Four Mile Run Design Guidelines

Prepared for

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CITY OF ALEXANDRIA

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Four Mile Run Design Guidelines

Final Report

Four Mile Run Design Guidelines

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Native Plant
Meadow
Do Not Mow
City of Alexandria
Recreation Parks and Cultural Activities

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FOREWORD

Three years ago, the Four Mile Run Restoration Master Plan was completed and adopted by the City of Alexandria and Arlington County. Now this companion document, the Four Mile Run Design Guidelines, is finished and ready to serve as a guide to move the Master Plan to reality. These guidelines provide a specific design language for the physical manifestation of the ecological and urban design elements previously recommended in the Master Plan.

The Master Plan envisioned a new and bright future for the blighted waterway, which now houses the infrastructure backbone upon which urban life in these two communities depends. The channel, designed with the single purpose of carrying flood waters away as quickly as possible, is framed by a wastewater treatment plant, a large power substation, and transit facilities, while high voltage transmission lines soar above it all. The waters are not clean enough to sustain native aquatic fauna and flora.

While the Master Plan addressed these infrastructure challenges generally, these guidelines more specifically address the character of our urban infrastructure, which is embraced as a positive attribute and influence in the urban design aspects of this restoration project. In these pages, the power lines, rusted sheet metal, large pieces of concrete, and rocks become the foundation for a design language that imagines a vibrant future for this corridor and seamlessly knits together new and existing elements. The use of these unique elements grounds future projects in this language of urban infrastructure and creates a place—and a distinct sense of place—that acknowledges the full range of challenges of a modern, urban existence…life in the city.

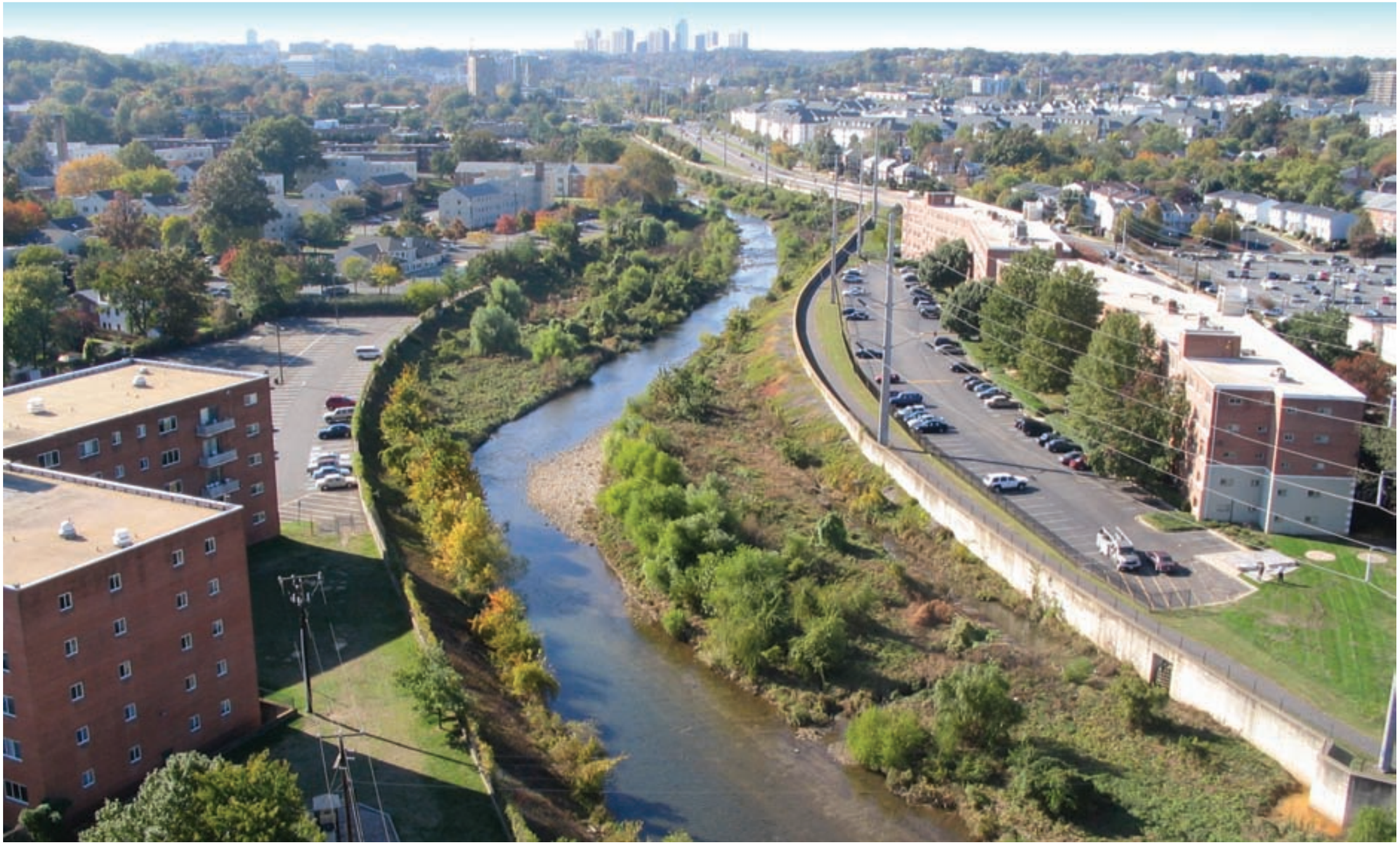
At the same time, these design guidelines further define and reinforce the principles of sustainable design articulated in the original Master Plan. The design direction developed in this document embodies ecological principles throughout all aspects of the stream restoration: trails and paths, public art, landscape design and the hardscape of the more urban aspects envisioned along this greenway. And it is here that we begin to see how public art can and should be seamlessly infused as an integral part of this restoration, so that it will become a highlight of this restored stream valley.

Like the visionary Master Plan, the development of the Design Guidelines is the result of an unprecedented collaboration between the two municipalities straddling Four Mile Run, the U.S. Army Corps of Engineers, the Northern Virginia Regional Commission and the neighborhoods and businesses nearby. We have already seen that the vision contained in these two companion documents is serving as a catalyst for positive change in the neighborhoods and commercial areas along this shared border. I pledge to continue to work closely with Arlington and Alexandria to bring to bear the necessary federal resources that will be required to fulfill the vision found in these pages, knowing that it will also take continued commitment and resources from both of these communities and the private sector to see it to fruition. I remain convinced that together, with all parties willingly working toward a common goal, we can ensure that Four Mile Run will have a very bright future, indeed.

Congressman James P. Moran

Eighth Congressional District

Virginia



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1 INTRODUCTION

Introduction

The *Four Mile Run Restoration Master Plan (March 2006)* established a broad vision to fulfill the great potential of the Four Mile Run stream corridor. Among its many recommendations, the Master Plan identified a number of design principles to guide future improvements within and adjacent to the stream corridor. These principles are organized under three central themes: (1) green design principles, (2) a vibrant public realm, and (3) a built environment that acknowledges and respects the stream and contributes positively to the public realm. This document supplements the Master Plan, by adding greater clarity and specificity to its overarching ideas and further establishes a visual and physical character for future improvements to the Four Mile Run stream corridor.

The magnitude of the recommendations in the Master Plan suggest that the improvements will likely be initiated over a long period of time and be completed in separate, phased segments. Many agencies, owners, and developers will need to collaborate with planners, architects, landscape architects, engineers, designers and artists to make the Master Plan vision a reality.

The publication of the Design Guidelines establishes a clear design framework that future collaborative teams may use as a basis for their work. The intent is not to restrict creativity or limit the possibilities of future design efforts, rather to build a strong framework within which ideas can be applied. At the broadest level, these guidelines provide a design language based on commonalities among materials and forms that are coordinated to create visual cohesiveness and compatibility. At their most specific, the guidelines establish performance criteria and design requirements for selected elements within the corridor. Portions of the guidelines are intentionally left open to allow for maximum creativity.

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ARLINGTON
SHIRLINGTON RD.
SOUTH GLEBE RD.
MT. VERNON AVE.
FOUR MILE RUN
I-395
ALEXANDRIA
WEST GLEBE RD.
ARLINGTON MILL RD.
VILLAGE AT
SHIRLINGTON

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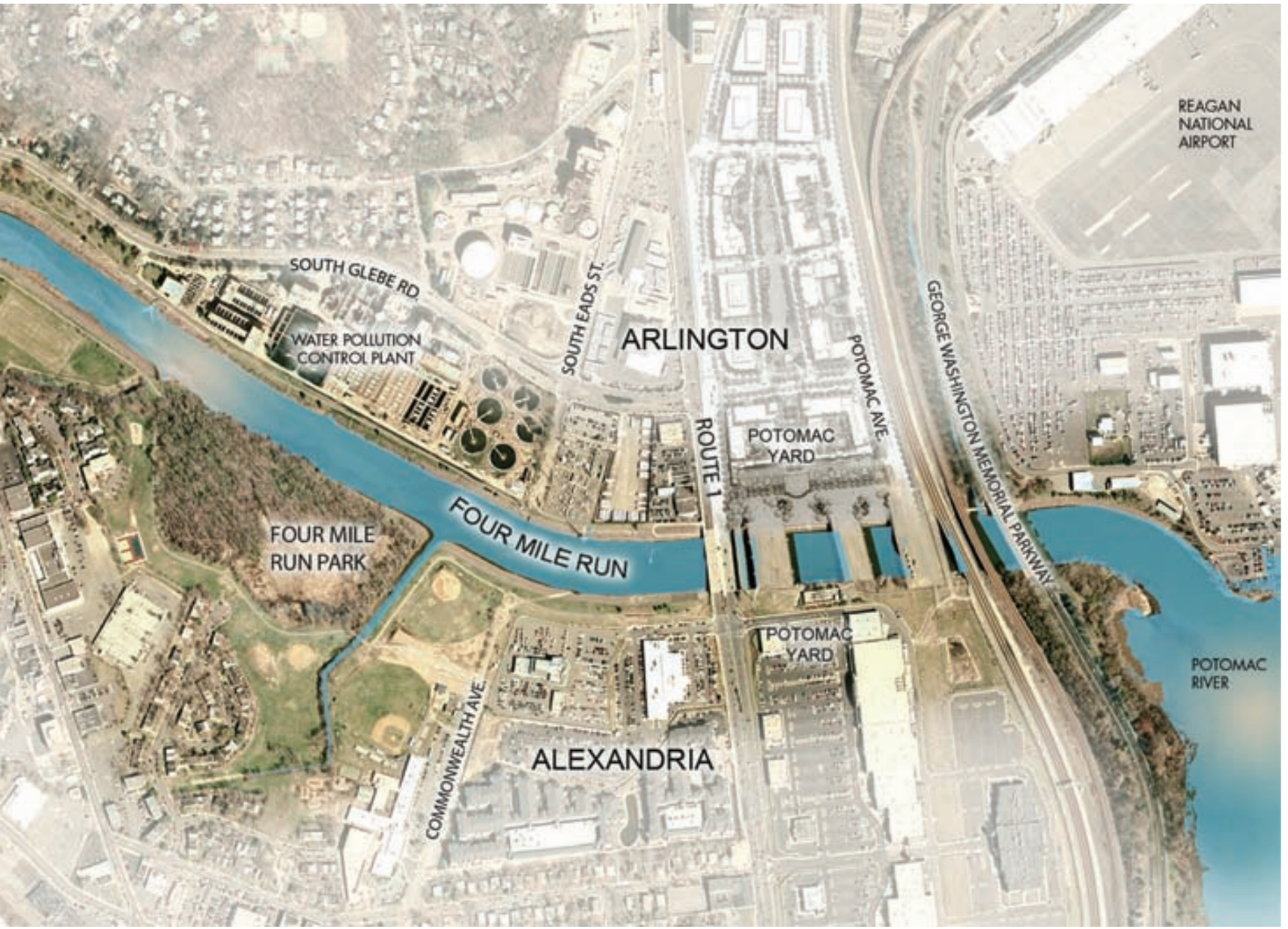

FOUR MILE RUN STREAM CORRIDOR

FIGURE 1.1

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How to Use the Guidelines

The Four Mile Run Design Guidelines document includes three primary sections. The first section, "Master Plan Recommendations" (Chapter 3), summarizes the key statements from the *Four Mile Run Restoration Master Plan (March 2006)* that set a design direction and establish the basis for this publication. As noted in Chapter 3, the Design Guidelines is a companion document to the Master Plan. It is anticipated that users be familiar with the Master Plan to fully understand the complexity of the stream corridor and its natural/human systems.

The second section, "Design Language / Design Themes" (Chapter 4), explains the reasoning behind the development of a design language and describes the qualitative characteristics of the language developed for the Four Mile Run stream corridor. This section begins where Chapter 5 of the Master Plan leaves off and provides greater clarity regarding the visual character, materiality, and functionality of the Master Plan vision. Chapter 4 also describes several overarching design themes that evolved during the Master Plan process. These themes, which address the less tangible concepts of movement and unity, apply to the design elements independent of the design language. This section ultimately helps users of this document understand the purpose behind many of the recommendations.

The third section, "Design Guidelines" (Chapter 5), addresses a wide array of elements within and adjacent to the Four Mile Run stream corridor. Categorized under the same three design theme headings first established in the Master Plan Green Design Principles, Public Spaces, and Built Features these elements represent the physical components that are central to the Master Plan vision.

FORMAT OF THE DESIGN GUIDELINES

The Design Guidelines document uses narratives, maps, diagrams, illustrations and photographs to communicate the visual and physical qualities envisioned for each design element. Each element or group of elements is preceded by a narrative that explains the topics, restates the applicable design principles from the Master Plan, and describes the overarching goals the guidelines intend to achieve. Where the Master Plan has already identified a general location of the design elements, a highlighted map assists the user in understanding where each element fits into the overall scheme.

The description of each element includes the design criteria, which is general in some cases to allow the greatest degree of flexibility, and is more specific in other instances. The document also presents design examples that meet the criteria, where appropriate.

A combination of photographs and illustrations depict the criteria for each element, depending on the specificity of the criteria. These depictions show the character, quality, and, in some cases, dimensions intended for a particular design element.

The following two pages illustrate typical page layouts used in Chapter 5. They are provided as a guide to assist users in locating and understanding the detailed recommendations addressed in the Design Guidelines section of this document.

It is anticipated that users be familiar with the Master Plan to fully understand the complexity of the stream corridor and its natural/human systems.

2 HOW TO USE THE GUIDELINES

Sample Page Layouts Used in the Design Guidelines

DESIGN PRINCIPLE: The document is organized consistent with three central design themes originally established in the Master Plan. Each section of the Guidelines begins with the name and description of a design principle.

MASTER PLAN DIAGRAM: Selected diagrams from the Master Plan show approximate locations of each design element addressed by the Guidelines.

PUBLIC SPACES

TRAILS, NODES, PROMENADES AND PLAZAS

This section of the Design Guidelines will establish criteria and provide options for the detail design of recreational spaces and urban outdoor gathering spaces as well as the trails that link them together.

The outdoor public spaces within Four Mile Run offer a wide variety of recreational experiences. From high-intensity athletic facilities to quiet retreats from the urban environment, there are many options for people to enjoy. The Master Plan suggests a range of improvements to enhance the existing facilities and link them as a cohesive network of open space. The Master Plan also calls for the creation of new public spaces where people can gather and enjoy the restored stream corridor.

This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of trails, roads, bridges and other public spaces. It is conceptual and does not represent the full range of opportunities that may exist.

Locations of nodes and overlooks will occur at path intersections and where future designers determine there to be an opportunity. Some general locations for seating nooks and overlooks were identified in the Master Plan and are shown on Figure 5.5.

FIGURE 5.4

EXAMPLE OF TYPICAL MAP LAYOUT

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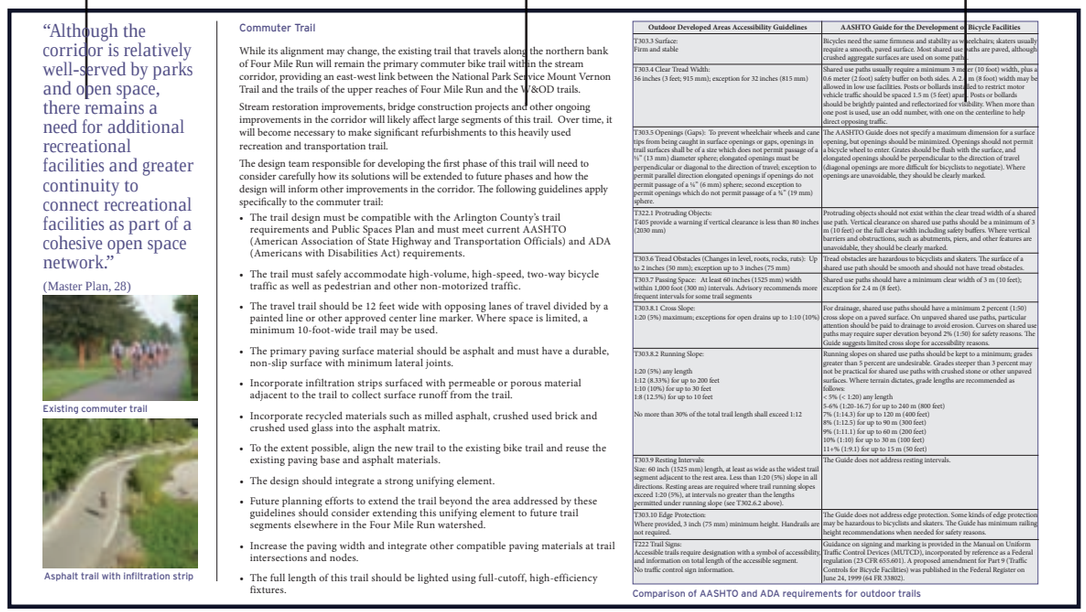
SIDEBAR ILLUSTRATIONS: Photos, graphics, quotations and captions augment the written guidelines.

DESIGN ELEMENT: Each design element addressed by the Guidelines includes a written narrative and a list of criteria.

SUPPLEMENTAL MATERIAL: Highlighted areas provide additional information to support the narrative.

CONCEPT EXAMPLES: Each design element is illustrated by photographs and/or graphic depiction.



"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 facilities as part of a cohesive open space network."

(Master Plan, 28)

Existing commuter trail

Asphalt trail with infiltration strip

Commuter Trail

While its alignment may change, the existing trail that travels along the northern bank of Four Mile Run will remain the primary commuter bike trail within the stream corridor, providing an east-west link between the National Park Service Mount Vernon Trail and the trails of the upper reaches of Four Mile Run and the W&OD trails.

Stream restoration improvements, bridge construction projects and other ongoing improvements in the corridor will likely affect large segments of this trail. Over time, it will become necessary to make significant refurbishments to this heavily used recreation and transportation trail.

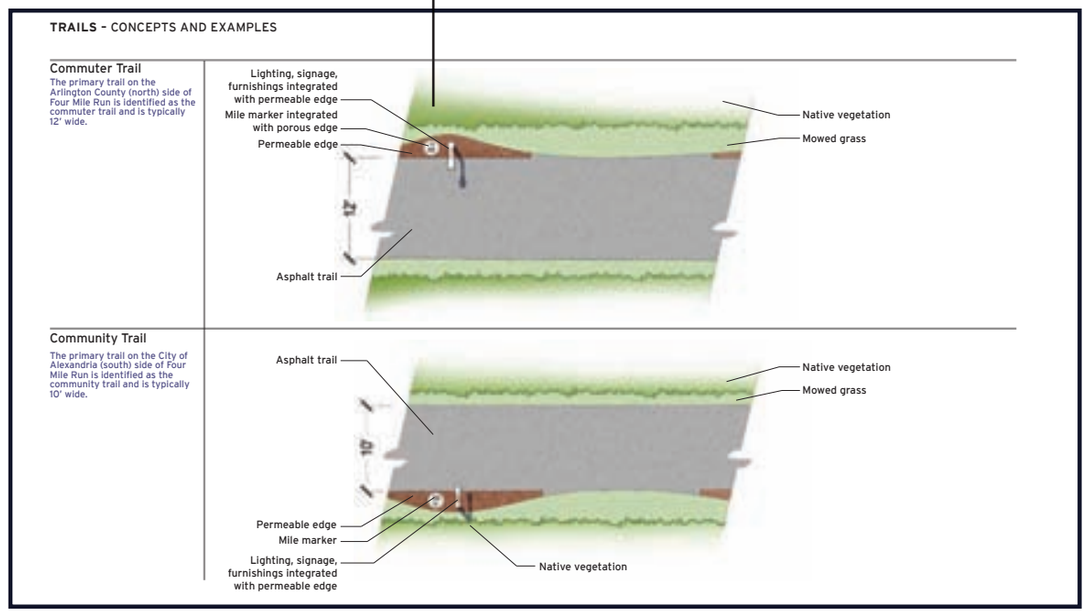
The design team responsible for developing the first phase of this trail will need to consider carefully how its solutions will be extended to future phases and how the design will inform other improvements in the corridor. The following guidelines apply specifically to the commuter trail:

- The trail design must be compatible with the Arlington County's trail requirements and Public Spaces Plan and must meet current AASHTO (American Association of State Highway and Transportation Officials) and ADA (Americans with Disabilities Act) requirements.
- The trail must safely accommodate high-volume, high-speed, two-way bicycle traffic as well as pedestrian and other non-motorized traffic.
- The travel trail should be 12 feet wide with opposing lanes of travel divided by a painted line or other approved center line marker. Where space is limited, a minimum 10-foot-wide trail may be used.
- The primary paving surface material should be asphalt and must have a durable, non-slip surface with minimum lateral joints.
- Incorporate infiltration strips surfaced with permeable or porous material adjacent to the trail to collect surface runoff from the trail.
- Incorporate recycled materials such as milled asphalt, crushed used brick and crushed used glass into the asphalt matrix.
- To the extent possible, align the new trail to the existing bike trail and reuse the existing paving base and asphalt materials.
- The design should integrate a strong unifying element.
- Future planning efforts to extend the trail beyond the area addressed by these guidelines should consider extending this unifying element to future trail segments elsewhere in the Four Mile Run watershed.
- Increase the paving width and integrate other compatible paving materials at trail intersections and nodes.
- The full length of this trail should be lighted using full-cutoff, high-efficiency fixtures.

Outdoor Developed Areas Accessibility Guidelines	AASHTO Guide for the Development of Bicycle Facilities
T303.3 Surface: Firm and stable	Bicycles need the same firmness and stability as wheelchairs; skaters usually require a smooth, paved surface. Most shared use paths are paved, although crushed aggregate surfaces are used on some paths.
T303.4 Clear Tread Width: 36 inches (3 feet; 915 mm); exception for 32 inches (815 mm)	Shared use paths usually require a minimum 3 meter (10 foot) width, plus a 0.6 meter (2 foot) safety buffer on both sides. A 2.4 m (8 foot) width may be allowed in low use facilities. Posts or bollards installed to restrict motor vehicle traffic should be spaced 1.5 m (5 feet) apart. Posts or bollards should be brightly painted and reflectorized for visibility. When more than one post is used, use an odd number, with one on the centerline to help direct opposing traffic.
T303.5 Openings (Gaps): To prevent wheelchair wheels and cane tips from being caught in surface openings or gaps, openings in trail surfaces shall be of a size which does not permit passage of a ½" (13 mm) diameter sphere; elongated openings must be perpendicular or diagonal to the direction of travel, exception to permit parallel direction elongated openings if openings do not permit passage of a ¼" (6 mm) sphere; second exception to permit openings which do not permit passage of a ¾" (19 mm) sphere.	The AASHTO Guide does not specify a maximum dimension for a surface opening, but openings should be minimized. Openings should not permit a bicycle wheel to enter. Grates should be flush with the surface, and elongated openings should be perpendicular to the direction of travel (diagonal openings are more difficult for bicyclists to negotiate). Where openings are unavoidable, they should be clearly marked.
T322.1 Protruding Objects: T405 provide a warning if vertical clearance is less than 80 inches (2030 mm)	Protruding objects should not exist within the clear tread width of a shared use path. Vertical clearance on shared use paths should be a minimum of 3 m (10 feet) or the full clear width including safety buffers. Where vertical barriers and obstructions, such as abutments, piers, and other features are unavoidable, they should be clearly marked.
T303.6 Tread Obstacles (Changes in level, roots, rocks, ruts): Up to 2 inches (50 mm); exception up to 3 inches (75 mm)	Tread obstacles are hazardous to bicyclists and skaters. The surface of a shared use path should be smooth and should not have tread obstacles.
T303.7 Passing Space: At least 60 inches (1525 mm) width within 1,000 foot (300 m) intervals. Advisory recommends more frequent intervals for some trail segments	Shared use paths should have a minimum clear width of 3 m (10 feet); exception for 2.4 m (8 feet).
T303.8.1 Cross Slope: 1:20 (5%) maximum; exceptions for open drains up to 1:10 (10%)	For drainage, shared use paths should have a minimum 2 percent (1:50) cross slope on a paved surface. On unpaved shared use paths, particular attention should be paid to drainage to avoid erosion. Curves on shared use paths may require super elevation beyond 2% (1:50) for safety reasons. The Guide suggests limited cross slope for accessibility reasons.
T303.8.2 Running Slope: 1:20 (5%) any length 1:12 (8.33%) for up to 200 feet 1:10 (10%) for up to 30 feet 1:8 (12.5%) for up to 10 feet No more than 30% of the total trail length shall exceed 1:12	Running slopes on shared use paths should be kept to a minimum; grades greater than 5 percent are undesirable. Grades steeper than 3 percent may not be practical for shared use paths with crushed stone or other unpaved surfaces. Where terrain dictates, grade lengths are recommended as follows: < 5% (< 1:20) any length 5-6% (1:20-16.7) for up to 240 m (800 feet) 7% (1:14.3) for up to 120 m (400 feet) 8% (1:12.5) for up to 90 m (300 feet) 9% (1:11.1) for up to 60 m (200 feet) 10% (1:10) for up to 30 m (100 feet) 11+% (1:9.1) for up to 15 m (50 feet)
T303.9 Resting Intervals: Size: 60 inch (1525 mm) length, at least as wide as the widest trail segment adjacent to the rest area. Less than 1:20 (5%) slope in all directions. Resting areas are required where trail running slopes exceed 1:20 (5%), at intervals no greater than the lengths permitted under running slope (see T302.6.2 above).	The Guide does not address resting intervals.
T303.10 Edge Protection: Where provided, 3 inch (75 mm) minimum height. Handrails are not required.	The Guide does not address edge protection. Some kinds of edge protection may be hazardous to bicyclists and skaters. The Guide has minimum railing height recommendations when needed for safety reasons.
T222 Trail Signs: Accessible trails require designation with a symbol of accessibility, and information on total length of the accessible segment. No traffic control sign information.	Guidance on signing and marking is provided in the Manual on Uniform Traffic Control Devices (MUTCD), incorporated by reference as a Federal regulation (23 CFR 655.601). A proposed amendment for Part 9 (Traffic Controls for Bicycle Facilities) was published in the Federal Register on June 24, 1999 (64 FR 33802).

Comparison of AASHTO and ADA requirements for outdoor trails

EXAMPLE OF TYPICAL NARRATIVE LAYOUT



EXAMPLE OF TYPICAL CONCEPT ILLUSTRATIONS

Four Mile Run Restoration Master Plan

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3 MASTER PLAN RECOMMENDATIONS

Master Plan Recommendations

The Master Plan provides a comprehensive vision for the future of Four Mile Run that transforms the stream corridor in a variety of ways. The recommended improvements address the central themes of environmental quality, open space amenities, transportation options and overall quality of urban life, as well as the creation of many new destinations and activities.

Master Plan highlights include emphasis on the "greening" of the Four Mile Run stream corridor by restoring the balance between nature and people, ecology and urban places. Where a straightened and channelized stream once rushed along concrete flumes and gabions, the restored stream is envisioned to meander gracefully through wetlands and past green and stabilized stream banks. Flood protection remains the paramount concern in a way that is compatible with both nature and people. The Master Plan proposes open space, plazas, public greens, promenades and secluded pockets of natural habitat zones.

Transportation improvements make it easier to access Four Mile Run and traverse through the area using a broad range of transportation modes. The Master Plan fosters urban vitality in the stream corridor's urban nodes and along its edges. A once forgotten corridor and barrier between communities, Four Mile Run is re-imagined as a front door to Alexandria and Arlington. Throughout the stream corridor, a variety of activities and destinations provide natural areas and outdoor recreation to cultural and educational attractions to commercial and dining venues.

This chapter summarizes the major recommendations that comprise the Master Plan vision for Four Mile Run. Grouped according to "in-stream" and "near-stream" recommendations, these components of the Master Plan provide the basis for the design guidelines elaborated on in subsequent sections of this document.

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.

FOUR MILE RUN RESTORATION MASTER PLAN

ILLUSTRATIVE PLAN


SOUTH GLEBE RD.
WATER POLLUTION CONTROL PLANT
SOUTH EADS ST.
ARLINGTON
POTOMAC AVE.
GEORGE WASHINGTON MEMORIAL PARKWAY
MT. VERNON AVE.
FOUR MILE RUN
ROUTE 1
POTOMAC YARD
FOUR MILE RUN PARK
POTOMAC YARD
COMMONWEALTH AVE.
ALEXANDRIA
BRIDGES
A. GEORGE WASHINGTON MEMORIAL PARKWAY
B. METRORAIL
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. I-395
M. SHIRLINGTON ROAD

FIGURE 3.1

In-Stream

HYDROLOGY AND FLOOD CONTROL: THE CORE OF THE PLAN

Create a "dynamically stable stream channel" using natural stream channel design techniques. (Master Plan, 45)

The design approach for the in-stream portion of Four Mile Run creates river channel characteristics that are more natural and stable. By emulating a natural channel—albeit modified in order to minimize common problems in urban channels—the Four Mile Run stream corridor will be "dynamically stable" and provide continued protection from floods while adding habitat diversity. To achieve a dynamically stable stream channel, the Master Plan recommends a multistage channel configuration and creates a low-flow channel with an "inset floodplain" that is inundated during relatively small storm flow events.

The Master Plan proposes to remove as many of the existing gabions and flood walls as possible without compromising flood control and bank protection. Instead, the Master Plan recommends more natural stabilization solutions, including a variety of bioengineering techniques and appropriate bank reconfiguration. The outcome of the Hydrologic and Hydraulic (H & H) modeling study, conducted subsequent to the completion of the Master Plan, will determine the extent to which the gabion and floodwall replacement may occur.

The Master Plan recommendations seek to minimize the amount of local maintenance required to achieve stream channel goals while maximizing other benefits of the restoration, such as restoring diverse microhabitats and enhancing recreational opportunities and public access to the stream.

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

Incorporate "green design" principles. (Master Plan, 52)

A successful and 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 "green design" principles, such as stormwater management, can help minimize the impact of surrounding land use and address both the quality and quantity of the water flowing into Four Mile Run. In concept, these techniques have the potential to improve aesthetics of the landscape. The Master Plan recommends a range of stormwater management techniques—including daylighting, bioretention, permeable pavement, green roofs, stormwater planters, litter control, and underground storage—and proposes locations throughout the stream corridor where one or more of these techniques may improve ecology and aesthetics. The Master Plan recommends reinforcing stormwater management practices already in place in Alexandria and Arlington while establishing Four Mile Run as a model of stormwater management for other communities.

VEGETATION AND HABITAT: ENRICHING LIFE ALONG FOUR MILE RUN

Improve the stream corridor ecosystem. (Master Plan, 53)

A major recommendation of the Master Plan is to reestablish vegetation that once lined the stream and existed in lowland wetlands areas, but has since disappeared or been colonized by invasive species. Ecosystem restoration—including preservation and enhancement of existing vegetation and 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 animals and birds.

The Master Plan recommends preservation and enhancement of existing native vegetation, inventory and eradication of invasive species and the introduction of new plantings to restore native vegetation. It also recommends coordination of vegetation recommendations with modeling of the flood control channel to ensure that proposed vegetation neither hinders the stream's flood conveyance potential nor requires substantial maintenance. The Master Plan also recommends restoration of marshland, noting its potential to provide additional flood protection. The Master Plan includes a list of representative species for each type of vegetative community, such as:

- Existing Emergent Tidal Vegetation
- Existing Floodplain Forest
- Existing Upland Forest
- Riparian Edge
- Freshwater Floodplain Planting
- Freshwater Wetland Cells
- Bank Stabilization Planting
- Tidal Wetland Bars
- Proposed Emergent Tidal Vegetation

Near-Stream

CIRCULATION AND CONNECTION: MAKING THE CORRIDOR ACCESSIBLE

Create a place for people to reconnect with water and nature within an urban context. (Master Plan, 58)

Another major recommendation of the Master Plan is to provide a greater range of enjoyable, safe, easy-to-use, beautiful connections to and across the stream corridor. The concept of "accessibility," suggests several improvements: creation of a continuous and connected trail system along the stream; a series of bridges that 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 stream corridor.

Non-Motorized Access

Provide a continuous and linked trail system. (Master Plan, 58)

The Master Plan proposes scenic, attractive and continuous trail systems—accommodating pedestrians, joggers and bicyclists—along both sides of the stream corridor. On the Arlington side, this trail is already in place and with some modifications, 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 trail that may 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 stream 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 Master Plan recommends that all new trail construction include either porous, permeable materials and/or adjacent filtration strips to reduce runoff into Four Mile Run.

Create multiple opportunities for physically linking the communities. (Master Plan, 59)

The Master Plan calls for creation of a series of new pedestrian/bicyclist bridges along the stream corridor that share a consistent and distinctive design theme. The Master Plan also recommends span-structure designs for all new bridges to minimize the impact on the stream.

Specific recommendations include the reuse of an inactive railroad bridge at the eastern end of the stream corridor for plantings, recreational uses, events and temporary retail amenities, such as vendor carts. New pedestrian/bicyclist bridges are proposed at other key locations: to link Eads Street to 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 connect with businesses along South Glebe Road; and at the confluence of Long Branch and Four Mile Run. A new vehicular bridge is proposed east of the existing West Glebe Road Bridge that would be converted to, or replaced by a pedestrian and bicycle bridge. 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, recreational linkages between the two communities.

Emphasize safe and secure access. (Master Plan, 61)

The Master Plan emphasizes the need for safe and secure access to the stream. The recommended improvements will create a safe pedestrian environment on surrounding streets, including a redesign of South Glebe Road to calm traffic and improve pedestrian crossing. The Master Plan also proposes improvements that enhance the feeling of safety through the installation of new lighting and by increasing the number of visitors to the stream and therefore the number of "eyes on the corridor."

Motorized Access

A parkway system that is compatible with the corridor. (Master Plan, 62)

The Four Mile Run stream corridor is surrounded by heavily traveled roads, for which the Master Plan recommends improvements that establish a parkway character. South Glebe Road divides the stream corridor from the residential areas to the north, would be transformed into a parkway setting with consistent rows of street trees and a planted median. New street crossing demarcations, special paving, signage and enhanced lighting would establish the road as a shared place for pedestrians, bicycles and vehicles. These improvements calm traffic and make the street more attractive, but are not anticipated to affect South Glebe Road's current capacity.

Other recommended improvements include extending the parkway character of South Glebe Road to a newly created thoroughfare (Potomac Avenue) within the Potomac Yard development. In addition, the area underneath the I-395 overpass is enlivened by reflective surface design and lighting enhancements to create a welcoming gateway along the trails that connect Shirlington to a more naturalized shoreline to the east.

New intersections to increase access and traffic flow. (Master Plan, 62)

The Master Plan proposes reconfiguration of the intersection of West and South Glebe Roads to eliminate traffic back-ups and resulting air pollution problems currently generated here. At this location the bridge is realigned to create a new crossing that is more direct and minimizes turns and bottlenecks. The existing bridge is altered or replaced with a pedestrian and bicycle-only span bridge. That will be developed with the design language of other bridges within the stream corridor. The new intersection configuration offers an added community benefit by opening up land for new green spaces along the stream.

