommended plan based on the comparison of alternative plans

The study area is defined as the Four Mile Run watershed, which includes portions of Alexandria, Arlington, Fairfax and Falls Church.

The feasibility study is currently estimated at a total cost of $3.72 million; this amount is being cost-shared 50-50, with the Corps of Engineers contributing $1.86 million and Alexandria and Arlington providing $1.86 million of professional services. The study is currently scheduled for completion in September 2008, subject to receiving sufficient funding.



Please note: ramps and promenades will not be constructed as part of demonstration project

FIGURE 6.1 DEMONSTRATION PROJECT : PREFERRED OPTION AND POTENTIAL COSTS

B. Coordination and Management

Just as the Master Plan for the Four Mile Run corridor could not have been accomplished without close coordination among the many stakeholders with an interest in its future, the implementation of the Master Plan will rely on the continued coordination between a large number of groups and individuals. These stakeholders include:

- Arlington County's elected officials, staff and citizenry
- The City of Alexandria's elected officials, staff and citizenry
- The U.S. Army Corps of Engineers
- The Northern Virginia Regional Commission
- Other entities impacting decisions in the stream corridor as well as in the entire watershed, including Fairfax County, the City of Falls Church, the National Park Service, the U.S. Environmental Protection Agency, Congress man James Moran's Office, the Northern Virginia Regional Park Authority, Dominion Power, the Washington Metropolitan Area Transit Authority, and others

Added to this complexity are the multiple layers of the Master Plan itself that will require long-term shepherding and stewardship to accomplish the vision defined for the Four Mile Run corridor in terms of both planning and design implementation as well as corridor management. These layers include: environmental restoration (both in-stream and near-stream), recreational resource enhancement (passive and active recreational pursuits as well as programmed and unprogrammed activities), circulation improvements (including pedestrian amenities and linkages, bikeways, traffic calming and intersection improvements, parking, and transit resources), aesthetic improvements and the design components related to creating a successful urban context for the corridor.

It is clear that a strong and clearly defined management structure is needed both to implement the Master Plan and to provide continuous coordination and management services for the Four Mile Run corridor. This structure could take several different forms. First, it might follow the model that was put in place to guide the master planning process: (a) a technical advisory group, the Agency Coordination Group, comprised of key representatives from the Corps of Engineers, the Northern Virginia Regional Commission, those Arlington and Alexandria agencies most involved in stream restoration issues, and two citizen representatives; and (b) the Joint Task Force of Arlington and Alexandria residents representing the various relevant boards, commissions and associations in their respective jurisdictions. Together, these groups provided structure, technical advice and guidance to the master planning effort. This management structure would provide ongoing multi-jurisdictional representation and would ensure the continued collaboration of all key stakeholder groups.

A second possible management structure is the creation of a new entity that would be empowered to work on behalf of both jurisdictions. This organization—whether developed as an authority, a non-profit 501(c)3, a public-private venture, or as some other legal entity—would have its own full-time staff, and would be guided by a management group, such as an Advisory Board, that includes representation by key stakeholders in both the public and private sectors from both jurisdictions, from the federal government, and from appropriate regional organizations. There are numerous examples of this type of management structures established for similar kinds of river restoration efforts, including the recent establishment of the Anacostia Waterfront Corporation in Washington, D.C. This latter group is charged by the Government of the District of Columbia with the revitalization of public lands along the Anacostia River and with the advocacy and coordination of environmental and programming initiatives to promote river clean up, public awareness and enjoyment of the Anacostia.

A third possible management structure would be the establishment of formal intergovernmental agreements between Arlington and Alexandria. Under such agreements, one or the other jurisdiction would have full-time staff committed to this effort. The staff would be guided by a policy group appointed by the two jurisdictional governing bodies and/or their chief executive officers. The advantage of this type of structure is that it does not require the creation of a new entity but uses existing governmental systems, management support, administrative policies (such as procurement, contracting and insurance) and procedures, all of which are already in place. Costs would be shared by the jurisdictions using agreed-upon formulae. Precedents for successful agreements between Alexandria and Arlington already include two major environmental projects (the Arlington Advanced Wastewater Treatment facility and the Alexandria-Arlington Waste-to-Energy facility) for which there have been significant capital investments and operations. By using an existing administrative structure to implement elements of the Four Mile Run Master Plan, the hired staff can focus on achieving the goals of the plan and not be distracted by the need to create new systems, processes, and procedures.

The management structure that is ultimately chosen for the Four Mile Run corridor restoration efforts should include the following responsibilities:

- *Ongoing actions to implement the Master Plan*, including the management of project phasing, fund raising, design and construction oversight, and ongoing public outreach.
- *Close coordination with Arlington and Alexandria elected officials and staff* to

ensure that all actions taken within the Four Mile Run corridor are compatible with, and beneficial to, other planning efforts near the corridor in both jurisdictions.

