MULTI-USE OF STORMWATER DETENTION PONDS IN PARKS AND OPEN SPACES

by

PALLAVI SHASHANK SHINDE

(Under the Direction of Bruce K. Ferguson)

ABSTRACT

Water possesses several qualities that contribute to positive aesthetic experience. But these qualities are rarely exploited in our cities. On one hand we treat water as an exciting element adorning our city squares in the form of fountains, while on the other hand is the merely functional drainage system. We overlook the possibility of utilizing stormwater for recreational and aesthetic purposes. The detention basins being designed today are still a single purpose facility. Some are rectangular boxes and look like mud holes in the ground, surrounded by fences. This thesis proposes a design that transforms such detention basins in the Southeast Clarke County Community Park, Athens, GA, into a multi-use amenity providing recreation, aesthetic value and wildlife habitat along with flood control. The design proposal exposes the flow of stormwater and brings people in contact with it, putting it back into the social consciousness of the urban society. The proposal illustrates that detention ponds do not have to be sterile and ugly but can be attractive and form sustainable systems.

INDEX WORDS: Stormwater, detention, parks, open spaces, Southeast Clarke County Community Park, multiple-use, wetland.

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# CHAPTER ONE

# INTRODUCTION

The everyday increase in the impervious and contaminated surfaces of the urban landscapes is resulting in severe floods and degraded waterways. This has led to an increased number of studies on stormwater. Many municipalities have adopted a dual approach to stormwater management that incorporates flood control and water quality improvement. This approach still fails to address broader needs of the community such as recreation and aesthetic enjoyment. Though water forms an important element of our landscapes in the form of streams, lakes, ponds, fountains and cascades, we too often overlook the possibility of utilizing stormwater for recreational and aesthetic purpose. An integrated approach should not only address the dual-purpose approach, but also aim at making the system a part of the community. This would have a positive impact on life in urban areas.

## Impacts of urbanization

Urbanization is replacing pervious ground cover and resulting in compacted soil. This allows only a small amount of water to infiltrate into the ground. The rate of runoff in urban areas is high due to the absence of vegetation or depressions that could have held and delayed the runoff. As runoff gains volume and speed, the flow becomes strong enough to transport materials, damage property and degrade streams. Chemicals and biological pollutants are discovered in urban stormwater, resulting from automobile greases and oils. The result is contamination of our streams and rivers, and adverse effects on aquatic flora and fauna.

**The potential for integration**

In response to the federal guidelines and growing awareness, efforts are made to detain stormwater. These usually take the form of detention ponds or structures in open spaces that are sometimes covered or fenced off and are considered an eye sore. They are often not very popular within communities. It is beneficial to make the hydrological system a part of the space not just physically but also socially. Stormwater if treated in an appropriate way can provide amenities in communities, especially when it is incorporated in open space and recreation grounds. It can have multiple functions like water quality enhancement, wildlife habitat and flood control while providing aesthetic value and community recreation.

**Thesis intent**

The intent of this thesis is to study the new integrated approaches to the urban stormwater problem used by a selected group of designers and to apply this knowledge to a site in Athens, Georgia. This thesis explores the possibility of a stormwater detention facility as a multiuse facility in parks and open spaces. In the process this thesis sheds light on the following questions,

- Why is there a need to make a detention pond a multiuse facility?
- What are the benefits of making a detention pond a multi-use facility?
- Can recreational amenities be successfully incorporated with the functional needs of stormwater? If yes, then what kind of recreational facilities can be incorporated?
- What kind of maintenance is required for such a system?
- Can there be a problem with the toxic materials in stormwater from the urban areas on vegetation, water, soil and wildlife?
- What are the safety concerns?

- What are the general planning considerations to make a detention facility into a recreational amenity?

**Structure of the following chapters**

Chapter two examines the importance of water in our landscapes, its symbolism and qualities, the impact of urbanization on the watersheds and the subsequent stormwater issues. It explores conventional and alternative methods of stormwater management. Chapter three deals with incorporation of stormwater detention facilities into parks and open spaces as multi-use facilities and the issues related to it. Chapter four presents, in detail, the case studies of Mill Creek Park in King County, Washington, Fishtrap Creek in Abbotsford, British Columbia and Skyline Park in Denver, Colorado. Chapter five applies the knowledge from the previous chapters to a site in Athens, Georgia. The design intent is to address the flood problem and water quality issues while providing recreation for the community, habitat for wildlife and aesthetic pleasure.

# CHAPTER TWO

# STORMWATER MANAGEMENT

## Water in landscapes

Water is life itself- the magical element that connects all creation. It is the magnet and mirror of life and genesis of settlement. Throughout history man has utilized it for various utilitarian, recreational and aesthetic purposes. Through sight and sound water enriches the place and its surroundings, whether in a city or in the wilderness. Everyday life can be enriched through sensitive relationship with water (Litton, Tetlow, Sorensen and Betty, 1974, 1-2). Water offers a primal attraction and provides an elemental form of open space and high contrast relief from the city (Don, 1980, 43). It has the potential to forge an emotional link between man and nature in the city (Spirn, 1984, 142).

### Symbolism of water

Water is a cooler, quencher and cleanser. It symbolizes life, purity, power, timelessness, refreshment, wildness, unpredictability and solace in hospitable surroundings. Blue water suggests coolness while white water suggests roaring power and sound (Litton, Tetlow, Sorensen and Betty, 1974, 4, 297). In the eastern philosophy, water is regarded as one of the five forces of the earth.

### Qualities of water

> *"Water is not just a vital element in our lives; it can also be experienced in a whole variety of ways. It creates different kinds of atmosphere and mood that appeal to our feelings."*
>
> *-Robert Woodward, Waterscapes, 2001, 12*

Water possesses several qualities that can contribute to positive aesthetic experience. Following are some of these qualities of water.

Sound: The sound of water can be powerful as the roar of the ocean or gentle as the gurgle of a small stream. Sound of water allows people to connect to nature, refresh spent minds or block out less desirable noises (Moore, 1995, 26). This quality has been exploited since ancient times by the use of water fountains and cascades in gardens, plazas and palaces. The sound of water is manipulated in musical fountains, where water is the artist; the fountain is the musical instrument (Dreiseitl, 2001, 40). Water's sound has all the characteristics of music, variety of volume and pitch, sharpness and softness, rhythm and harmony (Woodward, 2001, 13).

Touch: Water touching our skin is the most personally intimate experience we can have of it (Moore, 1995, 27). This quality of water entices us to walk along the shores in ankle deep water, to play in the streams, to take part in water sports and to be thrilled at water amusement parks. Emotional contact with water occurs when people are allowed to get close without actually touching it, resulting in our 'mental leaning out over' (Moore, 1995, 27).

Movement: Movement is the most exciting and vivid quality associated with water. It may be gravity descent, wind driven or forced movement. Chutes, cascades, boils, rollers, rapids and ripples are some of the falling and turbulent forms of water (Litton, Tetlow, Sorensen and Betty, 1974, 79). Water running in channels acts as a unifying element, linking spaces and providing continuity (Moore, 1995, 23).

Stillness: Still water instills peace of mind. Stillness of water symbolizes sacredness and serene dignity (Moore, 1995, 27).

Transparency: Transparency imparts depth to water. Light is absorbed as it passes through the medium, facilitating glimpses of the aquatic world below.

Reflection: Water can be described as nature's mirror of the landscape (Litton, Tetlow,

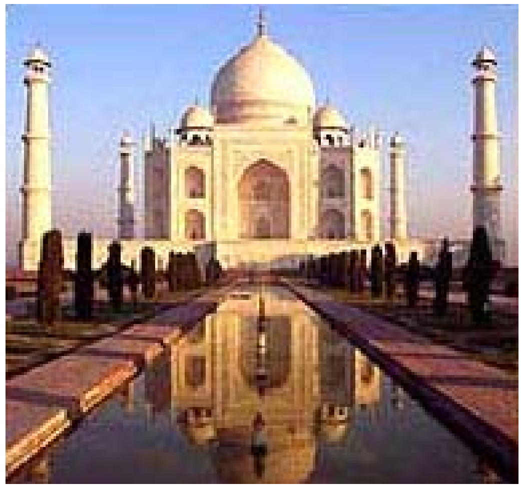

Figure 2.1 Taj Mahal, Agra, India (http://www.allindiatravels.com/gifs/taj-mahal)

Sorensen and Betty, 1974, 79). Sometimes the gentlest light from the moon accentuates mysticism. The intensity of light creates varied moods in people - from depressed to delighted. Reflective water adds an element of fantasy to architecture by filling shadows with light (Moore, 1995, 26). This quality of water has been used in Islamic gardens, where a large pool is built in front of a monument to produce its reflection; e.g., The Taj Mahal (Figure 2.1). Reflective water idealizes the places we build to symbolize the Gods we worship, the heroes we intend to remember or the ideals we cherish (Moore, 1995, 26)

Color: Water in nature is rarely colorless. It is often stained with vegetative stains or colored with suspended clay particles. Most color we see in water is from the reflection of the surrounding or from underwater objects seen from its transparent body (Woodward, 2001, 13).

These qualities of water are seldom fully exploited in cities. On one hand we treat water as an exciting element adorning city squares in the form of fountains while on the other hand is the merely functional drainage system buried underground, far from the eyes of the people. Rapid urbanization has altered our perception of water.

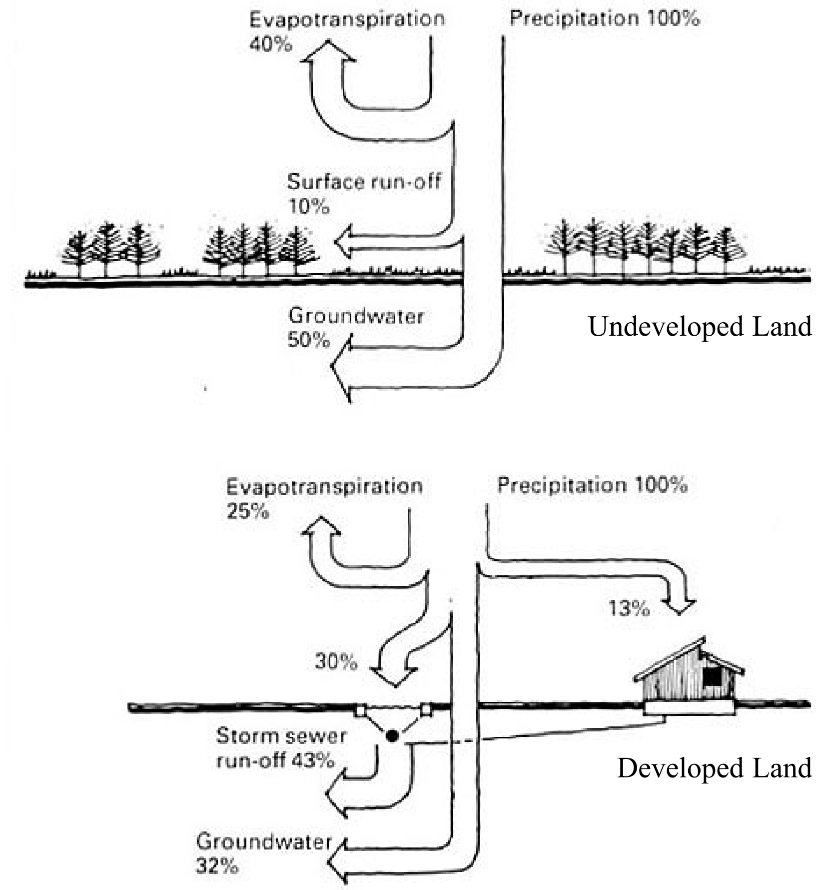


Figure 2.2 Impact of impervious surfaces (Hough, 1994, 39)

**Impacts of urbanization**

In nature when precipitation occurs, 50% of it is absorbed by the soil and vegetation and the rest is evaporated or transpired back into the atmosphere or carried over the land as surface runoff. Infiltration replenishes the ground aquifers thereby securing our supply of fresh water. Vegetated soils and woodlands provide storage by trapping and percolating water through the ground with minimum runoff and maximum benefit to the ground water recharge. Natural flood plains and lakes act as storage reservoirs for rivers that further reduce the magnitude of peaks down stream by spreading flows over a longer period of time. Nature takes care of itself, replenishing life forms and rejuvenating the landscape, forming a sustainable ecosystem.

With the advent of urbanization, the vegetation is cleared, land is graded, floodplains may be occupied and a waterproof seal covers the land. Asphalt and concrete replace the soil, buildings replace the trees and catch basins and storm sewers replace the natural streams (Hough, 1994, 39) (Figure 2.2). The meandering streams are straightened and now run in concrete channels. The streams of the pre-city landscape have vanished from modern maps. Old streams still flow through the city, buried beneath the ground in large pipes. They are invisible, but their potential contribution to downstream floods is nevertheless unabated and magnified (Spirn, 1984, 130).

The hydrological cycle is a water balance that accounts for the endless circulation of the earth's water. It is vital for sustaining life and necessary to maintain human food resources and social values (Wanielista and Yousef, 1993, 4). Urbanization has altered this hydrological cycle. The natural hydrological cycle is short-circuited by water diversions, artificial storage in reservoirs and urban piped supply streams. The absence of vegetation and pervious soil creates greater runoff, extreme floods and low ground water table.  Floods account for more property damage in the United States than any other single natural hazard. Floods increase in magnitude and destructiveness with each increment of urban growth; urbanization can increase the mean annual flood by as much as six times (Spirn, 1984, 129-130).

Another impact of urbanization is the degradation of water quality. The EPA's National Urban Runoff Program (NURP) established that in many cases the first flush of stormwater in an urban area might have the level of contamination higher than that normally present in sewage wastewater. This is primarily due to the tendency of the initial stormwater flow to pick up and transport much of the deposited vehicular, animal and human detritus from pavement (Campbell and Ogden, 1999, 123). Toxic chemicals are a by-product of modern industrial processes, agricultural practices and fuel consumption. These toxic chemicals enter the streams, rivers and lakes through storm runoff (Spirn, 1984, 136). Algae growth causes taste and odor problems in drinking water supplies and reduces recreational value of lakes and fundamentally alters its biological balance (Logan and Yaksich, 1990, 26). Every rainfall sweeps dirt and debris of the city streets into storm sewers and with it, heavy metals and other toxic materials such as oil and grease.

Pollutants from roads, paved surfaces and rooftops include a range of organic and chemical compounds and heat from paved surfaces, making urban stormwater hostile to aquatic life (Hough, 1994, 78). In nature sediment from gradually meandering stream bank builds point bars and aquatic habitats. In urban areas, the excess sediment in suspension makes water turbid, inhibiting plant growth and reducing species diversity. On settling at the bottom, excess sediment destroys spawning beds and habitats of bottom dwelling biota that depend on the interstices of sand and gravel particles for their habitat (Ferguson, 1998, 7). Turbidity and warmer temperatures, increase of nutrient and salts, and loss of dissolved oxygen further degrade the water quality in urban rivers, streams and lakes.

**Conventional stormwater management practices**

Conveyance has been the conventional method of dealing with stormwater. It owes its origin to the urban sanitation movement of the nineteenth century. The specter of water borne disease, which haunted cities in the past was laid off by the conveyance

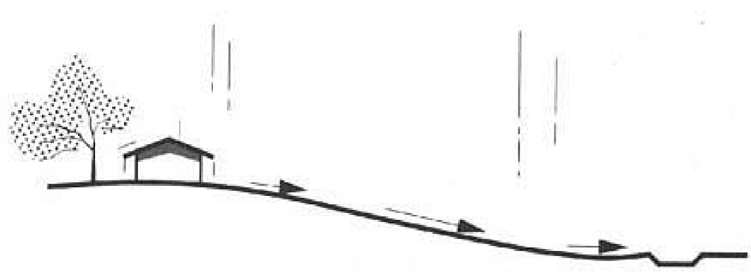

Figure 2.3 Conveyance (Ferguson, 1998, 41)

system. Conveyance is the moving of surface runoff from one place to another by a network of pipes, channels, swales and culverts draining into one another, until runoff disappears from the site (Ferguson, 1998, 40) (Figure 2.3). The pipes are usually buried underground and the surface of the conveyance system is essentially impervious.