A balanced solution to parking. (Master Plan, 62)

The Master Plan proposes minimizing the impact of parking lots along the stream corridor while, concurrently, providing parking for activities typically accessed by cars. At major urban and activity nodes, the Master Plan recommends addition of discrete parking areas as well as shared parking opportunities that incorporate features such as permeable surface materials, biofiltration areas to treat stormwater runoff and buffer plantings to absorb surface runoff and soften visual impacts.

Transit Access

The Master Plan recommends improved public transit access to Four Mile Run, limiting the number of vehicles along the stream corridor, . The Master Plan proposes making accommodations to existing transit service in the area as well as identifying possible new transit opportunities that may be explored by Arlington County and the City of Alexandria. (While there are no immediate plans or funding for new transit service, the Master Plan recommendations are compatible with future transit opportunities.)

Boat Access

The Master Plan proposes canoe and kayak launching areas and non-motorized boat ramps to encourage use of non-motorized boats within the stream corridor. The non-motorized boating experience will also be enhanced by the Master Plan proposals to improve the natural qualities of the stream and the architectural design of bridges.

URBAN FORM AND NEIGHBORHOODS: BUILDING COMMUNITY AROUND THE STREAM

Develop urban life opportunities along the Four Mile Run corridor. (Master Plan, 64)

The Master Plan recommends that urban form include "big picture" land use concepts and more fine-grain design details. Big-picture concepts center on the idea of urban nodes, as main centers of activity, interspersed with natural areas to achieve a balance between natural and urban environment throughout the stream corridor. The Master Plan proposes consolidating urban activity in existing urban nodes and proposed redevelopment areas while returning surrounding areas to nature.

From "Utility Corridor" to Front Door and Focal Place

Establish a balance between natural and urban areas. (Master Plan, 65)

The Master Plan recommends reorienting existing and future development toward the stream to engage it in a positive way and physically and psychologically reconnect Four Mile Run to surrounding neighborhoods. Key opportunities to establish vibrant urban nodes and urban edges include ongoing and proposed development in areas adjacent to and nearby the study area, such as 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. (Master Plan, 65)

The Master Plan proposes a transformation of 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 enhancing both the natural and built character of the stream cooridor and edges. This involves improving the quality of building design and orientation, adjacent public spaces and other elements of the built landscape such as lighting, fencing, bridge crossings and walkways.

Remove barriers and foster connections between stream and community. (Master Plan, 65)

The Master Plan proposes changes in land use to improve physical access to the stream and connection between nearby neighborhoods and Four Mile 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. (Master Plan, 66)

The Master Plan recommends opportunities to reinforce and advance the goals articulated as part of prior planning efforts in Arlington and Alexandria. A summary of these efforts appears in Appendix 2 in Chapter 6 of the Design Guidelines.

Establish additional guidelines for design and development. (Master Plan, 66)

The Master Plan recommends that Alexandria and Arlington consider establishing design guidelines to provide direction for new construction and development associated with Four Mile Run. This recommendation provides the basis for this document.

Promote equity and preserve diversity by increasing the supply of affordable housing. (Master Plan, 66)

The Master Plan underscores the importance of Four Mile Run remaining a community asset that is enjoyed by all residents. The Master Plan identifies possible areas for redevelopment and new affordable housing development.

RECREATION: CREATING A BALANCE

Create a balance between the natural elements of a restored stream corridor and urban activity areas in order to generate a lively, safe and well-used public resource. (Master Plan, 67)

The Master Plan recommends creation of place that people will enjoy for relaxation and recreation, that is in balance with environmental restoration goals for the Four Mile Run stream corridor. The Master Plan emphasizes that restoring environmental qualities of the stream and its edges to produce a place that people will visit and explore. The Master Plan encourages retaining and enhancing existing recreational resources while adding new recreational opportunities that are appropriate to their stream corridor setting.

The More Subdued Side of Recreation

The enjoyment of natural habitat areas within an urban context. (Master Plan, 68)

With exception of urban nodes, the Master Plan recommends transforming the Four Mile Run stream corridor into a natural habitat with plant communities that vary from wetlands to upland and floodplain forests. The Master Plan recommendations dramatically improve and expand the existing habitat area and pedestrian access throughout the stream corridor.

A place for contemplation, views and passing time. (Master Plan, 68)

Along the length of the stream corridor, proposed small seating areas and overlooks provide opportunities for contemplation, reading, enjoying nature and appreciating the views up and down stream. The Master Plan recommends picnic areas to encourage visitors to interact with the stream and spend time there, including more than 14 acres of passive, green open space.

A place for "digging in" and creating community gardens. (Master Plan, 68)

The Master Plan proposes creation of community gardens, consistent with Alexandria and Arlington traditions. Specific recommendations include a section of gardens at the edge of the Hume Springs community in Alexandria. These gardens will serve members of that community and others and will provide an additional green buffer between the residential area and the enhanced, reconnected Four Mile Run.

Responding to the Need for More Active Pursuits

Meeting the recreational needs of a growing and diverse community. (Master Plan, 68)

The Master Plan recommends reconfigurating the existing sports fields in Alexandria's Four Mile Run Park, reorienting one ballfield in order to enhance the proposed nature/cultural center and associated boat access. Realization of the *Arlandria Neighborhood Plan* will enable reorientation of the existing multipurpose field to accomodate an adjacent ballfield, and provide opportunity to connect with wetland areas in the southern section of Four Mile Run Park. The Master Plan recommends the creation of one additional multipurpose field on land that becomes available with the relocation of the South and West Glebe Roads 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. The Master Plan also recommends that all ball fields—whether existing, new or renovated—be surrounded by edge plantings to absorb runoff.

Other active recreation recommendations include expansion of the basketball and tennis courts in the recreation area along the east side of Mount Vernon Avenue and creation of multiple linkages between the pedestrian/bicycle trails along the north and south sides, to provide residents with convenient access to recreational facilities on both sides of the stream corridor.

Bring people down to the water to have fun: walking, biking, fishing, boating and climbing. (Master Plan, 69)

The Master Plan proposes improvements to the stream corridor that will attract visitors and encourage them interact with the Four Mile Run stream corridor. The continuous trail system on both sides of the stream, includes enhancement of the trail on the north side and the creation of a continuous trail on the south, will provide local and regional visitor access. The stream corridor will provide opportunities for a variety of other recreational pursuits including; fishing, kayaking and canoeing (boats may be launched and/or rented on-site) and climbing boulders placed along the northern edge of the stream in a new shoreline park created by the realignment of South Glebe Road.

But what about the kids? (Master Plan, 69)

The Master Plan recommends a variety of family-oriented recreational facilities, including biking and walking to ball-playing, picnicking, boating, and touring. The Master Plan proposes 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 include interactive water features and a sprayground, with stepping stones leading across the stream to an urban plaza area on the south side.

The Urban Recreational Experience

Incorporate community vitality into the life of the stream corridor. (Master Plan, 69)

The Master Plan recommends development of two urban nodes that become "bookends" of the stream corridor and offer a variety of recreational experiences. On the eastern end, the Master Plan proposes creation of a park on both sides of the stream at Potomac Yard, linked by a railroad bridge that is adaptively-reused "green" bridge. The park provides water access with a series of pervious grass steps that also function as seating. The park includes visible stormwater management and a "performance pontoon" tethered to the shoreline. The bridge includes an "experience tower" that affords visitors a spectacular view of the stream and serves as an architectural focus with interpretive information and other features (such as a café and boating/bike rentals). On the western end of the stream corridor, the Master Plan proposes an urban edge of walkways and promenades that will invite Shirlington visitors to stroll or bike along the water.

At the Northern end of Mount Vernon Avenue, the Master Plan recommends the creation of additional recreational amenities on both sides of the stream. On the southern side, in addition to the multipurpose fields described above, the Master Plan proposes an urban open space with lawn and trees, a plaza events area, and a playground facility. This space will be used for community festivals, farmers' markets, concerts, family gatherings and other community-related activities. A stepping-stone trai stream crossing or a new pedestrian/bicyclist bridge, will enable entrance to a park featuring an interactive sprayground, water features, extensive green open space areas and water-related interpretive elements.

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. (Master Plan, 71)

The Master Plan recommends improvements within the Four Mile Run stream corridor that provide the community and region with a living classroom focused on ecology, stream geomorphology, water quality, habitat protection and restoration. Considering the length of the stream corridor and the diversity of those likely to use it, it is important to create interpretive opportunities in a variety of formats and languages. A tacit approach to learning will be emphasized.

Opportunities for a Continuous "Stream of Learning"

Create a learning environment along the full extent of the Four Mile Run corridor. (Master Plan, 72)

The Master Plan proposes opportunities for learning at points along the entire stream corridor, particularly at primary entrances and in places where people will congregate, including trailheads, parks, overlooks, urban nodes and natural/habitat areas. Interpretive elements may consist of signs, display boards, pavement markings, artwork, water features, and play structures. A specific interpretive program for the Four Mile Run stream corridor is recommended in conjunction with the design of the various stream corridor elements.

Emphasize the joy of learning about the corridor and the community. (Master Plan, 72)

In addition to the interpretive sites throughout the stream corridor, several proposed facilities are dedicated to interpreting the stream corridor and 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 could address themes such as stream ecology and the benefits of the restoration project, the history of the area and its cultural diversity, and demonstrations of how bioretention, rain gardens, rain barrels, and other methods of stormwater management can positively affect the quality of Four Mile Run. In addition, the City has requested that the Master Plan consider locating a small recycling deposit center at this site, which could be incorporated into the interpretive "lessons" of the center.

The second location, the community open space area adjacent to Mount Vernon Avenue, provides a venue for educational and interpretive programs, including those that can be incorporated into festivals and events as well as an "event/information box" recommended as part of this space. A third location, the demonstration wetland created between the Arlington County Water Pollution Control Plant and the stream, will provide cleansing for some of the plant's discharge and serve as an opportunity to educate the public on wetland functions. At a fourth location, an experience tower and "performance pontoon" at the Potomac Yard site, provide opportunities for interpretive elements through exhibits, programs, view interpretation, experiments and performances.

Establish a partnership with local schools. (Master Plan, 72)

The Master Plan recommends that Four Mile Run will be used as a "laboratory" for schools in each jurisdiction. The stream corridor provides opportunity to explore environmental, cultural, historic and social issues that are part of the Alexandria and Arlington school curricula.

FINAL DRAFT

4 DESIGN LANGUAGE

Design Language

From its uppermost tributaries to its mouth at the Potomac River, Four Mile Run extends nine miles through Falls Church, Fairfax County, Alexandria and Arlington. The two-mile section that these guidelines address is dominated by overhead utility lines, urban infrastructure and flood control structures, which in addition to the variable terrain and diverse landscape conditions, make it difficult to recognize a distinct sense of place.

When seen from the network of streets and bridges that intersect the stream or from the trails and roads that pass along its edges, the Four Mile Run stream corridor offers few visual clues to suggest continuity along its length. Future improvements must create continuity within the stream corridor and a sense of unity between the Arlington and Alexandria communities.

This section of the Design Guidelines establishes the visual identity for the stream corridor. It provides guidance to architects, landscape architects, urban planners, engineers, designers and artists who will be working within or adjacent to the stream corridor.

The guidelines establish a design language specific to Four Mile Run. Design language is the underlying quality that connects all of the design elements through the use of compatible materials, forms, finishes, physical treatments and implementation strategies. The design language does not represent a stylie, movement or trend and is flexible to respond to evolving conditions over time.

The concepts for development of the design language is followed by detailed descriptions and illustrations.

Future improvements must create continuity within the stream corridor and a sense of unity between the Arlington and Alexandria communities.

RATIONALE OF THE DESIGN LANGUAGE

Master Plan Baseline

The Master Plan identifies beginnings of a design language as the baseline for these Design Guidelines.

Chapter 5 of the Master Plan begins to shape a basic design language; descriptions, illustrations, and photographs establish the design elements within Four Mile Run. Characteristics of the Master Plan design language include:

- Modern technology and materials
- Complimentarty design elements
- Design elements that complement the existing built elements
- Materials of a similar family
- Quality of detail of a similar standard
- Integration of sustainable elements
- Ease of maintenance

Images from the Master Plan that convey the baseline design language

Selected images of Atelier Dreiseitl / Waterscapes' built work

RATIONALE OF THE DESIGN LANGUAGE

Movement of Water as Formgiver

The Master Plan also incorporates input from German designer Herbert Dreiseitl. Through his work with Atelier Dreiseitl / Waterscapes, Mr. Dreiseitl has designed internationally recognized landscapes that integrate water in public, urban spaces. The Design Guidelines are founded in this idea and emphasize the following principles:

- Water in its many forms may be a source of human inspiration.
- Design should express human relationship with water.
- Moving water shapes the landscape in a way that may be expressed as an urban construct.

RATIONALE OF THE DESIGN LANGUAGE

Unifying Elements

The Master Plan proposes complementary design elements that provide unity and cohesiveness to Four Mile Run. The Design Guidelines document expands on this theme by identifying additional unifying elements:

- Continuous, linear elements that link diverse open spaces
- Repeating, recognizable features that provide visual connections
- Architectural components of a complementary character
- Planting design that establishes a sense of place
- Lighting that unifies the corridor at night

Selected elements that unify outdoor spaces

DESIGN LANGUAGE

The design language developed for Four Mile Run evolved by blending two distinct but compatible design aesthetics. The first, "Infrastructure Re-use," borrows form, material and an overall aesthetic from the existing utilitarian structures, such as the transmission towers or flood control structures, and elevates these elements to a central design theme that has both function and recognizable visual quality. The second, "Modern-Rustic," develops an intentionally modern design aesthetic for Four Mile Run, but incorporates materials with less refined qualities. This aesthetic is visually compatible with the natural features and ecological systems that exist in the stream corridor.

The basis for each of these ideas is described separately and summarized jointly as a composite design language.

Infrastructure Re-Use

Infrastructure Re-use acknowledges that existing transportation, utility and flood control structures are beneficial components of an urban community and that their presence in the stream corridor is inevitable. The Master Plan makes strong recommendations to minimize the impact of these structures. In some cases elimination is proposed, however this may be prohibitive due to cost or timing. This design language establishes an aesthetic that celebrates acknowledgement and re-use of infrastructure. The existing transmission towers, bridges, flood control walls, Water Pollution Control Plant and power stations were principally designed for function, however they offer conditions that may provide an opportunity for public art.

The electrical transmission towers that dominate the stream corridor can also be interpreted as a unifying element and a visual clue to the location of the stream. As sculptural forms, their repeating tapered profile creates striking silhouettes against the sky. The scale and continuity of the floodwalls and levees define the edges of the stream corridor, and their tectonic character establishes a strong situational framework. The various bridges provide promontories for dramatic views from above, and create intriguing urban spaces below, while connecting surrounding neighborhoods to the stream.

The Water Pollution Control Plant has the potential to be transformed by the community into a positive civic landmark. The treated water outfall, where treated water enters the stream provides a significant opportunity for public education and interpretation of the facility's important environmental processes. The electrical substations that flank the stream corridor emit visual interpretive energy that is characterized by their network of dynamic sculptural forms that should be expressed rather than hidden. Over time, as technology evolves, it is anticipated that the appearance of this infrastructure will change. It is impossible to predict what changes will occur, however it is assumed that function and practicality will continue to be the basis for design of these elements.

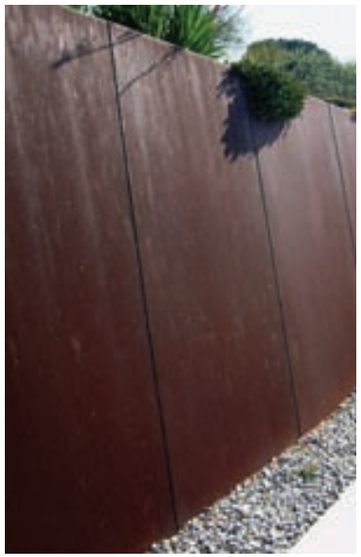
Common among these elements are their bold shapes, grand scale and repetition of form. Detailing is minimized to only the most essential connections, fittings and structural conditions. In some cases, such as the bridge embankments at the George Washington Memorial Parkway, minimal use of stone cladding has a dramatic positive impact on the perception of structure. Generally, the materials incorporated into these utilitarian structures are practical and typically require minimal maintenance. Some examples include:

- Galvanized steel
- Cast-in-place concrete
- Precast concrete components
- Unpainted masonry units
- Glazed ceramic
- Stone cladding

An existing transmission tower at Four Mile Run

Drainage structures and other elements of infrastructure exist throughout the stream corridor.

"Materials should be chosen from a predetermined family of materials. The quality of detail should be of a similar standard throughout the corridor." (Master Plan, 86)



A retaining wall made of weathering steel and an arcade constructed of formed concrete illustrate modern form and un-refined materials.

New architectural and built elements for Four Mile Run that complement these characteristics would be straightforward and practical in design. Their forms should consist of strong geometric shapes on a scale consistent with the large open space of the stream corridor. Materials should be selected to minimize the need for maintenance and replacement. Detailing should be focused at points of connection or where required for some essential function. Architectural enrichment should be limited to those locations.

Summary of Considerations for Infrastructure Re-use:

Positive Characteristics

- Design elements that complement the existing structures will improve visual harmony and unity
- Minimizing maintenance also minimizes cost and impact on natural resources
- Incorporation of existing elements will reduce the overall cost of construction

Negative Characteristics

- Current public perception of the existing infrastructure is negative
- The natural qualities of the stream corridor are dominated by the infrastructure components

Modern-Rustic

The Modern-Rustic design language reflects a contemporary design aesthetic using unrefined materials. Detailing is minimal, forms are simple and lines are regulated but imprecise. Materials are close to their natural state with little or no refinement. Where possible, surfaces are unpainted and allowed to weather with limited maintenance. Materials that are recycled or that can be recycled, are incorporated when possible. Some examples of materials that meet these qualifications include:

- Weathering steel
- Galvanized steel
- Copper or bronze
- Rebar or rolled steel (where rust won't stain other surfaces)
- Brushed finish stainless steel
- Natural cleft finish field stone
- Stone cobble recycled from gabions
- Local stone and gravel
- Recycled (plastic) lumber
- Cast-in-place concrete
- Concrete salvaged from on-site demolition
- Asphalt (with nearly all recycled content)
- Glass (recycled where possible)
- Recycled rubber surfacing
- Vegetated roof and walls

The use of materials and finishes that do not require frequent maintenance or repair is a priority. The rustic character will permit a high degree of weathering and wear before elements appear neglected. For example, weathering steel quickly oxidizes and forms a protective patina. The finish is intentionally mottled and uneven so that discoloration that may develop over time will not seem out of character. Similarly, cast-in-place concrete structures can have a rough-hewn appearance depending on formwork and finish applied. The irregularities that appear in the surface of the concrete are desirable in the rustic vernacular. Weathering and wear will mark and stain the surfaces and will not appear unintended over time.

Incorporating recycled components, such as concrete from the deconstruction of bridges within the stream corridor, is an excellent way to reduce energy required to transport and dispose of demolished materials. Designers should ensure that these re-used materials are safe, but imperfections and irregularities in these elements could complement the rustic character. Other recycled materials such as steel, stone, plastic, asphalt, rubber and glass contain slight irregularities that can be integrated into the rustic design language.

The built elements within Four Mile Run should complement the natural elements. Materials that have a dull or weathered finish and details that intentionally incorporate irregularities harmonize well in a natural setting. The modern-rustic design language balances the clean forms of modern design with natural imperfections found in the environment.

Summary of Considerations for Modern Rustic:

Positive Characteristics

- Bold architectural components are possible
- Built elements harmonize with landscape character
- Less maintenance required to keep intended appearance
- Many opportunities for incorporating recycled and reused materials

Negative Characteristics

- Unrefined character of modern rustic will challenge perceptions of a sleek, "modern" look.

Infrastructure Re-use and Modern Rustic: A Composite Approach Design Language for the Four Mile Run Stream Corridor

This combined solution integrates the approach to design of architectural and other built elements of existing public infrastructure with the visual and environmental sensitivity recommended by the modern-rustic elements.

The benefits of this composite approach include:

- Harmonizing new elements with existing structures and natural landscape elements
- Creating a distinctive sense of place within the existing framework
- Enabling the design language to evolve with technological advancement
- Allowing for natural weathering and wear without sacrificing intended appearance
- Emphasizing minimal maintenance and impact on resources
- Maximizing the use of recycled materials

The design language is most apparent when applied to architectural components, site furnishings or other built elements; however, the idea of integrating low maintenance, sustainable materials that harmonize with the existing elements can be applied to all areas of design.

For instance, the Design Guidelines address improvement of corridor habitat and ecology by enhancing existing vegetative communities through phased introduction of native species and removal of invasive species. The recommendation to "daylight" existing underground culverts and drainlines to expose the natural waterways integrates functional aspects of infrastructure as part of the design aesthetic.

More literal applications of the design language are described in the Design Guidelines under the theme of Public Spaces. The characteristics of the design language are demonstrated through development of a system of trails and open spaces. A family of paving materials and design concepts that integrate sustainable, recycled, low-maintenance materials apply to a range of recreational and accessible functions. The guidelines address issues of surface and edge treatment, transition areas and intersections, permeability and runoff collection, and opportunities for thematic development within the built elements.

Transmission lines and electrical substation are essential components of the urban environment that also have strong visual qualities.

New design elements should complement visual qualities of existing infrastructure and harmonize with the environment.

DESIGN LANGUAGE FOR THE FOUR MILE RUN STREAM CORRIDOR
INFRASTRUCTURE RE-USE / MODERN RUSTIC COMPOSITE SOLUTION

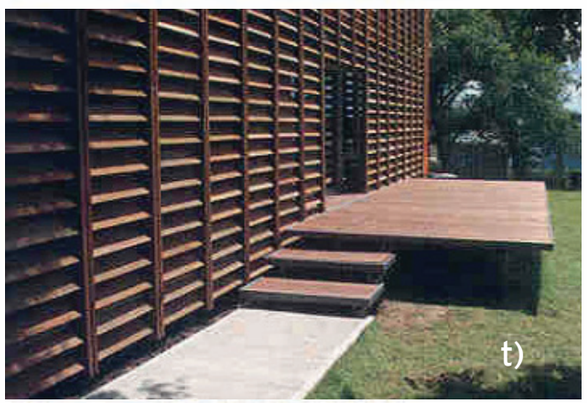
Left Page

a) Silhouette of the substation
b) Water Pollution Control Plant
c) Transmission tower/utility lines
d) Detail of substation equipment
e) Flood control wall
f) Arlington Water Pollution Control Plant outfall
g) Proposed re-use of the inactive bridge structure
h) Base of transmission tower
i) Below the Potomac Avenue bridge

Right Page

j) Stormwater management integrated with streetscape
k) Elevated path through native grasses
l) Combination of natural stone paving
m) Gabion wall filled with recycled materials
n) Recycled lumber deck
o) Weathering steel wall and permeable paving
p) Weathering steel retaining wall
q) Custom seating with rebar trellis
r) Weathering steel bench
s) Weathering steel bridge
t) Weathering steel wall

FINAL DRAFT



Infrastructure artifacts found in Four Mile Run (left page) combined with new modern-rustic design elements (right page)

FINAL DRAFT

5 DESIGN GUIDELINES

CENTRAL DESIGN THEMES

"First, the Master Plan includes a variety of 'green principles' that will make Four Mile Run 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." (Master Plan, 74)

The Design Guidelines is organized according to the three central design themes originally established in the Master Plan.

Green Design Principles

This section focuses on issues related to stream channel restoration and stabilization, as well as habitat restoration. These include options for modifying the stream channel morphology and stabilizing the adjacent banks and stream edges. These options have been developed in concert with flood control planning efforts performed by the U.S. Army Corps of Engineers (USACE) and are intended to provide guidance that is compatible with the USACE recommendations.

The Green Design Principles also address comprehensive stormwater management, identifying a range of solutions to help reduce stormwater runoff within Four Mile Run. While these solutions are specifically intended for improvements made within the Four Mile Run corridor, they may also be applied to development anywhere within the Four Mile Run watershed where improved stormwater management techniques will have a far-reaching benefit to the stream.

The Green Design Principles provide general recommendations for buildings and site development adjacent to the stream corridor to assist landowners, developers and policy-makers in identifying design and building methods that will enhance the ecological health of Four Mile Run.

Public Spaces

This section addresses circulation systems, network of outdoor spaces and methods for improving public access within the stream corridor. Topics cover a range of trail types and suggest design criteria, material selection and opportunities for integrating public art and thematic elements into proposed built elements. The treatment of passive and active recreational spaces along the corridor, attractive destinations that are compatible with functions of the stream corridor is also covered.

Built Features

This section includes architectural elements and other manmade components within and adjacent to the corridor. Where new development opportunities exist along edges of the corridor, the guidelines provide recommendations for improving the relationship between urban edges and the stream, including building orientation, setbacks, architectural massing and ground floor treatments.

This section also addresses built elements that will be part of improvements within the stream corridor. Unique, one-of-a-kind structures, such as the proposed nature/ cultural center or proposed bridges, are generally addressed to establish design parameters without restricting future design opportunities. Other recurring elements within the corridor, such as benches, lighting, or other furnishings, are represented with a greater specificity to ensure continuity between development phases.

Guidelines for planting design are addressed under this section. Intended as a supplement to the detailed discussion of habitat restoration planting under Green Design Principles, the recommendations will focus on the types of planting associated with circulation and open spaces, and how planting can integrate built elements with the natural systems.

Critical to these efforts is establishing an overall culture of environmental stewardship.

(Master Plan, 74)

Green Design Principles

CHANNEL RESTORATION AND STABILIZATION

This chapter is unique because, unlike the rest of the Design Guidelines, the information presented here is not intended to establish a framework for future design efforts. Restoration design work for the in-stream portions of the Four Mile Run stream corridor has begun, managed jointly by the City and County in partnership with the U.S. Army Corps of Engineers. This section explains the status of this work.

Guiding principles established in the Master Plan are stewarding the work as the project transitions into the design phase. However, there have been two key developments since approval of the Master Plan that continue to influence restoration and flood protection work in the stream corridor:

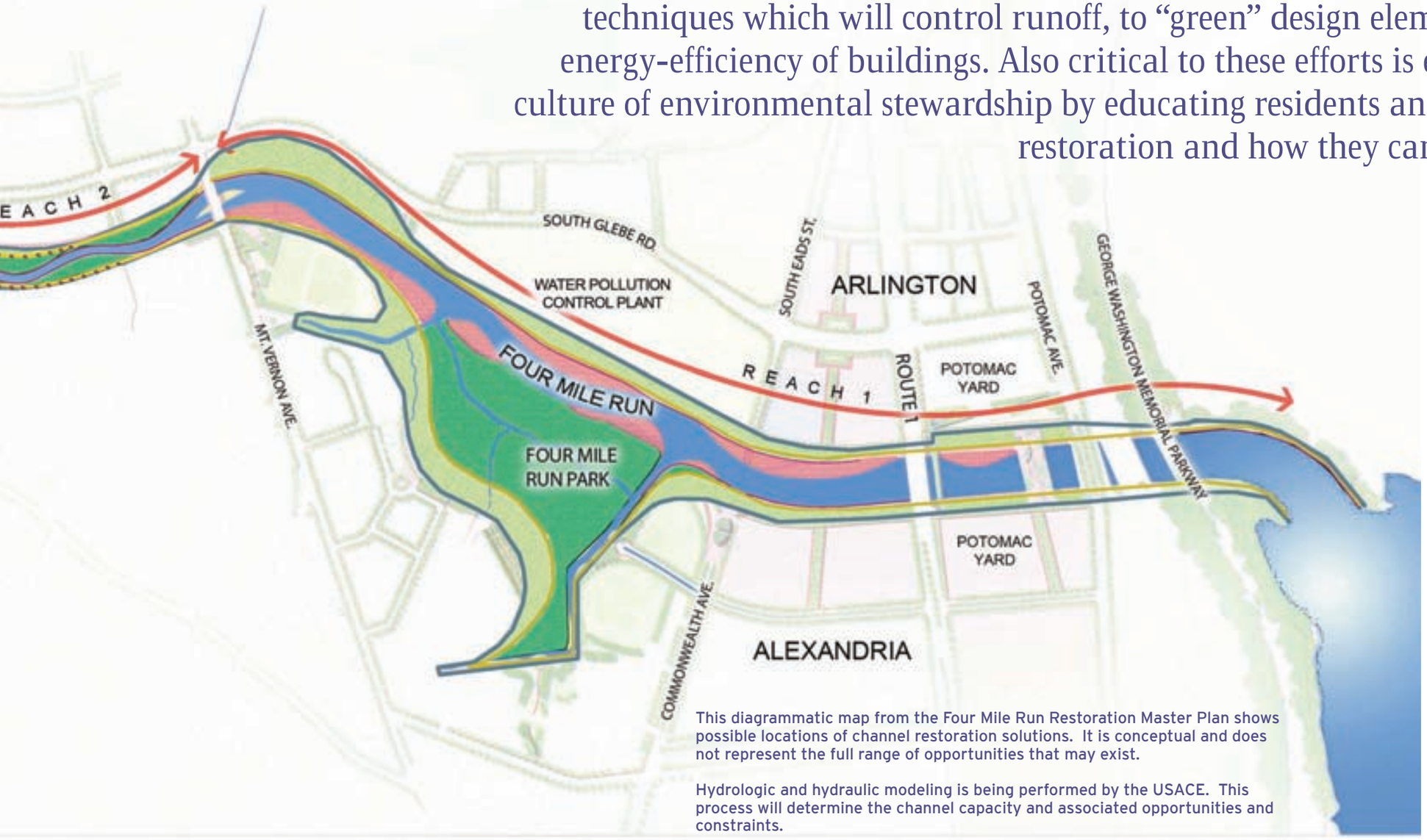
- When incorporated into a revised flood frequency analysis, the significant June 2006 storm resulted in a higher than predicted 100-year flood event, than when the Master Plan was adopted.

- Any new analysis of the levee certification requirements from the Federal Emergency Management Agency (based upon FEMA's new interpretation of 44 CFR 65.10), which affects the required additional levee height above design water surface, will be incorporated into future designs of the channel.

These issues will continue to be evaluated and resolved as part of the final design of the stream restoration and flood control components of the project.

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 to a variety of stormwater management techniques which will control runoff, to "green" design elements that improve the energy-efficiency of buildings. Also critical to these efforts is establishing an overall culture of environmental stewardship by educating residents and businesses about the restoration and how they can support these efforts.

(Master Plan, 74)



This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of channel restoration solutions. It is conceptual and does not represent the full range of opportunities that may exist.

Hydrologic and hydraulic modeling is being performed by the USACE. This process will determine the channel capacity and associated opportunities and constraints.

FIGURE 5.1

TIDAL REACH CROSS SECTION SYMBOL LEGEND

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

This section through Four Mile Run and Four Mile Run Park, also taken from the Master Plan, illustrates the tidal restoration work and its relationship to the near stream Master Plan elements.

CHANNEL RESTORATION AND STABILIZATION

Status

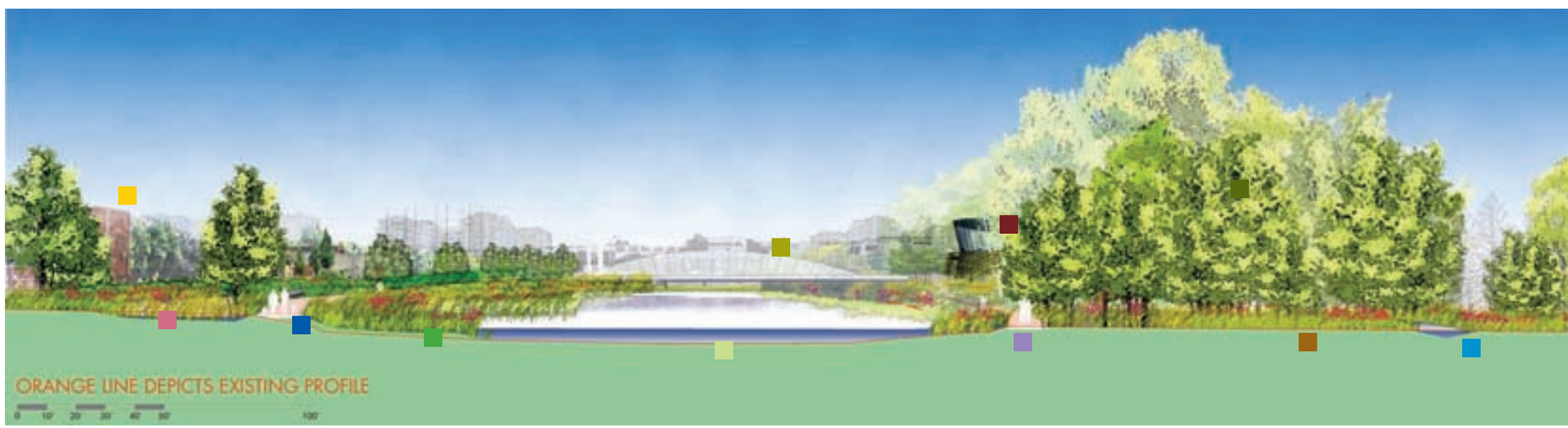
Tidal Reach

In the spring of 2009 a consulting team began development of restoration designs for the tidal portion of the stream corridor between Mount Vernon Avenue and the Potomac River. Their efforts have focused on completing design and implementation for a demonstration project between S. Eads Street/Commonwealth Avenue and U.S. Route 1. Future efforts will continue design and implementation work for the remainder of the corridor.

There will be several opportunities during this process for public participation and input.

Alluvial Reach

In summer 2008, the USACE completed stream restoration designs to the 60 percent level for the alluvial portion of the corridor (Shirlington Road to Mount Vernon Avenue) to articulate the basic restoration objectives identified in the Master Plan—creation of a dynamically stable stream channel using natural channel design techniques and improvement of in-stream habitat. This work has not yet incorporated levee and floodwall modifications (e.g., softer materials, levee/floodwall relocation, etc.) or floodplain and streambank vegetation. To maintain flood capacity, the larger 100-year event and the levee certification requirements together make it likely that vegetation will be limited to lower growing herbaceous and shrub plantings, in lieu of trees. There may be opportunities to relocate floodwalls and levees, as described in the Master Plan and Design Guidelines, to increase flood capacity and accommodate additional stream restoration components. These constraints and opportunities are under evaluation by USACE and their project partners.



TIDAL REACH CROSS SECTION

ALLUVIAL REACH CROSS SECTION

ALLUVIAL REACH CROSS SECTION SYMBOL LEGEND

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

This section of Four Mile Run and Arlington Mill Road illustrates the alluvial restoration work and its relationship to the near stream Master Plan elements.

HABITAT RESTORATION

One of the primary Master Plan goals derived from community and governmental input is to improve stream corridor habitat and ecology that supports native terrestrial and aquatic plants and animal species.

This section provides additional details and specifications for design of habitat-related features in the stream corridor, including wetlands restoration, planting of naturalized areas, invasive species management, soil conditions, wetland and riparian buffers, and habitat connectivity.

As described under Channel Restoration and Stabilization, these design guidelines are based primarily upon recommendations of the Master Plan. Changes in the design flow and levee certification will likely influence the amount and type of vegetation that is acceptable within limits of the flood control levee.

It is assumed that all habitat restoration within the City of Alexandria and Arlington County will incorporate the regulations and standards as outlined by the Virginia Department of Conservation and Recreation.

The Guidelines are intended to complement the existing land use requirements of the *Virginia Chesapeake Bay Preservation Act (1988)*, which provides specific requirements for management of areas designated as resource protection areas (RPAs), sensitive areas such as streams, rivers, lakes, and wetlands and a 100-foot perimeter buffer for each. All portions of the project area within 100 feet of the perennial channels/wetlands (including Four Mile Run and tributaries such as Long Branch) are designated as RPAs, and are regulated by the *Arlington County Chesapeake Bay Preservation Ordinance (rev. Feb., 2003)* and *The City of Alexandria Article XIII Environmental Management Ordinance (rev. April 2006)*.

The Riparian Buffers Modification and Mitigation Manual (2003) by the Chesapeake Bay Local Assistance Department and the Virginia Department of Conservation and Recreation provides additional recommended practices for habitat restoration actions within the RPAs.

