THE INKOMATI CATCHMENT MANAGEMENT STRATEGY

STATUS QUO REPORT

FINAL DRAFT

Compiled for

INKOMATI
CATCHMENT MANAGEMENT AGENCY

Compiled by

INHLAKANIPHO CONSULTANTS

March 2008

Version Control

The Catchment Management Strategy

Status Quo Report

Version 1 Final Draft	March 2008
List of Previous Versions	This version is the first and will be reviewed in due course
Current Version Controller	RS Ndlovu Private Bag X11214 Nelspruit, 1200 Mpumalanga

PROJECT TEAM

Robert Mbwana	Team Leader
Thomas Gyedu-Ababio	Project Manager
Geraldine Klarenberg	Water Resources
Karen van der Merwe	Legal and Institutional
Roy Kerr	Financial
Carol Zulu	Water Services
Solly Manyaka	Public Participation
Lucky Msimanga	GIS

APPROVAL

Title	**: Inkomati Catchment Management Strategy – Status Quo Report**
Project No	**:**
CMA Report No	**:**
Consultants	**:** Inhlakanipho Consultants
Report Status	**:** Version 1, March 2008
Version Controller	**:** Mr Sizile Ndlovu

Approved for Inhlakanipho Consultants

…….
Robert Mbwana (Pr. Eng)
Team Leader

…….
Dr. Thomas Gyedu-Ababio
Project Manager

Approved for Inkomati Catchment Management Agency

…….
Mr. RS Ndlovu
CEO

…….
Board Chairperson

INVITATION TO COMMENT

This report will be updated on a regular basis. Water users and other stakeholders in the Inkomati WMA and other areas are encouraged to study this report and to submit any comments they may have to the CEO of the ICMA

FOREWORD

Being the first CMA in the country, the Inkomati Catchment Management Agency continues to face challenges and the strategic objectives set out in the Business Plan and the Operational Plan are providing the organisation with a strategic framework to deal with those challenges successfully. All these challenges are directly linked to the mandate and the core functions as stated in the National Water Act, 1998.

Beyond contributing significantly towards elimination of poverty, the challenges include ensuring that water resources are used, developed, conserved, managed, controlled and protected in ways which take into account amongst other factors the following:

a) Meeting the basic human needs of present and future generations;
b) Promoting equitable access to water;
c) Redressing the racial and gender discrimination associated with apartheid legacy;
d) Promoting the efficient, sustainable and beneficial use of water in the public interest;
e) Facilitation of social and economic development;
f) Providing for growing demand for water use;
g) Protecting aquatic and associated ecosystems and their biological diversity;
h) Reducing and preventing pollution and degradation of water resources;
i) Meeting international obligations;
j) Promoting dam safety; and
k) Managing floods and droughts.

The Inkomati CMA's Business Plan fully acknowledges that in order to give effect to the purpose of the National Water Act, there is a need to establish suitable institutional arrangements that will enable community involvement in decision-making processes. These must reflect appropriate community, racial and gender representation.

The Act also requires Catchment Management Agencies to develop Catchment Management Strategies in line with the National Water Resources Strategy. Giving essence to the purpose of the Act, the Inkomati CMA's Catchment Management Strategy is premised on the principles of efficiency, equity, sustainability and representativity. This status quo presented is work in progress towards the development of the full fledged Catchment Management Strategy for the Inkomati Water Management Area to provide the strategic direction of the organisation spanning a five year period.

RS Ndlovu
CEO: Inkomati Catchment Management Agency

EXECUTIVE SUMMARY

Background: The world's freshwater resources are under pressure to meet the growing demands of burgeoning populations and their various activities. This problem is repeatedly acknowledged at international forums such as the 1992 Rio Summit. The fact that South Africa receives less than the world's average annual rainfall suggests that it is a potential candidate for water stress. The Inkomati Water Management Area (WMA) is currently in a deficit of about 800 m m^3. Institutional management and participation of all stakeholders is essential to achieve the successful protection, use, development, conservation, management and control of our water resources. The institutional framework outlined in the National Water Act provides for the progressive decentralisation of water resource management to the appropriate level as well as providing for participation in water resource management in South Africa. The NWA stipulates that the NWRS among other things should provide objectives for the establishment of institutions to undertake water resource management and also to determine the inter-relationship between institutions involved in water resource management. Although the decentralisation based reforms for water management defines a critical role for communities and users at large, the state will continue to play a fundamental and central role because of its responsibility for managing water as a public good and for ensuring redress, equitable allocation of water and equitable representation in decision making and safeguarding the sustainable provision of ecosystem goods and services, protecting the interests and welfare of all users especially the poor, women and the disabled.

Purpose of the CMS and this document: The ICMA was established by the Minister in September 2005 to give effect to the vision of integrated water resource management at a decentralised level. One of the initial functions of the ICMA is to develop a catchment management strategy. The key outcome of a catchment management strategy is the protection, use, development, conservation, management and control of water resources within a water management area. In the process of developing the strategy, the ICMA must seek co-operation and inputs on water related matters from various stakeholders and interested persons. It must also consider other planning documents such as those of local and provincial government. It is important to note that the strategy can be progressively developed, and must be reviewed from time to time.

This document is the "Situation Description". It is the first in a series of documents to be developed to support the process of developing a catchment management strategy in a collaborative and consultative way. The Situation Description provides the foundation for strategic action. It describes the profile of the current situation of the water management area with a clear focus on water resources, and anticipated trends which might impact water resource availability. The objective of describing the situation as it is to provide a holistic contextual profile of the key characteristics of the WMA as related to water, and the likely future profile in order to provide a sound basis for the development of appropriate and effective strategic direction.

Guiding Principles: The key outcome for the ICMA from this process is integrated water resource management. The founding principles that run throughout all policies and legislation forming the guiding principles in developing appropriate WRM strategies for the IWMA are:

- Sustainability
- Equity
- Efficiency / optimal beneficial use

A process of public participation in developing the strategy will be facilitate and encouraged in a transparent and structured approach, facilitating that views and recommendations made are received, considered and responded to.

Overview of laws impacting the activities of the ICMA

The National Water Act was promulgated in 1998. It is acknowledged internationally as a well-developed piece of legislation addressing integrated water resource management and co-operative and consultative decision-making. Although the National water Act is an important source of rights and obligations for the ICMA, the ICMA's activities are significantly impacted by a number of other laws. These include the Constitution and the Public Finance Management regulating the ICMA as a public entity; the broader body of water, forestry, agricultural and environmental laws and the local government suite of legislation which impacts how municipalities regulate their activities and planning requirements which have a direct impact on the water resources. Recognising that this is the first catchment management strategy ever developed in South Africa, and the infancy of the ICMA, this document includes a synopsis of some of the more prevalent laws impacting the activities of the ICMA, for background purposes.

Catchment Characteristics:

Situation description

The Inkomati Water Management Area (IWMA) is situated in the north-eastern part of South Africa and borders on Mozambique and Swaziland. The IWMA is situated in only one province, Mpumalanga. The IWMA includes areas under the jurisdiction of local municipalities and one district management area covering the Southern Kruger National Park. The political borders of the municipalities are not aligned with quaternary boundaries of the IWMA. The main rivers in the IWMA include the Sabie, the Crocodile (East) and Komati Rivers. The Inkomati Water Management Area, just like the entire Mpumlanga province enjoys a sub-tropical climate with hot summers and mild to cool winters. The Mean Annual Precipitation (MAP) ranges from 400 to 1000 mm (1500 mm in some mountainous areas). The average potential mean annual evaporation (as measured by A-pan) is in excess of the MAP.

Topography

The Great Escarpment, Drakensberg Mountains divide the WMA into two major topographical regions: the plateau area to the west, and the marginal lands (the Lowveld) to the east. The plateau area lies at 2000 m above sea level and consists

of the highveld and the Transvaal plateau. The middleveld, lowveld and the Barberton Mountain area make up the marginal lands. The Lebombo mountain range forms the eastern border of the catchment. The eastern part is generally low, reaching 140m.

Geology and soils
The Inkomati Water Management Area has 6 main geological fractions. Apart from the Barbeton Murchison which forms the boundary between the Crocodile and the Komati sub-catchments, the others run parallel to each other from the north to the south of the catchment.

Hydrology
All three sub-catchments have both perennial and seasonal rivers. Different types of water transfer occur in the IWMA. There is an inter WMA transfer: transfer from the Komati East to Eskom in the Olifants WMA. There is also an intra WMA transfer between the Sabie-Sand and the Crocodile sub-catchments. There are quite a number of dams and as deficit in water supply is a big issue many more dams have been proposed.

Ground Water
Very little is known about the ground water characteristics and usage in the IWMA. It is noted that the rural communities depend more on the ground water resources for domestic usage.

Water Quantity
Water availability is a critical challenge in the IWMA. The WMA is currently in a deficit of 800 m m^3. The Crocodile Catchment is the worst affected. Compulsory licensing is being implemented to ensure that stakeholders get their fair share of the water. Comprehensive Ecological Reserves are currently being calculated in many parts of the IWMA. The reserves that were determined in the past have not been implemented and the KNP has raised its concerns about this over the years.

Water Quality
Although water quality would appear to currently be fit for the purpose for which it is intended to be used, there is a concerning trend of declining quality and an increase in the threat of potential pollution activity. The nutrients' concentrations in the rivers are increasing steadily. The Electrical conductivity is also increasing in all the rivers in the IWMA. Whilst a monitoring system is in place, technical committees need to be set up in all the sub-catchments to aid in the monitoring of the water quality as in the Crocodile Catchment. Areas of water quality concern are the Kaap River and the lower reaches of the Crocodile River, with poor water quality becoming a problem to water users in the lower part of the catchment. The worst form of pollution that is almost a constant feature in all the rivers in the IWMA is sewage pollution. A health problem is envisaged if this problem is not controlled as soon as possible.

Ecological systems
The KNP is the main conservation body in the IWMA. The Sabie and the Crocodile River systems have impressive biodiversity especially in the KNP section of these rivers. The KNP enjoys specific protection as declared reserve. Although covered by more general laws, the wetland bodies in the other parts of the IWMA are not specifically protected and as such the ecological systems are more exposed. The KNP is the haven of both aquatic and terrestrial biodiversity and can be used as the seed factory for the entire system. It is also highlighted that if the KNP does not get the ecological water requirements, some biological species might be lost from the system.

Socio-economic aspects of the IWMA
Population Dynamics
The population of the IWMA is about 1.5 million. The Sabie Sand has the highest population amongst the 3 sub-catchments with a population of about 600 000. The Komati has the minimum, 415 000 whilst the Crocodile has about 475 000. The male and female ratio is 1:1. The area is predominantly rural but urbanisation is on the increase. Poverty is quite prevalent and so is the HIV/AIDS epidemic.

Heritage Resources
The IWMA has Cultural Heritage Resources which need to be protected. Some of the sites named to be of particular importance that might be affected by water resource development include; Groblers Bridge, Komati River (National Monument) and Mac Mac Waterfall.

Land Use and Water Use
All the various form of land use exist in the IWMA. They range from large scale commercial agriculture (irrigation), afforestation, conservation, human settlements, mining to tourism. Irrigated Agriculture use the highest amount of water in WMA. As many as 26 Irrigation Boards reside in the IWMA and use over 60% of the water in the IWMA. Rural settlements use only about 2% of the water in the IWMA.

Water Services Authorities
There are 9 water services authorities in the IWMA. 8 are local municipalities and the 9th is Ehlanzeni District Municipality which has water services authority jurisdiction over the southern portion of the Kruger National Park falling in Mpumalanga. The development hub is in the Crocodile Catchment in the Nelspruit / Hazyview / White River Corridor. The rest of the areas are predominantly agricultural and rural. The rural nature of most of the IWMA does not necessarily depict lower service levels or consumption, as most of the WSAs are moving towards higher levels of service. Water Services Institutions are expected to determine their own targets and benchmarks for efficient water use, hence the significance for the CMS to look at issues related to Water Services

Co-operative governance

Co-operative governance requires that public administration be development-orientated, efficient, transparent, accountable, representative, participative and compliant with all basic values and principles governing, public administration.

The Constitution provides for 3 spheres of government – national, provincial and local – which are "distinctive, inter-dependent and inter-related". Whilst each sphere of government is responsible for planning the activities for which it is constitutionally mandated, the activities and the plans and strategies that guide them must be aligned. The ICMA is significantly guided by the growth projections and plans as set out in the Mpumalanga Provincial Growth and Development Plan and the Municipalities Inte3grated Development Plans and Water Services Development Plans. This however, is an area which will need to see progressive improvement over time through co-operative governance to ensure adequate response by the ICMA to the future water resource requirements of the ICMA.

International Arrangements

The Inkomati River is an international trans-boundary river, crossing Swaziland and Mozambique, resulting in a number of international commitments by the Government. The National Water Act specifically makes provisions for international co-operation – obliging that provisions be made for meeting the needs of neighbouring countries with which water courses are shared. It further puts meeting international obligations as the next highest priority water use after the Reserve. Although this remains a national government function which will not be delegated to the ICMA, because South Africa is currently not meeting its international water obligations, this will impact the activities of the ICMA as the public entity responsible for integrated water resource management in the IWMA which has international borders.

Catchment Management Forums and Committees

The vision of the ICMA is clearly expressed in its Business Plan. The ICMA is providing support to stakeholders to establish 4 forums in the sub-catchments. The 5th forum – The Crocodile Forum – is well established. The vision of the Board is that the forums will represent stakeholders' views, but will not have decentralized or delegated responsibilities from the ICMA. The ICMA will observe and contribute but not lead any forum.

Transformation of Irrigation Boards

There are 26 existing irrigation boards in the ICMA. They were established under the 1956 Water Act, and are currently still operating in terms of that regime. In terms of the National Water Act, they were to have transformed themselves into Water User Associations within 6 months of the coming into effect of the National Water Act in 1998, but to date the process is still not finalised because existing irrigation districts do not correspond to DWAF's vision around transformed operational areas for water user associations. This impacts current assets and liabilities of the irrigation boards.

Traditional Leaders
Approximately 9% of the IWMA is within tribal area boundaries. There are accordingly a large number of traditional leaders in the IWMA. Although they are not significant "water users" and their requirements are accounted for in the rural requirement of 2% of total water use in the IWMA, they are institutional structures which can impact water resources.

CMA Income/Expenditure
The ICMA currently funds its activities by way of a grant from DWAF. The ICMA's main source of funds in the future will be from the sale of water and water charges. DWAF will phase out its grant funding as powers and functions are handed over to the ICMA and it is able to bill for services rendered. The ICMA operates its own basic accounting system and its expenditure to date has largely been on staff emoluments and the public participation processes.

Public Participation
The ICMA has appointed four officials working in the Institution and Public Participation Department. The three sub-catchments Sabie-Sand, Crocodile and the Komati each has one designated official to ensure effective public participation and empowerment. Currently, Catchment Forums have been established in all three sub-catchments. The Crocodile Catchment Forum is the oldest and has structures in place to aid the ICMA/DWAF in the integrated management of the resource.

Initiatives
There are some other initiatives in the IWMA that are ongoing and their output will be important in the development of the Catchment Management Strategies. Some of the initiatives will be completed after the development of the CMS. They include; Catchment Assessment Study, Water Availability Assessment study, Water Allocation Framework, Water Resource Classification, Reserve Determination, Compliance Monitoring and Enforcement.

Identified Challenges
Challenges reflected in the situational description with respect to IWRM include the following:

- The deficit in the Crocodile and Upper Komati (demand is currently greater than supply).
- Water use for all different sectors is currently not accurately quantified, so it is difficult to make decisions around allocations and allocation rules.
- Ecological requirements are currently not effectively implemented, which shows from the fact that some sub-catchments have a negative balance but physically still have water in the river.

The growth and development challenges in the province include; HIV/AIDS, poverty, infrastructure, intergovernmental co-operation, water availability, service delivery backlogs and lack of technical capacity.

Conclusion

The ICMA is a public entity within a framework of a government with high developmental priorities. In establishing the ICMA to undertake its primary function of water resources management, a key focus is ensuring that activities of the ICMA impact the people in the IWMA, by ensuring redress of equity, but finely balanced with the issues of environmental and financial sustainability, job creation, poverty alleviation and broad-based black economic empowerment.

TABLE OF CONTENTS

FOREWORD iii
EXECUTIVE SUMMARY iv
LIST OF FIGURES xv
LIST OF TABLES xvi
LIST OF ABBREVIATIONS xvii
1. INTRODUCTION 1
1.1 PURPOSE OF THE PROJECT 2
1.2 ICMA AND CMS 2
1.3 PURPOSE OF THIS DOCUMENT 3
2. GUIDING PRINCIPLES, LEGISLATION AND POLICIES 3
2.1 REQUIREMENTS OF THE NWA, NATIONAL POLICIES AND STRATEGIES 4
2.1.1 CMA Powers and Functions 4
2.1.2 Powers 4
2.1.3 Initial Functions 4
2.2 OVERVIEW OF LAW IMPACTING THE ACTIVITIES OF THE ICMA 4
2.2.1 The Constitution of the Republic of South Africa, Act 108 of 1996 5
2.2.2 National Water Act No. 36 of 1998 5
2.2.3 National Water Act Strategies 5
2.2.4 Water Services Act No. 108 of 1997 6
2.2.5 Water Services Regulations 6
2.2.6 Water Services Policies and Strategies 6
2.2.7 National Environmental Management Act (107 of 1998) 7
2.2.8 National Forests Act 84 of 1998 8
2.2.9 The Public Finance Management Act 1 of 1999 8
2.2.10 The Intergovernmental Relations Framework Act 13 of 2005 8
2.2.11 Division of Revenue Act (DORA) 8
2.2.12 Promotion of Administrative Justice Act 3 of 2000 8
2.2.13 Promotion of Access to Information Act 2 of 2000 8
2.2.14 Broad Based Black Economic Empowerment Act 53 of 2003 9
2.2.15 Local Government Legislation 9
2.2.16 Extracts from the PFMA 12
2.2.17 The South African National Water Resources Infrastructure Agency Limited Draft Bill 15
2.3 NATIONAL WATER REFORMS 15
2.3.1 Water Allocation Reform/Compulsory Licensing Process: 15
2.3.2 Waste Discharge Charge System 16
2.3.4 Land Reform (restitution and redistribution) 16
2.3.5 Monitoring and Enforcement 16
2.3.6 ICMA Business Plan 16
3. CATCHMENT CHARACTERISTICS 16
3.1 GENERAL DESCRIPTION OF THE STUDY AREA 16
3.1.1 The Komati River Catchment 1

3.1.2 The Crocodile (East) River Catchment 1
3.1.3 The Sabie-Sand River Catchment 1
3.2 TOPOGRAPHY 1
3.3 CLIMATIC CONDITIONS 1
3.3.1 Rainfall 1
3.3.2 Temperature 1
3.3.3 Wind 1
3.3.4 Extreme conditions 1
3.4 GEOLOGY AND SOILS 1
3.4.1 Geology 1
3.5 HYDROLOGY 1
3.5.1 Surface Water 1
3.5.2 Groundwater 20
3.6 ECOLOGICAL SYSTEMS 22
3.6.1 Aquatic Flora and Fauna 22
3.6.2 River Health 22
3.6.3 Ecologically sensitive sites 23
3.6.4 Wetlands 25
3.6.5 Vegetation types 27
3.6.6 The KNP as a protected area 30
3.7 SOCIO-ECONOMIC ASPECTS (PEOPLE OF THE CATCHMENT) 32
3.7.1 Population dynamics and Demographics of the WMA 32
3.7.2 Economic features of Mpumalanga 34
3.8 HERITAGE RESOURCES 36
3.8.1 Heritage Resources in the three subcatchments 36
3.8.2 The role of Heritage Resources in the general economy of the IWMA 40
3.9 LAND USE 41
3.9.1 Mining 41
3.9.2 Agriculture and Forestry 42
3.9.3 Alien vegetation 43
3.10 WATER USE 43
3.10.1 Water uses as described by the NWA in the WMA 43
3.10.2 Water resources related infrastructure 44
3.10.3 The Ecological Reserve 52
3.10.4 Impact of the water use on ecological systems 53
3.11 WATER DEMAND ANALYSIS 54
3.11.1 Water Balance in the IWMA 54
3.12 WATER CONSERVATION AND DEMAND MANAGEMENT 62
3.13 WATER RESOURCES MANAGEMENT CAPACITY 63
3.14 WATER SERVICES 64
3.14.1 Legislation (Including Policies and Plans) impacting on Water Services 65

3.14.2 Water Service Institutions in the IWMA 66
3.14.3 Water Services Authorities (powers and functions) 67
3.14.4 Water Services Providers 71
3.14.5 Water supply and infrastructure (Water Services) 72
3.14.6 Sanitation 76
4. INSTITUTIONAL ARRANGEMENT 82
4.1 GOVERNANCE / REGULATION OF THE ICMA 82
4.2 GENERAL WRM INSTITUTIONAL RELATIONSHIPS 82
4.3 CO-OPERATIVE GOVERNANCE 83
4.3.1 Intergovernmental Planning 83
4.3.2 Local government as a Water User 84
4.3.3 DWAF 85
4.3.4 The National Water Resources Infrastructure Agency (NWRIA) 85
4.3.5 International Arrangements 86
4.3.6 The Kruger National Park 89
4.4 INSTITUTIONAL ARRANGEMENTS IN THE IWMA 89
4.4.1 Scope and Mandate of the ICMA 89
4.4.2 Powers and Functions 90
4.4.3 The ICMA Governing Board 90
4.4.4 Scope and mandate of the CMA 92
4.4.5 Budget and Business Plan 92
4.4.6 Powers and Functions 93
4.4.7 Catchment Management Forums and Committees 95
4.4.8 Water User Associations 96
4.4.9 Irrigation Boards 96
4.4.10 Traditional Leaders 97
5.1 ECONOMIC OVERVIEW OF THE INSTITUTIONAL STRUCTURES 102
5.1.1 The principal draw cards in the IWMA 102
5.2 INSTITUTIONAL STRUCTURES AND THEIR FINANCIAL MATTERS OF THE ICMA 102
5.2.1 Sources of income to the ICMA 102
5.2.2 Financial Plan 103
5.2.3 CMA Income/Expenditure 103
5.2.4 Financial Year: 2007/08 104
5.2.5 Financial Years: 2008/09 and 2009/10 104
5.2.6 Water Pricing Strategy 107
5.3 FINANCIAL STATUS OF OTHER INSTITUTIONAL STRUCTURES 107
6. PUBLIC PARTICIPATION IN WATER RESOURCE MANAGEMENT IN THE IWMA 108
6.1 PUBLIC PARTICIPATION IN PERSPECTIVE 108
6.2 STATUTORY REQUIREMENTS FOR PUBLIC PARTICIPATION 109
6.3 OBJECTIVES OF PUBLIC PARTICIPATION IN CATCHMENT MANAGEMENT STRATEGIES 110
6.4 STATUS OF PUBLIC PARTICIPATION IN THE CATCHMENT 111

6.4.1 Public participation forums 111
6.4.2 Stakeholder database 111
6.4.3 ICMA's plan of action in so far as public participation is concerned 111
7. CRITICAL ISSUES AND OTHER IDENTIFIED CHALLENGES 112
7.1 WATER RESOURCES MANAGEMENT ISSUES 112
7.2 WATER SERVICES 112
7.3 FINANCIAL 113
7.4 INSTITUTIONAL 113
7.5 PUBLIC PARTICIPATION 114
7.6 OTHER CHALLENGES 114
8. INITIATIVES AND OTHER PLANNED PROGRAMMES IN THE IWMA 116
9. CONCLUSION 116
REFERENCES 118
APPENDICES 121

LIST OF FIGURES

Figure 1: Location of the Inkomati Water Management Area 1
Figure 2: General description of the Inkomati Water Management Area 1
Figure 3: Farm lands in the IWMA 1
Figure 4: Topography of the IWMA 1
Figure 5: Rainfall patterns in the IWMA 1
Figure 6: Geology of the IWMA 1
Figure 7: Soil types occurring in the Inkomati WMA 1
Figure 8: Hydrology of the IWMA 1
Figure 9: Surface water resources in the Sabie-Sand Catchment 1
Figure 10: Surface water resources in the Crocodile Catchment 1
Figure 11: Surface water resources in the Komati Catchment 1
Figure 12: Physico-chemical water quality in the Sand Catchment (X3H008Q01) 2
Figure 13: Historical water quality in the Sabie in the KNP (X3H013Q01) 3
Figure 14: Management units and monitoring points in the Crocodile Catchment 4
Figure 15: Historical water quality trends in the Crocodile - Upper Kwena (X2H013Q01) 5
Figure 16: Historical water quality trends in the Crocodile - Nelspruit MU (X2H006Q01) 7
Figure 17: Historical water quality trends in the Crocodile - Kaap MU (X2H022Q01) 9
Figure 18: Historical water quality trends in the Crocodile – KNP (X2H016Q01) 11
Figure 19: Historical water quality trends in the Upper Komati sub-catchment (X1H001Q01) 13
Figure 20: Historical water quality trends for Lower Komati sub-catchment (X2H036Q01) 14
Figure 21: Priority areas for faecal pollution in the IWMA (source NMMP Dec 2007) 18
Figure 22: Map of ecozones in the IWMA 25
Figure 23: Location of wetlands in the IWMA 27
Figure 24: Distribution of vegetation/veld types in the IWMA 29
Figure 25: Cessation of flow in the KNP section of Crocodile River (Gyedu-Ababio 2005) 31
Figure 26: Algal growth displacing fish in the KNP section of the Crocodile River (Gyedu-Ababio 2005) 32
Figure 27: Land Use in the IWMA 42
Figure 28: Map of raw water infrastructure (dams and schemes) 45
Figure 29: Hydrological gauging structures (obtained from DWAF) 48
Figure 30: Irrigation Boards and their geographical areas of operation 51
Figure 31: Map showing the municipal boundaries and WSAs in IWMA 70
Figure 32: Water treatment plants, pumps and reservoirs in the IWMA 75
Figure 33: Waste water treatment plants 81
Figure 34: Institutional relationships 83
Figure 35: Initial Committee Structure of the Inkomati CMA Governing Board 92
Figure 36: ICMA organisational structure 93
Figure 37: Summary of Institutional arrangements in the IWMA 95

Figure 38: ICMA CMC Vision 96

LIST OF TABLES

Table 1: Water Quality Objectives for the Upper Kwena MU 6
Table 2: Water Quality Objectives for Nelspruit MU 8
Table 3: Water quality objectives for the Kaap MU 10
Table 4: Water quality objectives of the KNP MU 12
Table 5: Water quality drivers at selected sites in the Komati (AfriDev, 2006) 15
Table 6: Microbial water quality at several points in the IWMA (*E. coli*, No./100 ml), Source: DWAF Regional Office, Nelspruit) 17
Table 7: Recent microbial analysis results in the priority areas in the IWMA (NMMP, RQS – DWAF) 19
Table 8: Guidelines for assessing the potential health risk for the four water uses (NMMP, RQS) 20
Table 9: Population figures for the Inkomati WMA - per sub-catchment (DWAF, 2003) 33
Table 10: Economic statistics in the Inkomati WMA 35
Table 11: Breakdown of land use in the IWMA 41
Table 12: Land use classification (area covered) 41
Table 13: Dams in the Komati Catchment 46
Table 14: Dams in the Crocodile Catchment 47
Table 15: Dams in the Sabie-Sand Catchment 47
Table 16: Ecological Reserve Requirements per sub-catchment, based on the Internal Strategic Perspective (DWAF, 2004) 53
Table 17: Water yield in the IWMA 56
Table 18: Water requirements by different water users in IWMA 56
Table 19: The water balance in the IWMA 57
Table 20: Water requirements/allocation by sector in the Inkomati WMA in 2004 58
Table 21: Water Service Authorities in the respective catchments of the IWMA 68
Table 22: Water services providers, their supply areas and raw water sources 71
Table 23: Ground Water yield in the IWMA 72
Table 24: Sanitation information in the IWMA 77
Table 25: Waste management sites and their permit status 79
Table 26: Target ecological flows at key points in the Inkomati WMA 87
Table 27: Impact of the minimum flows required at Ressano Garcia (Mozambique Border) on the available yield in the Komati and Crocodile River catchments 88
Table 28: The Governing Board of the ICMA as at January 2007 90
Table 29: Traditional leaders in the IWMA 98
Table 30: Projected CMA expenditure for 2007/08 to 2009/10 105

LIST OF ABBREVIATIONS

ASGISA	Accelerated Strategy for Growth and Shared Initiative for South Africa
BHNR	Basic Human Needs Reserve
Capex	Capital Expenditure
CBO	Community Based Organisation
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
CSIR	Centre for Scientific and Industrial Research
DEAT	Department of Environment Affairs and Tourism
DESC	Default Ecological Status Class
DM	District Municipality
DWAF	Department of Water Affairs and Forestry
EC	Ecological Category
EC (mS/m)	Electrical Conductivity
EIS	Ecologically Important and Sensitive
EISC	Ecological Importance and Sensitivity Class
EWR	Ecological Water Requirements
FAII	Fish Assemblage Integrity Index
GB	Governing Board
GWS	Government Water Scheme
HDIs	Historically Disadvantaged Individuals
I&AP	Interested and Affected Parties
IB	Irrigation Board
ICMA	Inkomati Catchment Management Agency
IDP	Integrated Development Plans
IHI	Index of Habitat Integrity
ISP	Internal Strategic Perspective
IWMA	Inkomati Water Management Area
IWRM	Integrated Water Resource Management
LED	Local Economic Development
LM	Local Municipality
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
Minister	Minister of Water Affairs and Forestry
MoU	Memorandum of Understanding
MU	Management Unit
NEMA	National Environmental Management Act
NMMP	National Microbial Monitoring Programme
NWA	National Water Act 36 of 1998
NWRS	National Water Resource Strategy
PDIs	Previously Disadvantaged Individuals
PES	Present Ecological Status
PESC	Present Ecological Status Class

PFMA	Public Finance Management Act 1 of 1999
PGDS	Provincial Growth and Development Strategy
PP	Public Participation
PPP	Public Participation Process
RVI	Riparian Vegetation Index
SASS	South African Scoring System
STEEP	Social, Technical, Ecological, Economic and Political
STP	Sewage Treatment Plant
TDS	Total Dissolved Salts
WAR	Water Allocation Reforms
WARMS	Water Use Authorisation and Registration Management System
WC/DM	Water Conservation and Demand Management
WDCS	Waste Discharge Charge System
WMA	Water Management Area
WQO	Water Quality Objectives
WRC	Water Research Commission
WSA	Water Services Authority
WSDP	Water Services Development Plan
WSP	Water Services Provider
WSPRF	Water Services Planning Reference Frameworks
WTW	Water Treatment Works
WUA	Water User Association
WWTP	Waste Water Treatment Plant
WWTW	Waste Water Treatment Works

1. INTRODUCTION

South Africa receives less than the world's average annual rainfall. This suggests that this country is a potential candidate for water stress. Currently only 11 out of the 19 Water Management Areas have been adjudged to have enough water. The Inkomati Water Management Area (WMA) is one of the water stressed WMAs and is currently in a deficit of about 800 million m^3 (demand for water is greater than supply). The rural residents depend mostly on water from streams, rivers and underground by means of boreholes and wells.

South Africa has a history of inequities. Unequal access to water resources was part of the historical problem. Since 1994 South Africa has undergone wide scale reform spanning the whole political system. The main triggers for the institutional reforms in water management were related to the inherently discriminatory water policy which intimately tied the access to water resources to that of the land through the riparian rights. This exclusion included any participation in decision making structures for the majority. In support of these processes, institutions were developed which increasingly intervened in the development of water resources in favour of a minority of the population (Eiman Karaar 2007). A new National Water Act (36 of 1998) was therefore promulgated to correct the imbalances of the past, among others, e.g. Integrated Water Resource Management and decentralisation of the management of the resource.

The institutional framework outlined in the National Water Act (36 of 1998) provides for the progressive decentralisation of water resource management to the appropriate level as well as providing for participation in water resource management in South Africa. The NWA stipulates that the NWRS among other things should provide objectives for the establishment of institutions to undertake water resource management and also to determine the inter-relationship between institutions involved in water resource management. Institutional management and participation of all stakeholders is essential to achieve the successful protection, use, development, conservation, management and control of our water resources. As per the NWA and the NWRS, 19 Water Management Areas (WMA) have been established throughout the country. The Inkomati Water Management Area was the first to have a Catchment Management Agency (CMA) established.

Although the decentralisation based reforms for water management defines a critical role for communities and users at large, the state will continue to play a fundamental and central role because of its responsibility for managing water as a public good and for ensuring redress, equitable allocation of water and equitable representation in decision making and safeguarding the sustainable provision of ecosystem goods and services, protecting the interests and welfare of all users especially the poor, women and the disabled (Molden, 2007)[1]. Thus, the objective of managing the quantity, quality and the reliability of the nation's water resources is to achieve optimum, long-term environmentally sustainable social and economic benefit for society from their use (NWRS 2004).

[1] Molden, D, 2007 (ed). Comprehensive Assessment

1.1 PURPOSE OF THE PROJECT

The National Water Act (Act 36 of 1998) calls for the development of strategies to facilitate the proper management of water resources in South Africa. The National Water Resource Strategy provides the framework for the protection, use, development, conservation, management and control of water resources for the country as a whole. The NWRS also stipulates that Catchment Management Strategies (CMS) be developed at WMA level by the respective CMAs and that these CMS should fit into the NWRS. The CMS development is one of the major initial functions of the Inkomati Catchment Management Agency (ICMA) which happens to be the first CMA in the country. The project of developing the CMS includes the following phases; the situational description (status quo), situational assessment, visioning and the development of the sub-strategies.

Integrated water resource management is the approach which ICMA can adopt to provide vision, leadership and direction for all those that have a role to play in the WRM of the IWMA. The ICMA is primarily challenged to ensure integration and co-ordination between the various sectors and cross-sectoral dimensions of water management, to achieve social, economic and ecological sustainability. The idea of stakeholders being involved in the management of water resources at the local level was to ensure that capacity is built in the local communities to ensure sustainable use of the resource. Environmental and water resource sustainability represents one of the greatest challenges facing any organisation or institution in the 21st century.

To achieve the above, a holistic assessment is required in order to inform development planning of the balance between environmental sustainability and different forms of developmental initiatives. The main objective of a CMS is to facilitate the management of the water resources and human behaviour in ways that achieve equitable, efficient and sustainable use of water at the WMA. According to the National Water Resource Strategy, the central objective of managing water resources is to ensure that water is used to support equitable social and economic transformation and development. Key to this is also balancing the need for sustainability. This project will therefore describe the current situation in the IWMA and attempt to bring up water resource management issues in the IWMA. This will lead to the development of a vision for a better future of the IWMA. An important aspect of this project is to outline strategies; institutional and governance to ensure that the CMA can eventually get to the vision of the IWMA for the benefit of the people in the IWMA and the whole of South Africa.

1.2 ICMA AND CMS

The NWRS provides the framework for the protection, use, development, conservation, management and control of water resources for the country as a whole. The NWRS also stipulates that CMS be developed at WMA level by the respective CMAs and that these CMS should fit into the NWRS. The Inkomati CMA is therefore obliged as one of its initial mandates, to develop a Catchment Management Strategy for the management of the water resources in the IWMA. To maintain ICMA's long term sustainability, the Catchment Management Strategy

(CMS) shall broadly investigate how the water resources could be used equitably in the most efficient way, how the increasing demand for water resources could be balanced against the limited supply, and to what extent improvement in environmental efficiencies are needed to reduce the pressure on the resource. This will also inform the poverty alleviation initiatives that centre on the water resources in the WMA.

Many state and other organisations that are responsible for biosphere related matters require **integrated** action to achieve their goals. Policy documents in every sector of society stress the imperative of collaboration and integration in this regard. However, at the implementation phase of the governance cycle, these imperatives are not supported by appropriate organisational structures. The 1998 NWA is unique in this regard, it specifies the CMAs which are a unique, imperative and valuable organizational form to facilitate integration and co-operation (Mark Dent 2006). The CMS will provide a framework for this form of integration.

1.3 PURPOSE OF THIS DOCUMENT

This document is the Situation Description. It attempts to present the existing situation in the Inkomati Water Management Area from a biophysical, institutional, social and economic perspective. This will provide the baseline from which the vision (desired state of the IWMA) will be compiled. The situation description is the first phase which has included collecting available and relevant information for the purpose of understanding the water resources of the study area. The second phase to follow this document involves public participation that will be used to share information and also to document issues and concerns of the public, interested people and affected parties that together comprise the stakeholders of the IWMA.

2. GUIDING PRINCIPLES, LEGISLATION AND POLICIES

Acknowledging that this is the first attempt at developing a catchment management strategy, for background purposes only, this section sets out the legal context within which a catchment management agency must operate. The general institutional context is depicted; the law in relation to the CMA, its powers and functions, governance and catchment management strategies is set out; and there is then an overview of law impacting the activities of CMAs, including the Constitution, the water sector legislation and strategies, health and environment law, and local government legislation.

CMAs are public entities established by the Minister and subject to regulation by the Public Finance Management Act and the National Water Act

CMAs are established to ensure that water resource management can be delegated to the regional or catchment level. The primary purpose of a CMA is to involve local communities in water resource management. CMAs must also seek co-operation and agreement on water-related matters between various stakeholders and interested persons.

2.1 REQUIREMENTS OF THE NWA, NATIONAL POLICIES AND STRATEGIES

2.1.1 CMA Powers and Functions

The National Water Act provides that when a CMA is established it has inherent powers and five initial functions. In addition there are a wide range of other powers and duties that may be delegated or assigned by the Minister. Section 80 and Schedule 3 to the National Water Act sets these in significant detail, parts of which are repeated here. It is relevant to note that;

- Functions are official tasks (activities and actions) that are required to exercise powers or perform duties.
- Duties are obligations imposed by statute (law), which must be performed.
- Powers are competencies given by statute which may be exercised.

2.1.2 Powers

The inherent powers of the ICMA include the powers of a natural person of full capacity except those powers which can only be that of a natural person or are inconsistent with the Act. This means the ICMA can do all things an individual can do, such as open a bank account, enter into contracts for supplies and borrow money. The National Water Act also regulates the management and institutional planning of a CMA and amongst other activities requires a CMA to submit business plans and annual reports.

2.1.3 Initial Functions

When a CMA is established, it has the following 5 initial functions[2];

- To investigate and advise on the protection, use, development, conservation, management and control of the water resources in its water management area;
- To develop a catchment management strategy;
- To co-ordinate the activities of water users and water management institutions within its water management area;
- To promote co-ordination between implementation of its catchment management strategy with implementation of water services development plans by water services authorities; and
- To promote community participation in the protection, use, development, conservation, management, and control, of water resources in its water management area.

2.2 OVERVIEW OF LAW IMPACTING THE ACTIVITIES OF THE ICMA

This section broadly sets out legislation impacting on water resource management institutions in the IWMA and water in general. It is evident that the legal framework is complex and should be approached from a practical perspective (i.e. the query related to governance / waste water discharge / reporting / finance / procurement etc.). Depending on the query, the law then needs to be investigated holistically to determine rights and obligations.

[2] As enshrined in the National Water Act 36 of 1998

2.2.1 The Constitution of the Republic of South Africa, Act 108 of 1996

The Constitution is the supreme law: It establishes South Africa as one sovereign, democratic state founded on values including human dignity and the rule of law within a framework of co-operative governance. Three primary spheres of government are recognised (local, provincial and national), each with powers and functions. In addition to protecting human rights of which water is dignity is recognised, it places a duty on everyone to protect the environment. It mandates local government with the responsibility for ensuring access to potable water and sanitation services. It obliges national government to both regulate and support local government.

2.2.2 National Water Act No. 36 of 1998

The National Water Act deals with the water resource – that is rivers, streams, dams, and ground water. It contains rules about the way that the water resource (surface and ground water) should be protected, used, developed, conserved, managed, and controlled in an integrated manner. The guiding principles are sustainability, equity and efficiency. This is a key instrument establishing and regulating the activities of the ICMA.

2.2.3 National Water Act Strategies

The most important strategies under the National Water Act are:

- The National Water Resource Strategy: This strategy is established by the Minister to ensure that there will be water for basic human needs, and socio-economic development both in the short and long term. The Strategy sets out amongst the other things the strategies, objectives, plans, guidelines and procedures for the overall management of the national water resource, determining how much must be reserved for basic human needs and the environment. It is based on the fundamental principles that:
    - Water institutions should strive to supply water efficiently and effectively, minimise water losses and promote water conservation and demand management among their consumers;
    - Users should not waste water and should strive to use water efficiently; and
    - Water conservation and demand management should be an integral part of the planning processes for water resource management, water supply and the provision of water services.
- Catchment Management Strategies: These strategies are developed locally in catchment management areas, following public participation and consultation, to set principles for allocating water to existing and new water users, to provide the framework for managing water resources within the catchment management area; and to ensure that water resources are protected, used, developed, conserved, managed and controlled. A catchment management strategy may be

established in a phased and progressive manner and in separate components over time and should be reviewed at intervals of not more than five years. A CMA must refer any proposed component of a catchment management strategy which raises a material question of policy or a question concerning the relationship between DWAF and other organs of state and their role, to the Minister for a determination by the Minister on the matter. A catchment management strategy or a component thereof may only be established with the written consent of the Minister.

- Pricing Strategy: This strategy is established by the Minister with the concurrence of the Ministry of Finance to address the overall strategy to set water use charges to cover the cost involved in developing and managing the water resource so that it is protected and conserved for beneficial use.

2.2.4 Water Services Act No. 108 of 1997

The Water Services Act deals mainly with water services or potable (drinking) water and sanitation services supplied by municipalities to households and other municipal water users. It contains rules about how municipalities should provide water supply and sanitation services. It also regulates the role of other water services institutions, especially water services providers, and water services intermediaries and water boards. It empowers the Minister to make standards and regulations. The Act is currently under review.

2.2.5 Water Services Regulations

The following regulations have been issued under the Water Services Act:

- Norms and Standards in respect of tariffs for water services in terms of s10(1) of the Water Services Act;
- Regulations relating to compulsory national standards and measures to conserve water in terms of s9(1) and s73(i)(j) of the Water Services Act; and
- Regulations relating to water services provider contracts in terms of s19 (5) of the Water Services Act.

2.2.6 Water Services Policies and Strategies

- Strategic Framework for Water Services, 2003
  The Strategic Framework for Water Services sets out a comprehensive approach to the provision of water services in South Africa, setting out the sector vision, goals and targets. It outlines the changes of approach needed to achieve policy goals of a democratic government. It sets targets for eliminating backlogs and climbing the water ladder of service levels. It requires DWAF to develop strategies around institutional reform and a support approach.

- National Joint Transfer Policy Position: Transfer of Water Services, 2003

  The document summarises the DWAF, Developmental Plans of Local Government (dplg), South Africa Local Government Association (SALGA) and NT policy position relating to the transfer of water services works and associated water services provision function from DWAF to the relevant water services authorities/institutions. The initial programme was set out in the Division of Revenue Act 5 of 2002. The policy acknowledges the need to support sustainable transfer to the 84 Water Services Authorities (WSAs) affected by the transfer programme. All transfer agreements are expected to be signed by 2007, although there are a number of ongoing activities required of both DWAF and the receiving WSAs to ensure effectiveness of the agreements.

- Joint National Water Services Sector Support Strategy, 2006

  The purpose of the support strategy is to give effect to the support objectives set out in the Strategic Framework including ensuring the establishment and functioning of capable, effective and efficient Water Services Institutions; to ensure the development of adequate skills and competencies required in the water services sector; and to enable all sector role-players and partners to fulfil their roles effectively.

- National Sanitation Strategy, 2005

  The White Paper on Basic Household Sanitation, 2001 emphasises the provision of a basic level of household sanitation to those areas with the greatest need. It focuses on the safe disposal of human waste in conjunction with appropriate health and hygiene practises, and promotes that provision of sanitation services should be demand driven and community based with a focus on community participation and household choice.

2.2.7 National Environmental Management Act (107 of 1998)

This Act under the Department of Environmental Affairs and Tourism aims to provide for co-operative environmental governance. It is a key piece of legislation for enforcement of environmental management laws, which could have a particular impact on water resources. The principles apply to all organs of state that may significantly affect the environment. The National Environmental Management Act is intended to integrate environmental management countrywide, by establishing principles to serve as a general framework for environmental matters and providing guidelines for the interpretation, administration and implementation of the National Environmental Management Act and any other environmental law. Each organ of state exercising environmental functions is required to prepare an environmental implementation and management plan and thereafter to exercise its functions, in accordance with the plan. The plan is submitted to the Committee for Environmental

Co-ordination and the Director General of Environmental Affairs and Tourism (and in turn to the Minister of Environmental Affairs and Tourism) followed by annual reports.

2.2.8 National Forests Act 84 of 1998

This act recognises that natural forests and woodlands form an important part of the environment and need to be conserved and developed according to principles of sustainable management. This law impacts activities impacting water resources, in particular stream-flow reduction. It also supports transformation and redistribution which will impact the profile of water users in the IWMA.

2.2.9 The Public Finance Management Act 1 of 1999

This Act regulates financial management of national and provincial government and public entities such as the ICMA. It aims to ensure that all revenue, expenditure, assets and liabilities of such entities are managed efficiently and effectively. It sets out responsibilities of the Ministers (Executive Authorities), the Boards (Accounting Authorities) and the administration. This Act is extremely important for the ICMA.

2.2.10 The Intergovernmental Relations Framework Act 13 of 2005

The Intergovernmental Relations Framework Act sets out the framework for national, provincial and local governments and other organs of state to promote and facilitate intergovernmental relations and to provide for the mechanisms and procedures to facilitate the settlement of intergovernmental disputes. This Act obliges government and public entities to attempt to settle disputes amicably before resorting to litigation.

2.2.11 Division of Revenue Act (DORA)

The DORA is enacted annually and gives effect to s214 (1) of the Constitution that provides for the equitable division of nationally raised revenue among the three spheres of government. It reflects a medium term expenditure framework over 3 year periods. National Transfers to public entities, such as the ICMA, are made transparent in this piece of legislation.

2.2.12 Promotion of Administrative Justice Act 3 of 2000

The Act applies to all administrative actions and reinforces the necessity for public bodies to apply their minds to every aspect of the decision-making process, and to ensure that deliberations consider every relevant aspect.

2.2.13 Promotion of Access to Information Act 2 of 2000

The Act gives effect to the constitutional right of access to any information held by the ICMA.

2.2.14 Broad Based Black Economic Empowerment Act 53 of 2003

This Act establishes a legislative framework for the promotion of black economic empowerment, empowers the Minister to issue codes of good practice and to publish transformation charters.

2.2.15 Local Government Legislation

This part sets out the primary pieces of legislation impacting on the local sphere of government. It is important for the ICMS to understand the regulatory environment of local government as it is in important stakeholder in the IWMA. It must be noted that other water users, such as tourism, agriculture and forestry are also regulated, but the detail is not set out in this document.

2.2.15.1 Local Government: Municipal Demarcation Act 27 of 1998

This Act created the framework for the re-demarcation of municipal boundaries by the independent Demarcation Board. The Demarcation Board reduced the number of municipalities from 843 to 284 effective with the municipal elections in December 2000 including 6 metropolitan municipalities, 47 district municipalities, and 231 local municipalities, although this has since changed with the disestablishment of for example, Bohlabela DM in 2006.

The Minister of provincial and local government has the power under the Municipal Structures Act to vest the water services authority in a local municipality, which power was exercised in 2003. Municipal boundaries are no longer limited to urbanised areas and extended to cover towns and rural areas, including farm lands.

It is important to note that municipal boundaries do not coincide with the CMA boundaries, although for ICMA, they do all fall in the Mpumalanga province.

2.2.15.2 Local Government: Municipal Structures Act 117 of 1998

The Municipal Structures Act establishes municipalities and creates their internal structures, such as whether the mayor will be executive and the form of the council. The Act deals with the division of powers and functions between district and local municipalities.

This Act allocates a broad range of powers and functions to district municipalities. Amongst these functions are water, sanitation, municipal health and electricity services, the way in which municipalities use water, and especially the way in which they manage waste water, industrial effluent and sewerage treatment has significant impact on water resource issues.

The Act is largely static in that it outlines the structures a municipality can have, and provides guidance on how these must be created – but does not elaborate on the functioning of these structures. This is contained in the Systems Act.

In the ICMA, all local municipalities were authorised as the water services authority. So instead of dealing only with 3 districts (the whole of Ehlanzeni and small parts of Nkangala and Gert Sibande) the ICMA must deal with 8 water services authorities.