**Problems with the conventional system**

The benefits of conventional stormwater design - well drained streets and civic spaces is paid for by the environmental costs of eroded streams, flooding, and impairment of water quality and aquatic life in downstream water courses. Gutters, curbs and drains collect rainfall and direct it to sewers, which transport it rapidly to streams and lakes. Storm sewers transport water from one point to another, merely changing its location and not reducing or eliminating water. As urban storm drainage system drains water efficiently from roofs, streets and sidewalks, the flood control system must be continually augmented to prevent flooding downstream (Spirn, 1984, 131-132). The impervious system provides no scope for infiltration of water thereby reducing the ground water recharge.

The system also separates urban society from environmental values that embrace both the city and the land. The natural processes are hidden away; buried underground far from the eyes of city dwellers. Conventional system fails to recognize the potential of stormwater as an environmental resource. The present problems associated with conventional stormwater management have promoted research and alternative methods have been explored in recent years.

**Alternative stormwater management methods**

The detrimental effects of stormwater runoff have prompted many municipalities to pass regulations that require that post-development runoff peak volumes and water

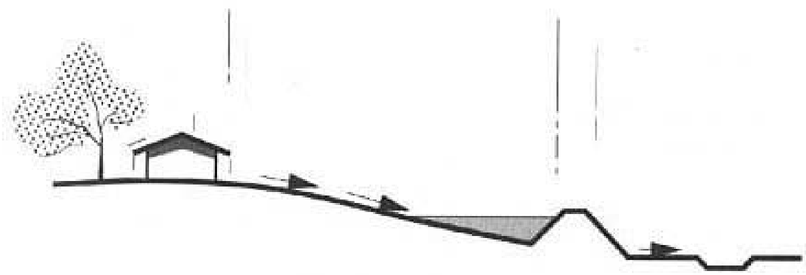

Figure 2.4 Detention (Ferguson, 1998, 41)

quality not exceed pre-development levels. This measure focuses on capturing stormwater on-site, immediately after rainfall and releasing it slowly at controlled rates downstream or allowing it to infiltrate back into the soil. It is achieved by detention, extended detention, infiltration and rainwater harvesting.

Detention

Detention is the slowing down of surface flows as they move over the ground (Figure 2.4). Its purpose is to suppress downstream flooding and erosion by reducing the rate of flow (Ferguson, 1998, 41). Urban detention was started in the 1960's when it was discovered that development is followed by increase in storm runoff and aggravated flood damage (Ferguson, 1998, 149). The main aim of detention is to control the peak rate of runoff. The basic elements of a detention facility are an inlet, a storage basin and a constricted outlet. There can be multiple inlets. A secondary overflow or emergency spillway is necessary to allow water to pass, if it exceeds the capacity of the basin. This can be in the form of earthen channels excavated on the sides of the dam or large weirs, higher than the principal outlet. The principal outlet can also be designed to act as emergency spillway. The detention storage is the volume of the reservoir above the outlet's invert elevation. In a dry basin the outlet is flushed to the basin's floor. It drains completely after a few hours of the flood event (Ferguson,

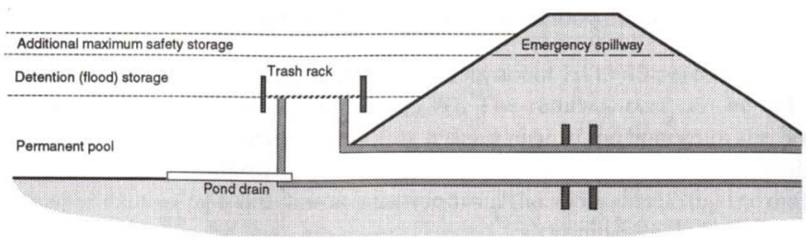


Figure 2.5 Extended Detention (Ferguson, 1998, 182)

1998, 150). Detention facility can be of two types depending on its proximity to the water source - source control (on-site) and downstream control (regional) (Stahre and Urbonas, 1990).

Extended detention

Extended detention stores water for a longer period of time thereby improving the quality of water. The extended detention basins can be dry or wet. The dry extended basin drains water completely like a dry detention basin but additionally contributing to water quality enhancement. In a wet basin the outlet is raised creating a permanent pool of water (Figure 2.5). Due to the extended period of detention, suspended particles settle out, chemicals get absorbed in the bottom sediment or by biota and biodegraded (Ferguson, 1998, 42). The permanent pools can be deep open ponds, shallow vegetated ponds or wetlands. The residence time of water is a crucial factor when designing an extended detention basin. This kind of basin is generally used for small frequent storms since design for a large storm would increase the basin size and subsequently the cost out of proportion. Water quality treatment is adequate when designed for small storms (Ferguson, 1998, 167). A consideration in a wet pond is the sediment. The pond must be designed for sediment storage. In a typical urban watershed with stable land use,

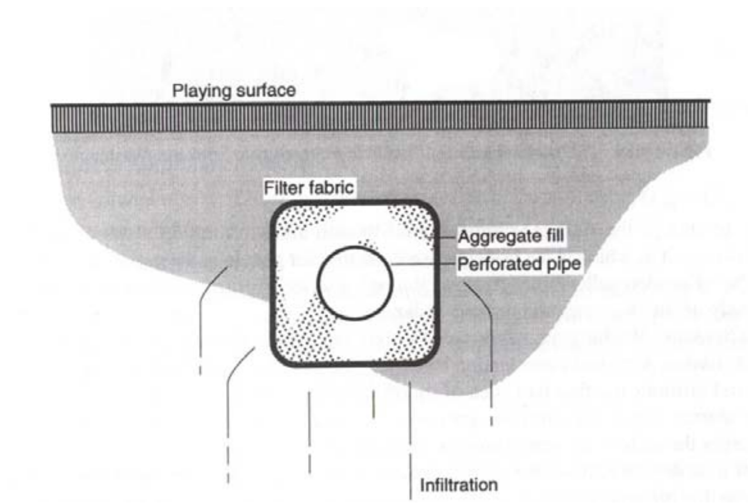


Figure 2.6 Subsurface infiltration (Ferguson, 1998, 213)

sediment storage volume of half-inch runoff may allow sediment removal once every twenty years (Ferguson, 1998, 179).

Infiltration

Infiltration captures runoff and allows it to soak into the ground in closed basins. Infiltration restores ground water to the earth in addition to addressing the flood problem. The soil acts as a powerful filter. Only a few inches of soil can trap and accumulate oils, metals and nutrients thereby protecting the aquifer from urban contamination (Ferguson, 1998, 195). The floors and sides of an infiltration basin must be densely vegetated to create a porous soil structure and to prevent raindrop impact. An infiltration basin requires an overflow to drain excess water. Most infiltration basins are dry. Where basins are excavated to intersect the water table, a permanent pool is formed. The runoff temporarily fills the basin and infiltrates through the sides (Ferguson, 1998, 207). Infiltration reduces and in some cases completely eliminates the need for primary conveyance downstream thereby saving a lot of cost.

In urban areas where space is limited, infiltration basins can be constructed below ground, leaving the surface for other uses like parking. Open graded aggregate is

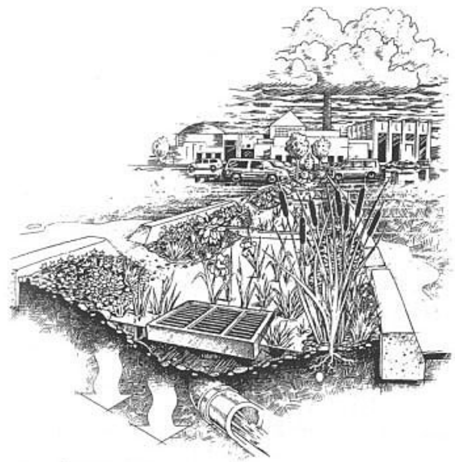

Figure 2.7 Bioswale (Thompson and Sorvig, 2000, 154)

used to create storage in subsurface basins. Perforated pipe, which is covered with aggregate and wrapped with filter fabric, is used in subsurface basins (Ferguson, 1998, 212) (Figure 2.6). Nowadays, different kinds of porous pavements are available to aid infiltration.

Vegetated swales referred to, as 'Bioswales' are another way of facilitating infiltration. These swales store runoff while conveying it downstream at a low velocity providing biophysical treatment and infiltration. Weirs or check dams facilitate ponding of water and help to slow down runoff. A raised outlet at the lowest point along the swale provides overflow for excess runoff (Figure 2.7). Swales can be used along streets, replacing curbs and gutters (Ferguson, 1998, 123).

Another concept, 'Rain garden' is also gaining popularity. A rain garden is a small-scale infiltration device that provides benefits of groundwater recharge, beauty and wildlife habitat. Rain gardens are 2 to 6 inches deep infiltration areas planted with native species. Runoff is captured in these depressions. The plants and soil filter pollutants in the stormwater allowing cleansed water to recharge the ground. These gardens can fit in small spaces like traffic islands and parking lots. Roads can be

Figure 2.8 Wenk and Associates Office Garden (Gregg and Wenk, 1998, 25)

designed without curbs, allowing water to flow overland, further increasing infiltration and eliminating the cost of curb and gutter (Russell, 2000, 24).

An example of rain garden is the design by William Wenk at his office building in Denver, Colorado (Figure 2.8). The design captures all roof runoff water from the building and provides controlled distribution to water landscape plants carefully selected and placed in a sequence of moisture requirements ranging from high to low, each area allowing infiltration into the ground. The site creates virtually no runoff. The downspouts used to convey water from the roof to the landscape also form a striking visual element (Campbell and Ogden, 1999, 136).

## Water Harvesting

Water harvesting is the collection and storage of rainwater from roofs, paved surfaces and the landscape. Harvested rainwater can be used for various utilitarian purposes, irrigation, recreation, drinking or as a visual element in the landscape. Water harvesting is common in Australia and the Caribbean islands. Harvesting from a ground

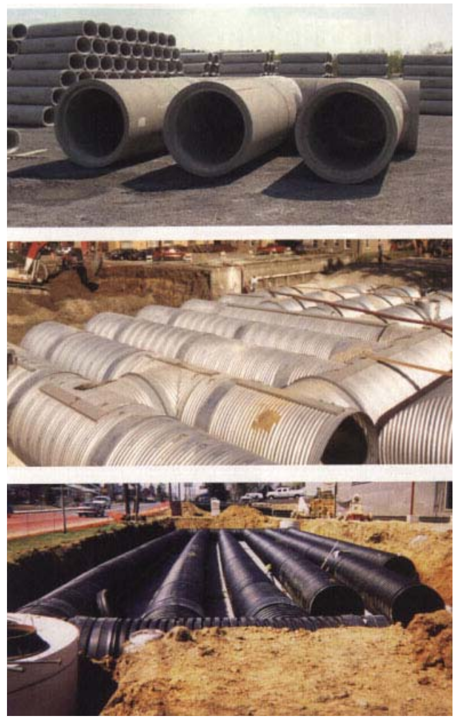

Figure 2.9 Pipes used for underground detention and infiltration (Tilton, 2002, 41)

surface catchment area has a longer history. Ancient Israelites, Chinese, Pueblo, Australians and other Indians of the American southwest have used such water harvesting systems to survive (Thompson and Sorvig, 2000, 154). In United States, in the nineteenth and early twentieth centuries, small concrete cisterns were common storage structures serving families settling the high plains. The systems ranged from large civic infrastructures to small cisterns for individual homes.

Underground stormwater management system

Recently stormwater detention and infiltration are being facilitated by underground pipes (Figure 2.9). Runoff is directed into large reinforced concrete, steel or polyethylene pipes buried below parking lots and paved surfaces. The system is being used in new developments because it leaves the surface free for other uses.

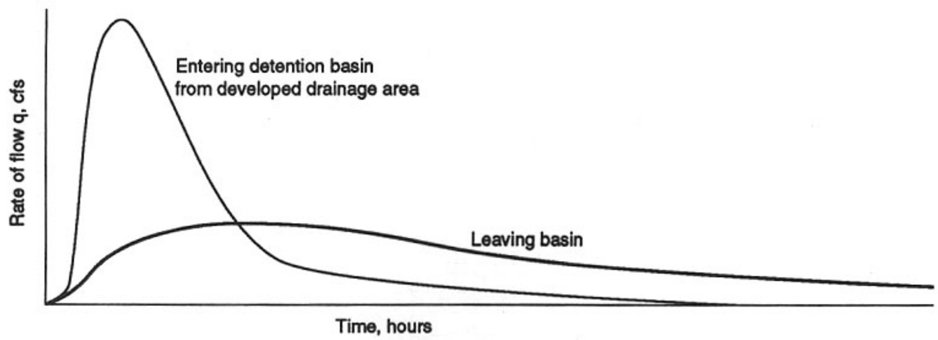


Figure 2.10 Effect of detention basin on a storm hydrograph (Ferguson, 1998, 150)

**Evaluation of alternative methods**

Detention and Extended Detention

Almost all state and local governments require developers to reduce peak stormwater discharge to its pre-development level. To comply with this regulation, a detention pond is built on every development site. A detention basin considered in isolation, reduces the peak rate of flow but uniform on-site detention practiced in a large watershed can have a negative impact. A detention basin does not eliminate the runoff; it only delays it. The total volume of discharge from a detention pond is the same as the inflow but the discharge is delayed with a lower peak and elongated flow period (Figure 2.10). When the flows from different tributaries join downstream, the result is a peak rate greater than the pre-development peaks and possibly even greater than the developed watershed would produce without the basins.

According to Debo (1982) randomly sited detention ponds cause concentrated discharge and increased flood peaks. They fail to control floods smaller than those of the design storm. Detention basins can reduce flood peaks if they are selectively located. A proposed detention basin should be evaluated on a site-by-site basis. In this scenario regional detention basins can sometimes work best. Municipalities can collect

Figure 2.11 Detention pond in a commercial area in Athens, Georgia (Photographed by author)

stormwater impact fees from developers and use them to construct regional detention basins (Ferguson, 1991, 76).

Extended detention can be effective in treating surface water quality but fails to address volume of runoff, groundwater recharge or water conservation (Ferguson, 1998, 42). A shortcoming of dry extended detention is its inability to treat the "first flush", which tends to be highly polluted. The residence time in a dry extended basin is too short for the pollutants to settle (Ferguson, 1998, 172). Wet extended detention has advantages over dry detention. It is effective in treating the "first flush". Due to the longer residence time, it continues settling and biochemical decomposition of pollutants. However, it is difficult to achieve sediment trap efficiency higher than 80% even in the most favorable ponds (Ferguson, 1998, 176-177).

Too many detention basins being designed today have a very functional approach. Some are rectangular boxes and look like mud holes in the ground surrounded by fences (Figure 2.11). The potential of these basins to become a multi-functional element in the landscape is hampered.

Infiltration

An infiltration basin is the only structural management practice that reduces both the peak flow rate and the volume of runoff from developed landscapes. By allowing the soil to absorb runoff, it diminishes erosion and flooding problems and supports groundwater recharge (MacElroy and Winterbottom, 2000, 52). Ferguson describes infiltration as environmentally the most complete solution to the problem of urban runoff. Infiltration, unlike detention, is recommended in numerous small upland basins or swales at the source of urban runoff. It gives the advantage of water traveling through the subsurface before discharging into streams. This aids in the filtration of water (Ferguson, 1991, 79). Some places like Long Island, Maryland and Florida have rigorously implemented infiltration technique to tackle development runoff.

