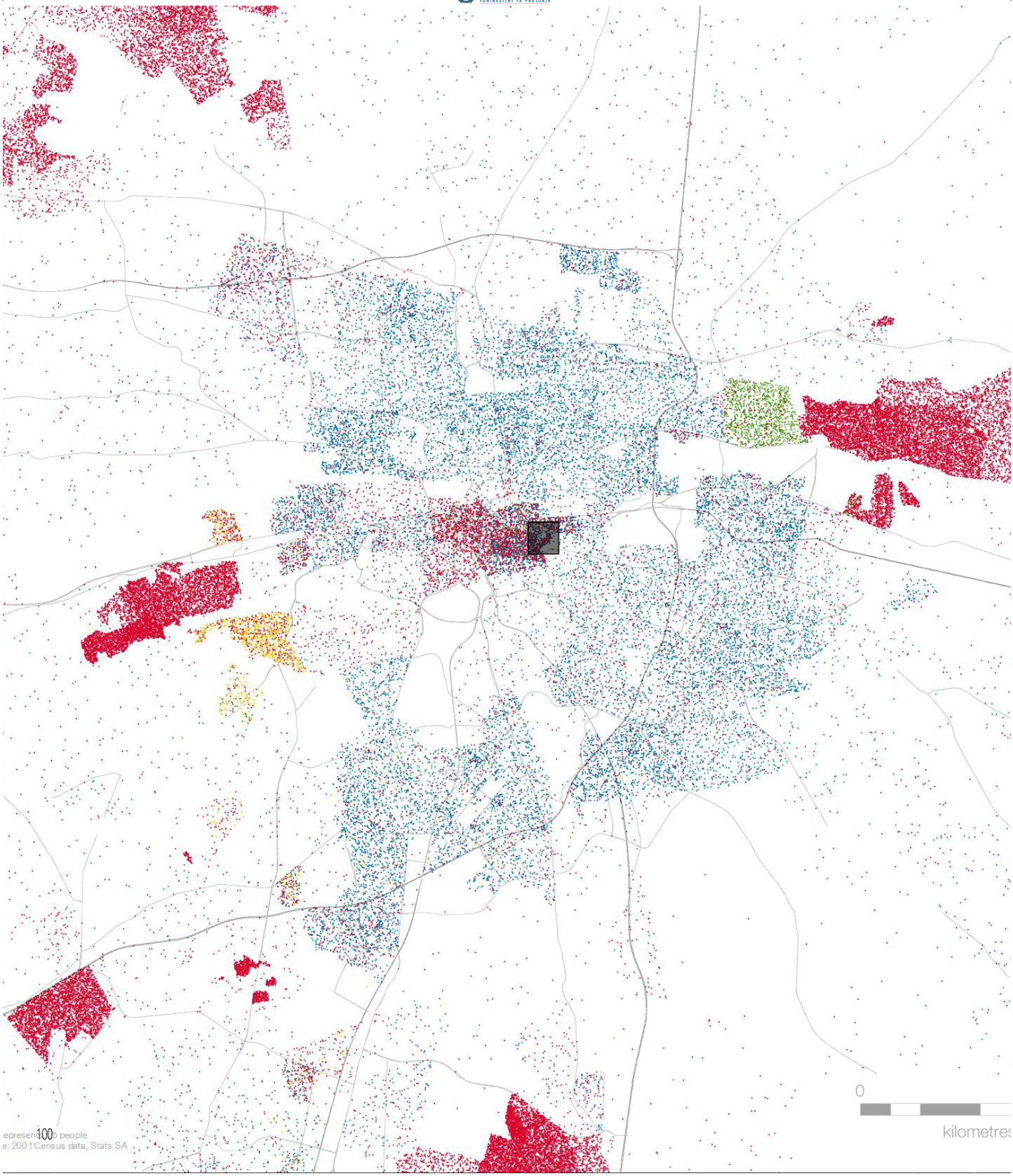
# CHAPTER 6

## RESILIENT LANDSCAPES

## 06.01 INTRODUCTION

Green infrastructure has become the way through which ecological systems and green assets can be understood as part of a greater infrastructural fabric sustaining and supporting society (Schaffler, et al., 2013). By incorporating ecosystem services which underpins green infrastructure, resilience in our cities can be achieved.

This chapter will investigate green infrastructure in the area, around Loftus Versfeld, and will analyse it according to the ecosystem services that were addressed.