2.2.15.3 Local Government: Systems Act 32 of 2000

The Systems Act focuses on internal systems and administration of the municipality. The Act provides the basic elements of public accountability and the constitutional requirement for public involvement in policies and decision-making and as such is premised on a notion of people centred "developmental local government". The Act further distinguishes the responsibility of a services authority and a services provider, sets out the roles of officials and councillors and provides for a range of requirements including IDPs, performance management and tariff setting.

The Act, together with the Municipal Finance Management Act, is the primary piece of legislation that regulates municipal services delivery. The Act provides a range of service delivery mechanisms through which municipalities may provide municipal services and sets forth the process to be applied and the criteria to be considered in reviewing and selecting municipal service delivery mechanisms.

Integrated planning under this Systems Act, together with the development and implementation of the Water Services Development Plan under the Water Services Act is important for the ICMA.

2.2.15.4 Local Government: Municipal Finance Management Act 56 of 2003

The Municipal Finance Management Act (MFMA) regulates the financial affairs of the municipalities and municipal entities and establishes treasury norms and standards for budgets, reporting and financial controls. The Act applies to all municipalities, all municipal entities and national and provincial organs of state to the extent of their financial dealings with municipalities. The objectives of the Act include ensuring transparency, accountability and appropriate lines of responsibility. It focuses on ensuring the management of revenues, expenditures, assets, liabilities and the handling of financial dealings.

This Act is relevant to ICMA in so far as it has dealings with the municipalities in its WMA.

2.2.15.5 Local Government: Traditional Leadership and Governance Framework Act 41 of 2003

This Act provides for the recognition of traditional communities, traditional councils and tribal leaders. It aims to set out the national framework and norms and standards that will define the place and role of traditional

leadership. The Act provides that national and provincial government must promote partnerships between municipalities and traditional councils.

2.2.16 Extracts from the PFMA

A. The Governing Board: Fiduciary Responsibilities as Accounting Authority

Section 50 of the PFMA sets out very clearly the fiduciary duties of the Board (the Accounting Authority):

1) The accounting authority for a public entity must-

   a) exercise the duty of utmost care to ensure reasonable protection of the assets and records of the public entity;

   b) act with fidelity, honesty, integrity and in the best interests of the public entity in managing the financial affairs of the public entity;

   c) on request, disclose to the executive authority responsible for that public entity or the legislature to which the public entity is accountable, all material facts, including those reasonably discoverable, which in any way may influence the decisions or actions of the executive authority or that legislature; and

   d) seek, within the sphere of influence of that accounting authority, to prevent any prejudice to the financial interests of the state.

2) A member of an accounting authority or, if the accounting authority is not a board or other body, the individual who is the accounting authority, may not-

   a) act in a way that is inconsistent with the responsibilities assigned to an accounting authority in terms of this Act; or

   b) use the position or privilege of, or confidential information obtained as, accounting authority or a member of an accounting authority, for personal gain or to improperly benefit another person.

3) A member of an accounting authority must-

   a) disclose to the accounting authority any direct or indirect personal or private business interest that that member or any spouse,

partner or close family member may have in any matter before the accounting authority; and

b) withdraw from the proceedings of the accounting authority when that matter is considered, unless the accounting authority decides that the member's direct or indirect interest in the matter is trivial or irrelevant.

B. The Governing Board: General Duties as Accounting Authority

Section 51 of the PFMA also sets out the general responsibilities of accounting authorities

1) An accounting authority for a public entity -

a) must ensure that that public entity has and maintains-

i. effective, efficient and transparent systems of financial and risk management and internal control;

ii. a system of internal audit under the control and direction of an audit committee complying with and operating in accordance with regulations and instructions prescribed in terms of section 76 and 77; and

iii. an appropriate procurement and provisioning system which is fair, equitable, transparent, competitive and cost-effective;

iv. a system for properly evaluating all major capital projects prior to a final decision on the project;

b) must take effective and appropriate steps to-

i. collect all relevant due to the public entity concerned; and

ii. prevent irregular expenditure, fruitless and wasteful expenditure, losses resulting from criminal conduct, and expenditure not complying with the operational policies of the public entity; and

iii. manage available working capital efficiently and economically;

c) is responsible for the management, including the safeguarding, of the assets and for the management of the revenue, expenditure and liabilities of the public entity;

d) must comply with any tax, levy, duty, pension and audit commitments as required by legislation;

e) must take effective and appropriate disciplinary steps against any employee of the public entity who-

i. contravenes or fails to comply with a provision of this Act;

ii. commits an act which undermines the financial management and internal control system of the public entity; or

iii. makes or permits an irregular expenditure or a fruitless and wasteful expenditure;

f) is responsible for the submission by the public entity of all reports, returns, notices and other information to Parliament or the relevant provincial legislature and to the relevant executive authority or treasury, as my be required by this Act;

g) must promptly inform the National Treasury on any new entity which that public entity intends to establish or in the establishment of which it takes the initiative, and allow the National Treasury as reasonable time to submit its decision prior to formal establishment; and

h) must comply, and ensure compliance by the public entity, with the provisions of this Act and any other legislation applicable to the public entity.

2) If an accounting authority is unable to comply with any of the responsibilities determined for an accounting authority in this Part, the accounting authority must promptly report the inability, together with reasons, to the relevant executive authority and treasury.

2.1 Officials of the ICMA:

Section 57 of the PFMA provides that an official of a public entity:

(a) must ensure that the system of financial management and internal control established for that public entity is carried out within the are of responsibility of that official;

(b) is responsible for the effective, efficient, economical and transparent use of financial and other resources within that official's area of responsibility;

(c) must take effective and appropriate steps to prevent, within that official's area of responsibility, any irregular expenditure and fruitless and wasteful expenditure and any under collection of revenue due;

(d) must comply with the provisions of this Act to the extent applicable to that official, including any delegations and instructions in terms of 56; and

(e) is responsible for the management, including the safeguarding, of the assets and the management of the liabilities within that official's area of responsibility.

(f)

2.2.17 The South African National Water Resources Infrastructure Agency Limited Draft Bill

The National Water Resources Infrastructure Agency is an agency which will be established as part of DWAF's restructuring process. The impact of the establishment of the National Water Resources Infrastructure needs to be carefully monitored by the ICMA. It is anticipated that this agency under the Minister will be established by April 2008, and that within 12 months of that an asset inventory will be drawn up indicating assets that will transfer to the Agency. The NWRIA will be established by DWAF to undertake the core business of development of national and multi-purpose water resource infrastructure. The links between the NWRIA and any national assets in the IWMA, or those developed that impact water resources in the NWRIA will need to be carefully managed. This will impact especially any works that transfer water across national boundaries or between water management areas; or comprise several interconnected catchments. The Bill, which has been published for comment makes no mention of the need for the NWRIA to align its planning with the ICMS.

.

2.3 NATIONAL WATER REFORMS

2.3.1 Water Allocation Reform/Compulsory Licensing Process:

The IWMA is described as a stressed catchment. Although there is no clear definition of what a stressed catchment is, the sense is that it is where the water requirements exceeds the water availability from a water quantity point of view. All Inkomati Rivers have been ear-marked for compulsory licensing. The DWAF will focus on Inkomati Rivers (and 6 other priority areas) in the next year or two. Any new ad hoc license applications from these areas will have to be handled with great caution. A revised National program for Compulsory Licensing has been developed (amending the National Water Resources Strategy). A further Water Allocation Reform Project be (supported by Pegasys) is being undertaken in the Inkomati Water Management Area. An aspect of the project is social participation in water reform. It has been explained (Gugu Mazabuko, Pegasys) that in addition to promoting equity through water allocation, a further social focus is empowerment, poverty alleviation and job creation. The key challenge is to identify opportunities where water can be used productively and then to co-ordinate efforts of all

stakeholders (including Provincial Land Affairs, Provincial Development Agency) to ensure support for such opportunities.

2.3.2 Waste Discharge Charge System

This is currently being rolled out in Crocodile West Catchment (WMA3); Upper Olifants Catchment (WMA 4) and Vaal Catchment in WMAs 8&9. The roll out of the Waste Discharge Charging System (WDCS) are lengthy processes and DWAF will only reach a stage where waste dischargers in those three catchments will start paying for water use in April 2009. Other catchments will follow after this.

2.3.4 Land Reform (restitution and redistribution)

Land Reform (restitution and redistribution) must happen in line with the compulsory licensing process for the redress of past social and economic inequities to have an impact on those identified to benefit. The PGDS has set impressive redistribution targets to be achieved by 2014. The Mpumalanga Province has 2600 land claims (38.5% of the national claims).

2.3.5 Monitoring and Enforcement

The strategy for monitoring enforcement of the outcomes of compulsory licensing will need to be developed by the ICMA taking cognisance of its powers and functions under the law and in terms of the delegations and assignments. There is currently no formal process to be inherited from DWAF. It will also depend on the roles and responsibilities of the CMCs and WUAs in the IWMA. Cognisance will also have to be taken of the National Environmental Management Act and its enforcement provisions around pollution, and the provincial and local government disaster management frameworks**.**

2.3.6 ICMA Business Plan

The ICMA Business Plan is for a three year period. It focuses quite significantly on institutional issues. It has prioritised

- Stakeholder engagement (mobilise, empower and consult stakeholders to enable them to participate in water resource management decisions and promote a positive perception of the CMA); and
- Development of the catchment management strategy.

The three year period ending June 09 is described in the Business Plan as a "consolidation period". It is anticipated that further delegated functions from DWAF will continue from 2009/10 to 2011/12

3. CATCHMENT CHARACTERISTICS

3.1 GENERAL DESCRIPTION OF THE STUDY AREA

The Inkomati Water Management Area (IWMA) is situated in the north-eastern part of South Africa and includes parts of Mozambique and Swaziland. It covers an area of 28,757 km^2. The IWMA is situated in one South African province, Mpumalanga. The IWMA covers about 95% of the Ehlanzeni District Municipality (with 5 local

municipalities) and one District Management Area (DMA) being the Southern Kruger National Park; portions of Albert Luthuli Local Municipality and Msukaligwa Local Municipality (both located in Gert Sibande District Municipality); and about 50% of Emakahazeni Local Municipality (located in Ngankala District Municipality).

The borders of the IWMA are determined by natural characteristics: borders between WMAs (or so-called "catchments") indicate which direction surface water drains[3]. In other words, all rainfall that falls within the Inkomati WMA is drained to the sea through the Inkomati system. Rainfall that falls outside the borders is drained through a different system, e.g. the Olifants system or the Upper Vaal system.
Therefore, they do not correlate to the political boundaries of the province or the local governments. It crosses international borders with Mozambique on the east and Swaziland on the south east. In the south, it borders on the Usuthu to Umhlatuze WMA and Upper Vaal WMA. The whole of the eastern and north eastern boundary of the ICMA borders on the Olifants WMA.

The IWMA's main rivers include the Sabie, the Crocodile (East) and Komati Rivers. Figure 1 gives the location whilst Figure 2 gives the general outline of the Inkomati Water Management Area. The three sub-catchments have been designated as per other major water management studies; Sabie-Sand, Crocodile and the Komati.

[3] Groundwater is generally not taken into account when determining WMA or catchment boundaries: aquifers can cut across catchment boundaries.

Figure 1: Location of the Inkomati Water Management Area

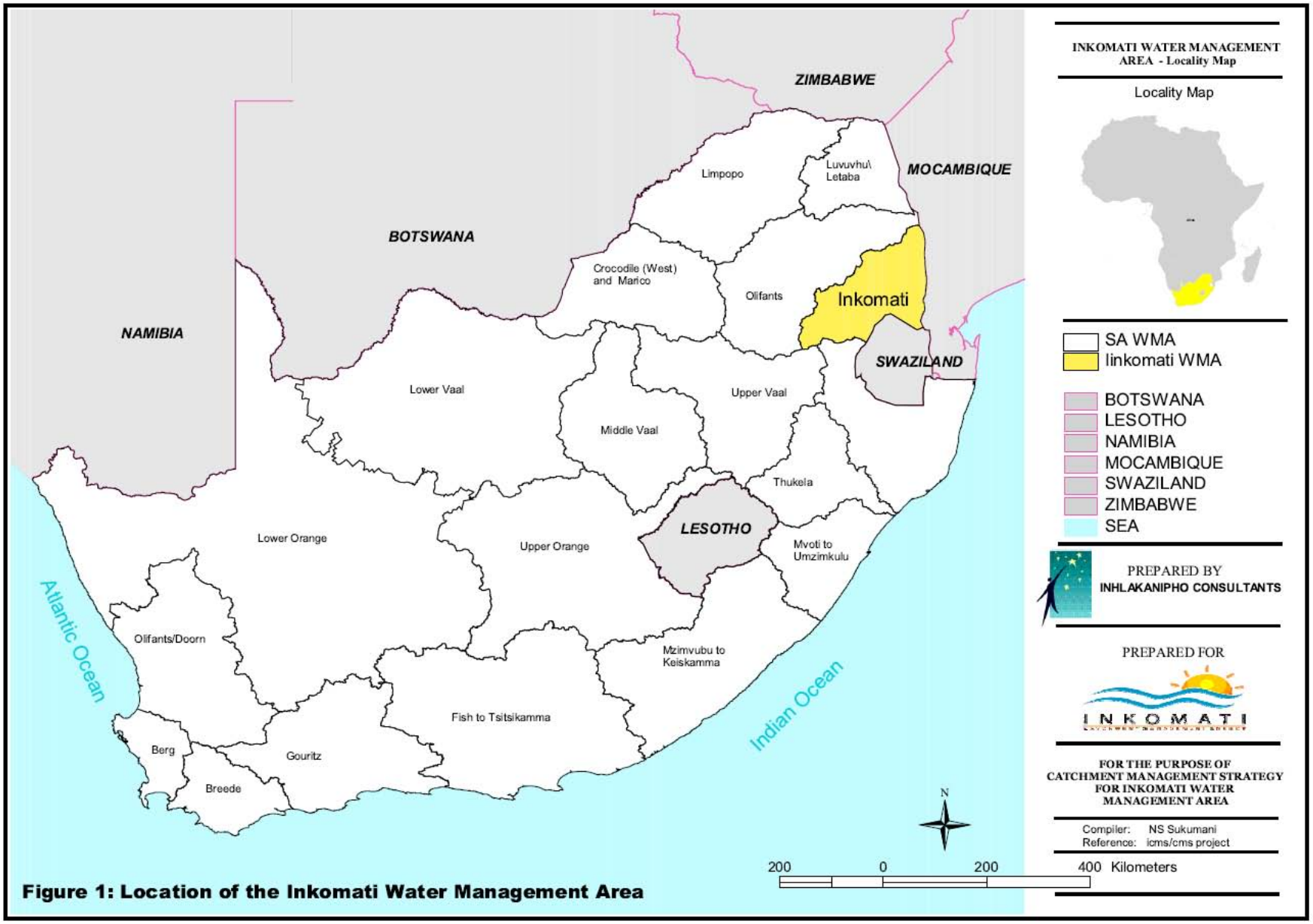


Figure 2: General description of the Inkomati Water Management Area

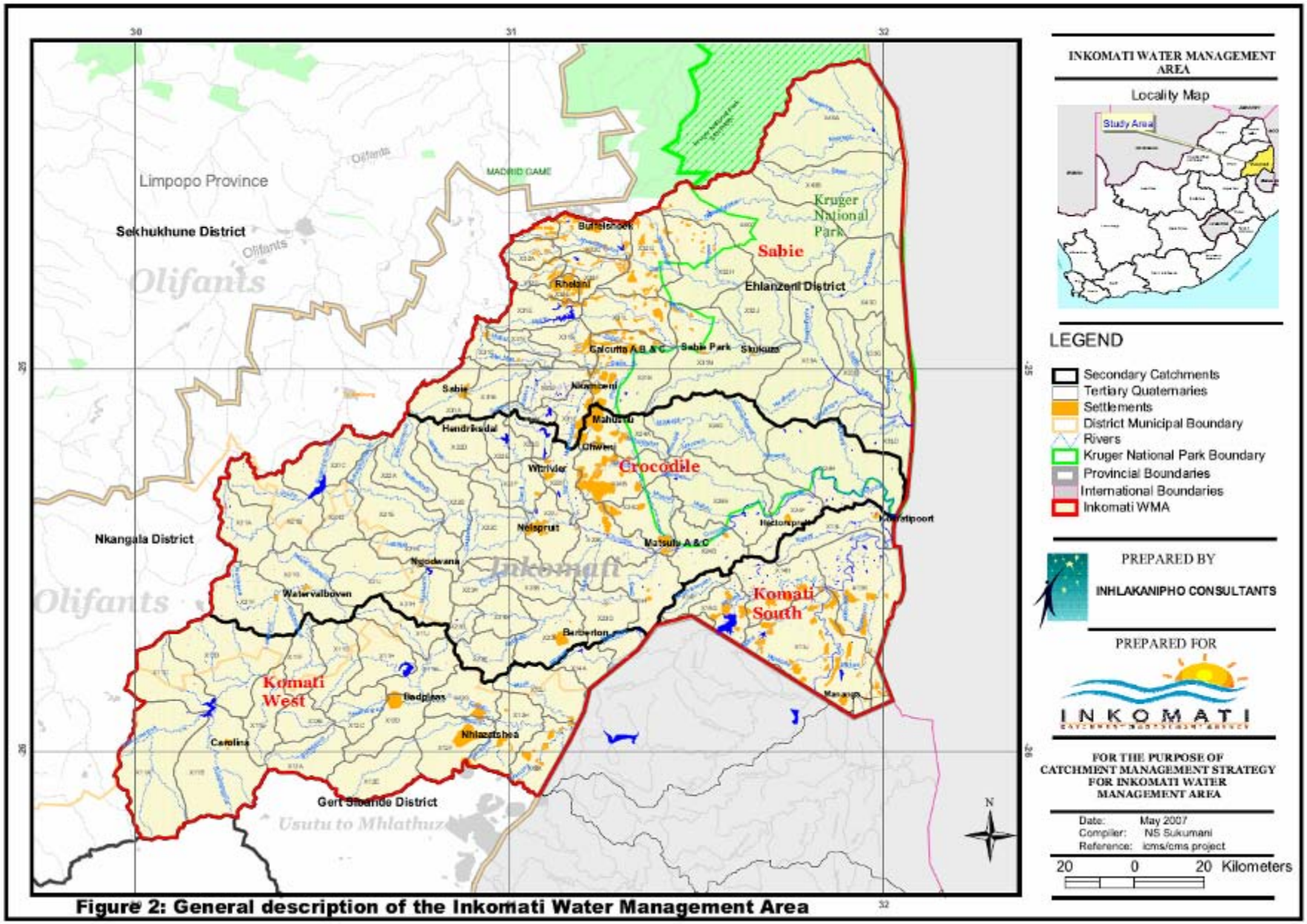
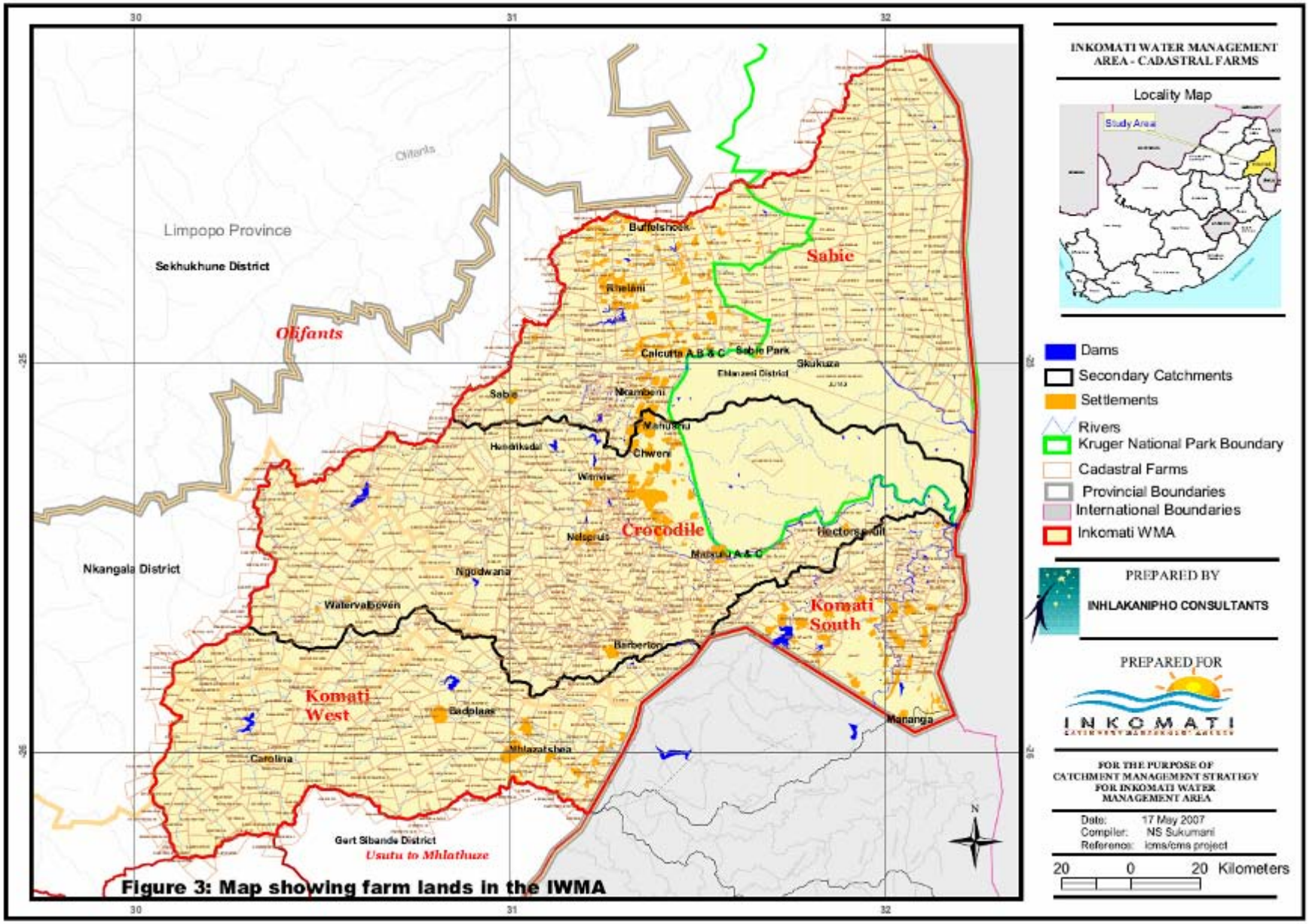


Figure 2: General description of the Inkomati Water Management Area

It can be seen from Figure 2 that the IWMA is entirely located within only one province of South Africa, Mpumalanga. The famous eco-tourism haven, the Kruger National Park occupies almost 35% of the IWMA.

The farmlands that form part of the IWMA have been indicated on Figure 3.

Figure 3: Farm lands in the IWMA



The Mpumalanga Province in which the Inkomati Water Management Area is located occupies 6.5% of the surface area of South Africa. It is characterised by spectacular natural beauty, a wealth of natural resources and has one of the fastest growing economies of all South African provinces

As indicated earlier, the IWMA has been divided into three catchments for the purpose of developing the Inkomati Catchment Management Strategy (CMS). The sub-catchments of the Komati, Crocodile (East) and Sabie-Sand confluence to form the Inkomati River inside Mozambique. The Inkomati River then flows into the Indian Ocean.

3.1.1 The Komati River Catchment

The Komati River originates just upstream of Nooitgedacht Dam near Carolina and flows through Swaziland to the south-eastern part of Mpumalanga. The Lomati River originates in the mountainous northern part of Swaziland and southern Mpumalanga. The confluence of the Komati and Lomati is in the south-eastern part of Mpumalanga.

3.1.2 The Crocodile (East) River Catchment

The Crocodile (East) River originates near Dullstroom, from where it flows eastwards. The Elands River originates near Belfast, and the Crocodile (East) and Elands join at Nelspruit and flow further east from there (as the Crocodile (East) River). The Kaap and Crocodile (East) Rivers confluence near Kaapmuiden in eastern Mpumalanga. The confluence of the Komati and the Crocodile occurs just upstream of the border with Mozambique. After the confluence, the river is called the Inkomati and flows into Mozambique.

3.1.3 The Sabie-Sand River Catchment

The Sabie River originates in the northern part of Mpumalanga, and the Sand River in Bushbuckridge. The two rivers join near Skukuza (in the Kruger National Park) and to become the Sabie River which then flows southeast into Mozambique, where it joins the Inkomati River. The Upper Rio Uanetze catchment comprises the Uanetse and Massintonto Rivers. These two rivers flow eastwards through dry central parts of the Kruger National Park, to the Mozambican border. They join the Inkomati River in Mozambique.

3.2 TOPOGRAPHY

The Great Escarpment (the Drakensberg Mountains) divides the WMA into two major topographical regions: the plateau area to the west, and the marginal lands (the Lowveld) to the east. The plateau area lies at 2000 m above sea level and consists of the highveld and the Transvaal plateau. The middleveld, lowveld and the Barberton Mountain area make up the marginal lands. The Lebombo mountain range forms the eastern border of the catchment. The eastern part is generally low, reaching 140 m above sea level (Figure 4).

Figure 4: Topography of the IWMA

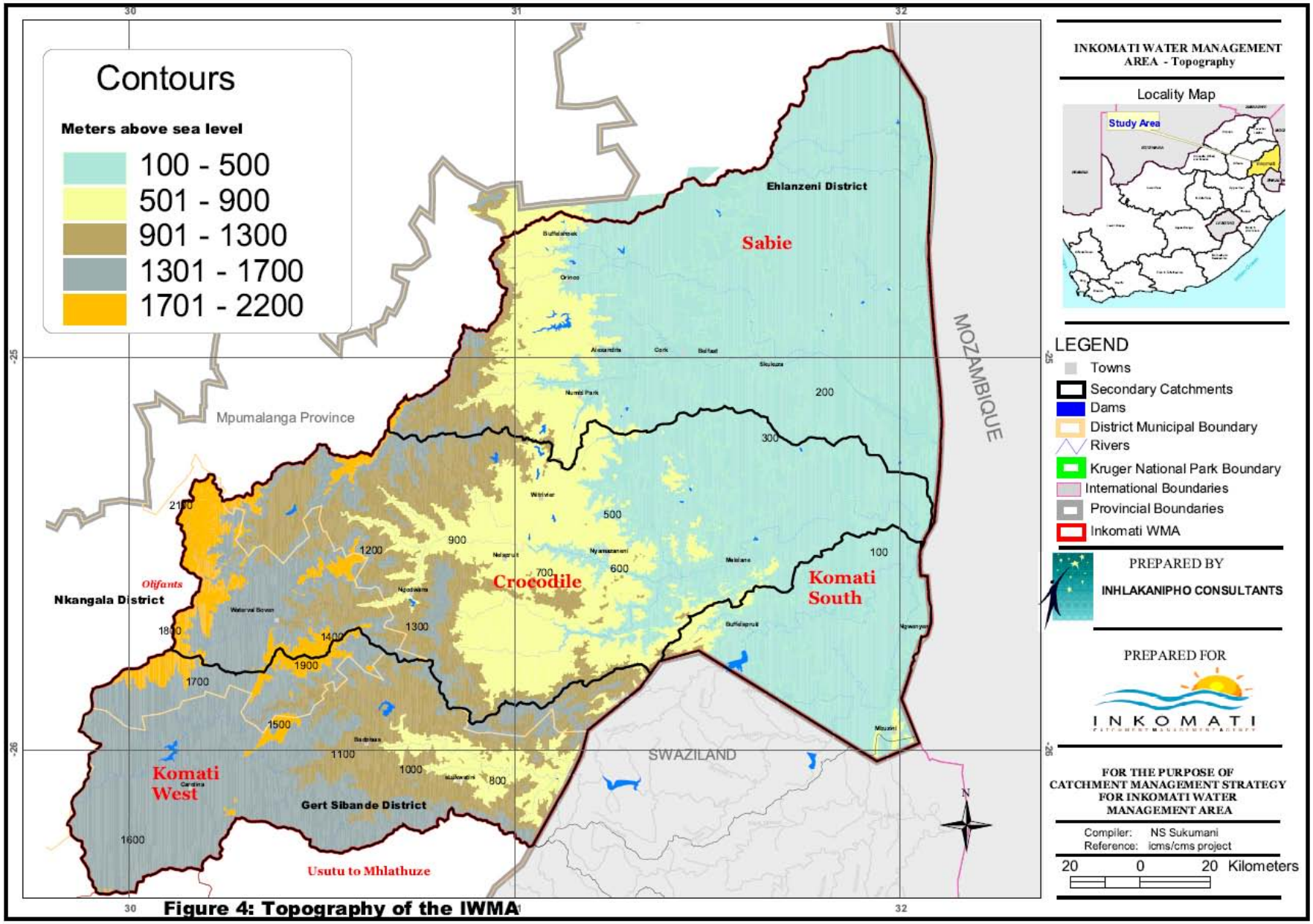


Fig 4 clearly shows that the towns; Buffelshoek in the north (Sabie-Sand Catchment), Malelane (Crocodile Catchment) and Mbuzini (Komati South) lie in the plains that have the least altitude in the Inkomati Water Management Area (100-500m above sea level). Waterval Boven is one of those locations on the higher altitude in the IWMA.

3.3 CLIMATIC CONDITIONS

3.3.1 Rainfall

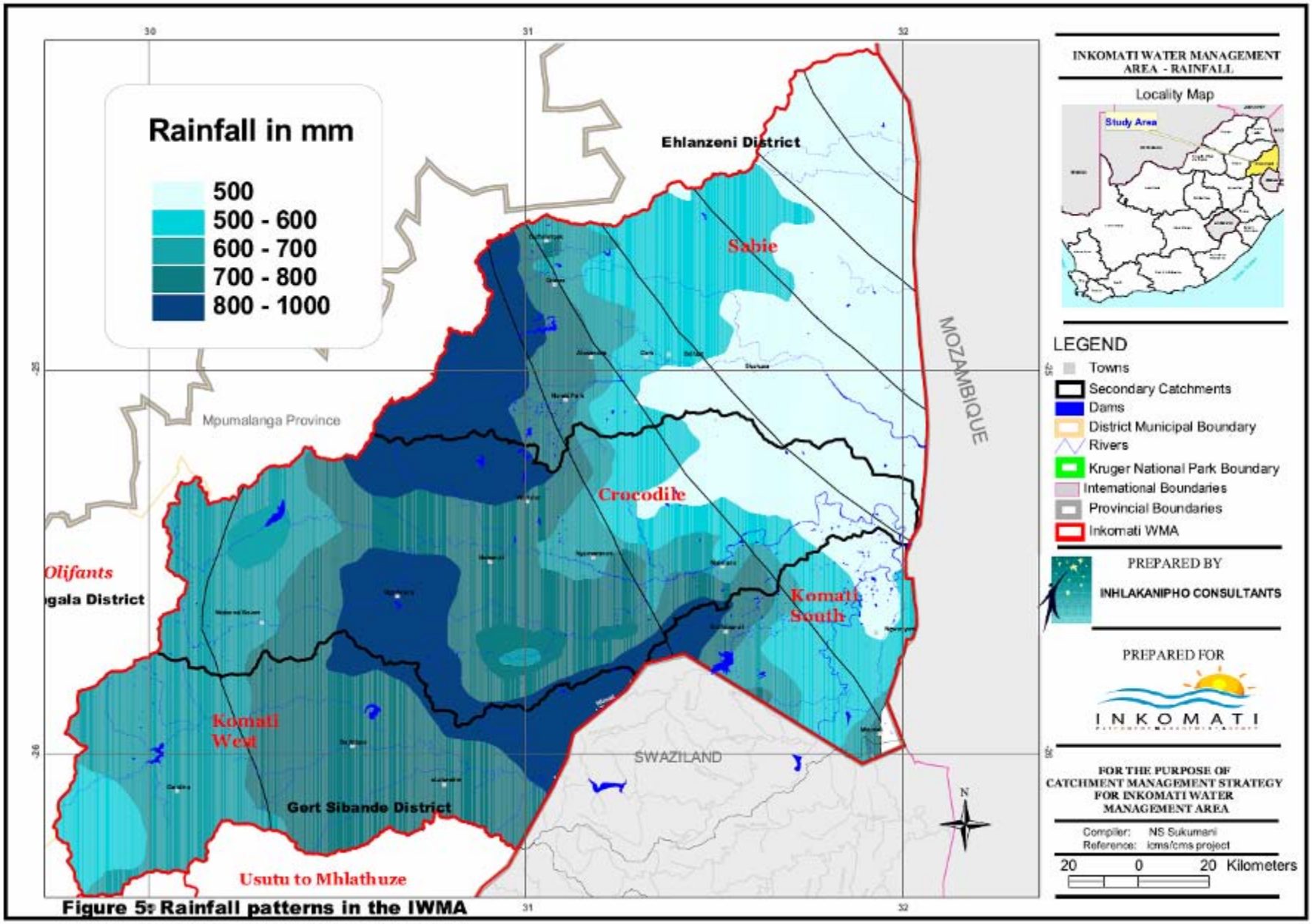
The average annual rainfall is 767 mm, with approximately 10 times more rain in summer than in winter (Stats SA, 2002). The Mean Annual Precipitation (MAP) ranges from 400 to 1000 mm (1500 mm in some mountainous areas). The maximum MAP in the central parts of the catchment is in excess of 1200 mm, 600 mm in the west and 400 mm in the eastern parts. Rainfall is seasonal, with most rain occurring in summer (October to April). Peak rainfall months are December and January.

The average potential mean annual evaporation (as measured by A-pan) is in excess of the MAP. Evaporation varies from 1 600 mm in the south-west of the WMA to 2 000 mm in the eastern parts (the mean value is 1 900 mm).

Gross irrigation requirements, (based on rainfall and A-pan evaporation) for the catchment ranges from 800 mm/yr in the west, to 1400 mm/yr in the east. The minimum monthly requirement is in June (appr. 97 mm), and the maximum monthly requirement is in September (appr. 149 mm).

As can be seen in Figure 5, the north-eastern part of the catchment, the downstream part, receives the least amount of rainfall in the water management area. It is clear that downstream users are extremely dependant on river flow and therefore on upstream rainfall and upstream users.

Figure 5: Rainfall patterns in the IWMA



The north-eastern part of the catchment which comprises mainly the Kruger National Park receives the minimum amount of rainfall in the whole water management area. Seasonal rainfall occurs, with most rain occurring in summer (October to April). Peak rainfall months are December and January. The eastern part of the WMA depends on the run-off from the western and middle areas where the rainfall is higher.

3.3.2 Temperature

The Inkomati Water Management Area, just like the entire Mpumalanga province, enjoys a sub-tropical climate with hot summers and mild to cool winters. The mean annual temperature is 17°C and maximum temperatures are experienced in January (with an average of 21°C). Minimum temperatures occur in June with an average of 11.5°C. Heavy frost takes place from June to early August, and only the far-eastern parts are generally frost-free.

3.3.3 Wind

Wind is a common feature in the Inkomati Water Management Area. Extreme wind that can destroy property is very rare.

3.3.4 Extreme conditions

Heavy frost takes place from June to early August: the average amount of frost days in the catchment is less than 60 days. Only the far-eastern parts are generally frost-free.

3.4 GEOLOGY AND SOILS

3.4.1 Geology

Figure 6 shows that the Inkomati Water Management Area has 6 main geological fractions. Apart from the Barbeton Murchison which forms the boundary between the Crocodile and the Komati subcatchments, the others run parallel to each other from the north to the south of the catchment. It must be highlighted that the ECCA formation is unique to the Komati East subcatchment. It is found at the tip of the subcatchment, blending slowly into the Transvaal formations (Figure 6). The Granite Sand River Gneiss forms the greatest percentage of the geological formations in all three subcatchments of the IWMA.

A closer look at the detailed geology (lithostratography) gives a further breakdown of the geological fractions.

The Inkomati WMA consists of seven broad lithostratographic[4] units (DWAF, 2003).

a. Acid and intermediate lavas. These rocks mainly consist of rhyolite and basalt. Residual[5] basaltic soils are up to 3 m thick and consist of active[6] black

[4] "Lithostratography" is the scientific study and categorization of rock strata based on their lithology (color, texture, and composition).

[5] "Residual soil" is soil formed from, or resting on, consolidated rock of the same kind as that from which it was formed and in the same location.

[6] Clays attract and hold cations onto negatively charged parts of their surfaces. "Active" clays internally bind some chemicals very tightly. As a result, it is difficult for plants to obtain the necessary

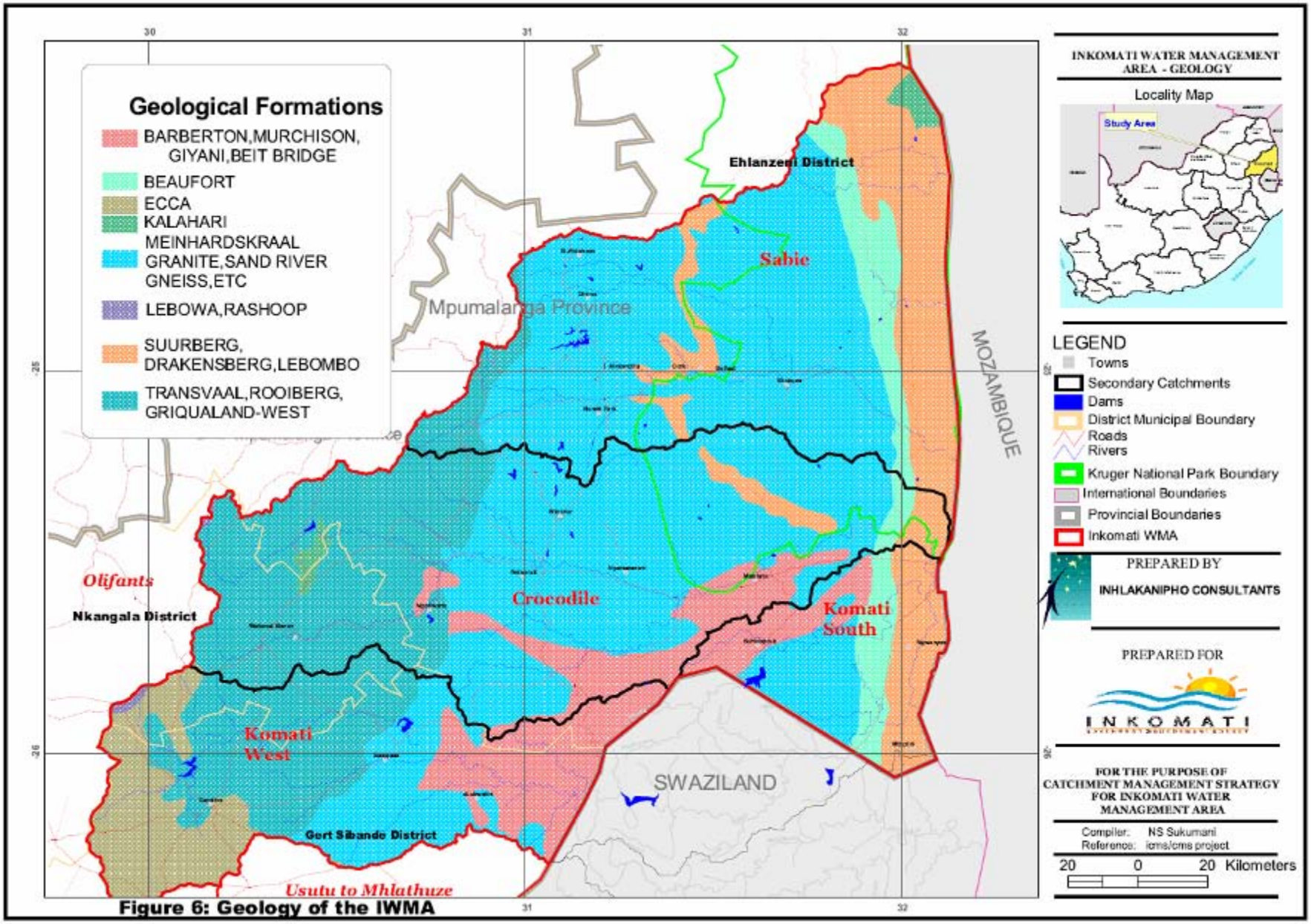
clay in places. The residual rhyolite soils are in general siltier and less active. Small deposits of perlite and volcanic glass occur in the rhyolite of the Lebombo group.

b. Mafic/basic lavas. The volcanic rocks consist mainly of Andesitic lava in a north-south band to the east of the catchment. Residual soils are potentially expansive, with extreme variability in depth and the degree of decomposition over relatively short distances.
c. Compact openaceous and argillaceous ("clayey") strata. Deep residual sandstone soils are common, with isolated cases of collapsible fabric. The residual mudrock soils are medium to highly expansive. Numerous coal seams occur within the sedimentary rocks of the Karoo sequence. Coal mining takes place in the Transvaal plateau and the Lowveld region of the catchment.
d. Acid, intermediate or alkaline intrusive strata. Various suites occur in the catchment. The Nelspruit, Mpuluzi and Cunning Moore Tonalite suites occupy the largest area. No significant mineral intrusions have been noted in these granitic rocks.
e. Compact sedimentary strata. There are several different formations, consisting of a variety of sedimentary rock types – including quartzite, shale, conglomerate, siltstone, breccia and diamictite. The residual soils are generally very shallow. Significant mineral deposits include gold, arsenic, copper and sulphur.
f. Dolomite, chert and subordinate limestone. These rocks also occur in a narrow band to the east of the study area. The rocks have various problems with the founding of structures, including the formation of sinkholes. Small deposits of manganese oxides occur in the dolomites and the rocks generally contain large quantities of groundwater.
g. Assemblage of compact sedimentary and extrusive rocks. The Barberton sequence mainly consists of sedimentary and volcanic rocks. Soil development in this area normally results in potentially expansive clays. Important minerals found in the Barberton sequence include gold and magnesite, with some associated mining activity. Other minerals include asbestos, barites, iron, mercury, nickel and copper.

---

nutrients from the soil solution. In areas of these highly active clays, lime (calcium carbonate) can be added to reduce the acidity of the soils and facilitate release of the nutrients from the clays into soil solution.

Figure 6: Geology of the IWMA



3.4.2 Soils

The soil types occurring in the Inkomati WMA follow the pattern of the geology of the area. The map of the soils in the IWMA is displayed as Figure 7.

The various types of soils in the IWMA are listed below[7]:

- The western part of the Komati River has occurrences of moderately deep clayey loam, with an undulating relief;
- Large parts of the catchment are covered by moderately deep sandy loam, with an undulating relief;
- Most of the central part of the catchment consists of moderate to deep clayey loam with a steep relief;
- The eastern part of the basin consists mostly of moderately deep clayey soils with an undulating relief.

[7] Water Resources Situation Assessment" (DWAF, 2003)

Figure 7: Soil types occurring in the Inkomati WMA

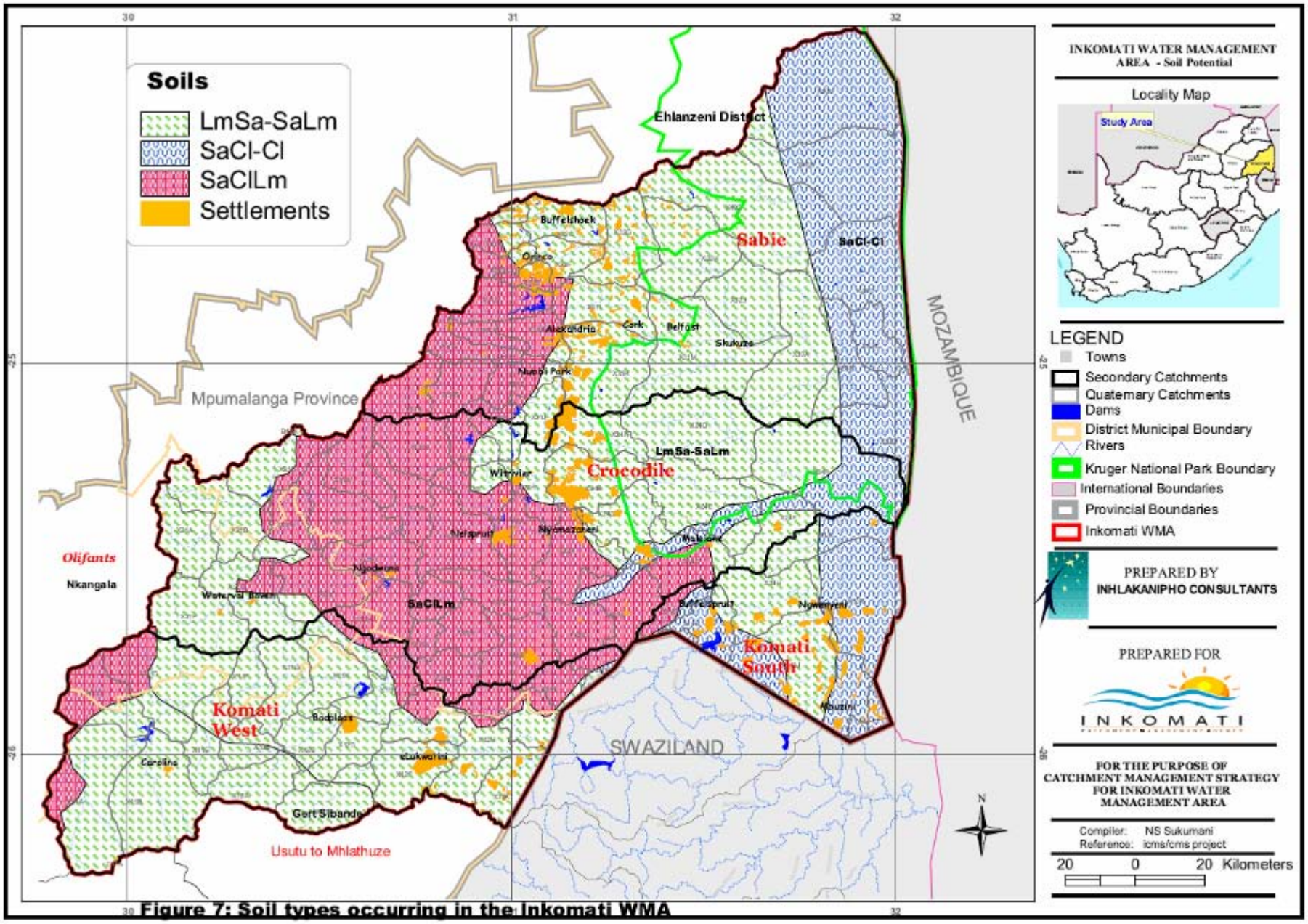


Figure 7: Soil types occurring in the Inkomati WMA

3.5 HYDROLOGY

3.5.1 Surface Water

The mean annual runoff (MAR) from the entire IWMA is estimated at 3 539 million m^3/annum (DWAF 2003a).

The Komati, Crocodile and the Sabie catchments all encompass areas of high rainfall and steep topography, and most of the surface runoff originates from these areas. The Sand River and the Massintonto and Nwanetsi Rivers catchments have less favourable natural characteristics, resulting in intermittent and seasonal flows only. There are no natural lakes in the catchment. Isolated wetlands also occur and small pan areas in the south-western extremity of the water management area.

Reduction in natural runoff is mainly caused by vast commercial plantations (rain-fed agriculture) and invasive alien vegetation (which covers an equivalent of about 132,000 ha). The impacts of afforestation and alien vegetation on runoff reduction are approximately 480 million m^3 and 240 million m^3 respectively (DWAF, 2003a).

The surface water resources in the three sub-catchments of the IWMA are displayed as Figure 8. The three main sub-catchments have both perennial and seasonal rivers. The hydrology map illustrates all the rivers of importance in the three sub-catchments.

An overview of the of surface water resources in the Inkomati Water Management Area per sub-catchment has been presented in Figures 9, 10 and 11.

