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

In particular, this chapter expands on three design themes that are central to the Master Plan vision. First, the Master Plan includes a variety of “green principles” that will make Four Mile 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. This chapter outlines some of the design tools and elements that will help to achieve these three overarching visions and provides some imagery to illustrate the design language for the corridor.

A. Green Principles

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

1. CHANNEL RESTORATION AND STABILIZATION

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

- Creation of a more natural meandering stream alignment
- Partial removal of floodwalls, gabions and riprap
- Regrading of banks to more natural and functional slopes
- Re-establishment and stabilization of stream banks and floodplain through bio-engineering techniques (layered clumps of plant material, rootwad revetment, rock-toe protection)
- ‘Natural’, Meandering Stream Alignment
- Expanded Vegetative Stream Edge
- Step-Pool Grade Control
- Stabilization of Stream Banks
• Expansion and enhancement of vegetative stream edge – riparian edge treatment, floodplain planting, bank stabilization planting
• Wetland creation to filter stormwater, reduce flooding and create habitat
• Vegetation management (removal of exotics; planting of natives)
• Step-pool grade control

2. HABITAT RESTORATION

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

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

3. COMPREHENSIVE STORMWATER MANAGEMENT

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

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

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

Daylighting

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

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

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

**Bioretention**

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

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

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

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

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

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

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

- Additional impervious surfaces should be minimized to the extent possible within the study area.
- Compliance with Alexandria’s Environmental Management Ordinance and Arlington’s Chesapeake Bay Preservation Ordinance.
- Chesapeake Bay Preservation Ordinances for Resource Protection Areas
- All new areas of hardscape within the study site should utilize pervious materials, to the maximum extent practicable and appropriate for the type of use, including:
  - Plazas and Promenades - Interlocking permeable pavers and/or harvesting of rainwater for later irrigation of landscape features
  - Parking Lots - Permeable asphalt or interlocking permeable pavers for parking stalls and other lower-traffic areas (or for the entire lot if use is limited).
  - Trails - Graded to utilize infiltration zone along edge or pervious recycled stone

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

Green Roofs

Green roofs are vegetated surfaces placed on building rooftops to help mitigate the effects of urbanization on water quality by filtering, absorbing and detaining rainfall that would otherwise run off the impervious roofs. They are particularly useful in highly urbanized areas, where space for other types of stormwater management is limited.

Green roofs are constructed of lightweight soils, with a drainage layer underneath and an impermeable membrane at the bottom that protects the building structure from moisture. The soil is planted with a specialized mix of plants that can thrive in rooftop conditions that may include high winds and low moisture. Green roofs attenuate peak flows by slowing down stormwater and reducing the runoff volume. The plants and soil in a green roof also capture airborne pollutants and prevent them from entering into contact with the stormwater. In addition to the stormwater management benefits of green roofs, other benefits include increased building insulation (which reduces energy heating and cooling costs) and improved aesthetic value (which could translate into increased property values).

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

Stormwater Planters

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

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

Stormwater planters should be considered for existing buildings in neighboring properties as a cost-effective technique.
Litter Control / Other Stormwater Proprietary Devices

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

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

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

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

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

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

Types of litter control devices include:

- Catch basin and curb inlet inserts
- Trash racks
- Catch basin sumps
Finally, other practices such as regular street-sweeping and modifying littering behavior can supplement the litter control benefits of the devices described above.

Underground Storage

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

4. BUILDING GREEN

Buildings

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

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

- Green roofs (see description under “Low-Impact Stormwater Management”)
- Ventilation efficiency and good indoor air-quality
- Lighting control that allows for natural lighting (i.e., skylights)
- Daylight harvesting by using a solar hot water system
- High-tech glazing to ensure temperature control
- Efficient insulation
- "Grey water" re-use
- Rainwater harvesting
- Use of energy-efficient appliances (for example, those with Energy Star certification)
- Use of non-toxic and recycled-content building materials
- Use of rapidly renewable materials
- For new development in the corridor, waste management practices should be incorporated into the construction process.

**External Lighting Requirements**

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

**Recycling Station**

Recycling is another way to protect the environment and foster an environmental ethos. The City of Alexandria has proposed constructing a small, state-of-the-art recycling station in Four Mile Run Park, adjacent to and in conjunction with the proposed
nature-cultural center. The design of the recycling station should enable use of the facility for educational purposes so that students can learn about how and why we recycle. The Four Mile Run corridor can contribute to this cause by providing informal facilities throughout the corridor.

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

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

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

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

Commuter Trail:
- 12-foot wide asphalt trail with a filtration strip
Community Trails:
• 6-foot - 9-foot asphalt trail with a filtration strip

Informal Trails:
• 4-foot trail made from recycled gabion stones

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

Pedestrian/Cyclist Bridges:
• 10-foot to 20-foot wide, composed of varying materials

Informal Stream Crossings:
• Boulders or logs placed in or over stream

2. PROMENADES AND PLAZAS

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

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

3. GREEN OPEN SPACE

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

4. SPORTS FACILITIES

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

5. PUBLIC ART

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

C. Built Features

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

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

• New development should engage and open up to the stream.
• New development should extend to within 10 feet to 15 feet of public promenades, or as close as the Resource Protection Area boundary permits; the available space would be appropriate for terraces or gardens.
• Interpretation of RPA boundaries vary between Arlington and Alexandria. Development opportunities should be reviewed on a case-by-case basis.
• Buildings in urban redevelopment areas should be 2 to 5 levels, depending on use and location. The first level should be devoted to retail or office use with 75-90 percent fenestration and functioning doors at approximately 60-foot-minimum intervals. The remaining levels should consist of residential or office uses with functioning doors and 40-80 percent fenestration. Balconies are encouraged.

2. ARCHITECTURAL COMPONENTS

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

Buildings, Bridges, Raised and Cantilevered Walkways

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

Key refers to photographs on opposite page
- Commuter Trail with Adjacent Filtration Strip
- Mount Vernon Avenue Plaza
- Informal Trails
- Ramps
- Promenades
- Pedestrian/Bicyclist Bridges
Four Mile run Master plan materials. The quality of detail should be of a similar standard throughout the corridor. Materials for consideration include glass, steel, steel cable and architectural mesh. Buildings, bridges and raised and cantilevered walkways should be considered the highlights of built form in the corridor and should not be undertaken until sufficient funds become available in order to sustain a strong, beautiful and consistent identity for the Four Mile Run corridor.

Site Furnishings and Signage

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

Fencing

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

Lighting

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

- **Continuous Lighting:**
  - Commuter trail and promenades

- **Partial Trail Lighting:**
  - Main connections through Four Mile Run Park

- **Feature Lighting:**
  - Bridge entrances, informal crossings, plazas, potential gathering places

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

- **Sports Lighting:**
  - Detailed design should consider and avoid adverse effects on Four Mile Run Park forests and wetlands, neighboring private property and public rights-of-way.
This chapter concludes the description of the Master Plan, a discussion that began in Chapter 4 with an overview of the plan’s main components and continued in this chapter with a more in-depth look at the general design character of the corridor. The next and last chapter (Chapter 6) explains the strategy for turning the Master Plan vision into reality. Topics include the ongoing demonstration project and Corps of Engineers feasibility study, as well as management, policy and cost considerations for implementing the Master Plan.