Underground detention system

Underground stormwater systems present fewer public hazards than open ponds, don't present aesthetic challenges and do not compete for surface acreage (Tilton, 2002, 41). This system is suitable for high-density urban areas where allotting a space for detention ponds is almost impossible. However, the main problem with this system is that it is an 'out of sight' and 'out of mind' approach. It is a purely technical solution, which does not provide any wildlife habitat, aesthetic pleasure or public involvement that a surface detention pond could offer. The construction and maintenance cost can be high depending on the amount of runoff to be treated. A full and clogged underground stormwater system is difficult to see and therefore regular inspection and maintenance are required (Northcutt, 2001, 3, 10). Due to these concerns it is best to use surface ponds and basins where space permits (Northcutt, 201, 16).

**Conclusion**

Some of the alternative stormwater management practices such as extended detention, infiltration and water harvesting, offer a better chance for managing the urban runoff than conveyance. The various benefits include groundwater recharge, water quality enhancement, flood control and wildlife habitat. Water harvesting reuses the stormwater reducing the load on municipal supplies and eliminating the need for conveyance downstream.

But there is still a lack of public participation in and awareness of these facilities. The facilities are still predominantly designed for single use and are located in remote places representing a missed opportunity to design them for multiple uses such as recreation. They are often neglected due to the lack of public awareness. The aesthetic potential of such facilities needs to be exploited. There is a need for a design language that makes the most of available opportunities, one that re-establishes the concept of multi-functional, productive and working landscape that integrates ecology, people and economy (Hough, 1994, 31). The following chapter explores this multi-use potential of detention facilities in parks and open spaces.

# CHAPTER THREE

# MULTI-USE DETENTION PONDS IN PARKS AND OPEN SPACES

**Need to expose the natural process of stormwater**

City development patterns have evolved. Cities no longer grow around rivers, cataracts, springs, pools and ports, but around airports or highways, in amorphous patterns that defy the presence of water and yet demand it all the same (Betsky, 1995, 13). We are forgetting how fundamental the vast systems of extraction, purification, distribution and drainage are to our urban life. There is little or no trace of it in our man-made environment. When we have to see water, we make trips to dams, the coasts and aquariums (Betsky, 1995, 13). Today's water is becoming increasingly domesticated and decreasingly appreciated. Modern treatment plants have replaced the natural water cycle with a mechanized hydrological cycle. The water supply and disposal systems today leave no indication that the water supplied to our tap has its origin to the rain falling on the roof tops and paved surfaces. Many of us have grown accustomed to taking fresh clean water for granted (Moore, 1995, 23).

The urban environment today isolates us from the natural processes that support life. Much of our daily existence is spent in the surroundings that conceal the natural processes. The curb and catch basin that make rainwater disappear without trace below ground cut the visible links with natural water cycle. We are unaware of the ecological damage being done to the receiving waters (Hough, 1994, 30). The abundance and security of water supply has led to the perception of water as a free commodity and an infinite resource. The recent drought situation in southeast United States and some other parts of the world now questions the infinity of this resource. This situation coupled with the ever-increasing water charges are a valid indication that we have been getting it very wrong, and that a complete rethink is now needed (Jones, 1995, 17). This can only take place by changing the public perception of water and increased environmental consciousness.

Making the processes visible is an essential component of environmental education, which can be brought about by constant and direct experience assimilated through daily exposure and interaction with the place one lives in (Hough, 1994, 24, 31). Exposing the flow of water - where it comes from, how and where it is used, where it is treated and released, and the seasonal variation will help people in understanding the hydrological cycle and influence them to conserve water.

**Incorporating multi-use detention ponds in parks and open spaces**

With the growing human population, land is becoming scarce. McHarg noted that, “Urbanization proceeds by increasing the density within and extending the periphery, always at the expense of open space. As a result, unlike other facilities, open space is the most abundant where people are the scarcest.” In cities it is difficult to hold stormwater due to limited space. In such situations it makes sense to design landscapes for multiple uses. Multiple-use can help in conserving space. There is a need to change our aesthetic conventions that have created a landscape of parks and playgrounds whose character rests on uniform application of cultivated turf and whose sole purpose is recreation (Hough, 194, 13). Instead of assigning recreation as the exclusive use of parks, parks can be designed to serve as temporary storage areas that can fulfill hydrological roles. Open spaces can thus become spaces for restoring the damage done by urban development rather than passive recreational space.

Skillful planning can provide play and sun bathing areas in basins when weather is dry, as they will not be used for this purpose when it is raining anyway (Dreiseitl, 2001, 43). The land thus serves dual purpose, assisting hydrological functions but providing space for other uses. Golf courses, playing fields and parks are some of the landscapes where management could accommodate compatible uses (Hough, 1994, 79). Multi-purpose open spaces can define the shape of future growth, rather than vice versa.

Online detention facilities, which pass the entire flood through them, are well suited for joint uses such as open space, wetlands and wildlife habitat that can tolerate frequent inundations. Off-line detention facilities, which bypass the frequent flows and allow only the excess flow into the detention area are well suited for intensive recreational uses such as playgrounds and play fields since they are flooded less frequently (DeGroot and Lloyd, 1992, 20). The uses can be combined at the time of development or could be retrofitted, either putting detention into an existing park or putting recreational facilities into an existing detention facility. If done well, the facilities become an asset to the community (DeGroot and Lloyd, 1992, 19).

In order for natural processes to be appreciated and maintained by people, human intention and care for land must be evident (Nassauer, 1995). Thus by placing stormwater systems right in the heart of the city in parks and open spaces, there are better chances of it being noticed and therefore cared for by the people.

**Benefits of multi-use detention ponds**

<u>Economic benefit</u>

Local governments are facing demands for services like parks, open spaces, recreation, drainage and flood control; increasing mandates from federal and state government and limited revenues to meet these demands. In such situation multiple-use can provide economic and political advantages. It increases the beneficiaries of the project and therefore makes administrative allocation of funds more justifiable. It also

Figure 3.1 Detention pond in a Housing Complex, Indianapolis (Photographed by author)

spreads the cost of land, design, construction and maintenance among more agencies (DeGroot & Lloyd, 1992, 20).

Increased property values

It has been noted that stormwater ponds and wetlands raise property values where they have been integrated into communities. Communities derive more property values when houses are fronted on stormwater ponds. Residents are willing to pay more for the maintenance and upkeep if they are provided access to these ponds and can utilize the recreational facilities located on the lakeshore (Ferguson, 1998, 14). Communities often resist single purpose storage facilities while multi-purpose facilities featuring parks, open spaces and recreation generally receive strong community support (Wright, 1982, 292). Figure 3.1 shows a detention pond in a housing complex in Indianapolis. The pond is provided with a deck, a shelter and picnic tables along the edge. It forms an integral part of the community and is extensively used for picnicking, fishing, bird watching or just hanging around.

Figure 3.2 Wildlfe in a detention pond, Indiannapolis
(Photographed by author)

Wildlife habitat

There is evidence that people living in metropolitan areas have a genuine interest in wildlife and in opportunities to view wildlife (Figure 3.2). It was discovered in a survey of children aged six to ten that fifty percent of their outdoor activities involved wildlife (e.g., observing, collecting) and that children unlike adults were more interested in “creepy-crawly” varieties such as amphibians, reptiles and insects. Research has also indicated that contact with plants and animals is therapeutic and enriches the lives of elderly people and others requiring specialized care (Campbell and Ogden, 1999, 191-192).

Many wildlife habitats are destroyed by urbanization. Detention ponds provide an opportunity to replace these habitats. Created wetlands can provide a number of aquatic and terrestrial habitats with opportunity for photography and nature study. Birds are particularly important for urban wildlife observers, many of whom are unable to travel long distances to see wildlife (Adams, Leedy and Franklin, 1982, 384, 386). A survey of the residents of Columbia, Maryland indicated that residents preferred future stormwater ponds to be managed for wildlife in addition to flood and sediment control.

There is also a movement within the golf course development industry to incorporate a wide variety of vegetation to create wildlife habitat (Campbell and Ogden, 1999, 191-192).

If designed well stormwater detention can serve as an amenity and be compatible with other park uses. It can provide a creative and practical alternative to traditional site development practices.

**Review of multi-use detention ponds**

One of the earliest examples of multi-use detention in a park is Boston's 'Emerald Necklace' park system, designed by Frederick Law Olmsted (Figure 3.3). Olmsted created the Fens and the riverway to combat the flooding and pollution problems of Boston's Back Bay tidal flats (Spirn, 1984, 147). Originally a muddy and foul smelling area, he converted it into an idealized stream and salt marsh meadow with a park-like setting (Tucker, 2001, 36) (Figure 3.4). It was a brilliant multi-functional design with bridle paths, walkways, canoeing and park drives in addition to sanitary and flood control feature (Tunney, 2002).

Olmsted forged a role for urban parks, which was bound in the alleviation of the nineteenth century city's social and environmental problems through the design of parks and parkways. He sought to improve the city's climate, to alleviate air and water pollution, to mitigate floods and to provide a naturalistic counter point to the city's modern infrastructure (Spirn, 1984, 243).

In recent years some municipalities have started encouraging the design of stormwater ponds for multi-use like Olmsted's design for the Fens. The Denver metro area has a long history of combining stormwater with parks and open spaces. The Flood Control District of Denver has designed numerous parks to contain stormwater.

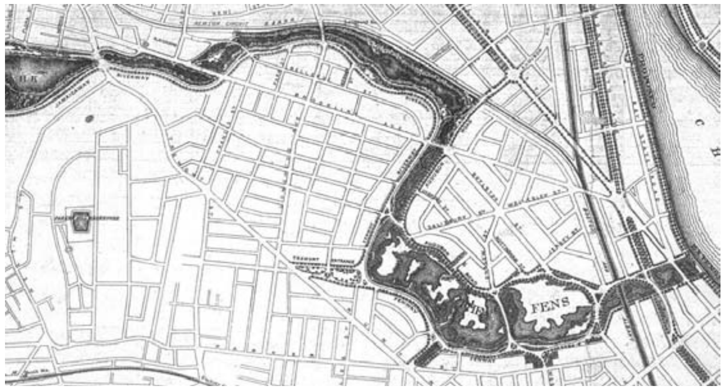


Figure 3.3 Olmsted's 1894 plan for the Back Bay Fens and the Riverway (Tucker, 2001, 35)

Figure 3.4 View of Boston Riverway, 1920 (Tucker, 2001, 34)

Examples

Herbert Hosana Park, Colorado

The Herbert Hosana Park is a school site being used as an off-line detention pond (Figure 3.5). Adjacent channels can carry flows up to the 25-year flood peak. The school grounds thus provide flood protection and are used as playfields including soccer fields and baseball fields, complete with press box and bleachers (DeGroot and Lloyd, 1992, 20).

Figure 3.5 Herbert Hosana School Park,
Colorado (Stahre and Urbonas, 1990, 34)

Jefferson High School Athletic Fields, Colorado

The athletic fields of the Jefferson High School in the city of Edgewater, Colorado, were built across a tributary to Sloans Lake with only an 18” pipe for drainage. As the upstream basin urbanized, flooding became a frequent occurrence. The solution was an off-line detention pond in the athletic fields. The excess flows of a 5-year peak are now detained on the athletic fields resulting in a 100-year flood protection downstream (DeGroot and Lloyd, 1992, 20).

Wallace Park, Colorado

Wallace Park is a 25-acre park designed by Wenk Associates, Denver. This park facilitates stormwater detention of 10-year or greater flood events thus providing flood protection and also park facilities to the adjoining offices and neighborhood (DeGroot and Lloyd, 1992, 20). The open areas are utilized for soccer and Frisbee games. The concrete low flow channel, which cuts through the center of the park, is combined with a walking path. The foot deep stream and the drop-structure “plazas” that punctuate the flow in three places, form play areas for children. These sandstone-colored plazas are studded with the “dragon’s teeth”, used by hydrologists in baffle-chute drop structures

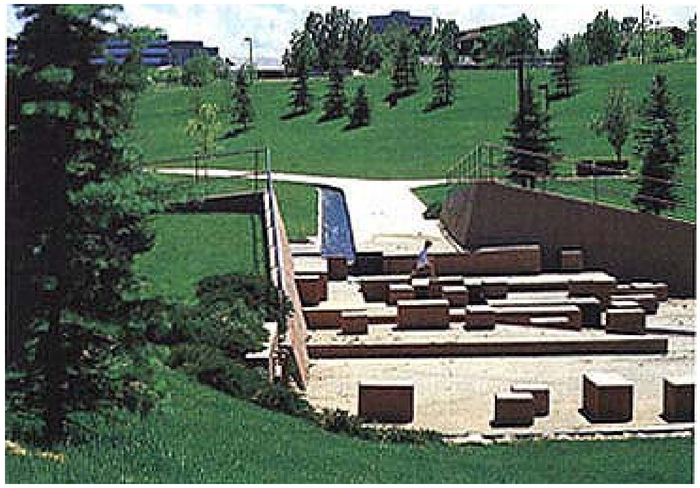

Figure 3.6 Wallace Park, Colorado (Strutin, 1991, 87)

to slow down water (Fig 3.6). These form elements of children's play and due to its sculptural quality it also draws park visitors to the water's edge, where it swirls around the baffles. The adjoining offices also utilize it during lunch hours (Strutin, 1991, 87). The Wallace Park has become a valuable part of the community due to its multi-purpose amenities.

Olympic Park, Colorado

The Olympic Park in Aurora, Colorado, also designed by Wenk Associates, includes softball and soccer fields along with other park amenities. A three-quarter acre all-season wet detention pond holds runoff from the parking lot and surrounding area (Figure 3.7). The pond holds a maximum depth of three feet water; the excess travels through a system of perforated pipes and recharges the ground water. The pond is accessible by concrete steps. Children use the wading pond for recreation (MacElroy and Winterbottom, 2000, 102). The fountains, which aerate the water, also form a visual element and enliven the space.

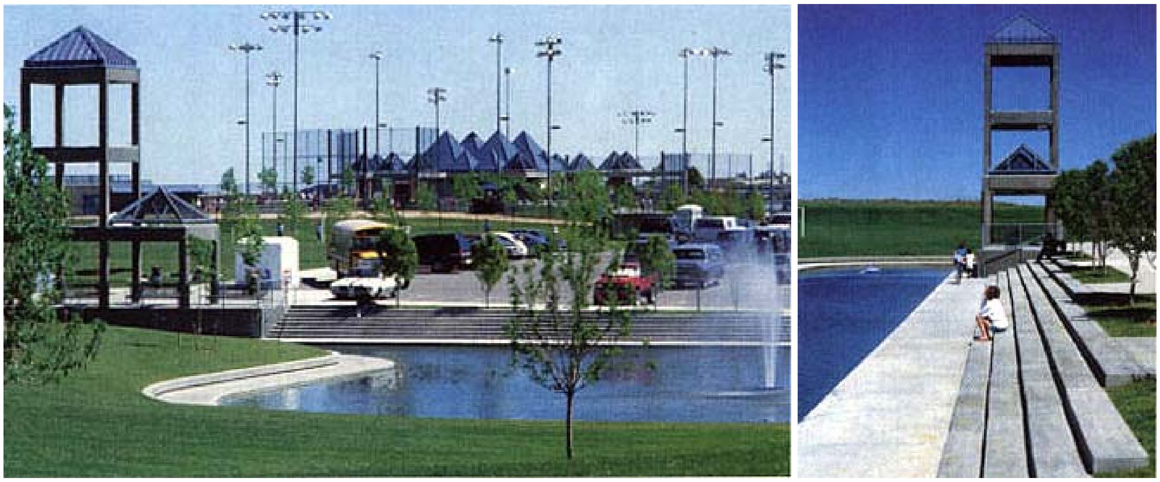

Figure 3.7 Detention pond in Olympic Park, Aurora, Colorado (McElroy and Winterbottom, 2000, 54)

Other examples

LeBreton Park, Canada

The LeBreton Park is an inner-city Park within a housing development in Ottawa, Canada (Figure 3.8). It has a hard surfaced detention area to hold a 2-year flood peak. This detention area provides an ephemeral pond for play and recreation that is linked to the hydrological cycle (Figure 3.9). Roof water from adjacent housing and overland flow within the park is conveyed by a series of drainage channels into the pond. The pond fills up to a depth of 18 inches. The hard surfaced bottom is designed to permit many different activities. During winter it becomes an ice skating rink. During summer, after rain, the activity focuses on water play. When the water dries out, the area is taken over by roller skaters and skateboarders. Thus the children's activities respond to the changing environment. By accommodating such multiple uses of the detention area, children are brought close to the cycles of rain and sunshine (Hough, 1994, 92).