Figure 8: Hydrology of the IWMA

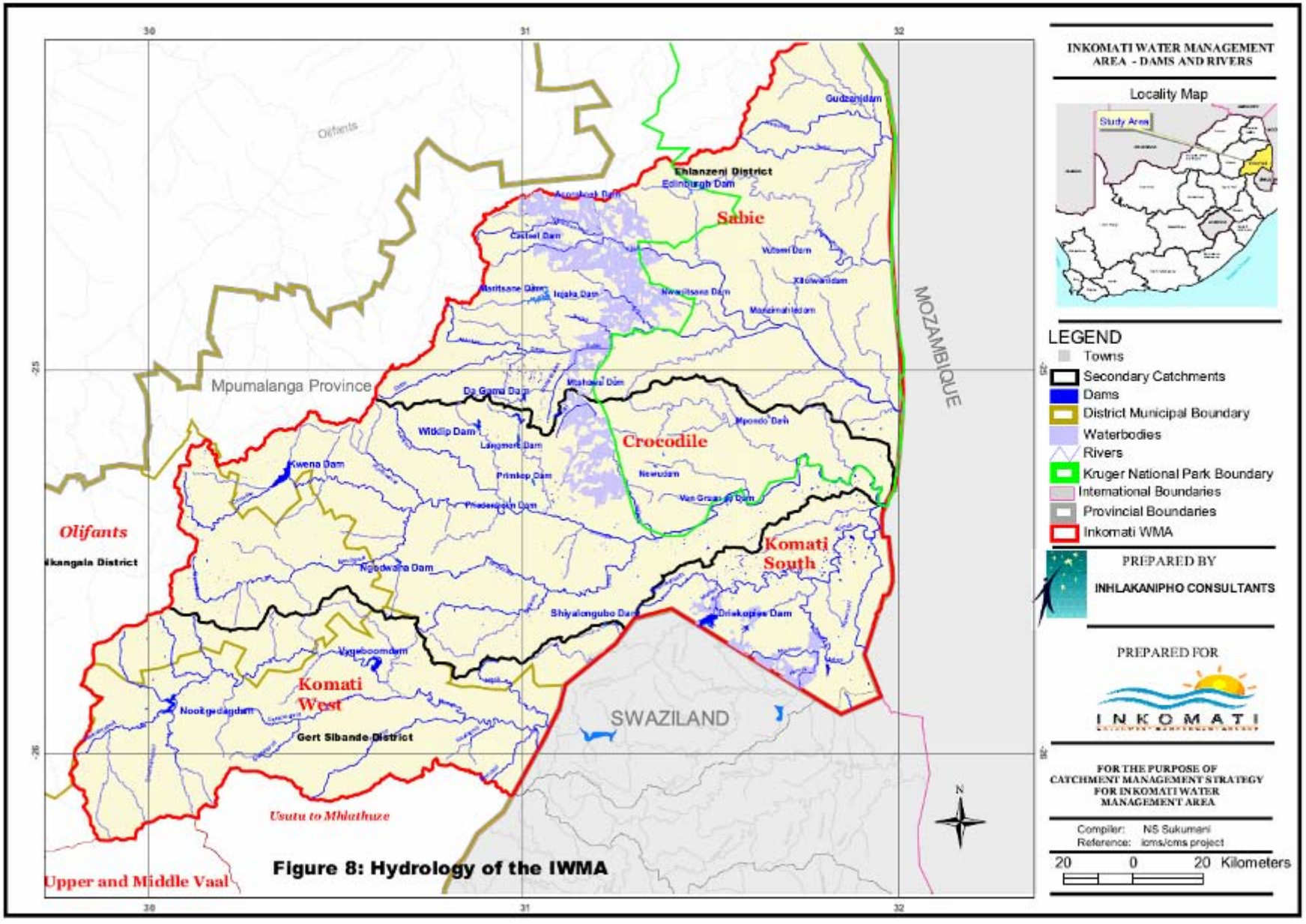


Figure 9: Surface water resources in the Sabie-Sand Catchment

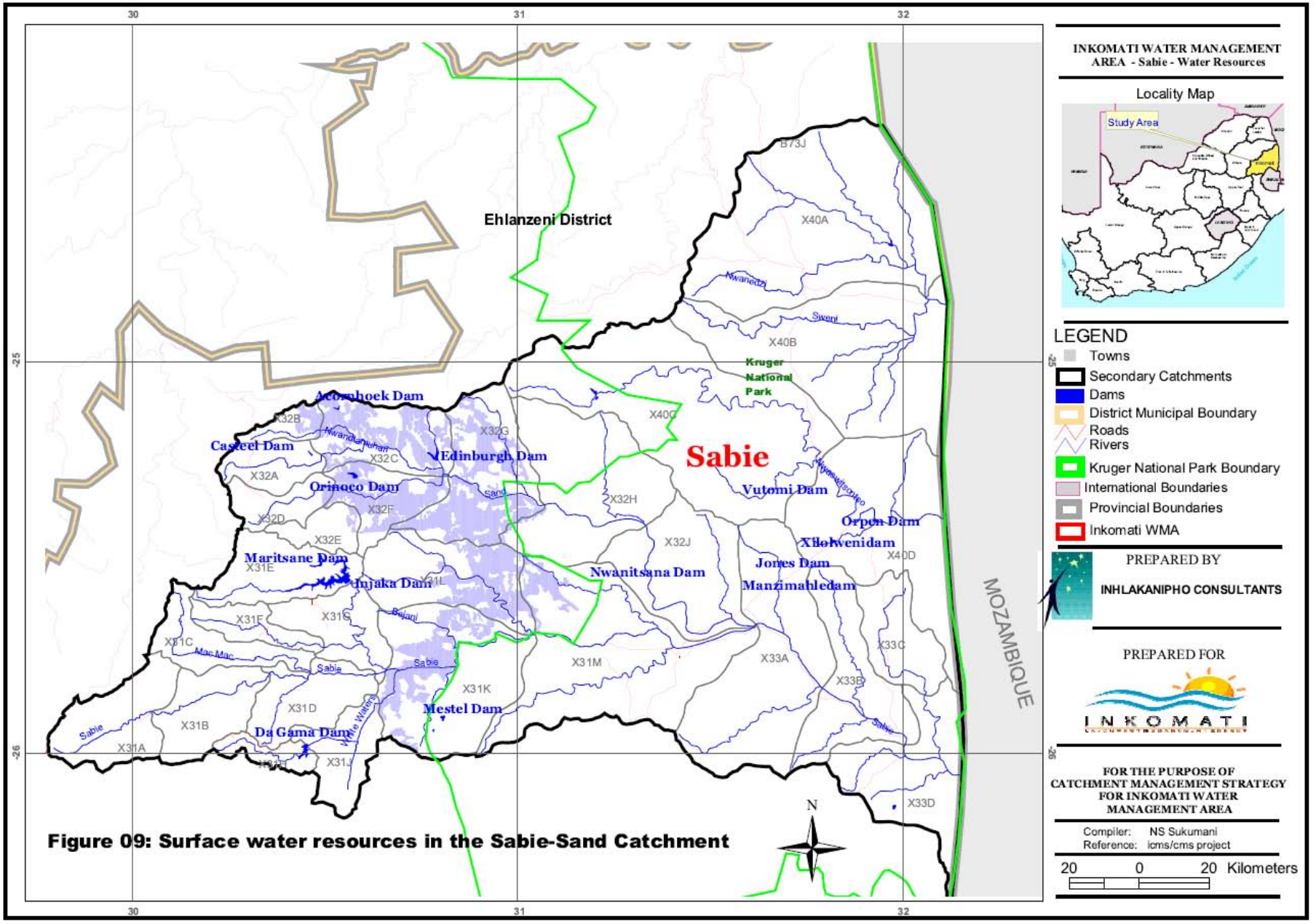


Figure 10: Surface water resources in the Crocodile Catchment

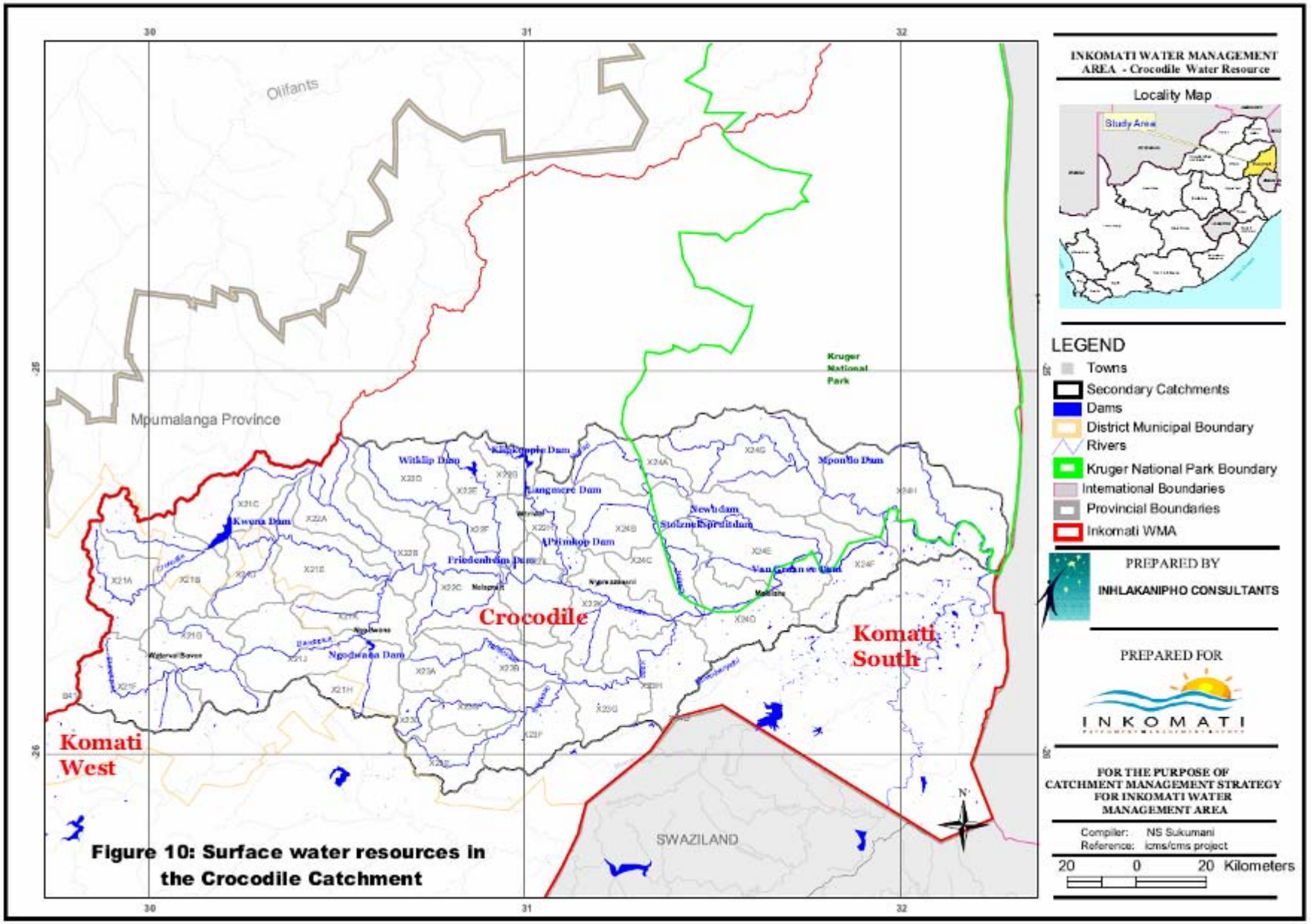
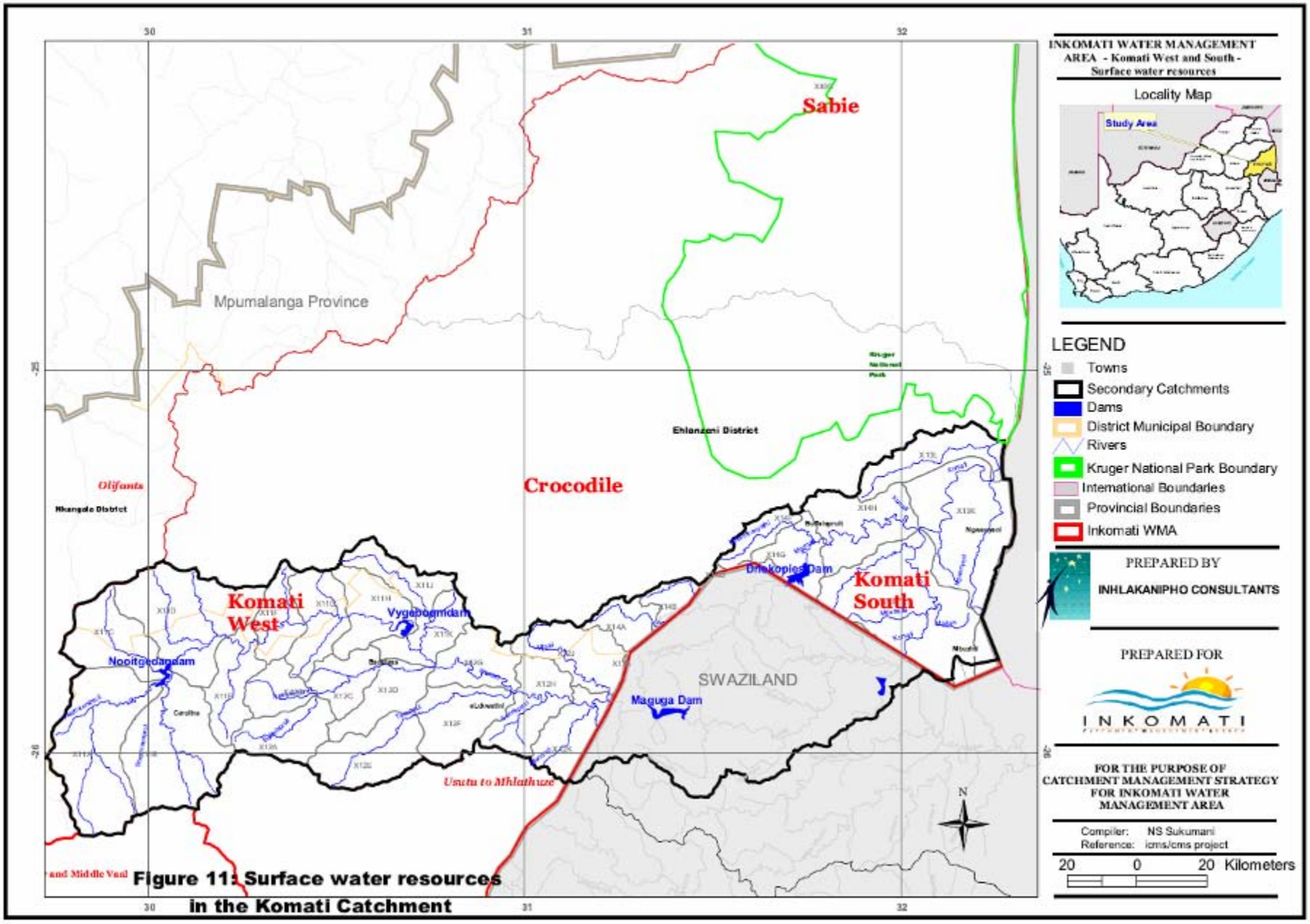


Figure 11: Surface water resources in the Komati Catchment



3.5.1.1 Surface water quality

Since water is only as good as its quality, water quality issues are very important in the IWMA where all the different types of water users are found. DWAF did a study in the IWMA in the early 2000s that focussed mainly on Total Dissolved Salts (TDS) and electrical conductivity (EC) (DWAF 2003).

Physical and chemical water quality data analysed in this section were obtained from DWAF, RQS in Pretoria. Some of the microbiological data used here were obtained from the DWAF regional offices in Nelspruit. Erwat (Kempton Park, Johannesburg) and Labserve, Nelspruit are the two laboratories that analyse the samples for the DWAF regional office. Only one year data was available for this report. For the purposes of the recent state of microbiological status in the IWMA, data from the National Microbial Monitoring Programme (NMMP) has also been used.

For the purposes of comparing the status of water quality in the sub-catchments, Sabie-Sand, Crocodile and the Komati, analytical graphs at selected points have been presented. The data dates from 1997 up to 2006 at some sites where available.

Although DWAF monitors the water quality in all the catchments in the IWMA, no proper enforcement of the water quality guidelines (DWAF 1996) is being applied. Stakeholders in the various sub-catchments have formed catchment forums which they are using to help DWAF in the monitoring of water quality and 'enforcing' legislation. It must be stated that a Catchment Forum is a voluntary organisation but stakeholders (members) take decisions that binds on all of them. This has helped in the monitoring of the water quality especially, in the Crocodile Catchment. In catchments where the reserve has not been determined (especially, water quality aspects), the Catchment Forum develop their own water quality objectives taking into account the historical water quality in the sub-catchment(s), DWAF's 1996 water quality guidelines and the Resource Quality Objectives (RQOs) model that has been developed by DWAF.

Data from 2 specific monitoring points representative of the water quality of each sub-catchment are presented as graphs to show historical trends. The Crocodile sub-catchment is the only exception where four monitoring points have been used because of the availability of monitoring information[8].

3.5.1.2 Physical and Chemical Water Quality Characteristics in the sub-catchments

a. Sabie-Sand

As indicated earlier in section 3.5.1.1, DWAF does the monitoring for all the sampling points discussed below. The sampling point with enough WQ data and representative of the status in the Sand River, X3H008Q01 Sand River at Exeter is presented as Figure 12.

[8] Work done by the Catchment Forum is considered useful

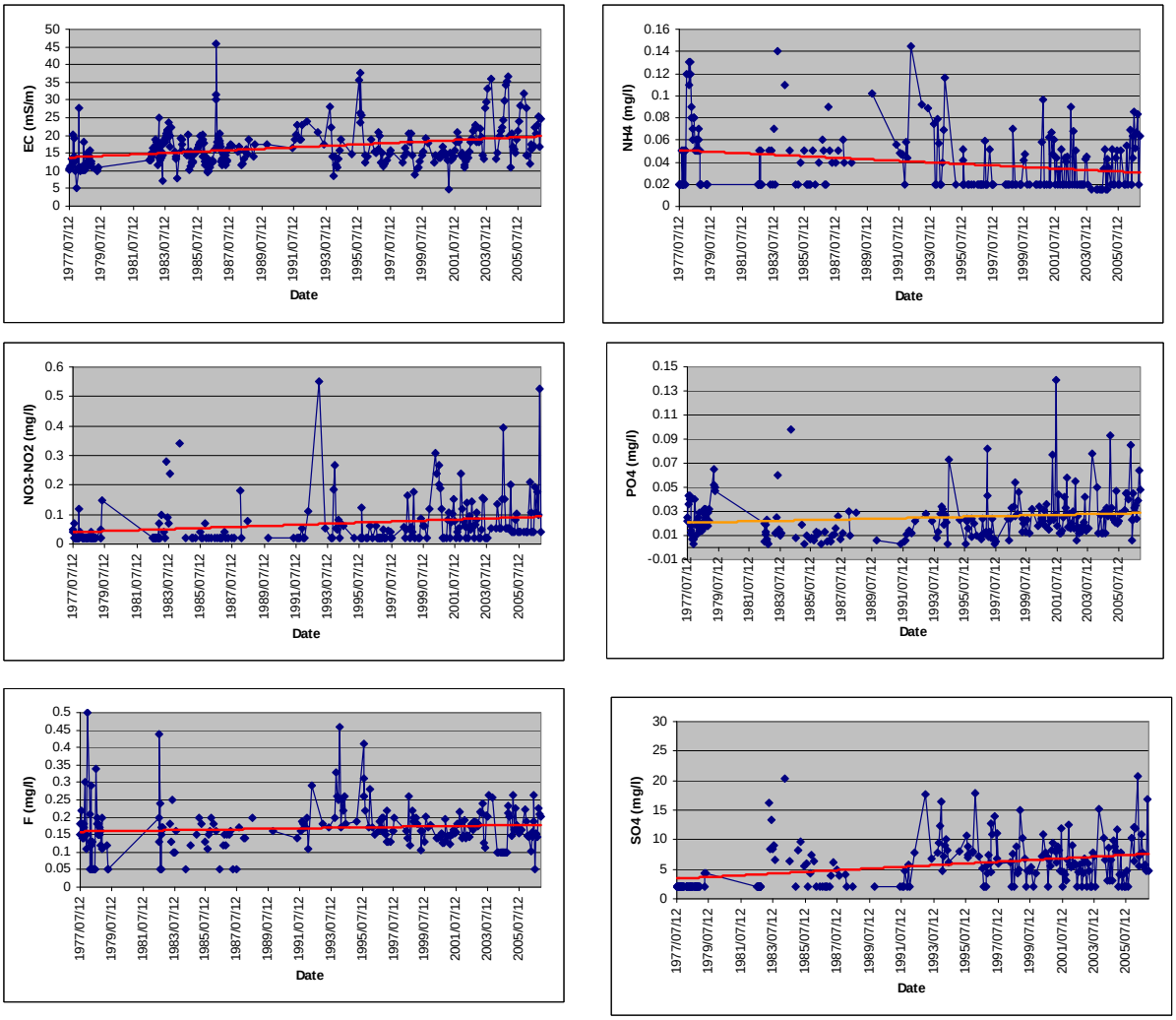


Figure 12: Physico-chemical water quality in the Sand Catchment (X3H008Q01)

It must be stated that the levels of the quality variables are rising as the trend lines indicate in the graphs in Figure 12. Levels of electrical conductivity, nitrate, fluoride, phosphate and sulphate are all on an upward trend. If allowed to continue, the quality of water in the sub-catchment will be compromised.

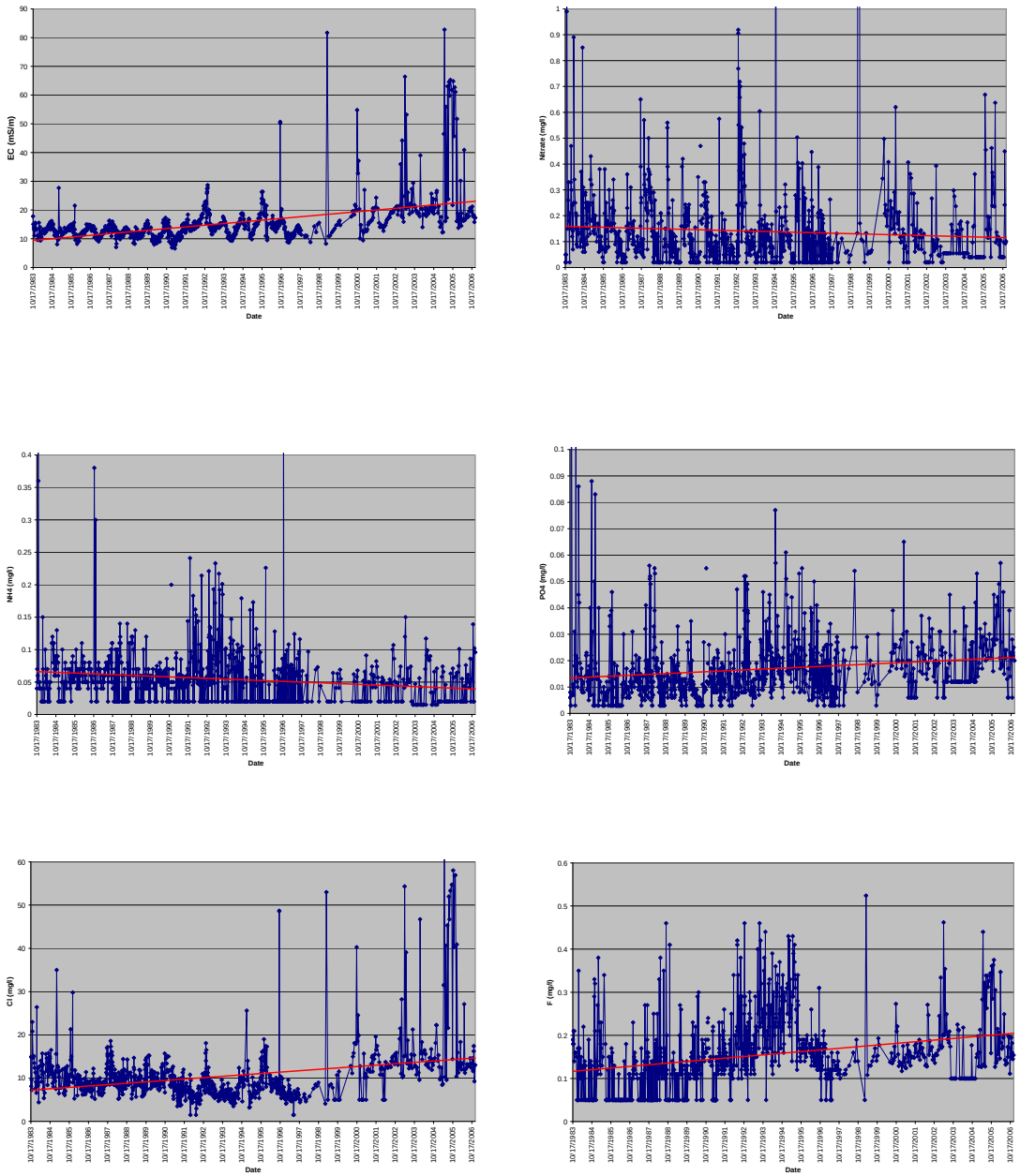


Figure 13: Historical water quality in the Sabie in the KNP (X3H013Q01)

Just like in the Sand, the Electrical Conductivity is on an upward trend together with chloride and fluoride.

b. Crocodile

Unlike the Sabie-Sand, the Crocodile Catchment currently has a Catchment Forum that is functioning very well. The Technical Committee of this forum has divided the Catchment into 4 Management Units (MU) for the purpose of water quality monitoring. The monitoring sites are not different from those sites currently being monitored by DWAF. Figure 14 shows the 4 MUs in the Crocodile Catchment. The 4 MUs are Upper Kwena, Nelspruit, Kaap and the Kruger National Park (KNP).

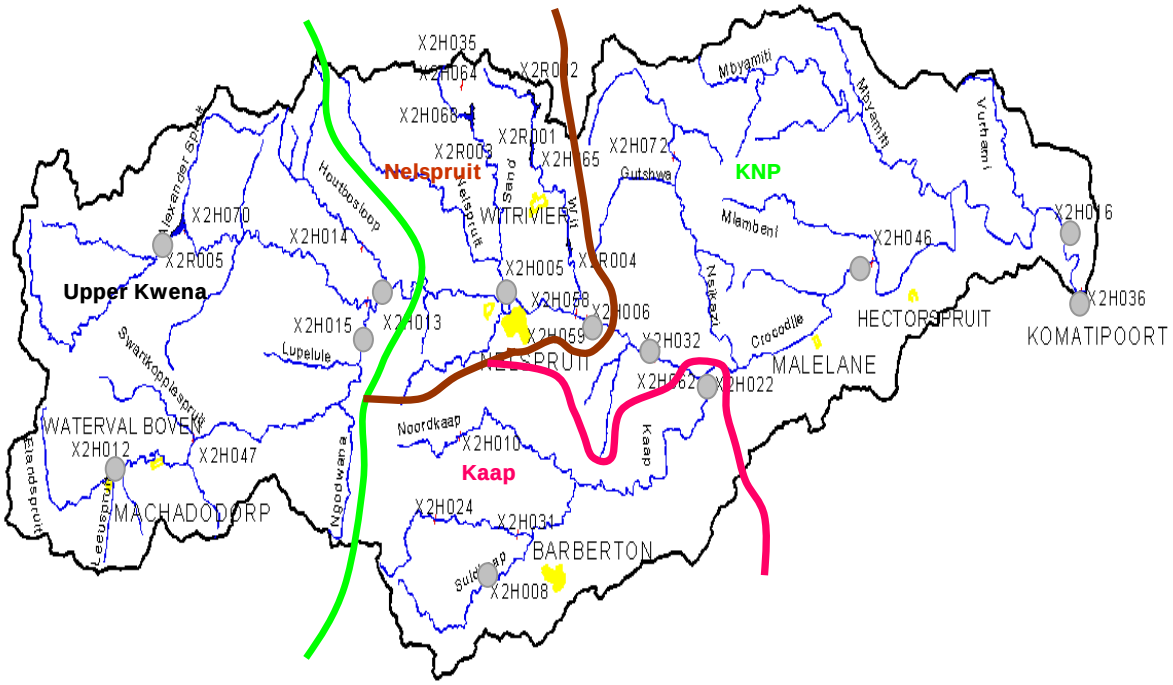


Figure 14: Management units and monitoring points in the Crocodile Catchment

The water quality analysis is based on important water quality variables. Not all the water quality variables analysed are discussed here.

The graphs for selected variables at a sampling point in a particular MU have been grouped as one figure. Two sampling points in each MU are discussed here.

The technical committee of the Crocodile Catchment Forum developed the WQOs based on the DWAF criteria (newly developed model for Resource Quality Objectives – which incorporates the DWAF Target Water Quality Range (TWQR) and the Desktop River Calssifications) but modified to suit the present conditions of the catchment. In the sections below, each MU is discussed and graphs are shown for one sampling point in each MU. The set water quality objectives per MU have also been presented for the sake of comparison. However, these water quality objectives do not override DWAF's official Water Quality Target Ranges (in DWAF 1996).

Upper Kwena MU:

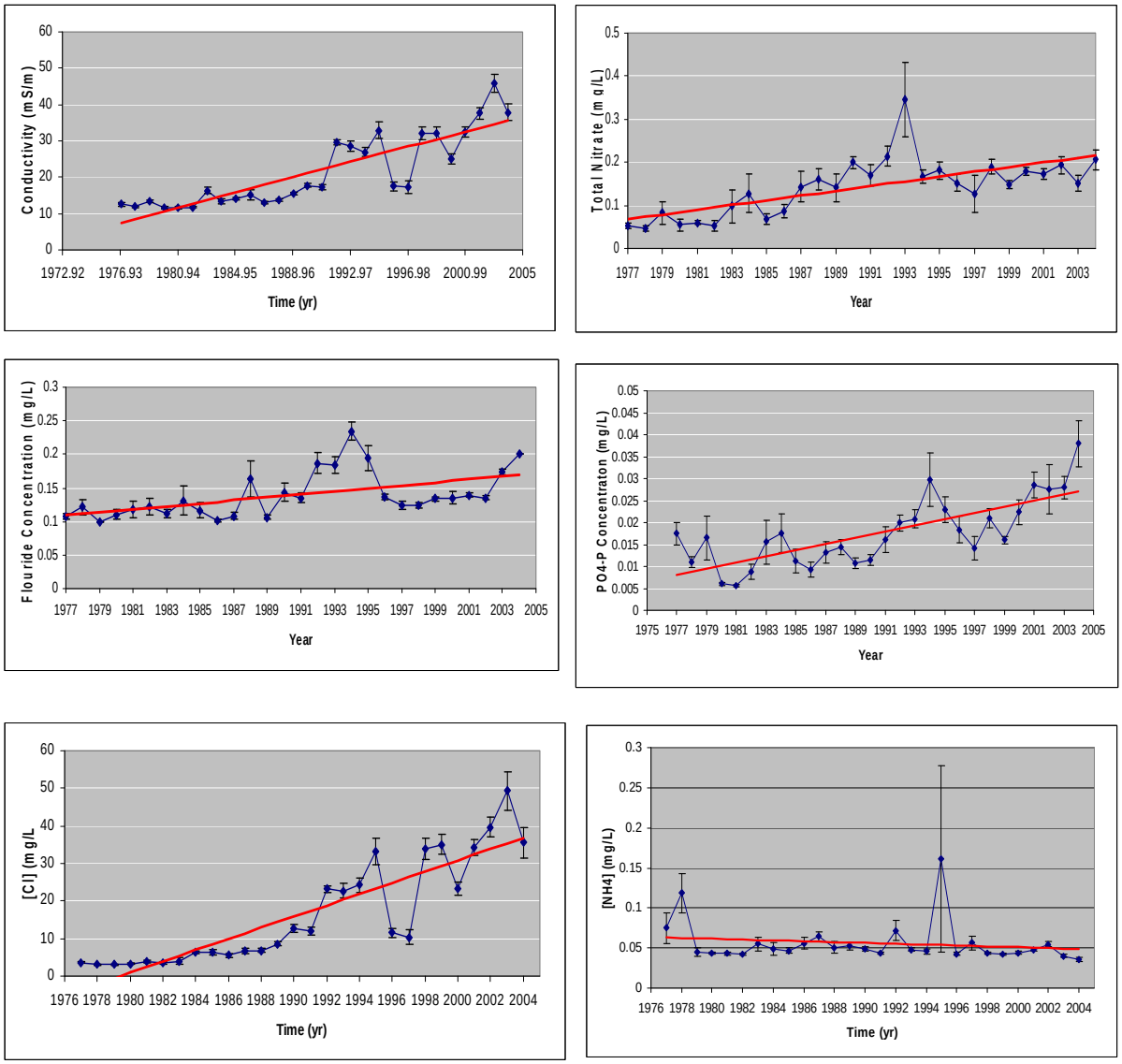


Figure 15: Historical water quality trends in the Crocodile - Upper Kwena (X2H013Q01)

Many of the variables have values below the WQOs for the Upper Kwena MU. It must however be stated that the trend in almost all the variables is increasing steadily. The implication is bad for the catchment.

Table 1: Water Quality Objectives for the Upper Kwena MU

Variable	Ideal	Acceptable
pH (pH Units)		6.5 – 8.4
Conductivity (EC - mS/m)	30	50
Total Suspended Solids (TSS - mg/l)	5	15
Ammonia Nitrogen (NH_3-N (mg/l)	0.015	0.058
Phosphate (PO_4 - mg/l)	0.01	0.03
Sulphate ($SO_{4\_}$ mg/l)	20	40
Nitrate – Nitrite (NO_3+NO_2 - mg/l)	0.5	1
Sodium Adsorption Ratio (SAR)	2	6
Chloride (Cl – mg/l)	30	40
Fluoride (F - mg/l)	0.3	0.7
Arsenic (As - mg/l)	0.01	0.05
Escherichia Coli (No./100 ml)	10	120
Iron (Fe - mg/l)	0.01	0.55
Aluminum (Al - mg/l)	0.03	0.07
Manganese (Mn - mg/l)	0.02	0.30
Magnesium (Mg - mg/l)	70	100

Nelspruit MU: The water quality in this MU shows a downward trend in the nitrate, ammonia and fluoride values (see Figure 16).

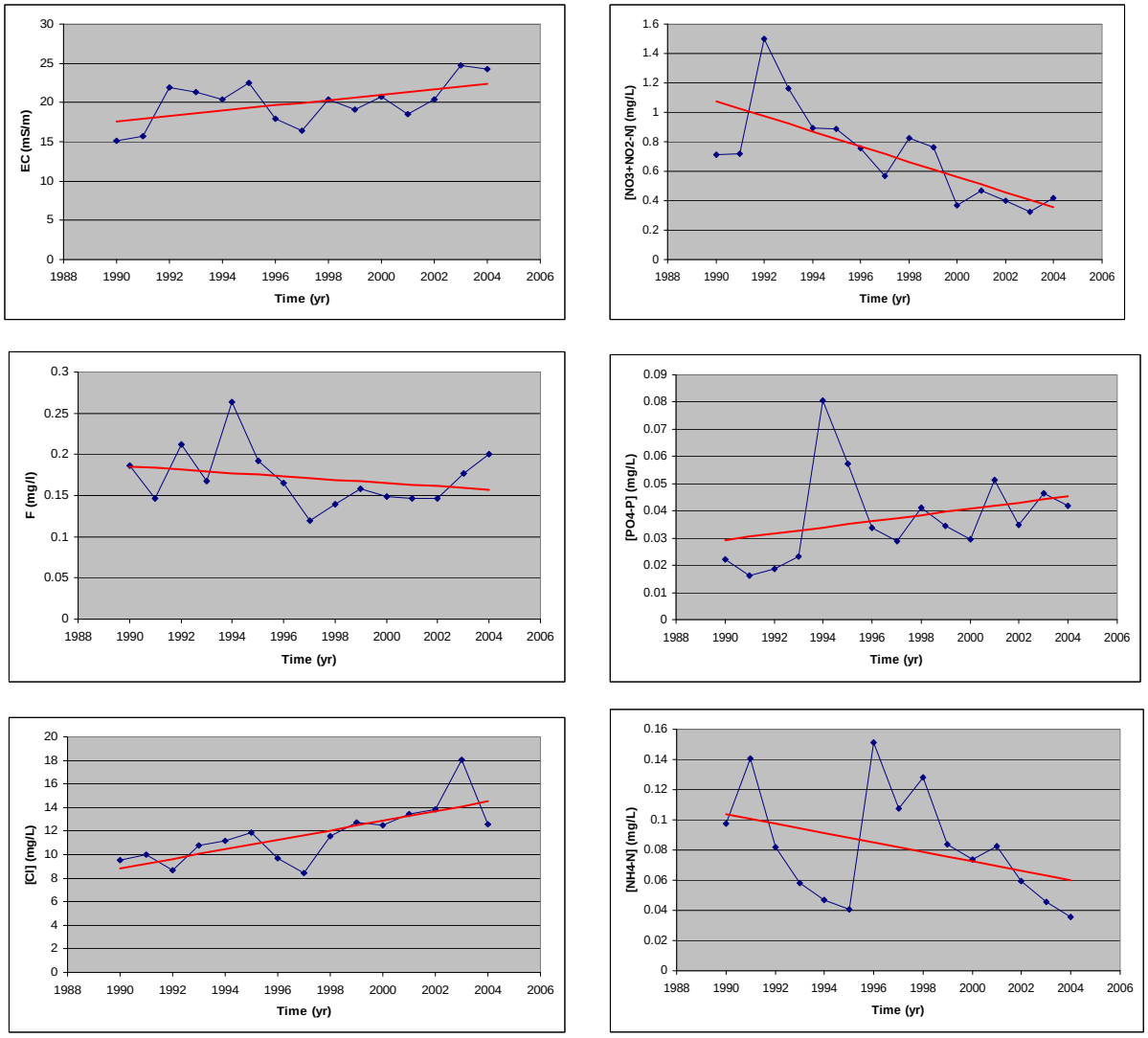


Figure 16: Historical water quality trends in the Crocodile - Nelspruit MU (X2H006Q01)

Increasing trend is observed in the chloride and electrical conductivity variables in the Nelspruit MU.

Table 2: Water Quality Objectives for Nelspruit MU

Variable	Ideal	Acceptable
pH (pH Units)		6.5 – 8.4
Conductivity (EC - mS/m)	30	50
Total Suspended Solids (TSS - mg/l)	5	15
Ammonia Nitrogen (NH_3-N (mg/l)	0.015	0.058
Phosphate (PO_4 - mg/l)	0.01	0.03
Sulphate ($SO_{4\_}$ mg/l)	20	40
Nitrate – Nitrite (NO_3+NO_2 - mg/l)	0.5	1
Sodium Adsorption Ratio (SAR)	2	6
Chloride (Cl – mg/l)	30	40
Fluoride (F - mg/l)	0.3	0.7
Arsenic (As - mg/l)	0.01	0.05
Escherichia Coli (No./100 ml)	10	120
Iron (Fe - mg/l)	0.01	0.55
Aluminum (Al - mg/l)	0.03	0.07
Manganese (Mn - mg/l)	0.02	0.30
Magnesium (Mg - mg/l)	70	100

Kaap MU:

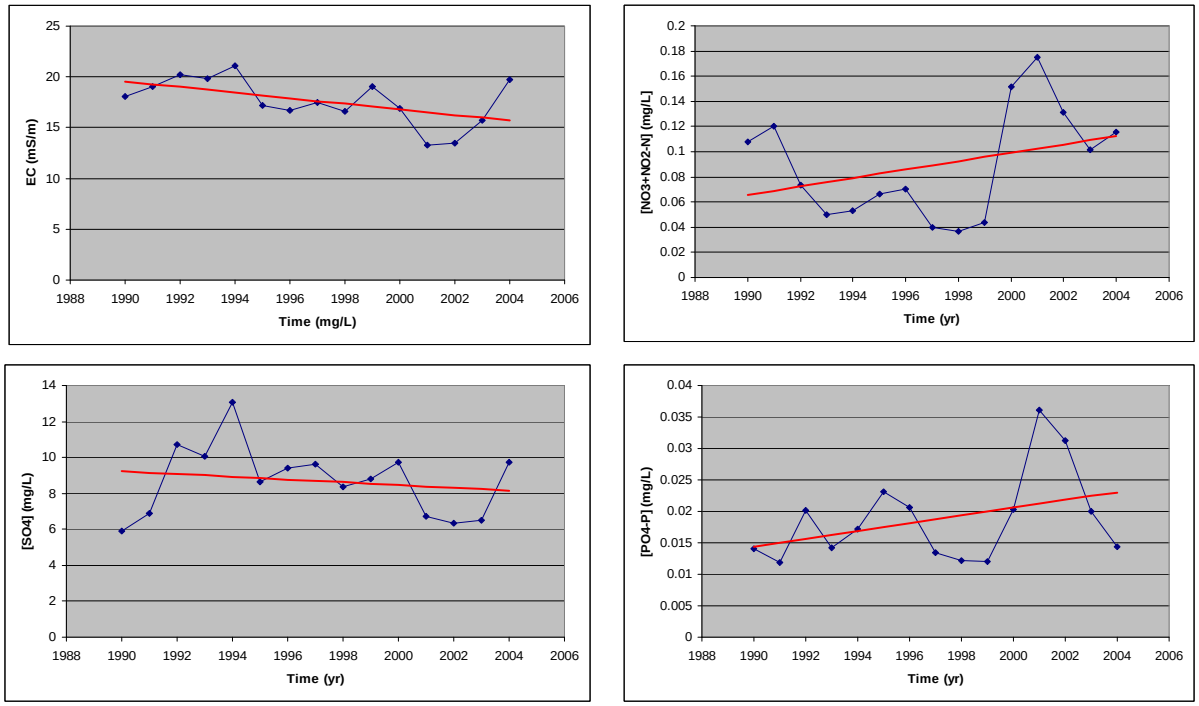


Figure 17: Historical water quality trends in the Crocodile - Kaap MU (X2H022Q01)

The trend in this catchment is increasing for phosphates and nitrates which might contribute to eutrophication in future if not checked. The trend is not very different from that of the Nelspruit MU.

Table 3: Water quality objectives for the Kaap MU

Variable	Ideal	Acceptable
pH (pH Units)		6.5 – 8.4
Conductivity (EC - mS/m)	30	70
Total Suspended Solids (TSS - mg/l)	5	15
Ammonia Nitrogen (NH_3-N (mg/l)	0.015	0.058
Phosphate (PO_4 - mg/l)	0.01	0.03
Sulphate ($SO_{4\_}$ mg/l)	20	40
Nitrate – Nitrite (NO_3+NO_2 - mg/l)	0.5	1
Sodium Adsorption Ratio (SAR)	2	6
Chloride (Cl – mg/l)	30	40
Fluoride (F - mg/l)	0.3	0.7
Arsenic (As - mg/l)	0.01	0.05
Escherichia Coli (No./100 ml)	10	120
Iron (Fe - mg/l)	0.01	0.55
Aluminum (Al - mg/l)	0.03	0.07
Manganese (Mn - mg/l)	0.02	0.30
Magnesium (Mg - mg/l)	70	100

The most downstream MU comprises largely of the Kruger National Park. It extends from the boundary with Nelspruit MU to the Mozambican border. Only Electrical Conductivity (EC) and phosphate (PO_4) show an increasing trend, see Figure 18.

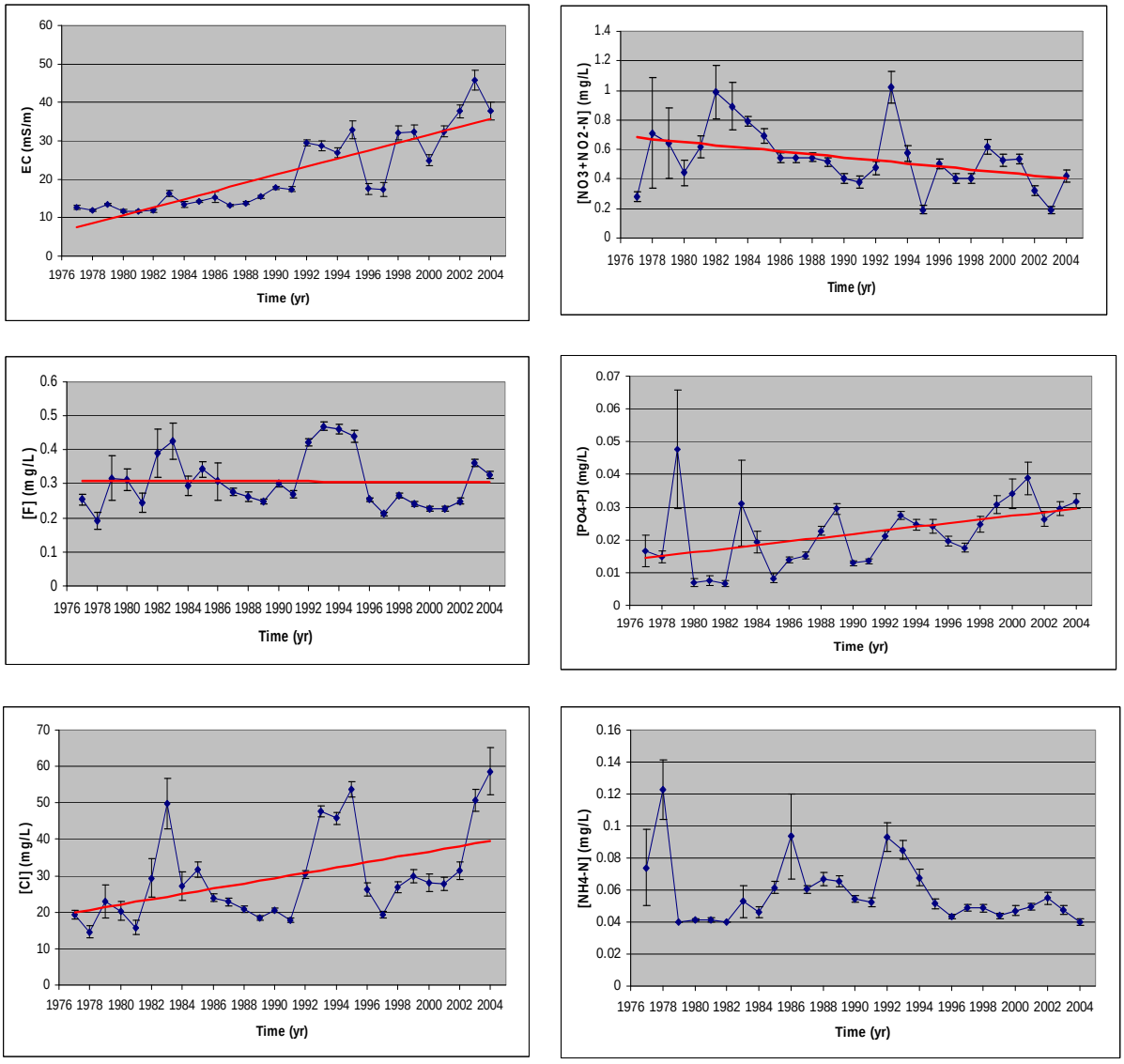


Figure 18: Historical water quality trends in the Crocodile – KNP (X2H016Q01)

It would have been expected that the downstream part of the Crocodile River would have higher concentrations of the identified variables but appropriate water quality management by the South African National Parks (SANParks) has prevented this. The WQOs set for the KNP MU is presented as Table 4.

Table 4: Water quality objectives of the KNP MU

Variable	Ideal	Acceptable
pH (pH Units)		6.5 – 8.4
Conductivity (EC - mS/m)	30	70
Total Suspended Solids (TSS - mg/l)	5	15
Ammonia Nitrogen (NH_3-N (mg/l)	0.015	0.058
Phosphate (PO_4 - mg/l)	0.01	0.03
Sulphate (SO_4 _ mg/l)	20	40
Nitrate – Nitrite (NO_3+NO_2 - mg/l)	0.5	1
Sodium Adsorption Ratio (SAR)	2	6
Chloride (Cl – mg/l)	30	40
Fluoride (F - mg/l)	0.3	0.7
Arsenic (As - mg/l)	0.01	0.05
Escherichia Coli (No./100 ml)	10	120
Iron (Fe - mg/l)	0.01	0.55
Aluminum (Al - mg/l)	0.03	0.07
Manganese (Mn - mg/l)	0.02	0.30
Magnesium (Mg - mg/l)	70	100

c. Komati

The Komati River Catchment has also got a Catchment Forum but it has not got a Technical Committee that will deal with the water quality monitoring yet. As a result we do not have management units or water quality objectives as yet. The sampling points of importance and have enough historical data are site X1H001Q01 Komati River at Hooggenoeg and (X2H036Q01 @ KOMATIPOORT) Kruger National Park on Komati River. The physico-chemical water quality of selected variables obtained from DWAF RQS are presented as Figures 19 and 20 respectively.