## 06.02 EFFECTS OF URBANISATION

According to the South African Demographichs Profile of 2014, 62% of South Africa's population lived in urban centres. Gauteng, South Africa's smallest province, is predicted to grow in population from 12,9 million to 15,6 million in 2020 - which is similar to the population density of New York City. The population density per square meter in Gauteng is predicted to double from 516 in 2001 to 859 in 2020 (GCRO, 2012).

The capital city, Tshwane, is rapidly developing towards the east. The Tshwane Development Framework (2012) shows that the area around Loftus Versfeld Stadium, especially Park Street and Hatfield will, within the next 25 years, become extremely dense (see figure 06.02).

Tshwane faces current and future challenges such as chronic diseases, social inequity, unemployment, food scarcity and environmental degradation. Although attempts have been made to cope with some of these challenges like the new Bus Rapid Transit System (currently being implemented), public space is not considered in planning and how it contributes to the well-being of the population.

Because of a high crime rate, the South African built environment is dominated by the gated communities and shopping malls. The result of this is a lack of good open public space and social interaction that can contribute to human health (see investigation below).

Further, statistics taken in South Africa show that South Africa is not a physically healthy nation. In fact, South Africa was recorded to have the third highest rate of obesity in the world with 31,3% of the nation recorded as obese. Also, almost eighteen percent of South Africa's population were living with HIV/AIDS in the year 2012 - a non-curable chronic disease. In addition, basic services are not available to all South Africans, for example: only 95,1% of the population has access to basic services such as drinking water and only 74,4% has access to sanitation services (SADP, 2014).

Tshwane faces many challenges in improving the well-being of residents. Some of these can be addressed through urban open space development and good landscape design.

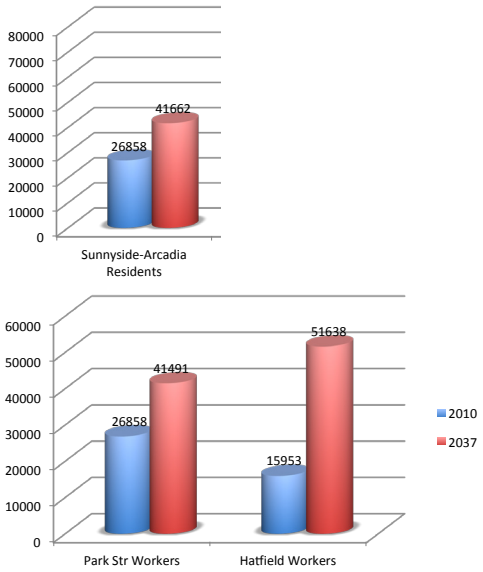



Figure 06.02: Graphs of how the population is predicted to grow in the specific areas in 2037 (Author - adapted from GCRO statistics)

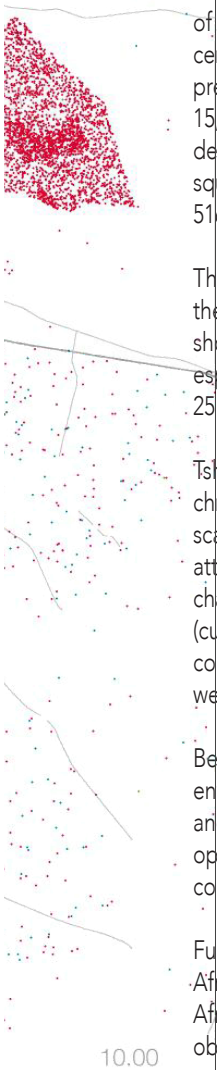



Figure 06.01: Current population density in Tshwane with various races shown as different colours

## 06.03 POTENTIAL OF GREEN INFRASTRUCTURE & ECOSYSTEM SERVICES

Frederik Law Olmsted, who was a leading practitioner of landscape design in the 19th century, believed that parks could be environmental cleaning machines with well-drained soils, open spaces of healthy sunlight, and shady groups of trees which reduce temperatures, absorb carbon dioxide and release oxygen. Landscape architectural interventions, such as: urban parks, public gardens, promenades and boulevards, parkways and enclaves in sub-urban residential area were the products of how culture has responded to and reshaped the processes of urbanisation and modernisation. Olmsted cared about the visual character of the landscape, but also how they worked (Meyer, 2008). Every work of landscape architecture, on whichever scale, has to respond to a range of interactive systems that will be affected by its design, such as: climate and hydrology, soils and geology, vegetation, wildlife and human community (Howett in Meyer, 2008).

