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Research Paper

PARKS AS VALUABLE CONTRIBUTORS TO GREEN INFRASTRUCTURE

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Cities are new hubs of innovativeness, productivity, and global economy there are suitable places for people to live. Today developed and developing countries are facing water pollution problems. One of the most major causes of water pollution in urban cities is Stormwater runoff, in most cities this water cannot soak into the soil as it should, it carries bacteria, heavy metals, and other pollutants. Infrastructure of cities plays a vital part in economic development, the infrastructures which we are constructing today will shape tomorrow's cities. The concept of green infrastructure is now embedded in a strategic approach to protect the environment, improve water quality support economic development, encourage redevelopment, and provide recreational facilities and improve residents' quality of life. From this point of view this paper focuses on two key issues; firstly: study and analysis of the parks as valuable contributors to green infrastructure to achieve sustainability, secondly: evaluating and analyzing a case study (storm water runoff management at Hunter Point South Waterfront Park, in Queens, New York to manage stormwater runoff, encourage recreational areas, and conserve water to achieve sustainable social and economic development.

Keywords: Green infrastructure, Parks land, Sustainable development, Urban flooding

INTRODUCTION

Cities are facing the challenges to protect water resources looking for approaches to minimize the negative environmental impacts especially in terms of stormwater runoff. Water runoff is the main cause of water pollution in the cities. One of these approaches to protect water resources is green infrastructure, it is an innovative and new approaches which not only environmentally friendly and sustainable, but also cost-effective

which can be better for the environment. Green infrastructure provides many community benefits such as reducing and managing stormwater runoff through capture, reuse and infiltration stormwater by directing it back into the ground. These practices keep rainwater out of the sewer system, reducing the amount of untreated runoff reduced flood damages, and improved urban aesthetics and community livability. From this point of view the research suggest a frame work

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for achieving green infrastructure as an approach to manage stormwater runoff for more sustainable future.

RESEARCH PROBLEM

Urbanization has a major effect on both the quantity and quality of stormwater runoff, Developing countries are facing a Controlling stormwater runoff and its impact, stormwater can causes water pollution also this runoff can kill aquatic life, and make our streams, lakes and rivers an unhealthy place to live, work, and play. It has also economic Impacts on tourism, recreational areas and fisheries.

RESEARCH GOAL

The goal of the research is to provide a practical framework for controlling stormwater runoff. It is a hybrid design, which integrates the goals of the green infrastructure, blends the sustainable features and includes new techniques based on the research to help make a difference to both the community and the city to achieve sustainability.

RESEARCH HYPOTHESIS

Integration between architecture, infrastructure, and landscape through transform the parks into new ecological communities to reduce stormwater runoff which means transfer parks into a new sustainable ecological paradigm. This paradigm achieved by employing sustainable design strategies and techniques through green infrastructure practices which design to improve water quality, improves drainage, reduces maintenance and infiltrates stormwater runoff through new multi-layers. These Sustainable layers include land conservation, urban tree canopy, planter boxes, green roof, downspout

disconnection, rain gardens, bioswales, stormwater harvesting, rain tanks and permeable pavement. So for economically sustainable growth we can apply a new vision of how the parks can co-exist in a sustainable and achievable manner.

RESEARCH METHODOLOGY

The research methodology is based on two approaches: theoretical and comparative analytical studies. The theoretical component seeks to identify the concepts of stormwater runoff and its impact on cities, green infrastructure, its objectives, benefits and advantages and sustainable development. This is followed by an applied study of the most successfully models that provide illustrative examples of strategies and techniques that could be applicable to reduce stormwater runoff in the parks as a contributor to green infrastructure (storm water runoff management at Hunter Point South Waterfront Park, Long Island City, NY). This location face many of the same challenges and opportunities to achieve green infrastructure to transform into an international model for sustainable development. Then the paper concludes with the most important recommendations on the development of parks to achieve economical sustainable development.

STORMWATR RUNOFF

Stormwater runoff is the main cause of water pollution in the cities. When rain falls on rooftops, parking areas, in cities and their suburbs, the water cannot soak into the ground as it should. These large amounts of water runoff are carried away to the rivers, streams and lakes and can cause flooding. The stormwater runoff carry different pollutants that are found on paved

surfaces such as trash, bacteria, heavy metals, and other pollutants. "These pollutants come from a variety of sources, including pet waste, lawn fertilization, cars, construction sites, illegal dumping and spills, and pesticide application" (New South Wales Department of Environmental Conservation, 2006). This runoff can make our waterways unhealthy areas to work, live, and play.

