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Support to the Implementation and Maintenance of the Reconciliation Strategy for the Crocodile West Water Supply System

INCEPTION REPORT

OCTOBER 2010



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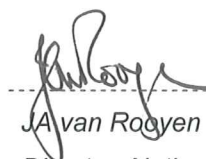
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Table of Contents

1	INTRODUCTION	1-1
1.1	Background to the project.....	1-1
1.2	Study area.....	1-1
1.3	Appointment of consultant	1-3
1.4	Scope and organisation of the study.....	1-3
1.5	Governance of the study	1-5
2	TASK 1: INCEPTION PHASE	2-1
2.1	Objectives	2-1
2.2	Inception meeting	2-1
2.3	Approach	2-1
2.4	Deliverables	2-2
3	RECURRING EVENTS.....	3-1
3.1	Task 2: Project management (Task Leader: Pieter van Rooyen).....	3-1
3.2	Task 3: Liaison and information dissemination (Task Leader: Hermien Pieterse)	3-2
3.3	Task 4: Stakeholder engagement and administrative support (Task Leader: Anelle Lötter) ..	3-3
4	TECHNICAL TASKS	4-1
4.1	Task 5: Water quality (Task Leader: Trevor Coleman).....	4-1
4.2	Task 6: Water Resources Planning Model (Task Leader: Johan Rossouw).....	4-2
4.3	Task 7: Develop operating rules for the system (Task Leader: Pieter van Rooyen).....	4-3
4.4	Task 8: Review the water tariff for the system (Task Leader: Peter Ramsden)	4-5
4.5	Task 9: Update the Reconciliation Strategy (Task Leader: Pieter van Rooyen).....	4-5
4.6	Task 10: Support to the Strategy Steering Committee (Task Leader: Pieter van Rooyen).....	4-7
5	ADDITIONAL TASKS	5-1
5.1	Task 11: Ad hoc tasks (Task Leader: JOHAN ROSSOUW).....	5-1
5.2	Task 12: Annual Operating Analysis	5-2
5.3	Task 13: Support to Mokolo-Crocodile Water Augmentation Project (MCWAP) (Task Leader: Pieter van Rooyen)	5-3
5.4	Task 14: Training.....	5-7
5.5	Integration of Resources Classification	5-7
6	STUDY TEAM.....	6-1
6.1	Team composition.....	6-1
6.2	Study Management	6-1

6.3	Task Leaders	6-1
6.4	Study Team	6-2
6.5	HDI component.....	6-3
7	COST ESTIMATE.....	ERROR! BOOKMARK NOT DEFINED.
7.1	General items	Error! Bookmark not defined.
7.2	Professional fees.....	Error! Bookmark not defined.
7.3	Disbursements.....	Error! Bookmark not defined.
7.4	Summary of study cost estimate	Error! Bookmark not defined.
7.5	Projected cash flow	Error! Bookmark not defined.
7.6	HDI participation.....	Error! Bookmark not defined.
	Appendix A Study programme	A
	Appendix B Organisational and task breakdown structure	B
	Appendix C Human resources to be used	C

1 INTRODUCTION

1.1 BACKGROUND TO THE PROJECT

The Reconciliation Strategy for the Crocodile West Water Supply System was developed and published in 2008 by the Department of Water Affairs (DWA) to ensure the future availability of water to key metropolitan and development areas in the catchment. The Strategy was primarily focussed on the quantitative reconciliation of the requirements for and availability of water, with due consideration of water quality where it impacts on the reconciliation. These goals, to ensure the sufficient and reliable supply of water of appropriate quality to users, should be achieved within the framework of the best utilisation of water resources, at the lowest cost and in an environmentally sustainable manner.

The **main objective** of this Study is to put in place arrangements and resources for the ongoing maintenance and implementation of the Strategy. This will be done by providing administrative, scientific and technical assistance to the Strategy Steering Committee (SSC) in support of their function to maintain and update the Reconciliation Strategy for a period of 36 months.

Also, it is recognised that although several actions with proposed time scales were recommended in the Strategy, this is a dynamic plan that need to respond to changing conditions. Therefore, tasks will be performed as requested by the SSC to implement and update the Reconciliation Strategy of the Crocodile West Water Supply System.

1.2 STUDY AREA

The Crocodile West River is the largest and most important river in the Crocodile West and Marico WMA. The catchment extends northwards from the Witwatersrand catchment divide in central Johannesburg (where the Crocodile West River originates) to the confluence of the Crocodile and Marico rivers. It is characterised by the sprawling urban and industrial areas of northern Johannesburg and Pretoria, extensive irrigation downstream of Hartbeespoort Dam and large mining developments north of the Magaliesberg. As a result, the Crocodile West River is one of the rivers in the country that has been most influenced by human activities, and where specific management strategies are of paramount importance.