Within cities, stress accumulates or sudden shocks can occur which could cause a physical collapse, social breakdown or economic deprivation. Unless a city is socially and environmentally resilient, that will be the result. Climate change, disease pandemics and economic fluctuations are risks that become increasingly unpredictable due to complex city systems (City Resilience Framework, 2014:3).

According to the City Resilience Framework (2014), resilient cities deliver basic needs which safeguard human well-being; protect, maintain and enhance assets; promote knowledge; facilitate human relationships and identity; defend the rule of law, justice and equity; support livelihoods; stimulate economic prosperity. Once a city can perform these functions, the city is resilient. Resilient cities are defined as cities with good health, social harmony and safe environments.

Permeable interconnected networks must be incorporated within the city for both wildlife and people (Grant 2012:63). The services that nature offers can be provided through creating biodiverse and multifunctional green infrastructure. *Green infrastructure* is defined by Benedict & McMahon (2001:5) as: "an interconnected network of green spaces that conserves natural ecosystem values and functions and provides associated benefits to human populations."

Green infrastructure assets, underpinned by ecosystem services, have a multifunctional nature which means that they provide a range of benefits that are mutually reinforcing and can also be enhanced once these assets are connected (Landscape Institute Position statement, 2009). "The services provided by healthy ecosystems are the unobtrusive foundation of daily life" (SITES v2 Rating System). More and more research shows natural elements generate ecosystem services, whether in cities or other areas, that are able to significantly improve the resilience of a community and improve quality of life in so many ways and contexts.

According to the TEEB Manual (2011) ecosystem services consist of four groups, known as (see image 06.03):