GREEN INFRASTRUCTURE

Green infrastructure is an approach to water management through the use of runoff reduction techniques, It can move stormwater away from the built environment, supply remediation in a dispense manner before stormwater runoff reaches the sewer system. Where restores and protects the natural water cycle. Green infrastructure is a smart and cost effective, economical system to enhance community health and safety, provide recreation and quality of life. "Green infrastructure solutions can be applied on different scales, from the house to the landscape level. On the local level, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. At the largest scale, the preservation and restoration of natural landscapes (such as forests, floodplains and wetlands) are critical components of green infrastructure" (The Value of Green Infrastructure: A Guide to Recognizing its Economic, Environmental and Social Benefits, 2011). Green infrastructure has environmental, ecological, economic and social advantages. It uses some practices like soils, vegetation and other elements to restore and infiltrate stormwater runoff and create more sustainable urban environments.

STORMWATER MANAGEMENT TO GREEN INFRASTRUCTURE

The meaning of Stormwater management is administering surface runoff, it is essential to prevent flooding of urban areas. Because if sanitation facilities are flooded, these results will be very expensive and massive suffering for the cities. So it can reduce the negative effects of stormwater runoff. "Traditional stormwater management was mainly to drain high peak flows away. This only dislocates high water loads. Modern approaches aim to rebuild the natural water cycle like to store runoff water (e.g., retention basins) for a certain time, to recharge ground water (e.g., infiltration basins) and to use the collected water for irrigation or household supply" (ARC, 2010).

CASE STUDY: STORMWATER RUNOFF MANAGEMENT AT HUNTER POINT SOUTH WATERFRONT PARK, LONG ISLAND CITY, NY

As one of the most sustainable waterfront projects in New York City's, New York City Economic Development Corporation (NYCEDC) has transformed Hunter's Point South in Queens, New York into an international model for sustainable development. The goal of this park is to design an ecological and technological paradigm to capture and reuse stormwater runoff, minimize non-renewable consumption, optimize performance of operational usage and maintenance and create a profitable and healthy environment for the city and suburban to improve the quality of life of New York City citizens.

Figure 1: The Site of Hunter Point South Park, NY



Figure 2: Layout of Hunter Point South Park, NY



Water Management System at the Park

The project considers as a sustainable urban community. The structure of the park is planned to resist rising in case of downfall, and its roof removes stormwater runoff into bioswales that pass stormwater onsite. The park provides a multi-use open space like: Green Oval: "Grassy oval framed by a continuous path and a pleated steel roof shade pavilion. The oval serves as a play area for most of the year, but it can also handle storm surges on the flood prone site" (Alex Maestre and Robert Pitt, 2005). Besides of the Grassy oval, Hunter's Point South includes also community facilities like schools, Parking areas, offices, retail space and a café. It contains also children's playground, fitness skills, a dog run, train track, rail garden and a park pavilion.

"This pavilion achieves net-zero power consumption through attached solar panels capable of powering up to 50% of the entire park. Rain water collection and landscaping extend into the inland streets. These landscaped streets frame views of the water's edge and beyond, linking the city to the park and the park to the waterfront" (Horsley and Carter, 2010).

From this point of view to make sure that the park is prepared for reducing stormwater runoff, there is a bio retention area filters stormwater from the new Center to minimize the impacts on the city's drainage infrastructure.

Innovative Infrastructure at Hunter Point South Park, NY

The design blends active and passive design of sustainable development, for example to make the most effective use for passive cooling and heating, and solar energy generation, Photovoltaic solar panels existing on the pleated roof of the pavilion which create 37,000 kWh per year, producing more than half of the park's energy needs. The park station, maintenance and the office building received LEED Silver-certification include photovoltaic panels systems. "Sixty-four photovoltaic panels located on the roof of the pavilion will generate 37,000 kWh per year, powering over 50% of the entire park. Additional panels can be installed over the remainder of the roof to provide 100% of the park's operating power. The pavilion also houses LEED Silver-certified public restrooms, maintenance and office space, and a future food concession" (California Stormwater Quality Association (CASQA), 2010).