Existing sanctuary for wildlife habitat

Planting of Naturalized Areas

Existing vegetative communities should be preserved and/or enhanced consistent with their location and composition. This will include the inventory and eradication of invasive species and the reintroduction of native vegetative communities as necessary. Invasive species management will occur throughout the stream corridor.

For habitat restoration efforts along the stream corridor, introducing a variety of plants will reduce the risk of monoculture creation and increase the tolerance to environmental stresses. See Appendix 1 for a listing of native plant communities according to their location along topographical gradients within the stream corridor. Where feasible, multiple canopy layers will increase the diversity of habitat options. Native plants listed by the Virginia Native Plant Society (www.vnps.org/) or the *Riparian Buffers Modification and Mitigation Manual (2003)* are also acceptable alternatives to the species listed in Appendix 1.

The availability of these and other species for planting/ replanting efforts along Four Mile Run should be considered as part of the selection criteria. The species listed in Appendix 1 are commonly available in the regional nursery industry. If the native species cannot be readily obtained, contract growing of the plants for projects within the corridor should be considered. Detailed planting specifications and standards for the City of Alexandria and Arlington County are provided in the City of Alexandria, Virginia Landscape Guidelines (1997, rev. 2007) and the Arlington County Landscape Standards (rev. March, 2005).

Recommendations for the restoration and/or replanting of buffer areas within the Four Mile Run RPA, including recommended species, locations, planting densities and specifications, are provided in the Riparian Buffers Modification and Mitigation Manual (2003) by the Chesapeake Bay Local Assistance Department and the Virginia Department of Conservation and Recreation.

Beyond the RPA, Arlington and Alexandria will promote their respective policies of enhancing forest areas wherever possible in the stream corridor.

Plant selection for areas within the Four Mile Run flood control levee should be coordinated with the U.S. Army Corps of Engineers. Permitted plant species within the flood control levee will depend upon the flood control capacity within each segment of the channel, as well as the maintenance requirements of Vegetation (Tree) Removal Guidance for Typical Floodwall Configurations (USACE, 2008).

Existing area of riparian buffer vegetation

Green Design Principles

RESTORATION PLANTING

Ecosystem restoration, including preserving and enhancing existing vegetation and where feasible, introducing new vegetative communities, benefits the stream corridor. Restoration planting provides additional flood and erosion control, stabilizes stream banks, filters and removes pollutants from water, regulates temperatures, and provides habitat for organisms. An important recommendation of the Four Mile Run Master Plan is to reestablish plant communities that once existed in the lowland wetlands and riparian areas along Four Mile Run, but have since been removed or colonized by invasive species.

This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of restoration planting areas. It is conceptual and does not represent the full range of opportunities that may exist.

FIGURE 5.2

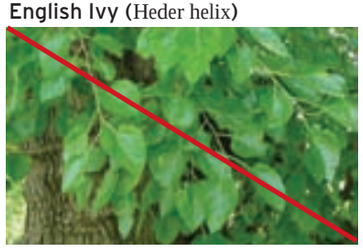
INVASIVE SPECIES

Marsh Marigold (Caltha palustris)

Tree of Heaven (Ailanthus)

Paulonia (Paulownia tomentosa)

English Ivy (Heder helix)



White Mulberry (Morus alba)

RESTORATION PLANTING

Invasive Species Management

Invasive species degrade existing and restored habitats by displacing native species and reducing the overall diversity of local ecosystems.

Invasive species currently identified in the Four Mile Run stream corridor 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), and porcelain berry (Ampelopsis brevipedunculata). Other species are likely to be present, but have not been yet been inventoried.

The Virginia Department of Conservation and Recreation maintains a list of current invasive and alien plant species in Virginia online at:

www.dcr.virginia.gov/natural_heritage/invsppdflist.shtml

Existing and restored native plant assemblages must be actively managed to reduce the occurrence of invasive vegetation. A Four Mile Run invasive species management plan should be created to specify procedures and policies for invasive species management throughout the corridor. This management plan should include, at a minimum:

- Goals and objectives to guide invasive species management.
- A prevention plan to restrict the introduction or spread of invasive species.
- A survey and detection program to identify and locate invasive species.
- An invasive species control plan, to eradicate invasive species and restore native habitats.
- An assessment of invasive species control methods for use on new or existing populations that analyzes species being controlled and characteristics of the site being treated. The assessment should evaluate comparative risks of each control method against the benefits of successful suppression. Control systems might include biological remedies, synthetic pesticide application, mechanical control, or prescribed controlled burning.
- A monitoring plan that will periodically assess the effectiveness of management actions in relationship to goals and objectives

The Four Mile Run invasive species management plan should be structured to integrate RPA requirements specified in the *Arlington County Chesapeake Bay Preservation Ordinance (rev. Feb., 2003)* and *The City of Alexandria Article XIII Environmental Management Ordinance (rev. April 2006).*

Soil Conditions

Urban soil characteristics vary greatly due to historical fill imports, compaction of native soils, or grading of native materials. Developed areas may or may not possess topsoil with reasonable physical and chemical plant growth characteristics.

Depending on the location within the stream corridor, soil assessments and selected soil testing for agronomic parameters may be required to determine and quantify the need for soil amendments to favor successful re-vegetation. Data collected by these assessments will be used to develop plant establishment criteria for each project within the stream corridor. Some considerations in determining the need for soil amendments include:

- Amendments to improve soils physical properties, including water retention, permeability, water filtration, drainage, aeration and structure.
- Amendments to increase available plant nutrients and sustain vegetative cover, reduce long-term erosion, and help reduce peak runoff volumes and discharges by increasing water absorption.
- Organic amendments such as sphagnum peat, wood chips, grass clippings, straw, compost, manure, biosolids, sawdust and wood ash. Inorganic amendments such as vermiculite, perlite, tire chunks, pea gravel and sand.
- Amendments that are prescribed based on the existing soil composition. In general, if the soil contains less than 3 percent organic content, soil amendments are recommended prior to planting installation.
- Currently, City of Alexandria and Arlington County landscape requirements provide that tree planting wells be backfilled with 50 percent clean existing soil, 25 percent topsoil, and 25 percent City-approved organic material (City of Alexandria, 2007; Arlington County, 2005). Arlington County also suggests a palette of additional amendment options.

In the Four Mile Run stream corridor, there are several options available to improve soil conditions prior to planting:

- Amend the existing soil in place. This generally involves roto-tilling compost into the existing soil to a minimum depth of 8 inches.
- Import topsoil with 8–13 percent organic matter content. Topsoil mix should include 30–40 percent compost by volume and can be backfilled into excavated planting areas.
- During any construction activities, stockpile native soil and duff and reapply after construction activities, or amend in place by mixing compost into the soils before reapplication.
- Use dredge material as appropriate.

Riparian and Wetlands Buffers

Riparian buffers have a range of essential functions within a watershed ecosystem. These include: filtration of sediment, nutrients and pathogens; stabilization of stream banks; floodwater attenuation; maintenance of in-channel base flow; and providing essential habitat and nutrients for aquatic, terrestrial, avian and amphibious organisms (Wenger and Fowler, 2000). In addition, buffers may have aesthetic and economic values.

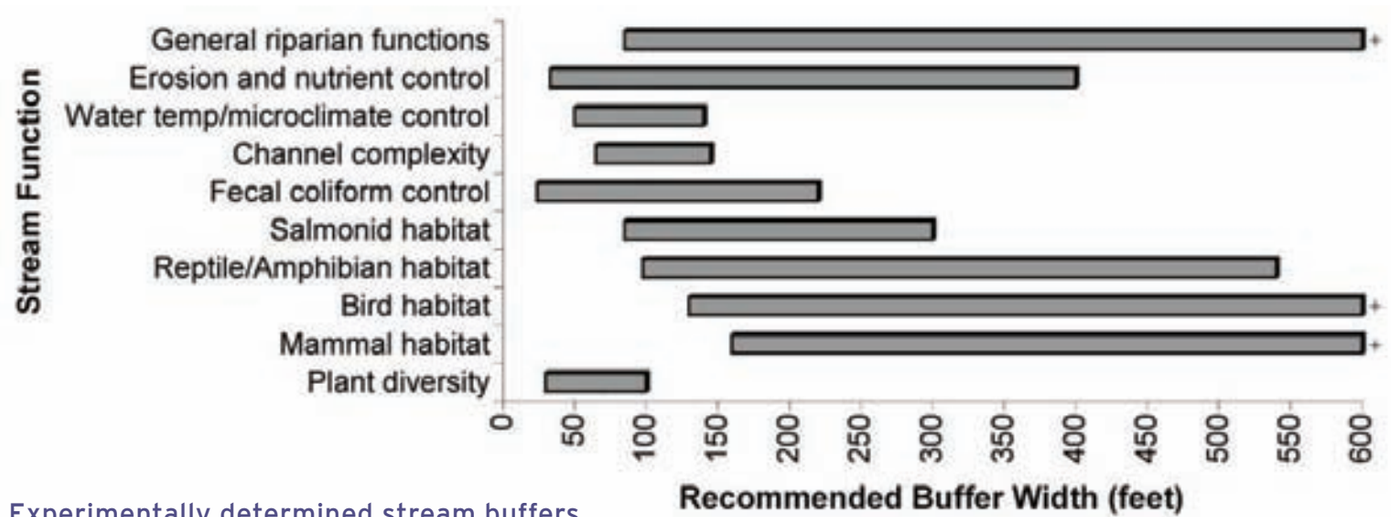
Riparian buffer recommended for implementation as a best management practice (BMP) by the United States Department of Agriculture (USDA) is based on a three-zone system: zone 1 consists of tall, rapidly growing trees closest to the stream or creek; zone 2 includes slow growing tree species and shrubs; and zone 3, closest to urbanized, cropped or grazed land, is composed of grasses and herbaceous species (Welsch, 1991). The USDA recommends minimum widths of 75 feet for Zones 1 & 2, and 20 feet for Zone 3, which when increased due to certain slope and soil type conditions, may total 170 feet of buffer on each stream bank.

A wide range of research has studied the ecological benefits of buffer dimensions, with the goal of determining an optimal width for desired management objectives. The results of this research are summarized in the matrix below.

Throughout the Four Mile Run stream corridor, urban development and infrastructure has severely limits the width of riparian buffers along the channel.

The *Virginia Chesapeake Bay Preservation Act (1988)* defines buffers within 100 feet of perennial streams and wetlands areas as Resource Protection Areas with special protections under local statutes (including *Arlington County Chesapeake Bay Preservation Ordinance (rev. Feb., 2003)* and *City of Alexandria Article XIII Environmental Management Ordinance (rev. April 2006)*).

To provide consistency with the *Virginia Chesapeake Bay Preservation Act (1988)*, riparian buffers 100 feet landward on each side of the perennial baseflow channels throughout the Four Mile Run stream corridor should be preserved and restored to provide erosion and nutrient control, water temperature control, fecal coliform control and plant community diversity. Management of these areas should be in accordance with local *Chesapeake Bay Preservation Ordinance* statutes, but opportunities for active restoration of these areas should be leveraged.



Experimentally determined stream buffers

INVASIVE SPECIES

Mile-a-Minute Weed (Polygonum perfoliatum)

Japanese Knotweed (Polygonum cuspidatum)

Porcelain Berry (Ampelopsis brevipedunculata)

Purple Loosestrife (Lythrum salicaria)

Bamboo (Bambusa sp.)

Buffer Conditions

The best buffers are those that share the traits of natural, undisturbed, forested vegetative systems. A natural forest contains a dense vegetative cover of native plants, groundcover and leaf litter, has undisturbed soils and sustains a healthy microbial community. "Forests provide the greatest range and number of potential environmental benefits…" (Palone *et al.*, 1997).

Riparian areas should be maintained as protected vegetated areas, with minimal disturbance from development or maintenance activities. Allowable uses in the RPAs are defined in the local ordinances (the *Arlington County Chesapeake Bay Preservation Ordinance (rev. Feb., 2003)* and *The City of Alexandria Article XIII Environmental Management Ordinance (rev. April 2006)*).

Riparian buffer restoration guidelines are detailed in the *Riparian Buffers Modification and Mitigation Manual (2003)* and should be used to guide restoration actions in the RPAs, with specific regulatory guidance provided by local *Chesapeake Bay Preserve Ordinance* statutes, as follows:

- Evaluate the hydrology of the site and take necessary measures to assure dispersal of concentrated flows into sheet flows before runoff reaches the riparian buffer area.
- Employ best management practices for erosion and sediment control during restoration activities to protect adjacent wetlands and shorelines of water bodies.
- Provide sufficient site preparation specific for the establishment and growth of riparian buffer plants and at a time to ensure their survival and growth.
- Ensure that plant stock comes from appropriately certified and inspected nurseries. Species should be non-exotic strains of native plants (non-hybrid, non-invasive), indigenous to the area and adaptable to the site conditions (some recommended vegetation types are included in the "Planting of Naturalized Areas" section).
- Select a diverse mix of species that reflects the ecological community in adjacent or nearby parcels.
- Encourage reforestation using native forest species.
- Incorporate a mixture of container grown or ball and burlapped species with not less than 1 canopy, 2 understory, and 3 shrub species per 400 square feet for a buffer restoration site of a quarter of an acre (10,890 square feet) or less.
- Complement natural features of the site. Use random spacing and clustered groups of mixed species in lieu of evenly spaced rows of plants.
- Incorporate mulching, tree shelters (at a rate of 100 per acre), grass mats, or other methods where necessary to ensure survival of the selected plant material.

Buffer Maintenance

Active maintenance is necessary to maintain healthy riparian buffer systems. This includes ongoing invasive species control (see relevant section in the Design Guidelines document). Riparian buffer areas in the flood control channel, especially those adjacent to the active channel, will undergo some disturbance during high-flow events. To allow natural heterogeneity within the channel and floodplain to occur, minimal maintenance should be performed on streamside vegetation, unless downed/damaged vegetation is deemed as a hazard to continued flood control objectives. In addition to flood control objectives, reasonable buffer maintenance and/or disturbance may be necessary to minimize impacts on recreational and or structural features within the buffer.

Detailed maintenance specifications and standards for riparian plantings in Alexandria and Arlington County are provided in the Arlington County Landscape Standards (rev. March, 2005). Riparian buffer maintenance recommendations are also provided in the Riparian Buffers Modification and Mitigation Manual (2003).

Ecological Connectivity

"Connectivity" can be defined as the linkages of patches of suitable habitat to sustain a given species, the connectedness of vegetative communities across a landscape, and the connectedness of ecological processes across multiple scales (Lindenmayer and Fischer, 2006). At Four Mile Run, the connectivity of natural areas in and along the stream corridor is critical for the health and survival of wildlife that use these habitats for refuge and forage.

Along Four Mile Run, fragmentation of connected riparian and wetlands areas occurs due to physical constraints such as road crossings, urban infrastructure, urban development, or ecological constraints such as the alteration of hydrologic regimes. Fragmentation of in-stream habitats can occur due to dams, weirs, or other structures in the stream channel that inhibit passage of aquatic species. Fragmentation results in a direct disturbance (reduced fitness and survivability) of natural communities due to reduction in the amount of usable habitat and the modification of vital ecological processes that sustain those communities (Lindenmayer and Fischer, 2006).

PREFERRED CHANNEL CROSSING DESIGN: Open span design allows unimpeded storm flow and wildlife movement.

To maintain the greatest amount of connectivity between riparian, wetlands, and aquatic habitats, the following provisions should be adopted:

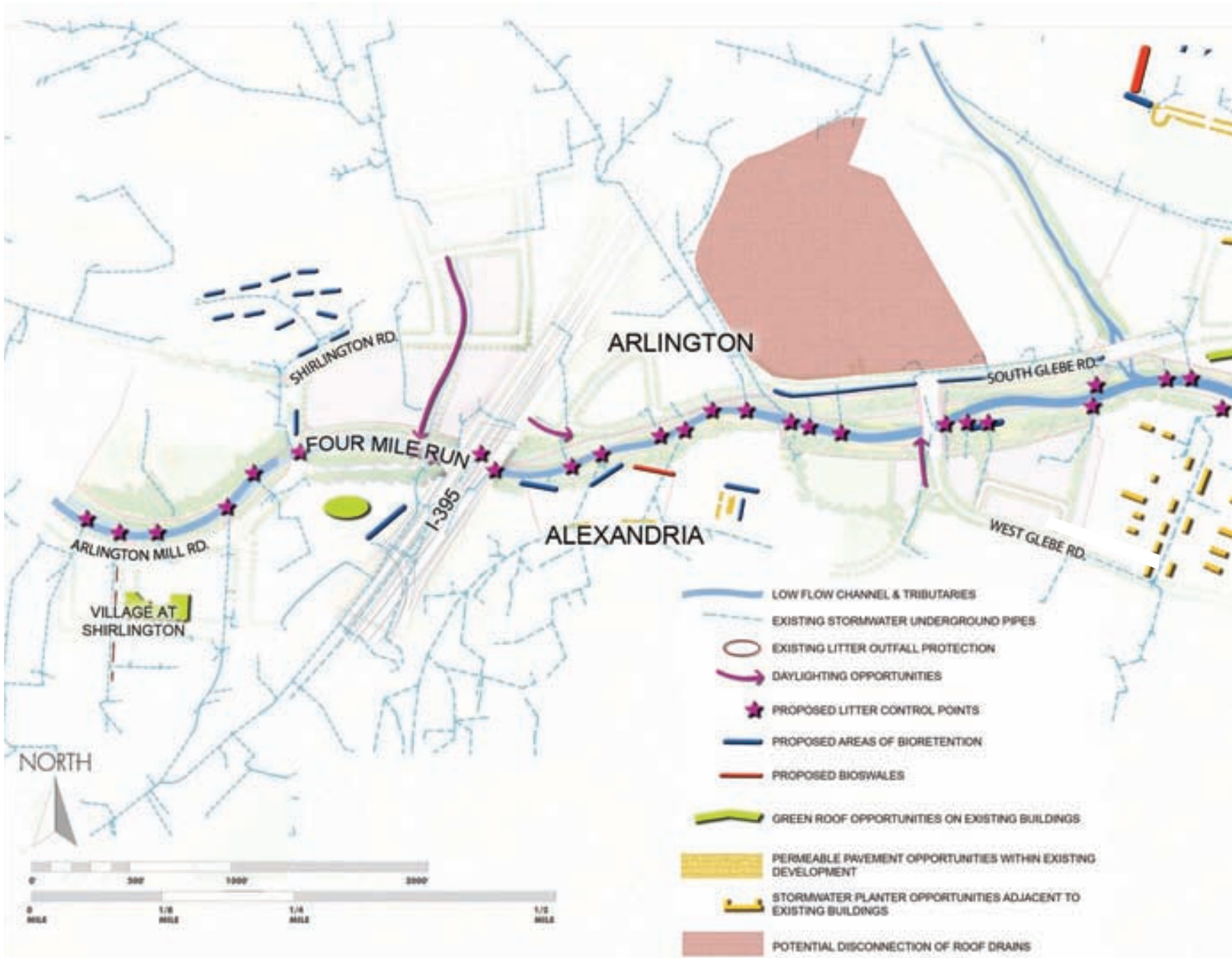
- Design new or retrofit stream crossings to allow the passage of fish and wildlife beneath the structure and facilitate migration between adjacent riparian vegetation communities (see image above). If possible, design stream crossings to allow riparian vegetation to flourish beneath the structure.
- Existing grade-control structures in the mainstem stream channel and along the lower reaches of Long Branch tributary presently serve as barriers to fish migration, and should be modified or replaced with structures that allow passage. Integrate the grade-control structures with pedestrian stream crossings to minimize impact on the stream channel.
- If considering construction of additional roads or trails through wetlands areas design structures to allow for wildlife migration under, through, or across the structures. For example, use elevated spans or boardwalks, in coordination with selective placement of roads or trails.
- Provide opportunities for tidal wetland migration into buffer areas.

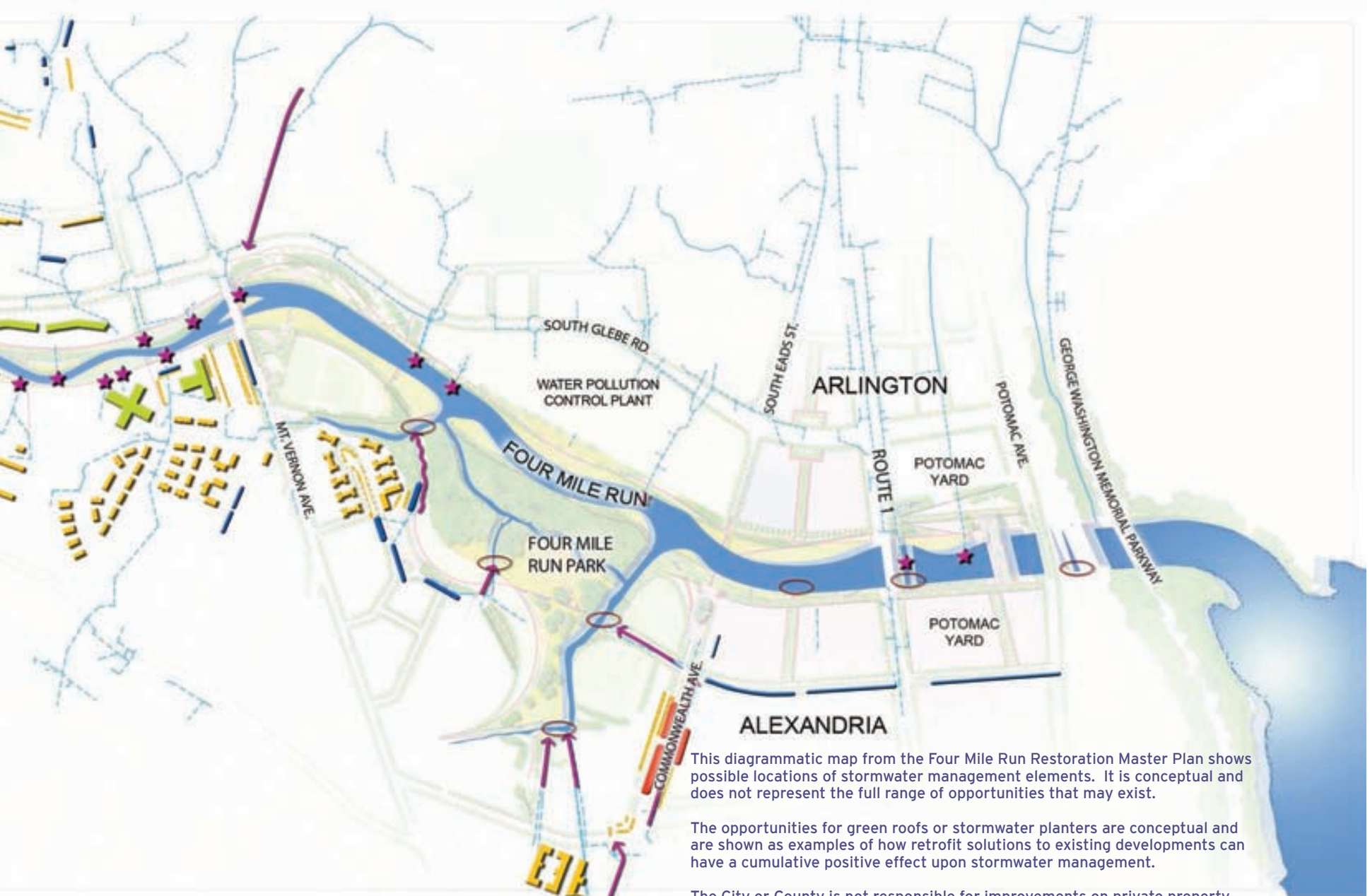
Green Design Principles

STORMWATER MANAGEMENT

Arlington and Alexandria are national leaders in stormwater management technology. Both jurisdictions currently require a variety of effective, sustainable and low-impact stormwater management techniques that reduce, retain, slow and filter stormwater before it reaches Four Mile Run. The restoration of Four Mile Run presents an opportunity to advance this leadership by exploring innovations in stormwater management that showcase both jurisdictions' commitment to watershed management and support the goals of the restoration.

Improved water quality is an essential component of the stream restoration effort. Creative stormwater management techniques, when incorporated into new development or as retrofits to existing land use, will help improve the aesthetics of the built environment and educate the community about stormwater management processes.





This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of stormwater management elements. It is conceptual and does not represent the full range of opportunities that may exist.

The opportunities for green roofs or stormwater planters are conceptual and are shown as examples of how retrofit solutions to existing developments can have a cumulative positive effect upon stormwater management.

The City or County is not responsible for improvements on private property.

FIGURE 5.3

Example of a bioretention planting strip in a parking lot

STORMWATER MANAGEMENT

In addition to these guidelines, projects located within the Four Mile Run watershed incorporating stormwater management must comply with regulations imposed by each jurisdiction. References to several of these documents are provided in Appendix 3. Staff at the City of Alexandria and Arlington County should be periodically contacted to obtain current information.

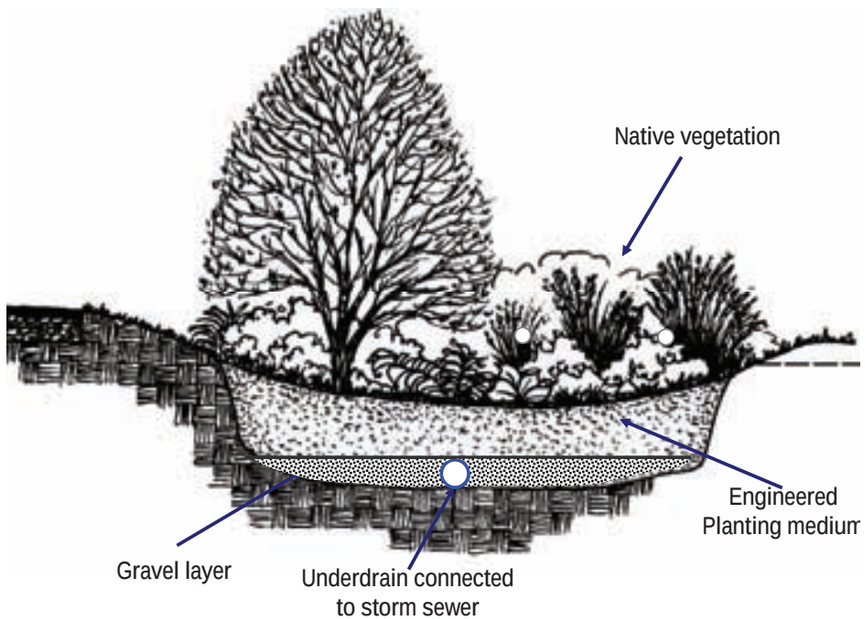
Bioretention

Bioretention facilities and bioswales are stormwater management measures recommended within the Four Mile Run watershed. Bioretention facilities can play an important role in runoff reduction. According to draft Virginia stormwater management guidelines, bioretention areas provide a 40-80 percent reduction.

A bioretention facility should be composed of :

- A depression in the ground (a ponding area where the water is captured)
- A soil mixture that supports various types of water-tolerant vegetation:
    - o An engineered soil mixture that serves as both planting soil and a filter
    - o An organic layer or mulch and plants
- Native vegetation, appropriate for the expected wet and dry conditions
- An entrance where water flows in to the facility
- An underdrain to collect treated runoff
- An overflow for excess water

Site specific conditions may prohibit the use of bioretention or require a different configuration. For instance, the stormwater drainage system in certain areas of Alexandria can be very shallow and the construction of a bioretention facility located in those areas may have difficulty with the underdrains, requiring the system to be reconfigured. Where such restrictions occur, bioswales could also be incorporated—long, narrow, vegetated swales—which carry stormwater overland to a bioretention area or water body during which time additional infiltration occurs. These swales often have a shallower cross section and could be feasible (even with underdrains) in areas where the existing stormwater drainage system is very shallow.



Typical bioretention detail

Four local examples illustrate different applications of stormwater management, including bioretention areas in (a) a public park in Washington, DC, (b) an Alexandria, Virginia public library, (c) a multi-family development and (d) a private residence.

Green roof on a government building, Arlington County, VA

Green roof on an office building, Albemarle County, VA

Green Roofs

Green roofs are effective stormwater management measures highly urbanized areas such as the Four Mile Run watershed. Green roofs are best suited for flat or gently sloping roofs and can be integrated into the design of a new structure or retrofit into an existing structure. The added weight of soil, water and plants must be factored into the structural design of any green roof. The initial cost of a green roof is often higher than conventional roofs, however a life-cycle cost analysis typically indicate that the energy savings will offset the initial investment. In addition, green roofs are also effective in runoff reduction. According to draft Virginia stormwater management guidelines, green roofs provide a 45–60 percent reduction in runoff.

Components of a green roof include:

- A lightweight soil media
- A drainage layer underneath the soil media
- An impermeable membrane that protects the building structure from moisture
- A specialized mix of plants that can thrive in roof top conditions

Typical green roof installation detail, depth of growing medium varies greatly from a few inches to several feet, depending on roof structure and desired planting types.

Green roof at Walter Reed Community Center, Arlington, VA

Green roof at the Jamieson, Alexandria, VA

Permeable Pavement

Permeable pavement systems, typically used for walkways, driveways and parking areas, allow stormwater to infiltrate quickly through voids in the pavement matrix before it can run off the pavement surface. Beneath the pavement, water is either absorbed into the subsoil or detained underground for slow release into a storm system or waterbody. Collected water may also be stored in a cistern for reuse. This best management practice can reduce peak surface runoff rates that flow directly into Four Mile Run and also has the potential to increase groundwater recharge at developed sites.

New impervious surfaces within the Four Mile Run watershed should be minimized as much as possible. Within the stream corridor all paved surfaces should be permeable or should include adjacent runoff collection areas. Some examples follow:

- Plazas and promenades – integrate permeable pavers
- Parking lots – permeable asphalt or 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 with pervious paving or other porous materials (refer to Trails section of this guideline)

Several issues need to be considered before a permeable pavement system is chosen. These design considerations include:

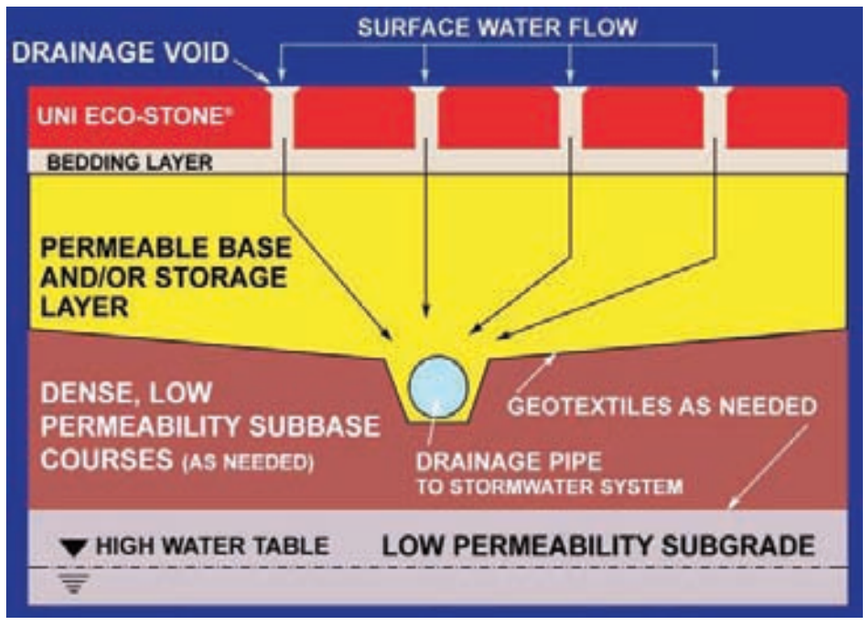
- Load requirements (vehicular, etc.)
- Hydraulic requirements
- Local climate of the installation

Components of permeable pavement include:

- Permeable surface: either cast-in-place or precast unit pavers (refer to page 57, 58 for options)
- Gravel layer below pavers to help infiltrate runoff *

* Adapted From: www.lid-stormwater.net and the North Carolina DENR Stormwater Best Management Practices Manual

Permeable pavers used in the on-street parking area of the roadway



Typical permeable paving section

Permeable pavers at the Navy Yard, Washington, DC

Permeable aggregate parking lot, St. Mary's College, MD

Stormwater planter with slotted curb

Stormwater planter connected to roof downspout

Rain garden elements at Powhatan Springs Park, Arlington, VA

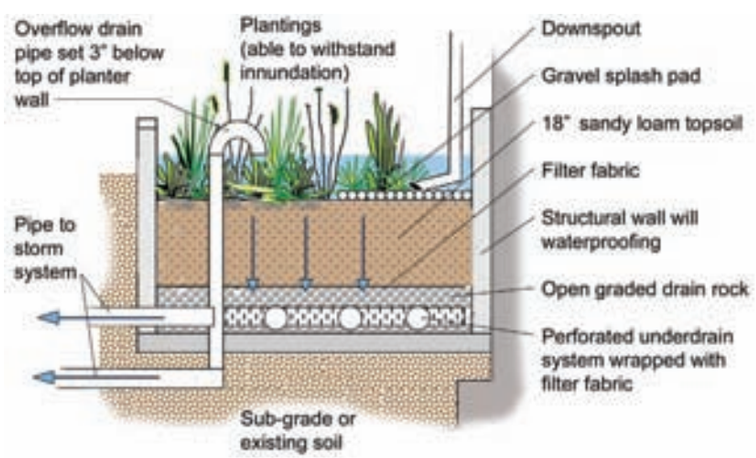
Stormwater Planters

Stormwater planters collect stormwater runoff from roofs via a rain gutter downspout and filter the runoff through planter soils before slowly discharging it into the stormwater system. A stormwater planter provides many of the same functions as bioretention facilities previously described. Stormwater planters may be integrated into the original site design, or be retrofit into existing developments. Stormwater planters are also well suited for residential applications and can be attractive amenities or provide opportunities for interpretation of the benefits of stormwater management.

A stormwater planter is typically composed of:

- Contained planting area(s) constructed either above-ground or at ground level in which the runoff is captured
- Downspout(s) directed into the planter (or other method to direct the flow of roof runoff)
- Engineered soil mixture for both planting soil and filtering purposes; vegetation should be native vegetation, appropriate for the expected wet and dry conditions
- Openings in curbs or connections to downspouts to allow water to enter
- Underdrains to collect treated runoff
- A means for excess water to overflow in a controlled way

Some site-specific conditions such as shallow drainage or high seasonal groundwater table may favor the use of stormwater planters over a bioretention area.



Typical stormwater planter installation detail

Litter Control/ Other Stormwater Proprietary Devices

Litter has been a major problem in Four Mile Run. The presence of trash compromises the aesthetics and appeal of the stream corridor and reinforces the perception that the stream is an appropriate place for dumping trash. The build-up of debris in catch basin inlets can also increase the chances of flooding in adjacent areas.

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

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

Litter control traps can be small devices, such as a basket in a catch basin, or large devices installed within a storm drain. The effectiveness of these devices depends on site-specific factors, such as use, particulate size, space availability, flows into the device and maintenance.

