The integration of spatial- and infrastructure planning at municipal level

WJ Kruger

20539215

Dissertation submitted in fulfillment of the requirements for the degree "*Magister Artium et Scientiae*" in Urban and Regional Planning at the Potchefstroom Campus of the North-West University

Supervisor: Dr. JE Drewes

April 2014

Opsomming

Hierdie navorsing was geloots om die integrasie tussen infrastruktuur beplanning en ruimtelike beplanning op munisipale vlak in Suid-Afrika vas te stel. Munisipaliteite is kragtens die Konstitusie van Suid-Afrika (Wed 108 van 1996) verplig om dienste in ‘n effektiewe wyse aan hulle betrokke gemeenskappe te lewer. Die groter meerderheid van hierdie bogenoemde munisipale dienste benodig werkende infrastruktuur om gelewer te word. Hiermee tesame speel infrastruktuur ook ‘n belangrike rol in ekonomiese groei en algemene ontwikkeling deur ekonomiese en sosiale aktiwiteite te fasiliteer. Strategiese beplanning van publieke infrastruktuur beleggings is daarvoor van kardinale belang. Afsonderlik van ‘konvensionele’ infrastruktuur, is die bydrae van ‘groen’ infrastruktuur tot die skepping van volhoubare dorpe en stede oor die afgelope drie dekades beklemtoon.

Dit kom egter voor asof infrastruktuur beplanning op munisipale vlak nie die nodige aandag geniet nie. Hiedie nalatigheid in beplanning word veral in landelike munisipaliteite waargeneem waar daar ‘n ondervoorsiening van infrastruktuur opgemerk kan word. Omdat fisiese infrastruktuur soos paaie en kragopwekkings stasies langtermyn stuktuur elemente neerlê, wat vir dekades ‘n invloed het, word daar voorgestel dat infrastruktuur met strategiese ruimtelike beplanning geïntegreer word. Hierdie navorsing sal poog om die volhoubaarheid van sodanige integrasie op munisipale vlak te bepaal deur die huidige ruimtelike en infrastruktuur beplannings meganismis op munisipale vlak te bestudeer. Ruimtelike beplanning in Suid-Afrika het verskeie paradigma verskuiwings ondergaan sedert die 1980’s. Gedurende die apartheid era was ruimtelike beplanning in Suid-Afrika gefokus op rasse skeiding, en het hewige kretiek ontvang. Na 1994 het ‘n konseptuele benadering tot ruimtelike beplanning ontwikkel wat gefokus het op abstrakte elemente soos nodusse en korridors.

Ruimtelike beplanning in Suid-Afrika word op drie owerheids vlakke beoefen soos uiteengesit in die Konstitusie naamlik nasionaal, provinsiaal en plaaslik. Die Suid-Afrikaanse Presidentsie het twee departemente daarop gerig om infrastruktuur beplanning op ‘n nasionale vlak te doen. Die eerste is die Nationale Beplannings

Kommissie (NBC), en die tweede is die "Department van Performance Monitoring and Evaluation" (DPME). Die eersgenoemde ontwikkel langtermyn ontwikkelings planne vir alle sektore insluitend infrastruktuur, en was vir die Nasionale Ontwikkelings Plan (NOP) verandwoordelik wat as 'n langtermyn visie vir Suid Afrika tot en met 2030 gesien word, terwyl die laasgenoemde gefokus is op die ontwikkeling van ekonomiese infrastruktuur. Alhoewel die fokus van hierdie navorsing op plaaslike owerheids vlak gerig is, moet kennis van nationale en provinsiale owerheids beleide en riglyne gedra word. Ruimtelike beplanning op 'n plaaslike vlak is ook onderworpe aan verskeie wetgewing en beleide insluitend die Municipal Systems Act (No 32 van 2000) wat plaaslike owerhede verplig om ontwikkelings planne vir hulle gebied op te stel. Hierdie verpligting suit die opstelling van Geintegreerde Ontwikkelings Planne (IDP) wat verskeie sektore in die munisipalitiet moet verbind, koördineer en integreer in. Sulke IDP's moet ook 'n Ruimtelike Ontwikkelings Raamwerk (SDF) insluit wat vorm aan die ruimtelike visie van die IDP moet gee.

Infrastruktuur beplanning op 'n plaaslike vlak is onderworpe aan verskeie institutionele reëlings wat gemik is daarop om die groot aantal rolspelers soos diens verskaffers en diens owerhede onder andere te fasiliteer. Munisipale infrastruktuur is vervolgens onderverdeel in verskillende kategorieë wat verband hou met die skaal en funksie daarvan. Eerstens word munisipale infrastruktuur verdeel in siviele en elektriese infrastruktuur waar die eersgenoemde paaie, water en sanitasie insluit en die laasgenoemde infrastruktuur insluit wat gepaard gaan met die opwekking en verspreiding van elektrisiteit. Siviele infrastruktuur kan ook verdeel word in grootmaat, aansluitings en interne infrastruktuur waar grootmaat infrastruktuur groter in skaal is en normaalweg op die buitewyke van dorpe en stede geplaas word, en interne infrastruktuur wat kleiner in skaal is en daarop gemik is om individuele erwe te bedien.

Soos met konventionele infrastruktuur, bestaan groen infrastruktuur uit verskeie elemente en word ook op verskeie skale beoefen. Die verskillende skale maak onderskeid tussen die eienaarskap en verandwoordelikheid van sulke groen infrastruktuur. Die betrokkenheid van plaaslike owerhede in groen infrastruktuur ontwikkeling is grotedeels onbekend omdat baie munisipaleteite nie voorsiening maak

vir groen infrastruktuur in hulle ontwikkelings planne nie. Hierdie navorsings projek maak verskeie voorstelle oor hoe om albei konventionele en groen infrastruktuur in strategiese ruimtelike planne te inkorporeer. Sulke voorstelle sluit onder andere die instelling van ‘n administratiewe raamwerk in wat daarop gemik is om inter-owerheidse samewerking en koördinering te fasiliteer; die instelling van laer-orde ruimtelike planne asook die instelling van ‘n multi disiplinere beplannings span.

Executive Summary

This study was initiated to evaluate the level of integration between infrastructure- and spatial planning at local government level in South Africa. Municipalities have been given a constitutional obligation to provide their communities with effective and efficient municipal services. Most if not all of these municipal services require adequate infrastructure to be delivered in a sustainable manner. In addition, infrastructure has been identified as being an enabler of economic growth and development by providing a foundation on which economic and social interaction can occur. The planning of infrastructure is therefore of absolute importance. Additionally, 'Green Infrastructure'[1] has increasingly been viewed as a means to create sustainable human settlements with numerous benefits.

Unfortunately, it seems that the important task of infrastructure planning has not been receiving the necessary attention at municipal level especially in rural municipalities. This has resulted in both over and under provision of infrastructure in certain areas. As physical infrastructure lays down influential structural elements that can last for centuries, it is proposed that infrastructure be planned in conjunction with strategic spatial planning in a structured manner. This research will determine the feasibility of such integration at municipal level by scrutinising the existing spatial planning system on local government level while considering the infrastructure planning system. The spatial planning system in South Africa has undergone several paradigm shifts over the past number of decades; altering from a master planning approach that was too rigid to adapt to any sudden form of change, to a more conceptual approach drawing on abstract elements such as nodes and corridors.

The South African Presidency has commissioned at least two departments with the task of integrated infrastructure planning on a national level. The first is the National Planning Commission (NPC), and the second is the Department of Performance Monitoring and Evaluation (DPME). The former develops long term integrated development plans for all sectors including infrastructure and produced the National Development Plan (NDP) as a long-term vision for South Africa up to 2030, while the

[1] "Green Infrastructure refers to structures constructed with natural materials in order to create environmentally sustainable urban spaces.

latter is dedicated to the advancement of economic infrastructure. Although the focus of this study is on local government level, cognisance must be taken of national and provincial government policy and guidelines.

The practice of spatial planning in South Africa is done on three levels of government as set out in the Constitution (Act 108 of 1996); national, provincial and local. Spatial planning on a local level is additionally subject to various other forms of policy and legislation including the Municipal Systems Act (No 32 of 2000) which instructs local government to undertake integrated development planning for their area of jurisdiction. This function involves the creation of an Integrated Development Plan (IDP), which must link, integrate and co-ordinate plans from all sectors within the municipality. Such IDP must additionally include a Spatial Development Framework (SDF) which must give form to the long term spatial vision of the IDP.

Infrastructure planning on a local level is subject to various institutional arrangements that are aimed to facilitate the large number of role players involved such as service authorities and service providers amongst others. Municipal infrastructure is therefore divided into different categories relating to the scale and function thereof. Firstly, municipal infrastructure is divided into civil and electrical infrastructure where the former consists of roads, water and sanitation infrastructure amongst others and the latter consists of infrastructure concerned with facilitating electricity generation, transmission and distribution. Civil infrastructure can additionally be divided into bulk, connector and internal infrastructure where bulk is larger in scale and normally situated outside formal urbanised areas, leading down to internal infrastructure which is designed to serve individual properties. The division in electrical infrastructure is normally only made between bulk and reticulation, where the latter includes both internal and connector infrastructure.

As in the case with conventional infrastructure, green infrastructure is made up of a large variety of different elements and is practiced on various scales. These scales distinguish between the ownership and responsibility of such green infrastructure. The appropriate level of involvement of local government in green infrastructure practices is fairly uncertain as many municipalities do not make provision for green infrastructure in their development plans. This study makes several proposals on how

to incorporate both conventional and green infrastructure into strategic plans. Such proposals include but are not limited to the introduction of an administrative framework aimed at intergovernmental co-operation, the introduction of lower-order spatial plans as well as the introduction of a multi-disciplinary planning team.

Keywords - Economic growth, economic development, infrastructure, planning, spatial, policy, legislation, framework, municipal, government, national, provincial.

Table of Contents

Executive Summary i

Table of Content iii

List of Figures and Maps vi

List of Graphs and Tables vii

Acknowledgement viii

Chapter 1: Introduction 1

1.1 Research orientation 1

1.2 Problem statement 2

1.3 Objectives and Aims 3

1.4 Methodology 4

1.4.1 A literature or resource analysis 4

1.4.2 An empirical inspection 5

1.5 Arrangement of the study 6

Chapter 2: Infrastructure and Development 9

2.1 Introduction 9

2.2 Infrastructure and economic theory 10

2.2.1 Infrastructure as a factor in production 11

2.2.2 Infrastructure and productivity 12

2.2.3 Infrastructure and human capital development 12

2.2.4 Infrastructure as a stimulus to aggregate demand 13

2.2.5 Infrastructure as a tool to guide policy 13

2.3 Contribution to GDP by specific types of infrastructure 14

2.3.1 Transport infrastructure 14

2.3.2 Information and telecommunications infrastructure 16

2.3.3 Power and electricity infrastructure 17

2.4 Infrastructure and economic growth in South Africa 21

2.5 Summary and Conclusions 23

Chapter 3: Spatial Planning Theory 26

3.1 Introduction 26

3.2 Theoretical principles 27

3.2.1 Planning approach 27
3.2.2 Strategic spatial planning 34
3.3 Strategic spatial planning in South Africa 36
3.4 Summary and Conclusions 40

Chapter 4: Infrastructure Planning in South Africa 42
4.1 Introduction 42
4.2 The need for infrastructure planning 42
4.3 Infrastructure classification in South Africa 44
4.3.1 Water and sanitation infrastructure 44
4.3.2 Electricity infrastructure 49
4.4 Types of municipal infrastructure 51
4.4.1 Road infrastructure 51
4.4.2 Electricity infrastructure 52
4.4.3 Water and sanitation infrastructure 55
4.5 Integrated infrastructure planning 56
4.5.1 Prioritisation of expenditure 58
4.5.2 Strengthening capacity 58
4.5.3 Policy and legislation 59
4.5.4 Resource management 61
4.5.5 Inter-Governmental co-operation 63
4.5.6 Public Private Partnerships 65
4.6 Summary and Conclusions 65

Chapter 5: Green Infrastructure Planning 68
5.1 Introduction 68
5.2 South Africa's vision 68
5.3 Green infrastructure planning 69
5.3.1 Theory and practice 69
5.4 Types of green infrastructure 73
5.4.1 Renewable energy infrastructure 74
5.4.1.1 Wind power infrastructure 75
5.4.1.2 Hydropower infrastructure 76
5.4.1.3 Solar power infrastructure 76

5.4.2 Urban forestry 77
5.4.3 Green alleys and streets 78
5.4.3.1 Permeable pavements 79
5.4.3.2 Sustainable Urban Drainage Systems (SUDS) 80
5.4.4 Downspout disconnection and rain water collection 83
5.4.5 Eco-Roofs 83
5.4.5.1 Green roofs 83
5.4.5.2 White roofs 85
5.4.5.3 Blue roofs 85
5.5 Summary and Conclusions 86

Chapter 6: Empirical Study 88
6.1 Introduction 88
6.2 Case Studies 91
6.2.1 Infrastructure Planning Case Studies 91
6.2.1.1 Nelson Mandela Bay Metropolitan Municipality 91
6.2.1.2 eThekwini Metropolitan Municipality 94
6.2.1.2.1 eThekwini SDF 94
6.2.1.2.2 Spatial Development Plan 96
6.2.1.2.3 Linking spatial and infrastructure planning 99
6.2.1.3 South East Queensland Australia 102
6.2.2 Green Infrastructure Planning Case Studies 104
6.2.2.1 North West England 104
6.2.2.2 Chicago 106
6.2.2.3 Faenza Italy 109
6.3 Planning Frameworks 112
6.3.1 Ugu District Municipality 114
6.3.2 Hibiscus Coast Municipality 117
6.3.3 Umzumbe Municipality 119
6.3.4 Dr Kenneth Kaunda District Municipality 121
6.3.5 Tlokwe Municipality 123
6.4 Qualitative perspective of integrated planning 124
6.4.1 Socio-economic significance of infrastructure 125
6.4.2 Municipal planning policy frameworks 126

6.4.3 Provincial and National Government responsibility 127
6.4.4 Municipal Climate Change policy 128
6.4.5 Integrated Planning methodology 130
6.4.6 Renewable Energy Infrastructure Planning in Local Government 131
6.4.7 Inter-governmental co-ordination 132
6.4.8 Precinct Plans 133
6.4.9 Green Infrastructure benefits 134
6.4.10 Integrating Spatial- and Infrastructure Planning 135
6.5 Summary and Conclusions 136

Chapter 7: Synthesis and Proposals 141
7.1 Introduction 141
7.2 Synthesis 141
7.3 Proposals 145
7.3.1 Co-operation and Co-ordination Plan 145
7.3.2 Urban Development Framework 150
7.3.3 Integrated Infrastructure Planning 152
7.3.3.1 Water and Sanitation 152
7.3.3.2 Electricity 154
7.3.3.3 Renewable Energy 155
7.3.3.4 Roads and Storm-water 159
7.3.3.5 Green Infrastructure 161
7.4 Summary and Conclusions 164

Bibliography 165

List of Figures and Maps

Figure 3.1	GIS in spatial planning	32
Figure 4.1	Water and Sanitation sector infrastructure	45
Figure 4.2	Water reservoir	46
Figure 4.3	Waste water treatment plant	46
Figure 4.4	Distribution pipeline	47
Figure 4.5	Sewer outfall	47
Figure 4.6	Internal pipeline	48
Figure 4.7	Ventilated Improved Pit latrine (VIP)	48
Figure 4.8	High voltage power lines	49
Figure 4.9	Neighbourhood transformer	50
Figure 4.10	Internal transformer	50
Figure 5.1	Photoelectric effect	77
Figure 5.2	Urban Forestry	78
Figure 5.3	Permeable pavement	79
Figure 5.4	Hard landscaping SUDS	81
Figure 5.5	Soft landscaping SUDS	81
Figure 5.6	Rain collecting cistern	82
Figure 5.7	Green roof structure	83
Figure 5.8	White roof	85
Figure 5.9	Roof drain inlets	86
Figure 6.1	Sustainable Community Planning Guide process	92
Figure 6.2	Nelson Mandela Bay Municipality planning framework	93
Figure 6.3	eThekwini hierarchy of spatial plans	97
Figure 6.4	Cost Surface Model of bulk infrastructure for the metropolitan area	100
Figure 6.5	Example of bio-neighbourhood in Faenza	111
Figure 7.1	Co-operation and Co-ordination Plan	146
Figure 7.2	Plan Hierarchy	151
Figure 7.3	Water & Sanitation	153
Figure 7.4	Electricity	155
Figure 7.5	Renewable Energy	157
Figure 7.6	Roads & Storm-water	160
Figure 7.7	Green Infrastructure	162

Map 6.1	KwaZulu-Natal province location	89
Map 6.2	North West province location	90
Map 6.3	eThekwini Municipality Metropolitan Area SDF	95
Map 6.4	Spatial Development Plan boundaries	97
Map 6.5	Location of the North West region of England	104
Map 6.6	Locality of Chicago	106
Map 6.7	Locality of Faenza	109
Map 6.8	Ugu District Municipality locality	115
Map 6.9	Hibiscus Coast Municipality locality	118
Map 6.10	Umzumbe Municipality Locality	119
Map 6.11	Dr Kenneth Kaunda DM Locality	122
Map 6.12	Tlokwe Municipality Locality	123

List of Graphs and Tables

Graph 2.1	Log of Energy Consumption (Spain)	19
Graph 2.2	Log of Real GDP (Spain)	19
Graph 6.1	Socio-economic significance of infrastructure	125
Graph 6.2	Municipal planning policy frameworks	126
Graph 6.3	Provincial and National Government responsibility	128
Graph 6.4	Municipal Climate Change policy	129
Graph 6.5	Integrated Planning methodology	131
Graph 6.6	Renewable Energy Infrastructure Planning in Local Government	132
Graph 6.7	Inter-governmental co-ordination	133
Graph 6.8	Precinct Plans	134
Graph 6.9	Green Infrastructure benefits	134
Graph 6.10	Integrating Spatial- and Infrastructure Planning	135

Acknowledgements

- My Heavenly Father for the strength and guidance.
- My supervisor and mentor, Dr. Ernst Drewes, for his continual support and leadership throughout the course of my studies.
- My parents, Erika Kotze and Johannes Kruger for their continual support during the course of my studies.
- Mr. Theoff Botha for linguistic assistance.

Philippians 4:13 – I can do all this through Him who gives me strength.

List of Abbreviations

APF	Annual Production Function
ASGI-SA	Accelerated and Shared Growth Initiative for South Africa
CBD	Central Business District
CCAP	Climate Change Action Plan
CO	Carbon Monoxide
CoGTA	Department of Cooperative Governance and Traditional Affairs
CSO	Combined Sewer Overflow
CSP	Concentrated Solar Power
DBMS	Database Management System
DBSA	Development Bank for South Africa
DoE	Department of Energy
DOB	Department of Buildings
DORA	Division of Revenue Act
DPME	Department of Performance Monitoring and Evaluation
DSS	Decision Support System
EIA	Environmental Impact Assessment
EOC	Economic Overhead Capital
EPWP	Expanded Public Works Programme
ESDP	Electricity Sector Development Plan
ETC	Endogenous Technical Change
FIT	Feed in Tariffs
GDP	Gross Domestic Product
GEAR	Growth Employment and Redistribution
GIS	Geographic Information System
HCM	Hibiscus Coast Municipality
IDP	Integrated Development Plan
INEP	Integrated National Electrification Programme
IPP	Independent Power Producers
IPPPP	Independent Power Producers Procurement Programme
IRP	Integrated Resource Plan
ISMO	Independent System and Market Operator

ITC	Information and Telecommunications
ITP	Integrated Transport Plan
LEED	Leadership in Energy and Environmental Design
LED	Local Economic Development
LGMSA	Local Government Municipal Systems Act
LUMS	Land Use Management Scheme
MDG	Millennium Development Goals
MEC	Member of the Executive Council
MIG	Municipal Infrastructure Grant
MIIF	Municipal Infrastructure Investment Framework
MISA	Municipal Infrastructure Support Agency
MOSS	Municipal Open Space System
NERSA	National Energy Regulator for South Africa
NDP	National Development Plan
NGP	New Growth Path
NOX	Nitrogen Oxide
NPC	National Planning Commission
NSDF	National Spatial Development Framework
NSDP	National Spatial Development Perspective
O3	Ground-level Ozone
OECD	Organisation for Economic Co-operation and Development
PGDS	Provincial Growth and Development Strategy
PICC	Presidential Infrastructure Co-ordination Commission
PM	Particulate Matter
PPP	Public Private Partnerships
PSEDS	Provincial Spatial Economic Development Strategy
PV	Photovoltaic Cell Technology
REFIT	Renewable Energy Feed In Tariffs
REIPPPP	Renewable Energy Independent Power Producers Procurement Programme
RES	Regional Economic Strategy
RSS	Regional Spatial Strategy
SABS	South African Bureau for Standards
SALGA	South African Local Government Association

SANRAL	South African National Road Agency Ltd
SANS 10400	South African National Standards
SDF	Spatial Development Framework
SDP	Spatial Development Plan
SEQIPP	South East Queensland Infrastructure Plan and Programme
SEQRP	South East Queensland Regional Plan
SO2	Sulphur Dioxide
SOC	Social Overhead Capital
SUDS	Sustainable Urban Drainage System
VIP	Ventilated Improved Pit Latrine
WSA	Water Service Authority
WSP	Water Service Provider
UDF	Urban Development Framework
UHI	Urban Heat Island
UV	Ultra Violet

Chapter 1
Introduction

1.1 Research Orientation.

Local government is in the frontline of the municipal infrastructure programme. According to the Constitution of the Republic of South Africa (Act 108 of 1996) municipalities have an obligation to provide effective and efficient municipal services, and to promote social and economic development for their communities. Municipal infrastructure is broadly defined as "*the capital works required to provide municipal services*" (MIIF, 2011:8). Additionally, 'Green Infrastructure' concepts and practices have increasingly received attention. The importance of green infrastructure cannot be overemphasized, especially as it has the potential ability to create more sustainable human settlements. According to recent publications, green infrastructure can be part of the transition process to a green economy.

Municipalities also have to compile, approve and review Integrated Development Plans (IDP) in order to fulfil their integrated planning mandate as stated in the Local Government Municipal Systems Act (Act 32 of 2000). A municipal IDP must include a Spatial Development Framework (SDF) in order to give effect to the principles and priorities set therein. A municipal SDF must contribute to integrating and aligning policies and plans emanating from the various sectors of the spheres of government as they apply spatially within the municipal area. The goal is therefore to better align infrastructure planning with spatial planning in order to achieve more sustainable human settlements. By linking infrastructure planning to spatial planning at this early stage, infrastructure can be prioritized according to its ability to provide socio-economic development. By evaluating the current system of spatial planning in South Africa and the alignment thereof with infrastructure planning, this research will aim to make recommendations on possible methods for successful integrated infrastructure planning.

1.2 Problem Statement.

In South Africa, professionals have dedicated decades to the planning of future spatial developments at both local and provincial levels. Similarly, planning for

infrastructural needs has been done by professionals. Since the turn of the 21st century, legislation has prescribed that, amongst other, these two processes need to be integrated at the appropriate time and geographical level. South Africa has a major backlog in adequate infrastructure and this has a stifling effect on the economy and social progress as a result. The Department of Cooperative Governance and Traditional Affairs (CoGTA) has recognised the challenges that municipalities face in terms of infrastructure provision and has subsequently created the Municipal Infrastructure Support Agency (MISA) (CoGTA, 2013). The lack of adequate infrastructure in South Africa may be the result of many factors; however this research will focus on the current spatial planning mechanisms in order to make practical proposals.

The planning of future infrastructural investments should not be taken lightly, especially as 'physical' infrastructure such as roads lay down very dominant structural elements that last for decades or even centuries. Internationally, attempts to align spatial planning with infrastructure planning are done through a comprehensive (or master) planning approach (Todes, 2008:4). In South Africa, there does appear to be some form of integration between spatial- and infrastructure planning at a strategic level; however in practice a number of problems arise (Goss, 2008:11). The South African spatial frameworks have been too broad and utopian to be practically applicable in terms of implementation and do not sufficiently link to infrastructure planning (Todes, 2008:1).

Global policy has forced countries to reduce carbon emissions in their territory, thus meaning that investing in green infrastructure such as wind power and other forms of renewable energy as well as urban green infrastructure has become a priority. In the President's 2012/13 State of the Nation address, various infrastructure projects have been pointed out to enhance the country's economy. Accordingly, the following problem areas need to be considered:

- Does the existing system of spatial planning in South Africa make sufficient provision for focused infrastructure developments?

- What are the appropriate levels of integration between spatial planning and infrastructure planning at municipal level?

- What is the socio-economic significance of planning infrastructure within spatial- and infrastructure planning frameworks?

- What is the impact of public policy and investment in infrastructure?

- What is the potential of investing in 'Green Infrastructure' through integrated spatial planning?

1.3 Objectives and Aims

Future infrastructure investments are of socio-economic importance. Investing in infrastructure that will enable South Africa to grow and develop its economy is seemingly the only sustainable option for future physical development initiatives. By evaluating strategic planning instruments such as Integrated Development Plans (IDP) and Spatial Development Frameworks (SDF) of selected Municipalities, it should become clear whether infrastructure planning is sufficiently integrated with spatial planning at the appropriate levels. The aim of this study is therefore:

- To determine whether the existing spatial planning system in South Africa can accommodate appropriate infrastructure planning;

- To determine the level of integration between infrastructure planning and spatial planning at municipal level;

- To observe whether socio-economic infrastructure is appropriately included in municipal IDP's and SDF's;

- To create awareness regarding the importance of infrastructure planning in terms of economic development; and

- To display the potential benefits of ‘Green Infrastructure’ provision through an integrated planning approach.

A concrete theoretical base will be laid before any investigation can begin. Through this theoretical framework and empirical study the goals stated above will hopefully be reached. At the end of this study it should be clear whether infrastructure planning in South Africa is sufficiently linked to spatial planning, and if not, to demonstrate where the challenges lay and to provide suitable recommendations.

1.4 Methodology

1.4.1 A literature or resource analysis.

Town and Regional Planning is a relatively new discipline compared to most professions and came about as a need to control development after rapid urbanisation led to unsatisfactory living conditions. Since the industrial revolution, the need for planning has drastically increased, especially in terms of spatial planning as it acts as one of the basic drivers for social progress (Glasson, 1978:17). Both locally and abroad, future spatial developments have been planned by professionals and infrastructure has also been planned and developed by professionals. In the South African context, these two have largely been planned separately rather than collectively and have caused both over and under provision of infrastructure in many areas. Infrastructure investments have been proposed in the development literature as having a profound influence on economic growth and development (Fedderke & Bogetic, 2006:2).

South Africa has major backlogs in adequate municipal infrastructure which has a stifling effect on socio-economic development as a result. The provision of adequate infrastructure serves as a tool to enhance the economy by laying the basis for stepped-up growth and employment creation whilst it can also address inequalities in society (NGP, 2011:11). The inability of numerous municipalities to fulfil their constitutional mandate towards sustainable service delivery is a direct result of the poor level of infrastructure. The lack of adequate infrastructure provision at municipal level may be the result of a lack of funding and poor budgeting, a shortage in human resource

capacity and poor management as well as a lack of proper strategic planning. This research will focus on the latter.

'Green infrastructure' has increasingly been discussed in the development literature as the potential social, economic and environmental benefits are becoming more evident. Green infrastructure consists of a variety of different elements that are aimed at creating sustainable human settlements. Renewable energy such as wind, solar and hydro power are also forms of green infrastructure and the development thereof has been identified by the South African government as a medium to long term agenda (NGP, 2011:35). As in the case of conventional infrastructure; green infrastructure can be applied on various scales. Large scale renewable energy projects can be considered as conventional bulk electricity infrastructure, whereas small scale renewable energy practices can be considered as conventional internal electricity infrastructure. The similarities between green infrastructure and conventional infrastructure in terms of scale and institutional arrangements will be discussed in more detail in this study.

1.4.2 An Empirical inspection

The empirical section for this study will be carried out by employing three different methods of research. Firstly, case studies discussing municipal infrastructure planning in both South African Metropolitan Municipalities and international Local Authorities will be discussed as well as green infrastructure planning practices from around the globe. Secondly, Local and District Municipal strategic planning frameworks will be examined to determine the different approaches to integrated planning in South African municipalities with specific reference to the integration of spatial- and infrastructure planning. And thirdly, interviews with professionals in the field will be conducted to determine the different views on integrated planning at Municipal level in South Africa.

One major feature of case study methodology is that various methods are combined in order to highlight the case from different angles. A specific case may be purposefully selected as it might be information rich or unique (Patton, 1990:554). If a case is purposefully selected, then there is usually an interest in generalising the findings.

Generalisations from case studies are not statistical, but rather analytical and are normally based on reasoning (Johansson, 2003:28).

Strategic planning frameworks such as IDP's and SDF's will be scrutinised by using the KwaZulu-Natal Province as the main study area, and the North West Province for comparison. The KwaZulu-Natal Province has been chosen because in the South African context, it has been recognised to be one of the leading provinces in terms of economic activity and sets a high standard for planning. The North West Province will be used for comparison as it is generally regarded as being one of the least developed provinces in South Africa. Selected District and Local Municipalities within each province will be used for reference. For KwaZulu-Natal, the Ugu District Municipality will be used along with the Hibiscus Coast Local Municipality and Umzumbe Local Municipality. For the North West, the Dr Kenneth Kaunda District Municipality and Tlokwe Local Municipality will be used.

Interviews with Town and Regional Planners as well as related professionals in the field will be conducted to discuss their different views on infrastructure planning in South African municipalities. The selected professionals to be interviewed will be chosen on their ability to provide objective answers to the questions with which they are presented. The method of interviewing that will be used for this study will be presented in the form of a questionnaire. A questionnaire is a series of written questions an interviewer presents to the interviewee, requesting his/her response. The questionnaires will be analysed and presented in the form of graphs to optimally illustrate the prevailing opinions.

1.5 Arrangement of the study.

The research will consist of seven chapters. These chapters can be arranged as follows: Chapter Two will aim to demonstrate the importance of infrastructure in achieving socio-economic development and therefore the need for proper infrastructure planning. Infrastructure has a positive effect on economic growth and development both directly and indirectly. The availability of infrastructure significantly influences the development of regions and should therefore be high on local government's priority list. Infrastructure can be divided into two categories:

Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). The former consists of transport, telecommunications and electricity infrastructure amongst others whereas the latter consists of education, health and national security infrastructure amongst others. Certain types of infrastructure are more recognizable in their contribution to economic growth. The influence of different types of infrastructure on economic growth and development will thus be a key focus point of this chapter.

Chapter three will aim to determine whether the current system of spatial planning in South Africa can accommodate focussed infrastructure planning at municipal level. In order to study the spatial planning system, the process that makes up the planning activity must initially be defined as spatial planning is merely a subsection of the broader planning activity. Strategic planning at municipal level in South Africa involves the formulation of Integrated Development Plans (IDP's) and Spatial Development Frameworks (SDF's). The South African spatial planning system is subject to various forms of policy and legislation which provides a framework wherein spatial planning can function.

Chapter Four focuses on municipal infrastructure and the various institutions entrusted with the important task of planning and providing such infrastructure. Municipal infrastructure consists of physical elements such as roads, power and water lines and provides the platform for successful municipal service delivery. Municipal infrastructure is classified into different categories based on the scale and function thereof. The roles of service authorities and service providers will also be discussed as they hold important implications for delegating responsibilities. National, Provincial and Local government are all responsible for infrastructure provision; it is therefore important to distinguish the division of functions and powers of the three spheres of government as well as the different tiers of local government.

Chapter Five focuses on 'green infrastructure' and aims to display the potential benefits of providing green infrastructure through an integrated planning approach. As in the case of conventional infrastructure, green infrastructure consists of a large variety of elements ranging from environmentally friendly building practices to large scale renewable energy developments. Some of the different types of green infrastructure will be discussed in detail in this chapter as well as their similarities in

relation to conventional infrastructure with regard to classification. The world is entering a stage where cities will need to become more environmentally sustainable and emit fewer harmful gases. Green infrastructure planning may be a new concept in South Africa; however internationally green infrastructure practices have grown from theoretical concept models to being implemented in and around the urban environment with a great deal of success. The transition from theory to practice will be discussed in this chapter in addition to the various forms of policy and legislation that can and should be used to guide the future success of green infrastructure in South Africa.

Chapter Six will form the empirical study for this study and will aim to establish the level of integration between spatial- and infrastructure planning in South African municipalities. This will be achieved by employing three different methods of investigation. These include case studies, municipal planning frameworks and interviews.

Chapter Seven will form the synthesis and proposals. This will form the closing chapter of the study and will consist of a summery of the most important findings of the study. Recommendations on how infrastructure investments at municipal level could be approached in order to promote socio-economic development and service delivery will form the main focus point in this chapter.

Chapter 2
Infrastructure and Development

2.1 Introduction

The aim of this chapter is to create awareness regarding the importance of infrastructure, and the role that infrastructure investments play in economic development. This will be achieved by studying theoretical publications on the general relationship between infrastructure and economic development as well as the contribution of specific types of infrastructure to economic growth.

All countries need efficient transport, energy and communications infrastructure if they are to provide a good quality of life for their citizens. In recognition of the afore-mentioned need, along with the 2010 FIFA World Cup, the South African Government has significantly increased investment in infrastructure since 2005. Many are of the view that this rapid expansion in infrastructure has cushioned the South African economy from the worst global economic recession since the 1930's (Kumo, 2012:5).

Development has extensively been researched during past decades. Hansen (1965:3-14) studied the impact of public infrastructure investments on economic development and divided public infrastructure into two categories; Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). The former is oriented largely towards the direct support of productive activities or towards the movement of economic goods whereas the latter is designed to enhance human capital and consists of social services such as education and health facilities amongst others.

There are a large number of studies which are devoted to analysing the correlation between infrastructure and economic development. Since the beginning of the 20th century, extensive literature on economic growth and development has emphasised the key role of infrastructure in both national and regional development. Such literary publications will be analysed in this chapter in order to display the relationship between infrastructure investments and economic development.

The availability of infrastructure significantly influences the development of regions and is normally the reason why infrastructure has a direct effect on business productivity and growth. In fact, local governments (or municipalities) can attract new businesses by investing in specific types of infrastructure. The impact of infrastructure investments on development is therefore an important issue for policy makers to consider.

2.2 Infrastructure and economic theory

Theories regarding economics identify five channels through which infrastructure can have an impact on economic growth and development (Fedderke & Garlick, 2008:4). These channels can be described as follows:

- Infrastructure may merely be regarded as a production input and serve as a factor of production;
- Infrastructure may be regarded as a complement to other factors of production in that infrastructure may lower the cost of production;
- Infrastructure can provide facilities for human capital development;
- Infrastructure investments can also boost aggregate demand during the construction phase; and
- Infrastructure investment can also serve as a tool to guide policy.

Different papers on the subject adopt different approaches and consider a range of factors of production, including labour as well as total factor productivity (see Fedderke & Bogetic, 2006:5) and capital (see Barro, 1990:117). The theory behind these linkages is usually very apparent. Considering production function capital such as machinery or electronic equipment; the effectiveness thereof would be greatly enhanced by a reliable power supply. In the same way, the productivity of labour would be far higher if good education and healthcare infrastructure were available.

2.2.1 Infrastructure as a factor in production

Economists generally define economic growth with a production function for goods and services where production output is a function of production input. Physical capital (infrastructure) is displayed in all theoretical models as a production input, along with technology and human capital (labour force). In some models, government policy and geographical features are used as determinants of growth as well. Typically, most factors of production translate into positive determinants of output, meaning that where an increase in production inputs occurs, an increase in production output can be expected. Thus, economic growth occurs when more factors of production are put to use.

Therefore, infrastructure may be regarded as a direct input of production. As infrastructure can be placed under the broader heading of physical capital, it can be assumed that infrastructure yields a different result to output from other forms of physical capital (Gramlich, 1994:1179). Economic theory holds that an increase in infrastructure will increase output and therefore boost economic growth.

One example of this theory can be observed in power and electricity infrastructure. Electricity is a necessary input into many production processes for both goods and services. The lack of electricity or poor supply thereof would render these processes nearly impossible (Fedderke & Bogetic, 2006: 121). Inadequate infrastructure can result in unforeseen costs for firms as they would need to have contingency plans in place for infrastructure failures or even need to build new infrastructure themselves (Fedderke & Garlick, 2008:4).

Inadequate transport infrastructure can have detrimental financial effects on firms as they would need to find alternative means of transporting both production input factors and final goods. The lack of adequate transport infrastructure has been one of the main reasons for Africa's poor growth performance in recent decades (Collier & Gunning, 1999:64). The solution then seems to be to encourage private investments in transport infrastructure; however, as public investment in transport infrastructure is

more sustainable than private provisions, due to the state's ability to achieve higher economies of scale, this option should be taken only when necessary.

2.2.2 Infrastructure and productivity

Infrastructure can alternatively be regarded as a complement to other production inputs. "Total Factor Productivity" is an economic term to describe output growth over and above that which can be ascribed to the primary factors of production. It can alternatively be described as the efficiency with which production factors can combine (Barrow, 1990:121). Productivity can be described as a means of achieving a greater level of output for a fixed level of input while simultaneously lowering the cost of the specific input. Improvements in infrastructure can thus lower the cost of production.

There have been numerous theoretical studies on the effect of infrastructure on macro-economic productivity that date back to Ratner (1983:213-217) and Aschauer (1989a:177-200). There are also several empirical studies using economic growth theory, such as Easterly and Rebelo (1993:417-458) and Devarajan, Swaroop and Zou (1996:313-344). All these studies found infrastructure to be an efficient factor of production. Inadequate infrastructure can cause negative economic growth as the economic activities that are reliant on such infrastructure will not be able to continue. One of the main functions of municipal infrastructure is to support local economic activities. Businesses cannot operate without roads, electricity and water infrastructure as they are dependent on such infrastructure for inputs into their production processes in addition to making their businesses more efficient.

2.2.3 Infrastructure and human capital development

In the case of the afore-mentioned production function, production output is a product of combining various forms of economic capital. Human capital can additionally be considered as a production input into the production process. Human capital is a function of factors such as health and education facilities amongst others where knowledge and skills are obtained. In particular, infrastructure in the form of schools,

electricity provided to schools and roads used to access schools are important factors in human capital development (Fedderke & Garlick, 2008:5). Thus, infrastructure can influence the economy in a direct manner in the provision of economic capital into the production process or by boosting productivity, and in a more indirect manner by enhancing human capital. In general terms, infrastructure is a determinant of many factors of production in a typical economy. Infrastructure development can additionally enhance human capital during the construction phase. Workers can earn an income for their labour while obtaining valuable skills and knowledge at the same time.

2.2.4 Infrastructure as a stimulus to aggregate demand

While the first three channels of infrastructure provision focussed largely on the supply side of the economy, infrastructure can additionally have an effect on the demand side. Large infrastructure projects typically involve a great deal of expenditure during the construction phase, but this can also be the case during maintenance operations and therefore increasing aggregate demand. Governments have often used large-scale infrastructure projects as stimulus policies during economic recessions in order to achieve particular growth targets (Fedderke & Garlick, 2008:5). Theories regarding the impact of infrastructure on economic growth usually consider the first three channels (supply), whereas the fourth (demand) channel is more widely contested due to the short-term intervention it provides.

2.2.5 Infrastructure as a tool to guide policy

Another channel focuses on the ability of infrastructure to guide policy. Governments might attempt to activate this channel by investing in specific infrastructure projects with the intention of guiding private investment (Fedderke & Garlick, 2008:5). An example of this is when large renewable energy projects are initiated by the public sector in a particular area in order to promote private sector investment. This method is not supported by all economists as they believe that such interventions do not actually succeed in stimulating economic growth but simply divert resources that could have been better utilised elsewhere (Fedderke & Garlick, 2008:6).

Despite the different opinions regarding the five channels, the overall consensus is that there is a general positive relationship between infrastructure investment and economic growth.

2.3 Contribution to GDP by specific types of infrastructure

The relationship between an economy and its economic infrastructure can be compared to that of a building and its foundation. Ferreira and Khatami (1996) argues that investment in infrastructure will play an increasingly important role in productivity. Economic infrastructure usually does not exist for itself, but rather to support various kinds of economic activities (Jimenez, 1995:2774). A study by Barro (1990) showed that infrastructure as a capital expenditure by the public sector raises the marginal product of other capital used in the production process, albeit only up to a certain point. Public spending on infrastructure is subject to diminishing marginal returns, and once it falls below unity, the financing of additional infrastructure becomes counter productive. For instance, a road can stimulate economic growth by enabling economic goods to be transported to and from markets; however the construction of a second road in the same location when it is not needed will require capital investment while not contributing the same amount back into the economy, thus impacting negatively on development. Businesses cannot function optimally without the necessary infrastructure as they need electricity and water as inputs in their production process, solid waste and sanitation infrastructure to remove waste from their premises and roads to allow their employees to get to work in addition to the transportation of economic goods.

2.3.1 Transport Infrastructure

Transport infrastructure can provide access to markets, social and medical services, education and employment opportunities as well as to friends and family (MIIF, 2011:12). Urban and Regional Planners need guidance based on solid empirical grounds to aid them in their decisions to improve existing and new transportation infrastructure. In this section, a brief overview of the theoretical considerations that

might explain the linkages between transportation infrastructure and economic growth is presented.

Infrastructure plays a vital role in economic growth and social development; this is particularly the case with transport infrastructure (UNCDF, 2007). The two most popular arguments pertaining to this topic have been those of reduced transportation costs and increased accessibility (Boopen, 2006:38). These two have often been referred to as the primary transportation benefits. The above-mentioned benefits not only positively impact the economy in a direct manner, but also work through other important avenues. They filter down through the following channels to enhance productivity and economic growth namely; rationalization and reorganisation of production, wider markets, better productivity and higher level of private investment, increased specialisation and economies of scale (Boopen, 2006:39). The labour market supply also benefits through decreased labour costs and higher productivity (Boopen, 2006:39). As transportation infrastructure provides mobility, the potential economic benefits thereof are not limited to a specific group or location.

