City of Ocean City

Cape May County

Post-Sandy Planning Assistance Grant

Development of Codes, Ordinances, Standards and Regulations

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The original of this document has been signed and sealed as required by NJS 45:14A-12.

Table of Contents

City of Ocean City
Development of Codes, Ordinances, Standards and Regulations

Introduction.

Effective management of stormwater and use of green infrastructure can reduce the impacts from flooding and improve resiliency from future storm events. Ocean City has adopted numerous ordinances and regulations to improve resilience and reduce the impacts from coastal storms and flooding. These include revision to the City's Flood Damage Prevention ordinance and Zoning code affecting grading, freeboard, repetitive loss and bulkheads to implement policies directly related to community plans for Post-Sandy redevelopment.

This report has been prepared in response to recommendations contained in the Ocean City Strategic Recovery Planning Report (October 7, 2015). Preparation of this "Development of Codes, Ordinances, Standards and Regulations" document has been made possible with funding provided by a Post-Sandy Planning Assistance Grant (COSR-2016-0508-684) administered by the New Jersey Department of Community Affairs.

The "Strategic Recovery Planning Report" recommends an update to the City's *stormwater management regulations*, and incorporation of *green infrastructure strategies* into the zoning code that will encourage renewable energy, green roofs, permeable pavement, reduction of impervious surfaces, rain gardens and other strategies. Recommended revisions to the City's stormwater regulations can be found in Appendix A. Appendix B describes green infrastructure strategies that may be incorporated into the City Code.

Stormwater Management.

Land development can dramatically alter the hydrologic cycle of a site and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or draw that portion that has infiltrated into the ground and return it to the atmosphere through evapotranspiration. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates. Clearing and grading a site can remove depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site. Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than natural areas.

This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the channel. Filtration of runoff and removal of pollutants by surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into a stream.

Increases in impervious area can also decrease opportunities for infiltration, which in turn, reduces stream base flow and groundwater recharge. Reduced base flows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced base flows can also negatively impact the hydrology of adjacent wetlands and the health of biological communities that depend on base flows. Finally, erosion and sedimentation can destroy habitat from which some species cannot adapt.

Master Plan

Ocean City's 1988 Master Plan addresses drainage and flood control in the context of the *Community Facilities and Services Plan Element*. Although brief, this section of the Master Plan recognizes the importance of wetlands and beaches and their ability to reduce wave action and flooding. The Master Plan discusses FEMA's Flood Insurance Rate Maps and the need to control development to reduce damage from flooding. The continued preservation of the beach and wetlands is also recommended in the Master Plan Conservation Plan Element.

Ocean City's Master Plan contains the following stormwater management goal:

> "To encourage the efficient management of stormwater runoff through the development of appropriate guidelines which will prevent future drainage problems and provide environmentally sound land use planning and to reduce water pollution and tidewater infiltration through capital improvements."

Stormwater Management Plan

Ocean City's Stormwater Management Plan (SWMP) documents the strategy for the City of Ocean City to address stormwater-related impacts. N.J.A.C. 7:14A-25 Municipal Stormwater Regulations require the creation of this plan. This plan contains all of the required elements described in N.J.A.C. 7:8 Stormwater Management Rules. The plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major development, defined as projects that disturb one or more acre of land. These standards are intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and the loss of groundwater recharge that provides base flow in receiving water bodies. The plan describes long-term operation and maintenance measures for existing and future stormwater facilities.

The final component of this plan is a mitigation strategy for when a variance or exemption of the design and performance standards is sought. As part of the mitigation section of the stormwater plan, stormwater management measures are identified to lessen the impact of existing development.

The goals of Ocean City's SWMP are to:

- reduce flood damage, including damage to life and property;
- minimize, to the extent practical, any increase in stormwater runoff from any new development;
- reduce soil erosion from any development or construction project;
- assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
- maintain groundwater recharge;
- prevent, to the greatest extent feasible, an increase in nonpoint pollution;
- maintain the integrity of stream channels for their biological functions, as well as for drainage;
- minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, and other uses of water; and
- protect public safety through the proper design and operation of stormwater basins.

To achieve these goals, the SWMP outlines specific stormwater design and performance standards for new development. Additionally, the plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the plan to ensure long-term effectiveness of stormwater management facilities. The plan also outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

Flood Damage Prevention

Ocean City adopted a Flood Damage Prevention Ordinance in 1985. This Ordinance is intended to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas.

The Flood Damage Prevention Ordinance (FDPO) identifies the Construction Official as the NFIP Floodplain Administrator. The floodplain administrator, assisted by four certified floodplain managers, assumes responsibilities for floodplain administration including, Permit review, inspections, damage assessments, record-keeping, GIS, education and outreach.

Ocean City is reviewing revisions to the FDPO that will address the New Jersey Department of Environmental Protection's model ordinance and continue the City's participation in the National Flood Insurance Program. The revised ordinance meets and/or exceeds the minimum requirements accepted by FEMA and the State of New Jersey.

Compliance Review

The City of Ocean City, through the Soil Erosion Control Act, CHP.251 PL1975, reviews development applications and regulates stormwater management. RSIS standards are implemented. The City has a stormwater management ordinance in effect. Developing properties must submit a stormwater plan that is reviewed by the Board Engineer and other jurisdictional agencies.

This activity has been effective in ensuring development that provides stormwater improvements that enhance the control of stormwater discharges. This activity shall remain as an activity in the plan. The Planning Board and Zoning Board shall be responsible for compliance with all regulations during the application review and approval process. No funding is required as the reviews are funded by application fees and escrow accounts.

Drainage System Maintenance

The City's Public Works Department maintains storm drains annually and as may be required to address emergent problems. Additionally, the City advises the public of regulations that prohibit dumping into storm drains. Construction sites are also regulated by State regulations administered by Cape Atlantic Soil District. All storm drains were marked with tags to make the public aware of the prohibition against dumping debris into the drains. Storm drains are cleaned more often than twice a year, when needed. A log is kept and an annual report is filed (MS4 Tier A Permit Annual Report) to document the storm drainage system maintenance activities. Certificates of Occupancy cannot be obtained without compliance.

The City's Floodplain Management Plan recognizes the value of drainage system maintenance to the overall effectiveness of managing the damaging affects for stormwater.

Regulation of Stormwater

Ocean City's stormwater management regulations are codified in Section 25-1700.32 of the City Code. These design and performance standards for stormwater management are intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies. These standards are applicable to all major development. Major development is defined as any development that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more. The design and performance standards address maintenance of stormwater management measures consistent with the stormwater management rules at for safety.

