Comprehensive Reserve Determination Study for Selected Water Resources (Rivers, Groundwater and Wetlands) in the INKOMATI WATER MANAGEMENT AREA, MPUMALANGA

PROJECT NO: WP 9133

INCEPTION REPORT: FINAL

SEPTEMBER 2007

REPORT NO.: 26/8/3/10/12/001

water & forestry
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

This report is to be referred in bibliographies as:

Department of Water Affairs and Forestry, South Africa. 2007. Comprehensive Reserve Determination Study for Selected Water Resources (Rivers, Groundwater and Wetlands) in the Inkomati Water Management Area, Mpumalanga. Prepared by Water for Africa, Louw, MD & Singh, A. Report no. 26/8/3/10/12/001

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
CHIEF DIRECTORATE: RESOURCE DIRECTED MEASURES

COMPREHENSIVE RESERVE DETERMINATION STUDY FOR SELECTED WATER RESOURCES (RIVERS, GROUNDWATER AND WETLANDS) IN THE INKOMATI WATER MANAGEMENT AREA, MPUMALANGA.

INCEPTION REPORT: FINAL

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TERMINOLOGY AND ACRONYMS

BBM	Building Block Methodology
BHNR	Basic Human Needs Reserve
CD: RDM	Chief Directorate: Resource Directed Measures
CMA	Catchment Management Agency
DFID	Department For International Development
D:NWRP	Directorate: National Water Resource Planning
D:RQS	Directorate: Resource Quality Services
DRIFT	Downstream Response to Imposed Flow Transformation
DTM	Digital Terrain Model
DWAF	Department of Water Affairs and Forestry
EC	Ecological Category
EcoSpecs	Ecological Specifications
EFR	Environmental Flow Requirements
EIS	Ecological Importance and Sensitivity
EPA	Environmental Protection Agency
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
GAI	Geomorphological Driver Assessment Index
GDP	Gross Domestic Product
GIS	Geographic Information System
GGP	Gross Geographic Product
GRDM	Groundwater Reserve Determination Methodology
HAI	Hydrological Driver Assessment Index
HFSR	Habitat Flow Stressor Response
HGM	Hydro-Geomorphic
IHI	Index of Habitat Integrity
ISP	Internal Strategic Perspectives
MAP	Mean Annual Precipitation
MIRAI	Macroinvertebrate Response Assessment Index
NGO	Non Governmental Organization
NWA	National Water Act
NWRS	National Water Resource Strategy
PAI	Physico Chemical Driver Assessment Index
PES	Present Ecological State
PMT	Project Management Team
PSP	Professional Service Provider
REC	Recommended Ecological Category
RQO	Resource Quality Objectives
RU	Resource Unit
SANBI	South African National Biodiversity Institute
SARS	South Africa Revenue Service
SCI	Socio Cultural Importance
SPATSIM	Spatial and Time Series Information Modelling

ToR	Terms of Reference
TPC	Threshold of Potential Concern
VEGRAI	Riparian Vegetation Response Assessment Index
WAAS	Water Availability Assessment Study
WHI	Wetland Health Index
WMA	Water Management Area
WRC	Water Research Commission
WRYM	Water Resource Yield Model

PSP ACRONYMS

Acon	AFRICON
A&L	Alexander and Llewellyn
CE	Conningath Economists
CES	Coastal and Environmental Services
INR	Institute for Natural Recourses
CS	Clean Stream
IWR	Institute for Water Research
J&G	Jeffares & Green
KAS	Koekemoer Aquatic Services
LW	Laughing Waters
P	Private
SS	Streamflow Solutions
WCS	Wetland Consulting Services
WFA	Water for Africa
UOF	University of the Free State
UOJ	University of Johannesburg

1 INTRODUCTION

1.1 BACKGROUND

The National Water Act (NWA, Act No. 36 of 1998, Section 3) requires that the Reserve be determined for water resources, i.e. the quantity, quality and reliability of water needed to sustain both human use and aquatic ecosystems, so as to meet the requirements for economic development without seriously impacting on the long-term integrity of ecosystems. It is therefore imperative that the Reserve be determined and requirements met before other economic activities can be satisfied. As the Department of Water Affairs and Forestry (DWAF) is the trustee of the nation's water resources, it is their responsibility to ensure the adequate protection and effective management of these resources. The Chief Directorate: Resources Directed Measures (CD:RDM) is the directorate within the DWAF tasked with the responsibility of ensuring that Reserve assessments take place before licensing can proceed.

The CD:RDM identified the Inkomati Water Management Area (WMA) as requiring a comprehensive Reserve assessment in light of the implementation of the Water Allocation Reform and Compulsory Licensing in the WMA and the proposed Montrose and Mountain View Dams. These studies require higher levels of confidence in the Reserve determination results as is currently available in certain of the catchments, such as the Sabie-Sand and Crocodile River catchments. This will assist the DWAF to make informed decisions regarding the authorisation of future water use and the magnitude of the impacts of the present and proposed developments.

1.2 STUDY AREA

The study area for the Reserve determination is the Inkomati system as represented by WMA 5. Information describing the study area has been obtained from the *Department of Water Affairs and Forestry, South Africa. 2004. DWAF Report No. P WMA 05/000/00/0303: Internal Strategic Perspectives: Inkomati Water Management Area – Version 1 (March 2004). Tlou & Matji (Pty) Ltd.*

1.2.1 Locality and physical characteristics

The Inkomati WMA is largely located within the Mpumulanga Province. It consists of Komati, Crocodile (East) and Sabie/Sand and the undeveloped Uanetse River Catchments. All these rivers drain the WMA and confluence to form the Incomati River in Mozambique which flows into the Indian Ocean. Southern Mozambique is therefore largely dependent on water from the upstream catchments. The Interim IncoMaputo Water Use Agreement sets out the water sharing arrangements of South Africa, Mozambique and Swaziland through which the Komati River flows.

Topographically the WMA is divided by the Great Escarpment (which runs roughly along the Graskop, Sabie, Nelspruit, Barberton axis) into a western plateau and sub-tropical Lowveld in the East. Rainfall varies from over 1200mm per annum in the mountains and the plateau in the west to as low as 400mm per annum in the lower eastern part of the WMA.

In terms of geology, the Inkomati WMA consists of a total of seven broad lithostratographic units. Five main vegetation types occur in the study area.

1.2.2 Development status

The Inkomati WMA mainly consists of urban and semi-urban populations. A large number of rural settlements exist in the Mhala, Mapulanneng, Nsikazi, Nkomati and Mswati regions. Major urban centres in the WMA are Nelspruit, White River, Komatipoort, Carolina, Badplaas, Barberton, Sabie, Bushbuckridge, Kanyamazane and Matsulu.

Future growth in population is expected to be moderate and to be concentrated in the urban areas, with a decline in some rural areas.

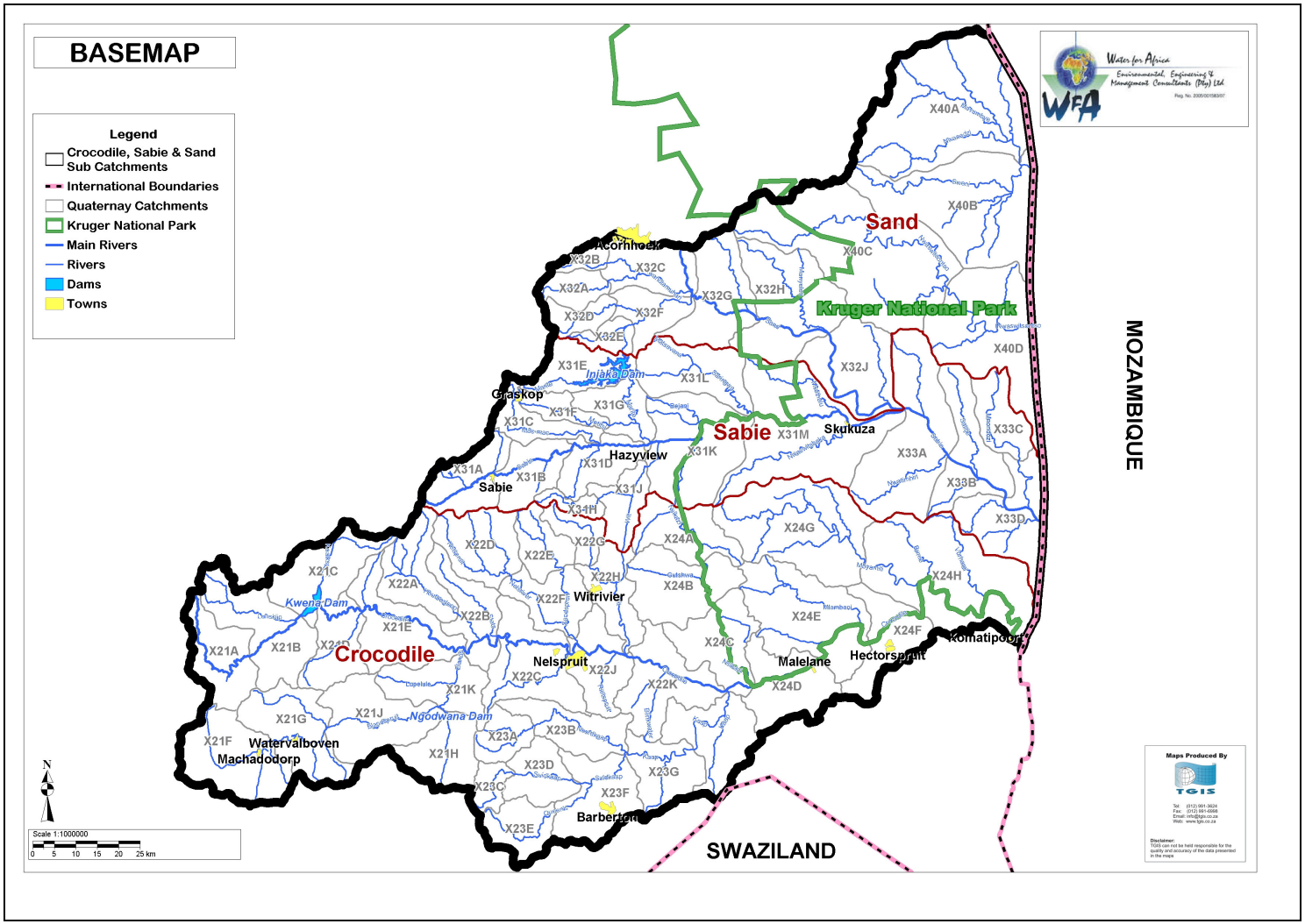

Figure 1.1 Layout and location of the Inkomati WMA.

1.2.3 Economic Characteristics

The gross geographic product (GGP) of the Inkomati WMA was R6,7 billion in 1997. The most important magisterial districts in terms of contribution to GGP in this WMA are:

- Barberton 17,1 %
- White River 9,2 %
- Nsikazi 7,9 %
- Pilgrims Rest 7,6 %
- Other 17,1 %

The most important sectors in terms of contribution to the GGP are:

- Manufacturing 24.6%
- Agriculture 18.6%
- Government 16.4
- Trade 13.4
- Other 27.0%

The largest part of the Inkomati WMA falls within the Lowveld, which has a warm sub-tropical climate which is suitable for growing many frost-sensitive crops and tropical fruit, such as bananas, avocados and mangoes. Sugarcane which is an irrigated crop is grown in the eastern parts mainly the lower Crocodile and Komati River valleys. The Malelane and Komati Sugar Mills are located here.

The higher mountainous areas are suitable for forestry and large plantations of pine and eucalyptus supply the wood, pulp and paper industries. SAPPI Ngodwana, one of the largest paper mills in the country is located in the Crocodile River catchment approximately 40km west of Nelspruit. A large number of manufacturing activities are situated in and around Nelspruit and industrial development is expanding rapidly. Development opportunities have been identified especially in the steel, chemicals, food, wood products, paper and pulp. An international airport just outside of Nelspruit improves access to international markets and tourism

The importance of the trade sector can partly be attributed to the trading activities taking place in Nelspruit and other urban areas such as Barberton and White River. Trade is further bolstered by the development of tourism activities such as hotels, a casino and the Riverside Mall in Nelspruit. A very important feature of the Inkomati WMA is the Kruger National Park, which also extends into the Olifants and Levuvhu/Letaba WMAs. This forms a large part of the tourism industry. The scenic areas around Sabie, Graskop, Pilgrim's Rest and the Blyde River Canyon also draw large numbers of tourists throughout the year. Trout fishing is another well-supported tourist activity in the area, in places such as Dullstroom and areas around Belfast (which falls partly in the Olifants WMA), Waterval Boven and Machadodorp.

1.2.4 Existing and proposed water related infastructure

Several major dams exist in the Inkomati WMA. The Komati River system is highly regulated by dams with the Crocodile and Sabie River systems less so.

Komati River System:

- The Vygeboom and Nooitgedacht Dams on the Upper Komati River are mainly used for the transfer of water to the Olifants WMA for the cooling of power stations.
- The Maguga Dam (in Swaziland) and the Driekoppies Dam that increase the assurance of supply to irrigators in the Lomati and Komati River sub-catchments to acceptable levels.

Crocodile River System

- The Kwena Dam in the Upper reaches of the Crocodile River which augments water supplies to users along the Crocodile River.
- Two new dams are proposed on the Crocodile River system, namely the Montrose Dam at the confluence of the Crocodile and Elands Rivers and the Mountain View Dam on the Kaap River (tributary of the Crocodile River). The latter dam could be used to supply Maputo's future water requirements and improve the water supplies in South Africa.
- The proposed Maroela weir on the lower Crocodile River which will improve the management of the downstream flow.

Sabie River System

- Inyaka Dam on the Marite River a tributary of the Sabie River was constructed mainly to supply the domestic and ecological water requirements on the lower Sabie River and the domestic water requirements in the Sand River sub-catchment by means of the Bosbokrand Transfer Pipeline (BTP) which will transfer up to 25million m^3/annum to the Sand River sub-catchment for this purpose.
- Possible developments on the Mutlumuvi River (a tributary of the Sand River) include the New Forest Dam which will increase domestic water supplies in the area.

There are a number of important canal systems that transfer water to irrigators in the Komati, Crocodile and Sabie River Catchments.

1.2.5 Water Quality concerns

- Komati River Catchment

The water quality in the Upper Komati River is generally very good. However, coal mining in the Upper Komati River catchment poses a very serious threat to the quality of the water that is transferred to the Eskom power stations. Coal mining activities could increase the sulphate levels in the water, which would have major implications for Eskom, and by implication to all electricity users.

A deterioration in water quality is evident in the lower reaches of the catchment due to irrigation return flows. However, the water quality can still be considered to be acceptable.

- Crocodile River Catchment

The water quality in the Crocodile sub-area is generally good although some deterioration of the quality in the lower Kaap River (often high levels of arsenic) and lower Crocodile River is observed. This is due to return flows from upstream users including irrigation, urban areas and old gold mining activities. Irrigation return seepage is noticeable during periods of low flow.
The potential water quality problems emanating from the SAPPI paper mill at Ngodwana is probably the most serious water quality problem in the catchment. Effluent has been disposed of through irrigation for a number of years but the soil has become saturated with salts (especially chlorine) and these leach out into the Elands River and then enter the Crocodile River.

- Sabie River Catchment

The surface water quality in the Sabie River sub-catchment is good with no immediate threats. Following completion of the Inyaka Dam there is considerable assimilative capacity available to maintain the water quality in the Sabie River in its current good state. Water entering the Kruger National Park is a major concern if appropriate sanitation upstream of the Park is not implemented.

The surface water quality in the Sand River sub-catchment is not as good as in the Sabie River sub-catchment due to over-abstraction which reduces the natural assimilative capacity of the river. Occasional elevated levels of nutrients in the Sand River are noted, with informal housing developments a suspected cause. The large number of rural settlements which rely on pit latrines is cause for concern as far as ground-water pollution goes but to date there have been no reported incidences of groundwater pollution.

1.2.6 Groundwater

Groundwater potential of the WMA is currently vastly under-utilised. Because of the nature of the groundwater aquifers involved, the yield of boreholes drilled in the area is generally very low, the use of groundwater on any extensive scale in the WMA for urban, industrial and agricultural water supply purposes is unlikely. The currently under-utilised groundwater potential of the diffusely settled rural areas can undoubtedly be used as a source of at least domestic water supply and probably for community gardens as well, without serious long-term depletion of this resource. Boreholes must however be operated in a manner which ensures the sustainability of the resource.

2 APPROACH TO THE RESERVE DETERMINATION STUDY

2.1 INTRODUCTION

The approach to the Reserve study will be within context of the eight-step Reserve procedure (Louw and Hughes, 2002). The eight step procedure is provided in (Figure 2.1).

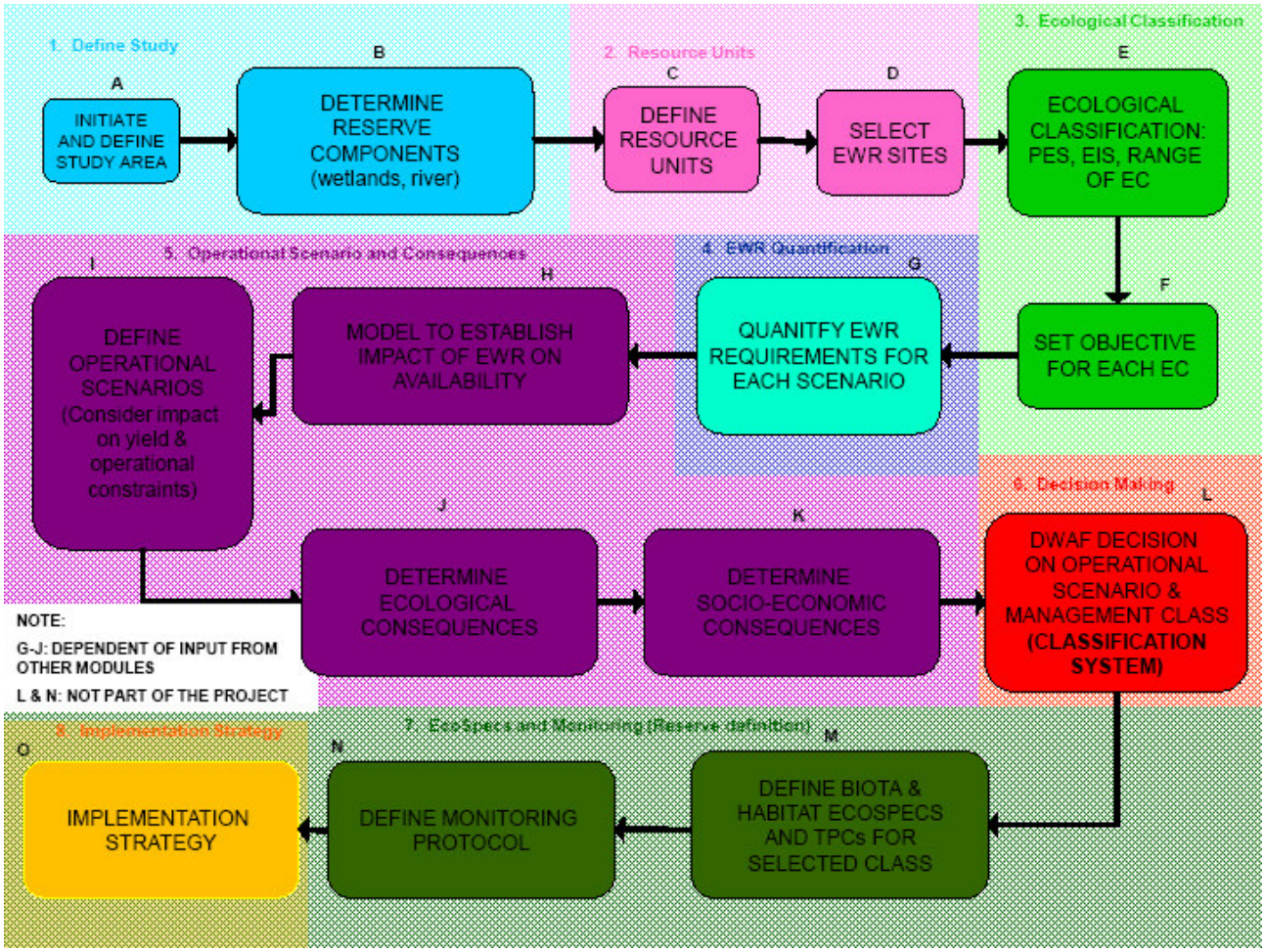

Figure 2.1 Diagram illustrating the process to be followed for the Inkomati WMA Reserve study (Adapted from DWAF 2006)

2.2 AIMS, OBJECTIVES AND OUTCOMES OF THE STUDY

The Reserve process is a scenario-based approach. The team will therefore generate a series of likely scenarios that will be determined by an interactive series of discussions between key specialists of the technical and the yield modelling consultants (WFA – Stephen Mallory). This approach enables the DWAF to make management decisions using scenarios, based on a number of alternatives with anticipated consequences.

The overall aim of the project as described in the Terms of Reference (ToR) is to provide EcoClassification results and Reserves for WMA 5 as well as a detailed capacity building programme. The detailed aims, objectives and proposed outcomes of the study are as follows:

- Provide technical and project management.
- Provide the typing, importance and habitat integrity for wetlands and make recommendations regarding Reserve assessments.
- Groundwater: Assess groundwater input to base flows at an intermediate level and make recommendations for Reserve assessments at a higher level of confidence if necessary.
- Provide Level 4 EcoStatus assessment for the Resource Units represented by comprehensive EWR sites as part of the EcoClassification process.
- Identify a range of Ecological Categories (ECs) for which water requirements must be set.
- Determine EWRs for each of these ECs or, where relevant, test existing EWRs for adequacy and purposes of monitoring.
- Determine the impact of EWRs on the allocatable yield and, based on the impacts, devise additional scenarios to optimize the allocatable yield.
- Determine the ecological and resource-economic consequences of each of these additional scenarios.
- Provide the Ecological Specifications (EcoSpecs), as input to the Resource Quality Objectives (RQOs), associated with the Management Class provided to the PSP, if available.
- Provide extrapolated results for each hydrological node in the Sabie and Crocodile catchment.
- Provide an implementation strategy for the Reserve
- Train selected specialist trainees in specific tasks relating to Reserve determinations.