The folded plate overshadows structure recollect the naval history of Hunters Point South Park and is making the effective use to

Figure 3: Using Photovoltaic at Hunter Point South Park, NY

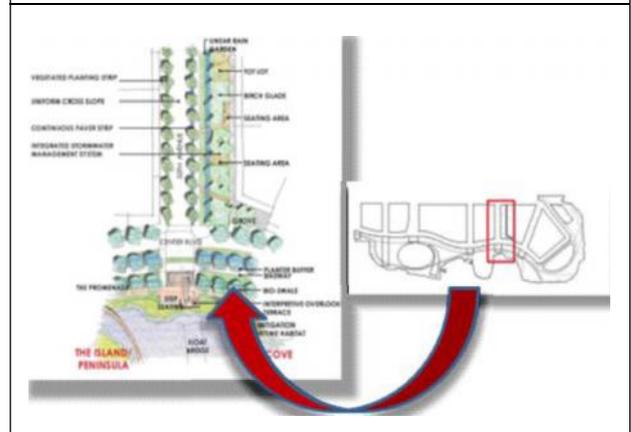


capture and reduce stormwater runoff and solar power. 64 Photovoltaic panels located on the southern facade of the pleats which generate 37,000 kWh per year, producing more than 50% of the park. The planning can harmonize extra panels to capability 100% of the park in the future. These folded plates can also gather stormwater which supplies near bioswales. A high textured brushed metal surface fold towards the external edge of the extension alongside the Green sweeps, and reflects the recreational activities at the Green and landscape areas.

Sustainable Features at Hunter Point South Park, NY

They implemented a lot of sustainable features include: a network of bike lanes, Pedestrian friendly streets, porous pavement, street side stormwater planters, using of environmentally sustainable wood, bioswales, the storm sewers improve water quality in the East River and New York and remove rain water out of the drainage water system. Sustainable stormwater runoff management is the most important features of sustainability at the park which provides both an environmental and ecological structure for this park. A long bioswale fills the length of the space and cleans up stormwater runoff from the adjacent neighborhood street.

Figure 4: Upgrading the Site of Hunter Point South Park, NY



Stormwater Runoff Reduction Techniques

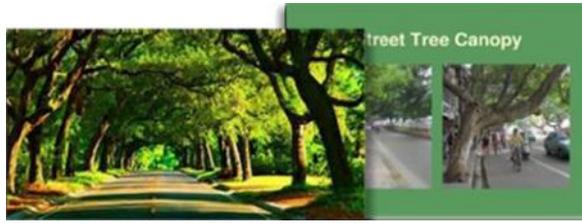
Land Conservation

Preserve the natural lands is The most actual way to reduce the impacts of stormwater runoff because Conserving natural areas like forests can decrease the amount of stormwater runoff. "The water quality and flooding impacts of urban stormwater also can be addressed by protecting open spaces and sensitive natural areas within and adjacent to a city while providing recreational opportunities for city residents" (<http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx>, 2012) Natural areas are crucial to both human and environment; they include wetlands, meadows, valley lands and forests.

Urban Tree Canopy

Increasing tree canopy above surfaces can also minimize the impacts of stormwater runoff by increasing interception of rainfall. Flooding and erosion can cause by heavy rains in urban areas which can damage habitat, infrastructure and environment. Trees are most effective at reducing stormwater runoff, by capturing and keeping water runoff in the tree canopy and removing the water into the air by evaporation.

Figure 5: Urban Tree Canopy at the Park



Planter Boxes

Planter boxes can be considered as rain gardens, they can collect and absorb stormwater runoff from streets and parking areas. They are ideal in dense urban areas and can be made completely from reclaimed timber from deconstructed to achieve sustainability.

Green Roofs

Green roofs are made up of multi layers; the top layer was vegetated to infiltrate stormwater runoff. Green roofs have many advantages they consider as a natural insulation to reduce energy costs, and absorb stormwater. It also can reduce the effect of heat land and improve air quality. They are cost-effective in dense urban areas where land values are high. “Green roofs reduce stormwater runoff volumes and are most effective in areas with substantial amounts of impervious surfaces” (Low Impact Development (LID): A Literature Review, 2000). “Green roofs in urban

Figure 6: Planter Boxes at the Park



Figure 7: Green Roof at the Park



areas offer a variety of benefits such as extending the life of roofs, reducing energy costs, and conserving valuable land that may otherwise be installed with stormwater runoff controls” (United States Environmental Protection Agency, xxxx).