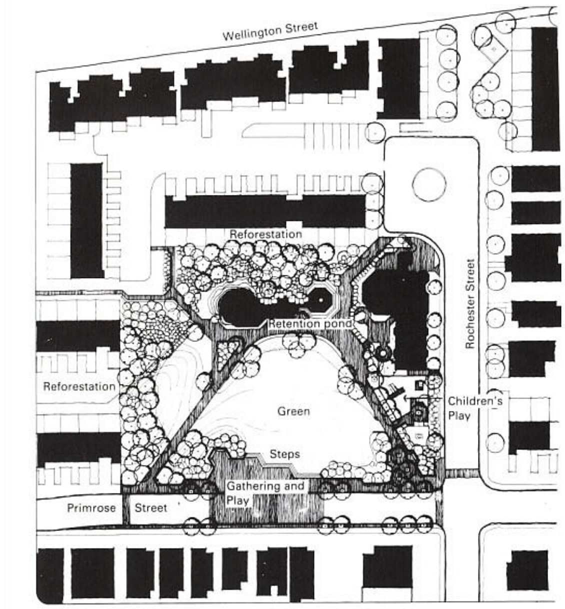


Figure 3.8 LeBreton Park and surrounding residential area (Hough, 1994, 91)

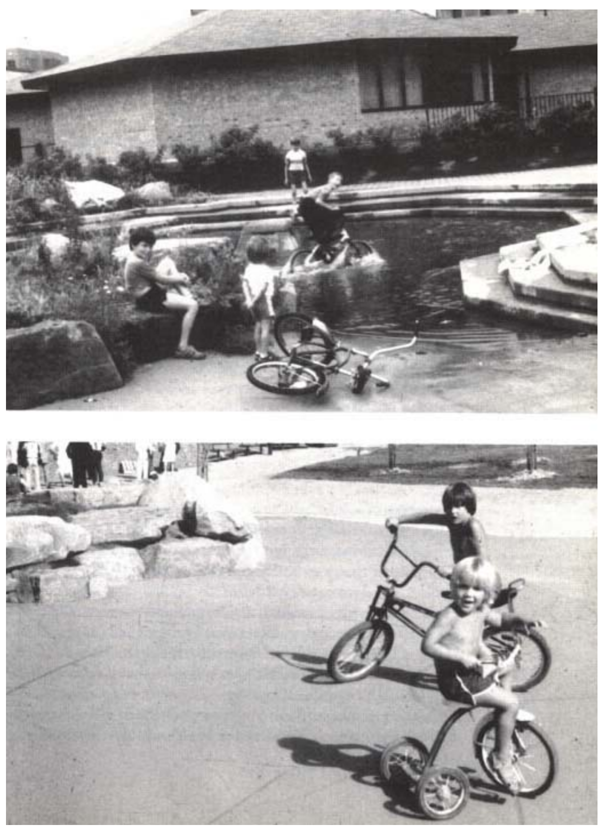

Figure 3.9 Seasonal changes in children's play at the LeBreton Park (Hough, 1994, 93)

Figure 3.10 Playfield in Sunset Meadow Park, Arlington, being used as a detention facility (Cappulli, 1984, 48)

Arlington Heights, Chicago

Arlington Heights, located to the northwest of Chicago, is an example of a community that works with the local government to develop stormwater facilities that serve dual purposes. Developers in Arlington Heights were required to provide on-site stormwater detention. They often turned these detention basins over to the community, which made agreements with the park district to maintain these areas as park or open space. But in the past these areas did not receive any design directions from the park district and often turned into a wasted space and a maintenance problem. Now the park district has an agreement with the community that they will only take over and maintain stormwater detention facilities that have a recreational use. Since then several recreational facilities like golf courses, ball diamonds, tennis courts, ice skating rinks, sledding hills and nature areas have been incorporated into detention ponds (Figure 3.10).

In addition to providing flood control and aesthetic enhancement, the Arlington Lakes Golf Course uses its detention lakes for irrigation purposes. The facility also provides year round use by offering the course as a cross country ski trail in the winter (Capulli and Jacobson, 1984, 49)

<u>Yauger Park, Washington</u>

The Yauger Park, located in Olympia, Washington is a 40-acre park and regional stormwater detention facility. It provides stormwater control as well as varied active and passive recreational opportunities. The park has three baseball fields, a playground, horseshoe pits, picnic tables, picnic shelter, one-mile jogging trail and a community garden. The park is designed to detain a 100-year storm event. Two settling ponds, the south parking lot and sports fields serve as stormwater detention areas. The park protects a commercial area downstream from flooding. Some of the playfields are built higher than the overflow structure hence they are rarely flooded (Weber, 1991, 61-62).

**Conclusion**

The examples above indicate that different kinds of recreational amenities can be incorporated in a stormwater detention facility and when these detention facilities are incorporated in parks and open spaces, they conserve space in urban areas while becoming community assets. Even the components of a detention facility can be designed as elements of play and to be visually attractive. Depending on the desired use of the facility, it can be natural or hard surfaced and have a hard edge or planted edge.

**Planning considerations for multi-use stormwater detention facilities**

There are several issues to be considered when planning for a multi-use stormwater detention facility, to make the facility acceptable by people. The primary considerations are regarding recreation, aesthetics, maintenance, safety, water quality and wildlife habitat. Care has to be taken to see that the recreational function does not

Figure 3.11 Detention pond in the backdrop of children's play area, Denver (Urban Drainage Criteria Manual, 2001, PL-22)

interfere with the hydrological function and vice versa. Multi-use would also involve interdisciplinary planning. It would require planners, designers, ecologists and managers of the city to work together on stormwater problems.

Recreation

As seen in the previous section, stormwater ponds can be designed for active and passive recreation like playfields, game courts, golf course, ice skating rink, skate boarding, nature trailing and picnicking. For many non-water oriented recreation activities, such as golf and children's play areas, water forms "an important backdrop" (Tourbier and Westmacott, 1992, 2; Jones, 1990, 53) (Figure 3.11). Urban residents highly value access to water and an opportunity to be close to nature. Docks, piers, decks and boardwalks that provide access and give people the opportunity to touch water are important design features that should not be ignored.

Using detention basins for recreation has both positive and negative aspects. The disadvantage is that the turf requires more care in high use areas compared to play areas without detention facility. Poor drainage and excessive sedimentation can damage the turf. Hence turf should be of a species of grass, which can withstand inundation. Overseeding needs to be done frequently. Ball fields are more difficult to maintain in detention basins because they need a smooth and even turf (Cappulli and Jacobson, 1984, 70). The recreation facilities should not be placed near the bottom of the detention pond as it might become subjected to frequent flooding. Hard-surfaced game courts and playgrounds incorporated into detention basins may require greater maintenance due to the occasional silt deposition (Weber, 1991, 21)

The detention ponds should be available for recreational activities as quickly as possible, following their use for runoff detention. Hence it is desirable to install a low flow channel to facilitate drainage. Bottom slopes should assure rapid drainage but should be carefully planned to minimize the likelihood of injury to sports participants (Jonathan Jones and Earl Jones, 1982, 325). Drainage of the pond bottom between storms has to occur efficiently if it is going to be used for recreation. To achieve this, the bottom has to be cross-sloped at no less than 2% towards the low flow channel (Stahre and Urbonas, 1990, 39)

In case of dry detention basins, which are used as playgrounds between storm events, there is concern about the possible buildup of metals and other substances on to the dirt comprising the floor of the basin, and its effect on children playing in the material and inhaling the dust (Cobb, 1982, 19). For this purpose the soil should be monitored for levels of toxins and harmful metals like lead. It usually takes a very long period for the soil to reach any objectionable level of contamination. The sources of toxic contaminants upstream can be inventoried prior to building the facility and necessary action can be taken.

Figure 3.12 Detention pond near a Housing Complex, Colorado (Urban Drainage Criteria Manual, 2001, DP-11)

Aesthetics

Aesthetics plays a major role in the public acceptance or rejection of a detention facility. For a detention pond to be an integral part of the community, it needs to blend into the landscape and into the community. Detention facilities can take a park-like appearance and actually enhance the aesthetics of an area (Debo, 1982, 334) (Figure 3.12). Wet ponds can be aesthetically pleasing and increase property values due to the waterfront effect. However there are differences in regional taste among people. For example, people in some areas enjoy a natural look with cattails and other aquatic life growing at the edge of the pond while others prefer a manicured lawn appearance around the pond. Dry ponds, on the other hand, may be perceived as unattractive by the public unless they are maintained as a lawn.

Wet ponds can be unattractive if the pond regularly develops heavy algae growths and weeds (Cobb, 19, 1982). Excessive algae can cause odor and aesthetic problems.  Lowering the impounded water surface for a time, then re-establishing it can sometimes accomplish effective algae and weed control (Jonathan Jones and Earl Jones, 1982, 327). Dry ponds do not have algae problems since water is drained frequently in-between storms (Stahre and Urbonas, 1990, 52). In wet ponds, aeration and introduction of algae-eating fish can reduce the growth of algae.

Fences, though used extensively for safety purposes, are considered unattractive. The use of natural landforms, meandering channels, water fountains, irregular configuration, gentle side slopes, mosquito control, planting of native trees and shrubs, concealment of inlets and outlets and other landscaping features can transform a detention facility into an attractive amenity for the neighborhood (Stahre and Urbonas, 1990, 32) (Urbonas, Carlson and Tucker, 1993, 17).

Maintenance

Maintenance of detention facilities is necessary for their hydrological functioning and acceptability by the community (Weber, 1991, 23). Easy and rapid access for maintenance equipment is essential to remove debris and sediment (Jonathan Jones and Earl Jones, 1982, 327). A maintenance access of width 12 feet is recommended to reach the key maintenance areas like inlet and outlet structures (Urban Stormwater Drainage Criteria Manual, 2001, MD-52)

Sediment removal is one of the most expensive maintenance activities for detention ponds. When the suspended solids load is high, the ponds will have to be cleaned more often. Special considerations are necessary if the sediment contains elevated concentrations of metals and organics (Jones, 1990, 52). Limitation of sediment removal, hauling and disposal costs require acquisition and preparation of a nearby sediment disposal site when the detention pond is conceived and constructed (Jonathan and Earl D. Jones, 1982, 328)

Other maintenance activities involve mowing, weed control, trash removal, algae control and mosquito control. Seeding the wetland with mosquito fish (Gambusia affinis) and dragonfly larvae, in addition to aeration, can control mosquitoes (Campbell and Ogden, 1999, 121). Ponds should not be designed with steep slopes as they pose a difficulty in mowing. Generally, construction, operation and maintenance costs will be less for one large pond than for a series of smaller ponds (Jonathan and Earl Jones, 1982, 324).

Safety

Human safety is another concern in the design of detention basins. The outlet of the basin is essentially a constricted culvert or a narrow pipe. The large volume of water exerts a lot of pressure on these narrow outlets leading to faster flow. According to Ferguson, conveyance should be as open and free flowing as possible. It should be slow, shallow and free of constrictions. Broad open weirs are much safer than narrow outlets. The basins are usually designed with steep slopes and located out of sight. This makes them more hazardous. The basin should be open and visible and accessible so that people can appreciate any hazard, take the necessary precaution, monitor others and provide rescue when needed (Ferguson, 1998, 26).

Proper landscaping is a fundamental element in safety design. Fencing of detention ponds should be discouraged wherever possible. Fences are expensive to install and maintain, tend to be unsightly, produce “edges”, which increase grounds maintenance needs, exists as a challenge to some of those they are intended to protect, and they impede emergency access in the unlikely event it becomes necessary (Jonathan Jones and Earl Jones, 1982, 325). Although safety should remain a concern, a properly designed detention pond should not be more hazardous than an urban lake, a playground, a hiking trail, or any other recreational or park facility in a city. It is definitely a safer facility than a city street, yet no one fences off the streets (Stahre and Urbonas, 1990, 36).

Figure 3.13 Hydraulic stucture blended into the landscape, Colorado (Urban Drainage Criteria Manual, 2001, HS-7)

Hydraulic structures

The planning, design, construction and maintenance of hydraulic structures must include considerations of aesthetics, safety and effects on the environment. Structures such as channels, inlet, outlet, overflow, grade controls, energy dissipators, maintenance roads and others can blend in with the park environment (Figure 3.13). The combination of diversity of forms, lines, colors and textures creates visual experience. Material selection and placement of vegetation can provide visual character and create interesting spaces in and around hydraulic structures. The use of planting that reduces erosion and dissipates residual energy are fundamental to good aesthetics and environmental quality as well as hydraulic function.

In highly developed streamside areas, concrete plazas and edge treatment can be combined to increase channel efficiencies while providing access to waterway area. Natural materials like rock and vegetation can be used for bank stability while providing interesting spatial character and diversity. Some hydraulic and drainage features offer an invitation to play and hence should be made structurally safe and attractive (Urban Stormwater Drainage Criteria Manual, 2001, HS-107).

Water quality

Urban detention ponds play an important role in stormwater quality management because they trap substantial quantities of pollutants. The pond should provide an average residence time of 24 hours for water quality. This will also eliminate mosquito problems since mosquitoes generally require 48 hours to breed and hatch. In a study conducted in New Jersey, it was found that the detention basins trap 60 to 70 percent of lead, total suspended solids and hydrocarbons during a detention time of 32 hours. Even during an 8-hour detention time, 30 to 40 percent of the pollutants are precipitated. A series of ponds can be more effective in removing about 80 percent of the pollutant (Jonathan Jones and Earl Jones, 1982, 321). Regular monitoring of water and sediment from the detention ponds should be done to ensure that they meet safety standards (Weber, 1991, 24)

Wildlife habitat

There is an opportunity to enhance wildlife in urban areas by creating wetlands as a by-product of stormwater management. Research initiated by the National Institute for Urban Wildlife (NIUW) in 1982 found that typical grass detention basins were of little use to wildlife. Permanent shallow water impoundments with a variety of aquatic plants, gentle slopes and less open water provided good wildlife habitat (Campbell and Ogden, 1999, 196). A native vegetation edge will encourage wildlife to use the area and is also more consistent with enhanced pollutant removal (Jones, 1990, 53). Creation of islands, bays and particular aquatic plantings like pondweeds, wild rice, wild celery and duckweed that provide maximum food and cover, help in assisting wildlife habitat. The addition of nesting and roosting boxes along with feeding stations, floating platforms, bird houses, shelters for squirrels, cover for chipmunks and other wildlife can increase the attractiveness and functioning of wildlife habitats (Campbell and Ogden, 1999, 200-

201). Maintaining an unmowed buffer of at least 25 feet can provide a good terrestrial and aquatic habitat. Also varying the pond depth, with at least 25 percent area at less than 2 feet depth can diversify the habitat (Schueler, 1987).

# CHAPTER FOUR

# CASE STUDIES

This chapter looks closely at three case studies; Mill Creek Park in King County, Washington, Fishtrap Creek Nature Park in British Columbia and Skyline Park in Denver, Colorado. Among the facilities available for discussions, these three were specifically chosen due the difference in their location, setting, character and design approach. Mill Creek Park was designed by an artist and has a sculptural quality; Fishtrap Creek Nature Park was designed by an interdisciplinary team and has a very natural appeal whereas the Skyline Park is a hard-surface urban plaza in downtown Denver and is a part of an urban renewal scheme.

## CASE STUDY 1: MILL CREEK PARK

The city of Kent is located in the south of the Seattle metropolitan region. Development of land in Kent, along Mill Creek had resulted in excessive flows of water during periods of heavy rain and the city needed a way of containing it and allowing it to recede slowly through the town (Beardsley, 1998, 94). In the late 1970's, the City's Public Works Department decided to fund and build a large regional detention pond along Mill Creek in response to the increasing volume of runoff generated in the 1500-acre watershed.

