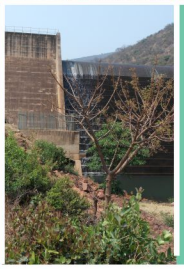
water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

REPORT NO: PWMA 01/000/00/02914/1



THE DEVELOPMENT OF THE LIMPOPO WATER MANAGEMENT AREA NORTH RECONCILIATION STRATEGY

INCEPTION REPORT

FINAL

MAY 2015

W69_2014/J02173

Project Name:	***Limpopo Water Management Area North Reconciliation Strategy***
Report Title:	***Inception Report***
Author(s):	***HS Pieterse, J Lombaard and team***
DWS Report No.:	***P WMA 01/000/00/02914/1***
DWS Contract No.	***WP 10768***
PSP Project Reference No.:	***J02173***
Status of Report:	***Final***
First Issue:	***2014/07/08***
Final Issue:	***2015/05/18***

CONSULTANTS: AECOM in association with Hydrosol, Jones & Wagener and VSA Rebotile Metsi Consulting

*Approved for **Consultants**:*

HS Pieterse
Task Leader

JD Rossouw
Study Leader

DEPARTMENT OF WATER AND SANITATION (DWS): Directorate: National Water Resource Planning

*Approved for **DWS**:*

Reviewed: OJS van den Berg
Acting Director: Options Analysis

T Nditwani
Acting Director: National Water Resource Planning

Prepared by:

AECOM SA (Pty) Ltd
PO Box 3173
Pretoria
0001

In association with:

Hydrosol | **Jones & Wagener** | **VSA Rebotile Metsi Consulting**

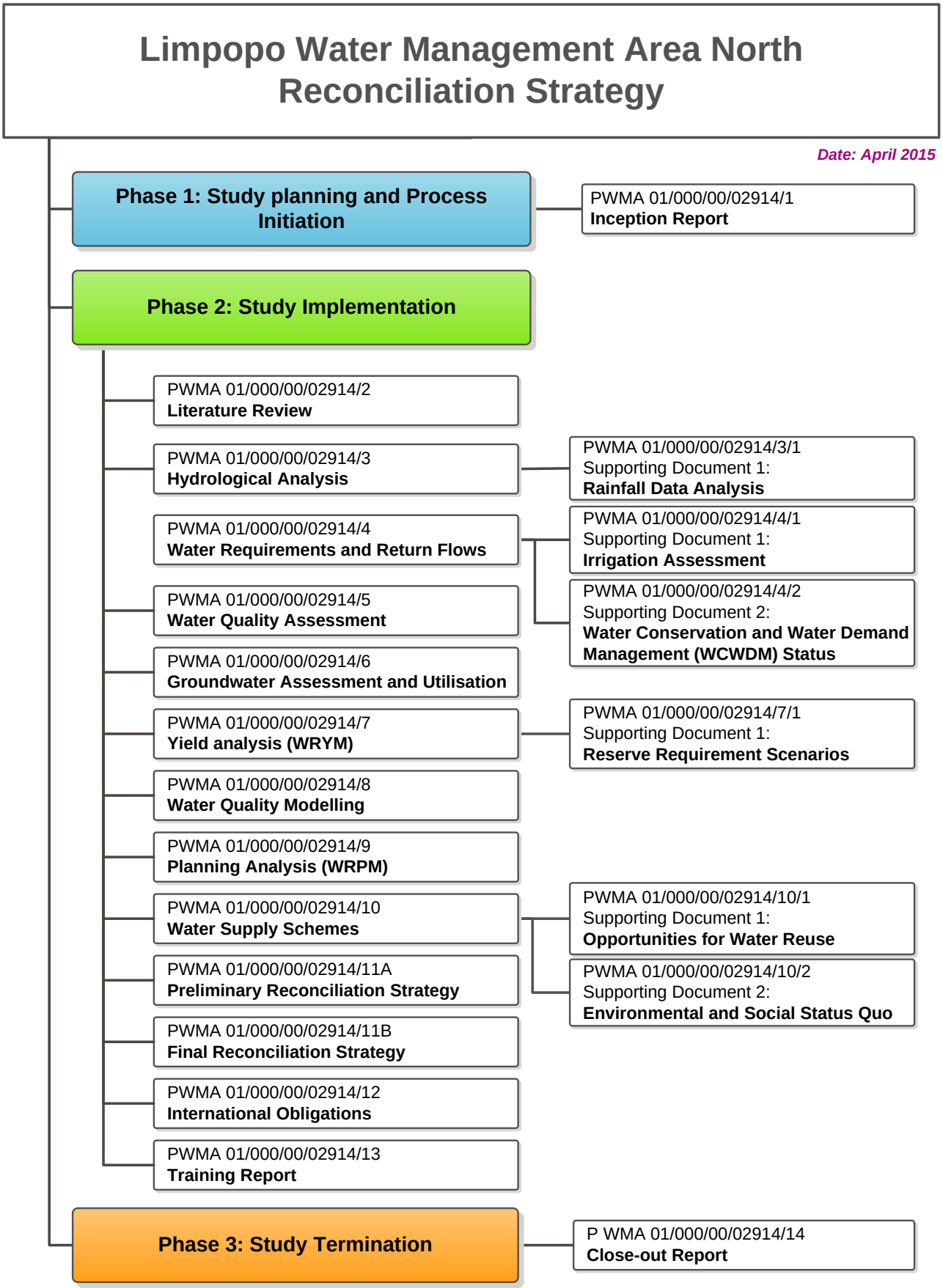

Limpopo Water Management Area North Reconciliation Strategy
Date: April 2015
Phase 1: Study planning and Process Initiation
PWMA 01/000/00/02914/1
Inception Report
Phase 2: Study Implementation
PWMA 01/000/00/02914/2
Literature Review
PWMA 01/000/00/02914/3
Hydrological Analysis
PWMA 01/000/00/02914/3/1
Supporting Document 1:
Rainfall Data Analysis
PWMA 01/000/00/02914/4
Water Requirements and Return Flows
PWMA 01/000/00/02914/4/1
Supporting Document 1:
Irrigation Assessment
PWMA 01/000/00/02914/4/2
Supporting Document 2:
Water Conservation and Water Demand Management (WCWDM) Status
PWMA 01/000/00/02914/5
Water Quality Assessment
PWMA 01/000/00/02914/6
Groundwater Assessment and Utilisation
PWMA 01/000/00/02914/7
Yield analysis (WRYM)
PWMA 01/000/00/02914/7/1
Supporting Document 1:
Reserve Requirement Scenarios
PWMA 01/000/00/02914/8
Water Quality Modelling
PWMA 01/000/00/02914/9
Planning Analysis (WRPM)
PWMA 01/000/00/02914/10
Water Supply Schemes
PWMA 01/000/00/02914/10/1
Supporting Document 1:
Opportunities for Water Reuse
PWMA 01/000/00/02914/11A
Preliminary Reconciliation Strategy
PWMA 01/000/00/02914/10/2
Supporting Document 2:
Environmental and Social Status Quo
PWMA 01/000/00/02914/11B
Final Reconciliation Strategy
PWMA 01/000/00/02914/12
International Obligations
PWMA 01/000/00/02914/13
Training Report
Phase 3: Study Termination
P WMA 01/000/00/02914/14
Close-out Report

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

APPENDICES

LIST OF ABBREVIATIONS

AECOM	AECOM SA (Pty) Ltd
BID	Background Information Document
CBO	Community Based Organisation
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EI	Ecological Importance
ES	Ecological Sensitivity
GPS	GIS Project Solutions
GRIP	Groundwater Resources Information Project
GWSWIM	Groundwater-Surface Water Interaction Model
IAP	Invasive Alien Plants
IDP	Integrated Development Plan
LBPTC	Limpopo Basin Permanent Technical Committee
LED	Local Economic Development
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NGOs	Non-Governmental Organisations
NWRS-1	National Water Resource Strategy First Edition
NWRS-2	National Water Resource Strategy Second Edition
PES	Present Ecological State
REC	Recommended Ecological Category
RSA	Republic of South Africa
SAM	Study Administration Management
SDF	Spatial Development Framework
SMT	Study Management Team
SSC	Study Steering Committee
SSI	Stuart Scott International
ToR	Terms of Reference
URV	Unit Reference Value
WCWDM	Water Conservation and Water Demand Management
WMA	Water Management Area
WRCS	Water Resource Classification System
WRNA	WR Nyabeze and Associates
WRP	WRP Consulting Engineers
WRPM	Water Resources Planning Model
WRSM2000	Water Resources Simulation Model

WRYM	Water Resources Yield Model
WRYM-MF	Water Resources Yield Model – Modelling Framework
WUA	Water Use Association

LIST OF UNITS

kℓ	kilolitre
ℓ/c/d	litre per capita per day
m^3	cubic meter
km	kilometre
m^3/a	cubic meter per annum
m	metre
mm	millimetre

1 INTRODUCTION

1.1 Appointment of the professional service provider

The Department of Water and Sanitation (DWS), then Department of Water Affairs (DWA) appointed **AECOM SA (Pty) Ltd** in association with three sub-consultants **Hydrosol**, **Jones and Wagener** and **VSA Rebotile Metsi Consulting** with effect from 1 March 2014 to undertake the **Limpopo Water Management Area North Reconciliation Strategy**.

1.2 Background to the project

The DWS (then DWA) identified a need for the development of the Limpopo Water Management Area (WMA) North Reconciliation Strategy. The Limpopo WMA North refers to the Limpopo WMA described in the first edition of the *National Water Resource Strategy* (NWRS-1) published in 2004. The 19 initial WMAs were consolidated into 9 WMAs during 2012 and accepted in the second edition of the *National Water Resource Strategy* (NWRS-2) of 2013. The newly defined Limpopo WMA includes the original Crocodile (West) and Marico WMA as well as the Luvuvhu River catchment, previously part of the Luvuvhu and Letaba WMA. However, these additional areas will not be part of this Reconciliation Strategy.

The Limpopo WMA North comprises of six main river catchments; Matlabas, Mokolo, Lephalala, Mogalakwena, Sand and Nzhelele and are shown in **Figure 1.1**. The very small Nwanedi River catchment forms part of the Nzhelele River catchment. Most of these river catchments rely on their own water resources and are managed independently from neighbouring catchments. This implies that some river catchments require separate and independent reconciliation strategies whilst others need integrated water management reconciliation strategies.

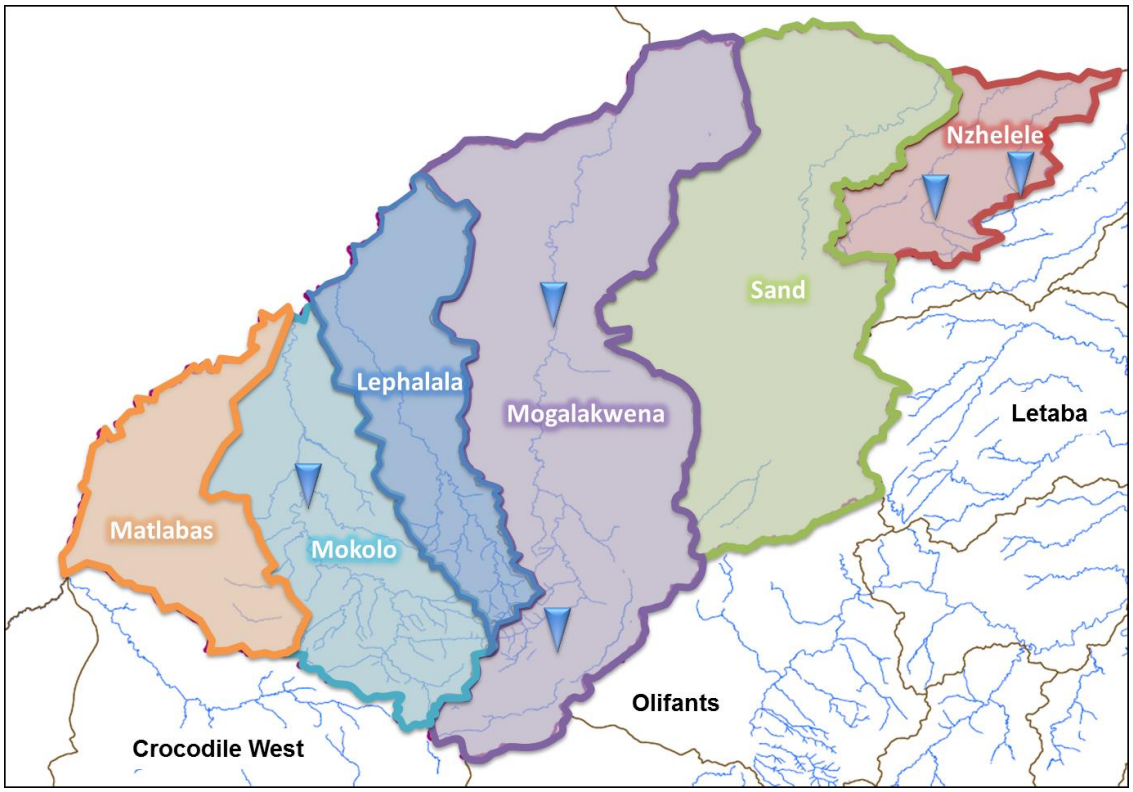


Figure 1.1: Overview of the catchments of the Limpopo WMA North

The main urban areas within the WMA include Mokopane, Polokwane, Mookgophong, Modimolle, Lephalale, Musina and Louis Trichardt. Approximately 760 rural communities are scattered throughout the WMA, mostly concentrated in the central region. The main economic activities are irrigation and livestock farming as well as expanding mining operations due to the vast untapped mineral resources in the area. The water resources, especially surface water resources, are heavily stressed due to the present levels of development. It is crucial that water supply is secured and well managed.

The most western area of the Limpopo WMA North, the Matlabas River catchment, is a dry catchment with no significant dams and with a low growth potential for land-use development.

The large Mokolo Dam, in the Mokolo River catchment, supplies water to the Matimba Power Station, Medupi Power Station, Grootegeluk Coal Mine, the Lephalale Local Municipality as well as a number of downstream irrigators. The dam is able to meet the bulk of the current requirements but will in future rely on transfers from other WMAs to meet the water requirements at a sufficiently high assurance of supply.

The middle reaches of the Lephalala River catchment have a high conservation value with irrigation activities dominant in the remainder of the catchment. Irrigation in this area is supplied by surface water and alluvial aquifer abstraction.

All the water resources in the Mogalakwena River Catchment have been fully developed. The Doorndraai Dam is over-allocated. Additional water to support the rapid expanding mining activities in the vicinity of Mokopane needs to be augmented by transfers from the Flag Boshielo Dam in the adjacent Olifants River Catchment. Glen Alphine Dam presently supplies water to emerging farmers, who has not yet taken up their full allocated quota, and is anticipated to supply the growing domestic requirements.

Groundwater resources in the Mogalakwena and the Sand river catchments have been extensively utilised, and possibly over-exploited by the dominating irrigation sector. The expanding urban and industrial requirements of Polokwane and Makhado local municipalities, currently supplied by Albasini Dam, rely heavily on water transfers from adjacent WMAs. This includes transfers from the Ebenezer Dam, Dap Naude Dam, Flag Boshielo Dam and Nandoni Dam in the Olifants WMA.

Domestic and irrigation water in the small but highly developed Nzhelele River catchment is supplied through the Mutshedzi Dam Regional Water Supply Scheme and the Nzhelele Dam Regional Water Supply Scheme as well as extensively from groundwater resources. The inflows to the Mutshedzi and Nzhelele dams have been reduced as a result of afforestation upstream of these dams. The area is in deficit due to the over-allocation and over development of irrigation.

The Sand and Nzhelele river catchments have high coal mining potential in the Louis Trichardt area but the availability of local water resources is a limiting factor for possible future mining development.

1.3 Study area

The Limpopo WMA North is the most northern WMA in South Africa and refers to the area described as the Limpopo WMA in NWRS-1. Refer to **Figure 1.2** for the location and general layout of the study area. The areas indicated in grey show the additional catchment and WMA areas included in the Limpopo WMA as per NWRS-2 and which do not form part of the study area for this reconciliation strategy.

The Limpopo WMA North forms part of the internationally shared Limpopo River Basin which also includes sections of Botswana, Zimbabwe and Mozambique. The Limpopo River forms the entire length of the northern international border between South Africa and Botswana and Zimbabwe before flowing into Mozambique and ultimately draining into the Indian Ocean. The dry Limpopo WMA North is augmented with transfers from the adjacent Letaba, Olifants and Crocodile West river catchments. No transfers are currently made from the Limpopo WMA North to other WMAs.

The main rivers in the study area, which form the six major catchment areas, are the Matlabas, Mokolo, Lephalala, Mogalakwena, Sand and Nzhelele rivers. These rivers, together with other smaller tributaries, flow northwards and discharge into the Limpopo River.

The climate over the study area is temperate and semi-arid in the south to extremely arid in the north. Mean annual rainfall ranges from 300 mm to 700 mm with the potential evaporation well in excess of the rainfall. Rainfall is seasonal with most rainfall occurring in the summer with thunderstorms. Runoff is low due to the prevalence of sandy soils in the most of the study area, however, loam and clay soils are also found.

The topography is generally flat to rolling, with the Waterberg on the south and the Soutpansberg in the north-east as the main topographic features. Grassland and sparse bushveld shrubbery and trees cover most of the terrain.

The southern and western parts of the WMA are mainly underlain by sedimentary rocks, whilst metamorphic and igneous rocks are found in the northern and eastern parts. With the exception of some alluvium deposits and dolomites near Mokopane and Thabazimbi, these formations are mostly not of high water bearing capacity. The mineral rich Bushveld Igneous Complex extends across the south-eastern part of the WMA, and precious metals are mined at various localities throughout the area. Large coal deposits are found in the north-west.

Several wildlife and nature conservation areas have been proclaimed in the WMA, of which the Nylsvley Nature Reserve, Mapungubwe National Park and the Marekele National Park are probably the best known.

