

Towards a Sustainable Green Space System: Understanding Planning and Management Dynamics in the City of Johannesburg.

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Declaration

I declare that this research report is my own unaided work. It is being submitted for the Degree of Master of Science in Development Planning to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree for examination to any other University.

Signed on the ____day of _____2012.

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Dedication

To my late father, Jeffrey Jubhi Nhlozi.

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Acronyms

BRT- Bus Rapid Transit

CBA- Critical Biodiversity Area

CoJ- City of Johannesburg

DDP- Department of Development Planning

DEAT- Department of Environmental Affairs and Tourism

DEPM- Department of Environmental Planning and Management

EMF- Environmental Management Frameworks

ESA- Ecological Society of America

GCR- Gauteng City-Region

GCRO- Gauteng City-Region Observatory

GDS- Growth and Development Strategy

GFN- Global Footprint Network

GI- Green Infrastructure

IDP- Integrated Development Plan

JCP- Johannesburg City Parks

JDA- Johannesburg Development Agency

JMOSS- Joburg Metropolitan Open Space System

JOSF- Johannesburg Open Space Framework

JRA- Joburg Roads Agency

MEA- Millennium Ecosystem Assessment

MOE- Municipal Owned Entity

MOSS- Metropolitan Open Space System

NGO- Non-governmental Organisation

SDF- Spatial Development Framework

SEA- Support Ecological Areas

SUDS- Sustainable Urban Drainage Systems

UNFPA- United Nations Population Fund

WSUDS- Water Sensitive Urban Design Systems

WWF- World Wildlife Fund

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Abstract

The notion of green infrastructure brings a new dynamic for dealing with urban problems in a way that responsively addresses urban problems while at the same maintaining the ecological integrity of the natural environment. Key to the notion of green infrastructure is the need to integrate and link green areas with built infrastructure in planning and development processes. Green infrastructure suggests that to achieve sustainable development in urban landscapes, green spaces should be planned for and managed as infrastructure and must be conceived of and understood as a genuinely possible means to improve and contribute to sustainability. Green infrastructure requires an institutional and policy framework that supports practices geared towards planning and managing green assets in the same way in which traditional infrastructure systems are managed.

This study explores the planning and management dynamics of green infrastructure in the City of Johannesburg. The study analyses the institutional and policy frameworks of City of Johannesburg to understand these dynamics. On the one hand, the aim is to explore whether green space planning and management is understood in an 'infrastructural' sense and on the other, to explore the institutional blockages for green infrastructure planning in the City. The study argues that a number of institutional and implementation challenges for planning and management of green infrastructure exist in Johannesburg. These are the result of an institutional setup which essentially provides fertile ground for some structures to compete against one another rather than work collaboratively in areas that are of common interest. While these challenges exist in the city, it has been established in the study that the City has begun to shift towards green infrastructure practices to address certain urban problems such as flooding and storm-water. For instance, the City is currently deepening its understanding of the concept of Sustainable Urban Drainage Systems (SUDS) to explore how this can contribute towards addressing issue of storm-water management. Important to note that is that while there is this gradual shift towards SUDS, the notion of green infrastructure largely remains at the conceptual level, in relation to particular issues, and is yet to be fully implemented and mainstreamed in the City's planning processes.

Chapter One: Introduction- Background Statement to the Study

...“just as we must carefully plan for and invest in our capital infrastructure-our roads, bridges and waterlines, we must invest in our environmental or green infrastructure-our forests, wetlands, stream and rivers”....(Maryland Governor Paris Glendening, 1999).

1.1 Background Statement to the Study

Green spaces in cities are continually under threat from urbanisation and the en-masse expansion of built infrastructure to service rapidly expanding urban areas (Esbah et al., 2009, ESA, 2000 and Huang et al., 2010). Green spaces are understood in this study as open spaces, woodlands, wildlife habitat, parks and other natural areas that sustain clean air, water and natural resources and enrich the quality of life (Benedict and McMahon, 2002). These can either be planned, for example, spaces preserved within residential developments, or unplanned spaces which offer wilder landscapes (Stubbs, 2008). Green spaces play an important role in providing critical life-support services, such as air and water purification, recreation and aesthetic opportunities, food and habitat provision (Ibid). While these services are critical, they are being undermined by contemporary urbanisation and development pressures. As a result, it is becoming increasingly important to prioritise well planned, easily accessible green spaces and the services they provide, which are often not recognised as integrated components of urban planning (ESA, 2000 and Maas et al., 2006). The challenge is that because green spaces and assets are under threat, the services they provide become less obvious and tangible over time. This is particularly the case in cities and urban areas, which are often not associated with ‘ecosystems’ but rather as places of traditional, grey infrastructure networks (Maas et al, 2006 and Millennium Ecosystem Assessment, 2005).

It is the view of this study that, green spaces are important elements contributing to urban sustainability because they are urban providers of ecosystem services. Ecosystem services, as defined by MEA (2005: 1) “are the benefits people obtain from ecosystems”. These services can be distinguished to both provisioning services- that is- food, timber, fibre, and regulating services (MEA, 2005). According to the Ecological Society of America (1997: 2) regulating services:

- moderate weather extremes and their impacts,
- mitigate drought and floods,
- protect people from the sun’s harmful ultraviolet rays,

- cycle and move nutrients,
- protect stream and river channels and coastal shores from erosion,
- detoxify and decompose wastes,
- maintain biodiversity,
- generate and preserve soils and renew their fertility,
- contribute to climate stability,
- purify the air and water,
- regulate disease carrying organisms.

Moreover, urban green spaces are crucial for both active and passive outdoor recreation, and for increasing residential and commercial property values (Stubbs, 2008) Local access to safe green space also helps individuals sustain levels of physical activity (Ibid). The significance of ecosystem services for urban sustainability lies in their multifunctional value so that in addition to providing social amenity-related services, they also provide both economic and environmental benefits. These benefits are illustrated in the diagram below.

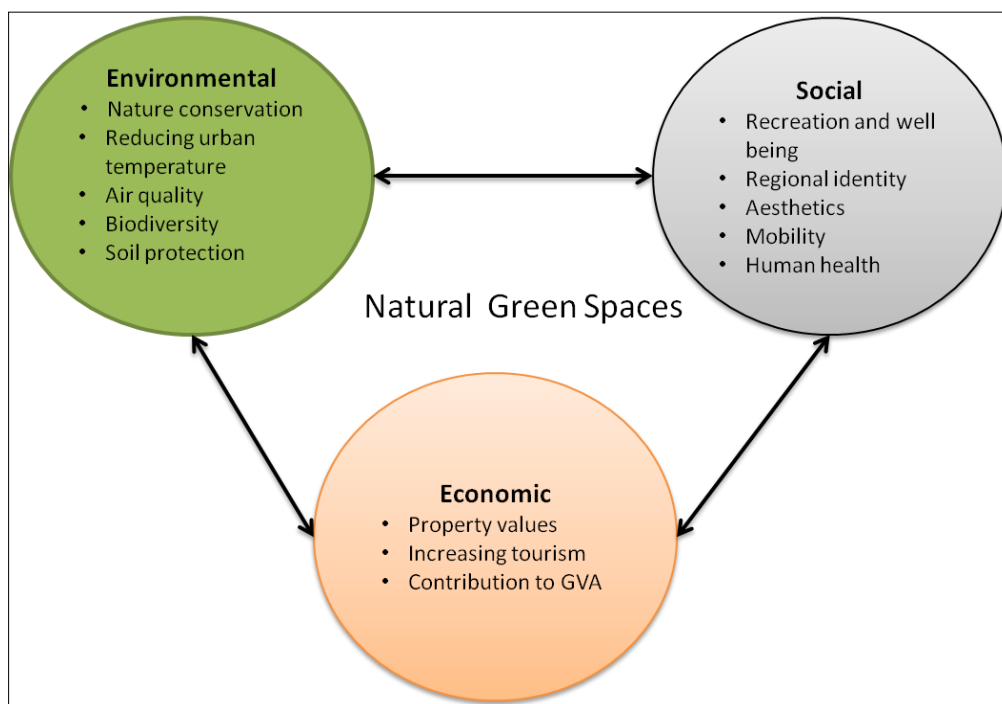


Fig 1: Benefits of natural green spaces (Adapted from Heidt and Neef, 2008).

To ensure that loss of green spaces (and services they provide) is addressed, it is increasingly important that these are planned and managed as forms of green

infrastructure (Swilling et al, 2011, Huang et al, 2010 and ESA, 2000). Green infrastructure means different things to different audiences, and has been applied in a variety of ways for example; green energy sources such as solar panels, solar water heaters and green building materials are also commonly referred to as green infrastructure. Noting that there are conceptual nuances and differences, green infrastructure is understood in this study as a network of all available green space and ecological resources within a given setting (Benedict & McMahon, 2002). This is different from ideas promoting more sustainable technical, grey infrastructure, and instead looks at the infrastructure embedded within ecosystems. Green infrastructure can therefore be viewed as the city and region's alternative infrastructure in that it provides key ecosystem services such as the maintenance of water quality, support of biodiversity, protection of air quality and health and quality of life for citizens (ESA, 2000). The key question with which this study is concerned is the extent to which these ecosystem services are understood and valued in the same way as hard infrastructure services, and whether this value is incorporated in the economic and development vision of cities.

1.2 Problem Statement

In the 20th century, approximately 16 cities globally had a million people or more and the vast majority of these cities were located in advanced industrial countries (UN-Habitat, 2011 and Cohen, 2006). Today, approximately 400 cities accommodate a million people or more, and about seventy percent of them are found in the developing world (Cohen, 2006). In 2007, the United Nations Population Fund reported that more than half of the world's population, that is, 3, 3 billion people, lived in cities, and developing countries are the major growth pressure points (UNFPA, 2007 and 2011 and UH-Habitat, 2011). It is expected that humanity will continue to be urban, and thus urbanisation trends are going to continue as people seek better economic and other related opportunities (Esbah et al., 2009 and Wyly, 2011). Developing country cities, together with smaller urban areas, continue to accommodate a substantial number of the global urban population, with estimates showing that approximately "52 percent of urban population" lives in these cities (UNFPA, 2007: 9). These urbanisation trends have critical implications for green spaces in our cities, and particularly for cities in developing countries, in the face of the second urbanization wave, which is much bigger

and faster than the first urbanisation wave which took place between the 1750s and the 1950s (UNFPA, 2007, Swilling et al., 2011 and Hadland, 2008). In this context, green spaces are constantly threatened and developed for purposes of expanding hard, built infrastructure services to accommodate increasing population and economic activities (Jim and Chen, 2009, UNFPA, 2007 and Constanza et al., 1997).

The particular challenge facing developing countries is therefore that these regions are facing both rapid urban development and a number of human, fiscal and resource constraints. It is a challenge which cuts across different facets of development. This is noted by UNFPA (2007: 7) which argues that the challenges facing developing cities are the result of the “second wave of demographic, economic and urban transitions”. The growth of cities in the developing world is “dynamic, diverse, disordered and increasingly space-intensive”, and the nature of this growth is manifesting in a mixture of informal urban slum dwellers, secluded, gated estates and various transitions areas (UNFPA, 2007: 48). Such complexity poses problems for integrated urban planning. In Africa for example, it is estimated that between 2000 and 2030, the urban population will “increase from 294 million to 742 million” (UNFPA, 2007: 9). The challenge is that growing urban areas require investment in new built infrastructure and basic services to accommodate new urban populations, and this often happens at the expense of the green spaces and/or their integration or connectivity (Esbah et al, 2009 and McConnachie et al, 2009). As the UNFPA (2007: 47) reflects regarding the expansion of roadway development in rapidly growing cities, “as transportation continues to improve, the tendency is for cities to use up more and more land per person”.

Equally important to note is that people moving to these are often poor (UNFPA, 2007 and Wyly, 2011). In Mumbai for instance, reports show that 10 to 12 million people live in informal settlements or are squatters (Wyly, 2011). Most cities of the developing world are faced with urbanisation issues related to shortage of proper housing and employment, which puts much pressure on these cities to grow their economies and infrastructure in efforts to get people out of poverty (UNFPA, 2011 and Swilling, 2011). As a result, cities often focus their efforts on planning strategies which seek to create conducive environments for employment and provision of adequate shelter, whilst ignoring the impacts of urban development on green spaces and natural ecosystems (Swilling et al., 2011 and Wyly, 2011).

The City of Johannesburg appears to be following a similar urbanisation trajectory to that of other cities of the developing world. As an economic power-house of South Africa and Southern Africa, the city is an important base for the movement of people, goods and money, to and from the rest of the continent (CoJ, 2008 and Kihato, 2009). In 2008 for example, Johannesburg's population stood at 3.8 million, which is a 20.6 percent increase from 3.2 million in 2002 (CoJ IDP 2010/11: 12). It is estimated that at this urbanisation rate, the number of people living in City of Johannesburg will grow by some 3, 5 million people in the next 25 years (CoJ, 2008). This population growth exacerbates pressure on resources and services, and in so doing creates pressures on land and natural ecosystems (Esbah et al., 2009 and Heidt and Neef, 2008).

In this context, Johannesburg is faced with a number of institutional and planning challenges. In addition to rapid urbanisation, Johannesburg is characterised by a highly fragmented open space system so that while losses to open space is a critical concern, many parts of the City's open space system remain isolated and excluded from a wider network due to the segregated spatial history inherited from Apartheid (CoJ, 2002). The City's open space system is a network of open spaces that incorporates areas of high biodiversity value linked together in a viable network of open spaces (CoJ, 2002). Yet the absence of a comprehensive policy framework or guidelines for the protection, management and optimization of open space areas within the city perpetuates loss and fragmentation of urban green spaces. Important to mention is that in instances where these guidelines have been implemented; this is often in an ad-hoc fashion with limited integration with other infrastructure planning processes. This places urban planning for green infrastructure as a key priority to minimise the negative ecological consequences associated with rapid population growth in the City of Johannesburg and to enhance the integrated planning of green assets (McConnachie et al, 2009).

As argued earlier, natural ecosystems perform fundamental life-support services upon which development of people depends (ESA, 2000). Unless these are carefully planned and managed, valuable ecosystems (and their services) will continue to be impaired or destroyed (Huang et al, 2010). Thus there is a growing need to begin committed planning for green space, (especially natural green spaces), as elements of green infrastructure. This has been voiced by various politicians around the world such as

Maryland Governor Parris Glendening in 1999 who argued that “just as we must carefully plan for and invest in our capital infrastructure-our roads, bridges and waterlines, we must invest in our environmental or green infrastructure-our forests, wetlands, stream and rivers” (Benedict and McMahon, 2002: 6). Cities of the developing countries have also begun raising concerns regarding loss of green spaces and natural ecosystems due to rapid growth and development (Omojola, 2004). For example, in an effort to manage loss of green spaces, Lagos has developed a green space management strategy which essentially provides incentives for development in the city centres, and as a result managing urban sprawl and infrastructure development in green spaces in outer areas of the city (Oloto and Adebayo, 2010). Such examples represent movements to link “natural green spaces and parks for the benefit of people”, but also most importantly “preserving and linking natural areas to benefit biodiversity and counter habitat fragmentation”, which are key principles underlying the idea of green infrastructure (Benedict and McMahon, 2002: 8). On the economic front, well planned and managed green spaces enhance tourism potential, value of properties and attract jobs to cities (NENW, 2008 and NRDA, 2007).

1.3 Research Question

How is the City of Johannesburg planning for and managing green spaces as green infrastructure?

This question begins to ask whether the City of Johannesburg understands and manages ecological assets in an ‘infrastructural’ sense. The question is important for the purpose of exploring whether the City is aware of the multiple benefits offered by these assets when planned for and managed as a linked and connected networks of green spaces functioning as one single system. Equally, the question investigates the challenges that prevent the City from implementing green infrastructure.

1.4 Sub-questions

- How does the City of Johannesburg perceive and plan for green spaces?
- What is the nature of the City’s green space planning?
- To what extent does the City value and recognise services provided by natural green spaces, relative to those provided by hard infrastructure systems?

- What are the opportunities and constraints for strengthening planning for green infrastructure in City of Johannesburg?

1.5 Aim of the Study

Urbanization is not only a “socioeconomic phenomenon” but it is also a process where people transform and develop natural ecosystems for their own survival purposes (Huang et al., 2010: 136). Thus urbanisation creates “heavy demands on timber consumption, biomass for heating, settlements, recreation, tourism and employment” (Huang et al, 2010: 137), and often exerts pressures on natural green spaces. As mentioned, the City of Johannesburg is experiencing rapid urbanisation, and green spaces are facing several threats due to development pressures. The growth and development pressures undermine the capacity of the natural green spaces to provide services such as food production, maintain freshwater and forest resources, regulate climate and air quality (ESA, 2000 and Huang et al., 2010). This study therefore aims to explore the institutional and policy landscape through which green spaces are currently planned, managed and budgeted for by the City of Johannesburg. In so doing the study seeks to understand how these spaces are understood by the City and the extent to which services provided by ecological assets are recognised by the City as parts of a wider infrastructure network. Furthermore, the study will look at the existing planning frameworks for green space planning and management in relation to other planning processes, and explore the dynamics that exist to either undermine or contradict comprehensive green infrastructure planning. The aim is to understand whether the City is making efforts to effectively plan for and manage ecological assets as an integrated network system providing crucial services for human development and maintenance of environmental integrity.

1.6 Research Methods in the Study

The nature of the study is qualitative in approach and is broken down into two components:

1.6.1 Literature review

A desktop-based literature review of the notion of green infrastructure is engaged in the study. The literature review explored the importance of green spaces in terms of the ecosystem services they provide, their ecological processes and their interaction with

urban planning processes. This set the premise through which to understand the importance of planning for and managing these spaces as interconnected ecological systems.

The study reviewed multidisciplinary literature on urban sustainability and environmental development. Various bodies of knowledge across environmental studies, economy, politics, geography, architecture and urban studies, green infrastructure studies, government and public policy were reviewed. This ensured that all fields that concern and study issues relating to sustainable development were critically engaged. Amongst others, the following concepts formed basis for the study; urbanisation, sustainability, integrated management, natural capital stock and green infrastructure. The study is embedded in the theory of social-ecological system thinking and infrastructure transition scholarship (which is further explained elsewhere in the study).

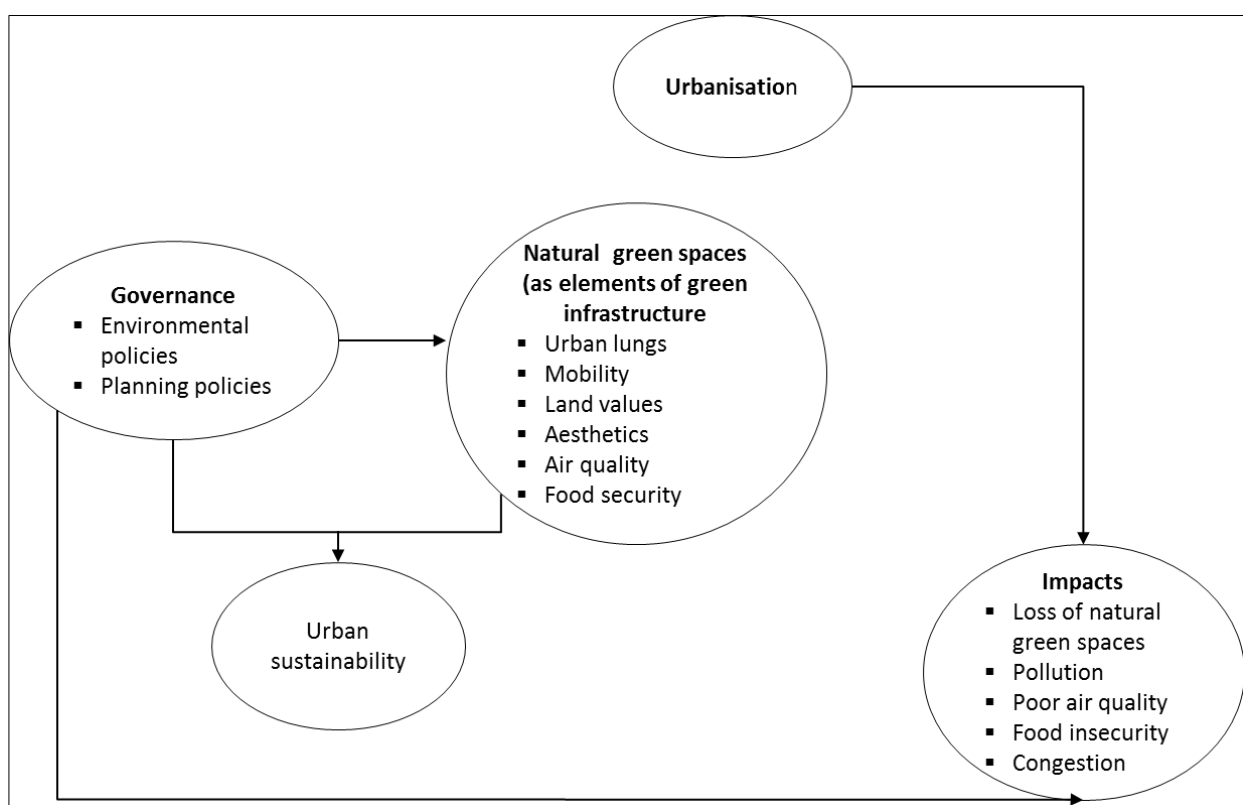


Fig 2: Conceptual framework for understanding notion of green infrastructure

1.6.2 Use of City of Johannesburg as a Case Study

Two key reasons motivated for the use of City of Johannesburg as a case study. Firstly, the City is the economic powerhouse in South Africa and sub-Saharan region, and as a result is under a lot of pressure to expand its built infrastructure systems to support the economy and growing population. Secondly, the City presents interesting dynamics of green space planning and management, where during apartheid, certain areas of the city were provided with well-developed green spaces over others. This has recently changed, and the study engages with these dynamics to explore the nature of planning and management of green infrastructure in the city.