Aschauer (1989b:171-188), studied the economic contribution of public investment in transport infrastructure for the G7[2] countries using panel data for the period 1966 – 1985. His research showed positive results which point to the importance of public investment in transport infrastructure for productivity and growth. Nourzad and Vrieze (1995:283-295) also studied panel data for 7 of the Organisation for Economic Co-operation and Development (OECD)[3] countries over the period 1963 – 1988 on the effect of public investment in transport infrastructure on output. They used a similar econometric specification as Aschauer (1989b:171-188), but controlling for energy input prices and taking into account random effects. This study also found a positive correlation with respect to transport infrastructure and economic growth.

The primary benefits of transport infrastructure seemingly have a profound direct impact on economic growth. This is achieved by linking people and economic

[2] The G7 are the seven wealthiest major developed nations on earth by national net wealth and include Canada, France, Germany, Italy, Japan, the United Kingdom and the United States of America.

[3] OECD is an international economic organisation of 34 countries founded in 1961 to stimulate economic progress and world trade.

activities with one another in a more cost effective manner. However, it can be noted that transport infrastructure additionally contributes to economic growth in a more indirect manner. This is achieved by providing people with jobs during the construction phase, as well as in the maintenance operations thereafter. Bringing people and activities together is apparently the primary function of transport infrastructure and therefore not only benefits a single group of people or a single location.

2.3.2 Information and telecommunications infrastructure

The notion that information and telecommunications (ITC) infrastructure is important to economic growth and development is not a new concept. Economists have studied the importance of Social Overhead Capital (SOC) on economic growth for many years. SOC is normally associated with health and education infrastructure. Telecommunications infrastructure is a crucial element of SOC (Waverman *et al.*, s.a:3). There is an external component in fixed telecom penetration, meaning that GDP is higher, and grows faster in countries with more advanced telecom networks (Hardy, 1980:279). In earlier periods, telecommunications infrastructure generated growth by enabling individuals to decrease transaction costs, and firms to widen their markets. The impact of investments in telecoms infrastructure illustrates that telecoms is linked to GDP (Roeller & Waverman 2001:909). ITC infrastructure will support economic growth, development and competitiveness including local, regional and national integration (NDP, 2012:170).

Generally there are two methods (Waverman *et al.*, s.a:9) in determining the extent of the impact of telecoms contribution to GDP. The first approach is called the Annual Production Function (APF) and is measured by GDP each year assumed to be determined by that year's aggregate capital, labour and other factors such as telecoms. The growth dividend of telecoms would be measured by its annual contribution to GDP. The second approach is called the Endogenous Technical Change (ETC) and relates the average rate of growth of GDP over a substantial period to the initial level of GDP, averaging investment as a share of GDP during that period. The contribution

of telecoms to growth is here measured by its boost to the long-term growth rate (Waverman *et al*., s.a:10).

Empirical results from a study undertaken by (Waverman *et al*., s.a) analysing the impact of mobile penetration on economic growth revealed that if all else were equal, a country with an average of 10 more mobile phones for every 100 people would achieve a higher per capita GDP growth by 0.59% (Waverman *et al*., s.a:21). The results also suggest that long-term growth in the Philippines could have been as much as 1% higher than in Indonesia, were the gap in mobile phone penetration evident in 2003 maintained. Another estimate of the importance of telecom infrastructure can be seen by comparing Morocco to the "average" developing country. The results suggest that if the mobile phone penetration in Morocco evident in 2003 persisted, the country's long-term per capita growth rate could have been nearly 1% higher than the average developing country (Waverman *et al*., s.a:21). Thus, current differences in mobile phone penetration between developing countries might generate significant long-term growth benefits for the mobile phone leaders.

Being able to connect can be seen is a basic human need and has evidently become increasingly important in how business is being done. The same argument of enhanced connectivity used for transport infrastructure could therefore also be used for ITC infrastructure. The application of ITC infrastructure means that people do not have to physically travel in order to connect, and therefore drastically decreases transaction costs and widens business markets.

2.3.3 Power and electricity infrastructure

Electricity is an essential component of modern day life, bringing benefits and progress in various sectors, including transportation, mining, manufacturing and communications. Electricity is vital for economic growth and development not only as it increases the productivity of capital, labour and other factors of production, but an increase in electricity consumption can be seen as an elevated economic status of a country (Jumbe, 2004:63).

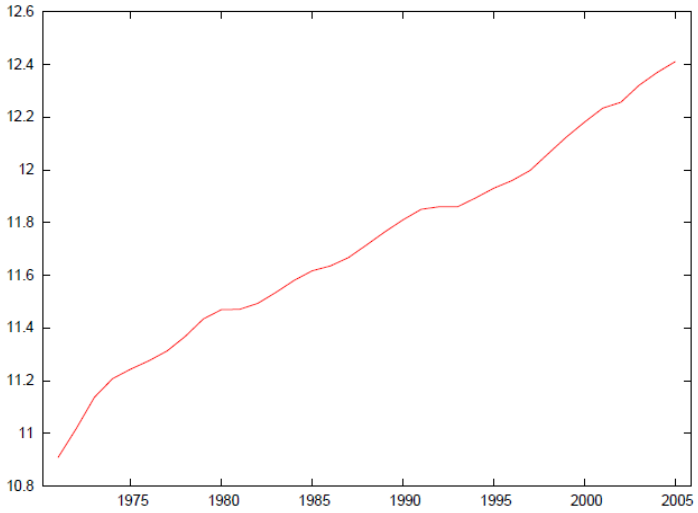
The literature from energy economists has developed significant theoretical contributions on the causal effects of energy consumption and economic growth. In most researchers' findings, the results indicated that there is a strong relationship between the two variables. Ferguson *et al*., (2000:923-934) found a positive correlation between electricity use and wealth creation in 100 developing countries. The research found that there is a stronger relationship between electricity use and wealth, than there is between total energy use and wealth.

We can classify the relevant studies into four categories. First, a large number of studies found a very strong relationship between electricity consumption and GDP. Studies done for Turkey found that the relationship between energy consumption and GDP was uni-directional during the period 1950 to 2000 (see Altinay & Karagol, 2005:849-856). The same results were found in Taiwan for the period 1954 to 2003 (see Lee & Chang, 2005:857-872) as well as for China during 1971 to 2000 (see Shiu & Lam, 2004:47-54). The second category found a strong relationship between electricity consumption and economic growth. Such studies included Gosh (2002:125-129) for the period 1950 to 1997 in India. The third category found bi-directional causality. This is the case of Soytas and Sari (2003:33-37) for Argentina, and Yoo (2005:1627-1632) for Korea during the period 1970 to 2002. And the last group includes all the studies that found no causal relationship between energy, or even electricity consumption and economic growth. Studies done by Stern (1993:137-150) in the United States of America during 1947 to 1990 showed such results.

Most of these studies were done in developing countries; it seems that the relationship between energy and electricity consumption is more closely linked to economic growth in developing countries than in developed countries. In order to find a more accurate result, an analysis of the relationship between economic growth and electricity consumption should be undertaken in a developed country. A study done in Spain from 1971 to 2005 can be reflected on for the relationship between these two variables in a developed country.

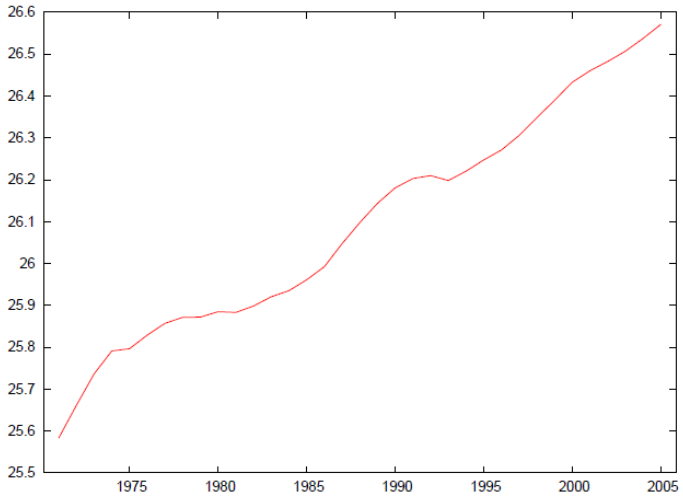
The study done in Spain was conducted by Ciareta and Zarrage, (2006) and the results of the study are displayed in Graphs 2.1 and 2.2 respectively.

Graph 2.1 Log of Energy Consumption (Spain)



Source: Ciarreta, A & Zarraga, A (2006)

Graph 2.2 Log of Real GDP (Spain)



Source: Ciarreta, A & Zarraga, A (2006)

The study concluded that a uni-directional causality relationship between Spanish real GDP and electricity consumption exists. The causality relationship establishes that the one variable has a positive effect on the other. This means that the increase in energy consumption increases the economic output; however, the growth of the Spanish economy is not exclusively reliant on electricity consumption. Similar results were found in other European Union countries such as France and Germany (see Soytas & Sari, 2003:33-37).

Africa as a continent has since the late 1970's been the focus area for economic research (see Akinlo, 2009:681-693) and (Wolde-Rufael, 2006:1106-1114). Kraft and Kraft (1978:401-403) utilised the causality test to investigate the relationship between electricity consumption and economic growth. The availability of time series techniques and the availability of long time series data on electricity have further stimulated the research in this particular area (see Altinay & Karagol, 2005:849-856).

The investigation of the relationship between economic growth and electricity consumption started with the work of Kraft and Kraft (1978:401-403) in the United States of America. Since then, numerous authors have investigated this vital relationship (see Ghosh, 2002:125-129). Although some of the above-mentioned studies showed conflicting results regarding the relationship between economic growth and electricity consumption, most have several similarities. An obvious similarity is the utilisation of causality tests to investigate this relationship. The other similarity is that uni-directional causality running from energy consumption to GDP is interpreted to mean that a country is not exclusively dependent on energy for its economic growth, and that power conservation policies can be undertaken with insignificant adverse effects on economic growth (Odhiambo, 2009:617). The long-run estimate tests indicated that electricity consumption is positively and significantly associated with real GDP. Therefore, improving electricity should improve income generation (Adebola, 2011:37). Most importantly, energy policy could orientate towards increasing supply of electricity to sustain economic growth. Since the turn of the 21st century, electricity generation methods have become more efficient as renewable resources have been combined with better technologies (Adebola, 2011:44).

There is seemingly a difference between energy use and electricity use, the former includes all forms of energy where the latter focuses on electricity itself. Empirical research regarding the relationship between electricity use and economic growth suggests that both total energy use and total electricity use reveal a positive correlation to economic growth. Studies regarding the relationship between economic development and electricity infrastructure can additionally be divided into four categories; where results range from a strong uni-directional relationship towards a bi-directional relationship towards no relationship. However, the vast majority of the

above-mentioned studies revealed a positive uni-directional relationship which means that although investment in electricity infrastructure boosts economic growth, it is not the only determinant of economic growth. Such research additionally revealed that there is apparently a stronger relationship between electricity use and economic growth in developing countries than in developed countries. This can be ascribed to the higher level of dependence on electricity for economic growth in developing countries. The overall consensus however is that electricity enables economic activities to take place, therefore an increase in electricity will increase economic growth (Jumbe, 2004:63). Adequate electricity infrastructure can therefore be considered as being critical for sustained economic growth.

2.4 Infrastructure and economic growth in South Africa

It can be assumed that South Africa's economy, as in the case of most industrialised countries, has experienced a major setback during the 2008 economic recession. Coupled with this fact, South Africa remains one of the most unequal economies in the world (NDP, 2012:3) which means that the quality of life for citizens, especially in rural areas is declining. The unemployment level is still a major concern as a large proportion of the population is still excluded from the benefits of the economic boom experienced during the latter part of the 1990's and early 2000's (NDP, 2012:3).

The South African government has recognised the importance of infrastructure for economic growth, and consequently established policy frameworks such as the Reconstruction and Development Programme (RDP, 1994), the Growth Employment and Redistribution (GEAR, 1996) programme, the Accelerated and Shared Growth Initiative for South Africa (ASGI-SA, 2006) and more recently the New Growth Path (NGP, 2011) and the National Development Plan (NDP, 2012). This recognition has recently affected government policy and in particular the financing of infrastructure (UNISA, 2011:1).

For South Africa to achieve economic growth and development, it is essential to ensure the participation of a significant part of the population in economic growth processes (ASGI-SA, 2006:23). One measure of infrastructure's empowering effect is

its ability to contribute to poverty alleviation (MIIF, 2011:11). The Accelerated and Shared Growth Initiative for South Africa (ASGI-SA, 2006) was aimed at a reduction in poverty, unemployment and improving the overall economy for greater economic development (ASGI-SA, 2006:1). ASGI-SA aimed for major development goals such as halving poverty and unemployment figures from 2004 by 2014 and raising economic growth to an average of 6% between 2010 and 2014 (ASGI-SA, 2006:1). However, the South African economy grew by a mere 2.8% during 2010 and is more than likely to remain below 4% for the remainder of the 2010 to 2014 period (Kumo, 2012:5).

As the ASGI-SA initiative failed to achieve the envisaged objectives, the South African government announced the New Growth Path (NGP) on 23 November 2010 in order to increase economic growth to sustainable rates of between 6% and 7% per year in order to create five million job opportunities by 2020 and to reduce the unemployment rate to 6% by 2030 (NDP, 2012:28). One of the key enablers that the South African government is aiming to use for this rapid economic growth and redistribution of income is accelerated investment in infrastructure (NDP, 2012:30).

By comparing South Africa to other developing countries, it can be seen that in terms of roads, educational institutions and health facilities, South Africa is well developed. However, key economic infrastructure such as energy has lagged far behind the domestic demand (NDP, 2012:4). In addition, evidence suggests that most of South Africa's economic infrastructure is in dire need of upgrading and maintenance. Public investment in infrastructure can create numerous jobs per annum in water, transport, energy and communications infrastructure (NDP, 2012:4). The jobs are in four categories; construction of new infrastructure, operation of new facilities, expanded maintenance and manufacturing of components for the infrastructure programme. In addition to these four activities, the impact of the large infrastructure programmes on job creation across the economy (alternatively known as the "multiplier effect") will be substantial (NGP, 2011:10).

The apparent importance of adequate infrastructure for a country's socio-economic development cannot be over-emphasized. Inadequate infrastructure has been known to exclude the citizens from economic opportunities as well as life supporting services

such as clean water, education, health, transport and communications. Economic Infrastructure investments support the Millennium Development Goals (MDG)[4] and are an essential part in improving the livelihood of the poor in addition to providing opportunities in terms of job creation (NDP, 2012:4). The provision of infrastructure also enhances the efficiency across the economy, by laying the basis for stepped up growth and employment creation in every industry while simultaneously advancing social equity goals and inequalities (NGP, 2011:11). In order to enhance rural employment, the finalisation of a spatial perspective that sets out the opportunities available and the choices that must be made in order to lay the basis for aligning government spending on infrastructure and housing investment and economic development initiatives must be achieved (NGP, 2011:14). Large investments in infrastructure are needed to propel economic activity, using structured approaches to prevent inappropriate initiatives being favoured over urgent priorities (NDP, 2012:137).

Economic development planning will seemingly not be successful without broader social and political progress. The National Planning Commission (NPC, 2009) has an important role to play in aligning the economic growth path with other social programmes such as education, migration demographics and health planning in addition to long-term infrastructure needs amongst others (NGP, 2011:32). Precedence should be given to infrastructure programmes that contribute immediately and practically to greater regional integration (NDP, 2012:138). Access to basic services and infrastructure is a basic human right for all citizens as stated in the Constitution (1996) and should therefore be high on the South African government's priority list.

2.5 Summary and Conclusions

The link between infrastructure and development has become one of the most discussed topics in recent scientific literature as the importance of financially viable investments is becoming more apparent. The term infrastructure can be divided into

[4] MDG's are eight international development goals that were established following the Millennium Summit of the United Nations in 2000.

two categories; Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). The former consists of economic infrastructure such as roads, electrical sub-stations and machinery and has a direct effect on the economy whereas the latter consists of social facilities such as schools and hospitals and influences the economy in a more indirect manner. Although infrastructure has various effects on the economy, economic theory and empirical research suggest that investment in infrastructure enables economic growth. The availability of infrastructure seemingly significantly influences the development of regions. However, economic development depends largely on the optimum utilisation of infrastructure investments and should therefore be strategically planned in order to optimise returns.

To determine the relationship between infrastructure and economic growth and development, this chapter discussed the role of infrastructure as a factor of production and noted that an increase in infrastructure typically leads to an increase in production output. Studies regarding the effect of infrastructure on productivity found that infrastructure is a significant factor in reducing income disparities by unlocking total factor productivity. Infrastructure provision in the form of schools and related social facilities additionally enhances human capital as a production input. Infrastructure can also create short-term demand in addition to being used as a tool to guide policy.

This chapter also examined the contribution of certain types of economic infrastructure to national GDP. Certain types of infrastructure are more predominantly observable in their contribution, whereas others contribute in an indirect manner. The relationship between transport, electricity and ITC infrastructure displayed a positive correlation to GDP. The contribution of infrastructure to economic growth is important as it can give a clear indication of where and what types of infrastructure investments need attention.

The overall conclusion that can be made from this chapter is that infrastructure investment positively influences economic growth and development by virtue of productivity, mobility and employment generation amongst others. Certain infrastructure investments can theoretically generate a higher return by being integrated with strategic spatial planning at municipal level. However, the ability of

the existing spatial planning system in South Africa to accommodate focussed infrastructure planning needs to be determined.

Chapter 3
Spatial Planning Theory

3.1 Introduction

The aim of this chapter is to determine whether the existing spatial planning system in South Africa can accommodate focussed infrastructure planning at local government level. This will require the analysis of theoretical principles relating to spatial planning in general as well as examining the spatial planning system currently operating in South Africa.

In order to study the spatial planning system in South Africa, the term planning as well as the process that makes up the planning activity must initially be defined as spatial planning is merely a sub-section of the broader planning activity (Hall, 1975:269). This chapter starts off by explaining why planning is necessary in today's society, and follows up with different authors' definitions of what planning is and should be.

Spatial planning can occur at various scales and can additionally be divided into four categories (Glasson, 1978:19). These four categories will be further discussed as well as spatial planning's function in regional development. However, as regions are complex in nature, regional development can not be realised without strategic planning. Strategic spatial planning can be carried out by using various approaches and involves multiple disciplines.

The spatial planning system in South Africa is subject to various policies and legislation including the National Spatial Development Perspective (NSDP, 2006), Provincial Growth and Development Strategies (PGDS), Spatial Development Frameworks (SDF), the Constitution of the Republic of South Africa (Act 108 of 1996), and the Municipal Systems Act (Act 32 of 2000) amongst others. The above-mentioned policies and legislation provide a framework for spatial planning at various levels of government and will be discussed in more detail in this chapter.

3.2 Theoretical principles

This section will aim to uncover some of the fundamental principles that apply to planning as an activity in order to better understand the process of spatial planning.

3.2.1 Planning approach

In order to study the field of spatial planning, the term planning must be defined in addition to the process that makes up the planning activity. According to Glasson (1978:17), mankind has since the dawn of civilisation had an almost instinctive need to plan, that stems not necessarily from our biological make up, but has been learned over many years and acts as one of the basic 'social drivers' of society. This need for planning has drastically increased over the last century, especially in terms of spatial planning and may well be the result of society not accepting situations that arise from a lack of planning (Glasson, 1978:17). One area where the lack of planning can be measured is in the disparities of income between different groups and regions (Glasson, 1978:18). Since the industrial revolution, the need for spatial planning has become more important as rapid urbanisation and technological improvements saw masses of people sharing the same space in a more complex manner (Glasson, 1978:18).

According to Hall (1975:3) the term planning is difficult to define, however he goes on by stating that "*planning is concerned with deliberately achieving some objective, and it proceeds by assembling actions into some orderly sequence."* Planning in the above-mentioned regard may or may not require physical plans or blueprints displaying the various components of the 'plan' (Hall, 1975:6). Planning is a continual process being used to control certain effects (Hall, 1975:269). Spatial planning (or town and regional planning) can additionally be seen as a sub-section of the broader planning activity (Hall, 1975:269). Town planning also refers to a spatial or geographical component where the spatial structure is better organised prior to planning, which implies a physical component (Hall, 1975:7). The action of planning can presumably be used to enhance the present status of a community in a large variety of areas that impact on people's lives. One of the general features of planning is that it comprises of a sequential chain of actions aimed at solving economic and social problems in the future (Glasson, 1978:19). There is consequently a 'process of

planning' that can be applied to most if not all problems. The above-mentioned process can be laid out as follows (Glasson, 1987:19):

- The first stage of the planning process starts of by identifying the problem;
- The second stage revolves around the formulation of strategies and objectives that are more specific to solving the problem;
- During the third stage, possible constraints are identified that may hamper the problem solving;
- During the fourth stage projections of future situations are mapped out;
- The fifth stage consists of generating alternative courses of action; and
- The sixth stage entails the production of a preferred plan.

According to Friedman (1964:61) "*planning is primarily a way of thinking about social and economic problems, planning is orientated predominantly towards the future, is deeply concerned with the relation of goals to collective decisions and strives for comprehensiveness in policy and program. Wherever these modes of thought are applied, there is a presumption that planning is being done*."

Planning can additionally be divided into four categories (Glasson, 1978:19): The first category lays in the distinction between 'economic' planning and 'physical' planning. The distinction of these two categories has often been a source of confusion. Physical planning is concerned with the physical structures of an area such as infrastructure and utilities and has its origins in the need to control town development (Glasson, 1978:19). Physical planning additionally relies heavily on direct controls such as land use, whereas economic planning is concerned with the economic structures of an area and its level of prosperity, therefore relying on market mechanisms (Glasson, 1978:19-20).

The second distinction in regional planning can be made between 'allocative' and 'innovative' planning (Friedman, 1967:12). These two types of planning differ from each other in terms of their area of concern. Allocative planning is concerned mostly with co-ordination and efficiency (Glasson, 1978:20). This type of planning can be observed in economic production processes whereby inputs are co-ordinated in a

certain manner to produce a higher level of output. Innovative planning is not merely concerned with the efficient functioning of existing systems as in the case of allocative planning, but aims to improve the system as a whole and is sometimes referred to as development planning (Glasson, 1978:20).

The third distinction can be made between 'multi' and 'single' objective planning (Glasson, 1978:20). Planning may come in several variations but there are always goals and objectives which the planning process is aiming to reach (Glasson, 1978:20). According to Young (1966:76) "*a goal is an ideal and should be expressed in abstract terms, an objective is capable of both attainment and measurement, its inherent purpose is explicit rather than implicit"*.

The fourth distinction can be made between 'indicative' and 'imperative' planning (Glasson, 1987:20). This distinction relates heavily to the implementation method of the plan. Indicative planning merely lays down general guidelines whereas imperative planning is more specific (Glasson, 1978:21).

During the early parts of the 20th century, planning students in the United Kingdom (UK) were taught that the sequential planning process followed tree steps; survey, analyse and plan (Hall, 1975:12). The first step comprised of the gathering of information relevant to the subject, the second step saw the planner analyse the data and tried to project the future state for the gathered variables and the third step was to produce a plan in order to realise the future projected in the second step (Hall, 1975:12). This process of planning is more simplistic in nature than the planning process from a later stage, which aimed to incorporate more elements.

According to Hall (1975:274-293) the correct sequential planning process starts of by identifying a set of 'goals' and 'objectives' for the development of an area and should additionally be redefined during the planning process. Thereafter, the planner[5] should create a model in order to project the future state of the region. This model should be flexible enough to accommodate alternative future states which can be evaluated

[5] The term planner refers to a Town and Regional Planner.

against the original set of goals and objectives, and finally the plan should be implemented.

Identifying objectives means that the planning process can be more clearly defined in terms of what the planner aims to achieve and to prioritise the information (Hall, 1975:275). In the case of regional planning, there may be only one goal; however there are usually multiple objectives (Hall, 1975:274). If objectives are not clearly defined, it cannot be possible to determine with certainty that these objectives are shared by the people being planned for, or to rationalise the preference of one plan over another. This first step can be divided into three stages (Hall, 1975:275); the first stage is to formulate goals, the second is to identify the objectives and the third stage is to set a target.

Goals are essentially abstract and tend to fall into broader categories such as economic, social or aesthetic which the planner finds important and aims to reach, whereas objectives are more specific and are defined in terms of actual programmes capable of being carried into action, which are used as targets (Hall, 1975:275). The complexity of the planning process in terms of identifying goals and objectives as well as the sequential steps that follow means that the planning professional must have a wide variety of skills and knowledge. The ideal town and regional planner should be a good economist, sociologist, geographer and social psychologist in addition to having several other physical-scientific skills (Hall, 1975:15).

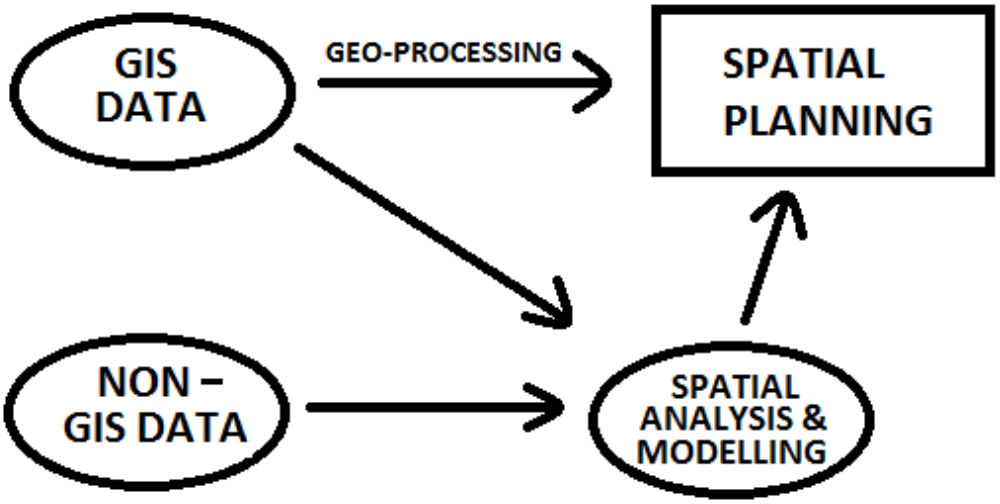
After the objectives have been clearly defined, the planner then sets targets that will lead to the fulfilment of the objectives by creating a model of the regional systems he/she wishes to control (Hall, 1975:277). This model describes urban systems and should accurately depict the recent past and present in order to be able to predict the future. There are two main questions that the planner must resolve about the modelling process (Hall, 1975:278); the first is what aspects of the urban system should be controlled, and the second is what models are available. In order to answer the first question, the planner should define what questions the model must answer. Urban and regional planners are usually concerned with the spatial representation of economic and social activities and the space available to carry out such activities (Hall, 1975:278).

The relationship between these activities must be defined in order to establish the infrastructural requirements to sustain these activities. The relationship between where people work, live and do their shopping is especially important to the planner as are their means of getting from the one to the other (Hall, 1975:278). The type of model will depend on the object of the planning exercise. Another question that must be answered by the planner is whether the model should be descriptive and only illustrate the various elements at any given point in time or predictive and be able to determine future states for the various elements (Hall, 1978:278). Some models are prescriptive, meaning that these models are capable of self evaluation (Hall, 1975:278).

The advances in computer technology have radically changed the method of creating planning models since the 1960's when the first Geographic Information Systems (GIS) were developed. However, GIS software was rarely used in the planning profession during its early development due to its prohibitive costs and limited capabilities (Yeh, 1996:877). The inevitable drop in hardware prices along with the improvement of such hardware made GIS more affordable and has increasingly been used by planners in both developed and developing countries (Yeh, 1996:877). Modern hardware makes it possible to store large amounts of data in usable formats which can be analysed by powerful GIS software capable of solving specific problems (Goodchild, 2005:1). GIS software can do calculations that would otherwise have needed to be done by hand, thus freeing up such person to engage in other activities while having the potential of being more accurate at the same time.

Apart from GIS, there are other information systems that are being used in spatial planning; such technologies include the Database Management Systems (DBMS) and Decision Support Systems (DSS) (Yeh, 1996:877). GIS enables planners to carry out spatial analysis by using geo-processing functions such as connectivity measurement and map overlay amongst others (Berry, 1987:122). The use of GIS in spatial planning is illustrated in Figure 3.1.

Figure 3.1 GIS in spatial planning



Source: Own Compilation 2013

Spatial analysis and modelling are the core uses of GIS in urban planning (Lavine & Landis, 1989:213). Spatial analysis and modelling can additionally be used for site selection and spatial statistical analysis amongst others (Yeh, 1996:878). It can be argued that one of the main functions of urban and regional planning entails the projection of future population as this determines where spatial intervention will be required. Spatial modelling of distribution patterns makes it possible for GIS to estimate a wide range of impacts relating to future population and economic trends, thus making GIS software ideal for such projections (Longley *et al*., 1994:219). GIS can additionally be used to model different development scenarios by displaying modelling results in the form of graphs, thus making the evaluation thereof easier (Armstrong *et al*., 1992:156).

At the evaluation stage of the planning process, all available technological resources have been used and it is time for the planner to exercise creative thinking (Hall, 1975:281). This stage of the planning process consists of two elements (Hall, 1975:282); the first relates to the choice of system models and the second to the evaluation of the model. The evaluation of the model derives directly from the goals and objectives that were identified in the beginning of the planning process and how well these objectives have been met (Hall, 1975:282). As objectives may in some

instances be contradictory to one another in practice, it is necessary for the planner to attach values to each of the objectives in order to determine their priority (Hall, 1975:283).

To help determine the priority, planners usually use instruments such as the 'cost-benefit analysis' which simply determines the highest economic output for public capital investments (Hall, 1975:283). However, cost-benefit analysis only works in economic terms which many critics of the model believe to be unethical. Certain elements can not be judged solely on their monetary value as sentimental value can in some instances be just as important to the general public. For instance, a building can be measured in terms of its insurance value to determine its monetary value, but this would not accurately represent what that particular building is worth in the public eye as it might be where someone spent the early years of their marriage and therefore adds more value than its monetary worth to the structure for these reasons.

A second method of determining an element's priority within the model is called 'planning balance sheet' and unlike the cost-benefit system, it does not rate investments in terms of an economic return but stresses advantages and disadvantages of alternative plans for different groups in the population (Hall, 1975:285).

The third method of evaluation is called the 'goals achievement matrix' and compels decision-makers such as politicians to attach values to the agreed objectives which are then applied to further judgements (Hall, 1975:286). The evaluation process as described above is what is also known as 'linear' as opposed to 'cyclical', where the latter is more complex in that the plans are developed and modelled in various levels of detail (Hall, 1975:287).

After evaluating the various options, the planner can make a decision and choose a course of action. However, it must be stressed that the sequential process of modelling, evaluation and implementation does not happen only once but should be continuously repeated (Hall, 1975:287). This can be ascribed to the fact that the real world is constantly changing and that even strong planning models cannot fully predict real world behaviour. For instance, determining the locality for an airport may be suddenly thrown off course by policies regulating the variations of noise-emission

levels from jet aeroplanes, or improvements in ground level city-to-airport transport. Plans can additionally go wrong due to complex interrelationships between different levels of planning of the planning system and by different actors in the planning system (Hall, 1975:289). Plans can also be rendered obsolete, as people's values may change over time (Hall, 1975:290). An example hereof can be found in London during the early 1970's when comprehensive restructuring was forced in order to separate people's recreational activities from the pollution generating traffic and necessitated a complete clean sweep of old urban areas (Hall, 1975:291).

3.2.2 Strategic spatial planning

There is no universal definition for strategic spatial planning (Albrechts, 2006:1150). Many authors have formulated their own definitions for strategic spatial planning and unsurprisingly, they vary significantly from one another due to the complexity of the term in addition to the different viewpoints from which each definition is formulated. The Webster's dictionary (1970:867) defines the word strategy as the "*science and art of employing the political, economic, psychological and military forces of a nation or group of nations to afford the maximum support to adopted policies in peace or war*."

According to Healy, (2004:46) "*Strategic spatial planning refers to self-conscious collective efforts to re-imagine a city, urban region or wider territory and to translate the result into priorities for area investment, conservation measures, strategic infrastructure investments and principles of land use regulation… The term 'spatial' brings to focus the 'where of things', whether static or in movement, the protection of special 'places' or sites, the interrelationship between different activities and networks in an area, and significant intersections and nodes within an area which are physically co-located…'Planning' also highlights a developmental movement from past to future. It implies that it is possible to decide between appropriate actions now in terms of their potential impact in shaping socio-economic spatial relations. This future imagination… is expected to be able to project a trans-generational temporal scale, especially in relation to infrastructure investment, environmental management and quality of life*"

Just as in any other form of planning, there are different approaches that can be taken and there is no ‘single best way' to carry out strategic spatial planning (Albrechts, 2006:1150). Regions differ from one another in terms of character and potential, therefore strategic spatial planning should aim to use whatever resources are available in order to achieve regional development (Albrechts, 2006:1150). The most appropriate approach to strategic spatial planning depends largely on the institutional challenges faced in the particular context of a region and the values and attitudes of the main actors in the process (Albrechts, 2006:1150). Strategic spatial planning is an integrative process through which a vision, coherent actions, and means for implementation are produced that shape and frame what a region is and what it might become (Albrechts, 2006:1152). This form of planning should additionally be initiated by the public sector (Kunzmann, 2000:262).

As there are many elements that must be considered when exercising strategic spatial planning, it can be assumed an almost impossible task to incorporate everything into one single plan. Strategic spatial planning should therefore focus on a limited number of strategic elements in terms of determining strengths and weaknesses in the context of opportunities and threats by studying the external trends, forces and resources available (Bryson & Roering, 1988:1002). Strategic spatial planning involves combining major actors in both public and private sectors, allowing for a broad and diverse involvement during the planning process while creating long-term visions and strategies at different levels, taking into account the political, economic, gender, cultural uncertainties and competing values (Albrechts, 2003a:912).

Albrechts, (2006:1149-1170) identifies five main characteristics of strategic spatial planning and can be described as follows:

- Firstly, strategic spatial planning is ‘selective’ and focuses on issues that really matter whereas traditional master planning is ‘extensive’ and aims to incorporate nearly everything.
- Secondly, strategic spatial planning is ‘relational-annex-inclusive’ by looking at space as something more than the two or three dimensional characteristics thereof, but instead acknowledges the complex social elements and inter-relationships between spaces.

- Thirdly, strategic spatial planning is ‘integrative’ by attempting to integrate objects, functions and processes. Horizontal integration stresses collaboration, co-ordination and the building of working relationships that span departmental and agency boundaries and policy areas (Albrechts, 2006:1153). Vertical integration offers the potential to tease out causal linkages between global, national, regional, metropolitan and local change, while also taking into consideration the highly diverse outcomes of such interactions (Albrechts, 2006:1153).
- Fourthly, strategic spatial planning is ‘visioning’ and aims to look into the future in order to imagine what a place could be or should be by involving creative thinking in order to realise the areas future potential.
- And finally, strategic spatial planning is ‘action orientated’ by not only responding to wider forces, but may become an active force in enabling change

3.3 Strategic spatial planning in South Africa

During the apartheid era, the South African spatial planning system largely took the form of master or comprehensive planning (Dewar & Uytenbogaardt, 1991:114). According to Njoh (2008:20) master or comprehensive planning makes several noteworthy assumptions that do not translate very effectively into practice. One such assumption is that there is ‘one best way’ for any given problem, and that planning professionals have the ability to find that ‘best way’ in dealing with the problem. Another assumption made by master planning is that there is a common identifiable public interest, which in a diverse country such as South Africa cannot be considered to be the case.

In the post-apartheid era, an abstract design approach centred on the use of nodes and corridors became the main focus point (Todes, 2008:1). It seems that this approach went along with arguments for urban restructuring and was broadly based on guiding future spatial development. This from of planning can also be seen as a reaction to previous forms of planning both locally and internationally (Todes, 2008:1).

The Constitution of the Republic of South Africa (Act No 108 of 1996) makes provision for three spheres of government; national, provincial and local. According to Section 40 of said act, these spheres are distinctive, interdependent and interrelated and must exercise their powers and perform their functions in a manner that does not encroach on the geographical, functional or institutional integrity of another sphere. Section 151 of the Constitution (1996) states that the local sphere of government consists of municipalities which are subject to national and provincial legislation. Furthermore, Section 155 of the Constitution (1996) states that municipalities are divided into three categories; Category A, B and C where Category A includes all metropolitan municipalities, Category B includes local municipalities and Category C includes district municipalities.

According to the Municipal Infrastructure Investment Framework (MIIF, 2011:7) metropolitan, district and local municipalities can be further divided into sub-categories according to their functions and size. All metropolitan municipalities are categorised as class-A municipalities. Local municipalities are divided into B1 to B4, where B1 local municipalities are those with the largest budgets and B4 being those with the smallest budgets. District municipalities are divided into C1 and C2, where C1 district municipalities are not water service authorities[6] and C2 district municipalities are water service authorities (MIIF, 2011:10).

The Municipal Structures Act (No 117 of 1998) makes provision for the division of powers and functions between district, metropolitan and local municipalities. It assigns the day to day service delivery functions to the local municipalities and the function of water and sanitation as well as the maintenance of water infrastructure to the district municipality; however the provincial Member of the Executive Council (MEC) are empowered to adjust these powers and functions according to the capacity of the municipalities to deliver services.

In 2000 the Municipal Systems Act (Act 32 of 2000) came into operation. Section 25(1) of said Act stipulates that each municipal council must, after the start of its elected term, adopt a single, inclusive and strategic plan for the development of the

[6] Service Authorities are the sphere of government or tier of local government given the obligation of providing services to their communities as prescribed by the Constitution.

municipality which must link, integrate and co-ordinate plans and take into account proposals for the development of the municipality, align the resources and capacity of the municipality with the implementation of the plan, form the policy framework and general basis on which annual budgets must be based, while being compatible with national and provincial development plans.

According to Section 26 of the Municipal Systems Act (2000), a municipal Integrated Development Plan (IDP) must include a Spatial Development Framework (SDF) which must include the provision of basic guidelines for a land use management system for the municipality. A municipal SDF should form part of the IDP in order to give effect to the principles and priorities set therein and must contribute to integrating and aligning policies and plans emanating from the various sectors of the spheres of government as they apply spatially within the municipal area. The Municipal Systems Act (2000) is therefore the principal piece of legislation governing integrated development planning at municipal level.

Some of the main strategic policy frameworks in the South African planning system on a provincial level include the Provincial Growth and Development Strategies (PGDS), and on a national level include the National Development Plan (NDP, 2012) which was developed by the National Planning Commission (NPC, 2009) in 2012; the New Growth Path (NGP, 2011) which government is aiming to use to achieve the NDP targets as well as the National Spatial Development Perspective (NDSP, 2006) which was approved by Cabinet in 2003 and finalised in 2006.

The NSDP aims to achieve economic growth in line with the South African government's socio-economic objectives by promoting regional development and has three main purposes (NSDP, 2006:1);

- The first is to provide principles to guide infrastructure investment across the three spheres of government;
- The second is to determine the manner in which economic, social and environmental trends manifest spatially; and
- The third is to interpret the spatial realities and the implications of government interventions.

Ultimately, all government activities and programmes are expressed spatially (NSDP, 2006:4). The spatial positioning of social and economic activities has important implications for government interventions as infrastructure investments need to display a positive return and therefore needs to be carefully planned (NSDP, 2006:4). The dispersed and fragmented urban areas pose serious challenges for public infrastructure investments whereas well connected settlements enable better service delivery (NSDP. 2006:4). In response to the apartheid era spatial planning which was aimed to benefit only a small portion of the population, the NSDP has set out five normative principles (NSDP, 2006:5-6) and can be described as follows:

- The first principle relates to the growth of the national economy in order to alleviate poverty;
- The second principle relates to government's constitutional obligation for service delivery to all citizens regardless of where they live;
- The third principle aims to guide fixed public investments in areas with economic potential in order to promote economic growth and stimulate private investments that will lead to employment opportunities;
- The fourth principle states that the eradication of social inequalities should focus on people rather than places. This should be done by focusing on areas where there are both high levels of poverty and economic potential. In areas where limited economic potential exists, government should aim to develop human capital in the form of education and training programmes; and
- The fifth principle aims to overcome the spatial distortions of apartheid by focusing economic activities along activity corridors and within activity nodes that are linked to established growth centres.

According to Section 25 of the Municipal Systems Act (2000), the spatial frameworks prepared by different spheres of government must be co-ordinated, aligned and be in harmony with one another. Planning at a local level can be detrimentally effected without the involvement of national and provincial spheres. According to the Constitution (1996); national and provincial government must support and strengthen the capacity of municipalities to perform their functions. This necessitates the direct involvement of the higher sphere in lower sphere planning.

The NSDP (2006) is one of a number of inter-governmental planning instruments along with the PGDS's and municipal IDP's. These policy frameworks are linked to one another through a series of interventions and processes (Goss, 2008:18). According to the NSDP (2006:13) each of these three spheres must identify areas of economic significance with comparative advantages and use the NSDP principles to provide guidance for the different spheres of government and departments relating to infrastructure investments in order to achieve a top-down and bottom-up planning process. The NSDP (2006:13) additionally highlights metropolitan areas as important geographic points where public investments should be made.

3.4 Summary and Conclusions

Mankind has long since had a need for planning as it acts as one of the basic 'social drivers' of society. The need for planning has significantly increased since the industrial revolution, especially in terms of spatial planning as rapid urbanisation and technological improvements saw masses of people sharing the same space. The aim of spatial planning can therefore be regarded as a means to improve the spatial structure of any given area.

Spatial planning should be a continual process that starts off by identifying a set of goals and objectives. Goals are essentially abstract targets that the planner aims to reach, whereas objectives are more specific and are capable of measurement and being carried out into action. The following step in the planning process revolves around the creation of a model that must be able to accurately predict the future. Advances in computer technology such as GIS software have radically increased the accuracy of planning models since the 1960's. Thereafter, the planning model must be evaluated prior to implementation. In order to assist in the evaluation of planning models, planning professionals use instruments such as the 'cost-benefit analyses, 'planning balance sheet' and the 'goals achievement matrix'. After the evaluation process, the plan must be implemented. However it must be stressed that this sequential planning process is not a linear process as the cycle should continuously be repeated.

Strategic spatial planning can be carried out through various approaches and is an integrative process aimed at reaching a region's full potential. As there are many different elements that need to be considered, it is not possible to incorporate them all. Strategic spatial planning therefore focuses on a limited number of strategic elements in order to determine a region's strengths and weaknesses in the context of opportunities and threats by using all available resources.