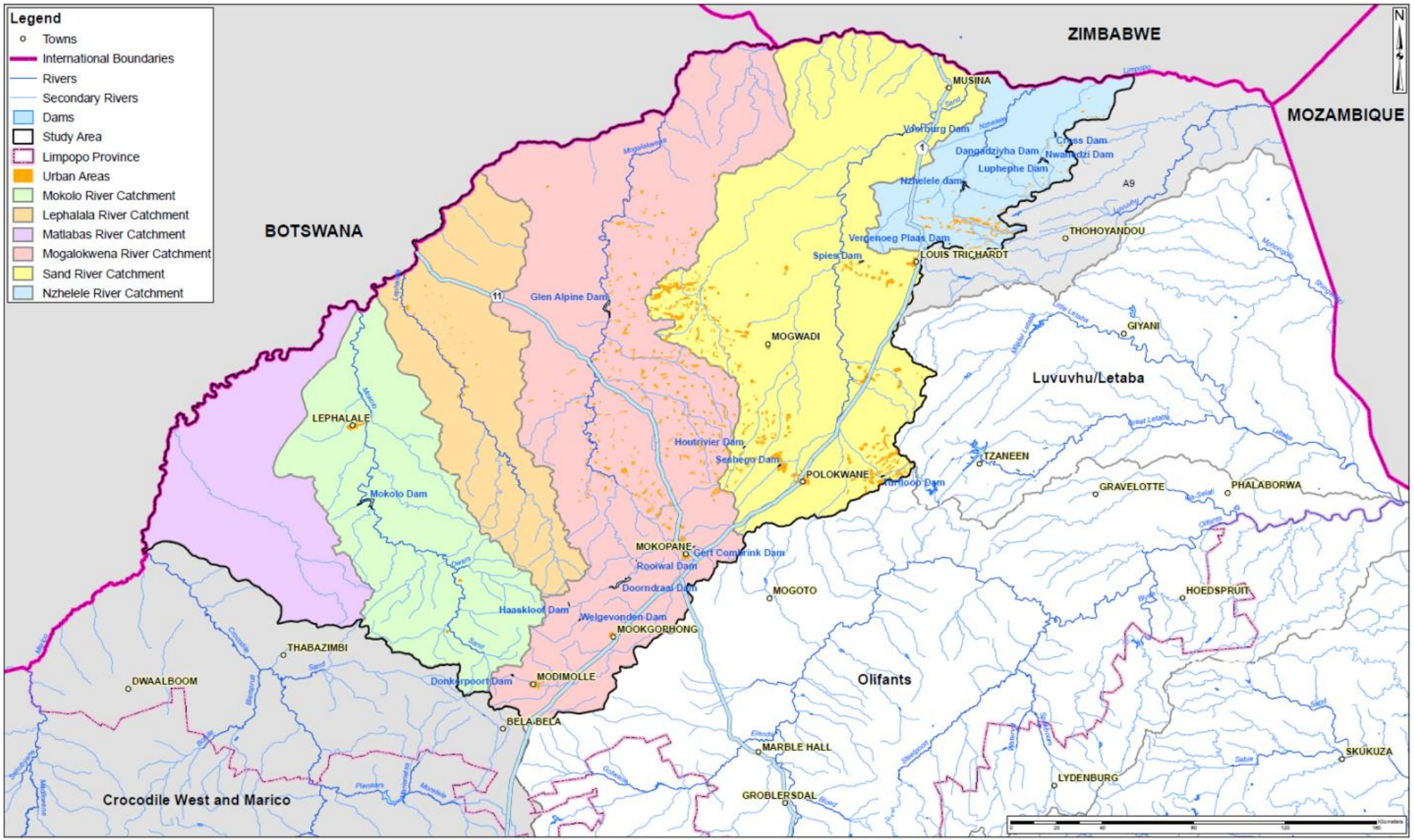


Figure 1.2: General layout of the study area

1.4 Objective, scope and organisation of the study

1.4.1 Objective of the study

The main objective of the study is to formulate a water resource reconciliation strategy for the entire Limpopo WMA North up to 2040. The reconciliation strategy must a) address growing water demands as well as water quality problems experienced in the catchment, b) identify resource development options and c) provide reconciliation interventions, structural and administrative/ regulatory. To achieve these objectives, the following aspects are included in the study:

- Review of all available information regarding current and future water requirements projections as well as options for reconciliation.
- Determine current and future water requirements and return flows and compile projection scenarios.
- Configure the system models (WRSM2000 rainfall-runoff catchment model, also known as the Pitman Model, the Water Resources Yield Model (WRYM) and the Water Resources Yield Model (WRPM)) in the study area at a quaternary catchment scale, or smaller, where required, in a manner that is suitable for allocable water quantification. This includes updating the hydrological data and accounting for groundwater surface water interaction.
- Assess the water resources and existing infrastructure and incorporate the potential for water conservation and water demand management (WCWDM) and water reuse as reconciliation options.
- Develop a preliminary short-term reconciliation strategy followed by a final long-term reconciliation strategy.

1.4.2 Governance of the study

The institutional framework is one of the most important aspects of water resources management, because it determines the effectiveness of policy implementation. Institutions (statutory and non-statutory) are also important in that they are the focus for the Water Act's requirements to consult widely with water users and other interested parties before policies and strategies relating to the management and use of water resources are implemented. The various sectors that receive water in the study area include agriculture and irrigation, mines, industry, urban as well as power generation. Thus, in a complex

institutional framework, the DWS involves not only key stakeholders of different spheres of Government, but also the different water users in the catchment.

The governance structure of the study is summarised in Figure 1.3, showing participants and the functions that will be undertaken. For efficient communication, three committees have been established, namely the Study Steering Committee (SSC), the Study Management Team (SMT), and the Study Administration Meeting (SAM) committee. The functions of these committees are taken up in separate documents that will be communicated with the different committee's members.

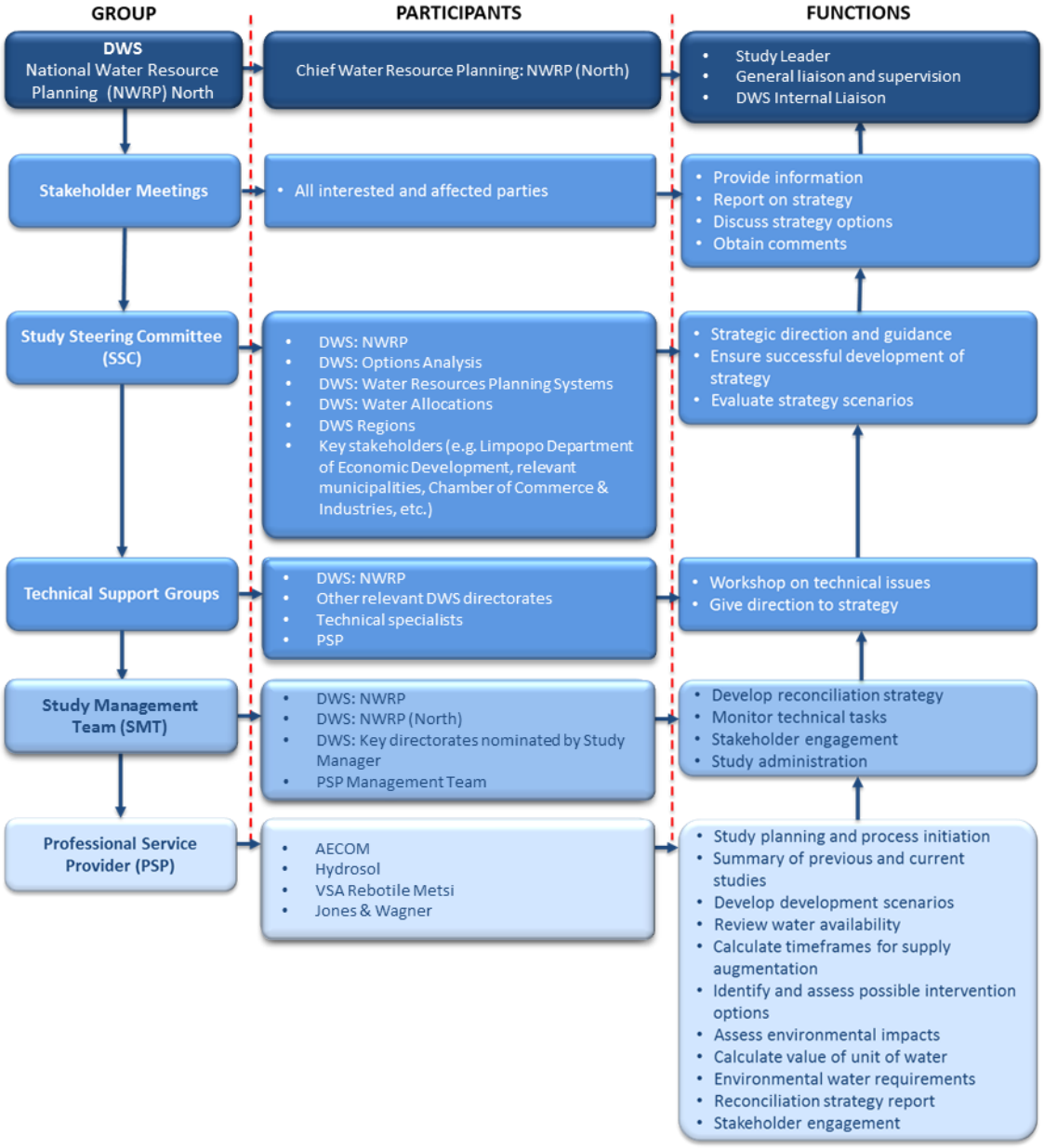


Figure 1.3: Study governance structure

1.4.3 Organisation and scope of the study

The study is divided into three phases of which Phase 2 - Study Implementation, consists of various tasks given in Table 1.1. At the first SAM, it was recognised that the Preliminary and Final Screening Workshops tasks (defined as Task 2 and 18 in the Terms of Reference (ToR)), will form part of the SSC, and were subsequently included in the Stakeholder Engagement and Public Participation Task (defined as Task 19 in the ToR).

More detail of the work breakdown structure, based on the proposed methodology for the study, is provided in Section 2, Section 3 and Section 4.

Table 1.1: Summary of proposed task activities

No.	Name	Task Leader	Task activities	Task outcomes and deliverables
Phase 1: Study Planning and Process Initiation				
	Assemble and assimilate available information. Compile Study Plan. Compile Inception Report	Hermien Pieterse / all task leaders	• Review of new information influencing the project • Client liaison to agree on the proposal and obtain confirmation of study tasks and activities • Compile a study plan • Compile an Inception report	• ***Report 1*** **Inception Report**
Phase 2: Study Implementation				
1	**Summary of previous and current studies**	Bennie Haasbroek	• Review previous reports and studies on demand projections • Establish current demands and seasonal variations • Contact municipalities, organised agriculture and industries regarding future demand growth • Develop demand projection scenarios	• ***Report 2*** **Literature Review**
2	**Hydrological Analysis**	Estelle van Niekerk	• Data collection and collation • Rainfall data analysis, review and update, if necessary • Evaporation data analysis, review and update, if necessary • Streamflow data analysis, review and update • Investigate groundwater-surface water interaction - update with Sami Model and new land-use and testing of the WRSM2000 • Calibration of the WRSM2000 in selected catchments • Naturalisation of flow records • Verification and validation of stochastic hydrology	• ***Report 3*** **Hydrological Analysis** • Supporting Document 1 to Report 3: Rainfall Data Analysis • Calibrated WRSM2000 configurations with data files • Hydrological data

No.	Name	Task Leader	Task activities	Task outcomes and deliverables
3	**Current and future water requirements and return flows**	Bennie Haasbroek	• Gather information from previous studies • Meetings and discussions with water authorities and informed people • Review previous public participation	• ***Report 4*** **Water Requirements and Return Flows** • Supporting Document 1 to Report 4: Irrigation Assessment • Updated DWS database • Water requirement projection scenario • Database spreadsheet
4	**WCWDM**	Abri Vermeulen	• Identify key demand centres • Status quo and priority assessment • Assess potential savings • Scenario development for savings • Collate all existing strategies	• Supporting Document 2 to Report 4: WCWDM Status Report
5	**Opportunities for water reuse**	Ayesha Laher	• Collate info from WTW • Verify info • Assess potential for reuse	• Supporting Document 1 to Report 10: Opportunities for Water Reuse
6	**Invasive alien plants (IAP)**	Gerald de Jager	• Determine water savings due to removal of IAPs. • Develop reconciliation scenario	• Section included in the Hydrological Analysis Report (Report 3)
7	**Water quality**	Ayesha Laher	• Collate water quality information • Risk assessment in Water Supply Systems • Rate risks • Outline mitigating factors	• ***Report 5*** **Water Quality Assessment**
8	**Reserve requirement scenarios**	Patsy Scherman	• Assess existing Reserve information • Develop Reserve scenarios and determine implications on yield	• Supporting Document 1 to Report 7: Reserve Requirement Scenarios
9	**Groundwater utilisation scenarios**	Bennie Haasbroek	• Determine groundwater options in terms of management, conjunctive utilisation, estimated yield, water quality aspects, unit and infrastructure costs, Reserve requirements and environmental impacts	• ***Report 6*** **Groundwater Assessment and Utilisation**
10	**International obligations**	Peter Ramsden	• Meet with DWS representatives to SADC, Limpopo JPTC and discuss latest Treaties and Protocols re international obligations and rights • Collate planning analysis results on impacts of water demand on Limpopo River	• ***Report 12*** **International Obligations**
11	**Yield analysis (WRYM)**	Bennie Haasbroek	• Obtain and verify existing model configuration • Update and test model configuration • Undertake systems analysis • Post-process and interpret results	• ***Report 7*** **Yield Analysis**
12	**Water quality modelling (WQT)**	Jonathan Schroder	• Gathering, evaluation and patching of water quality data • Set-up and test WQT model	• ***Report 8*** **Water Quality Modelling**

No.	Name	Task Leader	Task activities	Task outcomes and deliverables
13	**Planning analyses (WRPM)**	Jonathan Schroder	• Assess WRYM data • Discuss water use criteria • Set-up and test WRPM • Scenario development and implementation • Interpretation of results	• ***Report 9*** **Planning Analyses**
14	**Review schemes and update cost estimates**	Hermien Pieterse	• Gather information • Investigate the current state of infrastructure • Update cost estimates for selected schemes • Prepare URVs	• ***Report 10*** **Water Supply Schemes**
15	**Review or assess social and environmental impacts**	Nicola Liversage	• Environmental status quo assessment • Due Diligence Review	• Supporting Document 2 to Report 10: Environmental and Social Status Quo
16	**Assembly of information and formulation of scenarios**	Gerald de Jager	• Develop short-term and long-term water requirement scenarios • Assess intervention options • Develop short-term reconciliation study • Develop final reconciliation • Record the process • Identify all issues and concerns • Compile the final Reconciliation Strategy	• ***Report 11A*** **Preliminary Reconciliation Strategy** • ***Report 11B*** **Final Reconciliation Strategy**
17	**Stakeholder engagement and public participation (including the preliminary and final screening workshops)**	Anelle Lötter	• Identify stakeholders and during study, confirm stakeholders • Update stakeholder database • Project announcement and background information document (BID) information distribution • Response sheets distribution • Invitation letters for the SSC/workshop to the stakeholders • SSC meeting arrangements, recording, compilation of docs, agendas and minutes • Compile and distribute newsletters (2 editions) • Arrange and conduct a public meeting • Arrange for Limpopo WMA Web site to keep DWS and stakeholders informed	• Database and workshop proceeding, proceedings of meetings and two newsletters • Study website on DWS internet site • Summary of proceedings included in Report 2 • Summary of final screening workshop
18	**Training and capacity building**	Gerald de Jager	• Identify trainees • Develop training material • Conduct training • Analyses impact of training • Document the training process	• Trained officials • ***Report 13*** **Document summarising the training process and further training required**
Phase 3: Study Management and close out				
	Study management	Hermien Pieterse / Gerald de Jager	• Proactive study management • Client liaison, including progress meetings • Coordination of study team • Link between DWS and study team • Financial control • Study administration, invoices, project filing • Project closure	• Attendance and minutes of meetings • Progress reports • Financial reports

No.	Name	Task Leader	Task activities	Task outcomes and deliverables
	Study termination	Hermien Pieterse	• Compile and get approval for close out report	• ***Report 14*** **Close-out report**

1.5 Study programme

The programme presented in **Figure A.1** of **Appendix A** covers all the tasks shown in **Table 1.1** to complete the project within **36 months**.

For programming purposes, periods of three weeks and two weeks have respectively been adopted as non-working time during the holiday seasons of December / January and April each year. Ten working days are provided for comments on or approval of reports by DWS.

2 PHASE 1: INCEPTION PHASE

Objective

The objective of the Inception Phase is to obtain agreement between the Client (DWS) and the PSP on the final tasks and deliverables for the study and present the study execution plan in an Inception Report. This Inception Report describes the updated scope of work, a refined program and the updated budget and cash flow for the remainder of the complete scope of services.

Approach

During this phase the study team was mobilised through the task leaders, and project management and governance structures were set up, and activities necessary for compiling the Inception Report were initiated.

The assignment was initiated by the Study Leader on receipt of confirmation that the AECOM-led team had been selected to execute the project. The start-up meeting was held on 12 March 2014.

Subsequently, all Task Leaders were mobilised and an internal Project Team Meeting was convened to facilitate a full understanding of the assignment, align activities as a first step towards integration and confirm important milestones on the work programme.

According to the ToR, "*the Contract, however, allows revision upon the submission of an Inception Report, which upon agreement and approval of the Client, will then fix the final scope of work of the study*", therefore during the Inception Phase the study team finalised and redefined the Scope of Work for the assignment, confirmed the composition of the Study Team, the manpower schedule, work programme, revised budget and cash flow.

Furthermore, the proposed work plan for each task was examined in appropriate detail on the basis of the available information from previous study documents and other sources provided by the DWS. The outcome of this review is documented in this Inception Report under the specific tasks, and is recorded as the final terms of reference, methodology, project team, work programme and budget.

Deliverable: **Inception Report** (Report 1)

3 PHASE 2: STUDY IMPLEMENTATION

3.1 TASK 1: Summary of previous and current studies

Objective

The first key task of the PSP is to thoroughly review all work done in previous and current studies and this will involve liaison with known organisations and consultants engaged on such studies within the Limpopo WMA North.