- *Coordination with other public and private sector efforts impacting the Four Mile Run corridor.* These efforts would include, but would not be limited to, the Four Mile Run feasibility study being carried out by the Corps of Engineers, the implementation of the Northern Virginia Regional Commission's Four Mile Run Total Maximum Daily Load (TMDL) study, other jurisdictional and regional efforts to improve the Four Mile Run watershed (i.e., the Alice Ferguson Foundation's efforts to reduce trash in the watershed), utility improvements both within and adjacent to the stream (such as developing a strategy for the eventual undergrounding of the electric transmission lines, or ensuring close coordination with the design for the Water Pollution Control Plant), the linking of new Four Mile Run trails to existing National Park Service and Northern Virginia Regional Park Authority trails, the establishment of an educational entity (i.e., a nature-cultural center) in the corridor and the continued coordination with public and private donors to create this facility.

- *Provision of ongoing programming of events and activities within the Four Mile Run corridor.* These activities might include festivals, performances, educational and interpretive sessions and other strategies that will bring people into the corridor to experience and enjoy the full range of opportunities offered.

- *Continuous responsibility for providing a well-maintained, safe and secure corridor.* This will include a high level of vigilance with respect to anticipating and addressing potential issues before they occur, and to providing the necessary manpower and resources needed to establish a model maintenance program for both in-stream and near-stream facilities (including habitat area maintenance, recreational and open space upkeep and maintenance, trash collection and facility repairs), and a safe and secure setting for those using the corridor.

C. Regulatory and Policy Issues

ENVIRONMENTAL ACTIONS

Environmental quality is a central component of the Master Plan, and achieving the Master Plan's vision of a "green" corridor will require additional regulatory and policy actions.

Stormwater Management

Implementing the Master Plan presents the opportunity for Alexandria and Arlington to build on existing stormwater management programs by raising the bar for future development. Such efforts are already underway. However, most of the stormwater impacts in the watershed today are a result of the development and street network already in place, rather than ongoing new development and redevelopment. Consequently, there is a critical need for watershed-scale programs and projects ranging from street-sweeping to stormwater treatment facilities to stream restoration. The ongoing Corps of Engineers' feasibility study and work occurring throughout the Four Mile Run watershed by both jurisdictions will further these goals by addressing the significant impacts of existing development.

In the longer term, achieving the Master Plan's vision of Four Mile Run as a national model for stormwater management will require site plan review and planning processes that expand stormwater management beyond standard approaches to more comprehensive management solutions that expand on such techniques as low impact development, underground storage, where applicable, and other creative approaches that enhance the public realm in addition to managing stormwater. However, further study will be necessary to assess the applicability of recommended stormwater management strategies in some locations. Successful implementation of such management strategies are contingent on many factors, including the suitability of soils and site-specific data on soil percolation.

Habitat Restoration

Chapter 4 identifies plant species recommended as part of the restoration project. While the habitat restoration recommendations in the Master Plan represent the preferred approach at this time, the detailed design phases should revisit these recommendations to ensure that the species selected are appropriate for the corridor.

LAND USE CHANGES

Some actions recommended in the Master Plan will require the acquisition of land anticipated for public use through voluntary transactions or agreements with existing

ACQUISITION OF LAND FOR PUBLIC PLAZA ON MOUNT VERNON AVENUE

ACQUISITION OF LAND FOR TRAIL RIGHT-OF-WAY IN ALEXANDRIA

owners. Depending on ownership, proposed future uses and other characteristics of the land in question, possible methods of land acquisition include both future purchase of property and negotiating easements and dedications to enable use of the land for intended purposes described in the Master Plan.

Acquisition of Land for Public Plaza on Mount Vernon Avenue

The public plaza envisioned on Mount Vernon Avenue adjacent to Four Mile Run and the reconfigured multipurpose field will require the voluntary sale of private property for use as open space, consistent with Alexandria's approved Open Space Plan. This change in land use is also consistent with recommendations included in the *Long-Term Vision for the Arlandria Neighborhood*, which similarly envisions the retail properties at the northeastern corner of Mount Vernon Avenue as future community open space.