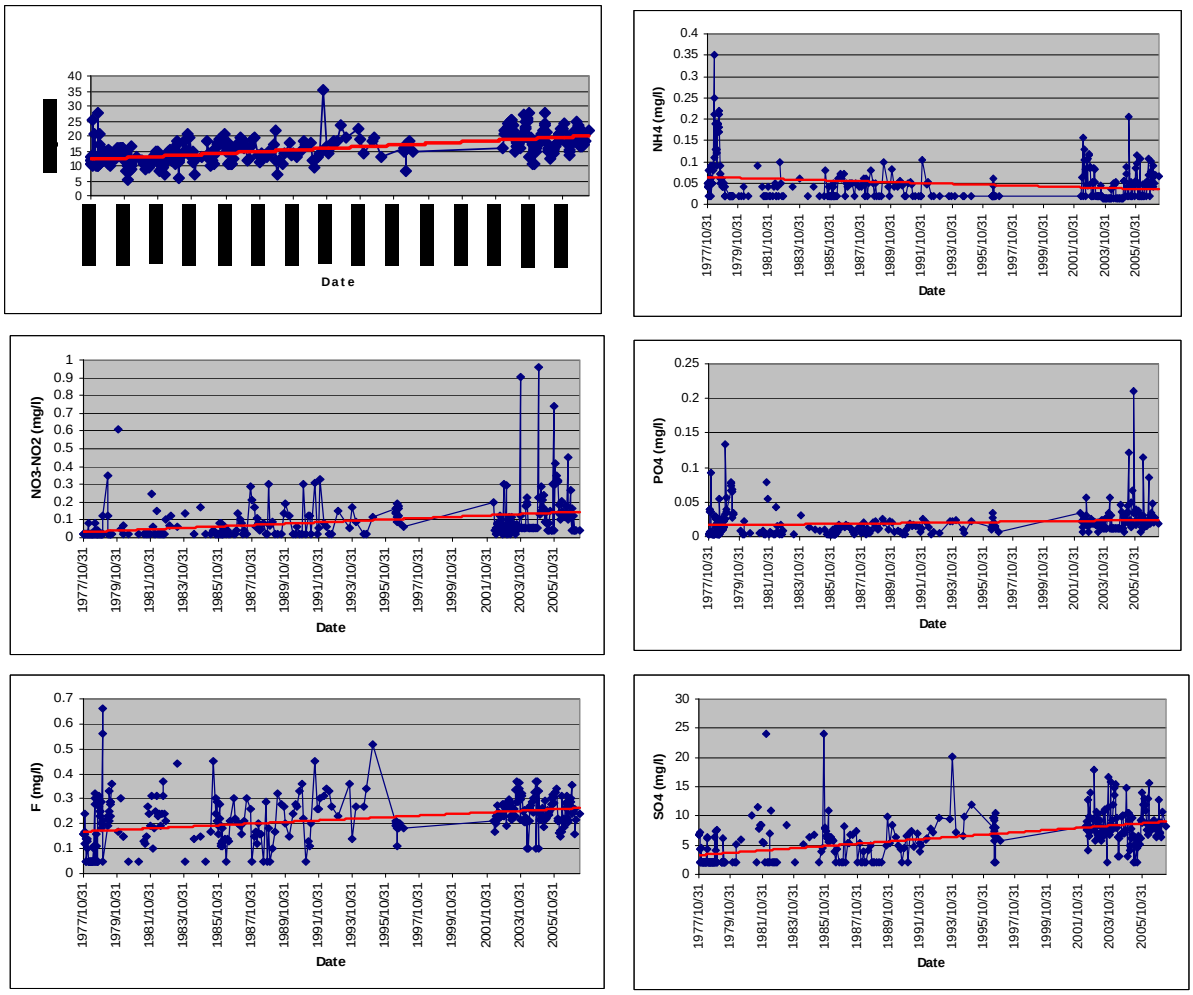


Figure 19: Historical water quality trends in the Upper Komati sub-catchment (X1H001Q01)

It is evident that the trend is increasing in the levels of Electrical Conductivity, Fluoride, Phosphate and Sulphate in the Komati sub-catchment.

The historical water quality trends for the Lower Komati sub-catchment (X2H036Q01 @ KOMATIPOORT) Kruger National Park on Komati River are displayed as Figure 20. This is the most downstream monitoring point on the Komati River on the South African side.

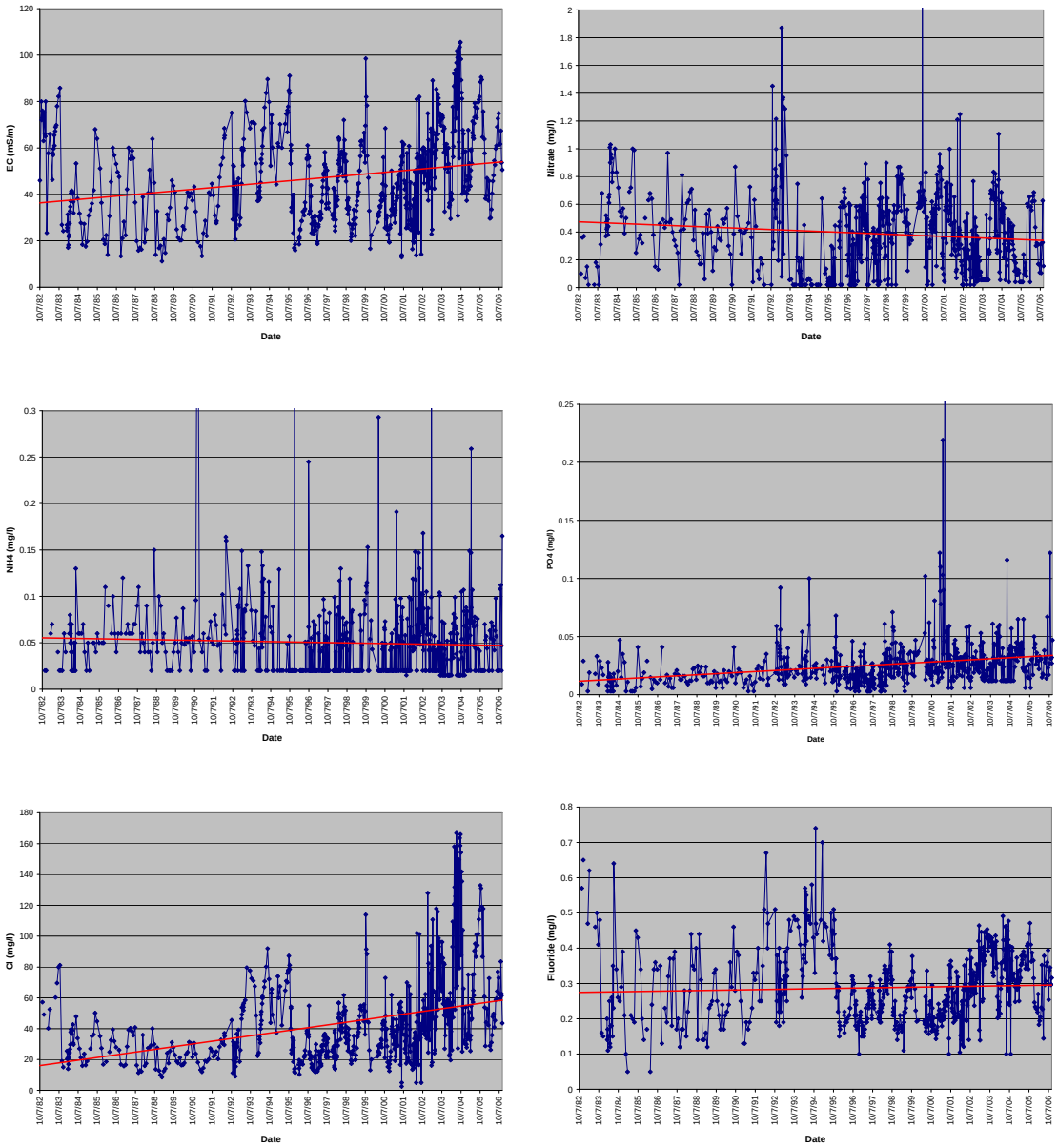


Figure 20: Historical water quality trends for Lower Komati sub-catchment (X2H036Q01)

Comparing the three sub-catchments, the Crocodile has the worst water quality in relation to the other two, Sabie-Sand and the Komati. The general trend in all three catchments in identified variables is however increasing. It must be stated that, according to data analysed for this project, water quality in the IWMA has not deteriorated to alarming proportions.

AfriDev (2006) also gives specific detail on water quality in the Komati catchment as part of a preliminary comprehensive Reserve determination. The report assessed

monitoring data available from DWAF (AfriDev, 2006) and identified key water quality issues (drivers and trends) at selected sites (EWR sites). See Table 5.

Table 5: Water quality drivers at selected sites in the Komati (AfriDev, 2006)

EWR site	Water quality drivers and trends
K1 – Upper Komati, Gevonden	The Upper Komati River Catchment is generally in a good ecological condition, with the main impacts relating to dry land farming and forestry. The upstream Nooitgedacht Dam does not make any compensatory releases, so low-flows[9] have decreased. Water temperatures are likely to have increased due to reduced low-flows, and nutrients have increased due to trout dams and tourist developments. There is large potential for opencast coal mining in this area, and this may compromise the good quality water that currently characterizes the area.
K2 – Upper Komati, Kromdraai	Although there is no cessation of flow, the hydrology has changed significantly: upstream Vygeboom Dam releases minimal water and has had moderate impacts on the floods. The main water quality issues are bacterial problems (cattle grazing, sewage effluent, waste water treatment works in the Seekoeispruit and lower Teespruit, runoff from poor sanitation in the area), nutrient enrichment, and some contamination from domestic washing powders.
K3 – Lower Komati, Tonga	The Lower Komati River Catchment is in a poor ecological condition. The large number of weirs and associated irrigation in the lower reaches of the river has resulted in a deterioration of the water quality to such an extent that it has become enriched with nutrients, and the dissolved oxygen levels become limiting to the ecology. Ecological conditions are highly impacted by frequent and extended periods of flow cessation, caused primarily by the diversion of water at Tonga Weir. The main water quality issues are nutrients (with associated benthic algal blooms) and bacterial contamination and increased water temperatures and high salinisation when the river stops flowing.
M1 – Middle Komati (Maguga)	Maguga Dam has had a significant impact on this site, and instream habitat availability is impacted by dense growth of benthic diatoms possibly associated with the release of cold water.
G1 – Gladdespruit, Vaalkop	The Gladdespruit is in a largely modified condition. The main impacts relate to trout farms, gold mines, forestry, and excessive encroachment of alien vegetation.
T1 – Teespruit	The hydrology and geomorphology of the Teespruit have been slightly impacted due to small-scale abstractions. The water quality is in good condition, except for the lower section where there is a sewerage works with associated organic pollution.
S1 – Seekoeispruit	The Seekoeispruit is unregulated and so the hydrology is close to natural, with small impacts related to abstraction of low-flows. Poor landuse practices have led to erosion and embeddedness of the stream bed. The main water quality issues are associated with a number of poorly functioning sewage works, and general low level of sanitation throughout the catchment, particularly in the vicinity of Badplaas.
L1 – Lomati, Kleindoringkop	The ecosystem is fairly healthy, although there has been a major change due to the impacts of Schoemans and Driekoppies Dam. Generally, the water quality is good, and the only potential impacts are due to dissolved oxygen and temperature from upstream regulation.

[9] Low flow is essentially base flow, i.e. it excludes events (floods).

3.5.1.3 Potential pollution sources

Various forms of pollution are currently being experienced in the IWMA. The industries and mines in the catchments are potential pollution sources. Currently the ground water pollution (mainly by chlorides) is under control in as far as it does not impact significantly on the surface water quality. There are however concerns that the situation might get to a certain limit at which higher chloride concentrations will find their way into the Elands and the Crocodile River

Sewage pollution is currently a very big problem in the whole Water Management Area. Waste Water Treatment Works discharging semi-treated or raw sewage into the rivers have significant impact on the surface water quality. The current situation does not seem to be under control and it is predicted that continuous impact from the sewage treatment plants or waste water treatment works (WWTW) will be experienced.

Table 6 gives an overview of some of the recent microbial water quality in the IWMA. Table 6 clearly indicates that some of the river samples have *E. coli* counts similar to those of some sewage effluents. The Crocodile Forum has 120 counts of *E. coli* per 100 ml as acceptable in their water quality objectives. The selected river sampling sites did not comply for most of the one year period indicated in Table 6. There were only a few sewage treatment plants that performed relatively well, for instance the Matsulu and the Hectorspruit WWTWs.

Table 6: Microbial water quality at several points in the IWMA (*E. coli*, No./100 ml), Source: DWAF Regional Office, Nelspruit)

River Monitoring points						Final Effluent of Sewage Treatment Plants						
Date	Croc. Bridge	Revulets	Montrose	DSKSW	Malelane	Komati poort	Hectorspruit	Matsulu	Barbeton	K'Mzane	W/River	Kabo-kweni
Sep-06		100		70	0	0	0	0	13000	0	100	220000
Oct-06	54	280	110	0	0	20000	0	19	58000	21	0	470
Nov-06		280	160	240	2	0	33	0	1900	100	17000	0
Dec-06		70	200	0	0	0	0	0	0	0	0	0
Jan-07		180	70		50	900000	1	120	9000	0	300	6
Feb-07	0	610			150	0	160	2	0	50	31000	0
Mar-07		70	340	100000	65	3600000	7	1	17000	0		0
Apr-07	140	110	310	310	60	6200000	4	2	1270	4200		0
May-07	400	220		42	14000	1350000	3	53	2900		70	500
Jun-07		80			580	10500000	1	0	90			6
Jul-07	180	230		430	1		200					
Aug-07			170									

According to the National Microbial Monitoring Programme (NMMP), there are areas in the IWMA that are described as priority areas for microbial/faecal pollution (Figure 21). These sites are located on the map below. Recent results are displayed in Table 7. People in body contact sports and irrigation of vegetables eaten raw in the priority areas should examine the guidelines in Table 8 carefully (this does not mean that the DWAF Target Water Quality Ranges should be avoided).

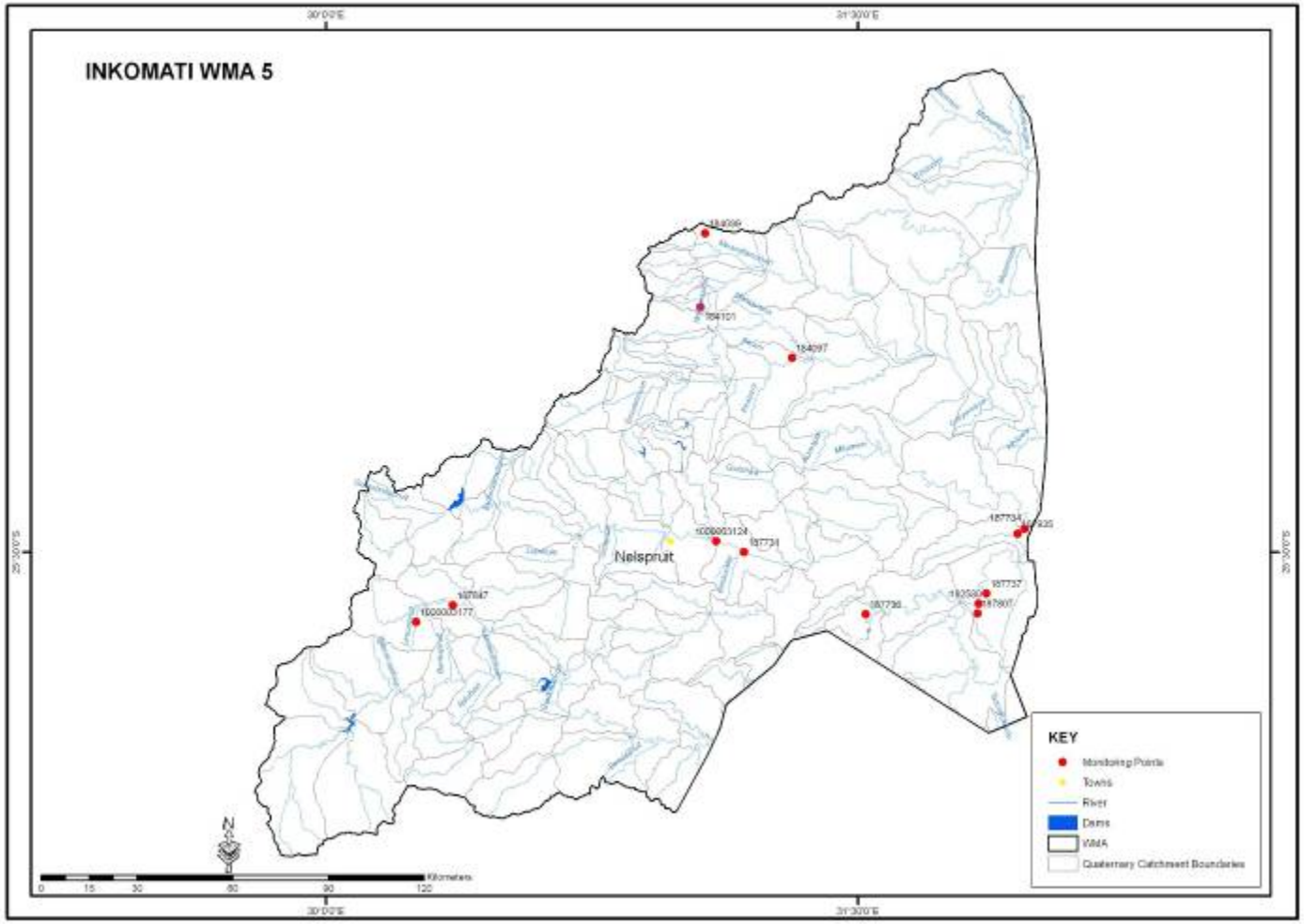


Figure 21: Priority areas for faecal pollution in the IWMA (source NMMP Dec 2007)

Table 7: Recent microbial analysis results in the priority areas in the IWMA (NMMP, RQS – DWAF)

Sampling site ID	Date	N/100ml
184099 MAHLEBE DAM EXTRACTION POINT FOR WATER WORKS	10/3/2007	27
	10/30/2007	21
	11/6/2007	131
	11/26/2007	46
184097 SABIE RIVER AT SAMORA CAMP	10/3/2007	1553
	10/30/2007	179
	11/6/2007	4840
	11/26/2007	123
187737 TSB AT BILTONG ON KOMATI	10/4/2007	1203
	10/15/2007	2420
	11/7/2007	50
	11/19/2007	41
1000003177 LEEUSPRUIT AT BRIDGE 50 M D/S EMTHONJENI S/W	10/3/2007	687
	10/15/2007	1096
	11/8/2007	387
	11/19/2007	488
187847 DOORNHOEK AT N4 BRIDGE D/S WATERVALBOVEN S/W ON ELANDSRIVIER	10/4/2007	140
	11/7/2007	1986
182580 NAAS WTW - RAW WATER	10/4/2007	2420
	10/15/2007	2420
	11/7/2007	48
	11/19/2007	75
1000003124 KARINO BRIDGE IN CROCODILE RIVER	10/3/2007	261
	10/9/2007	2420
	10/18/2007	99
	11/7/2007	261
187935 AT KOMATIPOORT N4 BRIDGE ON KOMATI	10/3/2007	1414
	10/9/2007	2420
	10/18/2007	687
	11/7/2007	1046
187736 NEAR BUFFELSPRUIT AT R570 BRIDGE ON MTILANE	10/4/2007	2420
	10/15/2007	2420
	11/7/2007	4840
	11/19/2007	731

Table 8: Guidelines for assessing the potential health risk for the four water uses (NMMP, RQS)

Low	High		Sensitive Water use	Narrative identifier	Abbreviated identifier
1	10	1	Drinking untreated water	Guideline: >10 = high risk when drinking untreated water	Untreated
600	2000	2	Full/partial contact	Guideline: >2 000 = high risk from full or partial contact	Contact
1000	4000	3	Irrigation of crops eaten raw	Guideline: >4 000 = high risk when irrigating crops that are eaten raw	Irrigation
2000	20000	4	Drinking after limited treatment	Guideline: >20 000 = high risk when drinking after only limited treatment	Limited treatment

3.5.2 Groundwater

Limited information is available on the Inkomati's groundwater resources. The ISP (DWAF, 2004) lists the following, quite general, characteristics:

1) primary porosity groundwater aquifers are only present to a limited extent, as sand of up to 5 or 6 meters depth in major rivers in places do not represent significant exploitable groundwater resources;
2) The greatest proportion of groundwater occurs in the secondary porosity aquifers (of the weathered and fractured classes);
3) Mean annual groundwater recharge varies from 100 to 150 mm in the higher rainfall areas (along the western boundary and to the south) to 10 to 20 mm in the low rainfall area (the easternmost part of the WMA);
4) Depth to the water table generally varies from about 10 to 20 m below ground level. Yields vary from 0.1 to 3 l/s.

As for slightly more detailed information, the following hydrogeological[10] regions (and their characteristics) fall within the Inkomati Catchment. They are identified and discussed (in terms of yield and expected development) in the draft Mpumalanga Groundwater Masterplan (DWAF, n.d.)

- Northern Lebombo Hydrogeological Region. The aquifers in this region generate low yield, but since the largest part of this region lies within the Kruger National Park, no development is foreseen.
- Lowveld Hydrogeological Region (this covers a large part of the catchment, from the northern part, through White River and Nelspruit almost to Malelane, and from within the Kruger National Park to Sabie). Groundwater use is low in the areas in the nature reserves. Farming with irrigation from probably both surface and groundwater sources are taking place within the western part of this region. The extent of groundwater use in this area is not properly quantified; no or little knowledge about the level of use and abstraction is known. Forestry forms another economic activity in the western portion of the

[10] Vegter divided the RSA into 64 homogeneous hydrogeological regions based on lithology and climatology: so-called Vegter-regions (this approach dates from 1990).

region, especially at the foothills of the Escarpment. Although very little groundwater is probably being abstracted artificially for this activity, the impact is large in that the trees use a lot of groundwater. Not enough data is available to establish aquifer properties or vulnerability.

- Eastern Bankeveld Hydrogeological Region (towards the northwest of the catchment). Little is known about utilization of groundwater in this area, and it is suspected that groundwater contributes significantly to surface water. Development of groundwater sources in this region can only be encouraged once the development potential (Reserve determinations) and the current level of groundwater use, has been established. Due to the important contribution the Dolomitic aquifers make to surface water in the area, any further development in groundwater use, including the extension of forests, needs to be regulated strictly. The interaction between ground- and surface water must be quantified and a project specific for the area must be started as soon as possible.
- Eastern Highveld Hydrogeological Region (only in the upper most regions of the catchment). Nothing is known about the level of groundwater use. The pollution risk[11] seems low, though this needs to be tested (in other areas, outside the Inkomati WMA, extensive coal mining takes place, which has the potential to pollute).
- North-eastern Middleveld Hydrogeological Region (in the southern part of the WMA, bordering Swaziland). The aquifers occurring in this region are mapped as having a medium development potential. Some potential for additional groundwater abstraction probably exists in this region. However, the current level of utilisation needs to be determined (e.g. some rural settlements may depend on groundwater, but this is not known currently).

3.5.2.1 Groundwater Quality

The NWRS indicates that groundwater in the Inkomati WMA is within the ideal range for domestic use at any location. Groundwater quality is very good in the WMA with most boreholes within the Class 0 quality range which makes the water suitable for drinking, food preparation, bathing and laundry. Still, despite this and other reports that both surface and groundwater quality are generally good (DWAF 2003), the TDS in groundwater does rise from west to east: from 300 mg/l to 500 to 1000 mg/l in the extreme east of the area.

The operations of the paper industry in the Elands sub-catchment of the Crocodile have rendered the groundwater in this area unsuitable for any use. According to the industry itself, groundwater may not be used for other beneficial purposes for the next 50 years.

.

[11] Pollution risk = potential of a pollution event happening and impacts

According to the Mpumalanga Water Services Planning Reference Framework and the Inkomati ISP (2004), it is evident that water quality monitoring is not adequately done based on the number of monitoring points available in the IWMA.

3.6 ECOLOGICAL SYSTEMS

3.6.1 Aquatic Flora and Fauna

The study on Aquatic Biodiversity has been done extensively in the Kruger National Park section of the IWMA. A new survey in the 3 catchments, Sabie-Sand, Crocodile and Komati has been done and the results have just been released. This new survey has been incorporated into the past records dating back to 1960 (available at RHP).

3.6.2 River Health

River health refers to the general ecological conditions of a particular river or a stretch of a river. This section relates the ecological status of the various rivers in the Inkomati Water Management Area based on recent or latest studies (reports)[12]. This particular one dates back to 2001.

The indices used are:

- The South African Scoring System (SASS) for aquatic invertebrate fauna;
- The Fish Assemblage Integrity Index (FAII);
- The Riparian Vegetation Index (RVI); and
- Index of Habitat Integrity (IHI).

3.6.2.1 Crocodile River

- Ecoregion 4.03 (Crocodile in the Drakensbergen – downstream of Kwena Dam): Good to fair with the in-stream biological components tending to be good and the riparian components (habitat and riparian vegetation) tending to be fair.
- Ecoregion 5.05 (Crocodile around Nelspruit): The overall state of this section can be described as fair. Upstream from Nelspruit the in-stream biota reflects a good to fair ecological state. Around Nelspruit the in-stream and riparian conditions deteriorate as indicated by riparian habitats and vegetation (poor), fish (fair to poor) and invertebrates (poor to unacceptable). Downstream from Nelspruit the river gradually recovers to a fair state.
- Ecoregion 6.01 (Lebombo uplands, immediately before the river flows into Mozambique, bordering the Kruger National Park): Throughout this section (also ecoregion 5, a little further upstream) both in-stream habitats and fish communities show fair health. Experience has shown that invertebrate fauna in this section give a more varied response, both over time and space, ranging from natural to fair. The riparian vegetation on the northern bank of the river is good, and yet generally fair to poor on the southern bank (where citrus and sugar cane farming takes place).

[12] The State of the Rivers reports, issued as part of the River Health Programme (CSIR, 2001)

3.6.2.2 Sabie-Sand River

- The lower ecoregions largely fall within the Kruger National Park and therefore have largely good to natural ecological states.
- *Sabie River:* Overall the ecological state is good. In-stream habitats and fish are good; riparian habitats and riparian vegetation varies between good and poor. The invertebrate index also reflects a varied picture, with results in this section ranging between natural and poor.
- *Sabane River:* Poor to unacceptable. The riparian zone and in-stream habitats are severely degraded. The Sabane River and Langspruit have been dammed and impacted in several places for irrigation of banana plantations. The clearing of ground cover for banana plantations has also increased erosion and sedimentation in-stream.
- *Phasa Phasa River:* Generally fair, but the invertebrate health is unacceptable.
- *Mutlumuvi:* The overall state is fair, although the state according to invertebrates ranges from good to unacceptable.

It should be noted that the report recommends a fair and poor state respectively for the Mutlumuvi and Sabane Rivers as realistically achievable future ecological states. This indicates the severity of the situation in these rivers.

3.6.2.3 The Komati

No records of similar nature on the Komati were available for this study. The water quality (chemical) has been analysed and discussed in section 3.5.1.2. Please, refer to the same section for the Afridev 2006 study which summarised the physical, chemical and ecological drivers for water quality trends in the Komati (Table 5).

3.6.3 Ecologically sensitive sites

Many factors could be considered in determining the desired ecological state for a particular river reach, including the strategic importance of the river for economic development as well as its ecological importance (in maintaining ecological diversity and functioning at local and wider scales) and sensitivity (ability to tolerate disturbances). The ecological importance and sensitivity of the river reach considers biodiversity, rarity, uniqueness, and fragility, from habitat, species and community perspectives. The ecosystems that are sensitive to changes in water quality and quantity in the Inkomati Water Management Area (DWAF 2003) have been listed according sub-catchments. They are given here per sub-catchment.

3.6.3.1 Komati River Catchment

The sensitive sites are:

- Barberton Mountains
- The Gorge between Nooigedacht and Vygeboom Dams
- Riffle areas between Vygeboom Dam and Bhalekane Bridge (Swaziland)
- Middle and lower reaches of the Lomati and Komati Rivers.

3.6.3.2 Crocodile River Catchment

The Crocodile River catchment is known for having more species of fish than any other river system in South Africa (49 indigenous and 5 introduced species) – mainly due to the high diversity of habitats occurring in the catchment. Habitats range from cold mountain streams in the Drakensbergen to slow flowing warm waters in the Lowveld. The sensitive sites are:

- Verloren Vallei and associated wetlands and streams upstream of Kwena Dam
- Lower Nels River
- Nelspruit
- Kaapsehoop
- The Elands River between Montrose and ZASM waterfall
- Gorge between Kwena Dam and Montrose Falls
- Crocodile Poort Gorge

3.6.3.3 Sabie-Sand River Catchment

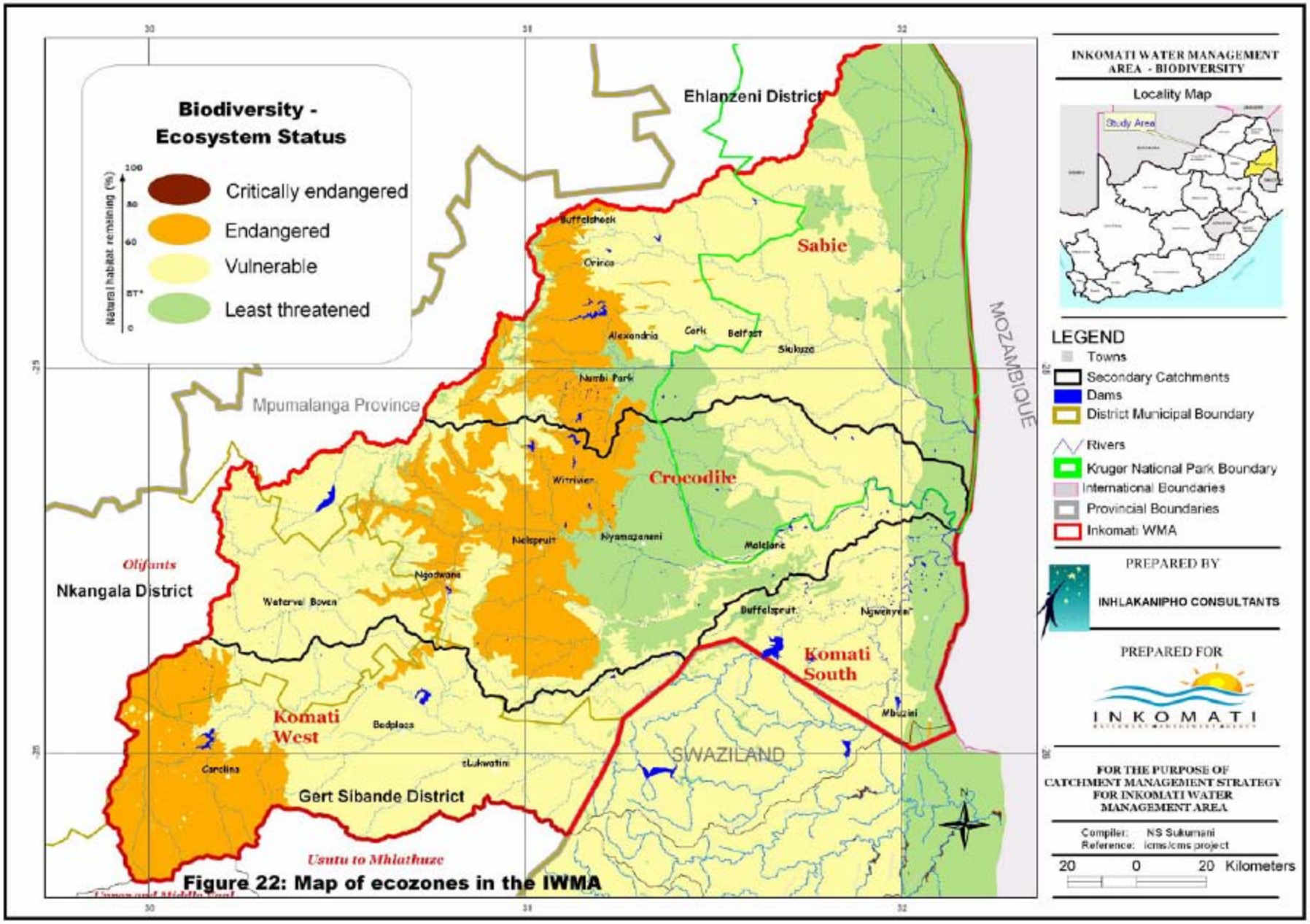
The Sabie is the only unregulated, perennial and pristine river in the lowveld (the system seems to have recovered from damage done by gold mining in earlier years). Also this catchment holds a large variety of fish species: 45 indigenous and 4 introduced species – again due to the high diversity of habitats, but also due to the mixing of cool and warm waters, the availability of refuge sites during dry times and historic affinities to the rich east African fish faunas. The Sabie River has the highest diversity of aquatic invertebrates of all rivers within the Kruger National Park.

The sensitive sites are;

- Mauchsberg, Gods Window and Mount Anderson
- Upper reaches of the Marite River
- Upper reaches of the Mac Mac River
- Upper reaches of the Sabie River and tributaries upstream of Sabie
- Upper reaches of the Mutlumuvi River
- Middle reaches of the Sabie River
- Middle reaches of the Sand River
- Mlondozi

The DWAF 2003 study consolidated information such as rare and endangered biota, unique biota, intolerant biota, species richness, diversity of habitat types or features, refuge value of habitats, sensitivity to flow changes and water quality changes, migration route/corridor for in-stream and riparian biota and the presence of conservation or natural areas. Figure 22 illustrates the various ecozones in the IWMA. The least threatened areas are mainly found in the KNP and adjacent areas. A greater proportion of the WMA is considered to be vulnerable. None of the ecosystems areas is considered to be critically endangered which means that rehabilitation measures can be put in place for the endangered systems.

Figure 22: Map of ecozones in the IWMA



3.6.4 Wetlands

According National Wetlands inventory, wetlands are referred referred to as a wide variety of ecosystems, defined as areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed ten meters. This is an adaptation of the definition adopted by the Ramsar Convention, which limits marine water to a depth of six meters at low tide (Davis 1994). Wetlands are areas where water is the primary factor controlling the environment and, therefore, wetlands develop in areas where soils are saturated or inundated with water for varying lengths of time and at different frequencies.

Cowardin *et al*. (1979) define wetlands as "*lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water*" and stipulate that, in order for an area to be classified as a wetland, it must meet at least one of the following criteria: 1) *at least periodically, the land supports predominantly hydrophytes;* 2) *the substrate is predominantly undrained hydric soil;* and/or 3) *the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season.*

According the Working for Wetlands, wetlands in the country will be classified after the classification system the National Wetlands Inventory is developing is completed and tested. Currently, information available on wetlands in the Inkomati WMA is limited. It has been indicated that endhoreic pans are found in Highveld sedimentary formations (AfriDev, 2006a and 2006c). The same type of pans is found in the Lebombo Mountains, but less information is available on this area. These pans function independent of groundwater flows and thus do not contribute much to baseflows in the river. Palustrine wetlands that are in touch with the groundwater system are found in the Komati system, but as indicated earlier very little information is available. The map (Figure 23) shows location of the various wetlands in the IWMA.

The collection of wetlands in the eastern part of the IWMA (in the Kruger National Park) has legal protection by virtue of being in a protected area. They are in healthy state. Those located outside protected areas although protected by law, do not enjoy the same status as those in the KNP. Many of such wetlands are under pressure from the communities for their various uses; farming, over-grazing and thatch harvesting. The many varied uses of wetlands and the ecological importance they offer makes them important systems that need protection from water resource managers.

Figure 23: Location of wetlands in the IWMA

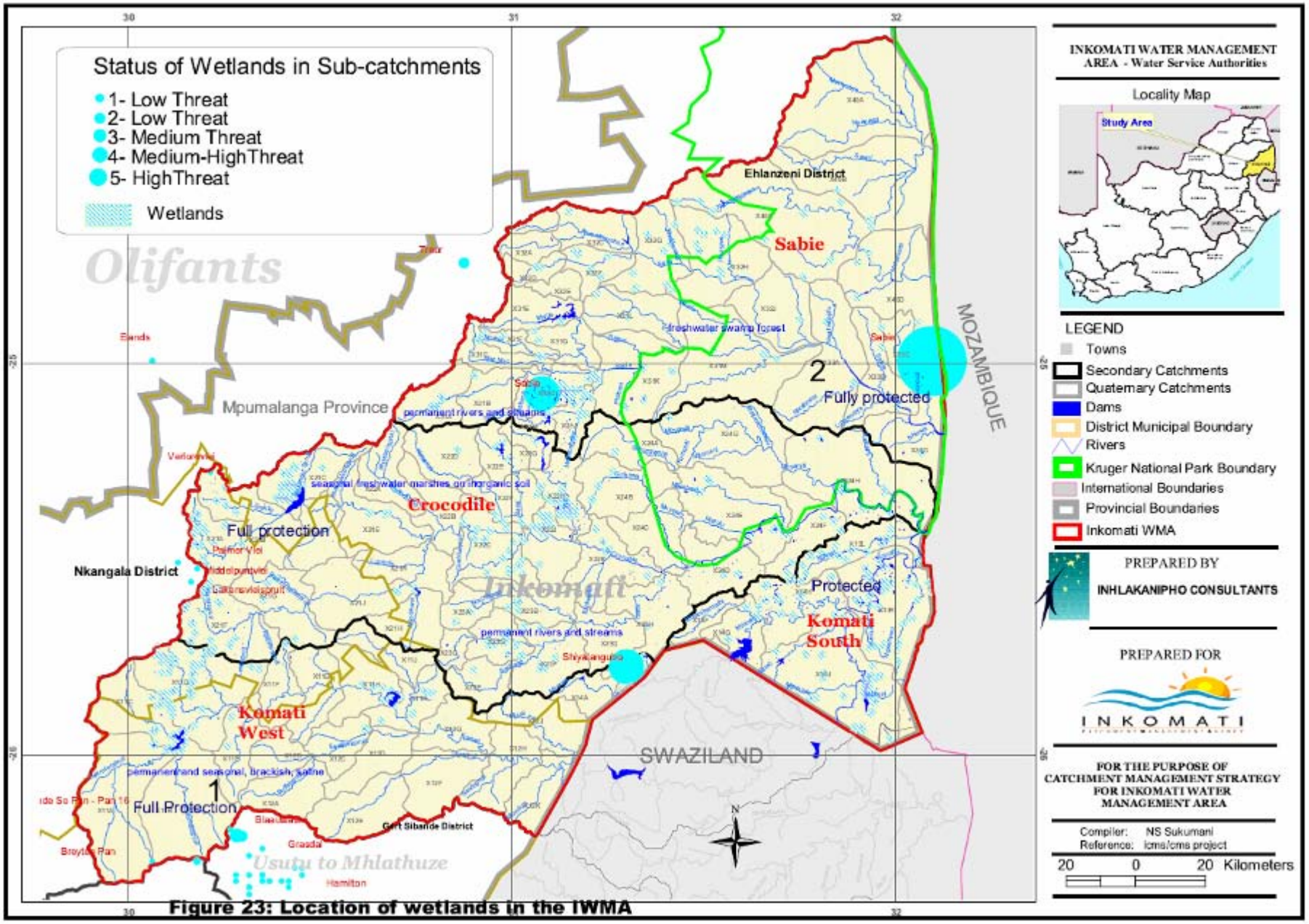


Figure 23: Location of wetlands in the IWMA

3.6.5 Vegetation types

Five main vegetation types occur in the area (Fig. 24): coastal tropical forest, inland tropical forest, tropical bush and savanna, pure grassveld and false grassveld. These types are derived from the so-called Acocks veld type categories. A brief description of the veld types occurring in the Inkomati catchment (DWAF 2003) is given below;

3.6.5.1 Coastal tropical forest

Small areas of this veld type (mainly Zulu thornveld) occur in the far-eastern parts of the catchment. The Mean Annual Precipitation (MAP) in these areas varies from 700 to 1000 mm, with an altitude range of 150 and 1050 m above sea level.

3.6.5.2 Inland tropical forest

This type of vegetation occurs in the central, mountainous, parts of the catchment and mainly consists of north-eastern mountain sourveld and lowveld sour bushveld. The MAP in these areas varies between 1000 and 1500 mm (although in some small areas it is only 700 mm).

3.6.5.3 Tropical bush and savanna

Tropical bush and savanna covers the eastern part of the Inkomati WMA. This veld type ranges from arid lowveld in the north to lowveld in the central and southern parts. The MAP varies from 1000 mm to only 400 mm in the northeast (the Kruger National Park). The vegetation occurs at altitude of 150 to 600 m above sea level. It is the largest vegetation type in the IWMA.

3.6.5.4 Pure grassveld

Pure grassveld can be found in the far western parts of the catchment and consists of north-eastern sandy highveld vegetation. The MAP in these areas ranges from 600 to 1000 mm.

3.6.5.5 False grassveld

This occurs in areas ranging from the central to the western parts of the study area. This veld type mainly consists of Bakenveld and Piet Retief sourveld. MAP varies between 800 to 1000 mm, although values above and below these values have been found in some areas.

Figure 24: Distribution of vegetation/veld types in the IWMA

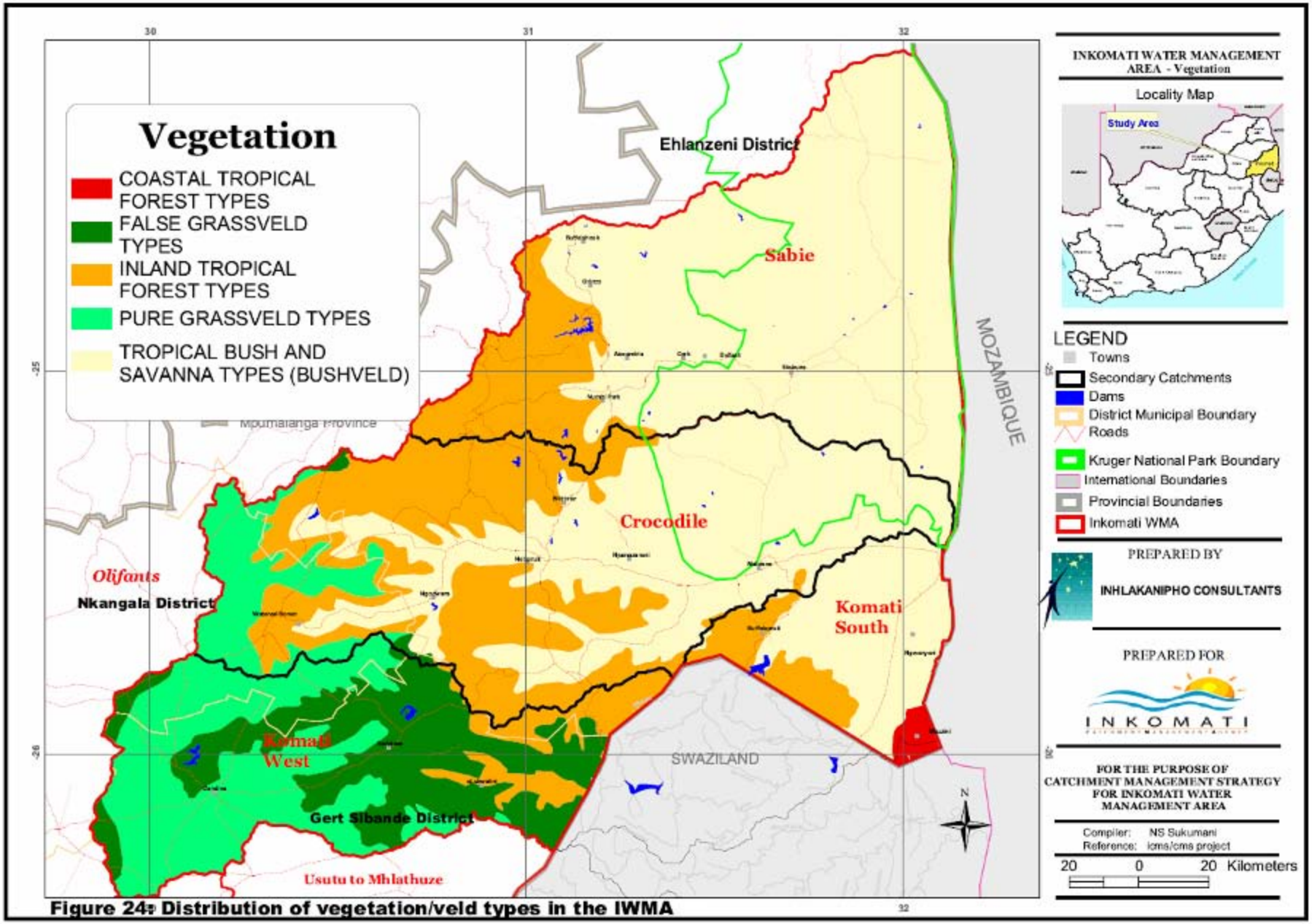


Figure 24: Distribution of vegetation/veld types in the IWMA

The vegetation types indicated on the map (Figure 24) are the major ones in the IWMA. Smaller ones like Mopani vegetation and others have not been delved into in this study.

3.6.6 The KNP as a protected area

KNP is the most prominent of all the conservation bodies in the IWMA. The Kruger National Park was established in 1889 to protect wildlife of the South African Lowveld. The park covers an area of approximately 2 million hectares (the southern part forms about 35% of the IWMA), and it is unrivalled in the diversity of its life forms and a world leader in advanced environmental management techniques and policies. The Kruger National Park is home to an impressive number of species, including; 49 fish, 34 amphibians, 114 reptiles, 507 birds and 147 mammals. Apart from the fish and the amphibians that directly depend on the water resource (habitat, food, reproduction and migration), other life forms depend on the available water resources in the KNP in different ways.

3.6.6.1 KNP Water Requirements

Another important institution regarding water management is the Kruger National Park. Though obviously a water user, this stakeholder is sufficiently important to be listed as a water management institution. It has its own water management structures, rules, goals and expertise. The strategic importance of the Park for tourism and its wildlife as a heritage warrants its strong presence and involvement in water management issues.

The climate in the KNP is subtropical with hot summers and mild, dry winters. Summer rains fall between October and March. The rainfall season is very erratic and most at times has dry spells throughout the year with occasional one to two rainfalls in a year depending on the location. The western parts of the catchments involving the KNP receive more rain. The rivers and catchments involving the KNP are governed by its largely semi-arid climate. This produces some of the most variable and unpredictable rainfall. The rainfall in the park is not favourable and it is forecasted that drought situation will continue to impact the KNP and environs for some years to come. The rainfall figures in the park is summarised below.

The rivers draining through the KNP are greatly over-utilised, especially the Crocodile and Sabie-Sand. Pollution from various sources compounds the problem thereby degrading the riverine habitats and reducing the supply and quality of the river water. The Kruger National Park has the mandate to conserve its biodiversity (including aquatic biodiversity) in the national interest. It has a mission to "…protect biodiversity in all its natural facets and fluxes…", which originates from the South African National Parks mission; "To develop and manage a system of national parks that represents the biodiversity, landscapes, and associated heritage assets of South Africa for the sustainable use and benefit of all".

The quantity and quality of the rivers are continuously deteriorating to the detriment of the biodiversity and this is making it difficult for the Kruger National Park to

achieve its mission/vision. There are various threats to the ecosystem in all the rivers involving the KNP when it comes to water availability. It is believed that this is primarily the result of dam management and dam and river abstractions. Irrigated agriculture in the catchments involving the KNP are using between 60-70% of the available water resource. It is likely that this direct removal of water in the dry season is the main cause of the drying or cessation of flow in the rivers (Fig 25).

Figure 25: Cessation of flow in the KNP section of Crocodile River (Gyedu-Ababio 2005)

The non-availability of sufficient water to the wild life is causing some elephants to break the fence to reach water on adjoining lands. The Hippos become very uncomfortable when the pools (their preferred habitats) dry up or begin to dry up. Fish die due to heat, predation by birds and other predators, competition for space and food, deprivation of oxygen, etc (Gyedu-Ababio 2005).

Many examples occur in upstream catchments involving agriculture, industry, etc. which do not seem to be properly monitored by the authorities concerned. Water quality has also deteriorated over time. A contributing factor to the deteriorating water quality is the overabstraction. The little amount of water that remains in the system become saturated with dissolved substances to such an extent that it becomes unsuitable for some of the sensitive species in the water. As indicated earlier, the catchments have a host of land/water uses. Sewage effluent problems have created microbiological pollution in the river systems. An example is found in the Crocodile River system and the White River where the pollution emanating from the municipal and private waste water treatment works is a constant feature. Figure 26 shows some consequences of increasing nutrient enrichment and very low flows in the KNP.

Figure 26: Algal growth displacing fish in the KNP section of the Crocodile River (Gyedu-Ababio 2005)

The growth of algae in the rivers has resulted from the nutrient build ups. Water quality has indicated that the threat of nutrients is not a severe one but inside the KNP where the quantity of water in the rivers is relatively small, the contribution of adjacent farms and effluent from nearby industries and WWTW into the river together with the intensity of the sun provide a perfect medium for algal growth. The growth of aquatic alien weeds like hyacinths is also encouraged by the increase in nutrient loads. According to the old KNP water policy document (cited by Gyedu-Ababio 2005), the "abuse" of perennial rivers in the KNP in the form pollution and abstractions started as far back as 1920 with the advent of industrial and agricultural development in the lowveld and adjoining areas. It is always difficult to substantiate such statements since the pre-pollution status is always not available (Gyedu-Ababio *et al*, 1999).