Meanwhile, the King County Arts Commission had decided to fund an earthwork project. The Mill Creek Park site was selected for this project and it was decided to design a large multi-use stormwater detention facility. Herbert Bayer, the artist selected for the project, designed a park containing a group of earth forms (Figure

Figure 4.1 Mill Creek Park, King County, Washington
(Matilsky, 1992, 46)

4.1). The earth forms are inundated during times of flood and provide an inviting 2.5 acre passive recreation park during dry periods (Beardsley, 1998, 94). The park is very successful in detaining stormwater and protecting downstream areas from flooding. The settling ponds effectively trap sediments thereby improving the water quality. The facility performed very well when tested by the severe 100-year storm on January 9, 1990. Without it flooding downstream would have been worse (Weber, 1991, 41).

The total project cost came to $572,000. Out of this, 450,000 was provided by the City Engineering Department to pay for the detention basin and the rest of the money came from a wide variety of sources, including the Kent's Park Department and Arts Commission, the King County Arts Commission, the Washington State Arts Commission, the National Endowment for the Arts, a Housing and Community Development Block Grant and over 150 donations of varying amounts from individuals and corporations (Beardsley, 1998, 97).

Figure 4.2 Ring pond filled with water, Mill Creek Park, King County, Washington (Beardsley, 1998, 93)

**Description**

The Earthworks Park occupies 2-1/2 acres at the foot of the Mill Creek Canyon. It is designed for a 100-year storm event. The design consists of two steep sided irregular detention basins broken by berms and mounds. The major features of the design are two mounds, a cone that supports a bridge over Mill Creek, a shallow ring pond surrounding a ring mound and inner pond (Figure 4.2), and a ring mound sliced into two by the creek and supported by retaining walls. Turf is the main ground cover for all the features and the floor of the detention basin (Weber, 91, 36).

The creek is first directed into a settling pond to remove sediment and debris. A controlled amount of stream water is diverted into a channel as part of the earthwork design, while the natural main channel remains to one side. The diverted channel meanders through the site and is lined with stone to prevent erosion. As it enters the park, it comes first to a mounded ring, 100’ in diameter and 5’ high, which breaks with the channel’s passage. The channel then passes under a conical mound and another earthen ring. This ring seems to be suspended in a circular pool of water, 85’ in diameter. This ring contains water part of the year and drains at other times to reveal the

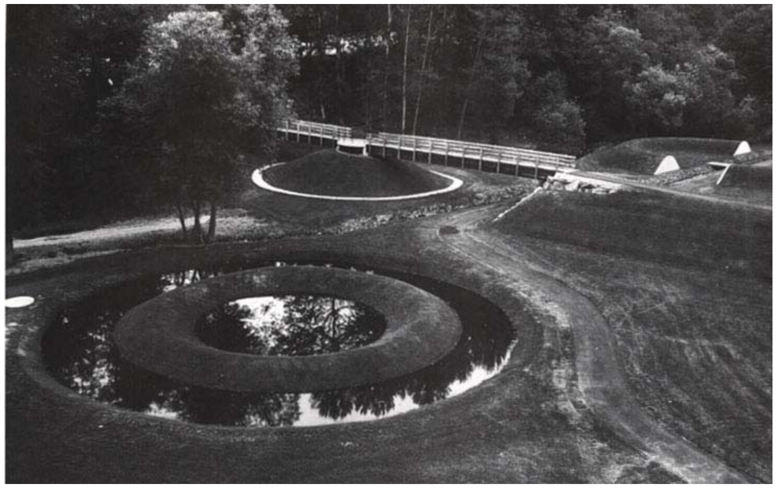

Figure 4.3 Oval mound with a bridge, Mill Creek Park, King County, Washington (Bourdon, 1995, 227)

full contours of the grass ring. Then comes the high berm topped with another cone. Below it is a final oval mound (Beardsley, 1998, 94) (Figure 4.3).

Two sets of stairs with a viewing platform and a viewing tower are incorporated with the overflow structure. Benches and picnic tables are placed along an asphalt path, which meanders through the site. An amphitheater and a concert stage are located upstream of the earthworks by the settling pond (Weber, 1991, 37).

**Recreational amenities**

Bayer's Mill Creek earth forms are the focal point of the one hundred acre park. The park serves as a gathering place for community. The grass covered mounds, berms and level areas create a variety of spaces for people to stroll through and play on. Children enjoy climbing on top of the berms and rolling down the hill. The benches, picnic tables and viewing platforms provide opportunities for resting, picnicking and viewing (Figure 4.4). The settling pond, which provides habitat for salmon, offers nature watching and fishing opportunities. The ring pond and stream channel are aesthetically pleasing, especially when filled with water (Weber, 1991, 45).

Figure 4.4 Meandering asphalt path with picnic tablesMill Creek Park, King County, Washington (Beardsley, 1989, 48)

Dances, concerts, weddings and a variety of other activities are scheduled every weekend (Figure 4.5). The park's landscape provides a beautiful backdrop for recreation activities. The 'Canterbury Faire' is held every year in the park (Weber, 1991, 46). The park is closed during heavy rain and during maintenance. The maintenance requires

Figure 4.5 Mill Creek Park during an event, King County, Washington (Beardsley, 1998, 93)

only a few days. Heavy rain events are rare and the facility dries very quickly after such event. Since there is only 5 inches of rainfall during the active recreation months - May through September, the facility is available during these months (Weber, 1991, 46, 47).

**Maintenance and other issues**

The park is well maintained by the Parks Department and Public Works Department of the city of Kent. The maintenance involves trash removal, regular mowing and annual dredging. Some features of the design pose a maintenance problem. The design does not accommodate access for heavy vehicles to the creek, ring pond and outflow. The paths are too narrow and steep in some places for vehicular access. Due to this, the silt has to be hand shoveled (Weber, 1991, 46, 47). The turf has withstood inundations well; perhaps due to the nutrients from the silt play a role in maintaining a healthy turf. But the steep slopes of the berms, mounds and ring pond pose a difficulty in mowing, resulting in an uneven appearance. The ring pond also develops algae on account of poor water circulation (Weber, 1991, 50). So far there have been no accidents or safety problems in the park. Also there does not seem to be a problem regarding the toxicity from the sediment.

**Conclusion**

Bayer's design for Mill Creek Park controls stormwater runoff into Mill Creek Canyon and is successful as both an artwork and a community gathering place. The park is a peaceful place where the sight and sound of water contributes a soothing place (Matilsky, 1992, 47). The city is proud of the project, calling it 'a landmark in park design and a revolutionary concept in solving the problem of surface runoff  (Beardsley, 1998, 97).

**CASE STUDY 2: FISHTRAP CREEK NATURE PARK**

Figure 4.6 Aerial view of Fishtrap Creek Park, Abbotsford, British Columbia (www.dayton-knight.com)

The Fishtrap Creek Nature Park in Abbotsford, British Columbia is a 57 acre park surrounded by suburban development in a small city in Fraser Valley (Figure4.6). The town of Abbotsford is located about 20 miles east of Vancouver in the district of Matsqui. Due to rapid development in the past thirty years and a heavy annual rainfall of 60 inches, the town faced increased flooding of farmlands. As a solution to this problem the municipality proposed two detention ponds in the Fishtrap Creek, which drains 7,526 acres of upland developed land and lowland farms as it flows south across the Canada-U.S border and joins the Nooksack River in Washington (Mooney, 2001, 66). The original purpose of the project was expanded by the landscape architects to include a variety of ecological and recreational objectives (Berris, 2000). The municipality acquired 57 acres of unused, overgrown farmland and woodland in the upper watersheds of the creek for the project.


Figure 4.7 Plan of Fishtrap Creek Park, Abbotsford, British Columbia (www.cbainc.bc.ca/services/parksite.html)

**Description**

The existing creek was relocated to include meandering and a wider cross section (Figure 4.7). During peak flows, water overflows from the stream channel filling the adjacent created wetlands. Floodwater from the wetland is released downstream over a period of time through a control structure. The wetlands provide a detention area of 10 acre-feet accommodating a floodwater rise of 5 feet. The wetland is designed to capture 60 percent of the suspended solids from a one-hour duration storm of a 10-year storm event. A sediment pond between the northern and southern areas of the park removes further sediment from the runoff. Year round flow of the creek is maintained by infiltration of water (Mooney, 2001, 66). The detention ponds and the walkway around it have a naturalistic form with side slopes of 1:3 or 1:5 and are planted with native dogwood and willow shrubs. The floor of the wetland is planted with cattails (Typha latifolia) due to its biofiltration property, ability to colonize quickly and to withstand water fluctuations. A buffer of mature forest is retained along the steep southern boundary of the site (Mooney, 2001, 69).

Figure 4.8 Entry Pier, Fishtrap Creek Park, Abbotsford, British Columbia (www.cbainc.bc.ca/services/parksite.html)

**Recreation amenities**

The Fishtrap Creek is extensively used by neighboring residents and people throughout the area. The park provides better shading, viewing and habitat possibilities, public recreation and education through ecological and cultural signage. The recreational uses are supported by a two-lane loop trail and six structures set within the

Figure 4.9 Picnic Shelter, Fishtrap Creek Park, Abbotsford, British Columbia (www.cbainc.bc.ca/services/parksite.html)

park. These six structures, an entry pier (Figure 4.8), picnic shelter (Figure 4.9), reading shelter, pedestrian bridge, wetland boardwalk and a railway deck, support viewing, access and interpretation. The structures are made of massive timber posts that are reminiscent of the historical agricultural buildings of the region. The railway deck is located at a high point on the site and serves as an overlook point. Park activities include walking, bird watching and picnicking. Active recreation includes jogging, roller blading, cycling and softball (Mooney, 2001, 69).

**Wildlife habitat**

The site is heterogeneous and includes meadow, old-field habitats, mixed woodlands, and riparian and wetland habitats. The park is home to beavers, muskrats, turtles and a wide variety of birds like owls, migratory waterfowls and the blue and green herons, which annually visit the park (Mooney, 2001, 69). The shoreline of the detention ponds provides good wildlife habitat because of the gentle slopes and a variety of edge effect. The peninsulas and islands, which are inaccessible to humans provide very good nesting habitats (Berris, 2000). Although cattail was required due to large water fluctuations, the predominance of a single species reduces the habitat value. Also to achieve a large stormwater storage capacity, the woodland habitat was excavated and replaced with a wetland and riparian habitat thereby increasing riparian species and decreasing forest species (Mooney, 2001, 125).

**Maintenance**

Maintenance of most of the areas in the park is kept to a minimum, allowing it to undergo natural succession. Only the walking path is mowed and the rest of the areas are allowed to grow into a grassy meadow. Invasive species are removed manually (Mooney, 2001, 125).

**Conclusion**

Both the users and the district engineering and park staff consider the park highly successful. The flood detention system has achieved its goal of mitigating peak flows and maintaining water quality while sustaining base flows. The project was headed by a multi-disciplinary team that included water resources and civil engineers, fisheries and wildlife biologists, soils and wetland vegetation consultants and landscape architects, including Catherine Berris. Both the passive and active recreation in the park is compatible with the wildlife habitat and flood control. In fact, the detention system provides the physical and visual setting for these activities (Mooney, 2001, 66, 123-125).

## CASE STUDY 3: SKYLINE PARK, DENVER, COLORADO

Figure 4.10 Skyline Park, Denver, Colorado (www.downtowndenver.com)


Figure 4.11 Skyline Park, Denver, Colorado (Greenberg consultants, 2001, 8) (www.downtowndenver.com)

The Skyline Park in downtown Denver, Colorado is a major public open space (Figure 4.10). The park is a part of the on-site stormwater detention scheme that was adopted for the 80-acre downtown Denver business area of the Skyline Urban Renewal Project. The scheme called for storage of 3 inches of rainfall on all rooftops, in parking areas and pedestrian plazas (Wright, 1982, 297).

**Description**

The park, designed by Lawrence Halprin, is a three-block long detention basin with a width of 100 ft and an approximate area of 3.2 acres (Figure 4.11). The park comprises of a set of depressed walkways, raised planters with shade trees and a

Figure 4.12 Skyline Park, Denver, Colorado (Mooney, 2001, 66)

sculpted fountain in each of the three blocks. It also has a series of steps and levels, and is paved with concrete and brick. It is at a lower grade than the adjoining area and is surrounded by grass and concrete berms (Figure 4.12). The park is designed for a 10year and 100year flood event and detains water from rooftops and surrounding paved surfaces thereby reducing the storm flow rates to the available capacity of the downstream sewers. The park has flooded several times after its construction and functions very well. Since it receives runoff from paved surfaces, there are no sediment problems (Kenneth Wright, Personal communication).

**Recreation**

The park is used by people for strolling, eating lunch or just relaxing in the sun. Children use the park for skateboarding (Stahre and Urbonas, 1990, 33-34). Even when the plaza is filled with water, the upper levels provide seating and access across the plaza (Weber, 1991, 19).

**Revitalization of the Park**

The changing context, in particular, the fact that Skyline Park is literally bisected by the 16th Street Mall, which did not exist at the time of its creation and the fact that the Park has begun to experience some difficulties, including physical deterioration, set the stage for a fundamental reconsideration of its role and form (Greenberg, 2001, 8). Two ideas that strongly emerged in the revitalization project were the notion of the ‘piazza’ at the junction with the 16th Street Mall - the hard surface; multipurpose ever-changing city space and the more pastoral soft and vegetated ‘gardenesque’ park. Some modifications were also suggested which would open up the park visually, improve the relationship between Skyline Park, the immediately adjacent buildings and the adjoining streets.

The presence of water has been identified as a permanent element in the proposed design, as in the present design by Halprin. Water would link and unify all the three blocks of the Park and would animate the space throughout the year in its various states of ice, liquid and vapor. Although the new design calls for a number of changes, it will still retain the stormwater detention function. The new vision for the park will allow for the necessary on-site stormwater detention of approximately 5000cu.ft of water per block (Greenberg, 2001, 47).

# CHAPTER FIVE
# DESIGN APPLICATION

## Design intent

This chapter presents an additional design proposal for part of the Southeast Community Park in Athens, Georgia. The site has three detention ponds, which collect the runoff generated on site and from other uphill areas. The excess stormwater is directed to a creek that runs through the site. The ponds are a purely technical solution to the urban runoff problem and do not, in any way, contribute to recreational or aesthetic experience. They are located along the edge of the park and are hidden from the people visiting the park. The design intent of this thesis is to facilitate multiple-uses of these detention facilities by re-shaping the ponds into a more naturalistic form to provide recreational and wildlife benefits. The design also tries to integrate them into the park, making them more accessible. The aim is to make the natural process of stormwater visible and understandable to people through sight and sound and thus establish a connection between the urban environment and natural processes.