The selection of interviewees was done through purposive sampling. Purposive sampling is a ‘non-probability sampling’ in which decisions relating to the selection of participants to be included in the study are taken based upon a variety of criteria which may include their experience and knowledge of the research issue (Teddlie and Yu, 2007: 77). Thus, the premise and aim of the study motivated for the selection of departments and participants in the study. In terms of selection of City departments, key departments directly linked with the planning and management of green assets and municipal owned entities (MoEs) that deal with daily management of these assets formed integral part of the interviewing process. Equally, other departments not directly related with green space management but who are largely affected by green space policies also formed part of the interviewing process. This was crucial for comparing how natural green spaces as providers of ecosystem services are understood and valued in relation to hard, built infrastructure services. A series of interviews, through semi-structured questionnaire, were also conducted to determine the institutional, implementation and perceptions for green infrastructure planning and management in the City of Johannesburg. The following are the city departments and municipal owned entities and non-governmental organisations formed part of the interview process in the study.

1.6.2 Key city departments to be interviewed:

- Department of Environmental Planning and Management (DEPM)
- Transportation Department
- Development Planning Department

1.6.3 *Municipal Owned Entities (MoEs)*

- Johannesburg City Parks
- Johannesburg Roads Agency

1.6.4 *Non-governmental organisations and environmental activists*

Non-governmental organisations (NGOs) are interviewed to explore their role in terms of planning and management of green spaces, their understanding of green infrastructure and planning dynamics in Johannesburg. An attempt was also made to understand the relationship they have with the City in shaping policy on management of green spaces. The NGOs interviewed are Green Peace and Just Environmental Action. Green Peace has a number of programmes relating to issues of climate change, forests, oceans, agriculture toxic pollutions, nuclear and peace (Green Peace, 2012). Just Environmental Action, on the other hand, plays a key role in among other things, protecting and conserving natural environments, especially environmentally sensitive areas for purposes to protect the quality of life for future generations (JEA, 2012). Equally, an effort was made to interview environmental activists, who in one way or another are advocating for responsive planning and management of urban green spaces.

1.7 **Ethical Issues**

The nature of research is qualitative, and thus there are ethical considerations which the researcher has to adhere to as stipulated by the university rules and regulations. Interviews formed the basis for the collection of data in the study. In conducting these, the interviewees were made aware of the objective and purpose of the research, which is solely for academic purposes. In circumstances where sensitive information is disclosed, this is done in condition of anonymity, and no names are published without the interviewee's consent. This is critical for the purposes of confidentiality of collected data in the study.

1.8 **Chapter Outline**

Chapter One: Introduction- Background Statement to the Study

This chapter introduces key challenges relating to planning and management of urban green spaces in big cities and towns, especially those of the developing world. Equally,

the chapter introduces the research question and sub-questions, methods, concepts and theoretical framework that underlie the study.

Chapter Two: Literature Review- Situating the Concept of Green Infrastructure in Theory

The literature review chapter deals with the conceptual and theoretical framework through which the concept of green infrastructure is understood in the study. The chapter reviews specifically the theory of socio-ecological system thinking and infrastructure transition scholarship. Concepts of ecosystem services, urbanisation, sustainability, integrated management and green infrastructure are explained in this chapter. An effort is also made to link importance of ecological services and process to urban planning processes.

Chapter Three: Introducing Planning and Policy Framework for Green Space Planning and Management in City of Johannesburg

This chapter introduces the case study, City of Johannesburg. The chapter introduces key city departments and municipal owned entities dealing with green space planning and management. Equally, the chapter deals with the policy landscape (not comprehensive) through which green spaces are planned for and managed in the City.

Chapter Four: Reflecting on the Implementation and Institutional Dynamics for Green Infrastructure Planning in City of Johannesburg

This is the analysis chapter. The chapter meticulously provides analyses of planning and management dynamics in City of Johannesburg in terms of institutional arrangements and relationships, policies and implementation dynamics. The chapter also acknowledges instances where the City has begun implementing the concept of green infrastructure. The chapter finally concludes that green infrastructure remains at a conceptual stage and has not been mainstreamed in the planning processes in the City.

Chapter 5: Conclusions and Recommendations

The chapter firstly provides a brief analysis of the key findings of the study and secondly, puts forward a number of recommendations which the City might consider in efforts to plan for and manage its green assets in an 'infrastructural' sense.

Chapter 2: Situating the Concept of Green Infrastructure in Theory

.... *"We need grey infrastructure, of course, but there is a glaring imbalance between the funding for roads and for networks of green spaces"* (Commission for Architecture and the Built Environment, 2009: 2).

2.1 Introduction

The second wave of urbanisation, which is largely taking place in cities and smaller towns of the developing countries, poses a number of development challenges (Pieterse, 2008, Huang et al, 2010 and UN-Habitat, 2011). Cities and towns of developing countries have to deal with wide-ranging development issues such as deepening inequalities, increasing high employment rates, unstable and unpredictable economies, high urban poverty and ever swelling urban informality (Wyly, 2011, Pieterse, 2008 and UNFPA, 2007). These challenges put enormous pressure on cities to create a conducive environment for employment opportunities in efforts to uplift people out of poverty and improve their living circumstances (UNFPA, 2007 and Devas, 2004). Coupled with this is the lack of institutional and resource capacity, for smaller towns in particular, to address these multiple challenges (UNFPA, 2007). As a result, cities and towns continue to grow in a disordered, chaotic manner as the demand for housing, industrial, commercial, infrastructure and transport facilities increases (Huang et al., 2010, UNFPA, 2011, Esbah, 2009). This leads to a number of issues such as the uncoordinated growth and development of cities, unequal spatial distribution of services and other related issues such as proliferation of informal settlements. The competing demand for land uses often results in the fragmentation and pressurisation of open green spaces.

This set of circumstances is subject to a growing discourse which can be understood in two ways. On the one hand, it is concerned with the phenomenon that as many cities grow, and land value rises, green spaces become "tempting prospects for exploitation", (Husqvarna Group, 2012: 6), and on the other that green spaces and services they provide, are often not planned for as elements of infrastructure by cities of the developing world (Fasona and Omojola, 2004 and UGI, 2012). Such concerns reflect a growing unease with an apparent over-emphasis on provision of traditional infrastructural services, and while these are important development goals, there appears to be a relative planning neglect of green spaces and their services (Husqvarna Group, 2012, UNFPA, 2011, Fasona and Omojola, 2004 and Huang et al., 2010). In the State of the Nation in 2012 for example, the South African government prioritised

infrastructural development to stimulate economic growth, high unemployment, poverty and inequalities as one of its priorities (The Presidency, 2012). At the local government levels, where infrastructure implementation occurs, the main thrust has been to ensure provision of basic services such as water, sanitation and roads to improve social well-being of citizens (CoGTA, 2009, Joubert, 2012 and CoJ, 2010). Further, in 2010, the Gauteng Premier Mokonyane asserted that the province “will work with the municipalities in the spirit of co-operative governance and, where necessary, assist them to ensure that all our people including those living in underdeveloped areas are able to access basic services” (CoJ, 2010: 2).

This chapter seeks to review the literature on green spaces and services they provide, coupled with an analysis of the emerging discourse on green infrastructure as it is penetrating urban planning. The aim is to cast light on the importance of integrated planning for, and management of, green spaces as elements of green infrastructure. The study seeks to understand the relationship between issues such as rapid, chaotic urban development and the prioritisation of ‘traditional’ infrastructure services, which although critical, are not being paralleled by an equal attention to green infrastructure. The study also makes use of examples from elsewhere to highlight how other planning and development issues have been prioritised over the need to enhance green spaces and the provision of ecosystem services. In terms of structure, the chapter firstly engages with the theoretical framework through which the notion green infrastructure is understood in the study. Secondly, the contextual challenges for planning for and management of urban green space will be presented, followed by a discussion of the importance of green infrastructure for planning and development practices.

2.2 Green Infrastructure Planning- Theoretical Framework

The notion of green infrastructure can be best understood from the “social-ecological system thinking and infrastructure transition scholarship” (Schaffler and Swilling, 2012: 2). These theoretical lenses begin to shed some light on the importance of urban green assets and the need to plan for these as integrated networks of green infrastructure providing wide ranging ecosystem services (Schaffler and Swilling, 2012 and Benedict and McMahon, 2002). Thus, urban green spaces should be seen as infrastructure “equivalent to water or power networks, for example, that provides multiple social, environmental and economic functions” (Landscape Institute, 2009 in Schaffler and

Swilling, 2012: 2). This section provides a theoretical framework through which green infrastructure is understood in the study. The section firstly provides background for environment planning and conservation. Secondly, it discusses the social-ecological system thinking, and lastly the infrastructure transition scholarship.

2.3 Foundation of Planning for the Natural Environment

As stated by Alexander (2008: 84) environmental planning exists because “some people value nature”. Planning for the natural environment has its origins in the mid to late 19th century. During this period, environmental planning was a result of several important conservationists and preservationists (Alexander, 2008 and Youngquist, 2009). It was purely concerned about the conservation of natural resources and attempts to understand the relationship between human beings and nature (Alexander, 2008). This drive for conservation led to the development of government agencies advocating for protection of natural resources such as forestry, fisheries and wildlife. Over time, this understanding of the relationship between nature and people began to change (Youngquist, 2009).

In the 20th century, the understanding of human population and the environment incorporated issues of ecological and human health (Youngquist, 2009). Yet, many scholars continued to criticise how human population had modified and in some cases, disturbed natural environment processes. Carson (1962) cited in Youngquist (2009: 14) stated that “the most alarming of all man’s assaults upon the environment is the contamination of air, earth, rivers, and sea with dangerous and even lethal materials”. This period then saw implementation of various policies to protect natural resources against human processes. The conservation emphasis was now more about enabling the “development of habitats and ecosystems that are resilient and robust enough to survive environmental change, whatever the reason for that change” (Alexander, 2008: 79). This emphasis began to move away from earlier protectionist or conservationist understanding of environment planning to an understanding that environment has its own processes with which to deal with natural and development pressures.

Recently, the understanding of ecology has shifted from conservationist to a growing emphasis about the need to plan for natural for natural environment as connected systems with open space linkages and important hubs (Benedict and McMahon, 2002,

Youngquist, 2009 and McDonald et al., 2004). The dominant view now is that the protection of urban green spaces is crucial for maintaining a high quality of life within cities as well as protecting the environment and its natural processes (MEA, 2005, McDonald et al, 2004 Youngquist, 2009). This period has been largely characterized by a desire to integrate human habitation and use of resources with the long term protection of natural systems (Youngquist, 2009). In the study, the notion of green infrastructure is understood from the two following theories or schools of thinking;

2.4 Social-Ecological Systems

The idea of social-ecological systems has its foundations in systems theory (Jahn et al., 2009 and Schaffler and Swilling, 2012). In planning and development, systems theory, helps us to understand the increasingly “complex systems across a continuum that encompasses” relationships between the person and their environment” (Friedman and Allen, 2010: 3). It enables us to understand the components and dynamics of systems to interpret problems and develop informed decisions that enhance the relationships between individuals and the environment in which they live (Chermack, 2004 and Friedman and Allen, 2010). It is worth noting that systems theory does not advocate specific interventions for understanding particular problems, but serves as an ‘organising conceptual framework” for understanding problems and finding relevant solutions (Friedman and Allen, 2010). Thus, social-ecological system thinking does not necessarily offer specific solutions to address urban development challenges, but rather, an analysis framework for the understanding of “relationships that exist between people and biophysical processes in cities” (Bai et al, 2010 cited in Schaffler and Swilling, 2012: 2). It helps us understand how a “goodness of fit” between the human societies and ecosystem systems can be best achieved to ensure sustainable management and maintenance of the latter (Friedman and Allen, 2010: 3 and Jahn et al., 2009). The concept has therefore been developed in order to provide both “a promising scientific gain as well as an impact on problems of sustainable development” (Jahn et al., 2009: 3).

The study borrows the definition of social-ecological systems from that of Glaser et al. (2008) in Jahn et al. (2009: 2) who states that “a social-ecological system consists of a bio-geo-physical unit and its associated social actors and institutions”. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries

surrounding particular ecosystems and their problem context.” Central to this definition is the idea that the natural system has the capacity to “cope with whatever the future brings, without undergoing undesired changes (Glaser et al., 2008: 80). This adaptive nature of natural environments is commonly referred to as resilience and is a conceptual foundation from which to motivate for a changed approach to addressing urban challenges in developing country cities (Glaser et al., 2008, Jahn et al., 2009 and Schaffler and Swilling, 2012).

2.5 Urban Resilience

The resilience perspective is increasingly used as an approach for understanding the dynamics of social-ecological systems (Folke, 2006: 253). The concept of resilience has its origins in ecological studies and the “discovery of multiple basins of attraction in ecosystems in the 1960-1970s” (Folke, 2006: 354). It was developed as a critique of non-linear theories of the human and nature relationship, which essentially ignored the complexities and relationships that exist between human population and natural environment (Folke, 2006). The resilience approach emphasises that there exist complex, multiple domains in natural systems and ecological processes, and as a result, human/nature relationship should not be understood through the stable equilibrium view, which “focuses on maintaining efficiency of function, constancy of the system, and a predictable world near a single steady state. It is about resisting disturbance and change, to conserve what you have” (Folke, 2006: 256). This perspective therefore began to shift thinking from one where the focus is on controlling change in natural processes to thinking about managing and improving the capacity of the natural environment to “cope with, adapt to, and shape change” (Folke, 2006: 254).

The understanding and application of the notion of resilience is of fundamental importance for urban environments, given the increasing impact of humans on the environment, as well as threatening changing climate conditions, and food and water scarcity (Folke, 2006 and Pfeiffer, 2006). As stated by Schaffler and Swilling (2012: 2) “reducing resilience exposes systems to greater risks, uncertainties and surprises, whereby it takes progressively smaller shocks for that system to lose its capacity to sustain a certain regime”.

For the purposes of this study, the concepts of social-ecological systems and resilience are crucial for helping those concerned with ensuring responsive urban development to address the challenge of creating governance systems that make it possible to relate to environmental or ecological assets in a manner that secures and improves their capacity to support societal development rather than degrading them (Folke, 2006). This is increasingly important in Johannesburg given growth and development pressures on ecological assets.

2.6 New Infrastructure Transition Thinking

Traditionally, infrastructure is understood as physically built, man-made, “substructure or underlying foundation on which the continuance and growth of a community or state depends” (Webster’s New World Dictionary in Benedict and McMahon, 2002: 1). Man-made infrastructure provides a wide range of functions, such as storm water attenuation, easy movement and connectivity, water supply and shelter. However, following the growth of urban populations, constrained municipal budgets and changing climate conditions, the level to which traditional infrastructure is capable of providing these functions in cities is increasingly becoming a concern (Schaffler and Swilling, 2012 and UN-Habitat, 2011). The poor state of infrastructure (both in terms of provision and maintenance) is also more prevalent in cities of the developing world and suggests a poor adaptive capacity for these cities to adjust and cope with shocks (EU, 2012 and UN-Habitat, 2011).

To respond to the infrastructure inefficiencies, new scholarship has been rapidly expanding around rethinking the way in which resources and infrastructure is used in urban environments for purposes to “maintain more sustainable metabolic flows” in these areas (Schaffler and Swilling, 2012: 3). Central to this is the view that green assets offer opportunities to support traditional infrastructure services, and in some situations provide alternative functions to improve the efficiency of over-stretched hard infrastructure in cities (Schaffler and Swilling, 2012). The reduction of storm water runoff through green spaces is one good example. Green spaces reduce peak flows by utilizing the natural retention and absorption capabilities of vegetation and soils (CRWA, 2009 and Heinze, 2011). By increasing the amount of pervious ground cover, green infrastructure increases storm water infiltration rates, thereby reducing the volume of runoff that enters the city’s water management system (Heinze, 2011).

2.7 Factors Leading to Loss of Urban Green Spaces

This chapter discusses factors leading to loss of green spaces in cities and towns. Loss in urban green spaces is a result of a combination of multifaceted, complex factors. On the one hand, growing populations in cities have resulted in huge demand for infrastructural services which may result in the conversion of green spaces to provide housing, roads and other services. While loss of green spaces remains a common phenomenon, it should be noted that there are instances where green spaces have been provided. The City of Johannesburg, through Johannesburg City Parks (JCP) embarked on a “massive greening programme that saw 200 000 trees planted in the run-up to the World Cup” (Schaffler and Swilling, 2012: 5). However, this greening programme appears to have been done in an uncoordinated and fragmented manner. As Schaffer and Swilling note “this programme has been done hastily, where speedy roll-out to address a historical backlog has been the driving imperative rather than the long-term sustainability of greening projects” (Ibid). These issues are discussed below.

2.7.1 *Rapid, uncoordinated growth of cities and smaller towns*

The growth of cities dates back in the 18th and 19th centuries when cities in the North became more industrialised (Cornwell and Inder, 2004, Henderson, 2009 and Ramjattan, 2004). As asserted by Anderson (1964: 1) “not entirely by coincidence, it follows that a country with a high level of industrialism also possesses high level of urbanism”. During the industrialisation period, cities changed from being commercial centres for rural hinterlands to industrial hubs. Cities such as Chicago, which had been a railroad centre serving the upper Midwest as a distribution hub for lumber, meat and grain, took a lead in the production of steel and meat production during the industrialisation period (Ramjattan, 2004). Industrialisation of cities began to attract large numbers of people from rural hinterlands seeking economic and work opportunities (Anderson, 1964, International Federation of Surveyors, 2010 and Ramjattan, 2004). Understanding the growth of cities should not only be narrowed to the industrialisation process, but should also consider the number of people living in cities and those who have recently migrated to cities (Aguilar, 2008, Anderson, 1964, and Henderson, 2009). The migration of people to cities begins to highlight the issue of rural-urban migration, which has critical implications for both cities and rural areas (Kihato, 2009). It is however important to point out that migration of people to cities

does not necessarily ensure access to opportunities because most of migrants have little to offer in terms of skills needed for the urban economies (Anderson, 1964 and Cornwell and Inder, 2004).

The growth of cities today is also somewhat different to that resulting from industrialisation (Anderson, 1968, Henderson, 2009, Pieterse, 2008 and UNFPA, 2007). Larger metropolitan cities are growing rapidly, and hundreds of small cities are growing into big ones (Anderson, 1964, Pieterse, 2008 and Ward et al., 2010). This growth is faster in cities of the developing world, if not in absolute numbers, “at least in relative to the resources of such countries and in relation to the civil and industrial organisation for coping with amounts of urban growth” (Anderson, 1964: 2). Cities and smaller towns are therefore under intense pressure to accommodate the new urban populations (FIG, 2010, UNFPA, 2007 and Wyly, 2011). This growth of cities and small towns has to some extent also created spatial patterns where cities and small towns function as connected, single and integrated regions. The Gauteng City-Region (GCR) in South Africa is one good example illustrating this polycentric urban growth (GCRO, 2011). The Gauteng City-Region which is “characterised by series of connected cities and smaller towns” functioning as an “integrated urban region”, has been experiencing enormous population growth since early 2000 (GCRO, 2011: 37). This growth has also created a “complex multi-nodal structure in which neither of the two major centres, Johannesburg or Tshwane, dominate or have their own self-contained labour market”, resulting in complex socio-spatial characteristics (GCRO, 2011: 40).

Within the global context, underlying these trends is a series of spatial relationships and patterns that are increasingly rapid and chaotic and often result in unsustainable land use (FIG, 2010, UNFPA, 2007, Pieterse, 2008 and UN-Habitat, 2009). “It is recognised that over 70 percent of the growth currently takes place outside the formal planning process and that 30 percent of urban populations in developing countries are living in slums or informal settlements” (FIG, 2010: 7). In sub-Saharan Africa for example, it is estimated that 90 percent of new urban settlements are taking the form of slums (FIG, 2010). The uncoordinated growth of towns and cities not only has severe economic and social implications, but also ecological implications. Large quantities of urban green spaces are often converted for purposes of housing and infrastructure service provision (FIG, 2010 and Vimal et al., 2012). Taking the City of Cairo for example, the city has

recently lost considerable urban green spaces because of rapid, unplanned, irregular urbanization on greener, agricultural land (UN-Habitat, 2011). More than 80 per cent of all informal settlement growth has taken place on these spaces (Ibid). Furthermore, future projections indicate that Cairo is to be one of the most populous cities of the world by 2025, and this suggests that more green spaces may be converted due to demands for housing, infrastructure and sanitation services (Arishie, 2011 and UN-Habitat, 2011 and 2010).

2.7.2 Biases in the planning system

Prioritisation of certain planning and development issues over green spaces is a common phenomenon in the development practice and links back to the issue of how city governments shape their development and 'infrastructure services' agenda (CABE, 2009 and UGI, 2012). In many cities of the developing world, there has been a push to provide housing or alleviate informal settlements, improve accesses to services and uplift people out of poverty (National Planning Commission, 2011, The Presidency, 2012, UNFPA, 2007 and UN-Habitat, 2009). In the town of Festac, Lagos, housing and development of industrial activities has received substantial attention by the local authority to "provide employment opportunities" for the increasing population moving into the town (Fasona and Omojola, 2004: 458). The subsequent conversion of green spaces to other forms, to accommodate these government interventions, is noted by Fasona and Omojola (2004) who point out that between 1980 and 2004, 35 percent of housing and 30 percent of shopping malls have been built in green spaces. These developments have decreased the green space profile from approximately 0.2 sq. km to only 0.003 sq. km in 2003 (Ibid).

South Africa presents another case of where green spaces are being treated as afterthoughts in many planning processes. Nationally, the South African government has made one of its priorities the provision of housing and removal or improvement of all slums as quickly as possible by no later than 2014 (Cross, 2006). Substantial resources have been directed towards achieving this goal while at the same time overlooking other development issues. Uplifting people from poverty and addressing inequalities in cities of the developing countries are planning and development agendas that often get the major share of attention from city governments. In South Africa, the recent policy discussions by the National Planning Commission (2011: 7) have firmly

stated that “the continued social and economic exclusion of millions of South Africans, reflected in high levels of poverty and inequality is the biggest challenge for the government”. These development agendas are often understood outside of the ecological realm and it appears that the creation of employment opportunities and eradication of poverty are largely de-coupled from the environment. From a sustainability perspective, these priorities appear to be developed with an economic mindset and largely removed from the priority of investing in the services provided by ecosystems.