During the apartheid era, strategic spatial planning in South Africa largely took the form of comprehensive or master planning. This form of planning received wide-ranging criticism as it was too static to accommodate rapid urbanisation while being inappropriately concerned with racial separation. As a result, strategic spatial planning in post-apartheid South Africa focussed largely on urban restructuring by using instruments such as nodes and corridors.

The Constitution of South Africa (Act 108 of 1996) makes provision for three spheres of government and consists of national, provincial and local governments. Local government can additionally be divided into three categories each with their own functions and powers as set out in the Municipal Structures Act (Act 117 of 1998); Category A, which includes metropolitan municipalities; Category B which includes local municipalities and Category C which includes district municipalities. The Municipal Systems Act (Act 32 of 2000) prescribes that local government must prepare Integrated Development Plans (IDP) as part of their integrated planning mandate. Such IDP's must include a Spatial Development Framework (SDF) in order to present the future spatial vision of the municipality.

Such strategic plans must additionally be prepared by each of the three spheres of government. On a national level, the National Spatial Development Perspective (NSDP) guides planning and has three main purposes; one of which relates to guiding infrastructure investment across the three spheres of government.

In order to determine whether spatial planning can be successfully integrated with infrastructure planning at local government level, the infrastructure planning system in the South African context must be more closely examined.

Chapter 4
Infrastructure Planning in South Africa

4.1 Introduction

The aim of this chapter is to identify the different types of municipal infrastructure in the South African context, the role that local government plays in aligning spatial planning with infrastructure planning at a strategic level, the institutional arrangements that infrastructure is subject to as well as the various indicators that should be analysed in order for optimum infrastructure planning to be achieved.

According to the Municipal Systems Act (Act 32 of 2000) local government heads the municipal infrastructure programme, as municipalities are responsible for infrastructure planning and implementation in addition to managing the various projects in the long-term. This means that municipalities should include effective infrastructure investment plans as part of their IDP's and convey such plans into the corresponding SDF in order to establish their spatial implications.

According to Chapter 3 of the Constitution (1996), the three spheres of government must work in unison for infrastructure provision and service delivery to be successful. Some of the main issues relating to the institutional arrangements that are relevant to the Municipal Infrastructure Investment Framework (MIIF, 2011) are the division of responsibilities for infrastructure provision between national, provincial and local government, the role of the private sector, service authority and service provider relationships (which are particularly important in the case of electricity) as well as the division of responsibilities between district and local municipalities. Such institutional arrangements will be discussed in more detail in this chapter as the successful delivery of infrastructure is reliant thereon.

4.2 The need for infrastructure planning

Infrastructure has the ability to facilitate growth and development by laying the foundation for economic activities. Infrastructure investments also serve to enhance efficiency across the economy by laying the basis for stepped-up growth (NGP,

2011:11). However, infrastructure investments must be strategically planned if the benefits are to be maximised (MIIF, 2011:11). Businesses cannot function properly without municipal infrastructure as they require water and electricity for production purposes, sanitation and refuse services to remove waste from their properties and roads to allow their employees to get to work in addition to transporting their goods and services to markets.

One of the major empowering effects of infrastructure is its ability to alleviate poverty (Duffy-Deno & Eberts, 1991:335). For example, access to electricity can ensure a more effective work environment by powering machinery and by providing information through the media. In addition, transport infrastructure can provide access to markets, social and employment opportunities. Despite the improvements made in terms of creating employment opportunities since 1994, South Africa still remains one of the ten countries with the lowest employment rate in the world (NGP, 2011:4). Public investment in infrastructure can create numerous employment opportunities in selected sectors such as energy, transport, housing, water and communications infrastructure (NGP, 2011:10).

These job opportunities are in four activities (NGP, 2011:10):

- The first is through the construction of new infrastructure;
- The second in the operation of the new facilities;
- The third is in maintenance; and
- The fourth is in the manufacturing of components for the infrastructure programmes.

In addition to these four activities, infrastructure investment can additionally create jobs through the entire economy alternatively known as the ‘multiplier effect’ (NGP, 2011:11). Strategic spatial planning should be carried out prior to infrastructure investments in order to maximise the multiplier-effect including strategies to develop new industries such as renewable energy (NGP, 2011:11). Another avenue through which infrastructure can alleviate poverty is via the Expanded Public Works Programme (EPWP). This programme includes a municipal infrastructure component

as there is a strong emphasis being placed on labour-intensive construction methods for job creation (MIIF, 2011:12).

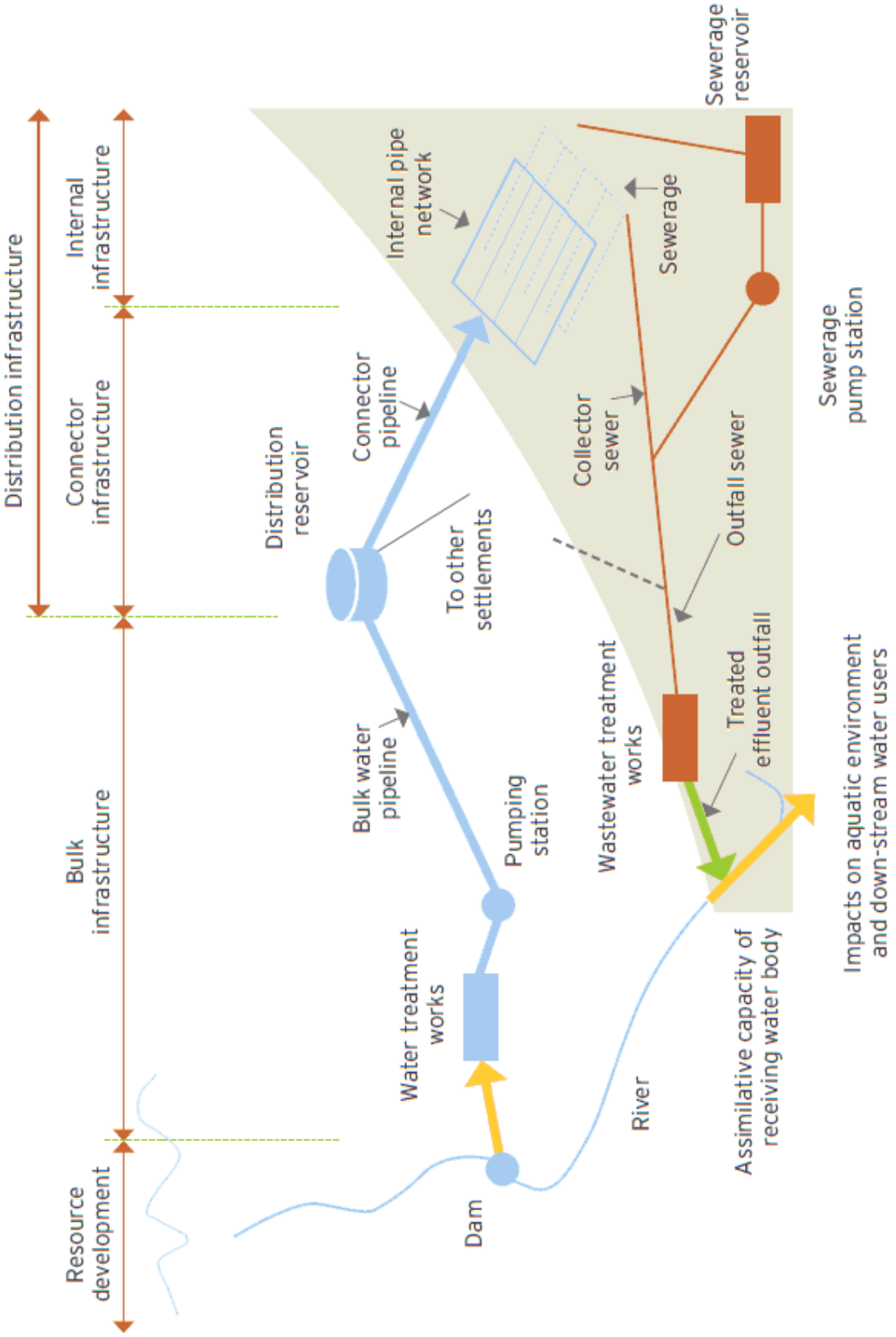
4.3 Infrastructure classification in South Africa

Municipal infrastructure in the South African context is divided into civil infrastructure and electrical infrastructure where the former includes roads, water, sanitation and storm-water infrastructure and the latter includes infrastructure relating to electricity generation, transmission and distribution (CSIR, 2000). Civil infrastructure such as water and sanitation infrastructure can be divided into three categories (CSIR, 2000); bulk, connector and internal infrastructure. The division for electrical infrastructure is usually only made between bulk and reticulation infrastructure where the latter includes both connector and internal infrastructure (CSIR, 2000).

4.3.1 Water and Sanitation infrastructure

Water and sanitation infrastructure is categorised in terms of whether it falls under national, regional or local responsibility (DWAF, 2012:7). Water and sanitation infrastructure can additionally be divided into public or private ownership. For example; in formal urban areas, household toilets are private, whereas bulk waste water reticulation and treatment infrastructure is public. The shift in water and sanitation infrastructure has been made from a focus on infrastructure to a more holistic resources management system (NDP, 2012:154-155). A water resource system includes the water source as well as the infrastructure necessary to supply end users (DWAF, 2012:7) as displayed in Figure 4.1

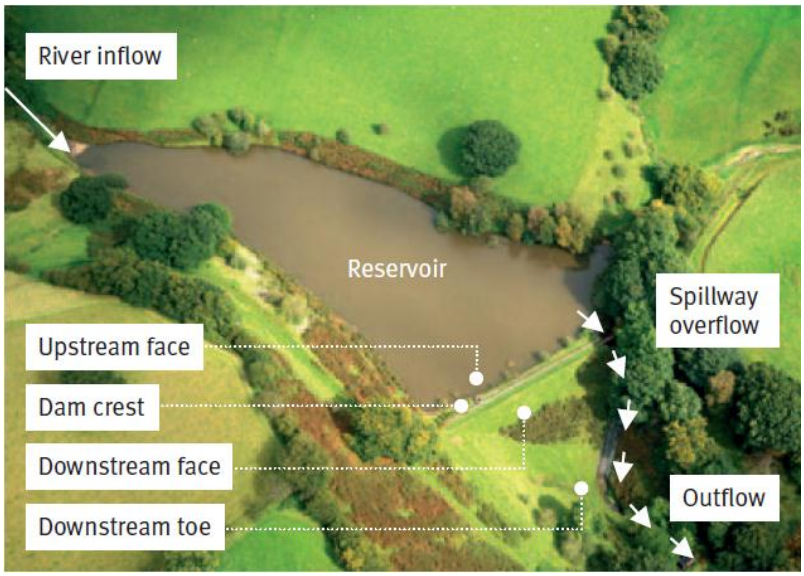
Figure 4.1 Water and Sanitation sector infrastructure



Source: DBSA (2012:72)

Bulk water infrastructure includes water treatment works as well as the bulk water storage systems such as reservoirs. (DWAF, 2012:7).

Figure 4.2 Water reservoir



Source: Environmental Agency (2010:13)

Bulk sanitation infrastructure includes major sewer outfalls which leave settlements along with wastewater treatment works and pipelines that channel treated water into rivers or groundwater (DWAF, 2012:7)

Figure 4.3 Waste water treatment plant

Source: Own compilation, 2013

Connector water infrastructure includes distribution reservoirs and pipelines that distribute water from reservoirs to neighbourhoods (DWAF, 2012:8).

Figure 4.4 Distribution pipeline

Source: Own Compilation, 2013

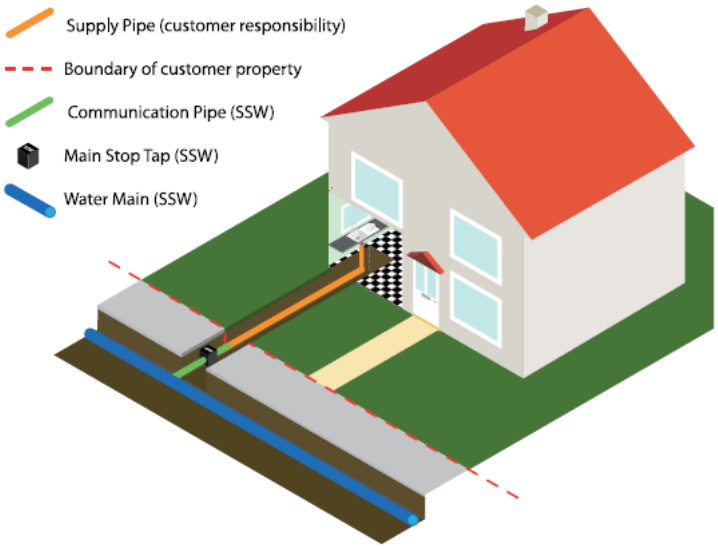
Connector sanitation infrastructure includes outfall sewers and in some cases local wastewater pumping stations which link neighbourhoods to the bulk outfall (DWAF, 2012:8)

Figure 4.5 Sewer outfall

Source: Own Compilation, 2013

Internal water infrastructure includes pipelines located within neighbourhoods as well as connections to plots with metres (DWAF, 2012:9).

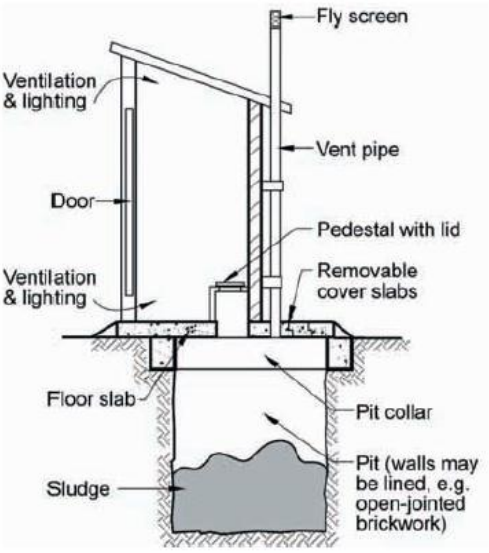
Figure 4.6 Internal pipeline



Source: South Staffs Water (2012:5)

Internal sanitation infrastructure includes sewers within neighbourhoods as well as connections onto individual plots. In the case of on-site sanitation options this includes ventilated improved pit latrines (VIP's), septic tanks or conservancy tanks (DWAF, 2012:9).

Figure 4.7 Ventilated Improved Pit latrine (VIP)



Source: CSIR (2000:6)

4.3.2 Electricity infrastructure

Electricity infrastructure in South Africa is divided into three categories; generation, transmission and distribution infrastructure (SAICE, 2011:28). Generation infrastructure includes bulk infrastructure such as the power stations that produces the electricity, transmission infrastructure includes both bulk and reticulation infrastructure such as the transmission lines and distribution infrastructure includes reticulation infrastructure such as neighbourhood transformers (SAICE, 2011:29).

Bulk electricity infrastructure (Figure 4.8) includes power stations, high voltage power lines which transfer electricity to settlements and associated switching stations (SAICE, 2011:28).

Figure 4.8 High voltage power lines

Source: Own compilation, 2013

Reticulation (connector) electricity infrastructure includes power lines, transformers and switching stations that link neighbourhoods to the bulk system (SAICE, 2011:29).

Figure 4.9 Neighbourhood transformer

Source: Own Compilation, 2013

Reticulation (internal) electricity infrastructure includes power lines and transformers within neighbourhoods which directly serve individual plots or dwellings (SAICE, 2011:29).

Figure 4.10 Internal transformer

Source: Own Compilation, 2013

Classification in infrastructure is important as it distinguishes the responsibility between national, provincial and local government and aids administration (MIIF, 2006:10). Bulk water and sanitation infrastructure is larger in scale and are located near the water sources where the water cycle starts off and ends up. Connector water infrastructure distributes water across large distances from where the water is stored

to towns and neighbourhoods, and connector sanitation infrastructure distributes waste water from neighbourhoods towards treatment plants. Internal water and sanitation infrastructure is smaller in scale and serves individual properties.

In the case of electricity, two distinctions are made. The first distinction relates to the scale where bulk infrastructure is larger in scale and reticulation infrastructure is smaller in scale, and the second distinction relates to the function where generation infrastructure is used for electricity production, transmission infrastructure is used for distributing high voltage electricity and distribution infrastructure is used for distributing low voltage electricity.

4.4 Types of municipal infrastructure

According to Section 152 of the Constitution (1996), municipalities have an obligation to provide their communities with basic services in a sustainable manner. Many of these services require infrastructure in order to function optimally. Such services include water, roads, electricity, and sanitation amongst others. Municipal infrastructure is defined by the MIIF (2011) as "*the physical facilities, including immovable assets which are required to provide municipal services*" (MIIF, 2011:21).

4.4.1 Road infrastructure

Roads can be classified into different operational systems, functional classes or geometric types (DBSA, 2012:47). These classifications are vital for communication among authorities and the general public. Different classification schemes have been applied for various purposes in different regions, and these vary from province to province. Roads are generally 'numbered' or 'designated' as being under control of a specific road authority. However, in South Africa there remain significant lengths of unnumbered or undesignated roads with no obvious ownership by any road authority (DBSA, 2012:47). The division of responsibilities relating to roads between local and provincial government remains uncertain in some provinces and needs to be resolved in order for future investments to be successful (MIIF, 2011:10).

While the condition of South African roads has deteriorated during the past decade due to over-utilisation and under-investment, there does appear to be a stabilisation of the condition of the primary systems as a result of higher investment (SAICE, 2011:23). It is, however difficult to provide a reliable assessment, as there is limited capacity to assess the condition of South Africa's road network. This issue is being addressed by the South African National Roads Agency (SANRAL), the South African Local Government Association (SALGA) and the Development Bank of Southern Africa (DBSA). The poverty associated with the rural areas has long been blamed on the physical exclusion from economic activities (DBSA, 2012:54).

The funding of municipal roads is received through intergovernmental transfers as set out in the Division of Revenue Act (No 2 of 2013) and includes the local government equitable shares grant (National Treasury, 2011:170). Municipalities can therefore choose to use a portion of the local equity share to finance road infrastructure, in line with their particular needs. For most municipalities however, the largest source of finance for municipal roads still remains the Municipal Infrastructure Grant (MIG) (National Treasury, 2011:170). The current funding for municipal roads and storm-water infrastructure is not sufficient, and therefore warrants the reprioritisation of municipal budgets (National Treasury, 2011:173).

4.4.2 Electricity infrastructure

From the point of view of the MIIF (2011:11), there is a difference between an electricity service authority and an electricity service provider. The electricity service authority is the sphere of government or tier of local government identified as being responsible for the constitutional function of the delivery of a service as set out in the Municipal Structures Act (No 117 of 1998). The electricity service authority is responsible for the planning of infrastructure and the allocation of resources. Eskom, which is a semi-government organisation, is the electricity service provider for the majority of municipalities. It is also possible for a service authority to be a service provider (MIIF, 2011:11).

It has been established that the separation of bulk, connector and internal infrastructure is not frequently applied in the electricity sector. The division is often made only between bulk and reticulation infrastructure where the latter includes both connector and internal infrastructure. The division between bulk and reticulation infrastructure has been the subject of heated debate as it represents the division between the responsibilities of National Government, Eskom and Local Government (MIIF, 2011:9). Reliable electricity supply is dependent on adequate bulk infrastructure such as power stations and reliable power grids in order to distribute electricity to end users (NDP, 2012:145). With regard to electricity reticulation infrastructure, Eskom retails approximately 60% of electricity sales in South Africa to 40% of national consumers. Approximately 187 municipalities including a small number of private distributors have the right to supply the remaining 60% of national consumers (Eskom, 2011:165).

The majority of electricity distribution consumers are in the residential sector. The distribution sector has an asset base of R261 billion and Eskom along with the 187 municipalities responsible for distribution, supply to approximately nine million customers (DBSA, 2012:61). However networks in many municipalities are believed to be in poor condition with substantial investment required to maintain and rehabilitate assets. Electricity backlogs are a major concern and stem from the low level of investment in generation capacity as well as the high demand experienced since the turn of the 21st century (NGP, 2011:5). Little progress has been made as a constitutional amendment aimed at shifting the responsibility for electricity distribution from municipalities to regional electricity distributors failed in the face of increasing opposition (NDP, 2012:386). Since the early 2000's, municipal investment in electricity infrastructure was poor and maintenance backlogs now exceed R30 billion (NDP, 2012:145). Given the realities, it would be wise to invest in both human and physical capital in the 12 largest distributors, which makes up 80% of the electricity distributed by local government (NDP, 2012:146). This is a major priority and collaboration between national and local government should be fostered to ensure that electricity distribution performs optimally.

Municipalities can achieve a large portion of their total revenue through the sale of electricity by which they can generate fiscal surpluses. Revenue from the sale of

electricity accounted for more than a quarter of total revenue for municipalities prior to the sharp tariff increases in 2009/10 (National Treasury, 2011:150). In order to fund Eskom's Build Programme, Eskom was forced to rapidly increase tariffs for electricity. Electricity generation tariffs are projected to be more than three times higher in 2014/15 than they were in 2009/10 (National Treasury, 2011:151). It has become clear that municipalities are responsible for electricity infrastructure and they must plan to ensure it is properly maintained. If municipalities continue to not invest in the maintenance of electricity infrastructure there will be breaks in supply (National Treasury, 2011:156).

National government is responsible for the funding of electricity distribution infrastructure through the Integrated National Electrification Programme (INEP) (National Treasury, 2011:157). INEP allocations funds the capital costs of providing electrical connections to poor households (National Treasury, 2011:158). Municipalities should therefore not rely on INEP funds to provide electricity to new developments or wealthy suburbs. Extending infrastructure to such areas must be funded through development charges from rates and levies that the consumer will pay to the municipality (National Treasury, 2011:158).

The South African government's goal is to diversify the energy mix in order to expand capacity (NDP, 2012:143). The second Integrated Resource Plan (IRP2) foresees almost a doubling of electricity capacity by 2030, with more than 30% coming from renewable sources and 25% from nuclear power (IRP2, 2010:15). These renewable sources have been given high priority in order to improve economic efficiency and to reduce carbon emissions (NGP, 2011:11). While most industries are open to competition from competitors, core components such as electricity grids tend to be natural monopolies (NDP, 2012:138). Although it is government policy for Independent Power Producers (IPP's) to complement Eskom's generation investments, South Africa has not seen the scale of private investments as in the rest of the world including several African countries. As there is a large amount of investment needed in addition to Eskom's financial situation, private investment should be encouraged where possible (NDP, 2012:145).

4.4.3 Water and sanitation infrastructure

Municipalities are divided into categories according to their responsibility in terms of water services. All metropolitan municipalities including the largest local municipalities are water service authorities. Several medium sized local municipalities are also water service authorities and are given the abbreviation 'LW'. All municipalities that are not water service authorities are classified as a 'DW' municipality. District municipalities that are water services authorities are classified as C2 and those that are not are classified as C1 municipalities (MIIF, 2011:11). However Section 84 of the Municipal Structures Act, (1998) states that the MEC for local government in a province can shift the responsibility of water provision from the district municipality to the local municipality according to their capacity. While local government will remain the responsible body for adequate service provision, regional utilities will assist where municipalities have inadequate technical and financial capabilities (NDP, 2012:154).

Water resources infrastructure includes dams, inter-basin transfer schemes and related infrastructure. Water service infrastructure includes the infrastructure necessary for the conveyance, treatment, storage and distribution of water to end-users. For the economy to be able to grow and to reduce poverty in South Africa, good quality reliable municipal water infrastructure and services are essential (DBSA, 2008:107). A number of industries rely on the effective provision of water services by the municipality including water-depending industries and the tourism sector. The provision of poor water quality may have a detrimental effect on development as it would negatively affect the labour productivity of domestic workers as well as learners.

Since 1994, water-related policy has shifted from the focus on infrastructure to a more holistic resource management approach that addresses both demand and supply. This has resulted in an increase in basic water supplied to South Africans from 23 million to more than 46 million (NDP, 2012:154). Due to South Africa's climate being semi-arid with unevenly distributed rainfall and high annual variability and

unpredictability, the country has invested a large amount of capital in the development and management of water resources (NDP, 2012:155).

Water and sanitation services are financed through the local governmental equitable shares, while water and sanitation infrastructure are financed through the Municipal Infrastructure Grant (MIG) (National Treasury, 2011:132). As national water resources are interconnected, administration and management should remain a national priority. However, as issues are location specific, some decentralisation of responsibilities is required and should therefore be resolved at a local level (NDP, 2012:155). Local Planning should additionally ensure that groundwater resources are optimally used prior to large scale infrastructure projects to supply local needs (NDP, 2012:156). Many municipalities lack the technical capacity to manage wastewater treatment systems which results in polluted water resources. (NDP, 2012:157). To guide water management in several areas, strategic planning decisions regarding economic and social development are necessary (NDP, 2012:158)

Sewage treatment plants that do not operate effectively have the ability to damage the environment. The health of people that are dependant on polluted water sources for domestic use can also be jeopardised. Poorly maintained systems will need early replacement, placing a burden on local and national taxpayers. Sanitation infrastructure includes the conveyance, treatment and disposal of wastewater and on-site treatment of domestic human waste (DBSA, 2008:107).

4.5 Integrated infrastructure planning

The Presidency has commissioned at least two departments tasked with integrated infrastructure planning: The National Planning Commission (NPC), which develops long-term integrated development plans for all sectors including infrastructure; and the Department of Performance Monitoring and Evaluation (DPME), which has a dedicated economic infrastructure outcome that is monitored and reported to Cabinet periodically (DBSA, 2012:102). The NGP is an instrument that government is aiming to use for achieving the NDP targets and contains an Infrastructure Build Programme amongst others. The Presidential Infrastructure Coordination Commission (PICC)

headed by the President is tasked with co-ordinating and overseeing the implementation of strategic infrastructure projects. The National Treasury is responsible for providing the budget for national infrastructure (DBSA, 2012:102).

The Department of Cooperative Governance and Traditional Affairs (CoGTA) has recognised the challenges that municipalities face in respect to infrastructure provision (CoGTA, 2013). Poor planning related to procurement processes has been identified as a major municipal problem in addition to a lack of capacity and senior officials being suspended from work (CoGTA, 2013). To assist municipalities in their infrastructure planning matters, CoGTA has created the Municipal Infrastructure Support Agency (MISA) (CoGTA, 2013).

In 2009, the World Bank published a report that explored the need for South Africa's municipal infrastructure up to 2019 (National Treasury, 2011:92). The report estimated that total municipal infrastructure investments required for all municipalities were approximately R500 billion. Of this amount, approximately R420 billion is required for new infrastructure to support economic growth, while the remaining R80 billion is required for eradicating backlogs (National Treasury, 2011:92).

Municipal service delivery infrastructure such as electricity, water and sanitation are all elements that municipalities need to consider (MIFF, 2011:70-73). Legislation and policies have been created to guide infrastructure provision and should be utilised properly. It appears that in order for municipal infrastructure planning to succeed, capacity at local government will need to be addressed and specialist infrastructure planners should be given the task. The co-ordination between the three spheres of government in terms of infrastructure provision is vital for successful service delivery. Infrastructure planning and investment should consider the socio-economic implications of large-scale projects as they involve large amounts of funds, further highlighting the importance of proper financial planning. Additionally, infrastructure should be integrated with spatial planning at municipal level for optimum results (Todes, 2008:2). This will be further discussed in chapter seven of this paper.

4.5.1 Prioritisation of expenditure

The overall question relating to infrastructure is not whether there should be investment, but rather what levels and forms of infrastructure should be provided in addition to its locality (NDP, 2012:241). The impact of infrastructure investments on socio-economic development is an important consideration for strategic planners to consider (Snieska & Simkunaite, 2009:16). Infrastructure development has the ability to contribute to socio-economic development in numerous fashions.

Nijkamp (1986:1-21) argues that infrastructure can be used to improve regional development by impacting positively on socio-economic development in a direct and indirect manner. Kessides (1993) explains that infrastructure contributes to socio-economic development by lowering costs of production and by raising the quality of people's lives. As physical infrastructure lays down very dominant structural elements that last for centuries, the placement of such infrastructure is therefore vitally important. The investment of public infrastructure enables geographic decentralisation of resources and therefore helps to determine spatial development patterns (Gu & Macdonald, 2009:9).

Certain types of infrastructure will have a more predominant impact on development than others; it is therefore important to determine what types of infrastructure to invest in for short and long-term benefits. Burinskiene and Rudzkiene (2009) identifies development of infrastructure as one of the most important considerations in strategic planning for sustainable territorial and socio-economic development. While it is clear that location is an important consideration in infrastructure investment decisions, there is relatively little available empirical evidence regarding the criteria upon which location decisions should be made pointing to the need for further research in this area (Snieska & Simkunaite, 2009:16).

4.5.2 Strengthening capacity

One of the key challenges in terms of infrastructure planning in South Africa is a lack of capacity (Fedderke, et al, 2006:1054). Effective budgeting and spending of funds by the South African government for infrastructure investments is one of the main

concerns when it comes to developing the county's infrastructure. The skills and experience that the national government possess are often not available at municipal levels (National Treasury, 2011:5).

The South African government lacks many specialists in key departments and this stifles the delivery of services and the provision of infrastructure as a result (National Treasury, 2011:87). These shortages of skills include planning, engineering and project management and are especially apparent at municipal level (National Treasury, 2011:87). The alignment of the planning cycle requires that the necessary personnel capacity is available to manage and facilitate the complex technical, procurement and other processes involved in planning large-scale infrastructure projects. It would then seem that this capacity is in short supply (DBSA, 2008:195).

This is contradictory to the apartheid era where government played an active role in producing professionals (NDP, 2012:380). Before 1994, graduate engineers and trainee technicians entered the public service and gained valuable experience which subsequently enabled them to qualify for professional registration. Government's position as initiator of major infrastructure projects meant that it was the ideal place for such training and recruitment programmes (NDP, 2012:380). Municipal service delivery may be detrimentally affected without the required professionals such as engineers and planners amongst others. In the fields of engineering and planning where large financial implications can be expected, it is important that only professionally registered persons are given the responsibility of implementing projects (NDP, 2012:380).

4.5.3 Policy and legislation

The Municipal Infrastructure Investment Framework (MIIF) is compiled by the Development Bank of Southern Africa (DBSA) in partnership with the Department of Cooperative Governance and Traditional Affairs (CoGTA), and is used as an initiative to assess the infrastructure investment needs of municipalities required to meet government infrastructure delivery targets and support municipalities to undertake sound infrastructure investment planning (MIIF, 2011:7). Policy creation should

enhance opportunities for co-operative projects in telecommunications, transport, water, energy and other related areas (NDP, 2012:225).

The central problem is that a number of important provisions in policy and legislation are not being effectively implemented (DBSA, 2012:21). Rail transport hardly features in the otherwise quite thorough, local government-based arrangements for transport infrastructure planning, including Integrated Development Plans (IDP's), Spatial Development Plans (SDP's), Integrated Transport Plans (ITP's) and Public Transport Registers (DBSA, 2012:22). There is a large amount of legislation and regulations governing both road infrastructure and transport services (DBSA, 2012:56). These range from national legislation, provincial road ordinances, and legislation governing local government.

There are however gaps which require urgent attention. In some provinces there are roads that do not seem to belong to either the province or municipalities (DBSA, 2012:47). These roads need to be clearly defined in order for responsible planning, investment and maintenance. SANRAL, provincial and local governments do not have access to dedicated funding for roads, thus relying on transfers from the fiscus (DBSA, 2012:56). The National Land Transport Act (No 5 of 2009) is not yet in operation, except in certain provinces where it came into operation on 31 August 2009, dealing with the roles of the three spheres of government and contracting for public transport services (DBSA, 2012:65). The Local Government Municipal Finance Management Act (No 56 of 2003) does not address taxes, levies and other user charges for the provision of municipal services and infrastructure with the exception of Gauteng and KwaZulu-Natal. The legislation governing roads in the remaining provinces was developed during the apartheid era (DBSA, 2012:56).

By 2030, the target for the new Build Programme is for 42 % of energy requirements to be met and provided for by renewable energy sources (DBSA, 2012:69). However, it is anticipated that during the 2011 to 2030 period only 30 % of all energy generation will be provided by using CO2 free sources (Including nuclear energy). The central policy challenge is to create both appropriate incentives and regulatory structures to encourage private investors in renewable energy generation. The lack of incentive and the uncertainty in the regulatory environment along with Eskom's

dominance in the sector has led to the discouragement of a vibrant Independent Power Producers (IPP) industry (DBSA, 2012:69).

In order to address this challenge, Cabinet has approved the establishment of an Independent Systems and Market Operator (ISMO). This system is aimed to support the introduction of IPP's by creating a non-conflicted buyer of power and electricity (DBSA, 2012:69). In order to provide incentive for renewable energy generation by private investors, the government has introduced the Renewable Energy Feed-in Tariffs (REFIT). However REFIT has since been replaced with the IPP procurement programme, which calls for competitive bids based on a price ceiling determined by the REFIT guidelines. The first bid that ended in November of 2011 produced 1415MW of renewable energy from independent producers (DBSA, 2012:70)

4.5.4 Resource management

Effective infrastructure delivery not only relies on proper planning, as all available resources (both human and financial) need to be appropriately managed as well. The Intergovernmental Fiscal Relations Act (No 97 of 1997) provides the framework for the division of nationally raised revenues between the three spheres of government. This piece of legislation establishes the Budget Forum wherein local government issues are discussed in relation to the national budget.

The 2011 Local Government Budgets and Expenditure Review by the National Treasury focused on key areas in the existing local government system that needs attention and refinement. All of these focus points relate to the shortage of both human and financial resources at municipal level in planning and delivering infrastructure. These issues can be listed as follows (National Treasury, 2011:4-6):

- The quality of leadership and the skills of senior management need to be addressed as good governance is vital for successful service delivery;
- The ability of municipalities to fund the municipal budget in accordance with the legal requirements as set out in the Municipal Finance Management Act (No 56 of 2003) and related legislation;
- The lack of maintenance of municipal physical assets;

- The ability of municipalities to fund their capital budgets. Municipalities should balance their operational and capital budgets in order to fund infrastructure;
- The ability of municipalities to combat poverty by ensuring greater access to basic services and infrastructure. Effective spatial planning and land use management regulations at municipal level are therefore crucial. Municipalities should additionally generate more employment opportunities through labour intensive practices in order to alleviate poverty; and
- National government should improve capacity at municipalities, especially in terms of co-ordinating policy instruments.

The Constitution (No 108 of 1996) states that local government is entitled to equal shares of national revenue and may receive transfers from national and provincial government. Local government should additionally raise their own revenues for infrastructure and service delivery from property rates and related taxes (Constitution, 1996:227).

Fiscal transfers from national to local government are divided into direct and indirect transfers. The latter includes funds that national government spends on behalf of municipalities (National Treasury, 2011:52). Although the primary source of infrastructure finance for municipalities should be internally generated, these sources are often not adequate. Municipalities may additionally use one of four alternative methods which include borrowing, development charges, land leases and Public Private Partnerships (PPP's) (National Treasury, 2011:93).

Often, municipal funding is only analysed from the needs of the communities and the resources to meet those needs. What is not always recognised is that municipal councillors, mayors and municipal managers are responsible for managing the resources of the municipality by ensuring that revenues of the municipality are allocated correctly (National Treasury, 2011:48). The collection of outstanding debt by municipalities is important; however it is also important to pay attention to all aspects of revenue management in order to ensure appropriate funding management.

Revenue management should be done holistically by every person within the municipality (National Treasury, 2011:69).

One of the main problems is that many municipalities do not understand how their various services and activities are funded, and what the balance between taxes and tariffs should be (National Treasury, 2011:70). One of the main challenges in municipal budgets involves the underfunding of maintenance and repairs. This is the result of repairs being the first expenditure that loses its priority as soon as there is a financial crisis (National Treasury, 2011:70). In order for a municipality to make more effective decisions, improved municipal planning and budgeting are essential (National Treasury, 2011:77). According to the Municipal Finance Management Act (No 56 of 2003) the municipal budget cycle involves a planning phase, a preparation phase, a public consultation phase, a revision phase, an approval phase and a publishing phase. The planning phase involves the strategic review of the municipal IDP by setting service delivery targets for the coming years and by reviewing the previous year's performance amongst others (National Treasury, 2011:77). The preparation phase analyses revenue and expenditure projections and considers all three spheres of government priorities.

4.5.5 Inter-Governmental co-operation

The Constitution of the Republic of South Africa (Act No 108 of 1996) provides for three spheres of government: national, provincial and local government. These three spheres are interrelated, interdependent and co-operative. Each sphere has certain rights and obligations and should work in unison with the other spheres to ensure that the needs of the citizens are met.

Local government is thus an equal sphere in its own right and not a sub-sphere of provincial or national government. The functions of each sphere are set out in Chapter 3 of the Constitution. The objective of South Africa's inter-governmental arrangement is to ensure that the three spheres carry out their responsibility in the spirit of co-operation, equity and efficiency. In order for the three spheres to be able to provide basic services, the Constitution makes provision for the allocation of equal shares from nationally collected revenues. The MIG allocations fall within the long-term

vision of the South African inter-governmental system. The MIG is the funding source for each municipality in order to provide its citizens with public services. The alignment of functions and powers between the different categories of municipalities should be addressed where certain district municipalities and local municipalities are not sharing their responsibilities (National Treasury, 2011:20).

In certain cases, the effective provision of municipal infrastructure is only possible through the collaboration between all three spheres of government. The provision of bulk electricity infrastructure is the responsibility of national government, through its service provider Eskom. The construction of water resources is the responsibility of national government. The municipal road network is linked to the provincial and national road network (MIIF, 2011:10) and therefore necessitates the co-operation between these spheres. Provinces should monitor and support the activities of municipalities and national departments have regulatory oversight of water services, solid waste disposal and electricity (MIIF, 2011:10). It must however be recognised that South Africa's inter-governmental framework is relatively new. The nine provinces were only formed in 1994 and the current municipal system of wall-to-wall municipalities was established as recently as 2000 (NDP, 2012:385). The optimum division of powers and functions between different spheres of government will take time and effort.

At present, one of the most challenging issues that face local government is the division of responsibilities between district and local municipalities (MIIF, 2011:9). In terms of water provision, district municipalities have been given the responsibility in less developed areas and local municipalities have been given the responsibility in more developed areas (MIIF, 2011:10). In terms of electricity, the responsibility is split between the local and district municipality. Eskom acts as the provider for electricity with little to no reference to local government (MIIF, 2011:10). Additionally, the division between district and local roads is uncertain in most districts (MIIF, 2011:10).

Large amounts of the budget have been allocated for the provision of electricity, fire fighting services, municipal airports, planning, health services, transport, roads, parks, water supply and sanitation (DBSA, 2008:122). Despite the increase in spending,

backlogs still occur and are a source of friction between the government and communities. Municipalities must therefore ensure the adequate provision of infrastructure in order to discharge their constitutional mandate (DBSA, 2008:122-123).

4.5.6 Public Private Partnerships

A municipality may also appoint a private firm as the service provider. This is commonly referred to as a 'public-private partnership' (PPP). Government should encourage investment by the private sector in order to create employment opportunities while simultaneously improving South Africa's capital base (NGP, 2011:7). This can be achieved by providing appropriate incentive schemes for private developers in targeted infrastructure sectors such as renewable energy projects and green technologies (NGP, 2011:7). The Municipal Systems Act (No 32 of 2000) makes provision for municipalities to provide their citizens with the minimum basic level of service through external mechanisms such as other bodies of government or private entities that are legally competent to enter such agreement.

4.6 Summary and Conclusions

Municipalities have been given the constitutional responsibility to provide their citizens with effective services such as water and sanitation amongst others. Many municipal services require infrastructure to function optimally and should therefore be strategically planned within municipal Integrated Development Plans (IDP's).

Service delivery infrastructure is generally assigned to be under control of a specific authority. However, there remain unresolved issues in terms of the responsibility of certain types of infrastructure. This is especially the case with road infrastructure as there are significant lengths of undesignated roads with no obvious ownership by any road authority. This issue needs to be resolved as road infrastructure plays an important role in socio-economic development and therefore necessitates sufficient planning and maintenance. The same uncertainty in terms of responsibility revolves around electricity infrastructure and has been the topic of heated discussion. The

responsibility of national and local government as well as Eskom needs to be addressed in order to achieve success in this regard. Eskom is the most commonly used electricity service provider and supplies electricity on behalf of the majority of service authorities.

Water-related policy has shifted from the focus on infrastructure to a more holistic resource management approach. Municipalities are divided into different categories according to their responsibility for water provision. All metropolitan and district municipalities are water service authorities as stated in the Municipal Structures Act (No 117 of 1998). However the MEC for local government in a province may adjust the responsibility according to each municipality's capacity.

As infrastructure lays down very dominant structural elements that last for decades or even centuries, the placement of infrastructure is vitally important; however, there is little empirical evidence regarding the criteria that should be used to ensure optimum localisation, pointing to a need for further research in this area. It is critical for investment choices to be in line with the NGP and the NDP. The NDP is national government's long term vision for South Africa, and aims to use the NGP as a policy instrument to achieve this vision.

One of the main issues in the South African government in terms of infrastructure planning is capacity, both human and financial. The shortage of capacity is particularly evident at local government level. The planning process requires that the appropriate personnel are available to manage and facilitate this complex process. One of the main reasons for the unsatisfactory level of service is that important policy and legislation provisions are not being considered and implemented. This can be observed in the deteriorating state of municipal roads and related infrastructure.

Electricity policy aims to increase capacity with a larger portion thereof to be provided by renewable energy sources than has ever been the case in South Africa. The aim of the new Build Programme is to produce 42% of all electricity from CO2 free sources by 2030. Central to policy frameworks is the creation of an appropriate incentive and regulatory structure to encourage private investors in renewable energy generation. The uncertainty of the energy sector has stifled the establishment of a

vibrant Independent Power Producers (IPP). This has subsequently led to the establishment of the Independent System and Market Operator (ISMO). This approach has been designed to encourage private investors by making them buyers and sellers of electricity.

It can be assumed that for municipal infrastructure planning to be more successful, the co-ordination between the three spheres of government needs to be strengthened in addition to the clarification regarding the functions and powers of the different tiers of local government. National government could also explore collaborations with private investors by encouraging Public Private Partnerships (PPP), especially in the renewable energy sector.