The output of the study will be EWR rules for every site and for an Ecological Category associated with a Management Class, if this is available, as well as the EcoSpecs (for EWR sites only).

Note that catchment activities are incorporated at a number of stages during the assessment, e.g. the socio-cultural importance of sites is taken into consideration when the EC is set, operational constraints and catchment requirements are incorporated into yield scenario modelling, and catchment activities impacting on ecology are considered when determining Resource Units. However, the focus of the Inkomati study is to determine the Ecological Reserve and to provide sufficient information regarding the consequences of the various operational scenarios to allow for decision-making. The Reserve specification is therefore a management decision based on ecological and other catchment-based information.

2.3 ASSUMPTIONS AND PROVISIONS

2.3.1 Methodology

The study will strive to use the best available methods at all stages of the project, provided budget and time constraints can be met.

Rivers

The procedure for rivers to be followed is according to the revised methods for rivers as outlined in Louw and Hughes (2002), HFSR manual (IWR Source-to-Sea, 2004) and the EcoClassification manual version 2 (Kleynhans *et al*., 2007). The physico chemical input into the EcoClassification process will be provided based on Kleynhans *et al*., 2005 presently being updated to version 2.

The most updated and applicable Jooste model will also be used as advised by Dr. P Scherman - water quality advisor to the CD:RDM.

To provide the final results of the study, it is assumed that the Management Class will be provided to the PSP during the final stages of the study. If this is not made available the PSP will proceed and finalise the study, by setting Ecospecs and an implementation strategy based on the Recommended Ecological Category.

Wetlands

Whilst the methods for the determination of Reserves for riverine systems are well developed, those for wetlands systems are poorly developed. DWAF has issued some guidelines for procedures for Reserve determination (DWAF 1999), but these guidelines do not detail any methods for the actual determination of scores or water volumes. Recently a DWAF/WRC workshop was held and draft Rapid Reserve approaches for wetlands were developed. These draft methods are currently in development and are being written up by CD:RDM in conjunction with the wetland PSP.

At this stage, only the desktop assessment of wetlands in the study area is budgeted for as requested in the ToR. This would include the desktop identification, classification (using the proposed WRC wetland classification system for South Africa) and description of general threats and PES of the wetlands in the catchment. A previous study has already conducted such an assessment of the wetlands of the Komati catchment, and therefore the wetlands of the Sabie and Crocodile catchments (including the Elands River) will be focused on in this study.

It is envisaged that some of the draft Rapid Reserve approaches for wetlands would be pilot tested in this catchment, and in conjunction with this study, but that the funding for such pilot testing would be sourced from the WRC through funds allocated by CD:RDM.

Groundwater

The study area will be described by collecting and collating digital data, map information and reports available for the study area. The information considered will be that pertaining directly to groundwater, its use, distribution, contribution to baseflows and aquifer sensitivities.
An Intermediate level assessment using the GRDM tool and software, will then be undertaken to quantify the volume of groundwater required to meet Classification requirements (if available) or the Recommended Ecological Category and to sustain the Reserve.

Socio-economics

The procedures for the impact of the different ecological scenarios on the socio-economy of the Inkomati WMA with the specific focus on the Crocodile (east) and Sabie/Sand River catchments will follow the Value Marginal Product (VMP) developed by Constanza, *et a*l (Ecological Economics 2002). However this method assumes the system is static, linear and requires a system equilibrium assumption. The method combines the ecological and economics based on the input/output matrix approach. In order to ensure system dynamics and scenario approach marginal valuation will be used using the current socio-economic and ecological state as the baseline scenario.

Basic Human Needs

A very simple calculation will be conducted to determine the BHNR of the Sabie-Sand and Crocodile River systems only. The BHNR for the Komati and Elands River systems was covered during the respective studies.

Demographic data supplied by the DWAF Directorate: Water Services will be used as a basis for analysis. Likely direct users of the surface water resources will be identified by demarcating a 5km buffer zone on either side of the rivers and major tributaries. The BHNR will be supplied at each EWR site and will be calculated based on 4 different quantities of water (e.g. the basic requirement of 25l per person per day; 60l/p/d; 80l/p/d and 120l/p/d).

Public awareness

The public awareness activity will be limited to the production of two newsletters. The first will make the public aware of the study at the outset and the second will make known the preliminary results after the scenario analysis. The newsletter will be posted to all water users currently registered on the DWAF database. A limited number will also be distributed to key Non Governmental Organizations (NGOs) and environmental lobby groups in the area. Local Municipalities will be informed of the study and if they request copies of newsletters to be distributed to their constituency, then these will be made available. If required, a Powerpoint presentation will be prepared and provided to the Client for presentation to Catchment Forums.

The emphasis will be on information dissemination rather than inviting comment on outcomes. Regular updates to stakeholders are not planned or provided for at present.

2.3.2 Number of EWR sites and level of assessment

The PSP recommends 8 comprehensive EWR sites in the Sabie-Sand system and the recommended 7 existing sites in the Crocodile River (one on Kaap and 6 in the Crocodile mainstem). However the cost of this is extensive and the following is proposed to accommodate the comprehensive assessment:

- Sabie-Sand system: Eight sites will be selected. It will be attempted to do all 8 at comprehensive level, however if there are any time problems, a minimum of 5 sites only will done at comprehensive level. It must be noted, to accommodate this within the budget, the following adjustments from the standard comprehensive approach will be required:
  - Only 3 hydraulic calibrations are catered for, rather than the normal 4.
  - Only one biophysical survey will be undertaken during the dry season, rather than the two surveys required (dry season and post wet season).
- Crocodile system: The existing 7 sites will be addressed at comprehensive level if all the existing benchmarks can be found. If the benchmarks are not available, the approach will be discussed with the client and a compromise reached within the existing budget.

Cognisance has been taken of the locality of the two proposed dam sites on the Crocodile River system.

- Montrose: There is a site upstream of the dam site as well as three sites well below the dam site. Two previous attempts by the PSP to find closer sites failed. The river consists of bedrock multi-channels and hydraulic modeling is not practical at these sites.

- Mountain View: The existing site in the Kaap River is upstream of this dam site. It is proposed to select a Rapid site downstream of the dam site as part of the extrapolation task.

On the Sabie-Sand River system, EWR sites will be selected at or close to the original sites. Simpler and more 'measurable' sites will however be selected. Additional sites will be selected that covers more of the upstream section of the Sabie and Sand River. The following is proposed:

- One site in the Sabie upstream of the Marite confluence.
- One site possibly in the MacMac or any other important tributary. (potentially at rapid level)
- One site in the Marite downstream of Inyaka Dam in the vicinity of IFR 1.
- One site in the Sabie River in the KNP downstream of the Marite and upstream of the Sand confluence in the vicinity of either IFR 2, 3, or 4.
- One site in the Sabie River downstream of the Sand confluence (vicinity of IFR 5). (potentially at rapid level). IFR 5 is not suitable for a rapid level and was an extremely complex comprehensive site. It might be that it is not practically possible to include a site at this stretch of river and extrapolation from the Sabie and Sand sites upstream of the Sand confluence might be required.
- One site in the Mutlumuvi in the vicinity of IFR 6.
- One site in the Sand in the conservation areas (potentially IFR 8).
- One site to cover important areas in the Sand or tributaries upstream of the conservation areas. (rapid)

The undeveloped Uanetse River is a seasonal system which arises just outside of the Kruger National Park (KNP) and flows through the Park. The ToR did not call for a Reserve Determination on this system, however if possible extrapolation to the river reach outside the KNP will be conducted.

2.3.3 Linking to other DWAF initiatives

For the purposes of Water Allocation Reform and Compulsory Licensing, a Water Availability Assessment Study (WAAS) is being undertaken for the Inkomati WMA. The WAAS requires an EWR at each hydrological node (approximately 200) for system and yield modelling, which this study will supply. As part of the current WRC/DWAF study, the extrapolation and estimation for the hydrological nodes (72) in the Komati River will be undertaken for use in the WAAS. This leaves only the Crocodile and Sabie systems, and with the input of D:RQS specialists, it will be possible to undertake the extrapolation for the additional sites manually. This will also serve as further piloting the method and will be a step towards the production of automated models and manuals.

The Reserve study will need to liaise closely with the WAAS study in order to obtain the following information:

- Naturalised hydrology
- Current day hydrology
- Physical constraints in the systems such as limitations on dam outlets
- The complete model setup for Reserve scenario modelling

This study will also link to the DWAF: RDM Implementation Project which is developing a framework for implementing the Ecological Reserve. This study allows for a number of pilot studies in which the Reserve implementation methodologies will be applied and tested. It may be possible

to include the Crocodile East as a pilot catchment, in which case the Reserve will be made available to the Implementation Team in a format convenient to them.

2.3.4 Capacity building

Strong emphasis is made on capacity building in the ToR. However, all previous capacity building exercises as applied on the Thukela, Komati, Letaba and Kromme Comprehensive Reserve studies have had limited success due to the lack of suitable trainees in a specialist field such as Reserve determination. Another major factor limiting training is the length of projects. During the course of a 2 - 3 year project dedicated trainees usually accept other or new job offers that does not allow for the training to be completed. Training has been structured in a range of set tasks according to a training strategy and a dedicated training task leader (Dr Patsy Scherman). The training project plan is described in Chapter 5.

2.3.5 Requirements of a Comprehensive Study

The scope of work follows where budget allows the requirements for a comprehensive Reserve assessment in terms of number of surveys, number of hydraulic calibrations and the level of EcoClassification. There are requirements however that cannot be accommodated due to cost constraints of the study. Key issues are listed below:

- Habitat Modelling at every suitable site.
- Sediment transport modeling at every suitable site.
- Riparian vegetation specialist present at site selection and at an additional survey.
- Fish and aquatic invertebrate surveys at various points in the RU and not only at the EWR site.
- Two fish and invertebrate surveys – this is probably not a problem due to the extensive biological information available on the system. However, use of this information is dependant on the input from D: RQS (Kleynhans and Thirion) as well as the other environmental Government Organisations.
- Sufficient liaison between the ecologists and the socio-economic valuation component.

3 PROJECT PLAN

3.1 PROJECT PLAN

The project plan generally used by the PSP has been adapted to the Inkomati Reserve Study (Figure 3.1). The blocks in blue in the figure indicate where input is required from outside this project and where it needs to link to the Inkomati Reserve study.

The project plan consists of a range of tasks and subtasks listed below and detailed in Chapter 4.

TASK 1 - PROJECT MANAGEMENT
1.1 Project Management
1.2 Technical management
1.3 PMT Meetings
1.4 Financial management
PHASE I: STUDY INITIATION AND DESIGN
TASK 2 - PROJECT PLANNING AND PROCESS INTEGRATION
2.1 Design of project plan and available current data collection
2.2 Mobilisation of study team
PHASE II: STUDY IMPLEMENTATION
TASK 3 - DESKTOP ECOCLASSIFICATION
3.1 Socio-cultural importance at quaternary level
3.2 Populating SCI model
3.3 Include in DFID Recommendations
TASK 4 - LIMITED PUBLIC AWARENESS ASSESSMENT
TASK 5 - BASIC HUMAN NEEDS RESERVE
TASK 6 – GROUNDWATER COMPONENT
6.1 Study description
6.2 Delineation of resource units
6.3 Resource Classification
6.4 Quantification of the groundwater contribution to the Ecological Reserve
6.5 Setting of quality and quantity groundwater Resource Quality Objectives
TASK 7 – RESOURCE UNITS
7.1 Geomorphological zones
7.2 Ecoregions
7.3 System operation
7.4 Water quality subunits
7.5 Land cover
7.6 Groundwater sub-units
7.7 Identification of Resource Units
7.8 Sabie EWR site selection and dry season survey
7.9 RU Report
TASK 8 – EXTRAPOLATION / ESTIMATION
8.1 Predict the indicator species at each hydrological node
8.2 Indicate the reach that each hydrological node and the EWR sites represent
8.3 Predict flow requirements for each hydrological node
8.4 Report
TASK 9 – WETLAND TYPING AND ECOCLASSIFICATION
9.1 Identify and map the wetlands

9.2 Classification of wetland types (HGM classification system)
9.3 Reference conditions
9.4 General Current Ecological Condition
9.5 Ecological Importance and Sensitivity
9.6 Prioritization of possible sites for pilot testing of Rapid Reserve methods
9.7 Report writing

TASK 10 –RIVER ECOCLASSIFICATION

10.1 Crocodile River survey & hydraulic calibration
10.2 Data and model preparation
10.3 Diatom assessment
10.4 EcoStatus assessment
10.5 Specialist meeting
10.6 Reporting

TASK 11: EWR SCENARIO ASSESSMENT

11.1 Hydraulic calibration
11.2 EcoHydraulic modelling
11.3 Sediment Transport modelling
11.4 EcoHydrology analysis
11.5 Data Collation and Preparation
11.6 EWR scenario determination
11.7 Reporting

TASK 12 SOCIO ECONOMIC PRESENT STATE EVALUATION

Task 12.1 Identification of the sectors
Task 12.2 Determination of economic zones and current water allocation
Task 12.3 Determination of the valuation technique
Task 12.4 Economic value of water

TASK 13 – DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES

13.1 Yield modelling
13.2 Concentration modelling
13.3 Determining ecological consequences
13.4 Socio economics & Ecosystem services consequences
13.5 Reporting

TASK 14 – IDENTIFICATION OF ECOSPECS AND MONITORING PROGRAMME

14.1 Component assessments
14.2 Reporting

PHASE III: STUDY TERMINATION

TASK 15- STUDY TERMINATION

15.1 Preparation of final Reserve results
15.2 Capacity building analysis and audit
15.3 Compilation of main report
15.4 Preparation of Reserve templates

TASK 16 CAPACITY BUILDING: TRAINING PROGRAMME

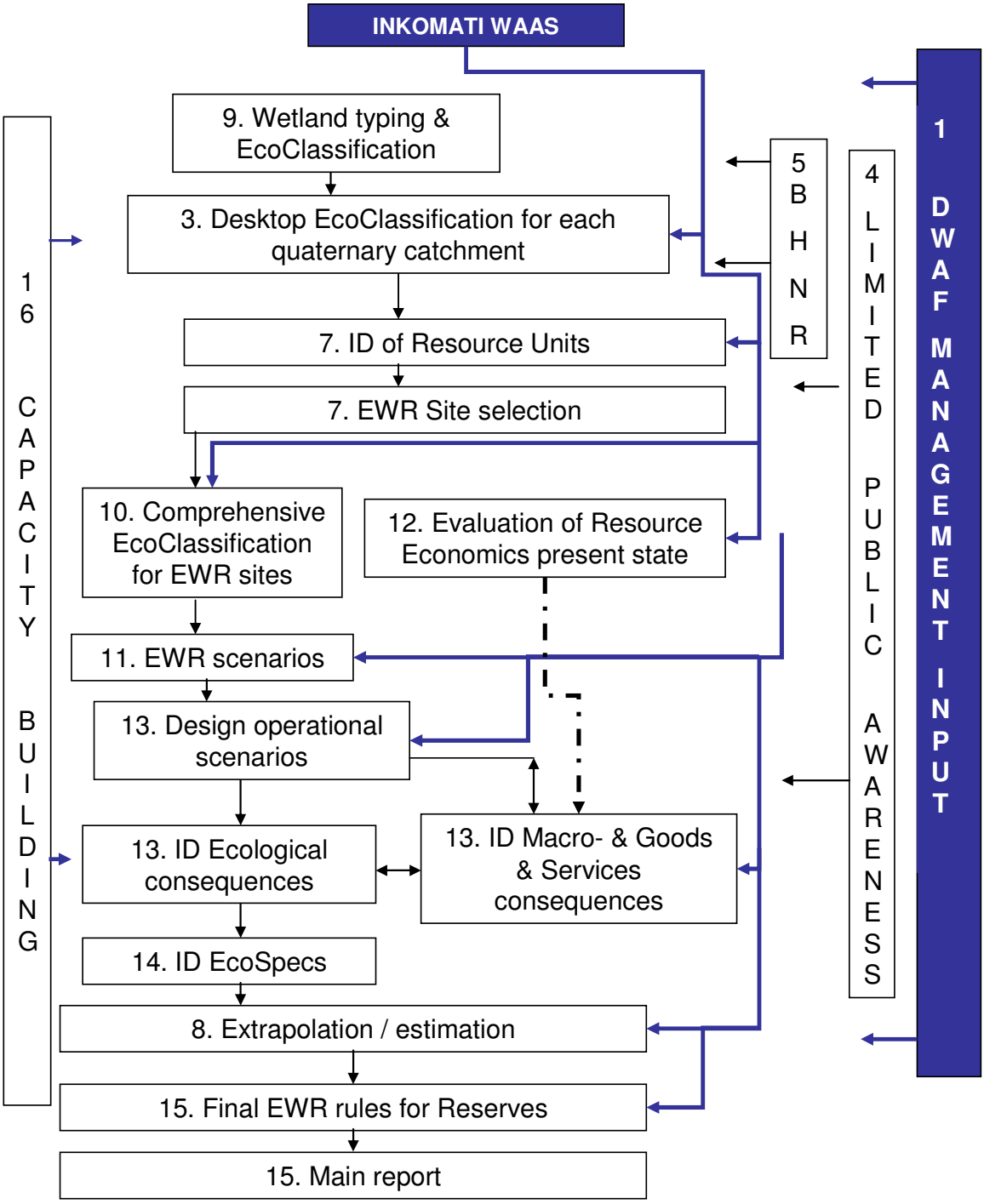

Figure 3.1 Project Plan for the Inkomati Reserve study

4 TASK STRUCTURE

This section of the Inception Report consists of detailed information per task. Task numbers in the text are aligned with those in the project scheduling (Chapter 7) and budget / cash flow (Appendix A and B). Tasks 1 and 2 present the management tasks to be undertaken during the study, with Tasks 3 - 15 presenting the technical and reporting tasks. Task 16 represents the training component which takes place during most of the tasks of the study. The following information is provided for each of the technical tasks and/or sub-tasks:

- Description
- Task responsibility (i.e. consultant(s) undertaking the task)
- Information required (where relevant)
- Actions
- Deliverables and milestones
- Responsibility of the Consultant

4.1 TASK 1 PROJECT MANAGEMENT

Objective and approach

The primary purpose of the **Project Management Component** is for the appointed PSP to assist the Client with the co-ordination of all the activities required to achieve the management information objectives, including all the Technical Components of the Reserve determination study, and the procedures followed to transfer skills and expand the expert knowledge in the Reserve specialist study field during the duration of the study (24 months).

The **Technical Management component** is aimed at the actual co-ordination and completion of the Reserve determination tasks to be undertaken for the study in the catchment.

The objective of this task is to ensure effective, efficient and pro-active management. The aim is to ensure that comprehensive technical documents that detail the results of a successful study process, be delivered on time, on budget and as per brief by ensuring general project management and administration, monitoring of progress, internal liaison within the team, liaison with the DWAF Study Manager, Ms Retha Stassen – who represents the CD:RDM, as well as report editing and review. This task includes all internal liaison required by the project including time spent on e-mail, the phone or at specific meetings with task leaders, specialists and the DWAF Study Manager.

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This task requires a three-person team and the management structure required has been designed accordingly.

Project administration will take place at two tiers. These are:

- Overall project management
  - D Louw – Technical management
  - A. Singh – Project Administrative management
  - S Louw – Project Financial management
- Task management
  - Administrative manager – A. Singh
  - Rivers Reserve team leader – D Louw

- Wetland team leader - M Rountree
- Groundwater team leader – J Vivier
- Basic Human Needs team leader – G Huggins
- Public Awareness team Leader – G Huggins
- Socio-economic team leader - T Tlou
- Capacity Building team leader – P-A Scherman

4.1.1 Task 1.1: Project Administrative Management

The Project Administrative Management will ensure the overall study runs smoothly and according to the requirements stipulated in the Inception Report. It will ensure that the various tasks are co-ordinated and undertaken timeously within the project brief. This component will form the link between the project and Client. It will also ensure the adequate transfer of skills in the Reserve specialist field.

Task responsibility
A Singh

Actions
- Meeting with the client and programme managers to clarify scope and process, prior to drafting the Inception Report
- Regular informal liaison with DWAF:RDM on project implementation
- Meetings/E-mail communication between the project management and technical specialists to discuss the programme and integration between the tasks.
- Design Management Information System (MIS) to monitor and control the study
- Establish specialist brief and agreements or contracts with specialists on the study
- General administration
- Assist the Client to identify external reviewers for the project
- Co-ordination of activities to achieve management information objectives
- Arrange Project Management Committee (PMC) meetings (see task 1.3)
- Prepare Reserve templates and motivation letter upon closure of study
- Finalise documentation and all study reports upon study completion
- Prepare final audit and financial reports and other contractual aspects upon study closure

Deliverables and milestones
- Draft Inception Report due mid July 2007.
- Identification of external reviewers (October 2007)
- Specialist contracts or agreements
- Reserve templates and motivation report (end of study)
- Final specialist reports and main reports at end of study

Responsibility of the Consultant
- Sound administration and management of study team.
- Ensuring milestones and deliverable dates are met on budget.
- Ensure skills transfer in the Reserve specialist field

4.1.2 Task 1.2 Technical Management

Integration and coordination between the various tasks will take place continuously. Coordination and liaison with other studies such as the WAAS will also take place.