Proposed revisions to the City's Stormwater Management Ordinance are described in Appendix A. Adoption of the revised stormwater management ordinance will provide an important update to these regulations and address concerns with the code identified by the City Engineer. In an indirect manner, the revised stormwater regulations will effectuate recommendations contained in the Floodplain Management Plan which recognize the importance of effective stormwater management to the City's on-going efforts to build resilience and minimize damages and losses associated from flooding.

Green Infrastructure Strategies

Green infrastructure (GI) refers to methods of stormwater management that reduce wet weather/stormwater volume, flow, or changes the characteristics of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing the stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse. Green infrastructure practices include, but are not limited to, pervious paving, bioretention basins, vegetated swales, and cisterns. The use of green infrastructure encourages the idea that stormwater is a resource that can be reused, instead of being treated as a nuisance that needs to be removed as quickly as possible.

As communities continue to recover from Superstorm Sandy and plan for future storms, strong efforts are being made to implement several resiliency practices to help handle the effects of similar future events. Green infrastructure is an important practice that can promote sound stormwater management and reduce the impacts of future storm events.

Green infrastructure plays an important role in preparation for and recovery from natural disasters. Climate change scenarios project that precipitation and temperature extremes, storm frequency and intensity, and sea-level rise will accelerate in the coming century. By incorporating green infrastructure into post-disaster recovery, communities can become more resilient to future disasters.

At the regional scale, green infrastructure is a network of natural areas and open spaces that provide multiple benefits for people and wildlife, such as regional parks and nature preserves, river corridors and greenways, and wetlands (Benedict and McMahon 2006). At the neighborhood and site scales, the U.S. Environmental Protection Agency (EPA) refers to green infrastructure as stormwater management practices that mimic natural processes by absorbing water, such as green streets, green roofs, rain gardens, and pervious pavement. Trees are a type of green infrastructure that spans these scales, from regional woodlands to the urban forest to street and other tree plantings.

Many states and local governments have adopted green infrastructure policies such as green streets or rainwater harvesting codes. Although no comprehensive catalogue of these policies exists, case studies illustrate policy commitments to use green infrastructure in demonstration projects, street retrofits, and other local capital projects. In addition, since communities regulate the green treatment of stormwater (either requiring or at least allowing it) they often have policies for both stormwater fees and incentives. Finally, many policies address education and outreach.

Adopting a variety of green infrastructure policies may be an effective approach in communities where there is political support and general acceptance of the benefits of green infrastructure. By using green infrastructure, planners hope to encourage a greater percentage of stormwater to infiltrate into soils or be taken up by plants.

Green infrastructure planning is important because it:

1. Supports working lands (farms and forest) and the landscapes for tourism
2. Prioritizes limited financial resources wisely
3. Helps a community or region visualize its future
4. Provides more information to decision makers to improve outcomes
5. May help with compliance with regulatory review and requirements
6. Provides predictability and a level playing field for both developers and conservationists
7. Supports ecosystem services that provide benefits to communities without additional financial investment
8. Makes communities more disaster resistant by using the landscape to protect communities from flooding and focusing development in appropriate areas
9. Supports biodiversity and facilitates ecotourism
10. Supports a high quality of life, attracting businesses and retirees.

This "Green Infrastructure Strategies" section of this report has been prepared in accord with recommendations contained in the Ocean City Strategic Recovery Planning Report (October 7, 2015), and has been made possible with funding provided by a Post-Sandy Planning Assistance Grant administered by the New Jersey Department of Community Affairs (Grant Agreement Number COSR-2016-0508-684).

The City of Ocean City has implemented green infrastructure strategies in a number of projects, and continues to explore additional opportunities to utilize these strategies where appropriate. This report provides an evaluation and recommendations in Appendix B for green infrastructure policies and strategies that would be most effective in Ocean City.

Key Points

For the purposes of the [Hurricane Sandy] Rebuilding Strategy[1], green infrastructure is defined as the integration of natural systems and processes, or engineered systems that mimic natural systems and processes, into investments in resilient infrastructure. Green infrastructure takes advantage of the services and natural defenses provided by land and water systems such as wetlands, natural areas, vegetated sand dunes, and forests, while contributing to the health and quality of America's communities.

KEY POINT #1: Green infrastructure reduces damage from storm surge and flooding and plays a role in other types of disasters.

Damage from flooding in inland areas, and from storm surge and flooding in coastal environments, is significantly reduced when natural wetland, riparian, and floodplain areas and the ecosystem services they provide are protected. Buildings, roads, and other supporting infrastructure are particularly vulnerable to storm damage when constructed in these areas, and loss of natural functions such as flood storage capacity can increase damage to development on adjacent, less sensitive lands. Thus a particularly effective use of green infrastructure to reduce damage from natural disasters is to conserve environmentally sensitive areas through strategies such as acquisition of land or easements, natural resource protection ordinances, and other regulatory controls and incentives.

In many urban areas, natural resources such as streams, floodplains, and wetlands have been replaced by development and natural hydrological processes have been disrupted by fill and impervious surfaces. The conventional stormwater management approach in such areas has been to collect the high volumes of runoff generated during storms and convey them via pipes to nearby waterways. This approach can exacerbate flooding from major storms and degrade water quality, for example from combined sewer overflow (CSO) in older cities with connected storm and sanitary sewer systems. Green infrastructure is an alternative approach that retains stormwater near where it is generated through infiltration (rain gardens, stormwater planters, pervious surfaces, etc.) and evapotranspiration from trees and other vegetation. While green stormwater infrastructure is most commonly used at the site scale to manage runoff from smaller storms, when deployed at a watershed scale it can reduce flooding from larger disasters such as the benchmark 100-year storm (Medina, Monfilis, and Baccala 2011).

[1] Hurricane Sandy Rebuilding Task Force 2013

Green infrastructure — and how it is managed — plays a role in other types of natural disasters. For example, intense urban heat waves such as those experienced by Chicago (approximately 700 fatalities in 1995) and Europe (more than 70,000 fatalities during the summer of 2003) will likely become more common in the future as a result of climate change and the global trend of increasing urbanization. Green infrastructure such as trees, parks, and green roofs can ameliorate the so-called urban heat island effect.

KEY POINT #2: Resilience to natural disasters is one of multiple benefits provided by green infrastructure.