This chapter focussed on what is also referred to as conventional infrastructure. Green infrastructure however can play just an important role in local socio-economic development in addition to complying with many national and international laws and policies relating to climate change adaptation. The potential of green infrastructure becoming part of the mainstream planning approach will be discussed in the next chapter.

Chapter 5
Green Infrastructure Planning

5.1 Introduction

The aim of this chapter is to display the potential benefits of green infrastructure[7] provision through an integrated planning approach. The different types of green infrastructure as well as the correlation between green infrastructure and conventional infrastructure in terms of application and ownership will also be discussed in order to establish the appropriate institutional arrangements.

The importance of green infrastructure planning cannot be overemphasised, especially as it has the potential ability to promote sustainable human settlements. It is frequently stressed from an environmental perspective that it is important to invest in green infrastructure. What is often lacking form these arguments are the potential economic and social benefits that green infrastructure could bring. Green infrastructure has become a frequently discussed topic in development literature as the environmental, social and economic benefits are becoming more apparent.

Funding and research are therefore vitally important as the vast majority of research in green infrastructure suggests that the varied focus of concepts can provide wide ranging benefits to ecological, economical and social spheres (Kambites & Owen, 2007:484). Such theoretical publications will be discussed in this chapter to highlight the importance of green infrastructure.

5.2 South Africa's vision

Adapting to climate change is one of the main challenges that many countries around the world are facing including South Africa (NGP, 2011:4). South Africa's approach in the above-mentioned regard should involve the creation of strategies for local, provincial and national government by identifying and introducing appropriate policy measures for various types of green infrastructure (NDP, 2012:180). Key contributors to stabilising South Africa's carbon emissions will include the expansion of

[7] "Green Infrastructure" refers to structures that have been constructed with natural materials in order to create environmentally sustainable urban environments.

renewable energy programmes and the introduction of local government climate change programmes amongst others (NDP, 2012:180). Such programmes should become key components and built into all aspects of planning policy (NDP, 2012:84).

The transition to a low-carbon economy will require careful phasing and strategic planning (NDP, 2012:192). Information regarding effective measures to support investment in low-carbon and clean technologies is needed and should be made available to national, provincial and local government agencies (NDP, 2012:187).Viability studies should be undertaken to determine the most appropriate directions for public green infrastructure investments. Benefits from green infrastructure investments will stretch across the three spheres of government by contributing to socio-economic development. The South African Government is identifying the green economy as one of the main job drivers, especially in the renewable energy sectors (NGP, 2011:35).

5.3 Green infrastructure planning

Just as conventional infrastructure needs to be carefully planned, designed and budgeted for far in advance of development, so too does green infrastructure (Benedict & McMahon, 2006:15). Moreover, it could benefit from being planned in conjunction with conventional infrastructure. As in the case of transport infrastructure, green infrastructure should be designed to link diverse green space elements into a system that functions as a whole, rather than separately (Benedict & McMahon, 2006:16). Green infrastructure planning should also be undertaken comprehensively in order to provide ecological, social and economic benefits. Additionally, the planning of future green infrastructure needs to be laid out strategically to cross multiple jurisdictions and spheres of government (Benedict & McMahon, 2006:16). The design of green infrastructure should be based on sound knowledge of professional disciplines such as landscape ecology, engineering, urban and regional planning and landscape architecture (Benedict & McMahon, 2006:16).

5.3.1 Theory and practice

The present research in green infrastructure can be divided into two categories (Mell, 2008:72); namely practical application and conceptual research. The latter has seen

authors and practitioners taking on board the underlying concepts from earlier examples and contextualising them within contemporary landscape planning (Mell, 2008:72). The idea of landscape multi-functionality consists of policy, practice and understanding the form and function of particular landscapes (Mell, 2008:72).

The above-mentioned principle has been heavily emphasised in current green infrastructure research. Within such research, the practical benefits to social and ecological populations are heavily emphasised and green infrastructure is placed at the head of sustainable landscape management practices (Blackman & Thackray, 2007:58). The development of green infrastructure conceptual ideas for practical landscape management practices is an important aspect that researchers should address.

Practical application consists of the physical implementation of the above-mentioned conceptual ideas. Although there are a number of green infrastructure researchers presently studying the theoretical benefits, only a few researchers are attempting to link the theory with practice. Davies *et al.,* (2006) is one of a few research teams that are aligning these two in producing the *Green Infrastructure Planning Guide* in 2006 for the North East England Region. Davies *et al.,* (2006) has been able to raise the profile of green infrastructure work and aids its implementation into natural documents. What is needed now is for this work to be taken further by researchers, policy makers and practitioners into issue specific areas such as climate change adaptation and urban regeneration.

The benefits of green infrastructure can be measured at a site level, where the benefits are reaped by the individual owner or at a community level where the benefits are spread across many private owners, or at a city, regional and national levels (Mell, 2008:60). However, to achieve these benefits of scale there must be co-ordinated implementation across a broader area involving multiple disciplines. Therefore, community-level, rather than individual-level implementation of green infrastructure particularly helps local governments to achieve environmental sustainability, and adaptation goals within their jurisdictions (Mell, 2008:64). Examples do exist relating the concepts of green infrastructure to adaptive planning practices. One such example is the use of water resources to mitigate the effects of climate change.

Water is viewed by many researchers as one of the most important aspects of green infrastructure and has led to the discussion of a potential sub-category of blue / green or turquoise infrastructure such as Sustainable Urban Drainage Systems (SUDS)[8] (Ahern, 2007:273). In addition, it has been suggested that climate change or global warming is one of the most important issues currently being discussed by planners and developers and that green infrastructure thinking needs to acknowledge this and react accordingly (Mell, 2008:74). Green infrastructure researchers and developers working on implementing green infrastructure have promoted the value of the concept as a way of controlling climate change through the sustainable design of housing and large-scale infrastructure developments (Beatley, 2000:310). Some examples hereof include SUDS and green roofs[9] as proposed by the Leadership in Energy and Environmental Design (LEED) (USGBC, 2007). Environmental design is therefore crucial in some of the thinking relating to green infrastructure.

Research by Cave (2002:491-512) in the Rogue River in Michigan led to the understanding of how SUDS can provide methods of capturing, releasing and filtering excess downfall in times of heavy rain to increase the capacity of water supply to any given area as a counter to water quality and shortages, especially in more arid countries. Cave (2002:506) also discovered that SUDS are more effective than traditional sewer or water retention systems and provide better environmental protection from adverse storm conditions. Ferguson (2002:11-29) further demonstrated the role of SUDS as a green infrastructure method in controlling adverse climate conditions.

The relevance of *Frederic Law Olmsted*[10] and *Sir Ebenezer Howard*[11] should not be underestimated when discussing green infrastructure theory. It has been suggested that the exemplar designs of Olmsted and Howard were fundamental to the development of green infrastructure thinking (Davies *et al.,* 2006:187). Olmsted and

[8] A SUDS is a form of urban water drainage system that works in a similar manner as conventional storm-water drainage by using natural materials in harmony with the natural environment. See 5.4.3.2
[9] Green roofs are partially or completely covered with vegetation. See 5.4.5.1
[10] Fredric Law Olmsted was an American landscape architect, journalist, social critic, and public administrator.
[11] Sir Ebenhezer Howard is known for his publication "Garden Cities of Tomorrow" (1898), the description of a utopian city in which people live harmoniously together with nature.

Howard were the first to link the ecological capacity and social opportunities of an area, and have since been taken for granted in landscape planning. Olmsted's work in New York and Boston is still discussed by many green infrastructure researchers as one of the earliest examples of the integration of form and function that led to landscape multi-functionality (Fabos, 2004:326). Howard (1985) worked in the United Kingdom and suggested that green spaces should be closely positioned to residential nodes in order to promote the physiological and physical health of the population and this is considered to be a fundamental green infrastructure practice.

Olmsted initially developed the Necklace system in Boston during the late 1870's in response to flooding from the Charles River (Fabos, 2004:331). The system was designed to link a number of metropolitan parks in central Boston with flood defence systems in order to control the excess water flow across the city's boundaries (Fabos, 2004:331). Olmsted's work in Brooklyn New York has been discussed with similar enthusiasm. Hiss (1990:57) argues that the design and location of Prospect Park have been seen as one of the biggest factors in promoting social cohesion and integration in the greater Brooklyn area and suggests that the case of Prospect Park proves that green infrastructure should act as a meeting point where social and ecological functions can interact simultaneously.

Howard's work on the other hand came forth as a method of controlling urban sprawl. The 'Garden City'[12] concept shows a number of similarities to the current values of the 'Smart Growth'[13] agenda in the United States (Mell, 2008:71). Green cities and Smart Growth models provide a number of ideas that have been discussed in green infrastructure literature and include the use of sustainable housing, employment and more effective transport systems (Mell, 2008:71). These ideas have also been incorporated into planning literature with green grid ideas found in the United Kingdom and European projects (Beatley, 2000:261).

Green infrastructure concepts provide a number of complementary benefits for ecological, economical and social spheres and have been increasingly viewed as

[12] The description of a utopian city in which people live in harmony together with nature (by Sir Ebenezer Howard)
[13] Town Planning theory that concentrates growth in compact urban centres to avoid sprawl

concepts that both planners and practitioners can draw on (Mell, 2008:69). Planning policy as a whole shares certain similarities with planning policy relating to green infrastructure such as landscape multi-functionality and organisational co-operation, which underpins the growth of green infrastructure (Mell, 2008:69). There is however certain issues that needs to be addressed in order for green infrastructure as a concept to become part of the mainstream planning practice. These issues include amongst others the promotion of spatial connectivity, accessibility, and integration and scale (Mell, 2008:70). Green infrastructure should promote place-based approaches to conserve, protect, restore and manage local and regional networks of natural living, and environmental resources and amenities (PCSD, 1998:141).

5.4 Types of green infrastructure

Originally, green infrastructure was thought of as elements such as parks, urban vegetation, wetlands or flood-ways in and around the urban area that were aimed at providing a better quality of life for local residents. These types of green infrastructure are also known as ecological infrastructure (McMahon, 2000:25). However, green infrastructure in its entirety consists of a variety of different elements including ecological infrastructure, renewable energy and more sustainable building practices (Foster *et al.*, 2011:3). Therefore, green infrastructure relates to environmental or sustainable goals that cities are attempting to achieve through a mix of natural approaches.

Recently, the concept of combining "green" infrastructure such as green roofs and urban forestry[14] with conventional "grey" infrastructure such as storm-water drainage systems and paved roads has been identified as 'best practice' at local government level for achieving greater urban sustainability and resilience (Foster *et al.*, 2011:2). For instance, innovations such as permeable pavements[15] could be considered a hybrid of green and grey infrastructure. Local governments from around the globe are using green roofs and urban forestry in an attempt to enhance sustainability and quality of life in addition to mitigating climate change (Foster *et al.*, 2011:2).

[14] Urban forestry includes a mix of natural vegetation within the urban environment. See 5.4.2
[15]Permeable pavements absorb water as opposed to channelling water. See 5.4.3.1

As in the case of conventional civil and electrical infrastructure, there are various scales of application for green infrastructure which distinguishes the ownership and responsibilities thereof between the different spheres of government. For the purpose of displaying the similarities between conventional and green infrastructure with regards to the above-mentioned responsibilities, large-scale green infrastructure will also be discussed in this section. Green infrastructure such as utility-scale renewable energy projects are national government's responsibility and therefore in public ownership for the most part whereas green infrastructure of a smaller scale such as green roofs or urban forestry will be on a local level and may be in private or public ownership. The following section will discuss the benefits, physical components and methods of application for the various types of green infrastructure as well as their relevant ownership.

5.4.1 Renewable energy infrastructure

By observing economies from around the world, it can be noted that economic growth is always subject to some sort of growth in energy consumption (Du Plooy, 2011:2). However, this has not been the case in South Africa during recent times as the increase in energy consumption has not brought about the desired per capita growth increase (Du Plooy. 2011:2). Oil and energy prices are generally increasing and this necessitates the shift to renewable forms of electricity generation for the sake of the environment and future generations.

People want clean air and a healthy environment to live in, while we also want energy to heat and light our homes and run our machines. The demand for energy is increasing and it is largely met by unsustainable forms of generation (Du Plooy, 2011:54). The use of non-renewable resources such as coal is polluting the environment with harmful gases which has an adverse effect on the natural environment (Du Plooy, 2011:57). This leaves us with two options; the first is to halt the demand for power and the second is to produce more power in environmentally sustainable ways. As the demand for power is not likely to decline or even stabilise over the coming years, it necessitates the latter option. The New Growth Path (NGP, 2011:35) identifies renewable energy developments as a medium to long-term agenda

for South Africa. Renewable energy infrastructure includes a large variety of technologies including solar, wind and hydro power amongst others.

The application of renewable energy infrastructure can come in various forms and scales. Wind and hydro power are largely developed for utility-scale electricity generation whereas solar power may be developed for utility-scale electricity generation or on a smaller scale for domestic purposes (IFC, 2012:11). In the following section, some of the various renewable energy generation technologies will be discussed.

5.4.1.1 Wind power infrastructure

Wind power is the process whereby wind is used to generate electricity by converting kinetic energy into electricity (IEEE, s.a:4). Wind turbines, much like an aeroplane propeller, turn in the moving wind and powers an electric generator that supplies an electric current (IEEE, s.a:4). Therefore, a wind turbine is the exact opposite of an ordinary desk fan; instead of using electricity to make wind, turbines use the wind to make electricity. This is achieved by the wind turning the blades on a rotor, which spins a shaft, which connects to a generator and produces electrical energy. Wind turbines are usually grouped together in a single location to form what is also known as a 'wind farm' (IEEE, s.a:5).

Wind power has several advantages that place it on the forefront of competitiveness and availability. The primary source of wind power (wind) is cost-free and renewable, thus ensuring that it can never run out. Wind power is also competitive in relation to other sources of power generation within the renewable field (Rechsteiner, 2008:51). The extraction method causes no carbon emissions, no air pollution and no hazardous waste. In addition, the system does not need water for cooling as in the case of many other forms of power generation (Rechsteiner, 2008:51). These are but a few of the many advantages of wind power, and as it is still a relatively new technology, innovations will continue to make it more viable over time. A consequence of the rapidly growing market is a virtuous cycle of technological improvement driving wind-generated electricity towards a cheaper-than-coal situation (Rechsteiner, 2008:113).

5.4.1.2 Hydropower Infrastructure

Hydro-electric power is generated (as in the case of wind power) by using the energy of water in motion (USBR, 2005:3). When the flowing water turns a turbine by running through the blades, this kinetic energy is converted into mechanical energy. A generator then converts the mechanical energy into electrical energy (USBR, 2005:3).

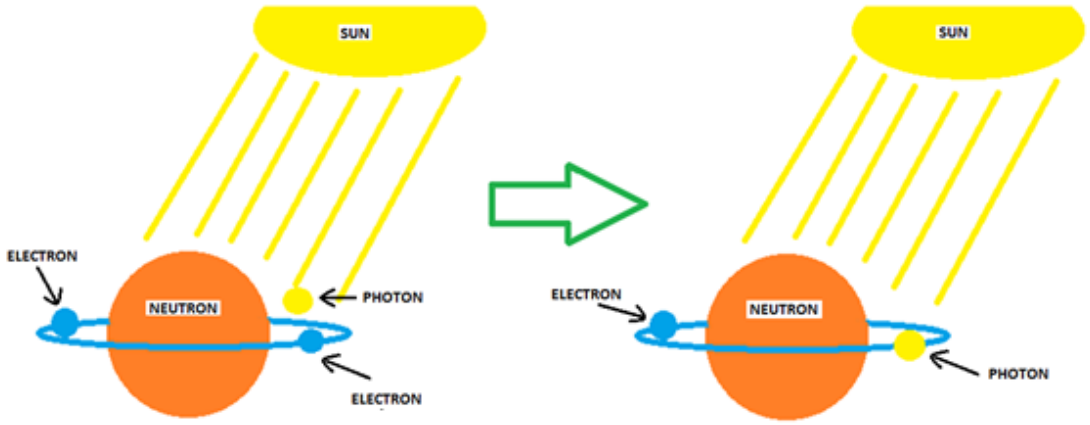
Hydropower is generated in hydro-electric power plants, which may be located on rivers, streams and channels. However, for a reliable water supply the best locations are near dams. Dams store large quantities of water that can be released for irrigation and domestic purposes, as well as hydro-electric power generation (USBR, 2005:4).

5.4.1.3 Solar power infrastructure

One of the greatest advantages of solar energy is that the sun (the primary source) is an almost inexhaustible resource. The development of solar power can bring numerous benefits to local, regional and national levels (depending on the scale of application) including job creation and increased energy security amongst others (IFC, 2012:11). Utility-scale solar projects are growing at an exponential rate and the growth is set to continue over the coming years as the technology becomes more affordable (NREL, 2012:30). Awareness of local economic advantages will aid public and private investors to utilise solar projects as a development tool for local government (NREL, 2012:34).

Solar energy can be harnessed by using two different technologies (Muneer, 2011:10): The first is called Photovoltaic (PV) Cell Technology, and the second is called Concentrated Solar Power (CSP) Technology. The PV Cell Technology uses semi-conductor materials such as thin film or polycrystalline silicon to convert solar rays directly into electrical energy by producing a photo-electric effect (when an electron gets "knocked-off" an atom by a photon particle, creating an electrical charge) (NREL, 2012:19) as illustrated in Figure 5.1.

Figure 5.1 Photo-electric effect



Source: Own Compilation, 2013

The CSP Technology relies on mirrors and lenses to concentrate the solar rays into a small area. These concentrated rays are used to heat a fluid (normally oil) which then boils water in order to create steam, the steam then turns a conventional turbine to generate electrical energy (NREL, 2012:3).

5.4.2. Urban forestry

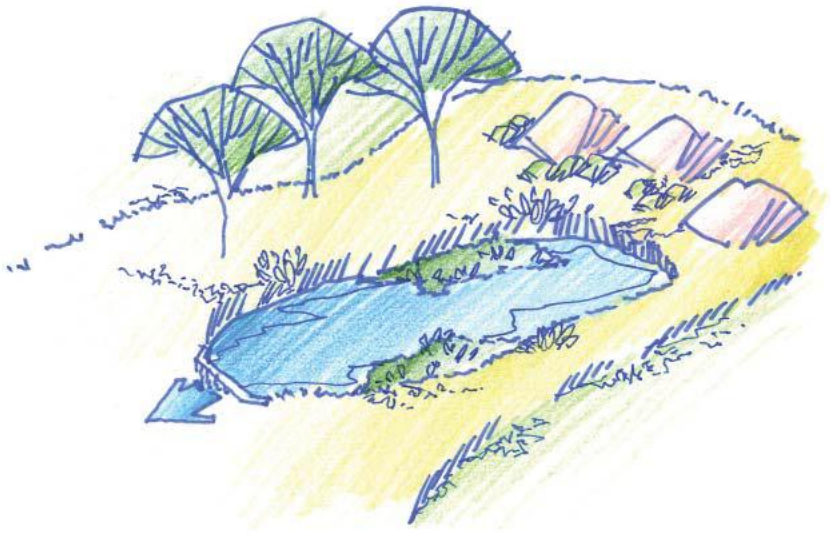
During the coming century, climate change scenarios project that urban regions will become more susceptible to extreme forms of rainfall and temperature, an increased storm frequency and intensity as well as a rise in sea-levels (Foster *et al.,* 2011:1). More specifically, it has been suggested that the above-mentioned climate extremes will include longer and hotter heat waves which will have an impact on the Urban Heat Island effect (UHI) resulting in higher cooling demand costs. This heating effect can additionally bring more damaging storms and floods which will result in greater river flooding and put enormous strain on urban storm water management systems and Combined Sewer Overflows (CSO's), as well as a loss of coastal wetlands (EPA, 2008).

The planting of trees and related vegetation (Figure 5.2) within the urban environment falls under the responsibility of local government and can be considered a quintessential green infrastructure practice with multiple benefits for resilience, adaptation, and climate change mitigation (Foster *et al.,* 2011:19). Trees can absorb

up to 90% of sunlight during the summer while additionally having the ability to reduce the maximum surface temperature of roofs and walls via shading, thus aiding in combating the UHI effect (Foster *et al.*, 2011:22). In addition to the afore-mentioned benefit, trees can also absorb carbon emissions as well as various pollutants such as nitrogen oxide and release clean oxygen, thus combating climate change (EPA, 2008). Urban forestry also provides diversity in terms of wildlife and contributes to the amenity of the ecosystem and overall quality of life within the urban environment (Foster *et al.*, 2011:21).

Urban forestry can be established in public spaces such as parks, alongside street and any open areas managed by the local government. 'Green-belts'[16] around cities can provide multiple benefits from regulating urban development and preventing sprawl to climate adaptation and resource management (Foster *et al.*, 2011:21). Local ordinances often guide property owners' responsibility for trees as a private and public good. Urban forestry delivers a range of storm-water benefits as well as managing the UHI effect (Foster *et al.*, 2011:21). Some communities have begun to achieve long-term infrastructure cost savings by looking at alternative means of dealing with storm-water management and water filtration by using urban forestry instead of the traditional 'grey' infrastructure (Foster *et al.*, 2011:23).

Figure 5.2 Urban Forestry



Source: CGAH, 2010:55

[16] Ring of vegetation surrounding a city or neighbourhood

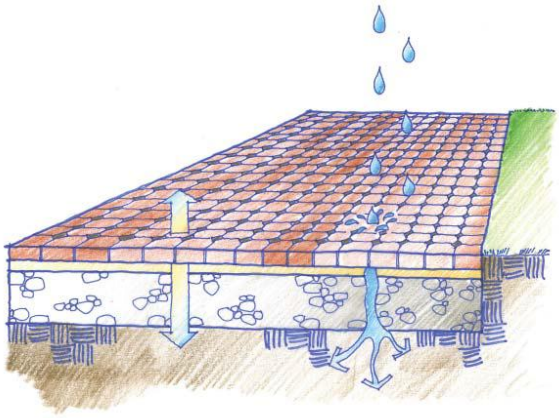
5.4.3 Green alleys and streets

The application of green alleys and streets may fall under the responsibility of local government. Alleys are usually located in cities in between buildings where fire, police and delivery vehicles are allowed to drive, whereas streets are more formal and used by the general public. Alleys are traditionally surfaced with impermeable materials such as asphalt or concrete. This is usually for achieving rapid storm-water runoff into storm sewers in addition to providing access for vehicles. These impermeable surfaces however do have some drawbacks; in times of heavy rainfall they can cause localised flooding and these heavy rainfalls are said to increase due to climate change (CGAH, 2010:5). Alleys covered in dark hard surfaces also contribute to the UHI effect by not reflecting solar rays. These higher temperatures can also lead to a reduction in air-quality (Foster *et al.*, 2011:14). Green alleys can help combat these impacts. Green alleys use a number of green infrastructure practices to achieve storm-water management, heat reduction and energy conservation. These include permeable pavements and Sustainable Urban Drainage Systems (SUDS) amongst others (CGAH, 2010:37).

5.4.3.1 Permeable pavement

Permeable pavements are covered in materials that allow water to seep into the ground rather than running over it as illustrated in Figure 5.3.

Figure 5.3 Permeable pavement



Source: CGAH, 2010:50

Permeable pavements can be utilised by local governments in urban areas where possible in order to achieve multiple benefits including storm-water management amongst others. Permeable pavements with proper 'sub-soiling' (maintenance of porous layer underneath) have the ability to reduce runoff to a large extent by absorbing excess water (CGAH, 2010:4). Permeable pavements also contribute to the reduction of the UHI effect by tending to be cooler than conventional hard surfaces due to their higher reflectivity and lower capacity for absorbing heat and greater evaporative capacity (Foster *et al.,* 2011:16).

5.4.3.2. Sustainable Urban Drainage Systems (SUDS)

Since the introduction of urban drainage systems, rainwater has been treated as waste water and flushed down pipes into overloaded sewerage systems (Granham *et al.*, 2012:1). The design of conventional storm-water systems in towns and cities comprise primarily of hard surfaces such as asphalt, concrete or tarred surfaces in order to rapidly direct storm-water into underground drains (Granham *et al.,* 2012:1). During times of heavy rainfall, these conventional drains run the risk of overflowing which not only wastes valuable water but has been known to cause structural damage as well.

Sustainable Urban Drainage Systems (SUDS) can present a solution to the above-mentioned challenge as they provide the ideal opportunity for local authorities to deliver multiple benefits for little costs, and can in some instances even be less expensive than conventional drainage systems (Granham *et al.*, 2012:1). SUDS can be designed using 'hard landscaping' or 'soft landscaping' (Granham *et al.*, 2012:11).

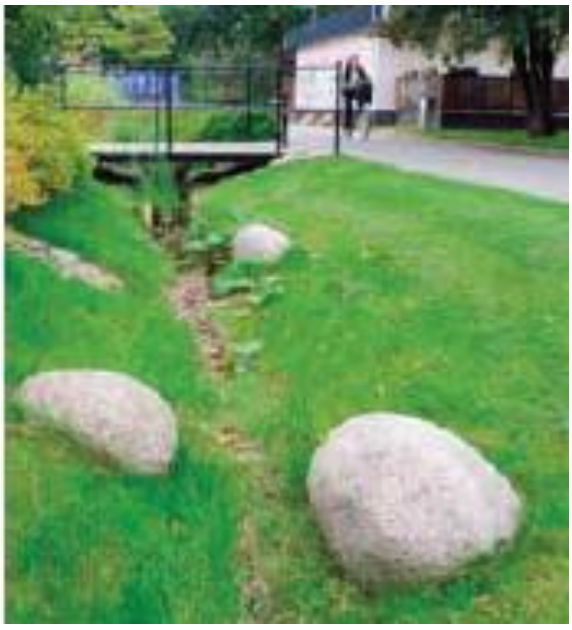
Hard landscaping should be designed to direct water laterally using attractive edge structures in order to remove run-off effectively from hard surfaces to resist blockage (Granham *et al.,* 2012:11) as depicted in Figure 5.4. They should also be simply designed to facilitate easy maintenance. Direct pipe connections should be avoided beyond the first treatment system stage where possible (Granham *et al.*, 2012:11).

Figure 5.4 Hard landscaping SUDS

Source: Granham et al, 2012:5

Soft landscaping should be designed using natural materials such as turf and vegetation as depicted in Figure 5.5. Such vegetation should preferably be native and of local provenance and can include trees, shrubs and ramblers. Where used, turf should be at least be 20mm below the edge of hard surfaces and kerbs to allow water to flow unhindered and prevent blockage (Granham *et al.*, 2012:11).

Figure 5.5 Soft landscaping SUDS



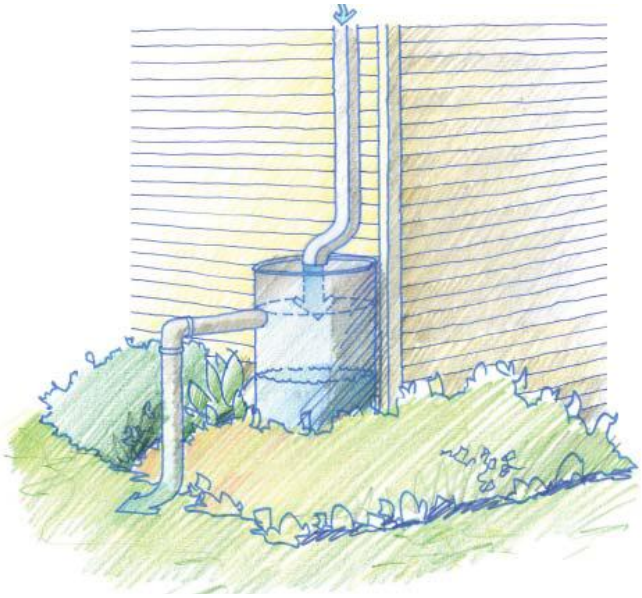
Source: Granham et al, 2012:27

Designing SUDS to deliver multiple benefits is not difficult or expensive, but does need to be considered at an early stage of the planning process (Granham *et al.*, 212:6). If SUDS are designed properly, they can provide benefits for the whole community in terms of biodiversity, climate regulation, regeneration and health amongst others (Granham *et al.*, 2012:6).

5.4.4 Downspout disconnection and rain water collection

Another method of capturing rainwater is to disconnect downspouts from homes and commercial buildings that would normally direct water into existing storm-water management systems (Foster *et al.*, 2011:16). The downspouts are then directed into a cistern (for storage) or a rain garden as illustrated in Figure 5.6.

Figure 5.6 Rain Collecting Cistern



Source: CGAH, 2010:29

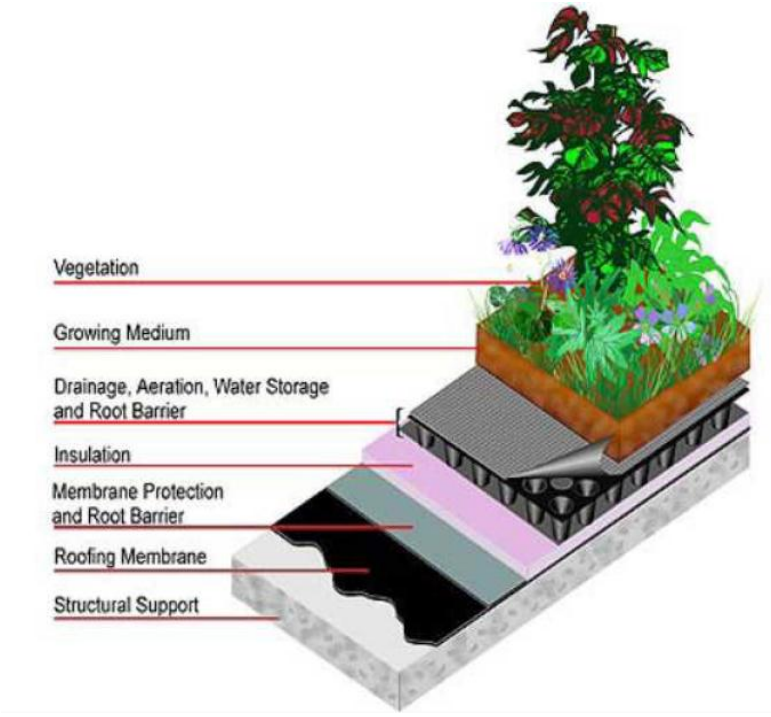
This method can be applied by private homeowners on a local scale and then use the captured water for domestic purposes while reducing the load on existing sewer systems as well. A downspout disconnection alone could lead to a reduction in local peak Combined Sewer Overflow (CSO) volume of 20% (NRDC, 2006).

5.4.5 Eco-Roofs

Eco-roofs are associated with climate adaptation and generally respond to two primary climate extremes, namely precipitation and temperature. Foster *et al.*, (2011:5) identifies three main types of eco-roofs: "Green" (vegetation) roofs, "Blue" (water managing) roofs and "White" (cooling) roofs. Eco-roofs are mainly installed on a local level by private property owners to achieve environmental and sustainability goals including water conservation, storm-water runoff, water quality management, electricity saving and carbon absorption. Local authorities should encourage private property owners to install eco-roofs by means of appropriate incentive schemes in order to achieve multiple benefits across towns and cities. The three types of eco-roofs, each with their own character and benefits can be described as follows:

5.4.5.1 Green roofs

Figure 5.7 Green roof Structure



Source: CGAH (2010:84)

Green or vegetated roofs are partially or completely covered with plants or trees that are appropriate to the local climate to support the particular plant life. These plants are

grown in 3 to 15 inches of soil, gravel or sand and upon a waterproof membrane to prevent water seeping onto the original roof (PlaNYC, 2008:40), as illustrated in Figure 5.7. Although green roofs can be expensive to install, they provide numerous benefits from climate control to financial savings.

Annual maintenance cost can vary greatly depending on the types of vegetation used, the nature of the roof, climate conditions as well as the local labour costs, but experience shows that annual costs are 2% to 3% of construction per year after vegetation has been installed (PlaNYC, 2008:40). In addition to climate adaptation, green roofs also protect the underlying roof material from damage caused by Ultra Violet (UV) rays and act as temperature regulators thus increasing the lifespan of the roof by 2 to 3 times and achieving associated life cycle-cost[17] savings (WBDG, 2012).

Green roofs can reduce annual runoff by 50% to 60% on average, including peak runoff (WBDG, 2012). The benefits of green roofs extend to climate change mitigation as well by filtering air pollutants, including Particulate Matter (PM) and gaseous pollutants such as nitrogen oxide (NOx), sulphur dioxide (SO2), carbon monoxide (CO) and ground-level ozone (O3) from the air (Foster *et al.,* 2011:7). Arguably the most valuable benefit of green roofs is their ability to combat the UHI effect.

The life-cycle cost and benefits of green roofs vary considerably, but the net present value to urban watershed has been estimated to be 10% to 14% higher than conventional roofs, even taking into account the higher installation costs of green roofs (Foster *et al.*, 2011:8). Some studies calculated a value as high as 20% to 25% more than conventional roofs based on the measurements of storm-water management and reduced electricity costs, and up to 40% when the air quality benefits are taken into consideration. A sampling of studies estimated energy savings from green roofs at 15% to 45% of annual energy consumption per household (Foster *et al.*, 2011:8).

[17] Sum of all recurring and non-recurring costs over the full life span of a good

5.4.5.2 White roofs

The UHI effect is caused by hard, dark surfaces such as paved roads and roofs. These surfaces trap the solar heat and can rise a city's temperature by 2°C to 5.5°C on hot summer days (Foster *et al.*, 2011:9). White roofs or cool roofs are generally flat roofs that have been painted white or a colour that reflects sunlight as opposed to absorbing it as illustrated in Figure 5.8. This can not only reduce the ambient temperature but adds durability as well. White vinyl roofs are the most reflective material used and can reflect up to 80% of the sun's rays compared to 6% reflection on a conventional black roof (Foster *et al.*, 2011:10).

Figure 5.8 White roof

Source: Foster *et al.*, 2011:10

5.4.5.3 Blue roofs

Blue roofs are mostly installed for water management. Examples of blue roofs include downspout valves, gutter storage systems, cisterns and roof drain inlets as illustrated in Figure 5.9. Water can be stored on a temporary basis or harvested for non-potable uses. Water captured in this manner can then be utilized for garden irrigation, direct groundwater recharge via methods such as downspout disconnections and filtration systems or landscaping (Foster *et al.*, 2011:12).

Blue roofs do not need additional expensive structural reinforcement that is required in cases of green roof retrofits. In addition, blue roofs need less maintenance than

green roofs. A typical blue roof with sufficient storage capability can store approximately 50% of the water that falls thereon annually (Yudelson, 2010). Lowering the amount of water that may need treatment will save energy and cut carbon emissions at the same time. While blue and white roofs are less expensive to install and maintain, they can only offer single focused benefits relating either to water conservation and runoff or heat reduction; green roofs may be the more sustainable solution if applicable and add to the aesthetic value as well.

Figure 5.9 Roof drain inlets

Source: Foster et al, 2011:11

5.5 Summary and Conclusions

Climate change or global warming is one of the most important issues currently being discussed by planners and policy makers around the world. Therefore, green infrastructure thinking needs to receive the appropriate attention so that measures can be put in place for the benefit of the environment and future generations alike.

Green infrastructure should be planned, designed and budgeted for far in advance. South Africa's approach to climate change adaptation should involve the creation of strategies for local, provincial and national government by identifying and introducing appropriate policy measures for various types of green infrastructure including smart building designs, urban forestry, and renewable energy projects. Co-ordination and participation are vitally important for successful green infrastructure planning given

the wide range of role players and institutions that are involved. Appropriate policy and legislation formulation will be the key to achieve the above-mentioned co-ordination

Green infrastructure not only consists of public parks and private conservation areas in and around the urban area, but includes a variety of different elements including ecological infrastructure such as urban forestry, sustainable building practices and renewable energy infrastructure. Utility-scale renewable energy projects such as wind, hydro and solar power is of national importance and should therefore be the responsibility of national government, however their impact in terms of policy and spatial realities must be considered with regards to local government. Urban forestry is considered a quintessential green infrastructure practice by local governments with multiple benefits including water and air quality improvements. Other examples of green infrastructure that can be applied by local governments include SUDS and permeable pavements which are predominantly designed for storm-water management. Green, blue and white roofs as well as downspout disconnections are mostly installed by private property owners in order to reap the various benefits thereof.

Infrastructure includes a variety of physical elements that supports development and sustainability. Therefore, municipal infrastructure as discussed in Chapter 4 and well as green infrastructure should be seen as a priority for authorities on all levels. The concept of including green infrastructure into the broader definition of public infrastructure is fairly new in South Africa as the knowledge base and institutional arrangements have seemingly not been sufficiently developed. An empirical investigation will provide more clarity on how both conventional infrastructure and green infrastructure have been successfully applied.

Chapter 6
Empirical Study

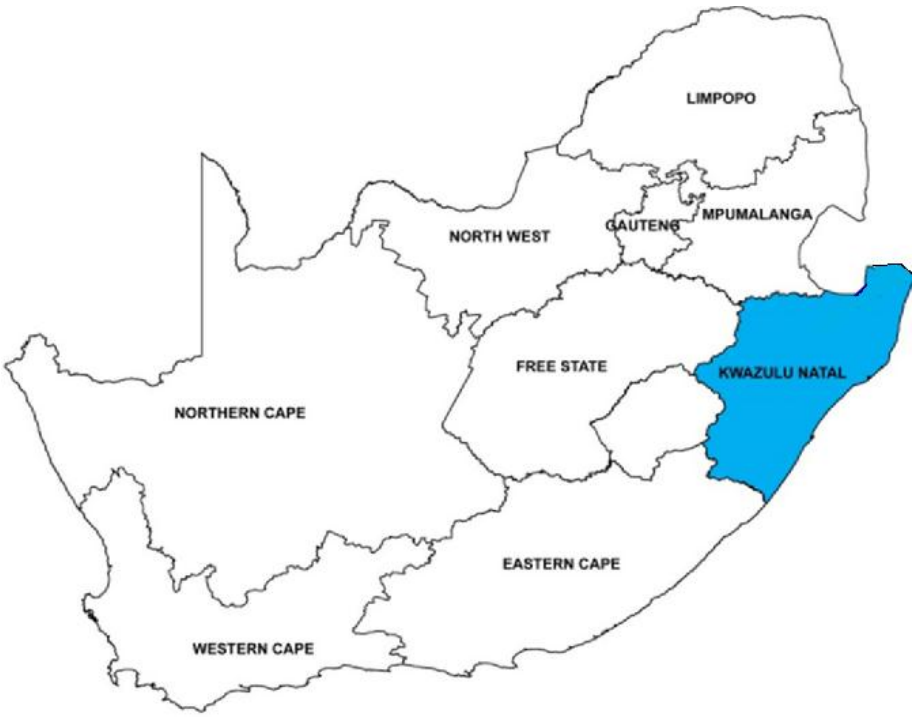
6.1 Introduction

This chapter forms part of the empirical investigation of this study and aims to determine the level of integration between infrastructure planning and spatial planning at municipal level in South Africa, and to ascertain appropriate integrated planning policies by using three research approaches. Firstly, case studies analysing municipal infrastructure planning in both South African Metropolitan Municipalities and international Local Authorities will be discussed as well as green infrastructure planning practices from around the globe. Secondly, Local and District Municipal infrastructure- and spatial planning policy frameworks were examined to determine the different approaches to integrated planning by South African municipalities. And lastly, interviews were conducted with related professionals to determine their views on integrated planning at municipal level in South Africa.

One major feature of case study methodology is that various methods are combined in order to highlight the case from different angles. In practice orientated fields of research such as planning, the case study has a special importance and usually focuses on an object. A specific case may be purposefully selected as it might be information-rich or unique (Patton, 1990:554). If a case is purposefully selected, then there is an interest in generalising the findings. Generalisations from cases are not statistical but rather analytical and are normally based on reasoning (Johansson, 2003:28). Infrastructure planning case studies from South Africa included the Nelson Mandela Bay Metropolitan Municipality and the eThekwini Metropolitan Municipality, whereas infrastructure planning case studies from abroad included the South East Queensland Regional Plan (SEQRP) - and Infrastructure Plan and Programme (SEQIPP). Several case studies discussing green infrastructure practices will also be discussed in this chapter including the Italian town of Faenza, the Climate Change Action Plan for North West England (CCAP) and the city of Chicago in the United States. The above-mentioned case studies will provide valuable information on how successful integrated planning can be achieved, and whether or not these principles can be applied in South Africa.

Strategic Planning frameworks such as IDP's and SDF's were scrutinised by using the KwaZulu-Natal Province as the main study area, and the North West Province for comparison. The KwaZulu-Natal Province has been chosen because in the South African context, it sets a high standard for planning and is also one of the leading provinces in terms of economic activity (ECSECC, 2013:1) and therefore highlights the importance of integrated planning. A map of KwaZulu-Natal is presented below in Map 6.1.

Map 6.1 KwaZulu-Natal Province location



Source: DWAF, 2012:185

The North West Province was used for comparison as it is generally regarded as being one of the least developed provinces in South Africa. Selected District and Local Municipalities within each province was used for reference: For KwaZulu-Natal, the Ugu District Municipality was used along with the Hibiscus Coast Local Municipality and the Umzumbe Local Municipality. For the North West Province, the Dr Kenneth Kaunda District Municipality and Tlokwe Local Municipality were used. The planning frameworks of each municipality were scrutinized to determine the level of integration between infrastructure planning and spatial planning at this level of Government, as well as the types of infrastructure being planned for. A map of the North West Province is presented below in Map 6.2.

Map 6.2 North-West Province location

Source: DWAF, 2012:293

The selected interviewees were chosen on their ability to provide subjective answers to the questions they were presented with. This means that they are either a professional Urban and Regional Planner with experience in strategic and statutory planning or related professionals that have a fair amount of knowledge regarding integrated planning. The method of interviewing that was used for this study was by means of a questionnaire. The means of analysis will influence the layout of the questionnaire. Questionnaires can be either structured, unstructured or a combination between the two. Structured data is organised and can be achieved by means of closed questions, whereas unstructured data is relatively disorganised and can be achieved via open questions. Closed questions make the analysis of data relatively easy, but restrict the number of responses; whereas open questions usually provide a space for the interviewee to respond freely. Although the open question produces data that is difficult to analyse, it usually provides more detailed answers. For the purpose of this research, a combination between the structured and unstructured formats has been used. This was achieved by providing three answers for each question from which the interviewee could choose, in addition to providing a space for their own response in

the event that none of the provided answers reflected their opinion on the specific matter. The results from the questionnaires will be presented in the form of graphs to optimally illustrate the prevailing opinions.