Task responsibility: **D Louw;** A Singh (groundwater, BHNR, Public Awareness)

Actions:

- Project team meetings to discuss programme and integration of tasks
- Continuous co-ordination and liaison with task leaders
- Liaison and co-ordination with other DWAF initiatives, such as the WAAS and Ecological Reserve Implementation Project
- Prepare a detailed plan of activities, roles and responsibility of team members and schedule timeframes and budget for each activity
- Provide report formats for specialist reports
- Ensure the timely and quality production of specialist reports
- Review specialist reports

Deliverables and milestones

- Quality controlled specialist reports to Client

Responsibility of the Consultant

- Ensure a well coordinated and integrated study that can be delivered within budget and timeframes.

4.1.3 Task 1.3 PMC Meetings (Progress meetings)

Eleven (11) Project Management Committee (PMC) meetings to be held every third month in Pretoria for the duration of the project. This allows for general liaison and progress meetings with DWAF:RDM (hereafter referred to as the Client) and key programme managers within DWAF. Formal reports, as per the format prescribed by the Client, will be submitted. Regular PMC meetings will allow for direct report-back and trouble-shooting with the project managers. Information included in the progress report will consist of:

- Activities undertaken during the period under review
- Progress against that anticipated in the project plan and milestones
- Expenditure against budget
- Progress of capacity building trainees
- Anticipated problems/savings

The consultant would in most cases send one or two representatives to the meeting. These would be either Ms MD Louw or Ms A Singh or both. The minutes of the meeting will be recorded and distributed to the Client by the consultant.

Task responsibility

A Singh, D Louw

Actions

- Establish the PMC to provide guidance to the project
- Arrange, attend and provide secretarial services at 11 PMC meetings
- Preparation of agenda and consolidate progress and financial reports
- Consolidate skills transfers report into the progress report
- Maintain Record of Decision register
- Evaluate any deviations of the technical component and prepare exception reports
- Produce minutes of the meeting and distribution thereof

Deliverables and milestones

- Progress report
- PMC meetings are shown in the project scheduling (Chapter 7).
- Minutes of meetings
- Record of Decision Register

Responsibility of the Consultant

- Provide adequate notification of PMC meetings and distribution of relevant material
- Ensuring attendance of appropriate technical team members at PMC meetings.
- Production and circulation of the minutes.

The budget does not allow for:
The attendance of more than eleven PMC meetings.

4.1.4 Task 1.4 Financial management

Financial management consists of the management of the technical project budget so as to ensure that the budget is not exceeded and that cash flow predictions are met. Financial management will include:

- Monthly invoicing

  Invoices will be submitted on a monthly basis. Invoices will be detailed to outline expenditure by person and per task and by disbursement per task.
- Budget management

  Budget management is critical to ensure that the specialists remain within specified limits. This will consist of monitoring budgets against briefs submitted to specialists.
- Cash flow projections

  Cash flow projections will be aligned to the budget management process and will be set against expenditure, expected expenditure and the budget. The cash flow (projected and actual) will be supplied in the progress reports.

Task responsibility
S Louw

Actions

- General financial management

Deliverables and milestones

- Production of invoice and appropriate financial reporting for the progress report

Responsibility of the Consultant

- Ensuring the appropriate high standard of financial accountability and that the invoice format is according to the criteria laid down by the SARS.

PHASE 1: STUDY INITIATION AND DESIGN

4.2 TASK 2 PROJECT PLANNING AND PROCESS INTEGRATION

Objective and approach

The objective of the project planning and process integration task is to produce a concise, clear and unambiguous Inception Report. This is required to ensure the Client, programme manager and consultants are clear as to the deliverables, timing and budget of the programme.

4.2.1 Task 2.1 Design of project plan and available current data collection

Key specialists and task leaders will design the ToR and associated programme. Integration between the tasks as well as with the Client to clarify scope and process will be ensured. All readily available reports associated with previous EWR studies will be collated or, if not available, listed. There is extensive research information in the biophysical fields available on these rivers, especially the Sabie. All of this information cannot be collated within this project. Individual specialists will source relevant information within their fields.

Task responsibility

Louw D, Rountree, Tlou, Huggins, Singh, Vivier, Louw S

Information required

- ToR, proposals and all subsequent agreements
- Reports on previous EWR assessments

Actions

- Meeting with the Client and Project Managers to clarify scope and process: held on 11 May 2007
- Task leaders to develop project plan (June 2007)
- Production of Inception Report

Deliverables and milestones

- Project plan available (June 2007)
- Draft inception report (July 2007)

Responsibility of the Consultant

To design a project plan that ensures that the agreements reached during negotiations are incorporated in the Inception Report and conveyed to the rest of the team.

The budget does not

- allow for the full compliance to comprehensive EWR assessments. The project plan is therefore designed according to available budget and time;
- allow for more than one round of comments each from the CD:RDM and Project Management Committee to be addressed.

4.2.2 Task 2.3 Mobilisation of study team

To ensure that the team is fully briefed on their responsibilities this task will include:

- Team briefs for all team leaders and specialists responsible for deliverables. Team leaders will be responsible for allocating sub-briefs to their team.
- Briefs will be issued with attached budgets. These will clearly stipulate the hours allocated for each sub-task.
- Contracts will be drawn up for sub-consultants who have not had a previous association with WFA. These will be based on contracts for previous Reserve studies.

Task responsibility

Singh, Louw D, Louw S

Information required

- Approved Inception report and budget

Actions

- Analysis of Inception Report and detailed work breakdown
- Production of task briefs and individualized budgets
- Production of contracts or agreements and ToR for sub-consultants

Deliverables and milestones

- Contracts or agreements and ToR for sub-consultants (August 2007)

Responsibility of the Consultant

- Appoint the approved sub-consultants
- The Consultant cannot be held responsible if indicated specialists resign, leave their work or do not have the capacity to undertake the work at time of appointment (i.e. after the inception report has been approved). Consultants as per ToR requirement keep themselves available for 3 months from the submission of proposal in February 2007. The Consultant will identify and recommend suitable replacements to the Client. The Consultant will not necessarily accept a replacement provided by the Company which the team member belongs to.

PHASE 2: STUDY IMPLEMENTATION

4.3 TASK 3: DESKTOP ECOCLASSIFICATION

Objective and approach

This task is a scoping phase to investigate the WMA at a desktop level and at the scale of quaternary catchments. This work has been done during a previous study and the results can be used as is. The only additional work required is the socio-cultural assessment at quaternary level. It is proposed that this be undertaken for the Crocodile and Sabie Catchments only as the work on the Komati River has been finalised. Socio-cultural results will then be integrated into the existing results to refine the recommendations. These results are also essential for identifying socio-economic zones. The Socio Cultural Importance (SCI) is generated by scoring each quaternary catchment, based on the features that include ritual use (e.g. ceremonial purposes, spiritual/religious activities), aesthetic value, resource dependence (refers to the goods and services delivered by the river system and peoples' dependence on these components), recreational use, historical/cultural value. The task will include:

- Populating SCI model.
- Database and Reporting: Adjust DFID report - *State of aquatic ecosystems in the Olifants and Inkomati WMA, 2007* to include the SCI.

4.3.1 Task 3.1 Socio-cultural importance at quaternary level (site visit)

Task responsibility

Huggins

Information required

- Previous DFID study results.
- Any available information that exists of socio-cultural importance as generated during previous studies.

Actions

- Reconnaisance site visit obtaining information from as many quaternaries as possible (Sept – Oct 2007)

Responsibility of the Consultant

The consultant is responsible for visiting as many of the quaternaries as possible within budget and programme.

4.3.2 Task 3.2 Populating SCI model

Task responsibility

Huggins

Information required

Information collated during Task 3.1

Actions
Modelling and mapping the evaluation of the quaternary catchments.

Deliverables and milestones
A Desktop EcoClassification model for the Sabie and Crocodile catchments that includes the SCI.

Responsibility of the Consultant
The consultant is responsible for providing the SCI for the Crocodile and Sabie catchments only. The Komati catchment has been addressed previously.

4.3.3 Task 3.3 Include in DFID recommendations (Reporting)

Task responsibility
Louw D, Huggins, Singh

Information required
The DFID report – *State of aquatic ecosystems in the Olifants and Inkomati WMA* - with the EIS and PES assessments

Actions
Integrating the SCI results with the existing EIS and PES results

Deliverables and milestones
Report that provides the results of the SCI and the integrated results – Dec 2007

Responsibility of the Consultant
The consultant is only responsible for providing the integrated results based on the existing PES and EIS results. No update of this information will be undertaken. The EIS and PES methods will not be explained in the report; reference will be made to the appropriate DFID report.

4.4 TASK 4: LIMITED PUBLIC AWARENESS ASSESSMENT

Objective and approach
A Public Awareness Programme will be undertaken. This will be limited to the construction of two newsletters. The first will make the relevant public aware of the study at the outset and the second will make known the preliminary results. The newsletter will be posted to all water users currently registered on the DWAF database. A limited number will also be distributed to key Non Governmental Organizations (NGOs) and environmental lobby groups in the area. Local Municipalities will be informed of the study and if they request copies of newsletters to be distributed to their constituency, then these will be made available. If required a Powerpoint presentation will be prepared and provided to the Client for presentation to Catchment Forums.

Task responsibility
Huggins; Singh

Information required

- General information from project leader describing the project and its objectives as well as preliminary results
- Database of relevant stakeholders

Actions

- Two newsletters will be produced that explain the project, its objectives and preliminary results in a manner that is understandable to the stakeholders. These will then be distributed.
- Provide a Powerpoint presentation if required.

Deliverables and milestones

- Production and distribution of two newsletters. (Aug 2007 and Aug 2009)

Responsibility of the Consultant

- Preparation and distribution of newsletters.
- Preparation of Powerpoint presentations

The budget does not provide for travelling, attendance and presentation at Catchment Forums or other form of public participation or meeting activities.

4.5 TASK 5: BASIC HUMAN NEEDS RESERVE (BHNR)

Objective and approach

The BHNR will be generated for the Sabie and Crocodile only (Komati was addressed during the Komati Reserve study) and will follow a number of steps.

- Use demographic data supplied by the Dir: Water Services (DWAF) (or other appropriate sources) as a basis for analysis. The appropriate source would be agreed upon with the Project Management Team. The ward or sub-place name data available for the Census 2001 will be compared to the DWAF data and the most recent/accurate set will be used.
- Analyse the data to reflect the likely direct users of the surface water resources by demarcating a 5km buffer zone on either side of the rivers and major tributaries.
- Use the buffer zone to estimate the numbers of people who would be reliant on the flow in the relevant river reach. It will be assumed that people outside of this area, although they might be making use of water from the rivers via a formal urban supply or a community water supply scheme, would in the main be using springs, minor streams or groundwater.
- Analyse the data further to estimate the population above and below the EWR sites. This gives an indication of the amount of water that would need to pass certain EWR sites in order to meet the needs downstream and would be fed into the yield modelling. If required, a ground truthing exercise could be undertaken to verify the data.
- Provide a report that gives the quantity of water required for the BHNR.

Task responsibility

Huggins

Information required

- Demography of the area

- Location of EWR sites

Actions

- Analysis of demographic data to generate BHNR model and dis-aggregation of model to reflect location of EWR sites.

Deliverables and milestones

- BHNR assessment and report (February 2008)

Responsibility of the Consultant

- Obtaining all relevant demographic data.
- Providing the necessary training as outlined in Section 5.
- Document the results and incorporating one round of comments.

The budget does not allow for:

- Ground-truthing data as a validity check.
- More than one round of comments to be incorporated in the final version of the report.

4.6 TASK 6 GROUNDWATER

Objectives and approach

Initially, the study area will be described by collecting and collating digital data, map information and reports available for the study area. The information considered will be that pertaining directly to groundwater, its use, distribution, contribution to baseflows and aquifer sensitivities.

An Intermediate level assessment using the GRDM tool and software, will then be undertaken to quantify the volume of groundwater required to meet Classification requirements and to sustain the Reserve.

The following tasks are foreseen:

- Task 6.1 Study area description: Description of the study area in terms of its physical and geohydrological characteristics in detail appropriate to the intermediate level of the GRDM assessment.

- Task 6.2 Delineation of groundwater units: Delineating groundwater resource units based on quaternary catchment boundaries, aquifer type (primary aquifer, secondary aquifer, dolomitic aquifer) and other physical, management and/or functional criteria.

- Task 6.3 Resource classification: Defining the present status category and water resource category of each groundwater resource unit using the prescribed categorisation system, the output of which will feed into processes for setting desired management classes for significant water resources.

- Task 6.4 Quantification of the Reserve: Quantifying the volume of groundwater that can be abstracted from a groundwater unit without impacting the ability of the groundwater system to contribute to the Reserve (basic human needs and ecological requirements)

- Task 6.5 Setting Resource Quality Objectives: Set RQOs for each resource unit using rules for selected classes

Task responsibility

The following personnel will be responsible for different tasks as specified:

- Task 6.1 –Study area description
  Vivier, JJP
  Nel, E
- Task 6.2 - Delineation of groundwater resource units
  Vivier, JJP
  Nel, E
  Bulasigobo, J
- Task 6.3 - Resource classification
  Vivier, JJP
  Nel, E
- Task 6.4 - Quantification of the Reserve
  Vivier, JJP
  Nel, E
- Task 6.5 - Setting Resource Quality Objectives
  Vivier, JJP
  Vivier, JC
  Nel, E

Information required

All results obtained from previous studies, including the geomorphological and ecological studies. Any other data available for the specified area, including reports from the CSIR and Dr. Juanita Kotze.

Actions

The following actions will be undertaken as part of this task:

- Geohydrological report of the area, including maps and tables, documenting characteristics such as climate, topography, drainage, geology, geohydrology and groundwater use.
- Delineation of resource units. Areas of similar character are mapped into distinct units using expert judgement and interpretation.
- Categorisation of each groundwater resource unit. Using a set of guiding tables, the present status category and water resource category of each groundwater unit is determined.
- Quantification of recharge to the unit, using appropriate methods. Quantification of the groundwater contribution to baseflow and groundwater-dependent ecosystems, using appropriate methods. Calculation of the Reserve as a percentage of recharge and the groundwater allocation.
- Based on the conceptual understanding of the area, selecting key measurable indicators as RQOs (e.g. water levels, total dissolved solids (TDS), faecal coliforms, etc) and the level at which they should be maintained (natural, slightly modified, etc.)
- Development of a Terms of Reference if a higher confidence study is required for certain groundwater units

Deliverables and milestones

- A progress report will be compiled at the end of each task.
- At the end of the project a technical report including a management plan with recommendations will be compiled as well as a terms of reference if a detailed study is required.

- Delineation of resource units- Sept 2007 – This will be short document serving as an appendix to the Resource Unit Report
- Quantification of groundwater contribution to baseflow – Feb 2008
- Setting of Resource Quality Objectives and development of ToR – March 2008

4.7 TASK 7 RESOURCE UNITS

Objective and approach

The purpose of this task is to define the study area for the comprehensive assessment and to delineate the study area into RUs. Each RU represents a homogenous area which requires its own specification of the Reserve. The process followed will be that described in the updated Reserve manuals. The individual tools and methods used to derive the RU are described in the sub-tasks below. The RUs will be assessed for the Crocodile and Sabie systems only. Cognisance will be taken of the National River Health Programme sites as well as any relevant previous EWR studies.

4.7.1 Task 7.1 Geomorphological zones

Geomorphology provides a basis of classification for the purpose of describing the physical habitat of riparian and aquatic ecosystems, as it encompasses the physical processes which have shaped the river channel. The hierarchical classification approach of Rowntree and Wadeson (1999) will be followed. The information is available from D:RQS for South Africa and the Consultant has the information available on Geographical Information System (GIS).

4.7.2 Task 7.2 EcoRegions

EcoRegional classification allows for the grouping of rivers according to similarities. The method is based on a top-down approach as developed by DWAF (Kleynhans *et al*., 2004). The existing delineation into Level II EcoRegions is required and the results are available. The information is available from D:RQS for South Africa and the Consultant has the information available on GIS.

4.7.3 Task 7.3 System operation

An overview of system management is required to ensure an understanding of the system operation and to interpret biological responses. System operation infrastructure is also often the logical endpoint of a RU. A description on the present operation which includes present uses, abstractions, curtailments etc., and operational structures if any, within the system must be available to the specialist team. Information can be provided from the WAAS.

Task responsibility

Mallory

Actions

Use available information to generate a short document describing the system in qualitative terms.

Information required

- The most up to date information from the WAAS.

Deliverables and milestones
A short document serving as an appendix to the RU report (Oct 2007)

Responsibility of the Consultant
- The budget does not include obtaining any additional information from that which is readily available.

4.7.4 Task 7.4 Water quality sub-units

The objective of this task is to identify river reaches homogenous in terms of water quality, and to select the water quality variables to be evaluated. It is anticipated that water quality subunits will exist within the RUs, but that additional areas, e.g. tributaries outside the comprehensive study area, will be assessed as refugia or hot spots where necessary.

Task responsibility
Scherman
Trainee: Wepener

Actions
A reconnaissance site visit will be undertaken and all available water quality information will be sourced.

Information required
- Water quality information from DWAF region and any other relevant organisations
- Documents of previous studies pertaining to the water quality component of the Reserve

Deliverables and milestones
- Water quality subunits on maps and a chapter contribution to the RU report (September 2007)

Responsibility of the Consultant
The consultant is responsible for obtaining relevant available information and providing the RUs. The budget does not include any water quality measurements and chemical analysis.

4.7.5 Task 7.5 Land cover

On request, the D: RQS can provide land cover GIS maps for 500m sections on both banks as well as the accompanying Excel spreadsheets which provides the statistics of each landuse in each quaternary catchment. The land cover information, including additional information such as videos, Google Earth, etc will be used to provide some indication of the homogeneity of impacts and aid in the RU assessment.

Task responsibility
Louw D

Information required
- Land cover maps and associated Excel tables

Actions

- Overlay the information on the other information to identify the RUs

Deliverables and milestones

- Land cover maps and Excel tables

Responsibility of the Consultant

- Requesting the information from D:RQS through CD:RDM and analysing the information for use in RU assessment.

The budget does not include:

- Obtaining the land cover information from any other source than D: RQS

4.7.6 Task 7.6 Groundwater sub-units

Included in Task 6.

4.7.7 Task 7.7 Identification of Resource Units

Using information generated during Task7.1 to 7.6, as well as local knowledge, motivated RUs will be supplied and illustrated using GIS mapping.

Task responsibility

Louw

Information required

- All information collated in Task 7.1 to 7.6
- Relevant shape files for GIS presentation
- Landcover maps from D:RQS
- 1:250 000 and 1:50 000 maps

Actions

- Produce the maps and motivations

Deliverables and milestones

- RUs available (September 2007)

Responsibility of the Consultant

- Obtaining all readily available information to use for RU identification.

The budget does not include:

- Geomorphological zonation to a finer level than zones.
- Any process descriptions or EcoRegional descriptions apart from that readily available from D:RQS.
- The provision of EWR sites for each RU.

4.7.8 Task 7.8 Sabie EWR site selection and dry season survey

EWR (quantity) sites are set at specific points on the river. These points are critical sites within a reach of river. The EWR sites must provide sufficient indicators for specialists to attach environmental flows to. The criteria for site selection as detailed in the BBM manual and DWAF (1999b) will be followed.

Eight sites will be selected of which a minimum of 5 will be at comprehensive level. The locality and approach are discussed in detail in 2.3.3.

Cross-sectional surveys to the required hydraulic standards (updated Reserve methods, Louw and Hughes, 2002 as well as DWAF, 1999 and the BBM manual, King and Louw, 1998) will also be undertaken as well as the required photopoint monitoring. Sites where two-dimensional hydraulic modelling will be undertaken will require a Digital Terrain Model (DTM). This will be undertaken at a maximum of 3 sites, depending on site characteristics. For these sites, the two-dimensional hydraulic/habitat modelling must be cost effective, i.e. the additional information and increase in confidence must warrant the additional resources required (DTM survey, hydraulic and habitat related data collection, two-dimensional hydraulic modelling).

Task responsibility

Louw D, Birkhead, Kotze, Uys, Koekemoer, Rountree, Mackenzie
Trainee: Desai

Information required

- Draft RUs
- 'Hot spot' assessment as identified from the Desktop EcoClassification results
- Previous Reserve studies conducted in WMA 5 available from CD:RDM

Actions

- Site selection during 1 to 7 September 2007

Deliverables and milestones

- EWR sites and localities available (September 2007).
- EWR site selection section in the Resource Unit report (October 2007).

Responsibility of the Consultant

- Coordinating the EWR site visit.
- Selecting the most suitable EWR sites according to the site selection criteria and within constraints such as access and safety.
- Ensuring that all necessary equipment is available during the site visit.
- Training of specialist hydraulic trainee.

The budget does not include:

- The selection of more than 8 EWR sites.
- Additional site visits if adverse weather conditions occur or benchmarks are removed.
- An EWR site to be situated in each RU.
- Making arrangements, booking or paying for any non-team members that are participating.

- Fixing benchmarks to a fixed datum. It will be recommended that DWAF undertakes this so that benchmarks can be reinstalled if removed or lost.

4.7.9 Task 7.9 RU report

The final Resource Units, which represent homogenous stretches of river, will be produced. The report will be produced according to the required standards.

Task responsibility
Louw D, Singh, Louw S

Information required
- All the information produced in the previous tasks

Actions
- Documenting and mapping of the results

Deliverables and milestones
RU report, which includes all the information, generated during the sub-tasks, as well as the final RUs (October 2007)

Responsibility of the Consultant
- Providing and documenting motivated RUs in the RU report.
- Supplying the report incorporating one round of comments from CD:RDM and the Project Management Committee.