Approach

Information will be gathered from documentation of previous studies and from persons undertaking current studies. All recent and current projects in the study area will be identified in consultation with DWS and the stakeholders. The following aspects will be included:

- Historical and projected water use (for all water use groups) and its geographical distribution in the WMA and in affected areas of the WMA.
- Existing water supply infrastructure.
- Hydrological information and concerns.
- Geohydrological information about the various aquifers.
- Water quality information and concerns.
- Reserve requirements.
- System modelling and operational management.
- WCWDM (urban and irrigation).
- Current water reuse and potential for future water reuse.
- Impacts of IAP eradication.
- Trading of existing allocation (especially unutilised allocations).
- Potential surface water schemes, both local and for transfer.
- Potential groundwater schemes, both local and for transfer (including utilising of treated mine water by local municipalities and Eskom).
- Potential desalination schemes.
- Other potential importation schemes and options.
- Existing institutional responsibilities and cooperative governance (including operating rules, infrastructure planning and development, tariff structure and monitoring).
- Existing public participation in the water sector.

The list of previous reports / studies consulted is shown in Table 3.1.

Table 3.1: List of previous studies and reports

Study/Project Name	Client	Consultant	Date
Development of a Reconciliation Strategy – for All Towns in the Northern Region	DWAF	SRK Consulting	2010 - 2011
Limpopo Water Management Area: Water Resources Situation Assessment	DWAF	WSM in association with Ninham Shand, Parsons & Associates, Maritza Uys and GIS Project Solutions (GPS)	2003
Limpopo Water Management Area: Overview of Water Resources Availability and Utilisation	DWAF		2003
Internal Strategic Perspective: Limpopo Water Management Area	DWAF	Goba Moahloli Keeve Steyn in association with Tlou and Matji and Golder Associates	2004
Joint Limpopo River Basin Study	Limpopo Basin Permanent Technical Committee (LBPTC)	Biggon Consortium	2010
Limpopo River Basin Monograph	Limpopo Watercourse Commission	Prepared by G Howard, F Denys, N Walker and A Gorgens	2013
Updating the Hydrology and Yield Analysis in the Mokolo River Catchment	DWAF	WRP, DMM Development Consultants and Golder Associates	2007 - 2008
Mokolo and Crocodile River (West): Water Augmentation Project (MCWAP) Feasibility Study	DWAF	Africon in association with Kwezi V3 and Vela VKE, WRP Consulting Engineers and specialists	2008 - 2009
Classification of Significant Water Resources in the Crocodile (West), Marico, Mokolo and Matlabas Catchments	DWA	Golder Associates, Prime Africa, Wetland Consulting Services	2011 - 2013
Establishment of Operating Rules for the Glen Alpine System	DWA	SSI in association with WRNA	2011
Development of a Feasibility Study for the Mutasshi/Musina Corridor Bulk Water Supply	DWA	Aphane Consulting	2013 - 2014
Drought Operating Rules for Stand Alone Dams/Schemes Typical for Rural/Small Municipal Water Supplies: Northern Cluster	DWA	WRNA	2012
Five-year Strategic Plan for Nylsvley Nature Reserve, Limpopo Province, South Africa	Department of Economic Development, Environment and Tourism		2013
Proposed Establishment of an Open Cast Platinum Group Metal Mine on the Farm Volspruit 326 KR and the Farm Zoetveld 294 KR, Mokopane District, Limpopo Province	EScience Associates	African Environmental Development	2012

Study/Project Name	Client	Consultant	Date
Proposed Establishment of an Open Cast Platinum Group Metal Mine on the Farm Volspruit 326 KR and the Farm Zoetveld 294 KR, Mokopane District, Limpopo Province	EScience Associates	Royal Haskoning DHV	2014
Olifants River Water Resources Development Project (ORWRDP)	DWAF		2004 - current
The Limpopo Development Plan (LDP) 2015-2019	Limpopo Provincial Government		2015
Lephalale Municipality Integrated Development Plan 2013-2016	Lephalale Municipality		2013
Modimolle Local Municipality Integrated Development Plan 2015/2016	Modimolle Local Municipality		2015
Mookgopong Local Municipality Integrated Development Plan 2011/2012	Mookgopong Local Municipality		2011
Mogalakwena Local Municipality Integrated Development Plan 2012-2016	Mogalakwena Local Municipality		2012
Blouberg Municiaplity Integrated Development Plan 2011-2016	Blouberg Municiaplity		2011
City of Polokwane Integrated Development Plan 2012 - 2013/2015	City of Polokwane		2012
Molemole Municipality Integrated Development Plan 2013/2014	Molemole Municipality		2013
Makhado Municiaplity Integrated Development Plan 2012/2013 – 2016/2017	Makhado Municiaplity		2012
Musina Municipality Integrated Development Plan 2012/2013 - 2017	Musina Municipality		2012
Thabazimbi Municipality Integrated Development Plan 2013/2014	Thabazimbi Municipality		2013
Development of a Reconciliation Strategy for the Crocodile West Water Supply System	DWAF	BKS in association with Arcus Gibb, Schoeman & Vennote and AGES	2006 - 2009
Support to the Implementation and Maintenance of the Reconciliation Strategy for the Crocodile West Water Supply System	DWA	BKS in association with DMM Development Consultants, Golder Associates, WRP and Zitholele Consulting	2010 - 2012
Development of a Reconciliation Strategy for the Olifants River Water Supply System	DWA	Aurecon in association with ILISO Consulting, MBB Consulting Services, WFA Aquatic Ecology, Chuma Development Consultants, WFA Water Resources	2010 - 2012
Development of a Reconciliation Strategy for the Luvuhu and Letaba Water Supply System	DWA	WRP in association with DMM Development Consultants, Golder Associates Africa, Worley Parsons, Kyamandi, Hydrosol and Zitholele Consulting	2012 - current

Furthermore, existing public participation structures which were established (e.g. committees or forums) and stakeholder database lists will be reviewed. In this way participation of all key individuals will be ensured, and duplication of stakeholder initiatives avoided.

Deliverable: **Literature Review Report** (Report 2)

3.2 TASK 2: Hydrological analysis

Objective

The objective of **Task 2** is to assess available hydro-meteorological data for the Limpopo WMA North and to extend the hydrology per quaternary catchment up to the 2010 hydrological year (September 2011).

The extent of the hydrological analysis will depend on the availability and reliability of existing hydrological data sets in the Limpopo WMA North, which includes the Matlabas, Mokolo, Lephalala, Mogalakwena, Sand and Nzhelele river catchments. More information in this regard is provided below, including a short description of the individual tasks involved.

3.2.1 Task 2a: Data collection and collation

The objective of this task will be to collect and review the available hydro-meteorological data of the Limpopo WMA North, with specific focus on the following recent studies *Limpopo River Basin Monograph Study*, the *Water Resources of South Africa 2005* (WR2005) and the *Updating the Hydrology and Yield Analysis in the Mokolo River Catchment* (2008). In this regard it is noted that existing data sets covering the entire study area will be collated as part of the Monograph study, but that no recalibration of the WRSM2000 will be undertaken as part of that study.

3.2.2 Task 2b: Rainfall data analysis

The outcome of the review of the rainfall data will dictate the necessity of more detailed analyses and adjustment of the existing rainfall data. For this purpose existing catchment rainfall data sets will be evaluated by means of visual inspection and basic statistical analysis. If critical problems are detected, individual rainfall gauge data sets will be re-analysed, in-filled and used for generating catchment rainfall.

Similarly, gauge rainfall data will be used to extend rainfall data to the 2010 hydrological year. For this purpose the DWS's Rain-IMS will be used, which incorporates the ClassR and PatchR suite of utilities, and the resulting data sets will be evaluated using standard stationarity tests.

3.2.3 Task 2c: Evaporation data analysis

Various sources of evaporation data sets, including WR2005, WR90 and observed S-pan evaporation data, will be overlaid on a topographical map to determine the best estimate of the mean annual evaporation (MAE) for quaternary catchments in the study area.

3.2.4 Task 2d: Stream flow data analysis

The locality of available flow gauging stations will determine the adequacy of available streamflow data for calibration of the WRSM2000, and the reliability of the calibration, in a particular area. The DWS Directorate: Hydrological Services will be consulted with regards to data evaluation and the need for field inspections to ensure that the limitations of the observed data are known and properly addressed. It is a concern that the WR2005 study considered only 19 of the 68 stream flow gauges located within the study area for calibration purposes. The hydro-meteorological data will be assessed for inconsistencies and gaps. Once the WRSM2000 configurations have been calibrated (as detailed later), modelled flow values will be used as a basis for in-filling missing values.

3.2.5 Task 2e: Groundwater assessment and groundwater-surface water interaction

The responsibility for the assessment of groundwater activities will be shared between the groundwater-surface water interaction and work of this task. **Task 9** will, however, focus on the development of groundwater utilisation scenarios. There will be significant overlap in the work between the two tasks, especially when it comes to the overall groundwater availability assessment for the WMA. This information is crucial for both scenario development and when calibrating the WRSM2000 to assess the impact of groundwater depletion on surface water availability. This task, however, will focus only on the configuration and calibration of the *Groundwater-Surface Water Interaction Model* (GWSWIM, also known as the "Sami Model") in the WRSM2000.

Groundwater will play an important role in the Limpopo Reconciliation Strategy, especially in the northern parts of the WMA. The effect of groundwater usage on

surface water availability will be modelled in the WRSM2000 and will be used during scenario planning to be undertaken later using the WRYM-MF and WRPM. The current-day groundwater use needs to be estimated as input to the GWSWIM, both in terms of spatial and temporal distribution of the use.

The simulated base flow time-series in the WRSM2000 will be evaluated by the groundwater and surface water specialists during the calibration process to ensure that the base flows are in line with known regional (and other more detailed) estimates as well as estimated groundwater base flow calculated from observed flow records. The Groundwater Resources Assessment II (GRAII) and other sources will also be used to evaluate the simulated time series against other variables, such as recharge and harvest potential.

The assumptions of temporal growth in groundwater use will also be adapted with the calibration, in areas where the historic growth in groundwater was unknown and had to be assumed.

This task will therefore provide for the following:

- Desktop assessment of the characteristics of the groundwater resources, including the delineation of groundwater units and the distribution of lithology per quaternary catchment (shared with **Task 9.1**).
- A graphic and tabular overview of the available groundwater resources (at least at quaternary level) in terms of groundwater harvest potential, exploitation potential and base flow as per the GRA2 and other sources. It is also important that dolomitic areas will be highlighted in this analysis (shared with **Task 9.1**).
- Assumptions of historical growth in groundwater use with best available current day use data and estimates for the whole WMA. Spatial distribution and location of the known high use areas are important to assess distance from surface water resources.
- A desktop assessment of the groundwater Reserve (where data are available as well as identification of places where Reserves will be required).
- Groundwater balance to compare the existing available groundwater per quaternary catchment to the estimated current utilisation and Reserve requirements.
- Verification of the groundwater parameters for the configuration of the GWSWIM in the WRSM2000. Support during the calibration of the GWSWIM to verify if simulated flows match groundwater base flow and recharge estimates.
- A desktop groundwater quality evaluation.

3.2.6 Task 2f: Configuration and calibration of the WRSM2000

The available WRSM2000 configurations will be reviewed and revised to accommodate updated hydro-meteorological data sets and any other refinements that may be required. The hydrology of the Mokolo River catchment was updated in 2008 at a high level detail using the WRSM2000 and including groundwater-surface water interaction modelling using the GWSWIM mentioned earlier. It is therefore proposed that the hydrology of the Mokolo River catchment is only extended without recalibration. However, the hydrology for the other catchments in the study area has been developed at varying levels of detail and would therefore have to be updated and extended accordingly.

It is anticipated that in the case of the Mogalakwena River catchment this would involve the incorporation of the GWSWIM model, as well as small model calibration refinements. For the remaining catchments a more comprehensive model update will be required with existing information as well as model configurations from either the current *Limpopo River Basin Monograph Study* or the earlier WR2005 study used as a point of departure. In this regard it is noted that earlier hydrological investigations have ignored the contributions from the Nylsvlei wetland area to the Mogalakwena River. It is proposed that the Nylsvlei wetland area is included as a modelling element in the WRSM2000 and that its impact modelled explicitly using assumed physical and behavioural characteristics. These will be determined from a basic desktop assessment and validated with a simple sensitivity analysis to assess the impact on simulated flows and calibration results obtained.

All calibrations will be undertaken in close consultation with both the water quality and groundwater specialists in order to ensure that coordination between the relevant tasks is achieved.

3.2.7 Task 2g: Naturalisation of stream flow records

Natural runoff data time-series will be developed on a quaternary catchment basis. This will be achieved either by means of the naturalisation and extension of stream flow data or by means of simulation for un-gauged catchments. The process of naturalisation will involve a standard process of accounting for the impact of historical in-catchment water use on gauged flows. Resulting natural runoff data time-series will be evaluated for consistency and stationarity by means of standard tests, such as the single mass-plot and plot of cumulative deviation from the mean.

3.2.8 Task 2h: Verification and validation of streamflow records

The STOMSA-model, incorporated in the WRYM-MF will be used for validation and verification of the natural runoff time-series for each quaternary catchment, with groundwater abstractions included to be compatible with other water resources models. This process will indicate if there are any problems in the natural flow records, in which case some of the above tasks could be re-visited. Once this process has been completed, a single integrated statistical parameter file (PARAM.DAT) will be generated for the entire study area and used as a basis for undertaking stochastic system analyses, as described in **Task 11**.

Deliverable: **Hydrological Analysis Report** (Report 3)

- **Rainfall Data Analysis Report** (Supporting Document 1 to Report 3: Hydrological Analysis).
- Quaternary catchment-based hydro-meteorological data time-series up to the 2010 hydrological year, including representative catchment rainfall, evaporation and naturalised and/or natural simulated catchment runoff.
- Estimated and reviewed GWSWIM parameters for use in the WRSM2000.
- Spatial and temporal groundwater use figures based on known values and historical growth assumptions.
- Groundwater balance figures at at least quaternary catchment level highlighting estimated harvest potential, recharge and base flow estimates to validate the WRSM2000 calibrations against.
- Time-series of historical and present day in-catchment water use including irrigation, domestic (urban and rural), industrial and mining water use, as well as water use by commercial forestry and IAPs.

3.3 TASK 3: Current and future water requirements and return flows

Objective

Formulation of water requirement scenarios for all water use categories, taking into account potential developments in the study area.

Approach

The focus of this task will be on the collection and processing of water requirements and calculation of return flows for the various water use categories. The team will liaise with local authorities, other PSPs, Regional and DWS officials to obtain information and water requirement projections. The baseline year for

the water requirements scenarios will correspond with the year of the last national census. Data will inter alia be collected and generated from:

- Direct consultation with stakeholders (to establish historic water demands, land-use information, population figures, economic and socio-economic indicators, etc.).
- Identification of key drivers that influence and impact on water use.
- Generation of various levels of assurances of supply for the different water use categories and sectors.
- Development of water requirement scenarios.

This task is linked to various other tasks in this assignment:

- Historical water abstractions and return flows for input into the hydrological analysis (**Task 2**).
- Current water requirements and return flows for use in the yield analyses (**Task 11**).
- Future water requirements and return flows for the planning analyses (**Task 13**) and in the formulation of short-term and long-term water requirement scenarios for the Reconciliation Strategy (**Task 16**).

Due to previous involvement in the Validation and Verification Study for the Limpopo WMA, detailed information and experience on the current and qualifying water requirements of all the water sectors, specifically for irrigation, is available.

3.3.1 Task 3a: Domestic water requirements and return flows

The first step will focus on the gathering of information on the water requirements and return flows from previous studies that were undertaken by DWS and other stakeholders. The intention is to extract all available data from such reports and databases and compile comparisons of the different sources of current and projected water requirements and return flow data. Meetings with the relevant municipalities will be held to obtain the most recent development plans (IDPs, SDFs, LEDs, etc.) and these datasets will be evaluated and compared with the data obtained from other studies, such as the Small Town Studies and databases held by the DWS: Directorate Water Resource Planning and Directorate: Water Services Planning and Information.

This task will include a demographical analysis to develop a water requirement profile from 2012 to 2040 based on water-use scenarios. Settlement-level statistics on demography from the 2011 Census data and projection, Water

Services information on current population linked with service levels, and the Census 2011 data will be used to formulate population growth projections for rural settlements and towns in the study area from 2012 to 2040. Natural population growth and migration trends will be factored into the projection. Changes in settlement patterns (settlement densification) and the implications for household water consumption will also be considered. Some correlation between historical economic indicators and water use growth/decline will also be investigated.

Water demand centres will be identified based on the layout of the current (and future) water supply systems and the possible sources (groundwater and surface water) that can supply these centres.

Once all the data have been collated, the most appropriate dataset of historical and future water requirements and return flows will be identified. The suggested projection figures up to 2040 will then be selected and confirmed with the DWS and other relevant stakeholders following consultation with socio-economic specialists. Various growth options will then be developed for the study area. The main objective is to develop scenarios (e.g. “High”, “Medium” and “Low”) which will assist in the identification of appropriate future interventions in order to balance water availability (from surface and groundwater resources) with future water requirements.

3.3.2 Task 3b: Industrial, power generation, and mining water requirements and return flows

Historical and current information on industrial, power generation and mining water usage and return flows provided by previous studies will form the base data for this task. The initial focus will be on the identification of the key users which currently use large volumes of water and also those that plan significant future expansion (such as the proposed development of the coal mining industry and planned power stations in the Lephalale area). The water use for these large users will also be evaluated in terms of the best practices worldwide. Discussions will be held with the key industries to inter alia establish and confirm their current water use volumes, current and projected water use efficiency levels and future water requirements. The various growth scenarios will then be developed for these users within the study area. In particular, scenarios for platinum, coal, diamond and other mining developments up to 2040 will be formulated and the associated water requirements will be estimated.

3.3.3 Task 3c: Irrigation water requirements and return flows

The irrigation sector is the largest water user in the study area and will therefore be investigated in great detail and will be based on information obtained from:

- Results from previous studies.
- The DWS Water Allocation Registration Management System (WARMS) database.
- Databases developed during the validation and verification of water use.
- Local knowledge of DWS officials and DWS Limpopo Province offices.