Types of litter control devices include:

- Catch basin and curb inlet inserts
- Trash racks
- Catch basin sumps
- Floating booms
- Hydrodynamic separation units
- Oil/grit separators

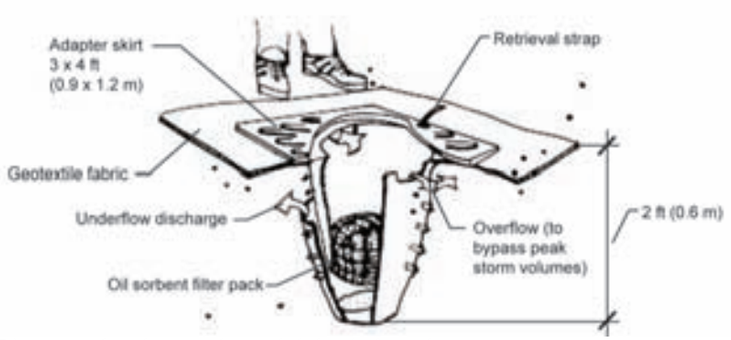
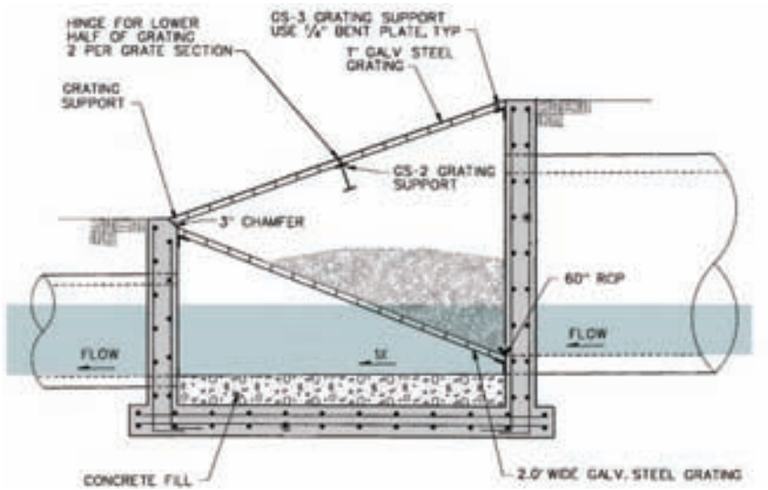


Diagram of a stormwater catch basin insert

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

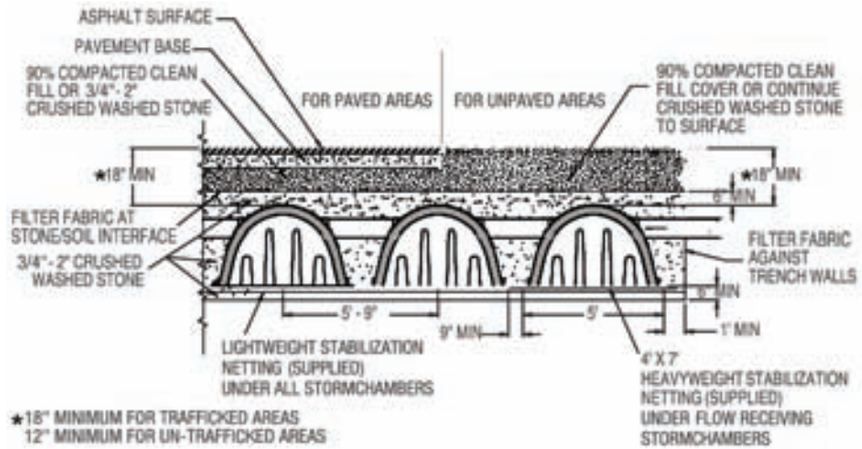
Some outfall devices for litter control do not meet the aesthetic goals of the Four Mile Run Design Guidelines. Selection should be coordinated with the appropriate municipal staff. Many proprietary litter control devices are on the market. Typically, a designer will work closely with the vendor to select the proper device for the site.



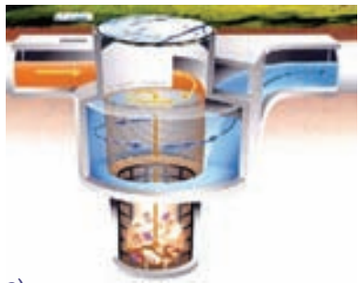
Example of a custom fabricated litter interceptor, detail/section above, photo below

Underground Storage

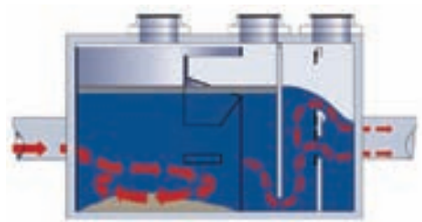
Underground storage (detention) is a beneficial stormwater management option in highly urbanized areas because it minimizes surface/at grade impacts. Stormwater runoff is collected in an underground chamber, then released slowly, either through an outlet or through infiltration in the bottom of the chamber. Examples of some techniques include vaults, cisterns, chambers and large pipes. The main disadvantage of this approach is the difficulty of conducting inspection and maintenance. This type therefore is not favored compared to the other types mentioned above. However, in some cases a combined approach that includes underground storage may be necessary. Not all areas within the watershed require detention. Contact representatives of the City of County to determine what restrictions and performance requirements apply to stormwater detention or storage.



Proprietary underground storage device (manufactured by StormChamber), detail/section above, photo left



a)



b)

c)

Proprietary litter control devices:
a) CDS Technologies;
b) Vortechnics;
c) Crystal Stream

Before: Entrance to Munn's Creek culvert, Oakville, Ontario, Canada

After: Munn's Creek reestablished, out of culvert

Daylighting

Daylighting of stormwater systems involves exposing waterways currently conveyed in buried culverts or pipes. Daylighting reestablishes a waterway in its original alignment, where feasible, or in a new alignment threaded between buildings, streets, parking lots and playing fields. Daylighted waterways provide several important water quality and quantity benefits as well as creating habitat or recreational opportunities, revitalizing neighborhoods, increasing property values, and reconnecting people to natural systems. An open waterway that replaces a buried pipe can appear natural or architectural, designed in context with a streetscape design.*

There are two types of daylighting–full flow or split flow. Full flow daylighting exposes the entire culverted stormwater pipe as a more natural stream channel. Split flow daylighting is a common option used in urban situations, in which the baseflow is diverted to a new surface channel while heavier storm flows are conveyed underground.

Where the storm drains to be daylighted are very deep, the design must address the conditions where the open channel will have steep side slopes. Care should be taken in implementation of this method, to ensure channel aesthetics, stability and public safety.

In identifying daylighting opportunities, several factors should be considered. Streams with perennial flow that are located in areas where a landscaped buffer could be established should be given priority. In determining the potential for daylighting, the designer should examine the additional benefits (stormwater management functions, habitat value). The *Alexandria Zoning Ordinance, Article XIII Section 13-110* recognizes stream daylighting as a potential improvement to meet the alternative stormwater management equivalency.

* Adapted from: www.forester.net/sw_0111_daylighting.html

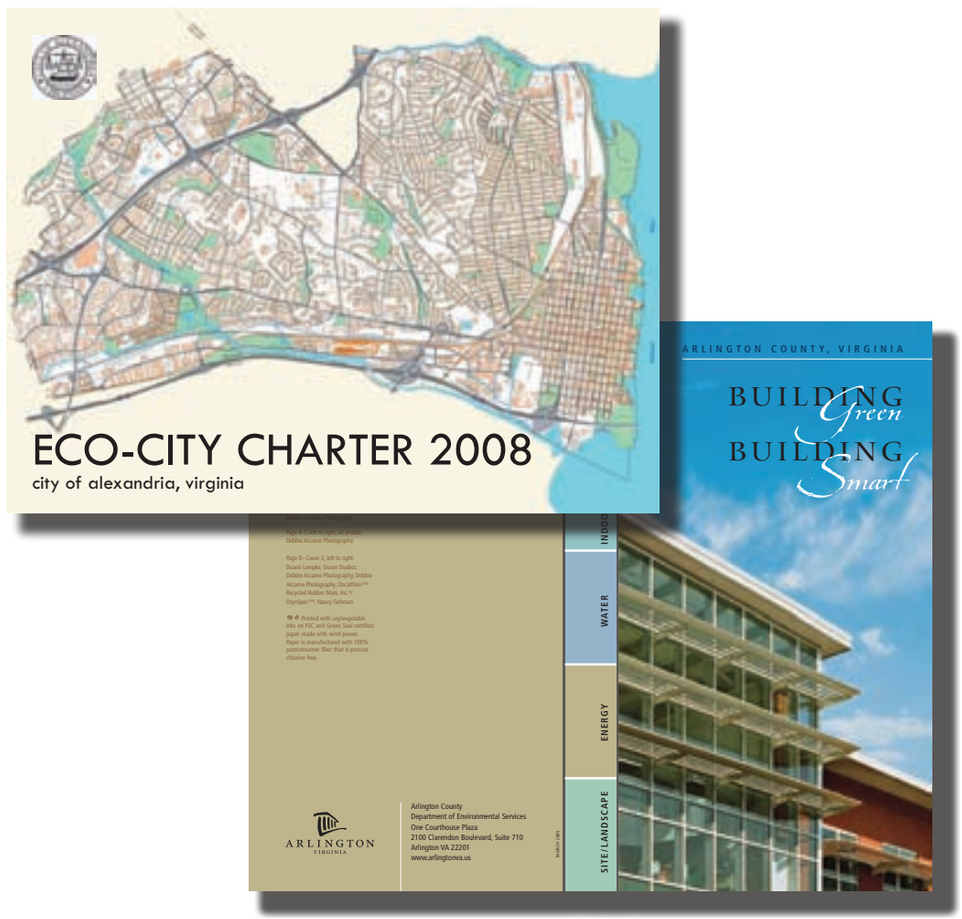
Before: Stream in underground storm culvert below mowed turf at the University of Virginia, Charlottesville, VA

After: Stream re-established at the University of Virginia

ENVIRONMENTAL AWARENESS

Sustainable Design Resources

Arlington County has established sustainable design goals for new and redeveloped sites and buildings. The City of Alexandria has approved its Eco-City Charter which is a vision of sustainability for the city, with the Phase I and Phase II action plans as goals and strategies to implement the vision. Alexandria has also approved building practice guidelines using the U.S. Green Building Council, LEED Requirements. Projects within the Four Mile Run stream corridor shall uphold the city's and the county's highest and best sustainability standards for renovation and redevelopment and shall follow the most up-to-date standards for sustainable building. These documents form the basis of the sustainable design goals for all elements of design within Four Mile Run.



Community Education

The improvements to Four Mile Run will bring significant benefits to the health of the stream, natural environment and species that inhabit the stream corridor. These improvements will also enrich the lives of the communities that surround it. Making people aware of the ecological and hydrological functions of the stream is an important component of the long-term success of the restoration efforts. Communities that are well informed about the natural systems around them will have a stronger connection to them and a better understanding of the importance of protecting them. Dynamic and interesting educational themes should be integrated into the design elements within the stream corridor and developed as public art projects.

> *The Four Mile Run Rechannelization Study: Educational and interpretive projects that explore the full range of environmental processes evident in the area should be considered. (Arlington Public Art Master Plan, 60)*

A program to develop community awareness must include elements that reach beyond the boundaries of the channel. It should be supported by adjacent residents, businesses and land owners; integrated with the curriculum of local schools; and reach all levels of the civic structure. Broader community awareness programs must also tie into the educational and interpretive elements developed within Four Mile Run.

The Four Mile Run Restoration Master Plan addresses opportunities to develop educational and interpretive opportunities including:

- Habitat area educational signage
- Tree and plant identification
- Wetland educational signage
- Flood markers
- Wildlife informational signage
- Recycling educational signage
- Stream alignment markers to show change over time
- Directional signage
- Temporary signage illustrating future improvements
- Revolving exhibits

"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."

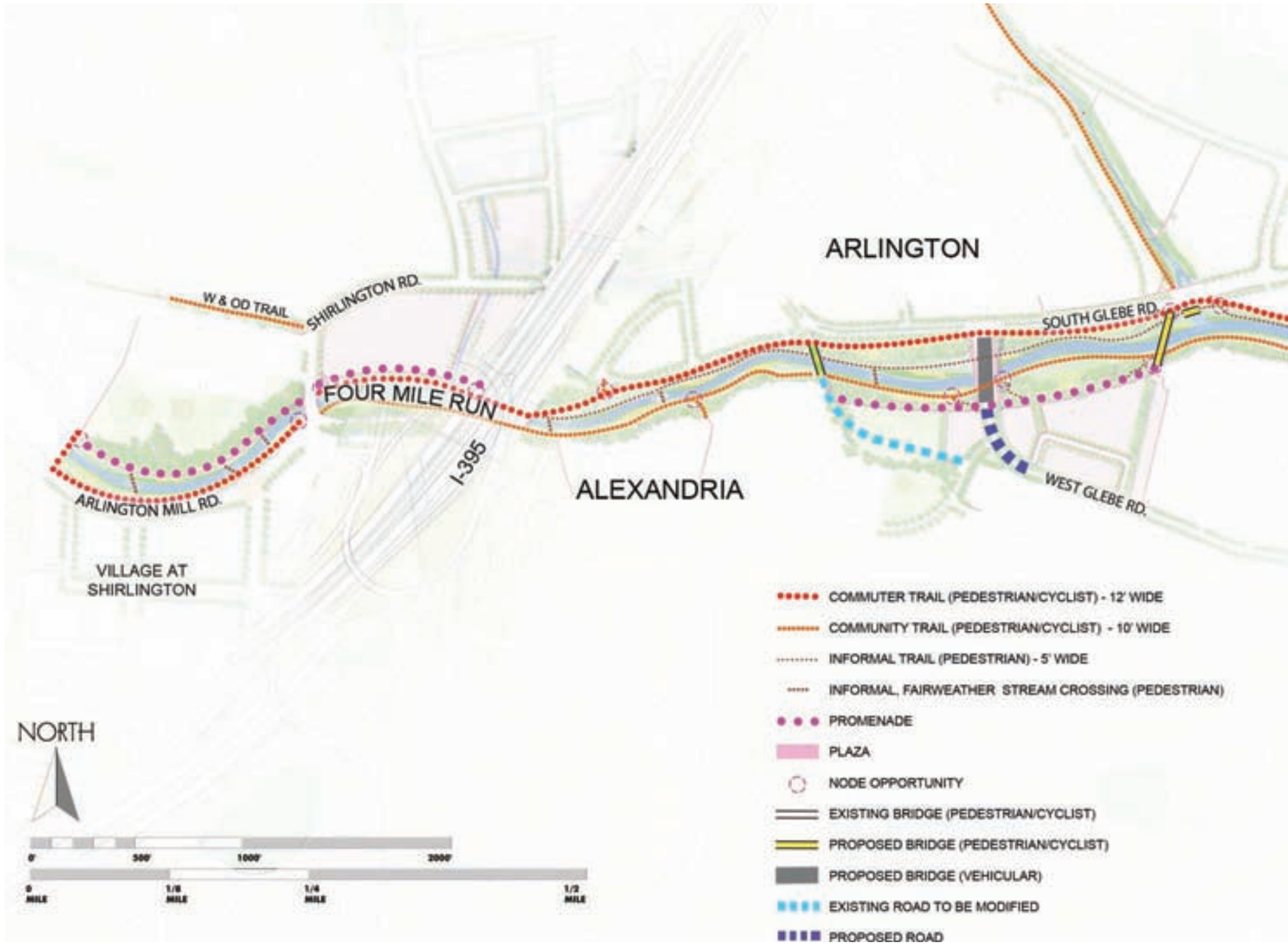
(Master Plan, 72)

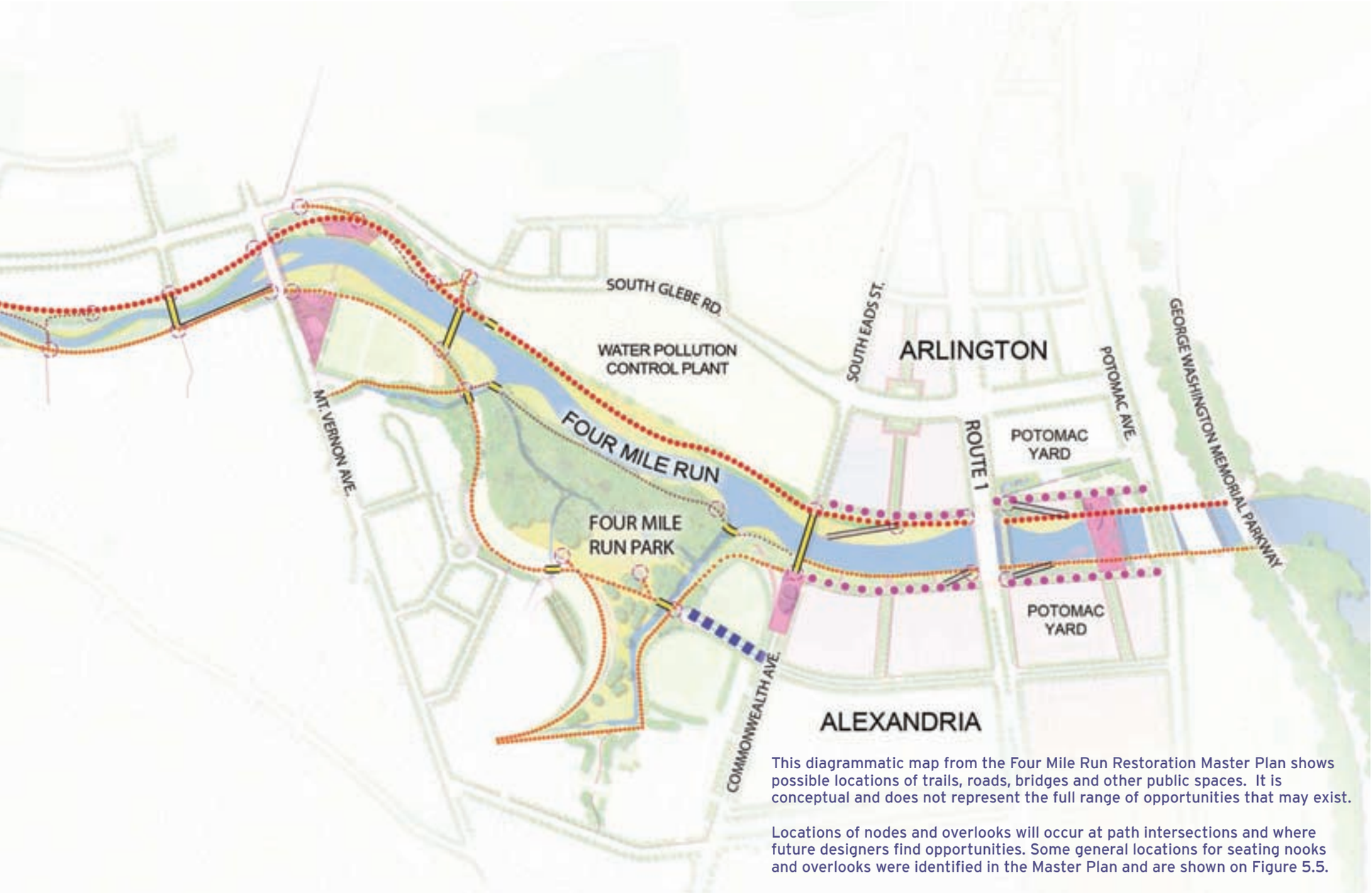
PUBLIC SPACES

TRAILS, NODES, PROMENADES AND PLAZAS

This section of the Design Guidelines will establish criteria and provide options for the detail design of recreational spaces and urban outdoor gathering spaces as well as the trails that link them together.

The outdoor public spaces within Four Mile Run offer a variety of recreational experiences. From high-intensity athletic facilities to quiet retreats from the urban environment, there are many options for people to enjoy. The Master Plan suggests a range of improvements to enhance existing facilities and link them as a cohesive network of open space. The Master Plan also recommends the creation of new public spaces where people can gather and enjoy the restored stream corridor.





This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of trails, roads, bridges and other public spaces. It is conceptual and does not represent the full range of opportunities that may exist.

Locations of nodes and overlooks will occur at path intersections and where future designers find opportunities. Some general locations for seating nooks and overlooks were identified in the Master Plan and are shown on Figure 5.5.

FIGURE 5.4

"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."

(Master Plan, 24)

TRAILS

A myriad of trails that intersect the corridor form the network that link public use areas. These trails connect users to various recreational facilities, naturalized areas and the stream. Physically bridging the stream, they also have the potential to improve connections between the surrounding communities.

The trails provide a means for people to experience all aspects of the stream corridor environment. The design of the trails will influence the way people perceive Four Mile Run. In developing trails, designers should consider how to take advantage of topography and views to make movement through Four Mile Run interesting and enjoyable.

Trails are continuous and extend the entire length and width of the stream corridor. They can become a unifying element that visually relates to all built elements and connects with all public spaces and natural areas. Trails also provide a framework upon which thematic ideas and artistic elements can be developed and should be considered an opportunity for the development of a large-scale public art project.

Design goals established in the Master Plan that apply to trails include:

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

Based on these and other goals articulated in the Master Plan, the following criteria apply to all trails within the stream corridor:

- Public access into the stream corridor must acknowledge that Four Mile Run is first and foremost a stream channel. Development of trails must be compatible with both hydrological functions and ecological systems.
- Trails should be designed in ways that minimize stormwater runoff or erosion.
- The design of trails should incorporate recycled materials and trail materials should themselves be recyclable.
- Commuter and community trails should meet or exceed the current requirements of the Americans with Disabilities Act (ADA).
- The alignment of trails should respond to topography and scenic opportunities and should accentuate significant views.
- The design aesthetic of trails should be integrated with the overall design language.
- Trail signage and location shall be in accordance with A*rlington County Wayfinding Analysis and Criteria* in Arlington, and in Alexandria, the *Alexandria Wayfinding Criteria*.
- Promote native forested canopies, where possible.
- The design of trails should integrate interpretive ideas and artistic elements or should be developed as a large-scale public art project.

TRAIL UNIFYING ELEMENT

The commuter and community trails are the threads that weave together the natural landscape, public spaces and built features. Like the stream itself, they are continuous elements meandering through diverse and changing environment.

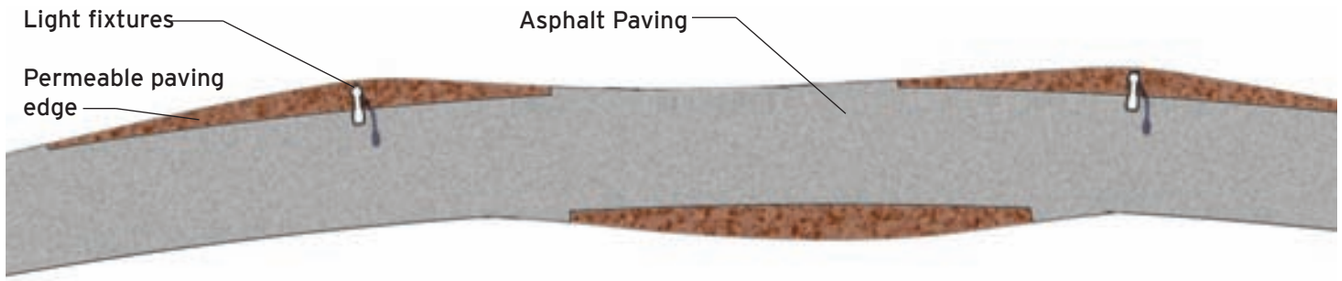
The concept for the commuter and community trails includes a continuous unifying element incorporated into the edge of the paved trail. This element is illustrated as a band of permeable paving set flush with the edge of the asphalt paved surface.

The permeable band performs a number of functions:

- **Stormwater Runoff Management: The area of permeable paving collects the stormwater runoff from the asphalt path, detains it and filters it before releasing it into the ground or stream.**
- **Paving Edge Definition: The permeable band gives definition to the primary trails and enhances the appearance of the paving.**
- **Organization of Elements: Lighting, trash receptacles, signage, seating and other site furnishing elements are located within the band, eliminating the need to mow around these elements.**
- **Informational System: Decorative markers will be embedded in the paving band every one-tenth of a mile to identify the location in the stream corridor (a safety benefit) and to provide a measurement of distance. Other information such as orientation or elevation of the trail also can be included at these marker locations.**
- **Thematic development: Environmental, historic, cultural and artistic themes can be developed that incorporate elements embedded or integrated with the band.**

Permeable Paving Edge

The paving of commuter and community trails is unified by this curvilinear edge treatment. Made of permeable paving material, this decorative edge also collects stormwater runoff from the path and directs it to underground drainage or storage areas.

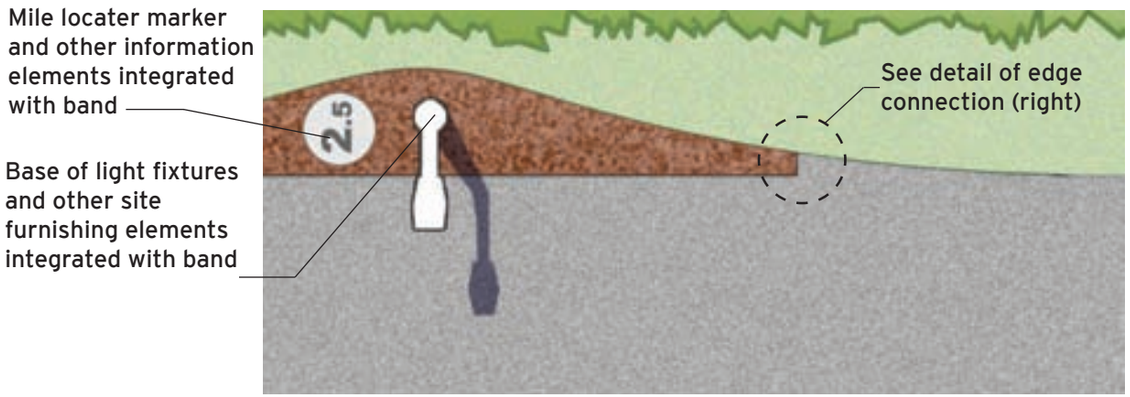


Typical plan of trail with permeable paving band.

Example of permeable paving next to an asphalt pathway.

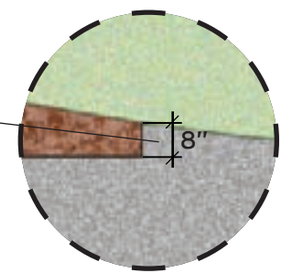
Organizational and Informational Elements

The permeable paving edge treatment also contains site furnishing, lighting, signage and other possible informational elements located adjacent to the trails. This will minimize the need to mow around these objects and minimize conflicts with pedestrians and cyclists.



Typical plan showing the permeable paving band detail.

The edge connection of the asphalt path is designed to eliminate a narrow area which would be difficult to construct



Thematic and Artistic Elements

The permeable paving edge creates opportunities for introduction of thematic elements or the development of public art projects that relate directly to Four Mile Run. These examples depict applied or embedded elements that could be incorporated into permeable paving.

Incised graphics, text or numbers

Surface applied graphics, text or numbers

Color and textural changes in pavement

Embedded recycled materials

Embedded sculptural elements

Lighting elements integrated into the paving

REFERENCED PAVING MATERIALS

Cast-In-Place Porous Concrete and Asphalt

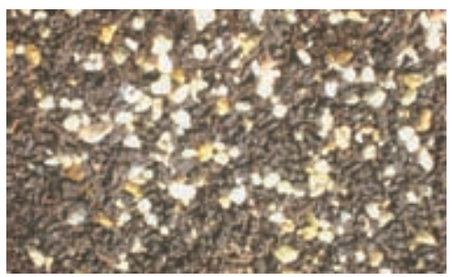
The open matrix of these materials allows water to flow quickly through the top layer into an aggregate subbase below.

* See maintenance requirements for permeable surfaces

Cast-In-Place Porous Recycled Rubber

The recycled material comes in many color options and has surface resiliency.

* See maintenance requirements for permeable surfaces



Permeable Pavers

Many shapes and color options of interlocking, permeable pavers are available. Those with smaller joints that allow the water to pass through to the aggregate subbase below are preferred.

* See maintenance requirements for permeable surfaces

Stone

Crushed stone, gravel or natural cleft flagstone placed over an aggregate base makes durable porous paving in areas where high-traffic wheelchair access or other vehicle access is not required. When used adjacent to mowed lawn areas, a steel edge/ bed divider is required.

MAINTENANCE REQUIREMENTS FOR PERMEABLE SURFACES

- Permeable paving requires minimal but regular maintenance to keep the voids between the aggregate free of fine debris. This may require periodic sweeping and vacuuming or low pressure washing to remove organic materials, such as decomposed leaves or soil.
- To minimize sediment deposits, it is important to stabilize any exposed soil uphill of the permeable paving system. Regular maintenance and replanting, if necessary, is required for areas adjacent to or upland of the permeable paving areas.
- If snow removal is required for permeable paving, use of sand or other granular de-icing materials should be avoided, because they may clog the voids in the paving.
- For permeable unit systems, periodic replacement of the aggregate fill may be required to supplement material that is washed or worn away.

-from Stormwater Management Fact Sheet: Porous Pavement, http://www.stormwatercenter.net

REFERENCED PAVING MATERIALS

Cast-In-Place Concrete

Standard concrete (non-porous) can be finished in many ways to enhance its character. Broom finish provides the minimum non-slip finish. Exposed aggregate also provides an interesting surface texture.

Broom Finish

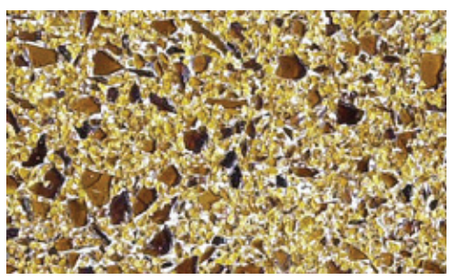
Exposed Aggregate

Asphalt with Recycled Aggregate

Recycled materials such as crushed brick or glass can be integrated with asphalt to enrich the surface appearance.

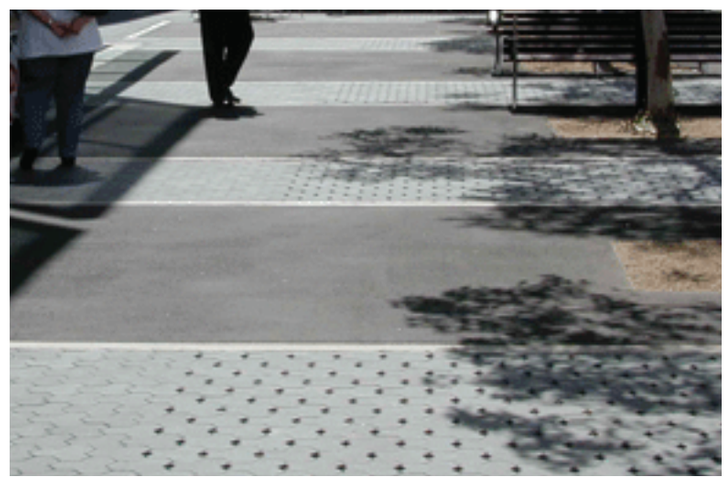
Pavers with Recycled Content

Precast pavers that integrate recycled materials such as fly ash or post-consumer crushed glass are commonly available and have attractive finish options.



Recycled Composite Lumber

Lumber made from recycled plastics and other post-consumer composite materials can be incorporated into decking, rail caps and other non-structural components of boardwalks or elevated walkways.



Examples of paving materials used in combination. Above, cast-in-place concrete, stone and recycled rubber; below, asphalt and permeable pavers

"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 facilities as part of a cohesive open space network."

(Master Plan, 28)

Existing commuter trail

Asphalt trail with infiltration strip

Commuter Trail

While its alignment may change, the existing trail that travels along the northern bank of Four Mile Run will remain the primary commuter bike trail within the stream corridor, and provide an east-west link between the National Park Service Mount Vernon Trail and connections of the upper reaches of Four Mile Run such as the W&OD trails.

Stream restoration improvements, bridge construction projects and other ongoing improvements in the corridor will likely affect large segments of this trail. Over time, due to heavy use significant refurbishments will become necessary.

The design team responsible for the first phase of this trail will need to consider how solutions will be extended to future phases and how the design will inform other improvements in the corridor. The following guidelines apply specifically to the commuter trail:

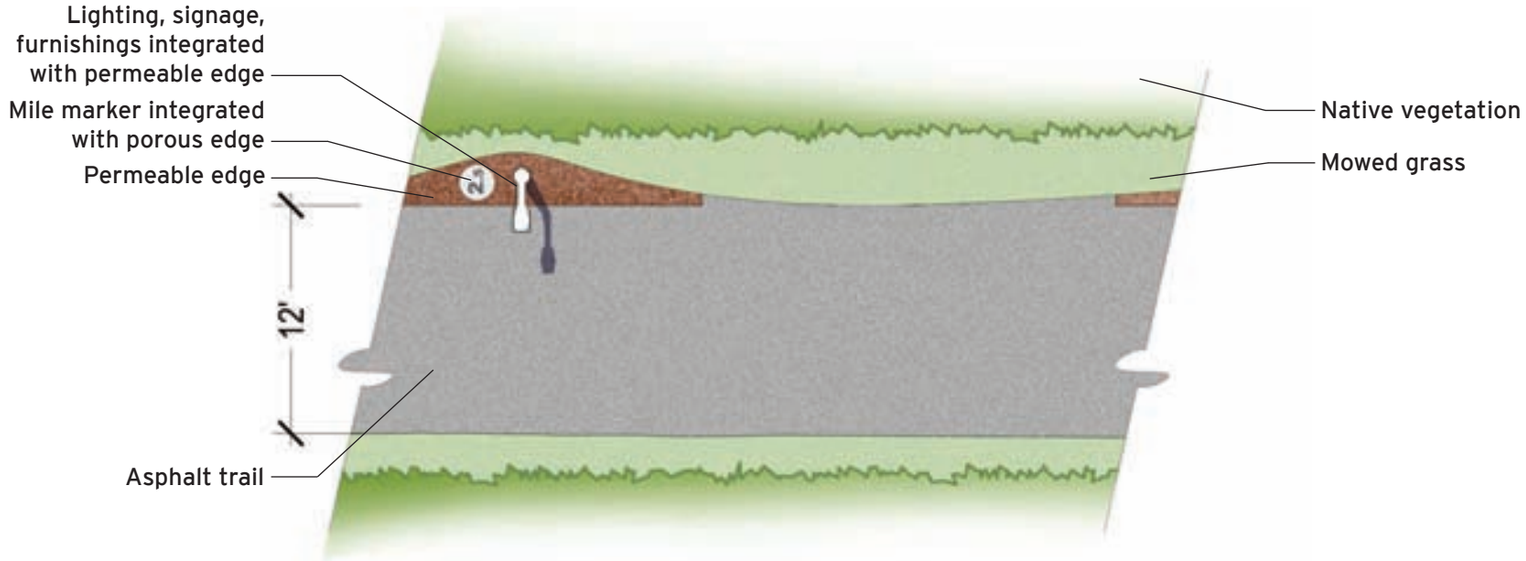
- The trail design must be compatible with the Arlington County's trail requirements and Public Spaces Plan and must meet current AASHTO (American Association of State Highway and Transportation Officials) and ADA (Americans with Disabilities Act) requirements.
- The trail must safely accommodate high-volume, high-speed, two-way bicycle traffic as well as pedestrian and other non-motorized traffic.
- The travel trail should be 12 feet wide with opposing lanes of travel divided by a painted line or other approved center line marker. Where space is limited, a minimum 10-foot-wide trail may be used.
- The primary paving surface material should be asphalt and must have a durable, non-slip surface with a minimum of lateral joints.
- Incorporate infiltration strips surfaced with permeable or porous material adjacent to the trail to collect surface runoff.
- Incorporate recycled materials such as milled asphalt, crushed brick and crushed glass into the asphalt matrix.
- To the extent possible, align the new trail to the existing bike trail and reuse the existing paving base and asphalt materials.
- The design should integrate a strong unifying element.
- Future planning efforts to extend the trail beyond the area addressed by these guidelines should consider extending a unifying element to future trail segments elsewhere in the Four Mile Run watershed.
- Increase the paving width and integrate other compatible paving materials at trail intersections and nodes.
- The full length of this trail should be lighted using full-cutoff, high-efficiency fixtures.