4.8 TASK 8: EXTRAPOLATION/ESTIMATION OF EWRS AT HYDROLOGICAL NODES

Objective and approach
The objective of this task is to provide an estimate which will be of higher confidence than the Desktop Reserve Model at every hydrological node in the Sabie and the Crocodile systems (the Komati information will already be supplied through a WRC/DWAF research project). Note that this task would normally be undertaken as the last task prior to the main report, as the final EWR results and the Management Class would then be available. However, due to the urgent need of the WAAS, certain assumptions regarding EC will have to be made, and this task is to be addressed as soon as possible. It must be noted that due to the method still being in a testing phase, the participation of D:RQS specialists is essential. The following sequential steps will be followed:

- Predict the indicator species at each hydrological node.
- Indicate the reach that each hydrological node represents.
- Indicate the reach for which the EWR results will be applicable.
- Predict the EWR for each hydrological node where extrapolation from EWR results is not viable. This will be undertaken for the PES only.

The existing fish database for reference condition and the EcoRegional and Geomorph Zone information is vital in this process and it might be required to only use fish if insufficient invertebrate information is available. This process will require some Rapid III assessments or basic hydraulic

data collation (widths, substrate, photo) at certain hydrological nodes that are not similar than any other known sites.

Task responsibility

Louw D, Louw S, Birkhead, Hughes, Singh

Information required

- Methods being developed at present in a joint DWAF/WRC proposal.
- The locality of the hydrological nodes
- The virgin and present hydrology at each hydrological node

Actions

- Mapping of the hydrological nodes
- Running filter models to predict biophysical similarity of reaches which each node represents.
- Predicting indicator species/groups.
- Estimating flow requirements at each hydrological node

Deliverables and milestones

EWR rules for each hydrological node. (May 2008)
Report documenting the basic approach and results (July 2008)

Responsibility of the Consultant

- Providing support and specialist services to D: RQS to undertaken this work.

The consultant will and cannot do this work without the input of D:RQS as the method is still in development and not in a format to be used by other specialists. The budget does not include any writing of manuals or training of this process.

4.9 TASK 9: WETLAND TYPING AND ECOCLASSIFICATION

Objective and approach

An approach applied in other Reserve studies will be used in this study. Due to the large number of wetlands in the catchment, a desktop assessment of the wetlands will be undertaken and recommendations for further Reserve studies on high priority wetlands will be proposed. This information will be used to advise possible pilot testing of the draft Rapid Reserve Methods which are currently under development (by CD:RDM in conjunction with the wetlands PSP).

For the desktop assessment, the following approach described below is proposed:

- Identification and mapping of the wetlands in the catchments at a 1:50 000 or (preferentially) 1:10 000 scale will be undertaken. Where available, existing databases of national and/or municipal wetlands coverage will be used to assess the extent of wetland areas. This will provide a broad overview of the number of wetlands.
- The identified wetland units will be classified using the Hydro-Geomorphic (HGM) method, which has been proposed by the WRC as a national wetland classification system for South Africa. This classification system for wetland systems groups wetland units by functional types as well as provides indications of their functions in the landscape.

- A description of the general reference conditions of the wetlands in the catchment will be developed. This description will rely heavily on expert knowledge and the specialist's experience with wetland consulting and research in the area.
- Due to budgetary and logistical constraints, the PES of each wetland system will not be possible to determine; simply because there will be hundreds to thousands of wetlands in the study area and it will be impossible to conduct the detailed field assessments required to determine PES for each wetland unit. Instead, general assessments of the overall condition of the different HGM wetland types will be assessed, and statements of the impacts and threats acting upon the wetlands will be described.
- EIS criteria will be adapted from previous wetland studies to assess the general EIS of the wetlands in the catchment.
- For some important wetland systems, statements relating to the EcoSpecs for these systems may be developed.
- The specialist is in the process of developing an approach to determining catchment-wide water requirement volumes for wetland ecosystems. The approach, based on water usage of wetland plants and hydrological modelling, will be further developed and tested in this study.

In addition to these tasks, priority wetlands for possible pilot testing of the draft Rapid Reserve methods for wetlands will be identified.

Rapid Reserve methods for wetlands are currently under development. If these wetland Reserve methods are available at the time of the field visit, they may be tested on the priority wetland systems. However the funding for testing the Rapid wetland Reserve methods will be sourced externally from this budget.

4.9.1 Task 9.1 Identify and map the wetlands

Existing databases of national and/or municipal wetlands coverage will be used to assess the extent of wetland areas in the catchments. This will provide a broad overview of the number of wetlands within the area. Where available, such data will be supplemented by existing wetlands information and coverages. Additional information obtainable from 1:50 000 topographic maps, and/or 1:10 000 imagery, will be undertaken to improve the generally available wetlands information for the study areas. The output will be a broad overview of the number of wetlands within the area.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- SANBI Wetlands Map (available)
- SANBI Wetlands Probability Layer (DWAF to source)
- 1:50 000 topographic maps (available)
- 1:10 000 orthomaps, if readily available from CD:RDM

Actions

- Desktop mapping of the wetlands within the study area

Deliverables and milestones

Wetlands identified and mapped – Nov 2007

Responsibility of the Consultant

- Providing the necessary training as outlined in Chapter 5.

4.9.2 Task 9.2 Classification of wetland types (HGM classification system)

The HydroGeomorphic (HGM) wetland classification will then be applied to the identified wetlands. This functional-based classification system for wetland systems (Brinson, 1993) has been adapted for South African Palustrine wetland systems (Marneweck, and Batchelor, 2002; Kotze *et al*., 2005; Ewart-Smith *et al*., 2006). Linking wetland assessments with the HGM classification will improve the decision-making abilities of the authorizing agencies, since the HGM classification provides a good initial understanding of the wetland system's functional attributes. Detailed wetland functional assessments are conducted using the HGM approach both in South Africa (Kotze *et al*., 2005) and internationally, (Smith *et al*., 1995 and Johnson, 2005). The USA Environmental Protection Agency (EPA) has gone so far as to issue instructions to all Federal agencies to initiate a National Action Plan to implement the HGM approach for assessing wetland functions (http://www.epa.gov/owow/wetlands/science). Providing local authorities with an understanding of the HGM wetland types would thus be in line with national and international trends. The HGM approach has recently been proposed as the basis of inland wetland classifications in South Africa (Ewart-Smith *et al*., 2006).

A larger (regional) scale of classification will be investigated in an effort to delineate wetland Resource Units within the catchment; most likely following geological boundaries nested within an EcoRegion classification approach.

The deliverable from this task will be a map of the study area, showing wetland presence and types; and nesting of these within geological and/or EcoRegional classifications to derive the wetland Resource Units.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 9.1

Actions

- Delineate and classify identified wetlands in the study area

Deliverables and milestones

- Classified layer of wetlands according to the HGM classification system (Jan 2008)

Responsibility of the Consultant

- Desktop delineation of the large wetland systems identified in Task 9.1.

- Classifying the wetlands, using the HGM wetland classification system as proposed by the WRC.
- Providing the necessary training as outlined in Chapter 5.

4.9.3 Task 9.3 Reference Conditions

Expert knowledge, experience and research will be relied upon to identify the Reference conditions of the various HGM wetland types identified. This component of the study will be conducted at the desktop level using remotely sensed imagery. The general reference conditions of the wetland types in the study area will be described, either by type or by the types within EcoRegions. This will be a desktop exercise using available imagery.

Task responsibility
Rountree
Trainee: Maphumulo

Information required
- Wetland layer from Task 9.2 (wetlands classified according to their HGM characteristics)

Actions
- Describe the general reference conditions of the wetland types in the Inkomati WMA

Deliverables and milestones
- Reference condition descriptions of the wetland types within the Inkomati WMA (Feb 2008)

Responsibility of the Consultant
- Describing general reference conditions of the various wetland types in the study area.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:
- Describing the reference condition of every wetland identified or of every wetland in the Inkomati WMA.

4.9.4 Task 9.4 General Current Ecological Condition

Due to budgetary and logistical constraints, PES of each wetland system will not be possible to determine. However, general assessments of the overall condition of the different HGM wetland types within the catchment will be assessed, and statements of the impacts and threats acting upon the wetlands will be described. This component of the study will be conducted at the desktop level using remotely sensed imagery.

Task responsibility
Rountree
Trainee: Maphumulo

Information required
- Wetland layer from Task 9.2 (wetlands classified according to their HGM characteristics) and the general reference conditions of the various wetland types (from Task 9.3)

Actions

- Description of the general current ecological conditions of the wetland types in the Inkomati WMA

Deliverables and milestones

- Current ecological condition descriptions of the wetland types within the Inkomati WMA (Mar 2008)

Responsibility of the Consultant

- Description of the general current ecological conditions of the wetland types in the study area. Assessing general assessments of the overall condition of the different HGM wetland types and describing the impacts and threats acting upon the wetlands.
- Providing the necessary training as outlined in Section 5.

The budget does not include:

- Determining the PES of each wetland system

4.9.5 Task 9.5 Ecological Importance and Sensitivity

For a maximum of three priority wetland systems, the EIS will be assessed. At present, new Rapid Reserve methods for wetlands are under development and, should draft versions of these tools become available, they will be employed here. Failing that, EIS criteria used in previous wetland studies will be used to assess the EIS of the priority wetlands.

Task responsibility

Rountree

Trainee: Maphumulo

Information required

- Wetland layer from Task 9.2 (wetlands classified according to their HGM characteristics); the general reference conditions of the various wetland types (from Task 9.3) and the prioritised wetlands identified under Task 9.5

Actions

- Describe the general EIS of selected wetlands of the Inkomati WMA

Deliverables and milestones

- EIS descriptions of selected wetlands within the Inkomati WMA (May 2008)

Responsibility of the Consultant

- Description of the EIS of selected prioritised wetlands in the study area.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- A description of the EIS of every wetland identified; or of every wetland in the Inkomati WMA.

4.9.6 Task 9.6 Prioritization of possible sites for pilot testing of Rapid Reserve methods

Priority wetlands within the study areas will be identified using various criteria (such as size and/or ecological; social and/or economic criteria). A screening approach being developed as part of the WRC National Wetlands Research Programme (Phase I) is to be employed in this task. The priority wetlands will provide guidance for the focus of the field (EIS and Wetland Habitat Integrity (WHI) assessment) component of the study.

Task responsibility
Rountree
Trainee: Maphumulo

Information required
- Wetland layer from Task 9.2 (wetlands classified according to their HGM characteristics) and the general reference conditions and current ecological condition of the various wetland types (from Tasks 9.3 and 9.4)

Actions
- A list of high priority wetlands within the study area, based on size or other importance criteria

Deliverables and milestones
- A list of prioritised wetlands; with the motivation for prioritisation (Jun 2008)

Responsibility of the Consultant
- Generating a list of high priority wetlands within the study area.
- Providing the necessary training as outlined in Chapter 5.

4.9.7 Task 9.7 Report writing

A report detailing the results and outcomes from the above-mentioned tasks will be compiled to document all the results from the Wetland Assessment of the Inkomati WMA. In addition, feedback and input into other related tasks (such as RUs and EcoClassification) will be provided. The report will be produced according to the required standards.

Task responsibility
Rountree

Information required
- Report, as well as data/information inputs in to related tasks

Actions
- Report compilation

Deliverables and milestones
- Final Wetlands Report for the Inkomati WMA (July 2008)

Responsibility of the Consultant

- Documenting the results and incorporating one round of comments.

The budget does not include:

- More than one round of comments to be incorporated in the final version of the report.

4.10 TASK 10 RIVER ECOCLASSIFICATION

Objective and approach

The EcoClassification methods as described in Kleynhans *et al*., 2005 and all refinements included in Version 2 (in press) will be followed. The approach would be at Level 4 and will be undertaken for the RUs where EWR sites exist or are selected in the Crocodile and Sabie systems. The EcoClassification approach includes determining the EIS, the SCI, PES and the REC. The EcoClassification process will also include predicting Ecological Categories linked to flow scenarios as well as for setting Ecological Specification (EcoSpecs) as part of RQOs.

This PES phase of EcoClassification aims to obtain sufficient information to supply a PES for each component and EcoStatus for each RU represented by an EWR site. All relevant existing information will be sourced, and the required surveys will be undertaken. The analysis of all the data collated will consist of individual indices and the PES categories for each component. The information will be documented in the required format. The rule-based models (HAI, PAI, GAI, VEGRAI, FRAI, MIRAI, IHI and EcoStatus), will be used to determine the PES.

4.10.1 Task 10.1 Crocodile River survey & hydraulic calibration

The existing 7 EWR sites will be used for comprehensive assessment. A low flow survey will take place and will include training for the specialist trainees. At the same time, low flow hydraulic information will be collated at the sites where required.

Task responsibility

Louw D, Birkhead, Mackenzie, Rountree, Kotze, Uys, Koekemoer
Trainees: Hlongane, Vos, Du Preez, Senoge

Information required

- Locality of previous EWR sites

Actions

- Low flow site visit (1-5 October 2007)

Deliverables and milestones

- Collated biological information for EcoClassification
- Low flow hydraulic calibrations where required

Responsibility of the Consultant

- Coordinating the EWR site visit.
- Ensuring that all necessary equipment is available during the site visit.
- Training of specialist trainees.

The budget does not include:
- The selection of any additional sites.
- Reinstating sites and obtaining the additional calibrations required if benchmarks have been removed or lost.
- Additional site visits if adverse weather conditions occur or benchmarks are removed.
- An EWR site to be situated in each RU.
- Making arrangements, booking or paying for any non-team members that are participating.
- Fixing benchmarks to a fixed datum. It will be recommended that DWAF undertakes this so that benchmarks can be reinstalled if removed or lost.

4.10.2 Task 10.2 Data and model preparation

A Index of Habitat Integrity (IHI)

The IHI is available based on aerial videos, but is potentially out of date. The IHI method has also been refined to fit into the EcoStatus models and updated in general. The IHI will be undertaken for the RUs or any more appropriate delineation utilising available information such as the videos, Google Earth, landuse analysis, etc. This will provide some indication of the homogeneity of impacts and aid in the RU assessment.

Task responsibility

Louw D

Information required
- Available videos and assessments
- Land cover maps and associated Excel tables
- HAI, GAI and PAI information

Actions
- Populate the IHI model

Deliverables and milestones
- IHI for each RU in which the EWR sites are situated (Nov 2007)

Responsibility of the Consultant
- Applying the latest updated IHI model within the EcoClassification process for each of the EWR sites.
- Documenting the results and providing the models as an electronic report.

The budget does not include:
- Producing a video for the river.
- Providing the IHI for areas other than the RUs in the main rivers.
- Explaining the methods and models in documentation for this project.

B Hydrological Driver Assessment Index (HAI)

Hydrological information must be supplied by the WAAS as natural and present day monthly data as well as any other relevant data. The HAI will be populated and the information provided to the other specialists to derive the responses.

Task responsibility
Hughes

Information required
- Monthly natural and present hydrological data for each EWR site as well as any other hydrological data required. (October 2007)

Actions
- Obtain data from WAAS (Mallory)
- HAI model to be populated

Deliverables and milestones
- PES for hydrology available for each EWR site (October 2007)
- Specialist appendix (October 2007)

Responsibility of the Consultant
- Using the hydrology to populate the appropriate level EcoStatus model within the EcoClassification process and documenting the results.

The budget does not include:
- Undertaking any hydrological modelling.
- Explaining the methods and models in documentation for this project.

C Physico Chemical Driver Assessment Index (PAI)
The information collated during the reconnaissance site visit and from available models will be used to populate the PAI after running the most up to date Jooste models.

Task responsibility
Scherman
Trainee: Wepener; Dickens

Information required
- All available hydrological data for relevant gauges
- Most up to date PAI and Jooste models

Actions
- Obtain relevant data
- Populate PAI model

Deliverables and milestones
- PES for PAI available for each EWR site (October 2007)
- Specialist appendix (October 2007)
- Providing the necessary training as outlined in Chapter 5.

Responsibility of the Consultant
- Using the physico-chemical data to populate the appropriate level EcoStatus model within the EcoClassification process and documenting the results.

The budget does not include:
- Undertaking any sampling and analysis.
- Explaining the methods and models in documentation for this project.

D Geomorphological Driver Assessment Index (GAI)

Information will be collated during the site visits to undertake the specialist Level 4 GAI assessment, and possibly to undertake sediment transport modelling at selected important sites to refine the flood requirements in the WMA (See Task 11). Reference conditions and GAI model (PES) results will be generated, and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Rountree

Trainee: Hlongwane

Information required
- Aerial photographic record of the EWR sites
- Cross-section and rating curve
- Hydrology information (daily flows if available)
- Sediment information from the sites

Actions
- Assessment of the Reference State of the EWR sites
- Population of GAI model

Deliverables and milestones
- Reference condition descriptions of the EWR sites
- PES for geomorphology available for each EWR site (November 2007)
- Specialist appendix (December 2007)
- Providing the necessary training as outlined in Chapter 5.

Responsibility of the Consultant

The consultant will use all relevant and readily available information available to populate the GAI.

E Fish Response Assessment Index (FRAI)

Information will be collated during the site visits to undertake the FRAI assessment for each EWR site. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Kotze

Trainee: Maseti (D RQS)

Information required
- Reference conditions established at all National River Health Programme sites as well as any additional sites in the WMA
- FRAI model and updated FRAI manual

- HAI, PAI, GAI and VEGRAI results
- All previously collated fish information

Actions
- Obtaining all relevant data
- Populating the FRAI model

Deliverables and milestones
- Fish reference conditions and PES for each EWR site (Dec 2007)
- Specialist appendix (Jan 2008)

Responsibility of the Consultant
- Populating the appropriate level EcoStatus model within the EcoClassification process for each EWR site.
- Documenting the results and providing the models as an electronic report.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:
- An explanation of the methods and models in documentation for this project.

F Macro Invertebrate Response Assessment Index (MIRAI)

Information will be collated during the site visits to undertake the MIRAI assessment. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Uys
Trainee: Vos, Senoge

Information required
- MIRAI model and updated MIRAI manual.
- HAI, PAI, GAI and VEGRAI results
- All information collated at the sites previously

Actions
- Obtaining all relevant information from D: RQS
- Populating the MIRAI model

Deliverables and milestones
- Macro-invertebrate reference conditions and PES for each EWR site (Dec 2007)
- Specialist appendix (Jan 2008)

Responsibility of the Consultant
- Populating the appropriate level EcoStatus model within the EcoClassification process for each EWR site.
- Documenting the results and providing the models as an electronic report.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- An explanation of the methods and models in documentation for this project.

G Vegetation Response Assessment Index (VEGRAI)

Information will be collated during the site visits to undertake the Level 4 VEGRAI assessment. The modelled results and an assessment of reasons for change from reference conditions will be provided.

Task responsibility

Mackenzie

Trainee: Du Preez

Information required

- VEGRAI4 model and updated VEGRAI manual.
- Aerial photographs from the project geomorphologist
- HAI, PAI, GAI results
- Information of previous assessments on the Sabie and Crocodile River

Actions

- Obtaining all relevant readily available information
- Populating the VEGRAI4 model

Deliverables and milestones

- VEGRAI reference conditions and PES for each EWR site (December 2007)
- Specialist appendix (January 2008)

Responsibility of the Consultant

- Populating the appropriate level EcoStatus model within the EcoClassification process for each EWR site.
- Documenting the results and providing the models as an electronic report.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- An explanation of the methods and models in documentation for this project.

4.10.3 Task 10.3 Diatom analysis

Diatoms are photosynthetic unicellular organisms and are found in almost all aquatic and semi-aquatic habitats. Diatoms are of ecological importance because of their role as primary producers, and form the base of the aquatic food web. They usually account for the highest number of species among primary producers in aquatic systems (Leira, 2005). Although diatoms are widely distributed as a group, most species occur only in habitats with specific physical, chemical, and biological characteristics, and consequently they are frequently used as biological indicators of water quality. According to Harding *et al.*, 2005 the analysis of diatom associations provides an integrative biological response and offsets the inconsistency of rapid changes in water chemistries that render the use of conventional analytical approaches inadequate. Diatom monitoring together with macro invertebrate monitoring will provide a method that combines two independent indicator

systems at different trophic levels. D:RQS has strongly recommended that diatoms be included in the EcoClassification process and has requested the development of a preliminary SADAI (South African Diatom Response Assessment Index) for use in these Reserve studies, until the index developed by Harding during the next three years become available.

Task responsibility
Koekemoer

Information required
- EWR site localities

Actions
- Collect one epilithon sample from each EWR site
- Prepare samples
- Analyse data
- Forward findings to Macro invertebrate and fish specialist

Deliverables and milestones
- Documenting the results in a Specialist appendix (November 2007)

Responsibility of the Consultant
- Collecting data according to international standards.
- Analysing data and documenting findings in a specialist report.
- Circulating results to component specialists.

The budget does not include:
- Diatom sampling and analysis other than for the EWR sites.

4.10.4 Task 10.4 EcoStatus assessment

All the above information will be used to populate the Level 4 EcoStatus models.

Task responsibility
Louw D

Information required
- All the populated suite of EcoStatus models.

Actions
- Populate the models for each EWR site

Deliverables and milestones
- PES EcoStatus for each EWR site (Jan 2008)

Responsibility of the Consultant
- Populating the appropriate level EcoStatus model within the EcoClassification process for each of the EWR sites.

The budget does not include:

- Explaining the methods and models in documentation for this project. The version 2 manual will be available.

4.10.5 Task 10.5 EcoClassification Specialist meeting

The EcoStatus models are presented to the specialists at a specialist meeting and results are refined if necessary. The trend is determined, the EIS refined and the REC determined. The alternative ECs for EWR assessment are then established and then all the models rerun in a predictive fashion for each of the ECs to be addressed.

Task responsibility

Louw D, Koekemoer, Kotze, Mackenzie, Uys, Rountree, Scherman
Trainees: Wepener, Dickens, Du Preez, Senoge, Vos, Hlongwane

Information required

- All information generated during previous tasks

Actions

Run the ecoclassification specialist workshop – Feb 2008

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.
- Supplying a range of ECs for EWR assessment.