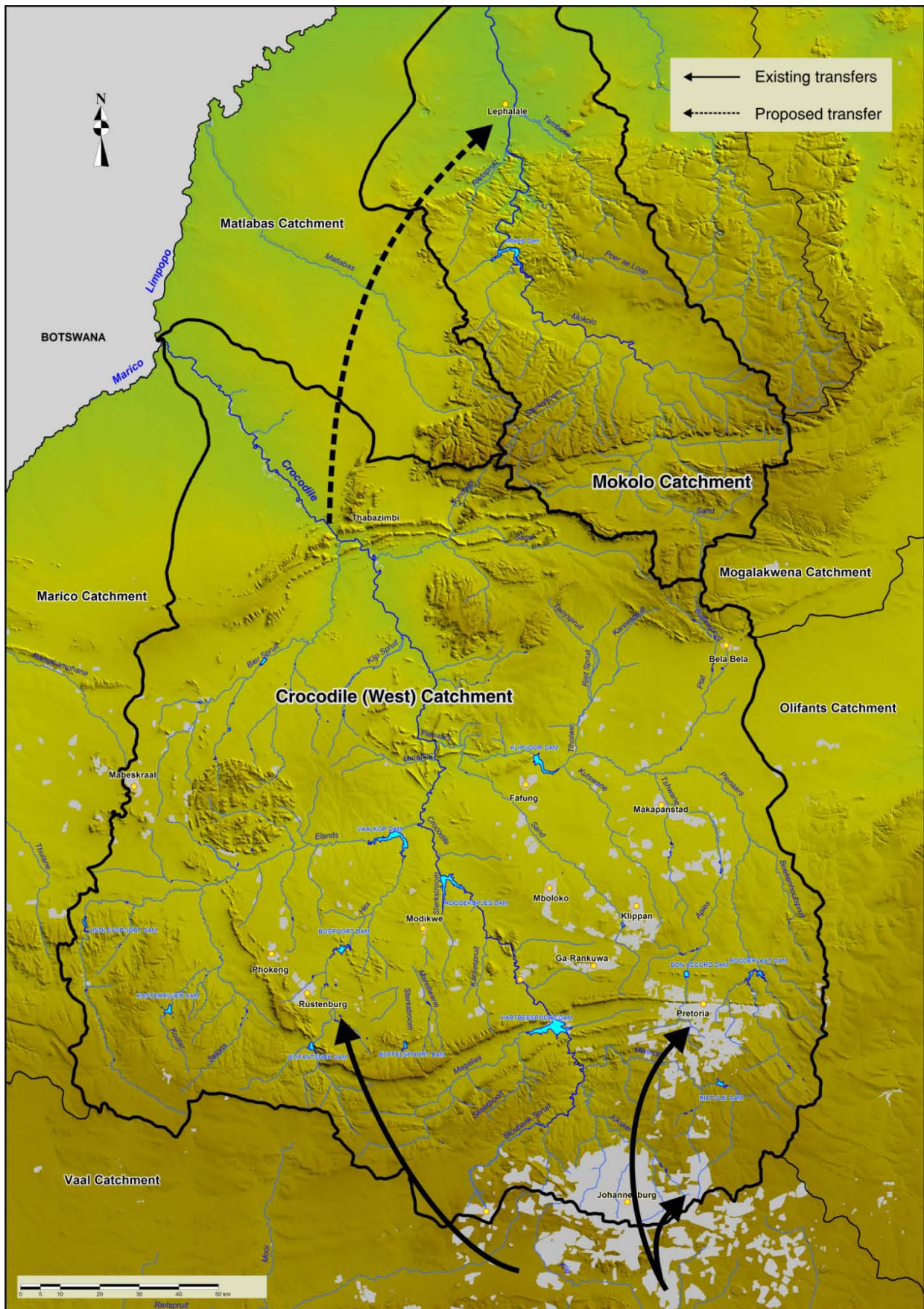


Figure 1.1 Study area

The study area includes the whole of the Crocodile West River catchment as shown in **Figure 1.1**. This figure also shows the Mokolo River catchment, where water supplies to the large potential mining, power generation and petrochemical developments in the Lephalale area need to be augmented from or via the Crocodile West River catchment.

From the confluence of the Crocodile and Marico rivers, the river is known as the Limpopo River which forms the northern border of South Africa with Botswana and then with Zimbabwe, before flowing into Mozambique where it discharges into the Indian Ocean. The Limpopo River basin thus is an international basin shared by South Africa, Botswana, Zimbabwe and Mozambique.

1.3 APPOINTMENT OF CONSULTANT

The proposal for this study was submitted on 10 November 2009, in response to the Department of Water Affairs' request for a proposal in accordance with the DWA Guidelines and Terms of Reference.

The Contract was approved on 22 January 2010 and the Directorate: National Water Resource Planning: North appointed BKS (Pty) Ltd in association with a number of sub consultants to undertake this study, entitled: "**Support to the Implementation and Maintenance of the Reconciliation Strategy of the Crocodile West Water Supply System**". For ease of reference, this study is also referred to as "*Maintenance of the Crocodile West Strategy*" (MOCWS).

Given the nature of the assignment, the BKS (Pty) Ltd team is strengthened by incorporating the following sub-consultants:

- ◆ WRP Consulting Engineers;
- ◆ Golder Associates Africa;
- ◆ Zitholele Consulting; and
- ◆ DMM Development Consultants.

1.4 SCOPE AND ORGANISATION OF THE STUDY

Organisation of the study is best explained by grouping the proposed functions into categories, firstly, the *Inception Phase*, the general support that will take place *recurring* during the study period, *technical tasks* as specified in the ToR, and lastly *additional tasks* requested by the Strategy Steering Committee (SSC) or Client.

The **recurring** support will involve activities such as stakeholder engagement, administrative support required for arranging meetings, liaison and information dissemination, as well as project management.

Specific **Technical tasks** were identified in the Strategy, such as finalising and testing of the Water Quality (Salinity) Model (WQT) and the Water Resources Planning Model (WRPM), developing of operating rules, reviewing of the system water tariff and updating of the Reconciliation Strategy.

Lastly, the Client and/or the SSC may request **additional** investigations and support. These will include support with the implementation and monitoring of the Strategy, technical studies and related activities, such as appropriate stakeholder intervention.

A high-level breakdown structure of these categories and the related tasks is shown below, also referring to tasks as defined in the Proposal and additional tasks identified by the Client or at the Study Management Team meetings.

	Newly defined tasks numbers	Tasks as defined in the Proposal
Inception	1. Inception Phase	1. Inception phase
Recurring events	2. Project management	10. Project management
	3. Liaison & information dissemination	8. Liaison & information dissemination
	4. Stakeholder engagement & administrative support, <i>including Annual Newsletters</i>	9. Stakeholder engagement & administrative support
Technical tasks	5. Water quality	2. Water quality model
	6. Water Resources Planning Model	3. Water Resources Planning Model
	7. Developing of operating rules	4. Operating rules
	8. Review the Crocodile West system water tariff*	5. Water tariff
	9. Update the Reconciliation Strategy	7. Reconciliation Strategy
	10. Support for the Strategy Steering Committee	11. Support for the Support Group
	Included in tasks 5 to 9	6. Reports
Additional Tasks	11. Ad hoc tasks requested by JA van Rooyen a. Assessment of the ultimate potential and future marginal cost of water resources in South Africa b. Water security strategy for South Africa	<i>New task</i>
	12. Crocodile West River catchment annual operating analyses*	<i>New task</i>
	13. Support to MCWAP	<i>New task</i>
	14. Training*	<i>New task</i>

* Tasks were subsequently cancelled as explained later.

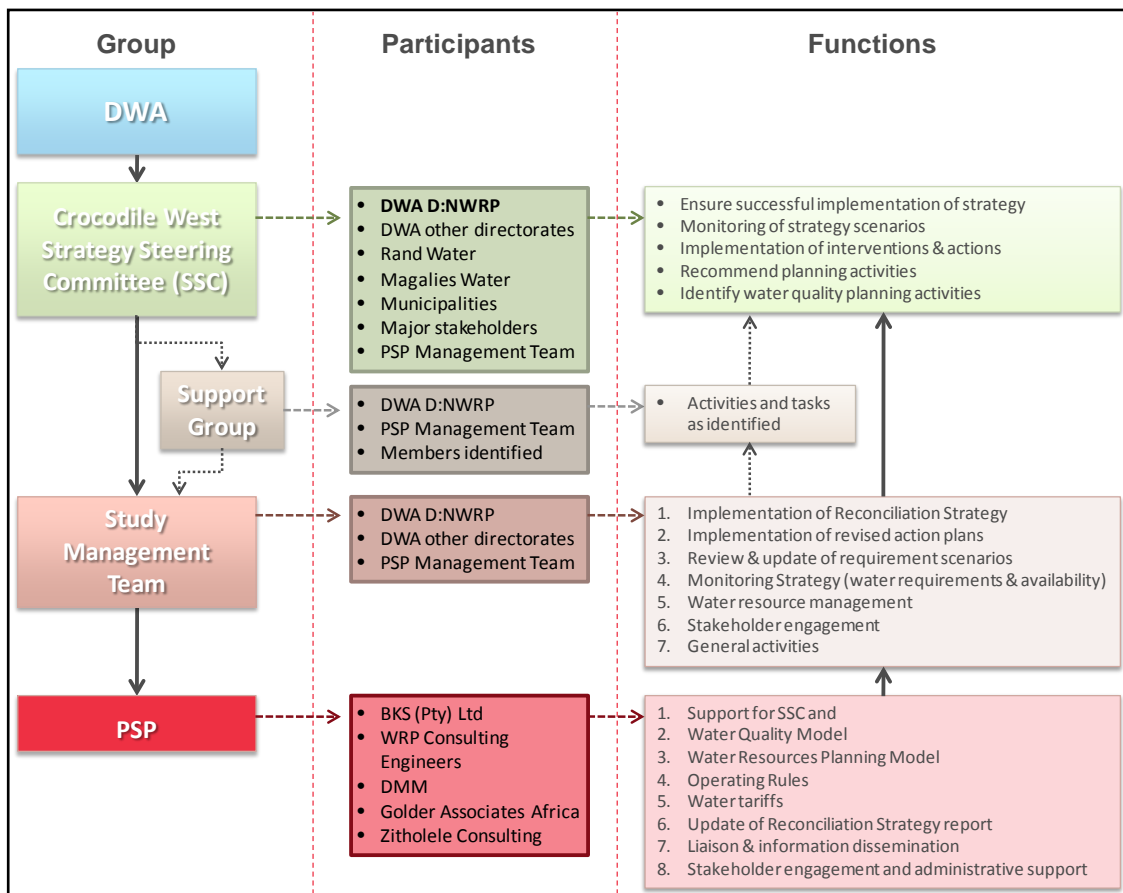
The high-level work breakdown structure given above is further described in **Section 2** to **Section 5**. These sections describe each task's objective, approach and deliverables.