The biases in planning are also enforced by municipal planning tools such as Spatial Development Frameworks (SDFs). While there is a mention of ensuring sustainable environmental management in the municipal SDFs, this remains implicit and equivocal, and does not necessarily embrace the concept of green infrastructure. In South Africa, municipal SDFs continue to focus on issues such as nodal development, densification, corridor development, sustainable housing development and managing the urban development boundary (CoJ, 2011), and there is little by way of integrated green infrastructure planning.

The City of Johannesburg context represents some of these complex institutional issues related to planning for urban green spaces. During the apartheid period, the City of Johannesburg reflected the racist planning framework which essentially separated black local authorities from white urban areas (Williams, 2000 and Wolpe, 1972). This was made more explicit by Dr Verwoerd, the “Minister of Native Affairs” at the time by declaring that “black townships should be separated from white areas by an area of industrial sites where industries exist or are being planned” (Williams, 2000: 167). Much emphasis on separating different races led to less efforts directed towards planning for green spaces, especially in areas falling within the boundaries of black local authorities (McConnachie, 2010). In contrast, the wealthier suburbs inhabited mainly by whites had the highest area of green space per capita (McConnachie, 2010).

The greening of the northern suburbs in Johannesburg has led to the creation of one of the largest urban forests in the world, and while the exact number of trees is yet to be confirmed, the City of Johannesburg has publicised that it has approximately ten million trees and two thousand developed parks (CoJ, 2012). Approximately 1.2 million of

these trees were planted in the northern suburbs of the City (CoJ, 2012). Whereas these trees play an important role as pollution reduction, oxygen enhancement and cooling resources, there remain questions relating to type of biodiversity provided by this urban forest as well as the forest's impacts on water consumption. Before the planting of the trees, Johannesburg was typical savannah/grassland system, with grassland and scattered scrub (CoJ, 2003). The early farmers or settlers brought seeds from the Cape and planted acorn, oak and walnut trees (Ibid). This has fundamentally changed the natural savannah/grassland vegetation type and underlying biodiversity, but also led to uneven distribution of green spaces between different areas within the City (Johannesburg City Parks, 2011). While the impacts of these plantations are not well documented, Mawson (2004) reports that in as early as early as 1900s, some of the alien trees had to be removed from parks such as Joubert Parks because of the large quantities of underground water these used.

Finally, in Johannesburg there remains a lot of emphasis on addressing the imbalances of the past. Whereas addressing these disparities remains important, so is the planning and sustainable management of the provided green spaces. It appears that the City of Johannesburg needs to put more effort into planning and managing these as a system of connected networks of ecological assets that provide seminal processes, services and associated benefits for human well-being (Jim and Chen, 2006 and The Conservation Fund, 2012). Green spaces planned for and managed as a system of connected ecological assets will ensure enhancement of ecosystem processes and services provided by green spaces. This will also play an important role in the protection of biodiversity in these spaces (The Conservation Fund, 2012).

2.8 A Glance at Green Spaces and their Services

Human populations have always benefited from a multitude of resources and processes provided by green spaces (ESA, 2000 and MEA, 2005). Whereas humans have over the years developed new ways of doing things through advances in technology, there remain services that are provided naturally by green spaces and ecosystems through their biophysical processes. Taking urban forests as an example, these form integral components of urban ecosystems, "which could generate significant ecosystem services, such as offsetting carbon emission, removing air pollutants, regulating the microclimate, and recreation" (Jim and Chen, 2009: 187). In this case, urban forests are crucial for

contributing to improvement of quality of life, quality of environment and most importantly to sustainable urban development (Jim and Chen, 2006 and 2009). These natural resources and processes are commonly known as ecosystem services (MEA, 2005 and Raymond et al., 2009). They are the “delivery, provision, protection or maintenance of goods and benefits that humans obtain from ecosystem functions” (Tzoulas et al., 2007: 170). While environmentalists and ecological scientists have always implicitly discussed this notion of ecosystem services, it was in 2005, through the Millennium Ecosystem Assessment (MEA) that ecosystem services were made popular and their definitions formalised (Constanza et al., 1997, MEA, 2005 and Raymond et al., 2009). The United Nations commissioned a four year study which is said to have involved more than one thousand and three hundred ecological scientists to assess ecosystem services (MEA, 2005). The study has been influential in shaping scholarship around issues related to human impacts on ecosystem services, which are discussed below.

2.9 Ecosystem Services

Ecological Society of America (2000: 1) defines an ecosystem as a “community of animals and plants interacting with one another and with their physical environment”. Thus, it includes the interaction among all organisms in a given habitat, including human beings. The concept of ecosystem (ecological) services was coined in the Millennium Ecosystem Assessment report of 2005. In the report, the MEA (2005: 1) defines ecosystem services as “the benefits people obtain from ecosystems”. They are the “biological or system properties or processes of ecosystems” (Constanza et al., 1997: 253). It is through these processes that ecosystems produce goods, for example, food and “services such as waste assimilation”, and are of benefit to human beings for their development purposes (Constanza et al., 1997: 253). These services can be categorised into supporting, regulating, cultural and provisioning services (ESA, 2000, MEA, 2005 and Wallace, 2007).

2.9.1 *Supporting services*

The MEA (2005) categorises supporting services as one of the most important ecosystem services provided by green spaces. These services play a vital role in the production of other ecological services. Amongst other things, supporting services are crucial for maintaining process of photosynthesis (which is crucial for plant production)

and nutrient cycling (MEA, 2005 and Wallace, 2007). Equally important to note is that supporting services maintain soil formation processes, primary production and water recycling (Wallace, 2007). Whereas some of these services do not have a direct impact or short-term impacts, for example, photosynthesis service, they can pose serious impacts in the long run (Ibid).

2.9.2 *Regulating services*

Regulating services perform a crucial role as lungs in urban areas (Jim and Chen, 2006). The services regulate and maintain hazardous environmental impacts from human processes (ESA, 2000, MEA, 2005 and Wallace, 2007). Among other things, regulating services are significant for:

- mitigating drought and floods
- maintaining biodiversity
- moderating weather extremes and their impacts
- protecting people from the sun's harmful ultraviolet rays
- protecting stream and river channels and coastal shores from erosion
- detoxifying and decomposing wastes
- contributing to climate stability
- purifying the air and water
- regulating disease carrying organisms

2.9.3 *Cultural services*

Cultural services are crucial for providing non-material benefits to people through spiritual enrichment, reflection, recreation, and aesthetic experiences (Constanza et al., 1997 and Jim and Chen, 2009). In the city of Guangzhou (China) for example, recent studies have revealed that residents are highly active in using urban forests for recreation and amenity purposes (Jim and Chen, 2009). Most of the interviewed city residents stated that they visit urban forests often for purposes of relaxation, nature appreciation, physical exercise and aesthetic enjoyment (Jim and Chen, 2009). Whereas this remains to be tested, natural green spaces which to some extent express these cultural values, are an increasingly important economic resource which can be crucial for also addressing issues of poverty, given that the urban poor are afforded access to it (MEA, 2005).

2.9.4 *Provisioning services*

Unlike supporting services, provisioning services can have direct, short impact to lives of the people (Wallace, 2007). These services are products which people directly obtain from ecosystems. They include among other things, fresh water (which is of fundamental importance for well-being of both ecosystems and people), biomass energy, food, timber and minerals. The increase in human population in cities has however negatively affected these services (Wallace, 2007). One good example is the increased production of bio-fuels to replace fossil fuels such as wood and charcoal, which has led to increased emission of carbon dioxide, which in turn negatively affects atmosphere and ecosystem services (MEA, 2005, Raymond, 2009 and Wallace, 2007). Also, the use of hydropower as a low-carbon energy source is dependent on freshwater-related ecosystem services which are provided, for example, by dams and can also have major impacts on upstream and downstream ecosystems (MEA, 2005).

2.10 **Ecosystem Services and their Interaction with Urban Development**

In this study, urban green spaces are understood as natural and semi-natural ecosystems free from buildings or other built infrastructure systems (Bilgili and Gokyer, 2012, and Heidt and Neef, 2008). These range from wetlands, conservation lands, wildlife habitats, greenways, parks, forests and other open spaces that support and maintain natural ecological processes (Benedict and McMahon, 2002). These different kinds of green spaces provide a number of services which in most cases are not acknowledged, or are taken as those natural processes which will always be provided (ESA, 2000, MEA, 2005, Wallace, 2007).

One of the major threats to the sustained provision of ecosystem services is that green spaces and ecological assets are not prioritised in the same way as other planning priorities such as employment creation, housing, and reducing poverty and inequalities (Constanza et al., 1997, Wallace, 2007 and Ward et al., 2010). Neglect of ecological assets is often more prevalent in cities and towns of the developing world where poverty, informal settlements and unemployment rates are high (Jim and Chen, 2009 and Wallace, 2007). While addressing issues of poverty and informal settlements remains important, ignoring the deterioration of green spaces also has implications for urban development and human well-being. Various research shows that ecosystem services are often not included in the decision-making criteria of urban planners. For

instance, as noted by Constanza et al. (1997: 253); “because ecosystem services are not fully captured in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions”.

Constanza et al. (1997: 253) warn that the neglect of planning for and management of green spaces may eventually “compromise the sustainability of humans in the biosphere”. This is problematic in light of the critical role that ecological assets and ecosystem services play for human well-being and economic development” (UNEP, 2008: 5). The implication is that human life would be fundamentally undermined without ecosystems as ecological life-support systems (Constanza, et al., 1997 and Raymond et al., 2009). This raises key questions of how cities and smaller towns are planning and managing urban green spaces and whether cities are doing so for the enhancement of these spaces, their ecological processes and the vital services they provide. Such questions are being asked within the emerging discourse of green infrastructure as an important theoretical and practical contribution to the maintenance of ecosystems services and the transition towards urban sustainability (ESA, 2000).

It is the argument of this study that despite the importance of green spaces for human development, various pressures are undermining the ability of these spaces to provide ecosystem services (Esbah et al., 2009, Huang et al., 2010, Liu et al., 2011, Niemela et al., 2010, Qureshi et al., 2010 and Vimal et al., 2012). The physical growth and development of cities gives way to the “fragmentation and isolation of urban green spaces from rural green areas” (Niemela et al., 2010: 3226). This change in land use and land cover often negatively affects the natural biological diversity in cities (Liu et al, 2011, Niemela et al., 2010 and Ward et al., 2010). Biodiversity is the “variability among organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; it includes diversity within species, between species and of ecosystems (UNEP, 2008: 4). Degradation of biodiversity by human activities weakens the ability of ecological assets to produce their key services (Jim and Chen, 2006, Niemela et al., 2010 and UNEP, 2008). The study seeks to investigate how, within the context of urbanisation and pressures this brings, the City of Johannesburg values services provided by green spaces. This raises a question of whether the City is planning

for green spaces in the same manner as it plans for traditional services given the importance of these ecological assets.

2.11 Planning for Green Spaces as Elements of Green Infrastructure

The concept of green infrastructure is a “new term, but not a new idea” (Benedict and McMahon, 2002: 8). The concept has its origins from the late 18th and early 19th centuries when calls by Frederick Law Olmsted began to introduce the notion of “linking parks and other green spaces for the benefit of people, and preserving and linking natural areas to benefit biodiversity and counter habitat fragmentation” (Ibid). The concept been applied (and developed) has for some time to refer to engineered structures or processes aimed at reducing human activities detrimental to the environment (Benedict and McMahon, 2002 and Kuppuswamy, 2009). The usage of the term however depends on the context and purpose for which the term is used (Benedict and McMahon, 2002 and Shih et al., 2009). For the purposes of this study, green infrastructure is understood as “coherently planned and managed interconnected systems of natural areas and other open spaces”, such as waterways, wetlands, woodlands, wildlife habitats, street trees, city parks, forests and open spaces “that conserves natural ecosystem values and functions and provides associated benefits to human populations” (Benedict and McMahon, 2002: 7, NWDA, 2008 and Vergnes et al., 2012).

The concept of green infrastructure is helpful in advancing previous ideas of green space through integrating green spaces and ecosystem services in planning agendas and frameworks. Green infrastructure is therefore a planning tool which begins to point to the need for committed planning and management of green spaces as integrated systems of ecological assets (Benedict and McMahon, 2002 and Constanza et al., 1997). Green infrastructure assists in prioritising the integration of urban green features such as street trees, urban forests, waterways, city parks and other green spaces to ensure that these function as one single system to contribute multiple benefits to the environment and societies alike, as discussed below (Benedict and McMahon, 2002 and Qureshi et al., 2010).

2.11.1 *Economic benefits*

There remains a challenge to value the economic benefits of green infrastructure, and enormous efforts have been directed to address this challenge, particularly towards creating tools to value ecosystem services (Altwegg and Grêt-Regamey, 2011, Constanza et al., 1997 and Lomis et al., 2000). While it remains important to measure the economic value of ecosystem services, these efforts sometimes fall victim to a reductionist preoccupation with economic valuation and do not unmask the underlying power dynamics (Altwegg and Grêt-Regamey, 2011 and Liu et al., 2010). Liu et al. (2010: 55) assert that “nature is vital to human survival and well-being for various reasons and, therefore, forcing all values into a single economic indicator is not realistic”. As a result, new valuation methods to evaluate the economic benefits of ecosystem services need to be developed (Liu et al., 2010 and Lomis, 2000). Such valuation methods aim to communicate the nature of ecosystem services to the respondents and have been used by agencies such as the Northwest Development Agency (NWDA) in measuring the contribution of green spaces in local economies (Lomis, 2000). In a 2007 study, the NWDA reported that “the region’s green infrastructure supports a wide range of economic activities and employment which contributes towards GVA through land based industries and their associated support services, as well as natural tourism” (NWDA, 2008: 10).

Green spaces also contribute economically through increasing the adjacent property values (Jim and Chen, 2009). A number of studies conducted in residential properties of the emerging housing market in Chinese cities discovered that there is a positive correlation between proximity of green spaces and property values (Ibid). As Jim and Chen (2009: 191) report, “in the old town centre of Guangzhou, the housing price would decrease by 6.6 percent with doubling in distance to the nearest urban park”. Residents of the town would be “willing to pay a premium for homes with pleasant views of and easy access to nature” and thus creating competition for properties in close proximity to green spaces (Ibid). This is also said to be the case in Athens, where “a large front yard tree could improve the selling price of a house by US\$336” (Anderson and Cordell, 1988 cited in Jim and Chen, 2009: 191).

2.11.2 *Social/health benefits*

Various studies have also attempted to examine the relationship between green spaces and the contribution it makes towards improving of quality of life' (Kuppuswamy, 2009 and Qureshi et al., 2010). This has come in the wake of many accounts made by environmental scholars that a healthy population is strongly related to a healthy natural environment (Niemela et al., 2010 and Qureshi et al., 2010). A healthy natural environment means "sufficient recreation areas, good accessibility (especially on foot) connectivity, and ecological diversity" (Niemela et al., 2010). An accessible and good quality recreational green space attracts people to engage in a physical activity which is of great importance in cities where people are always confined in offices and computerising work (Ibid). Also important to note is that green spaces make significant contribution to urban air quality (Jim and Chen, 2009). In Beijing for example, a study showed that "urban forests could capture from the atmosphere 1261.4 t/year of total air pollutants" (Jim and Chen, 2009: 189). This highlights the role of green infrastructure in improving the lives of the people through improving the quality of environment.

Investment in green infrastructure is important for cities of the developing world to have shrinking financial resources. Unlike most traditional infrastructures with single functions, green infrastructure is multi-functional (CABE, 2009). Taking trees for instance, these provide shade for offices, which then reduces need for air-conditioning, while at the same time cools the urban heat island and improves the aesthetic character of cities (Ibid). Thus, green infrastructure offers cities an opportunity to contribute to the local economy with potentially fewer investments in built infrastructural projects. Equally, with the increasing the need to create productive cities attracting high skilled personnel and where business will want to invest and stay, green infrastructure needs to be given more attention.

The above discussion begins to delve into the importance of green infrastructure benefits for urban sustainability (Arnberger, 2012, Mell, 2009, Niemela et al., 2010, Wickham et al., 2010). Green infrastructure helps to "promote increased human integration, ecological sustainability and economic regeneration" (Mell, 2009: 23). To achieve urban sustainability, there need to be meticulous planning and management of the green spaces and their services managed to ensure that they function as one single

earth life support system (Benedict and McMahon, 2002 and Mell, 2009). This is of particular importance for cities of the developing world which are currently experiencing rapid disordered growth and planning agendas oriented to bulk infrastructure planning.

2.12 Green Infrastructure and Benefits to Urban Planning Processes

The concept of green infrastructure brings a new dynamic for the planning and management of green spaces which is crucial for urban planning processes. Urban planners need to plan for adequate housing, transport infrastructure and support commercial development to secure the prosperity of a city or economy (Mell, 2011). This, as argued by Mell (2011) “directly contributes to trade-offs between economic needs and the support for ecological resources management”. The lack of mainstream financial and social valuations for ecological assets leads to marginalisation of these in cities (Constanza et al., 1997 and Mell, 2011 and TCPA, 2008). Just as with many other public goods, green spaces are not easy to value in monetary terms, and as a result are at a disadvantage against other types of city functions, for example, housing, roads, storm-water and other related traditional infrastructure services (Lomis, 2000 and Constanza et al., 1997).

The concept of green infrastructure begins to expose, integrate and elevate green spaces and ecosystem services into the planning mindset which has been quite biased. As noted by TCPA (2008), Mell (2011) and Bilgili and Gokyer (2012), recognition of these services and the need for planning and management of green spaces as connected systems assists planners to:

- Develop and support the implementation of land-management practices that deal comprehensively with competing urban land requirements for housing, industry, commerce, infrastructure, transport, green and forested areas;
- Develop and implement integrated green space management plans to ensure the proper development and conservation of ecosystem services;
- Promote urban planning that encourages creation of integrated networks of green spaces, and thus equally discouraging fragmentation of green spaces and loss in urban biodiversity.

The effective management of ecological assets is also crucial to end cycles of poverty and supporting developmental goals such as improving quality of life (GFN and WWF, 2008). With increasing population and demand for resources, the planet's bio-capacity to supply ecological services is under threat. If this depletion of ecological assets is allowed to continue, "consequences such as collapsed fisheries, biodiversity loss, climate change and water scarcity" will be inevitable (GFN and WWF, 2008: 6). Thus by acknowledging the importance for planning and management ecological assets and their services, green infrastructure begins to address the crucial questions about the need to ensure human development while sustaining environmental processes and nature's capacity to provide services.

2.13 Conclusion

Prioritising planning for, and management of, green spaces can be a daunting challenge in a city like Johannesburg where a significant portion of population is poor and social and spatial inequalities remain pervasive. However, bringing human actions into harmony with the ecological processes is one of the basic tasks to be undertaken in achieving sustainable development (Arnberger, 2012, Mell, 2009 and Wickham et al., 2010). This then brings the concept of infrastructure to the fore. Green infrastructure elevates green spaces and ecosystem services as important elements of development and planning. Within this logic, green spaces are seen as essential for biological and hydrological balance and economic development. They play an important role in reducing air pollution and in creating more suitable climatic conditions, thereby improving the living environment in cities (Husqvarna Group, 2012, Jim and Chen, 2009, Niemela et al., 2010 and Qureshi et al., 2010). It is important that these are given the same treatment given to traditional infrastructural services, to ensure that development is not decoupled from environmental processes, but is in harmony with these processes. This application of green infrastructure as a planning tool is the research question that informs this study, and will be used to explore the value put on planning and management of green spaces and the services they provide by the City of Johannesburg.

Chapter 3: Introducing the Planning and Policy Framework for Green Space Planning and Management in the City of Johannesburg

3.1 Introduction

Planning green spaces as elements of green infrastructure is a complex process, raising fundamental environmental, economic and social issues which are often contradictory (Ahern, 2007, Arnberger, 2012, Mell, 2009 and Wickham et al., 2010). This study maintains that green infrastructure offers myriad opportunities for the City of Johannesburg to move towards development that is in harmony with natural processes. Green infrastructure advocates “hybrid hydrological and drainage networks, complementing and linking relict green areas with built infrastructure that provides ecological functions” (Ahern, 2007: 267). It suggests that to achieve sustainable development in urban landscapes, green spaces planned for and managed as infrastructure must be conceived of, and understood as a genuinely possible means to improve, and contribute to sustainability (Ahern, 2007: 257). Thus, for example, storm water management must not solely be confined to traditional functions of controlling runoff, but should be designed as a system that incorporates green roofs, small ponds, infiltration wells and wetlands to deal with runoff, improve water quality and maintain ecological integrity (Ahern, 2007, Niemela et al., 2010, Qureshi et al., 2010 and Schaffler, 2012, *pers. comm*).

This kind of planning for green spaces as ‘infrastructure’ is still lacking in cities, and one reason for this relates to the “institutional failures to acknowledge mutual benefits that ecosystem services supply to both ecological and social systems” (Barthel et al., 2010 cited in Schaffler and Swilling, 2012: 2). There also seems to be a disjointed system of government within the City, where different city departments/institutions operate within their defined areas of jurisdiction (Eagle, 2012 and Letsoko, 2012, *both pers. comm*). Whereas the importance of ecological assets has been well document by organisations such as Millennium Ecosystem Assessment (MEA), Global Footprint Network (GFN), World Wildlife Fund (WWF) and Ecological Society of America (ESA), there remain questions as to whether these are acknowledged, valued and planned for as green infrastructure by local governments, especially those of the developing world.