6.2 Case Studies

6.2.1 Infrastructure Planning Case Studies

The following case studies reflect the different approaches to strategic spatial planning and the integration thereof with infrastructure planning both locally and abroad. The purpose of this section is to display the use of different forms of policy and legislation that can provide a framework wherein strategies can be formulated to guide the successful integration of spatial and infrastructure planning. The previous chapters of this study relating to spatial planning and infrastructure planning have pointed out that strategic planning is carried out on various scales and that municipal planning can not be thought of as being separate from its wider region or province. For this reason different scales will be discussed in this section.

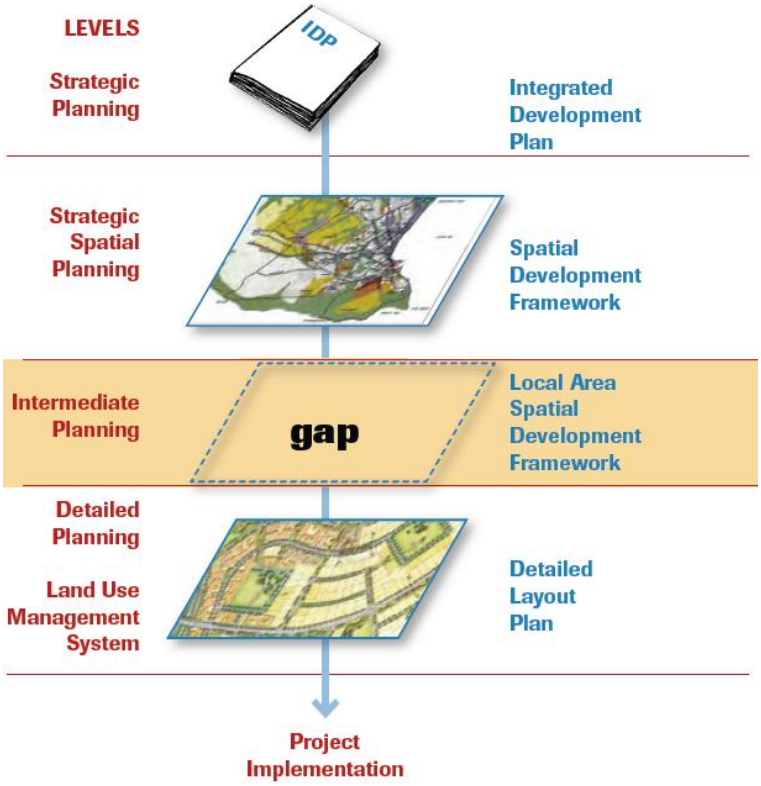
6.2.1.1 Nelson Mandela Bay Metropolitan Municipality

In June 2007, the Land Planning and Management Division of the Housing and Land Directorate department of the Nelson Mandela Bay Municipality published a Sustainable Community Planning Guide in partnership with other relevant departments. The project was funded by the Swedish International Development Co-operation Agency.

This guide was developed in terms of the South African planning system. The aim of the guide is to strengthen Integrated Development Planning by taking into account the social, economic and environmental considerations of the study area. Integrated planning can be achieved by identifying Sustainable Community Units as distinct planning units to bridge the gap between the Spatial Development Framework (SDF) and local neighbourhood planning (NMBM, 2007:3). The guide intends to "*help planners, professionals, community representatives and politicians understand and apply sustainable community principles in planning processes, in order to achieve more integrated and sustainable towns and cities with a better urban environment and quality of life."* (NMBM, 2007: 8). The unique element of the guide is that it

introduces an intermediate scale of integrated planning. This is achieved by introducing the concept of Sustainable Community Units which are defined as "*planning areas of a size defined by accessibility of services within a maximum walking distance of 2km or 30 minutes"* (NMBM, 2007:9). The Community Units are to serve as intermediate urban planning units. This is defined as "*planning at a level between that of the whole town or city and the local neighbourhood, i.e. planning a suburb or Sustainable Community Unit*" (NMBM, 2007:9). This is illustrated in Figure 6.1 below.

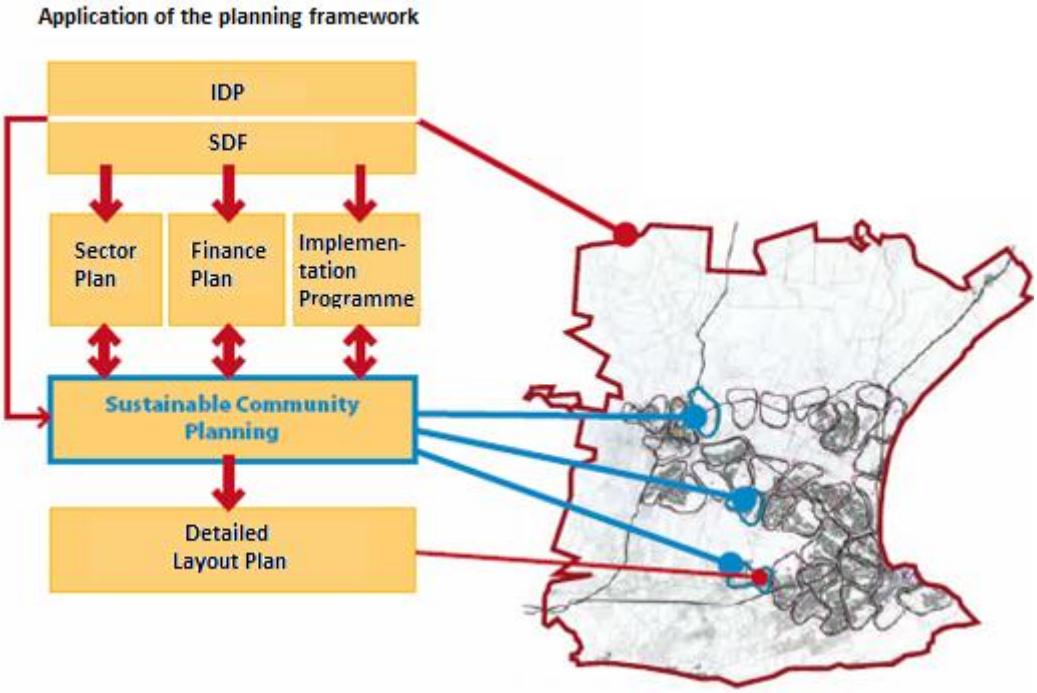
Figure 6.1 Sustainable Community Planning Guide process.



Source: NMBM, 2007:28

This method of planning involves the introduction of a link between the broad municipal strategic plans and detailed neighbourhood sector plans (NMBM, 2007:28). The application of the above-mentioned concept can be illustrated in Figure 6.2

Figure 6.2 Nelson Mandela Bay Municipality planning framework



Source: NMBM, 2007:99

Developed as a guideline for use in municipal planning, this initiative by the Nelson Mandela Bay Municipality is an illustration of the gap between high level strategic planning and the detailed level of planning that applies to the local level and provides a model of how to address this gap in the context of municipal planning (NMBM, 2007:28).

Although this case study deals mainly with the method of spatial planning as apposed to infrastructure planning within the Nelson Mandela Bay Municipality, it provides valuable information relating to the different scales that one should consider in order for optimum planning. An SDF needs to consider an entire municipal area and can therefore not always provide the desired level of detail for focussed infrastructure planning. The introduction of lower level plans such as precinct or sector plans will potentially assist in making infrastructure planning part of mainstream spatial planning. The planning of bulk, connector and internal infrastructure (see 4.3) is done on different scales and therefore necessitates different scales of plans.

6.2.1.2 eThekwini Metropolitan Municipality

Durban is located along the eastern coastline of KwaZulu-Natal with a population of approximately 3.5 million people (Breetzke, 2009:3). The Durban port is one of the main economic nodes in the region and is also the largest port in South Africa. Historically, infrastructure development originated adjacent the port and grew outward favouring the two national roads; the N2 running north to south parallel to the coast and the N3 linking Durban to Gauteng. There is substantial political pressure on the municipality to increase housing delivery irrespective of location in addition to the provision of basic infrastructure services such as community halls, clinics, libraries and sports fields (Breetzke, 2009:5).

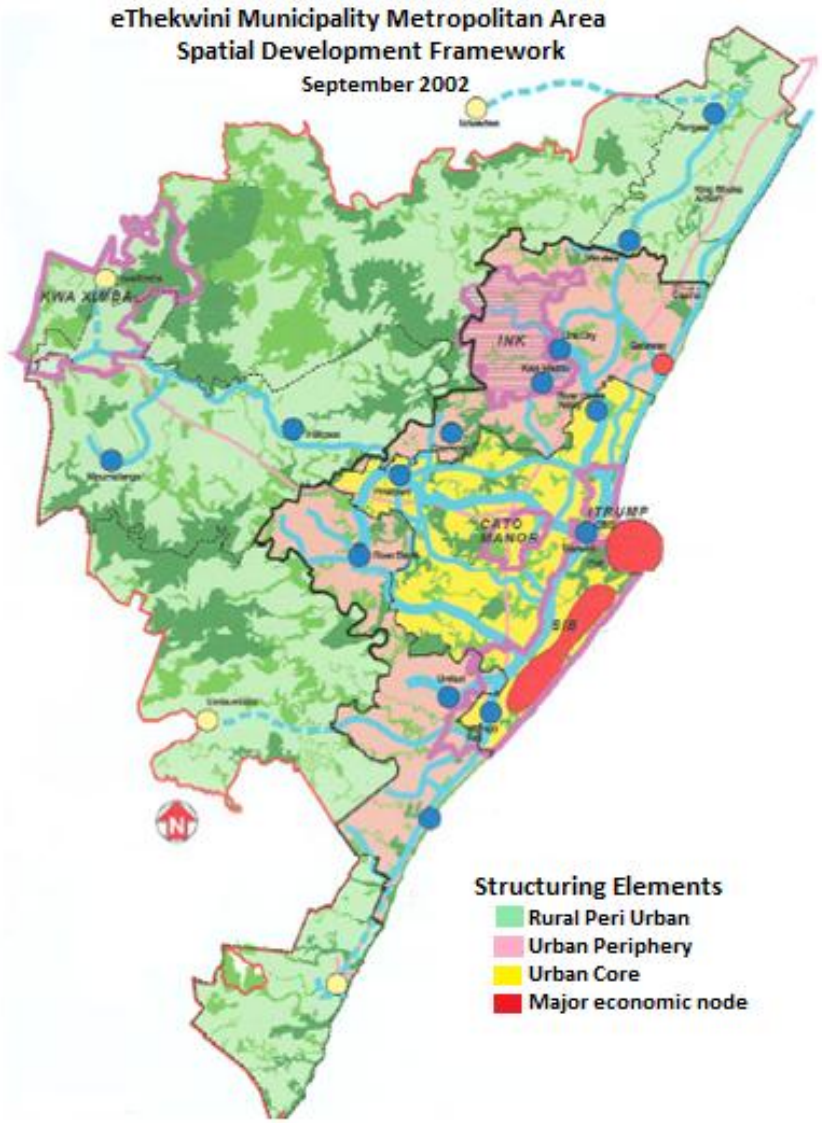
6.2.1.2.1 eThekwini SDF

Spatial planning prior to the proclamation of the metropolitan boundary in 2000 was carried out by the various local authorities, each responsible for planning and service delivery. A round of consolidation produced a metropolitan area comprising of six local councils. However, instead of integrating plans between the councils, competition occurred. The six councils were given the responsibility of providing basic services to vast areas that previously had little to no infrastructure investment or planning. A metropolitan SDF was formally adopted in 1997, but received little attention as the local authorities followed their own plans (Corporate Policy Unit, 2002:12). This was still the case after the formal consolidation of all the local councils in 2000.

The large-scale urbanisation of black South Africans during the 1980's and 1990's brought about the need to service these peripheral settlements with infrastructure and necessitated new rounds of infrastructure planning (Corporate Policy Unit, 2002:15). This came at a time when the planning profession was being accused for playing an active role in apartheid spatial planning and the emphasis within the planning profession shifted from detailed structure plans and town planning schemes to conceptual spatial frameworks with low levels of detail unable to accommodate focussed infrastructure planning (Breetzke, 2009:6). The 2002 eThekwini SDF is an

example of the conceptual frameworks mentioned before and can be seen on Map 6.3 below.

Map 6.3 eThekwini Municipality Metropolitan Area SDF



Source: eThekwini Municipality Corporate Policy Unit, 2002:52

The 2002 metropolitan SDF contained various intentional and structuring elements such as the intention to spatially restructure the apartheid city and remedy present structural problems (Corporate Policy Unit, 2002:56). There was additionally a vision to compact the city with high accessibility that overcomes the inefficiencies of low density sprawl. The aim was to refocus private investment within areas of high accessibility along major transport corridors and development nodes. Developments in poorer areas were to receive higher levels of social facilities and public transport in

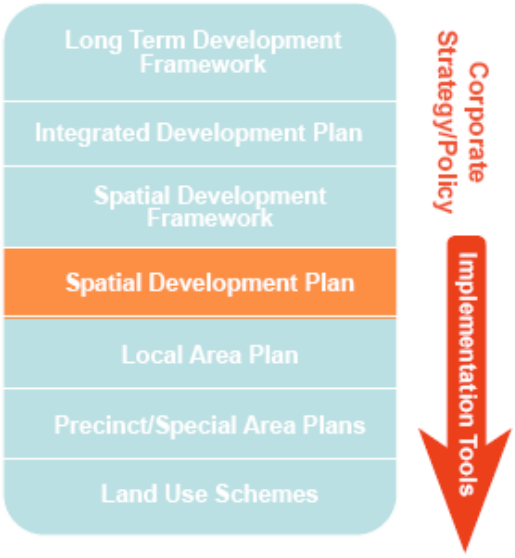
order to connect the 'rich' with the 'poor', thus improving social cohesion. Development within the urban edge was encouraged, especially along the north-south rail corridor in an attempt to increase public transport usage and viability to reduce transport subsidies. Subsequently this led to the introduction of an urban edge as a containment measure in an attempt to reduce urban sprawl, promote development compaction and secure valuable agricultural land. The urban edge was defined by areas that could be served by water borne sewerage. The intention of the urban edge was to limit the continued growth of the Umhlanga node which was competing with the Durban node (Corporate Policy Unit, 2002:57).

According to Redman (2008:24) there were several weaknesses in the 2002 eThekwini SDF as it failed to guide development due to its conceptual nature and did not bear any relationship with legal mechanisms that controlled land-use. The SDF therefore remained largely an in-house planning exercise. Political representatives in peripheral communities promoted development in these areas rather than urban compaction (Redman 2008:37). Due to the political pressures on housing delivery, the SDF simply included public housing plans which were largely driven by political imperatives and did not make sufficient room for inputs from the planning department. The provision of housing was largely unsuccessful due to the high costs of bulk infrastructure.

6.2.1.2.2 Spatial Development Plan

The inability of the 2002 SDF to guide development has led to the realisation that there was a missing piece of policy in the hierarchy of plans (Breetzke, 2009:11). This brought about the introduction of the Spatial Development Plans (SDP's) in order to bridge the gap between the broad SDF and the detailed land-use schemes as illustrated in Figure 6.3 below.

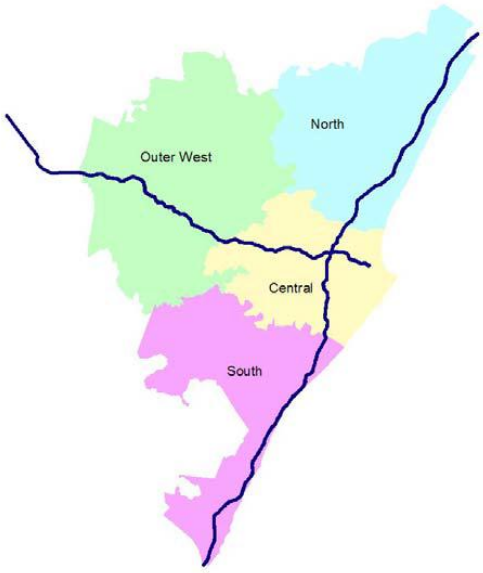
Figure 6.3.eThekwini hierarchy of spatial plans



Source: eThekwini Municipality Corporate Policy Unit, 2002:65

The metropolitan area was divided into four regions (North, South, West and Central). These regional boundaries were not based on political boundaries but largely followed major rivers which created physical barriers between regions since there are few points where bridges were in place to facilitate inter-regional movement as indicated in Map 6.4 below.

Map 6.4 Spatial Development Plan boundaries



Source: Redman, 2008:74

One of the strengths of the SDP's was that it promoted integrated planning since it was driven by several different disciplines in the professional field including development planners, environmental practitioners and infrastructure engineers (Redman, 2008:124). The development of the SDP's has however not overcome the infrastructure and housing provision related shortcomings of the SDF.

In order to estimate the requirements for infrastructure provision in any given area, land-use detailed plans need to be available with categories of industry types, residential net density as well as timing and phasing of developments (Redman, 2008:127). The land-use planners have found it difficult to provide these levels of detail due to inadequate data.

Before discussions on phasing could begin, the four SDP's needed to be complete as they all influence one another (Redman, 2008:129). The planning and provision of infrastructure have further been hampered by a lack of clear policy relating to Durban's Central Business District (CBD). The above-mentioned challenge was exacerbated by land development applications that found their way creeping up the priority list and stifled strategic planning momentum in the municipality (Redman, 2008:130). In many cases, the lack of political and senior management support has seen decisions being made in favour of developers rather than the SDP's and as a result, the SDP's have (similar to the SDF's) become mere conceptual versions of land-use plans with little to no obligation for implementation (Breetzke, 2009:13).

Despite the existence of adequate infrastructure in core areas, developers prefer to locate new developments beyond the urban edge as this is cheaper due to lower land costs. The development and review of land-use management systems to capture the intent of the SDP's have not occurred and this was a fatal flaw in implementing the hierarchy of plans (Redman, 2008:154). Large areas of the municipality have seen infrastructure backlogs and infrastructure systems reaching capacity. The provision of new infrastructure has been unsatisfactory and the lack of maintenance of existing infrastructure further fuelled the problem (Redman, 2008:154). The lack of infrastructure has however seen one of the SDF's visions come true in limiting the growth beyond the urban boundary (Redman, 2008:170).

6.2.1.2.3 Linking spatial and infrastructure planning

The infrastructure backlogs in the municipality have forced it to place an added obligation on private developers to finance the infrastructure investments needed to serve their developments. The above-mentioned obligation has been increasing due to poor alignment between developments and infrastructure plans (O'Leary, 2008:259).

Developers favour the edge of the built-up areas in the metropolitan boundary; however, these lands are largely without infrastructure and are also contradictory to the SDF policy (O'Leary, 2008:213). The lack of infrastructure in these peripheral areas has been seen by developers as an attempt by the municipality to block development. In response, an exercise has been launched whereby the infrastructure impacts on the land-uses have been modelled to determine and identify critical infrastructure projects. This exercise became a method by which spatial and infrastructure planning have become more closely co-ordinated (O'Leary, 2008:215).

The municipality's planning department officials provided the SDP's in terms of development densities for the North, South and Western regions. These three regions were compared on the basis of the need for different land-uses, the present and future development pressure and infrastructure requirements (Redman, 2008:53).

In South Africa, and especially the Durban area, public housing developments have 'led' and infrastructure planning has 'followed'. The way public housing subsidies are determined usually emphasises the housing units themselves and bulk[18] infrastructure costs are not taken into consideration (Breetzke, 2009:17). The cost of bulk infrastructure in the Durban peripheral locations is often much higher to provide and is then largely borne by the municipality. Thus the argument can be made for the optimum location for public housing developments being determined by the affordability of bulk infrastructure.

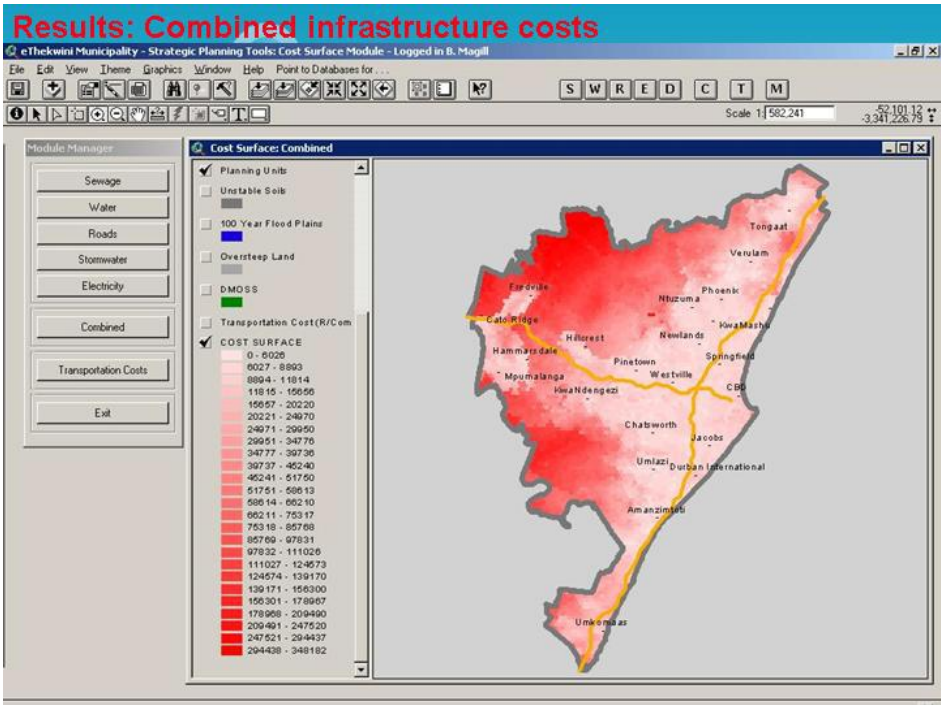
Infrastructure departments have allocated large capital expenses to serve housing projects which, due to their location, required dedicated bulk infrastructure. These

[18] In this context, bulk infrastructure refers to providing all necessary civil and electric infrastructure in a single location rather than large scale infrastructure as described in Chapter 4.

bulk infrastructures are not always economically viable as they cannot serve other developments or are in areas where development is not expected for at least 20 to 30 years and is considered premature. Sanitation engineers prefer to build their infrastructure networks into a single catchment area rather than to accommodate a host of dispersed catchments which require multiple treatment facilities (Breetzke, 2009:18).

Furthermore, the closer new developments are to existing infrastructure, the better, as this reduces extension costs, especially in the case of water-borne sanitation. Calculating the infrastructure costs for each and every housing development can be time consuming and expensive and therefore generally occurs only at project stage rather than at the planning stage. This provided the incentive to create a model that can calculate the costs of bulk infrastructure for housing projects anywhere within the municipality (Magill, 2004:6). A Geographic Information System (GIS) was created that could calculate the cost of bulk infrastructure, hence the name 'Cost Surface Model'. This is shown in Figure 6.4 below. The dark red represents areas where infrastructure costs would be highest.

Figure 6.4 Cost Surface Model of bulk infrastructure for the metropolitan area.



Source: Magill, 2004:27

The cost of bulk infrastructure is now playing a more profound role in public housing planning. The municipal Housing Department is now actively using the model as a tool to determine the cost for bulk infrastructure and as an input to decision making around potential locations for new public housing (Breetzke, 2009:20). As mentioned before, the costs for bulk infrastructure in the peripheral areas of the eThekwini Municipality are higher than in the central areas. The model has now provided inputs for formulating alternative locations (Magill, 2004:104).

The adequate provision of social infrastructure facilities to housing projects is being facilitated by another model called the 'Accessibility Model'. This model has been designed to consider the supply and demand for social infrastructure facilities across the metropolitan area (Green & Mans, 2008:11). The model does not comment on individual housing development projects as such projects generally do not require additional social facilities. However, when housing developments are clustered, new facilities are displayed by the model (Green & Mans, 2008:45).

It has been noted that in low income housing developments, there is usually not sufficient vacant land in the immediate vicinity to accommodate social facilities and these are being proposed in areas further from the housing developments than would be preferred. The Accessibility Model is also advancing the spatial intent of clustering public investments in nodes along corridors. The model has signified a move from the broad conceptual spatial frameworks to a more ridged approach to strategic spatial planning (Green *et al.*, 2008:311).

During the past 20 years, spatial planning in Durban has shifted from master planning with its inaccuracies and rigidity to planning frameworks which have been too conceptual in nature and more recently to harder and more numerically-based GIS modelling. These models have improved the integration of spatial and infrastructure planning in the municipality and assisted decision making. The development of a common future spatial vision that is shared by various stakeholders within and outside local government is essential. Commitment to these new and improved methods of planning will greatly assist the effective long-term forward planning for infrastructure.

6.2.1.3 South East Queensland Australia

In this section, the integration of infrastructure and spatial planning in South East Queensland Australia will be discussed as an example of sustainable infrastructure planning at a regional scale.

Australia's South East Queensland Regional Plan (SEQRP) is used as a statutory tool and is subject to national planning legislation, but is effective in its own right. This policy is also the pre-eminent plan for the South East Queensland (SEQ) region and takes precedence over all other planning instruments (Queensland Government, 2005a:1). Under the Integrated Planning Act 1997 (IPA), the Regional Plan reveals any inconsistency with any other policy, including any other planning instrument made under national legislation. The Regional Plan however has been created to complement other planning policy, rather than to override relevant national planning instruments. Any national plans must be in accordance with the Regional Plan when South East Queensland is affected (Queensland Government, 2005a:2). The purpose of the Regional Plan is to accommodate sustainable growth in the SEQ region. The strategy comprises of the determination of appropriate developable land to meet future population growth as well as the provision of timely and cost-effective infrastructure.

The SEQRP consists of several sections, one of which sets the regional policies to address growth management in SEQ and provides the planning principles and guidelines for managing the future development of the SEQ region (Queensland Government, 2005a:21). Such regional policies must be reflected in all relevant plans, policies and codes being prepared or amended by National or Local Governments in the SEQ region. This means that local government schemes must be in line with the above-mentioned policies as they relate to sustainability, urban development and infrastructure amongst others. These regional policies provide the direction for the various planning instruments. Maps indicated as being for information only are intended to represent general concepts for broad-scale planning. (Queensland Government, 2005a:116).

Another section of the SEQRP sets the regulatory provisions. These regulatory provisions controls the extent of subdivisions permitted for certain regional land-use categories. In such provisions, spatial referencing moves from conceptual to statutory. The regulatory provisions of the Regional Plan, including the regulatory maps have effect from the date of release. The regulatory maps include information such as the extent, ownership and value of properties in the region which is then placed into regional land-use categories for the purpose of the regulatory provisions of the Regional Plan (Queensland Government, 2005a:126).

The last section of the SEQRP relates to the implementation and monitoring of the Regional Plan. This regional level plan relies on a series of other plans to provide more accurate guidance in order to facilitate land-use management and infrastructure implementation. Additionally, it is stated in the SEQRP that the Regional Plan refers to a range of supporting documents including the Annual SEQ Infrastructure Plan and Programme (SEQIPP). The SIQIPP highlights the Queensland infrastructure priorities in support of the Regional Plan. It arranges infrastructure into priority categories for the next ten years, with a 20 year planning time frame (Queensland Government, 2005b:2).

Only regional investments significantly influencing the Queensland Government agencies were identified in the first Infrastructure Plan. Some Australian and strategic local government projects relevant to the SEQRP were also included in the Infrastructure Plan. Although the link between the SEQRP and the Infrastructure Plan is made explicit in both documents in terms of process and statutory status, the content links are not equally explicit in the way the documents are compiled, especially to an outside reader.

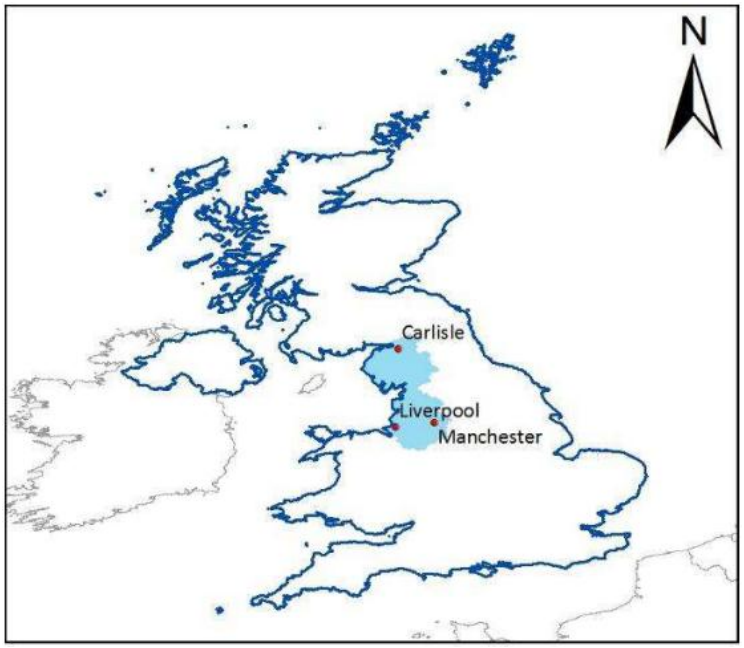
From this case study, it can be seen that a single strategic plan can improve the effectiveness of spatial planning as well as infrastructure planning for any given area. Such strategic plan must include the relevant policies and regulatory provisions that can provide a framework for successful strategic planning in addition to moving such strategic plans from conceptual to application. Such a strategic plan should additionally be the lone planning instrument that overrules any other plan that is not aligned therewith.

6.2.2 Green Infrastructure Planning Case Studies

6.2.2.1 North West England

North West England is located along the eastern boundary of the Irish Sea, along the western boundary of the Pennine hills, bordering on south Scotland to the north, and the Welsh Mountains to the south as indicated on Map 6.5 below.

Map 6.5 Location of the North West region in England



Source: Kazmierczak and Carter, 2010:1

The North West Climate Change Action Plan 2010 (CCAP, 2010) was drafted with the help of regional partners, organisations and experts and sets out a vision of a "*low carbon and well adapting Northwest England by 2020".*

The CCAP 2010 includes a document of green infrastructure as an adaptation response to climate change impacts. The adaptation to climate change is one of three objectives of the plan. The other two include reducing greenhouse gas emissions and capitalising on opportunities for economic growth offered by climate change (CCAP, 2010:6). The relationship between environmental issues and economic development is increasingly being recognised (Stern, 2006:12). In 2008 a report named the "*Critical climate change functions of green infrastructure for sustainable economic development in the North West"* (Mersey Community Forest, 2008) was produced by

Community Forests Northwest and aimed to highlight where the climate change mitigation and adaptation functions would benefit the Northwest Region in terms of economic development. This report is presently being updated as "*Green infrastructure: how and where can it help the Northwest mitigate and adapt to climate change?"*

The themes driving the CCAP 2010 are green infrastructure concepts in regional planning research and practice. Green infrastructure includes multi-purpose open space networks that support the natural and ecological processes which are essential to the quality of life of sustainable communities (CLG, 2008:4). Green infrastructure is seen as an important method in mitigating climate change by managing high temperatures, water supply and soil erosion and includes fossil fuel substitution amongst others. The Regional Economic Strategy (RES) refers to the natural environment as an underutilized economic asset and aims to exploit this potential to the fullest (NWDA, 2006:6). The Regional Spatial Strategy (RSS) states that local authorities need to plan and implement green infrastructure for climate change adaptation by using prescribed mechanisms (GONW, 2008:94).

Within the CCAP 2010, green infrastructure is primarily aimed at developing a regional adaptation framework which sets out the regional response to projected climate change impacts (CCAP, 2010:19), and includes amongst others the following:

- Flood and coastal risk management through catchment and shoreline management plans.
- The regional assessment of risk, opportunities and priorities for green infrastructure in adapting and mitigating for climate change.
- Adaptation response strategies for the region's distinctive landscapes, habitats and species, and the assessment of the contribution of natural systems to carbon sequestration and reduced flood risk.
- The development and delivery of plans for water efficiency, reliability and carbon reduction.

The CCAP (2010) demonstrates the importance of formulating appropriate policy frameworks for green infrastructure planning for local governments. Such policies

should identify the opportunities and challenges presented by green infrastructure provision while creating channels through which implementation can occur.

6.2.2.2 Chicago

The following case study is an example of green infrastructure application through appropriate incentive policies on a metropolitan scale. The Chicago local government launched several programmes in order to incentivise private developers to incorporate green building practices into their developments in return for financial compensation.

Chicago is the third largest city in America, situated alongside Lake Michigan as illustrated on Map 6.6 below.

Map 6.6 Locality of Chicago

Source: World Business Chicago, 2014:9

Chicago is one of the most important transportation and communications centres for the United States with a strong industrial presence boasting the second largest Central Business District (CBD) and workforce in America (City of Chicago, 2009:2).

Chicago aimed at becoming the 'greenest' city in America by implementing environmentally sustainable 'green solutions' such as green buildings, lowered energy consumption as well as infrastructure and resource management (WERF, 2013:5). As

a result, the Green Permit Programme was launched in 2005 in order to realise the above-mentioned goal. This initiative is based on linking sustainable practices with green economics, business projects and enhancing the quality of life for the local residents of Chicago as well as tourists.

This programme consists of an accelerated permit process for new building proposals which is subject to certain criteria. This criterion revolves around the incorporation of green building practices into new building designs. In instances where exceptionally low environmental impacts are achieved, the permit costs can be waived completely. Points are awarded for building design and construction practices according to six categories (DOB, s.a:3):

1. Sustainable sites,
2. Water Efficiency,
3. Energy and atmosphere,
4. Materials and resources,
5. Indoor environmental quality, and
6. Innovation and design.

In order to qualify for an expedited permit and to obtain planning permission for new buildings, developers must add elements of green building strategies to their designs as selected from the 'green menu' which was created by the Department of Buildings (DOB). Such planning permission permits can be issued in less than thirty days as apposed to the standard three months (USGBC, 2013b:23). In addition, the more items that are included into any given development design, the shorter the waiting period and in some cases may even have the permit fees completely waived where a particularly high level of green strategy is displayed (USGBC, 2013b:24).
Items available on the 'green menu' include the following (DOB.s.a:7):

- Green roofs,
- Exceptional energy performance,
- Renewable energy,
- Extra affordability,
- Transit-orientated developments and difficult to develop areas,
- Innovation,

- Exceptional water management, and
- Natural vegetation.

In addition, commercial, industrial and residential developments have to meet the criteria as set out in the Leadership in Energy and Environmental Design (LEED) rating system (USGBC, 2013a:1). By accumulating points, buildings can achieve a rating of LEED Silver, Gold or Platinum (USGBC, 2013a:2).

The Permits Program is one of several strategies within the Chicago Green Building Agenda. The Chicago local government realised that multiple initiatives must be used to address different areas of need and to accommodate different perspectives on development.

Subsequently the '*Green Roofs Initiative'* was launched in 2004 and applied to new public buildings as well as privately funded buildings (City of Chicago, 2009:1). The Chicago local government subsidized such buildings in an attempt to encourage the installation of green roofs. There is also a density bonus whereby developers may add a certain number of units allowed on a property if 50 percent or 2 000sq feet of a roof is covered by vegetation.

The '*Green Roof Implementation Programme*' is aimed at commercial developments within the financial district of Chicago (City of Chicago, 2009:2). Such developments can receive reimbursement grants if they meet certain criteria such as 50% or higher vegetated roof coverage that is highly visible to the surrounding properties and the monitoring of the green roof's performance in terms of storm-water management and Urban Heat Island (UHI) mitigation amongst others.

The '*Green Homes Programme*' is aimed primarily at residential buildings and developers to incorporate technologies relating to energy efficiency and improved indoor air quality amongst others (City of Chicago, 2009:3).

The following financial benefits can be achieved by developers with these programmes (USGBC, 2013a:5):

- Time for planning permission is reduced and therefore saves the developer money;
- Green roofs can last up to twice as long as conventional roofs due to their limited exposure to the elements;
- Financial savings on energy bills for cooling as green building practices can naturally reduce the temperature within the building; and
- Contributing to local economic development by creating job opportunities during the construction phase.

The case of Chicago is a prime example of a local authority that addresses the challenge of climate change in a creative manner. There are several benefits that can result from incentivising developers to invest in green building practices. Such benefits range from financial savings to environmental sustainability and aesthetics.

6.2.2.3 Faenza Italy

Faenza[19] is an Italian city located at the foot of the Sub Apennine hills approximately 50km south-east of Bologna in the province of Ravenna as illustrated in Map 6.7 below.

Map 6.7 Location of Faenza

Source: Kazmierczak and Carter, 2010:2

[19] The information for this case study has been collected and translated from Italian to English by Irene Ianni and Maria Grazia Cuvato from the University of Catania visiting the University of Manchester

During the preparation of the 1999 Town Planning Regulations for the city of Faenza, the local government developed a "Municipal Rule of Green", which emphasised the function of green open spaces in order to improve the air quality in the urban environment. This vision has led to the creation of the *bio-neighbourhoods incentive programme* which was included into the Faenza Town Planning Regulations. This programme incentivised developers to use recycled building materials, fully utilise the space inside buildings and to soundproof their buildings in order to achieve water and energy saving targets. Developers were allowed to incorporate a variety of land-uses and extend the extent of their buildings at the design stage of the development if they adhered to the required criteria. The programme additionally aimed to guide the placement of buildings in such a manner that allows continues green space areas to be maintained (Kazmierczak & Carter, 2010:2). Therefore, the objectives of the programme range from air quality improvement and energy savings to climate adaptation.

In addition to the above-mentioned criteria, developers could only increase the size of buildings and incorporate different land-uses, when the 'green building' criteria has been met. Such criteria include the following (Kazmierczak & Carter, 2010:2):

- Buildings must have large windows facing in a south-easterly and westerly direction;
- Making use of environmentally friendly and natural materials;
- Avoiding any forms of pollution (including sound and electromagnetic pollution);
- Promoting natural ventilation;
- Making use of electronic devices to limit the alteration of electro-magnetic fields;
- Making use of low-emission and efficient heating systems;
- Making use of rainwater-recovery systems and utilising captured water for irrigation purposes;
- Green spaces should be arranged in such a fashion that they provide shading and cooling in addition to screening wind and noise which means that appropriate tree species should be selected; and

- Taking local context into account such as the environment, architecture and building types.

These measures were drawn up by professional engineers of the Building Commission of the Faenza local government. If new developments incorporated existing buildings, such buildings would also need to meet the above-mentioned criteria. Furthermore, developers were granted the right to enlarge buildings if they minimize land consumption by concentrating development on one part of the site which then leaves the remainder of the site to be utilised for public open space (Kazmierczak & Carter, 2010:3). In urban areas, developments did not have to commit as large a portion of the land to open space to qualify for incentives as in peri-urban areas where plots tend to be larger in extent. Figure 6.5 below depicts one example of a bio-neighbourhood in Faenza.

Figure 6.5 Example of bio-neighbourhood in Faenza

Source: Kazmierczak & Carter, 2010:4

The municipal administration of Faenza has the authority to inspect completed development projects to assess whether the required criteria has been met. The administration of the Faenza municipality was also the leading role player in the development of the initiative (Kazmierczak & Carter, 2010:5). The political buy-in of the municipality to incorporate the bio-neighbourhoods scheme into the Town

Planning Regulations was an important factor in ensuring the success of the programme. Other stakeholders include the developers and individual citizens who want to construct a bio-neighbourhood. The stakeholders can by virtue of the programme be involved in the negotiations on the design of buildings and consequently become engaged in the town planning process.

Due to the inclusion of the bio-neighbourhoods programme in the Town Planning Regulations, the scheme covers the entire jurisdiction of the municipality of Faenza. The inclusion of the scheme into the Town Planning Regulations is arguably the most important element in the success of the programme (Kazmierczak & Carter, 2010:5).

This approach presents a true environmental planning initiative in contrast to the economically focused goals used by municipalities. This lack of rigid standards encourages developers to search for innovative solutions to the design of buildings. It can thus be noted that flexible rules in Town Planning Regulations to promote sustainable development can be as effective as rigid standards (Kazmierczak & Carter, 2010:6). The participation between developers and the municipality ensures a good understanding between all parties involved in addition to saving time.

6.3 Planning Frameworks

Spatial planning frameworks in South Africa have been too broad and utopian to be practically applicable in terms of implementation (Todes, 2008:1). Furthermore the spatial planning frameworks do not sufficiently link to infrastructure planning and have been contradicted by both trends in the property market and national policy (Todes, 2008:1). It can be argued that the framework plans looks well on paper but cannot realistically be executed in practice. Spatial planning frameworks are necessarily broadly based, as they need to consider long-term spatial development directions.

The planning of future infrastructure investments should not be taken lightly, especially as ‘physical’ infrastructure such as roads lay down very dominant structural elements that last for decades or even centuries. Although town and regional planners have been involved with Local Economic Development (LED) for decades, very little

attention has been given to the workings of the 'real economy' of the city in the South African context (Harris, 1990:10). The focus on economic activities and the positioning thereof in terms of maximum exposure have not effectively been made by local planning frameworks (Todes, 2008:3). Linking infrastructure planning to spatial planning at an earlier stage at a strategic and more local level would mean the economic potential of cities can increase, thus benefitting both the businesses and wider community (Todes, 2008:3).

Internationally, attempts to align spatial planning with infrastructure planning were done through comprehensive master planning, and through public provision of infrastructure (Todes, 2008:4). In South Africa, there does appear to be some form of integration between spatial planning and infrastructure planning at a strategic level; however this does not always unfold in practice as a number of problems arises between the two forms of planning (Goss, 2008:11). Strategic spatial planning is guided by spatial planning frameworks that prioritise individual elements at a conceptual level (Goss, 2008:11).

In the South African context, these framework plans are used at both national and local levels. The NSDP (2006) as discussed in Chapter 3.3 is an example of a strategic framework at national level, whereas the IDP's and SDF's are being used at local level. However in terms of national planning, the NSDP does not provide specific guidance for focused infrastructure investments (Goss, 2008:11).