## The Site

The site is located at the corner of Lexington and Whit Davis Road (Figure 5.1). It is an undeveloped tract of land measuring 146.39 acres. A creek runs diagonally northwest to southeast through the central portion of the site and divides the site into northern and southern parts. It is surrounded by undisturbed oak-hickory forest vegetation covering an area of about 51acres. A spring located in the northwestern part of this creek provides a continuous source of water. The water drains into Shoal Creek

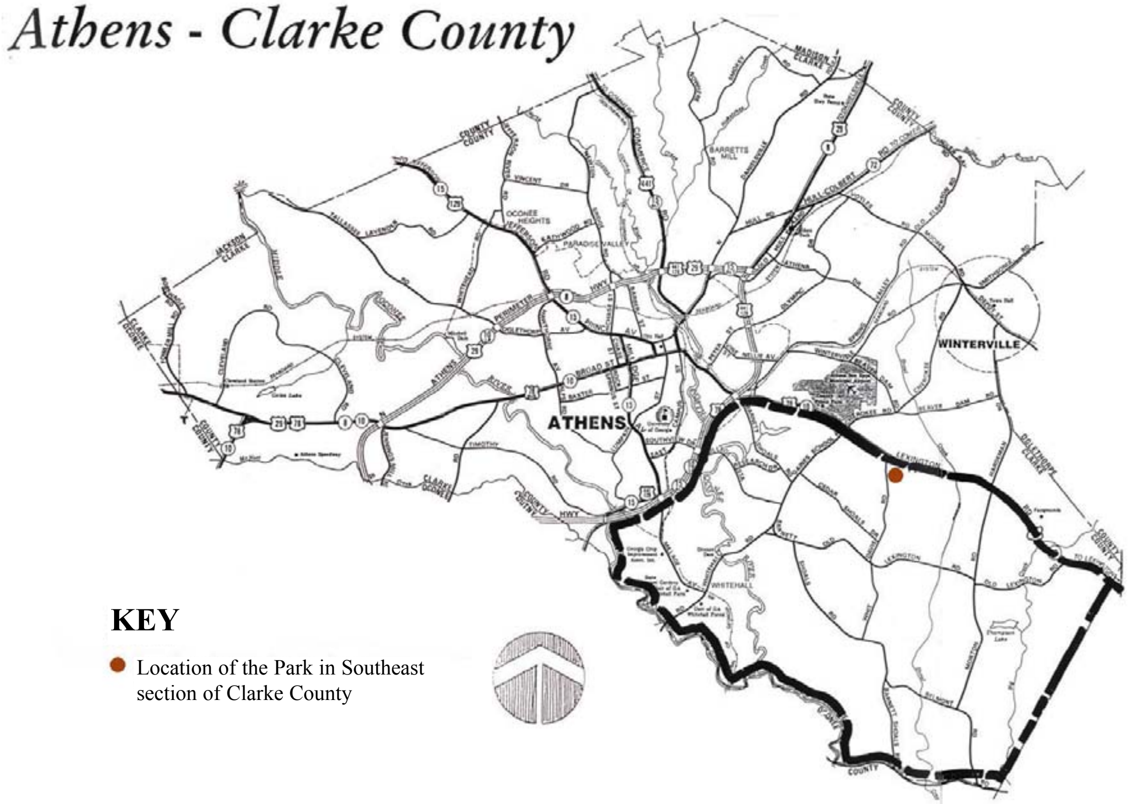


Figure 5.1 Location of Southeast Clarke County Community Park in Athens-Clarke County (Courtesy - Robby Bryant, Robert and Company, 2002)

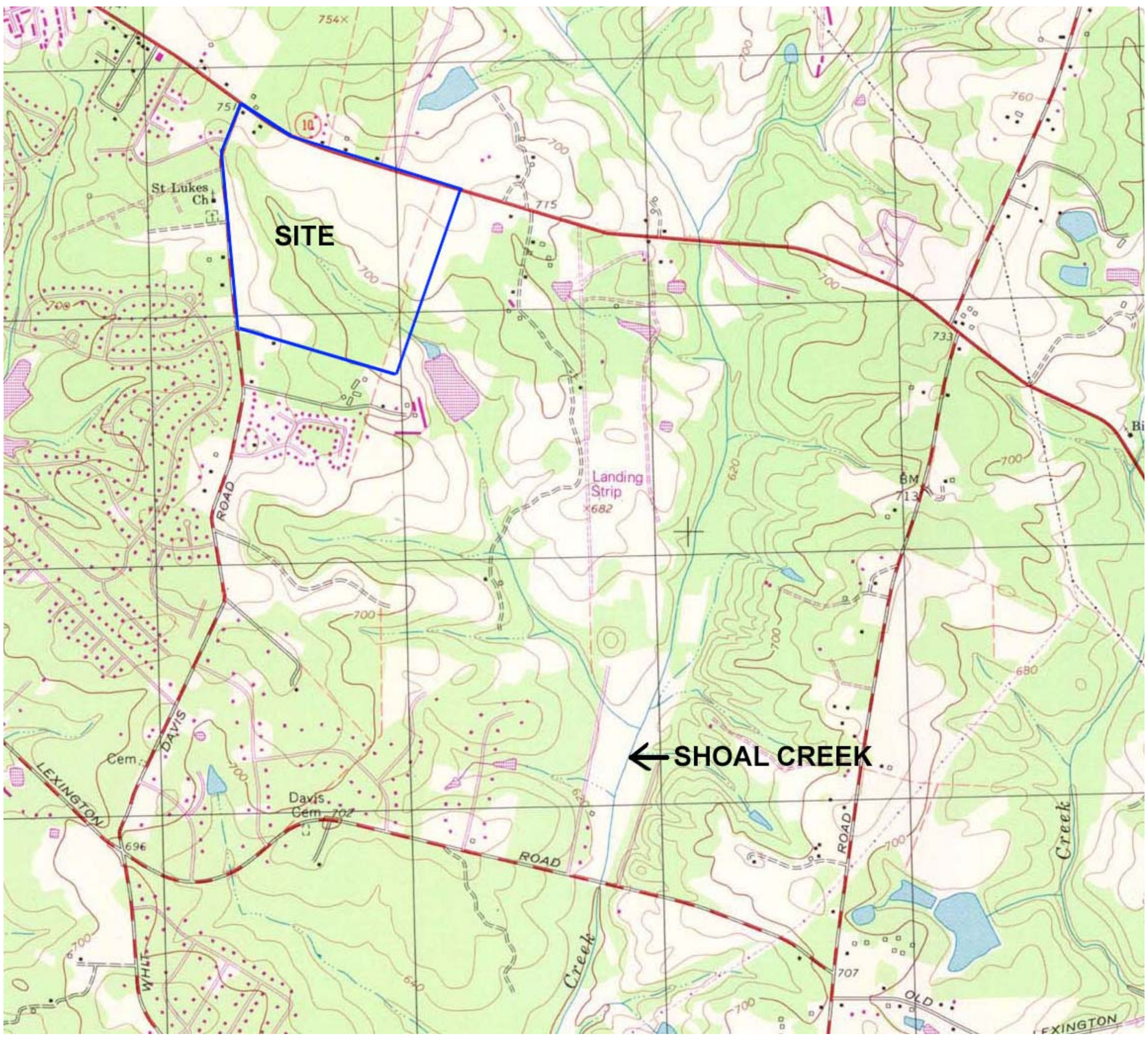


Figure 5.2 USGS map of east Athens,GA, 1998 — Site boundary

Figure 5.3 Aerial view of the site before development, January 1999 (www.terraserver.com)

Site boundary

located beyond the eastern boundary of the site (Figure 5.2). The northern part of the site is accessible by Lexington Road and the southern part is accessible by Whit Davis Road. The entire site slopes about 5 to 10% towards the creek. The slopes are steeper at the edge of the creek. Before development of the park in 2000-2002, more than 50 percent of the site had been cleared and maintained as a farmland (Figure 5.3). Single-family residences surround the site on the south and west. A commercial driving range borders the eastern edge of the site. The northern side is mostly undeveloped and consists of a mobile home park. A small tract of land measuring 9.743 acres, located on the northwest corner of the site, is designated as a future commercial area.

At present the site contains two baseball fields, a football/soccer field, two tennis courts, a jogging/walking trail around the play fields, a concession building, a nature trail, and parking lots. All these facilities, except a parking lot, are located in the northern half of the site (Figure 5.4). The nature trail that runs through the wooded area is the only connection between the two parts of the site. Additional recreational facilities that may be constructed in the future, depending on the funds available, include two baseball fields, a football/soccer field, another concession building, a community building, some hard-surface courts and additional parking in the northern part and two baseball fields, three tennis courts and a community garden in the southern part (Robert and Company,1999). The vehicular access roads in both parts of the site, which are unconnected at present, would be connected in the future.

There are three rectangular detention ponds located in the steeper northern part of the site, close to the creek. The ponds are designed for a 25year flood event. The first pond is located towards the north and is the largest of the three ponds. It occupies an area of 28,000sq.ft and has a depth of 10ft. It receives runoff primarily from the parking lot and the area designated for future commercial. The second pond is the smallest, occupying an area of 8,790sq.ft and has a depth of 6ft. The third pond has an area of


Figure 5.4 Existing plan of Southeast Community Park, Athens, GA
(Courtesy - Robby Bryant, Robert and Company, 2002)

11,600sq.ft and a depth of 6ft. The second and third ponds receive runoff from the play fields. The ponds are not hydraulically connected to each other and act as isolated stormwater detention systems. The ponds are provided with an outlet and an emergency spillway.

Apart from the natural forest in the central portion on the site, the only vegetation in the park is street trees. The site exhibits high contrast between the turf-covered playfields and the natural forest vegetation. The following is a list of existing vegetation on site (Walter Cook, Personal communication).

**Existing vegetation on site**

**A) Natural vegetation in the wooded section**

**i) Canopy Trees**

| | |
|---|---|
| Blackgum | *Nyssa sylvatica* |
| Eastern Red Cedar | *Juniperus virginiana* |
| Hickory | *Carya spp* |
| Loblolly Pine | *Pinus taeda* |
| Post Oak | *Quercus stellata* |
| Red Maple | *Acer rubrum* |
| Shortleaf Pine | *Pinus echinata* |
| Southern Red Oak | *Quercus falcata* |
| Sweetgum | *Liquidambar styraciflua* |
| Water Oak | *Quercus nigra* |
| White Oak | *Quercus alba* |
| Willow Oak | *Quercus phellos* |
| Winged Elm | *Ulmus alata* |
| Yellow Poplar | *Liriodendron tulipifera* |

**ii) Understory**

| | |
|---|---|
| Black cherry | *Prunus serotina* |
| Blueberry | *Vaccinium spp* |
| Dogwood | *Cornus florida* |
| Hawthorne | *Crataegus spp* |
| Japanese Honeysuckle | *Lonicera japonica* |
| Sparkleberry | *Vaccinium arboreum* |
| Sumac | *Rhus spp* |
| Tag Alder | *Alnus serrulata* |

**iii) Vines**

| | |
|---|---|
| Muscadine | *Vitus rotundifolia* |
| Poison ivy | *Toxicodendron radicans* |
| Smilax | *Greenbrier* |

**iv) Groundcover**

| | |
|---|---|
| Ground cedar (clubmoss) | *Lycopodium complanatum* |

**v) Invasives**

| | |
|---|---|
| Chinese privet | *Ligustrum sinense* |

**B) Vegetation planted on site**

**i) Trees**

| | |
|---|---|
| Crape myrtle | *Lagerstroemia indica* |
| Maidenhair tree | *Ginkgo biloba* |
| Plum cherry | *Prunus sp.* |
| Scarlet oak | *Quercus coccinea* |
| Willow oak | *Quercus phellos* |

Existing and potential wildlife on-site

Raccoon, opossum, rabbit, squirrel, chipmunk, beaver, deer, wood duck, waterfowls, frog, toads, geese, owls, hawks, migratory song birds and other birds (Frank Henning and Walter Cook, Personal communication).

## Design Process

Community suggestions

The Athens-Clarke County held community input meetings for the purpose of selecting a suitable site and program for the park. The facilities recommended during these meetings included multi-purpose building, children's nursery, multi-purpose athletic fields, baseball fields, softball fields, soccer fields, football fields, swimming pool, picnic shelters, playgrounds, recycling center, nature trail, tennis courts, parking, indoor soccer, batting cages, mountain bike trails, linkage to the greenway, barbeque shelter, walking trail, street hockey court, restrooms, a dog park, exercise trail, basketball court, open areas, canoeing/boating, fishing lake, amphitheatre and gardens. The recommendations were then ranked according to their priority. Following is the result of this prioritization (Robert and Company, 1997, 1, 3).

1) Athletic fields (including soccer, football, softball and baseball)
2) Passive nature areas (to include undisturbed land, nature trails and picnicking)
3) Paved paths (to include walking trail, greenway trail, exercise trail and bicycle trail)
4) Water features (to include naturally occurring features such as lakes and streams)
5) Tennis courts
6) Multi-purpose fields (to allow for unorganized free play, pick-up games and other games)
7) Multi-purpose buildings (to include classrooms and gymnasium)
8) Recycling center
9) Basketball courts
10) Playground (to serve all ages including pre-school and toddlers)
11) Picnic shelter (to serve large groups up to 500, moderate size up to 75, and small individual families)
12) Enclosed pool
13) Fitness center
14) Street hockey (to allow use for roller blade hockey)

15) Dog park

16) Swimming pool

17) Amphitheater – Outdoor terraces sited to blend with the existing topography. Seating capacity should be 500.

National Recreation and Park Association Suggestions

The National Recreation and Parks Association (NRPA) suggests that a community park should include an area of diverse environmental quality. It may include areas for intense recreational facilities, such as athletic complexes and swimming pools. However, the park should also include areas of natural quality for outdoor recreation, such as walking, viewing, sitting, and picnicking. The park should include a combination of the above facilities, depending upon site suitability and community needs (Robert and Company, 1997, 4).

**Initial Proposal**

Based on community recommendations and NRPA's suggestions, the Athens-Clarke County authorities and the landscape firm 'Robert and Company' came up with an initial program and design for the Southeast Community Park (Figure 5.5). The design called for creation of a lake on the creek, at the center of the site. The lake would provide recreational activities like canoeing, fishing and bird watching, and would also detain the runoff from the site. A trail around the lake would serve for walking and jogging. Some spots along the trail would serve as picnicking and viewing areas. This trail and a vehicular road would connect the two parts of the site. The lake would be supplied with water from the spring situated in the wooded area. However the construction of the lake required clearing of most of the existing natural vegetation and also cutting off the flow of the spring downstream for thirty days so that the water

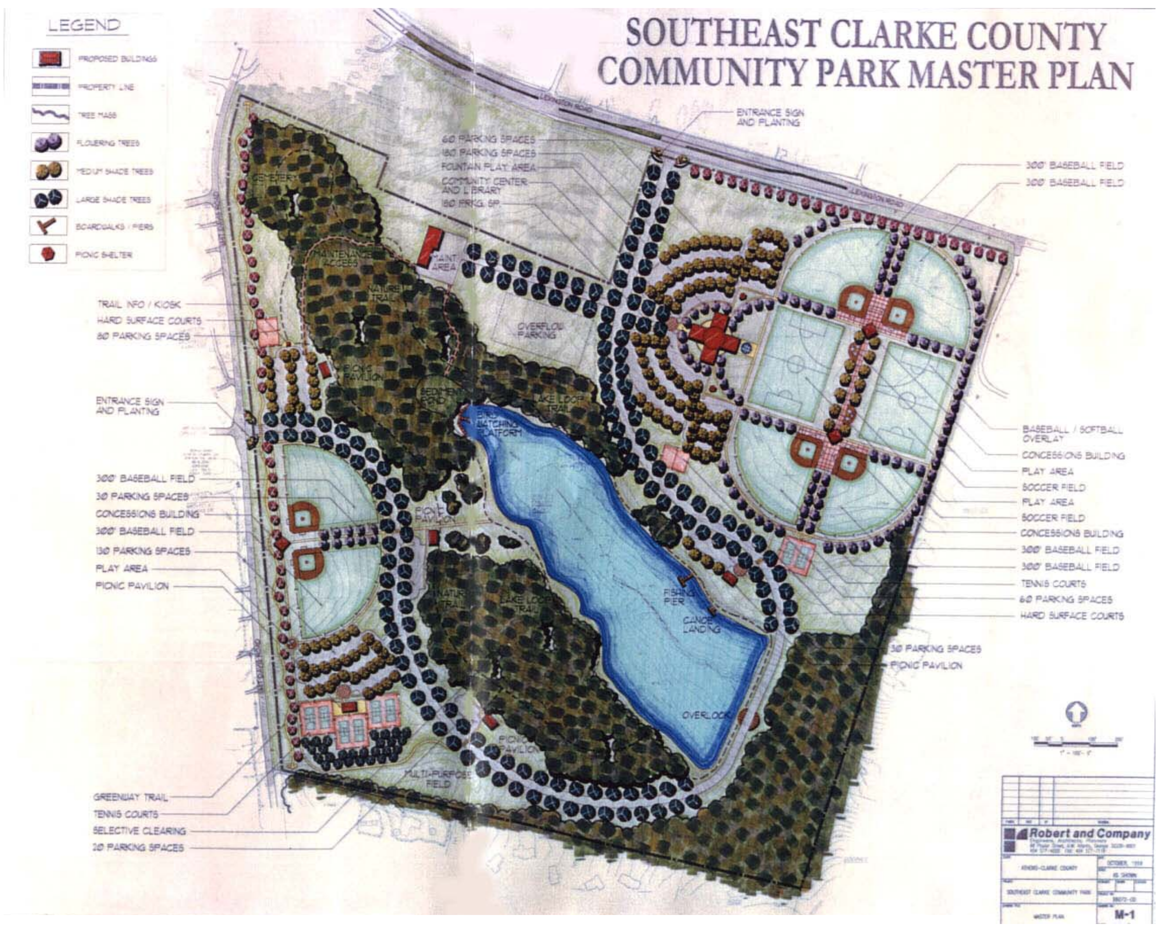


Figure 5.5 Initial design proposal by Robert and Company,
(Courtesy - Robby Bryant, Robert and Company, 2002)

would pond up in the lake. As soon as the desired level of water in the lake was reached, the water would then continue flowing downstream. The loss of considerable forest vegetation and interruption of the flow of the stream raised several environmental concerns, finally leading to the rejection of this initial proposal by the Athens-Clarke authorities (Robby Bryant, Personal communication).