This chapter introduces the planning and management system(s) and process(es) in City of Johannesburg. The aim is to analyse and explore the institutional and policy landscape through which green spaces are currently planned for, managed and budgeted for, but also more importantly to explore whether these assets are understood

in infrastructural sense. The analysis of the institutional and policy landscape is crucial for setting the base through which city processes, relating to planning and management of ecological assets, can be understood, and also for identifying opportunities for systematic planning and management of these to ensure that their processes are not compromised, but supported.

In terms of structure, the chapter firstly introduces a brief contextual background of green space planning and management in the City; provides the institutional and policy framework for the City and; eventually discusses recent green initiatives undertaken by the city. Concluding remarks are also provided.

3.2 Contextualising Green Space Planning in City of Johannesburg

3.2.3 Tree planting in the late 1880s

The City of Johannesburg presents an interesting history and set of dynamics for planning and management of green spaces. Firstly, it should be mentioned that when Europeans first settled in the Witwatersrand area in 1880s, the area had no trees, no gardens, no parks, but grassland and scattered scrubs (CoJ, 2012 and Johannesburg City Parks, 2012). The natural landscape was changed by the settlers as they began “planting trees and developed public parks for beautification purposes” Mawson (2004: 1). Initially, tree planting was done at a small-scale household level, but this changed with the increase in mining activities following the discovery of gold (CoJ, 2003, JCP, 2012 and Mawson, 2004). More trees were demanded by the mines, and as result a nursery was constructed at the present day Horticultural Training Centre at Zoo Lake (CoJ, 2012). At this centre, experiments were “conducted to test which trees were suitable for mine props” (CoJ, 2012: 1). This led to plantations of trees such as blue gums in places such as present day Saxonwold, Parktown, Langlaagte, Craighall and Fairlands (CoJ, 2012). Other trees were given to residents, especially those living in the north of Johannesburg, to plant in their gardens and streets (Ibid). Equally worth noting is that other mining companies imported a substantial number of trees from other countries, for example, eucalyptus trees from Australia for use in shoring up mine shafts (Mawson, 2004 and Schaffler and Swilling, 2004). The expanding suburbs in Johannesburg also led to planting of street trees (CoJ, 2012). Again, the preference was given to trees the colonials were familiar with, that is, oak, plane and jacaranda trees (CoJ, 2012 and

Mawson, 2004). A previous City official was quoted as saying “in fact indigenous trees don't make good street trees, a lot of them have thorns which could puncture car tyres or hurt passers-by. The perfect street tree must be quick growing, grow straight up, tolerate pruning, and have a root system that does not interfere with the underground systems or break the tar paving above,” (CoJ, 2012: 2).

This 19th century tree plantation process has led to one of today's claimed largest man-made in the world (CoJ, 2012 and JCP, unknown). Schaffler and Swilling (2012: 4) report that “of Johannesburg's 164458 ha, a total of 16.1 percent is covered by trees”. While this urban forest provides a lot services in the city, it has also come under criticism with issues relating to “inducing hydrological pressures” (Ibid). Equally, it has created a green space divide between the northern white suburbs and the southern, black townships. This is discussed further later in the study.

3.2.2 The first public park in the City- Joubert Park

The first planned park was developed in 1892 (Mawson, 2004). The planning for the park was done through a competition to see who could design the best park, which is known today as Joubert Park (Ibid). Following the design of the park, tree planting began, and Pepper trees were the first trees to be planted in the newly developed park (Mawson, 2004). However, it was discovered shortly that these trees were not suitable for the environment (Ibid). Stirrat, the park's superintendent of that time, asserted that “those trees threaten to consume all the fertile and nutritious ingredients in the soil, and were proving prejudicial to the younger generation of flowering trees and shrubs which happen to be growing adjacent to them” (Mawson, 2004: 2). They were then removed from the park to reduce their impacts on the quality of the environment. A number of parks were then developed in the following years, and in 1904, it is reported that the city had four major parks in its jurisdiction and these were; Joubert Park, End Street Park, Oval Park and Jeppe Park (CoJ, 2012). By 1934, the number of parks had increased to 67, and there was an active tree-planting policy by the council, with 8 000 trees being planted each year (CoJ, 2003 and 2012).

3.2.3 The green space system in City of Johannesburg today

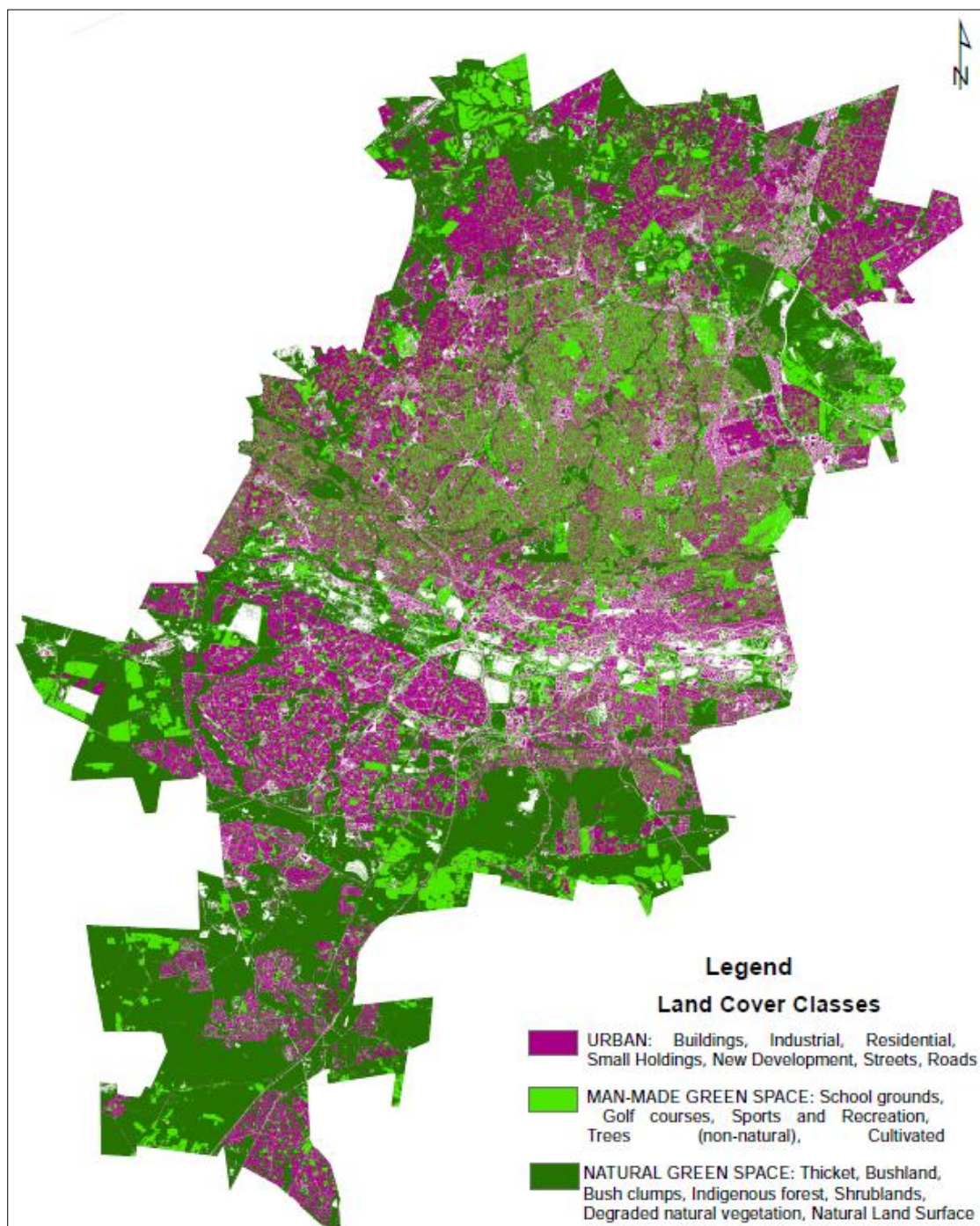


Fig 3: Green space profile in Johannesburg (GCRO, 2012)

Figure 3 illustrates different types of land cover classes where pink is urban land use light green is manmade green spaces and dark green representing natural green spaces.

From the above discussion, it is clear that the City of Johannesburg has a long, yet complex history of the management of and investment in green spaces. The initial investment in trees, through the gold rush in the 1880s, laid a foundation for man-made

green features as indicated by figure 3. This map, produced by the Gauteng City-Region Observatory (GCRO), indicates that a considerable portion of green space is owned by the City, but there is also an incredible density of green spaces that the City does not manage. This is further discerned through comparison between figure 3 and figure 4. Figure 4 is a map produce by the CoJ and illustrates of green space managed by the City, which remain a selection of public parks and public streets.

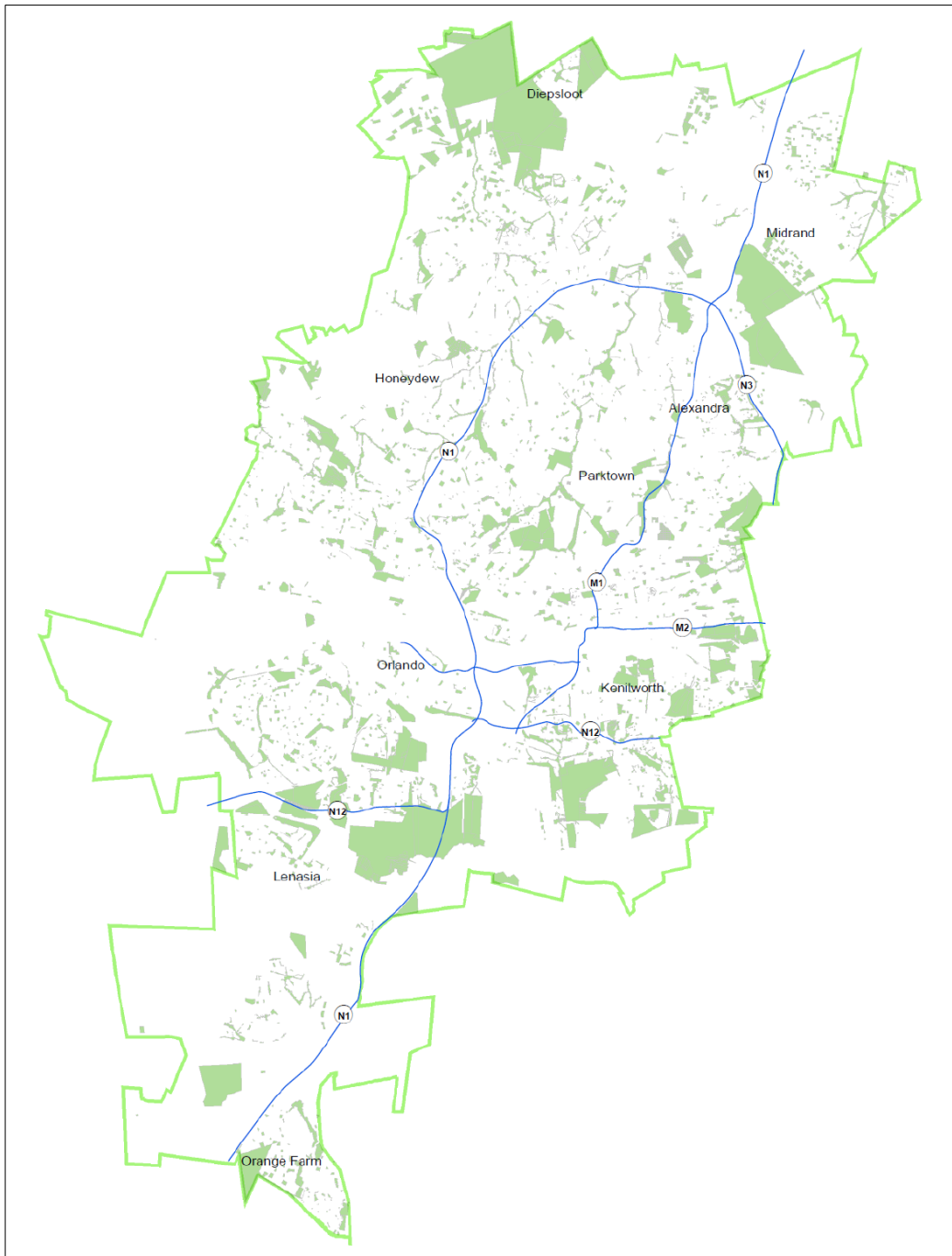


Fig 4: Green assets currently managed by the City (JCP, unknown)

Figure 4 illustrates green spaces which are currently managed by the City. When compared to figure 3, it is clear to note that a considerable quantity of green spaces still remain unmanaged by the City. This could be attributed to budgets allocations for green space planning and management in the CoJ, which may not able to the cover all green spaces, but prioritises those spaces that are earmarked critical support areas.

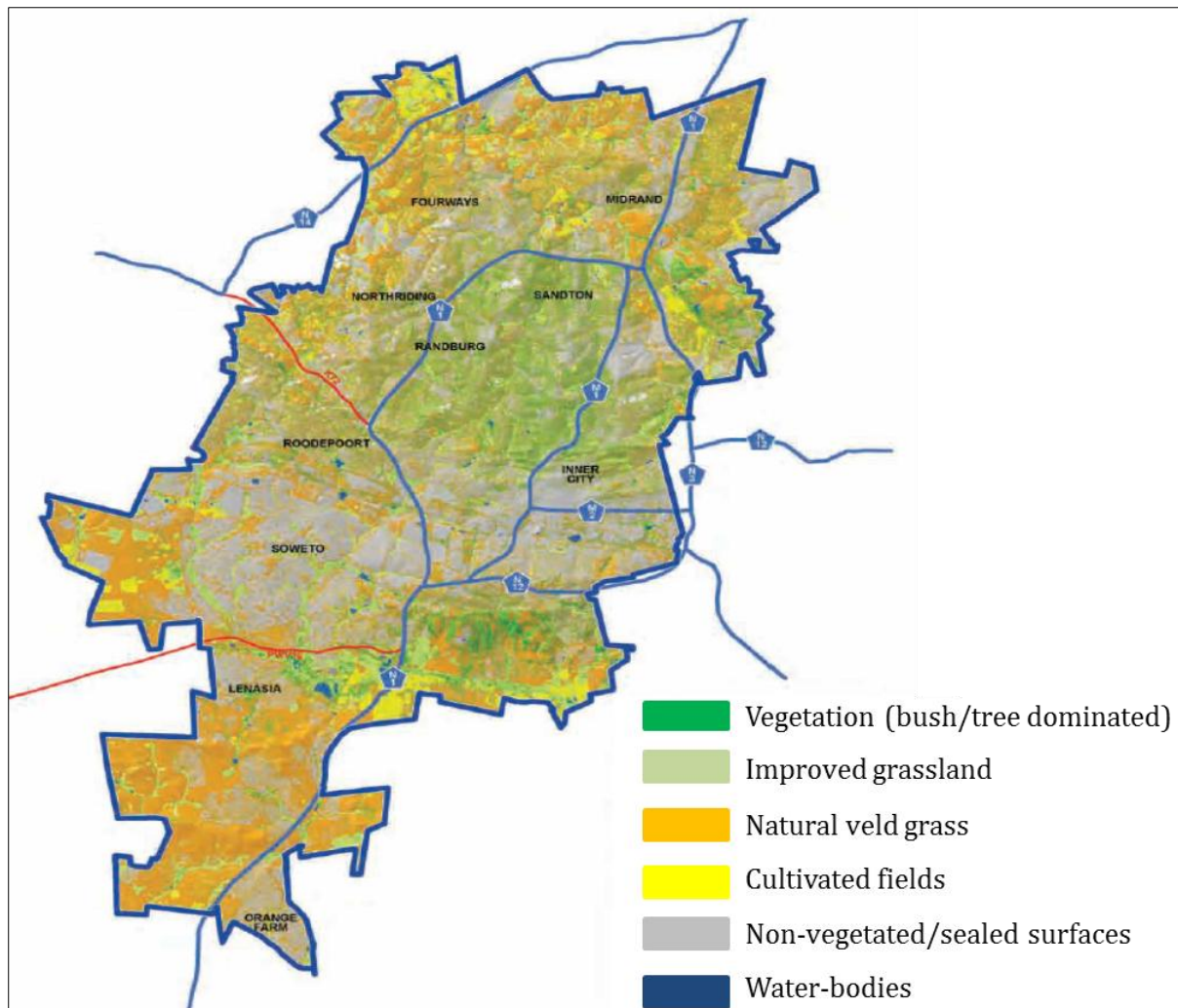


Fig 5: Different types of green spaces in CoJ (CoJ, 2008)

Figure 5 illustrates different types of green spaces that exist within Johannesburg as captured by the City. Again, it is important to note that quite considerable density of green spaces exist in City, and large portion of these remain unmanaged by the City. These in turn present opportunities for Johannesburg to boost its resilience capacity for purposes of dealing with future challenges, be it climatic changes, resource depletion and food insecurity. There is however a need to begin planning and managing these in way that enhances their ecological capacity than deplete it.

3.3 Understanding the Institutional Arrangements and Policy Framework for Green Space Planning and Management in City of Johannesburg

This section of the chapter does not aim to conduct a comprehensive review of all institutions or policies across the City of Johannesburg. Rather, the focus is on key City departments that directly deal with green space planning and management, as well as those which may not be directly linked to green space planning, but are affected by and affect green space policies, principles and guidelines. Firstly, city departments and their functions are introduced, which is then followed by the discussion of the two crucial policies for sustainable green space management, Joburg Metropolitan Open Space System (I & II) and the Bioregional plan.

3.3.1 *City's institutional arrangement*

The City of Johannesburg's institutional arrangement has been evolving since ever since the transformation of local government in 1994. In 2002, the city introduced the iGoli 2002 model which essentially aimed to address issues related to efficiency, cost effectiveness and sustainable service delivery (CoJ, 2012, Eagle, 2012 and Letsoko, 2012, both *pers. comm*). With only minor changes, this model still serves as the foundation for the CoJ institutional model (CoJ, 2012). In 2006, the City implemented a governance model that separated legislative and executive functions. Central to this was the intention to provide better oversight of the executive by the legislature through a clear delineation of powers (Ibid). The City also established Municipal Owned Entities with a specific focus on delivering services more efficiently to the citizens of Johannesburg. These range from the provision of basic services such as water and electricity and waste management, to the boosting of economic development, the provision of recreational facilities and the maintenance of the city's roads. In terms of green space planning and management, the restructuring of the city's institutional setting has sometimes resulted in the poor coordination between the different city departments (Eagle, 2012, *pers. comm*). This is evident in the failure of the City fails provide the benefits and potentials of a Metropolitan Open Space System- MOSS (CoJ, 2003). It is worth noting that the City is currently going through a restructuring process to achieve the vision of the Growth Development Strategy (GDS) 2040, and to also ensure a responsive institutional framework through which department coordination can be forged (Letsoko, 2012, Nyembe, 2012, both *pers. comm*).

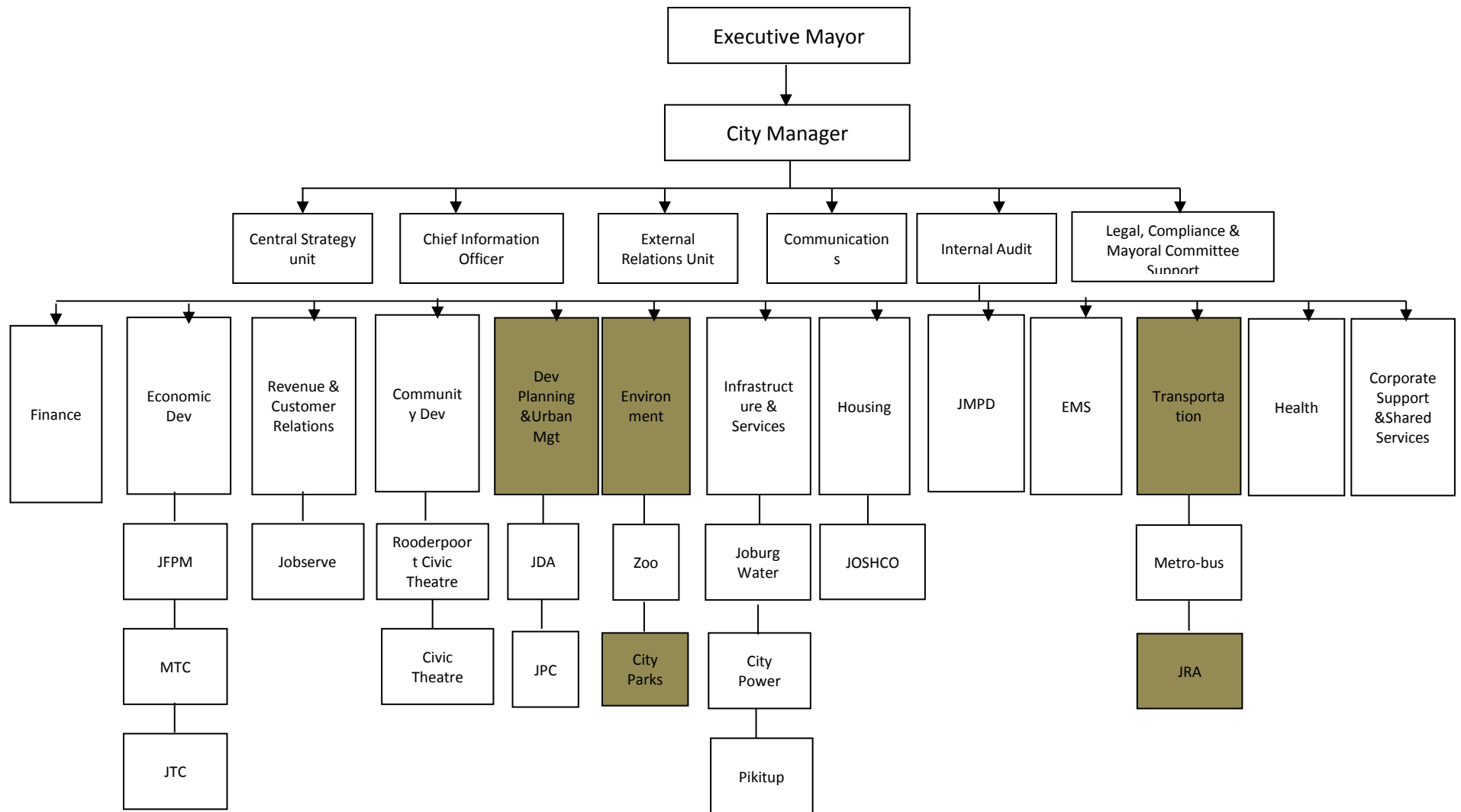


Fig 6: City of Johannesburg institutional framework (CoJ, 2011).