Green infrastructure can mitigate the direct effects of natural disasters through services such as reducing stormwater runoff, buffering against storm surge in coastal environments, and reducing surface temperatures during heat waves, while also providing a broad array of other community benefits. Often framed in terms of the triple bottom line of environmental, economic, and social return on investment, these additional benefits include:

Environmental

- Improved air and water quality
- Natural habitat preservation
- Climate change mitigation (from reduced fossil fuel emissions, reduced energy consumption, and carbon sequestration)

Economic

- Creation of job and business opportunities
- Increased tourism, retail sales, and other economic activity
- Increased property values
- Reduced energy, health care, and gray infrastructure costs
- Provision of locally produced resources (food, fiber, and water)

Social

- Promotion of healthy lifestyles through walking,
- Improved public health outcomes (e.g., by connecting people to nature)
- Increased environmental justice, equity, and access for underserved populations

- Enhanced community identity through public art, culture, and places for people to gather

While many of the above benefits do not directly relate to post-disaster recovery, they can contribute to increased community resilience and, in doing so, reduce vulnerability to natural disasters. A park designed to accommodate flooding during storms while providing benefits such as recreation, social interaction, and increased commerce is an example of using green infrastructure to leverage multiple benefits beyond mitigating the direct impacts of a disaster.

KEY POINT #3: Particularly in urban contexts, green infrastructure must be combined with gray infrastructure to effectively reduce damage from natural disasters.

According to a recent study by the Natural Capital Project and the Nature Conservancy, 16 percent of the U.S. coastline, inhabited by 1.3 million people and representing $300 billion in residential property value, is located in high-hazard areas (Arkema et al. 2013). Sixty-seven percent of these areas are protected by natural green infrastructure (intact reefs, sand dunes, marshes, and other coastal vegetation), and the number of people and total property value exposed to hazards would double if this habitat were lost. These findings underscore the effectiveness of preserving and restoring natural habitat areas, as well as mimicking the services provided by such areas through "nature-based" approaches (e.g., artificial oyster reefs and living shorelines), to increase resilience to natural disasters. However, in many populated areas at risk from flooding, natural ecosystems have been extensively altered or replaced by development. Moreover, barrier beaches, dunes, riverine floodplains and the like are dynamic systems that move in response to natural processes such as erosion and sea-level rise, with implications for adjacent developed properties. Green infrastructure can reduce damage but may be insufficient to protect against catastrophic events such as the storm surge experienced during Hurricane Sandy.

Traditional structural protection measures (often referred to as gray infrastructure) include, among others, seawalls, bulkheads, breakwaters, and jetties to protect against erosion and storm surge in coastal areas. Such measures can be effectively deployed to protect urban and other areas with extensive investment in buildings and infrastructure. Considerations regarding the use of gray infrastructure include cost relative to benefits provided (it is typically more expensive than green infrastructure), unintended consequences caused by interruption to natural processes, and the possibility of inadequate protection or even failure during catastrophic events (e.g., levee failure in New Orleans during Hurricane Katrina). Examples of unintended consequences include barriers that displace flooding from one area to another or groins (coastal erosion structures typically constructed perpendicular to the shoreline to trap sand) that cause beach erosion along the "downdrift" shoreline.

Integrated approaches to planning for future disasters combine green and gray infrastructure strategies. For example, a study of Howard Beach, a neighborhood in Queens that was flooded by Hurricane Sandy, concluded that a combination of natural and structural defenses would provide the most cost-effective protection against future storms (Nature Conservancy 2013). These "hybrid" strategies include restored marsh, mussel beds, rock groins, removable flood walls, and flood gates. At a larger scale, *A Stronger, More Resilient New York*[2] combines nature-based (e.g., beach, dune, and marsh restoration) and structural (e.g., floodwalls and storm surge barriers) measures to protect against the effects of climate change.

Louisiana's Coastal Protection Master Plan[3] proposes a combination of restoration, nonstructural, and targeted structural measures to provide increased flood protection for all communities. The plan proposes nine project types, ranging from marsh creation, barrier island restoration, and oyster barrier reefs to bank stabilization and structural protection (levees, flood walls, and pumps).

<u>KEY POINT #4</u>: Green infrastructure resources can suffer severe damage from disasters, which in the absence of preplanning can be exacerbated in short-term recovery response.

Dunes, marshes, and wetlands are adapted to withstand storm damage if natural processes such as overwash (the landward transport of beach sediments across a dune system) are retained. Other types of coastal vegetation can sustain significant damage from saltwater flooding, storm surge, and high winds.

While the effects of a severe storm can be devastating, the long-term recovery phase provides the opportunity to "regrow" forms of green infrastructure that provide enhanced community benefits while being more resilient to future disasters.

[2] New York, City of. 2013. *A Stronger, More Resilient New York*. Available at http://www.nyc.gov/html/sirr/html/report/report.shtml.

[3] Louisiana, State of. 2012. *Louisiana's Comprehensive Master Plan for A Sustainable Coast*. Coastal Protection Master Plan available at http://coastal.la.gov/a-common-vision/2012-coastal-master-plan.

Green Infrastructure Practices

Water Resource Projects

At the municipal scale, gray infrastructure for water resources and stormwater management has been largely focused on replacing natural systems for dealing with flood events. The man-made engineering approach is frequently expensive, adversely affects the environment, and has at times failed to correct the problem of flooding. Increasingly, municipal sewer districts and flood control authorities are using green infrastructure planning to identify undeveloped lands that could provide significant flood prevention benefits if acquired and conserved.

Responding to Climate Change

For this century the central challenge to the conservation community and planners is how to address the impacts of climate change. Many conservation models and planning efforts are snapshots in time, using existing information on the presence or absence of species or habitat types. Global climate change will force green infrastructure methods and models to become dynamic, taking into account both current environmental conditions as well as forecasting what the landscape could look like in 70 to 100 years.

Watershed Planning

Traditional, or gray infrastructure, generally focuses on collecting rainwater and sending it downstream to ultimately be discharged into a waterway. Green infrastructure (GI), on the other hand, mimics natural processes utilizing soils and vegetation to manage rainwater where it falls.

GI can be applied on different scales. For instance, on a regional scale, GI can focus on an interconnected network of waterways, wetlands and forested areas. In this way, municipalities can incorporate stormwater management goals into their open space plans and greenways plan. Information on the Garden State Greenways program is available at http://www.gardenstategreenways.org/.

Municipalities can also incorporate GI on a neighborhood scale. Tree plantings and downspout disconnection can be utilized in areas where there is an existing flooding problem. GI can also be used in downtown areas, green street planning can help promote walkability while at the same time managing stormwater. Schools and community groups can also incorporate GI strategies such tree planting and community gardens the neighborhood scale. These practices can go a long way to creating a neighborhood.