The reason for the vagueness of the NSDP (2006) and similar strategic frameworks in terms of investment guidance is that they were never intended for high levels of detail, and therefore necessitate lower level plans for guidance (Goss, 2008:11). The strategic spatial frameworks at a local level (SDF's) are similarly vague and conceptual in nature and pose several challenges for private investors as there is not sufficient information for decision making (Goss, 2008:11). Municipalities are seemingly finding it difficult to link spatial planning with infrastructure planning, as future infrastructure investments remain conceptual and strategic in nature with little to no detail within strategic spatial planning instruments.

In addition to the above-mentioned challenges relating to the conceptual nature of strategic plans, the complex statutory environment to which infrastructure planning is subject in the South African planning system makes the integration of spatial planning and infrastructure planning even more difficult (Goss, 2008:15). New infrastructure investment applications processed by municipalities have to undergo a variety of consent processes which not only take up time and money, but may decrease the chance of approval of new applications as consent must be provided by all relevant departments. As mentioned in chapter 3.3, the spatial planning frameworks being used in South Africa have focused on the positioning of development nodes and corridors and have neglected to consider the multi socio-dynamics of cities.

According to Godehart (2006:14) the primary use of nodes and corridors misses the way informal activities organise spatially at a local level, as well as the people supporting them. In many respects, the traditional use of nodes and corridors draws attention away from the need to understand how people use space within the city as well as how movement patterns occur (Todes, 2008:2). Many of South Africa's stadiums and airports built for the 2010 Soccer World Cup do not follow spatial plans and are driving development in certain directions not anticipated by planning frameworks. Such infrastructure developments can be more powerful in shaping the spatial structure of a city than spatial planning frameworks.

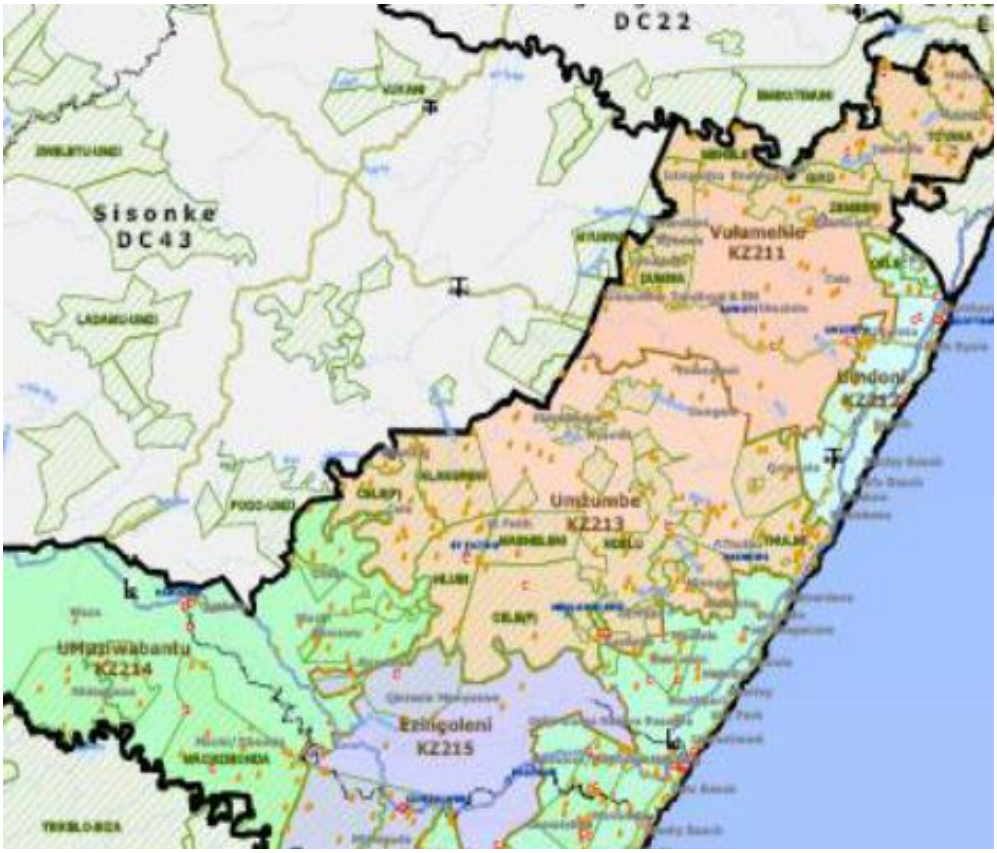
In the South African context, the idea of strong, credible spatial plans which have both political and stakeholder buy-in and are well founded in terms of spatial, demographic and economic analysis is becoming more popular (Todes, 2008:6). This suggests that there is a need for greater engagement between infrastructure and spatial planners focusing on various influences such as economics, politics and demographics.

6.3.1. Ugu District Municipality

The Ugu District Municipality (DC 21) is classified as a category C2 municipality and is located at the most southern tip of KwaZulu-Natal. It is bordered by the Eastern Cape Province to the South, Indian Ocean to the east, Sisonke and Umgungundlovu to

the west and eThekwini to the north. Ugu comprises of 6 local municipalities which include Ezinqoleni, Umuziwabantu, Hibiscus Coast, Umdoni, Umzumbe and Vulamehlo as indicated in Map 6.8

Map 6.8 Ugu District Municipality



Source: Ugu DM IDP, 2012:15

The draft Spatial Development Framework (SDF) Map for Ugu District Municipality depicts several different elements pertaining to development and land-use.

The Ugu District Municipality IDP refers to present and future infrastructure development plans including their Integrated Infrastructure Investment Plan, Integrated Transport Plan and Water and Sanitation Master Plan. These strategic plans consist of water and sanitation infrastructure backlogs and waste-water treatment studies and bulk infrastructure development studies.

Ugu is the Water Service Authority (WSA) and Water Service Provider (WSP) in the district and the provision of water constitutes 70% of the municipality's function. The

Water and Sanitation Master Plan additionally reveals that all policies relating to the urban water borne sanitation programme are in place; however adequate funding remains a challenge and the municipality's vision of reaching 100% access to water and sanitation by 2014 as indicated in the Millennium Development Goals (MDG) will not be reached. The water backlog in the municipality is 34% due to old water infrastructure and a lack of capacity in key treatment plants.

The Ugu IDP and SDF also list their infrastructure Status Quo for telecommunications, sanitation, housing, roads, electricity and renewable energy. Under telecommunications infrastructure the IDP acknowledges the importance of this particular infrastructure in terms of economic development and that there is a need to address the current backlog, especially in the rural areas of the municipality. It is also noted in the SDF that information on telecommunications infrastructure is difficult to obtain from the service providers due to competition. The involvement of Telkom and other service provides in planning workshops has been identified in the SDF as a suggestion for forward planning.

In terms of sanitation the IDP mentions that only a third of the coastal strip of the municipality has access to waterborne sanitation and that the remaining population makes use of alternative methods such as septic tanks, conservancy tanks and package plants. The SDF however does not address sanitation infrastructure management controls since the District Framework Plan is strategically based.

The IDP's section on roads states that the KwaZulu-Natal Department of Transport has identified certain intermodal public transport facilities in an attempt to improve public transport for economic gain. The town of Port Shepstone has been identified as a potential nodal point due to its location in close proximity to the hinterland where a large portion of the working population resides. Approximately 90% of residents using public transport in the district make use of Minibus Taxi's. The SDF explains that connectivity deals with the linking of the road network and that accessibility deals with the linking of various activities such as economic nodes and places of social significance. The Ugu district has relatively good connectivity; especially the roads linking the north to the south; the east to west connectivity however is poor. The

district additionally has poor accessibility due to a lack of road infrastructure maintenance.

Eskom is the electricity service provider for the majority of the Ugu district and the alignment of the municipality's plans and Eskom's plans is not always adequate. The SDF states that an Electricity Sector Development Plan (ESDP) is currently in place and that the rural areas have been identified as being in need of intervention. The Ugu IDP also mentions renewable energy infrastructure and states that several renewable energy generation projects have been identified in the Ugu District, including various sources such as wind-energy and sugar cane. The Municipality has commissioned a feasibility study on the potential resources that can be used while also drafting an Integrated Energy Strategy. Ugu District Municipality will apply for an energy regeneration licence in order to increase its revenue streams in addition to providing clean and affordable energy to the private sector.

In terms of storm-water infrastructure, the SDF states that Ugu does not have a Storm-water Management Plan in place. On local Municipal level, storm-water should be dealt with as part of a Roads and Storm-water Management Plan and be included in the local and district IDP.

To enhance integrated planning in the municipality, a Storm-water Management Plan needs to be in place, service providers of telecommunications infrastructure should be included in the planning process and future infrastructure should take spatial developments into consideration.

6.3.2 Hibiscus Coast Municipality

The Hibiscus Coast Municipality (KZN216) is a Category B municipality and located in the Ugu District of KwaZulu-Natal. The municipality covers approximately 837 square kilometres that stretches along the southern coastline as depicted on Map 6.9

The Hibiscus Coast Municipality (HCM) IDP provides a number of initiatives for infrastructure development including the following:

- Facilitating Ugu District Municipality in providing access to clean potable water by 2014 to all communities in HCM;
- Ensuring that all communities have access to electricity by 2014;
- Providing access to housing;
- Providing infrastructure that is conducive to economic development;
- Acquiring more resources to provide and maintain existing infrastructure; and
- Job creation through infrastructure development.

Map 6.9 Hibiscus Coast Locality

Source: HCM IDP, 2012a:6

The afore-mentioned initiatives have led to key focus areas in the HCM IDP including the provision and maintenance of infrastructure amongst others. There is however a number of challenges facing the municipality in terms of infrastructure service delivery including the deterioration of existing infrastructure.

Previous planners did not anticipate the rapid urbanisation and as a result, infrastructure services are now being put under a great deal of stress. Most roads (both provincial and local) are in a state of deterioration. This is due to the lack of regular maintenance of the road network. This is exacerbated by the heavy motor vehicles that make use of the municipal roads. A comprehensive Public Transport Plan was drafted in 2006; however, a local Integrated Transport Plan needs to be developed in

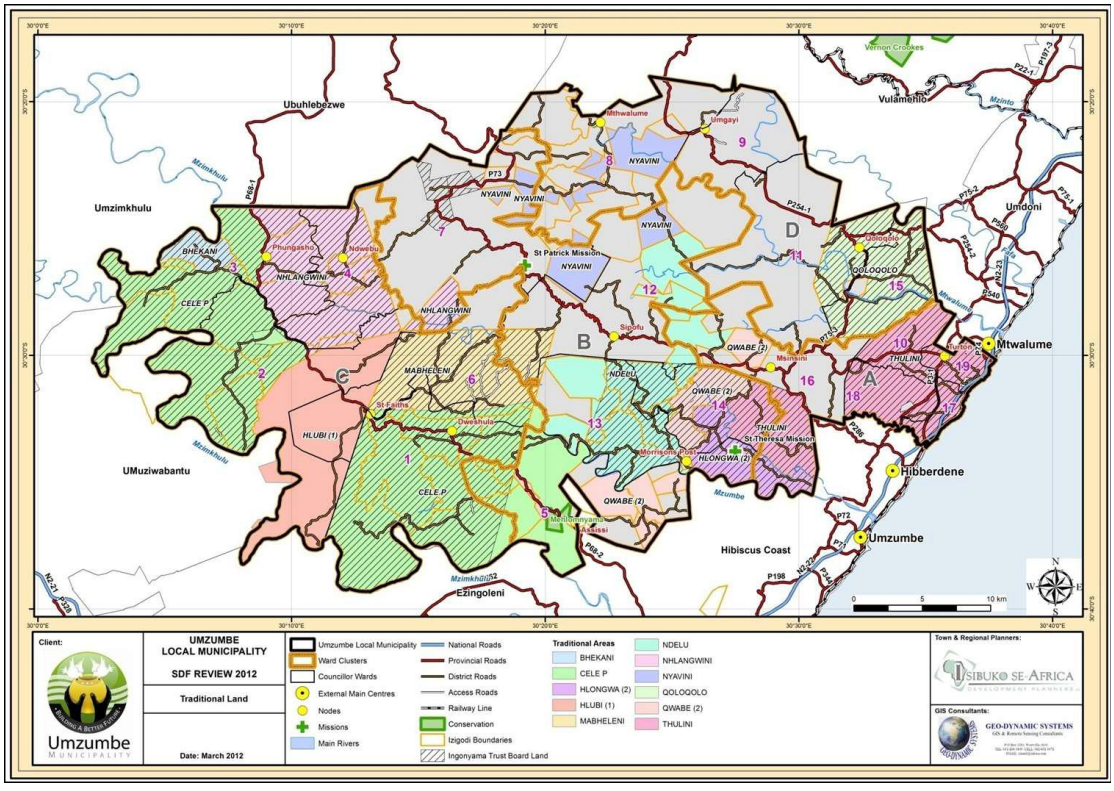
order for infrastructure planning to be successful. According to the municipality, the lack of proper town planning has been pointed out as one of the key causes for the deteriorating roads.

Eskom is the electricity provider for the majority of the municipal area, except for Port Shepstone which is supplied by the Hibiscus Coast Municipality. The Hibiscus Coast Municipality has set aside R3 600 000, 00 for alternative energy for the year 2012/2013 in the form of gel stoves and lamps. The municipality is further doing research on the viability of solar power in the areas that still do not have electricity.

6.3.3 Umzumbe Municipality

Umzumbe Municipality (KZN 213) is one of the six local municipalities within the Ugu District. It runs along the coast for a short strip between Mthwalume and Hibberdene and then balloons out into the hinterland for approximately 60 km as depicted in Map 6.10.

Map 6.10 Umzumbe Locality



Source: Umzumbe Municipality SDF, 2012a:31

One of the Umzumbe Municipality's key responsibilities is to provide access to basic infrastructure and services. The municipality faces certain challenges in providing the above-mentioned service, especially roads infrastructure in the rural areas.

The IDP indicates that Umzumbe has a large water backlog of approximately 35%. A number of potential sources have been identified for water provision. The SDF indicates that Umzumbe is located in the South Coast catchment, which includes the Mzumbe, Mtwalume and Mpambanyoni Rivers. Currently, this catchment is experiencing a small deficit, mostly during holiday peak season. The provision of off-channel storage can solve this problem.

In terms of sanitation, the IDP reveals that communities are not well provided with the necessary basic infrastructure as the municipality has a sanitation backlog of approximately 30% and the only sewer options are Ventilated Improved Pit Latrines (VIP). Within the Ugu Infrastructure Audit Report, it states that there is no accurate data concerning VIP's in the district. This poses a serious challenge as it hampers the future planning of VIP's in the area. The greatest challenge facing the rural sanitation programme is identifying how to deal with the emptying of full pits in a hygienic and cost effective manner.

With regard to transport infrastructure, the IDP states that only a limited number of roads have been constructed by the municipality as it is completely reliant on grants from other spheres of government. The SDF states that local roads account for 4% of the total roads and that the national and provincial roads are in a generally good condition, while the quality of district and local roads are poor. This is mainly because these roads are gravel and require regular maintenance and upgrading. The nearest airport to Umzumbe is located in Margate in Hibiscus Coast Municipality. However, the reliability of its service could not be confirmed. King Shaka Airport is approximately 100km from Umzumbe north of Ethekwini Metro along the N2.

In terms of electricity, the IDP states that access to electricity remains a challenge in the municipality. This is due to the lack of infrastructure as well as a lack of funding. To address the electricity backlog situation in Umzumbe, the municipality has identified regional projects for the period 2011 to 2024. The SDF reveals that 67% of

households in Umzumbe have access to electricity and has additionally identified extensive areas within Umzumbe for community level planned projects over the next five years.

The Umzumbe SDF further lists the social infrastructure status quo for education, health, police stations, sports facilities, libraries, community halls and cemeteries. The provision of health facilities should consider public transportation and service thresholds, and be located close to activity areas and regular places of gathering.

The Umzumbe SDF additionally includes a section for Climate Change Adaptation and Mitigation wherein it is stated that Umzumbe is an area that is highly sensitive and vulnerable to climate change due to the high degree of natural variability in climate, and that regular climate extreme events are already detrimentally affecting the inhabitants of Umzumbe. Mitigation strategies such as map delineation and the relocation of settlements that are located in areas with flood risk should be drawn up to prevent further damage.

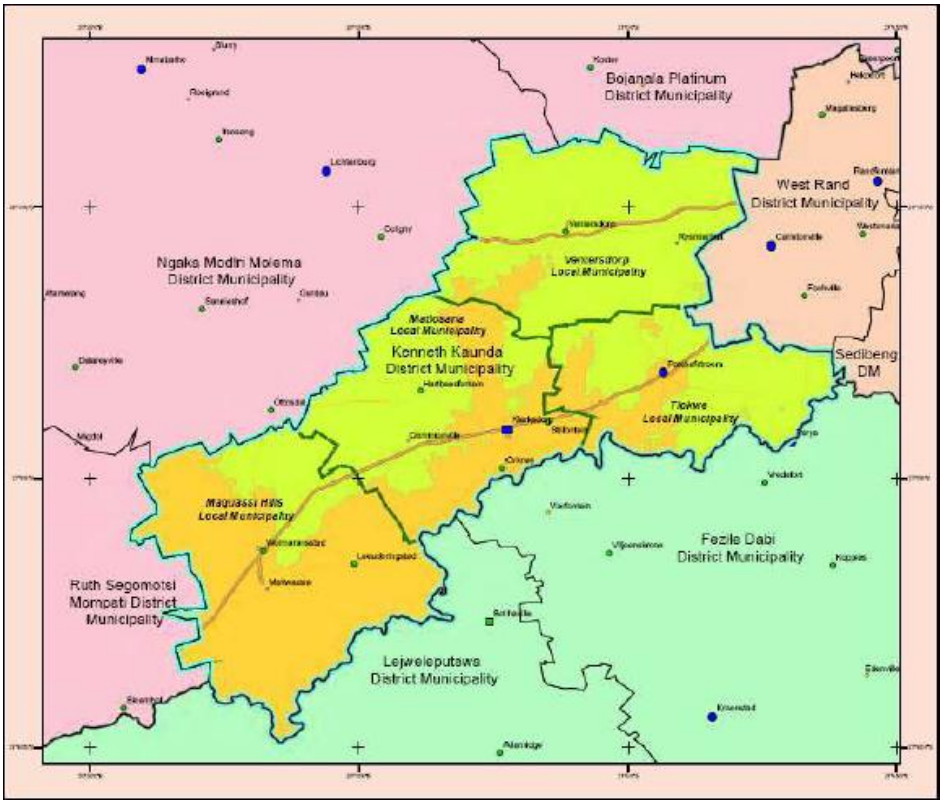
And lastly, the Umzumbe SDF includes an Integrated Sustainable Spatial Planning System wherein a hierarchy of plans will improve spatial planning in the municipality. These plans include a Local Area Plan which will focus on infrastructure provision and the protection of valuable land. The Precinct Plans will manage land on a more statutory level while the Settlement Plans should identify the constraints and opportunities of the land.

6.3.4 Dr Kenneth Kaunda District Municipality

The Dr Kenneth Kaunda District Municipality consists of four local municipalities including Matlosana, Tlokwe, Ventersdorp and Maquassi Hills. The municipality is located at the southern part of the North West Province of South Africa. The municipality borders the Free State Province along the southern boundary and Gauteng Province along the western boundary. The N12 highway is the primary transportation corridor within the district and links the municipality with the Gauteng and Northern Cape Provinces as illustrated by Map 6.11 below**.**

The Dr Kenneth Kaunda District Municipality IDP states that a strategic planning workshop was held in July 2008 wherein the strategic direction of the municipality was mapped out. The IDP includes strategic planning documents such as their Integrated Transport Plan and Integrated Waste Management Plan. The Dr Kenneth Kaunda District Municipality is not a Water Service Authority and therefore provides limited information relating to water or sanitation infrastructure in the IDP and SDF.

Map 6.11 Dr Kenneth Kaunda DM locality



Source:Dr Kenneth Kaunda DM IDP, 2012b:40

The IDP further includes the status quo for the municipality in terms of access to basic service delivery infrastructure. It reveals that the majority of residents in the municipality have access to piped water, either from within the dwelling or inside the yard. Approximately 82% of residents have access to electricity. More than 70% of residents have access to flush toilet facilities which are connected to a sewer system and only 2.4% of residents do not have access to toilet facilities.

More than half of the population resides in dwellings with a brick structure on a separate stand and approximately 17% of residents live in informal dwellings in informal settlements. The SDF lists the social infrastructure facilities up to 2020. These include Primary Schools, Secondary Schools, Clinics and Police Stations.

6.3.5 Tlokwe Municipality

Tlokwe Municipality is a Local (Category B) Municipality and located in the South Western corner of the North West Province of South Africa as indicated on Map 6.12. The southern boundary borders with the Free State Province and the eastern boundary borders with Gauteng Province. The N12 and N14 highways are significant transportation corridors in the municipal are, linking up with other major nodes within the province in addition to other provinces.

Map 6.12 Tlokwe Municipality locality

Source: Tlokwe Municipality IDP, 2011:5

The Tlokwe Municipality IDP provides a status quo for service delivery infrastructure including water and sanitation, housing, roads and storm-water and electricity, as well as social infrastructure such as education, libraries and tourism infrastructure.

The lack of maintenance of provided water pipes and insufficient underground water sources have been highlighted as the main reasons for the lack of water provision in the region.

During the past few years, there has been a vigorous process of tarring roads in the municipality. New developments have also had their roads tarred and storm-water systems are in the process of being installed.

In terms of transport, the SDF mentions the major transport links such as the N12 National Road, linking Tlokwe with Gauteng, Kimberley and Klerksdorp. Mobility in terms of public transport is provided via minibus taxis and buses. In October 2007, the Integrated Transport Plan of Potchefstroom was compiled focusing on the road network within the Potchefstroom City Council boundary. The SDF additionally mentions that the N12 caries the highest number of heavy motor vehicles. The strategic vision for the municipality is to capitalise on the location of Tlokwe on the N12 Treasure Corridor.

The SDF further explains strategic planning conceptual elements such as activity corridors, activity spines and streets as well as specialised nodes such as rural development nodes. Other conceptual elements include the Municipal Open Space System (MOSS) that focuses on the protection of biodiversity in the urban and rural areas and to provide plant species with habitats. The Mixed-Use Development emphasises the importance of locating compatible residential and non-residential land-uses together for economic and social benefits.

6.4 Qualitative perspective of integrated planning

An interview process was carried out by sending interview questionnaires to the relevant interviewees. The interview questionnaire contained three provided answers to each of the ten questions with an additional space for the interviewee to respond freely to any question in the event that none of the provided answers accurately reflected the opinion of the interviewee. The questionnaire was sent to professionals ranging from civil engineers, municipal infrastructure managers and lawyers to town

and regional planners working in both the public and private sectors. Such professionals were based in several different provinces across South Africa including the Northern Cape, North West Province, Gauteng and Kwa-Zulu Natal. International participants included town and regional planners form Australia working in both private and public sectors. A total of 17 individuals took part in the interview process. A short description of the ten questions that were presented to the interviewees along with the provided answers will be displayed in the following section, with the feedback illustrated in the form of a pie-graph. The feedback will then be summarised to indicate the prevailing opinions.

6.4.1 Socio-economic significance of infrastructure

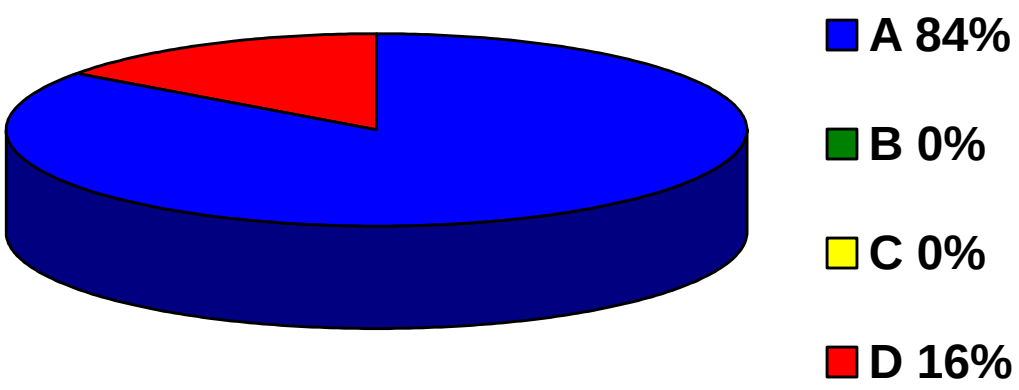
A) Infrastructure stimulates economic growth and development by providing a foundation for economic activities and job creation. Infrastructure further promotes the social wellbeing of citizens by enhancing connectivity and therefore positively impacts on socio-economic development.

B) Infrastructure development is costly; the return on investment can only be measured in the long-term and has therefore a negative impact on socio-economic development.

C) Infrastructure does not necessarily have a positive impact on socio-economic development as the benefits of infrastructure provision are subject to the optimum utilisation thereof.

D) Other

Graph 6.1: Socio-economic significance of infrastructure



Source: Own compilation

The vast majority of interviewees chose option A, meaning that the positive role that infrastructure plays in economic development and subsequently socio-economic development is well recognised. The provision of infrastructure that is linked to a proper service and maintenance plan will stimulate continued economic growth and development by providing a foundation for economic activities and sustainable job creation. Properly maintained infrastructure will further promote the social wellbeing of citizens by enhancing connectivity and therefore positively impact on socio-economic development.

6.4.2 Municipal planning policy frameworks

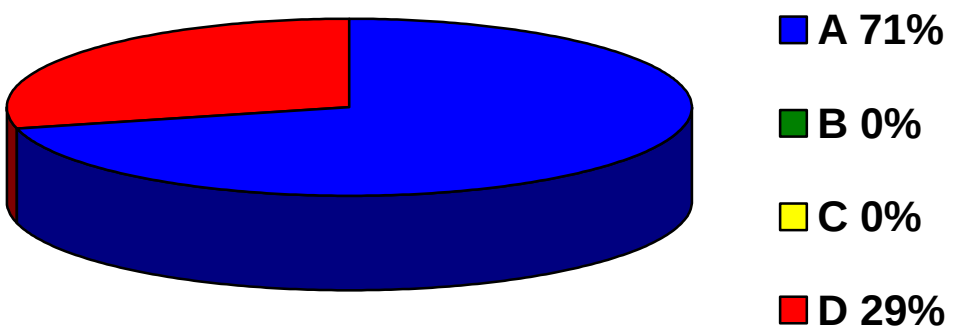
A) Municipal IDP's and SDF's set out strategic development objectives, direct future regional development by making use of all available resources and therefore provide sufficient guidance for planners in terms of infrastructure planning. However, ineffective budgeting and spending of funds as well as a lack of human capacity in key positions in Municipalities stifle the effective implementation process.

B) Municipal IDP's and SDF's are too conceptual in nature and can be interpreted in many different ways. They do therefore not provide sufficient guidance for planners in terms of infrastructure planning or implementation.

C) As Metropolitan, Local and District Municipality's IDP's and SDF's differ from one another to a large extent due to the different functions of each Municipality; the level of guidance in terms of implementation is difficult to determine.

D) Other

Graph 6.2: Municipal planning policy frameworks



Source: Own compilation

The largest portion of the interviewees chose option A, meaning that the strategic plans used by municipalities such as IDP's and SDF's offer sufficient guidance for focussed infrastructure planning. However the lack of crucial skills and knowledge in key positions stifles the effective implementation of infrastructure plans. All available resources are therefore not sufficiently being used by municipalities in their infrastructure planning process. In addition, the public participation process as provided for is not sufficiently being utilised. Civil Engineers are responsible for designing most if not all municipal infrastructure and should therefore be more involved in the planning process. It has also been mentioned that political interference plays an inappropriate role at local government level and stifles the effective planning and provision of infrastructure as a result.

6.4.3 Provincial and National Government responsibility

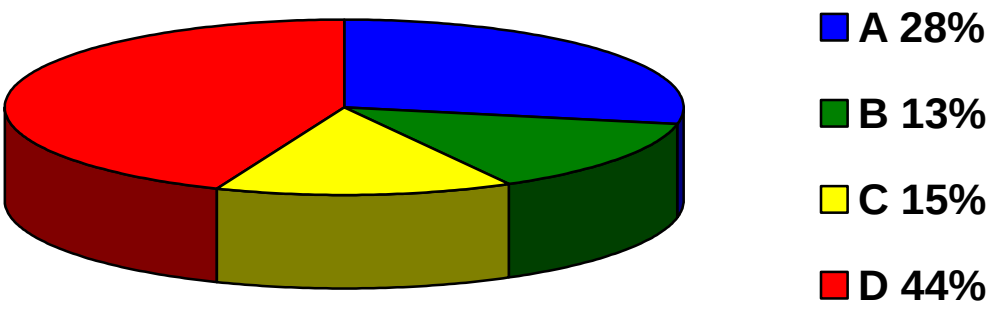
A) Infrastructure of national and provincial importance such as Education and Health Infrastructure should be planned by National and Provincial Government. The implementation of that particular infrastructure should be the responsibility of the Local Government in whose jurisdiction the particular infrastructure development falls. The implementation should further be initiated under the guidance of the relevant National or Provincial Government Department.

B) Provincial and National Government should take over the responsibility of infrastructure planning from Local Government in all respects.

C) Provincial and National Government should not form part of the infrastructure planning process. Local Government should be granted the freedom to plan and implement infrastructure of regional, provincial and national importance within their jurisdiction without the guidance of National and Provincial Government.

D) Other

Graph 6.3: Provincial and National Government responsibility



Source: Own compilation

A variety of responses were received to this question meaning that the roles and responsibilities of local, provincial and national government in terms of infrastructure provision are still not clearly defined. National and provincial government should take responsibility for the planning and implementation of economic infrastructure of national and provincial importance especially transport infrastructure such as national and provincial roads, railways, harbours and airports. Social infrastructure of national and provincial importance such as universities (education infrastructure), hospitals (health infrastructure), prisons (national security infrastructure) and reservoirs serving multiple municipalities (bulk water supply infrastructure) should also be the responsibility of national and provincial government. Maintenance of the above-mentioned infrastructure can either be done by national or provincial government, or it could be executed through a private-public partnership arrangement. Maintenance of such infrastructure can only be managed by municipalities if the national and provincial governments provide the funding for the task.

6.4.4 Municipal Climate Change policy

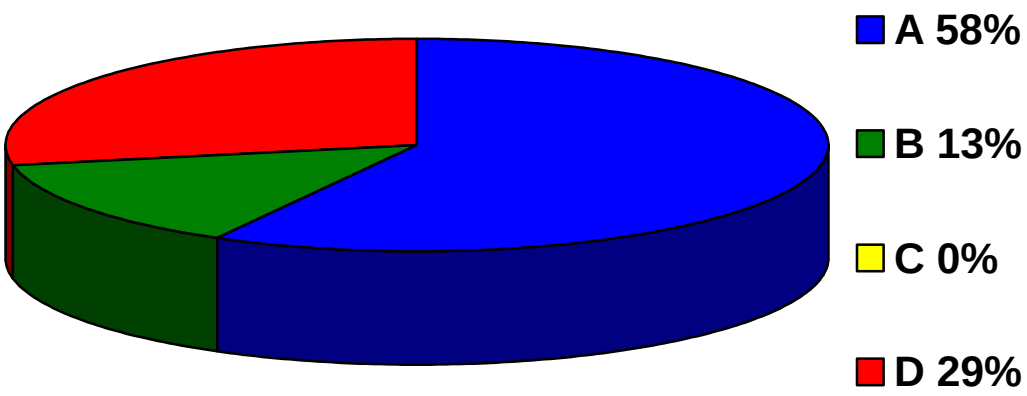
A) Climate Change is an important issue that needs to be addressed before it is too late. Green Infrastructure and Renewable Energy projects are not being given the necessary attention by Local Government in terms of planning or investment.

B) South African Municipalities are making the necessary attempts to address Climate Change in their current infrastructure policy.

C) Climate Change is an unproven international agenda driven by the United Nations (UN) to introduce a carbon-based tax onto the working class citizens. Municipalities should therefore not use their resources to plan for Climate Change.

D) Other

Graph 6.4: Municipal Climate Change policy



Source: Own compilation

The majority of interviewees chose option A, meaning that the importance of climate change adaptation is well recognised and that municipalities should address this issue in their infrastructure policy. There were however a variety of responses regarding the extent to which municipalities should address climate change in their policies and what national government's responsibility should be. The use of 'green building technologies' for climate change adaptation such as eco-roofs, solar geysers and rain water collection methods can be included into national building policies and legislation such as the National Building Regulations and Building Standards Act (No 103 of 1977), SANS 10400 and the National Bureau of Standards (SABS).

Although the National Building Regulations and Building Standard Act includes all local authorities, the Act makes provision for the exemption from the application of said Act for certain local authorities by notice in the Gazette from the Minister of Economic Affairs and Technology. This means that municipalities where 'green

building technologies' are not feasible will not be detrimentally affected. Large-scale renewable energy infrastructure such as solar, wind and hydropower should also be dealt with in national policies and legislation including the South African National Energy Regulator (NERSA) and the Independent Systems and Market Operator (ISMO). Green technologies such as permeable pavements, sustainable urban drainage systems (SUDS), solid waste and waste-water treatment methods and urban forestry can be addressed in local government policy such as town planning schemes.

6.4.5 Integrated Planning methodology

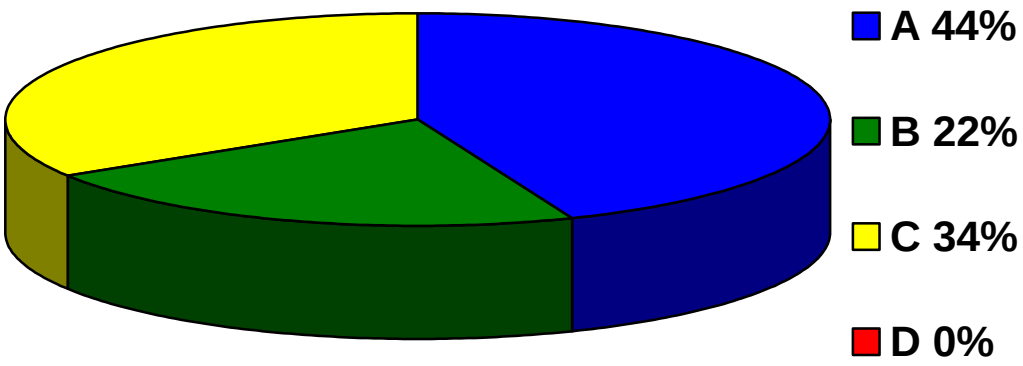
A) Development objectives, strategies and programmes are highlighted in national policy such as the National Spatial Development Perspective (NSDP), provincial policy such as the Provincial Spatial Economic Development Strategy (PSEDS) and local planning policy such as the Integrated Development Plans (IDP), and therefore provide sufficient guidance.

B) South African planning policy is too subjective and can be interpreted in many different ways. In addition, the absence of a National Spatial Development Framework (NSDF) is a definite shortcoming in current planning policy.

C) Integrated Planning is a specialised task and can only be mastered through years of experience in both Strategic and Statutory Planning in the professional arena.

D) Other

Graph 6.5: Integrated Planning methodology



Source: Own compilation

A variety of responses were received to this question meaning that the current planning policies in South Africa do provide a good framework for integrated planning in terms of methodology to some degree, but the absence of a National Spatial Development Framework (NSDF) is a definite shortcoming. There were additionally a fair amount of responses stating that integrated planning as an activity is not something that any person can learn to do by making use of policies and frameworks but can only be mastered by obtaining experience in the planning profession.

6.4.6 Renewable Energy Infrastructure Planning in Local Government

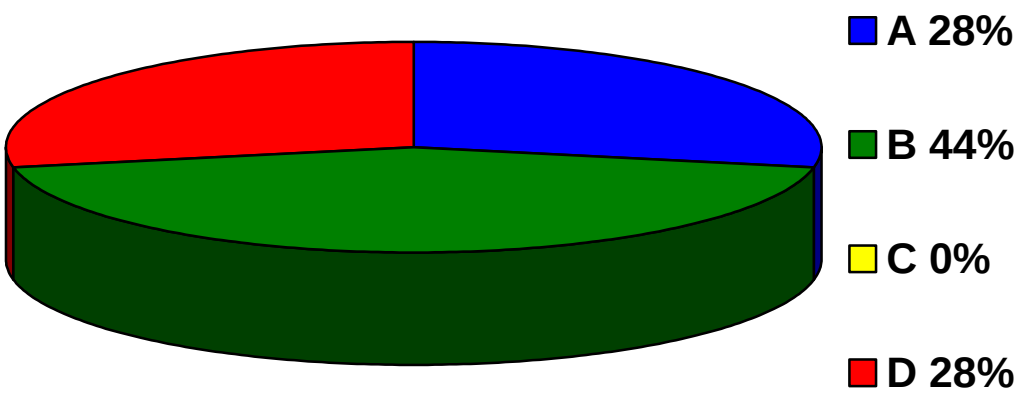
A) Municipalities should plan and promote Renewable Energy Infrastructure Investments that only benefit the citizens in that particular Municipal area.

B) Municipalities should plan and promote Renewable Energy Infrastructure Investments where possible regardless of scale.

C) Municipalities should not take responsibility for Renewable Energy Infrastructure Planning.

D) Other

Graph 6.6:Renewable Energy Infrastructure Planning in Local Government



Source: Own compilation

An equal proportion of interviewees chose both options A and D, with a large number of them choosing option B. The findings can be summarised as follows: Municipalities should plan and promote Renewable Energy Infrastructure Investments where possible regardless of scale in consultation and with the assistance of provincial and national government for the purposes of accessing public funding as provided for in the Division of Revenue Act (DORA) promulgated annually.

6.4.7 Inter-governmental co-ordination

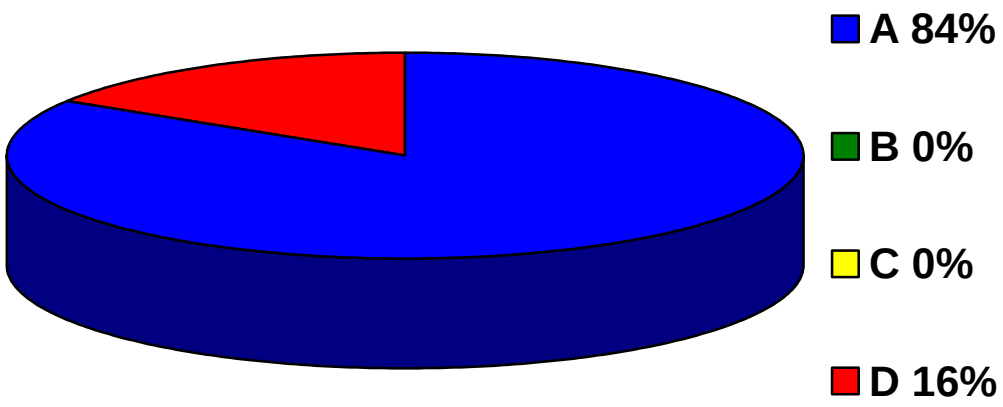
A) The Strategic Plans of the three spheres of Government are not sufficiently aligned with one another and revisions need to be made to existing planning policy in order to strengthen inter-governmental co-ordination.

B) The inauguration of the Presidential Infrastructure Co-ordination Commission (PICC) in 2011 headed by President Jacob Zuma has provided the necessary guidance.

C) Inter-governmental co-ordination should not be promoted. Each sphere of government should only be responsible for itself.

D) Other

Graph 6.7: Inter-governmental co-ordination



Source: Own compilation

The vast majority of interviewees chose option A, meaning that the co-ordination between the three spheres of government needs to be strengthened, not only in terms of infrastructure policies, but in the division of revenues between the three spheres as well.

6.4.8 Precinct Plans

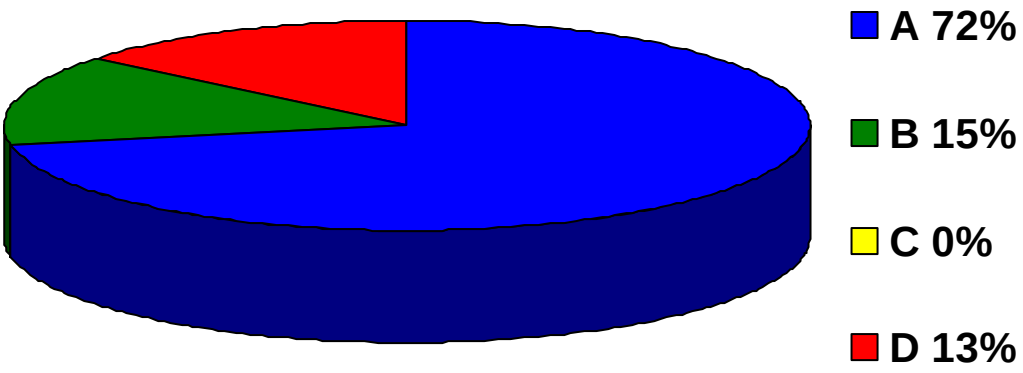
A) Precinct Plans provide sufficient strategic information at an appropriate scale for the implementation of IDP and SDF objectives.

B) Precinct Plans do not provide sufficient strategic information and will become mere conceptual versions of Land-Use Schemes.

C) Strategic Plans should not necessarily be driven for implementation as they are merely a conceptual exercise that depicts one of several different possibilities.

D) Other

Graph 6.8: Precinct Plans



Source: Own compilation

The majority of interviewees chose option A, meaning that the need for lower level plans to bridge the gap between the broadly based IDP's and SDF's is apparent. There were however mixed responses with some being of the opinion that such plans will become mere conceptual versions of existing Land-Use Schemes and others stating that there are already more than enough plans. The lack of leadership when it comes to implementing plans is the real problem and not the issue of not having enough, the right or sufficient plans. Implementation is about project management and proper utilisation of recourses.

