Bureau of Recreation and Conservation
Green Principles for Park Development and Sustainability

Principle #3: Manage Stormwater Naturally/ Green Infrastructure

Stormwater runoff occurs when excess water from rainfall and snow-melt events flows across paved streets, parking lots, rooftops and construction sites. This runoff has multiple impacts including: increased flooding, decreased groundwater recharge and stream baseflow, stream channel erosion, increased pollution and temperature impacts to waterways. Parks and natural areas can play a beneficial role in reducing the impacts of stormwater if designed correctly. Clean, reliable water resources are critical for sustaining the environmental health of our natural resources, protecting the public's health and safety, and maintaining the economic vitality of the Commonwealth.

Natural stormwater management can be more cost-effective than traditional gray infrastructure of pipes and treatment facilities. There are many best management practices (BMPs) for natural stormwater management that minimize the impact of impermeable surfaces such as roads, rooftops, and parking lots. BMPs can include pervious surfacing for parking lots, trails, walkways, ball courts, etc; rain gardens and vegetative swales; naturalized detention basins; and rainwater catchment systems for rooftops. Even just planting more trees near impermeable surfaces can reduce the need for large, expensive stormwater management systems.[1]

Green Infrastructure

Green Infrastructure encompasses a variety of technologies that replicate and restore the natural hydrologic cycle and reduce the volume of storm water entering the sewer system. Parks can implement green infrastructure techniques to capture runoff from adjacent roads, industry, parking lots, etc. and allow it to naturally infiltrate back into the groundwater instead of allowing the water to runoff and impact downstream communities. How does green infrastructure work:

- Infiltrate (allowing water to slowly sink into the soil)
- Evaporate, transpire and reduce energy consumption by using native vegetation
- Capture and reuse rainfall (rain barrels, cisterns, irrigation supply systems)

In contrast to gray infrastructure, a green infrastructure approach often has a higher return on investment and offers multiple benefits, including:

- Environmental – recharges ground water, provides natural stormwater management, reduced energy usage, and improved water quality.
- Social – beautifies and increases recreational opportunities, improves health through cleaner air and water, improves psychological well-being.
- Economic – reduces future costs of stormwater management and increases property values.

Green Infrastructure Types[5]:

- **Green streets/alleyways** use the existing form and construction of roadways to allow the public right of way area to manage the runoff that it creates as well as runoff from adjacent properties. Impervious surfaces can be replaced with pervious pavements with an infiltration bed beneath which provides temporary storage for peak rate control. Vegetation can be incorporated in available spaces to increase infiltration rates (tree trenches, curb extensions, sidewalk planters).

- **Green sidewalks** are created when sidewalks include curb extensions, planters, tree trenches and pervious pavements.

- **Naturalized infiltration basins** are shallow, impounded areas planted with a variety of native grasses and flowers designed to temporarily store and infiltrate stormwater runoff while also

improving water quality and promoting evapotranspiration. The use of turf grass is discouraged due to soil compaction from the required frequent mowing and maintenance requirements.

- **Wet pond/retention basins** are stormwater basins that include a substantial permanent pool for water quality treatment and additional capacity above the permanent pool for temporary runoff storage. Wet ponds require an adequate source of inflow to maintain the permanent water surface. They can provide aesthetic and wildlife benefits.

- **Rain garden/bioretention beds** are excavated shallow surface depressions planted with specially selected native vegetation to treat and capture runoff. They can be planted next to roads and highways, parking lots, buildings, sidewalks, etc.

- **Vegetated swales** are broad, shallow channels densely planted with a variety of trees, shrubs, and/or grasses. They are designed to attenuate and in some cases infiltrate runoff volume from adjacent impervious surfaces, allowing some pollutants to settle out in the process.

- **Green parking lots** typically have a stone subsurface infiltration bed in conjunction with porous pavements or stormwater inlets and catch basins redirected into the stone bed. Tree trenches or bioretention can be integrated with the design to increase tree canopy, promoting evapotranspiration.

- **Vegetated roof cover** is a veneer of vegetation grown on and covering an otherwise conventional flat or pitched roof, giving the roof hydrologic characteristics that more closely match surface vegetation; reducing the amount of stormwater that needs to be treated by municipal water treatment and filter pollutants from rainfall.

- **Runoff capture and reuse** encompasses a wide variety of water storage techniques designed to capture precipitation, hold it for a period of time, and reuse the water later. These storage devices include cisterns, rain barrels, vertical storage, etc.

- **Downspout disconnection** is the process of separating roof downspouts from the sewer system and redirecting water onto pervious surfaces, into rain gardens or rain barrels.

- **Enhanced street tree plantings.** Tree trenches perform the same functions that other infiltration practices perform (infiltration, storage, evapotranspiration, etc.) but in addition provide an increased tree canopy.