The budget does not include:

- Providing more than 3 ECs for EWR assessment. Three EC scenarios will only be provided if they are realistic
- Booking arrangements and payments for non-specialists.

4.10.6 Task 10.6 Reporting

All the information will be collated in a report on the EcoClassification. All the models will be provided on a CD. The report will be produced according to the required standards.

Task responsibility

Louw D, Koekemoer, Louw S

Information required

- Specialist meeting results

Actions

- Documenting final results and collating specialist appendices

Deliverables and milestones

- First draft available (April 2008)

Responsibility of the Consultant

- Supplying the report and incorporating one round of comments.

The budget does not include:

- More than one round of comments from the CD: RDM and Project Management Committee to be incorporated in the final version of the report.

4.11 TASK 11: EWR SCENARIO ASSESSMENT

Objective and approach

The objective of this task is to determine an EWR scenario for the range of ECs to be addressed at each EWR site.

The process followed for the determination of low flows will be the HFSR method as well as a modified BBM and Downstream Response to Imposed Flow Transformations (DRIFT) (Brown and King, 2001) approach for high flows. A range of high flows and their functions will be identified. These high flows are grouped into flood classes according to similar function, and the number of high flow events within each flood category is then specified for each EC.

The output of this task will be the standard requirement, i.e. the .tab and .rule files for each EC at each EWR site. SPATSIM (Spatial and Time Series Information Modelling) (Hughes and Forsythe, 2006) will be used as a framework for the hydrological information used within the process, and to capture the EWR results. The output is generated at a specialist EWR meeting and serves as the initial demands for the range of ECs to be modelled using a yield model.

4.11.1 Task 11.1 and 11.2 Hydraulic calibrations, modelling and wet season site visit

The objective of conducting cross-sectional surveys is to provide information on the topography of the EWR sites using cross-sectional surveys. Habitat modelling (a comprehensive Reserve study requirement) will be undertaken at key EWR sites or at sites that lend itself to an increase in confidence by utilising habitat modelling. Digital Terrain Modelling (DTM) will be undertaken at the selected sites for habitat modelling.

During the site visits the following will be undertaken to establish the cross-sections:

- Cross-sectional profiles will be surveyed.
- Stage levels and longitudinal riverbed and water surface gradients at sites located within this study relative to a local datum, will be measured.

The objective of the hydraulic data collection is to procure field data at EWR sites to enable cross-sections to be rated (relationship between discharge and stage). At a comprehensive level of determination, the aim is to achieve the highest possible confidence in the hydraulic characterisation by undertaking data collection from a low flow and through the high flow period of the hydrological season (at least 4 calibrations).

Crocodile EWR sites: Only two additional calibrations are required. The type of flow required for calibration is provided below. Int is an intermediate flow, i.e. between a low flow and a flood.

Site	Date	Q	Need
1	25/08/01	0.1	int
	19/11/011	2.7	flood
2	26/08/011	0.33	int
	19/11/01	6	flood
3	25/10/98	0.99	low
	31/08/01	3.2	flood
	10/10/981	5.4	
	20/11/01	8.5	
4	29/08/011	7.5	low
	09/05/01	18	
	21/11/01	72.5	
5	28/08/011	10.6	low
	20/11/01	150	flood
6	27/08/011	3.3	low
	21/11/01	136	med
	02/002	7000	
7	30/08/011	5	low
	21/11/01	14.1	flood

Budget is available for two calibrations.
Sabie EWR sites: Three additional (to the EWR site selection) calibrations are required. Budget is only available for two calibrations.

Ecohydraulic modelling will take place once sufficient data has been provided. The results will be supplied in the required format. It must be emphasised that additional data automated to supply frequency of velocity-depth classes for fish as well as substrate-velocity depth classes for invertebrates will be supplied. This information is a requirement for the applications of the available tools to determine the EWR.

Task responsibility
Birkhead
Trainee: Desai

Information required
- Locality of gauging weirs

Actions
- Field surveys to collate calibrations (Nov 2007, March 2008)
- Required modelling (April 2008)

Deliverables and milestones
- Cross-sectional profiles with the location of vegetation markers
- Hydraulic rating data from each site visit (needed for sediment transport modelling)
- Standard hydraulic relationships per cross-section (needed for sediment transport modelling)
- Habitat-type modelling per cross-section (needed for sediment transport modelling)
- Habitat-type modelling per site where DTM mapping and two-dimensional hydraulic analyses are undertaken (needed for sediment transport modelling)

Responsibility of the Consultant
- Obtaining the rating data at intervals spaced over the hydrological season.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:

- Ensuring that a range of flows is procured over the study period, although every effort is made by spacing site visits over the hydrological season.
- The loss of hydraulic data arising from the loss of bench marks due to vandalisation or flooding. This may be prevented by fixing the bench marks relative to the global coordinate system.
- Surveying the bench marks relative to the global coordinate system. The Survey directorate of the DWAF will be requested to undertake this task.

4.11.2 Task 11.3 Sediment Transport modelling

Limited sediment transport modelling, as has been conducted for numerous high confidence Reserve studies in the past, may be conducted at priority geomorphological sites. Such modelling will enable higher confidence assessments of the required flows to maintain the geomorphological condition at the site.

Task responsibility
Rountree

Information required

- Selection of field (EWR) sites
- Cross-section and rating curve
- Hydrology information (daily flows)
- Hydraulic parameters for various flows
- Sediment information from the sites

Actions

- Potential Bed Material Transport modelling

Deliverables and milestones

- Results from modelling (April 2008)

Responsibility of the Consultant
The consultant will undertake to obtain the necessary information required (from the hydrologist and hydraulicians involved in the study) in order to undertake the modelling exercise.

4.11.3 Task 11.4 EcoHydrology analysis

The objective of this task is to prepare hydrological data suitable for use by the EWR specialists in setting the ecological Reserve for a range of ECs. A further objective is to make use of the hydrological data, as well as the Stress-Flow relationships developed by the other specialists, to compile a time-series of ecological stress for use and evaluate during the workshops.

Where possible, daily time-series data for natural conditions will be prepared and the data will be checked to ensure that they are consistent with the monthly time-series data from the systems model. It is recognised that a variety of methods may be used, depending upon the quantity and

quality of the available information. It must also be recognised that in some areas it may not be possible to generate suitably representative daily time-series and it may be necessary to rely on monthly data from the systems model, together with a limited amount of daily information extrapolated from other sites. Possible modelling approaches will include the VTI daily time-series model (where existing set-ups allow the model to be used in the available time), the so-called 'Patching model' (a spatial interpolation approach using the characteristics of duration curves), as well as simple scaling of observed flow data. It must be noted that a lack of daily data will impact on the confidence level of the results of the study. All the hydrological data used will be those generated by the Hydrological PSP. It is not planned to undertake any additional modelling.

Task responsibility
Hughes
Trainee: Johnson; Gerber

Information required
- Monthly and all other relevant hydrological information from WAAS

Actions
- Setting up the WMA 5 on SPATSIM

Deliverables and milestones
- All hydrological data available on SPATSIM by March 2008

Responsibility of the Consultant
- Setting up SPATSIM using WAAS data.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:
- Modelling any additional hydrological data.

4.11.4 Task 11.5 Data collation and specialist meeting preparation

All the data collated from the various specialists must be analysed and structured for use during the multi-disciplinary analysis session.

Task responsibility
Louw D, Louw S

Information required
- All relevant data generated during the study

Actions
- Make all logistical arrangements
- Undertake all preparations for the specialist meeting

Deliverables and milestones
- Information available for the specialist meeting

Responsibility of the Consultant

- Undertaking logistical arrangements for the specialist meeting.
- Collect all relevant data generated during the study.
- Prepare data for specialist meeting.

4.11.5 Task 11.6 EWR scenario determination

The objective is to supply a relationship between an index of stress (0 to 10) and habitat availability during different flow conditions. This information is required for the determination of required stresses for different ECs. The information on habitat, collated during the previous tasks as well as the hydraulics will be used to determine the stress indices. These indices form the base information for the determination of low flows using the Habitat Flow Stressor Response method, i.e. for setting the low flow requirements for the Ecological Water Requirement (EWR) scenarios. The high flows will be assessed by indicating flood requirements based on the biophysical response of the floods. The floods are grouped into flood classes and the number of events required for different EWR scenarios are identified. The EWR scenario determination will be undertaken at two five-day workshops. A slightly different approach will be followed for EWR sites in the Sabie systems where EWR requirements are available. After the stress indices have been formulated, the old results will be converted to stress and will be checked or verified by specialists. The same will be done with the high flow requirements.

Task responsibility

Louw D, Birkehad, Hughes, Koekemoer, Kotze, Louw S, Mackenzie, Uys, Rountree
Trainee: Senoge; Gerber; Johnson; Desai; Hlongane; Vos; Du Preez

Information required

- All information collated during the previous tasks
- Range of ECs to be addressed as determined during task 10

Actions

- Two workshops, one for the Sabie and one for the Crocodile River systems

Deliverables and milestones

- EWR scenarios (May & June 2008)

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting.
- Undertaking the logistical arrangements for the consulting team.
- Supplying flow scenarios for the relevant ECs.

The budget does not include:

- Providing more than 3 flow scenarios per EWR site.
- Booking arrangements and payments for non-specialists.

4.11.6 Task 11.7 Reporting

The results generated during Task 11 will be documented in a report supported by specialist appendices and electronic data in CD format. The report will be produced according to the required standards.

Task responsibility
Louw D, Koekemoer, Singh, Louw S

Information required
- Results of specialist meetings

Actions
- Documentation of results

Deliverables and milestones
- First draft of two reports (Aug 2008)

Responsibility of the Consultant
- Supplying two draft reports, with the results and outcomes of Task 11.
- Supplying one final report incorporating one round of comments.

The budget does not include:
- More than one round of comments to be incorporated in the final version of the report.
- Explanations of the methods in the documentation of this project.

4.12 TASK 12: SOCIO ECONOMIC PRESENT STATE EVALUATION

Objective and approach

The purpose of this task is to evaluate the social and economic returns of the existing water use by the various water uses. The purpose of this task is to quantify and qualify the changes of socio-economy of each socio-economic zone from the baseline for comparison with the value of water for different flow scenarios.

Water due to its physical nature is a “high-exclusion” cost resource which means that exclusive property rights which are the basis of a market economy are relatively difficult and expensive to establish and enforce. It is useful therefore to group the types of values of water into five classes namely; (a) commodity benefits from use of water allocated to irrigation, commercial business and industries, mining, manufacturing and domestic water supply; (b) waste assimilation; (c) public and private aesthetic, recreational, and water based activities such as fishing, etc.; (d) biodiversity and ecosystem services, and (e) social and cultural values.

In order to determine the value of water for the various uses in the Crocodile (east) and Sabie/Sand River catchments it is important to identify the benefits accrued from its use in each sector that the available water of the Inkomati WMA has been allocated as well as the water left in the river at present. This will provide the baseline to compare with changes in water availability.

4.12.1 Task 12.1 Identification of the sectors directly and indirectly using water from the Crocodile and Sabie River System

- Identification and quantification of commodity benefits. In the Crocodile (east) and Sabie/Sand River catchments, the sectors identified include the primary sector (irrigation agriculture, mining), and the secondary sectors (major Industries, manufacturing sectors such as Tsb, and Sappi, Ngodwana).
- Identification and quantification of the biodiversity and ecosystem services of the catchment. The categories of the ecosystem services that will be identified and quantified will include waste assimilative capacity, regulation and stabilisation of floods, disbenefits of additional flows into the river system due to increase vulnerability to diseases and aesthetic, recreational and cultural benefits of various EWR flow scenarios.

Task responsibility
Tlou, Mullins
Trainees: Mosaka

Information required
- Registered Water usage database from DWAF
- Analysis of potential relevant and significant ecosystem services

Actions
- Analysis of water usage database to quantify usage

Deliverables and milestones
- Spreadsheet with water usage by sector
- First cut analysis of ecosystem services that will be needed to be quantified (April 2008)

Responsibility of the Consultant
- Identify economic sectors and first cut analysis.
- Generate analysis of water usage and returns.
- Providing the necessary training as outlined in Chapter 5.

4.12.2 Task 12.2 Determination of economic zones and current water allocation to each category of use

Our project team will determine the economic subsystems of the Crocodile (east) and Sabie/Sand River catchments based on logical economic zones. These economic subsystems will form the geographic areas of the water accounts. The criteria for the choice of the economic sub-systems and the rationale will be determined based on the sub-catchment level. Using information from the Internal Strategic Perspectives (ISPs) and any updated information, the current water allocation to each category of use will be determine including the assurance of supply.

Task responsibility
Tlou, Mullins
Trainees: Mosaka

Information required

- Map of Basin

Actions

- Analysis of economic activity for the catchment and disaggregating of activities into zones

Deliverables and milestones

- Economic zone map with quantification of economic sectors per zone (May 2008)

Responsibility of the Consultant

- Generation of map and analysis.
- Providing the necessary training as outlined in Chapter 5.

4.12.3 Task 12.3 Determination of the appropriate valuation technique for each use category

For each category of water use, there are various techniques that will be used to determine the economic value of water use.

Task responsibility

Tlou, Mullins
Trainees: Mosaka

Information required

- Completion of Task 12.2
- Straw Dog Economic returns on water (value per m^3)

Actions

- Interviews with key economic sectors to determine value

Deliverables and milestones

- Interim spreadsheet showing proposed values per sector
- Analysis of water usage by sector and quantification of economic return as well as job creation (June 2008)

Responsibility of the Consultant

- Data collection.
- Providing the necessary training as outlined in Chapter 5.

4.12.4 Task 12.4 Economic value of water use by each category

Production of any good or service requires a combination of resources or inputs including expendable materials, equipment, labour, management, capital and land. Each of these contributes to the total value of production. Estimating the economic benefits of one resource such as water entails isolating that portion contributed by water to the total value of the output. The approach that will be used is the use of the Value Marginal Product (VMP) of the input in this case water. Different valuing techniques will be used for different water uses to determine the economic value of water. The marginal valuation method will be used for each economic sector. The

marginal valuation method has been incorporated into the Water Productivity Model that our project team members have developed.

Task responsibility
Tlou, Mullins
Trainees: Mosaka

Information required
- Completion of Task 12.3
- Final analysis of economic returns on water (value per m^3)

Actions
- Interviews with key economic sectors to determine value
- Interrogation of all secondary data

Deliverables and milestones
- Final spreadsheet showing proposed values per sector with accompanying report
- Final analysis of water usage by sector and quantification of economic return as well as job creation (July 2008)

Responsibility of the Consultant
- Supplying a report with the results and outcomes of Task 10.
- Providing the necessary training as outlined in Chapter 5.

The budget does not include:
- More than one round of comments to be incorporated in the final version of the report.

4.13 TASK 13: DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES

Objective the approach
The objective of this task is to provide the final EWR recommendation. The EWR scenarios developed during Task 11 will be evaluated and Operational Scenarios designed which will consider the 'attainability', i.e. availability and the *present constraints* (such as outlet sizes of existing dams).

4.13.1 Task 13.1 Liaison: Yield modelling

It has been confirmed that modelling of scenarios for the Reserve assessment does NOT form part of the WAAS project. It has therefore been included in this project. During this task, intensive liaison between the Reserve PSP and the yield modelling PSP will be required, as the following interactive process will be followed:

- Provision of the EWR scenarios to the system modellers.
- Inclusion of the EWR scenarios in the system model. A no-EWR /present scenario must also be modelled.
- Design of operational scenarios (to a maximum of 6 scenarios excluding the no EWR and present EWR) considering constraints such as availability and operational aspects (for example, outlet sizes of dams).

- Modelling of the additional scenarios.
- Provision of the results at each EWR site.
- This information will then be used to determine a range of consequences.

Task responsibility
Louw D, Hughes, Mallory

Information required
- EWR scenarios

Actions
- Yield modelling
- Interactive process (meetings) to design a range of scenarios

Deliverables and milestones
- Range of scenarios available for consequences assessment (Sept 2008)

Responsibility of the Consultant
- Designing the range of operational scenarios to be assessed with the yield modeller.

The budget does not include:
- Setting up or reconfiguring the Water Resource Yield Model (WRYM).
- Assessing more than 6 scenarios (final scenarios).

4.13.2 Task 13.2 Concentration Modelling

The impacts of different flow regimes on the physico-chemical EC has to be assessed to aid in determining changes in the fish, biota and riparian vegetation ECs. Concentration modelling has been developed. The model is quite basic; it is however hoped that more sophisticated models will be available when required for this study.

Task responsibility
Scherman, Muller

Information required
This would depend on the models which are available and yet has to be developed

Deliverables and milestones
- Indication of changes on the PAI based on the changed hydrology – Oct 2008

Responsibility of the Consultant
The consultant is responsible to obtain the recommended model, to determine what the requirements would be for modelling, and to indicate any budget implications.

The budget does not include development of methods to undertaken this work

4.13.3 Task 13.3 Determining ecological consequences

Each of the scenarios will be assessed in terms of ecological consequences, i.e. the impact on the Ecological Category. This assessment forms part of the EcoClassification process where the rule-based models are used in a predictive manner. The other rule-based models will then be assessed for the rest of the components. The results will be used to generate the resulting EcoStatus. The process to determine the ecological consequences is as follows:

- The flows will be converted to stress for each scenario at each EWR site.
- The flow information will also be supplied in a format suitable for high flow evaluation to all the specialists.
- This information will be provided to the biological and geomorphological specialists as well as a template for completion.
- These specialists must complete their indices for the new flow/stress scenario to determine the resulting EC.
- This information will be used as input to the Ecostatus model.
- A meeting will be held with key persons present to confirm and refine the above results.

Task responsibility

Louw D, Hughes, Koekemoer, Kotze, Louw S, Mackenzie, Uys, Rountree, Mallory

Information required

- Operational scenarios in a format that can be used for assessment
- Physico-chemical consequences in terms of the PAI
- All information collated during the previous tasks

Actions

- Specialist meeting (November 2008)

Deliverables and milestones

- Ecological consequences in terms of predicted EC available for each EWR site and each operational scenario.
- Suite of EcoStatus models run for each operational scenario

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting where the EcoStatus of the river for each operational flow scenario will be determined.
- Translating the flow scenarios to the required format, and providing specialists with the templates and instructions of what is required.
- Integrating the results and providing the ecological consequences and recommendations.
- Undertaking the logistical arrangements for the consulting team.

The budget does not accommodate booking arrangements and payments for non-specialists.

4.13.4 Task 13.4 Determining consequences on Socio-economics and ecosystem services (goods and services)

Objective and approach

The purpose of this task is to evaluate and forecast for each EWR scenario, the social and economic values of changes in the water availability to the socio-economic sectors as well as the value of the ecosystem services by leaving different amounts of water in the river reaches of the Sabie-Sand and Crocodile River catchment.

- Change in value of the macroeconomic activities for different EWR scenarios.
- Changes in value of ecosystem services for different EWR scenarios.
- Optimisation of the overall benefits from water re-allocation.

Although the ToR does not clearly state the need to quantify the consequences of changes in available water to socio-economic sectors and the ecosystems due to different EWR scenarios, this component is fundamental to balancing social and economic objectives of water allocation with the need to sustain the functioning of the ecosystems in the study area.

Task responsibility
Tlou,
Trainees: Mosaka

Information required
- Completion of Tasks 12.1 and 12.4
- Input from ecological specialists as well as hydrological results

Actions
- Analysis of EWR scenarios against socio-economic returns

Deliverables and milestones
- Report showing results of analysis of EWR scenarios against socio-economic returns (Nov 2008)

Responsibility of the Consultant
- Generating a report section to be included in Task 14.4 showing significant and relevant socio-economic returns per scenario.
- Providing the necessary training as outlined in Chapter 5.

4.13.5 Task 13.5 Reporting

A scenario evaluation report supplying all the consequences will be produced. All the rule-based models used to predict the Ecological Category will be summarised in specialist appendices and on CD. The report will be produced according to the required standards.

Task responsibility
Louw D, Tlou, Koekemoer, Singh, Louw S

Information required
- Results of specialist meetings

Actions
- Documentation of results

Deliverables and milestones

- First draft report available (Jan 2009)

Responsibility of the Consultant

- Supplying the report incorporating one round of comments.

The budget does not include:

- More than one round of comments to be incorporated in the final version of the report.

MANAGEMENT CLASS DETERMINATION

At this point in the programme, it is assumed that the information generated to this point will be provided for use in the Management Class decision and that a management class will be provided to the consultant by February 2009.

4.14 TASK 14 IDENTIFICATION OF ECOSPECS (ECOLOGICAL RQOS)

Objective and approach

The objective of this task is to determine the EcoSpecs (the ecological component of RQOs) for the REC (linked to the determined Management Class) and link the ECs to TPCs (Thresholds of Potential Concern). EcoSpecs will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario as the Ecological Reserve. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible.

Draft documentation (Kleynhans & Louw, 2006) is available which describes the process of using the suite of EcoStatus models to generate the EcoSpecs and TPCs. These EcoSpecs and TPCs are then used for design of a monitoring programme. The Ecological Reserve Monitoring programme is described in Kleynhans and Louw, 2006 and is being refined as part of another RDM funded study. It is therefore recommended that the Inkomati EcoSpecs be used within the generic monitoring programme which will be finalised prior to the end of the Inkomati study. The assessment undertaken as part of the study will also include an assessment regarding the adequacy of existing data for a baseline for monitoring and make recommendation of the additional data required to set a baseline. The criteria for assessing the adequacy of data are also described in Kleynhans and Louw.