GI can also be applied on a site-specific scale. Business owners can retrofit parking lots with pervious pavement and larger bioretention systems that can be placed in the islands. Some businesses may be able to collect rainwater in a cistern for non-potable uses. Many school campuses are large enough to incorporate rain gardens and tree plantings, as well as installing pervious pavement on parking lots and basketball/tennis courts. Homeowners can also incorporate GI into their existing landscape. GI strategies, like rain gardens and rain barrels, are easily implemented into yards.

Low Impact Development (also known as non-structural strategies) is the concept of designing a site to reduce the impacts. Design techniques include:

- preserving stream buffer areas
- minimizing the number of trees cut down during construction
- minimizing the areas on site where heavy equipment is used
- using the soils and vegetation that are beneficial on site, and
- using GI practices that treat stormwater runoff through soil and vegetation

Green Infrastructure Design and Prototypes

This section describes green infrastructure designs that have been tested and may be appropriate for wider application in Ocean City.

Green infrastructure practices to be incorporated into site design should be selected based on an evaluation of individual site characteristics and needs. Informational fact sheets on common GI practices, including rain gardens/bioretention basins, grass swales, constructed gravel wetlands, and rain barrels are generally considered as part of development design, but most GI practices can also be used as a retrofit option once a site has already been developed depending on the site conditions. Finally, despite the name, "green" infrastructure doesn't have to be vegetated; GI can include designs incorporating pervious pavement and sand filters that use the soils to reduce runoff and treat pollutants, and rain barrels and cisterns that store rainwater for later reuse.

GI manages stormwater in two ways: by reducing the volume of runoff and by treating runoff. GI strategies reduce runoff volume by allowing rainfall to infiltrate into the soil where it can be used by plants or where it can recharge aquifers and stream base flow.

Another way to reduce volume is to capture the rainfall in man-made structures like rain barrels or cisterns where it is stored until it can be reused; however, the use of this stored water is limited to non-potable uses, such as irrigation.

Bioretention Curb Extensions and Sidewalk Planters.

Bioretention is a versatile green street strategy. Bioretention features can be tree boxes taking runoff from the street, indistinguishable from conventional tree boxes. Bioretention features can also be attractive attention grabbing planter boxes or curb extensions. Many natural processes occur within bioretention cells: infiltration and storage reduces runoff volumes and attenuates peak flows; biological and chemical reactions occur in the mulch, soil matrix, and root zone; and stormwater is filtered through vegetation and soil.

Ocean City constructed a bioretention curb extension at the intersection of North Street and West Avenue. This bioretention area takes runoff from the street and the sidewalk through curb cuts and has demonstrated the practical application of this GI and enhanced the appearance of this intersection. This practice may be used in other areas subject to an evaluation of the impact on parking, grade elevation and right-of-way width.

Complete Streets/ Green Streets.

'Complete streets' are those designed to balance the needs of pedestrians, bicyclists, motorists, transit vehicles, emergency responders, and goods movement. The specific design depends on the context of the location, but safety is always a priority. New Jersey is a national leader in complete streets policies, with the most policies of any state. The New Jersey Department of Transportation was among the first to adopt an internal complete streets policy.

Recognizing the value of complete streets, Ocean City adopted a resolution endorsing complete streets policies in October 2011. The City also received the State of New Jersey's "Complete Streets Excellence Award," and was commended "for instituting an all-encompassing program to provide a "safe, multi-modal transportation system that is accessible to all."

In conjunction with complete streets considerations, street design and infrastructure improvements in Ocean City incorporate features to increase the infiltration of storm water. Impervious surfaces are reduced where possible, and permeable landscaped areas are provided where appropriate.

Green streets are a component of complete streets and are beneficial for new road construction and retrofits. They can provide substantial economic benefits when used in transportation applications. Coordinating green infrastructure installation with broader transportation improvements can significantly reduce the marginal cost of stormwater management by including it within larger infrastructure improvements. Also, and not unimportantly, right-of-way installations allow for easy public maintenance. A large municipal concern regarding green infrastructure use is maintenance; using roads and right-of-ways as locations for green infrastructure not only addresses a significant pollutant source, but also alleviates access and maintenance concerns by using public space.

Green streets can incorporate a wide variety of design elements including street trees, permeable pavements, bioretention, and swales. Although the design and appearance of green streets will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, restore predevelopment hydrology to the extent possible, and provide environmentally enhanced roads. Successful application of green techniques will encourage soil and vegetation contact and infiltration and retention of stormwater.

Subsequent to further review, the City may conclude that amendment to the Complete Streets program to include green streets may be appropriate. The “Green Streets” and “Green Alleys” programs from Portland, Oregon and Chicago respectively may be considered to provide guidance for advancing green infrastructure in Ocean City. Portland’s green streets program demonstrates how common road and right-of-way elements (e.g., traffic calming curb extensions, tree boxes) can be modified and optimized to provide stormwater management in addition to other benefits. Where Portland used vegetation, Chicago’s Green Alley Program similarly demonstrates that hardscape elements can be an integral part of a greening program. By incorporating permeable pavements that simulate natural infiltration, Chicago enhances the necessary transportation function of alleys while enhancing infrastructure and environmental management.

Additional guidance regarding green streets is available from a number of sources including the "Green Streets Manual"[4] which subject to appropriate revisions may be adopted by the City to assist in advancing future green infrastructure projects.

Pervious Pavement

Pervious pavement systems are a component of green streets that allow rainwater to infiltrate into underlying soils. There are three types of pervious pavement systems: pervious concrete, porous asphalt and interlocking concrete pavers.

Rain that falls on these systems enters an underground storage bed through either pores in the paved surface, as in porous asphalt or pervious concrete, or through gaps between pavers, as in interlocking concrete pavers. Water is held temporarily in the storage area while it slowly percolates into the soil beneath the pervious paving system. Because rainwater is able to flow through this type of pavement, the runoff is treated for pollutants as it passes through the soils; from there it is available to replenish groundwater. In addition, the soils below pervious pavement tend to be wetter than soils underneath traditional pavement. The water in the soil traps heat, so pervious pavement does not freeze as quickly as standard pavement; this can reduce the amount of salt needed for de-icing in the winter.