3.6.6.2 Activities Downstream of the KNP, e.g. raising of dam walls

The raising of the height of wall of the Corumana dam in Mozambique is seen as a big threat to the KNP. The gorge in the Sabie will be flooded as the backwaters of the dam will push far inside the KNP. Many of the habitats for the aquatic species will be lost which will eventually lead to the disappearance of such species from these areas. These will affect biodiversity conservation plans as well as tourism in the Kruger National Park.

3.7 Socio-Economic Aspects (People of the Catchment)

3.7.1 Population dynamics and Demographics of the WMA

The Inkomati WMA is home to approximately 1.62 million people, who make up 3.7% of the country's population. The population is spread throughout the WMA, with the majority residing in rural areas. The main towns are Nelspruit/White River, Carolina, Malelane, Komatipoort and Barberton (DWAF 2006). The urban population comprises 25% of the total population. The rural population comprises 75% of the total population, and rural settlements are located in the Mhala, Mapulaneng, Nsikazi, Nkomati and Mswati regions. These demographics are highly influenced by

South Africa's apartheid history. High population densities occur in most of the former "homelands", with relatively sparse population in much of the commercial farming areas.

3.7.1.1 Gender

About 52% of the population are female residents whilst males constitute (48%). Thus, slightly more than half of the population is female.

3.7.1.2 Language

The population is largely SiSwati speaking: (31%) and IsiZulu: (26%) followed by IsiNdebele: (12%), SePedi: (11%), Afrikaans: (6%), XiTsonga: (4%), SeSotho: (4%), SeTswana: (3%), English: (2%), Xhosa: (1%), TshiVenda: (0%) and other: (0%).

Unfortunately, the breakdown of the recent population is not available and Table 9 details the available subcatchment data of 2003.

Table 9: Population figures for the Inkomati WMA - per sub-catchment (DWAF, 2003)

Secondary catchment		
Description	***Sub-catchment***	***Population***
Komati	Upper Komati	99,665
	Lower Komati	245,350
	Upper Lomati	1,228
	Lower Lomati	68,956
Sub-total		**415,154**
Crocodile	Upper Crocodile	5,519
	Middle Crocodile	254,780
	Elands	18,284
	Kaap	47,427
	Lower Crocodile	152,654
Sub-total		**478,664**
Sabie-Sand	Upper Sabie	209,644
	Sand	407,413
	Lower Sabie	245
	Upper Rio Uanetze	228
Sub-total		**617,530**
Total		**1,511,348**

DWAF (2003a) predicted – based on a population distribution study; that rural populations would stabilize after 2005, with even a possible decline in some areas. A moderate growth was expected in total for the WMA, due to growth of urban areas such as Nelspruit. This is similar to national demographic trends, and also reflects the impacts of HIV/AIDS (DWAF, 2003a). Future growth in population is expected to be moderate and to be concentrated in the urbanized areas, with a decline in some of the rural areas.

3.7.1.3 Labour and population

The work status of the total population indicates that 38.9% of the population is younger than 15 years of age and not available for the labour force. Another 22.2% of the population aged 16 and older is not economically active resulting in only 38.9% of the population to be economically active, (the employed and unemployed). Only 24.6% of the population is formally or informally employed and only 14.3% is actively looking for some form of employment.

Mpumalanga finds itself in this labour force trap because 85.8% of its labour force consists of Africans, who either had no formal schooling or only limited primary or secondary schooling.

3.7.2 Economic features of Mpumalanga

The WMA is wholly situated in the province of Mpumalanga. Its boundaries cross those of municipalities in the province and there is accordingly no definitive economic information about the WMA on its own. The economic information provided is for the whole province and has been obtained from the Provincial Growth and Development Strategy (2002/2012).

Economic growth in Mpumalanga as a province is broadly in line with that of the rest of the country, averaging 2.5% growth between 1996 and 2001, which shown a great increase in relation to the 1.2% achieved between 1990 and 1996, which was below the National average. The GGP growth rate between 1996 and 2002 exceeded the average population growth rate of 1.8% over that period. The most important sectors in terms if contributions to the Gross Geographic Product (GGP) are as follows;

- Manufacturing : 24,6%
- Agriculture : 18,6%
- Government : 16,4%
- Trade : 13,4%
- Other : 27%

Unlike the rest of South Africa where the services sector is the dominant component of the GDP, mining, energy and manufacturing dominate Mpumalanga's economy. All three of these sectors are highly capital intensive and generate relatively few jobs. Mining, manufacturing and electricity comprise almost 60% of total value added and yet contribute only 20% of the jobs in the Province. These industries' dominance of the economy is rooted in Mpumalanga's substantial coal reserves (which make up one-sixth of the world's coal reserves).

A sectoral breakdown of economic activity in Mpumalanga is shown in Table 10. The manufacturing, mining and quarrying, electricity, gas and water sectors dominate

Mpumalanga's economy. The wholesale and retail trade sector is also an important component of the economy (Table 10).

Table 10: Economic statistics in the Inkomati WMA

Economic Sectors	% of GGP	% of total employment	Average annual % growth in value added (1990-1996)	Average annual % growth in value added (1996-2002)
Agriculture, hunting, forestry and fishing	6.1	18.1	-0.1	1.0
Community, social and personal services	14.6	15.4	1.6	0.4
Construction	1.6	6.1	-1.6	0.7
Electricity, gas and water	10.1	1.8	4.1	2.0
Finance, insurance, real estate. and business services	5.4	5.3	2.9	6.6
Manufacturing	27.2	11.2	0.4	4.7
Mining and quarrying	22.3	7.5	-0.3	0.5
Transport, storage and communication	4.5	3.6	3.7	5.9
Wholesale and retail trade	8.2	13.9	1.4	1.8
Private households	-	10.9	-	-
Undetermined	-	6.3	-	-
Total	-	-	1.2	2.5

[Source: Mpumalanga Development Profile, Development Bank of Southern Africa, Development paper 152, June 2004; base data provided by Global Insight South Africa, 2004]

3.7.2.1 Agriculture

The agricultural sector registers –0.2 % growth rate despite being the second largest employer in the Province. This important resource is still not being utilised effectively to the benefit of the poor in the Province.

37.2.2 Mining

The mining sector registers –0.3% growth rate. This presents a challenge to the Province as the mining sector remains dominant in the economy.

3.7.2.3 Industry - Manufacturing

The manufacturing sector is not fully exploited while the Province has a strong primary manufacturing sector with a variety of minerals, electricity and agricultural products being exported as raw materials.

3.7.2.4 Retail, trade and tourism

Trade and tourism is quite exploited but there is still more room for improvement – more tourism opportunities exist and the opportunities are there for expansion.

The principal economic activities undertaken in the WMA are agriculture (sub-tropical fruit, forestry and sugar cane) and eco-tourism via the Kruger National Park.

3.8 HERITAGE RESOURCES

The Inkomati Water Management Area has Cultural Heritage Resources which according to National Heritage Act, (Act No. 25 of 1999) need to be protected. DWAF (2003) lists the following sites as of particular importance that might be affected by water resource development:

- Groblers Bridge, Komati River (National Monument)
- Mac Mac Waterfall
- Lone Creek Waterfall
- Berlin Waterfall
- Five Arch Bridge, Waterval Boven
- Hiking trails
- Langeloop cultural village
- Potteries at Tonga and Langeloop

This list only covers a fraction of the visible archaeological sites in the catchment, especially in the Lowveld. A summary of all the heritage sites have been provided in tabular form for the three sub-catchments.

Although it has been indicated that many of heritage resources/sites have no impact on water, this document would like to stress that developmental activities in the various catchments might impact on these heritage resources thereby affecting the income generating activities provided by these sites. The rich cultural history and natural resources need to be preserved.

3.8.1 Heritage Resources in the three subcatchments

3.8.1.1 Sabie Catchment

Site Name	Site Co-ordinates:	Site Location	Site Description	Site Declaration
Albasin store ruin	2514' 07.8"S 3194' 32.3"E	Situated adjacent the tarred road to Crocodile Bridge.	Ruins of Albasin store European history	Not yet declared
Jaoa Albasin ruin	25.02307 31.94399	The site is situated next to Phabeni Gate	Ruins of Joao Albasin European history	Not yet declared although is in the process of being declare as Provincial Heritage site
	25 20' 71.5"S 31 95' 70.1"E	Situated at Lower Sabie Ranger Section on relatively flat area.	Hut floors Iron age period	Not yet declared
Thandanyathi	25 20' 69.6"S 31 95' 95.0"E	Site is situated at Lower Sabie Ranger Section next to the entrance of Thandanyathi view point.	It is consisting of an inscription. European history	Not yet declared
Phabeni		Situated next to Phabeni Living Quarters.	The site is consisting of one grave. Iron age	Not yet declared
Phabeni	25 02' 29.9"S	is situated at Phabeni	Four graves.	Not yet declared

	31 24’ 89.2”E		Iron age Period	
Phabeni	25 02’ 26.6”S 31 24’ 31.8”E	is situated about 500m away from Phabeni information centre adjacent the dirt road heading to Nkaikai’s ruins	one stone packed grave Iron age period	Not yet declared.
Phabeni	25 02’ 45.3”S 31 24’ 16.8’E	This site is situated about 50m away from Phabeni reception adjacent to My Acre of Africa’s building to the East	Two graves. Iron age period	Not yet declared.
Paul Kruger Statue	24.98092S 31.48369E	This site is situated next to Paul Kruger gate and Sabie River	president S.J. Kruger statue European history	Not yet declared.
Selati rail line	24.99207S 31.59701E	This site is situated at Skukuza camp over Sabie River	Railway line Bridge European history	Not yet declared.
Huntington House and stables		Situated in Sabie town	Historic house European history	It has been officially declared as Provincial Heritage site
Sudwala Caves		Situated on Lowveld Legogote area on the Lydenburg road	Fossils site	It has been officially declared as Provincial Heritage site
Global Forest paintings		These sites are situated in the property belonging to Global Forest product	Rock art Stone age period Smelting Furnaces. and Slags Iron age period	Not yet declared.

3.8.1.2 Crocodile Catchment

Site Name	Site Co-ordinates:	Site Location	Site Description	Site Declaration
Fihla-Manzi	25 33' 56.7"S 31 58' 08.9"E	Situated on dirt road next to the Hlambanyati spruit.	An inscription or historic mark European history	Not yet declared
General Ben Viljoen attack site	25 39' 58.3"S 31 64' 70.1"E	Situated on dirt road on the Southern banks of the Crocodile River.	Historic mark European history	Not yet declared
Tengamanzi	25 39' 29.6"S 31 67' 99.6'E	Situated on the Northern Banks of Crocodile Bridge.	Historic mark European history	Not yet declared
Hippo pool.	25 36' 69.5"S 31 87' 04.7"E	Situated at Crocodile Bridge Section opposite Hippo pool.	Rock art paintings Stone age period	Not yet declared
Frans De Kuiper attack site	S 25 26' 57.4" E 31 53' 66.7"	Situated on the hill and on a huge granite rock adjacent to the tarred road to Berg-en-dal.	Rock art paintings. Stone age period	Not yet declared
	S 25 46' 26.7 E3149' 21.5"	The hill is situated adjacent to the tarred road to Berg-en-dal rest camp	Rock art site Stone age period	Not yet declared
	S 25 26' 50.7" E 31 53' 62.1"	This stone walling is situated not far from Afsaal and adjacent to the shelter	Stone walling Iron age period	Not yet declared
	S 25 26' 52.5 E 31 53' 60.7"	paintings are situated near Afsaal	Rock art site Stone age period	Not yet declared
	S 25 46' 54.3" E 31 53' 14.0"	Situated about 50m away from the tarred road to Malelane gate.	Hut floors Iron age period	Not yet declared
	S 25 46' 54.5" E 31 53' 15.1"	This site is situated about 200m away from Malelane gate.	Ruins Iron age period	Not yet declared
Stento Mountain	S 25 38' 95.4" E31 44' 13.2"	Situated about relatively flat area.	Rock art Late stone age	Not yet declared

			period	
	S 25.39475 E 31.05928	Situated on the Northern side of Berg-en-dal rest camp about 700m from Matjulu pan.	Cave Iron age period	Not yet declared
	S 25.39475 E 31.05928	situated under a medium-sized granite boulder	Rock art site Stone age period	Not yet declared and open to public
	S25.36229 E 31.34198		Rock art Stone age period	Not yet declared and open to public
	S25.23684 E31.18793	Situated close to and west of the Bushman Trails Camp	Rock art site Stone age period	Not yet declared and open to public
Nsikazi Rock Art		situated in the Bongani Mountain Reserve around Crocodile spoortberge	250 rock art sites Stone age period	Not yet declared and open to public

3.8.1.3 Komati Catchment

Site Name	Site Co-ordinates:	Site Location	Site Description	Site Declaration
Old Stock Exchange		Situated in Barberton.	Historic building European history	The site has been declared as Provincial Heritage Site.
Guard House		Situated in Barberton.	Historic building European history	The site has been declared as Provincial Heritage Site.
ETC Building		Situated in Barberton.	Historic building European history	The site has been declared as Provincial Heritage Site.
		Situated in Carolina	Rock art sites Stone Age period	None of the site is opened to public.
Stopforth			Historic building European history	The site has been declared as Provincial Heritage Site.
Waterval Boven Town		Situated in Waterval boven	Historic Town European History	The town has been declared as Provincial Heritage Site.

Bridge of five arches	In Waterval Boven	Historic Bridge European History	The site has been declared as Provincial Heritage Site.
Krugerhof		Historic House European history	The site has been declared as Provincial Heritage Site.
Elands River Bridge and the 1949 Train Disaster	Situated in Watervalboven	Historic building and Monument	The site has been declared as Provincial Heritage Site.
Blaauboschkraal stone ruins		Stone walling Iron age period	Not yet declared
Makonjwa Mountains	Situated in Barberton	Geological site	In the process to be declared as a World Heritage site.
Samora Michael Monument	Situated in Mbuzini	Monument	The site has now declared as a National Heritage site.
Komatipoort Town	Situated in Komatipoort	Historic town European history	The town has been declared as Provincial Heritage Site.
	Situated in Badplaas	Walling and Rock art paintings Stone age period	Not yet declared
Nzasm Railway Bridge	Situated in Komatipoort	Historic building European history	The bridge has been declared as a Provincial Heritage Site.
Lime Kilns	In Ngondwana	Historic site	Not yet declared
Batwa Site	Situated in Ermelo	Rock art site Stone age period	Not yet declared
Chrissiemeer		Rock art site Stone age period	Not yet declared

3.8.2 The role of Heritage Resources in the general economy of the IWMA

Currently, heritage resources in the IWMA have been incorporated into the conservation and tourism sectors of the economy. It is very difficult to isolate the

impact of Heritage resources in the economy of the IWMA. It is believed that heritage resources, together with the conservation and tourism will continue to play important roles in the economy of the IWMA and Mpumalanga Province in general

3.9 LAND USE

The break down of the 28,757 km^2 surface area of the Inkomati WMA in terms of land use is as follows (DWAF, 2003):

Table 11: Breakdown of land use in the IWMA

Land use	km^2	Percentage of total surface area
Irrigated crops	784	2.7
Commercial afforestation	3,452	12
Indigenous forest	132	0.5
Alien vegetation	1,243	4.3
Nature Reserves	10,128	35.2
Urban areas	19	0.1
Rural settlements	818	2.8

A validation and verification study is currently underway which might significantly alter these figures. Already it has been indicated through preliminary reports of the validation study that irrigation has expanded significantly. DWAF (2007) indicates changes in agricultural land use between 1996 and 2004 and subsequently shows the following land use figures for agricultural land use.

Table 12: Land use classification (area covered)

LAND USE CLASSIFICATION	2004 AREA (ha)	2004 AREA (km^2)
Cash Crop Commercial Irrigated	18,410	184
Cash Crop Emerging Farmer Irrigated	2,064	21
Citrus Commercial Irrigated	29,485	295
Grain Crop Dryland	118,876	1189
Grain Crop Irrigated	4,802	48
Plantation	365,613	3656
Sugar Cane Commercial Irrigated	64,936	649
Sugar Cane Emerging Farmer Irrigated	2,108	21
TOTAL irrigated agriculture	121,805	1218
TOTAL dryland agriculture	118,876	1189
TOTAL plantations	365,613	3656

3.9.1 Mining

Mining in Mpumalanga is primarily related to coal and gold, with the Province accounting for almost 90% of the country's coal production. The mining aspects in the IWMA is however relatively small. Other important mineral resources include chrome, asbestos, magnesite, iron ore, vanadium, limestone, dolomite, and silica and construction materials. Mining is relatively capital intensive – the sector accounts for more than one-fifth of the provincial output, but provides less than 8% of the jobs in whole of the Mpumalanga Province.

Figure 27: Land Use in the IWMA

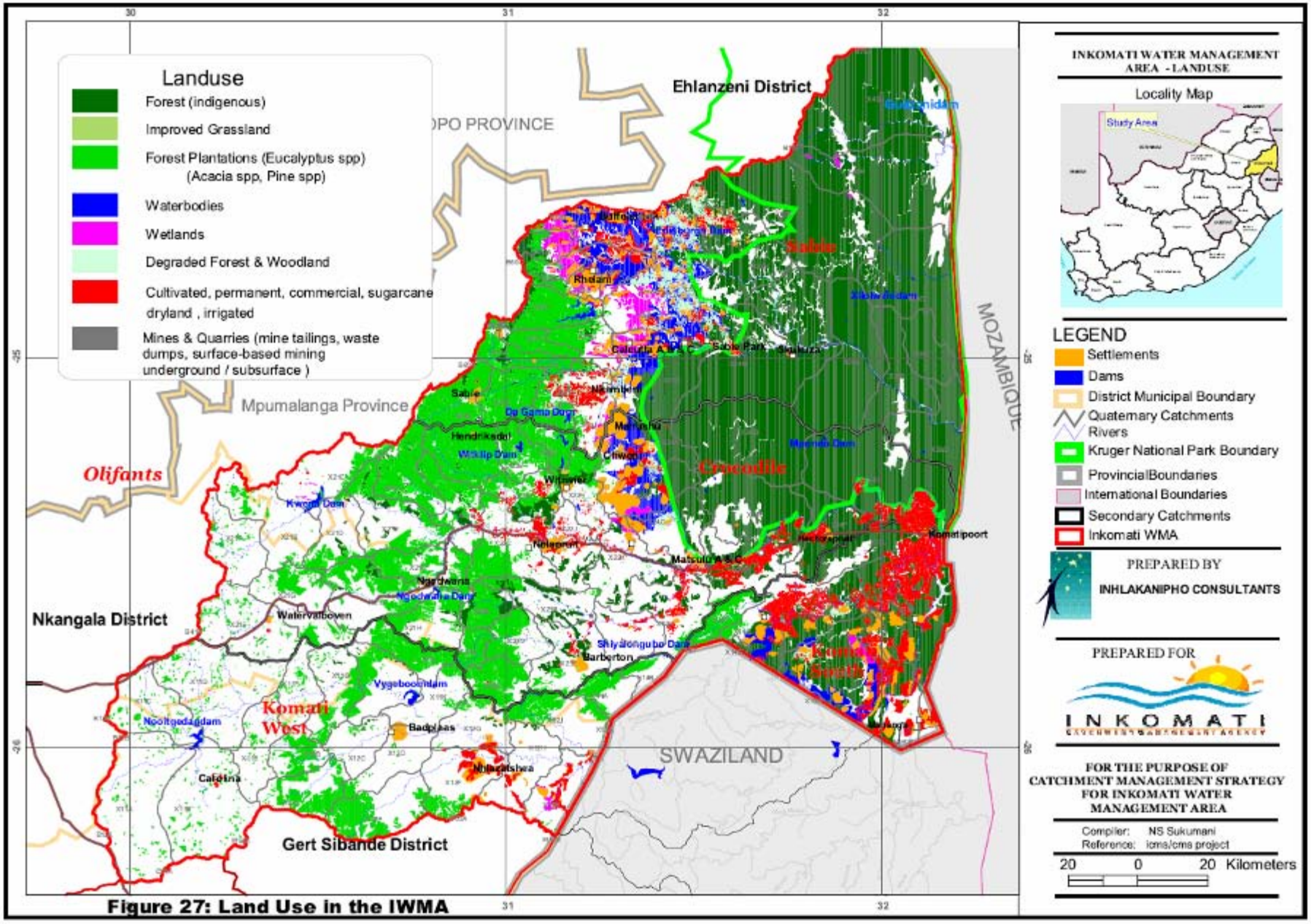


Figure 27: Land Use in the IWMA

3.9.2 Agriculture and Forestry

Another important part of the economy is forestry and agricultural production. Sappi has a large pulp factory in the Crocodile sub-catchment and one-third of South Africa's forestry activity takes place in the Province. 38.3% of the Province's total land area is used for forestry. Grazing land covers a further 39.6% of the Province's total land area. Forestry and other agricultural activities provide jobs far in excess of their contributions to Provincial GGP – the sector comprises 6.1% of total GGP yet provides 18.1% of the employment opportunities in the Province.

The agricultural sector saw a negative annual growth of -0.1% between 1990 and 1996 and grew rather slowly between 1996 and 2002 at only 1%. Despite this limited growth performance, 8 000 jobs were created in the agricultural sector between 1996 and 2001. Although resources in this sector are constrained, agriculture holds significant employment potential for the Province.

3.9.3 Alien vegetation

Alien vegetation covers a reasonable amount of land in the WMA, but the water use figures are more worrying. It is estimated that they use 3300 million m^3/a in the whole of South Africa, according to a study by Le Maitre *et al* (1999). For the Inkomati WMA, the water use by invasive alien plants as estimated by (DWAF, 2004) is as follows;

- Komati West: 7 million m^3/annum
- Lower Komati: 0 million m^3/annum
- Crocodile: 57 million m^3/annum
- Sabie: 24 million m^3/annum
- Sand: 3 million m^3/annum

A total of 91 million m^3/annum of water is used up by alien vegetation in the IWMA.

Acacias, pines, eucalypti and prosopis species and melia azedarachs are among the top ten invading plants, accounting for about 80% of the alien vegetation water use. Alien vegetation usually affects the riparian zone, taking over the riparian vegetation in some cases affecting the biodiversity of the indigenous populations.

3.10 WATER USE

Allocation of water to maintain downstream ecosystems and the livelihoods that depend on them is gradually being recognized as a vital element of sustainable water resource management in the IWMA.

3.10.1 Water uses as described by the NWA in the WMA

Water Use comprises among others; abstraction from the resource; storage; diverting the flow; alteration of the water course; discharge into the resource, and reduction of stream flow. Agriculture (various types), Environment, Entertainment/Sports, Transportation, Mining & Industry and Domestic are the main users identified by DWAF (DWAF 1996). The reserve which comprises the Basic Human Needs (BHNR) and the Ecological Water Requirements (EWR) together referred to as the Reserve

is the only right to water by law in South Africa. All the above mentioned water uses or water users are found in the IWMA. In the Komati sub-catchment, there is a large afforested area, which has a significant impact on the available yield. The other significant water use is irrigation, while domestic water use is very limited. The Crocodile River sub-catchment is dominated by irrigation and forestry. There is an estimated 42 300 ha of irrigation in the catchment and an estimated 1 775 km^2 of exotic forests. These two activities are also the major users of water in the catchment. Industrial water use in the catchment is limited and consists mostly of the Sappi paper mill at Ngodwana and the sugar mills at Malelane and Komatipoort. The Sabie sub-catchment is dominated by irrigation and forestry, although urban requirements are becoming increasingly significant as water services are being provided to what were formerly considered to be rural communities – now considered to be semi-urban (ISP 2004). The Sand River sub-catchment is a relatively dry catchment with limited water resources but a large semi-urban population. The water requirements in the catchment are mostly for domestic use and irrigation.

The position of the Kruger National Park downstream of the Sabie and Crocodile sub-catchments has a major impact on the management of the water resources of this sub-catchment.

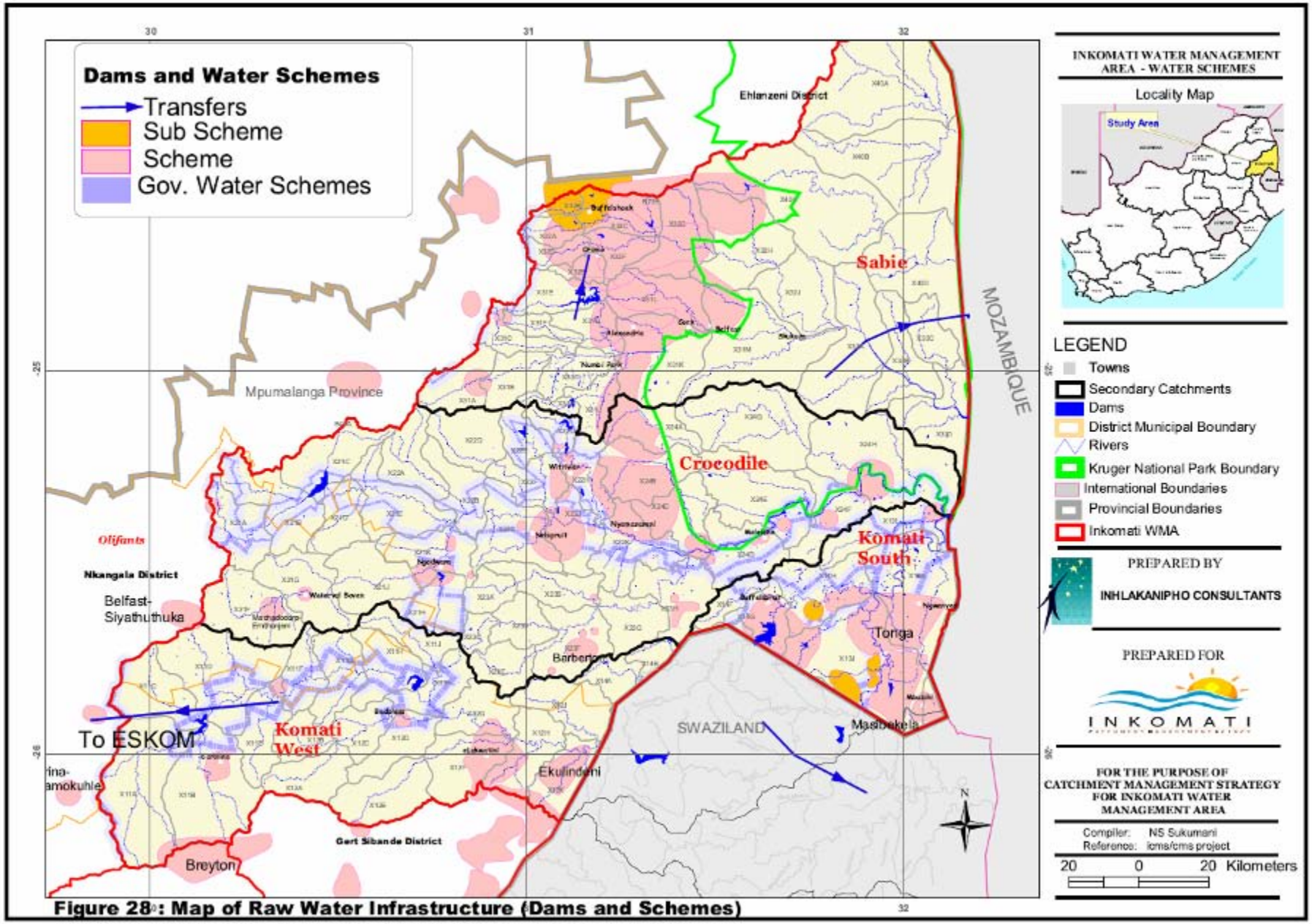
3.10.2 Water resources related infrastructure

This section refers to the infrastructure used to either store raw water or transfer raw water from one area to another for various purposes. Figure 28 gives an overview of the location such infrastructure in the IWMA. Figure 28 also illustrates the various transfers into and out of the Inkomati Water Management Area. The thick blue arrows indicate such transfers. There is an inter WMA transfer: transfer from the Komati East to Eskom in the Olifants WMA. There is also an intra WMA transfer between the Sabie-Sand and the Crocodile sub-catchments. The Crocodile sub-catchment is the “loser” and the Sabie-Sand, the “winner” or the recipient. This transfer serves the people in the Bushbuck Ridge area.

3.10.2.1 Komati-Olifants Transfer Scheme

Eskom’s Komati, Hendrina, Arnot and Duvha power stations are supplied with water from the Komati, from the Nooitgedacht and Vygeboom Dams, and the Gemsbokhoek weir. Limited releases are made from the dams to accommodate direct downstream riparian users.

Figure 28: Map of raw water infrastructure (dams and schemes)



3.10.2.2 Komati-Mbuluze Transfer Scheme

This water transfer scheme is located in Swaziland. Water is diverted from the Komati at the CDC weir, from where it gravitates to consumers. Water is transferred out at an estimated 136 million m^3 per year.

3.10.2.3 Usuthu-Komati Transfer Scheme

The Camden reservoir at the Camden power station (which receives water from the Usuthu WMA) can pump water into the Boesmanspruit – a tributary of the Komati. It can thus augment the Komati sub-system when necessary, to supply Eskom's requirements.

3.10.2.4 Dams as Water Supply Infrastructure

There are quite number dams in the Inkomati Water Management Area. The dams and their capacity have been listed below (see also Figures 28 and 29).

Table 13: Dams in the Komati Catchment

Dam Name	Secondary catchment	Full supply capacity (million m3)	Owner
Nooitgedacht	Komati	78.8	DWAF
Vygeboom	Komati	83.3	DWAF
Sand River	Komati	49	Mhlume Sugar Estate
Driekoppies	Lomati	251	KOBWA
Maguga	Lomati	332	KOBWA
Lomati	Lomati	5.1	
Shiyalongubo	Lomati	2.3	
Masibekela	Mdzabi	9.1	
Mbambiso	Mzinti	10.0	
Turfbult	Ngweti	3.2	
Swartvlei	Mnyeni	2.9	

There are also a number of weirs built in the Komati (for storage and regulation of flow) with, according to DWAF (2003) a combined capacity of 18,9 million m3/annum. However, accurate information is not available (e.g. on siltation) and personal communication quoted in Water for Africa (2007a) estimates the capacity on 16.5 million m^3/annum (for weirs on the Komati between Tonga and Komatipoort). Figure 29 has details of the hydrological gauging stations in the Inkomati WMA.

Table 14: Dams in the Crocodile Catchment

Dam Name	Full supply capacity (million m^3)	Owner
Kwena	159	DWAF
Ngodwana	10.4	Sappi
Witklip	12.3	
Klipkoppie	12.1	
Longmere	4.2	
Barberton	5.1	
Primkop	2.0	

A number of smaller dams, not listed in the table above (Table 14), have a combined capacity of 20 million m^3 per year.

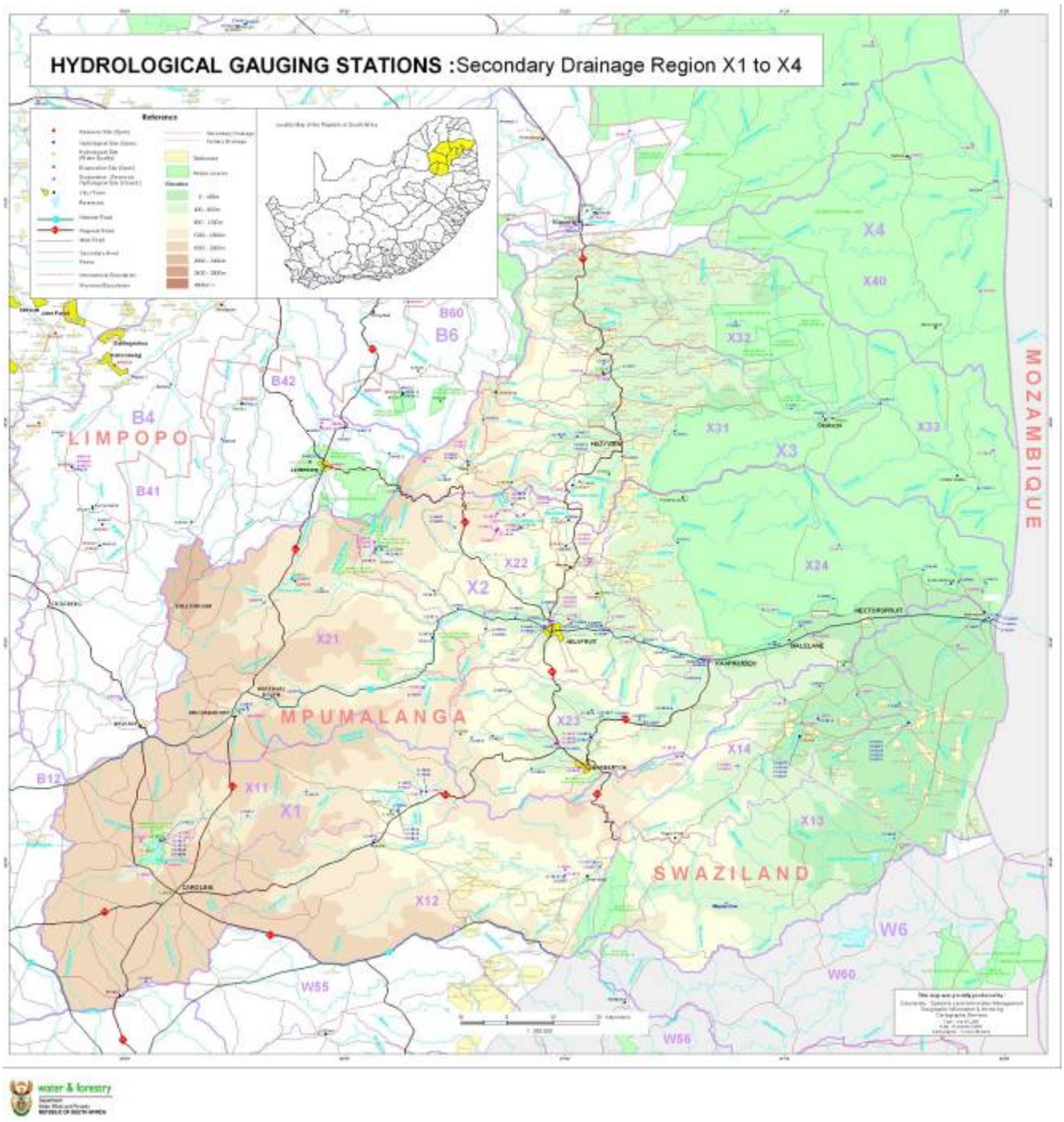
The Sabie-Sand catchment features the following dams:

Table 15: Dams in the Sabie-Sand Catchment

Dam Name	Full supply capacity (million m^3)	Owner
Injaka	159	DWAF
Maritsane	2.1	Sappi
Da Gama	13.6	
Orinoco	1.62	
Edinburgh	2.42	
Kasteel	1.35	

A large number of small dams, located in the Langespruit sub-catchment, have a combined storage capacity of about 6.3 million m^3.

Figure 29: Hydrological gauging structures (obtained from DWAF)



3.10.2.5 Hydropower

A small hydropower station (2 MW) has been built in the middle Lomati River. Water is diverted and returned 6 km downstream. The electricity is used to pump irrigation water. DWAF (2003) has more detailed information on the smaller schemes, pipelines and how certain schemes are supplied.

3.10.2.6 Irrigation Districts

Irrigation Districts as indicated here gives information as to where in the WMA raw water is used for irrigation purposes. This might also give an indication of Water Use Infrastructure in the IWMA. The irrigation areas and their boards are indicated in Figure 30. DWAF (2003) lists the following irrigation districts that have been established in the IWMA:

Komati Catchment

- Komati River Irrigation District
- Kaalrug Irrigation District (on the Mhlambanyathi River)
- Lomati Irrigation District (on the Lomati River)

Crocodile Catchment

- Elands Valley Irrigation District (on the Elands River)
- Crocodile River Major Irrigation District (on the Crocodile River, with 5 sub-districts)
- Friedenheim Irrigation District (Crocodile River)
- Malelane Irrigation District (Crocodile River)
- Tenbosch Irrigation District (Crocodile River)
- Sand River Irrigation District
- Queens River Irrigation District
- Suid Kaap Irrigation District (Kaap River)
- Noord Kaap Irrigation District (Kaap River)
- Eureka Irrigation District (Kaap River)
- Louws Creek Irrigation District (Kaap River)
- Lower Kaap Irrigation District (Kaap River)
- White River Irrigation District
- White River Estates Irrigation District
- White River Valley Irrigation District
- Ranch-Karino Irrigation District (White River)
- Curlews Irrigation District (White River)
- Manchester-Noordwyk Irrigation District (White River)
- Good Hope Irrigation District (White River)

Sabie-Sand Catchment

- Sabie River Irrigation District
- White Waters Major Irrigation District (Sand River, with 3 sub-districts)
- Burgershall Irrigation District (Sand River)
- De Rust Irrigation District (Sand River)

Figure 30: Irrigation Boards and their geographical areas of operation

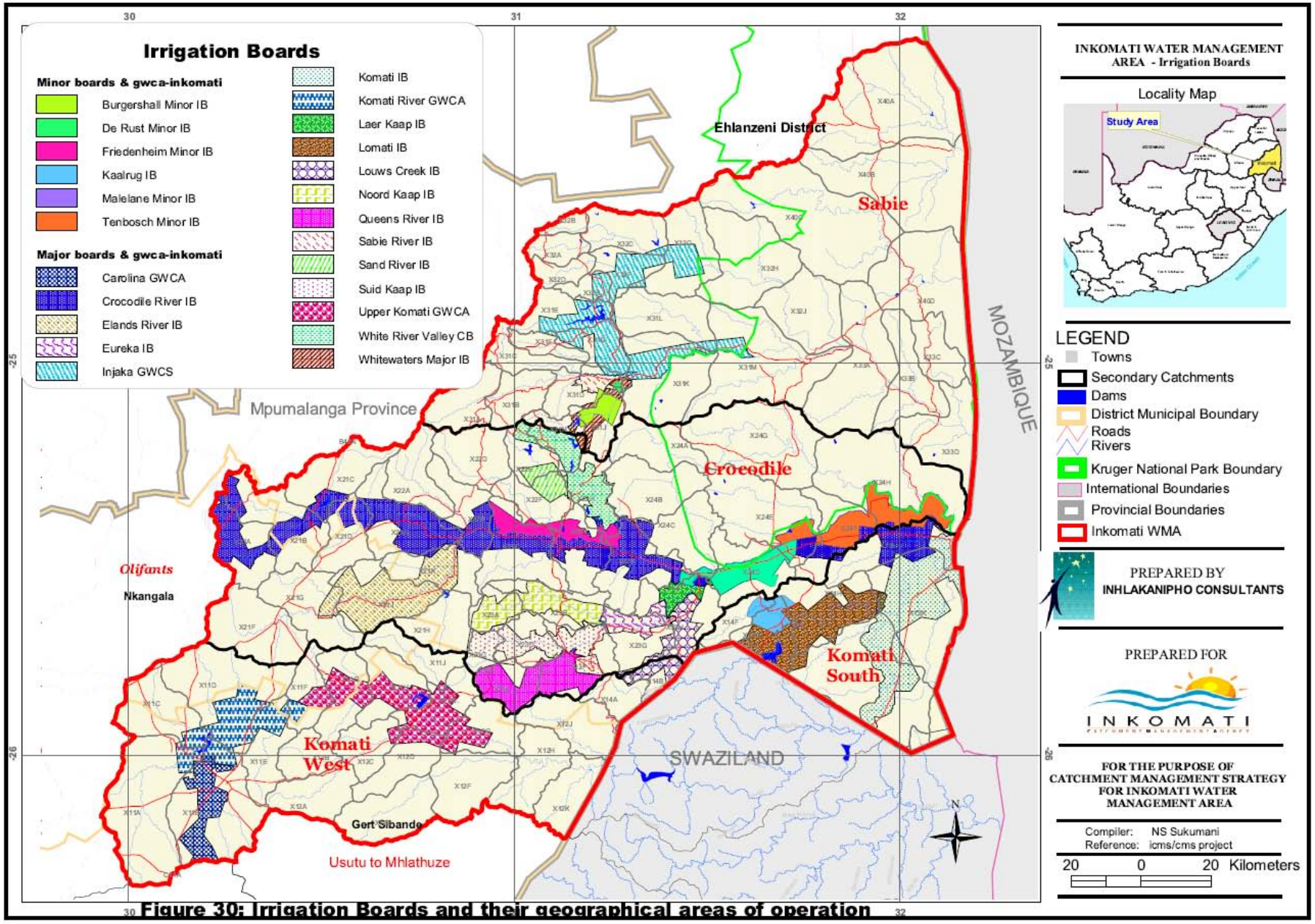


Figure 30: Irrigation Boards and their geographical areas of operation

3.10.2.7 Relationship between the three sub-catchments

There are transfers between the three sub-catchments which are intended for water services purposes. The first significant transfer within the WMA is into the Kaap River catchment from the Lomati River which is mainly for purposes of water supply to the town of Barberton. These transfers have an impact on the available water resources in the Crocodile sub-catchment.

The second transfer which was to be implemented after the completion of the Inyaka Dam and the Bosbokrand Transfer Pipeline, which will enable the transfer up to 25 million m^3/a into the Sand River sub-catchment from the Inyaka Dam. This transfer is to be used to meet the increasing domestic requirements of the area. Eight million m^3/annum of water had always been transferred until the floods in 2000 destroyed some of the mechanical infrastructure. Since then, temporary infrastructure have been installed and used to supply water as far as Bushbuck Ridge.

3.10.3 The Ecological Reserve

The reserve[13] is the only right to water in the South African Water Law. In terms of water allocations, the reserve should be the first to be 'secured' before allocation to other users. An ecosystem may be defined as the interaction of living organisms with the abiotic components. Aquatic ecosystems therefore encompass the aquatic community and water resources necessary to sustain its ecological integrity. The aquatic ecosystem is very important in the functioning of our socio-economic life. The Reserve refers to both quantity and quality of the resource. Accordingly, development must take cognizance not only of sensitivity of the receiving ecosystem but also of the resource requirements or Ecological Reserve of the aquatic communities it supports.

Currently, the Ecological Reserve and the Basic Human Needs Reserve (BHNR) have not officially been established for the greater part of the IWMA. A preliminary study of the Komati catchment was conducted, and a comprehensive study for the Crocodile is currently underway. Much work was done in the Sabie/Sand catchment, but this was never signed off. The official reserve determination (which includes public participation) is scheduled to start in September 2007 and end in April 2009.

Reserve determination is a complex project which involves scientific (including environmental considerations), social and economic parameters in a given catchment. The methodology is explained in detail in DWAF (2007a). The methodology looks at the Ecological Importance and Sensitivity (EIS), and the Present Ecological State (PES). It then compares the EIS and the PES and makes a judgment on whether or not it is important and/or realistic to improve conditions, based on which (realistically-attainable) Ecological Categories (ECs) would be set. The methodology, the Eco-Classification process, is based on Kleinhans *et al* (2005). These methods have been used (mainly desktop) and the Ecological Reserve Requirements (ERR) as indicated in the Internal Strategic Perspective (ISP) are tabled below.

[13] The reserve refers to the Basic Human Needs and the Ecological Water Requirements

Table 16: Ecological Reserve Requirements per sub-catchment, based on the Internal Strategic Perspective (DWAF, 2004)

Sub-catchment	Water requirements for the Ecological Reserve (million m^3/year)
Komati	76
Crocodile	105
Sabie-Sand	130
Total	**308**

In the absence of the reserve, In-stream Flow Requirements (IFRs) were determined for the rivers in the IWMA, mainly for the Sabie-Sand and the Crocodile because of the Kruger National Park. The values which were mainly for the water quantity are provided in Appendix A.

When the ecological water requirements have not been determined, it is always difficult to obtain Resource Quality Objectives to manage the water quality of the resources. In the Crocodile sub-catchments of the Inkomati Water Management Area, a Catchment Forum which comprises major stakeholders in the Catchment has set Water Quality Objectives (WQOs) to use as guidelines for the management of the water quality in the Crocodile Catchment. The Crocodile Catchment has been divided into Management Units (MU). The Management Units have been indicated in Figure 15. See section 3.5.1.3 for the WQOs for the Crocodile Catchment.

Unfortunately, the other sub-catchments (Komati and Sabie-Sand) do not yet have effective Catchment Forums, so there are no WQOs available (set by the Catchment Forums).

3.10.4 Impact of the water use on ecological systems

Based on the different water uses, various impacts on the ecological integrity of the river stretches could be described as high or low. DWAF (2007a) lists the following river stretches of concern (i.e. high Ecological Importance and Sensitivity, or low Present Ecological Status):

3.10.4.1 Komati River Catchment

High EIS:

- The Komati River for 5 quarternary catchments
- The Teespruit and Mtsoli

- The Komati downstream of the Teespruit to the Swaziland border
- The Lower Lomati River

Low PES:

- Lower sections of the Komati River (PES below D[14]), due to landuse management and catchment degradation.
-

3.10.4.2 Crocodile River Catchment

High EIS:

- The Alexanderspruit
- The Elands River (excluding the upper quarternary)
- The Ngodwana River
- Quarternaries in the Nels River, Queens River and Suid Kaap River.

None of the river stretches fall below a PES of D.

3.10.4.3 Sabie-Sand River Catchment

High EIS

- The Sabie River
- The Mac Mac River
- The Motitsi River
- The Marite River
- The Upper and Lower Sand River in conservation areas
- A stretch of the Mutlumuvi River
- The Nwarehle River

Low PES:

- The Saringa River (PES is E)

According to DWAF (2007a) ecological hotspots, based on the EIS and PES findings, as listed above, together with an assessment of water stress in these ecological hotspots led to recommendations of the level of the Reserve determination required (i.e. desktop, rapid, intermediate or comprehensive).

3.11 WATER DEMAND ANALYSIS

3.11.1 Water Balance in the IWMA

Information in this section is based on recent and ongoing studies. They include the validation of water use in the Nkomati, Crocodile (east) and Sabie river catchments, and the assessment of the current water use status in the Inkomati WMA (conducted as part of the Water Allocation Reform process, and the Water Availability Assessment Study.

[14] PES is set based on how much conditions have changed from natural conditions. A represents largely natural and F critically modified.

The water balance reflects the difference between total amount of water available in the IWMA and the demand for the resource in the IWMA. In this section the total available water will be given (based on the Mean Annual Runoff, MAR, and groundwater), after which water allocations will be identified that are 'fixed', i.e. they relate to obligations that have to be met. This includes international obligations, water for strategic use (e.g. power generation), the Ecological Reserve and the Basic Human Needs Reserve. Based on these figures, the available water for other uses will be given, water requirements will be identified and finally a water balance given.

3.11.1.1 Natural water yield and total available water

The Komati, Crocodile and the Sabie catchments all encompass areas of high rainfall and steep topography, and most of the surface runoff originates from these areas. The Sand River and the Massintonto and Nwanetsi Rivers catchments have less favourable natural characteristics, resulting in intermittent and seasonal flows only. Reduction in natural runoff is mainly caused by vast commercial plantations, invasive alien vegetation (which covers an equivalent of about 132,000 ha of the IWMA). The impacts of afforestation and alien vegetation (i.t.o. runoff reduction) are approximately 480 million m^3 and 240 million m^3 respectively (DWAF, 2003a).

The total available water, as a function of the Mean Annual Runoff, is estimated to be 3,539 million m3/a. However, the total available water is not all available for allocation, or for consumptive use of licensed users. First of all, river losses, alien vegetation, rain-fed agriculture and urban run-off impact on the total amount of water that can actually be allocated to users. Secondly, water has been earmarked to satisfy strategic water use, to meet international obligations, or to meet the Ecological Reserve and the Basic Human Needs Reserve – and is not to be used for any other use. The amounts of water for these uses are determined by the Department of Water Affairs and Forestry (DWAF) and decisions on these water uses will never be the responsibility of the CMA (i.e. they will never be delegated).

The determinations of the Ecological Reserve and the Basic Human Needs Reserve (BHNR), and of international obligations, are an important component in determining allocable water, and has been dealt with in more detail in a previous chapter. It is not possible to give EWRs in a simple way (i.e. m3/a), since they relate mainly to separate river stretches, and not to one amount as a whole. In terms of international obligations, minimum flows required at the Mozambique border have been specified (expressed as impacts on the 1:50 year yield) and can be found in section.

3.11.1.2 Water yield: groundwater and surface water

The most recent figures of available water as extracted from DWAF (2007) are given in Table 17.