Irrigation requirements will be determined from previous sources of information, but mostly from the current Validation and Verification Study of which the study team members are part of. Detailed irrigation data will be supplied for the modelling of the water requirements and return-flows for the historic, current and future scenarios. During the modelling of irrigation requirements, the theoretical irrigation water requirements for the identified irrigation development will be calculated. The actual water usage will be assessed by taking cognisance of on-farm irrigation system efficiency, the effect of droughts on the irrigation requirements and the expected return flows from irrigated fields.

The information that will be supplied to the modelling task will include (per quaternary or in a more detailed level) *inter alia* the following data:

- Representative crop parameters (crop factors, efficiency of application, estimated return flows).
- Growth/decline in crop areas.
- Sources of supply (from run-of-river, major dams, farm dams, canal systems, weirs, pipelines, etc.).

An agricultural development scenario will be formulated for the study area with specific reference to production configurations and irrigation technology. The water requirement implication of this scenario will also be quantified. Water requirement scenarios will also include:

- Eradication of unlawful irrigation.
- Revitalization of smallholder irrigation schemes.
- Trading of irrigation allocations.

3.3.4 Task 3d: Commercial forestry

There is only a very small area of afforestation within the Limpopo catchment which can be found in the Nzhelele River catchment. The reduction in runoff due to the afforestation in this area will be determined during this task.

Deliverable: **Water requirements and Return Flows Report** (Report 4)

- **Irrigation Assessment Report** (Supporting Document 1 to Report 4).
- An updated water requirement projection scenario database (spreadsheet-based).

3.4 TASK 4: Water conservation and water demand management

Objective

The objective is to review existing information and strategies to establish the potential for WCWDM in all user sectors. This includes consideration of alternative technologies, human behaviour and consumption patterns in the entire water supply chain with a view towards achieving better use with less water in order to optimise water use in all sectors by means of appropriate WCWDM policies, strategies and measures in the WMA.

WCWDM policies, strategies and measures must address all the relevant issues, including understanding of the total water balance within the institution's supply system, zoning and zonal analysis, leak detection, pressure management, infrastructure asset management, metering, billing, public awareness and communication, indigent policy and bylaws.

The PSP will liaise with all institutions in the WMA, including district and local municipalities, water boards, other water services providers, water user associations, as well as the proto-catchment management agency function / unit within the DWS Regional Offices, as follows:

- Municipalities to ensure that water services policies and bylaws of the relevant municipalities address WCWDM related issues, such as ability to introduce water restrictions. Municipalities may also require assistance with developing and implementing a WCWDM strategy.
- Water boards to ensure that they have appropriate WCWDM policies and measures in place and that their contracts with clients also address this.
- Water User Associations (WUAs) to ensure they have WCWDM measures and actions plans in place.

- The DWS proto-catchment management agency functions in the Regional Offices to ensure that water use license conditions and CME functions address WCWDM.

Additionally, potential for WCWDM in the irrigation sector as a whole will be considered and cost benefits will be assessed to determine where potential savings can be achieved. The team will liaise with national and/or provincial agriculture and land reform departments.

WCWDM for large industrial consumers, such as mines, power stations and industrial complexes will be assessed based on the reduce / reuse / recycle principles and proposals made on how to encourage and enforce better WCWDM measures.

3.4.1 Task 4a: Status quo assessment and prioritisation

All major users, including municipalities, in the study area will be approached for their latest WCWDM information and will be assessed on their water balance. The main objective of this is to identify the key demand centres and the extent of water losses in their systems. Having completed a first order water balance, the water demand centres will be prioritised according to the 80:20-principle.

3.4.2 Task 4b: Broad-based assessment of potential savings

The existing WCWDM information for the key demand centres will then be evaluated to gain a good understanding of the water systems, including municipal water supply networks, its operation and key problems. This will include a brief review of the existing condition of the infrastructure, the operation of the system, level of cost recovery and management practices.

The study team will assess whether the goals set by the institutions are realistic and that the savings can be achieved within the current constraints and that on-going monitoring and assessing of the benefits of various interventions are done. The project team will attempt to identify the priority projects whereby major savings can be achieved for limited capital investment.

3.4.3 Task 4c: Develop saving scenarios

Based on the results from the previous sub-tasks, a revised strategy will be developed for each urban demand centre, including the reduction of water losses, more efficient use of existing water supplies, deferred construction of new facilities, increased revenue collection, and decreased expenditure on purchasing or producing water, due to lower volumes of water required, reduced power costs,

reduced chemical costs, etc. The results from this task will include a realistic WCWDM strategy which will assess the potential savings, the cost implication and programme for implementation. The revised strategy will be forwarded to and agreed with the respective Water Service Authorities.

3.4.4 Task 4d: Reporting

The existing strategies will be compiled into a single WCWDM strategy for all water users sectors. The report will include summary information for each demand centre on the potential savings, cost of implementations and results. The impact of WCWDM on irrigation will be also summarised. The future WCDM scenarios will be linked to the future water requirements scenarios, in **Task 3**.

Deliverable: **WCWDM Status Report** (Supporting Document 2 to Report 4: Water Requirements and Return Flows)

3.5 TASK 5: Opportunities for water reuse

Objective

To conduct a study on the opportunities for the reuse of treated sewage effluent within the study area, focusing on the current impact of this source on the receiving environment.

Approach

All previous reports on this subject will be considered for background information. Municipalities in the area will be engaged to provide all relevant information relating to reuse of effluent which will include quantity and quality of effluent streams, existing or proposed reuse strategies, policy and pricing on reuse. The Green Drop Report will be used to verify the quality and quantity of effluent at municipal level and evaluate the cumulative risk rating (CRR), which provides an indication of the level of risk that each wastewater treatment plant poses to the environment. This information, together with surface water quality and GIS Information, will enable an assessment of the potential impact of reuse on the environment and as a possible resource to supplement current supply.

The Draft National Strategy for Water Reuse will be used as a guideline to identify all available water reuse opportunities within the study area. Key considerations that affect choices related to water reuse will be considered, namely water quality and

security of supply, water treatment technology, cost relative to other water supply alternatives, social and cultural perceptions and environmental considerations.

Deliverable: **Opportunities for Water Re-use Report** (Supporting Document 1 to Report 10: Water Supply Schemes)

3.6 TASK 6: Invasive alien plants

Objective

The objective of **Task 6** is to firstly estimate the current impact of IAP infestation within the study area on the availability of water and, secondly, to consider the possible benefit of IAP eradication.

Approach

The current extent of IAP infestation will be determined based on information from the recently published *National Invasive Alien Plant Survey* by the Agricultural Research Council. Associated water use will be estimated using the WRSM2000 and the results will be incorporated into the WRYM input data files to determine the possible benefit of eradication of these plants on the system yield. Furthermore, eradication scenarios will be formulated and evaluated in the WRPM as part of proposed reconciliation scenarios in **Task 16**.

Deliverable: Section in the Hydrological Analysis Report (Report 3)

3.7 TASK 7: Water quality assessment

Objective

The objective of this task is to conduct a water quality assessment of the study area outlining the current situation and all potential impacts from new developments.

Approach

Water quality information will be sourced from numerous literature sources, namely, existing All Towns Studies, Integrated Development Plans (IDPs), Water Services Development Plans (WSDPs), Spatial Development Frameworks (SDFs) and the Blue Drop Report. The Water Safety Plans of all Water Service Authorities will be used to identify possible risks in the respective water supply systems. Additional information will be sourced from DWS: Resource Quality Services. Aerial

photographs and land cover maps will allow for a qualitative assessment of current land uses in the study area.

In line with the requirements outlined in SANS241:2011 and the Water Safety Plan Manual of the World Health Organisation, all information gathered will be used to undertake a risk assessment of the study area to identify all possible impacts on the water quality. These will include existing and new mining developments, farming and irrigation, point and non-point sources of pollution and urban runoff. Each risk will be assigned a risk rating based on consequence to the environment and mitigating factors will be outlined which are aimed at reducing the potential impact of the risks identified.

Deliverable: **Water Quality Assessment Report** (Report 5)

3.8 TASK 8: Reserve requirement scenarios

Objective

To assess all Reserve information currently available for rivers and groundwater in the Limpopo WMA North, assess what scenarios have previously been evaluated for rivers in the study area, and the implications on yield of the water resources. Reserve requirements will also be utilised in yield modelling for strategies to be developed during the study.

Approach

The first step in this task would be a careful evaluation of Reserve work that has been previously conducted in the study area. Note that no additional Reserve studies will be conducted as part of this task, and no formal reviews or updates of previous Reserves will be undertaken.

The aim of the task is to focus on scenarios that have been developed and evaluated during previous Reserve or Water Resource Classification System (WRCS) studies and to assess impacts on yields of relevant water resources. Note that the Matlabas and Mokolo river catchments formed part of the recently completed Crocodile West WRCS study, and that the Olifants WRCS study also included parts of the Limpopo WMA. The relevant information and data files will be provided for use in **Task 11**, as the impact of Reserve and classification requirements on strategies considered will need to be determined. Reserve requirements and catchment configurations from previous studies will therefore be incorporated into the yield model set up during the reconciliation study. Should any strategies impact on areas where Reserve ecological

categories are not available, data from the national present ecological state / ecological importance / ecological sensitivity (PES/EI/ES) study recently completed for the Limpopo WMA, will be used as a desktop indication of PES and recommended ecological category (REC). Reserve requirements can then be generated using the Desktop Reserve Model.

The following activities will be incorporated into this task:

- Information obtained from Reserve work that has been conducted in the study area, and at what level and therefore associated confidence.
- A description of Reserve and classification scenarios that have been described and assessed during previous studies, together with a description of the ecological and other consequences associated with these scenarios.
- Recommendations on data gaps in the study area. It is assumed that information such as this will be useful to any additional WRCS studies initiated in the study area in future.
- An assessment of implications for Reserve Ecological Categories and catchment configurations linked to strategies considered during the Limpopo Management Area North Reconciliation study. Note that these assessments will be at a desktop level only, as a specialist team would be needed to assess results for a higher confidence result.

Deliverable: **Reserve Requirements Scenarios Report** (Supporting Document 1 to Report 7: Yield Analysis)

3.9 TASK 9: Groundwater utilisation scenarios

Objective

Determine the most favourable groundwater options in terms of management, conjunctive utilisation, estimated yield, required storage, water quality aspects, unit and infrastructure costs, Reserve requirements and environmental impacts.

Approach

The approach of this task will be to assess the available groundwater resources and develop and cost conceptual groundwater scheme scenarios. These scenarios will be based on the preliminary scenarios identified and possible other schemes based on the better understanding of the allocable WMA groundwater resources. A process of selecting the most favourable schemes will then be undertaken as recommendation to the Strategy.

This task will focus on assessing various scenarios for groundwater utilisation to be used in conjunction with surface water or serve as the primary source of water supply. Groundwater use impacts on surface water will be modelled using the WRSM2000 and WRYM-MF for present day use. The most favourable selected scenarios will be modelled in the WRYM to understand the impact on reservoir yields due to increased groundwater abstraction.

3.9.1 Selection of the most favourable development option

The following is a summary of the groundwater schemes in the Limpopo WMA:

- *Matlabas River catchment*. Note that groundwater is under-exploited in this catchment. Limited water users, but also no sustainable yield from surface water. The only sustainable water is groundwater and only for domestic users.
- *Mokolo River catch*ment. Note that significant amounts of irrigation from groundwater in this catchment, elsewhere groundwater is under-utilised).
- Lephalala River catchment. Alluvial aquifers.
- *Mogalakwena River catchment*. Note that large groundwater resources are within this catchment which has already been extensively exploited by irrigation.
- *Sand River catchment*. Note exceptional groundwater reserves within this catchment, which have been fully exploited.
- *Nzhelele River catchment.* Note that groundwater is already used extensively in this area.
- *Nwanedi River catchment:* No augmentation is currently required in this catchment.
- Validation and verification study for the Limpopo WMA, especially the irrigation use from groundwater, as well as supplemental WARMS information. Only verified data will be used.
- The Updated All Towns Studies, the Capricorn Bulk Water Services Master Plan and the Limpopo and Luvhuvhu WMA: SMP Details for groundwater abstraction for domestic use.
- National Groundwater Database and Groundwater Resources Information Project (GRIP) Database for information on boreholes and water quality.
- Limpopo Aquabase data, managed on behalf of DWS by GPM Consultants.
- VSA Rebotile Metsi Aquabase data which consists of approximately 25 000 boreholes. Hardcopy data of this is available.

- All available maps and explanatory brochures for the area pertaining to groundwater including, Groundwater resources of South Africa, 1:500 000 hydrogeological maps and Aquifer Classification maps.
- Other maps including the 1:1 000 000 and 1:500 000 geological maps, terrain morphology maps and 1:50 000 topography (where required),
- The 1:500 000 geological maps with the various lithologies which will form the basis to evaluate groundwater in each catchment.
- Terra Aster Satellite imagery interpretation of geological lineaments that may have a bearing and influence on groundwater occurrences. However, these will only be used if available for the area and are obtainable from DWS.
- Other sources such as Sustainable Development of Groundwater Resources, Groundwater Resources of South Africa, Quality of domestic water supplies in SA, the National Groundwater Quality Assessment and the WR2005.

The sources of available groundwater data will be used to calculate the allocable amount of water from different methods by including the Reserve and utilisation. Different estimates for the availability of groundwater will include harvest potential, exploitable potential, and aquifer recharge while taking into account transmission losses. Attention will be given to high borehole yield areas and dolomitic areas. The analyses will be at least at quaternary level and will be based on hydrogeological setup of each catchment. The findings of the current DWS study on reviewing the recharge estimates, based on monitoring data, will be taken in to account if available at the time of evaluation.

With these water balances the scenarios will be evaluated to assess which is most favourable, even though they might require further investigations.

3.9.2 Identification of options for conjunctive groundwater and surface water use

The scenarios identified earlier and potential additional areas for groundwater would be evaluated in terms of potential conjunctive use application. The surface water availability and allocable groundwater information will be used to identify areas were conjunctive use will be beneficial and special attention will be given to possible areas of artificial recharge and areas where high yield boreholes are located close by existing surface water infrastructure. These options will also be included as possible additional schemes. These types of schemes, however, will have to be modelled to assess the impact of conjunctive use on the overall yield of the system.

3.9.3 Cost estimates and evaluation of options

Conceptual designs for the groundwater utilisation scenarios in terms of well fields and conjunctive use scheme infrastructure development will be developed and cost estimates determined, including pipework, pumps, valves and storage facilities. Estimates of operational and maintenance costs will also be done. This will include the determination of unit reference values (URVs) of the ground water utilisation options. The conceptual design will include the following:

- Delineation of areas for single water sources or small schemes (5 km radius), small regional schemes (10 km radius), regional schemes (50 km radius). This will be done according to existing information, regional geology and structural geological interpretations.
- Review of groundwater utilisation, projected demands and Reserve needs.
- Liaise with role-players to finalise definition of project scope and objectives.
- Conceptualise system design approach and technical specifications.
- Conceptual design of well field piping infrastructure, minor storage facilities and determining conceptual quantities and yields.
- Assess the scheme's impact on surface water resources (part of **Tasks 2** and **11**).
- Conceptual design of conjunctive ground and surface water utilization schemes.
- Determine scenarios for the next 10, 20, 30 and 40 years with the required expansion of water schemes. For example a single village scheme must change to a regional scheme within the next 5 years to adapt to increasing water requirements.
- Determine possible environmental impacts of the proposed scheme.

Costing of the conceptual schemes will be done taking into account project costs, infrastructure development, operational and maintenance costs. Unit costs and URV will also be determined. Finally the most favourable options in terms of costs, benefits, and effectiveness of ground water utilisation and lowest impact on the environment and surface water resources will be identified.

Deliverable: **Groundwater Assessment and Utilisation Scenarios Report** (Report 6)

3.10 TASK 10: International obligations

Objective

The Limpopo River Basin is shared by South Africa, Botswana, Zimbabwe and Mozambique. All rivers in the Limpopo WMA flow directly to the main stem of the Limpopo River. The objective of this task is to undertake an appraisal of the international water-related aspects of the WMA. A further objective is to summarise the possible impacts of water resource management in the Limpopo WMA on water quality and quantity in the main stem of the Limpopo River.

Approach

The PSP will meet with DWS representatives to SADC and the Limpopo JPTC and will access the latest treaties and protocols pertaining to international obligations and rights pertaining to the water course states of the Limpopo River. In this regard a watercourse state is a state "in whose territory part of the watercourse is situated." In terms hereof South Africa, Botswana, Zimbabwe and Mozambique are all watercourse states with respect to the Limpopo River, and consequently the schedule of international obligations will refer primarily to the obligation on these states to make water available to other states (e.g. release water downstream) or to use Limpopo River water. The study team will review these treaties and studies and compile a short report of each treaty and protocol. The team will also compile a referenced schedule of international obligations and international rights (water allocations). This information will be supplemented by an analysis of the various studies undertaken by the JPTC.

Without pre-empting our analysis it is likely that the following treaties, and the studies done in terms of these treaties, and the studies done by the institutions established by these Treaties, will be relevant to developing a schedule of international obligations and rights:

- United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses, 1997.
- SADC Revised Protocol on Shared Watercourses 2000. (Note that the SADC Protocol on Shared Watercourses 1995 was effectively repealed by Revised Protocol).
- Various agreements under and reports of the JPTC.

The SADC Protocol on Shared Watercourses promotes the establishment of shared watercourse agreements and institutions and enshrines the principles of reasonable

use and environmentally sound development of the resource. It supports Integrated Water Resource Management (IWRM) and the Regional Strategic Action Plan for Integrated Water Resources Development and Management (RSAP-IWRM). The SADC Protocol supports strengthening the principles of integrated management of shared basins with specific provisions for equitable utilisation, planned measures, no significant harm, and emergency situations

A short report will be drafted on the results of the planning analysis that focuses primarily on the impacts of the water requirements, the likely storage of water, the water quality and on the allowances made for downstream releases as it impacts on the main stem of the Limpopo River and on the other basin states. The report will aim to interpret aspects of the international agreements that are of importance to the equitable utilisation of the water in the Limpopo River and also provides a summary of the possible impacts of water resource management in the Limpopo WMA on the water quality and quantity in the main stem of the Limpopo River.