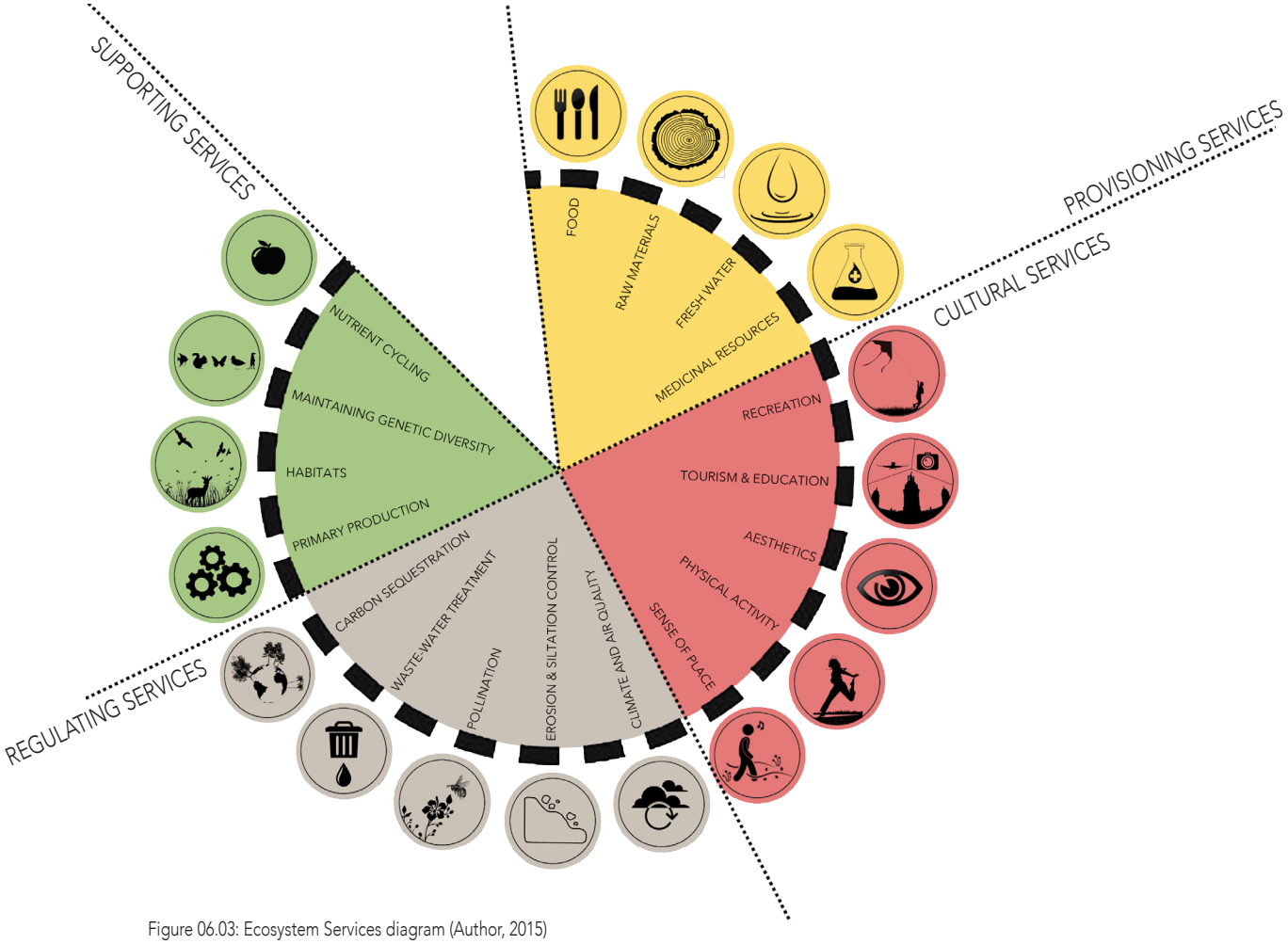



Figure 06.03: Ecosystem Services diagram (Author, 2015)

1. supporting services - this service is necessary for all the other services, like photosynthesis and soil formation;
2. provisioning services - food, fresh water, fibre, fuel and medicinal resources;
3. regulating services - climate control, air quality, erosion control; and
4. cultural services - aesthetics, recreation and non-material benefits for humans.

All four these groups are important for inclusion in urban areas to improve resilience.

1. Supporting services:
Supporting services maintain processes of biodiversity and maintenance with all the functions required for human well-being (Breed, 2015:33). This includes aspects of biodiversity and habitat for species which mainly rest on soil conditions and vegetation, though air and hydrology cannot be divorced from these. All other services rest on supporting services, which make them critical in terms of resilience.

2. Provisioning services:
Food production in the form of garden allotments, community gardens and orchards help build community and the connection to its environment, provide more access to healthy food, contributes to food security and provides educational opportunities (Landscape Institute Position statement, 2009).

The ability of natural systems to store, clean and distribute fresh water is of critical value. Rainwater can be harvested on sites, cleaned through wetlands and used as water features, irrigation and potable water. This reduces the use of off-site water and preserves fresh water resources.

3. Regulating services:
Trees regulate local climates by acting as windbreak and providing shade. Through evaporation and transpiration, plants absorb and store carbon and thereby moderates climate and provide "breathable atmosphere" (SITES V2 Rating System: ix). Various pollinator species promote the growth of myriad crops and plants by visiting their respective flowers. Stormwater is purified by soils and vegetation as it seeps through to underground aquifers. These ecosystem services occur at different scales and in different habitats that range from equatorial rainforests to parks in urban areas.

Water management helps to manage surface water runoff, floods, enhance biodiversity and recreation. Water can be stored in agricultural lands or wetlands, where no buildings are at risk. Important wildlife habitats (which is also then a supporting service) can be created while carbon sequestration is enhanced.

Most of these services occur mainly in the background and because it is so difficult to measure and monetize, their value in project design is usually ignored - this causes the site prior to construction to loose the ecosystem services that it provided (SITES V2 Rating System: ix). Many of these services are seen as automatically part of green space, while they need purposeful design.

4. Cultural services:
Managed and well-designed assets which relate to the landscape heritage and character, can promote local distinctiveness which allows for a community spirit and local sense of place. These spaces can stimulate employment opportunities through the attraction of tourism and investment and become catalysts for regeneration (Landscape Institute Position statement, 2009).

Economic value can be influenced by property value that becomes higher around quality open space (Landscape Institute Position statement, 2009).

Informal and active recreational opportunities are provided by green infrastructure. These assets need to be well maintained, be in walking distance from people's homes and must be designed with the community in mind because it is critical to public physical and psychological health and well-being (Landscape Institute Position statement, 2009).

HUMAN WELL-BEING
Human well-being consists of physical and psychological well-being. Human expression promotes emotional, spiritual and psychological well-being.

Sport and activites like walking, jogging, cycling, etc, promotes physical well-being. Grant (2012) states that it is difficult for people to change their behaviour, in terms of physical activity, if their environment does not support such behaviour. According to Christopher Coutts (Webinar, 2015), human well-being, both physical and psychological, is directly influenced by nature.