Downspout Disconnection

Downspout disconnection considers a cost-effective solution for decreasing the amount of stormwater Runoff. Water Runoff can be collected from roofs by frieze troughs, which are installed over the edge of the roof. Water collected in the friezes and then moved to the ground level by downspouts. “Downspouts may then connect directly into the storm sewer system or in older neighborhoods into a combined storm and sanitary sewer system” (David Paterson, 2014). Downspout disconnection is more sufficient to cities with combined sewer systems.

Figure 8: Downspout Disconnection at the Park



high stand. Cisterns can connect to the downspout disconnection of a roof and reuse the stormwater runoff for irrigation plants and landscaping.

Permeable Pavements

Permeable pavements allow storm water runoff

Figure 12: Cistern System at the Park



Figure 13: Rain Tank System to Manage Stormwater



to infiltrate, treat, and enter the soil. Where they allow water to soak into a layer of rock, the amount of storm water and pollution reaching storm sewers and streams is greatly reduced. Permeable pavements Such as pervious concrete, permeable interlocking and porous asphalt. They are the best for commercial, residential and industrial areas but they are not recommended for streets, and highways.

Table 1: Stormwater Runoff Reduction Techniques

| Practice | Description |
|-------------------------|---|
| Land Conservation | Reduce the impacts of stormwater runoff to preserve as much as possible the natural land and vegetation by restoring and/or permanently conserving these areas on a site. Natural areas that should be a focus of this effort include riparian areas, wetlands, and steep hillsides . |
| Urban Tree Canopy | Trees are most effective at reducing runoff, by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. |
| Planter Boxes | Collect and absorb stormwater runoff from streets and parking areas to reduce storm water runoff, and provide bank stabilization. |
| Green roof | Made up of a top vegetative layer that enable stormwater infiltration .The rooftop vegetation allows evaporation to reduce volume of runoff entering conveyance system. |
| Downspout Disconnection | Represents a cost-effective solution for reducing the volume of stormwater Runoff. |
| Rain Gardens | Vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets. |
| Bioswales | Linear, sloped vegetated channels designed to provide treatment and retention of storm water.. |
| Storm water harvesting | Collect and store rainfall for later use and also to decrease stormwater quantity and improve water quality and provide a source of water . |
| Rain tank/Cistern | Capture and store stormwater runoff to be used for landscaping uses and irrigation. the site. |
| Permeable Pavement | Designed to infiltrate stormwater rainfall through the surface, to reduce stormwater runoff from the site.. |

Figure 14: Stormwater Runoff Reduction Techniques



STORMWATER RUNOFF REDUCTION TECHNIQUES

Hunter's Point South Waterfront Park was envisioned as an international ecological paradigm for innovative sustainable urban design. The main design idea in the Park is to integrate between architecture, infrastructure, and landscape to convert the post-industrial waterfront site into new ecological community to anticipate the inevitable patterns of flooding and rising water levels along the East River, all of these will transform Hunter's Point South Park into a new sustainable ecological paradigm. This paradigm achieved by employing sustainable design strategies to reduce stormwater runoff through green infrastructure practices which design to improve water quality, improves drainage, reduces maintenance and infiltrates stormwater runoff through new multi-layers. These Sustainable layers include land conservation, urban tree canopy, planter boxes, green roof, downspout disconnection, rain gardens, bioswales, stormwater harvesting, rain tanks and permeable pavement. Figure 12 illustrates stormwater runoff reduction techniques which be applied at Hunter Point South Park, Long island city, NY. Table 1 provides an architectural design framework (prototype) about stormwater reduction techniques to obtain the sustainability in parks as valuable contributors to green infrastructure.

CONCLUSION

The research discussed the identification of green infrastructure as an integral component of sustainable cities. This approach can achieve a lot of goals such as reduce stormwater runoff, improving water and air quality, preserve natural areas, protect the environment, improving public

health, providing more recreation opportunities and encourage development in existing cities. The Integration between architecture, infrastructure, and landscape through can transform the parks into new ecological communities to reduce stormwater runoff which means transfer parks into a new sustainable ecological paradigm. Green infrastructure includes a lot of strategies for managing stormwater runoff. Most of these strategies can capture, slow down, and filter runoff and also collect and store rain water for future use. Some techniques, including land conservation, urban tree canopy, planter boxes, green roof, downspout disconnection, rain gardens, bioswales, stormwater harvesting, rain tanks and permeable pavement work at the site scale can reduce maintenance and infiltrates stormwater runoff through new multi-layers in the parks to achieve economical sustainable development.

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