Legend

Interviewed City departments and municipal owned entities (MoEs)

3.3.1.1 Key City Department(s)

a) *The Department of Environmental Planning and Management (DEPM)*

The CoJ Department of Environmental Planning and Management is responsible for the development and implementation of environment policy. The department also oversees Johannesburg City Parks and the Johannesburg Zoo to ensure that they adhere to the overall environmental management guidelines and sustainable development strategy (CoJ, 2012 and Eagle, 2012, *pers. comm*). The key functions of the department are among other things, to ensure conservation and biodiversity planning, air quality, waste and water resource management, and climate change adaption and mitigation (CoJ, 2012).

b) *Transportation Department*

The department is playing a key role in planning for a safe and efficient transportation system with a specific focus on public transport, well maintained and well developed roads and Stormwater infrastructure (CoJ, 2012). Transportation Department develops strategies and programmes, and plans to direct private, business and public transport systems in the city towards a common, long-term city vision, that is to turn Johannesburg into a world-class African city by ensuring efficient transport system around the city. To make sure that this vision is realised, the department oversees two other city agencies, the Johannesburg Roads Agency (JRA) and Metrobus. While the department and its related agencies do not have a direct responsibility of green space management, this study will explore whether efforts have been made to integrate green spaces with hard infrastructural systems, for example, storm-water management systems, mandated to these bodies.

c) *Department of Development Planning (DDP)*

This department plays a crucial role for oversight of urban management in the city. Among other things, the department plays a key role in:

- the eradication of urban sprawl and the effective management of the urban environment;
- the management of capital investment;
- a safe built environment; and
- efficient urban management (CoJ, 2012).

3.3.1.2 *Municipal-owned Entities (MoEs)*

a) *Johannesburg City Parks*

As a custodian of existing green spaces in the city, Johannesburg City Parks is responsible for developing and maintaining all parks, open spaces, cemeteries and conserved areas (Johannesburg City Parks, 2012). This unit performs this function by focusing on the following key areas:

- planning, design and landscaping;
- park utilisation management;
- environmental conservation, including biodiversity management and awareness;
- park, open space and cemetery maintenance;
- horticultural and arboriculture projects;
- bio-aquatic management;
- botanic research, monitoring and information sharing;
- conservation, rehabilitation, enhancement of ecosystems;
- invader species control and;
- infrastructural maintenance.

b) *Johannesburg Roads Agency*

JRA performs a number of functions, but for purposes of this study, two units will be considered for interviews, which are:

- Development control unit

This unit is responsible for the development and maintenance of storm-water catchments.

- Road infrastructure

This unit is responsible for road reserves, that is, footways or pavement, bridges, verge or edge/border/grass pavement and infrastructure development and maintenance.

The structure of the city is organised in a way that there are core city departments and municipal entities falling under different city departments, which in theory have clear mandates and areas of jurisdiction. City departments on the one hand are responsible for oversight and drafting policies and, municipal owned entities on the other hand, are responsible for implementation of developmental projects (Letsoko, 2012 and Nyembe,

2012, *pers. comm*). In terms of green space planning and management, two key city structures have a direct responsibility for this, namely the Department of Environmental Planning and Management (city department) and Johannesburg City Parks- JCP (municipal owned entity). Ideally, the department of Environmental Planning and Management has to develop policies and oversee JCP to ensure that it adheres to the overall sustainable development strategies. Equally worth noting is that while these units are directly responsible for planning and management of green assets, there also exist other city structures that are directly affected or their operations influence operations of these departments, for example, Johannesburg Roads Agency, Infrastructure and Services and Development Planning departments.

3.4 Embedding Green Infrastructure Planning in Policy Frameworks

Johannesburg resembles similar growth trends to other cities of the developing world (JCP, 2011 and Pieterse, 2008). The City is generally perceived as an economic hub of South Africa, and as a result attracts large numbers of people and investment for economic development (CoJ, 2009). These factors- population growth and development pressures- have been the major driving forces behind the degradation of the ecological environment in the city as they increase pressure to provide infrastructure for the growing population (Huang et al., 2010, Schaffler and Swilling, 2012 and UNFPA, 2007). For instance, the provision of low cost housing in the outskirts of the city has led to significant loss of natural land cover (CoJ, 2009).

Efforts at different levels of government have been made to address loss in green spaces. In 1995, the Department of Environmental Affairs and Tourism (DEAT) took a major step towards explicitly acknowledging and raising the awareness of importance of green spaces, and the need to plan and conserve these (CoJ, 2002 and CoT, 2005). According to DEAT, green spaces are crucial for providing recreational and educational opportunities, conserving natural processes and resources, providing concrete opportunity for urban agriculture, and enhancing city's appearance (CoJ, 2012). At local level, cities have also taken steps to protect and their conserve green assets. City of Johannesburg is one good example of cities that are attempting to conserve green spaces and biodiversity in their areas of jurisdiction. However, while the conservation of green assets is a necessary and positive sign, it remains unclear whether the notion of 'infrastructure' is factored into the planning and management of these. The

understanding of, and importance given to, green assets needs to move beyond a conservation and cultural/aesthetic mandate. The discussion of the following policy frameworks below seeks to further illustrate this. As stated earlier, this is not intended to be a comprehensive discussion of the Johannesburg institutional environment, but rather an illustrative overview of the nature of planning for green infrastructure in City of Johannesburg.

3.4.1 *Joburg Metropolitan Open Space System (JMOSS)*

The Joburg Metropolitan Open Space System (JMOSS) is one of the City's attempts to address depletion of green spaces. It is essentially a desktop study that provides a comprehensive policy framework and/or guidelines for the protection, management and optimisation of open space areas within the city (CoJ, 2002 and JCP, unknown). The JMOSS was developed as a response to the lack of such a policy framework to guide green space planning and management in the City (CoJ, 2002 and Eagle, 2012). Thus, JMOSS was essentially developed "to allow for an informed response from the CoJ to the loss of open space" (JCP, unknown: 5). It critically argues that, "planning development and management of green spaces can no longer be regarded as "secondary to other local council functions" (CoJ, 2002: 2). Further, the JMOSS states that green spaces "require recognition as an asset that requires careful management, and needs to be afforded a status by all citizens of Joburg" (Ibid). Thus, the JMOSS emerged as a response for a strategy with an aim to address rapid loss of green spaces, and to ensure that principles of sustainable environmental management are adhered to (CoJ, 2002).

The JMOSS policy document contains amongst other things:

- A literature review on open spaces, which included the value of open spaces and quantitative criteria.
- The identification and categorisation of existing open spaces.
- The identification of desired open spaces.
- The formulation of an open space network based on a precautionary, catch-all approach.
- The identification of further steps required to render the MOSS functional (JCP, unknown: 5).

JMOSS places a lot of attention on the scientific ecological principles such as connectivity, conservation value, disturbance levels and habitat diversity (JCP, unknown). Importantly, JMOSS gives three sets of categories for green spaces in the city, namely primary, secondary and tertiary open spaces. Within these categories are sub-categories which detail the features of different green spaces (CoJ, 2002). Worth noting however is that because of lack of ground-truthing, there are concerns about the accuracy and detail of the information about different green spaces and their features (Eagle, 2012, JPC, unknown and CoJ, 2002). Equally, the JMOSS policy provides overarching guidelines and principles, but not the “specific criteria to be applied to primary open space in order to determine the most appropriate management strategy and policy to give effect to MOSS and its management” (JCP, unknown :10). This, as a result, gave way to a wide range of challenges where areas were determined as a set of categories yet with no specific criteria about how these should be developed, supported or maintained (Eagle, 2012 and Letsoko, 2012, *both pers. comm*). This and other concerns therefore led to the city convening a second JMOSS policy, putting into question the usefulness of the initial JMOSS experience.

The second JMOSS policy sought to provide “more robust criteria and principles for the identification of high value primary open space, in line with broader legislative and policy frameworks, and creating further proactive and reactive mechanisms for the protection and management of open space” (CoJ, 2004: 9). The focus of the policy is the management of the existing and desired primary open spaces. It sets out guidelines for how these should be managed both in terms of biodiversity conservation and ecological sensitivity (CoJ, 2004 and JCP, unknown). Yet again, the application of JMOSS II needs to be treated cautiously as the propositions made for management of green spaces are still based on the data provided by JMOSS I which lacked ground-truthing (CoJ, 2004, Eagle, 2012, Letsoko, 2012 and Njingolo, 2012, *all pers. comm*). As stated in the JMOSS II report, “building on the criteria for primary open spaces and their function, as provided in JMOSS I, the policy aims to expand on the criteria in relation to recent legislative and policy changes criteria for inclusion of high value primary open space”, and thus ensuring synergy and practicality of propositions of JMOSS I in terms of green space planning (CoJ, 2004: 13).

3.4.2 *Bioregional Planning*

The City of Johannesburg contains a wide range of species and habitats for example, wetlands, grasslands and the man-made urban forest (Holness and Skowno, 2011). However, these are continually threatened by the demand for the provision of hard, built infrastructure services (Ibid). As a result, the City is reported to contain “a disproportionately high percentage of rare and threatened species and ecosystems” within its areas of jurisdiction (Holness and Skowno, 2011: 12). In future, lack of meticulous planning for the environment will yield a situation where all these threatened species are extinct (Holness and Skowno, 2011 and Eagle, 2012, *pers. comm*). To mitigate against this, the City is in the process of developing a Bioregional Plan, which is essentially a spatial plan mapping out the critical biodiversity areas, both land and aquatic, and providing resource-use principles and guidelines for endangered ecological areas (Skowno, 2011 and SANBI, 2009 and Holness).

The CoJ Bioregional Plan is developed with an expectation that it will feed into the broader planning and development framework, and should be streamlined with other planning tools such as the Environmental Management Frameworks (EMFs), Spatial Development Frameworks-SDFs (Holness and Skowno, 2011). The plan is also critical for the purpose of informing “land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity” (Holness and Skowno, 2011: 2). In theory, the plan should provide guidelines for the conservation of biodiversity and support for ecological areas in Johannesburg. Planning for these is even more important, given the high demand for “mining activity, industry, commercial enterprise activities” in the City (Ibid). In fact, it is reported that approximately 36 percent of the City is in a natural or near natural state and 48 percent of the city is reported to be built-up or transformed for various urban functions (Holness and Skowno, 2011). The Bioregional Plan seeks to mitigate further depletion of natural environment and urbanisation pressures through prioritising Critical Biodiversity Areas (CBAs) and Support Ecological Areas (SEAs).

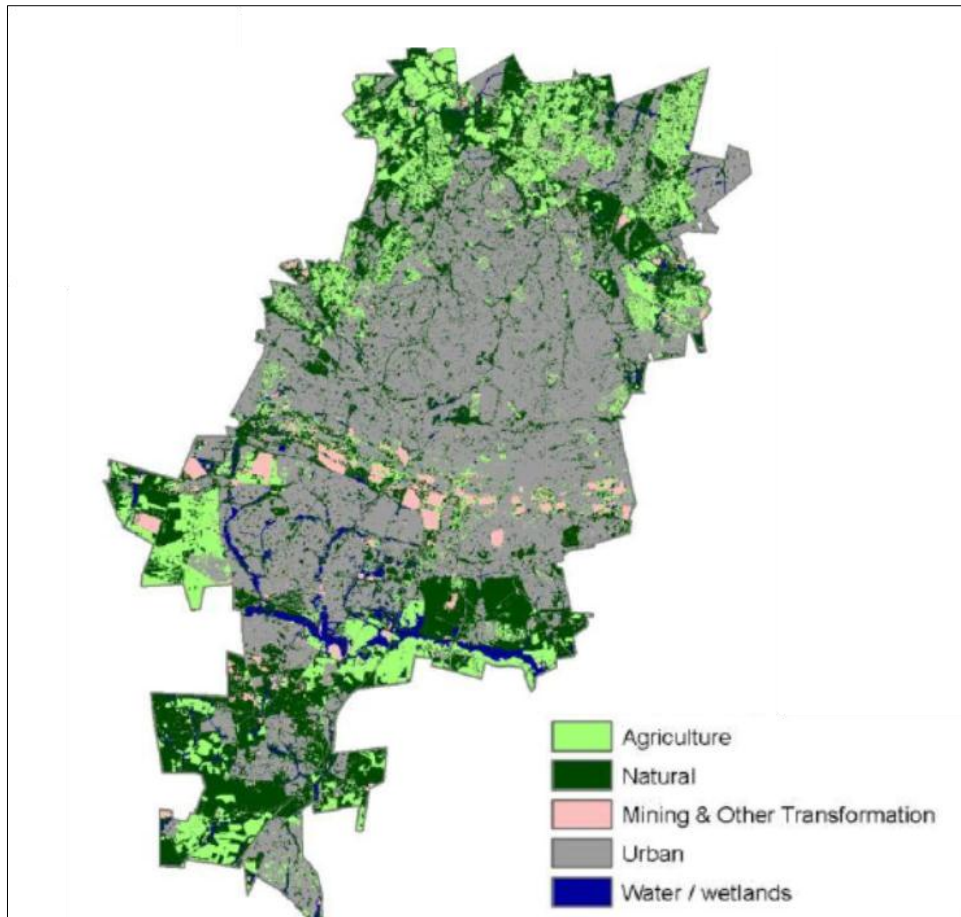


Fig 7: Land cover in Coj (Holness and Skowno, 2011).

Figure 7 indicates a highly urbanised city. Large portions of the natural green spaces have largely been developed to meet the urbanisation demands. This in turn, endangers ecosystem processes and biodiversity.

3.4.2.1 *Critical Biodiversity Areas (CBAs) and Support Ecological Areas (SEAs)*

Two key categories form the centre of the Bioregional Plan, and these are critical biodiversity areas and support ecological areas (Holness and Skowno, 2011). Critical biodiversity areas are the “portfolio of sites that are required to meet the region's biodiversity targets, and need to be maintained in the appropriate condition for their category” (Holness and Skowno, 2011: 26). These are further divided into two sub-categories which essentially determine the level of conservation that is required in that given particular site. Support ecological areas on the other hand, maintain the ecological processes on which critical based areas depend (Holness and Skowno, 2011). These are also categorised into two sub-categories for purposes of determining the level to which a particular given critical/sensitive area needs to be maintained (Ibid). Both these are

crucial for conservation of biodiversity and maintenance of functioning of ecosystems. They provide an indication of what kind of interventions one needs to take to support conservation of endangered ecosystem and species (Holness and Skowno, 2011).

To note from both the JMOSS and the Bioregional Plan is the emphasis on the need to conserve ecological assets for purposes of biodiversity, ecosystem maintenance and amenity purposes. Taking the Bioregional Plan for example, it firmly asserts that “the pressures placed on the environment and the remaining natural ecosystems are very high, and opportunities for conservation of biodiversity are limited” (Holness and Skowno, 2011: 2). The City’s Bioregional Plan does not appear to incorporate the idea that green spaces should be perceived and intentionally planned as infrastructure systems to provide a range of services, connected to the wider set of basic services. In occasions where green spaces are planned for as connected, linked systems, this is done with the purpose of the maintenance of biodiversity and/or ecosystems of a given particular area. The notion of creation of linkages through green space corridors is one good example of this. Through the bioregional plan, the city aims to create linkages of green spaces that will enable long term survival of a range of species and ecosystems especially in the context of unpredictable climate changes (CoJ, 2002, , Holness and Skowno, 2011 and Eagle, 2012, *pers. comm*). While this is necessary and definitely positive, there has been little prioritised in the plan between how ecosystems in Johannesburg connect to hard, built infrastructure systems and how this can happen through green infrastructure as a complementary network for the provision of urban services.

3.5 Bridging the Green-space Divide in the City

During the apartheid period, a substantial number of trees were planted and parks were developed in the City and white suburbs in the north, but nothing happened by way of “green spaces” in the black townships in south (CoJ, 2012 and JCP, 2011). As Schaffler and Swilling (2012: 5) state “approximately 24.2 percent of the total area of Johannesburg's historically wealthy northern suburbs” is covered with trees “while tree coverage in the poorer southern quadrant is approximately 6.7 percent”. This focus in the white suburbs therefore led to divide in terms of urban greening between the north and black townships in the south (JCP, 2012, Mawson, 2004 and Schaffler and Swilling, 2012). Black townships remained neglected, with few or no public parks and street tree

plantations (Mawson, 2004). In instances where green open spaces were provided in the southern townships, this was not done for purposes of environmental planning or even beautification, but rather for politically motivated reasons to separate different tribes or races from one another, and from areas of economic activity (Knuth, 2005, Schensul, 2008 and Schnidrig, 2006). These green belts were referred to as buffer zones, and unlike ecological buffer zones, had an underlying political reference (Schensul, 2008). In his speech to Parliament in 1952, “Native Affairs”, Dr Hendrik F Verwoerd stated that in the black townships “there should be suitable open buffer spaces around the black township, the breadth of which should depend on whether the border touches on densely or sparsely populated white areas” (Williams, 2000: 167). These buffers had to be designed in such a way that they allowed expansion of townships without spilling over into other racial group areas (Williams, 2000).

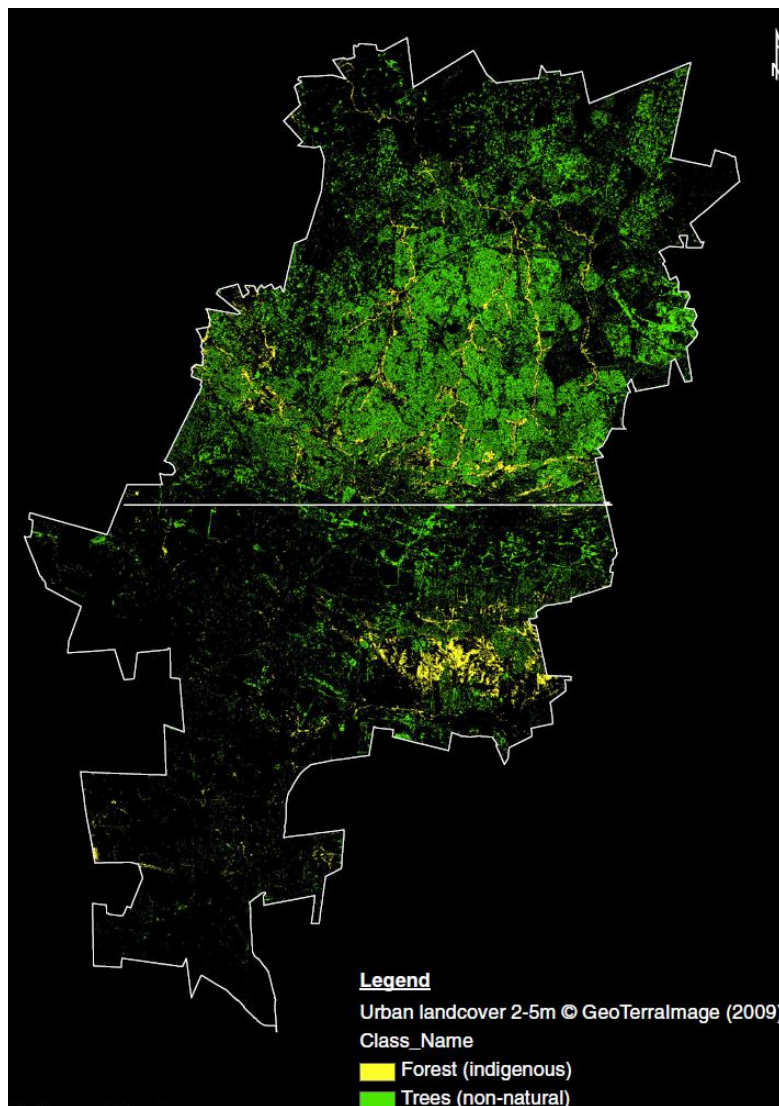


Fig 8: City of Johannesburg urban forest (Schaffler and Swilling, 2012).

Figure 8 illustrates the green space divide between the north and south of the city. Schaffler and Swilling (2012: 5) note that the urban forest “covers approximately 24.2 percent of the total area of Johannesburg’s historically wealthy northern suburbs, while tree coverage in the poorer southern quadrant is approximately 6.7 percent”. This green space divide has not been addressed until recently (CoJ, 2012 and JCP, 2011).

The ecological variance between the north and south has stimulated various greening actions by the City. Johannesburg City Parks, through the *Bridging the Green Divide 2010 Greening Strategy*, has recently embarked on re-greening projects with two key objectives; firstly to address lack of green spaces in the southern townships, and secondly, to fulfil the constitutional mandate relating to the “right of South African citizens to an environment which is not harmful to their health or well-being and to sustainable management and utilisation of the country’s resources for current and future generations” (JCP, 2011: 1, SACN, 2010 and Njingolo, 2012, *pers. comm*).

A number of projects has been implemented under the auspices of the Greening Strategy, and are generally labelled as “re-greening projects”. One example is the Soweto Greening Initiative, which was one of projects leading up to the 2010 FIFA Soccer World Cup (JPC, 2012). Central to this initiative was the idea of transforming the dry, dusty streets of Soweto township to one of vibrant green spaces enhancing lives of the community residents, reducing pollution and improving the aesthetic appearance of the area for people living in this areas and visitors (Ibid). Through this initiative, 200 000 trees were to be planted in Soweto (JCP, 2012). It is worth noting how the City encouraged active community involvement in the project, and the perspective amongst city officials is that this is not only a government led project, but one that enabled communities to have a shared responsibility in green assets (JCP, 2012 and Njingolo, 2012, *pers. comm*). Another re-greening project has been implemented in Orange Farm where approximately 17 000 trees have been planted (CoJ, 2004). What is clear from these initiatives is a distinct effort from the City to address the green space divide between affluent and poor areas of the city.