Deliverable: **International Obligations Report** (Report 12)

- A database of international agreements that impacts on the water resource management of the Limpopo River.

3.11 TASK 11: Yield analysis (WRYM)

Objective

The objective of this task will be to determine the water supply potential (yield) from the large dams in the Limpopo WMA North based on the updated hydrological data sets from **Task 2**.

Approach

Available WRYM model configuration data sets will be updated based on the data gathered and developed during previous tasks. Historical and stochastic yield analyses will be undertaken for all large dams (in excess of 1 million m^3) and for scenarios identified. Two main technical issues regarding the WRYM configurations for the Limpopo WMA are as follow:

- *Combined systems:* It is suggested that separate WRYM configuration are developed for the Matlabas, Mokolo, Lephalale, Mogalakwena, Sand, Nzhelele, and Nwanedi river catchments. However, a single PARAM.DAT-file (as developed in **Task 2h**) will be used to preserve cross-correlations between catchments. Furthermore, the model element numbering system of the

different WRYM systems will be unique to enable more efficient integration of the different systems into a combined single WRPM.

- *Groundwater modelling:* The GWSWIM has been implemented in the WRYM-MF and the WRPM for some time now. However, some significant problems were experienced with the stochastic groundwater flow generation and analysis. This problem has recently been addressed and tested on limited catchments. This functionality will enable modellers to change groundwater abstraction values and explicitly simulate the effect of conjunctive use in total system yield in the WRYM-MF and WRPM. At the onset of this task, spot checks will be undertaken with this new functionality to determine if the model adequately mimics the effect of groundwater abstractions on base flows in the WMA. If problems are experienced with the new functionality, different natural hydrological datasets will have to be developed using the WRSM2000 for each scenario to simulate effects of groundwater abstraction on surface water availability and yields.

In configuring the WRYM, the existing WRYM configurations, i.e. for the Mokolo, Mogalakwena, Nzhelele and Nwanedi, will be obtained and screened for required updates based on the information from **Task 2**. New WRYM configurations will be developed for the other catchments based on that of the WRSM2000. Water use priority and system operation will be modelled based on existing operating rules/practices. Once configured the WRYM setups will be tested thoroughly.

The following scenarios are envisaged both for historic and stochastic analyses (long- and short-term):

- Natural conditions.
- Present-day conditions.
- Present-day with EWRs.
- Various scenario development options as identified in this study.

The short-term yield reliability characteristics (YRCs) developed with the WRYM will be incorporated into the WRPM input data files (see **Task 13**).

Deliverable: **Yield Analysis Report** (Report 7)

- Fully functional electronic copy of the WRYM configuration within the WRYM-MF.
- WRYM configuration data files.
- Short-term YRCs.

3.12 TASK 12: Water quality modelling (WQT)

Objective

The main objective is to configure the Water Quality and Sulphates (WQT) hydro-salinity model at a quaternary catchment scale for each of the 10 tertiary catchments in the study area. This is required as input to the WRPM.

Approach

The WQT team will liaise at the earliest stages with the hydrological, WRPM and WRYM teams to ensure that key features that have water quality implications are incorporated in the hydrological system networks. The configuring of the WQT is planned to commence at a much earlier stage than in previous studies, as soon as the preliminary stages of smaller hydrological sub-systems are developed. This is an important departure since the salinity modelling adds another conservative mass balance that often reveals problems with the hydrology. Early identification of such issues makes it much easier to rectify the hydrology resulting in an overall improvement of the modelled results obtained. However, this advantage can only be derived at the WQT model calibration stage, which has been deferred to later phases of the study.

As salinity is not currently considered a critical factor in the Limpopo WMA, a full calibration of the WQT model is not deemed necessary for this first phase study. However, the model input data files. as well as the observed data records, will be prepared for inclusion in the WRPM. The input data files will be configured in parallel with the WRYM, so as to use the same model element numbering. Special attention will be given to the WQT irrigation blocks since the parameters controlling the volumetric response will be needed for the hydrology, the WRYM and the WRPM and are important in the allocation procedure for risk analysis purposes.

In-filling of water quality data available at key observation points will be conducted with the daily flow time-series using both the MOVE program and various spreadsheet techniques that have been developed and used to effect in recent catchment studies. Effluent discharge and water supply quality data will be obtained and in-filled with consideration of demand centre supply and effluent salinity information. It is anticipated that many quaternary catchments will lack observed salinity data. In such instances reasonable assumptions will be made based on experience gained from other studies.

Due account will be taken of potential changes in the salinity of water transferred from outside catchments. In particular, recent salinity modelling carried out in the adjacent Crocodile West River system has indicated a long-term possibility of saline mine discharges from the western mining basin adversely affecting the salinity of water transferred to the Mokolo River that supports at least two strategic power stations.

Also, unless effectively managed, exploitation of coal reserves holds particular potential for local acid mine drainage (AMD) generation, especially after decommissioning. A mining module is available in the WQT model specifically to assist in modelling these effects. The need for configuring the mining modules will be discussed with the Client and is recommended for key catchments in the study area, namely the Mokolo and Mogalakwena.

Atmospheric deposition associated with intensive power generation is another key factor that can impact the study area. The WQT model includes features to simulate the effect of deposition on catchments, including sulphate adsorption / desorption processes. Based on deposition impact studies carried out by team members in the Upper Vaal catchment, these impacts can be very substantial, even with flue gas desulphurisation. This is particularly relevant in the presence of sandy soils that have low sulphur retention capacity. These factors will be highlighted in the WQT Model report, for consideration when the WQT is fully calibrated in the future.

Deliverable: **Water Quality Modelling Report** (Report 8)

- Model configuration data files required as input to the WRPM
- Supporting data files and plots, the data used for patching stream flow, effluent and water transfer quality data and the data files and program executable codes required to run the WQT model for each sub-system

3.13 TASK 13: Planning analysis (WRPM)

Objective

To compile an integrated WRPM model configuration of all catchments in the study area that feed into the Limpopo River main stem.

Approach

The WRYM and WQT model data sets will be used as a basis for developing the WRPM model configuration. This includes the various sets of data files as well as the short-term yield-reliability curves. For this purpose, the study team will assess the progress that DWS has made with the development of the WRPM-MF for possible

application in this study. The setting up and testing of the WRPM will be undertaken in a stepwise manner, whereby the water quantity component of the WRPM (which is based on the WRYM data sets) will first be compiled, tested and confirmed to be functional for each of the main river catchments individually. Thereafter the salinity component (based on the WQT) will be added and tested. In this way fault finding will be simplified and the various catchments combined only once the WRPM model for each individual catchment has been successfully configured. The existing WRPM configuration for the Mokolo River catchment will be reviewed and updated where new information is available, including new water users and projected water requirement scenarios. The water users within the WMA will then be categorised to allow the selection of appropriate assurance of supply criteria. For this purpose:

- Existing assurance of supply criteria for the Mokolo catchment as well as the neighbouring Crocodile (West) catchment will be used as point of departure.
- Draft assurance of supply criteria be proposed for each water user category in each main catchment (irrigation may change for example if crop type changes significantly between catchments).
- The draft assurance of supply criteria will be presented to the SSC (as discussed under **Task 17**) during one of the earlier meetings for discussion, possible revision and approval.

With future water requirements determined as part of **Task 3** included in the model, the WRPM will be utilised to perform scenario analyses and associated water balances. The scenario analyses will consider the different reconciliation options identified as part of the screening task as well as the possible impacts of WCWDM, water reuse, removal of IAPs and groundwater development (**Tasks 4**, **5**, **6** and **9**). Various regional and localised interventions for reconciliation will be identified. The development scenario options that will be analysed in the WRPM will need to be limited, and will most likely be a combination of various interventions. A total of four WRPM reconciliation scenarios is considered practical and has been assumed for costing purposes. Water balances at key locations in the catchments will be derived to provide total catchment and, if necessary, total WMA system water balances.

Deliverable: **Planning Analysis Report** (Report 9)

- Fully functional electronic copy of the WRPM configurations (possibly within the WRPM-MF) with water quality included for the whole WMA.
- WRPM configuration data files.
- Annually revised water balances to inform the Strategy and the SSC.

3.14 TASK 14: Review schemes and update cost estimates

Objective

To review the configuration schemes identified as part of the Preliminary Screening Workshop and prepare updated cost estimates.

Approach

According to the *Limpopo Growth and Development Strategy* seven development clusters has been identified in the province, namely:

- Platinum mining cluster on the Dilokong Corridor between Polokwane and Burgersfort (Sekhukhune District) and also in the Waterberg District.
- Coal mining and petrochemical cluster at Lephalale on the east-west Corridor (Waterberg District).
- Fruit and vegetable (horticulture) cluster in Vhembe, Mopani and Bohlabela.
- Logistics cluster in Polokwane (Capricorn district).
- Red and white meat cluster on all the corridors (all districts).
- Eight tourism sub-clusters at a number of high-potential destinations.
- Forestry cluster in the Mopani and Vhembe districts

The formation and promotion of these developments has to go hand in hand with a water resource and management strategy and the identification of (i) management interventions; and (ii) water resource development schemes to augment water supply to the province. The management interventions and water resource development schemes will be updated and confirmed during the SSC1/Preliminary Screening Workshop. Some of the catchments will require separate and independent strategies, while some will have interdependent strategies. A summary of the more prominent water resource development schemes in the Limpopo WMA North, being developed at present and envisaged for the future, are listed below:

- Mokolo-Crocodile Water Augmentation Project (MCWAP) Phases 1 and 2.
- Raising of Mokolo Dam.
- Olifants River Water Resources Development Project (ORWDP) Phases 1 and 2.
- Water transfer from the Crocodile River catchment (either from Klipvoor or Roodeplaat dams) to augment the supply to Modimolle and Mookgopong.
- Water transfers from Nandoni Dam in the Luvuvhu/Letaba River catchment to augment the supply to Makhado and rural users in the Nzhelele River catchment.

- Raising of Nzhelele Dam.
- Development of bulk groundwater schemes within the province.

It is envisaged that the relevant municipalities will be visited and contact be made with the Municipal Managers to investigate and report on the state of the water services infrastructure and management thereof.

The estimated cost of development schemes considered for a reconciliation strategy, including the cost of infrastructure to convey the water to major users, will be, if necessary, updated for current prices. The rates, and where necessary also the quantities, will be updated and upgraded to the same level of accuracy and base date, in order to compare schemes on equal terms. It is anticipated that the year 2014 will be taken as the base year. Recognised cost models as well as rates from recent tenders for similar projects will be used. Water tariffs for existing transfer schemes will not be checked or recalculated. URVs for the schemes identified in the SSC1/Preliminary Screening Workshop will be prepared as input into **Task 16**. The schemes selected for further consideration identified will be discussed with the Client before commencement of the review and updating of the cost estimates. Provision has been made for assessing eight schemes in this task.

The locality and details of all identified and reviewed schemes will be described, highlighting the contribution of new schemes to water availability and water quality within the WMA. The impact of providing for the Reserve requirements as well as the updated cost estimates of the selected schemes will also be considered. This information will be used as input to **Task 16** to determine the URVs of the schemes and to formulate scenarios.

Deliverable: **Water Supply Scheme Report** (Report 10)

3.15 TASK 15: Review or assess social and environmental impacts

Objective

The objective of this task is to review the information from previous studies and carry out Social and Environmental *Status Quo* Assessments and a first order due diligence assessment of all options to identify any potential fatal flaws.

Social and environmental status quo assessment

An assessment will be undertaken to characterise the nature of the receiving environment of all options. The *Status Quo* Assessment will characterise the

current biophysical and social environmental conditions at a desktop level. A site visit and key stakeholder liaison will verify the desktop research.

Due diligence review

A first order due diligence assessment will be undertaken on the expected impacts of the project on the receiving social and biophysical environment. The process utilises a matrix approach to rate the various risks of each option and to provide recommendation of the preferred option/s to be taken forward from a holistic environmental perspective.

Deliverable: **Environmental and Social Status Quo Report** (Supporting Document 2 to Report 10: Water Supply Schemes)

3.16 TASK 16: Assembly of information and formulation of scenarios

Objective

To identify intervention measures to meet potential shortfalls in water supply in the Limpopo WMA North. This task will involve the development of a reconciliation strategy that is inherently cooperative, the assumptions are plausible and proposals are realistic and can be reviewed from environmental, technical, economic and institutional points of view.

Approach

This is one of the most important tasks of the assignment and involves the formulation of a Reconciliation Strategy for the Limpopo WMA North area. Possible interventions, both short-term (until 2015) and long-term (until 2040) will be identified and assessed to overcome potential shortages in water supply, with appropriate linkages to all other tasks undertaken as part of this assignment. The reconciliation process will be documented and other issues and concerns will to be identified. It is proposed that a two-phased approach is followed:

- **Phase 1:** Develop short-term water requirement scenarios, assess the required interventions so that water supply can meet the water requirements and prepare a short-term reconciliation strategy.
- **Phase 2:** This phase is similar to Phase 1, but will aim to develop long-term water requirement scenarios (up to 2040), assess the sequence of interventions and develop a final long-term reconciliation strategy.

The various water resources models developed as part of this study will incorporate different scheme development and management scenarios for the Limpopo WMA North (as reviewed in **Task 14**). The study area consists of seven individual catchments, some of which are interdependent, and/or dependent on water transfers from the Olifants and Crocodile West rivers. The formulation of scenarios will be based, primarily, upon these linkages which will also dictate the grouping of these sub-catchments for modelling purposes. It is anticipated that there will be more than one development scenario for each of the catchments, which could possibly lead to a large number of combinations for the study area as a whole. Therefore, each catchment will be investigated as a discrete unit before they are combined sensibly into more comprehensive scenarios.

Based on the results of **Task 3**, three final water requirement projections will be assessed based on the "High"-, "Medium"- and "Low"-development scenarios. Within each of these there will also be a number of permutations and it will be necessary to use some sound judgement to establish a rational scenario. This will be undertaken in consultation with the Client. It is likely that a number of "what-if" scenarios, resulting from interpretation of results from other scenarios, will also have to be analysed. The requirements for the Reserve will also be taken into account.

Deliverable: **Reconciliation Strategy Report** (Report 11)

- Draft Reconciliation Strategy
- Final Reconciliation Strategy

3.17 TASK 17: Stakeholder engagement and public participation

Objective

Stakeholder participation is one of the key elements in the compilation of the Reconciliation Strategy. If stakeholders do not buy into and support the Strategy its implementation stands a huge risk to be unsuccessful. The objective of the public participation process is to provide stakeholders with information to assist them in providing meaningful contributions to the process and ensuring their participation in its implementation.

Approach

During the Inception Phase, a **stakeholder database** will be compiled. Identification of stakeholders will take place by contacting local municipalities, communities, networking and from existing databases. Furthermore, reply and comment sheets accompanying mailing, will provide space for stakeholders to add the names of their

colleagues or other interested parties. The database will also be updated as the process proceeds and as new information becomes available. Representatives (relevant to the study) of the following sectors of society will be identified so as to afford them the opportunity to comment (the database will be categorised accordingly) and participate in the project. These sectors are:

- National, provincial and local government
- Reference groups in the catchment (e.g. WUAs).
- Agriculture and farmers' organisations.
- Regional and local media.
- Business and commerce
- Environmental bodies, both as authorities and non-governmental organisations (NGOs).
- Community representatives, community based organisation (CBOs), development bodies.

A project announcement in the form of a BID will be compiled (exclusively in English) and distributed to stakeholders on the database. The BID will provide a description of the anticipated outcomes of the study, the steps to be taken, when stakeholders may provide their inputs and also proposed timelines. Stakeholders will also be requested to complete a response sheet that will allow them to share any issues and comments that they may have with the proposed study and the methodology to compile a Reconciliation Strategy. The BID will be distributed during the Inception Phase, before the preliminary workshop. The BID will also provide information about the preliminary workshop which will be held and may call for nominations for the SSC.

A SSC will be vital for the development of this Reconciliation Strategy. The SSC will be a representative body of various user sectors in the study area. Its purpose will be to provide guidance in the progressive development of the Strategy. Members of the committee will be nominated early in the process and the committee will meet three times during the study in a centrally located area, as follows:

- *SSC 1 / Preliminary Workshop*: The SSC 1 / Preliminary Workshop will announce the proposed study to relevant representative stakeholders, obtain their comments on the proposed study approach and tasks to be followed. The SSC members will also be confirmed at the workshop. Their roles will be to guide the study processes and to provide their inputs at key milestones.
- *SSC 2 / Screening workshop:* The SSC 2 / Screening Workshop will provide members with a summary document on potential schemes and concerns in

order to obtain their comments and ultimately identify the preferred options. The meeting will also be to provide feedback on the preliminary workshop and a framework of the Reconciliation Strategy.

- *SSC 3*: To present the draft Reconciliation Strategy to members and to obtain their comments in preparation of the Final Screening Workshop.
- *SSC 4 / Final Screening Workshop*: The objectives of the Final Screening Workshop will be to present the preliminary Reconciliation Strategy of the Limpopo WMA North for discussion. The same people that attended the Preliminary Workshop will be invited to this workshop so that they may follow the outcome of their recommendations at the first workshop.
- *SSC 5 / Public Meeting*: To provide feedback on the final screening workshop and finalise the Reconciliation Strategy of the Limpopo WMA North.

A schematic diagram of the SSC meeting dates and process is shown in Figure 3.1.