Table 17: Water yield in the IWMA

	Available water for allocation in million m^3/a (2004)[15]			
Sub-catchment	**Surface water[16]**	**Groundwater**	**Transfers in**	**Total available**
Upper Komati	118	1.4	0	119.4
Lower Komati	259	9.1	39	307.1
Crocodile	252	8.4	12	272.4
Sabie-Sand	159	0	2.7	161.7
Total	**788**	**18.9**	**53.7**	**860.6**

Surface water provides for 92% of the available water in the IWMA. Currently, very little seems to be known about groundwater availability in the IWMA. Some studies are ongoing and it is suggested that these figures be updated in the next review session.

3.11.1.3 Water Requirements

Water requirements in the IWMA as indicated in DWAF (2007) are as follows;

Table 18: Water requirements by different water users in IWMA

Category	Water requirements (million m^3/a)	Percentage of total	National average
Irrigation	1,369	83%	59%
Transfers out (mainly for power)	126	7.7%	
Afforestation	114	6.9%	3.67%
Urban	31	2.0%	25.1%
Mining/industrial	4	<1%	5.7%
Rural (domestic use)	3	<1%	4.3%
Total	**1 647**	**100%**	**100%**

It is clear that irrigated agriculture requires more water in the Inkomati WMA than it does on a national average. Urban, rural and mining requirements are far lower than the national average. As mentioned earlier, other requirements that exist in the catchment, and that actually take legal precedence over any other water use, are water for the Reserve (the Basic Human Needs Reserve and the Ecological Reserve) and water to meet international obligations (to Swaziland and Mozambique).

[15] This excludes the Ecological Reserve and international obligations

However, for the purpose of establishing a water balance (for allocable water), these amounts have already been subtracted from the available (allocable) water and will therefore not be specified further.

3.11.1.4 The water balance

The current water balance (as in 2004, DWAF, 2007) is given in the table below, per sub-catchment.

Table 19: The water balance in the IWMA

Sub-catchment	Total available	Water requirements	Surplus (Deficit)
Komati	426.5	883*	(456.3)
Crocodile	273	664*	(391)
Sabie-Sand	162	101	61
Total	861	1 648	(786.3)

** includes transfers out of the catchment, as well as afforestation*

The combined water requirements in the three subcatchments are higher than the available water so infrastructure to increase the yield in the three subcatchments has been proposed. The proposed development indicates the seriousness with which the people in the IWMA need the resource.

Proposed dam sites in the Komati sub-catchment include:

- Boekenhoutrand (Komati)
- Hooggenoeg (Komati)
- Silingane (Komati)
- Tonga (Komati)
- Boesmanskop (Teespruit
- Gomba (Lomati)
- Ngonini (Lomati)
- Vlakbult (Lomati)

Proposed dam sites on the Crocodile and Sabie-Sand are;

- Montrose (Crocodile River)
- Mountain View (Kaap River, tributary of the Crocodile River)

New Forest (Mutlumuvi River, tributary of the Sabie River).

3.11.1.5 Water allocations and the actual usage

It is very important not to confuse water allocations (as specified above) with actual water use. Because if one looks at the water balance, it would seem there would not be a drop of water in the river system anymore! DWAF (2007) explains this, and makes the following points:

- Allocations are based on maximum demand, and are calculated taking into account factors such as the irrigation allocation based on a dry year, the entire area irrigated and crops which require the most water. This "worst case scenario" however, might not always apply. Sometimes it is as simple as the rainfall being more than average in a specific year.
- Even if all factors above are fully optimised, allocated amounts may still be in excess of what can actually be used.
- Actual water use may actually also exceeds the amount of water allocated (generally this would constitute illegal water use).

Also other reasons for water still being available for abstraction are:

- Users are accessing the Ecological Reserve, i.e. they are using water that is actually earmarked for the environment.
- South Africa may not be meeting its international obligations to provide agreed flows to Mozambique and Swaziland.
- Some irrigators might have improved their water use efficiency, which was not taken into account in the DWAF (2007) study.

The Department of Water Affairs and Forestry (DWAF) has subsequently instituted a study dubbed "validation and verification study". Validation involves determining the actual water use in the area (through satellite imagery, direct observation, etc.) and verification entails comparing this water use to the registered water use (water use on DWAF's WARMS system, and water use that was lawful under the previous legislation).

3.11.1.6 Water allocation per sectors (DWAF 2006)

The water available to support current economic activities has been fully allocated in most of the Inkomati WMA catchments, with the exception of the Sabie River catchment The sparsely populated nature of the WMA is underlined by the relative insignificance of the urban water requirement, which at 2% is far below the national average of 25.1%. Even the rural water allocation, at less than 1% of the total requirement, falls below the national average of 4.3%, due to the predominance of highly mechanised large-scale commercial agriculture as well as the presence of the unpopulated KNP in the WMA. For similar reasons, the water allocation to the mining and industrial sector is also below the national average of 5.7%, standing as it does at less than 1% of the WMA's total water requirement.

Table 20: Water requirements/allocation by sector in the Inkomati WMA in 2004

Category	Water Requirements (million m3/a)	Percentage of Total	National Average
Irrigation	1 369	83%	**59%**
Transfers out	126	7.7%	
Afforestation	114	6.9%	**3.67%**
Urban	31	2.0%	**25.1%**
Mining/industrial	4	<1%	**5.7%**
Rural (domestic use)	3	<1%	**4.3%**
Total	**1 647**	100%	**100%**

3.11.1.7 Operating rules

Operating rules are set up to ensure that releases from impoundments are managed to the benefit of all stakeholders. The operating rules for the Inkomati Basin are complicated (especially in the Komati sub-catchment), since three countries (South Africa, Swaziland and Mozambique) are involved in the management of the rivers. Legislation and institutional arrangements in this regard have been outlined in section 4 of this report. A short summary of how some of the dams and weirs are being operated will be given below, but it is highly recommended to use the draft report that is being developed under the Water Allocation Reform project as a more definite reference (Water for Africa, 2007a).

In terms of specific operating rules, two trigger mechanisms are used to control transfer volumes and timing. Firstly, "trigger levels" in dams are used to control when transfers should start and stop, either to prevent a dam from spilling or to reserve water for use by local or different users. Secondly, short-term yield capability of subsystems guides operation of infrastructure. Here, short-term yields and demand balances of subsystems should indicate - when the balance is negative - when a subsystem requires support from another subsystem. The yields and balances are based on stochastic[17] short-term yield characteristic curves for each subsystem.

How these mechanisms operate in practice in the Inkomati WMA is described in more detail in Water for Africa (2007a). Operating rules for the Upper Komati are mainly captured in the Operating Rules report prepared as part of the Komati Reserve

[17] statistics involving or subject to probabilistic behaviour

Determination. Also, the Tripartite Technical Committee set up the Inkomati System Operation Task group (ISOTG) to recommend operating rules.

Komati sub-catchment

The Komati transfer scheme transfers water to power stations in the Olifants WMA. An allocation of 132 million m^3/yr is reserved for this purpose, but in reality the actual volume of water transferred is always less. Water is transferred from the Usuthu into the Nooitgedacht Dam: the maximum that can be transferred, based on infrastructure, is 60 million m3/yr. Imported volume is estimated at 40 million m3/yr. Specific operating rules for dams and diversion works are as follows:

Upper Komati

- Nooitgedacht Dam: stores 133% of the MAR. The dam is managed in such a way that very little water is released, and for most of the time no releases at all are being made. New valves were installed in 2003 and it is anticipated these will release up to 150 l/s on a constant basis. Eskom is responsible for operation and maintenance of the dam, the pump stations and the pipelines that transfer water to the power stations.
- Vygeboom Dam: the only flows downstream are overflows from the weir. No compensation releases are being made.
- Gladdespruit and Poponyane River diversions: these augment flows into the Vygeboom Dam. Most of the time the total flow of the Gladdespruit is diverted. Generally, no releases are made to the lower reaches of the Gladdespruit or Poponyane Rivers.

Upper Lomati

- Lomati Dam: an estimated 3 million m^3/yr is transferred from the dam into the adjacent Kaap / Crocodile catchment.
- Shiyalongubo Dam: an estimated 4 million m^3/yr is transferred from the dam into the adjacent Kaap / Crocodile catchment.

Swaziland and Lower Komati

- Maguga Dam: supplies downstream irrigated agriculture and a hydropower generation plant is currently being installed. Controlled releases are generally less than 15 m^3/s. The dam is predicted to be drawn down to dead storage every 4 to 8 years, and at times can remain at these levels for up to 3 years.
- IYSIS Weir: managed by Mhlume Water who abstracts water according to a regime approved under the Swaziland Water Act of 1967. This is a problem since the Act is not compatible with current operating rules. Based on the maximum capacity, the weir is able to divert the entire flow of the Komati River. Previous permits allowed abstraction of 85% of the arriving flow – which is not in line with cross-border release obligations.
- Sand River Dam: privately owned, not managed to improve yields of the system as a whole. It does have the capacity to increase system yield in conjunction with Maguga and Driekoppies Dam. It is essentially an off-channel dam, receiving most of its water from the YISIS Weir and provides peak irrigation water requirements.

- Masibekela Dam: an off-channel storage dam which makes releases for irrigation.

(Lower) Lomati

- Driekoppies Dam: purpose of the dam is to provide for the increase in primary water demand, increase in the assurance of supply to irrigators downstream of the dam and allow for moderate increase in irrigation development.
- Weirs: a lot of weirs were built on the Lower Komati and Lomati Rivers after severe water shortages in 1984 and 1992. Most of them were built by the Komati River Irrigation Board, the Lomati Irrigation Boards and the Nkomazi Expansion Project. The weirs have become largely redundant for yield improvement (since the completion of Maguga and Driekoppies Dams) but they remain important to provide adequate suction conditions, reduce flow regulation response times and as part of the pump abstraction infrastructure. A problem however, is that most weirs do not have adequate outlet discharge capacities, which especially poses problems during low-flow periods (when it becomes difficult to meet downstream requirements and international obligations). KOBWA recently issued requirements that all weirs should be maintained full so that requirements for flow passage for downstream requirements are not affected (once a weir draws down, it takes quite a lot of water to recharge them, affecting downstream users). Though management issues are largely addressed this way, inundation of riverine habitats is significant.

To address the problem of over abstraction, the Komati Irrigation Board has installed a Water Allocation Metering System (WAMS) – abstraction pumps are calibrated and they automatically stop working once the weekly allocation has been pumped. The system was badly damaged in the floods of 2000 but most of it has been repaired. New development areas upstream of Tonga are still to be included in the system.

3.11.1.8 Crocodile sub-catchment

- Two small schemes transfer water from the Lomati into the upper Kaap River catchment. The Lomati Dam transfers water for domestic use by Barberton and water use by mines. Approximately 2.8 million m^3/annum is transferred. The Shiyalongubo Dam on the Shiyalongubo River transfers an estimated 4 million m^3/annum to the Kaap River Catchment and is operated by the Louw's Creek Irrigation Board. Water from the Crocodile River near Nelspruit is being pumped to the Primkop Dam, to supplement the yield of this dam. Water can only be pumped into the dam when storage is less than 50%.
- Kwena Dam: operation centres on the irrigation sector. Decisions on water supply to users are made in May of every year. DWAF's operating policy is to supply water at a very high level of assurance. Another rule however, is also that the Kwena Dam only supplements the supply to irrigators: first they make use of run-of-river water. Operation is complicated due to the delays with which water reaches users (up to 2 weeks for users in the lower reaches). The irrigation board assists in day to day management of releases. Based on dam levels, allocation restrictions are made, and day to day decisions on irrigations abstractions are made on the basis of a model that also takes into account inflows from the

Elands River, flow at Montrose, Karino, Riverside and Komatipoort. When river flow is less than the irrigation demand, pumping hours are restricted. However, it is suspected that many farmers have larger pumps than required to meet their allocation – and are thus abstracting more than their volumetric allocation.

- Other dams: other dams in the catchment supply directly to users and there are no complicated operating rules.
- Abstractions by irrigation boards: amounts and abstraction rules are generally determined by using an irrigation model. This model takes crops grown, month of the year and rainfall into account (crop requirements are calculated, and any rainfall is subtracted, leaving the amount needed through irrigation). However, irrigation boards determine their abstraction simply by crop area and application rate (in m^3/ha). It seems that they do not necessarily cease abstraction when it rains, but simply pump their allocation into off-channel storage.

3.11.1.9 Sabie-Sand sub-catchment

The Sabie-Sand sub-catchment does not have any complex operating rules related to meeting international obligations. This is because ecological requirements from the Sabie River are high (it flows through the Kruger National Park) and these flows satisfy international requirements.

Transfers only take place within the sub-catchment: from the Inyaka Dam in the Sabie River to the Sand River. This water supplies towns and villages, and it also fulfils the Sand ecological requirements.

Inyaka Dam: the main reason for constructing the dam was to ensure sustainable flow to the Kruger National Park. A complex operating procedure was developed which has been documented in a suite of reports by DWAF ("Sabie River Catchment: Operating Rules and Decision Support Models for Management of the Surface Water Resources", 2003).

3.12 WATER CONSERVATION AND DEMAND MANAGEMENT

Water Demand Management (WDM) is defined as: The adaptation and implementation of a strategy or a programme by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services and political acceptability.

On the other hand, Water Conservation is defined as: The minimization of loss or waste, the care and protection of water resources and the efficient and effective use thereof.

A project is currently underway to look at feasible Water Conservation and Demand Management (WCDM) measures, focusing on agriculture, water services and mining/industrial users. One of the first outputs is an assessment of the current situation. For the purpose of this study however, a report developed under the Water Allocation Reform process has been consulted, mainly indicating WCDM potential. It is anticipated that the WCDM project when completed will provide more detailed information.

Irrigated agriculture in the Inkomati consists of 78% sprinkler irrigation, 19% drip irrigation and a very small amount flood irrigation (probably only in the Sand River catchment). With average system efficiencies of 0.70 for sprinkler systems, 0.85 for micro-systems and 0.50 for flood irrigation, the overall system efficiency comes down to 0.72. This is regarded as high irrigation efficiency, but it needs to be noted that these are not actual measured efficiencies in the catchment.

Conveyance efficiency calculations though, indicate that the existing conveyance infrastructure (canals etc.) is only 30 to 55%. This low level of efficiency is due to the condition of the canal systems. Preliminary investigations suggest that conveyance efficiency could be improved to 70%, resulting in potential water savings of 205 million m^3/annum. Switching from flood irrigation to other systems such as centre pivot systems would save another 8 million m^3/a.

The main industries in the Inkomati WMA are the Sappi paper mill at Ngodwana and the Tsb sugar mills in the Lower Komati at Malelane. The Ngodwana mill uses 10 million m^3/annum, which is abstracted from the Ngodwana Dam. The Tab sugar mills are estimated to use 13 million m^3/annum – at the Komati sugar mill and the Malelane sugar mill.

Opportunities to improve water use efficiencies are limited for the industrial sector, mainly because of the state-of-the-art technologies already being applied. An example is seen in the Ngodwana mill which is one of the most modern pulp and paper mills in the world. It only discharges one-tenth as much effluent as the international average for mills the same size. Also, this effluent is not discharged into the river, but used for irrigation purpose. However, this irrigation is causing water quality problems (through leaching of salts), so there is an opportunity for the ICMA to improve water quality.

In terms of domestic water use, the current water use status report indicates that demand in the Inkomati WMA is about 34 million m^3/annum. However, this might be underestimated, seeing that Nelspruit alone already has an allocation of 64 million m^3/annum from the Kwena Dam. Average per capita consumption is 100 l/c/d – which are considered high for an area in which many households have standpipes or yard connections. Unaccounted for water for the province (Mpumalanga) are estimated in the region of 55%.

In general, monetary returns on increased water use efficiency can be high: with the correct measures, enough water could be saved to ensure non-agricultural water demand for the next 20 years, with these measures being much cheaper than developing additional storage capacity (dams). Also, ecologically, water use efficiency will contribute towards meeting the Ecological Reserve.

3.13 WATER RESOURCES MANAGEMENT CAPACITY

The Department of Water Affairs and Forestry (DWAF) and the ICMA are the main water resources management institutions in the IWMA currently. Their capacity needs depend largely on the tasks that they need to perform. In this regard, there is a shift of more responsibilities to the ICMA, away from DWAF. As a result, the ICMA is undertaking staffing arrangements, whereas

DWAF is anticipating (and implementing) downscaling. The extent of capacity gaps and skills shortages will be informed by the eventual strategies developed under the CMS and the responsibilities transferred from DWAF (the Minister) to the ICMA.

Development and land use planning is dependent on the capacity of provincial government and district municipalities. It is known that there are limited in-house technical skills and capacity at this level, though the extent has not been exactly quantified (DWAF, 2007). Though a lot of this technical work is therefore outsourced to external service providers, it is essential that provincial government and district municipalities continue giving strategic guidance.

Support to emerging farmers is limited, since government agricultural extension and
Marketing boards ceased to exist in the 1990s. There is no direct government support to emerging farmers around water use (other than financial subsidies for infrastructure development). TSB Sugar Ltd has support strategies in place for emerging farmers, assisting them in accessing markets, management support and financial structures to enable farmers to access land.

3.14 WATER SERVICES

According to the National Strategic Framework for Water Services, Water Services generally refers to water supply and sanitation services and include regional water schemes, local water schemes, on-site sanitation and the collection and treatment of wastewater. Water services are provided to domestic consumers, institutions, businesses and industries. As much as it is imperative that universal access to water services by households is ensured to at least a basic level of service; the provision of effective and efficient services to meet economic demands for all consumers (domestic and non-domestic) is equally important and must be taken into consideration.

The ICMA is responsible for water resources management. The role of a CMA is to investigate and advise interested persons on the management of the water resources in the water management area, coordinate the functions of other institutions involved in water-related matters (such as local government) , and to involve local communities in the management of the water resources. The CMS is meant to set out the framework for managing water resources within that specific area and the principles for allocating water to existing and prospective water users, including water for domestic use as a basic human right and will also have to align with key programmes of government, particularly in support of job creation, hence contributing to the WMA's economy.

It is then very important that the relationship between the ICMA and the municipalities in the WMA be maintained, to sustain interaction. CMAs have no function in the provision of water services, but they can be a means to effective provision of the service by local government, as municipal IDPs will need to be aligned with their WSDPs and the CMS. Local government needs to understand its obligation towards IWRM, more especially in relation to water conservation, demand and quality management. Sustainability is water services provision will increase the credibility of the CMA, as the general community's buy-in in water resources management can only be attained by sustained services provision.

Local government (municipalities authorised as the water services authority) is constitutionally obliged to ensure water services delivery to residential consumers. Municipalities may also supply water for industrial use. The two aspects are regulated by two separate pieces of legislation (the National Water Act, 1998 and the Water Services Act, 1997). Under the National Water Act, local government is regulated as a "water user". It can get its water directly from source by way of a license, or it can purchase bulk water from a water board or other institutions.

In the IWMA, local government uses approximately 6% of the water requirement for urban and it is estimated that rural (under local government and interfacing with tribal authorities) requires 2% of the yield. This must be contrasted with irrigation which has 83% of the requirement. The objectives of using water for growth and development must be borne in mind, as well as the objectives of alleviating poverty, job creation and broad-based black economic empowerment.

The ICMA must be clear on its roles and responsibilities in regard to resources, and how this impacts on both water services and the social and economic development of the IWMA. Although constitutionally, local government is obliged to ensure water services delivery, if people are not being serviced, the ICMA has a social duty to understand why. The legal mandate of the ICMA will be to manage the water resources so that the local government can plan to deliver services.

There is currently a big impact of the Water Services on the Water Resource. Pollution of the rivers by untreated or semi treated sewage has raised alarm in the IWMA. The problem of funds and capacity has been cited as causes for this problem. If left unattended to (immediately), grave consequences are envisaged.

The reserve is a very contentious issue in the IWMA. Providing water for the environment is necessary to ensure ecosystem integrity, productivity and long term sustainability. Healthy water dependent ecosystems contribute to the health of the water resources that sustain our industries and the community's economic, social and environmental values. The various forums in the Catchment are advised to educate the stakeholders on this issue to ensure smooth implementation as the reserve is the only right to water in the country.

3.14.1 Legislation (Including Policies and Plans) impacting on Water Services

Section 2.2 of this document deals with all the laws and legislations that impact on IWRM including laws impacting on general Water Services. This section specifically deals with Local Government related legislations. Local Government is constitutionally responsible for ensuring service delivery. This is interpreted to mean the retail municipal service of the supply chain – (i.e.) accessing and if necessary treating and then reticulating potable water; and receiving and treating waste water and sewage. These activities are regulated by the Water Services Act, 108 of 1997 (as distinct from the National Water Act, 36 of 1998 dealing with water resources issues).

3.14.1.1 Municipal Acts

The Municipal Structures Act, 1998, the Municipal Systems Act, 2000 and the Municipal Finance Management Act 2003 are sector specific Acts that regulates the Water Services and Local Government Operations. The Systems Act obliges the development of Integrated Development Plans (IDPs) through a consultative process, which documents must be developmentally orientated and set out the vision and strategic plans and policy frameworks on which budgets must be based for municipalities for 5 year periods. It also informs the Spatial Development Plans.

3.14.1.2 Local Government Development Plans

The Water Services Act prescribes the requirements for the Water Services Development Plan. This is regarded as the sector specific chapter of the IDP. In particular, section 13 of the Water Services Act requires the WSDP to address the status quo, a 5 year implementation programme, future projections around water use and infrastructure needs, and existing and proposed water conservation, recycling and environmental measures. These, together with the obligations in the Municipal Finance Management Act to deliver services effectively and efficiently, are important obligations of local government which directly affect the activities and plans of the ICMA.

3.14.2 Water Service Institutions in the IWMA

- **Department of Water Affairs and Forestry (DWAF)** is responsible for sector policy, support and regulation. DWAF currently operates water resource infrastructure (such as dams), some bulk water supply schemes and some retail infrastructure (providing services directly to consumers) although in line with the National Joint Transfer Policy. DWAF water services assets are currently in the process of being transferred to water services authorities. Mbombela, Nkomazi and Albert Luthuli local municipalities have already taken transfer of all DWAF water services assets, while Bushbuckridge is in the process of taken over the transfers of the water services assets which were previously transferred to the Bohlabela District Municipality.
- The Department of Provincial and Local Government regulates and oversees the activities of local government. Other national government departments and provincial governments also play an important role in supporting the water services sector.

- **Water Services Authorities** are responsible for ensuring provision of water services within their area of jurisdiction.
    - There are 8 local municipalities in the IWMA which are all Water services authorities.

- **Water Services Providers** are responsible for operating some water resource infrastructure, bulk potable water supply schemes (selling to municipalities and industries), some retail water infrastructure and some wastewater systems.
    - Most services are provided by the WSAs themselves through internal departmental WSP structures
    - The Local Municipalities are also water service providers in some of their own areas of jurisdiction. Mention them and explain how they operate

- There is currently one water board operating in the catchment; the Bushbuckridge Water board which operates mainly in the Bushbuckridge Local municipality and some parts of the Mbombela Local municipality
- Silulumanzi (Pty) Ltd is a water services provider in the greater Nelspruit area which is currently the second long-term concession in the country with a privately owned company

- **The Kruger National Park**

The Kruger National Park is an organisation of its own and has all the capacity to supply water to the residents as well as tourists in all the camps of the 20 000 km^2 eco-tourism centre. It is a District Management Area falling under the jurisdiction of Ehlanzeni DM.

- **Community-based organisations** manage some small water schemes in rural areas.

3.14.3 Water Services Authorities (powers and functions)

Water services authorities have the constitutional responsibility for planning, ensuring access to, and regulating provision of water services within their area of jurisdiction. They may provide water services themselves and/or contract external water services providers to undertake the provision function on their behalf. In such cases WSPs assume operational responsibility for providing water and/or sanitation services. In cases where water services authorities undertake any of these services themselves, they are a water services
provider.

Water services authorities are responsible for securing from DWAF (or CMAs where they are established and where this function is delegated) licences to abstract water from, and to discharge wastewater to, the water resource. (Regional water services providers secure licences directly from DWAF or CMAs.). Water services authorities may regulate the provision of water services within their local area through by-laws and contracts. They may delegate the responsibility for obtaining licences through contracts.

The contracting of water services provision functions, whether bulk or retail by a WSA to a WSP does not relinquish the WSA's constitutional responsibility. This will include functions of the WSA to manage the delegated WSP's functions as per their service delivery agreementst and ensuring compliance to Water Services provision legislation.

Table 21 shows the Water Service Authorities in each sub-catchment of the IWMA.

Table 21: Water Service Authorities in the respective catchments of the IWMA

Sub-Catchment	WSA	District (all in Mpumalanga)	% jurisdiction in the IWMA	IDP Status	WSDP Status
A. Komati	Msukaligwa LM	Gert Sibande DM	about 10%	Yes	1st draft-2004, with no reviews
	Albert Luthuli LM	Gert Sibande DM	about 15%	Yes	1st draft-2004, with no reviews
	Nkomazi LM	Ehlanzeni DM	100%	Yes	1st draft-2002, review in progress
B. Crocodile	Umjindi LM	Ehlanzeni DM	100%	Yes	1st draft-2002, review in progress
	Mbombela LM	Ehlanzeni DM	100%	Yes	1st draft-2002, review in progress
	Emakhazeni LM	Nkangala DM	about 50%	Yes	None
C. Sabie-Sand	Thaba Chweu LM	Ehlanzeni DM	about 50%	Yes	1st draft-2003, review in progress
	Bushbuckridge LM	Ehlanzeni DM	about 90%	Yes	Draft working document

**Information source: DWAF-WSA/WSDP Support Tools*

Another area in the jurisdiction of the IWMA is the Southern Part of the Kruger National Park (DMA32). This is the southern part of the Kruger National Park which is the only district management area (DMA) in the IWMA. Until 2006, there were also other parks comprising DMA lowveld (MPDMA31), but these have since been included into the LM boundaries within which they fell. A DMA is an area in a district municipality which has no local authority under it. The impact is that the DMA is responsible for all planning and service delivery. The reason for including the areas in local government boundaries is to allow local residents to vote in local government elections. In reality, the Kruger National Park (the northern part of which falls in Mopani District Municipality) which is controlled and managed by SANParks and Ehlanzeni.

The policy and strategy around DMAs is currently under review and the Municipal Demarcation Board issued a document for comment in July 2007 (available on the MDB website). The Kruger National Park as a water user is obviously significant to ICMA and developments in this regard needs to be monitored.

Although the water services sector only accounts for about 15% of the total national water use (excluding water supplied to industries by WSAs), it is the sector with the highest expected growth in demand. In relation to water services provision within the WMA, the rural nature of the areas does not necessarily depict lower service levels or consumption, as most of the WSAs are moving towards higher levels of service. Water Services Institutions are expected to determine their own targets and benchmarks for efficient water use, hence the significance for the CMS to look at issues related to Water Services.

Assessments of WSDPs and IDPs: Assessments of most of the Municipal WSDPs reveal that, these documents lack strategies but are more descriptive of the WSA's status quo. It is also evident that their quality is not comparable with those of the Municipal IDPs. The process of IDP reviews is considered very critical by Local government, but this seems not to apply to the WSDPs, hence the deficiency in their quality and credibility. This is questionable, as water services provision trends and projections are not clearly outlined, e.g. Water Conservation/Demand Management and Water Quality issues.

Figure 31: Map showing the municipal boundaries and WSAs in IWMA

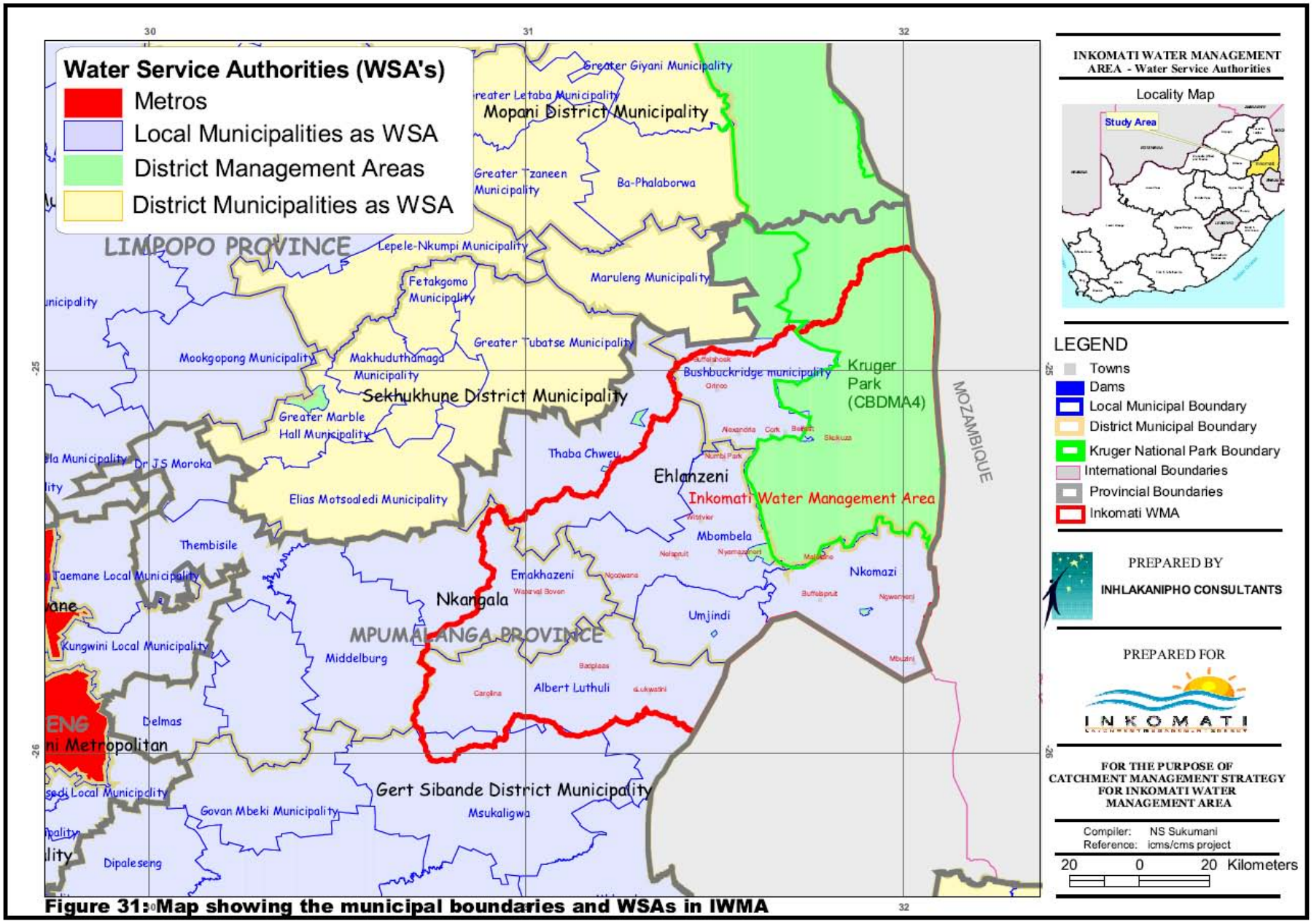


Figure 31: Map showing the municipal boundaries and WSAs in IWMA

3.14.4 Water Services Providers

The majority of settlements in the IWMA are predominately rural. Future growth in population is expected to be moderate and to be concentrated in the urbanized areas, with a decline in some of the rural areas. Table 22 depicts the major supply areas in the IWMA.

Table 22: Water services providers, their supply areas and raw water sources

MAIN TOWNS	NAME OF WSA	SUB-CATCHMENT	RAW WATER SORCE	WSP
Badplaas/ Dlamini	Albert Luthuli	Komati	Seekoeispruit	Albert Luthuli
Breyton/ Kwazanele	Albert Luthuli	Komati	Torbanite Dam	Albert Luthuli
Carolina/ Silobela	Albert Luthuli	Komati	Boesmanspruit Dam	Albert Luthuli
Ekulindeni/ Kranskop	Albert Luthuli	Komati	Komati River	Albert Luthuli
ELukwatini	Albert Luthuli	Komati	Komati River	Albert Luthuli
Barberton/ eMjindini	Umjindi	Crocodile	Lomati River	Umjindi
Dullstroom/ Sakhelwe	Emakhazeni	Crocodile	Dullstroom Dam	Emakhazeni
Machadodorp/ Emthonjeni	Emakhazeni	Crocodile	Elands River (Weir)	Emakhazeni
Waterval-Boven/ Emgwenyeni	Emakhazeni	Crocodile	Elands River (Weir)	Emakhazeni
Warburton/ Nganga	Emakhazeni	Crocodile	Teespruit Dam - Waterval Boven/ eMgwenya Elands River	Emakhazeni
Graskop	Thaba Chweu	Sabie-Sand	Fountain	Thaba Chweu
Sabie/ Simile	Thaba Chweu	Sabie-Sand	Mine shaft	Thaba Chweu
White River	Mbombela	Crocodile	White River	Mbombela
Hazyview	Mbombela	Crocodile	Sabie River	Mbombela
Nelspruit	Mbombela	Crocodile	Crocodile River	Silulumanzi
Matsulu	Mbombela	Crocodile	Crocodile River	Mbombela
Witriver/ Rockysdrift	Mbombela	Crocodile	Crocodile River	Mbombela
Kabokweni	Mbombela	Crocodile	Crocodile River	Silulumanzi
Kanyamazane	Mbombela	Crocodile	Crocodile River	Silulumanzi
Hectorspruit	Nkomazi	Crocodile	Crocodile River	Nkomazi
Komatipoort	Nkomazi	Komati	Komati River	Nkomazi
Kamaqhekeza	Nkomazi	Komati	Komati River	Nkomazi
Kamhlushwa	Nkomazi	Komati	Komati River	Nkomazi
Malelane	Nkomazi	Komati	Crocodile River	Nkomazi
Marloth Park	Nkomazi	Komati	Crocodile River	Nkomazi
Acornhoek	Bushbuckridge	Sabie-Sand	Injaka Dam	BBR Water

Thulamahashi	Bushbuckridge	Sabie-Sand	Injaka Dam	BBR Water
Marite	Bushbuckridge	Sabie-Sand	Injaka Dam	BBR Water
Mkhuhlu	Bushbuckridge	Sabie-Sand	Hoxani Weir/Sabie River	BBR Water
Breyten/Kwazenele	Msukaligwa	Komati	Boesmanspruit	Msukaligwa
Nganga/Warburton	Msukaligwa	Komati	Teespruit	Msukaligwa

Although there are a number of controversies regarding the reliability of the statistics on HIV and AIDS and its effect on population growth, the rapid rise in its prevalence and impact on services provision, including water services, cannot be disputed. The Province has an HIV and AIDS infection rate of 30%, which is one of the highest in the country. This epidemic cannot be overlooked with regards to planning for water services.

3.14.5 Water supply and infrastructure (Water Services)

Most of the dams and raw water infrastructure in the WMA is predominately used for irrigation purposes and is mainly used in the irrigation of sugar cane, citrus & subtropical fruits. This is followed by commercial afforestation, environmental then domestic requirements.

3.14.5.1 Ground water supply/usage

There is no reliable information that is currently available with respect to the extent of current usage of groundwater for domestic supply purposes in the WMA. Groundwater usage over the entire WMA area, including the relevant portion of the Kruger National Park was estimated to be 8 million m^3/annum (NWRS 2004). However, the recently registered groundwater use which can be found on the Water Use Authorisation and Registration Management System (WARMS) database indicates a groundwater use of 27.5 million m^3/annum, although 5.9 million m^3/annum of this use has not been assigned to a catchment and therefore its location is not known. The average annual groundwater recharge from rainfall over the entire area of the WMA is estimated to be 1 000 million m^3/annum. Thus annual groundwater usage appeared to be only about 2.8% of the annual recharge. Even if the usage figures were to be increased by 5 times, this would give an overall groundwater usage of only 14 per cent of that of the average annual recharge, which is still very low in comparison with proportional groundwater abstractions elsewhere in the drier parts of the country. In terms of a current total usage of 8 million m^3/annum of groundwater in the WMA, the estimated percentage of usage of the available average annual recharge for the various river catchments and sub-catchments comprising the WMA are given in Table 23.

Table 23: Ground Water yield in the IWMA

Catchment/ Sub-catchment	Estimated Current Annual Groundwater Usage (million m^3/a)		Estimated Average Total Annual Rainfall Recharge (million m^3/a)	% Current Annual Groundwater Usage of Annual Rainfall Recharge
	NWRS	WARMS		

Inkomati W & SW of Swaziland	1	1.4	200	0.5
Inkomati N of Swaziland	2	9.1	20	10.0
Crocodile	2	8.4	550	0.1
Sabie	2	1.6	200	0.1
Sand	1	1.1	30	0.3
Unknown location		5.9		
Total	**8**	**27.5**	**1000**	**0.8**

As indicated in Table 23, there is 5.9 million m^3/yr of registered groundwater use (for the Water Services Sector) in the Inkomati WMA, but the location of this is not indicated (WARMS). It is suspected that much of this water services use is in the Sabie/Sand area.

It can be seen from Table 23 that the only portion of the IWMA where groundwater is apparently currently being abstracted is the low-rainfall areas in the lower Inkomati catchment, to the North of Swaziland and in the Crocodile River. In these two catchments, groundwater is mostly used for irrigation.

3.14.5.2 Water Supply Schemes (Domestic purposes)

This section refers to water schemes intended for use by communities in the rural areas for domestic purposes.

- 3.14.5.3 Individual Town Supply Schemes

  Approximately 96% of the urban population is served through these schemes. The annual capacity of all schemes combined in the catchment is 38.7 million m^3, with the annual urban requirement calculated as 37.97 million m^3.

- 3.14.5.4 Regional Water Supply Schemes

  The four main regions where regional water supply schemes exist are the Nkomazi, Nsikazi, Bushbuckridge and the Mswati/Mlondozi regions. About 73% of the rural population is served through these schemes.

Census information for 1996 and 2001 indicate that the percentage of households with below basic access to water has decreased from 17.8% to 12.9%.

The number of households with basic/intermediate/full access to water has increased between 1996 and 2001 from 497 000 to more than 682 000. (**Below basic supply** is defined as: water carrier, tanker, borehole, rainwater, tank, well, dam, river, stream, spring, other, unspecified.

Basic supply implies public tap; **intermediate supply** implies piped water on site; and **full supply** is defined as piped water in a dwelling (DBSA, DIBU, 2004:23).

3.14.5.5 Water Services Infrastructure (Water Treatment Plants)

This section refers to the infrastructure used to abstract water, treat to potable standards and deliver to the end users. These include the water treatment works (WTW), pump stations and storage reservoirs (see Table 24).

Figure 32: Water treatment plants, pumps and reservoirs in the IWMA

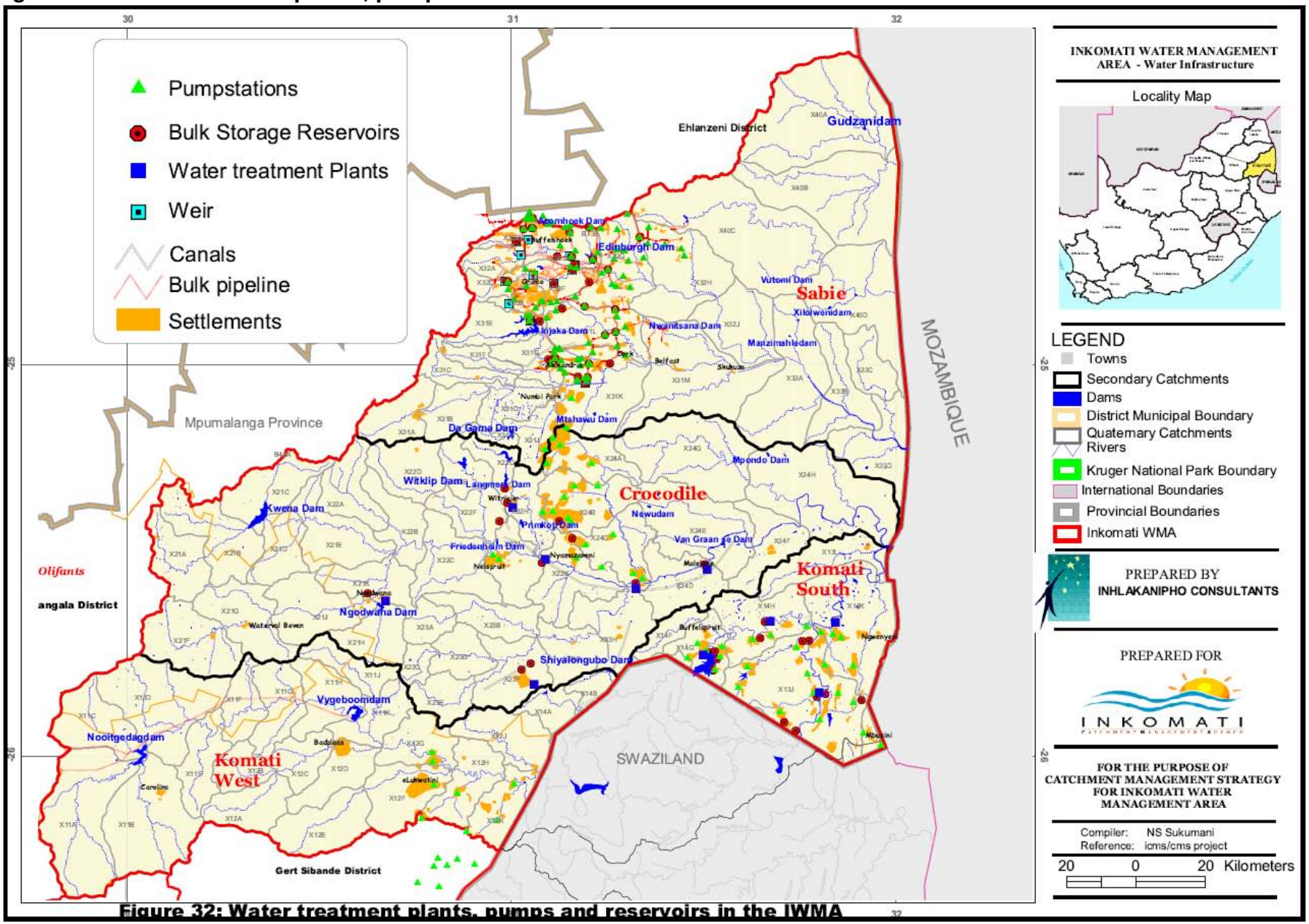


Figure 32: Water treatment plants, pumps and reservoirs in the IWMA

3.14.6 Sanitation

3.14.6.1 Basic sanitation facility: refers to the infrastructure necessary to provide a sanitation facility which is safe, reliable, private, protected from the weather and ventilated, keeps smells to the minimum, is easy to keep clean, minimises the risk of the spread of sanitation-related diseases by facilitating the appropriate control of disease carrying flies and pests, and enables safe and appropriate treatment and/or removal of human waste and wastewater in an environmentally sound manner.

3.14.6.2 Basic sanitation service: is the provision of a basic sanitation facility which is easily accessible to a household, the sustainable operation of the facility, including the safe removal of human waste and wastewater from the premises where this is appropriate and necessary, and the communication of good sanitation, hygiene and related practices.

The percentage of households with below basic access to sanitation (bucket latrine, none, unspecified) in the Inkomati WMA increased from 12.8% in 1996 to 13% in 2001. This is mainly due to the fact that more households indicated that they had no access to any form of sanitation (DBSA, DIBU, 2004:29).

The percentage of households with refuse collection services or access to a communal refuse dump remains unchanged from 1996 to 2001, namely 42.8% (DBSA, DIBU, 2004:29).

3.14.6.3 Water Services Infrastructure (Waste Water Treatment Works)

Table 24 lists the number of water treatment works (WTW) and waster water treatment works (WWTW) in the IWMA.

In general, the functionality of efficiency of Water and Waste Water Treatment works in the catchment is hugely affected by capacity challenges experienced by local government to properly operate and maintain the works. The remote nature of most of the, causing migration of skilled people out of the catchment creates a huge gap in the required skilled personnel for O&M requirements. Functionality of the works cannot only be determined by water or sewage treated, but must also concentrate on the effluent discharges and sludge disposal. Most of the works in the catchment do not have adequate sludge handling facilities no proper plans by local government to rectify such predicaments.

Table 24: Sanitation information in the IWMA

WSA	Scheme Name	WSP	Water Treatment Works	Type of Sanitation	Waste Water Treatment Works
Nkomazi	Driekoppies	Nkomazi LM	1	Dry	-
	Langeloop	Nkomazi LM	-	Dry	-
	Kamhlushwa	Nkomazi LM	1	Dry & Wet	-
	Tonga	Nkomazi LM	2	Dry & Wet	-
	Masibekela	Nkomazi LM	1	Dry	-
	Sibange	Nkomazi LM	-	Dry	-
	Magudu	Nkomazi LM	-	Dry	-
	Madadeni	Nkomazi LM	-	Dry	-
	Mbuzini	Nkomazi LM	1	Dry	-
	Low's Creek	Nkomazi LM	-	Dry & Wet	-
	Kaapmuiden	Nkomazi LM	1	Wet	-
	Kaapmuiden Citrus	Nkomazi LM	-	Dry & Wet	-
	Mkwaru-Mkwaru	Nkomazi LM	-	Dry & Wet	-
	Malelane	Nkomazi LM	1	Wet	1
	Hectorspruit	Nkomazi LM	1	Wet	1
	Marloth Park	Nkomazi LM	-	Dry & Wet	-
	Komatipoort	Nkomazi LM	1	Dry & Wet	1
Mbombela	Kanyamazane	Silulumanzi	1	Dry & Wet	1
	White River	Mbombela LM	1	Wet	1
	Hazyview	Mbombela LM	1	Dry & Wet	1
	Elandshoek	Mbombela LM	1	Dry	-
	Mjejane	Mbombela LM	1	Dry	-
	Mshadza	Mbombela LM	1	Dry	-
	Nelspruit	Silulumanzi	1	Wet	1
Bushbuck Ridge	Acornhoek	BBR Water	3	Dry	1
	BBR North-East	BBR Water	1	Dry & Wet	2
	Dwarsloop/Thulamahashi	BBR Water	7	Dry	1
	Shatale	BBR Water	2	Dry	1
	BBR South	BBR Water	1	Dry	-
	Marite	BBR Water	-	Dry	-
	BBR	BBR Water	2	Dry & Wet	1
Albert Luthuli	eKulindeni & Vlakplaas	Albert Luthuli LM	1	Dry	1
	eLukwatini/Eerstehoek	Albert Luthuli LM	1	Dry & Wet	1
	Lushuswane	Albert Luthuli LM	1	Dry & Wet	1

	Metula	Albert Luthuli LM	1	Dry	-
	Badplaas	Albert Luthuli LM	1	Dry & Wet	1
	Carolina	Albert Luthuli LM	1	Dry & Wet	1
Emakhazeni	Machadodorp	Emakhazeni LM	1	Dry & Wet	
	Waterval-Boven	Emakhazeni LM		Dry & Wet	
Thaba Chweu	Graskop	Thaba Chweu LM	-	Dry & Wet	1
	Sabie	Thaba Chweu LM	-	Dry & Wet	1
Umjindi	Barberton	Umjindi LM	1	Dry & Wet	1
Msukaligwa	Breyten	Msukaligwa LM	1	Dry & Wet	1

It is evident from Table 24, that the backlog in the sanitation department in the IWMA is quite big, especially in the rural areas.

3.14.6.4 Waste Management

Mpumalanga's per capita waste generation is higher than the National average and the Province is the largest producer of hazardous waste in South Africa. A large number of households in the Province do not have formal means of waste disposal. For example, only 34% of households in the Ehlanzeni District Municipality have access to formal means of waste disposal. This includes waste management practices in the Ikomati WMA, which also shows lack of adequate waste generated in domestically and hazardous/medical waste. A serious revelation is that less than 0.1% of the hazardous waste generated in the catchment, actually reaches a hazardous waste site. The remainder is disposed of on-site or in some other way (Mpumalanga State of the Environment Report, 2003).

.

The catchment has a per capita waste generation of 1.37 m^3/capita/year, higher than the national average of 1.04 m^3/capita/year. There is currently acceptable landfill airspace in the catchment, although certain regions may experience shortfalls in the near future, requiring either the establishment of new landfills or the identification of larger regional landfills in neighbouring regions. Recycling activities in the catchment are not properly co-ordinated.