Appendix A, the **study programme**, shows the schedule and duration of the tasks with a total study period of 36 months.

At the SMT meeting of 14 July 2010, the Client informed the PSP that a decision was taken by DWA that no Variation Orders (VOs) will be allowed on existing studies. Since some of the additional tasks, such as Tasks 11 and 13, were urgently required, the Approved Contract amount had to be redistributed and reprioritised between tasks defined in the original Scope of Work. Subsequently some of the tasks, as advised by the Client, were cancelled. Changes to the original Scope of Work are highlighted in the task descriptions below.

1.5 GOVERNANCE OF THE STUDY

The Strategy recommended a Strategy Steering Committee (SSC) to be established, with the monitoring and implementation functions, as shown in the figure below, which summarises the relationships and functions required to implement the Reconciliation Strategy. For the SSC to achieve its mandate, support is required in the form of the Study Management Team (SMT) which includes the Professional Services Provider (PSP).



2 TASK 1: INCEPTION PHASE

2.1 OBJECTIVES

The objective of the Inception Phase is to obtain agreement between the Client (DWA) and the PSP on the final tasks and work packages for the study and present the study execution plan in an Inception Report. The Inception Report describes the updated scope of work, the programme and the budget for the remainder of the complete Scope of Services.

2.2 INCEPTION MEETING

An Inception Meeting between the Client and the Study Team was held on 4 March 2010 at BKS. This was also the first Study Management Team (SMT) meeting. At the Inception Meeting the DWA Study Leader, Mr Nditwani, gave an overview of the Study and also highlighted additional work to be carried out as part of the Scope of Services. This additional work is listed and described in more detail in **Section 5**.

2.3 APPROACH

The Inception Phase will be lead by the Study Leader, Mr JD Rossouw, with input from all the Task Leaders, and will entail the following:

- ◆ Review of new information influencing the Strategy;
- ◆ Client liaison to discuss the proposal and obtain confirmation of study tasks; and
- ◆ Compilation of the Inception Report.

The following additional work was identified by DWA (additional to the original proposed scope of work) and has been incorporated in the Inception Report:

- ◆ Ad hoc tasks requested by Mr JA van Rooyen, Director: NWRP
 - Assessment of the ultimate potential and future marginal cost of water resources in South Africa; and
 - Water security strategy for South Africa.
- ◆ Integration of the Resources Classification
- ◆ Support to *Mokolo-Crocodile Water Augmentation Project (MCWAP)*

- ◆ Undertake the Annual Operating Analysis for the Crocodile West River System
- ◆ Provision of training for DWA personnel

2.4 DELIVERABLES

This *Inception Report* is based on the project proposal and additional tasks identified by DWA, which had been refined, where required, to provide a clear and concise description of how the project will be undertaken, what deliverables will be produced, and in which sequence. It provides detailed financial information and a summary study programme. This is therefore the document that aims to clarify outstanding aspects and uncertainties, address new issues or tasks identified during the Inception Phase, and list the anticipated deliverables.

3 RECURRING EVENTS

3.1 TASK 2: PROJECT MANAGEMENT (TASK LEADER: PIETER VAN ROOYEN)

3.1.1 Objectives

Ensure coordination of the Study Team and execution of the work through sound technical inputs and proper project management and financial control.

3.1.2 Approach

The success of the project execution will depend on the coordination of all study activities as well as accounting for the relevant external processes affecting the management of the water resources of the system. The Project Management task will therefore entail the following aspects:

- ◆ **Client liaison:** Liaison with the DWA Study Manager will include project management meetings, advising on important and difficult matters, keeping a record of project decisions and all contractual matters related to the Study Team and/or sub-consultants.
- ◆ **Coordination of the Study Team:** The Study Manager will be responsible for overall coordination, monitoring and performance control of the Study Team and will serve as the link with DWA.
- ◆ **Performance monitoring:** A performance monitoring system will be instituted whereby all key activities under each main task will be assigned milestone dates against which progress will be monitored. The system will allow for detecting potential issues at an early stage to enable remedial measures to be instituted to ensure that the study remains on course.
- ◆ **Financial control:** A financial control system, comprising an interactive spreadsheet model, will be used to monitor and manage budgeted vs. actual costs. Actual costs incurred will be correlated with completion targets to ensure compliance with progress, and whether corrective action is required.
- ◆ **Study administration:** Includes a secretariat, invoices, project filing.

3.1.3 Study Management Team (SMT)

The SMT Committee, chaired by the DWA Project Manager have convened to undertake the management of the study. The permanent members of the SMT are the Client, the

Study Team, the DWA Regional Offices and relevant DWA directorates. Regular progress meetings by the SMT, to monitor progress and expenditure against the programme and to discuss and clarify issues which might arise, have been provided for. These meetings will be held in the offices of BKS in Pretoria.

The Study Team will record proceedings of such meetings, make presentations at such meetings if required, distribute all agendas and minutes, and undertake other related administrative tasks that may be required. The Study Team shall keep an up-to-date record of all decisions taken during the execution of the study. The record shall identify the issues raised, findings of investigations and decisions taken.

3.1.4 Project Management Meeting (PMM)

At the second SMT meeting (15 April 2010), it was decided that all project contractual and administration matters will be handled in a separate meeting between the DWA Project Manager and the PSP, prior to each SMT meeting. The PMM is chaired by the DWA Project Manager.

3.1.5 Deliverables

- ◆ Progress Reports (maximum of 30 reports)
- ◆ Financial Reports (one with each invoice);
- ◆ “Record of Decisions” and “Record of Administrative Requests” to be updated continuously;
- ◆ Record of attendance of meetings; and
- ◆ Minutes of meetings, as required.

Due to budget limitations, as discussed in Section 1.4, most of the work for this task will be carried out during the a 16 month period, until June 2011. Thereafter the intensity of the task will reduce for the remainder of the study period. This is also evident in the projected cash flow provided in **Error! Reference source not found.**

3.2 TASK 3: LIAISON AND INFORMATION DISSEMINATION (TASK LEADER: HERMIEN PIETERSE)

3.2.1 Objectives

The Reconciliation Strategy requires the buy-in of decision makers of Governmental and other institutions to take up their respective responsibilities as defined in the Strategy recommendations, and also to align the Strategy with their planning initiatives.

3.2.2 Approach

The Study Team will prepare material to be distributed and presented at the Strategy Steering Committee, relevant Provincial Summits and on an *ad hoc* basis at the DWA Management and other meetings, such as Public Information Meetings, Water Forums, the System Operating Forum and the Strategy Steering Committee of the Vaal River System, municipalities, etc.

3.2.3 Deliverables

- ◆ Presentation material.
- ◆ Relevant technical documents.
- ◆ Record of communication, other than those within formal structures.

In addition to various reports described, other deliverables arising from this study which do not form part of the reports, such as presentations, maps, etc. on suitable scales, indicating all relevant detail and data and information collected during the study will be made available to the Client, if required.

3.3 TASK 4: STAKEHOLDER ENGAGEMENT AND ADMINISTRATIVE SUPPORT (TASK LEADER: ANELLE LÖTTER)

3.3.1 Objectives

Stakeholder engagement, underpinned by effective administrative support, is key to the successful implementation of the Strategy. Communication, sharing of information and engagement between members of the DWA, SSC, and PSP structures are vital (also refer to the figure in **Section 1.5**).