Ecosystem services, provided by green infrastructure, were researched mainly because of biodiversity loss and to demonstrate how it improves human health (O'Farrel & Anderson, 2010). Ecosystem services create the link between public health and ecosystem health. Through contact with ecosystems, humans obtain psychological, cultural and other non-material benefits which contribute greatly to human well-being in urban settings (Butler and Oluoch-Kosura, 2006 in Tzoulas et al., 2007:4).

Quality of life is supported by biodiversity and healthy ecosystems within city limits. It also helps to restore municipal services as well as a positive and integrated perception to people of the environment (Uslu & Shakouri, 2013:).
SUMMARY
Human well-being is an obvious concern in the South

African context. Basic services are not available to everyone and healthy food is also of great concern. It is therefore important to consider incorporating as many as possible, if not all, ecosystem services in our public spaces. Everyone should be able to access these services in walking distance in order to ensure the maximum well-being of the population.

In our urban conditions, it is not possible to incorporate square kilometres of natural spaces to enhance the well-being of the population. Meyer (2008) therefore emphasizes that designed landscapes do not need to be natural-looking in appearance to perform ecologically or sustainably, especially in constructed urban conditions. If the ecosystem services are addressed in our urban condition, a resilient future is guaranteed in our cities.

Ecosystem services can be a direct tool to improve ecosystems and human health through purposeful design.

## 06.04 ANALYSIS

The current green infrastructure surrounding the selected site will be investigated in order to see how the proposal can tie in with the existing green infrastructural network.

Parks withing the study area will be analysed in terms of the freedom of expression as well as ecosystem services they provide. Ecosystem services promote human and ecological health and therefore an investigation will be done of how successful the parks currently are.

Figure 06.04: Current green infrastructure network in relation to the site (Author, 2015)

## CONCLUSION OF GREEN INFRASTRUCTURE ANALYSIS:

The green infrastructure around Loftus is connected through street trees. Street trees, however, do not allow for enough habitat creational opportunities and the stretch between areas of habitats for birds and other species become far apart from each other.

Towards the east, green public open space is completely lacking and sport facilities all over the study area are either non-accessible (used by private institutions), derelict (for example Sunnyside Park and Berea Park) or accessible only if one is part of the sport club, which require a monthly or yearly fee.

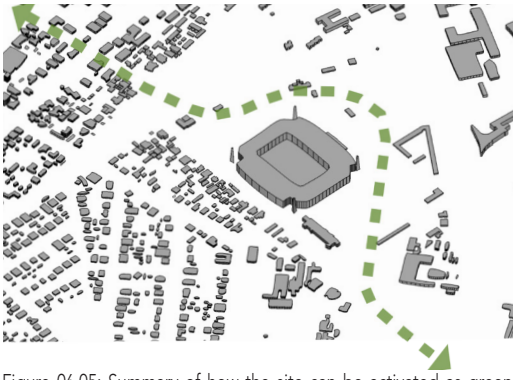


Figure 06.05: Summary of how the site can be activated as green infrastructure and become an ecological link (Author, 2015)

## ANALYSIS OF PARKS WITHIN THE STUDY AREA

The parks within the study areas were analysed according to how free people are able to express themselves. It is also analysed in terms of multifunctionality and ecosystem services:


Figure 06.06: Venning park summary (Author, 2015)

Venning Park:

The closest park to Loftus Versfeld is Venning Park. Venning Park is situated only two blocks north of the stadium in Arcadia. The park is a colonial style park with very formal planting. Most of its planting is not indigenous and require much irrigation together with its manicured lawns.

Because of its formal layout and rose gardens, people are restricted to play with a ball. The site is not accessible for bicycles and wheelchairs, which makes it accessible to only a selected group of people.

The park is situated across the USA's embassy and is surrounded by quite a few other embassies. A small coffee shop is situated within the park, which closed down shortly after it opened because the park does not attract many people. Residential buildings are situated within walking distance, but the park do not provide attractive activity. The fact that the park is colonial style can also have an influence on its usage - it does not speak to specific needs of the community, it actually reminds one of the apartheid era where everything is restricted and set out with rules and regulations.

The park has aesthetic value but no functional, social or ecological value.

Pretoria Art Museum:
The Pretoria Art Museum is situated within an accessible open space in Sunnyside. This park is more successfully used than Venning park for example. It is surrounded by residential buildings, sits adjacent to the Pretoria Technical College and a Spar. The park is completely open and accessible from all angles which contributes to its success. The children's playground draws parents with children from the residential buildings and parents can sit on the lush green grass


Figure 06.07: Pretoria Art Museum park summary (Author, 2015)

and watch their children play.
The setting is perfect for having picnics and just pure relaxation. The open lawn used to be a great setting for people to have soccer practices, but unfortunately recently many new trees were planted to prevent people from playing on the grass. *Why* is the question? Yes, why...? Why are people not allowed to express themselves if it promotes community building and healthy urban living.