4.14.1 Task 14.1 Component assessment

During the specialist meeting, EcoSpecs which form the ecological component of RQOs, will be set for flow, quality, habitat and biota. The quality and flow EcoSpecs are dependent on a decision regarding an acceptable operational scenario and are readily available. The habitat and biota EcoSpecs must be linked to the relevant category and will be quantified as far as possible.

Task responsibility

Louw D, Koekemoer, Kotze, Mackenzie, Uys, Rountree, Scherman

Information required

- Management Class converted to an EC

Actions

- Specialist meeting (March 2009)

Deliverables and milestones

- EcoSpecs and TPCs at each EWR site

Responsibility of the Consultant

- Co-ordinating and facilitating the specialist meeting where EcoSpecs and TPCs at each EWR site will be determined.
- Undertaking the logistical arrangements for the consulting team.

The budget does not include:

- Applying the classification system to determine the Management Class. If a Management Class is not available, the Consultants with the client will set the Ecospecs for the recommended scenario.
- Booking arrangements and payments for non-specialists;
- The assessments for more than one EC per EWR site;
- The design of a monitoring programme as a generic programme is being developed as part of a separate study. The Inkomati Ecospecs will be used within this programme.

4.14.2 Task 14.2 Reporting

The results generated during Task 15 will be documented in a report supported by specialist appendices and electronic data in CD format. The report will be produced according to the required standards.

Task responsibility

Louw D, Koekemoer, Singh, Louw S

Information required

- Results of specialist meetings

Actions

- Documentation of results

Deliverables and milestones

- First draft report available (April 2009)

Responsibility of the Consultant

- Supplying the report incorporating one round of comments each for the CD:RDM and the Project Management Committee.

The budget does not include:

- More than one round of comments to be incorporated in the final version of the report.
- Explanations of the methods in the documentation of this project.

PHASE 3: STUDY TERMINATION

4.15 TASK 15 STUDY TERMINATION

Objective and approach

The objective of this task is to

- produce the final EWR rules;
- analyse and audit the capacity building undertaken;
- summarise the technical reports in a main report;
- complete the Reserve in the required templates.

4.15.1 Task 15.1 Preparation of final Reserve results

The EWR rules and tables which were generated during Task 11 were modified to generate scenarios. Once one of these scenarios has been accepted as the final result, the modifications have to be used to adjust the EWR rules to generate a final result that represents the final accepted scenario.

Task responsibility

Hughes

Information required

- The final operational scenarios in the required formats

Actions

- Produce the .rul and .tab tables that fit the scenarios

Deliverables and milestones

- .tab and .rul tables (Jun 2009)

Responsibility of the Consultant

- Generating EWR rules that represent the final accepted scenario.

4.15.2 Task 15.2 Capacity building analysis and audit

Objective and approach

The objective of this task is to conduct effective training of persons from previously disadvantaged communities or companies– training is to be conducted in the form of workshops and one-on-one training per component. The training will briefly be covered in the progress reports, and a training Report will be available by July 2009. The report will include an audit and evaluation of the training process, as well as an assessment of each trainee's ability to operate within a Reserve team. Additional training needs will be outlined. This task is included in the training programme discussed in detail in Chapter 5.

4.15.3 Task 15.3 Compilation of main report

A summary report, which will consist of sections of all the reports produced during the study, will be compiled which include the final results of the study. Formatting requirements will be specified.

The report will also include a chapter on the implementation strategy. The implementation of the Ecological Reserve consists of both the physical implementation of the flow requirements, as well as the monitoring and management actions required if ecological objectives are not met. A current RDM study being undertaken by WFA is piloting the implementation of flows on 4 catchments as well as addressing the monitoring. Setting up the models for implementation should be a separate study as the cost would not fit into the existing available budgets without detracting seriously from all the other Reserve steps. The design of an implementation strategy of what is required to ensure implementation of both the flows and the monitoring and the identification of all actions that would be required will be included in this task.

Task responsibility
Singh, Koekemoer, Louw D, Louw S, Huggins, Hughes

Information required
- Results from all the previous tasks

Actions
- Collating all existing project data and results

Deliverables and milestones
- First draft report available (Sept 2009)

Responsibility of the Consultant
Supplying the final report incorporating one round of comments.

The budget does not include:
- More than one round of comments to be incorporated in the final version of the report.
- Explanations of the methods in the documentation of this project.

4.15.4 Task 15.4 Preparation of Reserve templates

The results will be tabled in the current Reserve templates and prepared for approval by DWAF.

Task responsibility
A. Singh

Information required
- Main report (Task 15.3)
- Final Reserve results (Task 15.1)

Actions
- Summary of project objectives and results

Deliverables and milestones
- First draft Reserve templates and motivation letter to Director General (DWAF) (Nov 2009)

Responsibility of the Consultant

Supplying the Reserve templates incorporating one round of comments.

The budget does not include:

More than one round of comments to be incorporated in the final version of the Reserve template

5 CAPACITY BUILDING

5.1 TASK 16 CAPACITY BUILDING: TRAINING PROGRAMME

The following technical trainees have been identified for the Inkomati Reserve study:

- Senoge, Ntaki
- Vos, Petro
- Louw, Shileen
- Hlongwane, Lindo
- Zimmerman, Stephanie
- Desai, Ahmed
- Johnson, Simon
- Gerber, Ans
- Mosaka, David
- Du Preez, Johan
- Wepener, Victor
- Dickens, Chris
- Maphumlo, Nonkanyiso

Technical training will also be provided to Pumza Maseti, Lungile Gaulana and Ramogale Sekwale of DWAF, RQS, and identified specialist trainees from CD:RDM (if required).

Objective and approach

The training programme shown below refers specifically to technical training for specialist trainees, and will form part of a joint training initiative for the Reserve studies currently taking place. Training opportunities will also be provided and communicated to DWAF personnel (particularly regional offices) for participation in workshops and field trips, but will take place outside of this study as a CD:RDM initiative. The focus of training in this task is therefore to provide technical training to identified trainees, which include identified specialist trainees from DWAF, RQS and CD:RDM.

One of the outcomes of this task is an evaluation of the training process and assessment of each trainee's ability and knowledge regarding EWRs. This information should be captured on a trainee database housed at CD:RDM, so that the following type of information can be captured per trainee:

- Specialist field + mentor details per Reserve study
- Project exposure and dates, e.g. worked as a specialist trainee on the Thukela and Inkomati Reserve studies
- Level of expertise, e.g. specialist trainee level 1 (no previous exposure to Reserve studies)
- Outcomes of performance evaluations on Reserves studies

Outcomes to CD:RDM will therefore be a Training Report, input to the trainee database to be developed by CD:RDM, a performance evaluation assessment form designed to gather training evaluation information from the trainees, as well as short reports from mentors. It is anticipated that trainees will be expected to fulfil a task to assess their performance and knowledge gained during the training process, e.g. an essay or test. This performance evaluation method will be developed

for the joint training initiative for the Reserve studies, and utilized during this training task. The Training Report will also provide recommendations regarding future training activities for RDM purposes, as well as evaluate each trainee's ability to operate within a Reserve team. It must be noted that the training provided by this study is one step in the training process and that additional exposure to Reserve studies will be required before trainees are sufficiently capacitated to operate as specialists.

The aims of the training process, and criteria against which training will be evaluated, will be communicated to mentor and trainee teams at the outset of the study. The aims of the training process are shown below, and may be expanded on pending the development of the joint training initiative. *Note that the training programme presupposes that trainees have an understanding of the Reserve concept and process.*

The main aim of the capacity building and training process is to ensure that each trainee has acquired the following information and developed or enhanced the following skills:

- A theoretical understanding of the Reserve concept and process.
- An understanding of the concepts related to a specific discipline (trainee-specific).
- The ability to utilize and understand the tools or software required by a discipline (trainee-specific) within the Reserve process.
- The ability to interpret information related to a specific discipline, particularly within the broader scope of the Reserve process.
- Gather field-based data and analyse the data as required by the mentor.
- Work within a team and understand the role of each specialist within the broader Reserve process.

Task responsibility

Programme design and evaluation of the training and capacity building process will be conducted by Patsy Scherman. General management of the training programme will be undertaken by Adhishri Singh. Lecturing at the training workshops will be undertaken by Delana Louw, Drew Birkhead and Patsy Scherman, while specialist one-on-one training will be provided by the assigned mentors.

Information required

- Previous exposure to the Reserve process, such as attendance of a FETWater Reserve training course, per trainee.
- Information will be provided by mentors allocated to each trainee using the budget assigned to the study.

Actions

The following training opportunities will be provided:

- Workshops: This form of training will include the attendance of the following workshops.
    - Appropriate specialist workshops (February 2008: EcoClassification workshop; and May / June 2008: EWR workshop)
    - Two training workshops: (a) A workshop on *multi-disciplinary interactions within the river Reserve process* will be held in January 2008, and will focus on the link

between flows and biotic responses. The principles of Ecological Water Requirements will be discussed per discipline, as well as the integration of the various disciplines to achieve EcoClassification and define EWR assessments.

(b) A technical *EWR training workshop* will be held in the first half of 2008, before the EWR specialist workshop. This will be a mock workshop which will prepare the trainees for the EWR specialist workshop. They will be exposed to evaluating consequence to operational flow scenarios, and designing monitoring programmes and EcoSpecs per discipline.

- Attendance of a field trip per trainee in September / October 2007.
- One-on-one training in specific disciplines: to be conducted throughout the project.

Table 5.1 Mentor and trainee teams for the Inkomati Reserve Study

Speciality	Trainee	Mentor
Aquatic Invertebrates	Senoge, Ntaki Vos, Petro	Uys, Mandy
Financial Admin and Coordination	Louw, Shileen Vos Petro	Louw, Delana
Geomorphology	Hlongwane, Lindo	Rountree, Mark
Ground Water	Zimmerman, Stephanie	Vivier, Koos
Hydraulics	Desai, Ahmed	Brikhead, Drew
Hydrology	Johnson, Simon Gerber, Ans	Hughes, Denis
Resource Economics	Mosaka, David	Mullins, David
Riparian vegetation	Du Preez, Johan	Mackenzie, James
Water Quality	Wepener, Victor Dickens, Chris	Scherman, Patsy
Wetlands	Maphumlo, Nonkanyiso Hlongwane, Lindo	Rountree, Mark

Deliverables and milestones

- Training Report will be due in July 2009. The report will include an audit and evaluation of the training process, an assessment of each trainee's ability to operate within a Reserve team, mentors report and the results of performance evaluation assessments.
- Training progress will be reported on at the PMC meetings and included into the progress reports generated for these meetings.

Responsibility of the Consultant

- Manage and oversee the training process and ensure that the goals and objectives of training are met.
- Liaise with the client and provide information on progress as required.
- Ensure adequate links are made with the larger training initiative of CD:RDM.
- Provide the Training Report by July 2009.

6 PROJECT TEAM

The key members and organisations, and their previous experience in Reserve Determination are summarised below. All resources approached have indicated that they are available for the times and tasks allocated to them according to Chapter 4.

The study has the following team leaders:

- Project Administrative manager – A Singh
- Project Technical manager – D Louw
- Rivers Reserve team leader – D Louw
- Wetland team leader - M Rowntree
- Groundwater team leader – J Vivier
- Basic Human Needs team leader – G Huggins
- Public Awareness Team Leader – G Huggins
- Socio-economic team leader - T Tlou
- Capacity building team leader – PA Scherman

Most of the above-mentioned task leaders have a wide range of expertise in Reserve studies, and have worked on many Reserve studies conducted to date in South Africa. As many team members have also been part of the method development related to the various components, the latest methods and tools will be used in the Inkomati Reserve assessment. **Figure 6.1** is a diagrammatic representation of the team.

The following organizations are represented by the teams:

- AFRICON
- Alexander and Llewellyn
- Conningath Economists
- Coastal and Environmental Services
- Institute for Natural Resources
- Clean Stream
- Institute for Water Research
- Jeffares & Green
- Koekemoer Aquatic Services
- Laughing Waters
- Streamflow Solutions
- Wetland Consulting Services
- Water For Africa
- University of the Free State
- University of Johannesburg

- AGES
- ERM Southern Africa

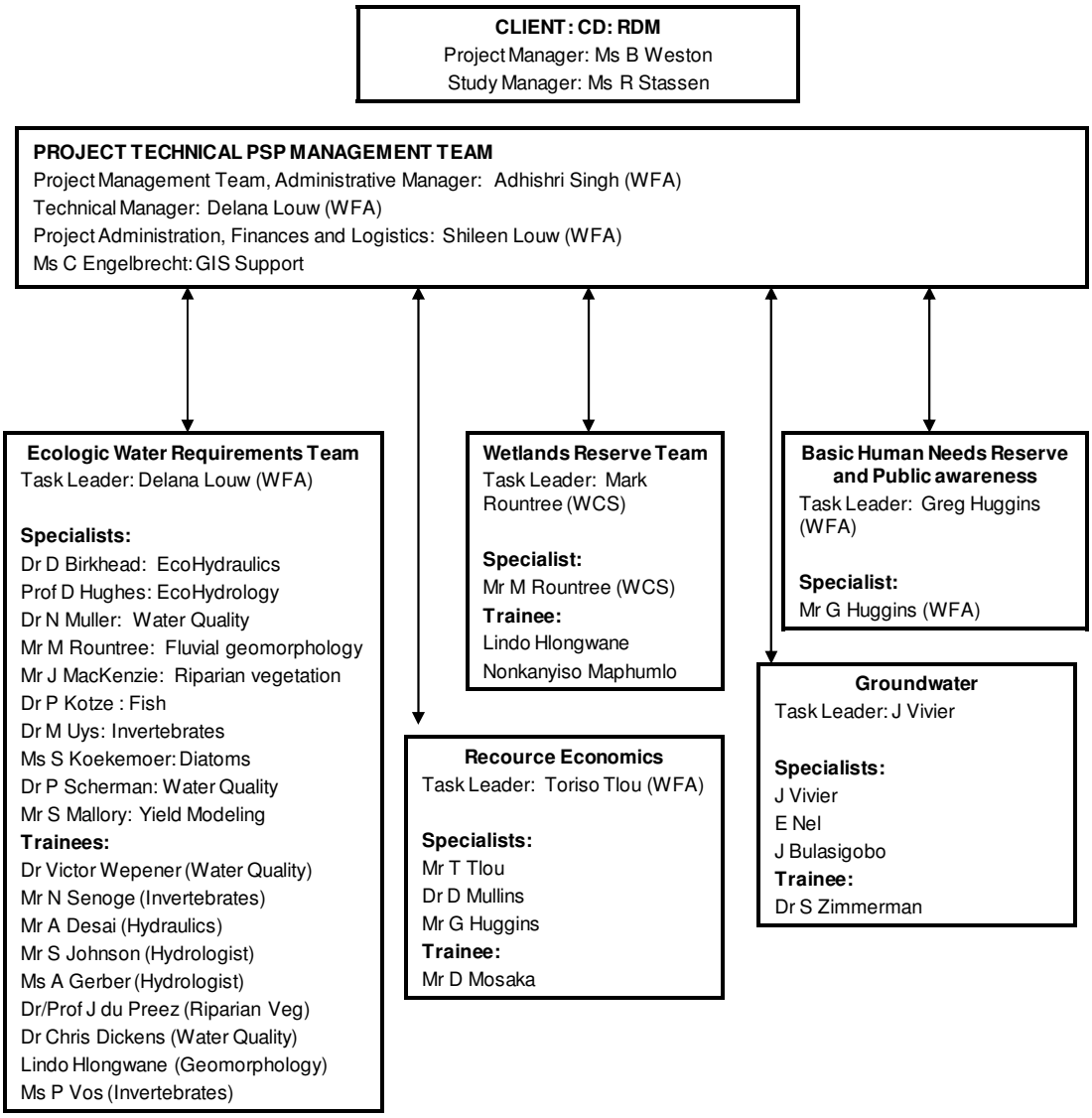

Figure 6.1 The Inkomati project team

7 STUDY PROGRAMME

7.1 KEY MILESTONES AND DELIVERABLES

The study was commissioned on 1 June 2007. The site selection and dry season survey of the Sabie-Sand systems is planned for the 3rd – 7th September 2007. To allow for a full spectrum of flows to be experienced for hydraulic calibration purposes, the collection of data will be undertaken until at least May 2008.

The report finalisation for the study along with the DWAF's decision making is expected to take place from July to October 2009.

The milestones and deliverables listed in Table 7.1 are in task sequence, rather than in date sequence. The date shown is the completion date of the task, as shown on the Gantt chart (Table 7.2).

Table 7.1 Milestones and deliverables

MS[1]	Deliverable	MS	Deliverable
1	Progress and financial reports	24	EcoClassification specialist meeting
2	Project plan	25	EcoClassification report
3	Inception report	26	Cross-sections and hydraulic look-up tables available
4	Appointment of team members	27	Sediment transport modelling
5	Desktop EcoClassification report	28	SPATSIM set up
6	BHNR report	29	EWR specialist meeting
7	Groundwater units identified	30	EWR scenario report
8	Groundwater component of Reserve quantified	31	ID of the sectors directly and indirectly using water
9	Groundwater Resource Quality Objectives available	32	Economic zones and current water allocation to each category of use
10	RUs available	33	Results of the appropriate valuation technique for each use category
11	EWR sites selected	34	Economic value of water use by each category
12	RU report	35	Operational scenarios available
13	Indicator species identified at hydro nodes	36	Determining consequences on Ecology
14	EWR rules available for each node	37	Consequences on socio economics & Ecosystem services
15	Desktop estimation report	38	Operation scenarios and consequences report
16	Wetlands identified and mapped	39	EcoSpecs - Component assessments
17	Wetlands delineated and classified	40	EcoSpecs report
18	Wetland reference	41	Final EWR rules available

	condition		
19	Wetland PES	42	Training audit and report
20	Wetland EIS	43	Compilation of main report
21	Wetland importance prioritisation	44	Preparation of Reserve template
22	Wetland report	45	Limited Public Awareness
23	River EcoStatus models populated		

Table 7.2 Gantt Chart illustrating milestones for the Inkomati Comprehensive Reserve study

	2007							2008												2009										
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
TASK 1 - PROJECT MANAGEMENT																														
1.1 Project management																														
1.2 Technical management																														
1.3 PMT Meetings		1			1			1			1			1			1			1		1	1			1			1	
1.4 Financial management																														
PHASE I: STUDY INITIATION AND DESIGN																														
TASK 2 - PROJECT PLANNING AND PROCESS INTEGRATION																														
2.1 Design of project plan	2&3																													
2.4 Mobilisation of study team			4																											
PHASE II: STUDY IMPLEMENTATION																														
TASK 3 - Desktop EcoClassification																														
3.1 Socio-cultural importance at quaternary level (site visit)																														
3.2 Populating SCI model																														
3.3 Include in DIFID recommendations (reporting)							5																							
TASK 4 - LIMITED PUBLIC AWARENESS: ASSESSMENT			45																								45			
TASK 5 - BASIC HUMAN NEEDS RESERVE									6																					
TASK 6 - GROUNDWATER RESERVE																														
Task 6.1 Study are description																														
Task 6.2 Delineation of resource units				7																										
Task 6.3 Resource classification																														
Task 6.4 Quantification of the groundwater contribution to the Ecological Reserve:									8																					
Task 6.5 Setting of quality and quantity groundwater Resource Quality Objectives										9																				
TASK 7 - RESOURCE UNITS																														
7.3 System operation																														
7.4 Water quality subunits																														
7.7 Identification of Resource Units				10																										
7.8 Sabie EWR site selection and dry season survey (4 sites)				11																										

	2007							2008												2009										
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
7.9 RU report					12																									
TASK 8 - EXTRAPOLATION / ESTIMATION																														
8.1 Predict the indicator species at each hydrological node									13																					
8.2 Indicate the reach that each hydrological node and the EWR sites represent																														
8.3 Predict flow requirements for each hydrological node												14																		
8.4 Report														15																
TASK 9 - WETLAND TYPING AND ECOCLASSIFICATION																														
9.1 Identify and map the wetlands						16																								
9.2 Classification of wetland types (HGM classification system)								17																						
9.3 Reference condtions									18																					
9.4 PES										19																				
9.5 EIS												20																		
9.6 Prioritization of possible sites for pilot testing of Rapid Reserve methods													21																	
9.7 Report writing														22																
TASK 10 - RIVER ECOCLASSIFICATION																														
10.1 Croc survey & hydraulic calibration																														
10.2 Data and model preparation							23																							
10.3 Diatom assessment data																														
10.4 EcoStatus assessment																														
10.5 Specialist meeting									24																					
10.6 Reporting											25																			
TASK 11 - EWR SCENARIO ASSESSMENT																														
11.1 Hydraulic calibration																														
11.2 EcoHydraulic modelling											26																			
11.3 Sediment transport modelling											27																			
11.4 EcoHydrology analysis										28																				
11.5 Data collation and preparation																														
11.6 EWR scenario determination												29	29																	
11.7 Reporting															30															
TASK 12 -SOCIO ECONOMIC PRESENT STATE EVALUATION																														
Task 12.1: Identification of the sectors											31																			

	2007							2008											2009										
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Task 12.2 Determination of economic zones and current water allocation												32																	
Task 12.3 Determination of the valuation technique													33																	
Task 12.4 Economic value of water														34																
TASK 13 - OPERATIONAL SCENARIOS AND CONSEQUENCES																														
13.1 Yield modelling																35														
13.2 Concentration modelling																														
13.3 Determining ecological consequences																		36												
13.4 Socio economics & Ecosystem services consequences																		37												
13.5 Reporting																				38										
DECISION MAKING ON MANAGEMENT CLASS/ ECOLOGICAL CATEGORY																														
TASK 14 - IDENTIFICATION OF ECOSPECS																														
14.1 Component assessments																						39								
14.2 Reporting																							40							
PHASE III: STUDY TERMINATION																														
TASK 15 - STUDY TERMINATION																														
15.1 Preparation of final Reserve results																									41					
15.2 Capacity building analysis and audit																										42				
15.3 Compilation of main report																												43		
15.4 Preparation of Reserve templates																													44	
Task 16 CAPACITY BUILDING																														

8 RESOURCES AND BUDGET

The financial detail for this project is outlined as followed:

- **APPENDIX A**
  Complete study budget
  Cash flow projection
  Resource Utilization summary

- **APPENDIX B**
  Hourly rates and disbursement tariffs

Please note that the monthly allocations are according to when the activity occurs and not necessarily when invoiced.