Because pervious pavement relies on the underlying soils to treat pollutants and to recharge groundwater, these soils must be sandy enough to allow the rainwater to flow through it. Also, because these types of systems ultimately do flow into the groundwater, they should not be used where chemicals that could contaminate groundwater supplies are present. Soils and depth to groundwater will limit the use of this permeable paving in Ocean City.

Many communities have implemented prototypes so that they can prove the benefits of a particular green infrastructure method before allowing, requiring, or funding it throughout a community. Green infrastructure demonstration projects at many locations in Ocean City have provided valuable insight into the benefits, challenges and potential future uses of GI in the City. The primary impetus behind the projects completed to date is to reduce flooding by increasing the infiltration of stormwater from rain events.

[4] http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/watershed_management/san_gabriel/lower_sangabriel/green_st/green_st_manual.pdf

Rainwater Harvesting.

Rainwater harvesting systems come in all shapes and sizes. Cisterns and rain barrels capture rainwater, mainly from rooftops. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses.

In practice, stormwater flows into the rain garden or basin where it is temporarily stored. The plants in the rain garden take up some of this rainwater, and the rest infiltrates the soil. Rain gardens are generally planted with more deeply rooted grasses and flowers than a traditional lawn, so water is able to drain more deeply into the soil, maximizing infiltration and groundwater recharge. Also, because runoff is collected in the rain garden instead of flowing directly into a storm drain, it has a chance to interact with the plants and soil, where pollutants can be broken down and filtered.

Cisterns and rain barrels are often paired with other green infrastructure practices to increase their storage capacity or efficiency. Most commonly, cistern or rain barrel systems are paired with a vegetative system (e.g., rain garden, bioswale, stormwater planter) to capture the overflow from the system when it has reached its full capacity.

These systems are good for harvesting rainwater in the spring, summer, and fall but must be winterized during the colder months. Cisterns are winterized, and then their water source is redirected from the cistern back to the original discharge area.

The Ocean City Environmental Commission conducted a Rain Barrel Workshop Wednesday, June 28, 2017 to acquaint the public with the potential benefits and use of rain barrels to reduce stormwater flows.

Permeable Paving.

Ocean City has utilized permeable paving in City-owned parking lots and road construction. Factors limiting the use of permeable paving include street grade and right-of-way width, on-street parking, traffic volumes, soil conditions and depth to groundwater. Projects utilizing permeable paving are helping the City build experience and a market for this green streets technology.

The City will also continue to encourage green infrastructure on private property including reduction of impervious surfaces, and rain harvesting via rain barrels and rain gardens.

Green Roofs

Green roofs are roofing surfaces that are partly or completely covered with vegetation. Green roofs provide stormwater management by slowing down rainfall and by allowing a portion of the precipitation to be returned to the atmosphere through evapotranspiration.

Precipitation that falls on the green roof is either taken up by the plants, which return it to the atmosphere, or slowly drain through to the planting media into the storage bed and drainage system below. Some of the water that passes through the planting or growing media remains in the soil. The portion that makes it to the storage slowly drains off the roof through a structure. Green roofs have been shown to hold a significant amount of the rainfall that reaches their surface in the summer, but the amount of rainfall which can be taken up by the plants are reduced in the winter. Green roofs decrease stress on storm sewer systems by retaining and delaying the release of stormwater. Non-stormwater related benefits of green roofs include insulation and shading of the building, mitigation of the "urban heat island" effect - a phenomenon that causes cities to be a few degrees warmer than surrounding areas, and reduced air pollution and greenhouse gas emissions.

The major components of a green roof are a waterproof membrane, root barrier, drainage system, planting media and vegetation. An extensive green roof is lightweight, includes shallow-rooted drought-resistant plants, typically Sedum species, and requires minimal maintenance. An intensive green roof has a thicker layer of growing medium, so it can contain a variety of vegetation, including grasses, ornamentals, flowers and small trees. This type of green roof requires a greater weight bearing capacity and more frequent maintenance. Extensive roofs are the more typical for stormwater management purposes.

Prior to implementation, rooftops must be evaluated for suitability in terms of roof load and accessibility for maintenance in advance of installation. Other factors to take into account are the height and the pitch of the roof, as well as construction and maintenance budgets. The best time to install a green roof is either during building construction or when a roof requires replacement.

The City may consider additional review and evaluation of green roofs to mitigate stormwater runoff and the "urban heat island" effect. Amendments to the land development and zoning code including the development of design standard may be required.

Stormwater Management

Managing stormwater with green infrastructure has become a high priority in MS4 (municipal separate storm sewer system) communities. The EPA has determined that MS4 systems can be regulated under the Clean Water Act. EPA's Stormwater Phase II Final Rule is "intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation."[5] Due to these Phase II regulations, NJDEP issued MS4 permits to all 565 municipalities in New Jersey. These permits require municipalities to develop, implement, and enforce a stormwater program that "shall be designed to reduce the discharge of pollutants from the municipality's small MS4 to the maximum extent practicable to protect water quality."[6] While these MS4 permits do not specifically require that green infrastructure be used to manage stormwater from uncontrolled sources, green infrastructure would be a cost effective way to reduce stormwater runoff and pollutants entering local waterways.

Even though the regulatory requirements do not specifically require municipalities to retrofit existing development with green infrastructure, there has been a strong need for municipalities to become more resilient to the changing climate. While recent hurricanes, superstorms, and nor'easters have severely impacted many New Jersey residents, localized flooding causes a more regular disruption in the lives of New Jersey residents. By retrofitting existing development with green infrastructure, these localized flooding events can be reduced or eliminated.

Ocean City's SWMP outlines specific stormwater design and performance standards for new development. Additionally, the plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the plan to ensure long-term effectiveness of stormwater management facilities. The plan also outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

[5] United States Environmental Protection Agency (USEPA). 2005. Stormwater Phase II Final Rule, An Overview. EPA833-F-00-001. http:// www3.epa.gov/npdes/pubs/fact1-0.pdf

[6] New Jersey Department of Environmental Protection (NJDEP). 2005. Tier A Municipal Stormwater General Permit (NJ0141852) Major Modification. http://www.nj.gov/dep/dwq/pdf/final_tier_a_permit.pdf

Conclusions and Recommendations

The "Strategic Recovery Planning Report" recommends an update to the City's *stormwater management regulations*, and incorporation of *green infrastructure strategies* into the zoning code that will encourage renewable energy, green roofs, permeable pavement, reduction of impervious surfaces, rain gardens and other strategies. In addition, the City will update its development codes and regulations as necessary to ensure continued compliance with FEMA.