6.4.9 Green Infrastructure benefits

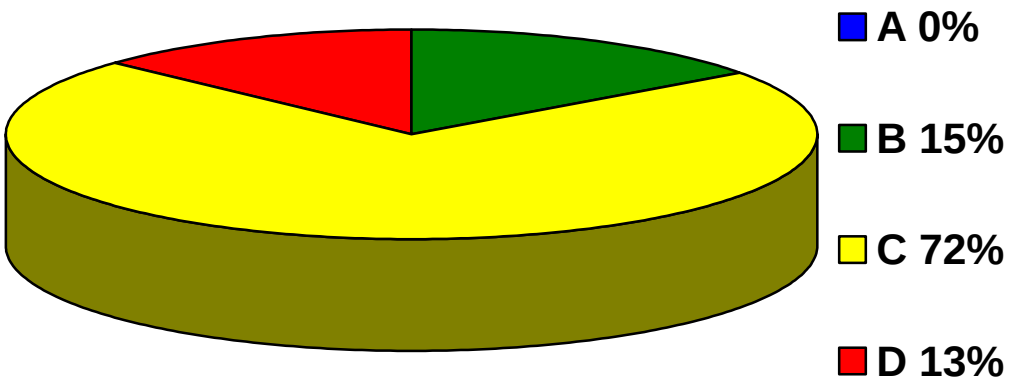
A) Green Infrastructure provides no measurable benefits and should not be a planning priority.

B) Green Infrastructure provides only environmental benefits. The cost of investment far outweighs the financial benefits.

C) Green Infrastructure provides a variety of social, economic and environmental benefits and should therefore be promoted where possible.

D) Other

Graph 6.9: Green Infrastructure benefits



Source: Own compilation

The majority of the interviewees chose option C, meaning that the importance of green infrastructure provision is being recognised. There were however different opinions regarding this particular subject which can be summarised as follows: Green Infrastructure provides environmental and social benefits and should be a planning priority, although it should be acknowledged that the costs currently outweigh the financial benefits; however it should also be acknowledged that it is a developing field and provision should be made to allow implementation for when costs become affordable.

6.4.10 Integrating Spatial- and Infrastructure Planning

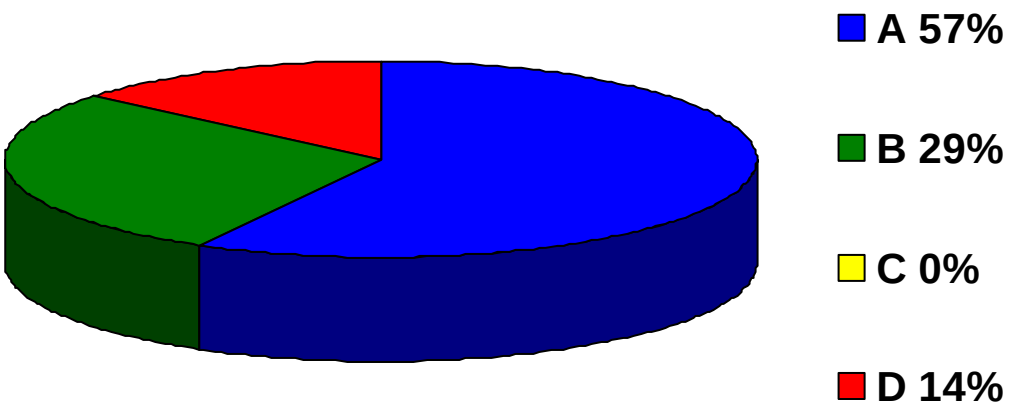
A) Infrastructure should be planned alongside newly proposed spatial developments at a strategic level as part of the SDF and implemented prior to any other form of construction.

B) Infrastructure should be planned alongside newly proposed spatial developments at a strategic level as part of the SDF. The infrastructure plans should then form part of the Land Use Management Schemes (LUMS) and be implemented when the need therefore arises.

C) Infrastructure should be planned, budgeted and implemented separately from newly proposed spatial developments.

D) Other

Graph 6.10: Integrating Spatial- and Infrastructure Planning



Source: Own compilation

The majority of interviewees chose option A; however there were mixed responses which can be summarised as follows: Infrastructure should be planned alongside newly proposed spatial developments at a strategic level as part of the SDF. Infrastructure should also be planned to promote spatial developments in certain areas and promote opportunities for industry investment at local government level. Investment in local government generates capital at local government level for re-investment in infrastructure. Planning should therefore not restrict or hinder investment initiatives. Examples include the Kruger Mpumalanga International Airport and Nelspruit Riverside Mall. Proper public participation and consultation with the private business sector at local government level is extremely important and lacking at municipalities.

6.5 Summary and Conclusions

The Nelson Mandela Bay Metropolitan Municipality introduced a programme whereby Sustainable Community Units are seen as a distinct unit of planning at an intermediate level between the SDF and city-level planning. This model of planning illustrates the various scales that one should consider when exercising spatial planning, and therefore infrastructure planning.

The eThekwini Metropolitan Municipality's SDF was too conceptual in nature to accommodate detailed and focussed infrastructure planning which also led to the realisation that there was a missing link in the hierarchy of plans to bridge the gap between the SDF and detailed Land-Use Plans. Subsequently, eThekwini introduced their Spatial Development Plans (SDP's). The SDP's however became mere conceptual versions of the Land-Use Schemes with little obligation for implementation. As a reaction to the SDP's not reaching their objectives, the municipality started to use computerised Geographic Information Systems (GIS) for more accuracy. The GIS system aimed to calculate the cost of bulk infrastructure for new developments anywhere in the municipality and was named the 'Cost Surface Model'. The municipality additionally created another GIS model to calculate the need for social services in the municipality and was named the 'Accessibility Model'. The use of computerised GIS models is still currently being used and has drastically increased the accuracy of strategic infrastructure planning in the municipality.

The Australian South East Queensland government has introduced two programmes to assist them in integrating infrastructure- and spatial planning. The first is the South East Queensland Regional Plan (SEQRP) and the second is the South East Queensland Infrastructure Plan and Programme (SEQIPP). The SEQRP is used as a framework plan and takes precedence over all other planning instruments in guiding integrated planning in the region. The SEQRP contains a set of regulatory provisions in order to move spatial referencing from conceptual to statutory. The SEQIPP highlights the region's infrastructure needs and priorities to support the Regional Plan and is updated annually. The SEQRP therefore maintains a safe balance between conceptual plans and statutory regulations for the successful implementation of strategic plans.

Green infrastructure planning has evolved from conceptual ideas into practical applicable concepts that are being implemented with a great deal of success. England's North West Climate Change Action Plan (CCAP) is a prime example of green infrastructure planning at a regional level. This case study highlights the importance of formulating appropriate policy frameworks wherein green infrastructure concepts can emerge and develop.

The city of Chicago in the United States introduced a green infrastructure plan for metropolitan-level implementation. The plan is called the Green Permit Programme and is aimed at developers wanting to construct new buildings. The Programme simply rewards developers for incorporating green infrastructure practices into their building designs. There are certain items available from what is called the 'green menu' from which developers can choose to incorporate into their building designs. Items on the 'green menu' include green roofs and the use of renewable energy amongst others. The more items that are incorporated into any given building design, the lower the cost for the building permits. Building permit fees can even be completely waived in cases where exceptional green infrastructure practices have been used. This not only saves the developer money, but speeds up the process relating to gaining planning permission for new buildings.

The city of Faenza in Italy introduced a similar incentive programme to that of Chicago and is called the Bio-Neighbourhoods Incentive Programme. This Programme has additionally been included into the Town Planning Regulations of the Faenza Local Government and has for this reason been very successful. The Town Planning Regulations emphasised the role of Green Open Spaces in and around the urban area in addition to guiding the placement of buildings in order to allow the creation of green spaces. Development designs that show the necessary green infrastructure practices relating to environmental sustainability and aesthetics are allowed to be extended in terms of their size above what is normally allowed by the Town Planning Regulations. This lack of ridged standards encourages developers to construct environmentally sustainable buildings while negotiations between developers and the municipality are less time consuming as well. It is therefore worth noting that more flexible rules in Town Planning Regulations can be as effective as ridged standards, if not more effective.

It is apparent that the selected municipalities from the North West Province and KwaZulu-Natal Province that formed part of this study approaches integrated planning in a very similar manner. The infrastructure chapter in the municipalities' IDP and SDF starts with a status quo for economic and social infrastructure and highlights the key challenges the respective municipalities face in regard to eradicating infrastructure backlogs. The Ugu District Municipality and Hibiscus Coast

Municipality were the only two municipalities to include alternative energy as part of their infrastructure plans, whereas the Tlokwe Municipality set the standard in terms of explaining strategic planning elements and the implementation of such elements in the municipality. The Umzumbe Municipality included climate change adaptation and mitigation strategies in addition to drawing up lower level plans at a less conceptual level focussed for implementation. The lack of funding, up to date information relating to infrastructure and human resource capacity seem to be the main challenges municipalities face in their integrated planning approach. The missing link in the hierarchy of plans further averts the implementation process. The division of functions and powers between local, provincial, national government as well as semi-government organisations such as Eskom, Telkom and privately owned companies such as Vodacom, MTN and Cell C needs to be more clearly defined along with the formulation of co-operation strategies in order for more successful service delivery to be achieved.

The interviews revealed noteworthy information relating to the subject matter including the following: The positive role that infrastructure plays in economic growth and development is well recognised. However, such infrastructure should be carefully planned and maintained if sustained development is to occur. The strategic planning instruments such as the IDP's and SDF's provide a fair amount of guidance in terms of forward infrastructure planning, however, all available resources are not sufficiently being utilised by municipalities in providing services. National and provincial government should be responsible for the planning and implementation of both economic and social infrastructure of provincial and national importance. However, the roles and responsibilities of local, provincial, and national government should be more clearly defined and co-operation between the three spheres of government should be strengthened. The role of green infrastructure in climate change adaptation is also well recognised. However, the responsibility of local government concerning climate change adaptation is still uncertain.

Municipalities should also aim to invest in renewable energy generation capacity where possible however it must be acknowledged that investments in such technologies on a large-scale are not financially viable at present and policies should be drawn up for when they do become financially viable. The implementation of

strategic plans necessitates lower level plans of a less conceptual nature. However, infrastructure provision is largely subject to proper project management which further highlights the importance of skilled personnel. In order to optimally integrate spatial- and infrastructure planning, infrastructure should be planned alongside newly proposed spatial developments at a strategic level on various scales in order to promote spatial developments in areas with economic potential. It has additionally been noted that many are of the opinion that integrated planning is a complex task and should only be undertaken by professionals with the necessary experience.

Chapter 7
Synthesis and Proposals

7.1 Introduction

The aim of this chapter is to summarise the most important findings of the research that has been done and to present such information in a manner that will clearly illustrate where the key challenges lay in order to make practical proposals. The proposals presented in this chapter will aim to be practically applicable in improving the current spatial planning system, and to strengthen the integration of spatial planning with infrastructure planning at municipal level.

7.2 Synthesis

The positive influence of infrastructure on economic growth and development has been investigated in this study on both theoretical and empirical bases (see 2.2). Whether it is via a direct or indirect manner, the availability of infrastructure significantly influences the ability of regions to develop by virtue of productivity, mobility and employment generation amongst others. The South African Government has realised the importance of infrastructure investment in terms of economic growth and development and has subsequently launched several programmes such as the Accelerated and Shared Growth Initiative for South Africa (ASGI-SA) and more recently, the New Growth Path (NGP) and the National Development Plan (NDP). However, it has additionally been found that infrastructure needs to be carefully planned and considered. It is for this reason that it has been suggested that infrastructure planning should be integrated with spatial planning at a strategic level.

Planning as an activity (of which spatial planning forms part) is a continual process that should be repeated for optimum results (see 3.2.1). The first step in the planning process involves the formulation of goals and objectives that are essentially targets that the planner is aiming to reach. In order to reach the above-mentioned goals and objectives, the creation of a planning model that can predict various outcomes is important. The characteristics of planning models have changed since the 1960's and are nowadays being aided by computerised GIS software. The eThekwini

Metropolitan Municipality for example has been using GIS programmes to calculate the cost of bulk infrastructure and the need for social infrastructure in the municipality and has considerably increased the accuracy of infrastructure planning as a result (see 6.2.1.2.3).

The spatial planning system in South Africa has undergone several paradigm shifts since 1994, altering from rigid master planning to the use of abstract instruments such as nodes and corridors. The Tlokwe Local Municipality makes use of such strategic elements in their SDF by highlighting development corridors such as the N12, the urban edge and fringe as well as specialised nodes such as the North West University (see 6.3.5).

The spatial planning system in South Africa is carried out on three distinctive and interdependent spheres of government; national, provincial and local (see 3.3). Local government can additionally be divided into three categories; metropolitan, local and district. These categories have been created in order to delegate functions and powers. Such responsibilities may be adjusted by the MEC for each province according to the capacity of each municipality if deemed necessary (see 3.3). Each of the three spheres has to prepare strategic plans that must be co-ordinated with one another. Therefore, in order to achieve optimum planning at a local level, provincial and national plans should also be considered. The NSDP provides principles to guide infrastructure investments across the three spheres of government, thus making it an ideal instrument to use in order to achieve the desired co-ordination.

However, strategic plans at a local government level have been criticised for being too broad and conceptual to accommodate focussed infrastructure planning (see 6.3). This is largely due to the fact that infrastructure plans should be conducted on various scales in order to accommodate bulk, connector and internal infrastructure (see 4.3). Municipal IDP's and SDF's need to consider entire municipal areas and can therefore not always provide the desired level of detail that is necessary for focussed infrastructure planning. For this reason, both eThekwini and the Nelson Mandela Bay Metropolitan Municipalities have introduced lower-tier plans in order to bridge the gap between the broadly based SDF and city-level planning (see 6.2.1.1 & 6.2.1.2).

Local government has been given the constitutional mandate to provide their citizens with effective and efficient services such as water, sanitation and electricity amongst others. Many of these services require the necessary infrastructure to be in place. Such infrastructure can be divided into civil and electrical infrastructure and is generally assigned to be under control of a specific authority (see 4.3). However, unresolved issues still remain regarding responsibility, especially in the transport and electricity sectors. The co-ordination of plans between service providers and service authorities has also been unsatisfactory in many municipalities including the Ugu District Municipality (see 6.3.1) and the Tlokwe Local Municipality (see 6.3.5). In addition, the lack of public participation and proper project management in the planning process further stifles the effective provision of infrastructure.

It is critical for infrastructure investment choices to be in line with the NGP and the NDP. The NDP is national government's long-term vision for South Africa, and aims to use the NGP as a policy instrument to achieve this vision (see 3.3). The Australian South East Queensland government has introduced two programmes to assist them in integrating infrastructure- and spatial planning. The SEQRP is a strategic regional framework plan that takes precedence over all other planning instruments when the SEQ region is affected, thus eliminating the risk of conflicting policies. This Regional Plan contains a set of regulatory provisions in order to move spatial referencing from conceptual to statutory, thus strengthening the commitment to implementation. The SEQRP additionally contains a focussed infrastructure plan (SEQIPP) that highlights the region's infrastructure needs and priorities to support the Regional Plan and is updated annually (see 6.2.1.3).

Utilising green infrastructure as a means to adapt to climate change or global warming, and to create more sustainable human settlements has become a frequently discussed topic (see 5.3). As in the case with conventional infrastructure, green infrastructure can be applied on various scales which also relates to the ownership or responsibility thereof. England's Climate Change Action Plan (CCAP 2010) is an example of green infrastructure application on a regional scale, whereas the city of Chicago's Green Permit Programme is a form of green infrastructure application on a city or metropolitan scale.

Utility-scale renewable energy projects should be the responsibility of national government whereas smaller scale renewable energy projects such as solar panels can be practiced by provincial or local government (see 6.4). Municipalities should aim to invest in renewable energy generation capacity where possible, however it must be acknowledged that such technologies may not be financially viable at present and that policies should be drawn up for when they do become financially viable. The Ugu District Municipality and Hibiscus Coast Local Municipality were the only two municipalities to include alternative energy as part of their infrastructure plans. However, the Umzumbe Local Municipality did include climate change mitigation strategies such as map delineation in their plans. Other forms of green infrastructure that can be practiced on local government level include urban forestry, SUDS and permeable pavements (see 5.4.2 & 5.4.3). Green infrastructure such as eco-roofs and downspout disconnections can additionally be practiced by private property owners for water and air quality management (see 5.4.4 & 5.4.5).

One of the main reasons for the unsatisfactory level of service in South Africa is that important policy and legislation provisions are not being utilised. In South Africa, the ISMO has been created to strengthen the IPP industry (see 4.5.3). Apart from encouraging private infrastructure investments, government should also consider to collaborate with the private sector as PPP's can be very successful.

On a more local level, the city of Chicago in the USA introduced a green infrastructure plan for city-level implementation (see 6.2.2.2). The Programme simply rewards developers for incorporating green infrastructure practices into their building designs by lowering (or in some cases completely removing) the fees pertaining to building permits. This not only saves the developer money, but speeds up the process relating to gaining planning permission for new buildings as well. The city of Faenza in Italy introduced a similar incentive programme to that of Chicago and is called the Bio-Neighbourhoods Incentive Programme (see 6.2.2.3). This Programme has additionally been included into the Town Planning Regulations of the Faenza Local Government and has for this reason been very successful. The Town Planning Regulations emphasised the role of Green Open Spaces in and around the urban area in addition to guiding the placement of buildings in order to allow the creation of green spaces. Development designs that show the necessary green infrastructure

practices relating to environmental sustainability and aesthetics are allowed to be extended in terms of their size above what is normally allowed by the Town Planning Regulations. This lack of ridged standards encourages developers to construct environmentally sustainable buildings while negotiations between developers and the municipality are less time consuming as well. It is therefore worth noting that more flexible rules in Town Planning Regulations can be as effective as ridged standards, if not more effective.

7.3 Proposals

This study has revealed that infrastructure developments are in fact being strategically planned at municipal level. However, the various infrastructure plans are not sufficiently being translated on to spatial plans.

The proposals presented in this research paper will commence with the first of three intervention plans. The first plan focuses on the co-operation and co-ordination between the different spheres of government and tiers of local government as well as between the service providers and service authorities at each sphere of government. The second plan proposes the introduction of a lower level plan which focuses on a smaller physical area than the IDP's and SDF's in order to promote the implementation of strategic infrastructure plans while the third plan makes proposals for integrated infrastructure planning at municipal level.

7.3.1 Co-operation and Co-ordination Plan

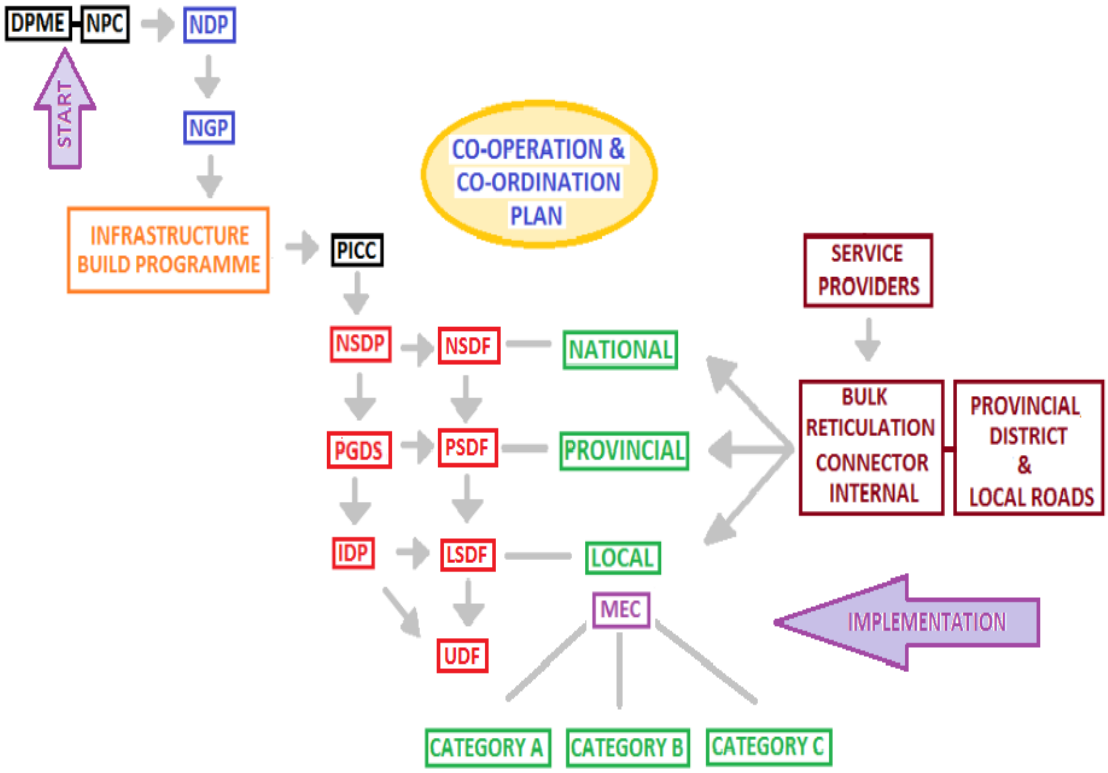
It was established from the empirical investigation that the alignment of infrastructure plans between the three spheres of government is not sufficient and needs urgent attention. It has also been established that the roles and responsibilities of the three spheres of government in terms of infrastructure are not clearly defined and has resulted in undesignated roads in some provinces for example.

Similarly, the roles and responsibilities of service providers and service authorities need to be more clearly defined at an earlier stage of the planning process as this alignment is vitally important for effective service delivery. The responsibilities of provincial and national government in terms of infrastructure plans at local

government level are equally unclear. Infrastructure of provincial and national importance should be planned by the relevant sphere of government; however, the implementation thereof has to take place within the jurisdiction of a municipality and should therefore be included into that particular municipal IDP and SDF.

As established, the Presidency has commissioned at least two departments tasked with integrated infrastructure planning, and should be the starting point: The first is the National Planning Commission (NPC) and the second is the Department of Performance Monitoring and Evaluation (DPME). The former develops long-term integrated development plans for all sectors including infrastructure and the latter is dedicated to the development of economic infrastructure. The NPC (2009) created the National Development Plan (NDP) in 2012 as a country-wide vision for 2030 and despite the order of coming into being, has come to take precedence over the New Growth Path (NGP) which was created in the latter part of 2010. Government is aiming to use the NGP as a guide to achieve the vision set out in the NDP and includes amongst other the Infrastructure Built Programme.

Figure 7.1 Co-operation and Co-ordination Plan



Source: Own Compilation 2013

The Presidential Infrastructure Co-ordinating Committee (PICC) is headed by the President and aims to co-ordinate infrastructure projects across all three spheres of government. It is critical for infrastructure projects to be in line with the NGP and NDP if the 2030 vision is to become a reality, and therefore necessitates that all planning relating to infrastructure supporting the above-mentioned vision starts with the DPME and the NPC and ends with the implementation thereof at municipal level, albeit with the assistance of national or provincial government.

The implementation process itself may vary depending on the type of infrastructure project. This means that collaboration between the municipality in which the infrastructure project is proposed and the relevant sphere of government can be an option, or the responsibility of implementation can be delegated to the municipality alone.

The infrastructure projects within the Infrastructure Build Programme should be prioritised by the PICC and monitored throughout the planning and implementation process by guiding infrastructure projects across the three spheres of government. The National Spatial Development Perspective (NSDP) is the main strategic framework in the South African spatial planning system and has three main objectives, one of which is to guide infrastructure investments across the three spheres of government.

Although there is presently no National Spatial Development Framework (NSDF) in place, it is prescribed by law and should co-ordinate provincial and municipal Spatial Development Frameworks (SDF's) with one another. The goals and objectives relating to infrastructure of the NSDP should be spatially represented in the NSDF as well as in provincial strategic planning frameworks such as the Provincial Growth and Development Strategies (PGDS) in order to promote the integration of infrastructure- and spatial planning at national level while initiating the co-ordination process between national and provincial government in terms of infrastructure plans. The NSDF should also link with the Provincial Spatial Development Frameworks (PSDF's) in order to incorporate infrastructure projects of national importance into the relevant provincial plans as they manifest spatially within that province.

The goals and objectives of the NDP and the NGP have to remain central to infrastructure plans across the three spheres of government and therefore necessitate a top-down approach. This approach continues with the inclusion of PGDS objectives (as indicated in the NDP and NGP) into the PSDF as well as into the relevant local IDP. As prescribed by the Municipal Systems Act, the spatial representation of IDP goals and objectives should be included into the municipal SDF in order to guide both private and public investment. The last step involves the inclusion of strategic plans as listed in the municipal IDP in a lower order plan such as an Urban Development Framework (UDF). The introduction of the UDF into the hierarchy of plans will be discussed in more detail in the second intervention plan.

The first section of the Co-operation and Co-ordination Plan relates to the alignment of the strategic infrastructure plans between the three spheres of government while simultaneously integrating such infrastructure plans with spatial plans at each of the three spheres. The second section of the Plan relates to the clarification of the roles and responsibilities of service authorities and service providers at each of the three spheres of government.

A service authority is the sphere of government or tier of local government that has been given the constitutional obligation for service delivery whereas the service provider is the entity that provides services to or on behalf of service authorities (see 4.4). Eskom is one of the service providers in the electricity sector and owns the largest portion of the electricity generation, transmission and distribution infrastructure in South Africa. Due to Eskom's dominance in the electricity sector, they have made plans relating to infrastructure investments for their own benefit rather than to align their plans with those of government. This has resulted in under provision of electricity in certain areas of South Africa as the relevant government authority has little to no input in the infrastructure planning process.

Municipalities should consult with Eskom's infrastructure planning department during the compilation of the municipal IDP in order to communicate their development goals and objectives to Eskom. The responsibilities of both Eskom and government in terms of implementation and maintenance of infrastructure projects must be clearly defined and included in the IDP. The division of electricity infrastructure into bulk

and reticulation has been made to promote the alignment of responsibilities between Eskom and each sphere of government. The same argument can be used for the alignment of government plans with all service providers, whether it is electricity, water, or waste-water services.

The division of roles and responsibilities between the three spheres of government in terms of infrastructure ownership needs to be more clearly defined in the municipal IDP, especially where road infrastructure is concerned. There remain many kilometres of undesignated roads in many provinces in South Africa which adds to the deterioration of such roads as they are not being maintained. A list of all roads within a municipality should be drawn up and each road must be assigned to either the municipality, or the provincial department of transport or SANRAL. This list must then be circulated to all relevant stakeholders for signatures and included into the IDP. The roles and responsibilities of local and district municipalities can be adjusted by the MEC for local government in each province according to their capacity. This delegation must be done as soon as possible in order to avoid confusion.

After the institutional arrangements have been finalised, the third section of this intervention plan can commence. This section relates to the implementation of infrastructure projects as listed in the IDP. As mentioned before, the strategic infrastructure plans that have been included in the IDP should be represented in the SDF in terms of their spatial implications as well as into the relevant UDF depending on the scale thereof. It must be noted that as UDF's cover a much smaller physical area than IDP's and SDF's, there will be several UDF's within each municipal area. The primary goal of the UDF is to promote the integration of infrastructure- and spatial planning for the effective implementation of strategic infrastructure plans.

Infrastructure that has been designated as being the responsibility of the municipality should be budgeted for in advance. The budged must form part of the Finance Plan and include the source of funding, whether it is internally generated or from another sphere of government.

7.3.2 Urban Development Framework

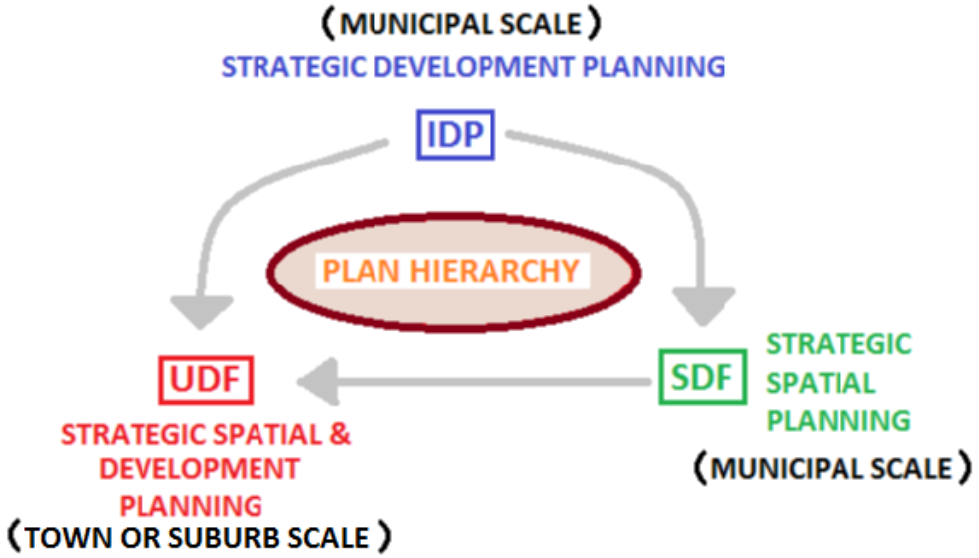
Both eThekwini and the Nelson Mandela Bay Metropolitan Municipalities introduced lower-level plans into their planning system in order to bridge the gap between the less detailed SDF's and city or neighbourhood level planning (see 6.2.1.1 & 6.2.1.2). The degree of success depended largely on the level of stakeholder involvement; however, the principle of introducing lower-level plans should contribute to the successful integration of infrastructure- and spatial planning.

Municipal IDP's are strategic development plans that aim to integrate a large variety of different elements into one single plan. Such elements include amongst others the demographic, economic, social and environmental characteristics of the municipality. The main goal of a municipal IDP is to guide decision making regarding development priorities in order to reach the municipality's development potential. In order for a municipality to fulfil its constitutional obligation towards service delivery, the IDP must include strategic infrastructure plans that support such services.

Each IDP must additionally include an SDF that should represent and contribute to the spatial development vision of the municipality. The municipal SDF must include a written and spatial representation of the medium to long-term spatial development plan for the spatial form of the municipality while identifying significant structuring and restructuring elements such as development corridors and activity nodes amongst others.

Another important function of a municipal SDF is that it must identify locations for municipal infrastructure for both existing and future developments. Infrastructure plans should therefore be an integral part of the SDF; however, SDF's need to cover an entire municipal area and can therefore not spatially represent each and every infrastructure project. Bulk infrastructure projects such as new reservoirs, power generation plants and waste water treatment plants should be identified in the IDP, and spatially represented in the SDF. Reticulation and internal infrastructure of great significance should also be included in the SDF.

Figure 7.2 Plan Hierarchy



Source: Own Compilation 2013

In order to improve the implementation process, more detailed plans that incorporate both strategic spatial- and development plans can be used. The Urban Development Framework (UDF) can fulfil this role and should obtain information from both municipal IDP and SDF as this will promote the integration of infrastructure- and spatial planning.

The UDF must include an implementation strategy and will focus on a town, suburb or on special nodes within the municipal area. The implementation strategy should be compiled by representatives of the relevant departments including the following:

- Environmental,
- Geotechnical,
- Civil Engineering,
- Land Surveying,
- Town Planning,
- The relevant sphere of government,
- The relevant tier of local government,
- Financier, and
- Service Providers

Such implementation strategy should additionally include a maintenance plan for the specific infrastructure project.

A single municipal IDP and SDF can inform several UDF's; the larger or more urbanised the municipal area, the more UDF's will be applicable. It should therefore be noted that the introduction of the UDF can apply to Categories A, B and C municipalities. If both the district and local municipalities within the same district implement UDF's they must be sufficiently aligned in order to avoid confusion. Information relating to infrastructure developments as discussed in the IDP will be transferred to the appropriate UDF in which the proposed development is set to occur.

The third and final intervention plan will illustrate this principle in more detail.

7.3.3 Integrated Infrastructure Planning

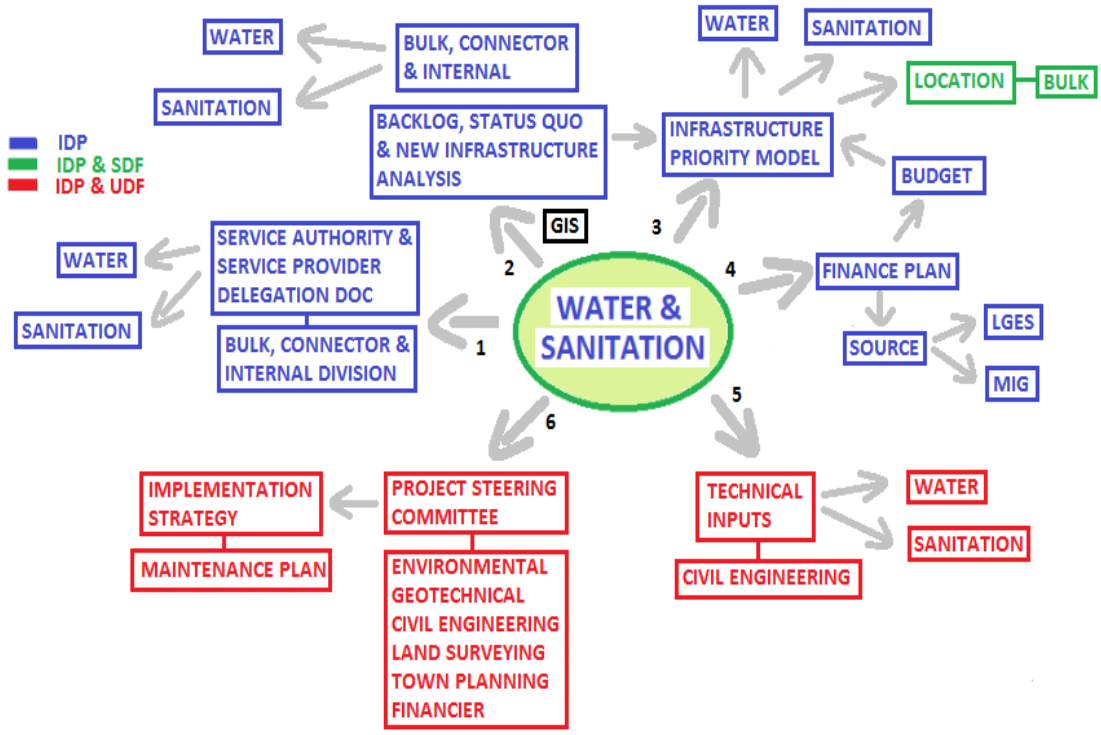
The IDP must guide municipal infrastructure investments in the municipality, including water, sanitation, power and electricity as well as roads and storm-water. This intervention plan additionally proposes the introduction of 'green infrastructure' and 'renewable energy' into the IDP infrastructure chapter. The various components within the infrastructure chapter of the IDP will be visually displayed in the following section. Each of the infrastructure plans will be discussed by listing the various sequential steps that must be followed and repeated.

7.3.3.1 Water and sanitation

The Water and sanitation section will start off by:

1. Clarifying the roles and responsibilities of Service Providers and Service Authorities for both water and sanitation infrastructure as dealt with in the Co-operation and Co-ordination Plan. The negotiations regarding the institutional arrangements should already have been finalised in the above-mentioned plan, the outcome of such negotiations in terms of water and sanitation infrastructure should merely be included in the IDP in order to avoid confusion regarding responsibility.

Figure 7.3 Water & Sanitation



Source: Own Compilation, 2013

2. Backlog, Status Quo and New Infrastructure Analysis for both water and sanitation infrastructure should then be undertaken wherein bulk, connector and internal infrastructure are analysed. The analysis should preferably be aided by a GIS model in order to determine the shortage of water and sanitation infrastructure and prioritise areas in need for intervention in order of severity.

3. Such information should then be included in the Infrastructure Priority Model. The municipality's own discretion should be used in order to prioritise such needs. The locations for proposed bulk water and sanitation infrastructure should additionally be included in the SDF.

4. Thereafter, the Financial Plan must be compiled and should consider the Source[20] of funding, in addition to allocating a Budget.

[20] Which in the case of water and sanitation infrastructure is the Municipal Infrastructure Grant (MIG) and in the case of water and sanitation services is the Local Government Equitable Shares Grant (LGES) as set out in the Division of Revenue Act (DORA)

5. The technical inputs regarding construction and the delivery of water and sanitation infrastructure should be made in consultation with the municipality's civil engineering department, or if the municipality does not have such department, a private civil engineering firm should be consulted on a retainer basis.

6. Appoint a Project Steering Committee that should include representatives from each of the relevant departments including the following:
    - Environmental,
    - Geotechnical,
    - Civil Engineering,
    - Land Surveying,
    - Town Planning, and
    - Financier/s.

    The Project Steering Committee must then compile an Implementation Strategy which should include amongst others a Maintenance Plan for new water and sanitation infrastructure which should be considered by the Budget and then be included in the relevant UDF. The maintenance plan must have stringent time frames attached to it which have been calculated by a civil engineer in the technical inputs stage of the planning process. Thereafter, the appointed contractor/s can commence with the implementation of the project and should periodically report back to the municipality. This planning process should continuously be repeated in order for the necessary revisions to be made at least once every year.

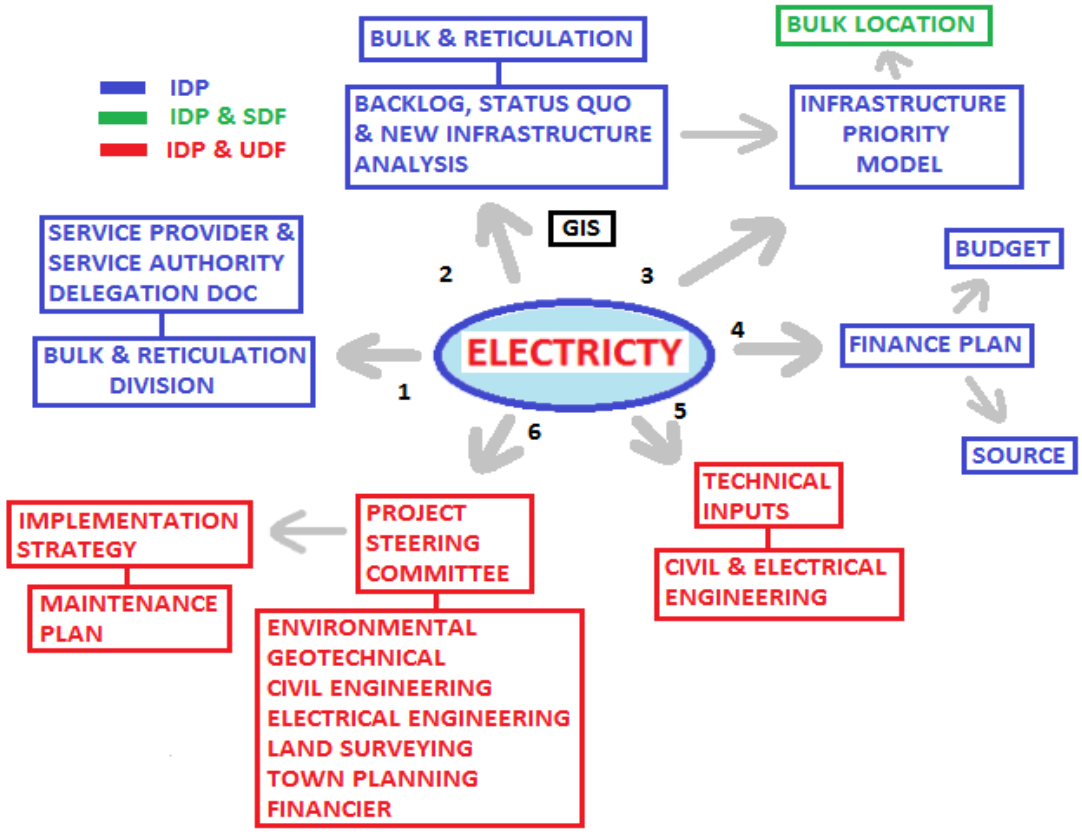
7.3.3.2 Electricity

The Electricity section will start off with:

1. The inclusion of the Service Authority and Service Provider Delegation Document wherein the roles and responsibilities of both Eskom and the relevant Service Authorities have been established as discussed in the Co-operation and Co-ordination Plan.

2. Thereafter, with the guidance of a GIS model, the Backlog, Status Quo and New Infrastructure Analysis for both bulk and reticulation infrastructure should be done.

Figure 7.4 Electricity



Source: Own Compilation, 2013

3. The analysis should determine the demand and costs relating to new electricity infrastructure in order to make up an Infrastructure Priority Model. The bulk infrastructure priority areas should then be spatially represented in the SDF.

4. The Finance Plan should then be drawn up that considers the Source[21] of funding in addition to allocating a Budget and must be in accordance with the requirements as set out in the Municipal Finance Management Act.

5. Thereafter, the Technical Inputs regarding the construction and the delivery of electricity infrastructure should be provided in consultation with the

[21] Which in the case of electricity infrastructure will be national government and/or Eskom

municipality's civil and electrical engineering departments, or if the municipality does not have such departments, private engineering firms must be consulted on a retainer basis and include such information in the relevant UDF.

6. The Project Steering Committee should then be appointed and consist of representatives from the relevant departments including the following:
    - Geotechnical,
    - Environmental,
    - Civil and Electrical Engineering,
    - Land Surveying,
    - Town Planning, and
    - Financier.