9 PROJECT MONITORING AND CONTROL

The project will be managed along strict project control guidelines. These will be based on the concept of "critical path management". In order to ensure that the project is managed so as to achieve all objectives on time, within budget and as per the stipulated briefs, the following will be put in place:

- A set of clear and concise briefs detailing their programme of work, budget and programme of deliverables will be sent out to all task leaders as part of their contracts once the Inception Report has been finalised.
- An example of the information required for the Progress Reports will be sent to each task leader, after discussion regarding layout with the CD:RDM.
- A consolidated Progress Report will then be forwarded from the Project Administrative Manager to the Client and PMC for review one week before the PMC meeting. The Progress Reports are anticipated to include information as described in Section 4.1.3.
- "Critical path management" control allows for relatively early detection of possible nonperformance. Counseling will be implemented where problem areas are identified and, if necessary, team members will be replaced with the approval of the PMC and Client. Delays in deliverables will be identified to the PMC. Changes to the programme will be presented to the PMC for approval.

10 REPORT PRODUCTION, GIS AND DATA STORAGE

10.1 REPORT PRODUCTION

- The budget allows for one round of comments from the PMC and external reviewer.
- Four weeks are allocated for PMC review of the draft reports.
- Once PMC comments have been received, the report will be updated and a final report will be submitted.
- The PSP budget does not allow for external reviewers.
- A total of two draft black and white reports will be provided per deliverable.
- A total of four full colour final copies will be provided for each deliverable.

10.2 CDs

A .PDF and MS Word version of the final documents will be provided at the end of the study. Five CDs will be provided to the client. If the budget allows, a fully interactive file with links, bookmarks and thumbnails will be produced.

10.3 GIS

The budget does allow for a GIS mapping system.

10.4 Data storage

Where possible all electronic data will be saved as part of the .PDF CD set. The budget does not, however, allow for the development of a data management system.

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APPENDIX A
INKOMATI COMPREHENSIVE RESERVE DETERMINATION STUDY: FINANCIAL COMPONENTS

A1 COMPLETE STUDY BUDGET

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
TASK 1 - PROJECT MANAGEMENT													
1.1 Project management													
Singh, A	WFA	1	82000	400	200.00	25.0	80000					2000	2000
Vos Petro	J&G	1	5600	350	16.00	2.0	5600						0
1.2 Technical management													
Louw	WFA	1	61800	420	140.00	17.5	58800					3000	3000
1.3 PMT Meetings													
Singh, A (progress reports, meetings, minutes)	WFA	1	30800	400	72.00	9.0	28800					2000	2000
Louw, D	WFA	1	16800	420	40.00	5.0	16800						
Vos Petro	J&G	1	9600	350	24.00	3.0	8400		1200				1200
1.4 Financial management													
Louw, D	WFA	1	16800	420	40.00	5.0	16800						
Louw, S	WFA	1	10000	150	60.00	7.5	9000					1000	1000
TOTAL TASK 1			**233400**		**592.00**		**224200**						**9200**
PHASE I: STUDY INITIATION AND DESIGN													
TASK 2 - PROJECT PLANNING AND PROCESS INTEGRATION													
Louw, D Technical coordination and planning	WFA	1	1680	420	4.00	0.5	1680						
2.1 Design of project plan & available data													
Louw, D	WFA	1	17800	420	42.00	5.3	17640			160			160
Rountree, M	WCS	0	1500	375	4.00	0.5	1500						
Tlou, T	WFA	0	2600	650	4.00	0.5	2600						
Huggins, G	WFA	0	1680	420	4.00	0.5	1680						
Singh	WFA	1	12800	400	32.00	4.0	12800						
Vivier, JJP	AGES	1	3840	480	8.00	1.0	3840						
Nel, E	AGES	0	6384	336	19.00	2.4	6384						
Louw, S	WFA	1	2400	150	16.00	2.0	2400						
2.2 Mobilisation of study team													
Louw, D	WFA	1	3680	420	4.00	0.5	1680					2000	2000
Singh	WFA	1	6400	400	16.00	2.0	6400						
Louw, S	WFA	1	7700	150	48.00	6.0	7200					500	500
TOTAL TASK 2			**68464**		**201.00**		**65804**						**2660**
PHASE II: STUDY IMPLEMENTATION													
TASK 3 - Desktop EcoClassification													
3.1 Socio-cultural importance at quaternary level (site visit)													
Huggins, G	WFA	0	23800	420	40.00	5.0	16800	2000	2500	2500			7000
3.2 Populating SCI model													
Huggins, G	WFA	0	6720	420	16.00	2.0	6720						0

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
3.3 Integrate SCI in available Desktop EcoClassification													
Huggins, G	WFA	0	3360	420	8.00	1.0	3360						
Louw, D (spreadsheet)	WFA	1	10080	420	24.00	3.0	10080						
Singh (report)	WFA	1	5800	400	12.00	1.5	4800					1000	1000
TOTAL TASK 3			**49760**		**100.00**		**41760**						**8000**
TASK 4 - LIMITED PUBLIC AWARENESS: ASSESSMENT													
Huggins, G	WFA	0	35920	420	76.00	9.5	31920					4000	4000
Singh	WFA	1	4800	400	12.00	1.5	4800						0
TOTAL TASK 4			**40720**		**88.00**		**36720**						**4000**
TASK 5 - BASIC HUMAN NEEDS RESERVE													
Huggins, G	WFA	0	23520	420	56.00	7.0	23520						0
Total Task 5			**23520**		**56.00**		**23520**						**0**
TASK 6 - GROUNDWATER COMPONENT													
Task 6.1 Study description													
Vivier, JJP			14400	480	30.00	3.8	14400						0
Nel, E			24024	336	71.50	8.9	24024						0
Task 6.2 Delineation of resource units													
Vivier, JJP			3840	480	8.00	1.0	3840						
Nel, E			7392	336	22.00	2.8	7392						
Bulasigobo, J			7392	336	22.00	2.8	7392						
Task 6.3 Resource classification													
Vivier, JJP			9600	480	20.00	2.5	9600						
Nel, E			13440	336	40.00	5.0	13440						
Task 6.4 Quantification of the Groundwater contribution to the Ecological Reserve													
Vivier, JJP			45200	480	40.00	5.0	19200		10000	10000	3000	3000	26000
Nel, E			37632	336	112.00	14.0	37632						
Task 6.5 Setting of quality & quantity groundwater Resource Quality Objectives													
Vivier, JJP			11520	480	24.00	3.0	11520						
Nel, E			4032	336	12.00	1.5	4032						
Total Task 6			**178472**		**401.50**		**152472**						**26000**
TASK 7 - RESOURCE UNITS													
Louw, D Technical coordination and planning	WFA	1	6720	420	16.00	2.0	6720						
Louw, S Logistics and coordination	WFA	1	4200	150	28.00	3.5	4200						0
7.3 System operation													
Mallory, S	WFA	0	4800	600	8.00	1.0	4800						
7.4 Water quality subunits													
Scherman	CES	1	26560	420	48.00	6.0	20160	2000	2500	1900			6400
Wepener (Trainee)	UOJ	0	11900	250	40.00	5.0	10000			1900			1900
7.6 Groundwater sub-units													

CROCODILE EAST & SABIE COMPREHENSIVE STUDY														
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Included in tak 6													
7.7 Identification of Resource Units													
Louw, D	WFA	1	5880	420	14.00	1.8	5880						
7.8 Sabie EWR site selection and dry season survey													
Site selection													
Birkhead, D Preliminary selection	SS	0	11800	420	20.00	2.5	8400	2000	400	1000			3400
Louw, D, Preliminary selection	WFA	1	13620	420	16.00	2.0	6720		5900	1000			6900
Dry season survey, Sabie (Hydraulic survey & calib)													
Birkhead, D	SS	0	22200	420	40.00	5.0	16800			2400	3000		5400
Louw, D,	WFA	1	20400	420	40.00	5.0	16800			2400	1200		3600
Fish Technician	CS	0	8600	150	44.00	5.5	6600			2000			2000
Kotze, P	CS	0	21400	350	44.00	5.5	15400		3000	2000	1000		6000
Uys , AC	LW	1	23000	400	46.00	5.8	18400	2000	0	2000	600		4600
Koekemoer, S	KAS	1	19800	300	44.00	5.5	13200		4000	2000	600		6600
Rountree, M	WCS	0	19500	375	44.00	5.5	16500					3000	3000
Mackenzie, J	BRS	0	18280	370	44.00	5.5	16280			2000			2000
Habitat modelling survey													
Birkhead, D	SS	0	12280	420	24.00	3.0	10080			1000	1200		2200
Louw, D	WFA	1	12380	420	24.00	3.0	10080		1000	1000	300		2300
7.9 RU report													
Singh (review)	WFA	1	3200	400	8.00	1.0	3200						
Louw, D	WFA	1	13440	420	32.00	4.0	13440						
Louw, S	WFA	1	4400	150	16.00	2.0	2400					2000	2000
Engelbrecht, C (GIS)	WFA	1	11400	380	30.00	3.8	11400						0
Total Task 7			**295760**		**670.00**		**237460**						**58300**
TASK 8 - EXTRAPOLATION / ESTIMATION													
Louw, D Technical coordination and planning	WFA	1	10080	420	24.00	3.0	10080						
Louw, S Logistics and coordination	WFA	1	2400	150	16.00	2.0	2400						0
8.1 Predict the indicator species at each hydrological node													
Louw, D	WFA	1	6720	420	16.00	2.0	6720						
Louw, S	WFA	1	1200	150	8.00	1.0	1200						0
8.2 Indicate the reach that each hydrological node and the EWR sites represent													
Louw, D	WFA	1	10080	420	24.00	3.0	10080						
Engelbrecht, C (GIS)	WFA	1	4040	380	8.00	1.0	3040					1000	1000
8.3 Predict flow requirements for each hydrological node													
Collating basic information (10 Rapids and 10 hydraulic info sites)													
Louw, D	WFA	1	36320	420	56.00	7.0	23520		5000	3000	4800		12800

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Birkhead, D	SS	0	32300	420	60.00	7.5	25200	2000	600	3000	1500		7100
Modelling													
Birkhead, D	SS	0	30240	420	72.00	9.0	30240						0
Predicting flow requirements													
Louw, D	WFA	1	27520	420	56.00	7.0	23520			4000			4000
Birkhead, D	SS	0	31020	420	56.00	7.0	23520	2500	1000	4000			7500
Hughes	IWR	0	39600	550	72.00	9.0	39600						0
8.4 Report													
Louw, D	WFA	1	17800	420	40.00	5.0	16800					1000	1000
Louw, S	WFA	1	3600	150	24.00	3.0	3600						0
Engelbrecht, C (GIS)	WFA	1	9120	380	24.00	3.0	9120						0
Singh (review)	WFA	1	3200	400	8.00	1.0	3200						
Total Task 8			**265240**		**564.00**		**231840**						**33400**
TASK 9 - WETLAND TYPING AND ECOCLASSIFICATION													
9.1 Identify and map the wetlands													
Rountree, M	WCS	0	32250	375	78.00		29250					3000	3000
Rountree, M (Field verification of desktop mapping)	WCS	0	23250	375	38.00		14250		6000	3000			9000
9.2 Classification of wetland types (HGM classification system)													0
Rountree, M	WCS	0	14250	375	38.00		14250						0
9.3 Reference condtions													0
Rountree, M	WCS	0	9000	375	24.00		9000						0
9.4 PES													0
Rountree, M	WCS	0	9000	375	24.00		9000						0
9.5 EIS													0
Rountree, M	WCS	0	9000	375	24.00		9000						0
9.6 Prioritization of possible sites for pilot testing of Rapid Reserve methods													0
Rountree, M	WCS	0	14250	375	38.00		14250						0
9.7 Report writing													0
Rountree, M	WCS	0	14550	375	38.00		14250					300	300
Total Task 9			**125550**		**302.00**		**113250**						**12300**
TASK 10 - RIVER ECOCLASSIFICATION													
Louw, D Technical coordination and planning	WFA	1	6720	420	16.00	2.0	6720						
Louw, S Logistics and coordination	WFA	1	3600	150	24.00	3.0	3600						0
10.1 Croc survey & hydraulic calibration													
Birkhead, D	SS	0	25380	420	44.00	5.5	18480	2000	400	2000	2500		6900
Louw, D	WFA	1	24300	420	40.00	5.0	16800		4500	2000	1000		7500
Mackenzie, J	BRS	0	17100	370	40.00	5.0	14800			2000		300	2300
Rountree, M	WCS	0	17300	375	40.00	5.0	15000			2000		300	2300
Kotze, P	CS	0	18500	350	40.00	5.0	14000		1500	2000	1000		4500
Uys , AC	LW	1	22200	400	44.00	5.5	17600	2000	0	2000	600		4600

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Koekemoer, S	KAS	1	18600	300	42.00	5.3	12600		4000	2000			6000
10.2 Data and model preparation													
Scherman	CES	1	33600	420	80.00	10.0	33600						
Hughes, D	IWR	0	8800	550	16.00	2.0	8800						
Louw, D (IHI)	WFA	1	20160	420	48.00	6.0	20160						
Kotze, P	CS	0	27300	350	78.00	9.8	27300						
Louw, D	WFA	1	6720	420	16.00	2.0	6720						
Mackenzie, J	A&L	0	28860	370	78.00	9.8	28860						
Uys , AC	LW	1	32000	400	80.00	10.0	32000						
Rountree, M	WCS	0	31250	375	78.00	9.8	29250					2000	2000
10.3 Diatom assessment													
Koekemoer, S	KAS	1	24000	300	80.00	10.0	24000						
10.4 EcoStatus assessment													
Louw, D	WFA	1	9240	420	22.00	2.8	9240						
10.5 Specialist meeting													
Koekemoer, S	KAS	1	15700	300	40.00	5.0	12000		1200	2500			3700
Kotze, P	CS	0	18400	350	40.00	5.0	14000		2400	2000			4400
Louw, D	WFA	1	20800	420	40.00	5.0	16800		2000	2000			4000
Mackenzie, J	A&L	0	19200	370	40.00	5.0	14800		2400	2000			4400
Uys , AC	LW	0	22200	400	44.00	5.5	17600	2000	600	2000			4600
Rountree, M	WCS	0	17000	375	40.00	5.0	15000			2000			2000
Scherman	CES	1	22100	420	40.00	5.0	16800	2500	800	2000			5300
10.6 Reporting													
Koekemoer, S	KAS	1	12000	300	40.00	5.0	12000						
Louw, D	WFA	1	10080	420	24.00	3.0	10080						
Singh (review)	WFA	1	3200	400	8.00	1.0	3200						
Louw, S (editing and final production)	WFA	1	6800	150	32.00	4.0	4800					2000	2000
Total Task 10			**543110**		**1294.00**		**476610**						**66500**
TASK 11 - EWR SCENARIO ASSESSMENT													
Louw, D Technical coordination and planning	WFA	1	6720	420	16.00	2.0	6720						
Louw, S Logistics and coordination	WFA	1	7300	150	32.00	4.0	4800					2500	2500
11.1 Hydraulic calibration													
Sabie & Croc 3rd calibration (floods)													
Birkhead, D	SS	0	23500	420	40.00	5.0	16800	2000	500	2000	2200		6700
Louw, D	WFA	1	17840	420	32.00	4.0	13440		2500	1500	400		4400
Sabie & Croc 4th calibration (intermediate)													
Birkhead, D	SS	0	23500	420	40.00	5.0	16800	2000	500	2000	2200		6700
Louw, D	WFA	1	17840	420	32.00	4.0	13440		2500	1500	400		4400
11.2 EcoHydraulic modelling													
Birkhead, D	SS	0	36960	420	88.00	11.0	36960						
11.3 Sediment Transport modelling													

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Rountree, M	WCS	0	22500	375	60.00	7.5	22500						0
11.4 EcoHydrology analysis													
Hughes, D	IWR	0	44000	550	80.00	10.0	44000						
11.5 Data collation and preparation													
Louw, D	WFA	1	10720	420	16.00	2.0	6720					4000	4000
Louw, S	WFA	1	4800	150	32.00	4.0	4800						
11.6 EWR scenario determination													
A Sabie Workshop													
Birkhead, D	SS	0	22880	420	44.00	5.5	18480	2000	400	2000			4400
Hughes, D	IWR	0	21900	550	28.00	3.5	15400	2000	3000	1500			6500
Koekemoer, S	KAS	1	16300	300	42.00	5.3	12600		1200	2500			3700
Kotze, P	CS	0	17200	350	40.00	5.0	14000		1200	2000			3200
Louw, D	WFA	1	23540	420	42.00	5.3	17640		2400	2000	1500		5900
Louw, S	WFA	1	8300	150	42.00	5.3	6300			2000			2000
Mackenzie, J	A&L	0	11860	370	28.00	3.5	10360			1500			1500
Uys , AC	LW	0	21600	400	44.00	5.5	17600	2000		2000			4000
Rountree, M	WCS	0	12000	375	28.00	3.5	10500			1500			1500
B Crocodile workshop													
Birkhead, D	SS	0	22880	420	44.00	5.5	18480	2000	400	2000			4400
Hughes, D	IWR	0	21900	550	28.00	3.5	15400	2000	3000	1500			6500
Koekemoer, S	KAS	1	16300	300	42.00	5.3	12600		1200	2500			3700
Kotze, P	CS	0	17200	350	40.00	5.0	14000		1200	2000			3200
Louw, D	WFA	1	23540	420	42.00	5.3	17640		2400	2000	1500		5900
Louw, S	WFA	1	8300	150	42.00	5.3	6300			2000			2000
Mackenzie, J	A&L	0	11860	370	28.00	3.5	10360			1500			1500
Uys , AC	LW	1	21600	400	44.00	5.5	17600	2000		2000			4000
Rountree, M	WCS	0	12000	375	28.00	3.5	10500			1500			1500
11.7 Reporting													
Koekemoer, S	KAS	1	21000	300	70.00	8.8	21000						
Singh (review)	WFA	1	3200	400	8.00	1.0	3200						
Louw, D	WFA	1	17960	420	38.00	4.8	15960					2000	2000
Louw, S	WFA	1	4500	150	30.00	3.8	4500						
Total Task 11			**573500**		**1290.00**		**477400**						**96100**
TASK 12 -SOCIO ECONOMIC PRESENT STATE EVALUATION													
Task 12.1: Identification of the sectors													
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	23000	650	30.00	3.8	19500		1000	1500		1000	3500
Task 12.2 Determination of economic zones and current water allocation													
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	25000	650	30.00	3.8	19500		3000	1500		1000	5500
Task 12.3 Determination of the valuation technique													
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	23000	650	30.00	3.8	19500		1000	1500		1000	3500

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Task 12.4 Economic value of water													
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	23000	650	30.00	3.8	19500		1000	1500		1000	3500
Total Task 12			**138000**		**208.00**		**122000**						**16000**
TASK 13 - DETERMINING OPERATIONAL SCENARIOS AND CONSEQUENCES													
Louw, D Technical coordination and planning	WFA	1	10080	420	24.00	3.0	10080						
Louw, S Logistics and coordination	WFA	1	5400	150	16.00	2.0	2400					3000	3000
13.1 Yield modelling													
Mallory, S	IWR	0	33600	600	56.00	7.0	33600						
Hughes, D	IWR	0	30500	550	40.00	5.0	22000	4000	3000	1500			8500
Louw, D	WFA	1	13440	420	32.00	4.0	13440						
13.2 Concentration modelling													
Muller	IWR	1	25600	400	64.00	8.0	25600						
Scherman	CES	1	16800	420	40.00	5.0	16800						
13.3 Determining ecological consequenses													
Hughes, D	IWR	0	29900	550	44.00	5.5	24200	2000	1300	2400			5700
Koekemoer, S	KAS	1	15600	300	40.00	5.0	12000		1200	2400			3600
Kotze, P	CS	0	19200	350	40.00	5.0	14000		2800	2400			5200
Louw, D	WFA	1	20700	420	40.00	5.0	16800		1500	2400			3900
Louw, S	WFA	1	8400	150	40.00	5.0	6000			2400			2400
Mackenzie, J	A&L	0	17200	370	40.00	5.0	14800			2400			2400
Uys, AC	LW	1	22500	400	44.00	5.5	17600	2500		2400			4900
Rountree, M	WCS	0	17416	375	40.00	5.0	15000			2416			2416
Mallory, S	WFA	0	29000	600	40.00	5.0	24000		2500	2500			5000
13.4 Socio economics & Ecosystem services consequences													
A Change in value of the socio-economic activities for different EWR scenarios													
Huggins, G	WFA	0	9780	420	14.00	1.8	5880	2500	400	1000			3900
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	14300	650	22.00	2.8	14300						0
Ecological input													
Kotze, P	CS	0	3300	350	8.00	1.0	2800			500			500
Louw, D	WFA	1	3860	420	8.00	1.0	3360			500			500
Mackenzie, J	A&L	0	3460	370	8.00	1.0	2960			500			500
Uys, M	LW	0	3700	400	8.00	1.0	3200			500			500
Rountree, M	WCS	0	3500	375	8.00	1.0	3000			500			500
B Changes in value of ecosystem services for different EWR scenarios													
Huggins, G	WFA	0	6720	420	16.00	2.0	6720						
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	18800	650	22.00	2.8	14300		2000	1500		1000	4500
Mallory, S (Yield Modeling)	WFA	0	19900	600	24.00	3.0	14400		3000	2500			5500
C Optimisation of the overall benefits from water re-allocation scenarios													