Acquisition of Land for Trail Right-of Way in Alexandria

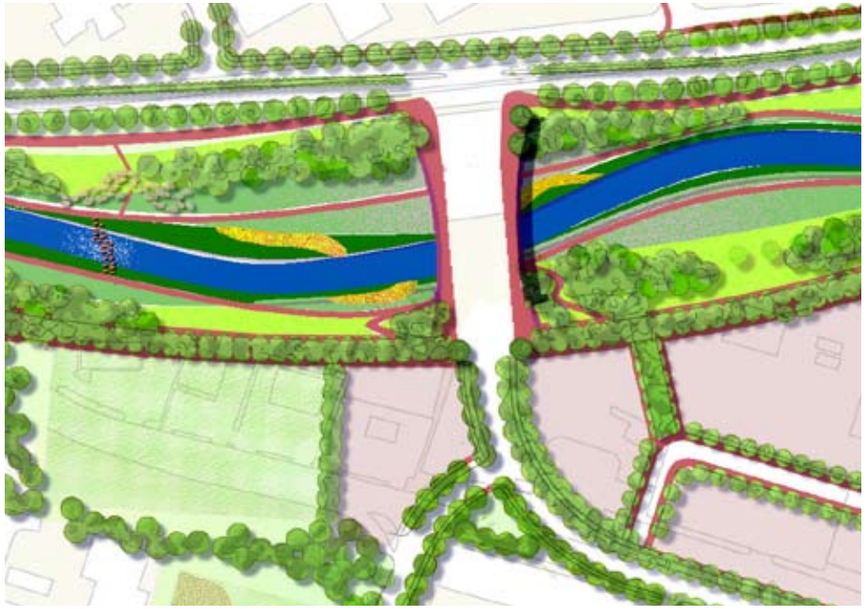
The trail recommended alongside the edge of the stream in Alexandria will require either the acquisition of the land through voluntary sale or other mechanisms to ensure continuous public use of the trail right-of-way on the Alexandria side of the stream. Likely mechanisms for assembling the trail right-of-way include conservation easements, public access easements and open space dedications. Any land acquisition will be consistent with the approved Alexandria Open Space Plan.

Acquisition of Land for the Realignment of the South and West Glebe Intersections

As recommended in the Master Plan, the new configuration of the intersection of West and South Glebe Roads will require the acquisition, through voluntary means, of private property to create space for the new West Glebe Road right-of-way located to the east of the existing West Glebe Road. The acquisition of this land will also enable the creation of a new recreational field on the land bordering the eastern edge of the existing West Glebe Road alignment. Given the conceptual acceptance of this proposal, it is understood that additional public meetings are required to bring this proposal into the design phase. These actions also require a study of potential impacts of the realignment, as described below in Section D ("Infrastructure Actions").

Urban Redevelopment Opportunities

The Master Plan identifies a number of areas that represent opportunities for future urban redevelopment. Before any redevelopment can occur, however, changes in land ownership and, in some cases, zoning may be prerequisites to any proposed actions.



ACQUISITION OF LAND FOR THE REALIGNMENT OF THE SOUTH AND WEST GLEBE INTERSECTIONS

DESIGN GUIDELINES

Creation of specific design guidelines to establish a cohesive design identity for the corridor, as envisioned by the Master Plan and described in Chapter 5, will be required to ensure design consistency and compatibility during each phase of the evolution of the Four Mile Run corridor plan. Intended as a guide for both public management entities and private developers, these guidelines would build upon the design language in Chapter 5, but with a greater specificity regarding design requirements, styles and materials. These guidelines will not, however, supersede or supplant existing design standard elements for roadway design.

D. Infrastructure Actions

The Master Plan recommends two major actions impacting the existing transportation and power utility infrastructure within the Four Mile Run corridor. The first of these is the relocation and realignment of the South and West Glebe Road intersections with the creation of a new vehicular bridge. The second action is the undergrounding of the high voltage electrical transmission lines that currently occupy, and visually dominate, the corridor, both in the stream and alongside it. This section discusses the prerequisites needed for these important, yet complex, possible actions to occur.

URBAN REDEVELOPMENT OPPORTUNITIES

Realignment of the South and West Glebe Road Intersections

This action is intended to yield a more direct connection to Arlington County outside the zone of influence of the I-395 interchange and to yield more common green space. As called for in the Master Plan, the existing bridge at the intersection of South and West Glebe Roads would be replaced by a new pedestrian/bicyclist bridge while a new, larger bridge would be constructed further to the east. This new configuration, while alleviating current I-395 interchange issues by providing smoother and more efficient and more direct vehicular access across Four Mile Run, also allows for the creation of additional usable open space on the south side of the stream. Prior to any further action, however, it will be necessary for the City of Alexandria to undertake a study of the proposed change in order to determine the anticipated impacts to traffic, adjacent neighborhoods, and safety as a result of this action.

Undergrounding of the Dominion Virginia Power Transmission Lines

One of the major issues raised by the public during the many meetings held as part of the master planning process was that of the transmission lines. There were numerous comments regarding the visual blight caused by the existence of these lines, which are located both alongside and within the stream. Given the high level of importance placed

WITH TRANSMISSION LINES

WITHOUT TRANSMISSION LINES

FOUR MILE RUN: WITH AND WITHOUT DOMINION POWER TRANSMISSION LINES

on this action, counterbalanced by the potentially high costs associated with it, a separate study was completed to explore the specific actions needed and costs related to undergrounding the lines within the stream corridor. These projected costs are provided in section E of this chapter on cost estimates.