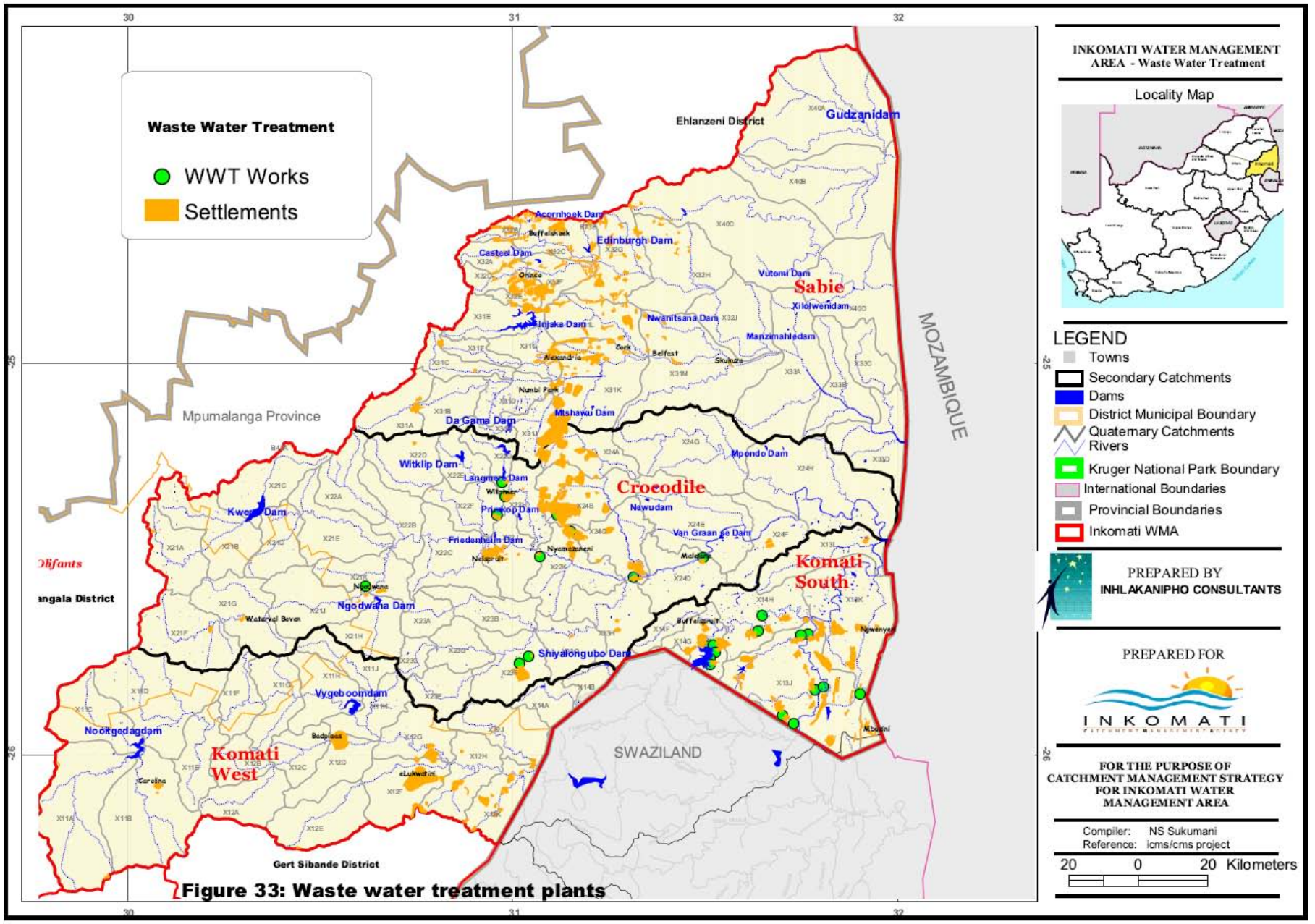
The province is moving towards the development of Integrated Waste Management Plans, which will, in future be available for planning and implementation.

Table 25: Waste management sites and their permit status

No.	Name of Sites	Permit Status	Facility Owner
1	Machadodorp Waste Disposal Site	Permitted	Emakhazeni Municipality
2	Waterval Boven Waste Disposal Site	Permitted	Emakhazeni Municipality
3	Sabie Landfill Site	Not permited	Thabachweu Municipality
4	Graskop Landfill Site	Permitted	Thabachweu Municipality
5	Barberton Landfill Site	Not permited	Umjindi Local Municipality
6	Nelspruit Landfill Site	Permitted	Mbombela Municipality
7	Mbonisweni Disposal site	Not permited	Mbombela Municipality
8	Hazyview Disposal Site	Not permited	Mbombela Municipality
9	Kamhlushwa Landfill Site	Not permited	Nkomazi Municipality
10	Kamaqhekeza Landfill Site	Not permited	Nkomazi Municipality
11	Hectospruit Landfill site	Not permited	Nkomazi Municipality
12	Komatipoort Landfill Site	Not permited	Nkomazi Municipality
13	Marloth Park Landfill Site	Permitted	Nkomazi Municipality
14	Lydenburg Landfill Site	Permitted	Thabachweu Municipality

15	Breyten Landfill Site	Not Permitted	Msukaligwa Local Municipality
16	Elukwatini Landfill Site	Permitted	Albert Luthuli Local Municipality
17	Carolina Landfill Site	Not Permitted	Albert Luthuli Local Municipality

Figure 33: Waste water treatment plants



4. INSTITUTIONAL ARRANGEMENT

This section sets out the description of the institutional arrangements in the Inkomati Water Management Area. The objective is to understand the status quo against the legal requirements so as to inform the pubic participation process, and the visioning exercise and the development of the strategy.

4.1 GOVERNANCE / REGULATION OF THE ICMA

In addition to what is stated earlier pertaining to the NWA, this Act sets out the provisions for establishment of CMAs and other institutional structures to support the CMAs in the management of the water resources in the respective WMAs. Some of these institutions include the Water User Association (WUAs) and Catchment Management Committee (CMCs). The CMAs are supposed to establish stakeholder consultative forums like a Catchment Forum (non statutory) to ensure effective interaction of stakeholders on water resource management issues.

4.2 GENERAL WRM INSTITUTIONAL RELATIONSHIPS

There are a number of role players in the process of integrated water resources management. The following depicts the relationships, from the perspective of a catchment management agency. As a public entity performing a public function, the activities of the catchment management agency are regulated and decision making would be considered administrative action in that it will impact the rights and obligation of the public.

Figure 34 shows the general institutional relationships impacting the CMA directly. It highlights the overall objectives and the role of the Minister of Water Affairs and Forestry.

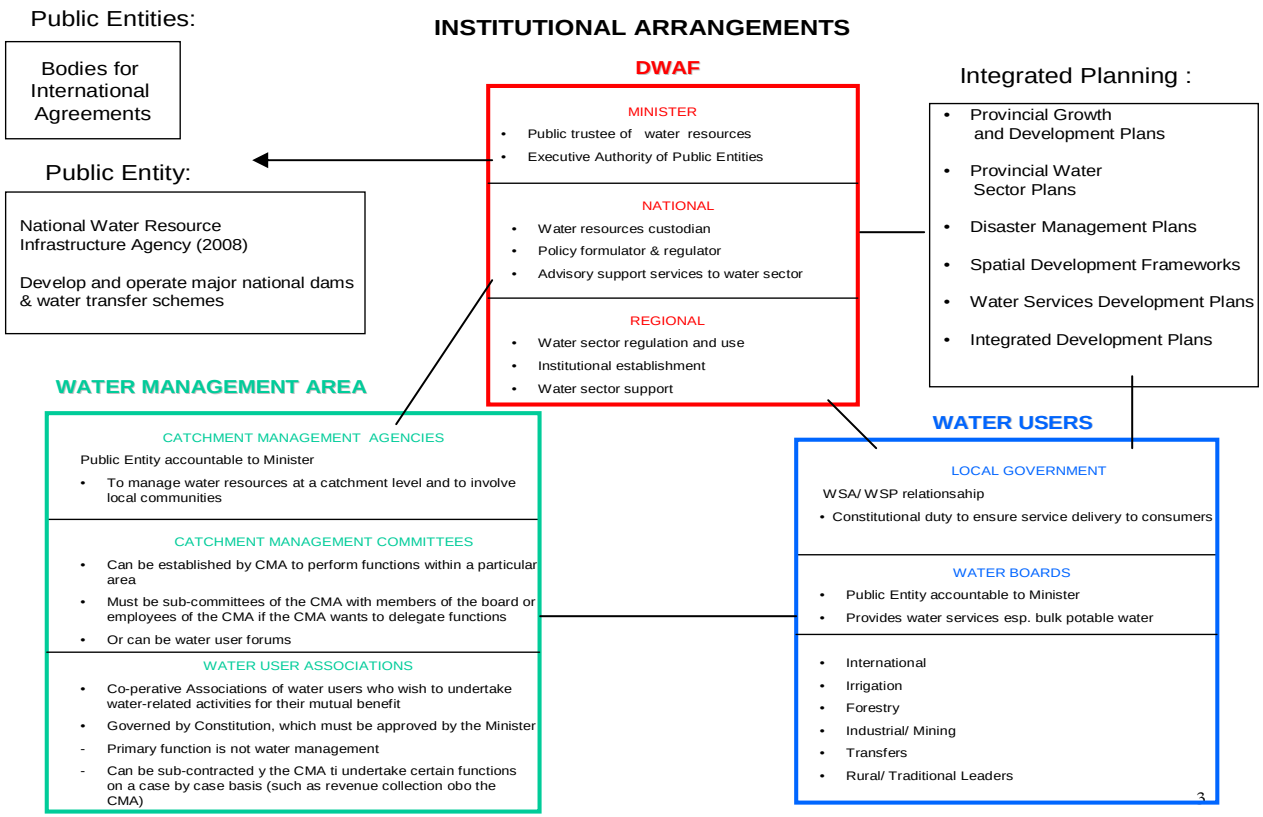


Figure 34: Institutional relationships

4.3 CO-OPERATIVE GOVERNANCE

Co-operative governance requires that public administration be development-orientated, efficient, transparent, accountable, representative, participative and compliant with all basic values and principles governing, public administration.

4.3.1 Intergovernmental Planning

The Constitution provides for 3 spheres of government – national, provincial and local – which are "distinctive, inter-dependent and inter-related". Whilst each sphere of government is responsible for planning the activities for which it is constitutionally mandated, the activities and the plans and strategies that guide them must be aligned. In terms of the planning framework:

- National Government provides a framework of common principles, and coordinated and prioritised programs, within which provincial, municipal and sectoral planning can take place;
- Provincial growth and development strategies provide a more specific framework for the development of projects and programs on a provincial level as well as the coordination of sectoral and municipal planning and disaster management; and
- Under the Systems Act, municipalities are required to prepare 5 year Integrated Development Plans and under the Water Services Act, Water Services Development Plans, and under the Disaster Management Act, Disaster Management Frameworks.
- The national programs to consider are the Integrated Rural Development Program and the urban Renewal Strategy.
- The IDPs and WSDPs of the local governments are assessed by a separate document. From review of DWAF's Water Services Planning Framework it would seem that the provincial, district and municipal growth point in the area is centred around the Nelspruit areas. Mbombela LM in its IDP 2002 – 2006 has specific vision around the Nelspruit / White River Corridor Development.

4.3.2 Local government as a Water User

Local government is recognised in the IWMA as the water services authority, responsible for water and sanitation services delivery directly to the communities living in their jurisdictions. It is also a water user and its activities impact on water resources management. As such the Water Resources/ Services interface is important.

In addition to being the Authority for water services delivery to the community and regulating the provider function, local government also has obligations as a "Water User" under the National Water Act. The National Water Act recognises that effective and sustainable management of water resources is critical to human life and environmentally sustainable development. It recognises that water is a scarce and precious resource that belongs to all the people of South Africa. Water Resources Management, a function of national government, impacts on municipalities' ability to perform their constitutional obligation to ensure access to basic water services. When water resources are over- exploited, the provision of water services becomes the problem of the WSA. Furthermore, WSAs undertaking water services planning through WSDPs need to understand their role in water resources management and allocation, and how this links with planning for water services and the broader issues of local economic development. Municipalities have an important role in water resources management in terms of:

- Catchment Management Agency (CMA) processes – WSAs are a key organ of state to be consulted and included in processes towards establishing water management institutions, strategies and decisions;
- Public Participation – municipalities must participate in the CMA processes;

- Poverty eradication – across all spheres, government is striving to create "a better life for all". A key outcome expected from the establishment is empowerment and upliftment of marginalised communities, and local government's developmental role is essential;
- Strategy and planning – CMAs will take the municipal IDPs and WSDPs into account as they develop catchment management strategies for the catchment management area, and there will be agreements on abstractions and discharge, planning for new developments and water conservation ad demand management; and
- Monitoring – municipalities have a key role in monitoring the efficacy of all of these interventions and processes.

4.3.3 DWAF

4.3.3.1 The Role of the Minister of the DWAF

The Minister has a direct statutory and regulatory role in relation to:

- the ICMA (executive authority of the public entity);
- the WUA's established in the IWMA (must approve the Constitution);
- Bushbuckridge Water (executive authority of the public entity); and
- The South African National Water Resources Infrastructure Agency, scheduled to be established in approximately April 2008 (executive authority of the public entity.

The Minister must also regulate water services provision which local government has the power and function for and has a constitutional duty to support local government and work within a framework of co-operative governance.

4.3.3.2 The Minister of DWAF's approach

The minister of DWAF is approaching the WUAs as public entities. Legally, the question as to whether they meet the definition of "public entity" as specifically defined in the Public Finance Management Act is debatable, although they might still perform a pubic function. WUAs are essentially co-operative associations of individual water users who wish to undertake water related activities for their mutual benefit. The exact functions of a water user association depend on its constitution which has to be approved by the Minister. It is important to note that the primary function of a WUA is not water management. This will be a direct consequence if they operate effectively and efficiently. This aspect needs to be thought about very carefully in the CMS to avoid further delay in transformation and natural rules of law and economics frustrating implementation.

4.3.4 The National Water Resources Infrastructure Agency (NWRIA)

The National Water Resources Infrastructure Agency is an agency which will be established as part of DWAF's restructuring

process. The impact of the establishment of the National Water Resources Infrastructure needs to be carefully monitored by the ICMA. It is anticipated that this agency under the Minister will be established by April 2008, and that within 12 months of that an asset inventory will be drawn up indicating assets that will transfer to the Agency. The NWRIA will be established by DWAF to undertake the core business of development of national and multi-purpose water resource infrastructure. The links between the NWRIA and any national assets in the IWMA, or those developed that impact water resources in the NWRIA will need to be carefully managed. This will impact especially any works that transfer water across national boundaries or between water management areas; or comprise several interconnected catchments. The Bill, which has been published for comment makes no mention of the need for the NWRIA to align its planning with the ICMS.

4.3.5 International Arrangements

The National Water Act specifically makes provisions for international co-operation – obliging that provisions be made for meeting the needs of neighbouring countries with which water courses are shared. It further puts meeting international obligations as the next highest priority water use after the Reserve. South Africa is currently not meeting its international obligations which will expose the ICMA, as the authority responsible for managing the resources on the South African side of the border[18]. The Internal Strategic Perspective (2004) describes the arrangements comprehensively. For sake of completeness, these are repeated here:

The Komati River drains parts of both South Africa and Swaziland, and then flows into Mozambique after the confluence with the Crocodile River at Komatipoort. The Sabie and Sand River catchments and the smaller Uanetse catchment to the north also drain into the Komati River in Mozambique, although here it is referred to as the Incomati River.

This has resulted in a number of obligations on the basin states in terms of international agreements, the most recent of which is the Tripartite Interim Agreement between the Republic of Mozambique and the Republic of South Africa and the Kingdom of Swaziland for co-operation on the Protection and Sustainable Utilisation of the Water Resources of the Incomati and Maputo Water courses. For the purposes of this report, the agreement is referred to as the Interim IncoMaputo Water Use Agreement. This agreement can be found on DWAF's website www.dwaf.gov.za. This agreement sets limitations on water use in each of the basin states, target flows to be maintained to sustain the riverine ecology and sets water quality standards. These target ecological flows which are relevant to South Africa are listed in Table 26 below;

[18] See Operating Rules (International Aspects)

Table 26: Target ecological flows at key points in the Inkomati WMA

River	Key Point	Interim Targets	
		Mean (million m^3/a)	**Minimum (m^3/s)**
Sabie	Lower Sabie	200	0,6
Crocodile	Tenbosch	245	1,2
Komati	Diepgezet	190	0,6
	Mananga	200	0,9
	Lebombo	42	1,0
Inkomati	Ressano Garcia	290	2,6

The operating rules of the basin in order to achieve these cross-border flows are being developed through a separate task group, referred to as the Incomati System Operation Task Group of the TPTC (ISOTG). According to the operating rules proposed by the ISOTG, as a first step towards the implementation of the various agreements between the countries, the Komati River must contribute 55% of the requirements of Mozambique at the border at Komatipoort (Ressano Garcia) while the Crocodile River must contribute 45%. Based on the minimum target interim in-stream flow requirements given in the above table, of Mozambique's total consumptive requirements in the Incomati River upstream of the confluence of the Sabie River, 60 million m^3/annum at a 1:50 equivalent assurance must be contributed from the Komati River and 49 million m^3/annum at a 1:50 year equivalent assurance from the Crocodile River. This contribution from the Komati River needs to be apportioned between South African and Swaziland. In terms of the proposals of the ISOTG, the South African contribution would therefore be 42 million m^3/annum at a 1:50 year equivalent assurance and 18 million m^3/annum from Swaziland. See Table 27 below for a summary of the proposed cross-border flows, as expressed as impacts on the 1:50 year yield.

The operating rules now need to be developed further to include the whole WMA and to give full effect to the Interim IncoMaputo Water Use Agreement.

The other agreement of importance, especially in the Komati River catchment, is the Treaty between the Government of the Republic of South Africa and the Government of the Kingdom Swaziland on the Development and Utilisation of the Water Resources of the Komati River Basin that deals mainly with the development of the water resources of the catchment and which led to the construction of the Maguga and Driekoppies dams.

Table 27: Impact of the minimum flows required at Ressano Garcia (Mozambique Border) on the available yield in the Komati and Crocodile River catchments

River	Contribution (million m3/annum)		TOTAL	
	RSA	Swaziland	Million m^3/annum	Percentage
Komati	42	18	60	55%
Crocodile	49	-	49	45%
Total	91	18	109	100%

In the case of the Komati River, operating rules will be implemented on the Driekoppies and Maguga dams to ensure compliance with the above proposal. However, there is only one significant dam on the Crocodile River, the Kwena Dam, and this is situated in the far upper reaches of the catchment, a long way from the Mozambique border. It will be difficult to ensure that releases made from this dam reach the border, and some form of abstraction control and probably water regulating structures will also need to be implemented.

In addition to the above, an amount of 87 million m^3/annum is reserved in the interim for the city of Maputo. The water will be drawn from the total water available after further development of the Incomati Water Course. The Interim IncoMaput Use Agreement also places the following limitations on the consumptive water use from the Incomati Water Course by South Africa, including water transfers.

4.3.5.1 Komati River catchment in South Africa

Domestic, livestock and industrial water use	183 million m^3/annum
Irrigation water use:	381 million m^3/annum
Afforestation: Area:	90 233 ha
Runoff reduction	99 million m^3/annum

4.3.5.2 Crocodile River (East) catchment

Domestic, livestock and industrial water use	73 million m^3/annum
Irrigation water use:	307 million m^3/annum
Afforestation: Area:	199 715 ha
Runoff reduction	247 million m^3/annum

4.3.5.3 Sabie River catchment (including the Massinto and Uanetse**)**

Domestic, livestock and industrial water use	81 million m^3/annum
Irrigation water use:	98 million m^3/annum
Afforestation: Area:	75 027 ha
Runoff reduction	129 million m^3/annum

Note that the above water uses are at different assurances of supply and not directly comparable with the water use expressed at a 1:50 year level of assurance in this report. A task team has been formed under the auspices of the TPTC to oversee the implementation of the agreement.

Being international obligations, DWAF will remain responsible for these arrangements. However, the ICMA will need to participate as a technical advisor on the various technical committees, which generally meet twice a year and propose operating rules of the basin in order to achieve the agreed cross-border flows. These rules will need to then be further developed by ICMA to include the whole of the IWMA. The ICMA must further familiarize itself with all of the rights and obligations arising from the agreement and take these into consideration in its annual and long-term strategic business planning, as the way in which water is managed by the ICMA in the IWMA impacts on international borders.

4.3.6 The Kruger National Park

Another important institution regarding water management is the Kruger National Park. Though obviously a water user, this stakeholder is sufficiently important to be listed as a water management institution. It has its own water management structures, rules, goals and expertise. The strategic importance of the Park for conservation and tourism (including heritage) warrants its strong presence and involvement in water management issues.

4.4 INSTITUTIONAL ARRANGEMENTS IN THE IWMA

4.4.1 Scope and Mandate of the ICMA

The Inkomati Water Management Area and its boundaries were established by the Minister of DWAF in the Government Gazette No. 20491 dated 1 October 1999. The water management area was defined to include the major rivers Nwanzedzi, Sabie, Crododile (East) and Komati. With recent incorporation of Bushbuckridge LM the IWMA now falls 100% within

Mpumalanga Province. Following a public participation process, the Minister approved the proposal and the Minister established the Inkomati Catchment Management Agency in Government Gazette No. 26185 dated 26 March 2004. The Governing Board was formally inaugurated in September 2005.
The Minister of Finance approved the listing of the Inkomati CMA as a schedule 3A public entity in terms of the Public Finance Management Act in Government Gazette No. 286005 dated 17 March 2006. It is an entity which is established in terms of the National Water Act, and is fully or substantially funded either from the national revenue fund or by way of a tax, levy, or other money imposed in terms of national legislation and is accountable to parliament.

4.4.2 Powers and Functions

The following directorates have been identified, with the description of the roles and responsibilities set out in the ICMA Business Plan:

- Corporate and Finance (fully resourced) ;
- Water Use (executive manager appointed);
- Water Resources and Planning (still with DWAF proto CMA - DWAF staff and operating assets still to be identified and transferred on the terms as set out in the MOU); and
- Institutions and Participation (fully resourced)

4.4.3 The ICMA Governing Board

The ICMA has a governing board which was appointed by the Minister effective September 2005. The original term of office expires in August 2008. Key obligations of the Board are set out in the PFMA and in Schedule 4 of the National Water Act.

Table 28: The Governing Board of the ICMA as at January 2007

	Name	Position	Representing
1.	Thokozane Patience Nyakane-Maluka	Chairperson of the Board	Local Government
2.	Nandha Govender	Deputy Chairperson of the Board	Eskom
3.	MM Makhubela	Member	Emerging Farmers
4.	EG Mashele	Member	Civic Organisations
5.	Ms Patricia Mothibi-Makheshe	Member	Forestry

6.	Edward S Thwala	Head of the Finance Sub-Committee	Tourism
7.	Frans Roux	Member	Environment
8.	B KrisJan Mokoena	Member	From SANCO- represents Community Users
9.	Lilian Masilela	Head of the Marketing Sub-Committee	NGOs
10.	MG Mkhatshwa	Member	Office of the Traditional Leaders
11.	Gulam Karim	Head of the HR Sub-Committee	Provincial Government
12.	Cas JH du Preez	Head of the Operations Sub-Committee	Commercial Farmers

**Source: ICMA CEO*

The board has developed its second generation Business Plan for the Financial Years 2007/08 to 2009/10. In addition to the obligations placed on the board under the National Water Act, the Public Finance Management Act and the general aspects of the King Code on Corporate Governance regulates the fiduciary duties of the Board. It must be noted that the Public Finance Management Act places strict obligations on Boards, obliging members to act in the best interest of the institution (not their represented stakeholder group) when executing their responsibilities. The Board appears to be representative of stakeholders in the water management area. The Board has established the Audit Committee and the Chairpersons Working Committee. There are 4 sub-committees:

- Finance & Risk
- Remuneration and HR
- Technical
- Marketing and communication

The Board is meeting regularly, and reports that it has adopted a Code of Conduct as part of the Governing Board Charter. It indicates that its 3 year second generation business plan constitutes the Shareholder Compact with the Minister.

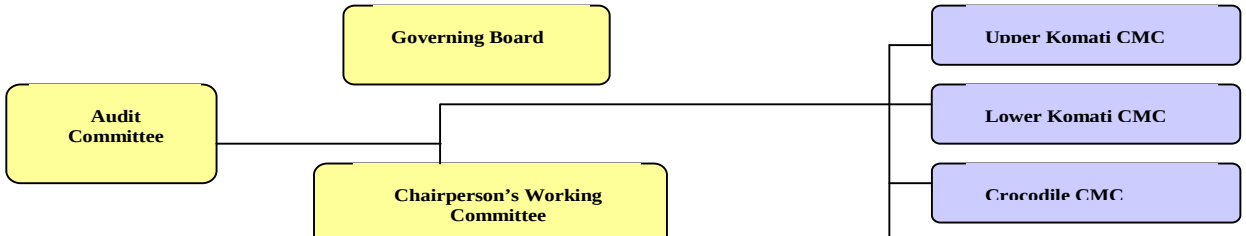


Figure 35: Initial Committee Structure of the Inkomati CMA Governing Board
**Source: ICMA 2nd Generation Business Plan, 2007*

4.4.4 Scope and mandate of the CMA

The Inkomati Water Management Area and its boundaries were established by the Minister of DWAF in the Government Gazette No. 20491 dated 1 October 1999. The water management area was defined to include the major rivers Nwanzedzi, Sabie, Crododile (East) and Komati. With the changes in the boundary, it now falls 100% within Mpumalanga Province.

4.4.5 Budget and Business Plan

Section 53 of the PFMA obliges the Board to submit to the Minister, at least 6 months before the start of the financial year (July) a budget of estimated revenue ad expenditure for that financial year for approval by the executive authority.

The ICMA Business Plan is for a three year period. It focuses quite significantly on institutional issues. It has prioritised

- Stakeholder engagement (mobilise, empower and consult stakeholders to enable them to participate in water resource management decisions and promote a positive perception of the CMA); and

- Development of the catchment management strategy.
  - The three year period ending June 09 is described in the Business Plan as a “consolidation period”. It is anticipated that further delegated functions from DWAF would only be considered in the period 2009/10 to 2011/12. This still does not derogate from the importance of finalising the transfer of the DWAF proto CMA to the ICMA to allow it to undertake its initial functions.

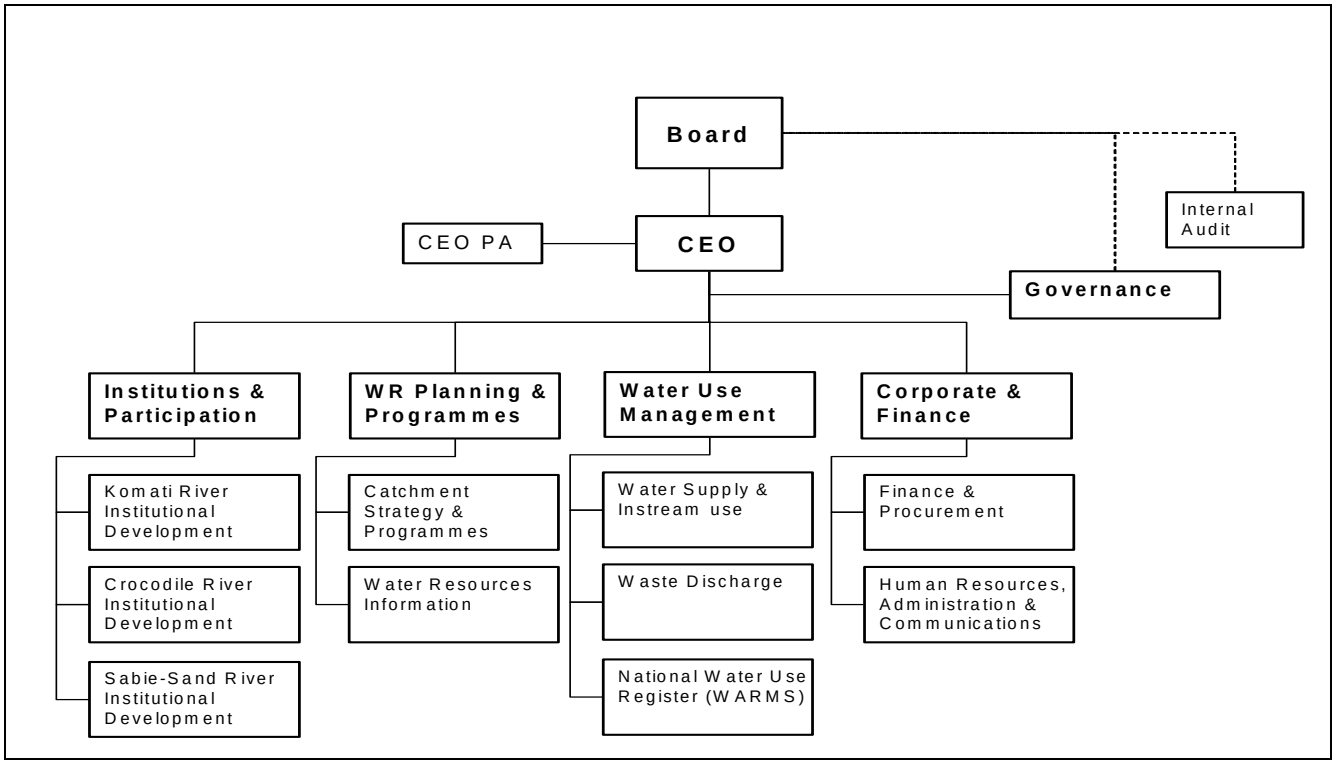


Figure 36: ICMA organisational structure

4.4.6 Powers and Functions

The ICMA has the inherent functions mentioned earlier and is doing things such as opening bank accounts, setting policies, business planning, renting property and employing staff. At this stage it is progressing on its initial functions as follows:
Investigation and advice on water management: The Inkomati CMA advertised, and appointed a full time manager to head up the Water Use Section, but it has no further critical capacity regarding Water Resource Planning and programmes and Water

Use Management. This is currently all still housed in the DWAF proto–CMA. The MoU between DWAF and the CMA identifies DWAF staff to transfer (post an initial secondment period) but this has not yet been affected. This initial function needs significant attention and execution of the duty will depend on cooperation between the ICMA and DWAF.

Catchment Management Strategy and Planning: The process of developing the CMS is underway, with the support of consulting advice. A key risk is the link between the CMA powers and functions and what DWAF is and will continue to do (reserve determination / water use verification / classification) and what the impact of the soon to be established National Water Resources Infrastructure Agency will be.

Coordination of activities of water users and WMIs: this function has commenced, but there is no significant progress. Some of the examples attesting to this include the fact that: stake holder data-bases do not exist in any useful format; the relation ship between DWAF and the ICMA is strained; the transformation of irrigation boards is lagging; the establishment of forums still needs attention. This can be rectified with the development of systems and proper formal communication strategies. In addition to the existing water users, the role and responsibilities of the National Water Resources Infrastructure Agency will need to be determined. This Agency will be responsible for the planning, developing, operating and maintenance of the national water resources infrastructure. Within 12 months of establishment, the Minister will compile the inventory of existing assets to transfer. The enquiry as to whether “national assets” exist in the Inkomati CMA has to be investigated, but it definitely includes water works that transfer water across national boundaries or between water management areas.

Promotion of coordination with CMS and implementation of WSDPs: This activity will follow after the CMS has been developed. The ICMA has fully established its “Institutions and Participation” structure, with management, secondment of DWAF staff and appointment of 3 “Institutional Specialists” for each of the sub-catchment areas. The law requires that the CMS take into consideration other plans such as the WSDP, IDP and PGDS. These documents are not yet optimally focussed on water resource requirements as a result of future projections about needs. This impacts the ability of the IDMA to rely on these documents. The strategic nature of the WSDP as a future planning tool, impacting significantly on local economic development strategies must be stressed to the WSAs at this stage of building foundations.

Promotion of community participation: the community in the IWMA is generally well organized. It participated in the proposal to form the ICMA and is regularly invited to participate in a number of both DWAF and ICMA processes. However, there is no formal communication or participation strategy. Even if this was in place, because of the challenges identified in the third bullet above, it cannot be executed until these challenges are addressed. A key risk is coordination between DWAF and the ICMA processes and avoiding mixed or duplicated messages.

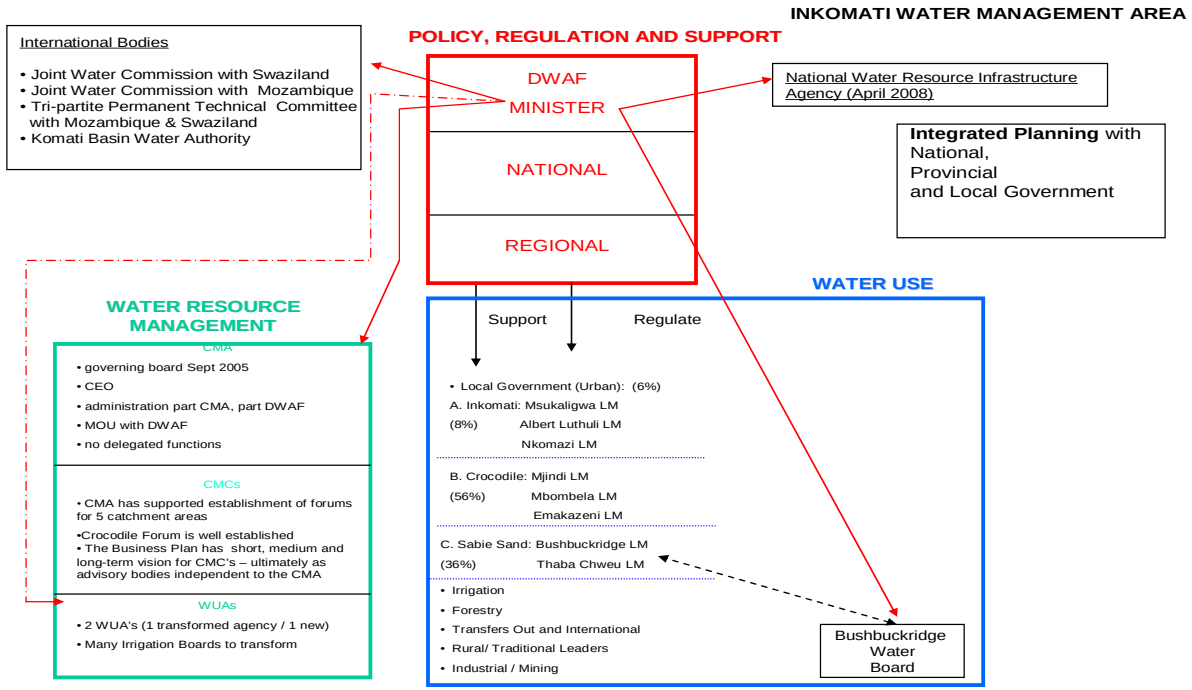


Figure 37: Summary of Institutional arrangements in the IWMA

4.4.7 Catchment Management Forums and Committees

Catchment Management Committees have not yet been established by the Board. It is the intention of the CMA to oversee the establishment of voluntary forums and in 5 sub-catchment areas. The vision of the Board is that the forums will represent stakeholders' views, and the forums will not be committees of the ICMA board, and will not have decentralized and delegated responsibilities from the ICMA. The ICMA will observe and contribute but not lead any forum.

A Crocodile sub-catchment forum exists. It was established on a voluntary basis and is evidently working very well as a representative forum of the stakeholders of that area. The remaining 4 forums have just been launched by the ICMA and are not as established and capacitated as the Crocodile one.

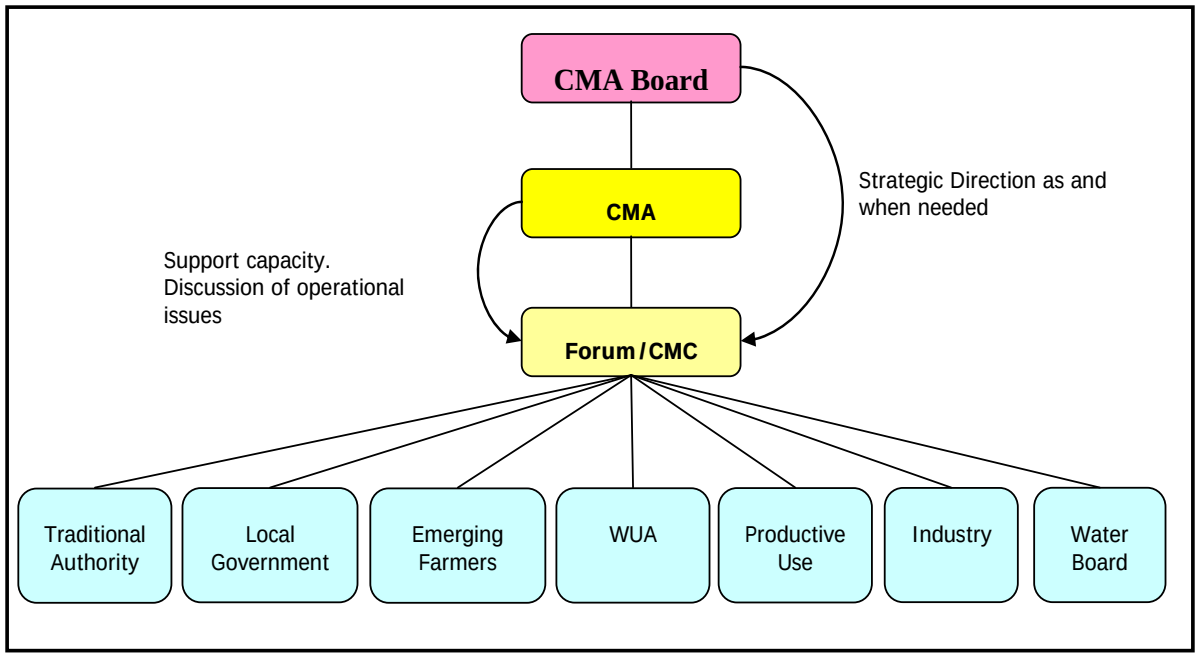


Figure 38: ICMA CMC Vision
Source: ICMA 2nd Generation Business Plan, 2007

4.4.8 Water User Associations

There are two water user associations established in the IWMA under the National Water Act (36 of 1998).

- The Upper Inkomati WUA: this is a new institution. It has no infrastructure. The water users are emerging farmers who have benefited from national government's land distribution initiative. This particular WUA requires lot of support from the ICMA and or the government.
- The Elands WUA: This is a transformed conservancy agency focused on tourism and is evidently not a recognised water user.

The remaining irrigation boards have not transformed. There are on-going discussions around issues of assets and funding.

4.4.9 Irrigation Boards

There are 26 Irrigation Boards operating in the proclaimed Irrigation Districts. Their powers and functions are still regulated by the 1956 Water Act. In terms of the National Water Act, they were to have transformed themselves into Water User Associations within 6 months of the coming into effect of the National Water Act in 1998, but to date the process is still not finalised. DWAF has expressed its expectation that the 26 Irrigation Boards transform by amalgamation into 11 operational areas, aligned to quaternary boundaries (rivers) rather than the existing irrigation districts.

4.4.10 Traditional Leaders

In terms of the Traditional Leadership and Governance Framework Act 2003, the premier of the Province may, following consultation, recognise a "traditional community" by publication of a notice in the provincial gazette. That is, if a community is subject to a system of traditional leadership and observes a system of customary law. The House of Traditional Leaders sits in Nelspruit (recognised under the Council of Traditional; Leaders Act 10 of 1997). In addition, there is dedicated resource in the office of the Premier.

There are a large number of traditional leaders in the IWMA. Although they are not significant "water users" and their requirements are accounted for in the rural requirement of 2% of total water use in the IWMA, they are institutional structures which can impact water resources. Their role viz-a-viz the role of the water services authorities is contentious. It has been suggested that they can influence water resources through spiritual intervention (praying for rain). The ICMA recognises the Traditional Leaders as a stakeholder, and will encourage participation in the Forums in which the traditional leaders have jurisdiction. The ICMA is developing a database of all stakeholders including Traditional Leaders.

Table 29: Traditional leaders in the IWMA

NO.	DISTRICT	NAME OF TRADITIONAL LEADER	TRADITIONAL AUTHORITY	AREA OF JURISDICTION
1	Nsikazi	Inkosi T.S. Dlamini 0723130903	Lomshiyo Traditional Authority P O Box 1305 Matsulu, 1203	RSA GN No 2341 of 12/12/1975
2	Nsikazi	Inkosi T.F. Mashego 0726657424	Masoyi Tribal Authority P O Box 1414 White River, 1240	RSA GN No 1291 of 17/08/1962
3	Nsikazi	Vacant	Nkambeni Tribal Authority P O Box 99 Hazyview, 1242	RSA GN No 1291 of 17/08/1962
4	Nsikazi	Onkosi M.I. Mdluli 013 796 3943 0724965237	Mdluli (Bhekiswayo) Tribal Authority P O Box 153 Kabokweni, 1245	RSA GN No 1291 of 17/08/1962
5	Nsikazi	Acting Mr Khumalo 0722249027 013 796 4125	Gutshwa Tribal Authority P O Box 1617 Kabokweni, 1245	RSA GN No 1291 of 17/08/1962
6	Nsikazi	Inkosi Z.T. Mbuyane 013 796 0284	Mbuyane Tribal Authority P O Box 371 Kabokweni, 1245	RSA GN No 1291 of 17/08/1962
7	Nsikazi	Inkosi H.R. Nkosi 072 2654 5611	Msogwaba Tribal Authority P O Box 112 Kanyamazane, 1214	RSA GN No 1291 of 21/08/1970
8	Nsikazi	Inkosi S.A. Nkosi 013 794 8234 083 344 9977	Mpakeni Tribal Authority P O Box 1	RSA GN No 1291 of 17/08/1962

			Sibuyile, 1216	
9	Nsikazi	Inkosi Mhola Nkosi	Kamhola; Emjindini Tribal Authority	RSA GN No 1291 of 17/08/1962
10	Nsikazi	Emakhazeni	Emakhazeni Tribal Authority	-
11	Nsikazi	Mbombela	Mbombela Tribal Authority	-
1	Eerstehoek	Inkosi T.S. Dlamini 072 313 0903	Embhuleni Traditional Authority P O Box 295 Elukwatini, 1192	RSA GN No 2341 of 12/12/1975
2	Eerstehoek	Inkosi K.J. Malaza	Mandlamakhulu Traditional Authority P O Box 589 Elukwatini, 1192	KaNgwane GN No 6 of 1973 RSA GN No 1410 of 12/07/1975
3	Eerstehoek	Inkosi J.M.Nkosi 017 883 0701 082 427 8336	Somcuba Bhevula Traditional Authority P O Box 48 Elukwatinin, 1192	RSA GN No R343 of 05/03/1976 RSA GN No R661 of 15/04/1976 KaNgwane GN No. 6 of 1993
4	Eerstehoek	Inkosi E.M Nkosi 076 119 4193	Enikwakuyengawa Traditional Authority Private Bag x1002 Breyten, 2330	KaNgwane GN No 6 of 1993
5	Eerstehoek	Nkosi T.P Nkosi 083 944 7313 083 464 3346	Ebutsini Traditional Authority P O Box 161 Crysbestos, 1307	KaNgwane GN No 6 of 1993
6	Eerstehoek	Acting Chieftainess F.L. Msibi 082 867 1435 017 883 0013	Enkhaba Traditional Authority P O Box 52 Elukwatini, 1192	KaNgwane GN No 6 of 1973 RSA GN No 1179 of 1981
7	Phophenyane	Inkosi M.B. Mnisi 072 482 4855	Mantjolo Traditional Authority P O Box 223 Badplaas, 1190	Private Land

8	Umjindi	Inkosi K.M. Nkosi 082 422 4197	Emjindini Traditional Authority P O Box 3047 Barberton, 1300	RSA GN No 2349 of 12/12/1975 RSA GN No 1410 of 12/07/1975
9	Nkomazi	Deceased	Matsamo Traditional Authority P O Box 601 Shongwe Mission, 1331	RSA GN No 311 of 01/03/1975
10	Nkomazi	Inkosi M.S. Mahlalela 082 342 0473	Mlambo Traditional Authority P/Bag x4009 Kwalugedlane, 1341	RSA GN No 1399 of 03/08/1956
11	Nkomazi	Inkosi E.S. Mkhatshwa 082 806 6989	Mawewe Traditional Authority P O Box 99 Manzolwandle, 1341	RSA GN No 1853 of 03/08/1957
12	Nkomazi	Inkosi M.G. Mkhatshwa	Mhlaba Traditional Authority P/Bag x744 Shongwe Mission, 1341	RSA GN No 1853 of 29/11/1957
13	Nkomazi	Inkosi S.O Ngomane 082 255 2042	Siboshwa Traditional Authority P/Bag x530 Komatipoort, 1340	RSA GN No 311 of 01/03/1957
14	Nkomazi	Inkosi S.G. Ngomane 013 782 0207 083 413 0013	Hoyi Traditional Authority P O Box 28 Kwalugedlane, 1341	RSA GN No 311 of 01/03/1957
15	Nkomazi	Vacant	Lugedlane Traditional Authority P O Box 28 Kwalugedlane, 1341	RSA GN No 311 of 01/03/1975
1	Pilgrims Rest II	Acting P.N. Mohlala 076 971 7099	Mohlala Traditional Authority P/Bag X418 Graskop, 1270	Lebowa gn No R13 of 18/06/1982 RSA GN No 279 of 03/03/1967
2	Pilgrims Rest II	Kgosi M.F. Mashile 072 052 3749	Mashilane Traditional Authorities P/Bag X513	RSA GN No 1547 of 06/10/1967

			Pilgrimsrest, 1290	
3	Pilgrims Rest II	Kgosi N.S. Mogane 082 408 6018	Kgarudi Traditional Authority P O Box 1952 Hazyview, 1242	Lebowa GN No R13 of 18/06/1982
4	Pilgrims Rest II	Kgosi M.M Mogane 013 761 6101 073 953 5451	Mogane Traditional Authority P O Box 45 Thaba-Tlou, 1271	Lebowa GN No R13 of 18/06/1982
5	Pilgrims Rest II	Hosi Nxumalo M.E 072 474 9207	Amashangana Traditional Authority	
6	Pilgrims Rest II	Hosi Mnisi P.P 073 6577 489	Mnisi Traditional Authority	
7	Pilgrims Rest II	Hosi Knoza H.N. 076 240 0967	Jongilanga Traditional Authority	
8	Pilgrims Rest II	Hosi Nkuna M.L 084 273 7660	Hoxane Traditional Authority	
9	Pilgrims Rest II	Kgosi Chiloane R.N 072 814 1993	Sethlare Traditional Authority	
10	Pilgrims Rest II	Kgosi Mashego D.G 083 513 0513	Thabakgolo Traditional Authority	
11	Pilgrims Rest II	Kgosi Mashego M.O. 072 814 1993	Moreipuso Traditional Authority	
12	Pilgrims Rest II	Ngosi Moloena B.L 083 337 5528	Mathibela Traditional Authority	
13	Pilgrims Rest II	Kgosi Malele S.E. 083 553 0417	Malele Traditional Authority	
14	Pilgrims Rest II	Kgosi Chiloane A.L 072 522 5355	Moletele Traditional Authority	

**Source: ICMA (J Mabunda)*

5. FINANCIAL ISSUES AND ECONOMIC OVERVIEW

The ICMA financial year is approximately 20 months since the appointment of the ICMA governing board.

5.1 ECONOMIC OVERVIEW OF THE INSTITUTIONAL STRUCTURES

5.1.1 The principal draw cards in the IWMA

This section refers to the main economic powers contributing to the local economy.

- South African Pulp and Paper Industries (SAPPI) one of the world's largest pulp and paper suppliers established the Ngodwana mill almost 25 years ago. At the time the mill was the largest of its kind in the world. This mill is in addition to its other smaller SAPPI mills are located in the IWMA.
- There are other timber operations in the ICMA notably the timber grown in the SABIE area, which boasts one of the world's largest man-made forests. Almost all this timber is used for basic forest products, much of which are exported.
- The major forest owners in the ICMA are SAPPI, Mondi and Komatiland Forests, the later being formally part of the government state forests.
- The timber and paper industry provides employment for a considerable number of people in the IWMA. All these make SAPPI and the forest industry an economic draw card in the IWMA.
- There are also many mines in the area most notably gold mines in the Barberton area. The mines are some of the oldest in South Africa. Gold in South Africa was first discovered in Barberton. The mines operate using their own underground water resources while they buy water from municipalities for human consumption.
- The famous conservation and tourism centre in the IWMA is the Kruger National Park (KNP). The KNP contributes greatly to the local economy as well as the national one.
- The cane growing irrigation farming is another economic giant in the IWMA together with the sugar factory, TSB. They contribute greatly towards the economy in the water management area.

5.2 INSTITUTIONAL STRUCTURES AND THEIR FINANCIAL MATTERS OF THE ICMA

5.2.1 Sources of income to the ICMA

ICMA income must be derived from water use charges. DWAF is supposed to provide money to the ICMA at the beginning or during the inception phase. DWAF has since the appointment of the governing board provided the funds needed for the survival and functioning of the ICMA. It can be inferred that currently, the ICMA's revenue is based on a grant from DWAF, as DWAF collects ALL the revenue generated from the licensing of water users. This report will therefore focus on the financial plan which basically deals with expenditure related issues.