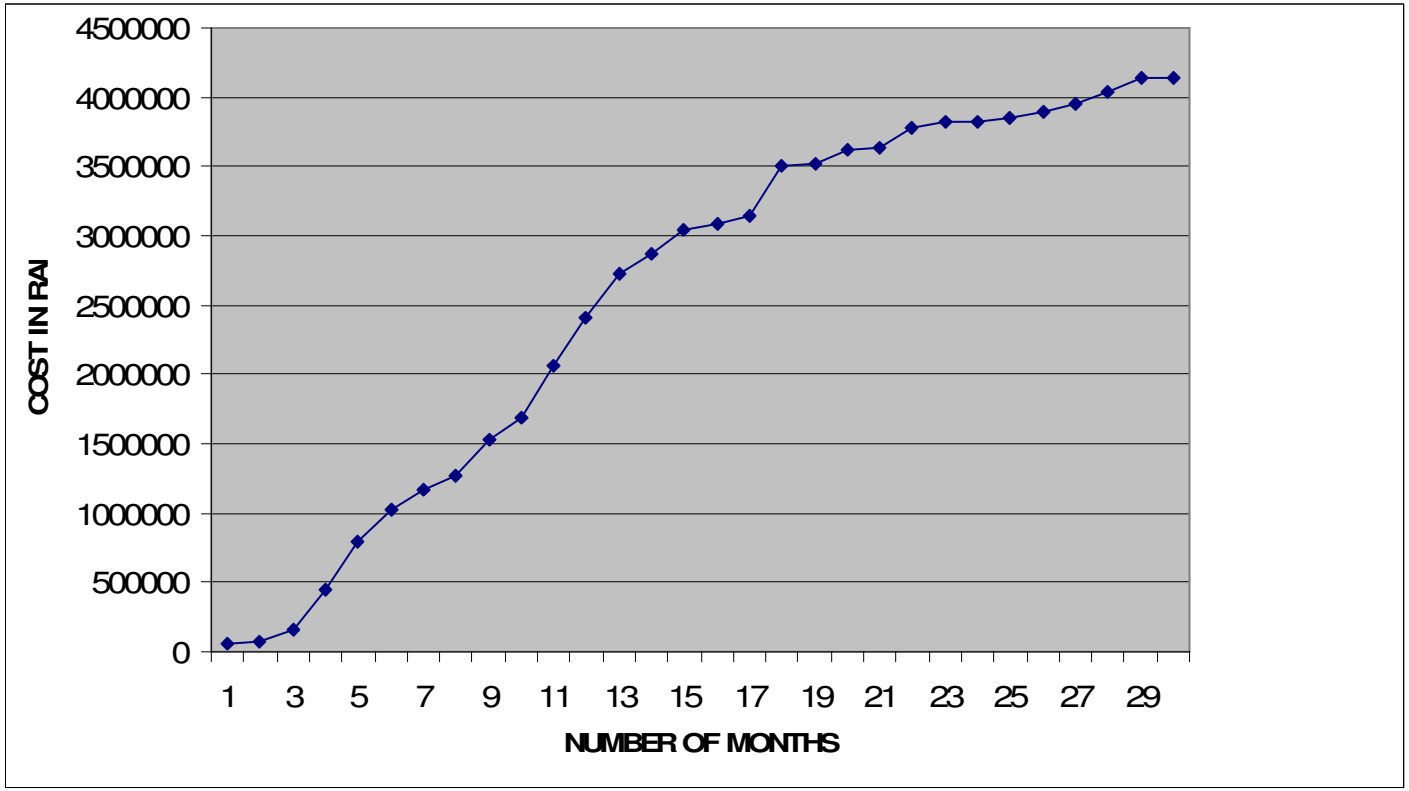
CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Huggins, G	WFA	0	10620	420	16.00	2.0	6720	2500	400	1000			3900
Mullins, D	CE	0	11000	500	22.00	2.8	11000						
Tlou, T	WFA	0	37000	650	50.00	6.3	32500		2000	1500		1000	4500
13.5 Reporting													
Koekemoer, S	KAS	1	16800	300	56.00	7.0	16800						
Louw, D	WFA	1	10080	420	24.00	3.0	10080						
Singh (review)	WFA	1	3200	400	8.00	1.0	3200						
Louw, S	WFA	1	4400	150	16.00	2.0	2400					2000	2000
Tlou, T	WFA	0	20800	650	32.00	4.0	20800						
Total Task 13			**538556**		**1046.00**		**464740**						**73816**
TASK 14 - IDENTIFICATION OF ECOSPECS													
14.1 Component assessments													
Koekemoer, S	KAS	1	15200	300	40.00		12000		1200	2000			3200
Kotze, P	CS	0	18800	350	40.00		14000		2800	2000			4800
Louw, D	WFA	1	23100	420	40.00		16800		2800	2000		1500	6300
Mackenzie, J	A&L	0	16800	370	40.00		14800			2000			2000
Uys, AC	LW	1	22900	400	40.00		16000	2500	2400	2000			6900
Rountree, M	WCS	0	17000	375	40.00		15000			2000			2000
Scherman	CES	1	21300	420	40.00	5.0	16800	2500		2000			4500
14.2 Reporting													
Koekemoer, S	KAS	1	10600	300	32.00		9600					1000	1000
Singh (review)	WFA	1	1600	400	4.00	0.5	1600						
Louw, D	WFA	1	5040	420	12.00		5040						
Louw, S	WFA	1	1800	150	12.00		1800						
Total Task 14			**154140**		**340.00**		**123440**						**30700**
PHASE III: STUDY TERMINATION													
TASK 15 - STUDY TERMINATION													
15.1 Preparation of final Reserve results													
Hughes, D	IWR	0	22000	550	40.00	5.0	22000						
15.2 Capacity building analysis and audit													
Included in task 16													
15.3 Compilation of main report													
Huggins, G	WFA	0	3360	420	8.00	1.0	3360						
Singh	WFA	1	29000	400	54.00	6.8	21600	2500				4900	7400
Koekemoer, S	KAS	1	12500	300	30.00	3.8	9000	2500				1000	3500
Rountree, M	WCS	0	1500	375	4.00	0.5	1500						0
Louw, D	WFA	1	21500	420	30.00	3.8	12600	2500	1500			4900	8900
Louw, S	WFA	1	13100	150	38.00	4.8	5700	2500				4900	7400
Nel, E			1344	336	4.00	0.5	1344						
Tlou, T	WFA	1	5200	650	8.00	1.0	5200						0
Engelbrecht, C	WFA	1	7600	380	20.00	2.5	7600						0
15.4 Preparation of Reserve templates													
Singh	WFA	1	16000	400	40.00	5.0	16000						
Total Task 15			**133104**		**276.00**		**105904**						**27200**

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Task 16 CAPACITY BUILDING													
16.1 Design and application of capacity building plan													
Louw, D, technical input	WFA	1	6040	420	12.00	1.5	5040					1000	1000
Scherman, process advisor, design or pogramme, audtit and report	CES	1	19340	420	32.00	4.0	13440	4900		1000			5900
Singh	WFA	1	39500	400	80.00	10.0	32000	2500		1000		4000	7500
16.2 Introductory EWR workshop													0
Senoge, N (Trainee)	CS	1	80	100	0.00	0.0	0			80			80
Desai (Trainee)	Acon	1	480	190	0.00	0.0	0		400	80			480
Hlongwane (Trainee)	WCS	1	0	110	0.00	0.0	0						0
A Gerber (Trainee)	P	1	480	250	0.00	0.0	0		400	80			480
S Johnson (Trainee)	J&G	0	2700	300	0.00	0.0	0	1400	800	500			2700
Louw (Preparation of material and participation) (presenter)	WFA	1	3520	420	6.00	0.8	2520		500			500	1000
Vos Petro	J&G	1	480	350	0.00	0.0	0		400	80			480
Du Preez	UOF	0	2600	350	0.00	0.0	0	2000		600			2600
16.3 Individual training Task 1: Management													0
Task 1.1 Louw, S (Management and coordination)	WFA	1	4500	150	30.00	3.8	4500						0
Task 1.1 Vos, P (Coordination)	J&G	0	28300	350	78.00	9.8	27300					1000	1000
Task 1.2 Louw, S (Trainee)	WFA	1	4800	150	32.00	4.0	4800						0
Task 1.4 Louw, D, (mentor)	WFA	1	7720	420	16.00	2.0	6720					1000	1000
Task 1.4 Louw, S (training and financial admin)	WFA	1	11700	150	78.00	9.8	11700						0
16.4 Individual training Task 6 Groundwater													0
Task 6.5 Zimmerman, S (Trainee)	ERM	1	83700	450	186.00	23.3	83700						0
Task 6.5 Vivier, JJP	AGES	1	17280	480	36.00	4.5	17280						0
Task 6.5 Nel, E	AGES	0	20160	336	60.00	7.5	20160						0
16.5 Task 7 RU determination (Sabie site visit)													0
Task 7.8 Desai	Acon	1	10100	190	40.00	5.0	7600			2500			2500
16.6 Individual training Task 9 Wetlands													0
Maphumlo	WCS	1	7040	110	64.00	8.0	7040						0
M Rountree	WCS	0	4500	375	12.00	1.5	4500						0
16.7 Task 10 EcoClassification (Croc site visit)													0
Task 10.1 Hlongane	WCS	1	6900	110	40.00	5.0	4400			2500			2500
Du Preez	CS	0	18500	350	40.00	5.0	14000	2000		2500			4500
Senoge, N (Trainee)	CS	1	6500	100	40.00	5.0	4000			2500			2500
Vos Petro (Trainee)	J&G	1	18500	350	40.00	5.0	14000		2000	2500			4500
16.8 Individual training Task 10 EcoClassification (Model preparation)													0
16.8.1 Geomorph (includes Task 11 training)													0
Hlongwane (Trainee)	WCS	1	1760	110	16.00	2.0	1760						0
16.8.2 Inverts													0

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Senoge, N (Trainee)	CS	1	2800	100	28.00	3.5	2800						0
Vos Petro (Trainee)	J&G	1	8400	350	24.00	3.0	8400						0
Uys, AC	LW	1	9600	400	24.00	3.0	9600						0
16.8.3 Rip veg													0
Du Preez (Trainee)	UOF	0	15400	350	44.00	5.5	15400						0
Mackenzie (Mentor)	A&L	0	5920	370	16.00	2.0	5920						0
16.8.4 PAI													0
Wepener (Trainee)	UOJ	0	12300	250	32.00	4.0	8000	2000	800	1500			4300
Dickens (Trainee)	INR	0	17900	450	32.00	4.0	14400	2000		1500			3500
Scherman (Mentor)	CES	1	13440	420	32.00	4.0	13440						0
16.9 Task 10 EcoClassification (Workshop (Croc))													
Wepener (Trainee)	UOJ	0	6100	250	16.00	2.0	4000		1500	600			2100
Dickens (Trainee)	INR	0	10900	450	16.00	2.0	7200	2500		1200			3700
Du Preez (Trainee)	UOF	0	14900	350	32.00	4.0	11200	2500		1200			3700
Senoge, N (Trainee)	CS	1	2200	100	16.00	2.0	1600			600			600
Vos Petro (Trainee)	J&G	1	16000	350	44.00	5.5	15400			600			600
Hlongwane (Trainee)	WCS	1	4300	110	20.00	2.5	2200		1500	600			2100
16.10 Individual training Task 11 EWR Scenario assessment													0
16.10.1 Hydrology													
A Gerber (Trainee)	UOJ	1	29000	250	92.00	11.5	23000	2000	1500	2500			6000
S Johnson (Trainee)	J&G	0	32100	300	92.00	11.5	27600	2000		2500			4500
Hughes, D (Mentor)	IWR	0	13200	550	24.00	3.0	13200						0
16.10.2 Hydraulics													0
Desai (Trainee)	Acon	1	8360	190	44.00	5.5	8360						0
Birkhead, D (mentor)	SS	0	5040	420	12.00	1.5	5040						0
16.11 Technical EWR Training workshop													0
Senoge, N (Trainee)	CS	1	0	100	0.00	0.0	0						0
Desai (Trainee)	Acon	1	0	190	0.00	0.0	0						0
Hlongwane (Trainee)	WCS	1	0	110	0.00	0.0	0						0
A Gerber (Trainee)	P	1	1500	250	0.00	0.0	0		1000	500			1500
S Johnson (Trainee)	J&G	0	3500	300	0.00	0.0	0	2000	500	1000			3500
Vos Petro (Trainee)	J&G	1	500	350	0.00	0.0	0			500			500
Du Preez (Trainee)	UOF	0	4500	350	0.00	0.0	0	2500	800	1200			4500
Louw (Preparation of material and participation) (presenter)	WFA	1	5540	420	12.00	1.5	5040			500			500
Birkhead (presenter)	SS	0	7310	420	8.00	1.0	3360	2500	250	1200			3950
Louw, S (preparation of material)	WFA	1	900	150	6.00	0.8	900						0
16.12 Task 11 workshop (Croc)													0
Senoge, N	CS	1	4700	100	32.00	4.0	3200			1500			1500
A Gerber	P	1	11000	250	24.00	3.0	6000		3500	1500			5000
S Johnson	J&G	1	11200	300	24.00	3.0	7200	2000	500	1500			4000
Desai	Acon	1	3640	190	16.00	2.0	3040			600			600

CROCODILE EAST & SABIE COMPREHENSIVE STUDY													
Task No	Affiliation	HDI	Task Cost	PROFESSIONAL FEES				DISBURSEMENTS					
				Rate	Time (hr)	Days	Cost	Flights	Vehicle & parking	Accom & meals	Equip	Other	Cost
Hlongane	WCS	1	4140	110	24.00	3.0	2640			1500			1500
Vos	J&G	1	12700	350	32.00	4.0	11200			1500			1500
Du Preez	CS	0	11800	350	24.00	3.0	8400	2000		1400			3400
16.13 Task 12 Socio-economics													0
Task 12.1 Mosaka, D (Trainee)	CE	1	9800	350	28.00	3.5	9800						0
Task 12.2 Mosaka, D (Trainee)	CE	1	9800	350	28.00	3.5	9800						0
Task 12.3 Mosaka, D (Trainee)	CE	1	9800	350	28.00	3.5	9800						0
Task 12.4 Mosaka, D (Trainee)	CE	1	9800	350	28.00	3.5	9800						0
Task 13.3 A Mosaka, D	CE	1	11200	350	32.00	4.0	11200						0
Task 13.3 B Mosaka, D	CE	1	11200	350	32.00	4.0	11200						0
Task 13.3 C Mosaka, D	CE	1	11200	350	32.00	4.0	11200						0
16.14 Capacity building evaluation and reporting													0
Scherman	CES	1	17424	420	40.00	5.0	16800					624	624
Total Task 16			**728194**		**2028.00**		**623800**						**104394**
TOTAL (Vat Exclusive)			**4089490**		**9456.50**		**3520920**						**568570**
Escalation fee per annum applicable from Jan 2008			**55000**										
Total including escalation			**4144490**										
14% VAT			**580229**										
PROJECT TOTAL BUDGET			**4724719**										

A2 CASH FLOW PROJECTION



A3 RESOURCE UTILIZATION: SUMMARY

HDI	Total Hours	% Time committed	Hourly Rate	Total income	NON HDI		Total Hours	% Time committed	Hourly Rate	Total income
Desai, A	100	1.06%	190	19000	Birkhead, Drew		592	6.26%	420	248640
Engelbrecht, C	82	0.87%	380	31160	Dickens, C		48	0.51%	450	21600
Gerber, A	116	1.23%	250	29000	Du Preez, J		140	1.48%	350	49000
Hlongwane, L	100	1.06%	110	11000	Hughes, D		364	3.85%	550	200200
Koekemoer, S	598	6.32%	300	179400	Huggins, G		254	2.69%	420	106680
Louw, D	1332	14.08%	420	559440	Johnson, S		116	1.23%	300	34800
Louw, S	718	7.59%	150	107700	Kotze, P		370	3.91%	350	129500
Maphumlo, N	64	0.68%	110	7040	Mackenzie, J		362	3.83%	370	133940
Mosaka, D	208	2.20%	350	72800	Mallory,S		128	1.35%	600	76800
Muller, N	64	0.68%	400	25600	Mullins, D		154	1.63%	500	77000
Scherman, P	352	3.72%	420	147840	Rountree, M		728	7.70%	375	273000
Senoge, N	116	1.23%	100	11600	Tlou, T		258	2.73%	650	167700
Singh, A	562	5.94%	400	224800	Vivier, J		172	1.82%	480	82560
Uys, M	418	4.42%	400	167200	Wepener, V		88	0.93%	250	22000
Vos, P	258	2.73%	350	90300	Fish Tec		44	0.47%	150	6600
Wiethoff, A	367	3.88%	336	123312						
Zimmerman, S	186	1.97%	450	83700						
Total	5641	59.64%		1890892.00			3818	40.36%		1630020.00

APPENDIX B

INKOMATI COMPREHENSIVE RESERVE DETERMINATION STUDY: HOURLY RATES AND DISBURSEMENT TARIFFS

B1 HOURLY RATES AND DISBURSEMENT TARIFFS

A summary of the PSPs involved in the Inkomati Comprehensive Reserve is given below (Table B 1). The DWAF approval rates and disbursement tariffs are outlined in Table B 2.

Table B 1 Summary of PSPs and Applicable Rates

Team member	Company name	Position in company	Position in team	Resp[1] Level	Rate (R/h)	HDI	Applicable experience
						Yes/No	Years
Study team with negotiated rates below R432/h (VAT excluded)							
Birkhead, D	Streamflow Solutions	Member	Specialist	E	420	No	15
Desai, A	AFRICON	Employee	Trainee	B	190	Yes	none
Du Preez, J	UOF	Snr. Lecturer	Trainee	B	350	No	20
Engelbrecht, C	WFA	Specialist	Specialist	C	380	Yes	12
Gerber, A	Private	Private	Trainee	B	250	Yes	3
Hlongwane, L	Wetland Consulting Services	Employee	Trainee	B	110	Yes	none
Huggins, G	WFA	Director	Specialist	E	420	No	15
Johnson, S	Jefferes & Green	Employee	Trainee	B	300	No	7
Koekemoer, S	KAS	Member	Specialist	D	300	Yes	4
Kotze, P	Clean Stream	Director	Specialist	E	350	No	8
Louw, D	WFA	Director	Specialist	F	420	Yes	15
Louw, S	WFA	Office manager	Trainee	C	150	Yes	1
Mackenzie, J	Alexander & Llewellin	Member	Specialist	E	370	No	8
Maphumlo, N	Wetland Consulting Services	Employee	Trainee	B	110	Yes	none
Mosaka, D	Conningarth Economists	Economist	Trainee	C	350	Yes	7
Muller, N	IWR Rhodes	Member	Specialist	E	400	Yes	13
Rountree, M	Wetland Consulting Services	Director	Specialist	E	375	No	8
Scherman, P	CES	Director	Specialist	F	420	Yes	13
Senoge, N	Clean Stream	Junior Aquatic Scientist	Trainee	B	100	Yes	2
Singh, A	WFA	Director	Specialist	F	400	Yes	10
Uys, M	Laughing Waters	Member	Specialist	E	400	Yes	12
Vos, P	Jefferes & Green	Snr Environmentalist	Trainee	C	350	Yes	10
Wepener, V	Jhb University	Snr Lecturer	Trainee	B	250	No	15
Wiethoff, A	AGES	Employee	Specialist	E	336	Yes	8
Study team with negotiated rates above R432/h (VAT excluded)							
Dickens, C	INR	Subject area leader	Trainee	B	450	No	20
Hughes, D	IWR	Director	Specialist	F	550	No	25
Mallory, S	WFA	Director	Specialist	F	600	No	15
Mullins, D	ConningarthEconomists	Director	Specialist	E	500	No	25

Team member	Company name	Position in company	Position in team	Resp[1] Level	Rate (R/h)	HDI	Applicable experience
						Yes/No	Years
Tlou, T	WFA	Director	Specialist	F	650	No	20
Vivier, J	AGES	Director	Specialist	E	480	No	12
Zimmerman, S	ERM Southern Africa	Snr Consultant	Trainee	B	450	Yes	7

1 Responsibility

The negotiated rates are fixed to March 2008.

Table B 2 In-house disbursement tariffs

Table 1: Printing, copying, etc. (VAT excluded)

Description	Rate (R/item)
Typing and printing of original per A4 colour sheet	R9.00
Typing and printing of original per A4 B&W sheet	R8.00
Printing only of original per A3 colour sheet	R12.00
Printing only of original per A3 B&W sheet	R10.00
Duplicating per A4 sheet (B&W)	R0,55
Duplicating per A3 sheet (B&W)	R0,75
Duplicating in colour per A4 sheet	R7,00
Duplicating in colour per A3 sheet	R13.20
Printing in colour on photo quality paper per A4 sheet	R15,00
Spiral binding with A4 covers (per book)	R30.00
Conversion of reports to PDF (per report)	R500.00

Table 2: Rates for communication (VAT excluded)

Description	Rate (R/item)
Telephone calls, faxes and e-mails	R350/month

Table 3: Rates for computers (exclusive of VAT)

Description	Rate (R/item)
Computer hardware, software and consumables	none

Table 4: Rates for site visit equipment (VAT excluded)

Description	Rate (R/item)
Boat and engine hire	R350 per day or part there-of
Fish shocker	R250 per day or part there-of
Camera	R70 per day or part there-of
GPS	R60 per day or part there-of
Total Station	R350 per day or part there-of
Current meter large	R250 per day or part there-of
Current meter small	R200 per day or part there-of
SASS Equipment	R60 per day or part there-of
Data projector	R350 per day or part there-of