The study explored phasing of the project in three parts: (1) undergrounding the circuits from Potomac Yard to the existing Glebe substation; (2) undergrounding the circuits from the Glebe substation to I-395; and/or (3) undergrounding the circuits from the Glebe substation to the Arlington substation north of the Four Mile Run corridor area. It should be noted that only phases 1 and 2 directly impact the visual conditions within the Four Mile Run corridor. Given the high costs for any of these undergrounding actions, it appears likely that other physical improvements will be made within the Four Mile Run corridor before any action will be taken to bury the lines. If, however, funds for undergrounding could be secured via various means—either partially or wholly—such as through an eventual need to replace outdated and obsolete power systems, or through future development activities, the positive impact on the corridor of relocating these lines underground would be significant.

When implemented, the other physical enhancements to the corridor presented in the Master Plan will provide important visual benefits for the area and will, it is anticipated, draw one's eye away from the transmission lines to the more beautiful setting provided by the stream, its green and lush banks, and its inviting pedestrian/bicyclist bridges.

E. Cost Estimates

The related costs estimated for the restoration of Four Mile Run will be significant, as would be expected given the breadth and scope of the restoration Master Plan. Nevertheless, the impact of these costs on either Arlington County or the City of Alexandria can be mitigated through the identification of cost-sharing opportunities and project phasing. Some of the potential sources of funding are identified in the next section of this chapter. During the coming year, the ACG will begin to define the projects that will need to be tackled in the short- and mid-terms and the most realistic cost-sharing strategies for each of these "early priority" actions.

It should be noted that the costs provided are estimates only, appropriate to the master planning level of project definition. To view the more detailed background data that was used to determine these costs, please go to the project website at: www.novaregion.org/restoration.

The order-of-magnitude cost estimate is outlined in Figure 6.3, while Figure 6.2 identifies the cost estimate areas.

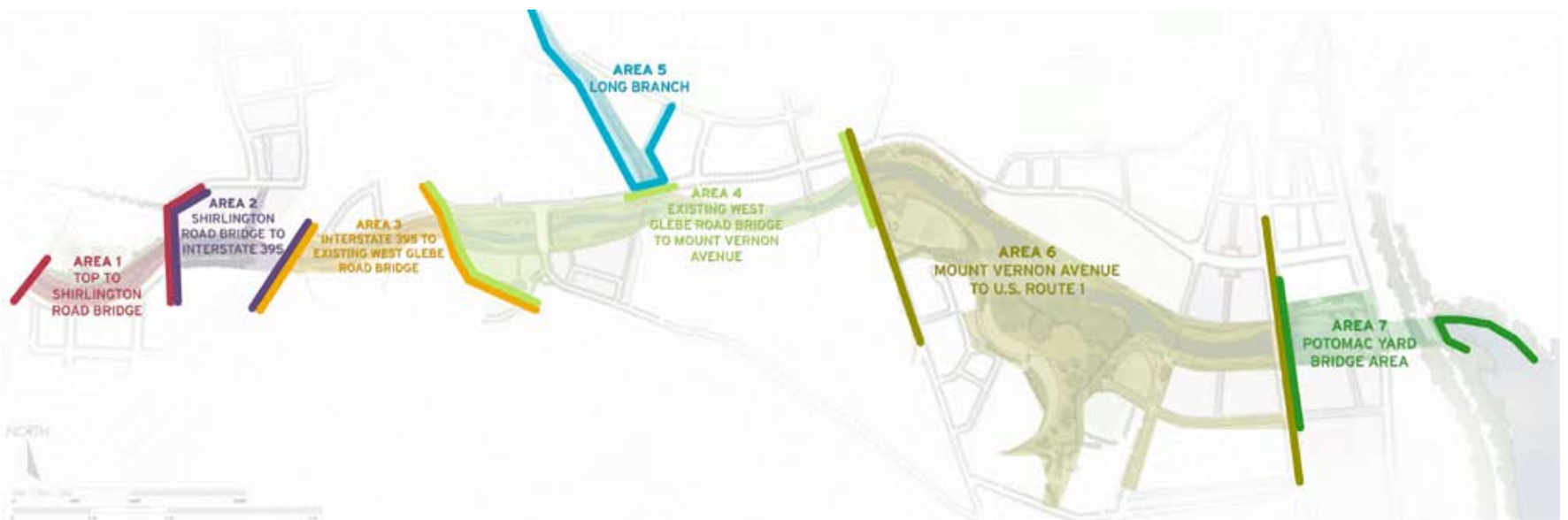


FIGURE 6.2 ORDER-OF-MAGNITUDE COST ESTIMATE AREAS

AREA 1
Top to Shirlington Road Bridge

Major components include:

- Demolition of riprap and debris
- Stream restoration and reforestation
- Pedestrian/bicyclist promenade
- Stormwater management components
- Step-pools
- Site furnishings and lighting
- Public art component

TOTAL $15,000,000

AREA 2
Shirlington Road Bridge to Interstate 395

Major components include:

- Demolition of riprap, debris and portions of concrete flood walls
- Stream restoration and reforestation
- Stormwater management components
- Pedestrian/cyclist promenade
- Site furnishings and lighting
- Aesthetic upgrades to underside of Interstate 395

TOTAL $12,000,000

AREA 3
Interstate 395 to Existing West Glebe Road Bridge

Major components include:

- Demolition of gabions and removal of riprap
- Stream restoration and reforestation
- Stormwater management components
- Trails and walkways
- Site furnishings and lighting

TOTAL $9,000,000

AREA 4
Existing West Glebe Road Bridge to Mount Vernon Avenue

Major components include:

- Removal of existing West Glebe Road vehicular bridge
- Demolition of portions of West Glebe Road
- New multi-purpose Field
- South Glebe Road realignment
- *New vehicular bridge
- *New pedestrian / bicyclist Bridges
- Demolition of gabions and portions of floodwalls and disposal of debris
- Stream restoration and reforestation
- Stormwater management components
- Trails and walkways
- Site furnishings and lighting

TOTAL: $86,000,000

AREA 5
Long Branch

Major components include:

- Stream restoration and reforestation
- Stormwater management components
- Trails and walkways
- Site furnishings and lighting
- Removal of riprap and disposal of debris

TOTAL: $5,000,000

AREA 6
Mount Vernon Avenue to U.S. Route 1

Major components include:

- Commonwealth Avenue improvements
- *New road from U.S. Route 1 to Four Mile Run Park
- Mount Vernon Avenue improvements
- *Nature Center
- *Pedestrian/bicyclist bridges
- Stream restoration and reforestation
- Wetland bar creation
- Four Mile Run Park wetland enhancements
- Stormwater management components
- Trails and walkways
- Site furnishings and lighting
- Demolition of gabions
- Removal of riprap and disposal of debris
- New sports fields and associated facilities
- Public plaza
- *Flood Control Structure

TOTAL: $116,000,000

AREA 7
Potomac Yard Bridge Area

Major components include:

- Demolition of one disused rail bridge
- Demolition of gabions and disposal of debris
- Public plaza on remaining rail bridge
- Wetland bar creation
- Trails and walkways
- Promenades
- Stream restoration and reforestation
- Stormwater management components
- Site furnishings and lighting

TOTAL: $18,000,000

TOTAL FOR AREAS 1 -7 :
$ 261,000,000

ADDITIONAL COSTS+

Undergrounding of power lines

TOTAL: $94,000,000

Additional stormwater management components situated on private property

TOTAL: $4,500,000

NOTES:

1. Accuracy and Usage:
The estimates shown above are considered order-of-magnitude cost estimates, in 2005 dollars, and are expected to be accurate to +50%/-30%. They are suitable for use in project evaluation and planning. Actual construction costs will vary from these estimates due to market conditions, actual costs of purchased materials, quantity variations, regulatory requirements, and other factors existing at the time of construction.
2. Gabion removal assumes stone can be reused on site for stream restoration, path construction, etc.
3. Debris hauling and disposal costs are highly variable, depending on material quality and hauling distances.
4. The unit cost of a pedestrian bridge is highly dependent on the level of architectural design and the dimensions. The cost can range from $1 Million for a pre-fabricated bridge with a 15 ft wide trail to upwards of $6 Million dollars for a bridge similar to the ones depicted in the renderings, with two trails totaling 30 ft width.
5. The lump sum cost for this road is included in the project area from Mount Vernon Avenue to the bridges, although the road crosses over the boundary into the bridges section.
6. The cost of transport and disposal of cut or purchase of fill was estimated assuming no re-use of existing fill. This could be reduced if the existing fill is of good quality and the project can be phased in such a way as to re-use the excavated material. In disposal cost the fill is assumed to be clean. Any contamination will increase the cost of disposal significantly.
7. Stream restoration plantings include vegetation proposed to the top of the flood wall slope.
8. Flood control structures are assumed to include the "ring levee and associated pump station" proposed by the USACE in 1973. Costs of $5.25 million in 1973 were updated to $20.74 million in 2005 dollars, based on the Engineering News Record Construction Cost Index (ENRCCI) change from 1895 in 1973 to 7478 in August 2005. A DETAILED ANALYSIS AND PUBLIC OUTREACH PROCESS WILL BE CONDUCTED AS PART OF THE IMPLEMENTATION PHASE FOR THE MASTER PLAN TO DETERMINE IF THE RISK OF FLOODING IS ACCEPTABLE TO ALL STAKEHOLDERS AND TO DETERMINE IF ANY ADDITIONAL FLOOD MITIGATION IS REQUIRED.