The ICMA in its bid to comply with the NWA and also to establish the ICMA as a viable entity developed a second generation business plan. The business plan focuses on issues of strategic direction, organisational development and risk management

over the next 3 years, in line with the role of the Governing Board[19]. As such it is presented as a combination between a strategic institutional development plan and a business plan.

5.2.2 Financial Plan

According to the second generation business plan, the financial plan was based on a simple financial model for the ICMA for the 3 years 2007/08 to 2009/10. It is based on detailed expenditure, differentiating salary, overhead, outsourcing and capital repayment costs, with recovery through a combination of water use charges and financial support. It takes account of a number if issues, including non-payment by users.

5.2.3 CMA Income/Expenditure

The ICMA has not been able to generate any funds from their activities. Their main source of income should be from the sale of water and other water charges. The reason being that at the time of this study, DWAF was yet to hand over some of the responsibilities to them. The ICMA accounting system has therefore been largely expenditure based. Expenditure has largely been on staff emoluments and public participation processes[20].

- The expenditure for the 2007/08 financial year not covered by water use charges must be covered through bridging financial support from DWAF, as the ICMA has not had an opportunity to set charges. The level of this support must cover the agreed expenditure, possibly by way of 2 to 4 payments of working capital during the year. It needs to be agreed with DWAF whether all outstanding water use debt prior to 1 April 2007 will be carried by DWAF.
- For the 2008/09 and 2009/10 financial years, the ICMA expenditure was assumed to be recovered through water use and discharge charges (in accordance with the Pricing Strategy), but with some proposed bridging financial support due to the current low rates of cost recovery.
- The ICMA would need to determine its pricing model for charging users and have meaningful input to the National DWAF Pricing Strategy to enable it to be viable whilst pursuing its transformation agenda.
- The ICMA would need to work closely with and identify linkages with the National Water Resource Infrastructure Agency in terms of billing and revenue collection.

Refer to the second generation business plan

[20] Items under 6.2.1 largely extracted from the ICMA second generation business plan

5.2.4 Financial Year: 2007/08

It is proposed that the ICMA collects water use charges from 2007/08 (assuming the WARMS-SAP system is stable). From Table 2 the ICMA costs for 2007/08 (excluding Capex of R1.5 million) are projected to be R16.6 million, based on the strategic direction and staffing required for implementing the identified functions.

There is a need to determine the source for funding the shortfall between the projected water use income of R10.0 million and the projected CMA costs of R16.6 million, as well as the Capex projection of R1.5 million.

5.2.5 Financial Years: 2008/09 and 2009/10

It is proposed that the ICMA sets and collects water use and discharge charges from 2008/09 (assuming the WARMS-SAP system is stable).

If there was no financial support and all registered users paid their accounts, the ICMA would have to set the WRM charges for raw water use for 2008/09 and 2009/10 at about 1.1 c/m^3 and waste discharge at about 3.5 c/m^3 discharged, in terms of the revised Pricing Strategy.

Currently there is significant under-recovery of WRM charges in the WMA (<40%), due to a number of factors (largely due to lack of service delivery and poor debt collection by DWAF). The ICMA will inherit this legacy and therefore cost recovery in the first few years is expected to be low, until the ICMA can demonstrate service delivery and legitimacy.

Assuming a cost recovery of 76% in 2008/09 and 83% 2009/10, the charge required to cover the projected costs would be significantly higher than the current WRM charges (not including Working for Water). This would severely jeopardise the legitimacy of the ICMA and may hamper its ability to improve cost recovery. It is therefore proposed that DWAF provides adequate financial support to enable the ICMA to set charges at levels assuming full cost recovery (as DWAF currently does). This would be tied to an agreement to increase cost recovery each year, with an associated decrease in the operating support to the ICMA. This would imply R4.8 million financial support for 2008/09 (76% cost recovery) and R4.0 million support for 2009/10 (83% cost recovery), excluding Capex.

Table 25 provides the projected ICMA expenditure for the 3 year period 2007/08 to 2009/10, based on the financial model assumptions outlined above. The staff expenditure in the year 2007/08 was first calculated assuming that the staffs was in place for the entire year, but then this was reduced to take account of the phased appointment that will take place. This results in the staff costs being about 70% of the cost of assumed salaries for the entire year. It is based on the assumption that the total CEO cost to ICMA is R650 000 per year, the average manager cost is R450 000 per year, senior professional cost is R300 000 per year, junior professional cost is R150 000 per year and administrative cost is R100 000 per year, based on the Patterson grading and remuneration policy as selected by the Governing Board (Table 30).

Table 30: Projected CMA expenditure for 2007/08 to 2009/10

Category	Portfolio	Year		
		2007/08	2008/09	2009/10
Staff costs	Board	R715 000	R757 900	R803 374
	CEO Office	R760 000	R805 600	R853 936
	Institutions & Participation	R2 220 000	R2 353 200	R2 494 392
	WR Planning & Programmes	R2 540 000	R2 692 400	R2 853 944
	Water Use Management	R2 390 000	R2 533 400	R2 685 404
	Governance	R300 000	R318 000	R337 080
	Corporate & Finance	R2 650 000	R2 809 000	R2 977 540
	Total (full)	***R11575 000***	***R12 269 500***	***R13 005 670***
	Total (projected)*	***R8 107 000***	***R12 269 500***	***R13 005 670***
Overheads		**R2 957 000**	**R3 801 000**	**R3 801 000**
Set-up		**-**	**-**	**--**
Outsourcing	Organisational development	R500 000	R250 000	R250 000-
	Institutional development	R1000 000	R1000 000	R1000 000
	CMS development	R1500 000	R1500 000	0
	Financial & Corporate	R 500 000	R250 000	R250 000
	WR Planning & Programmes	R1 000 000	R1 000 000	R1 000 000
	Water Use Management	R500 000	R500 000	R500 000
	Governance	R500 000	R500 000	R500 000

	Total	**R5 500 000**	**R5 000 000**	**R3 500 000**
Capital repayments		**-**	**-**	**-**
Capital	Waterworks	**R1 500 000**	**R2 000 000**	**R2 500 000?**
TOTAL CMA		**R18 064 000**	**R22 070 500**	**R22 806 6700**

** The projected total staff cost considers the appointment of staff during the year.*

At this stage no allowance has been made for repayment of loans as it is assumed that the requirements of the first 3 years infrastructure and equipment would be paid from the set up financing or transferred with the proto-CMA. Provision has however been made in respect of capital expenditure for waterworks. No decision has yet been made about the need for ICMA vehicle/s.

While the expenditure is indicative, it would be premature for the Board to further develop and cost activities, as this will be the responsibility of the ICMA executive. However, this provides a framework against which to propose required financial support for the Inkomati CMA.

Mr. Gary Robbertze, a DWAF assigned consultant, who is currently the acting Chief Finance Officer, says (Personal comm.):

- There is a final draft Memorandum of Understanding (MoU) between DWAF and ICMA which provides guidance on roles and responsibilities between DWAF and ICMA and also when transfers of staff, budget and activities will take place

- It should be noted that the MOU has not yet been signed and is therefore not yet roles and responsibilities. The ICMA's roles and responsibilities do not as a result go beyond those set out in Sections 79 and 80 of the Water Act.

In addition:

- DWAF has already calculated and published rates/charges for abstraction and discharge by each designated water user

- DWAF has issued licenses to specific classified water users in the ICMA area

- ICMA does not have the exact information or a list of who has been licensed.

- DWAF bill and collect revenue from water users based on the agreed consumption set out in the water licenses, either monthly, quarterly or annually depending on the license issued.

The ICMA is maintaining a simple computerised accounting system to manage its day to day activities, so as to produce financial statements.

5.2.6 Water Pricing Strategy

The pricing of water and related charges must be in line with the powers and functions the ICMA will be given by the National Water Act. Even if only some of the powers and functions are adopted or implemented the strategy should cover all the anticipated activities. DWAF's current pricing policy does not address all the activities that it should

5.3 FINANCIAL STATUS OF OTHER INSTITUTIONAL STRUCTURES

At the moment only a few institutional structures exist but are not 'transformed' to support the ICMA in their efforts to manage the water resources in the IWMA. Irrigation Boards (IB) exist and traditionally, they have been managing the water resources which were in their respective areas of jurisdiction. An investigation into the financial status of the IBs indicated that the assets of the Irrigation Boards run into several hundred million rands. These assets are solely owned and controlled by the Irrigation Boards via legal property servitudes.

The assets include dams, irrigation canals, weirs, pump stations etc. The Irrigation Boards in addition have a collective staff of 40 to manage and maintain the assets. It was realised during the situational assessment that the relationship between DWAF and the IBs is not very harmonious. DWAF Regional Office in Nelspruit appears to have no documents on the activities of the Irrigation Boards. It was evident that all information is handled in Pretoria. Currently the Irrigation Boards are 'sitting on' up to R15 Million that should have gone to DWAF but because of the seemingly, a dispute over the payment of fees to the Irrigation Boards for handling collections, this amount is still in the IB's coffers. The Irrigation Boards are financially sound and are sustainable.

Some of the issues that were gathered from the Irrigation Boards in connection with financial issues include the following:

- Sugar is irrigated while timber is not. But the trees absorb more surface rain water and ground water. In addition, timber growers refuse to pay for water consumed by their trees. There is a real dispute here.
- The Irrigation Boards should be transformed into Water User Associations (WUAs) who should report directly to the CMA who in turn would report directly to the Minister. This would be an efficient process and ensure that the irrigation boards retained their assets and powers and functions.
- Any attempt to strip the boards of their assets would be resisted and there are a number of legal opinions to support the irrigation board's views.
- The boards have played a very important role since 1913 and they should continue to do so under a different heading.
- The assets have not been valued recently but it would cost many hundreds of millions for the assets to be replaced. The irrigation channel in Malelane is 20 km long and would cost not less than 20 million rand to replace

- All the boards are established in terms of section 95 of the 1956 Water Act No. 54. Although there is the new Water Act of 1998 the provisions covering the irrigation boards have not been repealed. All the boards have the full powers and functions assigned by the Minister in terms of section 89 of the 1956 Act.
- The entire area is divided into rateable areas and water rights with quotes have been assigned to each area. The entire physical area is covered by the irrigation boards including water allocated to the municipalities. DWAF has lost the documentation supporting the water allocations which was allocated some 20years ago.
- Water Bailiff's are also employed from time to time to collect outstanding service charges.
- The powers and functions of the irrigation boards with respect to ownership are set out in section 89 of the Water Act (36 of 1998).
- To date there have not been any disputes. But places like White River have effectively run out of water due to expanding domestic use. It is possible that disputes will arise in the future. New developments and the planting of trees require environment impact studies and special licenses before they can go ahead.
- Each board manages its own affairs. Each board bills for consumption based on the water allocated to the user. DWAF bills separately and the boards act as their collection agents. However there is a dispute with DWAF over the collection commission due to the boards so monies collected have not been paid over to DWAF but remain in trust with the boards.

6. PUBLIC PARTICIPATION IN WATER RESOURCE MANAGEMENT IN THE IWMA

6.1 PUBLIC PARTICIPATION IN PERSPECTIVE

Public participation transforms the democratic system, energizing it, by creating a permanent connection between the governed and those who govern. The joint venture permits more reasoned decisions (being these the product of a higher consensus), enables a better understanding of the problems that preoccupy a society, and allows the two parties to work cooperatively towards possible solutions.
The challenge of a development pattern striving to harmonize economics with social and environmental needs requires active citizen participation in public issues. Public participation in decisions about development of CMS is fundamental to achieving lasting and possible solutions in this particular Water Management Area (WMA).

Catchment management can not be done effectively and efficiently if public participation is not built into the process right from the beginning. Capacity building cuts across all stages in the catchment management processes. Public participation therefore becomes central to capacity building at the various stages in catchment management (especially in the development of CMS which are new in this country). Various definitions of public participation abound in literature. They include;

- "The redistribution of power that enables the have-not citizens (the Historically Disadvantaged Individuals - HDIs), presently excluded from the political and economic processes, to be deliberately included in future. In short it is the means by which they can induce significant social reform which enables them to share in the benefits of the affluent society" (Arnstein 1969)
- "A process through which stakeholders influence and share control over development initiatives and the decisions and resources which affect them. (World Bank, 1994)

The Department of Water Affairs and Forestry's (DWAF) Generic Public Participation Guidelines (2001) describes public participation as a variety of relationships between the implementing agency and its stakeholders. The International Association of Public Participation (IAP2) differentiates between five levels of public participation namely, informing, consulting, involving, collaborating and empowering. In so far as involvement is concerned, the World Bank identified two types of involvement namely, passive, consultative and interactive participation. Public participation in catchment management therefore seeks to incorporate concerns of all tiers of society (corporate or public) in decision-making processes on water resource management issues that affect the society or community concerned. The aim is to build capacity to ensure the involvement of stakeholders and local community in decision-making on water resource management issues. Participation ranges from being given notice of public hearings to being actively included in decisions that affect communities. Notices per se do not in any way build capacity on specific issues on water resource management. It must be understood that before a society or community can be involved in decision making processes in catchment management issues, they need to be capacitated in a way.

6.2 STATUTORY REQUIREMENTS FOR PUBLIC PARTICIPATION

Institutional management and participation of all stakeholders is essential to achieve the successful protection, use, development, conservation, management and control of our water resources. The institutional framework outlined in the National Water Act (NWA 36 of 1998) provides for the progressive decentralisation of water resource management to the appropriate level as well as providing for participation in water resource management in South Africa. The NWA stipulates that the NWRS among other things; should provide objectives for the establishment of institutions to undertake water resource management and also to determine the inter-relationship between institutions involved in water resource management.

The National Water Act (Act No 36 of 1998) requires consultation with "society at large" in the progressive development of water resource strategies. The Inkomati Catchment Management Strategy is one of such strategies. One of the NWA's main objectives is to progressively decentralise the responsibility for water resources management from national to regional institutions, e.g. CMAs. The CMAs must, in turn, promote the participation of the water users and other stakeholders in their

areas in all aspects of water resources management. The requirements for public participation applicable to catchment management agencies with regard to the development of catchment management strategies are noted below:

- Chapter 2, Part 2: In the process of developing the strategy, catchment management agencies must seek co-operation and agreement on water-related matters from the various stakeholders and interested persons;
- Section 8: Requirements for publication of the strategy in the Government Gazette, bringing it to the attention of interested persons and considering their comments;
- Section 9(g): Enable the public to participate in managing the water resources within its water management area; (h) take into account the needs and expectations of existing and potential water users; and (i) set out the institutions to be established;
- Section 10(2): In developing a catchment management strategy, a catchment management agency must consult with (a) the Minister; (b) any organ of state which has an interest in the content, effect or implementation of the catchment management strategy; and (c) any persons, or their representative organisations - (i) whose activities affect or might affect water resources within its water management area; and (ii) who have an interest in the content, effect or implementation of the catchment management strategy.

The National Water Resource Strategy (NWRS, 2002) states that before water users and stakeholders can effectively contribute to water resources management in their area they need to be aware of water resources management issues and problems and to understand what must be done. Furthermore, the NWRS suggests that a comprehensive stakeholder analysis be conducted to determine the capacity of users and stakeholders to participate in the management of the water resource.

6.3 OBJECTIVES OF PUBLIC PARTICIPATION IN CATCHMENT MANAGEMENT STRATEGIES

The NWA (Section 3 (2)) states that water must be allocated equitably and used beneficially and sustainably in the public interest, while promoting environmental values. To achieve sustainability, there must be appropriate water supply for everyone (equity) forever (sustainability). The three dimensions of sustainability must be taken into consideration at all times, informed by local catchment needs and circumstances to address social development, ensure equitable access to water, promote economic growth and ecological integrity. A catchment management strategy must thus balance all the recognised uses of water in a catchment while protecting the catchment's water resources. An appropriate public participation process will capacitate the stakeholders. It will also ensure the buy-in of stakeholders and that will lead to:

- improved decision-making in the management of the resource;
- sustainable development is achieved;
- creating awareness amongst the public of the competing use and the related trade-offs

6.4 STATUS OF PUBLIC PARTICIPATION IN THE CATCHMENT

The Inkomati CMA (ICMA) is the first CMA in the country, established through a lengthy consultative process in accordance with the Act. Public participation in different forms has taken place in the IWMA for various reasons and objectives. Currently the ICMA has embarked on empowerment programmes to ensure that the stakeholders and the communities in the water management area will be able to participate effectively in the management of water resources. As a result 4 catchmet forums have been initiated (to add to the Crocodile Forum that was in existence before the launch of the ICMA). In the past many other initiatives or projects in the IWMA organised their own Public Participation exercises. The ICMA has now come up with a 'master plan' to ensure that all public participation programmes are aligned and controlled by the public participation specialists in the ICMA.

6.4.1 Public participation forums

DWAF recommends that forums be established before and during the establishment of Catchment Management Agencies. This is because they have proved to be of great value in focusing consultation with the public, and integrating the water-related activities of other non-governmental and community-based organisations (CBOs). Under normal circumstances, forums would have been created during the establishment of the ICMA to develop constructive and trusting relationships between DWAF, water resource managers and the public, and a common vision and understanding of the agency's role and functions. One prominent Catchment Management Forum in the Crocodile Catchment exists which has a well-maintained stakeholder database. Currently Catchment Forums have been established in all the sub-catchments.

6.4.2 Stakeholder database

A stakeholder database is a body of information collected over time, dedicated to a particular project and containing details of stakeholders identified and consulted to participate in the public participation process of a project. Normally, such a database is kept in electronic files and categorised according to sectors so that one can have a better perspective of all stakeholders participating and the sectors they represent. The Institutional and Public Participation section of the ICMA did not have such a database from the participation process conducted during the establishment of the ICMA. The only stakeholder information at their disposal was that which they have collected themselves when they consulted with stakeholders in the sub-catchment in their bid to establish stakeholder empowerment groups (capacity building).

6.4.3 ICMA's plan of action in so far as public participation is concerned

The entire catchment is divided into three sub-catchments namely, Sabie, Crocodile and Komati sub-catchment. Each of the three Institution and Participation specialists has been assigned a sub-catchment to manage its stakeholder engagement activities. The Institution and Participation specialists have embarked on a catchment-wide awareness creation campaign. It is

understood that where necessary and possible, stakeholders, particularly from previously-disadvantaged backgrounds, are offered assistance in understanding water resource management issues, so that they may participate in an informed and meaningful way. According to the CEO of ICMA, a number of issues regarding the public participation process for the development of the catchment management strategy are very important, one of which is the desire to see the ICMA play a visible role in promoting awareness about the ICMA and its role in the IWMA.

7. CRITICAL ISSUES AND OTHER IDENTIFIED CHALLENGES

7.1 WATER RESOURCES MANAGEMENT ISSUES

Most of the water resources management issues identified in this status quo report are the same as the ones mentioned in the Internal Strategic Perspective (DWAF, 2004). Some additions have been made in accordance with newer studies and interaction with stakeholders. They are:

- Deficit in the Crocodile and Upper Komati (compulsory licensing – ongoing studies)
- Meeting international requirements – operating rules are being developed in the Inkomati WMA.
- Ecological requirements, e.g.
    - Operating rules to ensure ecological requirements are met
    - Monitoring of ecological indicators
    - Reserve determination (ongoing studies)
- Distribution of water from the Inyaka Dam - Finalisation of the Bosbokrand Transfer pump(not yet)
- Continued high quality water transfers to the Olifants catchment for power generation
- The manufacture of pulp and paper requires an enormous amounts of water, firstly by the growing tree and secondly in the manufacturing process used by the mill
- The volume of chemicals used in pulp and paper production is extensive and the waste water is not fit for anything other than watering grass after it has been used by the mill
- The main concerns are the Sappi paper mill at Ngodwana: effluent has been disposed of through irrigation and the salts that have accumulated in the soils (especially chlorine) are leaching into the Elands and thus the Crocodile River. Other pollution takes place around the Kaap River and the Lower Crocodile River (return flows from irrigation, urban areas and old gold mining activity)
- A more detailed groundwater study is needed

7.2 WATER SERVICES

- Lack of general participation of local government in the ICMS process and meaning contributions
- WSDPs do not considerably address issues related to Water Resources Management.
- Lack of skilled personnel for water services provision, eg; WWTW operations and networks maintenance which contributes to water losses and impact on water quality

- Uncontrolled developments, causing huge migration of people to urbanized areas of the catchment, causing strain of water services provision
- Lack of proper infrastructure asset registers, O&M plans and asset management planning.

7.3 FINANCIAL

- The current basis for pricing water charges by DWAF appears to cover only some activities and the methodology on which the charges are calculated is not explained.
- The development of a Water Pricing Strategy in line with all the powers and functions the ICMA will be given by the National Water Act is essential.
- The ICMA must move to a sustainable financial basis as soon as possible by billing for services rendered and thus ensuring that DWAF ceases to bill.
- A single consolidated bill should be prepared for consumers which should include the charge currently billed by the Irrigation Boards
- The financial implications of the amalgamation of Irrigation Boards need to be understood and quantified.
- The financial strategy of the ICMA needs to identify and quantify “Economic Value” for consumers in its charges.
- The business plan and budget of the ICMA current covers only limited activities a more comprehensive budget is required soon.
- A strategy for funding of bodies such as the Water Users Associations is essential.
- A financial assistance strategy for the poor is essential for the ICMA to remain financially sustainable and the poor to have an equitable share of the water resources.

Local government should contribute to the finances of the ICMA as the ICMA is likely to undertake, on an unfunded basis, activities that should be undertaken by the municipalities in their capacity as WSA’s.

7.4 INSTITUTIONAL

- Institutional alignment between DWAF and the ICMA regarding all WRM activities
- Power, framework and capacity to monitor and enforce IWRM
- Provincial and local government plans to specifically address trends and projections and activities impacting on water resources management
- Transformation of Irrigation Boards
- The roles and responsibilities of the National Water Infrastructure Agency
- The roles and responsibilities of ICMA in relation to DWAF’s international commitments
- The attraction, development and retention of skills and expertise in water resources management
- The land reform / water reform interface
- The water resources / water services delivery interface

7.5 PUBLIC PARTICIPATION

- All the four officials working in the Institution and Participation Department are new in the field, most of them started with the CMA in February 2007
- None of them was involved in the process to establish the ICMA and therefore they do not have knowledge of the previous public participation process
- Very little information (on the public participation process and water resource management in general) if any, was left behind for them to work with
- They have not been involved in the determination or the execution of the other initiatives in the IWMA

7.6 OTHER CHALLENGES

Most of the challenges stem from the severe poverty faced by many in the Province and the high inequality between the rural poor and well-serviced urban centres as well as under-serviced townships and informal settlements. The growth and development challenges in the province can be summarised in a few distinct, but interrelated categories, namely:

Poverty

- Poverty can broadly be defined in terms of a lack of access to opportunities for a sustainable livelihood. These opportunities can be characterised in terms of income, skills, knowledge, self-confidence and access to decision-making. The most severe and deep poverty in South Africa has been created in the former homeland areas.
- There is a gap between economic and demographic growth resulting in increasing unemployment due to insufficient investment in economic development and job creation in the Province. The Province is predominantly rural and economic development is largely concentrated in urban areas.

HIV and AIDS

- Although there are a number of controversies exist relating to the reliability of the statistics on HIV and AIDS and its effect on economic growth, the rapid rise in its prevalence cannot be disputed. The Province has one of the highest HIV and AIDS infection rates in the Country (30%).
- HIV and AIDS will stretch the social system to its limit with a high number of professional people losing their livelihood due to illness in addition to a rapidly increasing number of orphans.
-

Infrastructure and service delivery backlogs

- The socio-economic development potential of the Province is constrained by the insufficient road/rail infrastructure.
- There exists a backlog in the delivery of services, especially in rural areas. Water supply and sanitation are major challenges.

Lack of appropriate skills

- The Province is characterised by a lack of critical skills and a “brain drain” phenomenon among its population.
- The rural nature of the Province is one of the factors contributing to the lack of appropriate skills.

Governance

- Corruption limits the effects of good governance measures and service delivery.
- The potential of revenue collection, to improve the income base, is not fully exploited.

Environmental degradation

Pressures on environmental resources are not comprehensively monitored. The pollution of the waters in the WMA is increasing and sewage and other sources are seen as a threat to the suitability of the resource for all the identified users in the IWMA.

Communication Strategies

There are no formal communication strategies existing between the ICMA and DWAF, or the ICMA and its stakeholders. The current instrument regulating the DWAF/ ICMA relationship is the memorandum of understanding. This is a document reflecting intention, but acknowledging that there is still key information and detail to work out. A formal communication strategy with stakeholders will be an element to be addressed through the development of the CMS.

Planning Tools

The ICMA has it 2nd generation Business Plan, which sets outs its activities in a prioritised manner. The development of the CMS must take into account the WSDPs of the WSAs and the Provincial Growth and Development Plans. Key issues are projected growth in the various sectors and the impact on water requirements. From the review of 2 WSDPs so far, the WSAs have not specifically focussed on their projected water requirements. The Institutional Specialists of the ICMA must educate their WSAs on the importance of the WSDP as a planning tool which will feed into its LED strategies.

8. INITIATIVES AND OTHER PLANNED PROGRAMMES IN THE IWMA

DWAF is currently evaluating progress towards race and gender reform with respect to access to water for productive purposes (WFSP / WRM / CONSOOS). The objective of the study is to use existing information to determine the status of race and gender reform, but estimating the proportion of water in each WMA that is allocated to HDI's. At a very high-level, and subject to a number of assumptions and qualifications, it is estimated that the percentage registration –water to black users in the IWMA is about 25%.

Other initiatives that were either initiated by DWAF or the ICMA include the following: Catchment Assessment Study, Water Availability Assessment study, Water Allocation Framework, Water Resource Classification, Reserve Determination, Compliance Monitoring and Enforcement. None of the outputs of this initiative has officially been signed off.

9. CONCLUSION

The strategy for monitoring enforcement of the outcomes of compulsory licensing will need to be developed by the ICMA taking cognisance of its powers and functions under the law and in terms of the delegations and assignments. There is currently no formal process to be inherited from DWAF. It will also depend on the roles and responsibilities of the CMCs and WUAs in the IWMA. Cognisance will also have to be taken of the National Environmental Management Act and its enforcement provisions around pollution, and the provincial and local government disaster management frameworks.

The ICMA is a public entity within a framework of a government with high developmental priorities. In establishing the ICMA to undertake its primary function of water resources management, a key focus is ensuring that activities of the ICMA impact the people in the IWMA, by ensuring redress of equity, but finely balanced with the issues of environmental and financial sustainability, job creation, poverty alleviation and broad-based black economic empowerment.

The description of water related issues in the IWMA has revealed or emphasised that the IWMA is water-stressed at the moment. The quality of the water in the IWMA is a key issue. The quality is currently good, but is threatened by the activities of various stakeholders including mines, agriculture and municipal works. The impact of waste water treatment works in the IWMA has reached alarming levels. Deterioration of the quality would have serious repercussions for Eskom, which requires good

quality water for their power stations, Aquatic biodiversity and for domestic use. In fact all identified users will be affected. The sub-strategies to be developed should make provision for the quantification and measures to limit the risk of serious deterioration in the water quality and quantity as a result of illegitimate and non efficient use.

REFERENCES

AfriDev, 2006a. Main Report. Komati Catchment Ecological Water Requirements Study. Department of Water Affairs and Forestry, Pretoria. Report No. RDM X100-00-CON-COMPR2-1205.

AfriDev, 2006b. EWR Report: Quality. Komati Catchment Ecological Water Requirements Study. Department of Water Affairs and Forestry, Pretoria. Report No. RDM X100-01-CON-COMPR2-0407.

AfriDev, 2006c. EWR Report: Wetlands Scoping Report. Komati Catchment Ecological Water Requirements Study. Department of Water Affairs and Forestry, Pretoria. Report No. RDM X100-03-CON-COMPR2-0303.

Cowardin LM, Carter V, Golet FC and LaRoe ET (1979). Classification of Wetlands and Deepwater Habitats of the United States. FWS-OBS-79-31. US Fish and Wildlife Service, Washington, DC.

CSIR, 2003. State of the Rivers Report: Crocodile, Sabie-Sand and Crocodile River Systems *Development Strategic Plan 2004 to 2014* (DBSA, DIBU, 2004:23).

Davis TJ (ed.) (1994). The Ramsar Convention Manual: A Guide to the Convention on Wetlands of International Importance especially as Waterfowl Habitat. Ramsar Convention Bureau, Gland, Switzerland. 207pp.

Department of Water Affairs and Forestry, South Africa. 2004. DWAF Report No. P WMA 05/000/00/0303: Internal Strategic Perspectives: Inkomati Water Management Area – Version 1 (March 2004). Tlou & Matji (Pty) Ltd.

DWAF (2006). Undertake the validation and verification of registered water use in the Nkomati, Crocodile (east) and Sabie river catchments as well as in the Olifants (north) catchment. Draft final report. Task 2: Validate water use in the catchment.

DWAF 2004. Internal Strategic Perspective: Inkomati Water Management Area. DWAF report no. P WMA 05/000/00/0303.

DWAF published charges for abstraction and discharge of water

DWAF, 1996a. South African Water Quality Guidelines. Volume 1: Domestic Use.

DWAF, 1996b. South African Water Quality Guidelines. Volume 4: Agricultural Use: Irrigation.

DWAF, 1996c. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems.

DWAF, 2003. Inkomati Water Management Area: Water Resources Situation Assessment – Main Report. DWAF Report no. P05000/00/0101.

DWAF, 2003a. Inkomati Water Management Area. Overview of Water Resources Availability and Utilisation. DWAF Report no. P WMA 05/000/00/0203.
DWAF, 2006. Undertake the validation and verification of registered water use in the Nkomati, Crocodile (east) and Sabie river catchments as well as in the Olifants (north) catchment. Draft final report. Task 2: Validate water use in the catchment.

DWAF, 2006. Inkomati WMA Catchment Assessment Report (Draft)

DWAF, 2007. Undertake and Assessment of the Current Water Allocation Status and Potential for Establishing viable Water using Enterprises in the Olifants and Inkomati WMA. Inkomati WMA Catchment. Assessment Report.

DWAF, 2007a. Undertake and Assessment of the Current Water Allocation Status and Potential for Establishing viable Water using Enterprises in the Olifants and Inkomati WMA. State of the Aquatic Ecosystems in the Olifants and Inkomati WMA. Final Report. January 2007.

DWAF, n.d. Mpumalanga Groundwater Masterplan.

Final draft Memorandum of Understanding with DWAF

Five year budget prepared by Dr. Guy Pegram of Pegasus

Gyedu-Ababio, TK. 2005. Water Crisis in the Kruger National Park, Position Paper for KNP Management.

Gyedu-Ababio, TK; Furstenberg, JP; Baird, D and Vanreusel, A. 1999
HYDROBIOLOGIA. **397:**155-169. Nematodes as indicators of pollution: A Case
Study from the Swartkops River system, South Africa

ICMA Strategic Operational plan – 2007/08

National Water Act (36 of 1998)

National Water Resource Strategy 2004

National Wetland Inventory, 2006: Natioanl Wetland Map (Beta)

Ninham Shand 2007. Evaluate progress towards race and gender reform with respect to access to water for productive purposes, DWAF report no. WFSP/WRM/CON5005

Second generation Business Plan – February 2007

State of the Environment Report, 2003. Mpumalanga

STATS SA 2002. Rainfall data in the IWMA

Water for Africa (2007). Infrastructure report for the Inkomati Water Management Area. DRAFT. Unpublished.

Water for Africa (2007a). System operation: Inkomati System. DRAFT. Unpublished.

Water Services Act (108 of 1997)

APPENDICES
APPENDIX A: Instream Flow Requirements in the IWMA
Table 5a: Sabie River IFR (Downstream of Marite confluence)

BUILDING BLOCKS		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Maintenance IFR	Magnitude (m^3/s)	2	3	5	6	6	6	5	4	3.5	3	2.6	2.3
	Depth (m)	5.3	7.8	13.4	16.1	14.5	16.1	13	10.7	9.1	8	7	6
Base flows	Volume (MCM)	100	100	100	100	100	100	100	100	100	100	100	100
	FDC % V	79	87	86	76	85	86	90	90	86	86	83	80
	FDC % V												
	Magnitude (m^3/s)	9	12	30	17	50 190	16	14					
	Depth (m)	3	3	7	5	10 14	5	5					
Higher flows	Duration (d)	1:1	1:1	1:1	1:1	1:1 1:3	1:1	1:1					
	Return period (y)	0.9	1.2	7.6	2.4	19 100	2.1	3					
	Volume (MCM)	67	46	10	26	4 0.4	28	36					
	FDC % V	33	23	6	15	3 0.3	16	19					
	FDC % V												
CAPPING FLOWS						**NOTE IRRIGATION DEMANDS**							
DROUGHT IFR	Magnitude (m^3/s)	1.5	1.9	2.3	2.6	3	2.8	2.5	2.3	2.1	1.9	1.7	1.6
	Depth (m)	4	4.9	6.2	7	7.2	7.5	6.5	6.2	5.4	5.1	4.5	4.1
BASE FLOWS	Volume (MCM)	100	100	100	100	100	100	100	100	100	100	100	100
	FDC % V	90	95	97	99	98	99	99	99	96	95	94	92
	FDC % V												
	Magnitude (m^3/s)		3.8	4.6	5.2	6	5.6	5					
	Depth (m)		3	3	3	3	3	3					
	Duration (d)		1:1	1:1	1:1	1:1	1:1	1:1					
	Return period (y)		0.25	0.3	0.34	0.39	0.36	0.32					
HIGHER FLOWS	Volume (MCM)		99	98	96	92	94	97					
	FDC % V		78	69	63	54	58	65					
	FDC % V												

Maintenance IFR	Base flow	Higher flows	**Total**	**Drought IFR**	Base flow	Higher flows	**Total**
Volume (MCM)	127	63.2	**190.2**	**Volume (MCM)**	68.6	2	**70.6**
As % of MAR	(V) 23.2 (P) 33.8	(V) 11.6 (P) 16.9	**(V) 34.8** **(P) 50.7**	**As % of MAR**	(V) 12.5 (P) 18.3	(V) 0.4 (P) 0.5	**(V) 12.9** **(P) 18.8**
MAR (MCM)	(V) 547	(P) 375					

MEDIAN (MCM)	(V) 466	(P) 298

Table 5b: Sabie River IFR (Inside the KNP)

BUILDING BLOCKS		**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
Maintenance IFR	Magnitude (m^3/s)	4.5	6	9	10	12	11	10	8	6	5	4.5	4
	Depth (m)												
	Volume (MCM)	12.1	15.5	24.1	26.8	29	29.5	25.9	21.4	15.4	13.4	12.1	10.4
	FDC % V	94	94	90	90	82	85	89	92	95	97	98	98
Base flows	FDC % V	33	49	54	52	64	62	54	43	49	50	44	44
Higher flows	Magnitude (m^3/s)	9	12	30	17	50	16	14					
	Depth (m)					20							
	Duration (d)	3	3	7	5	0	5	5					
	Return period (y)	1:1	1:1	1:1	1:1		1:1	1:1					
	Volume (MCM)	0.6	0.8	6.3	1.5	10	1.1	0.9					
	FDC % V	68	47	10	27	14	29	37					
	FDC % V	34	24	6	15	1:1	16	20					
						1:3							
						16.4							
						100							
						5							
						0.4							
						3							
						0.3							
CAPPING FLOWS		**NONE SPECIFIED**											
DROUGHT IFR	Magnitude (m^3/s)	2.5	3.5	4	5	6	5.5	4.5	3.5	3	2.5	2	2
	Depth (m)												
	Volume (MCM)	6.7	9.1	10.7	13.9	14.5	14.7	11.7	9.4	7.8	6.7	5.3	5.2
	FDC % V	100	100	100	100	90	100	100	100	100	100	100	100
BASE FLOWS	FDC % V	72	80	92	92	87	89	94	93	91	91	92	88
HIGHER FLOWS	Magnitude (m^3/s)		7			10							
	Depth (m)												
	Duration (d)		3			5							
	Return period (y)		1:1			1:1							
	Volume (MCM)		0.4			0.9							
	FDC % V		84			60							
	FDC % V		46			30							

Maintenance IFR	Base flow	Higher flows	**Total**	**Drought IFR**	Base flow	Higher flows	**Total**
Volume (MCM)	235.7	55.5	**291.2**	**Volume (MCM)**	115.7	1.3	**117**

As % of MAR	(V) 42.1 (P) 60.6	(V) 9.9 (P) 14.3	**(V) 52** **(P) 74**	**As % of MAR**	(V) 20.7 (P) 29.7	(V) 0.2 (P) 0.3	**(V) 20.9** **(P) 30**
MAR (MCM)	(V) 560	(P) 389					
MEDIAN (MCM)	(V) 476	(P) 308					

Table 5c: Sabie River IFR (At Skukuza)

BUILDING BLOCKS		**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
Maintenance IFR	Magnitude (m^3/s)	3	4	5	6	9	8	7	6	5.2	4.5	4	3.4
	Depth (m)	0.82	0.89	0.96	1.02	1.17	1.12	1.07	1.02	0.97	0.93	0.89	0.85
	Volume (MCM)	8	10.4	13.4	16.1	21.8	21.4	18.1	16.1	13.5	12	10.7	8.8
	FDC % V	100	99	99	100	94	96	98	98	98	98	98	98
Base flows	FDC % V	54	69	86	79	74	77	76	65	59	55	48	49
Higher flows	Magnitude (m^3/s)	9	12	30	20	50 180	21	18					
	Depth (m)	1.17	1.3	1.83	1.57	2.21 3.54	1.6	1.51					
	Duration (d)	3	3	7	5	10 14	5	5					
	Return period (y)	1:1	1:1	1:1	1:1	1:1 1:3	1:1	1:1					
	Volume (MCM)	0.8	1	7.6	3	17.7 100	2.8	2.4					
	FDC % V	70	66	18	65	25 5	70	80					
	FDC % V	10	25	8	40	20 1	50	42					
CAPPING FLOWS		**NONE SPECIFIED**											
DROUGHT IFR	Magnitude (m^3/s)	2	2.5	3	3.5	4	3.7	3.3	3.1	2.8	2.5	2.3	2.1
	Depth (m)	0.73	0.77	0.82	0.85	0.89	0.87	0.84	0.82	0.8	0.77	0.76	0.74
BASE FLOWS	Volume (MCM)	5.3	6.5	8	9.4	9.7	9.9	8.6	8.3	7.2	6.7	6.2	5.4
	FDC % V	100	100	100	100	100	100	100	100	100	100	100	100
	FDC % V	72	87	92	97	95	95	95	93	90	87	81	77
HIGHER FLOWS	Magnitude (m^3/s)		5	6	7	8	7	6					
	Depth (m)		0.96	1.02	1.07	1.12	1.07	1.02					
	Duration (d)		3	3	3	3	3	3					
	Return period (y)		1:1	1:1	1:1	1:1	1:1	1:1					
	Volume (MCM)		0.3	0.4	0.4	0.5	0.4	0.3					
	FDC % V		96	97	99	96	99	100					
	FDC % V		58	78	65	77	81	85					

Maintenance IFR	Base flow	Higher flows	**Total**	**Drought IFR**	Base flow	Higher flows	**Total**
Volume (MCM)	170.3	62.7	**233**	**Volume (MCM)**	91.2	2.3	**93.5**
As % of MAR	(V) 28.7 (P) 41.3	(V) 10.6 (P) 15.2	**(V) 39.3** **(P) 56.5**	**As % of MAR**	(V) 15.4 (P) 22.1	(V) 0.4 (P) 0.6	**(V) 15.8** **(P) 22.7**
MAR (MCM)	(V) 594	(P) 412					

MEDIAN (MCM)	(V) 512	(P) 338

Table 5d: Sabie River IFR (Downstream of Sand River confluence)

BUILDING BLOCKS		**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**
Maintenance IFR	Magnitude (m^3/s)	4	8	10	13	18	14	10	8	6	4	4	3
	Depth (m)												
	Volume (MCM)	10.7	20.7	26.8	34.8	43.5	37.5	25.9	21.4	15.5	10.7	10.7	7.8
	FDC % V	96	77	87	80	71	81	93	94	96	100	98	99
Base flows	FDC % V	38	33	53	48	58	62	63	53	57	67	53	56
	Magnitude (m^3/s)	8	12	30	20	45 180	21	18					
	Depth (m)												
	Duration (d)	3	3	7	5	10 14	5	5					
Higher flows	Return period (y)	1:1	1:1	1:1	1:1	1:1 1:3	1:1	1:1					
	Volume (MCM)	0.5	0.5	6	3.7	11.7 96	1.5	1.7					
	FDC % V	81	56	15	27	8 0.9	26	33					
	FDC % V	45	30	10	17	6 0.8	16	19					
CAPPING FLOWS		**NONE SPECIFIED**											
DROUGHT IFR	Magnitude (m^3/s)	3	3.5	4	4.5	5							
	Depth (m)												
	Volume (MCM)	8	9.1	10.7	12.1	12							
	FDC % V	100	100	100	100	100							
BASE FLOWS	FDC % V	54	70	90	92	91							
HIGHER FLOWS	Magnitude (m^3/s)			12		10							
	Depth (m)												
	Duration (d)			3		3							
	Return period (y)			1:1		1:1							
	Volume (MCM)			1		0.6							
	FDC % V			56		69							
	FDC % V			30		36							

Maintenance IFR	Base flow	Higher flows	**Total**	**Drought IFR**	Base flow	Higher flows	**Total**
Volume (MCM)	266	48.3	**314**	**Volume (MCM)**	108.9	1.6	**110.4**
As % of MAR	(V) 37.6 (P) 53.4	(V) 6.8 (P) 9.7	**(V) 44.4** **(P) 63.1**	**As % of MAR**	(V) 15.4 (P) 21.9	(V) 0.2 (P) 0.3	**(V) 15.6** **(P) 22.1**
MAR (MCM)	(V) 708	(P) 498					
MEDIAN (MCM)	(V) 607	(P) 394					

Table 6: Sand River IFR

BUILDING BLOCKS		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Maintenance IFR	Magnitude (m^3/s)	0.3	0.3	0.75	1	1.5	1.5	0.9	0.7	0.6	0.5	0.4	0.3
	Depth (m)	0.51	0.51	0.65	0.71	0.79	0.79	0.69	0.64	0.61	0.58	0.55	0.51
	Volume (MCM)	0.8	0.8	2	2.7	3.6	4	2.3	1.9	1.6	1.3	1.1	0.8
	FDC % V	85	88	91	95	87	87	90	92	91	92	93	92
Base flows	FDC % V	39	44	48	61	63	67	70	65	64	63	61	55
	Magnitude (m^3/s)	1.5	5	6	10	15 60	10						
	Depth (m)	0.79	1.1	1.16	1.33	1.49 2.16	1.33						
	Duration (d)	2	8	8	8	8 10	8						
Higher flows	Return period (y)	1:1	1:1	1:1	1:1	1:1 1:3	1:1						
	Volume (MCM)	0.1	1.6	1.8	3.1	4.7 25.3	2.9						
	FDC % V	54	15	12	7	4 1	7						
	FDC % V	33	11	10	5	3 1	5						
CAPPING FLOWS		**NONE SPECIFIED**											
DROUGHT IFR	Magnitude (m^3/s)	0.1	0.1	0.3	0.3	0.5	0.5	0.5	0.3	0.1	0.1	0.1	0.1
	Depth (m)	0.38	0.38	0.51	0.51	0.58	0.58	0.58	0.51	0.38	0.38	0.38	0.38
BASE FLOWS	Volume (MCM)	0.3	0.3	0.8	0.8	1.2	1.3	1.3	0.8	0.3	0.3	0.3	0.3
	FDC % V	94	95	94	98	95	93	95	98	100	98	98	98
	FDC % V	59	54	61	82	81	85	84	89	89	86	79	68
HIGHER FLOWS	Magnitude (m^3/s)			3	3	6							
	Depth (m)			0.96	0.96	1.16							
	Duration (d)			2	2	3							
	Return period (y)			1:1	1:1	1:1							
	Volume (MCM)			0.2	0.2	0.7							
	FDC % V			26	26	12							
	FDC % V			18	18	10							

Maintenance IFR	Base flow	Higher flows	**Total**	**Drought IFR**	Base flow	Higher flows	**Total**
Volume (MCM)	22.9	21.1	**44**	**Volume (MCM)**	8	1.1	**9.1**
As % of MAR	(V) 18.8 (P) 23.9	(V) 17.3 (P) 22	**(V) 36.1** **(P) 45.9**	**As % of MAR**	(V) 6.6 (P) 8.3	(V) 0.9 (P) 1.1	**(V) 7.5** **(P) 9.4**
MAR (MCM)	(V) 122	(P) 96					
MEDIAN (MCM)	(V) 90	(P) 60					

TABLE 7A: CROCODILE RIVER IFR – IFR SITE 5: MALELANE

Virgin MAR 12.11 x 10^6 m^3 (WR90)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL 10^6 m^3
IFR MAINTENANCE LOW FLOWS													
Flow (m^3/s)	7.3	8.1	8.8	9.5	10.3	11	10.3	9.5	8.8	8.1	7.3	6.6	
Depth (m)													
FDC %	82	99	96	97	96	96	92	88	83	82	80	92	
Volume (**10^6 m^3**)	19.64	20.91	23.57	25.53	24.84	29.46	26.61	25.53	22.81	21.61	19.64	17.11	227.26
IFR MAINTENANCE HIGH FLOWS													
Flow (m^3/s)	11	55	90	100	250	50	15						
Depth (m)													
Duration (days)	5	5	5	5	8	5	5						
Return period	1	1	1	1	2	1	1						
FDC %	65	28	16	17	7	50	86						
Volume (**10^6 m^3**)	0.792	10.14	17.6	19.54	41.43	8.424	1.022						98.882
TOTAL IFR MAINTENANCE													**376.142**
IFR DROUGHT LOW FLOWS													
Flow (m^3/s)	4.4	4.9	5.3	5.7	6.2	6.6	6.2	5.7	5.3	4.9	4.4	4	
Depth (m)													
FDC %	96	100	99	99	99	99	99	96	96	94	100	100	
Volume (**10^6 m^3**)	11.87	12.61	14.2	15.36	14.92	17.68	15.98	15.36	13.74	13.03	11.87	10.37	166.99
IFR DROUGHT HIGH FLOWS													
Flow (m^3/s)	5	15	20	8	225	7	8						
Depth (m)													
Duration (days)	4	4	4	4	4	4	4						
Return period	1	1	1	1	2	1	1						
FDC %	93	88	85	98	8	98	95						
Volume (**10^6 m^3**)	0.098	1.751	2.540	0.392	18.91	0.069	0.317						24.074

TOTAL IFR DROUGHT	191.064

TABLE 7B: CROCODILE RIVER IFR – IFR SITE 6: NKONGOMA

Virgin MAR 1260 x 10^6 m^3 (WR90)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL 10^6 m^3
IFR MAINTENANCE LOW FLOWS													
Flow (m^3/s)	7.7	9.4	11.2	13	14.7	16.5	14.7	13	11.2	9.4	7.7	5.9	
Depth (m)													
FDC %	80	97	93	95	93	92	88	78	77	79	80	97	
Volume (**10^6 m^3**)	20.53	24.45	30	34.73	35.64	44.19	38.19	34.73	29.03	25.27	20.53	15.29	352.59
IFR MAINTENANCE HIGH FLOWS													
Flow (m^3/s)	12	30	90	147	225	80	15						
Depth (m)													
Duration (days)	5	5	5	5	8	5	5						
Return period	1	1	1	2	2	1	1						
FDC %	61	62	17	8	8	30	88						
Volume (**10^6 m^3**)	0.936	4.442	17.02	14.48	41.52	13.72	0.058						92.166
TOTAL IFR MAINTENANCE													**444.756**
IFR DROUGHT LOW FLOWS													
Flow (m^3/s)	3.1	3.6	4	4.4	4.9	5.3	4.9	4.4	4	3.6	3.1	2.7	
Depth (m)													
FDC %	98	100	100	100	99	98	100	100	100	100	100	100	
Volume (**10^6 m^3**)	8.39	9.24	10.71	11.87	11.77	14.2	12.61	11.87	10.37	9.55	8.39	7	125.99
IFR DROUGHT HIGH FLOWS													
Flow (m^3/s)	8	15	20	16	255	15	10						
Depth (m)													
Duration (days)	4	4	4	4	4	4	4						
Return period	1	1	1	1	2	1	1						
FDC %	79	87	85	92	8	93	93						

Volume (10^6 m^3)	0.841	1.976	2.765	1.999	21.61	1.676	0.887						31.755	
TOTAL IFR DROUGHT													**157.745**	