3.3.2 Approach

The PSP will be responsible for the logistics and arrangements of the **Strategy Steering Committee and other related meetings** that will be held at regular intervals. Invitations will be distributed to members together with a response sheet, an agenda as well as the relevant documents to be discussed at the meetings. Minutes will be distributed to members within two weeks of each meeting.

The activities:

- ◆ Confirm stakeholders from previous studies.
- ◆ Develop and upkeep of stakeholder database.

- ◆ Arrange SSC meetings.
- ◆ Disseminate information through meeting minutes, media releases, newsletters, etc.

Directly involved stakeholders will be informed of the study and its progress through the SSC meetings. Several other sectors of **stakeholders** (agriculture, industry, local government, domestic users) also need to be kept **informed and engaged** in the study. In our Proposal annual newsletters, media releases and electronic publication of information were proposed as means to communicate with stakeholders, but, as indicated, *were not costed*. During the Inception Phase it became evident that the following activities will be the most effective communication tools, and was provided for in the Inception budget:

a) Annual newsletter

The objective with the publishing and distribution of an Annual Newsletter to all stakeholders on the database is to maintain sound communication with interested parties and to facilitate information flow about the plans, activities and progress made with the study.

The first Annual Newsletter will be published between the first and second SSC meetings. The second Annual Newsletter will be published within 12 months from the date of the first newsletter. The objective of this newsletter will be to report on progress made and proposed future activities. The last Annual Newsletter is to be published at the end of the study period, reporting on achievements and successes of the study. The second and last newsletters will only be published if the budget allows this.

b) Media releases

To communicate, if relevant on the findings, progress made, future plans and how outcomes of the study may directly impact all water users. Newspaper articles may also be used to educate and make domestic water users aware of the water situation. It is anticipated to compile and distribute a news release after each SSC meeting to communicate the deliberations of the SSC and any newsworthy information for the public.

c) Public information meetings:

There are currently extensive public engagement undertaken through the EIA process of the *MCWAP* where the reconciliation strategy, and in particular the need for

additional water transfer from the Vaal River System, is communicated to all interested and effected parties. This process allows for comments and the raising of concerns on all aspects of *MCWAP* and therefore serves to inform the public of DWA's proposed water resource management interventions.

The SSC membership is inclusive of all the stakeholders involved in or responsible for water supply in the system as representative of their respective organisations. One of their functions will be to disseminate information from the SSC into their organisations and provide a channel for comments and feedback.

Given the above activities that are designed to inform and engage with stakeholders it is considered unnecessary for an additional dedicated public engagement process as part of this study. **During the Inception Meeting, it was agreed that public information meetings will not be held as a general means of conveying information.**

d) Electronic access to information:

Development and maintenance of a project web site (within the DWA website) is critical for the access of electronic information. All documents to be produced by the Study Team will be published on the DWA web site. The link to this site is <http://www.dwa.gov.za/projects>.

e) Linkages with other initiatives:

This study is not taking place in a vacuum. Information will be shared with other initiatives of the DWA, as well as Provincial and Local Governments, to ensure that the broadest range of people is aware of the study, its objectives and results.

3.3.3 Deliverables

- ◆ SSC agendas and minutes of meetings, invitation letters and reply sheets, attendance registers and name tags.
- ◆ SSC database of interested and affected parties.
- ◆ Upkeep of stakeholder details on overall project database.
- ◆ If budget allows, three editions of the newsletter are being planned which each will consist four to eight pages printed in full colour. It is anticipated that about 300 copies of each edition will be printed.
- ◆ Media releases will be compiled and released where relevant. Two releases are foreseen as a maximum.

- ◆ Provision of information in electronic format to DWA for publishing on the Departmental web site.

4 TECHNICAL TASKS

4.1 TASK 5: WATER QUALITY (TASK LEADER: TREVOR COLEMAN)

4.1.1 Task 5a: Water quality (salinity) model - WQT (Task Leader: Trevor Coleman)

a) Objectives

The objective for this task is to calibrate the water quality model (WQT) for total dissolved solids (TDS) and produce the start conditions for input into the WRPM.

b) Approach

The process of calibrating the WQT that was started during the recently completed *Crocodile West Reconciliation Strategy* study, undertook the following:

- key calibration points have been selected and the TDS concentration data patched to create monthly average concentrations for use in calibration exercise;
- schematics for the WQT have also been prepared based on the schematics used for the WRYM and the calibration points;
- available point source discharge information has been collected; and
- WQT has been set up for some of the sub-systems.

The following activities will be performed in the WQT for this study:

- liaison with WQT developers;
- prepare calibration data building on the work done during previous studies;
- review WQT schematics;
- set up WQT input files;
- calibrate the WQT model at the key points; and
- run the WQT model to determine the starting conditions in the WRPM.

The outcome of the previous water quality study emphasised the necessity to broaden the water quality modelling expertise in this country. It is therefore critical that the WQT manual be updated. Maintenance of this manual should also be a dynamic process. Expertise within the Study Team exists to address this very important deficiency. Knowledge transfer should also be addressed during the

execution of this task. No provision for the updating of the manual was included in the budget for this study.

c) Deliverables

- Calibrated WQT model for input into WRPM.
- Water quality report.

4.1.2 Task 5b: Water quality status assessment

Due to budget limitations, as discussed in Section 1.4, this proposed task, identified at SMT meeting no. 3 on 31 May 2010, has been suspended.

4.2 TASK 6: WATER RESOURCES PLANNING MODEL (TASK LEADER: JOHAN ROSSOUW)

4.2.1 Objectives

The objective of this task is to finalise the setting up and testing of the Water Resources Planning Model (WRPM). The WRPM will be used, *inter alia*, to analyse different potential future development scenarios within the Crocodile West River catchment as well as in the Lephalale area in the neighboring Mokolo River catchment. The WRPM will also be the decision support system to be used in the annual operating analyses for the Crocodile West River catchment. Provision has been made to include a link between the Crocodile West River catchment and the Mokolo River catchment.

4.2.2 Approach

The WRPM was initially set up as part of the *Crocodile West Modelling Study* and the *Crocodile West Reconciliation Strategy Study*. The activities involved in the WRPM for this study are listed below:

- ◆ Liaison with WRPM developers
- ◆ Finalise setting up of the WRPM
- ◆ Incorporate groundwater aquifers in the Lower Crocodile sub-catchment
- ◆ Incorporate water quality model output (from Task 5)
- ◆ Incorporate operating rules (from Task 7)
- ◆ Testing of the model (for both quantity and quality) – this could also include some model “calibration”
- ◆ Scenario analyses

The WRPM will be used to analyse scenarios that will impact on water availability and water quality in the Crocodile West River catchment. Provision was made to analyse

three scenarios, which will incorporate possible future water transfer to the Lephalale area to meet the growing water requirements, including transfer of treated effluent from the Vaal River system to the Crocodile West River catchment, if required.

Urbanisation has significantly altered the flow regime of the Crocodile West River. All proposed scenarios will report on compliance with the ecological water requirements (EWR). This is especially relevant below Hartbeespoort Dam (site EWR3) and at Vlieëpoort, at sites EWR7 and EWR8 in the Crocodile West River, upstream and downstream of the most likely abstraction point for transfers to the Lephalale area.

The Study Team proposes that the existing (outdated) user manual for the WRPM be updated, using the Crocodile WRPM configuration as test sample in parallel to this task. The team responsible for the updating of the WRPM should work closely together with this Study Team to achieve this. **No provision** for the updating of the manual was included in the budget for this study.

The WRPM will, after setup and testing have been completed, also be used to confirm water balances at different time intervals as reported in the Crocodile West Reconciliation Strategy Report: Version 2 (see **Task 9**).