Does not include:

1. Land acquisition
2. Demolition of any buildings associated with land acquisition
3. Reclamation of land as part of 'A Long to Vision and Action Plan for the Arlandria Neighborhood' Plan
4. Realignment of Shirlington Road as part of Nauck Village redevelopment
5. Potential urban redevelopment opportunities
6. Investigation / remediation of hazardous materials

* Represents components of significant cost.
\+ These "additional costs" are provided individually as they comprise actions that can be dealt with separately from other Master Plan elements.

FIGURE 6.3 ORDER-OF-MAGNITUDE COST ESTIMATE

F. Funding Opportunities

One of the most significant challenges in implementing the Master Plan vision will be obtaining sufficient funding. Implementation will require the identification of a variety of funding sources, as well as matching these funding sources with specific projects. The upcoming year-long implementation planning process conducted by the ACG will begin to identify potential funding sources and appropriate projects. Portions of the overall restoration effort will need to compete for increasingly scarce municipal Capital Improvement Program monies. Other efforts will require additional federal, state and private funding sources, and some efforts will require multi-layered funding plans.

The list below provides a starting point for investigating potential sources of funding and resources to implement the Master Plan. This list does not guarantee access to listed funding sources, nor is it intended to be exhaustive. It will be the obligation of the ACG, or any future management structure that supersedes the ACG/JTF, to investigate these and other potential funding sources to support the implementation of the Master Plan.

LOCAL CAPITAL IMPROVEMENT PROGRAM (CIP) FUNDS

On a periodic basis, both Arlington County and the City of Alexandria prepare six-year jurisdiction-wide comprehensive capital improvement programs (CIPs) that detail expected capital projects to be executed within each jurisdiction. Typical projects run the gamut of municipal infrastructure including roadway construction, municipal facilities installations, park land acquisition, bridge replacement, multi-use trail expansion, etc. The Four Mile Run Restoration project will require substantial capital improvements within the project area. Such improvements comprise an array of items, such as new pedestrian/bicyclist bridges, park enhancements, multi-use trail extensions, in-stream adjustments, and possible vehicular bridge modifications or replacements. This level of capital expenditure must be planned for well in advance. The CIP plans offer an excellent opportunity for programming these commitments in the advance timeframe required.

Additionally, it is likely that any future federal funding for the restoration project will require some level of matching obligation from Alexandria and Arlington. Each of these matching requirements will vary depending on the type of federal funding.

As is the case with any CIP planning or budget process, each capital project competes for limited local resources for funding. This competitive process means that when each proposed CIP is prepared and then decided upon in both jurisdictions, each proposed element of the Master Plan will need to compete and be prioritized along with all other County and City capital improvement projects in order to determine which and how many components of this Master Plan can be funded at any point in time. The estimated costs for implementing the entire Master Plan constitute a larger budget than the jurisdictions will be able to fund with local monies. Therefore, it will be imperative to identify and obtain substantial external federal, state and private funds.

FEDERAL FUNDS

Corps of Engineers Partnership Funds

Through the feasibility study effort underway with the Corps of Engineers, the project partners are examining all facets to determine which portions will be eligible for partnership with the Corps of Engineers. Funding for those project aspects that are eligible can typically be split between the Corps of Engineers and a local partner at a 65-35 allocation, with Corps of Engineers providing 65 percent of the project cost and the local project partner responsible for 35 percent of the project cost. If some particular project pieces fall under Corps of Engineers' Section (§) 1135 authority, they can be rolled into that program. Under the §1135 authority, the Corps of Engineers shares the cost of the projects on a 75-25 basis with the local partner. It is important to note that §1135 opportunities for partnering with the Corps of Engineers will be limited to those flood control and ecosystem restoration projects directly associated with the levee corridor or upstream ecosystem restoration projects. These funds also depend on Congressional appropriations as well as internal Corps of Engineers budgeting processes.

OTHER FEDERAL FUNDING OPPORTUNITIES[8]

Agriculture Department

- Natural Resources Conservation Service: Watershed Protection and Flood Prevention (also known as the "Small Watershed Program" and "PL 566 Program")

Provides technical and financial assistance to address resource and related economic problems on a watershed basis. Eligible projects include those related to watershed protection, flood prevention, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, and public recreation.

Commerce Department

- Grants for Public Works and Economic Development

Provides grants for public works improvements related to restoration efforts.

- National Marine Fisheries Service: Community-Based Restoration

Supports riparian and in-stream habitat improvements.

- National Marine Fisheries Service: Habitat Conservation

Provides funding for research, management, public education and conservation of wetlands and other coastal habitats.