The potential of green infrastructure to reduce damage from natural disasters has risen to the forefront in recent years in the aftermath of catastrophic events such as Hurricanes Katrina and Sandy. Preservation and restoration of marsh, dune, floodplains, and other natural systems; creation of living shorelines, oyster reefs, and other nature-based solutions; and integration of green resources (trees, green streets, green roofs, etc.) into the urban environment can increase community resilience while providing multiple environmental, economic, and social benefits. Planning for post-disaster recovery should use green infrastructure in combination with appropriate structural protection measures to reduce potential risks. The result will be healthier communities that are more resilient to future disasters.

As part of its multi-faceted approach to minimizing the damaging effects of coastal storms and improving the community's resilience, Ocean City currently employs a number of stormwater management and green infrastructure strategies. As described herein, the City has realized the tangible benefits of green streets, porous paving, bio swales, restoration of wetlands, maintenance of stormwater infrastructure, street trees, landscaped islands, and management of the beach and dune system. It is anticipated that Ocean City will benefit from continuation of these practices. The City will continue to explore and evaluate the use of green infrastructure strategies discussed in this report and implement them where feasible.

Appendix A contains revisions to the City's stormwater management ordinance that will improve efficiency and design. The City may recognize additional benefits from the formal acceptance and adoption of green infrastructure policies and strategies. Appendix B contains green infrastructure policies and practices that could improve stormwater management and enhance the City's resilience to future storm events.

Appendix A – Stormwater Ordinance

Revisions to Section 25-1700.32.2 of the City Code are proposed as follows.

25-1700.32.2 Standards.

All storm drainage conveyance ~~pipes~~ shall be either slip joint type reinforced concrete, ductile iron~~ pipe~~, polyvinyl chloride or ~~subject to the restrictions herein, fully coated, invert paved, corrugated metal steel~~ high density polyethylene culvert pipe meeting the requirements of the Standard Specifications.

a. All pipe shall have a wall thickness sufficient to meet the proposed conditions of service; however, no wall thickness less than Class 3 ~~Wall B~~ for concrete pipe~~, ,or No. 14 gauge for corrugated metal steel pipe,~~ class 50 for ductile iron pipe, or SDR 35 for polyvinyl chloride ~~shall be class 50 or better~~ shall be allowed.

b. All pipe shall comply with the requirements of the current New Jersey Department of Transportation Standard Specifications, Standard Construction and Details governing construction.

c. Generally, high density polyethylene ~~concrete pipe or ductile iron~~ pipe will be used except in areas of ~~steep grades insufficient cover~~ or other restrictive physical conditions where ~~corrugated metal~~ reinforced concrete pipe or ductile iron pipe or other types of pipe may be permitted.

   1. No concrete pipe may be laid on grades exceeding eight percent (8%).

   2. ~~Concrete pipe below thirty inches (30") (or equivalent) in size will be jointed using a mortared joint in accordance with the specifications.~~

   3. All ~~Concrete~~ storm drain pipes ~~thirty inches (30") or larger in diameter~~ will be jointed using a preformed bituminous pressure type joint sealer or rubber-ring-type or other equivalent approved joint which will exclude infiltration.

d. All ductile iron pipe shall be cement lined meeting the requirements of the New Jersey Department of Transportation Standard Specifications.

e. ~~All steel pipe shall be fully bituminous coated with paved invert and of a gauge meeting the requirements of the Standard Specifications sufficient for the proposed service.~~ High density Polyethylene pipe shall meet the requirements specified in ASTM F2306.

~~1. Where conditions permit, corrugated aluminum storm drains may be substituted for steel storm drains where the same is otherwise permitted on the basis of an equivalent three (3) edge bearing or crushed strength.~~

~~2. Substitution on an equivalent gauge basis will not be allowed.~~

~~3. No aluminum pipe shall be laid in areas subject to marsh gasses.~~

f. All storm drains shall be tangent between inlets, manholes, or other structures, except that the use of fittings or factory curved pipe may be allowed by the City Engineer when necessary to accommodate existing geometry or utilities.

g. Prior to laying any storm drains, the bottom of all trenches shall be inspected by the City Engineer.

1. Should the Engineer determine that the trench is unsuitable for the placement of the pipe, the developer shall take all necessary action to remove or eliminate any unsuitable conditions at no cost to the City.

2. These may include, but are not limited to, excavation and backfilling with suitable material, placement of bedding material, construction of pipe cradles or such other action necessary to remove all unsuitable conditions.

3. Proposed storm drainage installations which do not conform to the above must be fully detailed and approved as part of the final plat.

4. Installation shall comply with the requirements of the current New Jersey Department of Transportation Standard Specifications, Standard Construction and Details governing construction.

(Ord. #94-16, Appx. A)

25-1700.32.3 Inlets and Manholes.

Inlets and manholes shall be constructed where required in accordance with the requirements of the Standard Specifications and Standard Construction Details.

a. All street inlets shall be New Jersey Department of Transportation Standard Type ~~B~~ A or E. ~~Casting heights on any streets shall be two inches (2") greater than the specified curb face and the gutter shall be properly transitioned approximately ten feet (10') on either side of the inlet.~~

b. All yard inlets shall be Standard Type A or E.

c. Combination drains shall be installed where the character and composition of the earth in the roadbed itself or adjacent terrain renders such installation necessary.

1. These combination drains shall be constructed as follows: The bottom one third (1/3) of the pipe shall be caulked with jute or equivalent material and the pipe shall be laid in a stone bed for a depth equal to one-half (1/2) the diameter of the pipe.

2. The trench shall then be filled in the same manner as described in Section 25-1700.32.2g above.

d. In continuous conduit runs, spacing between structures (inlets or manholes) shall not exceed ~~six hundred~~four hundred feet ~~(600)~~ (400').

e. Structures (inlets or manholes) shall be located so as not to interfere with primary routes of pedestrian travel or any proposed handicapped ramp or similar facility.

f. In general, surface flow length, for flows of four or more cubic feet per second, on paved surfaces shall not exceed seven hundred fifty feet (750'), provided that:

1. Gutter flow widths on local and local collector streets shall not exceed eleven feet (11'), or such narrower width as may be necessary to provide a twelve foot (12') wide clear lane in the center of the roadway.

2. Gutter flow widths on collector streets shall not exceed nine feet (9'), or such narrower width as may be necessary to provide two (2) twelve foot (12') wide clear lanes in the center of the roadway.

3. Gutter flow widths on major collector streets without shoulders shall not exceed five feet (5'), or such narrower width as may be necessary to provide four (4) ten foot (10') wide clear lanes in the center of the roadway.