4.2.3 Deliverables

- ◆ Updated WRPM setup (schematics and data files), also to be used for Task 15
- ◆ Water Resources Planning Model report

Due to budget limitations, as discussed in **Section 1.4**, the WRPM will be used to verify water balances, as reported on as part of Version 2 of the Strategy during September 2010, towards the end of 2010. During the first half of 2011, after completion of the water quality task, the water quality data files will be included in the WRPM and an update of the Strategy Version 2 will be compiled which will include specifics on water quality.

4.3 TASK 7: DEVELOP OPERATING RULES FOR THE SYSTEM (TASK LEADER: PIETER VAN ROOYEN)

4.3.1 Objectives

The Water Resource Planning Model (WRPM) compiled in **Task 7** will be applied to evaluate alternative operating scenarios through simulation analyses. The objective is to develop the optimum operating rules that can be applied in the long-term planning

analysis and provide input into the annual operating analysis study which Directorate: Water Resource Planning Systems will manage.

The emphasis will be on the five major dams in the catchment, Hartbeespoort, Roodekopjes, Roodeplaat, Klipvoor and Vaalkop dams. The other dams in the catchment will be treated as stand-alone dams and will not be used to support downstream water requirements not allocated to these dams specifically.

4.3.2 Approach

- ◆ **Review existing operating rule:** Information on the existing operating rules will be obtained from reports and through discussions with relevant DWA officials. Both water supply and water quality related rules will be summarised and tested.
- ◆ **Evaluate and define operating rule scenarios and criteria:** The information gathered from the existing operating rules will be evaluated in context of the results from the previous system analysis, hydrology, return flows and regulating storage (dams) with the aim to formulate alternative operating rules scenarios for analyses. Criteria for operating rule evaluation will be proposed, including assurance of supply, restricted reservoir drawdown needs, water quality based flow requirements and operating costs. Consideration will also be given to the potential future water transfer to the Lephalale area and from the Vaal River system. A selection of rule scenarios will be identified for analysis. The proposed criteria and rule scenarios will be presented to the Client for consideration.
- ◆ **Configure operating rule in WRPM and undertake analyses:** The WRPM will be configured to simulate the selected rule scenarios, checks will be performed to ensure the intended rules are simulated correctly. Stochastic analyses of 201 sequences will be carried out and box plots of reservoir storage, selected demand centres, curtailments and total storage will be produced and evaluated for correctness. If required adjustments to the initial rule scenarios will be analysed and a final rule scenario will be proposed.
- ◆ **Present rule scenario analysis to the Client for consideration and comments, and document final selected rules.**

4.3.3 Deliverables

- ◆ WRPM data files for input into Task 6.
- ◆ Report describing the operating rule development methodology and selected operating rule.

- ◆ Graphical results of the system behaviour based on selected operating rules (which will be included in the report).

4.4 TASK 8: REVIEW THE WATER TARIFF FOR THE SYSTEM (TASK LEADER: PETER RAMSDEN)

Due to budget limitations, as discussed in **Section 1.4**, this Task has been suspended. For completeness the original Scope of Works is included below.

4.4.1 Objectives

A water use tariff financial model and proposed water use tariffs for each user group (calculated in accordance with the national water pricing strategy) will be developed for the Crocodile West River catchment.

4.4.2 Approach

The DWA National Water Pricing Strategy provides for different approaches depending on whether the infrastructure is privately or State funded. The Pricing Strategy also differentiates between water use tariffs for domestic and industrial users, agricultural users, and afforestation. A spreadsheet based financial model will be developed and tariffs will be calculated and proposed for the above water use categories.

Waste discharge charges are provided for in the Pricing Strategy, but have not yet been implemented by DWA. DWA is, however, currently evaluating a tender for the pilot implementation of these charges in three catchments. The study team will liaise with the Consultants who are appointed to develop the waste discharge methodology and apply a consistent methodology (selection of pollutants to be charged etc.) when determining waste discharge charges for the Crocodile West River catchment.

4.4.3 Deliverable

Report including proposed water use tariffs for each user group.

4.5 TASK 9: UPDATE THE RECONCILIATION STRATEGY (TASK LEADER: PIETER VAN ROOYEN)

4.5.1 Objectives

To monitor and assess actual developments (in particular water requirements and return flows) for the purpose of regularly reviewing the continued applicability of the Strategy;

and adjustment of the Crocodile West River Strategy Report: Version 1, which was prepared as part of the *Crocodile West Reconciliation Strategy Study* during May 2008.

4.5.2 Approach

This task will include updating mining water requirements, urban water requirements (Johannesburg and Tshwane Metros), water transfers and the accompanying urban return flows to re-assess the water balance. The irrigation water requirements, calculated as part of the *Crocodile West Reconciliation Strategy Study*, will be included as the irrigation water requirements for this task. Updated water requirements and availability for the proposed development in the Lephalale area (in the neighboring Mokolo River catchment) will be taken into account to calculate the water balances for the combined Crocodile/Mokolo system to be able to determine if, when, how much and from where water needs to be transferred in addition to the surplus available water in the Crocodile West River catchment to meet the growing water requirements in the Lephalale area. The original ToR made allowance for the Strategy to be updated twice during the course of this project, in 2010 (Version 2) and in 2012 (Version 3), but due to budget limitations, discussed in **Section 1.4**, the Strategy will only be updated once, probably by mid-2011.

The annual water balance for the Crocodile West and the Mokolo-Crocodile was updated and a presentation of the results was made to some DWA staff members on 31 August 2010. This information was provided to the team performing the Maintenance of the Vaal River Reconciliation Strategy Study with specific reference to the required raw water transfer of water from the Vaal River System.

In preparation for the second SSC meeting to be held in March 2011 scenario analysis (using the WRPM) and additional water balance scenarios will be carried out to evaluate alternative reconciliation options.

A key observation from the initial water balances indicates that there will be excess water available in the Crocodile West River System over the long term due to the increasing return flows from the urban areas. Options will be formulated for utilising this excess as part of the update of the reconciliation strategy.

Specific attention will be given to the planned water schemes identified for water supply provision to areas north of Klipvoor Dam as well as options to transfer water from Hartbeespoort Dam to the Rustenburg and surrounding areas. A review of the All Town Reconciliation Strategies will be undertaken to ensure coherence and appropriate

assumptions are made with respect to groundwater availability and water requirement scenarios.

4.5.3 Deliverable

- ◆ Updated Reconciliation Strategy Report Version 2.
- ◆ Executive Summary.

4.6 TASK 10: SUPPORT TO THE STRATEGY STEERING COMMITTEE (TASK LEADER: PIETER VAN ROOYEN)

4.6.1 Objectives

- ◆ Identify and undertake evaluations of options for reconciliation (typical reconnaissance investigations).
- ◆ Prepare presentation material on proposed solutions for the Study Steering Committee.

4.6.2 Approach

The ToR did not specify specific detail requirements for this generic task. It is understood that the scope of work will be defined during the course of the study based on the needs of the Client and the SSC. In order to demonstrate the Study Team's approach, typical tasks that can form part of support to the SSC are briefly described in the following sections.

- ◆ **Water Resource System Analyses:** Water resource scenario simulations (quantity and quality related) using the WRPM will form the basis of the water resource analysis. The results will focus on projected curtailment levels; behaviour of the system; monthly TDS concentrations and inter-basin transfers and supply to water users.
- ◆ **Intervention planning of options:** This task would involve assessing the viability of interventions such as WC/WDM measures, dams, transfer schemes and re-use options to mention a view. The investigations may include engineering investigations of WC/WDM; implementation timelines and schedules and economic comparisons.
- ◆ **Evaluations:** It is envisaged that specific evaluations could be required to assess the environmental, economic and water quality consequences of water resource management measures.
- ◆ **Review and assess environmental and social impacts:** Key environmental and social issues for any planned intervention or action could be identified through desktop investigations Potential impacts associated with environmental and social activities

will then be assessed to determine their level of risk. Recommendations for a full impact assessment and further specialist assessments will be made.