From an ecological perspective, the tree species are quite monotonous and require quite a lot of water, together with it's manicured lawns. Apart from the limited activity to young people in this park, and its lack of ecological health, it does provide accessible green open space for residents.

Springbok Park:
Springbok park is situated between businesses and embassies in the Hatfield area, north-east of the Loftus Versfeld stadium. The park has 3 points of access and is enclosed by a 1m high fence. A Dross Restaurant is situated on the eastern side of the park and is unfortunately not at all integrated with the park. The park consist of many indigenous plants and regionally indigenous tree species. The park is not used on a regular base, mostly homeless people or a single person or two would take a nap in the park, but otherwise it is not used.


Figure 06.08: Springbok park summary (Author, 2015)

The park is not visually accessible from the road. The fence and it's densely planted trees around the edges prevent any views into the park. People do not feel safe in the park because of the lack of passive surveillance. The park contributes to ecological health but not social health.

Myrtle Park:
Myrtle park is situated within the Clydesdale (low density residential) area, across the street from the Walker Spruit. The park is mostly used by residents from Sunnyside (high density area), situated south of the Walker Spruit. The park is fenced off and provides limited access. A few children's play equipment is situated at the main entrance of the park - which is the most used space of the park. The rest of the park is not used regularly. Nothing draws one to the other side of the park. It has been modified by earth berms to prevent people from utilising the park effectively


Figure 06.09: Myrtle park summary (Author, 2015)

and playing ball games such as soccer. The park is covered with lawn and a few new trees. The park does not contribute greatly to ecological and social health.

Magnolia Dell:
Magnolia Dell is quite a successfull recreational park. It is used on a daily base. The Walker Spruit runs through the park. A small dam and beautiful trees provide lots of shade. On weekends people play with their dogs, play with a ball and children's parties, baby showers, family picnics, etc. are quite popular. The children's play equipment is usually used well. A small restaurant in the park contributes to its success.

Magnolia Dell has a variety of indigenous plant and tree species which contributes to biodiversity. The park is visually accessible from the roads and it is also accessible from various points around the park.


Figure 06.10: Magnolia Dell summary (Author, 2015)

CONCLUSION:
Most of the parks discussed do not promote physical, psychological or ecological well-being because the lack of multifunctionality as well as the amount of ecosystem services they provide. The parks do not at all allow the youth specifically to express themselves freely, once team sports are played, or ball sports, the landscape gets modified in order to prevent it.

From the green infrastructure analysis in Chapter 3, it was found that no other sport facilities are openly accessible. The proposal of Newtown Landscape Architects will be the first accessible sports field. With the predicted urban growth in 2037 and the growth of the University of Pretoria, one sports field as a recreational park will not be enough.

Very little commercial activity was found in an around the parks that were investigated. The Abland developers saw this gap and proposes the large mixed use commercial and office complex as discussed in Chapter 3. This development unfortunately does not provide any recreational opportunities in terms of physical activity and community building.

A CASE STUDY: Washington Canal Park

A park that supports green infrastructure and ecosystem services is the Washington Canal Park, Washington D.C., USA, led by The OLIN Studios and opened in November 2012. Canal Park was designed to become a social hub for the neighbourhood as well as an economic catalyst. The project served as pilot project for the Sustainable Sites Initiative (SITES™) and is also a candidate for LEED® Gold certification. The park has become a model for green infrastructure strategies, where the former brownfield site was developed into a landscape the restores important ecosystem services that got lost when the site was previousy used as a parking lot.

Native plant habitats were re-introduced to replace the contaminated soils. The park's stormwater system is a linear rain garden system which spans over the length of the park, with two underground tanks which can hold 302 833 liters of water. The water gets treated and stored and provides the park with 95% of the necessary water use on site - within buildings and in the park e.g: fountains, irrigation, ice skating path and toilets. Underneath the park sits 28 geothermal wells that provide a highly efficient energy supply within the park. Other features that contribute to sustainability (resilience) include: benches made of sustainably harvested wood, sufficient amount of bicycle racks and streets designed to reduce the speed of vehicular traffic around the park to ensure a safe pedestrian environment.