Outdoor Developed Areas Accessibility Guidelines	AASHTO Guide for the Development of Bicycle Facilities
T303.3 Surface: Firm and stable	Bicycles need the same firmness and stability as wheelchairs; skaters usually require a smooth, paved surface. Most shared use paths are paved, although crushed aggregate surfaces are used on some paths.
T303.4 Clear Tread Width: 36 inches (3 feet; 915 mm); exception for 32 inches (815 mm)	Shared use paths usually require a minimum 3 meter (10 foot) width, plus a 0.6 meter (2 foot) safety buffer on both sides. A 2.4 m (8 foot) width may be allowed in low use facilities. Posts or bollards installed to restrict motor vehicle traffic should be spaced 1.5 m (5 feet) apart. Posts or bollards should be brightly painted and reflectorized for visibility. When more than one post is used, use an odd number, with one on the centerline to help direct opposing traffic.
T303.5 Openings (Gaps): To prevent wheelchair wheels and cane tips from being caught in surface openings or gaps, openings in trail surfaces shall be of a size which does not permit passage of a ½" (13 mm) diameter sphere; elongated openings must be perpendicular or diagonal to the direction of travel; exception to permit parallel direction elongated openings if openings do not permit passage of a ¼" (6 mm) sphere; second exception to permit openings which do not permit passage of a ¾" (19 mm) sphere.	The AASHTO Guide does not specify a maximum dimension for a surface opening, but openings should be minimized. Openings should not permit a bicycle wheel to enter. Grates should be flush with the surface, and elongated openings should be perpendicular to the direction of travel (diagonal openings are more difficult for bicyclists to negotiate). Where openings are unavoidable, they should be clearly marked.
T322.1 Protruding Objects: T405 provide a warning if vertical clearance is less than 80 inches (2030 mm)	Protruding objects should not exist within the clear tread width of a shared use path. Vertical clearance on shared use paths should be a minimum of 3 m (10 feet) or the full clear width including safety buffers. Where vertical barriers and obstructions, such as abutments, piers, and other features are unavoidable, they should be clearly marked.
T303.6 Tread Obstacles (Changes in level, roots, rocks, ruts): Up to 2 inches (50 mm); exception up to 3 inches (75 mm)	Tread obstacles are hazardous to bicyclists and skaters. The surface of a shared use path should be smooth and should not have tread obstacles.
T303.7 Passing Space: At least 60 inches (1525 mm) width within 1,000 foot (300 m) intervals. Advisory recommends more frequent intervals for some trail segments	Shared use paths should have a minimum clear width of 3 m (10 feet); exception for 2.4 m (8 feet).
T303.8.1 Cross Slope: 1:20 (5%) maximum; exceptions for open drains up to 1:10 (10%)	For drainage, shared use paths should have a minimum 2 percent (1:50) cross slope on a paved surface. On unpaved shared use paths, particular attention should be paid to drainage to avoid erosion. Curves on shared use paths may require super elevation beyond 2% (1:50) for safety reasons. The Guide suggests limited cross slope for accessibility reasons.
T303.8.2 Running Slope: 1:20 (5%) any length 1:12 (8.33%) for up to 200 feet 1:10 (10%) for up to 30 feet 1:8 (12.5%) for up to 10 feet No more than 30% of the total trail length shall exceed 1:12	Running slopes on shared use paths should be kept to a minimum; grades greater than 5 percent are undesirable. Grades steeper than 3 percent may not be practical for shared use paths with crushed stone or other unpaved surfaces. Where terrain dictates, grade lengths are recommended as follows: < 5% (< 1:20) any length 5-6% (1:20-16.7) for up to 240 m (800 feet) 7% (1:14.3) for up to 120 m (400 feet) 8% (1:12.5) for up to 90 m (300 feet) 9% (1:11.1) for up to 60 m (200 feet) 10% (1:10) for up to 30 m (100 feet) 11+% (1:9.1) for up to 15 m (50 feet)
T303.9 Resting Intervals: Size: 60 inch (1525 mm) length, at least as wide as the widest trail segment adjacent to the rest area. Less than 1:20 (5%) slope in all directions. Resting areas are required where trail running slopes exceed 1:20 (5%), at intervals no greater than the lengths permitted under running slope (see T302.6.2 above).	The Guide does not address resting intervals.
T303.10 Edge Protection: Where provided, 3 inch (75 mm) minimum height. Handrails are not required.	The Guide does not address edge protection. Some kinds of edge protection may be hazardous to bicyclists and skaters. The Guide has minimum railing height recommendations when needed for safety reasons.
T222 Trail Signs: Accessible trails require designation with a symbol of accessibility, and information on total length of the accessible segment. No traffic control sign information.	Guidance on signing and marking is provided in the Manual on Uniform Traffic Control Devices (MUTCD), incorporated by reference as a Federal regulation (23 CFR 655.601). A proposed amendment for Part 9 (Traffic Controls for Bicycle Facilities) was published in the Federal Register on June 24, 1999 (64 FR 33802).

Comparison of AASHTO and ADA requirements for outdoor trails

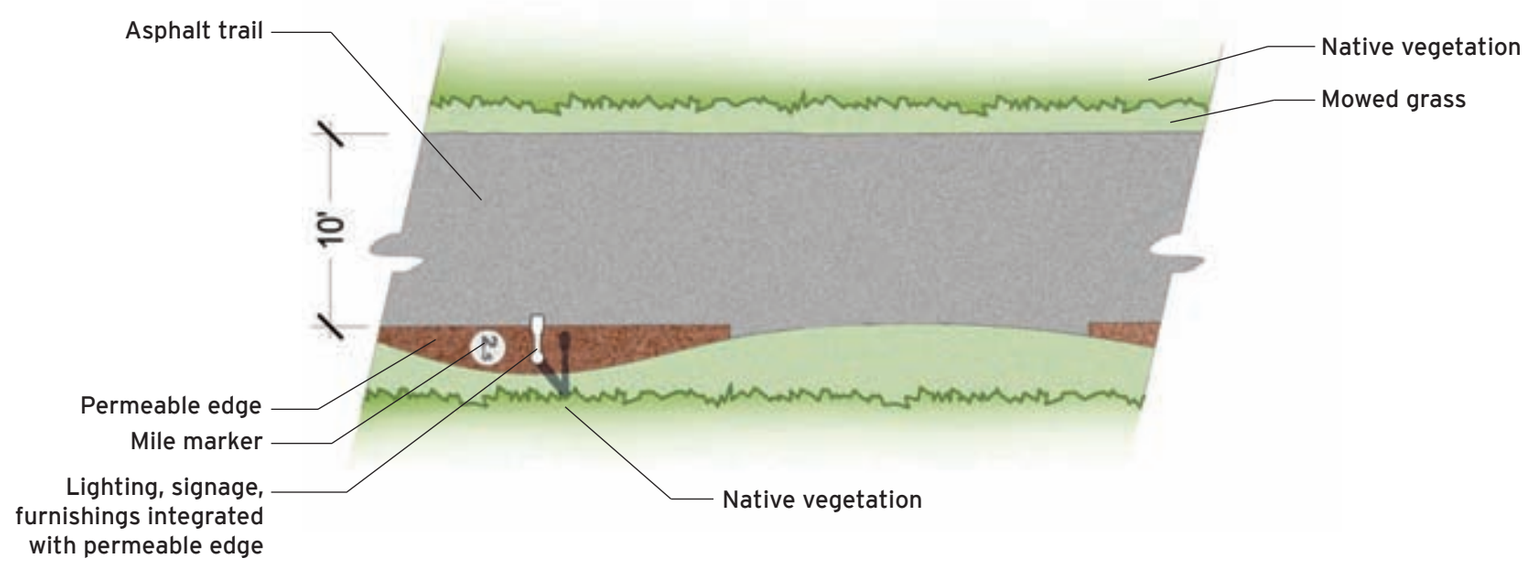
Commuter Trail

The primary trail on the Arlington County (north) side of Four Mile Run is identified as the commuter trail and is typically 12′ wide.



Community Trail

The primary trail on the City of Alexandria (south) side of Four Mile Run is identified as the community trail and is typically 10′ wide.



Examples of informal stream crossings

Community Trail

The primary trail on the south side of the channel is the community trail, which is similar in design to the commuter trail with the following exceptions:

- The trail must meet Alexandria's Pedestrian and Bicycle Mobility Plan and must meet current AASHTO and ADA requirements.
- The width should be 10 feet (8 feet where space is limited).
- The community trail is not considered a high-speed commuter bicycle trail, but will accommodate slower-paced bicycles, rollerbladers, runners, walkers and other non-motorized travel.

Informal Trail

The informal trails are recreational, designed for hiking, jogging and walking and provide a secondary level of access within the Four Mile Run stream corridor. They are not intended for bicycle access. These trails make connections to the commuter and community trails while providing opportunities to access more naturalized areas, including the stream and vegetated stream banks. Criteria for informal trails include the following:

- Width should be 6 feet.
- Longitudinal slope should be less than 5 percent.
- Character of the trails should be compatible with the immediate surrounding conditions. The color, texture, degree of reflectivity and edge treatments should not detract from the adjacent landscape treatment.
- Primary surface of informal trails should be paved with non-slip, durable, porous materials and that incorporates recycled materials and/or materials that can be recycled. Suggested materials include:
    - In areas where high traffic is expected and through lawn areas, trails should be paved with porous concrete paving, porous asphalt or permeable pavers.
    - In areas where moderate traffic is expected, porous paving made of recycled rubber may be used in addition to porous materials listed above.
- Increase the trail width and integrate other compatible paving materials at trail intersections and nodes.

Ramps

Ramps include ADA-compliant accessibility areas, non-motorized boat launches and other trails with a slope of 5 percent or greater. Each requires special treatments, such as non-slip surfacing and/or handrails and must meet the following guidelines:

- Handicap-accessible trails should be provided to all primary recreation areas, bridges and public facilities within the stream corridor.
- Trails designated as handicap-accessible must be compliant with all current ADA requirements.
- Where handrails are required, they should be compatible with the overall design language.
- Ramps on trails between 5 percent and 8.33 percent slope may be the same material as the trail. Additional non-slip texturing may be required.
- Ramps sloping 8.33 percent or greater should be paved in concrete with a non-slip finish treatment.

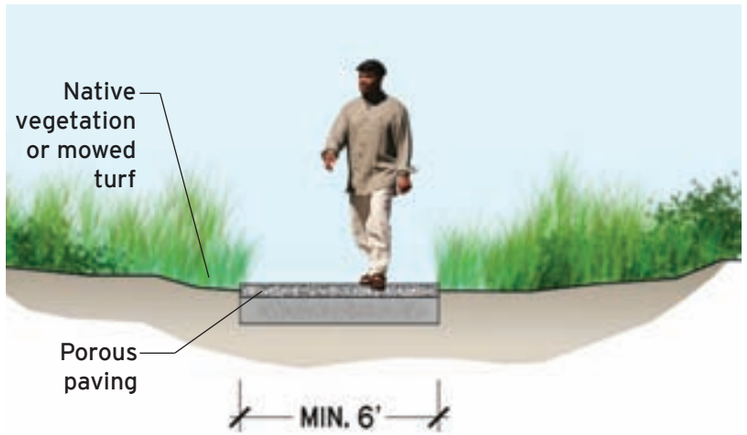
Informal Stream Crossings

The Master Plan identifies several at-grade informal fair-weather stream crossings, stating that "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." (Master Plan, 61) These crossings are not intended to provide essential trail connections, and must be designed to accommodate periodic inundation. The exact location of these crossings must be integrated with overall channel restoration efforts and not impede or compromise hydrologic functions or ecological systems. They must also meet the following guidelines:

- At-grade stream fords may be fair-weather crossings and must be secured to foundations and must be stable. Informal stream crossings should include signage for additional safety.
- Crossings should be compatible with the overall design language and should be integrated into the design of the trail leading to them.
- Crossings must be designed and located so that they do not impede hydrologic functions or impede the passage of aquatic wildlife.

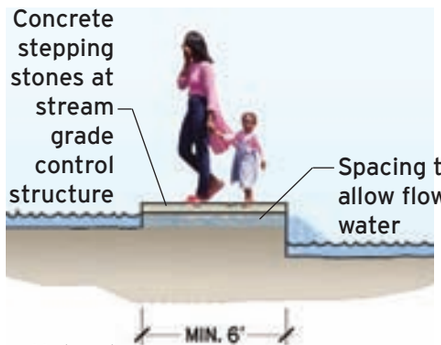
Informal Trail

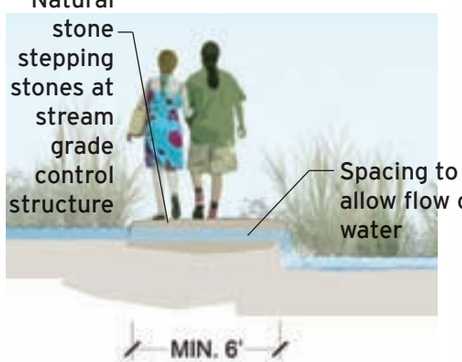
Informal trails provide a connection between the commuter and community trails and access to more naturalized areas of the stream corridor. The degree of traffic expected will determine the best paving material option.

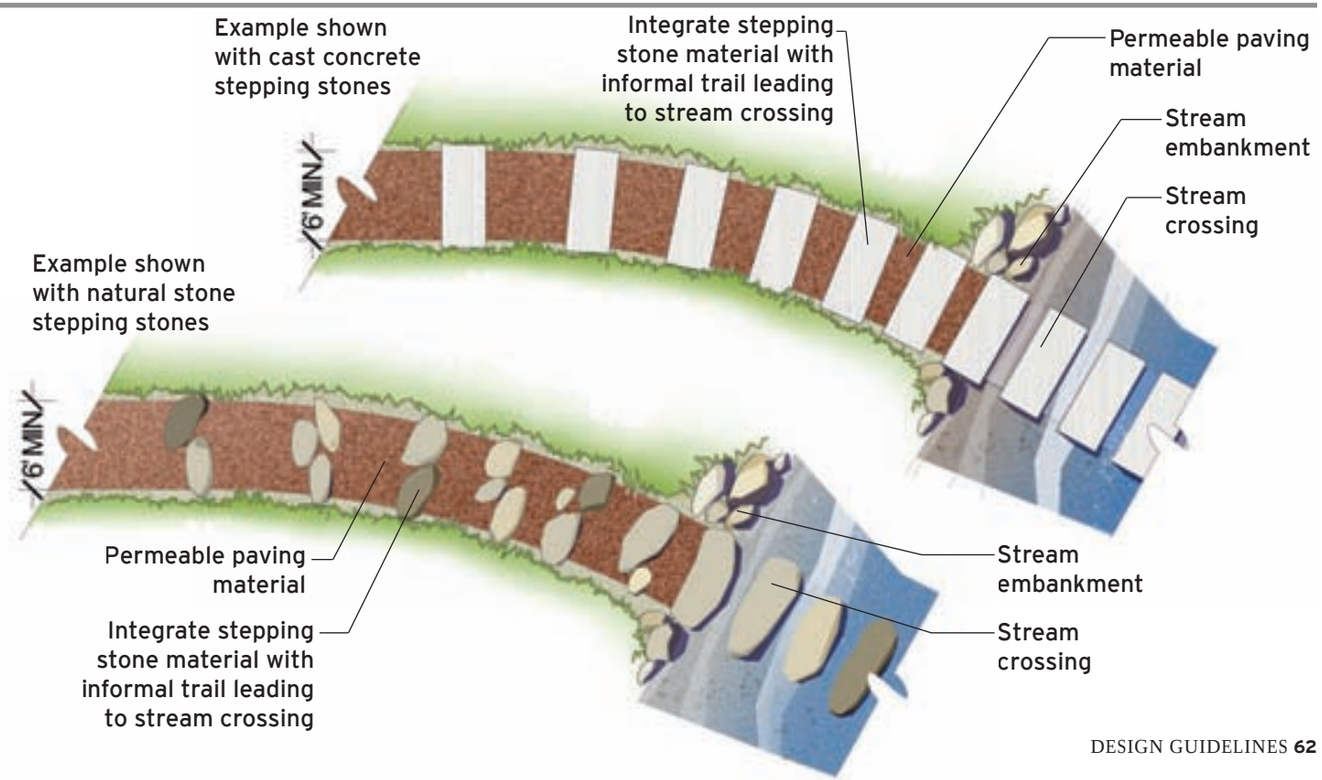


Stream Crossing

At selected locations, where the stream hydrology and other environmental conditions will permit, stepping stones provide a means to cross at stream level. Here two examples, show how an informal trail connects to the edge of a stream crossing.



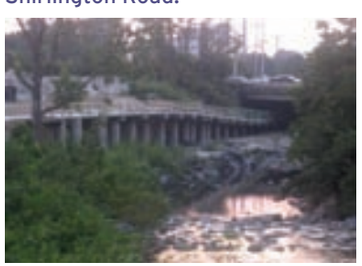




A boardwalk support structure designed to minimize disturbance

The finished boardwalk limits disturbance of sensitive sites

Partially completed raised trail at Shirlington Road.



The support structure of the raised trail

Raised Trails/Boardwalks

Where topography or other conditions will not permit the construction of at-grade trails, a raised trail may be necessary to make an essential connection. Where trails cross over tributaries or through wetland areas, it will be necessary to provide raised boardwalks. These structures must be designed to minimize impact on the hydrological or ecological systems. They also must meet the following guidelines:

- Structures must meet all current building code and ADA requirements.
- The width of the raised trail or boardwalk should be the same as the trail that leads to it, 6 feet at a minimum.
- The surface decking should incorporate high-quality, recycled, composite lumber with a non-slip, textured finish. The structural components must be Environmental Protection Agency-approved and sustainably produced.
- The boardwalk should be constructed to minimize material waste and foundation requirements.
- Where required, handrails should be provided.
- The design should be consistent with the overall design language.

The recently constructed multi-use trail extension between I-395 and Shirlington Road on the Arlington side of the stream corridor provides an example of a raised trail that incorporates materials consistent with the design language. The local stone retaining walls and cast-in-place concrete support structures are fitting treatments for this element. Future raised trails of this nature should incorporate railings and handrails that comply with these guidelines.

Railings & Handrails

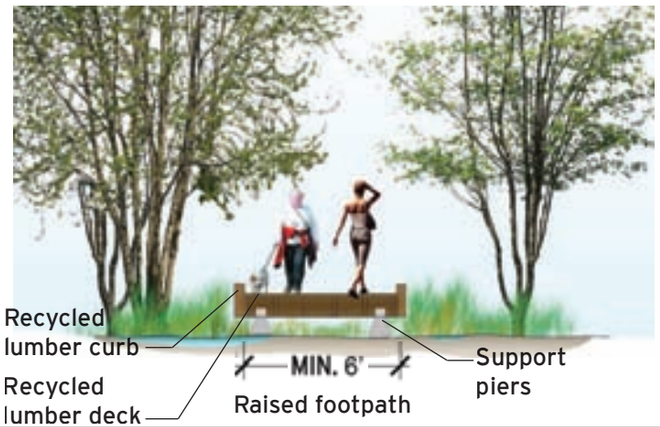
When guard railings and handrails adjacent to trails are required their designs must meet current building codes and all ADA requirements. They should not protrude into the trails or obstruct movement along trails.

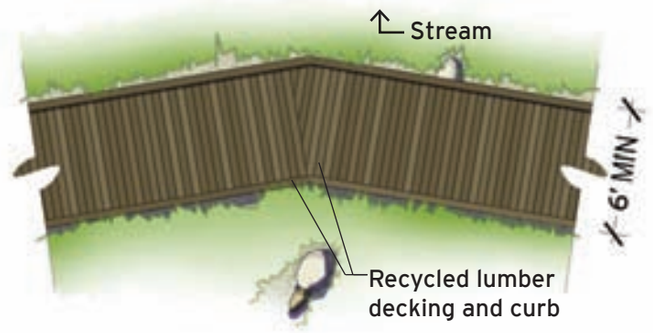
The essential components of railings are the support posts and the top railing. In some instances, pickets, mesh or vertical panels will be required. Railings should be designed to avoid obstructing views and minimize non-essential components. In addition, the following guidelines should be observed:

- Railings should be considered architectural opportunities and should be compatible with the overall design language.
- Materials incorporated into the top railing should be smooth. These include galvanized steel, recycled-composite lumber, and brushed stainless steel. Avoid materials that require painting or refinishing, or that will splinter or crack.
- Railing support components and vertical panels should be made of heavy gauge or solid bar galvanized steel, weathering steel, brushed stainless steel, or stainless or galvanized steel mesh.
- Consider integration of trail lighting with railing design.

Raised Trails/Boardwalk

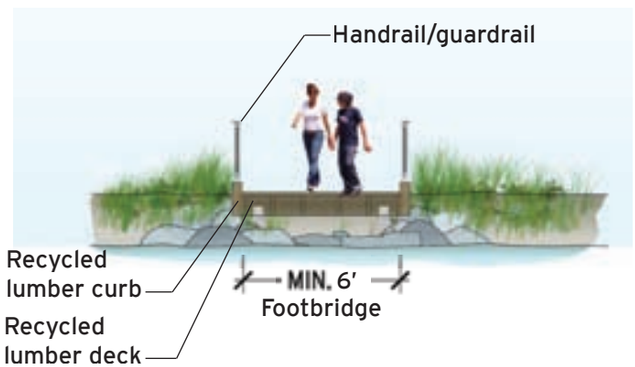
In sensitive areas, where construction of at-grade paving would otherwise disturb soil and vegetation, raised boardwalks can provide pedestrian access with minimal disturbance. These examples suggest a simple structure that incorporates recycled decking to minimize material waste.

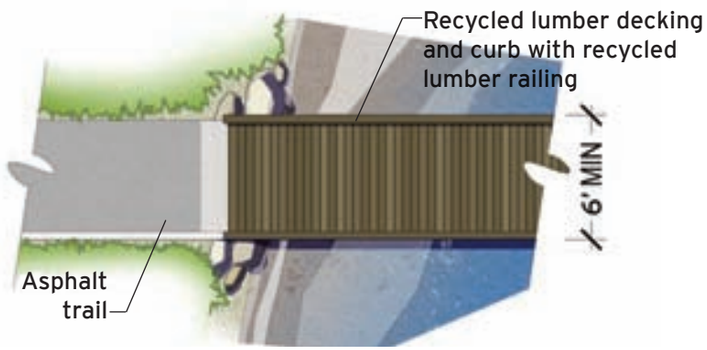




Raised Footbridge

At several locations within the Four Mile Run stream corridor, short footbridges will be required to span small tributaries. These examples show a simple structure that is compatible with the boardwalk design element.





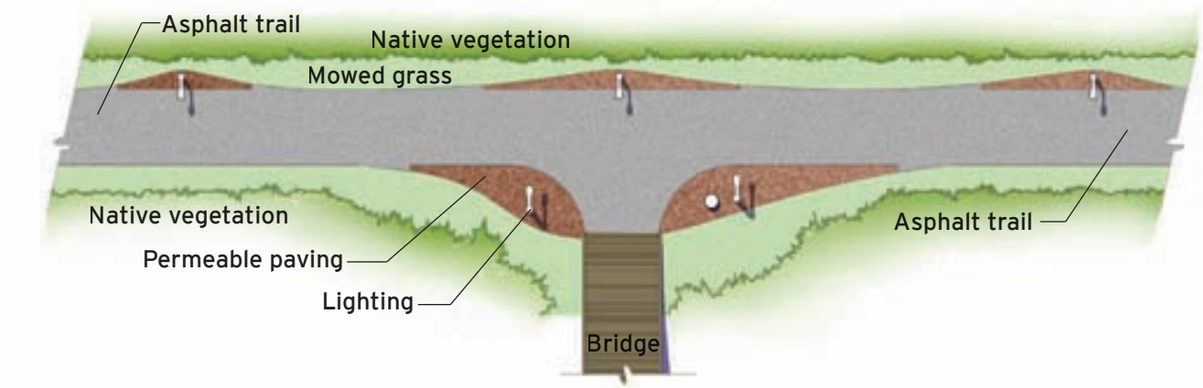
Handrail / Guardrail

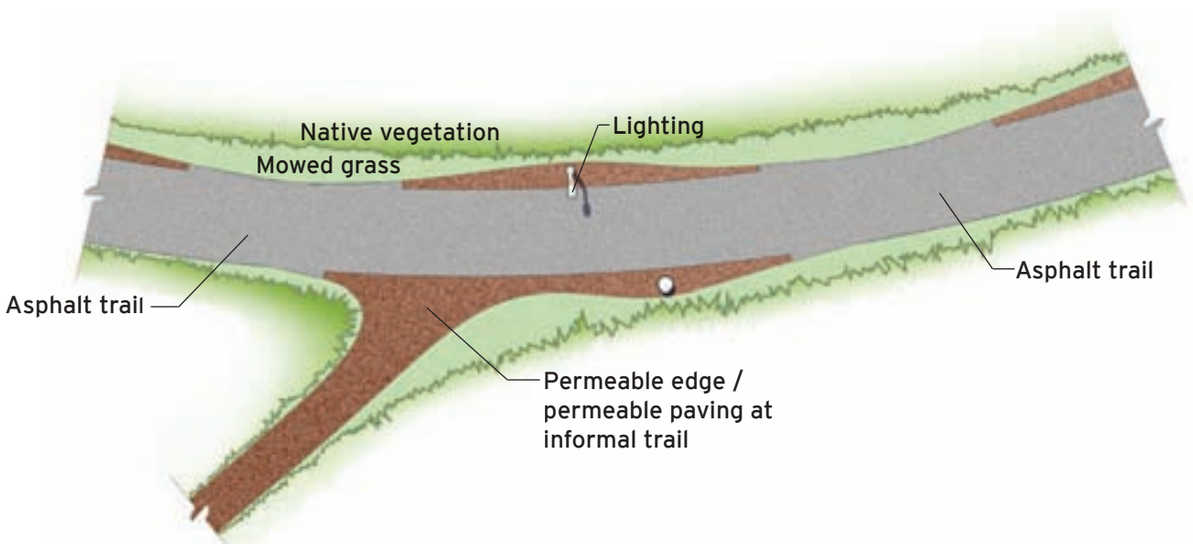
At accessible ramps, stairs or sudden changes of grade adjacent to walkways, handrails and guard rails will be required. These examples minimize vertical obstruction and incorporate galvanized steel, weathering steel, concrete, or recycled composite timber.

Nodes: Intersections

These examples show how a node might be developed at the intersection of two trails, or where a trail divides. Additional paving width is accommodated in the porous paving edge treatment as are the clusters of lighting and other site furnishings.

Example of a node at a trail intersection





NODES

A node is a place along a trail where it intersects with another trail, connects to a bridge or where vistas exist that might cause someone to want to pause and take in the view. Nodes require a slight widening of the trail to enable trail users to slow down and pass one another. A node is typically a good location for a seating area or special design element.

Where nodes occur along the trail, there should be a transition in the paving design to accommodate circulation and create special opportunities to enjoy the stream corridor. A variety of nodes can be developed, as described below:

- Vary the trail width to allow people to gather and pass safely.
- Vary the paving material by introducing special detailing and textures that are conducive to a slower speed.
- Congregate site furnishings such as seating, lighting, or signage at nodes appropriate to their purpose.

Nodes: Seating Areas

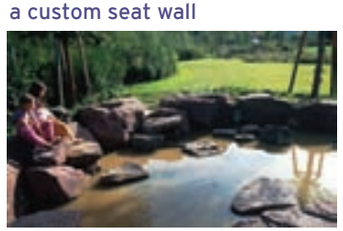
These examples show two variations of how a seating node might be designed.

The first illustrates a node along the commuter or community trail where the porous paving edge expands to accommodate custom-designed or prefabricated seating and site furnishings.

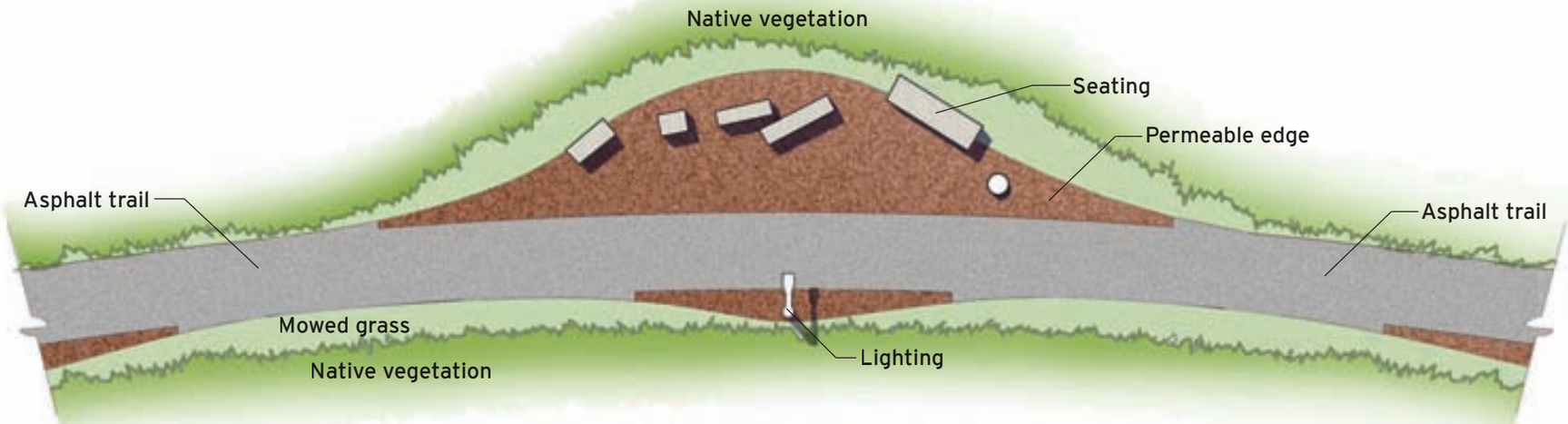
The second occurs along an informal trail, where the permeable paving is integrated with natural flagstone, and large natural boulders offer a casual seating opportunity.

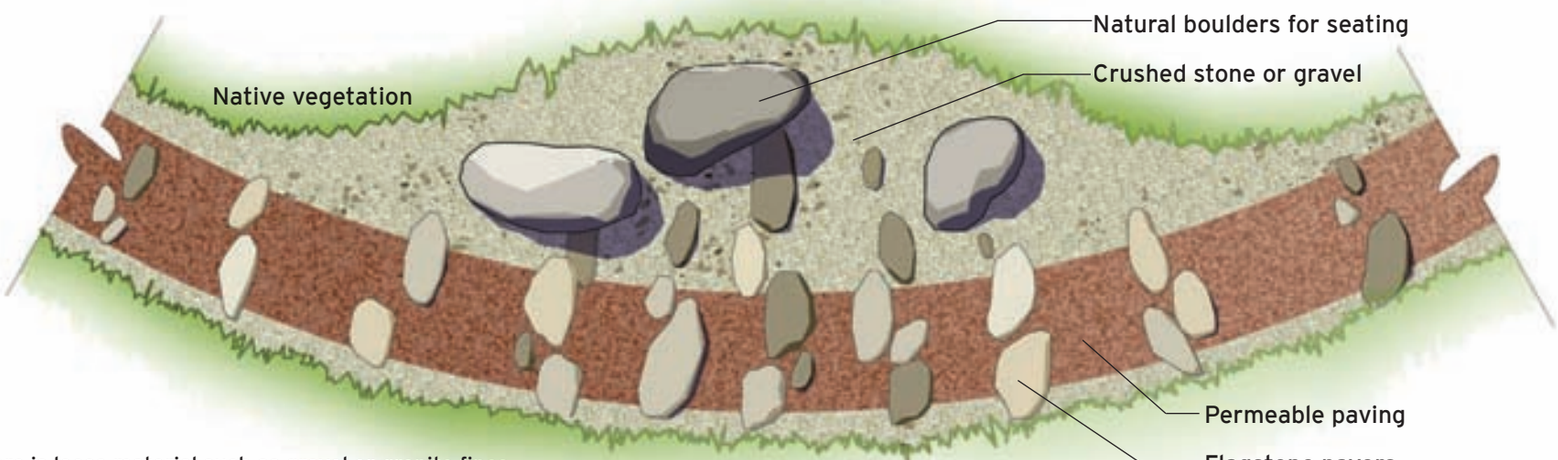
Seating nodes should be located where existing trees will provide shade or conditions will permit addition of native shade trees.

Example of a seating node with a custom seat wall



Example of a seating node at waters edge with boulders for seating





Note: If there is loose material such as gravel or granite fines, then an edge restraint (such as steel edging) is required to contain the material.

Promenades adjacent to public amenities

Plaza with water-themed activities

PROMENADES

The Master Plan identifies several urban development opportunities along the edges of the stream corridor where strong visual and physical interaction between the adjacent land uses and Four Mile Run is envisioned. At these locations, linear urban spaces overlooking the stream can function as vibrant public gathering spaces. The Master Plan describes promenades in this way: "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." (Master Plan, 59)

The design of promenades should be integrated with adjacent land uses and building designs. For guidelines on how the adjacent development should relate to the promenade, refer to the section on Building Form under Built Features.

In general, the design of promenades should meet the following guidelines:

- Promenades should be approximately 30 feet wide to accommodate pedestrians, bikes and other recreational traffic and allow adequate space for seating and outdoor public gatherings.
- Paving materials should consist primarily of high-quality, permeable pavers. The particular design, color and finish should respond to adjacent development.
- The paving system should incorporate Low Impact Development (LID) stormwater management technology. Refer to the *Northern Virginia Regional Commission Low Impact Development Supplement* for additional guidance.
- Paving must accommodate emergency vehicles.
- The trail's unifying element should continue through the promenades as a means to connect them into the overall trail network.
- Include provision for the integration of thematic and artistic elements with designs for promenades.
- Benches, trash receptacles and drinking fountains should be located at intervals along the walk.
- Wayfinding signage should be located to direct people to other parts of the corridor.
- Shade trees with ornamental shrubs and perennials should be planted along the length of the promenade.

PLAZAS

In addition to promenades, the Master Plan recommends creation of new public urban spaces at several key locations within the corridor. Near the Mount Vernon Avenue bridge, a major plaza is envisioned on the Alexandria side of the stream, which is described as follows in the Master Plan:

> 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. (Master Plan, 71)

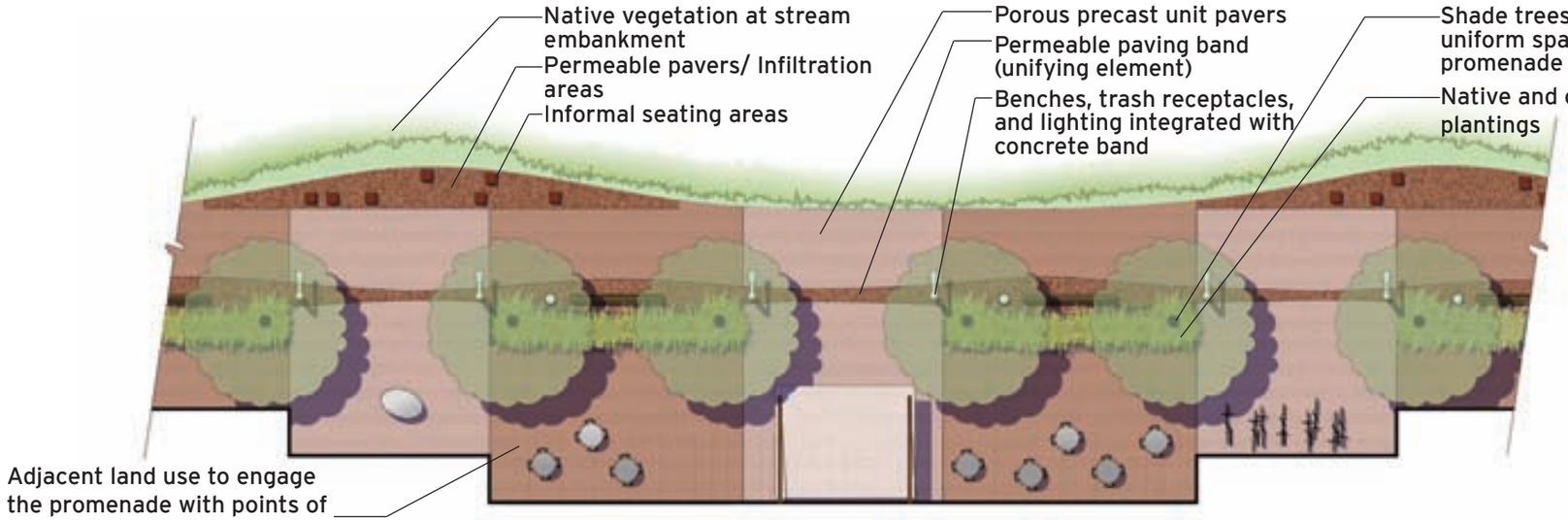
The Master Plan locates another key space across the stream in Arlington. A public space with interactive water features is envisioned in this area.