Responsive planning and management of green spaces is crucial in Johannesburg if the City is to achieve the goals and objectives it has set itself in the long term in the 2040

Growth Development Strategy's component on improving management of natural resources and the services they provide (CoJ, 2011). Equally, considering the unpredictable climatic change and the depletion of resources, the City needs to begin thinking more critically about how it manages the ecological assets that exist within its area of jurisdiction. However, it is worth mentioning that the City of Johannesburg has begun directing some of its efforts towards boosting the capacity for resilience of the city through developing policies, such as the Bioregional Plan, Joburg Metropolitan Open Space System, Catchment Management Policy and Wetland and Riparian Protection and Management Plan emphasising conservation of ecologically sensitive and critical areas.

While these efforts should be acknowledged, this study argues that these re-greening efforts have largely happened according to a logic of 'ecological disparity' that is predicated on a view of equalling the trees in the North by planting more trees in the South'. This logic is mainly concerned with equality, which is only one part of green infrastructure planning, and has largely happened without consideration of how the trees planted interact with the built infrastructure systems such as storm water drains and other related hard infrastructure systems (Schaffler, 2012, *pers. comm*). Equally important to mention is that while a major focus on ensuring equality in green spaces across the regions of city is important, these re-greening projects may also be susceptible to creating new green space inequalities (Storie, 2012, *pers. comm*). As discussed elsewhere in the study, some of the areas/regions within the city in already have noticeable number of trees, and to have a policy that parallels these with previously neglected areas such as Diepsloot, Orange Farm, Ivory Park, Soweto and other areas, creates a fertile ground for new green space disparity patterns across the city. Perhaps, the re-greening strategy should be explicit about providing green spaces in previously deprived areas, while simultaneously maintaining these in areas where they already exist.

3.6 Conclusion

The City of Johannesburg has made a concerted effort towards greening historically previously marginalised areas in the southern part of the city. There has also been an increasing awareness towards conservation of ecological resources in the city. The city is continually developing policies and strategies to ensure green space planning and

management. The recent or on-going development of the Bioregional Plan is yet another effort by the city to ensure responsive management of green assets. Green space planning and management in CoJ has not only been limited to public parks and tree planting, but also to conservation and/or management of critical priority areas such as wetlands, agricultural areas and water bodies (CoJ, 2008, Holness and Skowno, 2011 and Eagle, 2012, *pers. comm.*). This understanding of the importance of green spaces has emerged as a result of the recognition that intensive planning and management of green spaces is crucial for supporting biodiversity, but also for climate change mitigation (Eagle, 2012, *pers. comm.*). Equally, these green assets, especially trees, are important for purposes of air regulation, urban heat island effect regulation, storm-water runoff regulation and absorbing pollutants (Fazio, 2010, Schaffler and Swilling, 2012 and Eagle, 2012, *pers. comm.*). While conservation of these assets is robust in the City, it remains unclear as to whether these assets are planned for and managed in an 'infrastructural' manner through forging networks of green spaces, but also more importantly through creating linkages between green spaces and hard infrastructural systems to support functions of these man-made infrastructure systems.

Chapter 4: Reflecting on the Implementation and Institutional Dynamics for Green Infrastructure Planning in City of Johannesburg

...."you will remember that greening issues are always treated as soft issues, and as a result are not prioritised in terms of budget allocation"(JCP official, 2012, pers. comm).

4.1 Introduction

This chapter provides a detailed analysis of how planning and management dynamics of green infrastructure in City of Johannesburg manifest in practice. A number of issues have emerged following discussions and a semi-structured interview process with a wide range of city officials. Thus, the major part of the analysis presented in this chapter draws from the content of these discussions. Additionally, this chapter presents an analysis of the institutional and policy frameworks through which green infrastructure is planned for in the City. The aim is to firstly explore whether green space planning and management is understood in an 'infrastructural' sense and secondly, to explore blockages (both institutional and policy) against, and opportunities for, green infrastructure planning in Johannesburg. Fundamentally, the chapter analyses the existing city structures and policies, and from these, identifies opportunities for green infrastructure planning in the City.

In terms of structure, the chapter first introduces 'traditional' infrastructure challenges in the City with particular respect to issues of flooding and storm-water management, and contamination of water sources. The focus on these is done for a purpose of later identifying how the recent shift towards green infrastructure practices can address these challenges. Secondly, the chapter gives a thorough analysis of the nature of green space planning and management in the city both in terms of policy frameworks and implementation. A range of examples is cited to further illustrate instances where the notion of green infrastructure was overlooked and/or instances where the city has systematically planned green assets in an 'infrastructural' sense. Concluding remarks are also provided.

4.2 Challenges Facing the City of Johannesburg

For purposes of contextualising the importance of green infrastructure in Johannesburg, it is important to understand the challenges faced by the city relating to infrastructure and any related infrastructure deficiencies. Of these challenges, storm-water management (drainage) and flooding are some of the most problematic because these have serious effects on human safety, damage to infrastructure, and more importantly

the degradation of the environment (Dept. of Environmental Planning and Management, undated, Eagle, 2012 and Letsoko, 2012, *both pers. comm*). While there are multiple infrastructure challenges facing Johannesburg, storm-water and flooding represent the need for a changed approach to both green space management and infrastructure provision.

4.2.1 *Flooding and storm-water management challenges in the city*

Flooding and storm-water challenges in the city should be understood within the context of “changes to the whole natural drainage system resulting from urban development” (Dept. of Environmental Planning and Management, undated: 1). In Johannesburg, much development has occurred in places such as wetlands and natural springs (Ibid). Increased hard surfacing in these areas reduces the capacity of these natural systems to attenuate store water runoff, leading to increased surface ground water runoff (Dept. of Environmental Planning and Management, undated). This interference with the natural systems also impacts the “flood regime as water has to find different routes and emerges in new areas or is forced above ground” (Dept. of Environmental Planning and Management, undated: 1). As argued elsewhere in the study, loss of natural green spaces through expansion of hard infrastructure and built-up surfaces further exacerbates this problem. Development of these reduces the ability of the natural environment to manage flooding “as recharge, seepage and infiltration capacity is lost” (Ibid).

Problems relating to flooding and drainage have serious effects on biodiversity, ecosystem services and processes of green infrastructure systems such as wetlands and river streams which have to collect and manage flooding and storm-water (Eagle, 2012, *pers. comm*). Recently, watercourses in the city have been increasingly deteriorating and “showing high levels of stress, with erosion, bank collapse, channelling, loss of hydrological functioning” (Dept. of Environmental Planning and Management, undated: 1). This has negative impacts on the ability of aquatic ecosystems to provide provisioning services such as water supply and also the support of biodiversity in these hydrological ecosystems (Ibid). With unpredictable climate changes, flooding and drainage problems will only be exacerbated in the city and reports have suggested that in future, the intensity of rainfall is to increase in Johannesburg, which will in turn

increase storm-water runoff (Schaffler and Swilling, 2012 and Dept. of Environmental Planning and Management, undated).

4.2.2 Contamination of water sources

The contamination of water sources from domestic waste in the inner-city is increasingly becoming a major challenge facing the City of Johannesburg. The pollution of water in Johannesburg has been exacerbated due to various reasons. Of these, uncontrolled waste from informal (deteriorated) residential buildings in the inner city is polluting drainage pipes, while a lack of citizen knowledge and/or ignorance regarding the need not to use storm-water drains for dumping of solid waste is adding to the problem (Letsoko, 2012, Storie, 2012 and Ward 73 committee member, 2012, *all pers. comm*). The waste thrown into these drains is therefore carried by storm-water channels into surface water systems. One city official stated that “the first stop for evidence of the damage we are doing to our river systems is Bruma Lake. All the waste from the city finds its way into this lake, and today the quality of water in the lake is appalling” (CoJ official, 2012, *pers. comm*).

As a city with relatively scarce water resource, water contamination is a serious problem for Johannesburg, and also means that the quality of water is seriously reduced. As Nyembe (2012, *pers. comm*) states, “a couple of months ago we did tests in Klipriefiel and the results showed us that the river has a pH of approximately 3. Now you can imagine how many species have died which cannot survive in acid water”. The contamination of the water system affects ecological sustainability as well as social sustainability in terms of peoples’ livelihoods. A ward 73 committee member (2012, *pers. comm*) noted that “because of the waste from the city, Woolworths has recently decided to stop procuring some of its food products from the small farmers in Hartbeespoort Dam. Amazingly, there seem to be little that the city is doing about this”. Equally worth noting is the negative impact this is having on aquatic ecosystems and valuable and scarce water resources in the city and country as whole (Dept. of Environmental Planning and Management, undated).

4.3 Departmental Relationships and their Effect on Green Infrastructure

4.3.1 *Department of Environmental Planning and Management vs. Johannesburg City Parks relationship*

The conclusions made about the relationship between these city departments are based on interviews and discussions with officials. From the interviews, there appears to be a close relationship between the two city departments. JCP officials are cognisant of the policies mandated to the Environmental Planning and Management Departments, such as the Catchment Management Policy and Wetland and Riparian Protection and Management Plan, and there appears to be an institutional synergy in this regard. However, while there exists an apparently close relationship between the two departments, there are biases within each department regarding the nature of greening plans and the types of projects that appear to receive priority.

Most of the JCP projects seem to be focused on ‘public park developments’ and the idea of public greening and material beautification, overlooking conservation or ecological sustainability aspects, which are driven by most of the policies of the department of Environmental Planning and Management (see figure 9, recreational public park). It appears that the JCP-driven projects appear to be largely aesthetic and to reduce green space disparity between the north and south areas of the city (Mokone, 2012, Njingolo, 2012 and Nyembe, 2012, *all pers. comm*). For the 2009/2010 financial year, approximately R43.8 million was spent by JCP on public parks based in order to provide new and upgrade current parks, but largely to do with the city’s drive to bridge the green space divide (JCP, 2010).



Fig 9: Dlamini recreational park (JCP, 2010).

Another key challenge relates to the mixing and/or overlapping of responsibilities for drafting of policies. The drafting of the Johannesburg Open Space Framework (JOSF) is one good example illustrating this. In the development of the JOSF, JCP assumed a leadership role rather than a supporting one. Ironically, it was the department of Environmental Planning and Management that assumed the supportive role. As noted by one of the JCP officials “we are the ones who developed the Johannesburg Open Space Framework that guides planning and management of our green assets today” (JCP official, 2012, *pers. comm*). In such a situation, it then becomes unclear how the responsibilities and functions are shared. Furthermore, it becomes difficult to understand how the city departments exercise their oversight functions. In the case of the JOSF, it was reported that the issue of budgetary constraints for the department of Environmental Planning and Management was a central challenge (CoJ Official, *pers. comm*). This lack of funding constrained the department to develop JOSF, which as mentioned above was led and driven by JCP. It is not clear what role the department of Environmental Planning and Management played in this particular case because its core responsibility, which is to craft policies, was exercised by Johannesburg City Parks.

4.3.2 *Relationships between different City departments and Municipal Owned Entities*

It was noted from the interactions with the different departments that coordination between departments for green space planning and management is still lacking. Different city departments and municipal owned entities still largely continue to work within their confined area of jurisdiction. In the Rea Vaya Bus Rapid Transit (BRT) implemented by Johannesburg Development Agency (JDA) for example, the provision of green assets in Rea Vaya stations followed the traditional approaches, that is, concrete drainage systems, and as result missed the opportunity to invest in green infrastructure as part of the wider city drainage system (see figure 10). As Figure 10 shows, investments in green assets in this traditional ‘engineering’ project appear to be largely for beautification purposes. One reason for this is arguably that, in most cases, city officials are concerned with meeting their individual key performance indicators. During the interviewing process, one of the city officials noted that “since my arrival here, the organisation has managed to meet all its objectives. To show for our efforts, we have collected a number of awards, both locally and internationally” (JCP official, 2012, *pers. comm*). While it is important for the different departments to meet their

targets, this should not lead to a situation where opportunities to collaborative efforts are overlooked because they might not necessarily relate to key performance areas. In the provision of trees in BRT stations for example, both Johannesburg Roads Agency and Johannesburg City Parks should have worked together in linking these trees with the traditional storm-water management systems. This would have created a situation where trees are not only seen as beautifying elements, but also important 'infrastructure' for storm-water management serving to retain some of the storm-water into the ground. This would have been crucial for purposes of recharging ground water. In future, it should not be that after the completion of projects such as that of BRT, JRA install the storm-water infrastructure and JCP only focuses on providing green spaces for solely aesthetics purposes. Both these agencies will have to work together in designing green infrastructure systems that will address urban problems while at the same maintaining the ecological integrity (see figure 11).

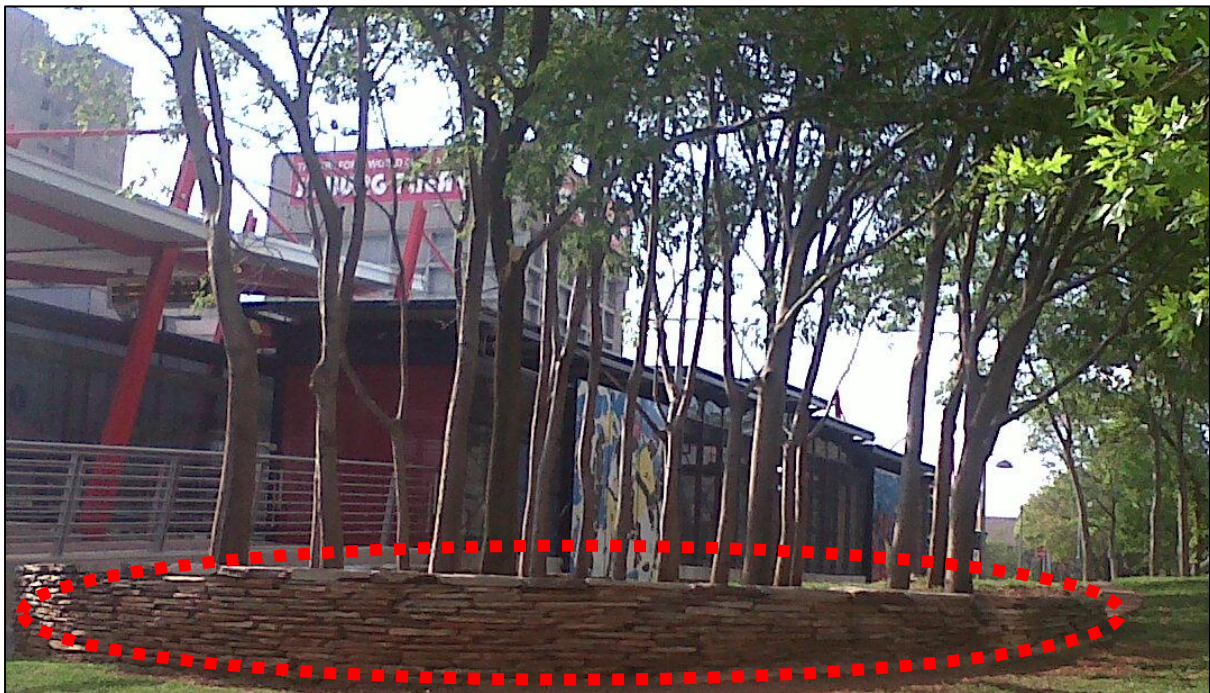


Fig 10: Traditional engineering landscaping practices in a BRT station, Braamfontein, Johannesburg (Nhlozi, 2012).

The provision of impermeable walls around the trees, shown in Figure 10, prevents the opportunity for these to collect some of the storm-water runoff. It would have been more appropriate if these trees were provided as or integrated with a bioswale where runoff is directed or retained to evapotranspirate and either filter or slowly attenuate

storm water,-see figure 11 (EPA, 2008 and Letsoko, 2012 *pers. comm*). This would have also made it possible for these trees to filter pollutants from the surface run-off water, and together with attenuating storm-water, reduced the amount of water and purification, the city will need for irrigation purposes.



Figure 11: Green infrastructure design principles in Wilmington, Delaware designed to absorb and retain storm-water runoff (EPA, 2008).

The green infrastructure design illustrated in figure 11 is an international example of how alternative solutions can be incorporated to divert storm-water from the sewer system to a bioswale where it is infiltrated and reused by the natural landscape. While the context is different to that of Johannesburg, the innovation to use trees in conjunction with, traditional drains, gutters and pipes for managing storm-water runoff, represents what is possible if urban planners overcome planning in silos and think differently about infrastructure solutions. The support for traditional storm-water infrastructure systems, improvement of water quality and enhancement of water supply also shows the multiple benefits from which urban societies can benefit from green infrastructure.

In Johannesburg, this disjointed nature of government goes beyond relationships between city departments to the relationship between local and provincial government. The proposal for the development of low cost housing in Huddle Park in the eastern

part of Johannesburg in the year 2002/3 is one example illustrating this. Within Huddle Park, there are numerous wetlands, and because of these, the area should be categorised as a critical biodiversity area to be conserved. The proposal by the City of Johannesburg to develop Huddle Park sparked a lot of uproar and frustration for the local communities who use the park for leisure purposes. One of the ward committee members stated that “I still do not understand how they came to this decision. We personally had to fight them, the City, for this proposed development. It just seems as if they do not care about the environment, but collecting rates” (Ward 73 committee member, 2012, *pers. comm*). While issues such as well-located land for low income housing still remain a challenge in South Africa, proposals such as in the Huddle Park development illustrate disjointed planning, and perhaps to a greater extent, a willingness of the local and provincial governments to overlook environmental issues over social issues, and the potential ways of creating synergies between the social and the ecological.

Equally worth noting is that the disjointed nature of governance also exists between the different Municipal owned Entities. These entities emerged from the need to ensure efficient operation and to assist in generating profits from the services they provide. As a JRA official reflects, “as JRA, we should be able to deliver and manage infrastructure in the city as efficiently as we possibly can. While we cannot literally put tolls on our roads, we should however be able to collect service rates from motorists would use our roads”. This need to generate profits is one of the factors that acts as a catalyst for disjointed relationships between municipal entities. The entities are likely to work collectively in the provision of services that might not generate profits and fall outside of their area of jurisdiction. Taking the use of vegetated street swales for storm-water attenuation for example, Johannesburg Roads Agency might overlook this because provision of green spaces falls outside their area of jurisdiction, and might be seen as adding extra implementation and maintenance costs.

In addition, there exists a perception that implementation of green infrastructure will prove inefficient for effectively addressing serious urban challenges such as flooding. One city official stated that “our role is to ensure that the surface of the road gets dry as quickly as possible after rainfall. Now, I am not sure if having green servitudes will appropriately serve this purpose” (JRA official, 2012, *pers. comm*). As a result, most of

the professionals and engineers within JRA appear to prefer designing infrastructure in a traditional way, which is essentially the provision of concrete and piped networks to deal with urban flooding problems. An example of traditional this is the provision of gabions, steel reinforcing and concrete canals in Braamfischer's storm water management plan for a purpose of managing storm-water off site as quickly as possible, either directly to a stream or river (CoJ, 2009 and CoJ official, 2012, *pers. comm*). As alluded to by one city official "on the other hand, the problem is that you have engineers who, in most cases, do not want to change and adapt to new ways of thinking about the engineering and design, of for example, pavements" (CoJ official, 2012, *pers. comm*). This calls for more work to be done in terms of crystallising the value-add of green infrastructure design practices.

It therefore appears that in Johannesburg, there is a rigid perception that green infrastructure will add to infrastructure implementation costs, and as a result, engineers prefer traditional designs for infrastructure systems. As one city official further states, "most traditional engineers think that if you use for example, street swales or buffer strips for drainage, you then have a situation where you constantly have to maintain these and as a result incur more cost you would have avoided if you provided concrete paving" (CoJ official, 2012, *pers. comm*). Another official stated that "even the notion of implementing green roofs or gardens raises a lot of concerns. For those trees to grow, tons of soil will have to be loaded on the building roofs that were not initially designed for such mass. With rainfall, this mass will be even doubled. Now you can imagine the effect this will have on the building. So, to have such initiatives will require that more money is spent to ensure that we do not have buildings collapsing in next few years" (JRA official, 2012, *pers. comm*).

The above discussion begins to shed light on the implementation dynamics of green infrastructure in the City, particularly around the perceptions and attitudes to shifting from conventional engineering designs to incorporating green space, which are seen as separate to 'infrastructure'. This is not to overlook the City's efforts towards maintaining and supporting the natural ecological processes through its various environmental policies and/or plans, for example, Bioregional Plans and Wetland Protection and Management Plan 2010 (draft). It is through some of these plans that the city is beginning to value the importance of green assets and ecological services these

provide. The challenge is that these plans are largely happening in isolation, as 'environmental conservation' plans with little integration into the commitments made to address city-wide infrastructure challenge. This is further evident in the City's attempt to explore innovative solutions, such as sustainable urban drainage and water sensitive urban design to address water-related issues. While these approaches are beginning to take hold in the City, there are conceptual and institutional difficulties in their implementation as cross-sectoral projects, as discussed below.

4.4 Sustainable Urban Drainage Systems (SUDS) and Water Sensitive Urban Design Systems (WSUDS)

Sustainable Urban Drainage Systems or Water Sensitive Urban Design Systems are the two ideas being explored by the City to address the challenges of flooding and storm-water management. SUDS and WSUDS essentially draw lessons from nature with respect to managing storm water, urban drainage and the conservation and protection of water resources (Armitage, 2010 and Nedelcu, 2012 *pers. comm*). These concepts are not new, but have existed for a long time, even though it is only recently that cities around the globe have taken these seriously in their urban planning processes (Armitage, 2010 and Button et al., 2010 and Nedelcu, 2012 *pers. comm*). The key principle inherent in the concepts of SUDS and WSUDS is a holistic approach to urban water cycle management that includes "all water flows, and optimises opportunities for conservation of the water resources from all streams" (Dept. of Environmental Planning and Management, undated: 2).