**Present Site Condition**

The site is presently devoid of the lake feature and all the recreational facilities that the lake would have provided (Figure 5.6). Only a part of the nature trail exists on site (Figure 5.7). The site lacks any kind of water feature or areas for seating and viewing. The facilities like the community center and additional play fields might be incorporated in various phases in the future. Due to the rejection of the lake feature in the design, the three detention ponds that were constructed temporarily on site to take care of the runoff prior to construction of the lake are now a permanent feature of the site. These ponds have very steep slopes and are devoid of any aesthetics (Figure 5.8). They could be fenced off in the future to avoid people from getting close to them. The situation is another example of the conventional treatment and attitude towards stormwater detention ponds.

**Further proposal**

This thesis proposes a design that broadens the recreational and landscape program of the site by redesigning the detention ponds and the area around them. It tries to achieve the recreational goals of the initial proposal along with additional community needs, which had been rejected due to space constraints. The design deals only with on-site runoff and avoids changes to the existing recreational features on site. The design did not attempt to determine the runoff and detention volumes for the ponds since this

Figure 5.6 View of the site from the trail towards playfields (Photographed by author)

Figure 5.7 View of the nature trail (Photographed by author)

Figure 5.8 View of the large detention pond with play fields in the background (Photographed by author)

had been already determined. However care was taken not to reduce the existing storage volume of the detention ponds while re-shaping thereby maintaining their original detention function (Ferguson, 1998, 165). The design will mainly concentrate on the linear strip of land that measures about 17.32 acres with the detention ponds.

Site assets

The site is easily accessible and highly visible from the adjoining roads (Refer figure 5.4). The central portion of the site containing the creek and undisturbed forest vegetation forms a major asset to the site. It enhances the potential to provide wildlife habitat, nature trails and create viewing area. It also forms a beautiful backdrop for the site. Excess stormwater can continue to be directed to the creek, not requiring any connection to municipal drain. The overall slope towards the creek provides advantage in directing the stormwater to the creek. The site adjoins a trail on the western edge that is a part of the regional greenway masterplan. Hence a design, which provides wildlife habitat and various passive recreational opportunities, can be an attraction along this greenway corridor.

Design constraints and considerations

The main design constraint is the availability of space. Play fields and parking lots occupy most of the site hence there is little room to enlarge the detention ponds in order to incorporate shallow slopes while maintaining the same volume to detain stormwater. The wooded section of the site places a further constraint along the southern border. Because the site slopes towards the creek, there would be a need to build embankments to enlarge and re-shape the detention ponds. The slope is steep in some sections near the creek making it difficult to construct trails that would be consistent with ADA (Americans with Disabilities Act) access codes. Because the detention ponds lie between an urban park setting and undisturbed natural vegetation, the design would need to respond to the character of both these settings. The design would also need to provide adequate handicapped access to the additional facilities that would be proposed.

Proposal description

The design celebrates stormwater and educates us to its fate in the urban environment. By incorporating various features like water channels, swales and fountains, the journey of stormwater is made more enjoyable and pleasurable (Figure 5.9). An 8ft wide two-way pedestrian trail paralleling the flow of stormwater provides access and view of stormwater as it makes its way from the high pond to the lower pond. The trail is constructed of porous concrete to absorb rain water. This also reduces maintenance and provides easy universal access. The detention ponds are re-shaped into naturalistic forms with slopes of 1:5 or 1:10 and planted with native vegetation and willow shrubs to absorb the pollutants and stabilize the banks. Boulders placed along some sections of the channels act as energy dissipators.

An additional pond is proposed in the northwestern part of the site to treat the first flush of stormwater from the future commercial area (Figure 5.10). The pond is shaped and oriented to capture maximum possible runoff from the future commercial site above and is lined with native vegetation to absorb pollutants. Trash and sediment traps are located at the inlet and outlet of this pond to enhance the water quality. Excess water overflows from the pond through the outlet into a swale. It is joined by another swale that carries stormwater from the proposed parking lot. The water then pools up into a small pond. This helps in slowing down water and also facilitates infiltration. The water then flows over the concrete tiers of a proposed amphitheater. The tiers are depressed into the ground where water flows over them. These depressions act as *flow*


Figure 5.9 Proposed design masterplan for part of Southeast Community Park, Athens, GA

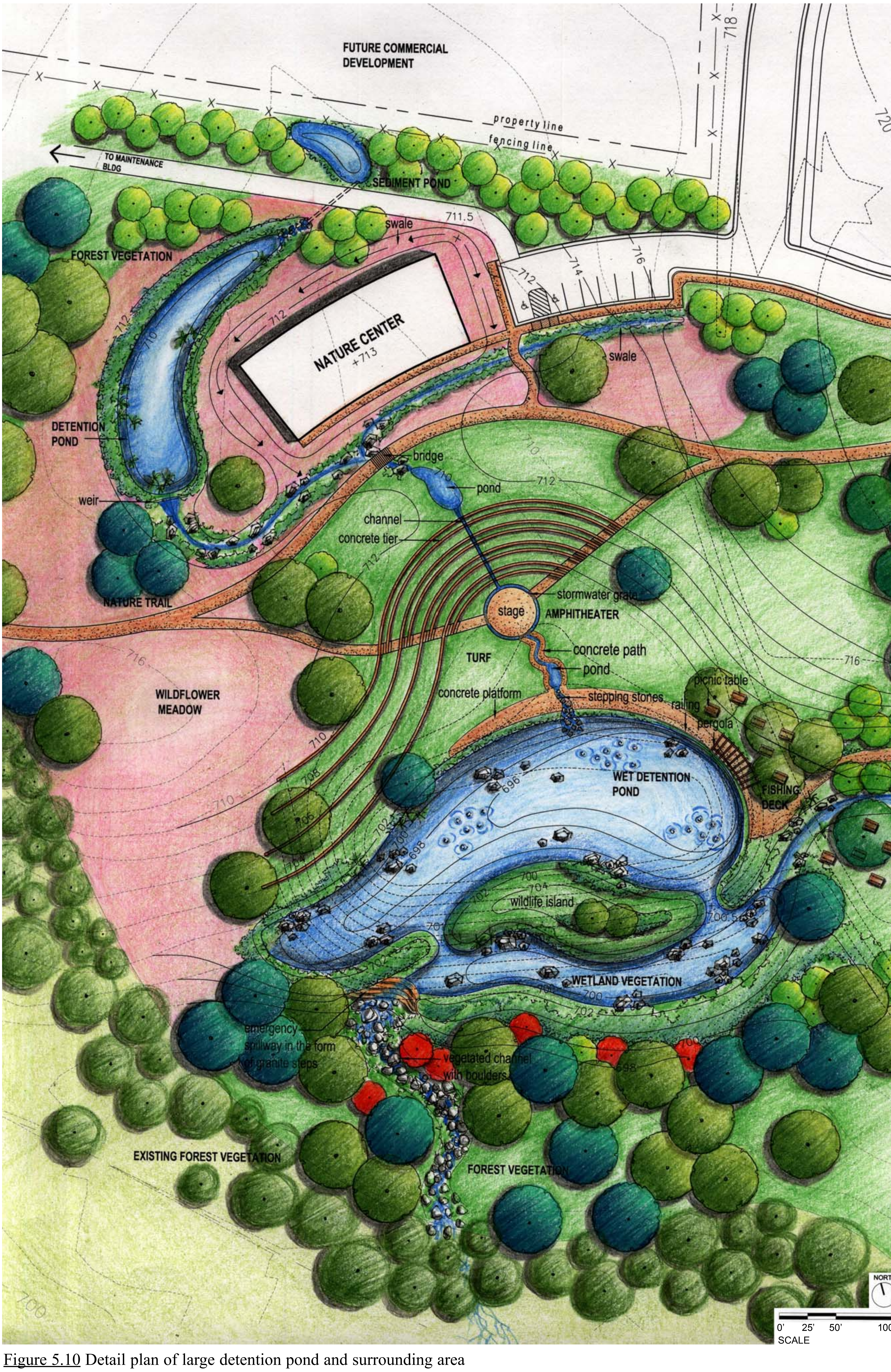


Figure 5.10 Detail plan of large detention pond and surrounding area

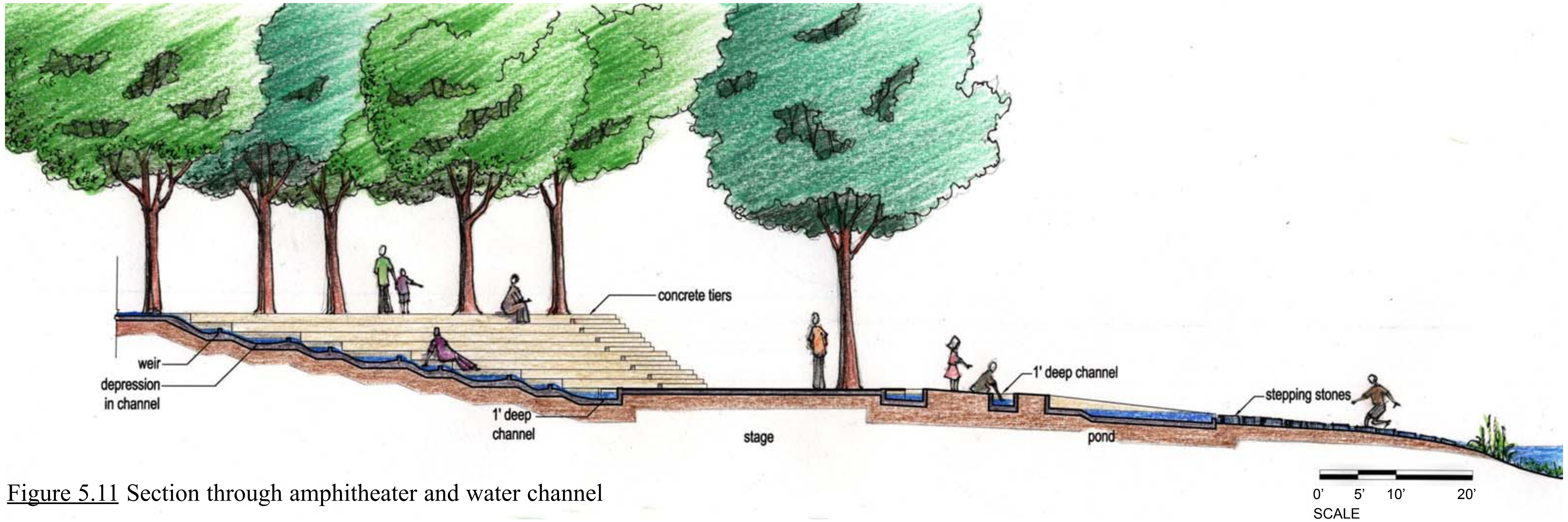


Figure 5.11 Section through amphitheater and water channel


Figure 5.12 General section through amphitheater and large detention pond

*forms* (Schwenk, 1976), pulsating the water further down the site (Figure 5.11). The flow of water through these sculptural forms acts as a visual feature and also helps in improving the water quality by aeration.

The water channel then splits around the stage of the amphitheater and reconnects on the other side. Access to the stage is provided by stormwater grates placed over the channel at three points allowing the sight and sound of water in the channel while it passes below. The water then pools up again in a small pond before entering a large detention pond. The water channel leading from this small pond to the large pond is gradually broadened and made shallow. Stepping-stones placed in this portion of the channel break the flow of water into several irregular channels that eventually discharge into the large detention pond (Refer figure 5.10). These stepping-stones not only act as hydrological structures but also become a feature of children's play.

A 12ft wide concrete platform on the northern edge of the large pond provides access for recreation and vehicular access for maintenance. A part of the detention pond is designed with a steep slope. The concrete platform near this steep part of the pond provides fishing opportunities and also acts as a viewing deck. It is secured with a wooden railing. A part of the railing is lowered to cater to handicap fishing access. The handrail has holes to anchor fishing rods. A pergola, benches and picnic tables are located along this edge of the pond to provide shade and serve as rest areas for anglers and pedestrians.

The large pond is designed as a wet pond providing the benefits of a small lake. It is planted with wetland vegetation that improves water quality and enhances the appearance of the pond. The pond would contain native varieties of fish suited to the environmental conditions in the detention pond. The fish would attract raccoons and other wildlife. An island located in the center of the pond is inaccessible to humans and serves as a good spot for wildlife. Wooden logs and large stones placed in and along the pond provide perching opportunities for birds and act as water level markers, displaying changes in the water level with passing storms. Clusters of bubblers are placed at three places in the pond. These small fountains aerate the water by throwing it to a height of about 2 to 3ft providing thermal mixing of the water and improving the oxygen content, which is necessary for the fish in the pond, enhancing water quality and inhibiting the growth and spread of mosquitoes. The advantage of these small bubblers in contrast to powerful jet fountains is that they prevent the loss of water by evaporation, which can be important for a pond with a small watershed. The water travels around the island and overflows through a spillway. By directing water around the island, it is made to travel a longer path, which helps in improving the water quality. But in case a very large amount of water enters the pond during an extraordinary storm, it short circuits this path and directly overflows through the spillway. Figure 5.12 shows the various activities taking place along the water channel and the large detention pond.

The spillway is in the form of a set of roughly cut curvilinear granite steps having a rise of 6 inches each. The steps facilitate re-aeration of water as it leaves the pond, further enhancing the water quality, before it flows into the creek. The water cascades over these steps forming a visual feature. The flow of water from the spillway is routed to the existing outlet path but is converted into a more naturalistic path in contrast to the existing outlet of riprap. The outlet channel is broadened and is fitted with boulders and native vegetation to help slow down water as it flows over the steep slope. In dry seasons, this pond can be supplemented with municipal water supply or well water to keep the fish alive and to retain the appearance and recreational value of the site.

The concrete platform along the edge of this wet pond connects to a pedestrian path, which leads to another detention pond. This pond is re-designed from present


Figure 5.13 Detail plan of 'Splash pond' and surrounding area

condition to serve as a "splash pond" for children (Figure 5.13). It provides interactive play opportunities with water. As this pond receives runoff from the turf-covered play fields, there is no concern about objectionable urban pollutants. The pond is divided into a shallow, ephemeral section and a deeper, perennial section. The shallow section has stepping stones to provide access for wading. Depending on the amount of water entering the pond, these stones may be partially or completely submerged in water. The maximum water depth permissible in this shallow section is only 16 inches (Figure 5.14). There is an 8 inch pebble layer beneath the water. The stepping-stones rise 8 inches above this pebble layer. The pond has a 6 inch concrete base and is surrounded by granite steps. The steps provide seating for children and parents while viewing and supervising their kids. The deeper section of the pond is 2ft deeper than the shallow section and is a permanent pool. It has a low stainless steel railing to demarcate it from the shallow portion and prevent any accidents. The railing also provides support to children while crossing the pond. A hand pump is located at the edge of this pond. Children can pump water from the pool and watch the flow of water through the channel. The shallow section of the pond drains completely after a storm exposing the stepping stones and pebbles. Picnic tables and benches are located near the pond to provide resting and viewing opportunities.