4.6.3 Deliverables

- ◆ Reports on task evaluations.
- ◆ Presentation material to SSC.

*It should be noted that a preliminary indicative budget has been allocated to **Task 10**. The actual work and expenditure for the proposed evaluations/analyses will be agreed with the Client.*

5 ADDITIONAL TASKS

5.1 TASK 11: AD HOC TASKS (TASK LEADER: JOHAN ROSSOUW)

5.1.1 Task 11a: Assessment of the ultimate potential and future marginal cost of water resources in South Africa

a) Objectives

The objective is to give an overview of the future water resources and water balance situation in South Africa, which should serve as input to national spatial and sectoral development planning. It includes the identification and assessment of all remaining large scale water resource development options as well as the determination of the ultimate water resources potential for South Africa.

b) Approach

As a general approach, all potential sources of water that could still be developed, will be identified. In order to facilitate an initial and indicative ranking of developments and interventions, all the options will be evaluated on a common basis. Assessments will also be made of the quantities of water that could be made available through the various options and of the lead times for implementation, to facilitate the broad reconciliation of the potential resources with the expected future requirements for water. From this, estimates will be made of the ultimate capacity of South Africa's water resources, and by when the resources are likely to reach full utilisation in the respective geographic areas.

Use will mainly be made of existing information from previous studies and other sources, which will all be processed to common denominators.

c) Deliverables

A report with graphics, documenting the options for water resource development and future water balances for key geographic growth areas. The unit costs of water and unit electricity requirements will be given for each of the development options. Estimates will be given of the ultimate water resource potential in the respective regions, and of the costs associated with the development options.

Presentations on the above will be made to selected groups and organisations.

The final report for this task has been completed for approval by the Client on 22 September 2010.

5.1.2 Task 11b: Water security strategy for South Africa

a) Objectives

To draft a Water Security Strategy for South Africa.

b) Approach

Clearly define Water Security and assess what a Water Security Strategy should consist of and contain.

Determine the various components of Water Security and assess these in terms of the current situation in South Africa. Identify possible remedial measures and strategies to ensure sustainable overall water security in future.

c) Deliverable

A report that documents the relevant background and sets out a draft Water Security Strategy and recommended actions. A draft report has been compiled for this task. The report will, however, not be updated to a final report.

5.2 TASK 12: ANNUAL OPERATING ANALYSIS

During the inaugural Management Meeting it was identified that a study initially proposed by the Directorate: Water Resource Planning Systems for performing the Annual Operating Analysis (AOA) on the Crocodile West River System has substantial synergies with this Study. The Client therefore requested that a further task be included in the Inception Report to undertake the additional work necessary for performing the AOA as part of this study. However, due to budget limitations as discussed previously, this task was cancelled and will be carried out in a separate study by Directorate: Water Resource Planning Systems. A minimal amount was spent on preparation for this task.

5.3 TASK 13: SUPPORT TO MOKOLO-CROCODILE WATER AUGMENTATION PROJECT (MCWAP) (TASK LEADER: PIETER VAN ROOYEN)

5.3.1 Objectives

At a start-up meeting, held at the BKS Offices in Hatfield, Pretoria on 4 March 2010, it was highlighted that the Study Team needs to support the Study Team of the *Mokolo-Crocodile Water Augmentation Project* (MCWAP) being executed by Aurecon for the DWA, Directorate: Options Analysis. Follow up meetings were held at the BKS offices on 18 and 19 March 2010. This task has been completed and a draft report was submitted to DWA during June 2010.

The MCWAP is undertaken to investigate options of water supply to power stations and petro-chemical developments in the Lephalale area in the Mokolo River catchment.

The support for the *MCWAP* Study Team was conducted to support the EIA process of the MCWAP and done primarily with the Water Resources Yield Model (WRYM). The work was carried out to provide information on four aspects with regards to the transfer of water from the Crocodile to Lephalale. The four main aspects which were investigated are:

- ◆ What will the effect of transferring water to the Lephalale area be on the existing irrigators within the Crocodile West catchment?
- ◆ How will the water levels in Hartbeespoort Dam fluctuate because of the possible water transfers?
- ◆ What volume of water needs to be brought into the Crocodile River catchment from the Vaal to augment the water supply to the Lephalale area?
- ◆ What additional yield can be obtained by the raising of Klipvoor Dam and/or construction of a dam at Vlieëpoort in the Lower Crocodile sub-catchment?

The following sub-tasks were carried out:

a) *Task 13a: Inclusion of groundwater aquifers in the Lower Crocodile sub-catchment*

It was requested by DWA that the modelling of the irrigation abstraction in the Koedoeskop and Makoppa areas in the Lower Crocodile sub-catchment be changed to incorporate the groundwater aquifers originally used in the *Crocodile West Catchment Study*.

This task entailed the following

- Include the aquifers at Koedoeskop and Makoppa into the Lower Crocodile sub-catchment in the WRYM.
- Adjust the abstraction points of the irrigation at Koedoeskop and Makoppa accordingly.
- Conduct a calibration and verification exercise to confirm the correct operation of the new WRYM setup with the aquifers included. This will be done by comparing irrigation water abstractions and supply, flows into the Limpopo River and losses for the new WRYM setup against those of the recent WRYM setup utilised for the *Crocodile West Modelling Study* as well as the older setup of the *Crocodile West Catchment Study*, for which the aquifer model was originally developed).

b) Task 13b: Change irrigation water requirements in the WRYM from irrigation blocks to monthly values

Irrigation water requirements have been included as irrigation blocks in the WRYM setup as part of the Crocodile West Modelling Study. These irrigation blocks were changed to monthly irrigation abstractions (min-max channels) for the stochastic analysis to be able to accurately assign the required allocation of water to the irrigators in the WRYM.

c) Task 13c: Determine transfer requirements while maintaining assurance of supply to existing users

The following irrigator groups were the main focus of the assessment:

- Hartbeespoort GWS.
- Crocodile West Irrigation Board.
- Makoppa irrigators.

The water requirements of the three irrigation areas were determined as follows:

- Hartbeespoort GWS: Irrigation water requirements for the Hartbeespoort GWS will be based on the quota of 6 200 m³/ha/a, with the associated official area. Assurance of supply assumed to be according to the standard 70/30 rule that applied to government water schemes.
- Crocodile West Irrigation Board: The following alternatives of water requirements for the Crocodile West Irrigation Board will be evaluated:
 - Alternative A: Irrigation water requirements based on a quota of 6 000 m³/ha/a without Roodekopjes Dam.
 - Alternative B: Irrigation water requirements based on a quota of 8 000 m³/ha/a with Roodekopjes Dam.

For both Alternatives A and B, the assurance of supply was according to the White Paper (100% of the allocation for 70% of the time, 70% of the allocation for the other 30% of the time - this is equivalent to 91% assurance of supply). The additional allocation of 2 000 m³/ha/a of water as a result of the construction of Roodekopjes Dam (Alternative B) was supplied when available, and no specific assurance of supply was specified.

Makoppa: Irrigation water requirements were based on the 1998 irrigated areas measured by satellite imagery (as calculated as part of the Crocodile West Modelling Study) plus 15%. No assurance of supply specified.

The assurances of water supply that the irrigators are entitled to were determined where not known. This assurance of supply then needs to be maintained for future scenarios while transferring water to the Lephhalale area.