- National Marine Fisheries Service: National Fisheries Habitat Program

Promotes local hands-on involvement in habitat restoration projects.

Environmental Protection Agency (EPA)

- Environmental Education Grants

Provides financial support for projects that design, demonstrate, or disseminate environmental education practices, methods or techniques.

- Nonpoint Pollution Implementation Grants (§319)

Provides funds to states for on-the-ground projects to reduce nonpoint source pollution runoff under the Clean Water Act. Funds are directed to states, but may be re-granted to local governments or non-profits.

- Sustainable Development Challenge Grants

Encourages community members, businesses and government to work cooperatively to develop community-based projects that promote environmentally and economically sustainable development.

• Watershed Assistance Grants

Supports organizational development and capacity building for watershed partnerships through a cooperative agreement with EPA.

• Wetlands Protection Development Grants

Supports initial development of wetland protection, restoration or management programs or enhancement of existing programs.

Interior Department

- Land and Water Conservation Fund

Provides funds to acquire and protect land and water resources.

- Fish and Wildlife Service: North American Wetlands Conservation Act (NAWCA)

Provides funds to conserve wetland ecosystems, waterfowl and the other migratory birds and fish that depend on these habitats.

- National Park Service: Rivers, Trails, and Conservation Assistance Program

Provides staff assistance to support partnerships between government and citizens to increase the number of rivers and landscapes protected, and trails established, nationwide.

- National Park Service: Urban Park and Recreation Recovery

Provides federal grants to local governments for the rehabilitation of urban recreation areas and facilities. Provides both planning grants and rehabilitation capital grants.

STATE GRANTS

There are a variety of state grants that could be applied to certain pieces of the restoration project. Possible funding sources include:

Virginia Department of Transportation

- Transportation Enhancements

Projects must have a relationship to surface transportation systems, pedestrian and bicycle facilities, bike racks, underpasses, landscaping and scenic beautification, or trailhead interpretation.

Department of Conservation and Recreation

• Virginia Recreational Trails Fund Program

Provides grants for new trails, maintenance and rehabilitation of existing trails, development of trailside and trailhead facilities, and construction of features that facilitate use by people with impairments. Planning is not eligible.

- Urban and Community Forestry Assistance Grants

Provides funding for greenway development planning, tree planting, landscaping, and brownfield site rehabilitation.

PUBLIC/PRIVATE PARTNERSHIPS

There are many examples in local government where localities work in partnership with private entities to accomplish a local good. For example, Coastal America, the abbreviated name for the National Corporate Wetlands Restoration Partnership is a public-

private entity structured to encourage private corporations to join forces with federal and state agencies, local communities and non-profit organizations to restore wetlands and other aquatic habitats. Corporations contribute funds to private foundations or state trust funds, which are in turn matched by federal funds. Further research can help identify other public/private partnership opportunities.

Private Grants

There may also be various private grants that could be applied to certain pieces of the Four Mile Run Restoration Project. Possible funding opportunities include:

• American Rivers-NOAA Community-Based Restoration Program Partnership

Provides funds for fish passage improvements (i.e., dam removal, fish ladders, by-pass channels, culvert removal/retrofit) and preliminary analysis essential to development of the project (i.e., engineering, design, sediment analysis.)

• Chesapeake Bay Trust Stewardship Grants Program

Supports schoolyard habitat projects; hands-on Bay education programs; workshops and forums that advance the public's knowledge of Bay restoration techniques; on-the-ground projects that demonstrate the range of restoration approaches and increase public awareness about the Bay; and watershed planning and assessments that identify specific restoration opportunities that can involve the public. In addition, the Chesapeake Bay Small Watershed Grants program provides small grants to organizations working on a local level to protect and improve watersheds in the Chesapeake Bay basin while building citizen-based resource stewardship.

• National Fish and Wildlife Foundation: Various Grant Programs

Funding opportunities include NFWF Challenge Grants for projects that address priority actions promoting fish and wildlife conservation, involve other conservation and community interests, and leverage Foundation funding.

LOCAL ACTIONS

Infrastructure Projects

Within the project area, multiple existing infrastructure projects will, on occasion, need maintenance or refurbishing. These projects include the Arlington County Water Pollution Control Plant, City, County and State maintained roadways and bridges, linear infrastructure projects (sewer, potable water, stormwater, power lines, gas lines, etc.), and park lands. As portions of this infrastructure age, each will require a certain amount of care, and maintenance and eventual rehabilitation or replacement. At points deemed appropriate for such infrastructure improvements, these projects should consider the possibility of implementing related components of the Master Plan.

Developer Proffers and Conditions of Approval

With the amount of development approved or proposed in the City of Alexandria and Arlington County and with more to occur, it is likely that developers will request special use/special exception permits from either the City Council or County Board. These elected bodies should be conscious of each development project's impact on Four Mile Run and the benefits derived from a restored Four Mile Run in negotiating the permits. Such negotiations could result in proffers or conditions of approval that work to complete various components of the Master Plan.