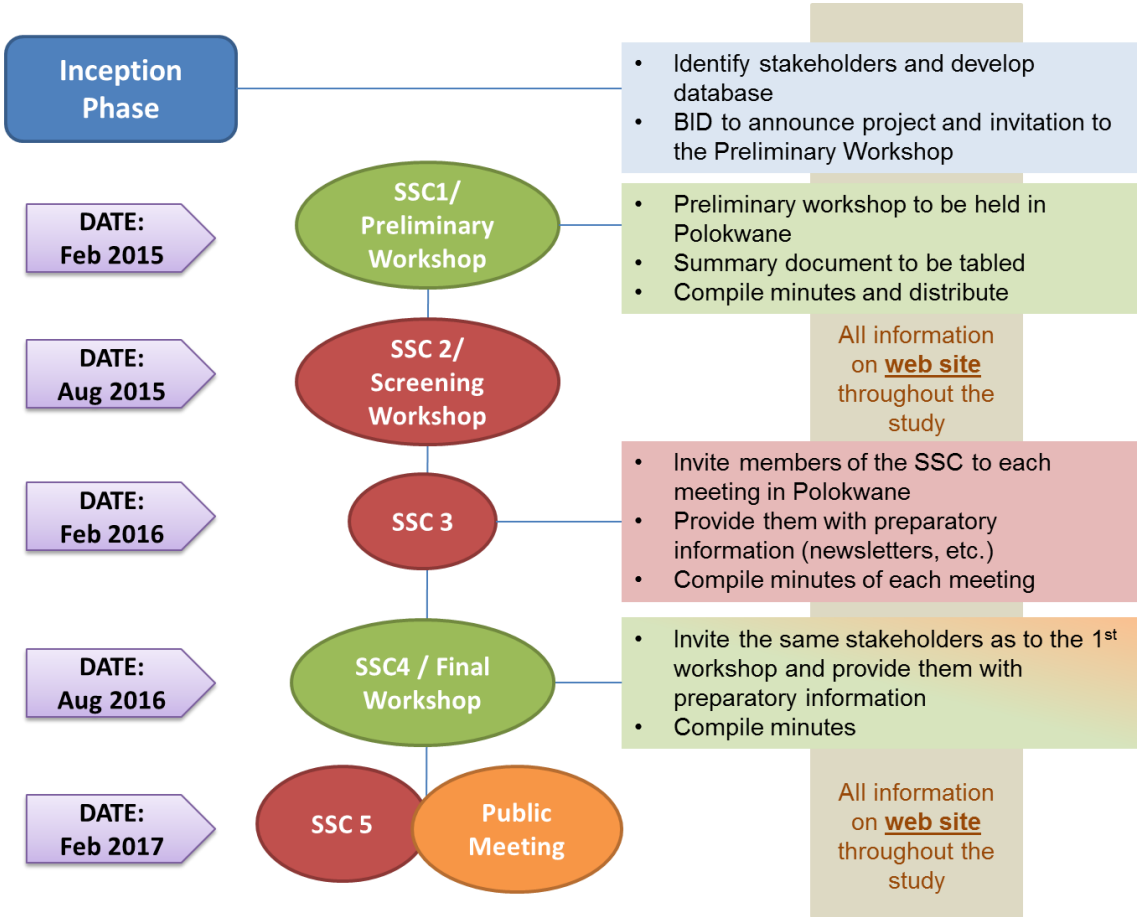


Figure 3.1: SSC schematic diagram

The PSP will be responsible for the distribution of invitations and documents to the SSC members two weeks in advance of the meeting. Recording, compilation and

distribution of the minutes of each SSC meeting will also be undertaken. A dry-run meeting will be held before each SSC meeting.

A list of stakeholders to be invited, an invitation letter and an agenda will be compiled and distributed with the summary document. Stakeholder attendance will be followed up. A dry-run meeting will be arranged and held. Attendance register, name tags and copies of relevant documents will be provided at the workshop. Minutes will be compiled, distributed to stakeholders and finalised. A summary will be included in Report 2.

Public meeting: One public meeting is to be held to present the findings of the SSC 4 / Final Screening Workshop. It is proposed that the meeting be held at a centrally located venue such as Polokwane, to receive public comment on the final draft Reconciliation Strategy for the Limpopo WMA North.

Newsletters: Two editions of the *Limpopo WMA North Reconciliation Strategy News* will be compiled and distributed to all those on the stakeholder database. The newsletters will provide an update on progress made with the study and the steps to be taken in the next phase.

Limpopo WMA website: All public information will be made available to the DWS to upload on their website. The web address will be sent to all stakeholders.

Deliverable: **Background Information Document**

- A stakeholder database.
- Dry-run meetings in preparation of the SSC and public meetings
- Invitation, agenda, attendance register, minutes of SSC meetings.
- Invitation, agenda, attendance register, minutes of a public meeting.
- Two editions of a newsletter.
- Inputs to the DWS website.

3.18 TASK 18: Training and capacity building

Objective

Training and capacity building are considered to be key components of the assignment, not only because it will serve to develop the competence and expertise of DWS staff, but also because it will establish a common understanding of technical aspects between the Client and the study team and thereby contribute to the overall success of the assignment. The task consists of a number of activities as detailed below.

Identification of trainees

Five Departmental staff members will be identified for training in consultation with the Client during the Inception Phase of the study. A proposal in this regard will be made at the first Study Management Meeting for approval.

Develop training material and make arrangements for training

It is proposed that a training programme is undertaken which will involve two distinct components, namely:

- A formal two day training course which will be held to provide attendees with a general background of the processes involved with developing and implementing a reconciliation strategy. The training will address issues such as the basic principles of water resources planning, use of water resources systems models, developing and monitoring water requirement projections, water balances and timing of future intervention measures and the practical implementation and monitoring of a reconciliation strategy.
- Further training will be undertaken during the course of the project through a process of ad-hoc instructions. This will involve the actual participation of attendees in the practical aspects of the assignment and will involve the periodic short-term to medium-term secondment of trainees to the offices of the PSP. Ad-hoc instructions will depend on the progress of the assignment and the needs and availability of the trainees. Specific dates will therefore only be scheduled after consultation with the Client.

Analyse impact of training

The impact of the proposed training undertaken will be assessed based primarily on feedback obtained from a designated Departmental representative on perceived benefits regarding the knowledge base, practical insight and / or work-related behaviour of trainees. Ideally, the representative in question will be a line manager or senior colleague of trainees and will be selected in consultation with the Client.

Document the training process

Progress on the above training programme will be continually monitored and, upon conclusion, documented in a concise training report. The report will include details on the process of selecting trainees, attendance and feedback of the formal training course and a schedule and milestones of the ad-hoc instruction process. The report will also include conclusion on the success of the training based on the impact analysis described above, as well as recommendations on

further training that may be required and also on the potential for improving similar training programmes in future. Feedback from the trainees on the value of the training experience will be obtained and communicated to the study team. This will support the Department on the value of the training and lessons learned during this process. This will support the Department in similar training in future.

Deliverable: **Training Report** (Report 13)

- Training material for 2-day training course

4 PHASE 3: STUDY MANAGEMENT

4.1 Study management

Specific organisational arrangements will be made during the Inception Phase of the assignment to ensure that the execution of all activities are supervised and controlled in an effective way and in accordance with the Client's needs.

The objective of this task is to ensure that there is:

- Close and effective liaison between the DWS Project Manager and the Study Leader, and also with all Task Leaders and the task teams.
- Regular and timeous progress reporting against programme.
- Effective management of project costs and expenses against budget, DWS cash flow provisions and progress being made.
- Communication with stakeholders in a way that elicits their support for the assignment by way of providing information, facilitating fieldwork and developing their confidence in the findings and recommendations.
- Adherence to and compliance with the work programme and milestones.

Approach

A SMT committee will be established compromising of the DWS Study Manager and the PSP Study Leader for effective communication. The SMT will provide strategic direction and guidance and will comprise of Government representatives.

SAMs, which will mainly deal with the study management, administration and contractual aspects, will be held on a six-weekly basis. The first SAM was held on 1 July 2014 after the Mobilisation Meeting on 12 March 2014. It is envisaged that a maximum of 20 SMT/SAM meetings will be required during the execution of the study. SAMs will normally be scheduled to coincide with the SMT. The PSP will be responsible for the meeting administration and technical progress reports.

The SSC will be the forum for stakeholder consultation and public participation, as discussed in **Task 17**. The SSC comprising of DWS Directorates, other National and Government Departments, municipalities, Water Boards, study team representatives as well as other interested parties identified in the Scope of Work

will provide high level direction and guidance with support of the SMT. It is envisaged that five SSC meetings will be held.

Deliverable: **Project management deliverables**

- Logistical arrangements for the SSC, SAM/SMT meetings, including full secretarial and documentation support.
- Monthly invoicing, progress reports, financial control, and HDI participation records.
- Presentations to the DWS Management Team.

4.2 Study termination

The objective of Phase 3 is to transfer the final study information to DWS.

Deliverable: **Clouse-out Report**

- Electronic copies of all reports, minutes and presentations

5 STUDY TEAM

5.1 Team composition

AECOM SA (Pty) Ltd is the lead consultant for this project and will receive specialist input and support from the following sub-consultants: **Hydrosol**, **Jones & Wagener (Pty) Ltd**, **VSA Rebotile Metsi Consulting** and several specialist sub-consultants. An organogram of the team composition is provided in Figure 5.1.

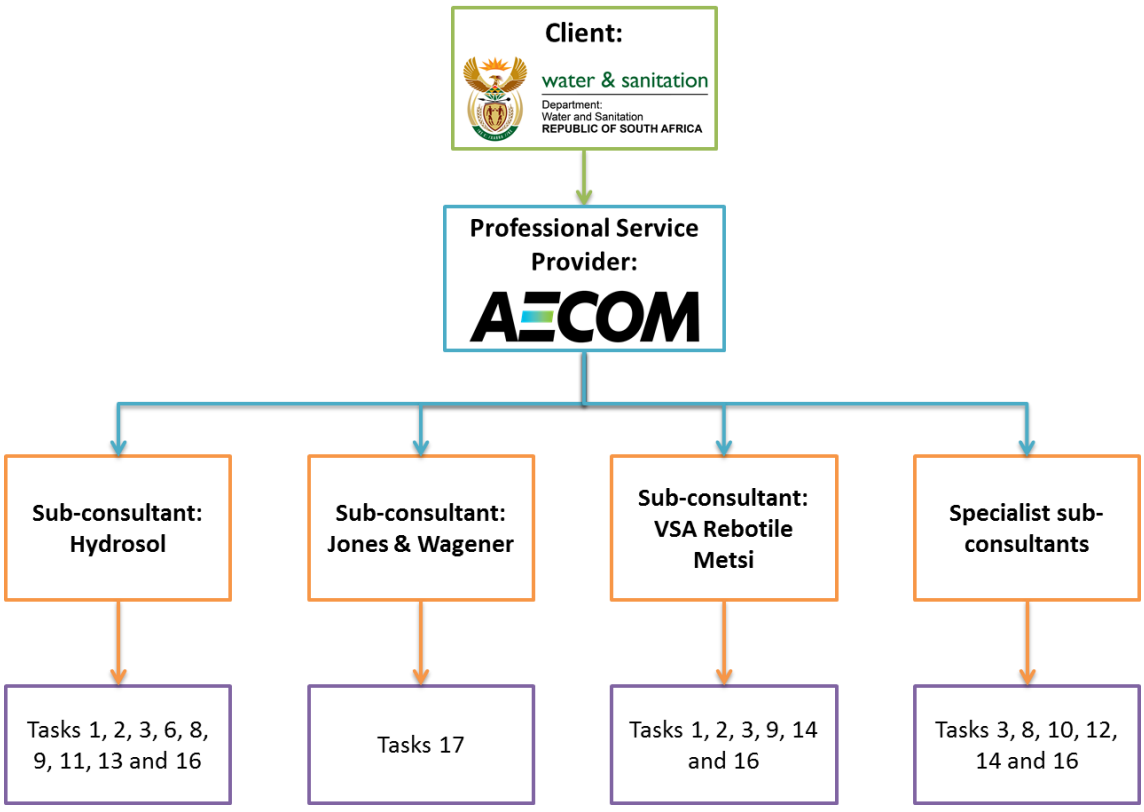


Figure 5.1: Organogram of team composition

5.1.1 Changes to the study team

The following individuals were added as study team members:

- Miss Jaretha Lombaard
- Mr Guy Robertson
- Mr Emile Enslin
- Mr Tewie Human
- Mr Bharat Gordhan

These team members were added to aid towards capacity building on the project.

5.2 Task leaders and key personnel

The task leaders will manage the various technical tasks. They are responsible for directing and co-ordinating the personnel working on each task, as well as ensuring technical precision and applicability. They will ensure that each task is completed within budget and on time, and to acceptable standards.

Table 5.1 provides a brief overview of the high level of experience and knowledge available from the Task Leaders and other core members of the Study Team.

Table 5.1: Core study team members

Name	Position	Profession	Overview
de Jager, Gerald	Project Director and Technical Leader	Civil Engineer	Gerald holds a B Eng (Civil) and is an experienced manager, responsible for leading small- and medium-sized technical teams in the planning and implementation of projects 17 years of experience in water resources systems analysis, water infrastructure development planning, water resources allocation planning and hydrological modelling Involved with the development and testing of water resources systems models, documentation and user manuals.
Pieterse, Hermien	Study Leader	Civil Engineer	Hermien holds a B Eng (Civil) and an M Com (Business Management) and has 20 years of experience in a wide spectrum of civil engineering fields, and focuses on the planning of water resources development and management projects and studies. She has worked extensively with the three spheres of Government, and has a thorough understanding of the challenges faced by Government to meet its delivery mandate.
Rossouw, Johan	Specialist reviewer	Civil Engineer	Johan Rossouw holds a Hons BEng (Civil) and has more than 30 years of experience in water resources management, development planning and modelling, specialising in the management and planning of water resource development, including reconnaissance, pre-feasibility studies as well as water resources systems modelling.

Name	Position	Profession	Overview
Lötter, Anelle	Task Leader: Public participation	Public Participation and Communication	Anelle has managed dozens of public participation projects, worked in communication, awareness creation and stakeholder engagement for the last 15 years. She coordinated some of the logistically most challenging processes in South Africa, upon occasion coordinating more than 40 stakeholder meetings countrywide within the space of some weeks, and coordinating the distribution of tens of thousands of documents and other materials in various languages to stakeholders countrywide.
Haasbroek, Bennie	Task Leader: WRYM, Water requirements, Groundwater	Hydrologist	Bennie has 17 years of experience in hydrological, yield and planning analyses of water resources for reconciliation planning in Southern Africa. He is an experienced manager for small technical teams in the planning and implementation of projects. And is also the key manager for the updating of the standard water resources systems models as used by DWS
Herold, Chris	WQT Specialist	Civil Engineer	Dr Chris Herold has 39 years of experience in water resources and water quality modelling and assessment. Developed first integrated water resources-salinity system model for the Vaal River system and applied it to solve numerous water quality problems, including implementation of the RW blending option and the assessment of the LHWP and its closest rivals, which saved the community tens of billions of Rands.
Steyn, Glen	Economist	Specialist: Socio-Economics/ Demography	Glen specialises in socio-economic analyses, scenario formulation, development strategy formulation and development project implementation planning. His involvement in Limpopo WMA has been in the planning work for major infrastructure development projects in collaboration with consulting engineering firms.
Liversage, Nicola	Task Leader	Environmental Scientist	Nicola obtained a MSc in Geography and have more ten years' work experience in her field. She specialises in Environmental Planning and Management, Sustainable Development and GIS.
Schroder, Jonathan	Key support: Planning model	Agricultural Engineer	Specific experience in the *DWSF Water Resource Study in Support of the AsgiSA-EC Mzimvubu Development Project:* Task Leader for the Water resources and hydropower modelling, assisted with costing of dams, Five years' experience in water resources analyses and water systems modelling Water resources planning and costing experience: "*Assessment of the Ultimate Potential and Future Marginal Cost of Water Resources in South Africa*"

Name	Position	Profession	Overview
Scherman, Patsy (Dr)	Task Leader: Environmental (Reserve) Considerations	Environmental Practitioner: Reserve and water quality specialist	Patsy has been actively involved in managing large Reserve studies (Kromme / Seekoei (2001-2006) and Knysna / Swartvlei (2006 – 2010), as well as conducting water quality Reserve development and the application of these methods during Reserve determinations. Coordinator of the technical training programme for the Comprehensive Reserve studies initiated by DWS in 2007, and is a member of the Project Management Team for the Vaal Water Quality Reserve Study (2007-2010).
Ramsden, Peter	Task leader: International Obligations	Financial, Legal and Engineering Consultant	Peter Ramsden specialises in the contractual/legal and financial/economic aspects of water resource infrastructure provision and operations.
Vermeulen, Abri	Key Support: WCWDM	Water services and water resources	23 years' experience in water services, 15 of which was with DWS. With this he has extensive knowledge and experience in managing WCDM policies, strategies and studies.
van Niekerk, Estelle	Task Leader: Hydrology	Hydrologist	Estelle has 27 years' experience in water resources analysis and modelling (WRSM2000 and WRYM). She has extensive experience in most of the South African Water Resources Models (WRIMS (WRYM-MF), WRSM2000, WQT, Spatsim).
Laher, Ayesha	Key support: water quality and water reuse	Water Scientist	Ayesha is a professional scientist with experience in water and wastewater treatment and management. She is a Blue and Green Drop Lead Inspector and has knowledge of the current situation of water and wastewater management at municipal level in South Africa. Ayesha has undertaken various process audits and water quality assessments and has been active in developing risk-based water safety plans for a number of municipalities.

6 COST ESTIMATE

6.1 General

6.1.1 Form of agreement

The Contract entered into on 27 February 2014, between DWS and AECOM SA (Pty) Ltd, is the legal binding document between the Client and the Consultant, supported by this Inception Report.

6.1.2 Value added tax (VAT)

All fees and cost items shown in this report exclude VAT, except where otherwise indicated.

6.2 Contract Price

The Contract Price, also referred to as Original Contract Amount, is ***R6 939 182 (VAT included)***.

6.2.1 Professional Fees

Total professional fees for the study is ***R 5 852 886.00 (excl VAT)***.

The study team for the study with their rates are given in Table 6.1.