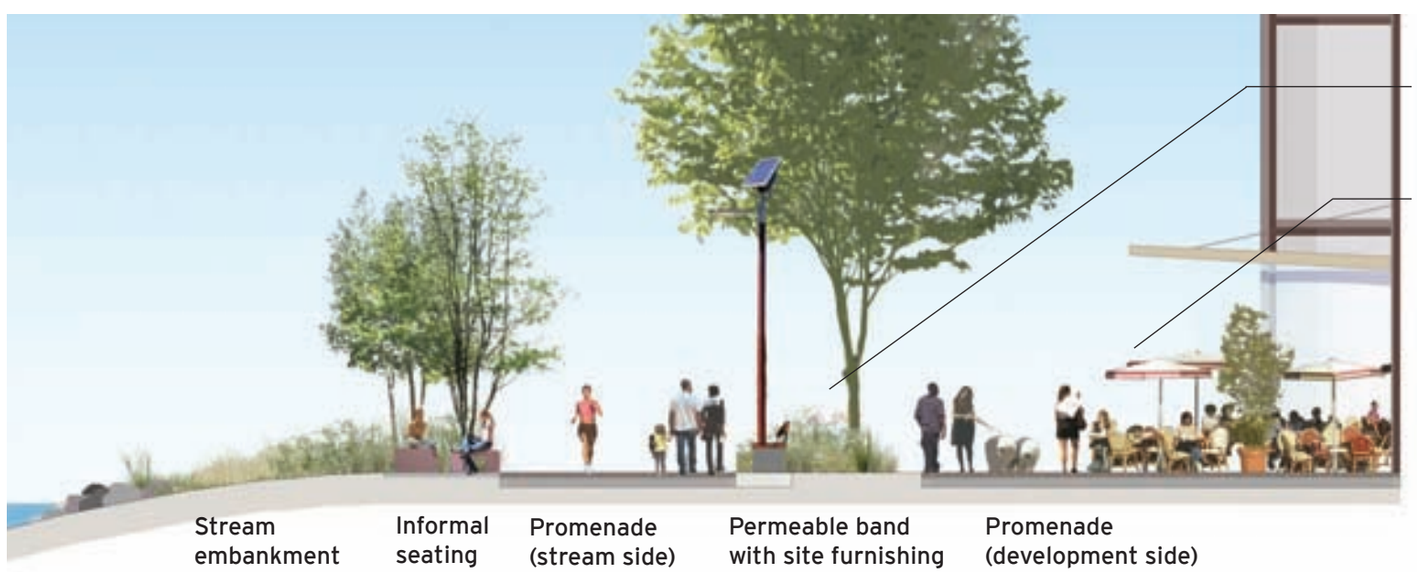
The multi-purpose plazas identified in the Master Plan are each unique public spaces requiring extensive concept development and community input to establish the program requirements and specific design goals. While the plazas are intended as an integral component of the public open space system that fits within the overall design language, the design guidelines for these spaces are intentionally left open to allow for maximum creativity. Guidelines for plazas generally include the following:

- Spaces should be flexible to accommodate a variety of functions, such as markets and festivals.
- Spaces should be vibrant and designed to attract visitors.
- Plazas should include amenities such as benches, trash receptacles, drinking fountains and signage.
- Spaces may include play areas, public art, restrooms, sports facilities, information kiosks, performance spaces, cafes, and canoe/kayak rental facilities.
- Stormwater management and other sustainable design elements should be integrated into all aspects of the design.
- Plazas should include shade trees, ornamental shrubs and perennials.
- Paving should consist primarily of high-quality pavers.
- The paving system should be permeable or should incorporate other Low Impact Development (LID) stormwater management technology. Refer to the *Northern Virginia Regional Commission Low Impact Development Supplement* for additional guidance.

Promenades

This example shows how the design elements that might exist along the urban edge of the stream corridor work together to create a lively and inviting public space. Compatible adjacent development is oriented toward a public pedestrian space that includes permeable precast pavers, various kinds of seating, trash receptacles, bike storage, lighting, shade trees, urban gardens and a multi-use trail.





Public Spaces

RECREATION AND SPORTS FACILITIES

This diagram, taken from the Master Plan, illustrates the range of recreational opportunities that exist within the Four Mile Run stream corridor.

From active-use ballfields and sport courts to quiet seating nodes and overlooks, this plan suggests possible locations for many new design elements. Through more detailed design, the exact locations and types of recreation facilities will need to be refined and expanded.

This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of sports and recreation facilities. It is conceptual and does not represent the full range of opportunities that may exist.

FIGURE 5.5

Thematic public artwork integrated with design of bridge

Public art that directly engages the water

Public art incorporated into the design of a trail

GREEN OPEN SPACE

Green open space includes open lawn areas within Four Mile Run not identified as sports fields. These unprogrammed areas should be flexible to support a variety of active recreation uses. Lawn areas that are large enough to accommodate active recreation should be graded with enough cross slope to allow drainage (minimum 2 percent). Lawn areas that are exceedingly small or narrow or lawn areas exceeding 4:1 slope are difficult to maintain and should be avoided.

Turfgrass species should be selected for tolerance of drought and durability under heavy use conditions. Bioretention areas, or other LID stormwater management technology around the perimeter of the lawn areas should be provided to minimize any impact that stormwater runoff carrying chemicals associated with lawn maintenance may have on the stream ecology. Refer to *Northern Virginia Regional Commission Low Impact Development Supplement* for additional guidance.

Surrounding green open spaces, a buffer of native vegetation will help absorb runoff and transition between the manicured turf landscape and the naturalized landscape. Shade trees and benches, picnic tables, trash receptacles and play areas near the edges of the green open spaces will expand use opportunities. Encourage the reforestation of native trees where uses and hydrological conditions permit.

SPORTS FACILITIES

The Master Plan seeks to balance the goals of environmental restoration with the expansion of recreational opportunities within Four Mile Run. It suggests enhancing the existing ballfields and paved sports courts to improve their condition and relationship to the natural environment. It also identifies a range of new sports facilities that will expand recreational opportunities in the corridor.

The Master Plan suggests ways that the athletic facilities can be designed to be more compatible with the overall stream restoration goals:

> 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. (Master Plan, 68)

> Underground storage [of stormwater] can be placed under basketball courts, tennis courts or other impervious surfaces. Some artificial turf surfaces, such as soccer fields, may be able to provide greater infiltration and underground storage. (Master Plan, 52)

In addition, sports facilities should follow these guidelines:

- At Mount Vernon Avenue, consider using artificial turf, engineered to promote stormwater detention/retention at the multipurpose field.
- Under paved courts, consider implementation of underground stormwater detention/retention cisterns.
- Design stormwater retention areas to collect water from nearby impervious areas for irrigation reuse on ballfields and grass multi-use fields.
- Adjacent to natural grass fields, develop bioretention areas to treat water runoff.
- Provide buffer planting around sport fields and courts to minimize their impact on naturalized areas and other recreation activities.
- Athletic fields that require lighting should incorporate high-efficiency fixtures that prevent overspill into the adjacent habitat areas and residential neighborhoods.

PUBLIC ART

The Four Mile Run Restoration Master Plan and the Four Mile Run Design Guidelines complement the recommendations established in Arlington's public art master plan: *Public Art Public Places: A Public Art Master Plan for Arlington, Virginia*. This document identifies current, short-term and long-term public art project opportunities within and adjacent to the stream corridor and goes on to state that:

> Four Mile Run should be the focus of a major initiative on the part of the Public Art Program staff to conceive, organize, and execute a series of public art projects. These art projects should be concerned with human activity in the area, particularly small-scale park infrastructure elements such as stream crossings, bridges, and fords; trails markings or oases; interpretive or historical projects; support structures and pavilions; park lighting and entry markers; or landscape management. (Public Arts Public Spaces, 58)

While the design guidelines lay the foundation for stream restoration and the design of built elements within Four Mile Run, they are intended to be flexible enough to allow future design efforts to incorporate thematic, historic, artistic and cultural ideas into the Four Mile Run landscape. Design teams working within the corridor will collaborate with representatives of public art agencies from both Arlington and Alexandria to identify opportunities for the inclusion of public art referenced throughout the Design Guidelines and shall consider the development of large scale public art projects in the following areas: trails; buildings; bridges; retaining walls and levees; site furnishings; lighting; perimeter, entries and wayfinding; and education and interpretation.

MOTORIZED ACCESS

The urban conditions that surround and shape Four Mile Run have a significant impact on how people perceive the stream corridor, none more so than the roadways and parking lots that engage its edges. Within the stream corridor, motorized vehicular access for maintenance and emergency vehicles creates special challenges that can only be met through careful integration and sensitive design.

The Master Plan addresses the issue of motorized access in the following way:

> While the Master Plan provides opportunities for the corridor to become a destination point, the roads that run into 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. (Master Plan, 61)

The Design Guidelines recommend improvements to the adjacent roadways and parking to alleviate some of their impact on stormwater runoff, pedestrian and bicycle safety, and public perception of Four Mile Run. Design requirements for motorized vehicle access within the stream corridor are as follows:

- Emergency vehicle access routes must be defined during the design process of any portion of work to occur within Four Mile Run. Such routes must be approved by appropriate agencies of each jurisdiction.
- Pavement width, slope limitation and load bearing capacity along emergency access routes must be designed to meet the necessary maintenance vehicle load and turning radii requirements.
- Any barriers or fencing must be designed to be accessed or removed if necessary to allow emergency or maintenance vehicle access.

Adjacent Streets and Intersections

South Glebe Road is a primary connector road that parallels Four Mile Run and, at several points, engages its edge. This busy thoroughfare divides the stream corridor from the communities to the north and acts as a barrier to pedestrians and cyclists trying to access the trails along the stream. The Master Plan recommends "improvements to South Glebe Road that, while retaining its current capacity, will transform it to an attractive and more appropriate parkway setting." (Master Plan, 62) The Master Plan also envisions that "street crossing demarcations and special streetscape paving, signage and lighting will further establish the road as a place for pedestrian, bicycles and vehicles." (Master Plan, 62)

The following guidelines address specific improvements to South Glebe Road:

- Employ traffic-calming techniques to reduce traffic speed and increase pedestrian and bicycle safety.
- Widen the existing raised center median and plant a consistent row of street trees down the center and along both sides of the street.
- Improve the quality of street lighting and signage to improve visibility and visual character.
- Develop special textured and patterned crosswalk surfaces at intersections to increase visibility and safety.
- Improve safety and convience of pedestrian and non-motorized vehicle crossings

Parking

Surface stormwater runoff generated by existing parking lots adjacent to Four Mile Run has a negative impact on the hydrology and ecology of the stream. The Master Plan includes small additional parking areas to support the expected increase of users. It states "the approach to vehicle 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." (Master Plan, 62) New surface parking areas or renovations to existing parking should be designed to mitigate negative effects on the corridor.

The Master Plan proposes that parking lots "should be surfaced with permeable, functional and maintainable materials or designed with biofiltration areas to treat runoff from paved areas. These should be buffered by planting to minimize runoff and visual impacts on the stream." (Master Plan, 63)

Specific guidelines for surface parking areas include:

- Maximize the efficiency of parking areas to minimize paved areas.
- Maximize the benefits of LID stormwater management technology. (Refer to the *Northern Virginia Regional Commission Low Impact Development Supplement* for additional guidance.)
- Meet local planting and screening requirements. Refer to both the *City of Alexandria , Virginia Landscape Guidelines (1997, rev. 2007)* and *Arlington County Landscape Standards (rev. March, 2005)*.
- Include additional canopy tree coverage to reduce/minimize heat island effects.
- Provide shade trees and plantings to minimize the visual impact on the stream corridor.
- Provide full-cutoff, high efficiency lighting fixtures.

Median and street trees on Washington Street in Alexandria show how planting can transform the perception of a street.

Parking that incorporates permeable paving or other LID stormwater management technology can mitigate the impact on Four Mile Run.

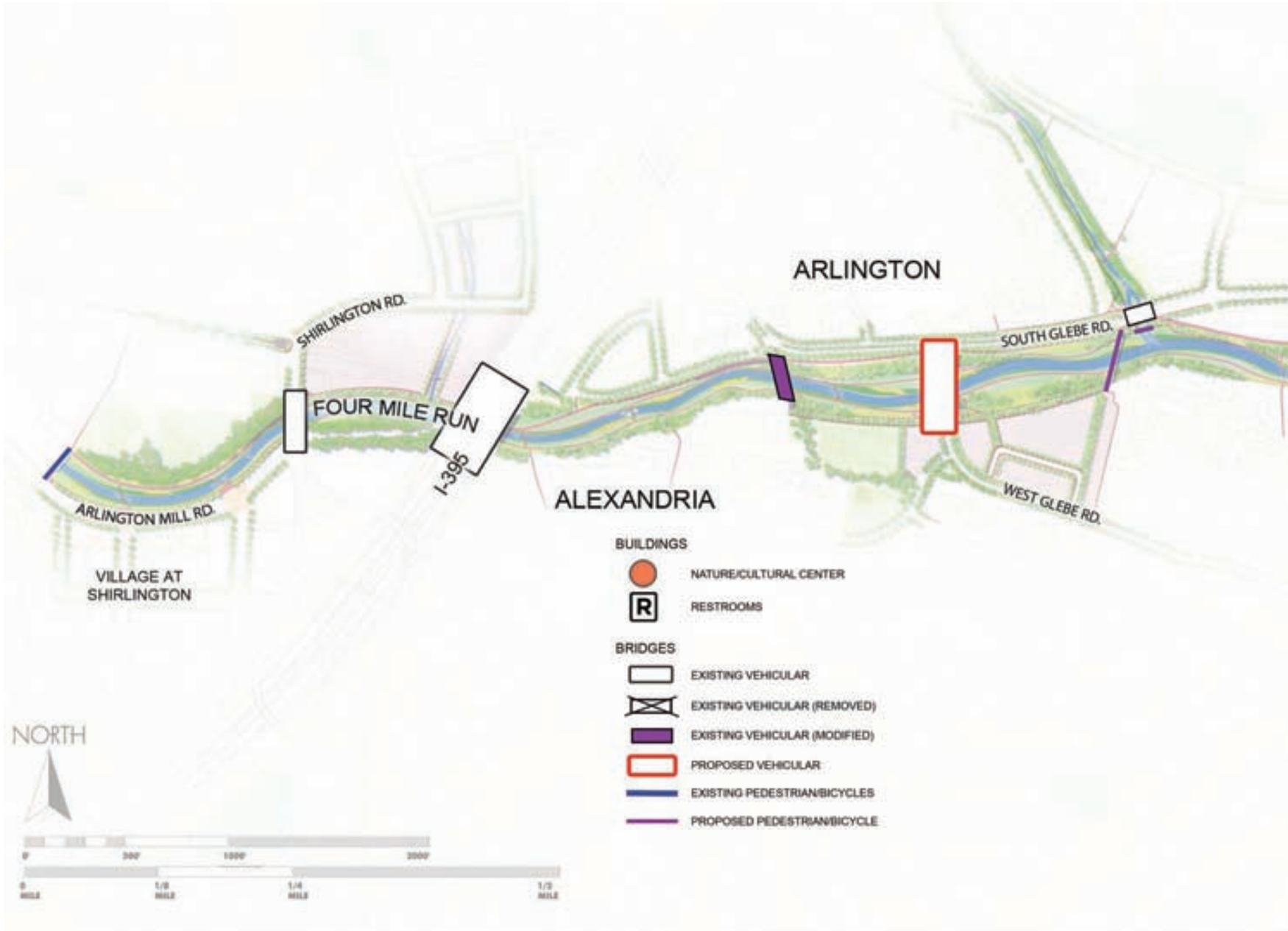
Built Features

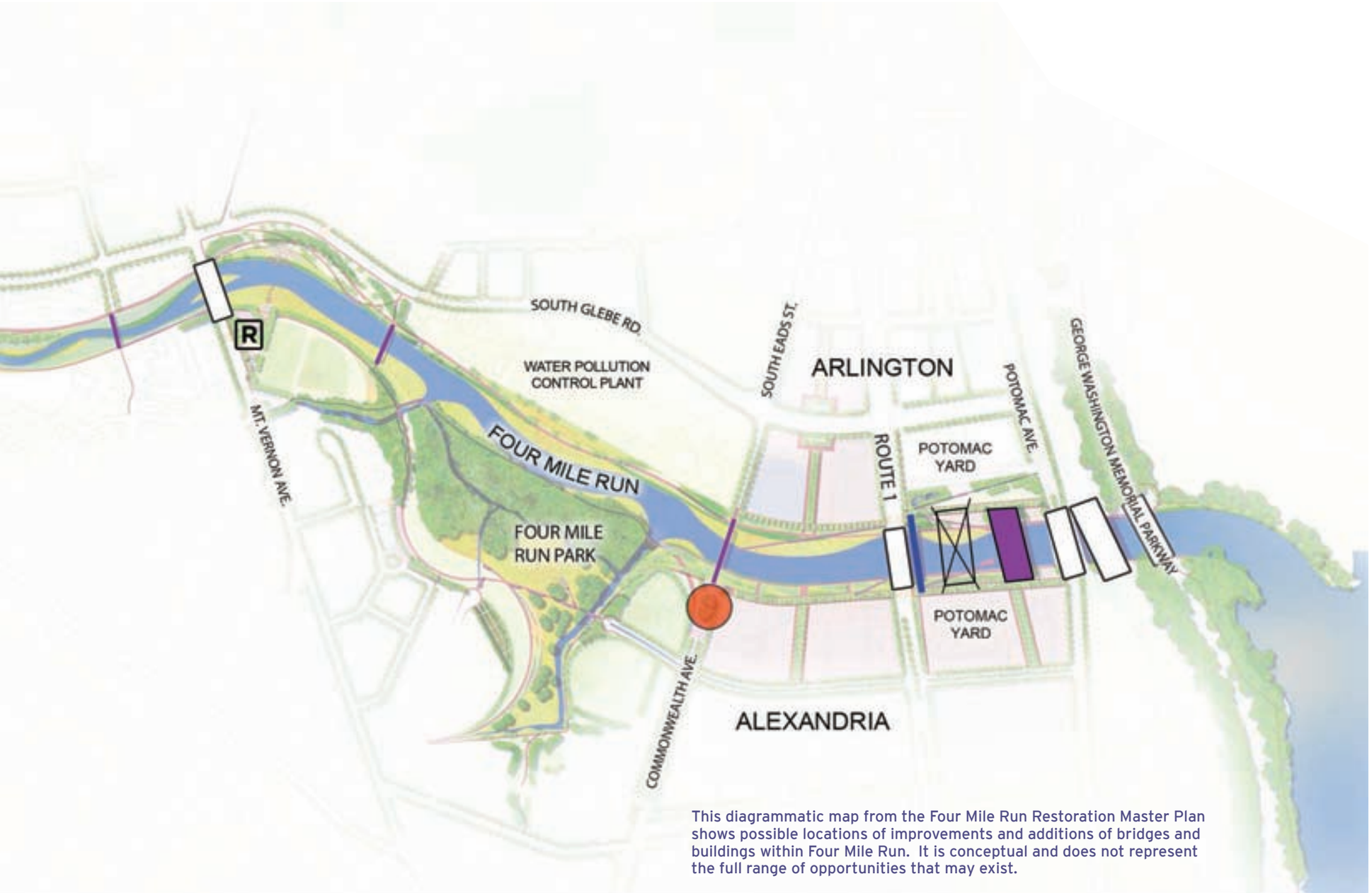
ARCHITECTURAL COMPONENTS, SEATING AND LIGHTING

An important principle of the Master Plan is the development of a distinctive built environment. As stated,

> [t]he 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. (Master Plan, 65)

While both the natural and manmade design elements within the Four Mile Run stream corridor contribute to the sense of place, the built features most clearly reflect the characteristics of the design language. Materials, forms and details outlined in the design language are articulated in the design of buildings, bridges, walls and site furnishing components. Built features also represent an opportunity to incorporate a range of thematic and artistic expressions.





This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of improvements and additions of bridges and buildings within Four Mile Run. It is conceptual and does not represent the full range of opportunities that may exist.

FIGURE 5.6

Bridge decks activated with inviting public amenities

ARCHITECTURAL COMPONENTS

The multidisciplinary teams that will be brought together to design the architectural components within Four Mile Run must understand the overarching vision of the corridor and how their relates in context. Each should allow their designs to be influenced by the precedent work of others and consider how their work, in turn, will become precedent for future projects.

Buildings (within the Four Mile Run stream corridor)

Few new buildings are proposed within the stream corridor. The Master Plan identifies the location of a new nature/cultural center near the North end of Commonwealth Avenue and indicates new restroom facilities at the plaza near the Mount Vernon Avenue Bridge. Also identified are shade structures within Four Mile Run Park and opportunities for future small shade shelters elsewhere in the stream corridor.

The nature/cultural center is envisioned as an icon of environmental stewardship. It will symbolize the transformation of Four Mile Run from utility corridor to a healthier ecosystem. It will be the focus of community awareness and interpretative programs about the stream ecology and the importance of the environment. These ideas should be clearly expressed in its architectural design.

Each of the buildings may be designed independently by separate interdisciplinary teams. They should be conceived as a family of architectural components that when viewed in context with the nature/cultural center, bridges and other built elements, forge a strong visual relationship.

The visual and material qualities that new buildings are expected to exhibit are described under the Design Language section of this document. New buildings should comply with the following guidelines:

- All applicable building and zoning codes.
- All current ADA requirements.
- City and County highest and best sustainability standards.
- Celebrate the sustainable characteristics through the building's visual expression.
- Integrate educational opportunities about sustainability, stream ecology or other relative subjects.
- Design buildings that are compatible with the established design language or that are developed through the public art process.
- Design buildings and necessary infrastructure that are compatible with the goals and requirements of the stream restoration efforts.

Bridges

Bridges spanning the channel will become the symbolic and physical link between Alexandria and Arlington. These structures will also symbolize Four Mile Run itself and the role it plays in the lives of those who pass over and through it.

However, the function of the bridges within the corridor is more than just a way to traverse the stream cooridor. The views they afford and spaces they create make bridges unique in the way they influence perceptions of Four Mile Run. When designing new bridges or modifying existing bridges, designers should exploit the opportunities for creating special public spaces above and below the bridge structure.

The Master Plan recommends enlivening the upper and lower spaces through the adaptive reuse of one of the existing bridges:

> The recycled (sic) 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. (Master Plan, 69)

Bridges and overpasses require solutions that integrate light and design elements to make the space below them safe and inviting. In reference to the space below the I-395 overpass, "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." (Master Plan, 62)

The Master Plan identifies a total of eighteen bridges crossing the stream corridor between the George Washington Memorial Parkway and Shirlington Road. Of these, ten will remain at their current level of service, two will be downsized from vehicular service to pedestrian/bicycle service, one will be removed, one new vehicular bridge is proposed, and four new pedestrian/bicycle bridges are proposed.

As existing bridges are modified or as new bridges are developed, the design of each bridge should be considered in relation to all of the bridges. The Master Plan envisions that "bridges will be of a consistent design theme that will identify them as a distinctive collection of bridges unique to Four Mile Run." (Master Plan, 61) There should be variation among the bridges that makes each one unique, but among them there should

Nature/Cultural Center

These architectural examples represent characteristics that would be fitting for a nature/ cultural center within Four Mile Run: modern forms, rustic or unrefined materials, scale and position that are integrated with the site, and incorporate sustainable elements.



Shade Structure

Small shelters or other structures within the stream corridor should contribute to the overall character of Four Mile Run. These examples are exuberant and light. They integrate rustic, recycled, reusable materials and engage the site in a positive way.



Pedestrian/Cyclist Bridges

These bridges demonstrate how strong, modern architectural form executed in rustic materials harmonize with a natural setting.





be unifying elements. The design of the bridges and the unifying elements that connect them should be considered as a large-scale public art project.

The following general guidelines apply to the design of bridges:

- Bridges must meet all applicable current building codes and requirements, including ADA.
- Bridges must meet all state and local transportation requirements.
- Bridge design must be integrated with hydrology models to ensure no negative impact on flood control.
- Bridges should span the channel to minimize impact on the stream.
- Bridges should be unique, custom-designed structures; however, pre-engineered components may be considered.
- Design of bridges should respond to the adjacent streetscape character.
- Bridge design should be compatible with the overall design language or be developed through the public art process.

Retaining Walls and Levees

The existing retaining walls and levees within Four Mile Run are integral to the flood control system and any modifications to these structures must be in coordination with the overall hydrology strategy developed by the U.S. Army Corps of Engineers. The design guidelines address surface treatment of these walls to enhance their visual quality and do not imply any alterations that may impact their effectiveness as flood control structures.

From Mount Vernon Avenue to West Glebe Road, the channel is lined almost continuously on both sides with high, vertical concrete walls. It is hoped that hydrological analysis will confirm that some of the walls can be reduced; however, it must be assumed that their presence will not be eliminated entirely.

The aesthetic of these utilitarian structures is compatible with the design language, however some modulation of their appearance will enhance their appeal. If construction of new walls is required, concrete may be formed to incorporate surface designs, patterns or colors. For existing concrete walls, options for surface treatments include veneers, etching, staining, or other applied finishes. Other ideas include incorporation of translucent materials to allow light and possibly views through the walls. Materials such as glass block, glass panels or precast concrete units embedded with light transmitting fibers could be embedded into segments of the walls. The walls should also be considered as an opportunity for the development of a large-scale public art project for which a wide range of surface treatments might be considered that would help transform these elements into attractive amenities.

The focus of any effort to enhance the appearance of the retaining walls and levees should be in areas where they are most visible and where they engage public open space directly. At these locations, even limited surface enhancements will have the greatest impact on how people perceive Four Mile Run. The following guidelines address considerations for enhancing the surface treatment of the concrete flood control walls:

- Prepare a view analysis to identify the best opportunities for enhancing wall treatments.
    - Focus on views from bridge crossings, entry points, open space nodes and public spaces.
    - Identify primary viewsheds in the corridor and evaluate the impact that treatment of the walls will have.
- Treatments should strive to bring the walls into greater harmony with the natural environment.
- Treatments should be durable, low-maintenance, and not compromise the integrity of the walls.
- The wall enhancements should be compatible with the overall design language or be developed through the public art process.
- Weepholes shall not drain onto paved surfaces.

Retaining Walls and Levees

The structural design of flood control levees and retaining walls must be properly engineered. Any surface treatments must not interfere with the structural integrity of the wall or impede the hydraulic functions of the stream. Within these parameters, there are many opportunities for improving the visual quality of the walls within Four Mile Run.

Levee wall surface treatment focused at bridge crossing

As illustrated on the George Washington Memorial Parkway overpass, limited stone cladding can significantly enhance the appearance of infrastructure components.

Other examples illustrate the use of innovative materials or the incorporation of public art as a way to improve character of the walls.

Stone cladding on bridge at George Washington Memorial Parkway (new guard rails in the Four Mile Run stream corridor should comply with guidelines addressing railings and handrails)

Stone and gabion clad concrete wall

Public art integrated with concrete wall

Public art applied to the surface of a concrete wall

"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."

(Master Plan, 87)

Site Furnishings

The Design Guidelines recommendations include a variety of site furnishing options. The guidelines do not to identify specific site furniture for use throughout the corridor; rather, their intention is to develop a flexible range of options that are suitable for a range of different seating or furnishing needs, while maintaining visual compatibility

Seating options range from benches with backs that may be appropriate for an urban promenade to irregular boulders that might be found along an informal stream-side trail. These recommendations include a variety of material and design options that together suggest a family of site furnishings evocative of the design language.

Site furnishing within the corridor, include trash receptacles and recycling containers, drinking fountains, bike racks and traffic-control bollards. Site furnishings design should be appropriate to their particular context and compatible with the overall design language. Each may be developed in coordination with a public art process. At a minimum, they should meet the following guidelines:

- Site furnishings should incorporate recycled content and reusable materials.
- Where similar options exist, preference should be given to locally manufactured products and materials.
- Furnishing should be durable and require minimal maintenance for optimum appearance and use.
- Furnishing should be designed for universal access. Benches should include options with or without backs and with or without armrests. Picnic tables and drinking fountains should include options that are wheelchair accessible.
- Furnishing should not impede pedestrian or other non-motorized traffic on trails and located to avoid impeding or obstructing the flow of the channel.
- Furnishing should be compatible with the overall design language or be public art.
- For athletic facilities located in Alexandria, incorporate City standards for bleachers, dugouts and other sports field-related site furniture.

Trash Receptacles

Trash receptacles should be designed so that they are stable and are located at entry points or nodes.

Examples of receptacles that apply are shown to the right. Features include stationary post mounting, weathering steel or galvanized steel, and ease of content removal.

Receptacles must meet Occupational Safety and Health Administration requirements.

Picnic Tables

Picnic tables should be durable and repairable and incorporate recycled materials to the extent practical. These examples include an in-ground base or surface mount base, and feature steel or recycled timber tables and seats. Each feature wheelchair access options.

Benches with recycled concrete elements

Example of custom bench made from concrete salvaged from deconstructed structures



Benches combining prefabricated components and integrating art elements

Limitless options exist for the development of seating as public art.


Prefabricated benches

Examples of pre-manufactured benches that are compatible with the design language. Many manufacturers produce furnishings incorporating recycled materials such as recycled steel, aluminum, or composite timbers and many incorporate weathering steel or galvanized steel into their standard designs.




"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 and enhanced along the stream."

(Master Plan, 61)

Existing "colonial" fixtures at Four Mile Run Park are not compatible with the design language developed for Four Mile Run.

LIGHTING

Site lighting design must address several key factors. Lighting fixtures must be selected and located to minimize impact on habitat areas of the stream corridor. Lighting levels must be adequate to meet safety and security requirements, while meeting the highest and best sustainability requirements for light pollution reduction (for guidance, see the most current LEED standards for new construction). Light fixtures must be energy-efficient and require minimal maintenance. Light fixtures should be compatible with the design language and integral to the family of site furnishings or be designed through the public art process.

There are generally six types of lighting addressed by the Design Guidelines:

Continuous Trail Lighting

Regularly spaced, repeating light standards that provide uniform levels of light along continuous outdoor spaces, including the following:

- Commuter trail
- Community trail
- Promenades

Node Lighting

Clusters of lighting to create higher levels of light at nodes, including the following locations:

- Intersections along the commuter and community trails
- Intersections with bridges
- Seating areas along the commuter and community trails
- Plazas and outdoor urban spaces where night use is expected

Feature Lighting

Integrated, low-level lighting elements that enhance special architectural features or spaces, including:

- Bridges
- Buildings
- Public Art Elements
- Integrated with paving
- Integrated with entries, wayfinding, educational and interpretive elements.

LIGHT POLLUTION REDUCTION

Intent

Minimize light trespass from the buildings and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments.

REQUIREMENTS FOR EXTERIOR LIGHTING: Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for buildings facades and landscape features as defined in ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)/ IESNA (Illuminating Engineering Society of North America) Standard 90.1-2004, Exterior Lighting Section, without amendments.

All projects shall be classified under one of the following zones, as defined in IESNA RP-33, and shall follow all of the requirements for that specific zone:

LZ1 - Dark (Park and Rural Settings)

Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ2 - Low (Residential Areas)

Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.10 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

LZ3 - Medium (Commercial/Industrial, High-Density Residential)

Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

POTENTIAL TECHNOLOGIES & STRATEGIES: Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible, and model the site using a computer model. Technologies to reduce light pollution include full cutoff luminaires, low-reflectance surfaces and low-angle spotlights.

Excerpt from LEED for New Construction Version 2.2

Trail and Node Lighting

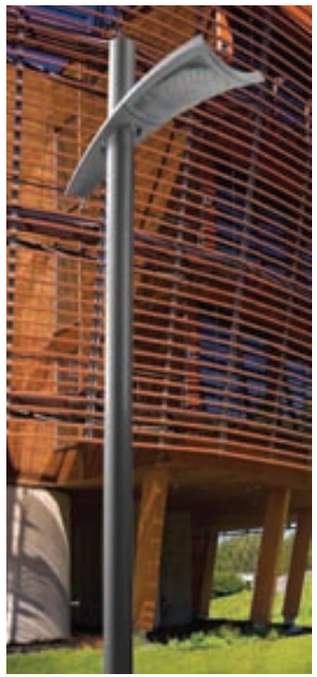
The examples of light fixtures pictured here represent different characteristics that should be considered for the trail and node lighting:

Energy efficient such as LED or solar powered; full cutoff or shielded; form, color and material that complements the design language.

Light pole bases should be flush to adjacent grade and not exposed.

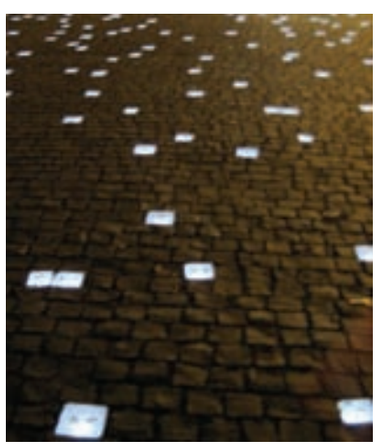






Feature Lighting

Examples of feature lighting pictured here include lighting inset in paving to delineate pathways, and public art projects that incorporate lighting to enhance infrastructure.