In the City of Johannesburg, these concepts remain at the conceptual stages. Different city departments, in particular, Environment Planning and Management, Technical Coordination-Development Planning and Johannesburg Roads Agency meet on a monthly basis to discuss and explore opportunities for implementation of these approaches. Nedelcu, (2012, *pers. comm*) stated that "these forums are important for the city to find ways to deal with the challenge of storm-water management. The involvement of departments such as the Environmental Planning and Management is crucial for the development of policies or plans for these approaches". Another official noted that 'for the first time, the city is open to new ways of addressing storm-water problems. SUDS offer us with an opportunity to responsively address this problem in a way that is in harmony with processes of nature" (CoJ official, 2012, *pers. comm*).

SUDS and WSUDS strategies are beginning to set the basis for paradigm shift in a way in which the City manages storm-water, urban drainage, and the entire water cycle. This shift is crucial not only for ensuring greater protection of the environment and scarce water resources, but also for minimising risks to human life and infrastructure which will in future help towards building greater resilience in the face of changing weather patterns and climatic conditions (Eagle, 2012, Letsoko, 2012 and Nedelcu, 2012, *all pers. comm*).

Although the City has made some progress in terms of deepening its understanding of the concept of SUDS, this has not been mainstreamed into planning processes and development frameworks. This is evident in the examples provided above relating to the provision of trees for solely beautification purposes in the Rea Vaya BRT station and the design for Braamfischer's storm water management plan. These projects offer numerous opportunities for implementation of SUDS and other related green infrastructure practices, but the SUDS language and ideas are largely absent from these plans and design. This is concerning because these are opportunities for the City to experiment and pilot alternative solutions.

This study has established that issues of rigid traditional engineering design principles, personal perceptions and attitudes and institutional blockages are the main underlying factors preventing the mainstreaming of these green infrastructure practices in the planning processes. As a result, there is a need to direct concerted efforts towards publicising green infrastructure practices such as SUDS for purposes of getting city officials to understand the importance of green infrastructure. With the problems of flooding and storm-water management becoming important for shaping government agendas, SUDS may gradually become one of the likely avenues or channels through which green infrastructure is mainstreamed into the planning processes. The results to be achieved through SUDS are potential channels to be used as a basis for launching other wide ranging green infrastructure practices.

4.5 Conclusion

A number of institutional and implementation dynamics affect planning and management of green infrastructure in City of Johannesburg. While the institutional

setup of the city is important for responsive delivery of services; it also provides a fertile ground for blockages and is susceptible to conflicts. Taking municipal-owned entities for example, these are crucial for providing services at much efficient, cost-recovery basis for purposes of accumulation of profit. This business model however creates conflicts where municipal owned entities compete against each other; and as a result often miss the opportunity to work collectively in addressing problems which cut across their areas of common interest. Equally, the City is faced with a challenge of having to negotiate attitudes and perceptions of professionals involved in the implementation of hard-built infrastructure and green assets in the City. To manage these institutional challenges and perceptions, a lot of effort needs to be directed towards crafting frameworks and policies geared towards valuing green infrastructure related practices. The development of policies such as the Catchment Management Policy, Bioregional Plan, Storm-Water By-laws and other related policies is a good start for ensuring responsive planning and management of green assets. However, more needs to be done in terms of advocating for creation of linkages between hard, built infrastructure systems and green assets to complement each other for provision of urban services. This will require an integrated approach across the planning, urban design, landscaping and engineering components of development and a move away from a traditional conveyance-oriented approach (Eagle, 2012, *pers. comm*).

Chapter 5: Conclusions and Recommendations

5.1 Concluding Remarks and Recommendations

Throughout the study, an effort has been made to shed light on the importance of planning for and managing green spaces as integrated networks supporting ecological life systems and human development processes. Equally, the study has explored the importance of green infrastructure in an urban context, particularly for sustainable urban planning and development processes. While the benefits of green infrastructure have been documented in the study, a number of challenges, both in terms of institutional organisation and implementation, and perceptions and attitudes towards shifting into green design principles and management practices, remain in City of Johannesburg.

On the one hand, the City continuously needs to deal with issues of control and conservation of green assets through enforcing policies, plans and by-laws geared towards elevating the status of green assets, which are necessary given development pressures faced by the City and the need to provide hard infrastructure services to support the economy and accommodate growing urban population (NDP, 2012 and Schaffler and Swilling, 2012). On the other hand, the City is faced with institutional blockages, especially at the policy implementation level, where municipal owned entities (MoEs) compete rather than work together in delivering development projects. The existence of these challenges however does not suggest a complete lack of opportunities for the implementation green infrastructure in the city. As discussed elsewhere in the study, the City has begun exploring more sustainable ways of dealing with different problems it currently faces, for example Sustainable Urban Drainage Systems (SUDS). However, a lot more needs to be done if the City is to achieve its vision of being a resilient and sustainable city.

This chapter aims to do two things; it firstly gives a condensed analysis of the arguments presented in the study regarding the importance of green infrastructure for urban development, and discusses the dynamics for green infrastructure planning in City of Johannesburg. Secondly, the chapter outlines a number of actions which may assist Johannesburg in creating a conducive environment for managing its ecological assets in an 'infrastructural' sense.

5.2 Green Infrastructure Planning- A Step Towards Building Resilient Cities

With increasing urban population pressures and demand for resources, urban policy-makers face a number of intersecting challenges (Foster, et al, 2011 and Mell, 2011). As a result, the capacity of traditional, hard infrastructure systems will be stretched, and a number of events are signalling a series of infrastructural deficits and pressures (Foster, et al, 2011). As argued elsewhere, the notion of green infrastructure brings a new dynamic for dealing with urban problems in way that is not detrimental to natural ecological processes (Constanza et al, 1997 and Mell, 2011).

The benefits of green infrastructure relating to the maintenance of environmental integrity have been well documented in global research (see MEA, 2005, ESA, 2000, Constanza et al, 1997, Huang et al, 2010, Heidt and Neef, 2008, Jim and Chen, 2009 and Lomis et al, 2000). These benefits go beyond support for ecosystems services to social and economic benefits such reducing long-term infrastructure costs (Constanza et al, 1997 and GFN and WWF, 2008). Taking use of vegetated bioswales for storm-water management for example, these ensure removal of pollutants from storm-water through filtering by vegetation and soils, and by this means improve water quality and ground water recharge (EPA, 2008). Improved water quality suggests lowered costs for water purification to be incurred by city governments (Nyembe, 2012, *pers. comm*). Bioswales planted with native flowering vegetation can also provide food and support biodiversity for certain species (EPA, 2008).

5.3 Institutional Restructuring for Realisation of the Resilient City Vision

The findings of this study suggest that effective planning and management of green spaces will not be a result of ad hoc processes, but will only be realized if systematic institutional structures are put in place to forge coordination between different city departments and sectors, and importantly between local and provincial government spheres. It is also important to note that the City of Johannesburg is currently undergoing an institutional restructuring process guided by the overarching objective of the Joburg GDS 2040 strategy to build “a vibrant, equitable African city, strengthened through its diversity; a city that provides real quality of life; a city that provides sustainability for all its citizens; a resilient and adaptive society” (GDS, 2011: 13). The institutional structure of CoJ should be the one which will make it possible for different departments and the MoEs to share ideas, knowledge and intelligence, and be able to

work together, particularly in areas of common interest. The knowledge sharing meetings/forums between the Department of Environmental Planning and Development, JRA and the Development Planning department need to be standardised as one of many opportunities for raising awareness about the importance of green infrastructure practices and existing opportunities for this in the City. Increased communication and relationships between the different city departments will not only assist integrated planning in the City, but will also be crucial for reduction of public funds invested in addressing challenges faced by the city as the City will be working as single, well-coordinated system of government.

Worth noting however is that institutional structures alone will not automatically lead to the achievement of sustainable urban development. Institutional structures can only work effectively when people with the right attitudes manage these. While changing attitudes will prove challenging, it is crucial that measures are put in place to allow all city personnel, in different levels, to understand the importance of green infrastructure and need to conserve and support these assets.

5.4 Recommendations

There are a number of intervention points that may assist the City of Johannesburg in achieving more sustainable development. These opportunities are profiled below and relate to the City departments and MoEs directly dealing with green space planning and management.

5.4.1 *Identify opportunities and design context specific approaches of green infrastructure planning*

It may be necessary for the City to engage a process of identifying opportunities for green infrastructure planning. This is likely to involve conducting prefeasibility studies to identify areas where the City can implement green infrastructure projects. Such studies should not only be limited to conservation and maintenance of green spaces, but should cover a range of green infrastructure practices from green roofs and food gardens, to more ecologically friendly storm-water management systems. Equally, the studies could contribute to identifying context specific approaches to be implemented at the different scales, for example, from individual buildings, lots, and neighbourhoods to the entire city scale. Work done by research organisations such as the Gauteng City-

Region Observatory (GCRO) on the mapping of green infrastructure in urban contexts is crucial for identifying these opportunities. It may be necessary for the City to explore the feasibility of *inter alia*:

a) *Eco/garden roofs*

The Johannesburg inner city presents an opportunity for the implementation of garden roofs. In the City, eco roofs can be used for two purposes, local food production and cooling of buildings, and is important for given the expected population growth in Johannesburg which will have significant implications for demand for food and energy (NDP, 2012 and Winkler et al, 2007). Non-governmental organisations such as Ekhaya and Green House have begun using the roofs of their buildings for crop growing. With quite a number of buildings that are owned by the city, such projects can be rolled out on a much wider scale.

b) *Street swales and permeable pavements*

The shift to vegetated street swales and permeable pavements is an alternative approach to address storm-water challenges, which are expected to become more acute in future. New developments and the repair old street pavements offer opportunities for these alternatives and the City could use these to motivate for green infrastructure practices.

c) *Water harvesting*

Given the scarcity of water in the City and South Africa as a whole, it appears important that water harvesting is given much more attention by the City. There are gradual ways of experimenting with water harvesting, which can initially be piloted at relatively small scale, that is, individual buildings and household level through use of water tanks to assess feasibility. Water harvesting may reduce the water supply burden, but also improve the quality of life of citizens as these will save household incomes to spend on other household necessities. This may also encourage household food gardens which are crucial for improving access to food for low income households.

While best practices can be adapted from elsewhere, concerted efforts should be made to develop context specific approaches for the implementation of the above suggested green infrastructure practices.

5.4.2 *Review and remove regulatory barriers*

Many current policies, strategies and regulations in the city are barriers to green infrastructure practices. For example, JRA's storm-water management is based on traditional management policies and the mentality to "get the road surface as quickly as possible". The City may benefit from reviewing and updating old policies for purposes of encouraging creativity and the implementation of sustainable practices.

5.4.3 *Craft plans and policies for green infrastructure planning*

Currently, most, if not all of the City's environmental related policies are focused only on the conservation of ecological assets. While this is important given urbanization pressures faced by the city, there is room to think about how the City can plan for these in the same way it plans for and manages hard, built infrastructure services. It is worth building on already existing policies and plans such as JMOSS and the Bioregional Plan, which are starting to think about creating green space linkages for purposes of having one integrated green space system. The challenge is that there is a need to influence the design and construction of developments and importantly, to provide incentives for developers to use green infrastructure related practices. As noted by one of the City's officials "in most cases, the only thing developers want to know is what will be of benefit for them before they take on any idea, and it should really be our responsibility to make them understand the importance of green infrastructure" (CoJ official, 2012, *pers. comm*).

5.4.4 *Raise awareness and engage built environment professionals and residents*

The notion of green infrastructure is still alien to most of the city officials and residents. For example, during the interviewing process, some city officials understood green infrastructure from a green energy sources perspective. Residents on the other hand did not seem to understand the concept of green infrastructure. Their concerns only related to need to conserve green spaces, public parks in particular. One reason for this lack of understanding relates to definitions different professionals ascribe to the concept green infrastructure. But, also people are unfamiliar with this concept because relevant City departments are not explicitly stating its relevance and importance for achieving sustainable development. As a result, increased active engagement and sharing of information between the different City departments and communities is critical. The existing monthly meetings between department of Environmental Planning and

Management, JRA and Development Planning department could be used as a launch-pad for these engagements. It may also be appropriate from a leadership perspective if relevant City departments and MoEs directly responsible for green space planning and management assume a leading role in this.

5.4.5 *Develop economic models for valuing green infrastructure*

The lack of mainstream financial and social valuations for ecological asset is one of the major challenges which ultimately leads to marginalisation of these in cities (Constanza et al., 1997 and Mell, 2011). Whereas putting an economic value on these will prove challenging, it is important that the City, JCP in particular, begins devising economic measures for green assets. This will not only assist in enhancing green assets of high economic value, but also for purposes of securing funding for development of these to increase their economic value. However, developing these measures is not only about focusing on an economic benefit, but the wider social value green assets have for all citizens and their needs.

Overall, the City of Johannesburg presents a number of opportunities for the implementation of green infrastructure to tackle a wide range of development challenges such as storm-water drainage, flooding, food security and water harvesting. The effort made by the City to conserve critical ecological assets is one major step towards the realisation of green infrastructure. This said, the thinking for planning and management of ecological assets should not be solely confined to conservation, but should begin to move towards responsively managing these in an infrastructural sense. In this respect, the City may greatly benefit from focusing on planning for these green assets in a way that connects and links them as one single functioning system of green infrastructure. Equally, given the importance and multiple benefits provided by green infrastructure, the City's transition towards a different approach to infrastructure involves directing financial and human resources towards conserving and developing these assets in an integrated way.

6. References

- Aguilar, A.G., 2008. Peri-urbanization, illegal settlements and environmental impact in Mexico City. *Cities*, 25, 133–145
- Ahern, J., 2007. Green infrastructure for cities: the spatial dimension. Accessed from <http://people.umass.edu/jfa/pdf/Chapter17_Ahern2%20copy.pdf>. 22/08/2012.
- Alexander, M., 2008. *Management Planning for Nature Conservation: A Theoretical Basis and Practical Guide*. Springer Science and Business Media: New York.
- Altwegg, L. and Grêt-Regamey, A., 2011. Challenges in integrating ecosystem services in sustainable land management. Paper for REAL CORP 2011. Accessed from <http://www.corp.at/archive/CORP2011_187.pdf>. 13/08/2012.
- Anderson, N (ed.). 1964. *Urbanism and Urbanisation*. E.J. Brill: Leiden. Netherlands.
- Arishie, M. 2011. The encroachments on agricultural lands continue. The Egyptian Gazette Online, February 27, 2011. Accessed from <<http://213.158.162.45/~egyptian/index.php?action=news&id=15517&title=The%20encroachments%20on%20agricultural%20lands%20continue>>. 28/05/2012.
- Armitage, N., 2010. Sustainable Urban Drainage Systems. Presentation made at the Seminar for Sustainable Urban Drainage Systems held in Tshwane, 27 January 2010.
- Arnberger, A., 2012. Urban densification and recreational quality of public urban green spaces- a Viennese case study. *Sustainability*, 4, 703-720.
- Benedict, M.A. and McMahon, E.T. 2002, Green Infrastructure: smart conservation for the 21st century. Sprawl Watch Clearing House Monograph Series. Accessed from <<http://www.sprawlwatch.org/greeninfrastructure.pdf>>. 21/04/2012
- Bilgili, B.C. and Gokyer, E., 2012. Urban Green Space System Planning. Accessed from <<http://www.intechopen.com/download/pdf/37556>>. 25/06/2012
- Bond, P., 2000. *Elite Transition: From Apartheid to Neo-liberalism in South Africa*. University of Natal Press, Pietermaritzburg and Pluto Press, London. (Chapter 4: The Housing Question. 122-151).
- Button, K., Jeyaraj, E., Ma, R. and Muniz, E., 2010. Adapting Sustainable Urban Drainage Systems to stormwater management in an informal setting. Accessed from <http://www.wpi.edu/Pubs/E-project/Available/E-project-121610-134208/unrestricted/CTPC10_Stormwater_Executive_Summary.pdf>. 09/10/2012.
- Charles River Watershed Association, 2009. Stormwater, trees, and the urban environment. CRWA. Accessed from <<http://www.crwa.org/pubs/StormwaterTreesUrbanEnvMar09.pdf>>. 26/09/2012.

Charlton, S. and Kihato, C., 2006. Reaching the poor? An analysis of the influences on the evolution of South Africa's housing programme. In Pillay, U., Tomlinson, R, du Toit, J (eds), *Democracy and Delivery: Urban Policy in South Africa*. HRSC Press, Cape Town.

Chermack, T., 2004. The role of system theory in scenario planning. *Journal of Future Studies*, 8, 4, 15-30.

City of Johannesburg, 2012. We're living in an urban forest. Accessed from <http://www.joburg.org.za/index.php?option=com_content&task=view&id=355&Itemid=52>. 8/07/2012.

City of Johannesburg Official, 2012. Green space planning in City of Johannesburg. Personal communication. 6 September 2012.

City of Johannesburg, 2011. City of Johannesburg Integrated Development Plan 2011-2012- focusing on the basics and preparing for long term. Accessed from <<http://www.joburg-archive.co.za/2011/pdfs/idp201112.pdf>>. 07/09/2012.

City of Johannesburg, 2011. Spatial Development Framework 2010 -2011. Accessed from <http://www.joburg.org.za/index.php?option=com_content&view=article&id=5941&catid=61&Itemid=114>

City of Johannesburg, 2010. Service delivery is on the agenda. Accessed from <http://www.joburg.org.za/index.php?option=com_content&task=view&id=5514&Itemid=209>. 06/08/2012.

City of Johannesburg, 2010. Draft Integrated Development Plan 2010/11. Accessed from <http://www.joburg.org.za/index.php?option=com_content&task=view&id=5017&Itemid=114>. 17/10/2012.

City of Johannesburg, 2009. Implementation of Integrated Storm-water Management Plan. CoJ. Accessed from <http://www.joburg-archive.co.za/2009/pdfs/economic_development/stormwater_management_plan.pdf>. 16/10/2012.

City of Johannesburg, 2008. State of the Environment Report 2008. Accessed from <http://www.joburg.org.za/index.php?option=com_content&task=view&id=3959&Itemid=114>. 06/09/2012.

City of Johannesburg. 2008. City slide desk: Overview. Accessed from <<http://www.joburg-archive.co.za/2008/pdfs/overview2008.pdf>>. 02/05/2012.

City of Johannesburg, 2004. Jozi's urban forest now at 10m trees, and growing. <http://www.joburgnews.co.za/2004/sep/sep8_forest.stm>. 8/07/2012.

City of Johannesburg, 2004. Johannesburg Metropolitan Open Space Policy. City of Johannesburg.

City of Johannesburg, 2003. Joburg's first trees. Accessed from http://www.joburg.org.za/index.php?option=com_content&task=view&id=934&Itemid=52>. 06/08/2012.

City of Johannesburg, 2003. State of the environment report. Report. Accessed from http://www.joburg-archive.co.za/2007/pdfs/enviroreport_apr2003.pdf>. 03/09/2012.

City of Johannesburg, 2002. Joburg Metropolitan Open Space System. City of Johannesburg. Accessed from <http://www.joburg.org.za/docs/jmossreport.doc>>. 05/05/2012.

City of Tshwane, 2005. Proposed Tshwane Open Space Framework. City of Tshwane. Accessed from <http://www.tshwane.gov.za/Services/OpenSpaceManagement/Open%20Space%20Framework/Open%20Space%20Framework%20Vol%201.pdf>>. 02/09/2012.

Cohen, B. 2006. Urbanization in developing countries: current trends, future projections, and key challenges for sustainability. *Technology in Society*, 28, 63-80.

Commission for Architecture and the Built Environment, 2009. Grey to Green: how we shift funding and skills to green our cities. CABE Report. Accessed from <http://www.designcouncil.org.uk/Documents/Documents/Publications/CABE/grey-to-green.pdf>>. 06/08/2012.

Cooperative Governance and Traditional Affairs, 2009. State of local government in South Africa. Overview Report. CoGTA.

Cornwell, K. and Inder, B., 2004. Migration and unemployment in South Africa: when motivation surpasses the theory. Accessed from <http://www.csaе.ox.ac.uk/conferences/2004-GPRAHDIA/papers/5f-Cornwell-CSAE-2004.pdf>>. 25/06/2012

Costanza, C., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387, 253-260

Cross, C., 2006. Attacking urban poverty with housing: toward more effective land markets. Urban Landmark Position Paper 2.

Dept. of Environmental and Management, undated. Optimising the benefits of Green Infrastructure - promotion of Sustainable Urban Drainage Systems (SUDS) and Water Sensitive Urban Design Systems (WSUDS). Unpublished reports.

Devas, N. 2004. *Urban Governance, Voice and Poverty in Developing World*. Earthscan: London. (Chapter 2).

Eagle, J., 2012. Green space planning in City of Johannesburg. Personal communication. 10 September 2012.