4. Gutter flow widths on minor and principal arterial streets and major collector streets with shoulders shall be retained within the shoulder areas.

5. Swale gutter flow widths in parking areas shall not exceed twelve feet (12').

6. Gutter flow widths shall provide for the maintenance of two (2) ten foot (10') wide clear lanes in all access and major circulation drives and one twelve foot (12') wide clear lane in all other aisles in all parking areas, except as otherwise provided in Section 25-1700.22.

g. Maximum design capacities which may be used to determine actual inlet location spacing are:

1. Not in Sump Conditions:

Type ~~B~~ A	2 ~~4~~ cubic feet per second
Type E (in paved areas)	4 cubic feet per second
Type E (in yard areas)	1.5 cubic feet per second

2. In Sump Conditions:

To be individually designed

h. Only Type ~~B~~ A and E inlets shall be used in curbed roadways or curbed access or major circulation drives.

i. Generally, sufficient inlets will be placed to eliminate any flow exceeding two (2) cubic feet per second across any intersections.

~~j. Parking areas may be designed to allow ponding in order to decrease intensity of runoff. In such case, ponding will not be allowed in any access or major circulation drive or in any area of heavy pedestrian activity and shall not exceed six inches (6") at any point calculated for the appropriate design storm in accordance with Section 25-1700.33.~~

25-1700.32.12.2 Definitions.

Unless specifically defined below, words or phrases used in this Ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this Ordinance ~~its~~it's most reasonable application. The definitions below are the same as or based on the corresponding definitions in the Stormwater Management Rules at N.J.A.C. 7:8-1.2.

CAFRA Centers, Cores or Nodes shall mean those areas within boundaries accepted by the Department of Environmental Protection pursuant to N.J.A.C. 7:8E-5B.

CAFRA Planning Map shall mean the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

Compaction shall mean the increase in soil bulk density.

Core shall mean a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

County review agency shall mean an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The County review agency may either be:

(1) A County planning agency; or
(2) A County water resource association created under N.J.S.A. 58:16A- 55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances. Department shall mean the New Jersey Department of Environmental Protection.

Designated Center shall mean a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

Design Engineer shall mean a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

Development shall mean the division of a parcel of land into two (2) or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, by any person, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. In the case of development of agricultural lands, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act, N.J.S.A. 4:1C-1 et seq.

Drainage Area shall mean a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Empowerment Neighborhood shall mean a neighborhood designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A 55:19-69.

Environmentally Critical Areas shall mean an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitat of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

Erosion shall mean the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

Impervious Surface shall mean a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

Infiltration shall mean the process by which water seeps into the soil from precipitation.

Major Development shall mean any "development" that provides for ultimately disturbing ~~one (1)~~ one half (1/2) an acre or more of land. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation or increase of impervious coverage of one quarter (1/4) an acre.

Municipality shall mean any city, borough, town, township, or village.

Node shall mean an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

Nutrient shall mean a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

Person shall mean any individual, corporation, company, partnership, firm, association, Ocean City, or political subdivision of this State subject to municipal jurisdiction pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.

Pollutant shall mean any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. "Pollutant" includes both hazardous and nonhazardous pollutants.

Recharge shall mean the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

Sediment shall mean solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

Site shall mean the lot or lots upon which a major development is to occur or has occurred.

Soil shall mean all unconsolidated mineral and organic material of any origin.

State Development and Redevelopment Plan Metropolitan Planning Area (PA1) shall mean an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the State's future redevelopment and revitalization efforts.

State Plan Policy Map shall mean the geographic application of the State Development and Redevelopment Plan's goals and statewide policies, and the official map of these goals and policies.

Stormwater shall mean water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

Stormwater Management Basin shall mean an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

Stormwater Management Measure shall mean any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal nonstormwater discharges into stormwater conveyances.

Stormwater Runoff shall mean water flow on the surface of the ground or in storm sewers, resulting from precipitation.

Tidal Flood Hazard Area shall mean a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

Urban Coordinating Council Empowerment Neighborhood shall mean a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

Urban Enterprise Zone shall mean a zone designated by the New Jersey Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et seq.

Urban Redevelopment Area shall mean previously developed portions of areas:

(1) Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;

(2) Designated as CAFRA Centers, Cores or Nodes;

(3) Designated as Urban Enterprise Zones; and

(4) Designated as Urban Coordinating Council Empowerment Neighborhoods.

Waters of the State shall mean the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

Wetlands or *wetland* shall mean an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

Appendix B – Green Infrastructure

1. Planning and Zoning Definitions

Revise Section 25-107 of the City Code to add the following terms and definitions.

Bioretention - The process of collecting stormwater in a treatment area consisting of soil and plant materials to facilitate infiltration and remove sediment and other contaminants through physical, chemical, and biological processes. Used as the technical term for a rain garden that meets regulatory criteria as a stormwater best management practice.

Green Roof - Green roofs absorb and filter rainwater, provide building insulation, enhance roof lifespan, moderate roof deck temperatures, improve heating and cooling system efficiency, and add amenity value for urban rooftop views and spaces.

Permeable Pavement - Includes several methods and materials, such as blocks, concrete and asphalt, that allow water and air to move through the pavement and into the underlying soil.

Rain Garden - A planted depression or a hole that allows rainwater runoff from impervious urban areas, like roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be absorbed.

Shared Parking - Shared parking may be applied when land uses have different parking demand patterns and are able to use the same parking spaces/areas throughout the day. Land uses often used in specific shared parking arrangements include: office, restaurants, retail, colleges, churches, cinemas, and special event situations. Shared parking is often inherent in mixed-use developments, which include one or more businesses that are complementary, ancillary, or support other activities. General parking lots and/or on-street parking that is available for patrons of nearby businesses/commercial districts is another form of shared parking.

2. Design Standards

Revise **§25-300.12 - Parking Requirements** of the City Code as follows:

- The required number of parking spaces may be reduced by ten (10) percent when the subject site is within one thousand (1,000) feet of a mass transit station
- Shared Parking - The minimum number of parking spaces for a mixed use development or where shared parking strategies are proposed shall be determined by a study prepared by the applicant following the procedures of the Urban Land Institute Shared Parking Report, ITE Shared Parking Guidelines, or other approved procedures. A formal parking study may be waived for small developments where there is established experience with the land use mix and its impact is expected to be minimal. The actual number of parking spaces required shall be based well-recognized sources of parking data such as the ULI or ITE reports. If standard rates are not available or limited, the applicant may collect data at similar sites to establish local parking demand rates. If the shared parking plan assumes use of an existing parking facility, then field surveys shall be conducted to determine actual parking accumulation.