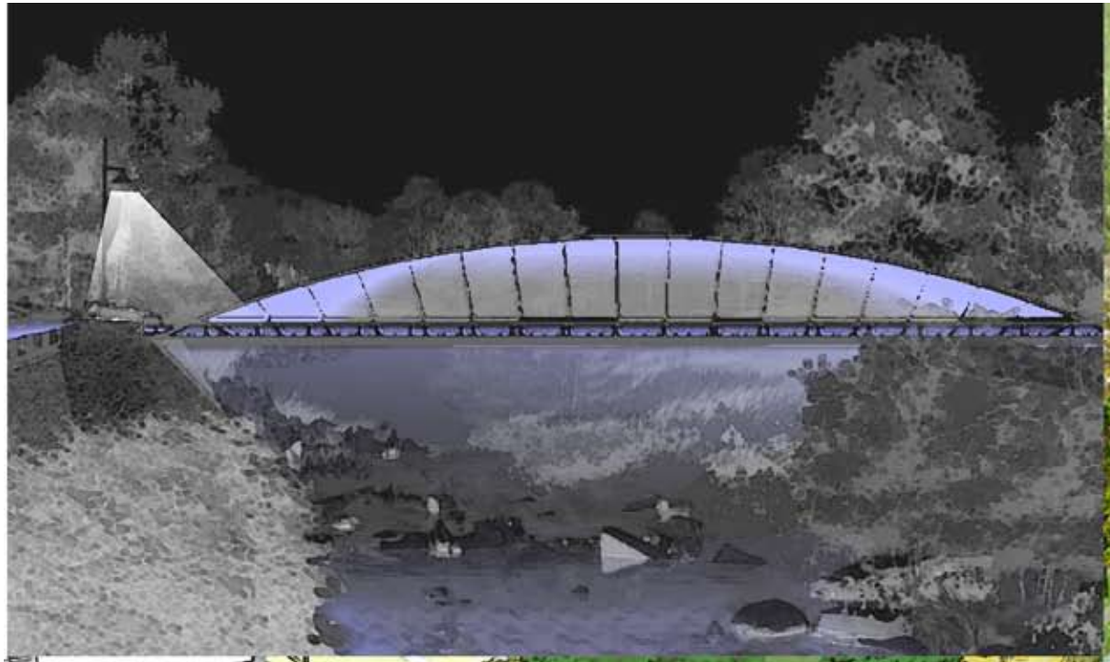
Contributions to the Water Quality Improvement Fund

Both Arlington County and the City of Alexandria have instruments through which funds are collected through certain development projects for watershed improvements in the respective jurisdictions. Although these funds can be spent jurisdiction-wide on an array of water quality improvement measures, it is likely that there will be opportunities to apply some of these funds in the project area.

G. Four Mile Run: The Collaboration Continues...

The Master Planning process has established an inspiring model of jurisdictional collaboration for the improvement of a significant local and regional resource. The future of the Four Mile Run corridor depends on the continuation of this collaborative effort. The degradation of the Four Mile Run corridor has been a gradual process, occurring over many years. So, too, will be its progressive restoration. As such, it will need the ongoing guidance, support and commitment from both County and City leadership.

Eventually, the community vision established for Four Mile Run will be realized: Four Mile Run will become a model of urban ecological restoration. It will be a place along which the communities of both Arlington County and the City of Alexandria can gather, recreate and celebrate a shared waterfront legacy. This Master Plan is the first step toward realizing the vision.



END NOTES

[1] U.S. Census Bureau, Census 2000.

[2] Northern Virginia Regional Commission, *Flood Frequency Analysis for Four Mile Run at USGS Gaging Station 1652500* (November 9, 2004), 7.

[3] Field research, including a field tour of the Four Mile Run Park Wildlife Sanctuary with City of Alexandria plant ecologist Roderick Simmons, occurred on May 31, 2005; additional wetlands data came from the National Wetlands Inventory and the City of Alexandria. The U.S. Army Corps of Engineers will conduct formal wetland delineation during a later phase of its study.

[4] Virginia Native Plant Society, 2004 site observations.

[5] Metropolitan Washington Airports Authority bird survey (2005)

[6] See, for example, the standards recommended by the International Dark-Skies Association in its *Outdoor Lighting Code Handbook* (September 2002). Available online at http://www.darksky.org.

[7] For more information on green buildings, see the U.S. Green Building Council web site at http://www.usgbc.org.

[8] For more information on these and other funding opportunities, see the American Rivers report *Restoring Riverfronts: A Guide to Selected Federal Funding Sources* (Washington, D.C.: American Rivers, 2002). The report is available online at http://www.AmericanRivers.org.

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