- Ecological Society of America, 2000. Ecosystem services. Accessed from <http://www.esa.org/education_diversity/pdfDocs/ecosystems-services.pdf>. 7/05/2012.
- Ecological Society of America, 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems. Accessed from <<http://www.epa.gov/owow/watershed/wacademy/acad2000/pdf/issue2.pdf>>. 9/05/2012.
- Environmental Protection Agency, 2008. Design principles for storm-water management on compacted, contaminated soils in dense urban areas. EPA. Accessed from <<http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10096CO.PDF>>. 16/10/2012.
- Esbah, H., Cook, E. and Ewan, J., 2009. Effects of increasing urbanization on the ecological integrity of open space preserves. *Environmental Management*, 43, 846–862.
- European Commission, 2012. Infrastructure for sustainable development. Accessed from <http://ec.europa.eu/europeaid/what/infrastructure-transport/index_en.htm>. 26/09/2012.
- Fasona, M.J. and Omojola, F.S. 2004. *GIS and remote sensing for urban planning: A case of Festac Town, Lagos, Nigeria*. University of Lagos: Nigeria.
- Fazio, J. R., 2010. How trees can retain stormwater runoff. Arbor Day Foundation. <http://www.fs.fed.us/psw/programs/uesd/uep/products/11/800TreeCityUSABulletin_55.pdf>. 06/09/2012.
- Folke, C., 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16, 253–267.
- Foster, J., Lowe, A. and Winkelmann, S. 2011. The value of green infrastructure for urban climate adaptation. The Centre for Clean Air Policy. Accessed from <http://www.ccap.org/docs/resources/989/Green_Infrastructure_FINAL.pdf>. 11/10/2012.
- Friedman, B.D. and Allen, K.N. 2010. Systems theory, in Brandell, J.R (ed), *Theory and Practice in Clinical Social Work*, 2nd edition, Sage Publications: New York and London. Chapter 1. Accessed from <http://www.sagepub.com/upm-data/32947_Chapter1.pdf>. 22/09/2012.
- Gauteng City Region Observatory, 2012. Overview of green space in Johannesburg. Unpublished document.
- Gauteng City Region Observatory, 2011. OECD Territorial Reviews: The Gauteng City-Region, South Africa. OECD.
- Glaser, M., Krause, G., Ratter, B. and Welp, M., 2008. Human/nature interaction in the anthropocene: potential of social-ecological systems analysis. Paper prepared for the annual conference of the German Society for Human Ecology in Sommerhausen in May

2008. Accessed from <http://www.dg-humanoeekologie.de/pdf/DGH-Mitteilungen/GAIA200801_77_80.pdf>. 25/09/2012.

Hadland, A. 2008. Second wave of urbanisation to hit cities. Accessed from <<http://www.iol.co.za/news/africa/second-wave-of-urbanisation-to-hit-cities-1.410145>>. 9/05/2011.

Heidt, V. and Neef, M. 2008. Benefits of Urban Green Space for Improving Urban Climate. *Ecology, Planning, and Management of Urban Forests*.

Heinze, J., 2011. Benefits of green space. Environmental Health Research Foundation. Accessed from <<http://www.ehrf.info/wp-content/uploads/2011/09/BenefitsofGreenSpace.pdf>>. 25/09/2012.

Henderson, J.V., 2009. Urbanization in China: policy issues and options. China Economic Research and Advisory Programme. Accessed from <<http://www.econ.brown.edu/faculty/henderson/Final%20Report%20format1109summary.doc>>. 25/06/2012.

Holness, S. and Skowno, A., 2011. Draft Bioregional Plan for the City of Johannesburg. South African National Biodiversity Institute (SANBI).

Huang, S., Yeh, C. and Li-Fang Chang, L. 2010. The transition to an urbanizing world and the demand for natural resources. *Current Opinion in Environmental Sustainability*, 2, pp. 136–143.

Huchzermeyer, M., 2011. *Cities with 'Slums': From Informal Settlement Eradication to a Right to the City in Africa*, University of Cape Town Press, Cape Town.

Husqvarna Group., 2012. Global garden report: A closer look at urban green spaces around the globe. Accessed from <http://husqvarnagroup.com/afw/files/press/husqvarna/Husqvarna_Global_Garden_Report_2012.pdf>. 24/06/2012.

Ingram, G.K. and Liu, Z. 2000. Determinants of motorization and road provision. Research paper for Research Advisory Staff and the Transport, Water, and Urban Development Department.

International Federation of Surveyors. 2010. Rapid Urbanization and Mega Cities: The Need for Spatial Information Management. FIG Report. No. 48.

Jahn, T., Becker, E., Keil, F., and Schramm, E., 2009. Understanding social-ecological systems: frontier research for sustainable development. Implications for European Research Policy. Institute for Social-Ecological Research (ISOE). Accessed from <http://ec.europa.eu/research/sd/conference/2009/papers/7/thomas_jahn_-_social-ecological_systems.pdf>. 23/09/2012.

Jim, C.Y. and Chen, W.Y., 2006. Perception and attitude of residents towards urban green spaces in Guangzhou (China). *Environ Manag*, 38 (3), 338–349.

Jim, C.Y., and Chen, W.Y. 2009. Ecosystem services and valuation of urban forests in China. *Cities*, 26, 187-194.

Johannesburg City Parks, 2012. Maintaining Joburg's green crown. Accessed from <http://www.jhbcityparks.com/index.php?option=com_content&view=article&id=110&Itemid=31>. 21/08/2012.

Johannesburg City Parks official, 2012. Green space planning in City of Johannesburg. Personal communication. 12 September 2012.

Johannesburg City Parks, 2011. Bridging the green divide. Accessed from <http://www.jhbcityparks.com/index.php?option=com_content&view=article&id=590:city-parks-holds-green-concert-&catid=1:latest&Itemid=56>. 06/08/2012.

Johannesburg City Parks, 2011. Musical fountain is on. Accessed from <http://www.jhbcityparks.com/index.php?option=com_content&task=view&id=598&Itemid=56>. 30/08/2012.

Johannesburg City Parks, 2011. Conserving the past, advancing the future. Report. Accessed from <http://www.jhbcityparks.com/pdfs/information_brochure.pdf>. 04/09/2012.

Johannesburg City Parks, 2010. Capex 2009/2010. Accessed from <http://www.jhbcityparks.com/index.php?option=com_content&view=article&id=328&Itemid=115>. 09/10/2012.

Johannesburg City Parks, 2008. Open spaces in Johannesburg. Accessed from <<http://www.jhbcityparks.com/images/stories/pdfs/openspaces.pdf>>. 02/09/2012.

Johannesburg City Parks, Unknown. Johannesburg Open Space Framework- Status Quo. JCP, unpublished reports.

Johannesburg City Parks, Unknown. Our Parks. Accessed from <http://www.jhbcityparks.com/index.php?option=com_content&view=section&layout=blog&id=5&Itemid=28>. 24/06/2012.

Johannesburg Roads Agency Official, 2012. Green space planning in City of Johannesburg. Personal communication. 19 September 2012.

Johannesburg Roads Agency, 2011. Annual report 2010-2011. JRA. Accessed from <http://www.joburg-archive.co.za/2011/annual_report_1011/jra_annual_report11.pdf>. 21/08/2012.

Joubert, R., 2012. Service delivery tops the agenda at march. Accessed from <<http://www.looklocal.co.za/looklocal/content/en/polokwane/polokwane-news-general?oid=5576776&sn=Detail&pid=4730479&Service-delivery--tops-the-agenda-at-march>>. 06/08/2012.

Kihato, C.W. 2009. Migration, gender and urbanisation in Johannesburg. University of South Africa. Accessed from http://uir.unisa.ac.za/xmlui/bitstream/handle/10500/2693/dissertation_kihato_%20c.pdf?sequence=1>. 24/04/2012.

Knuth, L., 2005. Legal and institutional aspects of urban, peri-urban forestry and greening: a working paper for discussion. Accessed from <http://www.fao.org/FCIT/docs/lpo48.pdf>>. 04/09/2012.

Kuppuswamy, H. 2009. Improving Health in Cities Using Green Infrastructure: a Review. *Forum e-journal*, 9, 63-76.

Letsoko, F.M., 2012. Green space planning in City of Johannesburg. Personal communication. 06 September 2012.

Liu, S., Costanza, R., Farber, S. and Troy, A., 2010. Valuing ecosystem services: theory, practice, and the need for a transdisciplinary synthesis. *Ecological Economics Reviews*, 54–78.

Lomis, J., Kent, P., Strange, L., Fausch, k. and Covich, A., 2000. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. *Ecological Economics*, 33, 103-117.

Maas, J., Verheij, R.A., Groenewegen, P.P., de Vries, S. and Spreeuwenberg, P. 2006. Green space, urbanity, and health: how strong is the relation? *J Epidemiol Community Health*, 60, 587–592.

Mawson, N., 2004. Johannesburg's rich tree heritage. Accessed from <http://www.engineeringnews.co.za/article/johannesburgs-rich-tree-heritage-2004-09-03>>. 31/08/2012.

McConnachie, M.M., 2010. Public green space inequality in small towns in South Africa. Accessed from <http://eprints.ru.ac.za/2436/1/Public%20green%20space.pdf>>. 28/06/2012.

McConnachie, M.M., Shackleton, C.M. and McGregor, G.K. 2009. The extent of public green space and alien plant species in ten small towns of the Sub-tropical thicket biome, South Africa. Rhodes University, Grahamstown. Accessed from <http://eprints.ru.ac.za/953/1/Public-green-space.pdf>>. 2/05/2012.

McDonald, L., Allen, W., Benedict, M. and O'Connor, K., 2004. Green infrastructure plan evaluation frameworks. *Journal of Conservation Planning*, 1 (1), 12-43.

Mell, I.C., 2010. Green infrastructure planning: a contemporary approach for innovative interventions in urban landscape management. Accessed from <http://www.journalofbiourbanism.org/2012/mell/>>. 9/07/2012.

Mell, I.C. 2010. Green infrastructure: concepts, perceptions and its use in spatial planning. PhD., Newcastle University, United Kingdom.

Mell, I.C. 2009. Can green infrastructure promote urban sustainability? *Engineering Sustainability*, 162, 23-33.

Millennium Ecosystem Assessment, 2005. Ecosystems and human well-being: current state and trends, Volume 1. Accessed from <http://www.maweb.org/en/Condition.aspx>. 10/05/2012.

Mokone, T., 2012. Green space planning in City of Johannesburg. Personal communication. 21 September 2012.

National Planning Commission, 2012. National Development Plan 2030: Our Future-make it work. NPC. Accessed from <http://www.npconline.co.za/MediaLib/Downloads/Downloads/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf>. 5/09/2012

Nedelcu, G., 2012. Green space planning in City of Johannesburg. Personal communication. 28 September 2012.

Nhlozi, M.W. Figure 4.2- Traditional engineering landscaping practices in a BRT station, Braamfontein, Johannesburg.

Niemela, J., Saarela, S.R., Soderman, T., Kopperoinen, I., Yli-Pelkonen, V., Vare, S., and Kotze, D.J. 2010. Using the ecosystem services approach for better planning and conservation of urban green spaces: a Finland case study. *Biodivers Conserv*, 19, 3225–3243.

Njingolo, B., 2012. Green infrastructure planning in City of Johannesburg. 12 September 2012, Personal communication.

Northwest Development Agency, 2008. The economic benefits of Green Infrastructure: developing key tests for evaluating the benefits of Green Infrastructure. Accessed from <http://www.naturaleconomynorthwest.co.uk/download.php?The%20Economic%20Benefits%20of%20Green%20Infrastructure%20-%20Developing%20Key%20Tests.pdf>. 10/05/2012.

Northwest Regional Development Agency. 2007. The Economic value of green infrastructure. Accessed from www.naturaleconomynorthwest.co.uk. 02 April 2012.

Nyembe, Green infrastructure planning in City of Johannesburg. 26 September 2012. Personal communication.

Oloto, E.N. and Adebayo, A.K. 2010. *The new Lagos - challenges facing the peri-urban areas and its relationship with its City centre*. University of Lagos: Nigeria.

Payne, G., 2004. *Making Common Ground: Public-Private Partnerships in Land for Housing*. Intermediate Technology Publications, London. Chapter 1: Introduction, 1-16.

Pfeiffer, D. K., 2006. *Eating Fossil Fuels: Oil, Food and the coming Crisis in Agriculture*. New Society Publishers: Canada.

Pieterse, E., 2008. *City Futures: Confronting the Crisis of Urban Development*. Zed Books: London and New York.

Qureshi, S., Kazmi, S.J.H. and Breuste, J.H. 2010. Ecological disturbances due to high cutback in the green infrastructure of Karachi: Analyses of public perception about associated health problems. *Urban Forestry & Urban Greening*, 9, 187-198.

Ramjattan, U., 2004. Industrialization in Europe and the changes to European society: Technology, urbanization, changes in the social structure and working class life. Accessed from <<http://www.writers.net/writers/books/27504>>. 27/06/2012.

Raymond, C.M., Bryan, B. A., MacDonald, D.H., Cast, A., Strathearn, S., Grandgirard, A. and Kalivas, T. 2009. Mapping community values for natural capital and ecosystem services. *Ecological Economics*. 68, 1301-1315.

Schaffler, A., 2012. Research report consultation. Personal Communication, 20 August 2011.

Schaffler, A. and Swilling, M., 2012. Valuing green infrastructure in an urban environment under pressure- the Johannesburg case. *Ecological Economics*, 1-12.

Schensul, D., 2008. From resources to power: the state and spatial change in post-apartheid Durban, South Africa. *St Comp Int. Dev*, 43, 290-313.

Schnidrig, S., 2006. Kliptown Park, Soweto. Workshop on International Social Housing (WISH). Accessed from <<http://wish.arch.unisi.ch/2006/A>>. 04/09/2012.

Shih, W., Handley, J. and White, I. 2009. Mapping biotope and sociotope for green infrastructure planning in urban areas. Real CORP Project. Accessed from <http://www.corp.at/archive/CORP2009_145.pdf>. 22/04/2012.

South African Cities Network, 2012. Award for greening campaign. Accessed from <<http://www.sacities.net/workwith/joburg/news/270-award-for-greening-campaign->>. 04/09/2012.

South African National Biodiversity Institute, 2009. Systematic biodiversity planning. Accessed from <<http://biodiversityadvisor.sanbi.org/bioplan/relevance.asp>>. 02/10/2012.

Storie, M., 2012. Green infrastructure planning in City of Johannesburg. Personal communication. 26 September 2012.

Stubbs, M. 2008. Natural green space and planning policy: devising a model for its delivery in regional spatial strategies. *Landscape Research*, 33 (1) 119-139.

Sullivan, G., 2012. Highlights in Johannesburg. Accessed from http://www.afar.com/highlights/kerk-street-shopping?context=geo&context_id=8995>. 09/10/2012.

Swilling M., Robinson, B., Marvin, S. and Hodson, M. 2011. Growing greener cities. Discussion paper commissioned by UN Habitat for Expert Group Meeting in Nairobi, 16-19 February, 2011.

Taylor, N. 2003. The aesthetic experience of traffic in the modern city. *Urban Studies*, 40, (8), 1609-1625.

The Presidency, 2012. State of the Nation Address. Accessed from <http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=24980&tid=55960> ≥. 06/08/2012.

Teddlie, C. and Yu, F., 2007. Mixed methods sampling: a typology with examples, *Journal of Mixed Methods Research*, 77-100.

The Conservation Fund, 2012. What is green infrastructure? Accessed from <http://www.greeninfrastructure.net/content/definition-green-infrastructure>>. 01/07/2012.

Toth, O. 2009. Strategic Plan for Egyptian Village: a policy analysis of the loss of agricultural land in Egypt. Msc Thesis, Wageningen University: Netherlands.

Town and Country Planning Association, 2008. The essential role of green infrastructure: eco-towns green infrastructure worksheet- Advice to promoters and planners. Accessed from http://www.tcpa.org.uk/data/files/etws_green_infrastructure.pdf> 8/07/2012.

Turok, I., 2004. Cities, regions and competitiveness. *Regional Studies*, 38 (9), 1069-1083.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A., Niemela, J. and James, P. 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: a literature review. *Landscape and Urban Planning*, 8, 167-178.

Urban Green-spaces Institute, 2012. Ecosystem Services and Green Infrastructure. Accessed from <http://www.urbangreenspaces.org/ecosystem>>. 06/07/2012

United Nations Environment Programme, 2008. Biodiversity and ecosystem services: bloom or bust. A Document of the UNEP FI Biodiversity & Ecosystem Services Work Stream (BESW).

United Nations Population Fund, 2011. State of world population 2011: people and possibilities in a world of 7 billion. UNFPA. Accessed from <http://www.unfpa.org/swp/>>. 9/05/2012.

United Nations Population Fund, 2007. State of world population 2007: unleashing the potential of urban growth. UNFPA. Accessed from <http://www.unfpa.org/swp/swpmain.htm>>. 9/05/2012.

UN-Habitat, 2011. Cities and citizens: Cairo- a city in transition. Accessed from <http://www.scribd.com/doc/59923404/Cairo-A-City-in-Transition>>. 19/05/2012.

UN-Habitat. 2011. State of the world's cities 2010/2011: bridging the urban divide. Accessed from <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2917>>. 1/05/2012).

UN-Habitat, 2011. Infrastructure for economic development and poverty reduction in Africa. UN-Habitat: Nairobi.

UN-Habitat, 2010. The State of African Cities: Governance, Inequality and urban Land Markets. UN-Habitat Report.

Vergnes, A., Le Viol, I. and Clergeau, P. 2012. Green corridors in urban landscapes affect the arthropod communities of domestic gardens. *Biological Conservation*, 145, 171-178.

Vimal, R., Geniaux, G., Pluvinet, P., Napoleone, C. And Lepart, J. 2012. Detecting threatened biodiversity by urbanization at regional and local scales using an urban sprawl simulation approach: application on the French Mediterranean region. *Landscape and Urban Planning*, 104, 343– 355.

Wallace, K.J. 2007. Classification of ecosystem services: problems and solutions. *Biological Conservation*, 139, 235-246.

Ward 43 committee member, 2012. Green infrastructure planning in City of Johannesburg. Personal communication. 08 September 2012.

Ward, C.D., Parker, C.M. and Shackleton, C.M. 2010. The use and appreciation of botanical gardens as urban green spaces in South. Africa. *Urban Forestry & Urban Greening*, 9, 49-55.

Wickham, J.D., Riitters, K.H., Wade, T.G. and Vogt, P. 2010. A national assessment of green infrastructure and change for the conterminous United States using morphological image processing. *Landscape and Urban Planning*, 94, 186-195.

Williams, J.J., 2000. South Africa: urban transformation. *Cities*, 17 (3) 167-183.

Winkler, H., Mukheibir, P., Mwakasonda, S., Garg, A. and Halsnaes, K., 2007. Electricity supply options, sustainable development and climate change priorities- case studies from South Africa. UNEP Riso Centre. Accessed from <http://www.erc.uct.ac.za/Research/publications/07Winkler%20et%20al%20Electricity%20supply%20options.pdf>>. 12/10/2012.

Wolpe, H., 1972. Capitalism and cheap labour-power in South Africa: from segregation to apartheid'. *Economy and Society*, 1 (4) 425-456

Wyly, E. 2011. Contemporary urbanization and global city-systems. *Urban Studies*, 200, 1-19.

Youngquist, T.D., 2009. What is green infrastructure? An evaluation of green infrastructure plans from across the United States. *Msc. Thesis*, Iowa State University: Ames, Iowa.

7. Annexure 1

Questionnaire for City departments, municipal-owned entities, non-governmental organisations and environmental activists.

Department of Environmental Planning and Management

- What is the department's main role in the planning and management of green spaces?
- How does this department define green spaces?
- What kinds of green spaces currently exist in the City?
- Why is DEPM planning for green spaces?
- What role do green spaces play in the City? Or how does DEPM understand the role of green spaces?
- Does DEPM have green space management strategy?
- When was the strategy formulated?
- Before the formulation of the strategy (if there is one) what mechanisms were used to manage green spaces?
- Does DEPM have a medium term plan for green space management?
- What is the City's long term plan for management of green spaces?
- What are the challenges currently faced by DEPM in planning for green spaces?
- What does the concept of green infrastructure mean to you?
- How are green spaces conceptualised within this concept (green infrastructure)?
- In the budgeting processes, how are green spaces planned for?
- Currently, what are the pressing demands for conversion of more green spaces?
- Has the City developed a framework for measuring the value (especially economic value) of green spaces?

Johannesburg City Parks

- What is the unit's main role in the planning and management of green spaces?
- How does this unit define green spaces?
- What kinds of green spaces currently exist in the City?
- Why is City Parks planning for green spaces?
- What role do green spaces play in the City? Or how does City Parks understand the role of green spaces?
- Does City Parks have green space management strategy?
- When was the strategy formulated?
- Before the formulation of the strategy (if there is one) what mechanisms were used to manage green spaces?
- Does City Parks have a medium term plan for green space management?
- What is the City's long term plan for management of green spaces?
- What are the challenges currently faced by City Parks in planning for green spaces?
- What does the concept of green infrastructure mean to you?

- How are green spaces conceptualised within this concept (green infrastructure)
- In the budgeting processes, how are green spaces planned for?
- Currently, what are the pressing demands for conversion of more green spaces?
- Has the City developed a framework for measuring the value (especially economic value) of green spaces?

Johannesburg Roads Agency and Development Planning- Technical Coordination

- What is the unit's main role in the planning and management of green spaces?
- How does this unit define green spaces?
- How does this unit understand the role of green spaces in the city?
- What are the challenges do you face in planning for green spaces?
- What does the concept of green infrastructure mean to you?
- How are green spaces conceptualised within this concept?
- In the budgeting processes, how are green spaces planned for?
- Currently, what are the pressing demands for conversion of more green spaces?

Green Peace and Just Environmental Action

- What is your organisation's main role in the planning and management of green spaces
- How does your organisation define green spaces?
- How does your organisation understand the role of green spaces?
- How do you understand the current planning for green spaces in the City of Johannesburg?
- What nature of planning for and management of green spaces does your organisation advocates for?
- How does your organisation understand the notion of green infrastructure?
- How does the organisation conceptualise green spaces within this concept (green infrastructure)
- Currently, what are the pressing demands for conversion of more green spaces?
- What sort of relationship do you have with the City? How do you communicate your ideas/concerns relating to green spaces with the City?

Environmental Activists

- Briefly describe your main role, the organisation you work for (if any), and its role in green space planning
- Why do you advocate for conservation of green spaces
- What relationships do you have with the City?
- How long have you been involved in this role?
- What projects are you currently involved in?
- What more can you tell me about green space planning and management in Johannesburg?