The assurances of supply to the irrigators that were determined are:

- **Crocodile West Irrigation Board:** The assurance of the additional 2 000 m³/ha/a was determined by evaluating both Alternatives A and B (without and with Roodekopjes Dam) at a 1981 level and calculating at what assurance the additional 2 000 m³/ha/a can be supplied.
- **Makoppa irrigation area:** The assurance of water supply were calculated at the 1998 development level, as that which can be supplied by all the incremental flows below Klipvoor, Roodekopjes and Vaalkop dams, i.e. the incremental flows will be allocated to the Makoppa irrigators and their assurance of supply determined accordingly. These incremental flows that are not used by the Makoppa irrigators will be available for transfer to Lephale.

In summary the following scenarios were conducted to assess the existing irrigation in the Crocodile West River catchment, and determine the volume of water that can be transferred to the Lephale area:

- **Scenario 1 A & B:** At 1981 development level – to determine the assurance of supply of the additional 2 000 m³/a/a to the Crocodile West Irrigation Board.
- **Scenario 2:** At 1998 development level – to determine the water supply volume and assurance of supply to the Makoppa irrigators.
- **Scenario 3:** At 2010 development level – to determine current water supply to the irrigators.
- **Scenario 4:** At 2030 development level – to determine the volume of water that can be transferred from the Crocodile to Lephale while maintaining the water supply to the existing irrigators before the transfer, as determined in Scenarios 1 and 2. This scenario will also be used to determine the volume of water that needs to be brought into the Crocodile River catchment from the Vaal River system to augment the transfer of water to the Lephale area so that the water requirements in the Lephale Area are supplied at a 99.5% assurance level (again while maintaining the water supply to existing irrigators as determined in Scenarios 1 and 2).

d) Task 13d: Determine the impact of water transfer to the Lephale area on the water levels at Hartbeespoort Dam

Long-term stochastic analyses (101 sequences) were executed for Hartbeespoort Dam with the WRYM for the following two scenarios:

- **Scenario 1:** 2010 upstream and downstream requirements and return flows, with water supply from Hartbeespoort Dam to the Hartbeespoort GWS as well as supplementation to Vaalkop Dam. No support were included from

Hartbeespoort Dam to the Crocodile West Irrigation Board – this is the status quo scenario.

- **Scenario 2:** As for Scenario 1, but including the abstraction of the long-term stochastic yield from Hartbeespoort Dam at
 - 99.5% assurance of supply
 - 98% assurance of supply

Water level trajectories at Hartbeespoort Dam were plotted for the scenarios analysed above.

e) Task 13e: Determine additional yield available from a raised Klipvoor Dam and/or a dam at Vlieëpoort

Long-term stochastic analyses (at 99.5% assurance of supply for 201 stochastic sequences) were executed for a raised Klipvoor Dam on its own and a Vlieëpoort Dam on its own with the WRYM for the 2010 development level.

5.3.2 Deliverables

- ◆ WRYM configuration data files for the scenarios analysed.
- ◆ Report describing the analysis and results.
- ◆ Inputs for presentation material for use by the MCWAP Study Team.

5.4 TASK 14: TRAINING

During the 2nd SMT meeting of 15 April 2010, the Client requested for the inclusion of training on the WRYM, WRPM and WQT models. Due to budget limitations this task will not be included within this Study.

5.5 INTEGRATION OF RESOURCES CLASSIFICATION

During the Inception Phase the "Integration of the resources classification" was highlighted as a component that needs to be considered as part of this study. The final meeting of the *Crocodile-Marico Reserve Study* (held on 12 May 2010) indicated that the recommended classes are in accordance to the Present Ecological State, which implies that the current flow regimes in the rivers are acceptable. It was therefore concluded that no additional analyses would be required as part of this study for the purposes of the integration of the resources classification.

6 STUDY TEAM

6.1 TEAM COMPOSITION

The study team comprises the consultants BKS (Pty) Ltd, WRP Consulting Engineers (Pty), Golder Associates Africa, Zitholele Consulting and DMM Development Consultants cc. In addition to the firms in association, a number of sub-consultants and individual specialists are utilised on specific technical tasks. The composition of the proposed Study Team attests of the highest level of experience and professional capacity.

6.2 STUDY MANAGEMENT

During the tender phase, Dr MS Basson was identified as Study Leader. Dr Basson has recently, however, retired and was replaced by **Mr Johan Rossouw** from BKS. Dr Basson will still be available to participate and could specifically be involved with Task 11, the update of the Reconciliation Strategy as well as specialist reviewer.

Mr Pieter van Rooyen from WRP Consulting Engineers is the Study Manager. He will manage and co-ordinate the technical tasks. **Ms Hermien Pieterse** from BKS is Deputy Study Manager. She will assist with the co-ordination on the various activities, and is also responsible for the day-to-day management of the study.

The **Study Management Team** (Johan Rossouw, Pieter van Rooyen and Hermien Pieterse) will be responsible for liaison with the Client, the general supervision of the Study and providing direction on all tasks. Their collective previous experience in water resources planning and management studies as well as specific intimate knowledge of the study area will ensure that they provide the necessary direction to the Study Team in undertaking the Study and enable efficient liaison with representatives of the Client.

6.3 TASK LEADERS

The Task Leaders, listed in **Table 6.1**, will manage the various tasks. They are responsible for directing and co-ordinating the personnel working on each task, as well as ensuring technical correctness and applicability. They will ensure that each task is completed within budget and on time, and to acceptable standards. Their responsibility is also to provide timeous and adequate warning of any problems encountered, which can either delay the study or result in budget overruns.

Table 6.1 Task Leaders

Task leader	Company	Task description
Rossouw JD	BKS	1. Inception phase
van Rooyen PG	WRP	2. Project management
Pieterse HS	BKS	3. Liaison & information dissemination
Lötter A	Zitholele	4. Stakeholder engagement & administrative support
Coleman T	Golder	5. Water quality
Rossouw JD	BKS	6. Water Resources Planning Model
van Rooyen PG	WRP	7. Developing of Operating rules
Ramsden PAA	BKS	8. Review the Crocodile West system water tariff (suspended)
van Rooyen PG	BKS	9. Update the Reconciliation Strategy
Rossouw JD	BKS	10. Support for the Strategy Steering Committee
Rossouw JD	BKS	11. Ad hoc tasks requested by DWA a. Marginal cost of water b. Water security
Rossouw JD	BKS	12. Annual Operating Analyses (suspended)
van Rooyen PG	WRP	13. Support to MCWAP
van Rooyen PG	WRP	14. Training (cancelled)

6.4 STUDY TEAM

Current members of the Study Team and their HDI status are listed in **Table 6.2.:**

Table 6.2 Team members and HDI status

Name	Company	Position in Study Team	HDI
Basson, MS	BKS	Specialist/Reviewer	White male
Combrinck A	BKS	Key Support	White female
Gallagher LC	BKS	Support	White female
Reynders T	BKS	Project Administrator	White female
Schroder JH	BKS	Key support: Water resources	White male
Steenkamp M	BKS	GIS expert	White male
Teurlings P	BKS	Specialist: Environmental	White male
van Niekerk E	BKS	Specialist Hydrologist	White female
Whiteman S	BKS	Support: Administration	White female
Mnguni DM	DMM	Key support	Black male
Herold C	Golder	Specialist	White male
Maletse O	Golder	Support	Black female
Moodley P	Golder	Key support	Black female
van Niekerk A	Golder	Key support	White male
Jeleni A	WRP	Key support	Black male

Name	Company	Position in Study Team	HDI
Maré HG	WRP	Key support	White male
Seago C	WRP	Key support	White female
Swart S	WRP	Key support	White female
Talanda C	WRP	Key support	White male
Joubert A	Zitholele	Key support	White male
Mnqokoyi P	Zitholele	Support	Black female

** HDI members*

Appendix B shows the organisational and task breakdown structure. A full schedule of the human resources to be used on the project is provided in the **Appendix C**.