Table 6.1: Study team rates

Name	Rate (R/hr)	Company	Position in Study Team	HDI
Badenhorst, Danie	1 600	AECOM	Specialist: Dams	White male
De Jager, Gerald	1 200	AECOM	Task Leader/ Technical Leader	White male
Delport, Kobus	360	AECOM	Support	White male
Enslin, Emile	520	AECOM	Project Administrator	White male
Fynn, Cameron	405	AECOM	Support	White male
Gallagher, Lodia	440	AECOM	Graphics Artist	White female
Ghoor, Zarmeen	360	AECOM	Support	Black female
Gordhan, Bharat	750	AECOM	Key Support	Black male
Herold, Chris	1 210	AECOM	Specialist: Water Quality	White male
Howard, Mike	1 300	AECOM	Specialist: Water Quality	White male
Human, Tewie	300	AECOM	Support	White male
Joubert, Francois	950	AECOM	Specialist	White male
Kilian, Johann	880	AECOM	Key Support	White male

Name	Rate (R/hr)	Company	Position in Study Team	HDI
Kwele, Kagiso	450	AECOM	Key Support	Black female
Laher, Ayesha	750	AECOM	Task Leader: Water Quality	Black female
Liversage, Nicola	850	AECOM	Task Leader: Environmental	White female
Lombaard, Jaretha	360	AECOM	Support	White female
Modua, Fred	410	AECOM	Key Support	Black male
Pieterse, Hermien	1 350	AECOM	Study Leader	White female
Pullen, Bob	1 400	AECOM	Specialist: Strategy Integration	White male
Ramsden, Peter	1 400	AECOM	Specialist: Financial and Institutional	White male
Reynders, Theresa	350	AECOM	Project Finance Administrator	White female
Robertson, Guy	360	AECOM	Support	White male
Rossouw, Johan	1 500	AECOM	Study Director	White male
Scherman, Patsy	770	AECOM	Task Leader: Reserve	White female
Schoeman, Hennie	1 100	AECOM	Specialist	White male
Schroder, Jonathan	900	AECOM	Task Leader: WRPM	White male
Selopyane, Sylvia	300	AECOM	Project Administrator	Black female
Sikosana, Siyabonga	550	AECOM	Support	Black male
Steyn, Glen	1 045	AECOM	Specialist: Demographics	White male
Van Niekerk, Estelle	1 000	AECOM	Task Leader: Hydrology	White female
Vermeulen, Abri	1 300	AECOM	Task Leader: WCWDM	White male
Haasbroek, Bennie	900	Hydrosol	Task Leader: Water Resources	White male
Bambisa, Sibongile	500	Jones & Wagener	Support	Black female
Lötter, Anelle	900	Jones & Wagener	Task Leader: Public Participation	White female
Nwaila, Musa	275	VSA Rebotile	Support	Black male
Sonnekus, CJ	900	VSA Rebotile	Task Leader: Groundwater	White male
Weidemann, J	550	VSA Rebotile	Support	White male
Weidemann, Reinardt	700	VSA Rebotile	Key Support	White male
Woithe, San-Mari	550	VSA Rebotile	Support	White female

6.2.2 Disbursements

An amount of ***R 234 115.00*** (excl VAT) is allowed for disbursements, as specified by the Contract. In this regard it should be noted that:

- Translation of documents is not budgeted for.
- Costs for venues for meetings / workshops are conservative and includes R250 per person per meeting.
- Costs were included for 30 people per SSC, 50 people per workshop and 80 people for a public meeting.

6.2.3 Summary of study cost estimate

The summary of the cost estimate for the study is given in Figure 5.1.

Table 6.2: Summary of cost estimate

	Amount (R)
Professional fees	5 852 886
Disbursements	234 115
Total	**6 087 001**
VAT (14%)	852 180
Total	**6 939 182**

6.3 Projected cash flow

The projected cash flow for the project is reflected in Figure 6.1.

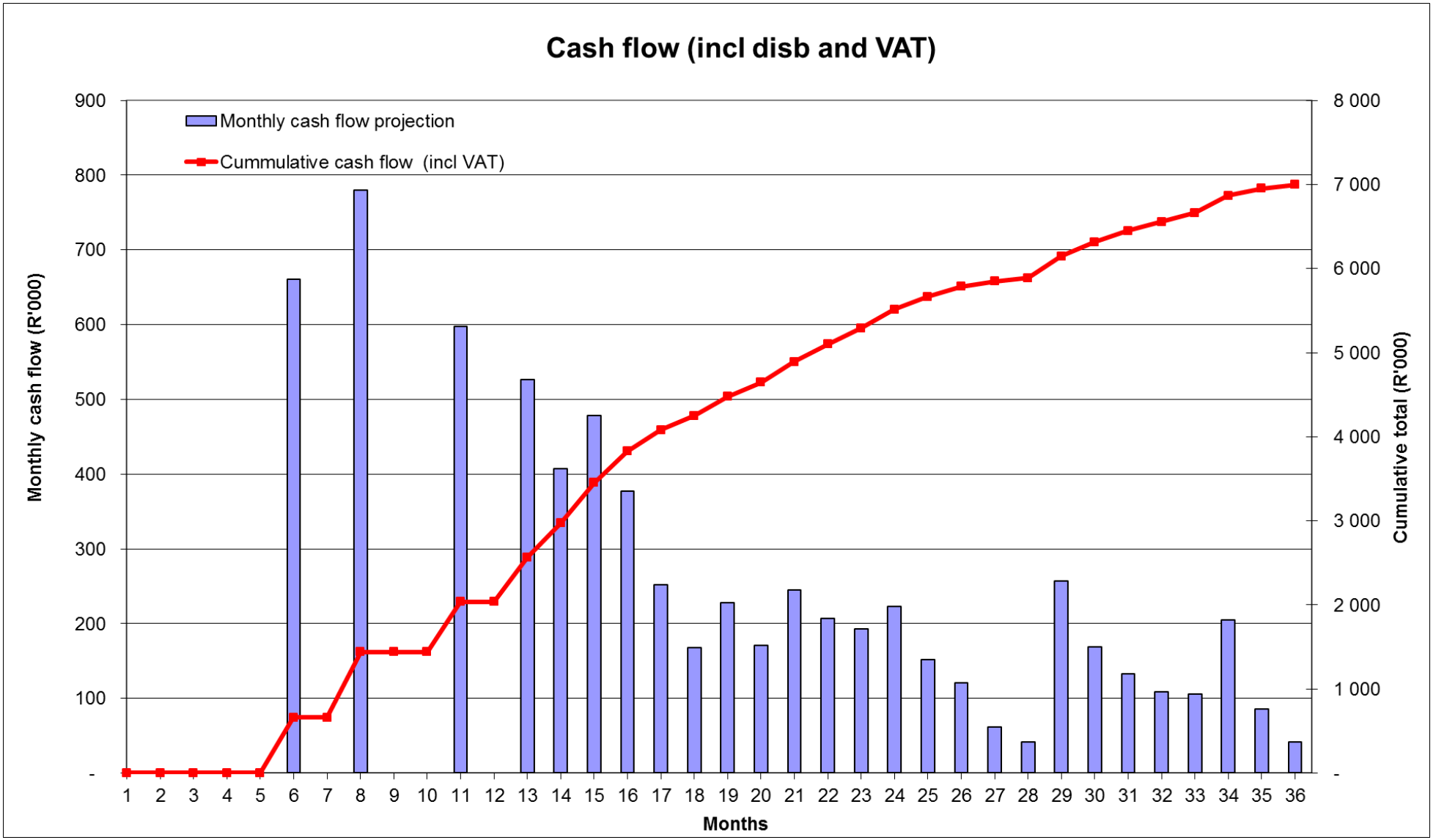


Figure 6.1: Cash flow over study period

6.4 HDI participation

The HDI involvement on the project is summarised in Figure 5.1.

Table 6.3: HDI participation

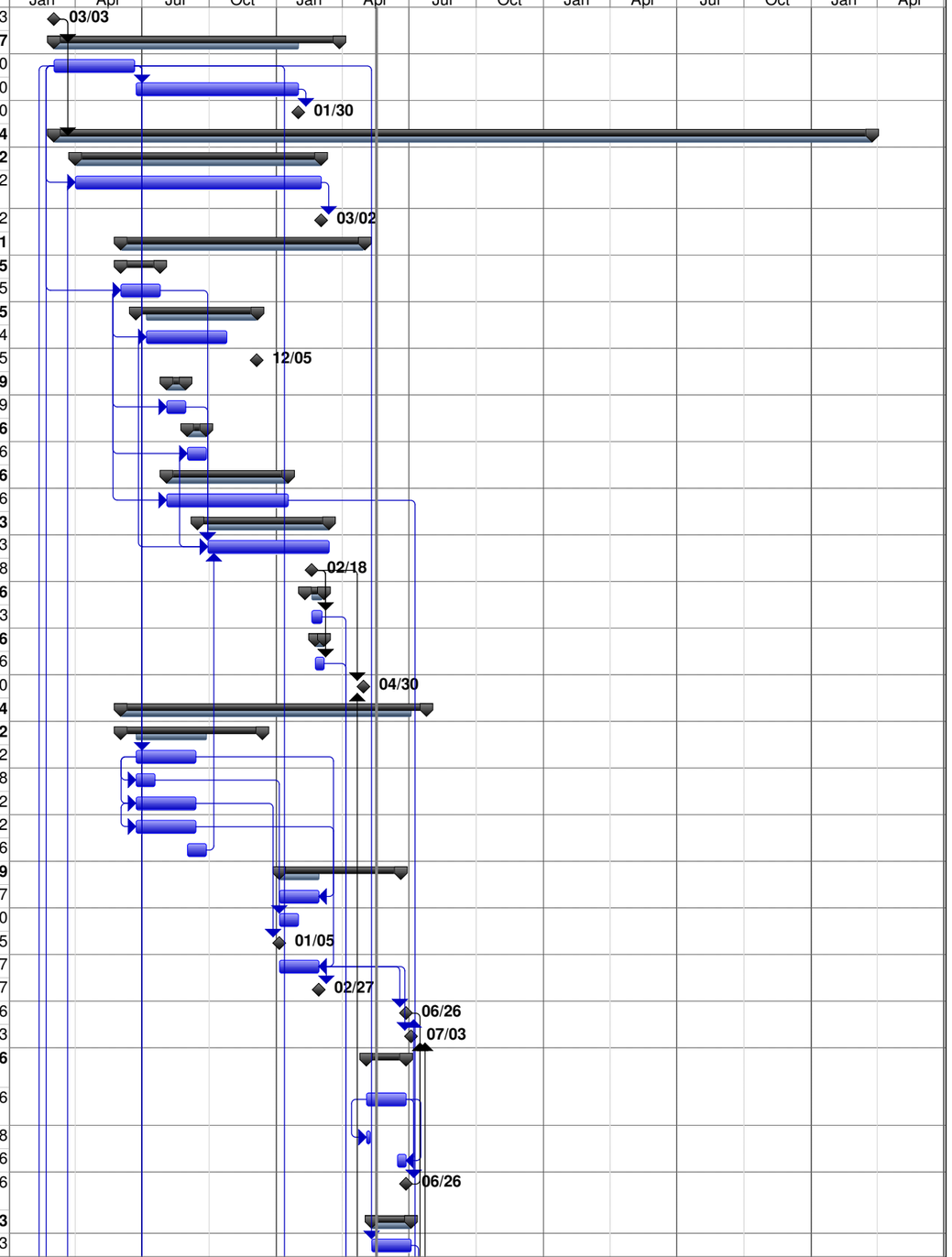
HDI status	Professional fees (R)		Hours	
	Excl VAT	% of total	Number	% of total
Black male	976 530	16.5%	1 743	24.1%
Black female	449 966	7.6%	754	8.3%
White female	2 138 439	36.2%	3 514	36.9%
Sub-total	**3 564 934**	**60.4%**	**6 010**	**69.2%**
White male	2 336 441	49.6%	2 970	30.8%
TOTAL	**5 901 375**	**100%**	**8 980**	**100%**

Appendix A

Study programme

WP 10768 -
DEVELOP LIMPOPO WATER MANAGEMENT AREA NORTH RECONCILIATION STRATEGY

ID	Task Name	Duration	Start	Finish
1	**START OF CONTRACT**	0 days	Mon 14/03/03	Mon 14/03/03
2	**PHASE 1: STUDY PLANNING AND PROCESS INITIATION**	**14 mons**	**Mon 14/03/03**	**Fri 15/03/27**
3	Prepare study plan, budget, work programme and description of study reports	4 mons	Mon 14/03/03	Fri 14/06/20
4	Inception Report (Report 1)	8 mons	Mon 14/06/23	Fri 15/01/30
5	Presentation to DWA D: NWRP	0 days	Fri 15/01/30	Fri 15/01/30
6	**PHASE 2: STUDY IMPLEMENTATION**	**40 mons**	**Mon 14/03/03**	**Fri 17/03/24**
7	**TASK 1: SUMMARY OF PREVIOUS AND CURRENT STUDIES**	**12 mons**	**Tue 14/04/01**	**Mon 15/03/02**
8	Abstract information from previous studies, liaison with organisations etc. (incl. info on potential schemes (SW/GW/Desalination/Other))	12 mons	Tue 14/04/01	Mon 15/03/02
9	Summary of Previous and Current Studies Report (Report 2)	0 days	Mon 15/03/02	Mon 15/03/02
10	**TASK 2: HYDROLOGICAL ANALYSIS (COMPREHENSIVE)**	**12 mons**	**Mon 14/06/02**	**Fri 15/05/01**
11	**3a) Data collection and collation**	**2 mons**	**Mon 14/06/02**	**Fri 14/07/25**
12	Prepare hydrological database (rainfall, streamflow, evap, land-uses, nat. streamflow etc.)	2 mons	Mon 14/06/02	Fri 14/07/25
13	**3b) Rainfall data analysis (RAIN-IMS)**	**6 mons**	**Mon 14/06/23**	**Fri 14/12/05**
14	Generate catchment rainfall files (.RAN files)	4 mons	Mon 14/07/07	Fri 14/10/24
15	Rainfall Data Analysis Report (Supporting Document 1 to Report 3: Hydrological Analysis)	0 mons	Fri 14/12/05	Fri 14/12/05
16	**3c) Evaporation data analysis**	**1 mon**	**Mon 14/08/04**	**Fri 14/08/29**
17	Generate evaporation data	1 mon	Mon 14/08/04	Fri 14/08/29
18	**3d) Streamflow data analysis (WRSM2005)**	**1 mon**	**Mon 14/09/01**	**Fri 14/09/26**
19	Generate complete streamflow gauging data	1 mon	Mon 14/09/01	Fri 14/09/26
20	**3e) Groundwater assessment and groundwater-surface water interaction**	**6 mons**	**Mon 14/08/04**	**Fri 15/01/16**
21	Model GW / SW interaction (GWSWIM)	6 mons	Mon 14/08/04	Fri 15/01/16
22	**3f) Configuration & testing of the WRSM2005**	**6.5 mons**	**Mon 14/09/15**	**Fri 15/03/13**
23	Configure WRSM2000 model	6 mons	Mon 14/09/29	Fri 15/03/13
24	Calibrated WRSM2000 model with data files	0 days	Wed 15/02/18	Wed 15/02/18
25	**3h) Naturalisation of streamflow records**	**1 mon**	**Mon 15/02/09**	**Fri 15/03/06**
26	Naturalise streamflow records (.INC files)	0.5 mons	Wed 15/02/18	Tue 15/03/03
27	**3i) Verification & validation of stochastic hydrology (STOMSA)**	**0.5 mons**	**Mon 15/02/23**	**Fri 15/03/06**
28	Generate PARAM.DAT	2 wks	Mon 15/02/23	Fri 15/03/06
29	Hydrological Analysis Report (Report 3)	0 days	Thu 15/04/30	Thu 15/04/30
30	**TASK 3: CURRENT AND FUTURE WATER REQUIREMENTS AND RETURN FLOWS**	**15 mons**	**Mon 14/06/02**	**Fri 15/07/24**
31	**(i) Historical data**	**7 mons**	**Mon 14/06/02**	**Fri 14/12/12**
32	4a(i) Domestic WR & RF	3 mons	Mon 14/06/23	Fri 14/09/12
33	4b(i) Industrial, power generation and mining WR & RF	1 mon	Mon 14/06/23	Fri 14/07/18
34	4c(i) Irrigation WR & RF (incl. illegal irr / rev smaller irr schemes / trading of allocations)	3 mons	Mon 14/06/23	Fri 14/09/12
35	4d(i) Afforestation & AIPs WR	3 mons	Mon 14/06/23	Fri 14/09/12
36	Generate historical water demand files	1 mon	Mon 14/09/01	Fri 14/09/26
37	**(ii) Future projections - Low, medium, high scenarios**	**6 mons**	**Mon 15/01/05**	**Fri 15/06/19**
38	4a(ii) Domestic WR & RF (obtain population data & service levels)	2 mons	Mon 15/01/05	Fri 15/02/27
39	4b(ii) Industrial, power generation and mining WR & RF	1 mon	Mon 15/01/05	Fri 15/01/30
40	4c(ii) Irrigation WR & RF	0 days	Mon 15/01/05	Mon 15/01/05
41	4d(ii) Afforestation & AIPs WR	2 mons	Mon 15/01/05	Fri 15/02/27
42	Updated DWA water usage database	0 days	Fri 15/02/27	Fri 15/02/27
43	Water requirement and return flow scenario database spreadsheet	0 days	Fri 15/06/26	Fri 15/06/26
44	Water Requirements and Return Flows Report (Report 4)	0 days	Fri 15/07/03	Fri 15/07/03
45	**TASK 4: WATER CONSERVATION AND DEMAND MANAGEMENT (WCWDM) - All water user sectors**	**2 mons**	**Mon 15/05/04**	**Fri 15/06/26**
46	Review previous reports, liaise with municipalities/WSAs, update and assess costs & benefits, assess impacts etc.	2 mons	Mon 15/05/04	Fri 15/06/26
47	Assess opportunities for WCWDM in irrigation	1 wk	Mon 15/05/04	Fri 15/05/08
48	Include WCWDM measures in future water requirement and return flow scenarios	2 wks	Mon 15/06/15	Fri 15/06/26
49	WCWDM Status Quo Report (Supporting Document 2 to Report 4: Water Requirements and Return Flows)	0 days	Fri 15/06/26	Fri 15/06/26
50	**TASK 5: OPPORTUNITIES FOR WATER RE-USE**	**2 mons**	**Mon 15/05/11**	**Fri 15/07/03**
51	Review previous reports, obtain information from municipalities, update costs & benefits	2 mons	Mon 15/05/11	Fri 15/07/03