The water flows out of this pond slowly through a weir located at the end of the pond. The water channel from this pond is curvilinear and is lined with concrete to allow access for play. It is fitted with low walls that serve as seating while playing in the channel. The channel is also fitted with weirs that can be opened and closed with shutters operated by hand. Excess water spills over the weirs. Small boulders placed along the channel act as energy dissipators helping to slow down water and provide visual feature, as water splashes over them. The channel gradually broadens and

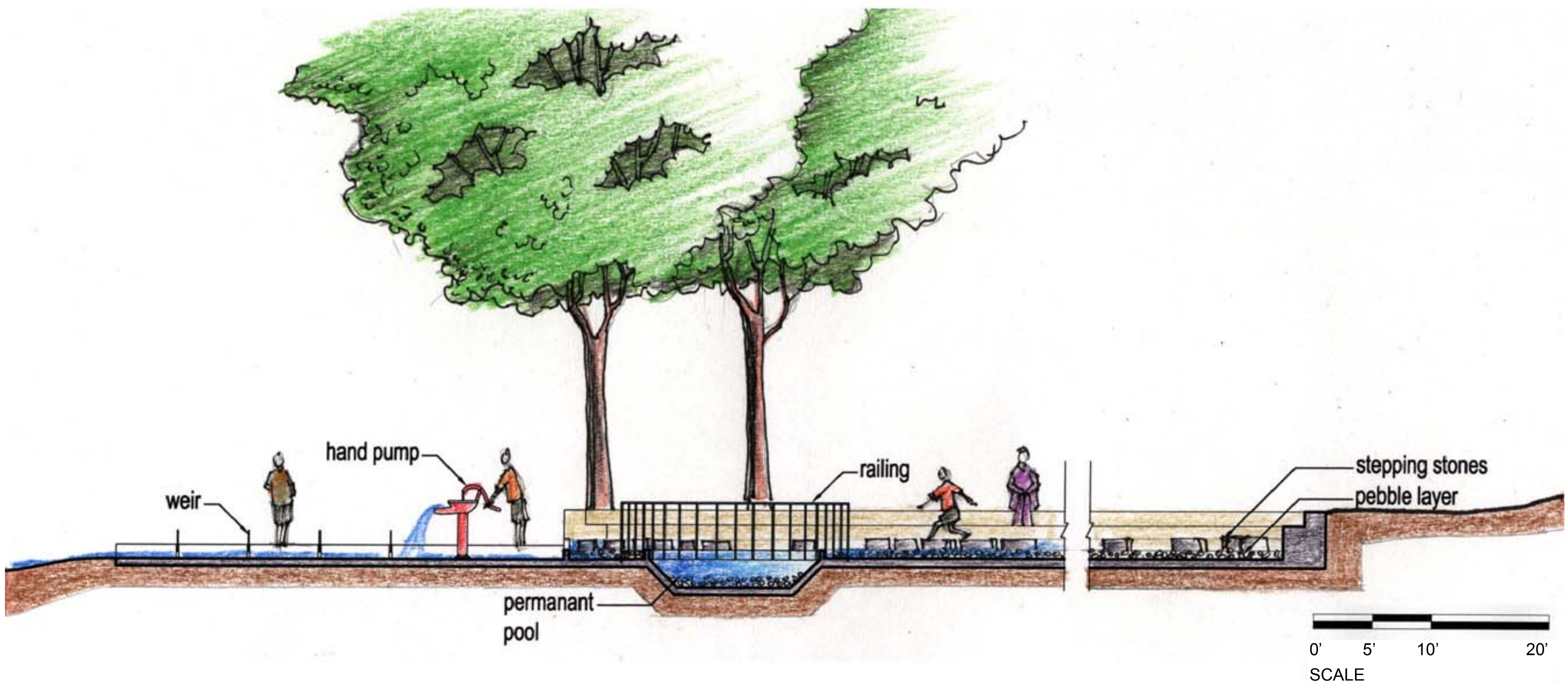


Figure 5.14 Section through ‘Splash pond’

becomes more naturalistic. It is lined with vegetation and fitted with boulders. It finally drains into the large detention pond.

A circular shelter and a circular open plaza measuring 40ft in diameter are located alongside this channel, near the existing parking lot, to provide rest and picnic opportunities along the trail while viewing water (Figure 5.15). The shelter is fitted with benches. These structures overlook the large detention pond and provide opportunities to view wildlife. They are surrounded by vegetation to conceal their presence and merge them with the natural setting. They are accessible by bridges connected to the pedestrian trail. A flight of steps from the parking lot to the trail provides direct access. The floor of these structures is made of granite tiles cut in circular patterns. The roof of the shelter is located at a height of 12ft and is made up of red cedar wood and supported by posts of the same material (Refer Figure 5.14).

The trail further connects to another, more isolated pond. Benches are placed along this part of the trail. The pond is re-designed from present condition into a natural wetland (Refer figure 5.9). A 6ft wide secondary trail loops around the main trail providing wildlife viewing opportunities. A boardwalk from this secondary trail leads to a viewing deck, which is provided with benches. The main trail is then connected to the existing trail that runs around the playfields. The wetland area is a detention basin. It receives runoff from the play fields and stores it to facilitate infiltration. The wetland vegetation helps to remove sediments and facilitates infiltration of water. Excess water flows, flowing detention, through the spillway to the creek. This spillway is designed in a similar manner as the one for the large detention pond but without the re-aeration feature.

A building proposed in the northwestern part of the site, covering an area of about 6900sq.ft, serves as a Nature Center (Refer figure 5.10). It would contain classrooms, auditorium and facilities for staff. The building facilities would provide

Figure 5.15 View of the shelter and open plaza

information about the hydrological function of the park and educate people about the wildlife and vegetation existing on site. It would provide opportunities for community gatherings, school field trips and special events. Vehicular access to the building is by the existing road on site. Additional parking with handicap facilities for the Nature Center is also provided on the eastern side of the building. The roof of the Nature Center building is arched towards the south and fitted with solar panels that provide energy to run the bubblers placed in the large detention pond.

The existing nature trail that connects to the sidewalk on the main access road is re-designed into a smooth curve. This trail runs through the wooded section of the site and connects to the other side of the park. A pedestrian path proposed in front of the Nature Center and along the parking lot connects to the existing road, providing access to the Center from the road. This path is also connected to the curvilinear trail. Wooden bridge is provided at the point where the path and trail intersect the water channel. The road connecting the main road and the existing parking lot is re-aligned to provide vehicular access from the main road to the proposed parking lot for the Nature Center. A 12ft wide road continues further to provide access to the proposed maintenance building located in the northwestern part of the site. A swale around the Nature Center discharges water into the channels. The Nature Center overlooks the whole area of the paths, channel, amphitheater and the large detention pond.

Being consistent with the expressed community needs, an outdoor informal amphitheater is planned as one of the facilities on site. The amphitheater takes a semi-circular form (Refer figure 5.10). Flights of steps on either side of the amphitheater provide access to the tiers and the stage. The tiers are extended on the northwestern side to merge with the topography of the site. The amphitheater would be used for small concerts, community gatherings and outdoor classes or just hanging around, viewing and other leisurely activities. The extended tiers provide opportunities for seating and viewing even when the amphitheater is being used for a different purpose. A secondary trail on either side of the amphitheater connects it with the main trail. The space between the tiers would be maintained as turf.

Proposed vegetation

Trees and other vegetation are proposed to provide shade and to blur the contrast between the design area and the wooded section along the creek. The design proposes various zones of vegetation like turf, wildflower meadow, forest vegetation, riparian and wetland areas, exhibiting a heterogeneous character. This helps in diversifying wildlife and provides different recreational opportunities. The pedestrian trails cut through these varied vegetation zones providing people different experiences of nature. Trees proposed along some of the detention ponds help in preventing loss of water due to evaporation and reducing the temperature of the water, which increases its oxygen content. The vegetation also provides food, shelter, cover and nesting opportunities for wildlife. Bird houses, nesting and shelter boxes placed in appropriate vegetation zones and concealed from the pedestrian circulation areas will help in increasing the use of this area by wildlife.

The trees were selected based on the existing trees in the wooded section. Bermuda grass is proposed in the amphitheater area. Centipede grass is selected along the trails as it requires low maintenance and is also drought tolerant. Some of the species selected for the meadow, like chickweed, provide food for birds. The wetland plants were selected based on their pollutant removal properties and ability to withstand frequent changes in water level. The design proposes bioengineering techniques for stabilizing the edges of the large detention pond. Vegetation proposed along the future commercial area, existing parking lot and wetland pond helps in reducing noise pollution and acts as a buffer. Following is a list of the proposed vegetation.

## Proposed vegetation

**i) Turf areas**

| | |
|---|---|
| Bermuda grass | *Cynodon dactylon* |
| Centipede grass | *Eremochloa ophiurides* |

**ii) Wildflower meadow**

| | |
|---|---|
| Aster divaricatus | *Aster sp.* |
| Blazing star | *Liatris microcephala* |
| Blue-eyed Susan | *Rudbeckia sp.* |
| Broomsedge | *Andropogon virginicus* |
| Chickweed | *Stellaria sp.* |
| Cone flower | *Echinacea sp.* |
| Fringed loosestrife | *Lysimachia ciliata* |
| Goldenrod | *Solidago sp.* |
| Indian grass | *Sorghastrum nutans* |
| Joe Pye weed | *Eupatorium fistulosum* |
| Purpletop | *Tridens flav us* |
| Spitheara Bluestem | *Andropogon ternaries* |
| St. John's Wort | *Hypericum multilum* |
| Sunflower sp. | *Helianthus sp.* |
| Switch grass | *Panicum virgatum* |

**iii) Canopy Trees**

| | |
|---|---|
| Blackgum | *Nyssa sylvatica* |
| Hickory | *Carya sp.* |
| Post Oak | *Quercus stellata* |
| Red maple | *Acer rubrum* |
| Southern Red Oak | *Quercus falcata* |
| Tulip Poplar | *Liriodendron tulipefera* |
| White Oak | *Quercus alba* |

**iv) Understory**

| | |
|---|---|
| Buttonbush | *Cephelanthus occidentalis* |
| Silky dogwood | *Cornus amomum* |

**v) Bioengineering**

| | |
|---|---|
| Alder | *Alnus sp.* |
| Black willow | *Salix nigra* |

**vi) Wetland**

| | |
|---|---|
| Arrow arum | *Peltandra virginica* |
| Arrowhead | *Sagittaria latifolia* |
| Bulrush | *Scirpus sp.* |
| Pickerel weed | *Pontederia cordata* |
| Soft rush | *Juncus effusus* |
| Spatter dock | *Nuphar luteum* |
| Swamp milkweed | *Asclepias incarnata* |
| Water lily | *Nymphaea sp.* |

Maintenance

Vehicular access to the detention pond for maintenance is provided from the existing parking lot. This access road connects to the pedestrian trail. The 8ft wide trail with 2ft grass shoulder on either side serves as the vehicular access paralleling the water channel. The maintenance of this section of the park, with the detention ponds, will be kept to a minimum. The detention ponds may require dredging at interval of years depending on the amount of sediment. The inlets, outlets and other hydraulic structures will require regular inspection and cleaning to prevent clogging from trash and sediments. The park, outside grass and meadow areas, would be allowed to undergo natural succession. The turf in the amphitheater area will require mowing every 2 to 3 weeks. The grass along the trail would not require frequent mowing as centipede grass is a slow growing grass and does not grow very tall. The vegetation along the detention ponds would require harvesting to control overgrowth. Other maintenance would involve clearing and litter removal, keeping the trail surface in good condition, removal of obstructions along pedestrian and vehicular routes, removal of dead vegetation and keeping the views unobstructed.

Additional recommendations

The proposal recommends monitoring water quality of the facility by taking regular samples from the detention ponds. School groups and volunteers can take active part in this activity thereby increasing their understanding of water quality issues and solutions.

The proposal goes beyond the design area limits and proposes the restoration of the creek. At present the creek is occupied by a lot of invasive species, privet being the most dominant. Due to the massive presence of these invasive species, there is absence of ground cover. Removal of the invasive species would help in the colonization of native species. It would have an added advantage of providing better views along the nature trail and benefit the wildlife. The spring, which at present is visible only at a few points along the trail, will also be visible and enhance the aesthetics of the site. The spring channel should be planted with ferns and other wetland species recommended in this thesis, which would help in stabilization of the channel and enhance its appearance.

**Public awareness and involvement**

Many ecological designs in the past have failed due to lack of awareness of their functions by the people using them. Hence this design recommends interpretive signage and information kiosks along the trail and other pedestrian areas that would make the visitors aware of the hydrological function of the park and its benefits. This would help in preserving the landscape and assist in its proper functioning. It would also help in respecting the presence of wildlife by humans, as the wildlife is intended to be an integral part of this part of the park. A program should be designed for the Nature Center that helps in getting the communities involved in the working of the park. School trips, visitor orientation, informative brochures and special weekly or monthly events related to the park can be organized to educate the people about the park.

Volunteer programs can be organized for the planting, cleaning and overall maintenance of the park to get people and surrounding neighborhoods involved in the working of the park. Only through public involvement can a park become an integral part of the community.

**Conclusion**

The design converts a currently wasted space into a recreational and educational amenity while providing detention facilities. The proposal takes advantage of the fact that the interface of land and water holds attraction for most people. The design brings together geometric and naturalistic forms creating a harmony in the landscape. By incorporating various kinds of water features and structures, the design caters to all age groups and varied interests. Some of the hydraulic structures also become a part of natural setting and provide recreational opportunities. The design exposes the flow of stormwater and brings people into contact with it, putting it back into the social consciousness of urban society. The debris and trash collected in the sediment pond will heighten awareness among people about their role in keeping the environment clean. The proposal attempts to serve not only human needs but also respects wildlife and vegetation, and tries to provide for their benefit. It returns cleansed water back into the system, completing the hydrological cycle. The design also enhances the regional greenway corridor. The overall project cost would be about $1,484,800.

The proposal illustrates that detention facilities do not have to be sterile and ugly but can be attractive and form sustainable systems. The design attempts to change the perception of stormwater systems. It displays that stormwater can be transformed from a liability to an asset. It is a step toward increasing public awareness of stormwater. By recommending restoration of the creek, the proposal goes beyond its design area thereby taking care of the complete hydrological system. By recommending natural succession and minimum maintenance, the proposal tries to increase people's respect for lightly maintained open spaces in contrast to the highly maintained park areas.

Although the proposal demonstrates that such multi-use stormwater systems can be retrofitted, incorporating such ideas early into the design process has additional benefits. The design constraints will definitely be less and the project could be more economical. The present proposal being a retrofit faced several design constraints, space being one of the most important. Although the proposal tried to retain the existing topography, considerable re-grading would have to be done. But the benefits would certainly be worth it. Had the proposal been thought of in the beginning of the design process, it would have been more integrated with the rest of the park facilities.

The design sets an example to be followed for future stormwater management projects illustrating that active and passive recreation, and wildlife habitats can be compatible with stormwater detention facilities. Such multi-use designs can make stormwater facilities acceptable and desirable in communities and thus encourage municipalities to change their approach to treating stormwater. Stormwater should be viewed as an opportunity to go beyond the basics of civil engineering, to involve landscape architecture and aesthetics, in creating sustainable landscapes. Architects and landscape architects should play an important role in designing, developing and marketing such multi-use and sustainable landscapes, which are the growing need of today's urban environment. All parks and open spaces should incorporate such hydrological systems forming a network and thus alleviate the landuse pressure.

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