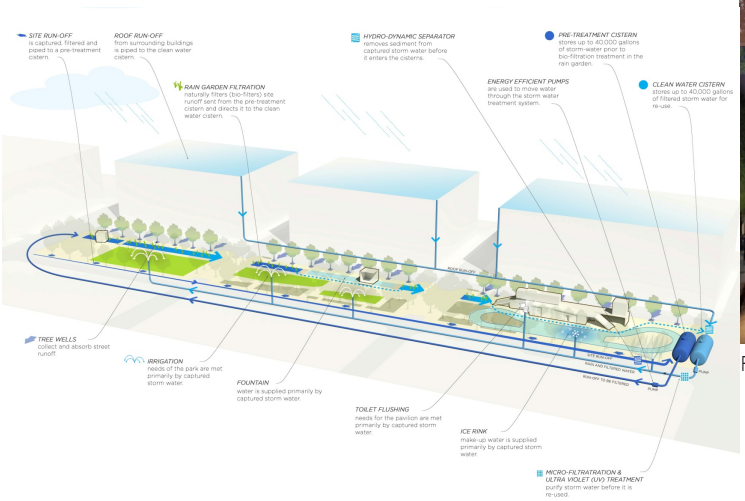



Figure 06.11: Canal Park water management strategy (designed by The Olin Studio)

Figure 06.12: Images of the park (designed by The Olin Studio)

# 06.05 BIOPHYSICAL ANALYSIS

## 06.05.01 VEGETATION AND SOIL TYPE

The vegetation and soil types are important to know in terms of ecological design. The planting will be influenced by the identified vegetation unit.

According to Musina and Rutherford (2006:463), the valley of Pretoria falls within the Marikana Thornveld vegetation unit. It occurs within an altitude of about 1050-1450m in valleys or slightly undulated plains and lownd hills. Shrubs grow more densly within drainage lines or in other habitats which are protected from fire.

The geology and soils of the area is shale and quartzite of the Pretoria Group (Transvaal Supergroup). Soils are mostly clay with "some dystrophic or mesotrophic plinthic catenas and some freely drained, deep soils" (Musina & Rutherford, 2006:463).

The Magaliesberg Nature Area conserve only 1% of the vegetation unit. Erosion is very low within this vegetation unit and alien invasive species occur usually in the high density areas especially along drainage lines (Musina & Rutherford, 2006:464).

HYDROLOGY

TYPOGRAPHY

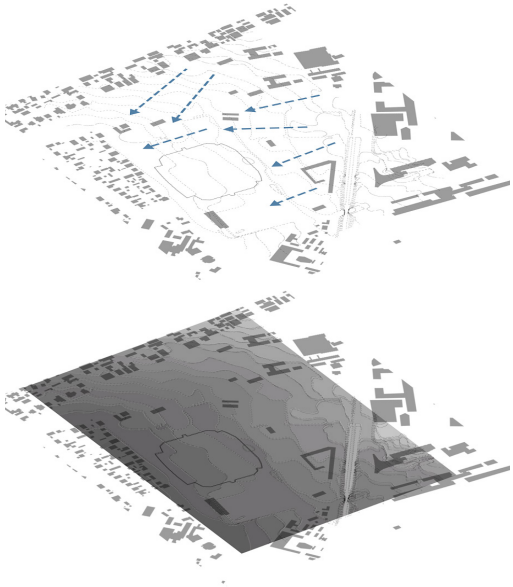


Figure 06.14: Drainage and topography on site (Author, 2015)