Common Stormwater BMPs:

- Rain gardens
- Pervious pavement
- Enhance riparian areas
- Vegetated swales
- Naturalized infiltration basin
- Floodplain and wetland restoration
- Reforestation
- Extensive green roof
- Warm season meadows
- Runoff capture and reuse

Costs/ Maintenance of Green Infrastructure

Green infrastructure techniques are not maintenance free, whether related to vegetation or operational maintenance/repair (for example vacuuming pervious pavement biannually). Costs for green infrastructure vary widely depending on specific site conditions and the type of technique being used. Often the cost of green infrastructure projects is competitive with or less than comparable gray infrastructure projects and the environmental and public health benefits of green infrastructure add to the equation.

Create and Enhance Riparian Buffers

Riparian buffers and riparian forest buffers are areas of vegetation alongside streams and other bodies of water that mitigate floods, recharge groundwater, prevent erosion and sedimentation of the stream, trap pollutants within plant roots, improve aquatic and terrestrial species habitat, and provide optimum food for stream communities. In these locations native vegetation (ideally a variety of native trees, shrubs,

grasses and wildflowers) provides wildlife habitat, bank stabilization, and water quality benefits.[1] Although smaller buffers will still provide some benefits, to provide the maximum benefits a buffer should be a minimum of 100 feet on each side of a perennial or intermittent stream, river, lake, pond, and reservoir. For those bodies of water designated as Exceptional Value or High Quality waters the minimum width should extend to 150 feet.[4] Below is a list of tips for managing buffers:[3]

- Provide some public access to the water.
- Avoid work in streams, wetlands or waterways whenever possible.
- Don't alter a stream bank or shoreline unless you're returning it to a natural state (banks should normally be sloping and covered with vegetation).
- Soil disturbance should not take place within the buffer by grading, stripping of topsoil, plowing, cultivating, or other practices.
- Motorized vehicles should not be stored or operated within the riparian forest buffer.
- Remove/manage invasive non-native species to keep them from spreading.
- Improve riparian buffers by planting native trees, shrubs and ground covers that are tolerant of wet or seasonally flooded sites.
- Avoid or minimize the use of pesticides and fertilizers near water-bodies.

Protect Wetlands and Critical Recharge Areas

Natural wetland functions include water quality improvement, floodwater storage, fish and wildlife habitat, aesthetics, and biological productivity. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface-water runoff from pavement and buildings. They also recharge groundwater and trap sediment, fertilizers, and pollutants. Construction and other forms of disturbance should be avoided in and near wetlands. A vegetated buffer should be maintained around wetlands wherever possible. Man-made wetlands cannot duplicate all the functions of a natural wetland, so it is critical that natural wetlands be protected whenever possible.[1]

Critical recharge areas are typically large contiguous areas of land that allow precipitation and other surface waters to infiltrate through the soil to recharge the groundwater. Without constant recharge, periods of drought could leave streams and wells dry, thus affecting available drinking water and wildlife habitat.[1] It is important to protect the natural drainage patterns of the land and minimize site disturbance during development.

References:

1. DCNR. Creating Sustainable Community Parks. A Guide to Improving Quality of Life by Protecting Natural Resources. http://www.dcnr.state.pa.us/brc/publications/

2. The Stormwater Manager's Resource Center. http://www.stormwatercenter.net/

3. U.S. Environmental Protection Agency. Mid-Atlantic Region Green Landscaping- Stormwater Control and Managing Natural Areas. http://www.epa.gov/reg3esd1/garden/

4. Department of Environmental Protection. Bureau of Watershed Management. Riparian Forest Buffer Guidance. http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf

5. PA Department of Environmental Protection, Pennsylvania Stormwater Best Management Practices Manual, Chapter 6- Structural BMPs. http://www.elibrary.dep.state.pa.us/dsweb/Get/Version-48477/07_Chapter_6.pdf

Additional Resources:

Dauphin County Conservation District. Stormwater Best Management Practices Tour. http://www.dauphincd.org/swm/bmptour.html

EPA. Functions and Values of Wetlands. http://www.epa.gov/owow/wetlands/pdf/fun_val.pdf\

Pennsylvania Department of Environmental Protection. PA Stormwater Best Management Practices (BMP) Manual - (363-0300-002) http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

Pennsylvania Department of Environmental Protection. The Wellhead Protection Program In Pennsylvania: An Overview. http://www.dep.state.pa.us/dep/subject/advcoun/ag/Whppover.doc

Shermans Creek Conservation Association. Up The Creek Newsletter. Riparian Buffers? What are Riparian Buffers? http://www.shermanscreek.org/2007JanNewsletter.pdf

U.S. Environmental Protection Agency. Watersheds. "After the Storm". http://www.epa.gov/weatherchannel/stormwater.html

U.S. Environmental Protection Agency. Storm Water Technology Fact Sheet- Porous Pavement. http://www.cleanwatermn.org/Documents/MS4%20toolkit%20files/Good%20Housekeeping/Porous%20Pavement/porouspa.pdf