6.5 HDI COMPONENT

Building capacity of historically disadvantaged individuals (HDIs) in the fields of water resource planning and development is viewed as an integral part of the study. Capacity building entails giving HDIs the requisite practical exposure and background training to be able to participate meaningfully in the study.

7 COST ESTIMATE

CONTRACTUAL MATTERS

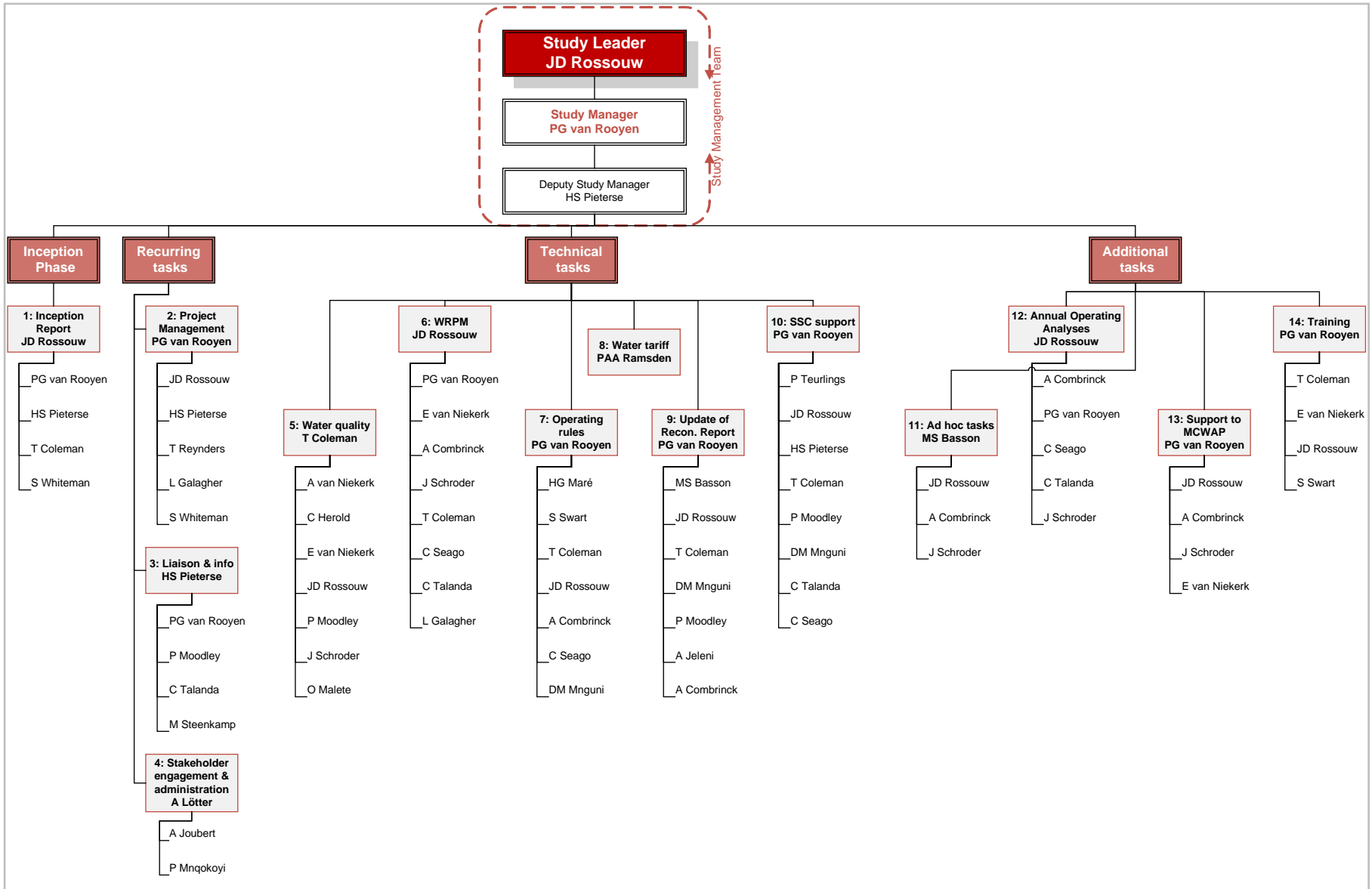
Appendix A

Study programme

Appendix B

Organisational and task breakdown structure

Support to the Implementation and Maintenance of the Reconciliation Strategy of the Crocodile West Water Supply System
Inception Report



Appendix C

Human resources to be used

#	Task description	Person	Company				
1	Inception	Basson MS	BKS				
		Van Rooyen PG	WRP				
		Pieterse HS	BKS				
		Rossouw JD	BKS				
		Whiteman S	BKS				
		Steenkamp M	BKS				
2	Project Management	Van Rooyen PG	WRP				
		Rossouw JD	BKS				
		Pieterse HS	BKS				
		Gallagher LC	BKS				
		Whiteman S	BKS				
		Reynders T	BKS				
		Basson MS	BKS				
3	Liaison & information	Pieterse HS	BKS				
		Van Rooyen PG	WRP				
		Steenkamp M	BKS				
		Moodley P	Golder				
		Talanda C	WRP				
		Rossouw JD	BKS				
4	Stakeholder & administrative support	Lötter A	Zitholele				
		Joubert A	Zitholele				
		Mngokoyi P	Zitholele				
		Lötter A	Zitholele				
		Joubert A	Zitholele				
5	Water quality	Coleman T	Golder				
		Herold C	Golder				
		Malete O	Golder				
		Moodley P	Golder				
		Rossouw JD	BKS				
		Van Niekerk A	Golder				
		van Niekerk E	BKS				
6	WRPM	Rossouw JD	BKS				
		Combrinck A	BKS				
		van Niekerk E	BKS				
		Schroder JH	BKS				
		Van Rooyen PG	WRP				
		Talanda C	WRP				
		Gallagher LC	BKS				
		Coleman T	Golder				
7	Operating rules	Van Rooyen PG	WRP				
		Swart S	WRP				
		Seago C	WRP				
		Maré HG	WRP				
		Mnguni DM	DMM				
		Rossouw JD	BKS				
		Combrinck A	BKS				
		Coleman T	Golder				
8	Water tariff						
	Ramsden P	BKS					
9	Reconciliation Strategy Update	Rossouw JD	BKS				
		Van Rooyen PG	WRP				
		Moodley P	Golder				
		Coleman T	Golder				
		Mnguni DM	DMM				

#	Task description	Person	Company				
		Combrinck A	BKS				
		Jeleni A	WRP				
		Schroder JH	BKS				
		Steenkamp M	BKS				
		Seago C	WRP				
		Talanda C	WRP				
10	Support to SSC						
		Rossouw JD	BKS				
		Van Rooyen PG	WRP				
		Pieterse HS	BKS				
		Coleman T	Golder				
		Moodley P	Golder				
		Seago C	WRP				
		Teurlings P	BKS				
		Basson MS	BKS				
11	Ad hoc tasks: Marginal cost of water & Water Security						
		Basson MS	BKS				
		Rossouw JD	BKS				
		Combrinck A	BKS				
		Schroder JH	BKS				
		Van der Westhuizen JLD	BKS				
		Whiteman S	BKS				
		van Niekerk E	BKS				
		Gallagher LC	BKS				
		Reynders T	BKS				
12	Annual operating analyses						
		Rossouw JD	BKS				
		Combrinck A	BKS				
		Schroder JH	BKS				
13	Support to MCWAP						
		Van Rooyen PG	WRP				
		Rossouw JD	BKS				
		Combrinck A	BKS				
		Schroder JH	BKS				
		van Niekerk E	BKS				
14	Training						
TOTAL							