| Climate Variable | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max Temperature °C ( °F) | 19 (66) | 22 (72) | 25 (77) | 27 (81) | 27 (81) | 28 (82) | 27 (81) | 27 (81) | 26 (79) | 24 (75) | 21 (70) | 19 (66) | 24 (76) |
| Average Temperature °C ( °F) | 11 (52) | 14 (57) | 17 (63) | 20 (68) | 21 (69) | 22 (71) | 22 (71) | 22 (71) | 20 (68) | 17 (63) | 13 (55) | 11 (52) | 17 (63) |
| Average Min Temperature °C ( °F) | 3 (37) | 6 (43) | 9 (48) | 13 (55) | 14 (57) | 15 (59) | 16 (61) | 16 (61) | 14 (57) | 10 (50) | 5 (41) | 3 (37) | 10 (51) |
| Average Precipitation mm (in) | 3 (0) | 6 (0) | 22 (1) | 71 (3) | 98 (4) | 150 (6) | 154 (6) | 75 (3) | 82 (3) | 51 (2) | 13 (1) | 7 (0) | 732 (29) |
| Number of Wet Days (probability of rain on a day %) | 1 (3) | 1 (3) | 3 (10) | 7 (23) | 11 (37) | 12 (39) | 12 (39) | 10 (35) | 10 (32) | 5 (17) | 3 (10) | 1 (3) | 76 (21) |
| Average Sunlight Hours/ Day | 9h 23' | 9h 54' | 9h 18' | 8h 54' | 9h 00' | 9h 05' | 8h 17' | 8h 02' | 7h 42' | 8h 42' | 9h 19' | 9h 12' | 8h 54' |
| Average Daylight Hours/ Day | 10h 41' | 11h 14' | 11h 59' | 12h 45' | 13h 23' | 13h 42' | 13h 32' | 13h 00' | 12h 17' | 11h 30' | 10h 52' | 10h 32' | 12h 00' |
| Percentage of Sunny (Cloudy) Daylight Hours | 89 (11) | 89 (11) | 78 (22) | 70 (30) | 68 (32) | 67 (33) | 62 (38) | 62 (38) | 63 (37) | 76 (24) | 87 (13) | 88 (12) | 74 (26) |
| Sun altitude at solar noon on the 21st day (°). | 43.8 | 52.2 | 63.6 | 74.6 | 83.3 | 87.6 | 83.6 | 74.4 | 63.9 | 52.4 | 44.1 | 40.8 | 63.7 |

Figure 06.13: Climate of Tshwane (Pretoria)

06.05.02 IMPORTANT TAXA WITHIN THE VEGETATION UNIT
according to Musina & Rutherford (2006)

*Big trees:*
*Celtis africana*
*Combretum molle*
*Olea europaea subsp. africana*
*Siersea lancea*

*Small trees:*
*Acacia caffra*
*Acacia gerrardii*
*Acacia karroo*
*Acacia nilotica*
*Acacia tortilis subsp. heteracantha*
*Dombeya rotundifolia*
*Euclea crispa subsp. crispa*
*Pappea capensis*
*Peltophorum africanum*
*Terminalia sericea*
*Ziziphus mucronata*

*Tall Shrubs:*
*Ehretia rigida subsp. rigida*
*Euclea undulata*
*Grewia flava*
*Pavetta gardeniifolia*

*Low Shrubs:*
*Asparagus cooperi*
*Rhynchosia nitens*
*Indigofera zeyheri*
*Justicia flava*

*Woody Climbers:*
*Clematis brachiata*
*Helinus integrifolius*

*Herbaceous Climbers:*
*Pentarrhinum insipidum*
*Cyphostemma cirrhosum*

*Graminoids:*
*Elionurus muticus*
*Eragrostis lehmanniana*
*Setaria sphacelata*
*Themeda triandra*
*Aristida scabrivalvis subsp. scabrivalvis*
*Fingerhuthia africana*
*Heteropogon contortus*
*Hyperthelia dissoluta*
*Melinis nerviglumis*
*Pogonarthria squarrosa*

*Herbs:*
*Hermannia depressa*
*Ipomoea obscura*
*Barleria macrostegia*
*Dianthus mooiensis subsp. mooiensis*
*Ipomoea oblongata*
*Vernonia oligocephala*

*Geophytic Herbs:*
*Ledebouria revoluta*
*Ornithogalum tenuifolium*
*Sansevieria aethiopica*

## 06.07 CONCLUSION

Habitat creation will enhance the biodiveristy of the area and regionally indigenous species of plants can be used to achieve this. The site can become an ecological link by pulling it into the site to give more opportunity for nesting for wildlife such as birds and then connect back to the other green spaces.

The topography shows that the site is draining towards the west and south-west. Water should therefore be harvested on the lower areas of the site.

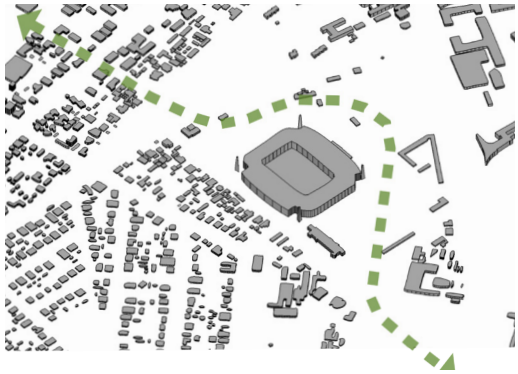


Figure 06.15: Creating a green infrastructural node (Author, 2015)