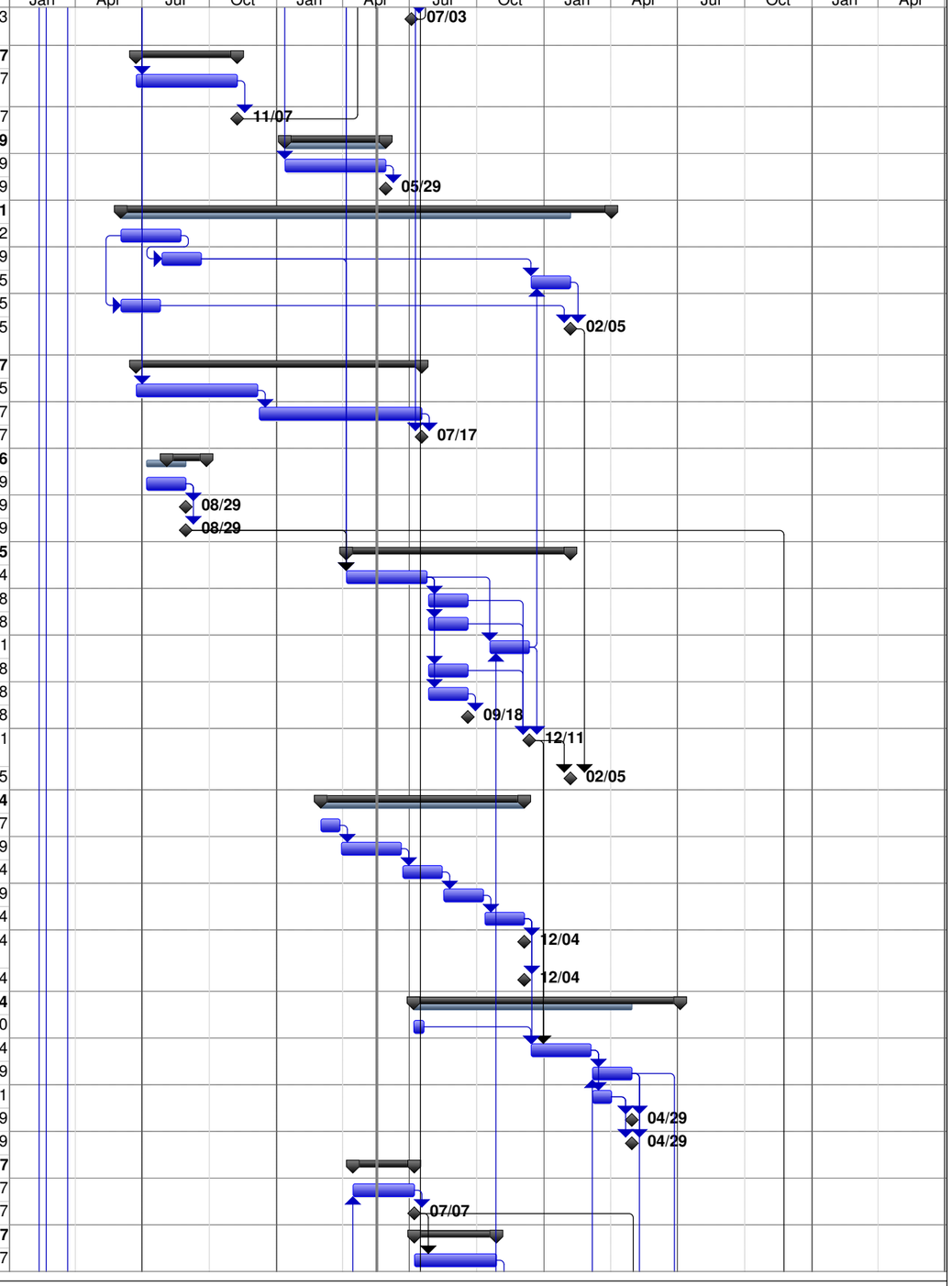


Project: Project Programme_AC
Date: Mon 15/05/25

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

WP 10768 -
DEVELOP LIMPOPO WATER MANAGEMENT AREA NORTH RECONCILIATION STRATEGY

ID	Task Name	Duration	Start	Finish
52	Opportunities for Water Reuse Report (Supporting Document 1 to Report 10: Water Supply Schemes)	0 days	Fri 15/07/03	Fri 15/07/03
53	**TASK 6: INVASIVE ALIEN PLANTS (IAPs)**	**5 mons**	**Mon 14/06/23**	**Fri 14/11/07**
54	Analyse scenarios for removal of IAPs & Liaise with DWA Working for Water (regarding future plans for IAP eradication)	5 mons	Mon 14/06/23	Fri 14/11/07
55	Section to be incliuded in Report 3: Hydrological Analysis Report	0 days	Fri 14/11/07	Fri 14/11/07
56	**TASK 7: WATER QUALITY**	**5 mons**	**Mon 15/01/12**	**Fri 15/05/29**
57	Assess impacts of potential mining & irrigation/Assess potential effect of nutrients etc./Assess mitigating	5 mons	Mon 15/01/12	Fri 15/05/29
58	Water Quality Assessment Report (Report 6)	0 days	Fri 15/05/29	Fri 15/05/29
59	**TASK 8: RESERVE REQUIREMENT SCENARIOS**	**24 mons**	**Mon 14/06/02**	**Fri 16/04/01**
60	Site visits	3 mons	Mon 14/06/02	Fri 14/08/22
61	EcoClassification	2 mons	Mon 14/07/28	Fri 14/09/19
62	Evaluation of scenarios	2 mons	Mon 15/12/14	Fri 16/02/05
63	Establish priorities for determining a Reserve for GW schemes	2 mons	Mon 14/06/02	Fri 14/07/25
64	Reserve Requirement Scenarios Report (Supporting Document 1 to Report 7: Yield Analysis (WRYM))	0 days	Fri 16/02/05	Fri 16/02/05
65	**TASK 9: GROUNDWATER UTILIZATION SCENARIOS**	**14 mons**	**Mon 14/06/23**	**Fri 15/07/17**
66	Select previously identified options, identify options for conjunctive GW/SW usage	6 mons	Mon 14/06/23	Fri 14/12/05
67	Prepare cost estimates of schemes etc.	8 mons	Mon 14/12/08	Fri 15/07/17
68	Groundwater Assessment and Utilization Scenarios Report (Report 6)	0 days	Fri 15/07/17	Fri 15/07/17
69	**TASK 10: INTERNATIONAL OBLIGATIONS**	**2 mons**	**Mon 14/08/04**	**Fri 14/09/26**
70	Reviewing international obligations and communicating with co-basin states	2 mons	Mon 14/07/07	Fri 14/08/29
71	Appraisal of international water-related aspects	0 days	Fri 14/08/29	Fri 14/08/29
72	International Obligations Report (Report 12)	0 days	Fri 14/08/29	Fri 14/08/29
73	**TASK 11: YIELD ANALYSIS (WRYM)**	**11 mons**	**Mon 15/04/06**	**Fri 16/02/05**
74	Configuration and testing of the WRYM	4 mons	Mon 15/04/06	Fri 15/07/24
75	Historic firm yield analysis	2 mons	Mon 15/07/27	Fri 15/09/18
76	Testing of existing operating rules	2 mons	Mon 15/07/27	Fri 15/09/18
77	Scenario analyses (present and future)	2 mons	Mon 15/10/19	Fri 15/12/11
78	Long-term stochastic analysis	2 mons	Mon 15/07/27	Fri 15/09/18
79	Short-term stochastic analysis	2 mons	Mon 15/07/27	Fri 15/09/18
80	Set of short-term yield curves (for WRPM)	0 days	Fri 15/09/18	Fri 15/09/18
81	Fully functional WRYM configuration - water quantity (within the WRYM-IMS) with input files (ASCII format)	0 days	Fri 15/12/11	Fri 15/12/11
82	Water Resource Yield Analysis (WRYM) Report (Report 7)	0 days	Fri 16/02/05	Fri 16/02/05
83	**TASK 12: WATER QUALITY MODELING (WQT)**	**10 mons**	**Mon 15/03/02**	**Fri 15/12/04**
84	Data preparation	1 mon	Mon 15/03/02	Fri 15/03/27
85	Set-up of the salt washoff model	3 mons	Mon 15/03/30	Fri 15/06/19
86	Model calibration	2 mons	Mon 15/06/22	Fri 15/08/14
87	Scenario analysis	2 mons	Mon 15/08/17	Fri 15/10/09
88	Set of output files (for WRPM)	2 mons	Mon 15/10/12	Fri 15/12/04
89	Fully functional WRYM configuration - water quality (within the WRYM-IMS) with input files (ASCII format)	0 days	Fri 15/12/04	Fri 15/12/04
90	Water Quality Modelling Report (Report 8)	0 days	Fri 15/12/04	Fri 15/12/04
91	**TASK 13: PLANNING ANALYSIS (WRPM)**	**13 mons**	**Tue 15/07/07**	**Mon 16/07/04**
92	Split water requirements - water use categories & assurances of supply	2 wks	Tue 15/07/07	Mon 15/07/20
93	Configuration and testing of the WRPM	3 mons	Mon 15/12/14	Fri 16/03/04
94	Analyses of scenarios identified during development of Reconciliation Strategy	2 mons	Mon 16/03/07	Fri 16/04/29
95	Calculation of water balance at key points	1 mon	Mon 16/03/07	Fri 16/04/01
96	Fully functional WRPM configuration with input files (ASCII format)	0 days	Fri 16/04/29	Fri 16/04/29
97	Water Resource Planning Analysis (WRPM) Report (Report 9)	0 days	Fri 16/04/29	Fri 16/04/29
98	**TASK 14: REVIEW SCHEMES AND UPDATE COST ESTIMATES**	**3 mons**	**Wed 15/04/15**	**Tue 15/07/07**
99	Investigate state of water services infrastructure, update cost estimates & prepare URVs	3 mons	Wed 15/04/15	Tue 15/07/07
100	Water Supply Schemes Report (Report 10)	0 days	Tue 15/07/07	Tue 15/07/07
101	**TAKS 15: REVIEW OR ASSESS SOCIAL AND ENVIRONMENTAL**	**4 mons**	**Wed 15/07/08**	**Tue 15/10/27**
102	Undertake desktop assessments/review of previous and recent assessments & site visits	4 mons	Wed 15/07/08	Tue 15/10/27

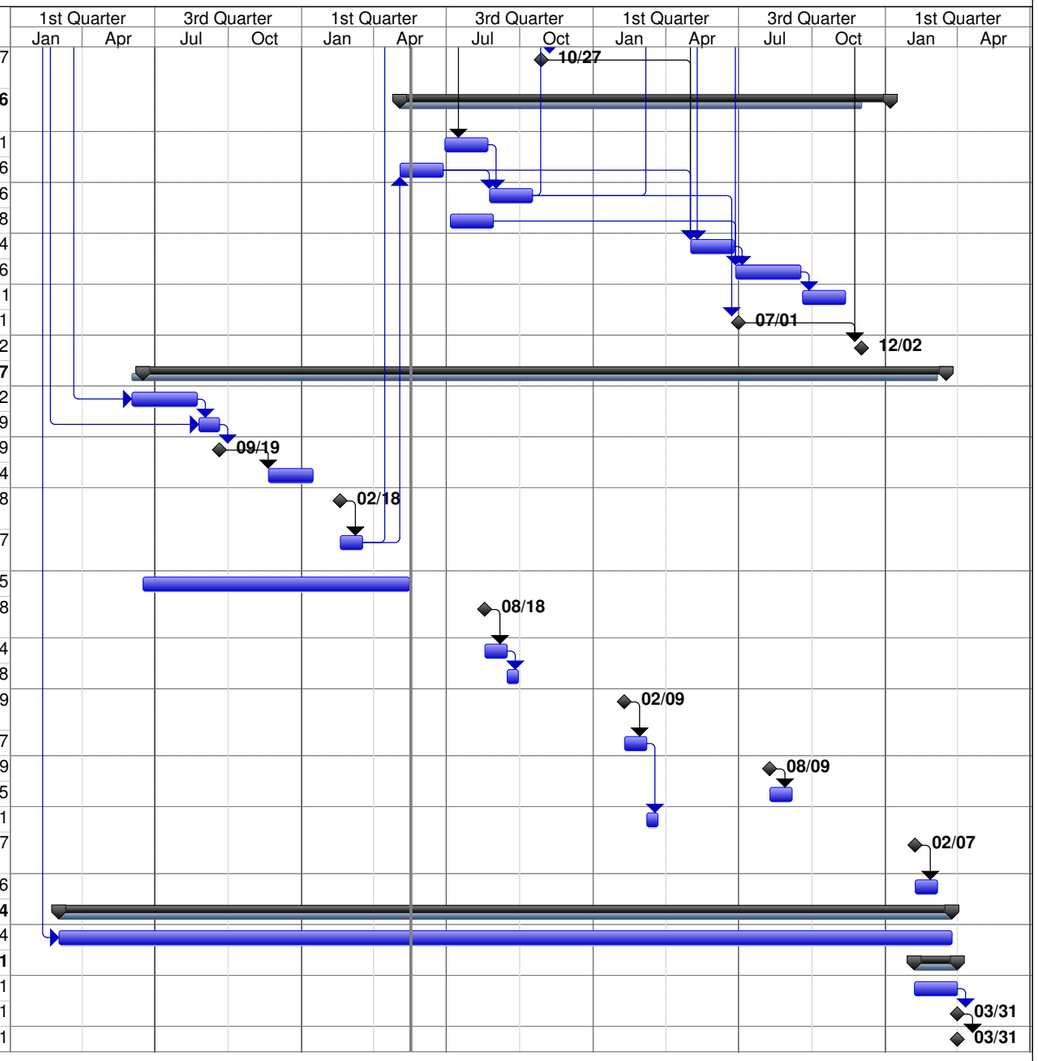


Project: Project Programme_AC
Date: Mon 15/05/25

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

WP 10768 -
DEVELOP LIMPOPO WATER MANAGEMENT AREA NORTH RECONCILIATION STRATEGY

ID	Task Name	Duration	Start	Finish
103	Environmental and Social Status Quo Report (Supporting Document 2 to Report 10: Water Supply Schemes)	0 days	Tue 15/10/27	Tue 15/10/27
104	**TASK 16: ASSEMBLY OF INFORMATION AND FORMULATION OF SCENARIOS (RECONCILIATION STRATEGY)**	**22 mons**	**Mon 15/05/04**	**Fri 17/01/06**
105	Develop short-term water requirement scenarios	2 mons	Mon 15/06/29	Fri 15/08/21
106	Assess required interventions	2 mons	Mon 15/05/04	Fri 15/06/26
107	Develop a short-term reconciliation strategy	2 mons	Mon 15/08/24	Fri 15/10/16
108	Develop long-term water requirement scenarios	2 mons	Mon 15/07/06	Fri 15/08/28
109	Assess sequence of interventions	2 mons	Mon 16/05/02	Fri 16/06/24
110	Develop a final reconciliation strategy	3 mons	Mon 16/06/27	Fri 16/09/16
111	Record/document the reconciliation process & identify other issues & concerns	2 mons	Mon 16/09/19	Fri 16/11/11
112	Preliminary Reconciliation Strategy Report (Report 11a)	0 days	Fri 16/07/01	Fri 16/07/01
113	Final Reconciliation Strategy Report (Report 11b)	0 days	Fri 16/12/02	Fri 16/12/02
114	**TASK 17: STAKEHOLDER ENGAGEMENT AND PUBLIC PARTICIPATION**	**36 mons**	**Mon 14/06/16**	**Fri 17/03/17**
115	Identify key stakeholders, main issues and concerns	3 mons	Mon 14/06/02	Fri 14/08/22
116	Assist DWA's RO to establish database of I&A parties	1 mon	Mon 14/08/25	Fri 14/09/19
117	Database of I&A parties	0 days	Fri 14/09/19	Fri 14/09/19
118	Arrange workshop/meeting and compile summary document on the proposed study approach	2 mons	Thu 14/11/20	Wed 15/01/14
119	Meeting 1 (SSC and Preliminary Screening Workshop) - Present study approach and confirm stakeholders	0 days	Wed 15/02/18	Wed 15/02/18
120	Prepare workshop proceedings, including comments on proposed study approach and stakeholders	1 mon	Wed 15/02/18	Tue 15/03/17
121	Identify potential schemes and concerns	12 mons	Mon 14/06/16	Fri 15/05/15
122	Meeting 2 (SSC) - Present findings of Preliminary Workshop and framework of reconciliation strategy	0 days	Tue 15/08/18	Tue 15/08/18
123	Prepare proceedings of Meeting 2 - Defining schemes for further investigation and shortfalls	1 mon	Tue 15/08/18	Mon 15/09/14
124	Prepare and distribute newsletter (on findings of SSC 2) to SSC stakeholders	2 wks	Tue 15/09/15	Mon 15/09/28
125	Meeting 3 (SSC) - Present draft Reconciliation Strategy in preparation of final screening workshop	0 days	Tue 16/02/09	Tue 16/02/09
126	Prepare proceedings of Meeting 3	1 mon	Tue 16/02/09	Mon 16/03/07
127	Meeting 4 (SSC and Final Screening Workshop) - Present Preliminary Reconciliation Strategy	0 days	Tue 16/08/09	Tue 16/08/09
128	Prepare proceedings of Meeting 4	1 mon	Tue 16/08/09	Mon 16/09/05
129	Prepare and distribute newsletter (on findings of SSC4 and Workshops) to SSC stakeholders	2 wks	Tue 16/03/08	Mon 16/03/21
130	Meeting 5 (SSC and public meeting) - Present findings of Workshops and finalise Reconciliation Strategy	0 days	Tue 17/02/07	Tue 17/02/07
131	Prepare proceedings of Meeting 5	1 mon	Tue 17/02/07	Mon 17/03/06
132	**TASK 21: STUDY MANAGEMENT**	**40 mons**	**Mon 14/03/03**	**Fri 17/03/24**
133	General administering and managing, progress & brief reports & meetings	40 mons	Mon 14/03/03	Fri 17/03/24
134	**PHASE 3: STUDY TERMINATION**	**2 mons**	**Mon 17/02/06**	**Fri 17/03/31**
135	Finalise reports & facilitate study termination	2 mons	Mon 17/02/06	Fri 17/03/31
136	Project Close-out Report (Report 13)	0 days	Fri 17/03/31	Fri 17/03/31
137	**END OF CONTRACT**	0 days	Fri 17/03/31	Fri 17/03/31



Project: Project Programme_AC
Date: Mon 15/05/25

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	