Uplighting

Lighting elements aimed upward to brighten the underside of solid structures must be shielded to avoid any light spill beyond the object being uplighted. These conditions include:

- Underside of bridges
- Building overhangs

Sports Lighting

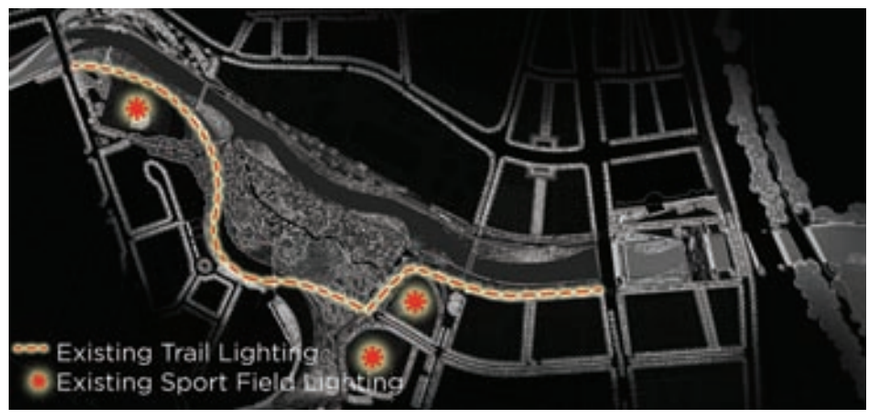
Pole-mounted flood lighting is aimed downward to light athletic fields for evening and night play. The following conditions apply:

- Flood lighting only at the multipurpose field at Mount Vernon Avenue and the ball diamonds at Four Mile Run Park
- Minimize adverse effects on the adjacent habitat areas or neighboring private rights-of-way with shielded lights and high performance cut-off fixtures

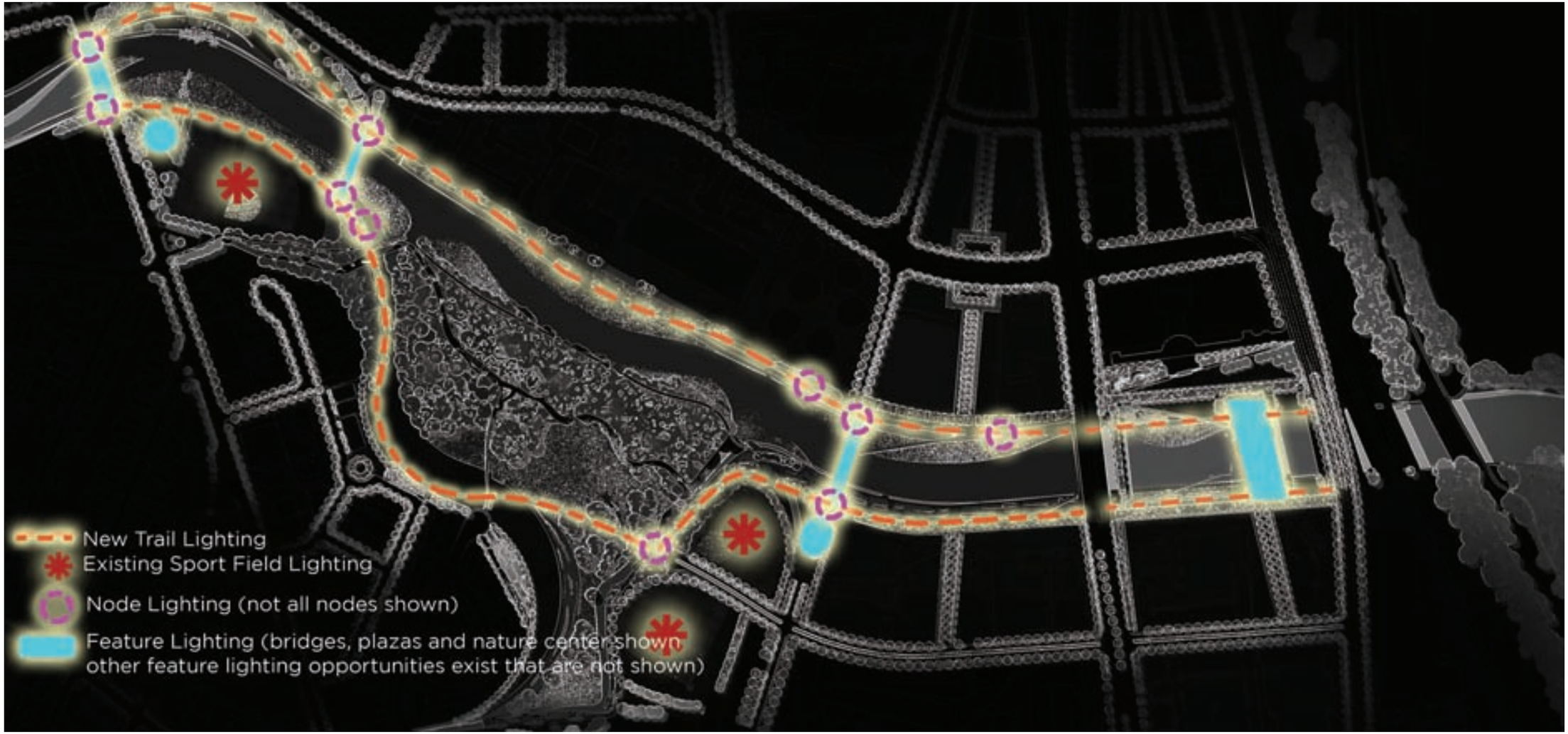
The purpose of all lighting types is to improve safety and security within the stream corridor, extend the use of public spaces after dark and enhance special features by increasing the visibility and awareness of Four Mile Run. The goal is to meet these needs in a sensitive and artful way that does not have a negative environmental impact. The highest and best sustainability standards identified in these guidelines, and further described under the most current LEED standards regarding light pollution reduction, should be used as a guide in the development of all lighting applications, except for the lighting of athletic fields.

This Design Guidelines document does not prescribe specific light fixtures to be used throughout the Four Mile Run stream corridor; however, the guidelines recommend that a single fixture type be selected for each lighting condition (with the exception of feature lighting) to strengthen visual continuity and minimize the complexity of maintenance or replacement. The fixture selection will occur during design of each phase of work. The initial lighting designers will be challenged with selecting fixtures based on these guidelines and in coordination with Arlington and Alexandria to ensure that fixtures proposed for one condition in one part of the stream corridor will be appropriate for use in a similar condition in other parts of the stream corridor.

The sport fields at Four Mile Run park currently have lighting as pictured here.



This diagram shows the extent of existing lighting within the stream corridor.



This diagram illustrates some of the opportunities for improved lighting within the tidal portion of the stream channel.

Built Features

PERIMETER, ENTRIES AND WAYFINDING

The Design Guidelines addresses treatment of the perimeter edge, points of access and the wayfinding system in Four Mile Run. These three elements form the "mental map" that will help people navigate the stream corridor. They become a useful framework for development of educational and interpretive programs and provide an opportunity for the development of a public art project.

The diagram on this page illustrates the existing pedestrian and cyclist points of entry into the stream corridor. These locations are important in determining where possible perimeter and entry treatments will be most effective and how a wayfinding system may best be organized.

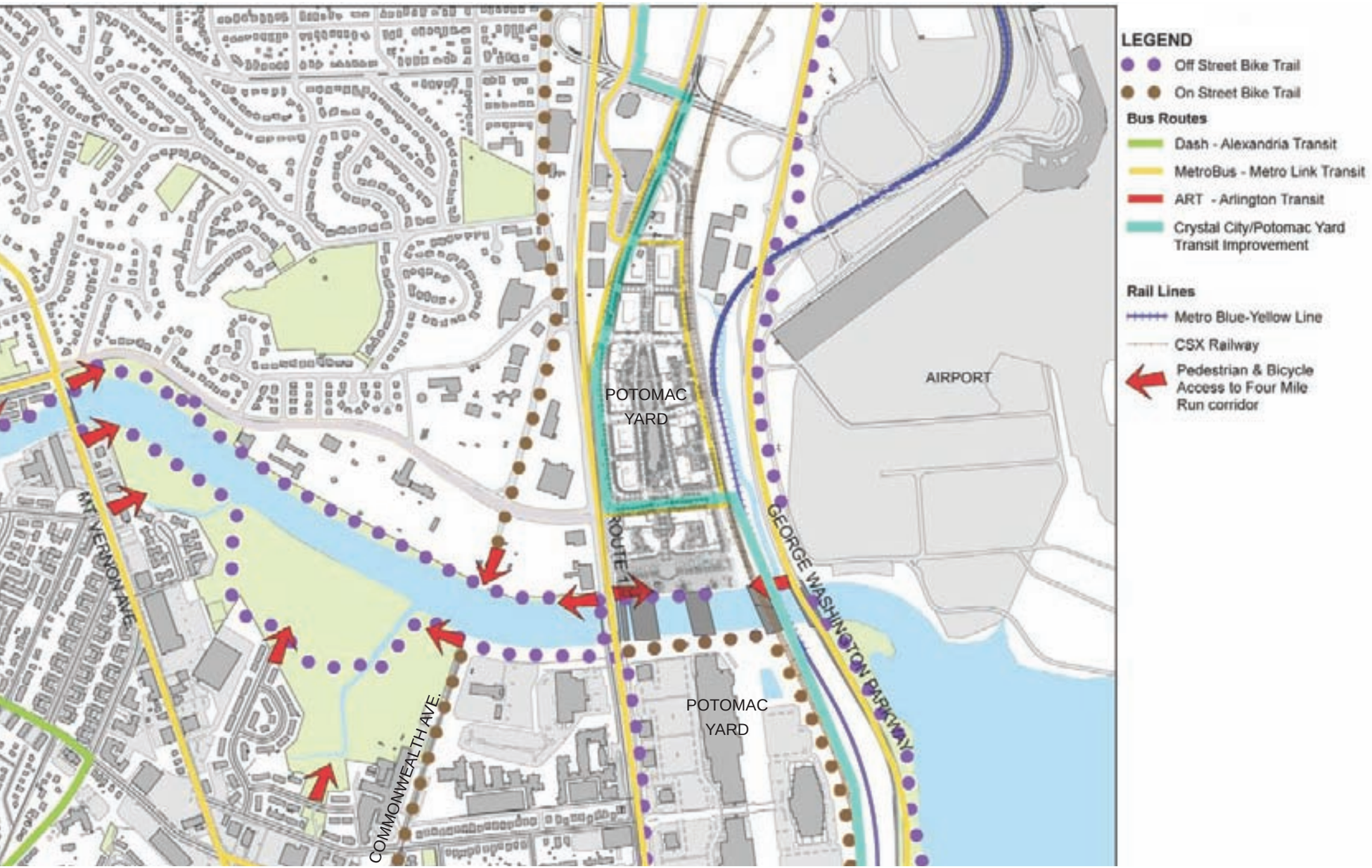

LEGEND
Off Street Bike Trail
On Street Bike Trail
Bus Routes
Dash - Alexandria Transit
MetroBus - Metro Link Transit
ART - Arlington Transit
Crystal City/Potomac Yard Transit Improvement
Rail Lines
Metro Blue-Yellow Line
CSX Railway
Pedestrian & Bicycle Access to Four Mile Run corridor
POTOMAC YARD
AIRPORT
MT VERNON AVE.
ROUTE 1
GEORGE WASHINGTON PARKWAY
POTOMAC YARD
COMMONWEALTH AVE.

FIGURE 5.7

"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"

(Master Plan, 72)

PERIMETER

The boundaries of Four Mile Run vary and are sometimes difficult to identify. In some areas the edge of the stream corridor aligns with a major street, such as along South Glebe Road where there is continuous open access. In other areas, the stream is bounded by infrastructure, such as the Water Pollution Control Plant, where a continuous fence prevents public access. Where residential and commercial developments border the channel, a variety of walled, fenced or partially accessible edges exist.

It is not necessary to demarcate the entire perimeter of Four Mile Run, but definition of its edge in certain locations will strengthen the corridor's identity. The Master Plan states that "(f)encing should be used sparingly" and that where fencing is necessary "encourage attractive, inviting fencing that is sympathetic to both the stream corridor and other built components in the corridor." (Master Plan, 87). The Water Pollution Control Plant has been identified as a location for future design enhancement associated with its new perimeter fence. While this land use does not permit public access, the enclosure is designed to be transparent and can incorporate design considerations, related to the envisioned adjacent wetland demonstration project.

Where residential or commercial land uses meet edges of the corridor, a semi-permeable perimeter treatment is recommended. This can include some segments of solid or transparent fencing or low walls with frequent openings to allow pedestrian accesss. Gates are discouraged, and chain link fencing is not acceptable. Guidelines for perimeter fencing include:

- Fencing must comply with applicable building codes.
- Fencing facing Four Mile Run should be attractive and not brightly colored or bright white. Fencing should be solid and durable.
- Fencing should incorporate recycled or sustainably produced materials to the extent practical.
- Fencing or the definition of perimeter edges should be considered as an opportunity for the development of a public art project.
- Fencing for athletic facilities shall be consistent with player protection and security for the designated sport.

Where Four Mile Run is bounded by other public open spaces or roadways, no perimeter enclosure is needed. Transitions from these areas into the corridor should be seamless and should encourage the passage of pedestrians and bicyclists.

ENTRIES

At key pedestrian and bicycle access points along the boundary of Four Mile Run elements should be developed that mark entries into the stream corridor. These elements should be developed in coordination with a corridor-wide interpretive program that may include environmental, historic, artistic, cultural or educational themes and tied into a designed wayfinding system (described below).

Entry markers should be a series of built elements that are unique sculptural objects or designed as a family of repeating forms. The entry markers should be considered as an opportunity for the development of a large-scale public art project. Guidelines for these elements are intentionally broad:

- Entry markers should be compatible with the design language or should be developed through the public art process.

WAYFINDING AND SIGNAGE

Understanding how people access Four Mile Run is important for establishing wayfinding systems and for organizing interpretative signage programs. The locations, content and design of wayfinding and interpretive signage were generally addressed in the Master Plan, as stated here:

> 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. (Master Plan, 72)

A thorough wayfinding and signage study must be prepared to develop a complete program of themes, content, format and location of elements within the corridor. This effort should be performed in concert with the development of entry markers (described above) and in coordination with Alexandria's and Arlington's wayfinding signage guidelines (in development at the time of completion of the Design Guidelines). This program should also complement built features described by the design language and established by these guidelines. Wayfinding and signage should be considered an opportunity for the development of a large-scale public art project.

Perimeter Fences

Many options exist for the incorporation of public art into perimeter or entry design elements, including sculpted weathering steel, lighted cut-out elements, and a sculptural frame containing natural stones.

Street tree in planting areas that integrate stormwater management

Formal tree planting along a promenade

Urban gardens featuring native and compatible ornamentals

Naturalized areas adjacent to public spaces

PLANTING

The majority of planting that will occur within Four Mile Run will be associated with channel and habitat restoration efforts. This is addressed in the section Green Design Principles under Habitat Restoration. This section complements the restoration planting recommendations and provides guidelines for the planting associated with streets, urban edges and the public spaces within Four Mile Run that are not directly associated with stream or habitat restoration.

Street Trees

Streetscape improvements recommended for South Glebe Road, as discussed under Adjacent Streets and Intersections in the section Public Spaces, includes the addition of street trees and median trees. Trees planted along roadways are exposed to a variety of urban conditions that can impact on their health and survivability. The goal of planting street trees is to establish a healthy, long-lasting shade canopy without compromising infrastructure and paved elements. This can be done by selecting appropriate species and creating the best possible growing conditions within the limitations of planting areas. The benefits of successful street tree plantings include reduced ambient temperatures, increased permeability, and improved streetscape character. The following guidelines apply to selection and planting of street trees:

- Must comply with Arlington and Alexandria Urban Forestry Master Plans and Landscape Guidelines.
- Preference should be given to native species proven to perform well as urban street trees.
- Select trees appropriately scaled to the width and size of the street.
- Select tree that are unlikely to conflict with overhead structures and utilities.
- Develop continuous improved soil panels the length of street tree planting area.
- Where possible, improve soil under sidewalks and use paving support systems to maximize the root growth areas.
- Where possible, incorporate stormwater management planting areas adjacent to roadways.

Urban Gardens

Planting areas in urban public spaces within and adjacent to Four Mile Run should make them inviting and lively. Planting areas should be compatible with the goals of stream restoration efforts and be attractive year round. They should be designed to minimize maintenance and need for herbicides, pesticides and other chemicals that may be detrimental to the stream ecology. Many native plant species are well suited for urban conditions and should be given preference. Non-native species that are drought-tolerant, non-invasive and compatible to native species should also be considered to introduce a greater range of color, texture and character in urban planting areas.

Naturalized Areas

Where naturalized planting areas developed as part of the habitat restoration effort are immediately adjacent to public spaces and in paved trails, promenades and plazas, care must be taken to create an edge condition that is compatible with both uses.

Plants that spread or lean into the trail can create hazards for hikers or bikers on the trails. A narrow zone of crushed stone or mowed turf or some other low, permeable material should be established along the paving edge where the adjacent native species can be controlled.

To encourage people to stay on the trails, and not to enter into sensitive planting areas, a combination of signage and dense low planting should be established along the trail edges. Along the edges, select native species appropriate to the particular habitat or stabilization conditions that are densely structured and are quickly established.

Urban Gardens

Naturalized Areas

Built Features

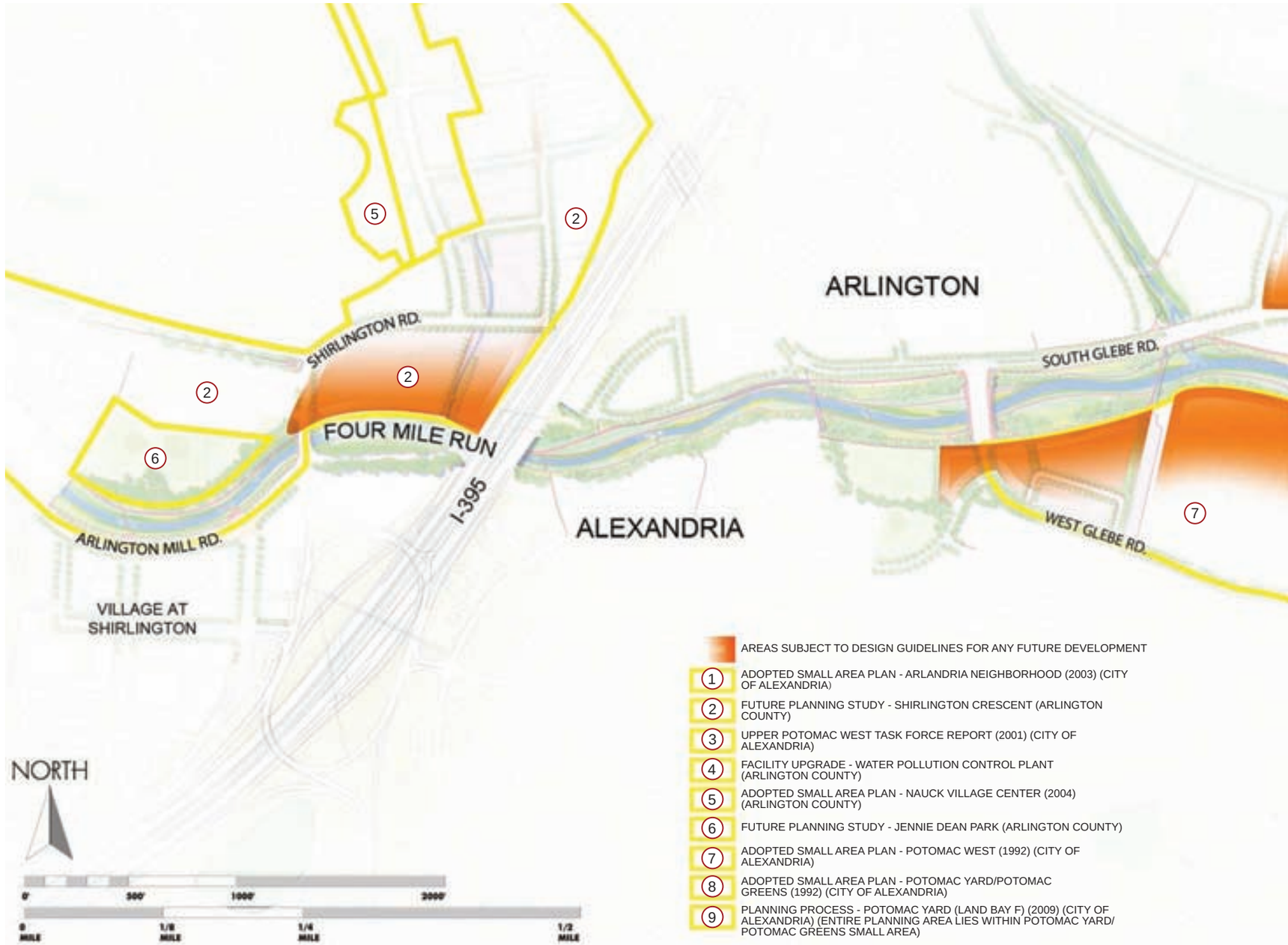
BUILDING FORM

Building form design guidelines are based on an integrated view of the Four Mile Run urban environment. With a focus on the design of places, not simply individual buildings, the guidelines address building form as it relates to neighborhoods, streets, public space and the stream corridor. The guidelines establish principles and performance objectives, rather than rigid codes, standardized formulas, or added zoning complexity.

The application of these guidelines will require flexibility and interpretation in addressing conditions on the ground and requirements unique to each particular development. Each jurisdiction should be consulted for explicit zoning requirements governing building heights, massing, form, density, and setbacks.

This section identifies five key areas:

- MINIMIZE BUILDING IMPACT ON STREAM ECOLOGY
- ALLOW FOR A VARIETY OF PUBLIC EXPERIENCES ALONG THE STREAM
- INCREASE REAL AND PERCEIVED SAFETY ALONG THE PROMENADE
- ENCOURAGE PROMENADE USAGE, ACTIVITY, AND ACCESS
- CREATE EXCITING, HIGH-QUALITY ARCHITECTURE



This diagrammatic map from the Four Mile Run Restoration Master Plan shows possible locations of future development and planning efforts. It is conceptual and does not represent the full range of opportunities that may exist.

FIGURE 5.8

MINIMIZE BUILDING IMPACT ON STREAM ECOLOGY

Integrate innovative stormwater management

- Encourage stormwater planters and maximize the use of pervious surfaces.

These strategies help to protect the stream from adverse effects of surface runoff. From the left: this catch basin in Portland, Oregon also functions as a planter; structured turf offers an alternative for parking or emergency vehicle access; open grid paving and porous concrete allow stormwater to soak directly into the ground.

- Encourage green roofs.

Green roofs provide an opportunity to use soil and vegetation to detain roof runoff and delay it from reaching the stream. From the left: the Solaire building in New York City; and the American Society of Landscape Architects national headquarters building in Washington, DC.

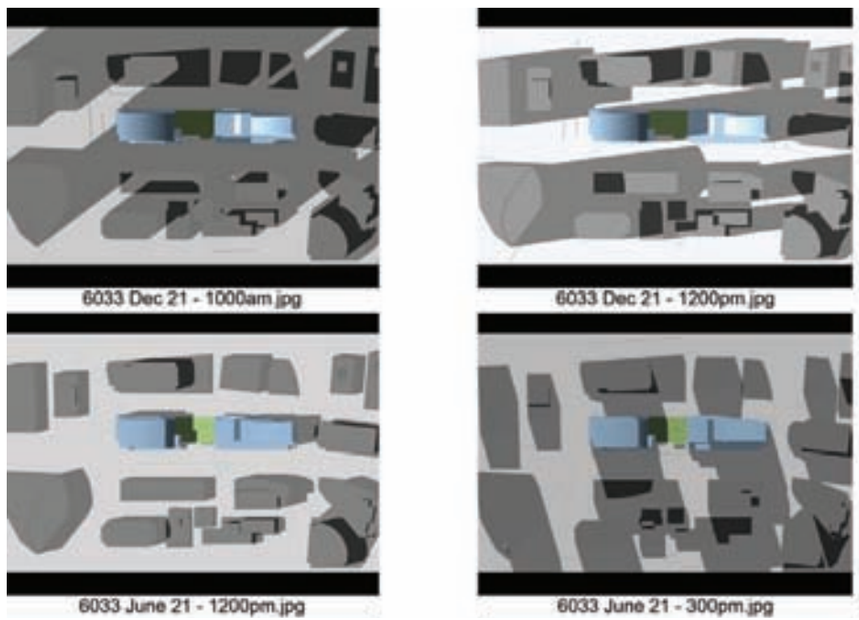
- Encourage on-site rainwater harvesting.

By collecting rainwater from the site for reuse, for irrigation or greywater systems, the burden on the city's storm system can be reduced. Below are examples of equipment for rainwater collection; these can also be located within buildings or parking structures.

Consider impacts of building's solar envelope to maximize daylight along stream corridor and public spaces

- Require sun/shade analysis for all stream-facing developments.

Sun/shade analyses for stream-facing developments help to detect potentially adverse affects (such as excessive shading of public spaces or habitat areas) created by new construction. Computer models show the configuration of light and shadow for any specified date and time throughout the year and should be used as a tool to adjust massing to minimize adverse affects. Below, is an example of an analysis conducted for a new high-rise development in Rosslyn, Virginia.



(above) An example of a computerized sun/shade analysis

- Encourage incremental building stepbacks along the stream for increased solar access and views of the sky from the promenade.

Buildings that step back incrementally, in response to the changing angles of the sun and natural light patterns of each site, allow for increased light and views along the stream corridor. Step-backs on the south of the stream will more directly affect solar access. Step-backs on the north side will also permit views outward from the promenade and create a sense of openness from within the stream corridor. The Broward County Florida building below, left is an example of multiple building stepbacks, increasing solar access to an adjacent city park.

- Encourage orientation that places the longest sides of buildings perpendicular to the stream corridor for increased solar access and views of the sky from the promenade.

Another technique for minimizing daylight obstruction involves orientation of building masses to avoid "walling" in the stream corridor. For "tower" elements, or building elements above the predominant cornice height, the short side should face the stream corridor, creating more space for light and views between buildings and increasing solar access to the stream corridor.

(above, left) Varying stepbacks in Broward County, Florida's main library building allow for terraces, solar access, and views to the sky from the public open space. (above, right) An example of a solar access diagram showing building massing and height that maximizes daylighting

ALLOW FOR A VARIETY OF EXPERIENCES, PUBLIC IN NATURE, ALONG THE STREAM

New development should engage and open to the stream

- Minimize continuous fences between buildings and the promenade; provide access along promenade.

Fences and other barriers discourage public access and reduce the potential for activity along the stream. Where barriers are necessary, they should include key pedestrian access points, and constructed of high-quality materials consistent with principal site buildings and vegetation. They should be consistent with the design language described in these guidelines. Opaque fencing should remain low (less than 4 feet in height).

(top row, left) These Milwaukee residences achieve privacy without the use of physical barriers/fences. (top row, right) If fences are necessary, low, semi-transparent fences such as this example in Portland, Oregon's Pearl District may be used.

- Encourage ground floor transparency and interior-exterior visual connections in locations facing the stream, important viewsheds, and other pedestrian-oriented areas (recommended 75-90 percent fenestration at the first level for retail, commercial and public uses).

Buildings should appear to open directly to the stream corridor. Making buildings more transparent allows for more activity to be visible from the promenade and adds to the perception of safety, or 'eyes-on-the-street' effect. Pedestrians on the promenade should not feel that they are passing behind the 'backs' of buildings, which detracts from the perception of a space being public.

(top row, left) Storefront in Georgetown, Washington, DC with a high degree of transparency; (top row, right) example of strong building-to-landscape visual connections.

Create active urban edges facing the stream

- Within existing land use/zoning requirements, encourage active, pedestrian friendly ground floor uses facing the stream (such as retail, occupied commercial, residential, other public or semi-public uses).

Activity at the promenade level—where urban development engages the stream corridor—will enhance the use of Four Mile Run. Residences, studios and lofts, intermixed with cafes, restaurants, galleries, shops, small office spaces, and other active uses should be encouraged along the public promenade. Residential buildings should be designed with ground-floor units having entry stoops like traditional townhouses, raised slightly above street level for privacy. Multiple entrances will enliven the promenade and create a sense of community, while ground-level elevator lobbies provide access to midrise buildings above.

(above, left) These Portland, Oregon townhouses, part of a larger multi-family residential building, engage an adjacent promenade with multiple individual entrances. (above, right) This grocery store in Vancouver utilizes canopies, colorful displays, signage and inviting entrances to activate the sidewalk.

- Within existing land use/zoning requirements, prohibit 'static' uses such as storage, parking, over-sized lobbies, utility and trash rooms. Avoid pedestrian conflicts such as loading docks or parking garage entrances in locations facing the stream and within important viewsheds, prominent approaches to the stream corridor, and other pedestrian-oriented areas.

For parking and service entrances:

- Parking garage and service access entrances are prohibited from being located on the Four Mile Run frontage., and should occur in the following locations: 1) alleys or service roads; 2) streets that are not primary pedestrian routes.
- Parking garage and service access entrances should be restricted from within approximately 200' of the stream top of bank, or mid-block, whichever is greater.
- Surface parking lots are not allowed within 200' of the top of stream banks. Only temporary or on-street short-term parallel parking will be allowed.
- Front-loaded townhouse garages facing the stream or stream-approaches are prohibited. Parking for individual townhouse units may occur from the rear, or block interior (within interior-block garages, or via rear alley access).

The types of uses shown below create inactive areas in conflict with neighborhood/ corridor character, will make the stream corridor feel less safe, and detract from the visual and aesthetic experience of an improved Four Mile Run.

ALLOW FOR A VARIETY OF EXPERIENCES, PUBLIC IN NATURE, ALONG THE STREAM

Create active urban edges facing the stream

- Maximize number and proximity of functioning doors and entrances (recommended 60' maximum spacing) in locations facing the stream, important viewsheds, and other pedestrian-oriented areas.

Functioning doors create opportunities for a direct relationship between indoor and outdoor spaces. Multiple points of entry can distribute activity strategically along the length of a building, creating a more open relationship between private and public spaces. By limiting the maximum distance between doors, it is possible to avoid excessive blank stretches of building frontage. Functioning doors are defined as doors that are operable for active ingress and egress. Emergency only exits or egress only do not qualify.

(above, left) Multiple residential entries in this example, at both cellar and raised ground-floor levels, less than 60' apart, distribute people and activity along the length of the block. (above right) At-grade retail entries should also be inviting, as in this San Francisco Harvest Urban Market, and spaced closely together.

- Orient building fronts to the stream. Where not feasible or practical, create facade elements on the stream-facing side of the building that engage the stream and pedestrians. These elements include breaks in the building facade, installation of awnings and windows, lighting, and landscaping or other uses integral to the building that reinforce activity along the stream. Such uses include lunch or exercise rooms, meeting rooms, or other group assembly areas.

With an improved Four Mile Run, the stream corridor will be perceived as a focus of community activity, rather than a barrier. This transformation should be supported by the architecture of buildings lining the stream corridor. In addition to the ground-floor connections, overall building expressions should be oriented to the stream corridor, redefining previous building frontage patterns.

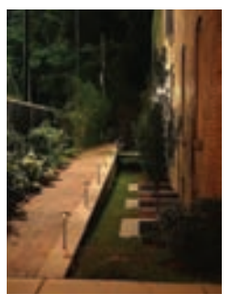
(above) The Torpedo Factory building in Alexandria, Virginia "faces" the waterfront with a primary frontage.

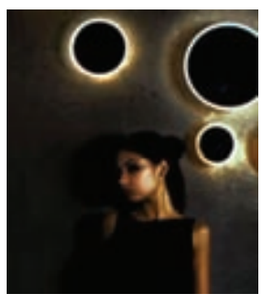
INCREASE REAL AND PERCEIVED SAFETY ALONG THE PROMENADE

Illuminate buildings and associated public spaces for safety

- Provide lighting with an inviting character that addresses security and public safety with pedestrian-scaled, integrated, light fixtures.
- Utilize Crime Prevention Through Environmental Design (CPTED) principles to ensure safety along the corridor.

Use a variety of pedestrian-scaled, low-level, indirect lighting fixtures, to increase safety and comfort. The intensity of lighting may be greater where urban development meets the stream corridor. Use shielded fixtures to prevent light trespass and ensure that aiming of fixtures does not conflict with adjacent uses.





(top row, left) Subtle, indirect lighting at the Cromley Lofts in Alexandria, VA; (middle) Encourage creative lighting solutions, like the pavement-embedded lighting shown in this example; (right) Energy-efficient fixtures, such as the solar powered fixtures shown, are also encouraged.

- Minimize light pollution spillover into natural habitat areas and the night sky through the use of full cut-off fixtures and other techniques.

Use photometric calculations to quantify site lighting design. Projects should meet the criteria of the most current LEED and IESNA lighting standards.



(above left and middle) Use full cut-off light fixtures to reduce light pollution.

Increase public space visibility and multiple sightlines from adjacent development

- Require active uses on upper levels facing the stream with opportunities for transparency and heightened indoor-outdoor visual connections (minimum 50 percent fenestration recommended; balconies and terraces recommended).

A critical component of real and perceived safety in successful urban public spaces is the amount of "eyes-on-the-street," a phrase commonly used in planning to describe the existence of angles of view from multiple vantage points.


(above left) Building features a variety of fenestration types, balconies, and terraces; (above right) An example from Portland, Oregon demonstrates the sense of security created by multiple angles of view toward a public open space.

ENCOURAGE PROMENADE USAGE, ACTIVITY, AND EASY ACCESS

Increase connectivity and permeability in and around the stream corridor

- Require a sightline evaluation for each individual project as part of development review, demonstrating: 1) preservation and enhancement of existing ground-level sightlines towards the stream, and the potential for new sightlines from streets and trails leading to the stream; 2) preservation and enhancement of key sightlines within the corridor, and views across the stream.

The streets and paths leading toward Four Mile Run are key elements in connecting people with the stream. Streets and paths near the stream should be designed as "green fingers" leading to the park, with tree-lined sidewalks and plantings complementary to the stream corridor. Views across the stream corridor should speak to one another through enhanced visual connections such as plantings, related building materials and site furnishings.

This view of the Census Bureau building in Maryland shows one potential technique for opening up the ground-plane sightlines at or along important view corridors.

- Maintain and create strong pedestrian connections to the stream corridor.

On streets approaching Four Mile Run, encourage wider sidewalks and active ground floor uses. Create at least one primary pedestrian access point to the promenade from each stream-front development. Encourage mid-block connections to the promenade for development sites with more than 200' of stream frontage. Plazas, mid-block walkways, and other open spaces should open up to the corridor, but they should not detract from the linear character of the stream corridor's edge.

- Avoid inappropriate prioritization of car access over pedestrian access.

'Motor court' drop-off placed in front of building entrances may compromise the continuity of pedestrian street-life and are not permitted. Modest drop-off areas that are easily accommodated along adjacent streets with little disturbance to pedestrian circulation are encouraged. See page 104.

Provide bike facilities at adjacent developments

- Encourage bike facilities (including entrances) to open up to promenade.

Increased bike use supports both sustainable and recreational goals for Four Mile Run. This zero-emission transportation alternative should be encouraged with bike facilities along the trail, ranging from simple bike racks to storage and changing facilities.

(top row, left and right) Bike facilities at Chicago's Millenium Park; (bottom row) Bike rack at the Salt Lake City Public Library in Utah.

Create public terraces, plazas, and garden spaces between developments and promenade

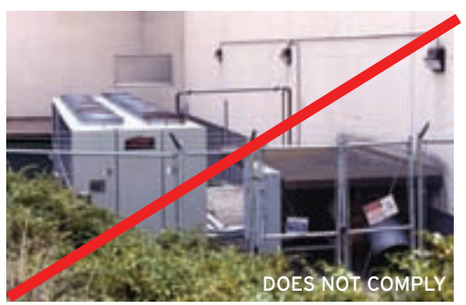
- Encourage building use-related terraces and plazas as opportunities for seating, public gathering, and transitional landscapes.

Examples illustrate the range of alternatives available for 'in-between' transitional spaces (between urban development and the promenade), ranging from primarily hardscape to primarily softscape.

Minimize building features that detract from the pedestrian experience of the public realm

- Discourage noise and fume-producing equipment facing the stream, or close enough to negatively impact on public space.

To mitigate noise pollution and fume disturbance along the stream, mechanical equipment, such as exhaust fans, generators, or other similar systems should be muffled and directed away from public spaces, their adjacent properties, and the streets leading to the stream corridor.



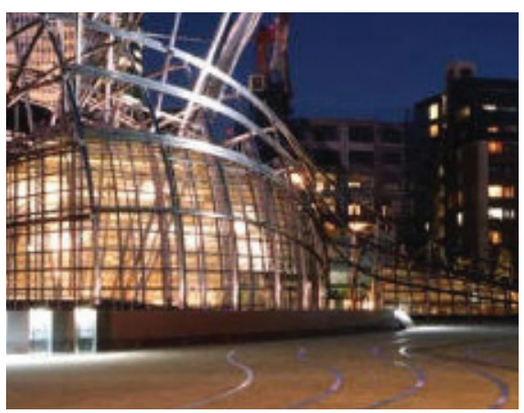
(above, top row, left) Green, or "living", walls are one potential technique for disguising or shielding loading docks, mechanical equipment and/or trash collection areas. (above, top row, right) A street view of the Torpedo Factory building in Alexandria, Virginia shows a well-placed loading dock—facing away from the public waterfront space and the main pedestrian approaches to the waterfront.

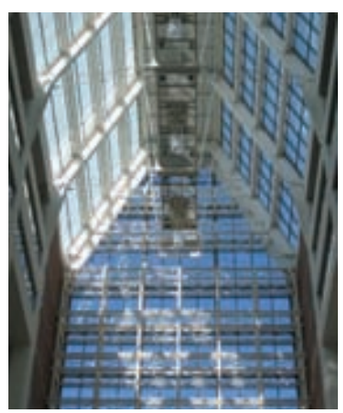
CREATE EXCITING, HIGH QUALITY ARCHITECTURE

Encourage innovative, contemporary, sustainable architecture

- Require new construction to utilize highest and best sustainability standards for new construction as guidance, wherever possible. In addition, meet or exceed City/County goals for green building practices.

Architecture should respond to the area's specific climatic conditions, with a focus on solar orientation for day lighting and thermal comfort, wind direction and rainfall/water management. Development of these elements can lead to a common thread in the architectural expression along Four Mile Run. The examples below demonstrate varying approaches towards 'green' building, ranging from architectural sun-shade screens (top row examples) to building floorplate organization around central atrium spaces (lower row examples).





Use high-quality materials

- Respond to site's unique identity by complementing the guiding design language of the Four Mile Run corridor (see Chapter 4).