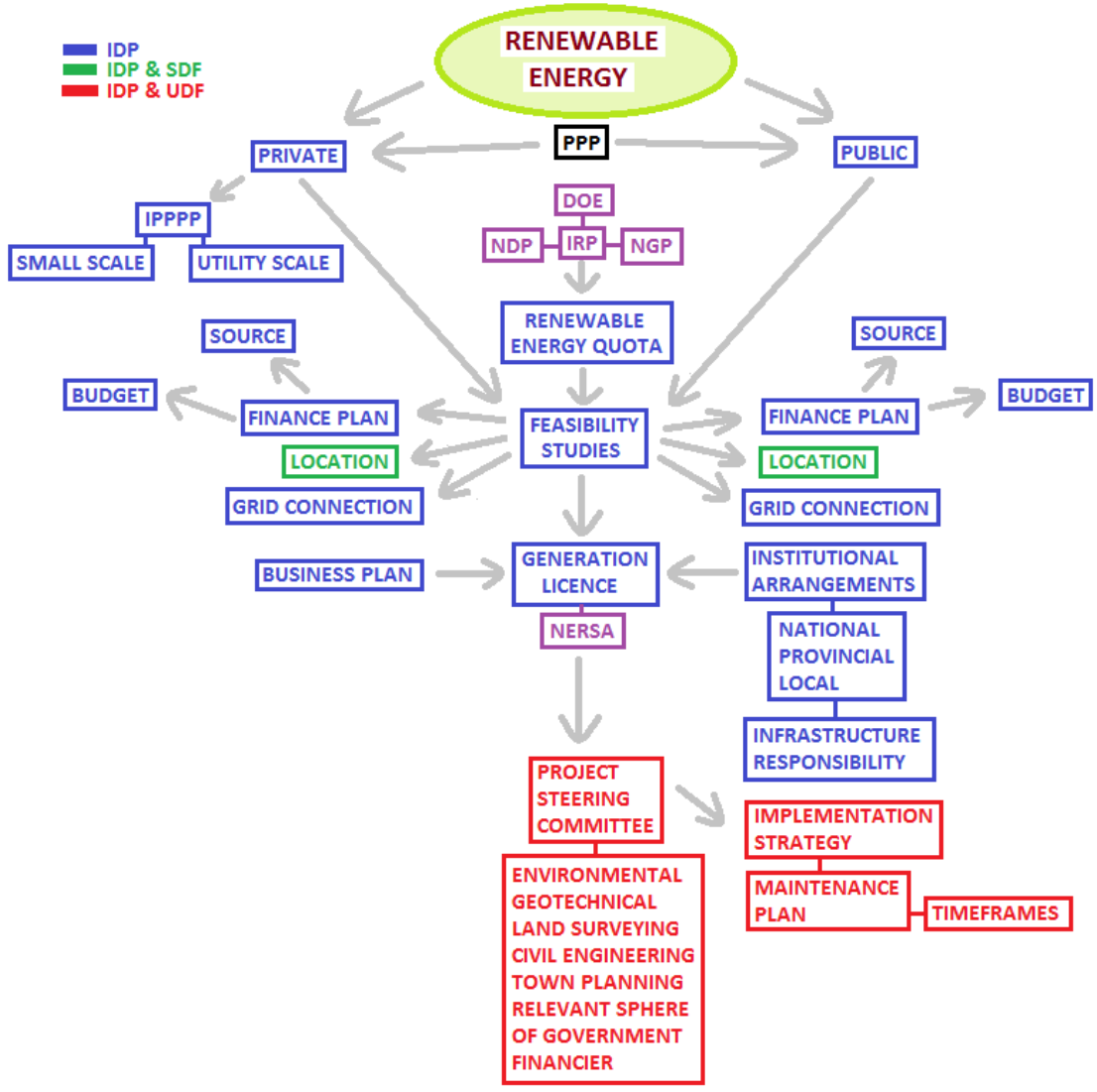
    The Project Steering Committee should compile an Implementation Strategy and should include amongst others a Maintenance Plan for new electricity infrastructure with stringent time frames that have been calculated in the Technical Inputs stage. The Maintenance Plan should be considered by the Budget and then be included in the relevant UDF. Thereafter, the appointed contractor/s can commence with the implementation of new electricity infrastructure and should periodically report back to the municipality. This planning process should continuously be repeated in order for the necessary revisions to be made at least once every year.

7.3.3.3 Renewable energy

The Renewable Energy section can be divided into two sections; Private and Public. The Department of Energy (DoE) is responsible for drafting the Integrated Resource Plan (IRP) which is a national electricity plan. The IRP should establish a Renewable Energy Quota (as set out in the NGP and NDP) which means that a predetermined portion of the total electricity produced within South Africa should come from renewable energy sources.

This quota will determine the number of Renewable Energy Generation Licences that will be made available to both the Private and Public Sectors. The Public Sector will receive a predetermined amount of Renewable Energy Generation Licences which it must utilise itself or it may enter into a Public Private Partnership (PPP). The remaining Generation Licences will be made available to the Private Sector. The National Energy Regulator for South Africa (NERSA) should be responsible for handing out such Generation Licences after a series of steps has been completed.

Figure 7.5 Renewable Energy



Source: Own Compilation, 2013

The first step that has to be completed before either Private or Public Sectors can obtain a Generation Licence will be:

1. To compile and submit a Feasibility Study which must include a Finance Plan indicating the Source of funding as well as a Budget. The Feasibility Study must additionally include amongst others the following:
    - Socio-Economic Report,
    - Environmental Impact Assessment (EIA),
    - Grid Connection Agreement,
    - Number of job opportunities to be created.

    The Feasibility Study should earmark the locations to be utilised which must be indicated in the relevant SDF.

In the case of the Public Sector, the Institutional Arrangements (the relevant sphere of government to take responsibility for the infrastructure after construction) will also need to be finalised prior to the acquisition of a Renewable Energy Generation Licence. In the case of the Private Sector, a Business Plan will need to be compiled prior to the acquisition of a Renewable Energy Generation Licence.

2. Thereafter, a Project Steering Committee should be assembled which comprises of representatives of the relevant departments including the following:
    - Environmental,
    - Geotechnical,
    - Land Surveying,
    - Civil Engineering,
    - Town Planning , and
    - Financier/s.

3. The Project Steering Committee must then compile an Implementation Strategy which should include amongst others a Maintenance Plan. This Maintenance Plan must be considered by the Budget and the locations earmarked for development should also be included in the relevant IDP and UDF. In the case of the Private Sector, the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) will make both small

and utility scale Generation Licence holder's sellers of electricity. The price for the generated electricity payable to the Generation Licence holders will be determined according to the Feed in Tariffs (FIT) scheme (Price of Generation).

7.3.3.4 Roads and Strom-water

The Roads and storm-water section will start off with:

1. The inclusion of the Road Designation Document which should be compiled as part of the Co-ordination and Co-operation Plan and must distinguish the roles and responsibilities between the different spheres of government as well as SANRAL. All national, provincial, district and municipal roads within the municipality must be assigned to the appropriate service authority and such information should be included in the IDP in order to provide clarity and to avoid confusion.

2. The Backlog, Status Quo and New Infrastructure Analysis for both roads and storm-water infrastructure should then be undertaken with the assistance of a GIS model. This report should determine the need, cost and location for new infrastructure in order to create an Infrastructure Priority Model which should be considered by the Budget and be spatially represented in the SDF. This model should include new infrastructure and infrastructure backlogs.

3. Thereafter, a Finance plan should be drawn up that considers the Source of funding[22] in addition to allocating a Budget.

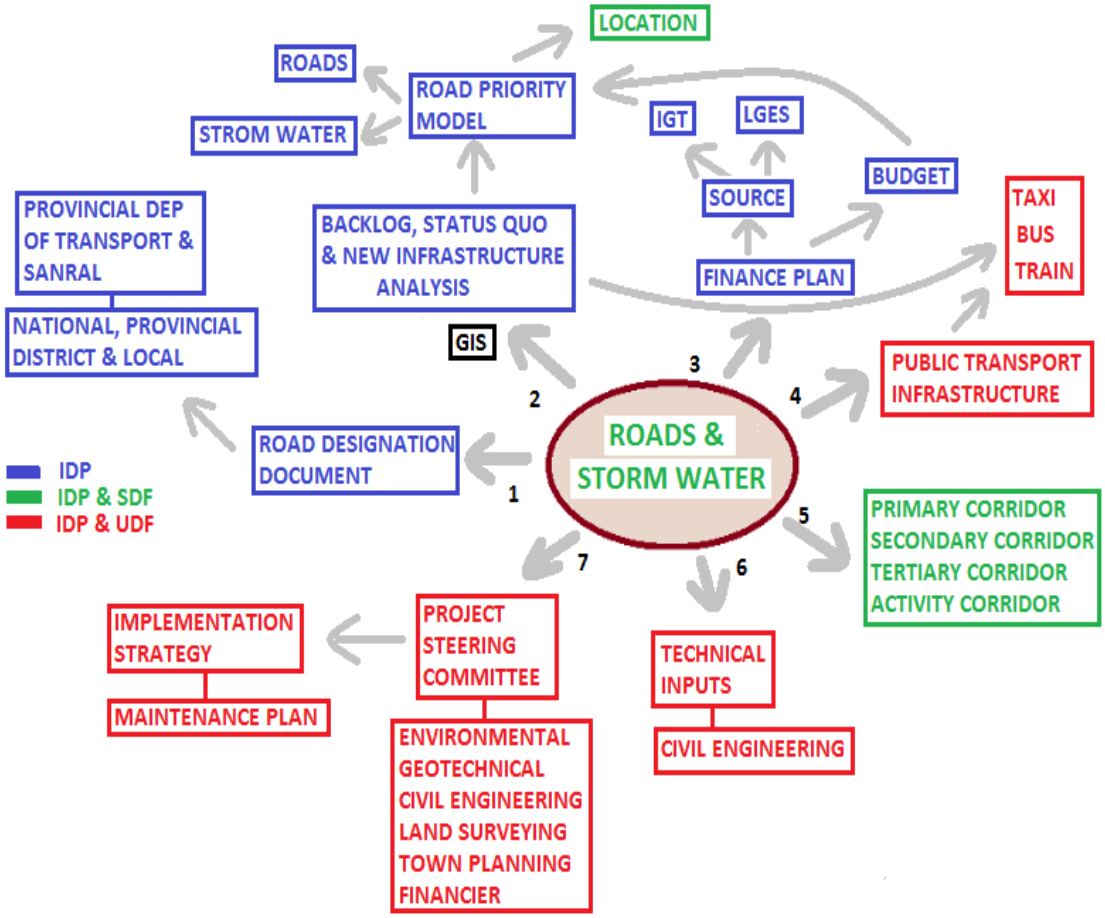
4. The Roads and Storm-water Chapter must preferably include an assessment of public transport infrastructure such as taxi ranks as well as bus and train stations in the municipality. The public transport infrastructure should also undergo a Backlog, Status Quo and New Infrastructure Analysis and be included in the UDF.

[22] which in the case of roads and storm-water infrastructure is the intergovernmental transfers and Local Government Equitable Shares (LGES) as provided in the Division of Revenue Act (DORA)

5. The various corridors should then be highlighted.

6. Technical Inputs from the municipality's Civil Engineering department must then be provided, or if the municipality does not have such a department, a private civil engineering firm must be consulted on a retainer basis.

Figure 7.6 Roads and storm water



Source: Own Compilation, 2013

7. Appoint a Project Steering Committee which should consist of representatives of the following departments:

- Environmental,
- Geotechnical,
- Land Surveying,
- Civil Engineering,
- Town Planning, and
- Financier/s.

The Project Steering Committee should then compile an Implementation Strategy which should include amongst others a Maintenance Plan for the new roads and storm-water infrastructure with stringent time frames that have been calculated in the Technical Inputs stage. The Maintenance Plan should be considered by the Budget and then be included into the relevant UDF. Thereafter, the appointed contractor/s can commence with the implementation of new roads and storm-water infrastructure and should periodically report back to the municipality. This planning process should continuously be repeated in order for the necessary revisions to be made at least once every year.

7.3.3.5 Green infrastructure

The green infrastructure section can be divided into two categories; 'Soft' and 'Hard' green infrastructure. Soft green infrastructure refers to 'Urban Forestry' such as parks, amenity reserves, public open spaces and street vegetation amongst others. Hard green infrastructure refers to 'Green Building Practices' such as eco-roofs and green alleys and streets amongst others.

Soft Green Infrastructure will be the municipality's sole responsibility and will begin with:

1. Identifying the different types of urban forestry that will be appropriate to the municipal area. This will entail determining the various plant species that will be best suited to the local climate as well as their maintenance requirements.

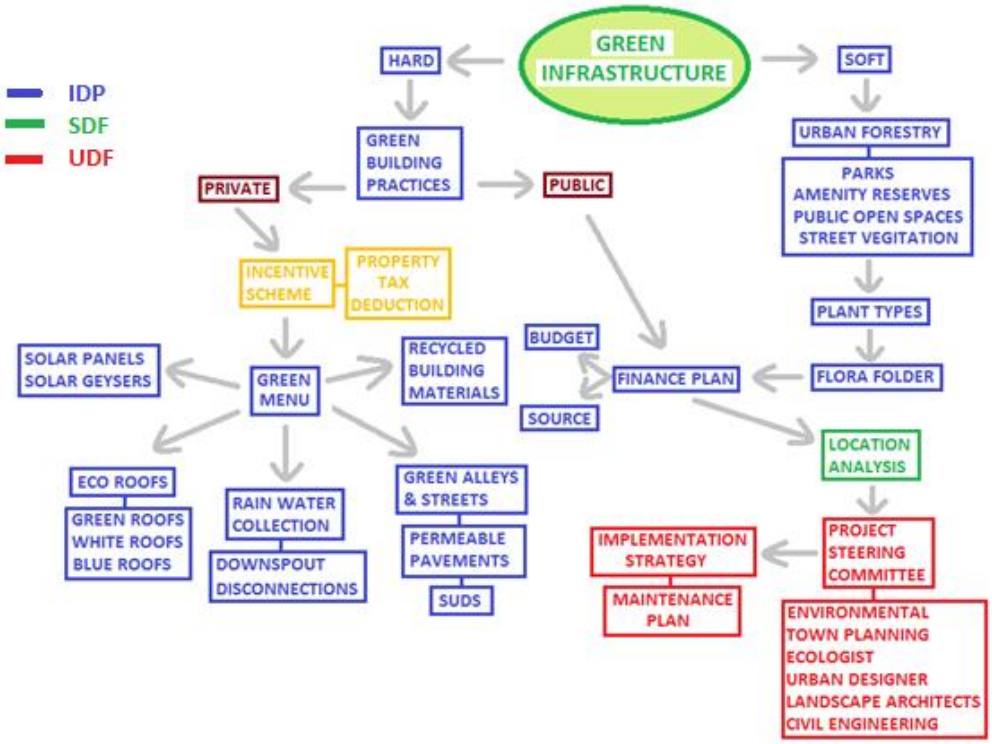
2. After the different types of applicable plant species have been identified and included into the Flora Folder, the Finance Plan must be drawn up considering the Source[23] of funding in addition to allocating a Budget.

3. Thereafter, the Locations Analysis will determine the locations that will be best suited for each of the various types of flora. This analysis should

[23] which would normally be the municipalities internally generated revenues

preferably be undertaken by the municipality's Environmental Practitioners or related professionals who would be able to make such distinctions. The locations should then be included in the relevant UDF.

Figure 7.7 Green infrastructure



Source: Own Compilation, 2013

4. The Project Steering Committee must then be assembled and should preferably consist of the following departments:

- Environmental,
- Ecological,
- Town Planning,
- Urban Designing and
- Landscape Architect professionals.

The Project Steering Committee must then compile an Implementation Strategy which should amongst other include a Maintenance Plan for the various types of flora. The Maintenance Plan should additionally consider the Budget and be included in the relevant UDF. The Project Steering Committee

should report back to the municipality periodically to inform them of their latest developments.

Hard Green Infrastructure can be carried out by the municipality in addition to being used by private developers in return for financial compensation. Municipalities should begin with:

1. Drawing up a Financial Plan wherein they identify the source of funding in addition to allocating a Budget.

2. Thereafter, the Location Analysis should be done wherein the different locations are identified where Green Building Practices will be viable and be included in the SDF (if large enough or otherwise in the UDF).

3. The Project Steering Committee must then be assembled and should preferably consist of representatives of the following departments:
    - Environmental,
    - Town Planning,
    - Ecology,
    - Urban Designing,
    - Landscape Architect and
    - Civil Engineering.

    If the municipality does not have such departments, private professionals should be consulted. The Project Steering Committee should then compile an Implementation Strategy which must include a Maintenance Plan amongst others which must be considered by the Budget.

Private developers can also incorporate Green Building Practices into their developments in return for a reduction on property taxes. Developers will have the option to choose from items on the Green Menu which include amongst others the following:

- Eco-Roofs,
- Rain Water Collection Methods,

- Green Alleys and Streets,
- Solar Panels and Geysers
- Recycled Building Materials.

The more items that are incorporated into a development design, the larger the portion of property tax that can be deducted.

7.4 Summary and Conclusions

The proposals made in this chapter aim to improve municipal infrastructure planning in an attempt to facilitate effective and sustainable service delivery and economic development. The proposals focus on key areas of concern within the existing infrastructure and spatial planning systems. Two main areas of concern were identified. The first relates to the lack of co-ordination in terms of planning between the three spheres of government, the three tiers of local government as well as between service providers and service authorities in addition to the uncertainty revolving around responsibility. The second relates to the lack of practically applicable plans that provide sufficient guidance for implementation. This chapter additionally proposed the introduction of green infrastructure and renewable energy infrastructure into the municipal infrastructure planning system.

Bibliography

Adebola, S. 2011. Electricity Consumption and Economic Growth: Tri-variate investigation in Botswana with Capital Formulation. *International Journal of Energy Economics and* Policy 1(2): 32 – 46.

Ahern, J. 2007. Green Infrastructure for cities: The Spatial Dimension. University of Massachusetts, Amherst: 269-283 Available at: http://people.umass.edu/jfa/pdf/Chapter17_Ahern2%20copy.pdf Date of Access: 13 June 2013

Akinlo, A.E. 2009. Electricity Consumption and Economic Growth in Nigeria: Evidence from Co-integration and Co-Feature Analysis. Journal of Policy Modelling 31(5): 681-693.

Albrechts, L. 2006. Shifts in strategic spatial planning? Some evidence from Europe and Australia. *Environment and Planning A* 38:1149-1170. Available at: www.core.kmi.open.ac.uk/download/pdf/6997261 Date of Access: 4 September 2013

Altinay, G., & Karagol, E. 2005. Electricity consumption and economic growth: Evidence from Turkey, Energy Economics 27:849-856.

Armstrong, M.P., Densham, P.J., Lolonis, P. & Rushton, G. 1992. Cartographic displays to support locational decision-making. *Cartography and Geographic Information Systems* 19:154-164

Aschauer, D.A. 1989a. "Is Public Expenditure Productive?" *Journal of Monetary Economics* 23:177-200.

Aschauer D. A. 1989b. Does Public Capital Crowd Out Private Capital? *Journal of MonetaryEconomics* 24:171-88.

ASGI-SA. (Accelerated and Shared Growth Initiatives of South Africa). 2006. Annual Report 2006. Available at:

www.info.gov.za/asgisa/ASGISA_Annual_Report.pdf Date of access: 30 March 2013.

Barro, R. 1990. Government Spending in a Simple Model of Endogenous Growth. Journal of Political Economy 98(5):102

Beatley, T. 2000. Green Urbanism: Learning from European Cities. Island Press, Washington D.C. Available at: http://napa.vn:8080/uris/uploads/1/1559636823.Island.Press.Green.Urbanism.Learning.From.European.Cities.Dec.1999.pdf Date of Access: 26 March 2013

Benedict, M. & McMahon, E. 2006. Green Infrastructure: linking landscapes and communities. Island Press, Washington.

Berry, J.K. 1987. Fundamental operations in computer-assisted map analysis. *International Journal of Geographical Information Systems* 1:119-136

Blackman, D. & Thackray, R. 2007 The Green Infrastructure of Sustainable Communities. England's Community Forests Available at: www.roomfordesign.co.uk

Boopen, S. 2006. "Transport Infrastructure and Economic Growth: Evidence from Africa Using Dynamic Panel Estimates." *The Empirical Economic Letters*, 5 (1).

Breetzke, K. 2009. From Conceptual Frameworks to Quantitative Models: Spatial Planning in the Durban metropolitan area, South Africa – the link to housing and infrastructure planning.

Bryson, J.M. & Roering, W.D. 1988. Initiation of strategic spatial planning by governments. Public Administration Review 48:995-1004

Burinskiene, M., & Rudzkiene, V. 2009. Future Insights, Scenarios and Expert Method Application in Sustainable Territorial Planning. *Ukio ekonominis ir technologinis vystymas-Technological and Economic Development of Economy*

Cave, K. 2002. Urban Watershed management (Detroit, Michigan). In France, RL (Ed.) (2002) Handbook of Water Sensitive Planning and Design. Lewis Publishing, New York 491-512.

CCAP (Climate Change Action Plan). 2010. Rising to the challenge. A climate change action plan for England's Northwest 2010-2012. Available at: http://www.climatechangenorthwest.co.uk/sites/default/files/00110%20NW%20Climate%20Change%20Action%20Plan%202010.pdf. Date of Access: 2 May 2013.

CGAH (Chicago Green Alley Handbook). 2010. An Action Guide to Create a Greener, Environmentally Sustainable Chicago. Available at: http://www.cityofchicago.org/content/dam/city/depts/cdot/Green_Alley_Handbook_2010.pdf Date of Access: 24 August 2013

Ciarreta, A. & Zarraga, A. 2006. Electricity consumption and economic growth: Evidence form Spain. Preliminary version. Available at: www.researchgate.net/publication/.../79e4150ea8d02c7b4f.pdf Date of access: 17 April 2013.

City of Chicago. 2009. Chicago green homes program guide. Available at: http://www.cityofchicago.org/dam/city/depts/doe/general/GreenBldsRoofsHomes/ChicagoGreenHomesGuide_v2.pdf. Date of Access: 15 May 2013.

CLG (Communities Local Government). 2008. Planning Policy Statement 12: creating strong safe and prosperous communities through local spatial planning. Department for Communities and Local Government, The Stationery office, London. Available at: http://webarchive.nationalarchives.gov.uk/20120919132719/http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps12lsp.pdf. Date of Access: 4 June 2013.

COGTA (Department of Cooperative Governance and Traditional Affairs). 2013. Municipalities Spending of Municipal Infrastructure Grant (MIG) Available at: http://www.cogta.gov.za/cgta/index.php/tenders/news/1-latest-news/389-

municipalities-spending-of-municipal-infrastructure-grant-mig.html Date of Access: 19 August 2012.

Corporate Policy Unit, eThekwini Municipality. 2002. Unpublished report 2008

Collier, P. & Gunning, W. 1999. Explaining African Economic Performance. Journal of Economic Literature 37 (1):64

CSIR (Council for Scientific and Industrial Research). 2000. Guidelines for Human Settlement Planning and Design (The Red Book) Available at http://www.csir.co.za/Built_environment/RedBook/ Date of Access: 10 November 2013.

Davies, C, McGloin, C, MacFarlane, R & Roe, M. 2006. Green Infrastructure Planning Guide Project: Final Report.

DBSA (Development Bank of Southern Africa). 2008. Infrastructure Barometer 2008.

DBSA (Development Bank of Southern Africa). 2012. The state of economic infrastructure: Opportunities and challenges. Available at: http://www.dbsa.org/Research/Documents/DBSA%20State%20of%20SAs%20Economic%20Infrastructure%20Report%202012.pdf?AspxAutoDetectCookieSupport=1 Date of access: 14 April 2013.

Devarajan S., Swaroop V., & Zou H. F. 1996. The Composition of Public Expenditure and Economic Growth, *Journal of Monetary Economics* 37:313-344.

Dewar, D. & Uytenbogaardt, R. 1991. South African cities: A manifesto for change. Cape Town: University of Cape Town.

DOB (Department of Buildings). s.a. Green Permit Program Brochure., City of Chicago. Available at:

http://egov.cityofchicago.org/webportal/COCWebPortal/COC_EDITORIAL/GreenPermitBrochure_1.pdf. Date of Access: 7 June 2013

a & b Dr Kenneth Kaunda District Municipality. 2012b. Integrated Development Plan 2012/16.

A & b Dr Kenneth Kaunda District Municipality. 2012a. Spatial Development Framework.

Duffy-Deno, K. & Eberts, R. 1991. Public Infrastructure and Regional Economic Development: A Simultaneous Equations Approach. Journal of Urban Economics 30:329-343.

Du Plooy, P. 2011. Infrastructure and Greening the Future. Trade and Industrial Policy Studies Centre (TIPS) Infrastructure Dialogues: Macro-economic motivation and financial innovation for green infrastructure. Dialog Summary.

DWAF (Department of Water Affairs). 2012. Assessment of Infrastructure and Financing. Available at: http://www.dwaf.gov.za/Projects/PERR/documents%5CAssessment%20of%20Infrastructure%20and%20Financing%20Dec%202012%20v1.pdf. Date of Access: 11 November 2013.

Easterly, W. & Robelo, S. 1993. "Fiscal Policy and Economic Growth," *Journal of Monetary Economics* 32:417-458.

ECSECC (Eastern Cape Socio Economic Consultative Council). 2013. Quarterly Economic Update. First Quarter. July 2013. Available at http://www.ecsecc.org/files/library/documents/1Q2013_Economic_update.pdf Date of Access: 14 November 2013.

EPA (United States Environmental Protection Agency). 2008. Reducing Urban Heat Islands: Compendium of Strategies (October 2008): Urban Heat Island Basics.

Available at: http://www.epa.gov/heatisld/resources/compendium.htm Date of Access: 21 July 2013

Eskom. 2011. Integrated Report. Eskom, Johannesburg. Available at: http://www.google.com/#as_qdr=all&fp=97aff36dafc2301d&q=eskom+integrated+report+2011+pdf&safe=active Date of Access: 17 May 2013

Fábos, JG. 2004. Greenway planning in the United States: its origins and recent case studies. Landscape and Urban Planning 68: 321-342

Fedderke, J.W &. Bogetic, Z. 2006. Infrastructure and growth in South Africa: Direct and indirect productivity impacts of 19 infrastructure measures. http://www.tips.org.za/files/infraprod2wbfinal2.pdf Date of access: 13 January 2012.

Fedderke, J. & Garlick, R. 2008. Infrastructure Development and Economic Growth in South Africa: A Review of the Accumulated Evidence. May 26, 2008.

Fedderke, J.W., Perkins, P. & Luiz, J.M. 2006. Infrastructural investment in long-run economic growth: South Africa 1875—2001, World Development 34(6):1037—1059.

Ferguson, B. 2002. Stormwater Management and Stormwater Restoration. In France, RL (Ed.)(2002) Handbook of Water Sensitive Planning and Design. Lewis Publishing, New York: 11-29.

Ferguson, R., Wilkinson, W. & Hill, R. 2000. Electricity use and economic development, Energy Policy 28:923-934.

Ferreira, D. & Khatami, K. 1996. *Financing Private Infrastructure in Developing Countries.* World Bank Discussion Paper No.343. World Bank, Washington, D.C.

Foster, J., Lowe, A. & Winkelman, S. 2011. The Centre for Clean Air Policy (CCAP). The value of green infrastructure for urban climate adaptation.

Friedman, J. 1964. Regional Planning as a Field Study, in Friedman, J. & Alonso, W. Regional Development and Planning. MIT Press, Cambridge, Mass.

Friedman, J. 1967. A Conceptual Model for the Analysis of Planning, Administrative Science Quarterly, 12.

Ghosh, S. 2002. Electricity consumption and economic growth in Taiwan, Energy Policy 30:125-129.

Glasson, J. 1978. An Introduction to Regional Planning. *The Built Environment Series*: Concepts Theory and Practice. Second edition, London.

Godehart, S. 2006. The Transformation of Townships in South Africa. The case of KwaMashu, Durban, Spring Research Series 49, Dortmund: University of Dortmund.

Goodchild, F. 2005. Spatial analysis and modelling. University of California, Santa Barbara. Available at: http://www.geog.ucsb.edu/~good/papers/352.pdf Date of Access: 7 November 2013

GONW (Government Office North West). 2008. The North West of England Plan. Regional Spatial Strategy to 2021. Published by The Stationery Office, London. Available at : http://www.cumbria.gov.uk/elibrary/Content/Internet/538/755/1929/1982/3972715317.pdf. Date of Access: 23 June 2013.

Goss, H. 2008. Demonstrator Toolkit for Integrated Planning (2): The value of Technology in Supporting Spatial and Infrastructure Planning. CSIR Built Environment Planning Support Systems. Available at: http://www.espace.csir.co.za Date of access: 14 August 2012.

Gramlich, E.M. 1994. Infrastructure Investment: A Review Essay, Journal of Economic Literature 32(3):1176-96.

Granham, A., Day, J., Bray, B. & Mackenzie, S. 2012. Sustainable drainage systems. Maximising the potential for people and wildlife. A guide for local authorities and developers.

Green, C., Breetzke, K. & Argue, T. 2008. 'Standards for improved governance and performance management in the eradication of backlogs and delivery of public facilities' paper presented at '11th International Winelands Conference on Public & Development Management', Stellenbosch, South Africa.

Green, C. & Mans, G. 2008 'Accessibility Modelling of eThekwini Social Facilities project', Centre for Scientific and Industrial Research, unpublished report

Gu, W., & Macdonald, R. 2009. The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates. The Canadian Productivity Review. *Research paper* (21).

Hall, P. 1975. Urban and Regional Planning. Hardmondsworth / London, Penguin.

Hanson, M. 1965. "Unbalanced Growth and Regional Development," Western Economic Journal 4:3-14.

Hardy, A. 1980. "The Role of the Telephone in Economic Development." Telecommunications Policy 4(4):278-86.

Harris, N. 1990. Urbanisation, Economic Development and Policy in Developing Countries. London: Development Planning Unit, London College University.

Healy, P. 2004. Relational Complexity and the Imaginative Power of Strategic Spatial Planning in European Planning Studies. Published online.

HCM (Hibiscus Coast Municipality). 2012a. Integrated Development Plan. 2012/2013 Final.

HCM (Hibiscus Coast Municipality). 2012b. Spatial Development Framework 2012 Final.

Hiss, T. 1990. The Experience of Place. Vintage Books, New York.

Howard, E. 1985. Garden Cities of To-morrow. Attic Books, Eastbourne.

IEEE (Institute of Electrical and Electronics Engineering). s.a. TryEngineering. Working with Wind Energy. Available at: http://www.ieee.org/documents/tisp_region7_wind_energy.pdf Date of Access: 17 July 2013

IFC (International Finance Corporation). 2012. Utility Scale Solar Power Plants. A guide for developers and investors. New Delhi. Available at: http://www.ifc.org/wps/wcm/connect/04b38b804a178f13b377ffdd29332b51/SOLAR%2BGUIDE%2BBOOK.pdf?MOD=AJPERES Date of Access: 2 September 2013

IRP2 (Integrated Resource Plan). 2010. Building on the Findings of the Electricity Governance Initiative South Africa. Available at: http://www.google.com/#as_qdr=all&fp=97aff36dafc2301d&q=Integrated+Resource+Plan+IRP2&safe=active Date of Access: 22 July 2013

Jimenez, E. 1995. "Human and physical infrastructure: public investment and pricing policies in developing countries." In Behrman, J and Srinivasan, TN (eds.), 1995, *Handbook of Development Economics*, 3B, Amsterdam: Elsevier Science, North-Holland.

Johansson, R. 2003. Case Study Methodology. Royal Institute of Technology Infrastructure / Urban Studies / Built Environment Analysis. Available at: http://www.psyking.net/htmlobj-3839/case_study_methodology-_rolf_johansson_ver_2.pdf

Jumbe, C.B.L. 2004. Co- integration and Causality between Electricity Consumption and GDP: Empirical Evidence from Malawi. Energy Economics 26:61-68.

Kambites, C & Owen, S (2007) Renewed prospects for green infrastructure planning in the UK. Planning Practice and Research 21(4):483-496.

Kazmierczak, A. & Carter, J. 2010. University of Manchester. Adaptation to climate change using green and blue infrastructure. A database of case studies: Available at: http://www.grabs-eu.org/membersArea/files/faenza.pdf. Date of Access: 19 July 2013.

Kessides, C. 1993. The Contributions of Infrastructure to Economic Development: A Review of Experience and Policy Implications. Washington, DC: The World Bank, Discussion Paper No. 213.

Kraft, J. & Kraft, A. 1978. On the relationship between energy and GNP. Journal of Energy and Development 3:401-403.

Kumo, W. 2012. Infrastructure investment and economic growth in South Africa: A granger causality analysis. *African Development Bank Group*. Working Paper No 160.

Kunzmann, K. 2000. Strategic spatial development through information and communication. The Revival of Strategic Spatial Planning Eds W Salet, A Faludi, Royal Netherlands Academy of Arts and Sciences, Amsterdam: 259-265

Lavine, J. & Landis, J.D. 1989. Geographic information systems for local planning. *Journal of the American Planning Association* 55:209-220**.**

Lee, C. & Chang, C. 2005. Structural breaks, energy consumption, and economic growth revisited: Evidence from Taiwan, Energy Economics 27: 857-872.

Longley, P., Higgs, G. & Martin, D. 1994. The predictive use of GIS to model property valuations. *International Journal of Geographic Information Systems* 8:217-235.

Magill, B. 2004. Cost Surface Model project. Unpublished report.

McMahon, E. 2000. "Looking Around: Green Infrastructure", Planning Commission Journal (Winter 2000) Burlington, Vermont, Number 37.

Mell, I. 2008. Green Infrastructure: concepts and planning. Newcastle University 8:69-80

MIIF (Municipal Infrastructure Investment Framework). 2011. Round 7 (2009 – 2010): A capital investment perspective. Available at: www.cogta.gov.za/subwebsites/annualreport/miif/miif.pdf Date of Access: 02 August 2012.

Muneer, W. 2011. Large-Scale Solar PV Investment Planning Studies. Ontario, Canada: UW (Thesis – MBA). Available at : https://ece.uwaterloo.ca/~ccanizar/thesis/wajid.pdf Date of Access: 1 September 2013.

National Treasury. 2011. Local Government Budgets and Expenditure Review: 2006/07 – 2012/13. Available at: http://www.treasury.gov.za/publications/igfr/2011/lg/03.%20Foreword%202011%20LGBER%20-%20Final%20-%209%20Sept%202011.pdf. Date of Access: 16 August 2013

NDP (National Development Plan) National Planning Commission. 2012. 2030. Available at: http://www.npconline.co.za/medialib/downloads/home/NPC%20National%20Development%20Plan%20Vision%202030%20-lo-res.pdf. Date of Access: 5 July 2013

NMBM (Nelson Mandela Bay Municipality). 2007. Sustainable Community Planning Guide. Port Elizabeth: Nelson Mandela Bay Municipality.

NGP (New Growth Path). 2011. Available at : www.poa.gov.za/Outcome4/.../New%20Growth%20Path.pdf Date of Access: 27 July 2013.

NREL (National Renewable Energy Laboratory). 2012. Utility-Scale Concentrating Solar Power and Photovoltaics Project: A Technology and Market Overview. Available at: http://www.nrel.gov/docs/fy12osti/51137.pdf

NRDC (Natural Resource Defence Council). 2006. Rooftops to Rivers. Available at: http://www.nrdc.org/water/pollution/rooftops/contents.asp Date of Access: 21 May 2013

NSDP (National Spatial Development Perspective). 2006. The Presidency RSA. Pretoria. Available at: http://www.npconline.co.za/MediaLib/Downloads/Home/Tabs/Diagnostic/MaterialConditions2/The%20Presidency%20National%20spatial%20development%20perspective.pdf Date of Access: 13 August 2012

Nijkamp, P. 1986. Infrastructure and Regional development: A multidimensional policy analysis. *Empirical Economics* 1:1-21.

Njoh, A. 2008. The emergence and spread of contemporary urban planning. Draft chapter for the global report on human settlements: revisiting planning. In Report to the UN-HABITAT, Nairobi.

Nourzad, F. & Vrieze, M. 1995. Public Capital Formation and Economic Growth: Some International Evidence. Journal of Productivity Analysis 6(4):283-295.

NWDA (Northwest Regional Development Agency). 2006. Northwest Regional Economic Strategy 2006, Warrington.

Odhiambo, N.M. 2009. Energy Consumption and Economic Growth Nexus in Tanzania:an ARDL Bounds Testing Approach. Energy Policy 37: 617-622.

O'Leary, B. 2008. Corporate Policy Unit, eThekwini Municipality, unpublished report.

Patton, M. 1990. *Qualitative Evaluation and Research Methods.* Thousand Oaks, London, New Delhi: Sage.

PCSD (President's Council on Sustainable Development). 1998. Towards a Sustainable America: Advancing Prosperity, Opportunity and a Healthy Environment for the 21st Century. Available at: http://clinton2.nara.gov/PCSD/Publications/tsa.pdf Date of Access: 1 May 2013

PlaNYC, 2008. Sustainable Stormwater Management Plan. Available at: http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/nyc_sustainable_stormwater_management_plan_final.pdf Date of Access: 29 August 2013.

Queensland Government, Office of Urban Management, Department of Local Government, Planning, Sport and Recreation. 2005a. *South East Queensland Regional Plan, 2005-2026*. Queensland Government.

Queensland Government, Office of Urban Management, Department of Local Government, Planning, Sport and Recreation. 2005b. *South East Queensland Infrastructure Plan and Programme, 2005-2026.* Queensland Government.

Ratner, J.B. 1983. "Government Capital and the Production Function for U.S. Private Output," *Economic Letters* 13:213-217.

Rechsteiner, R. 2008. Wind Power in Context. A clean Revolution in the Energy Sector. Scientific and parliamentarian advisory board: Energy Watch Group. Available at: http://www.energywatchgroup.org/fileadmin/global/pdf/2009-01-09_Rechsteiner_Statement.pdf Date of Access: 04 May 2013

Redman, T. 2008. Development, Planning & Management Department, Research & Policy Unit, eThekwini Municipality. Unpublished report.

Roeller, L.H. & Waverman, L. 2001. "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach." American Economic Review 91(4): 909-23.

SAICE (South African Institute of Civil Engineers). 2011. Infrastructure Report Card for South Africa. Midrand. Available at: http://www.csir.co.za/enews/2011_jun/download/infrastructure_report_card_sa_2011.pdf Date of Access: 12 November 2013.

Shiu, A. & Lam, P.L. 2004. *Electricity Consumption and Economic Growth in China*. Energy Policy 32:47-54.

Snieska, V. & Simkunaite, I. 2009. Socio-Economic Impact of Infrastructure Investments. *Economics of Engineering Decision.*

South Africa. 1977. National Building Regulations and Building Standards Act No 103 of 1977.

South Africa. 1996. Constitution of the Republic of South Africa 108 of 1996.

South Africa. 1997. Intergovernmental Fiscal Relations Act No 97 of 1997.

South Africa. 1998. Municipal Structures Act 117 of 1998

South Africa. 2000. Municipal Systems Act 32 of 2000.

South Africa. 2003. Municipal Finance Management Act No 56 of 2003

South Africa. 2009. National Land Transport Act No 5 of 2009

South Africa. 2013. Division of Resources Revenues Act No 2 of 2013

South Staffs Water. 2012. Water Leakage & Your Responsibilities, Information Guidance. Available at:

http://www.southstaffswater.co.uk/publications/your_home/water_leakage_responsibilities.pdf. Date of Access: 04 May 2013

Soytas, U. & Sari, R. 2003. Energy consumption and GDP: causality relationship in G-7 countries and emerging markets, Energy Economics 25:33-37.

Stern, C. 1993. Energy use and economic growth in USA, a multivariate approach. Energy Economics 15:137-150.

Stern, N. 2006. The Stern Review: the economics of climate change, executive summary, HM Treasury, London.

Tlokwe Municipality. 2011. Integrated Development Plan of the Tlokwe City Council Third Generation IDP.

Tlokwe Municipality. 2008. Spatial Development Framework.

Todes, A. 2008. Rethinking spatial planning. South African Planning Institute Planning Africa Conference. Available at: http://siteresources.worldbank.org/INTSOUTHAFRICA/Resources/Todes_bladgereedSSno_532008_revised3.pdf Date of access 25 November 2012.

Ugu District Municipality. 2011. Integrated Development Plan 2007/08 to 2011/12. As revised in 2011/12 IDP Review.

Ugu District Municipality. 2012. Spatial Development Framework 2012 – 2013. Consolidated Report.

A & b Umzumbe Municipality. 2012b. Integrated Development Plan 2012/2013 – 2016/2017

A & b Umzumbe Municipality. 2012a. Spatial Development Framework and Strategic Environmental Assessment. Consolidated Report: Final Draft November 2012.

UNCDF (United Nations Capital Development Fund). 2007. Localizing the Millennium Development Goals, available at: http//www.uncdf.org Date of access: 14 February 2013.

UNISA (University of South Africa). 2011. A broad review of the New Growth Path Framework with a specific emphasis on the feasibility of its proposed targets. Available at: http://www.unisa.ac.za/contents/faculties/ems/docs/Press413.pdf Date of access: 25 July 2013.

USBR (U.S. Department of the Interior Bureau of Reclamation Power Resource Office). 2005. Reclamation Managing Water in the West. Hydroelectric power. Available at: http://www.usbr.gov/power/edu/pamphlet.pdf Date of Access: 24 July 2013

USGBC (United States Green Building Council). 2007. Available at: http://www.usgbc.org Date of Access: 25 August 2013

USGBC (United States Green Building Council). 2013a. LEED Rating Systems: Available at: http://www.usgbc.org/leed/rating-systems. Date of Access: 23 June 2013.

USGBC (United States Green Buildings Council). 2013b. LEED Certification Fees: Available at: http://www.usgbc.org/leed/certification/fees/overview. Date of Access: 23 June 2013.

Waverman, L., Meschi, M. & Fuss, M. s.a. The impact of Telecoms on Economic Growth in Developing Countries.

WBDG (Whole Building Design Guide). 2012. National Institute of Building Sciences website, Extensive Green Roof – Definition. Available at: http://www.wbdg.org/resources/greenroofs.php Date of Access: 23 August 2013

Webster. 1970. Webster's Seventh New Collegiate Dictionary. Merriam-Webster, Springfield, MA.

WERF (Water Environment Research Foundation). 2013. Chicago, Illinois: Becoming the "Greenest City in America": Available at: http://www.werf.org/livablecommunities/studies_chic_il.htm. Date of Access: 19 June 2013.

Wolde-Rufael, Y. 2006. Electricity Consumption and Economic Growth: A Time Series Experience for 17 African Countries. Energy Policy 34:1106-1114.
World Business Chicago. 2014. Driving Success in North America's Global Business Centre. Available at: http://www.worldbusinesschicago.com/data/maps

Yeh, A. 1996. Urban planning and GIS. Available at: http://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/files/ch62.pdf Date of Access: 25 October 2013.

Young, C.R. 1966. Goals and Goal Settings, *Journal of the American Institute of Planners* 76-85.

Yudelson, J. 2010. A look at the looming water crisis and what it may mean for Architects, contractors, Engineers, and technology suppliers. EcoStructure website, "Blue is the New Green" Blog (February 2010). Available at: http://www.ecobuildingpulse.com/water-conservation/blue-is-the-new-green.aspx Date of Access: 28 August 2013

Yoo, S.H. 2005. Electricity consumption and economic growth: Evidence from Korea. Energy Policy 33:1627-1632.