Revise **§25-1700.22 Off-Street Parking - Construction Standards** of the City Code as follows:

- All parking lots with a capacity of forty (40) or more vehicles shall be designed to include pedestrian walkways constructed with pervious paving systems and landscaped dividers
- Upstream parking areas shall have flush curbing
- Permeable pavement shall be permitted for overflow parking

Add the following sections to **Article 1700 Design Standards and Improvement Specifications** of the City Code.

Green Roofs

(1) Applicants seeking approval for development in any industrial or commercial zone shall be encouraged to use green roofs to control stormwater runoff.

(2) Green roofs shall be constructed using soil and plantings which will trap and absorb stormwater and prevent its off-site runoff.

(3) Any Applicant utilizing a green roof shall be entitled to seek a building coverage bonus of five (5) percent of the green roof area to assist in facilitating its construction.
(4) Any building coverage bonus associated with an application before the municipal Planning Board shall be considered permitted and not require relief pursuant to either N.J.S.A. 40:55D-70 or N.J.S.A.40:55D-51.

Rain Harvesting

Rain gardens may be placed where there is sufficient area in the landscape and where soils are suitable for infiltration. Rain gardens can be integrated with traffic calming measures installed along streets, such as medians, islands, circles, street ends, chicanes, and curb extensions. Rain gardens are often used at the terminus of swales in the landscape.

Permeable Pavement

Permeable pavement is a system with the primary purpose of slowing or eliminating direct runoff by absorbing rainfall and allowing it to infiltrate into the soil. Permeable pavement also filters and cleans pollutants such as petroleum deposits on streets, reduces water volumes for existing overtaxed pipe systems, and decreases the cost of offsite or onsite downstream infrastructure. This BMP is impaired by sediment-laden run-on which diminishes its porosity. Care should be taken to avoid flows from landscaped areas reaching permeable pavement. Permeable pavement is, in certain situations, an alternative to standard pavement. Conventional pavement is designed to move stormwater off-site quickly. Permeable pavement, alternatively, accepts the water where it falls, minimizing the need for management facilities downstream.

Location and Placement Guidelines

Conditions where permeable pavement should be encouraged include:

- Sites where there is limited space in the right-of-way for other BMPs;
- Parking or emergency access lanes; and
- Furniture zones of sidewalks especially adjacent to tree wells

Material and Design Guidelines

A soil or geotechnical report should be conducted to provide information about the permeability rate of the soil, load-bearing capacity of the soil, the depth to groundwater

(10 feet or more required), and if soil will exhibit instability as a result of implementation. Infiltration rate and load capacity are key factors in the functionality of this BMP. Permeable pavement generally does not have the same load bearing capacity as conventional pavement, so this BMP may have limited applications depending on the underlying soil strength and pavement use. Permeable pavement should not be used in general traffic lanes due to the possible variety of vehicles weights and heavy volumes of traffic.

When used as a road paving, permeable pavement that carries light traffic loads typically has a thick drain rock base material. Pavers should be concrete as opposed to brick or other light-duty materials.

Other possible permeable paving materials include porous concrete and porous asphalt. These surfaces also have specific base materials that detain infiltrated water and provide structure for the road surface. Base material depths should be specified based on design load and the soils report. Plazas, emergency roads, and other areas of limited vehicular access can also be paved with permeable pavement. Paving materials for these areas may include open cell paver blocks filled with stones or grass and plastic cell systems. Base material specifications may vary depending on the product used, design load, and underlying soils.

When used for pedestrian paths, sidewalks, and shared-use paths, appropriate materials include those listed above as well as rubber pavers and decomposed granite or something similar (washed or pore clogging fine material). Pedestrian paths may also use broken concrete pavers as long as ADA requirements are met. Paths should drain into adjoining landscapes and should be higher than adjoining landscapes to prevent run-on. Pavement used for sidewalks and pedestrian paths should be ADA compliant, especially smooth, and not exceed a 2 percent slope or have gaps wider than 0.25 inches. In general, tripping hazards should be avoided.

Design considerations for permeable pavement include:

- The location, slope and load-bearing capacity of the street, and the infiltration rate of the soil;
- The amount of storage capacity of the base course;
- The traffic volume and load from heavy vehicles;
- The design storm volume calculations and the quality of water; and
- Drain rock, filter fabrics, and other subsurface materials

Bioretention

Bioretention is a stormwater management process that cleans stormwater by mimicking natural soil filtration processes as water flows through a bioretention BMP. It incorporates mulch, soil pores, microbes, and vegetation to reduce and remove sediment and pollutants from stormwater. Bioretention is designed to slow, spread, and, to some extent, infiltrate water. Each component of the bioretention BMP is designed to assist in retaining water, evapotranspiration, and adsorption of pollutants into the soil matrix. As runoff passes through the vegetation and soil, the combined effects of filtration, absorption, adsorption, and biological uptake of plants remove pollutants.

For areas with low permeability or other soil constraints, bioretention can be designed as a flow-through system with a barrier protecting stormwater from native soils. Bioretention areas can be designed with an underdrain system that directs the treated runoff to infiltration areas, cisterns, or the storm drain system, or may treat the water exclusively through surface flow. Examples of bioretention BMPs include swales, planters, and vegetated buffer strips.

Location and Placement Guidelines

Bioretention facilities can be included in the design of all street components; adjacent to the traveled way and in the frontage or furniture sidewalk zones. They can be designed into curb extensions, medians, traffic circles, roundabouts, and any other landscaped area. Depending on the feature, maintenance and access should always be considered in locating the device. Bioretention systems are also appropriate in constrained locations where other stormwater facilities requiring more extensive subsurface materials are not feasible.

If bioretention devices are designed to include infiltration, native soil should have a minimum permeability rate of 0.3 inches per hour and at least 10 feet to the groundwater table. Sites that have more than a 5 percent slope may require other stormwater management approaches or special engineering.

Revise **§25-177.38 Landscaping** by adding the following.

- Removal of any tree located with the public right-of-way requires a permit from the City and shall only be removed by a licensed contractor
- Homeowners shall consult the City Shade Tree Committee prior to pruning any tree within the public right-of-way.
- If conditions upon the subject property at the time of planting will negatively affect the property or the survivability of street trees required by this Ordinance, a payment to the Shade Tree Fund in lieu of the trees may be requested.

Resources

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