Require high-quality materials for entire buildings, with a special emphasis on detailing and durability for the lower portion of buildings facing the stream corridor and its approaches. Richer materials, finer levels of detail, and enhanced lighting design will improve the pedestrian experience. Durable materials, such as stone, masonry, metal paneling, precast concrete panels, and glass are encouraged. Less durable materials, such as vinyl or aluminum siding, molded plastic or fiberglass details and moldings, are prohibited.

(left) "Diagonal Building", by Rafael Moneo, in Barcelona, Spain articulates the lower levels with a durable stone cladding, which is further emphasized at the ground level with a polished finish of the same material.

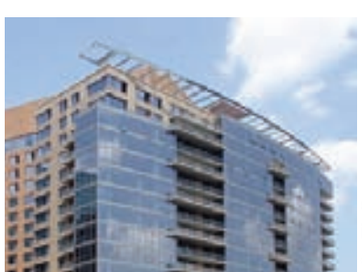
Create a variety of building forms facing the stream

The examples illustrate several approaches for achieving a variety of building forms that might face the stream. Buildings should encourage a variety of architectural expressions to avoid the look of single, large development "projects," and create a varied urban setting as a backdrop to the stream corridor. Architectural variety should be designed with coherence and integrity of expression. Articulation of façade design should include bay windows, balconies, and other projections that create interest and provide amenities to residents.

- Encourage a variety of architectural elements and façade articulation.

(above, left) Building projections create interest; (above right) At the Shirlington Library in Arlington, Virginia, building massing reduces the scale of development with a strong integrity of expression.

- Encourage building tops that relate to adjacent buildings, and contribute to the backdrop of the stream corridor.



(left) The Odyssey in Arlington, VA, responds to its context with the curved cornice-like trellis and change in materials at the upper levels.

- Encourage building tops that relate to distant views, and contribute to the skyline, locating distinctive, expressive features at key sightlines or visual axes.

(above, left) View from Gannett Corporation tower toward the USA Today building in McLean, Virginia. The design incorporates vertical tower elements to reduce building massing. (above, right) The Netherlands Architecture Institute building accentuates its massing with a trellis structure that marks the skyline.

CREATE EXCITING, HIGH QUALITY ARCHITECTURE

Integrate public art, water features, and sustainable building features into the design for the building/site development

- Celebrate sustainable design/water management features by integrating those features into building/site design.

The major themes of sustainability and habitat restoration proposed throughout Four Mile Run should manifest themselves in the adjacent urban areas as well. The examples below suggest how site design can integrate sustainable building features with building elements to achieve a level of artistry at pedestrian scale, or at the scale of a major urban-architectural feature.

(above left) A water feature consisting of a narrow recycling fountain; (above right) A drainage spout and "rain chain" highlights the building's water management; (above) Seattle's Olympic Sculpture Park

Encourage "Buildings That Teach"

- Encourage information kiosks or integrated design elements that demonstrate how the building works to protect the stream ecology. Information kiosks may display energy and water saving strategies, innovative materials, lighting strategies, site massing strategies, or actual building performance data.

Below the Alberici headquarters in St Louis, Missouri, shares its sustainable practices by hosting guided tours of its LEED Platinum buildings. The Whole Foods Market in Sarasota, Florida, incorporates a number of green building education centers that demonstrate various sustainable strategies ranging from water saving techniques to local material selection.

PULLING IT ALL TOGETHER

These diagrams illustrate possible solutions to meet the design criteria as outlined in the previous Building Form section of the guidelines (top) and show a non-compliant condition (bottom). Neither diagram is intended to represent actual architectural design solutions.

COMPLIES WITH DESIGN GUIDELINES

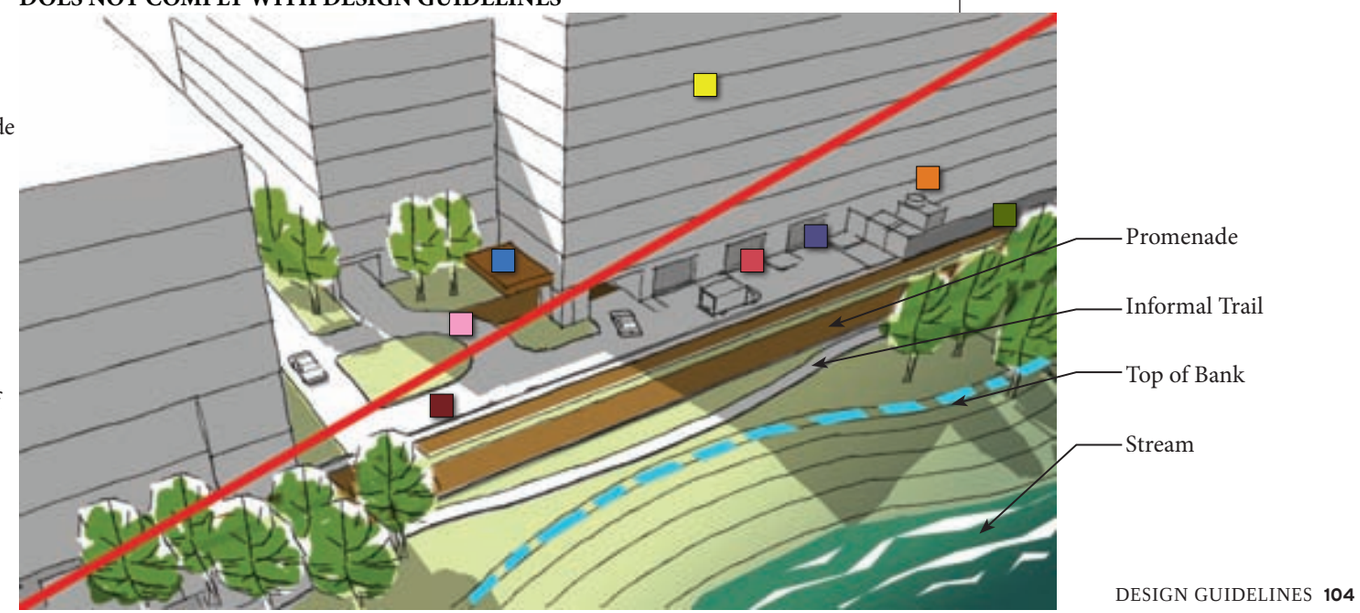
- Do not locate parking garage or service access entrances or surface parking within 200' of top of bank
- Orient longest sides of building perpendicular to stream ("streetwall").
- Building massing should step down to stream corridor to respond to natural light patterns and open views to the sky
- Avoid inappropriate prioritization of car access over pedestrian access
- Development should maximize pedestrian-oriented design at the ground floor
- In residential buildings, require individual entrances to multiple ground-floor units
- Private/semi-private open spaces open to the stream corridor should not detract from reinforcing the corridor edge
- Create strong pedestrian connections to stream with wide sidewalks and active ground floor uses
- Create at least one pedestrian access point to promenade from each stream-front development
- Encourage mid-block pedestrian connections to the promenade for development sites with more than 200' linear stream frontage
- Parking garages for individual townhouses with separate entrances should be accessed from the rear of the unit and not visible from Four Mile Run and promenade
- Encourage balconies and bay windows to animate and activate building facades
- Encourage green roofs and integrated stormwater management

DOES NOT COMPLY WITH DESIGN GUIDELINES

- Building massing with no setbacks or openings that create a "fortress" effect
- Garage entrance faces the public open space and stream corridor
- Active streetscape elements do not face promenade or sidewalks
- Building entrances with large motor court drop-offs that compromise continuity of pedestrian street-life
- Townhouse garages, loading access is prohibited along the promenade
- No permanent vehicular circulation permitted parallel to stream/promenade between building and stream
- Continuous fencing is located along the promenade
- Mechanical equipment and trash area is located along promenade

COMPLIES WITH DESIGN GUIDELINES

DOES NOT COMPLY WITH DESIGN GUIDELINES



FINAL DRAFT

Appendix

APPENDIX 1: PLANT LISTS

Vegetative Communities with Representative Species

Freshwater Communities

Riparian Edge is located within the flood control channel on terraces that lie above the 2-year water surface elevation. Representative species include:
Shrubs:
- Black Willow (Salix nigra)
- Smooth Alder (Alnus serrulata)
- Silky Dogwood (Cornus amomum)
- Red Osier Dogwood (Cornus sericea)
- Marsh Mallow (Hibiscus moscheutos)

Meadow Seed Mix:
- Little Bluestem (Andropogon scoparius)
- Indiangrass (Sorghastrum nutans)
- Black Eyed Susan (Rudbeckia hirta)
- Partridge Pea (Chamaecrista fasciculata (Cassia f.))
- Spotted Joe Pye Weed (Eupatorium maculatum)
- Joe Pye Weed (Eupatorium fistulosum)
- Virginia Wild Rye (Elymus virginicus)
- Soft Rush (Juncus effusus)
- Switchgrass (Panicum virgatum)
- Giant Ironweed (Vernonia gigantea (V. altissima))
- Arrow Wood (Viburnum dentatum)

Freshwater Floodplain Plantings are located within the flood control channel on terraces immediately adjacent to the active channel along the alluvial reach (between the 1-year and 2-year water surface elevation). Representative species include:
Herbaceous:
- Soft Rush (Juncus effusus)
- Switchgrass (Panicum virgatum)
- Cardinal Flower (Lobelia cardinalis)
- Tickseed Sunflower (Bidens polylepsis)
- Black-eyed Susan (Rudbeckia hirta)
- Spotted Joe-Pye Weed (Eupatorium maculatum)
- Broom Sedge (Andropogon gerardii)
- Fox Sedge (Carix vulpinoidia)

Floodplain Wetland Cells are located in permanently flooded pockets (cells) within the inset floodplain. Representative species include:

Herbaceous:

- Duck Potato (Sagittaria latifolia)
- Soft Stem Bulrush (Scirpus validus)
- Three-sided Sedge (Dulichium arundinaceum)
- Lizard Tail (Saururus cernuus)
- Bur-reed (Sparganium americanum)

Bank Stabilization Plantings are located along the banks of the flood control channel, in areas with relatively low risk of excessive erosion. These plantings may also be planted on or between existing gabion structures, with provision that they do not interfere with the structural integrity of the gabions. 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, however long-term erosion protection in these areas will be provided by the root structure and soil coverage of vegetation. Representative species include:

Shrubs:

- Sassafras (Sassasfras albidum)
- Black Haw (Viburnum prunifolium)
- Silky Dogwood (Cornus amomum)
- Red Osier Dogwood (Cornus sericea)

Meadow Seed Mix:

- Little Bluestem (Andropogon scoparius)
- Virginia Wild Rye (Elymus virginicus)
- Indiangrass (Sorghastrum nutans)
- Purple Top (Tridens flavus)
- Lance Leaved Coreopsis (Coreopsis lanceolata)
- Black Eyed Susan (Rudbeckia hirta)
- Partridge Pea (Chamaecrista fasciculata (Cassia f.)
- Appalachian Beard Tongue (Penstemon laevigatus)
- Spotted Beebalm (Monarda punctata)
- Whorled Rosinweed (Silphium trifoliatum)
- Butterfly Milkweed (Asclepias tuberosa)

Upland Forest vegetation is located on the upper terraces, on the landward edge of the flood control channel. Representative species include:

Trees:

- 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)

Shrubs:

- Spicebush (Lindera benzoin)
- Sweet pepperbush (Clethra alnifolia)
- Witch hazel (Hamamelis virginiana)
- Possum haw (Ilex decidua)
- Maple leaf viburnum (Viburnum acerifolium)
- Red chokeberry (Aronia arbutifolia)

Meadow Seed Mix:

- Little Bluestem (Andropogon scoparius)
- Virginia Wild Rye (Elymus virginicus)
- Indiangrass (Sorghastrum nutans)
- Purple Top (Tridens flavus)
- Lance Leaved Coreopsis (Coreopsis lanceolata)
- Black Eyed Susan (Rudbeckia hirta)
- Partridge Pea (Chamaecrista fasciculata (Cassia f.)
- Appalachian Beard Tongue (Penstemon laevigatus)
- Spotted Beebalm (Monarda punctata)
- Whorled Rosinweed (Silphium trifoliatum)
- Butterfly Milkweed (Asclepias tuberosa)
- Virginia Spiderwort (Tradescantia virginiana)

Tidal Wetland Communities

Tidal Wetland Bars located in and along the tidal channel provide additional habitat for the insects, birds and mammals that currently inhabit wetland areas in Four Mile Run Park. They also promote the expansion of rare and/or endangered vegetation, such as wild rice and river bulrush. Representative species include:

Herbaceous:

- 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)

Emergent Tidal Vegetation will be planted as part of the reconnection of the wetland areas in Four Mile Run Park to the Hume Springs wetlands. This will substantially increase and enrich the total area of emergent tidal wetland vegetation. Representative species include:

Herbaceous:

- 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 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 include:

Trees:

- Sweetgum (Liquidambar styraciflua)
- Sycamore (Platanus occidentalis)
- Red Maple (Acer rubrum)
- Hackberry (Celtis occidentalis)
- Blackgum (Nyssa sylvatica)
- River Birch (Betula nigra)

Shrubs:

- Silky Dogwood (Cornus amomum)

Herbaceous:

- 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)

APPENDIX 2: PLANNING EFFORTS

City of Alexandria

City Master Plan

http://alexandriava.gov/planning/info/default.aspx?id=7518

Potomac Yard Urban Design Guidelines

http://alexandriava.gov/WorkArea/showcontent.aspx?id=7288

Small Area Plan for Arlandria

http://alexandriava.gov/uploadedFiles/planning/info/Arlandria/pnz_arlandria_visionandactionplan.pdf

Draft Transporation Master Plan

http://alexandriava.gov/tes/info/default.aspx?id=3088

Landscape Guidelines

http://alexandriava.gov/uploadedFiles/recreation/info/040907_land_guidelines.pdf

Arlington County

General Land Use Plan

www.arlingtonva.us/departments/CPHD/planning/docs/CPHDPlanningDocsGLUP.aspx

Potomac Yards Design Guidelines

www.arlingtonva.us/departments/CPHD/planning/docs/CPHDPlanningDocsMain.aspx#rb_streetscape

Public Art Public Spaces: A Public Art Master Plan for Arlington, VA

www.arlingtonarts.org/cultural_affairs/Images/Public%20Art%20Master%20Plan%20low%20resolution.pdf

APPENDIX 3: REFERENCED WEBSITES

City of Alexandria Stormwater Related Guidelines and Regulations:

Alexandria Zoning Ordinance - Article XIII discusses Alexandria's environmental management policies and has several sections related to stormwater management.

http://alexandriava.gov/uploadedFiles/tes/info/Article_XIII_2006.pdf

Arlington County Stormwater Related Guidelines and Regulations:

1. Chesapeake Bay Preservation Ordinance—includes stormwater quality, RPA, tree canopy requirements

- Link to the General Overview and Description of the Chesapeake Bay Ordinance: www.arlingtonva.us/Departments/EnvironmentalServices/epo/EnvironmentalServicesEpoChesapeakeBayProtectionOrdinance.aspx
- Link to Arlington Ordinance to Enact Chesapeake Bay Ordinance: www.arlingtonva.us/Departments/EnvironmentalServices/epo/pdffiles/cbpo.pdf
- Link to the Arlington County Guidance Manual for the Chesapeake Bay Ordinance: www.arlingtonva.us/Departments/EnvironmentalServices/epo/pdffiles/cbpoguide.pdf

2. Stormwater Detention Ordinance - stormwater quantity

- Link to the General Overview and Description of the Stormwater Detention Ordinance: www.arlingtonva.us/Departments/EnvironmentalServices/epo/EnvironmentalServicesEpoRegulatoryPrograms.aspx#SD
- Link to the Stormwater Detention Ordinance: www.arlingtonva.us/Departments/CountyBoard/CountyCode/Ch60_StormwaterDetention.pdf
- Link to the Arlington County Guidance Manual for the Stormwater Detention Ordinance: www.arlingtonva.us/Departments/EnvironmentalServices/cpe/permits/chesbay/images/Stormwater%20Detention%20Ordinance%20guidance%20packet% 0-%20Arlington.pdf

3. Arlington County Stormwater Facility Maintenance Agreement
www.novaregion.org/DocumentView.asp?DID=1681

Arlington County Wayfinding Analysis and Criteria:

www.arlingtonvirginiausa.com/index.cfm/13609?newsid=308

State of Virginia Conservation and Recreation Regulations:

www.dcr.virginia.gov/

References

Arlington Cultural Affairs. 2004. Public Art Public Places: A Public Art Master Plan for Arlington, Virginia. Arlington Department of Parks, Recreation, and Cultural Affairs.

Chesapeake Bay Local Assistance Department. 2003. Riparian Buffers Modification & Mitigation Assistance Manual. Virginia Department of Conservation and Recreation. Reprinted 2006.

City of Alexandria, Virginia Landscape Guidelines (1997, rev. 2007). City of Alexandria.

City of Alexandria, Virginia. 2006. Amendments to City of Alexandria Article XIII: Environmental Management Ordinance. Adopted by the City Council April 11, 2006.

Department of Community Planning, Housing, and Development. 2005 (rev.) Arlington County Landscape Standards. Arlington County, VA.

Department of Parks, Recreation and Cultural Resources. Urban Forest Master Plan. Arlington County, VA.

Department of Environmental Services. 2005. Arlington County Chesapeake Bay Preservation Ordinance Guidance Manual, Version 2.1. Arlington County, VA.

Lindenmayer, D. B. and J. Fischer. 2006. Habitat Fragmentation and Landscape Change: An Ecological and Conservation Synthesis. Island Press. Washington D.C.

Palone, R. S. & Todd, A. H. eds. 1997. Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers. USDA Forest Service. NA-TP-02-97. Radnor, PA. p. 6-5

Park and Recreation Commission. March 2009. Urban Forestry Master Plan. City of Alexandria.

Rhodeside & Harwell, Inc.; CH2MHill; Biohabitats, Inc.; Waterscapes/Dreiseitl. 2006. Four Mile Run Restoration Master Plan. Arlington County and City of Alexandria, VA.

Robins, J. D. 2002. “Stream Setback Technical Memo.” Napa, CA: Jones & Stokes.

Transportation & Environmental Services. June 2008. Pedestrian and Bicycle Mobility Plan. City of Alexandria.

Welsch, D. 1991. “Riparian Forest Buffers, Function and Design for Protection and Enhancement of Water Resources.” Radnor, PA: US Forest Service.

Wenger, S. J., and L. Fowler. 2000. Protecting Stream and River Corridors. Edited by Richard W. Campbell, Public Policy Research Series: Carl Vinson Institute of Government, The University of Georgia.

U.S. Army Corps of Engineers (USACE), 2008. April 2008. Vegetation (Tree) Removal Guidance for Typical Floodwall Configurations.

ACKNOWLEDGMENTS

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All aerial photographs provided by Arlington County and City of Alexandria

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All photos and images by Rhodeside & Harwell, Incorporated, CH2M Hill, Biohabitats, Incorporated, Waterscapes / Dreiseitl, or Beyer Blinder Belle except for the following:

CHAPTER 4

p. 23 *(top row, left)* LED strip by Hess, www.hess.eu/en/Produkte_Leuchten/LED-Effektbeleuchtung/LEDIA_LL_OD/; *(top row, right)* photo by Peter Terezakis, www.terezakis.com/; *(middle row, 1st)* WaterFire Providence, www.providenceri.com/richardbenjamin/; *(2nd & 3rd)* The Red Ribbon, Tanghe River Park by Turenscape, 2007 ASLA Honor Award, www.asla.org/awards/2007/07winners/ 056_tbtd.html; *(4th)* Toronto City Hall, photo by Sam Javanrouh, wvs.topleftpixel.com/06/07/04/

p. 25 *(top)* Barcelona Botanical Institute, Barcelona, Spain, www.pushpullbar.com/forums/spain/5743-barcelona-botanical-garden-botanical-institute-carlos-ferrater-3.html; *(bottom)* Gas Works Park, Seattle, WA

p. 26 *(bottom)* Pedestrian bridge in Lake Austin, TX by Miro Rivera Architects, www.architecturalreviewawards.com/ARAwards2006/winning%20entries/RIVERAwinner.htm

p. 28 *(j)* Potsdamer Platz, Berlin; *(k)* Overland Track boardwalk, Tasmania, Australia; *(m)* The Sunshine Garden at Hampton Court Flower Show by Paul Stone, http://i.treehugger.com/files/th_images/gabion.jpg2.jpg; *(o)* Redes by Escofet, www.escofet.com/; *(p)* Barcelona Botanical Institute, Barcelona, Spain, www.pushpullbar.com/forums/spain/5743-barcelona-botanical-garden-botanical-institute-carlos-ferrater-3.html; *(r)* Bagdad cafe bench by Woodhouse/Escofet, www.woodhouse.co.uk/products.php?show=details&name=escofet_bagdad_cafe_bench__seat; *(s)* Pedestrian bridge in Lake Austin, TX by Miro Rivera Architects, www.architecturalreviewawards.com/ARAwards2006/winning%20entries/RIVERAwinner.htm

CHAPTER 5

p. 46 *(bottom right)* Residential rain garden by Center for Watershed Protection, www.flickr.com/photos/stormwater/2416862658/in/set-72157604556046965/

p. 47 *(top left)* Green roof on county building at Courthouse Plaza, Arlington, VA, www.arlingtonva.us/NewsReleases/greenroof.jpg; *(top right)* Walter Reed Community Center, www.arlingtonva.us/Departments/EnvironmentalServices/epo/EnvironmentalServicesEpoGreenBuildingsinArlington.aspx; *(bottom left)* Albemarle County office building, www.albemarle.org/department.asp?department=planning&relpage=7079; *(bottom right)* The Jamieson green roof, Alexandria, VA, www.metrodcliving.com/new_home_trekker/images/2007/10/14/dscn3377.jpg

p. 48 *(top left)* Westmoreland pervious pavers project, Portland, OR, www.commissionersam.com/files/Green%20Streets%20Tour%20Map%20-%20BES.pdf; *(bottom left)* www.uni-groupusa.org

p. 49 *(top two left)* Photos courtesy of Arlington County; *(bottom two left)* Rain garden, collaboration by artist Jann Rosen-Queralt, Oculus, the Kerns Group Architects and Christopher Consultants; *(bottom, left)* www.flickr.com/photos/12066961@N02/1223078155/, photo by Jann Rosen-Queralt

p. 56 *(top right)* Guadalupe River Park & Garden, San Jose, CA, www.geocities.com/rhorii/GRPG/GRPG2.html; *(bottom 1st)* National Aquarium in Baltimore; *(2nd)* Milwaukee Riverwalk, www.flickr.com/photos/27263074@N00/204381844/sizes/l/, photo by nodarkroom; *(4th)* Paving in Barcelona, Spain, www.flickr.com/photos/coanri/256336838/, photo by coanri; *(5th)* Dance steps in Seattle, Washington, www.flickr.com/photos/allegri/2351335772/sizes/o/, photo by allegri; *(6th)* 'Underground Spring' by Catherine Woods, www.cglassstudio.com/Image.asp?ImageID=348992&full=1&apid=1&gpid=1&ipid=1&AKey=EGW9FJRW

p. 59 *(bottom left)* Guadalupe River Park & Garden, San Jose, CA, www.geocities.com/rhorii/GRPG/GRPG2.html

p. 61 *(bottom left)* Bay Meadows Mixed-Use Redevelopment, San Mateo, CA, Gates & Associates, www.dgates.com/PORT_proj_mixed_bayMeadows.htm

p. 63 *(top two photos, left)* San Dieguito Lagoon Coastal Boardwalk, www.sdrp.org/projects/Boardwalk/Coastalboardwalk.htm

p. 64 *(bottom row, 1st)* Tanner Springs Park, Portland, OR, http://flickr.com/photos/justsmartdesign/1083841975/, photo by justsmartdesign; *(2nd)* Castleford Footbridge, Yorkshire, United Kingdom, www.flickr.com/photos/reinholdbehringer/ 2824172669/, photo by reinholdbehringer; *(3rd)* photo courtesy of www.metalco.it

p. 65 *(top)* www.flickr.com/photos/baccarati/2526518533/, photo by baccarati; *(middle)* South Portland Waterfront; *(bottom)* Guadalupe River Park & Garden, San Jose, CA, www.geocities.com/rhorii/GRPG/GRPG2.html

p. 68 *(top left)* James Clarkson Discovery Center by MSI, photo by Ellen Pucket and Justin Machonochie, www.gardener.ru/panorama/asla2008/8/8.jpg

p. 69 *(top)* York Bridge replacement project, Redmond WA, by Cliff Garten Studio, www.cliffgartenstudio.com/; *(middle)* Greenwood Pond: Double Site for the Des Moines Art Center, by Mary Miss, http://dailyheadlines.uark.edu/images/Mary_Miss_Des_Moines.jpg; *(bottom)* Gateway to the Bristol and Bath Railway Path, www.flickr.com/photos/antphotos/768228166/, photo by Ant

p. 75 Photos of Thames Festival, London *(top)* www.flickr.com/photos/jbparker/1525897108/sizes/m/, photo by jbparker; *(middle)* www.flickr.com/photos/mattcitizen/1387773301/, photo by in.vino.veritas; *(bottom)* www.flickr.com/photos/pineapplebun/1447133301/, photo by pineapplebun

p. 76 *(top row, 1st)* Mount Stuart Visitor's Centre, Isle of Bute, Scotland, www.flickr.com/photos/yellowbookltd/1259266936/, photo by yellow book ltd; *(2nd)* Chesapeake Bay Foundation, MD, www.flickr.com/photos/reiser/1438337248/, photo by timreiser; *(3rd)* Mercator Sportplaza, Amsterdam, www.flickr.com/photos/thom_mckenzie/3262910528/, photo by thom's; *(middle row, 1st)* Kanaaleiland, Brugge, Belgium, West 8, www.west8.nl/projects/kanaaleiland/?s=brugge; *(2nd)* Union Point Park, Oakland, CA, www.flickr.com/photos/7860620@N07/1891614733/, photo by DD97; *(bottom row, 1st)* Pedestrian bridge in Lake Austin, TX by Miro Rivera Architects, www.architecturalreviewawards.com/ARAwards2006/winning%20entries/RIVERAwinner.htm; *(2nd and 3rd)* Castleford Footbridge, Yorkshire, United Kingdom, www.dezeen.com/2008/07/17/castleford-bridge-by-mcdowellbenedetti/; *(4th)* River Oaks Bridge, San Jose, CA, www.flickr.com/photos/michaelpatrick/1524859412/, photo by Michael Patrick; *(5th)* Kanaaleiland, Brugge, Belgium, West 8, www.west8.nl/projects/kanaaleiland/?s=brugge

p. 78 *(bottom row, 2nd)* National Aquatic Centre, Dublin, www.hy-tengabions.co.uk/case_history/case_history_national_aquatic_centre.pdf; *(3rd)* La Cholla Boulevard, Tucson, AZ, by Vicki Scuri, www.vickiscuri-siteworks.com/projects-all/lacholla-a1.html; *(4th)* Trento Industrial Parks, Sonora, Mexico, www.trento.com.mx/Images/park/art_wall_lg.jpg

p. 79 Trash Receptacles *(top row, 1st)* www.escofet.com; *(2nd)* Project for Public Spaces, Denver, Colorado, www.pps.org; *(3rd)* www.metalco.it; *(4th)* www.victorstanley.com; Picnic Tables (bottom row) www.victorstanley.com

p. 80 *(top row, 1st)* Concrete bench at Longwood Gardens, www.flickr.com/photos/photoplanet71/2064890247/, photo by photoplanet2007; *(2nd)* http://farm2.static.flickr.com/1410/1056690463_e2ca24e9dd.jpg; *(3rd)* Mosaic bench, www.flickr.com/photos/lisaschaos/390797458/, photo by lisaschaos; *(middle row, 1st)* Zuera bench by Escofet, www.escofet.com; *(bottom row, 1st)* Bagdad cafe bench by Woodhouse/Escofet, www.woodhouse.co.uk/products.php?show=details&name=escofet_bagdad_cafe_bench__seat; *(2nd)* Campus bench by Metalco, www.metalco.it; *(3rd)* Bancal bench by Landscape Forms, www.landscapeforms.com; *(4th)* http://images.sub-studio.com/images/2008/0310urban.jpg

p. 82 *(top row, 1st)* Sonne solar light by Se'lux, www.selux.com; *(2nd)* Pelican light by Luminis, www.luminis.com; *(3rd)* EverLast PVW Hybrid, www.everlastlight.com; *(4th)* Ful lighting by Escofet, www.escofet.com; *(5th)* Leonis series, LifeLED by Lumec, www.lumec.com; *(bottom row, 1st)* Place du Molard, Geneva, Switzerland, www.flickr.com/photos/psd/55220068/sizes/o/, photo by psd; *(2nd)* Underpass in Brussels, Belgium, www.flickr.com/photos/akanekal/2679159515/, photo by akanekal; *(3rd)* Electrabel's Power Station in Drogenbos, Belgium, www.mediaarchitecture.org/2006/11/; *(4th)* Light rail bridge, Tempe, AZ, www.flickr.com/photos/mdutile/3188290462/; photo by Matthew_Dutile

p. 88 *(top left)* Farrar Pond Residence, Lincoln, MA, Mikyoung Kim Design, www.asla.org/awards/2007/07winners/ 276_mkd.html; *(right)* Doncaster Hill public art fence; www.doncasterhill.com/Media_Images.htm; *(bottom left)* Web trellis, www.flickr.com/photos/badecbrosdeco/ 3049980576/, photo by badecbros

p. 89 *(top)* Street filter strip, Portland, OR, www.epa.gov/owow/podcasts/greenstreetsusa.html; *(bottom)* New York Battery Park promenade, www.soulofthegarden.com/Images/NYBateryPromenadePlanting.jpg, photo by Tom Spencer

p. 93 *(left column, top row, left)* Portland street stormwater planters, Portland Bureau of Environmental Services, www.portlandonline.com/bes/index.cfm?a=123776&c=45386; *(right)* Grasspave structured sod by Invisible Structures, http://invisiblestructures.com/GP2/grasspave.htm; *(bottom row, left)* Open grid pavers, http://flickr.com/photos/33119616@N00/897640868/, photo by Andrew Kao; *(right)* Porous pavement, http://envplan240.pbwiki.com/Permeable+Pavement; *(right column, top row, left)* Solaire building, New York, NY, http://flickr.com/photos/birdw0rks/ 180089281, photo by birdw0rks; *(right)* ASLA Headquarters, Washington, DC, http://flickr.com/photos/64183923@N00/1257927703, photo by Drew Saunders; *(bottom row, left)* Full Tank, www.fulltank.com.au/products/lumi.html; *(right)* rainwater system for Denton Fire Station, www.flickr.com/photos/rainwater-collection/2519784783/, photo by watercache.com

p. 94 *(right column, right)* Diagram by Hines/Archstone Smith; *(left column, left)* Broward County Main Library in downtown Fort Lauderdale, FL, www.flickr.com/photos/lumberroom/1590250067/, photo by Lumber Room

p. 95 *(left column, top row, left)* Milwaukee, Wisconsin, Beerline, www.flickr.com/photos/repowers/425900801/, photo by repowers; *(right)* Portland, OR's Pearl District, www.nwprogressive.org/weblog/2007_04_01_archive.html; *(right column, top row, right)* Tahari workspace, Millburn, NJ, ASLA 2006 Professional Award by Michael Van

Valkenburgh Associates Inc., http://asla.org/awards/2006/06winners/263.html, photo by Elizabeth Felicella

p. 96 *(left column, left)* Portland townhouses, http://flickr.com/photos/koshalek, photo by Anne Koshalek; *(left column, right)* Urban Fare grocery store, Vancouver, Canada, flickr.com/photos/madamlemon/68503126/, photo by Priscilla Huang; *(right column, left)* http://untitledname.com/2005/07/loading-dock, photo by Will Sherman; *(middle)* Richard Schiller, www.norman.k12.ok.us/001/bond05/

p. 97 *(left column, left)* Rogers Marvel Architects, www.rogersmarvel.com/StateStreetTownhouses.html; *(right)* David Baker + Partners Architects, www.dbarchitect.com; *(right column*) Torpedo Factory, Alexandria, VA, http://flickr.com/photos/aperturef64/2422757282/, photo by Aperturef64

p. 98 *(left column, top row, left)* Cromley Lofts, Alexandria, VA, www.cromleylofts.com/photos.html; *(middle)* 'Underground Spring' by Catherine Woods, www.cglassstudio.com/Image.asp?ImageID=348992&full=1&apid=1&gpid=1&ipid=1&AKey=EGW9FJRW; *(right)* Corona Solar Light, www.coronasolarlight.com/; *(left column, bottom row, left)* Opticone Series by Lumec, www.lumec.com; *(middle)* SILL Cityliter 150 by se'lux, www.selux.com; *(right column, left)* Tanner Springs Park, Portland, OR, Atelier Dreiseitl with Green Works P.C., www.greenworkspc.com/500-tanner-springs-park; *(right)* http://flickr.com/photos/koshalek, photo by Anne Koshalek

p. 99 *(left column, left)* Census Bureau building, MD, www.archphoto.com/, photo by Eduard Hueber; *(right)* San Antonio Riverwalk, TX, www.lindsayfincher.com/2006/04/i_messed_with_texas.html, photo by Lindsay Fincher; *(right column, top, right and left)* Bike facilities at Chicago's Millenium Park, San Francisco Bike Coalition, http://flickr.com/photos/sfbike/398138068; *(bottom)* bike racks, Salt Lake City, UT public library, www.flickr.com/photos/neufcent9/2962674441/, photo by neufcent9

p. 100 *(left column, top row, left)* Reston Town Center, VA, www.restontowncenter.com/gallery.html; *(bottom)* Tanner Springs Park, Portland, OR, Atelier Dreiseitl with Green Works P.C., www.greenworkspc.com/500-tanner-springs-park; *(right column, top row, left)* Living wall, www.g-sky.com/; *(right)* Torpedo Factory, Alexandria, VA, http://flickr.com/photos/rudiriet/509862469/, photo by Rudi Riet

p. 101 *(left column, top row, left)* Phoenix Central Library by Will Bruder + Partners, www.pixelmap.com/dma_bruder_41.html; *(right)* US Census Building in Maryland, www.archphoto.com/, Eduard Hueber; *(bottom row, left)* Genzyme building in Cambridge, MA, Anton Grassl, http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=274; *(right)* US Patent and Trademark Office Consolidated Headquarters Complex, Alexandria, VA www.flickr.com/photos/remotecontrols/543217703/, photo by King of All Remote Controls; *(right column, top left)* Diagonal Building by Rafael Moneo, Barcelona, Spain a El Croquis #64, Madrid 1994; *(right)* The Kunsthal, Rotterdam, Netherlands, OMA, www.rml2.nl/ckv1/kunstinstellingen.htm

p. 102 *(left column, top row, left)* Yerba Buena Lofts, San Francisco, CA, www.yerbabuenalofts.com; *(right)* Shirlington Library, Arlington, VA, http://flickr.com/photos/54292413@N00/356472493, photo by Mj*laflaca; *(bottom, left)* Tanner Springs Park, Portland, OR, Atelier Dreiseitl with Green Works P.C., www.greenworkspc.com/500-tanner-springs-park; *(right)* The Odyssey, Arlington, VA, www.alarmtechsolutions.com/Projects/tabid/56/Default.aspx; *(right column, left)* Gannett Corporation Tower USA Today building, 2008 ASLA professional award, Micheal Vergason Landscape Architects, www.asla.org/awards/2008/08winners/415.html, photo by Timothy Hursley

p. 103 *(left column, top row)* fountain, http://lakii.com/vb/showthread.php?threadid=332323&s=; *(right)* David Baker + Partners, Architects, www.dbarchitect.com/words/press/35/Builder%27s%20Choice.html; *(bottom)* Olympic Sculpture Park, Seattle, WA, http://artculture.com/artists/art-design-features/seattle-olympic-sculpture-park; *(right column, top)* Alberici headquarters, St. Louis, MO, www.alberici.com; *(bottom)* Whole Foods Market, Sarasota, FL www.edutracks.com/displays/wholefoods.leed.html

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