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RESILIM : Resilience in the Limpopo River Basin Program

# Resilience in the Limpopo Basin: the Potential Role of the Transboundary Ramotswa Aquifer

Stakeholder Inception Report

Implemented by:

IWMI International Water Management Institute

CGIAR Research Program on Water, Land and Ecosystems

In partnership with:

University of Botswana

XRI

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# *Resilience in the Limpopo Basin: the Potential Role of the Transboundary Ramotswa Aquifer (RAMOTSWA)*

*DRAFT STAKEHOLDER INCEPTION REPORT*

30 Nov 2015

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## 1. INTRODUCTION

This report serves as the Inception Report for the stakeholders of the **Resilience in the Limpopo Basin: the Potential Role of the Transboundary Ramotswa Aquifer** project - shortly denoted **RAMOTSWA**. RAMOTSWA is a project, of which the first phase is co-funded by RESILIM (Resilience in the Limpopo Basin)[1], a USAID (United States Agency for International Development)-funded program, and the CGIAR (Consultative Group on International Agricultural Research) Research Program on Water, Land and Ecosystems (WLE) led by IWMI, the International Water Management Institute. Project Phase 1 runs from **28 July 2015 to 27 Feb. 2017**. A second anticipated 3-year phase of the Project (RAMOTSWA-Phase 2) is presently proposed for funding to the US Global Development Lab.

### 1.1 Preamble

RESILIM supports the riparian countries of the basin (Botswana, Mozambique, South Africa, Zambia) in their efforts to improve shared management of water and ecosystem resources and equitably address the economic, environmental, and social needs of each of the countries, thereby enhancing the resilience of the ecosystems and the people.

The overall objectives of the RESILIM program are:

1. Reduce climate vulnerability in the Limpopo River Basin
2. Improve the conservation of biodiversity and the sustainable management of high priority ecosystems
3. Build the capacity of stakeholders in the basin to sustainably manage water and ecosystem resources

The Joint Permanent Technical Committee on Water (JPTC) between Botswana and South Africa and under LIMCOM expressed interest in focusing on shared aquifers as part of their previous engagement with RESIILIM. Furthermore, IWMI had preliminary consultations with stakeholders from Botswana and South Africa in Oct. 2013, as part of an ongoing project on the Stampriet Transboundary Aquifer (TBA) shared between Botswana, Namibia, and South Africa[2]. The response and interest was very positive. Based on this confirmed demand, IWMI and RESILIM together with the national partners initiated a process of project conceptualisation and further consultations, which confirmed the favourable conditions on both sides of the border for pursuing the project. The Ramotswa Aquifer had already been identified as one of the critical ones in the Southern Africa region requiring imminent attention and joint approaches (Davies et al., 2013; SADC, 2009). IWMI has supported the mapping of transboundary aquifers in Africa, and reviewing conditions for their management (Altchenko and Villholth, 2013), and developing training materials on groundwater management for the River Basin Organisations in Africa[3].

Transboundary aquifers are progressively receiving more attention from the regional development partners and donors. SADC has a Strategic Action Plan 2011-2015, which explicitly mentions the

[1] Chemonics as the contracting party for RESILIM, funded by USAID

[2] Groundwater Resources Governance: Assessment of the Stampriet Aquifer, funded by Swiss Agency for Development and Cooperation and implemented by UNESCO-IHP
http://en.unesco.org/events/groundwater-resources-governance-assessment-stampriet-aquifer

[3] http://www.un-igrac.org/special-project/capacity-bulding-groundwater

Program on ***Groundwater Management and Development***, and a component under this on ***Transboundary Aquifer Management*** (SADC, 2010). SADC, with support from the World Bank, is establishing a regional Groundwater Management Institute at the Institute for Groundwater Studies at the University of the Free State in Bloemfontein, South Africa. This institute will be coordinating and supporting regional research and management on groundwater and in particular transboundary aquifers.

The **RAMOTSWA** addresses the RESILIM objectives by critically examining the role and options that the freshwater dolomite Ramotswa transboundary aquifer offers in terms of adaptation to climate variability and human induced changes, while preserving and enhancing the resource and associated ecosystems through transboundary and local management.

**1.2 Background**

Water is essential to economic development, biodiversity conservation, resilience of ecosystems, and population health and welfare in the Limpopo Basin. Managing the water resources to balance the demands of these needs is challenging, especially as populations grow and climate becomes more variable. The trade-offs of demands on water resources are further complicated in this transboundary river basin where multiple countries regulate, compete for, and depend on the same shared water resources.

Linked to the surface water resources of the Limpopo River, major shared (transboundary) groundwater resources exist in the region. These could support sustainable development, drought and flood resilience, urban expansion as well as small-scale agriculture if properly and conjunctively developed, shared, recharged, and managed as part of ongoing joint collaboration between the states. However, historically, the underground water resources have been accorded less attention as part of international, integrated and conjunctive water development planning, and if developed, their development has been approached unilaterally, by each state individually without due recognition of the transboundary character and potential implications of their use.

The RAMOTSWA project focuses on one of the most important shared aquifers in the Limpopo Basin, the Ramotswa Aquifer, shared between Botswana and South Africa. The project proposes to develop a scientifically informed, integrated and participatory strategy for how to solve some of the demographic, institutional, and climate-related water issues of the region, with a focus on what the internationally shared aquifer can provide in terms of sustainable, equitable and socially acceptable solutions. The project will also develop partnerships, experience, and tools to allow and enhance further cooperation on TBAs in the region.

RESILIM has provided funds for the first phase of RAMOTSWA, which entails the development of a better understanding of the aquifer and the socio-economic context of the greater Ramotswa Transboundary Aquifer Area (RTBAA) as well as a draft joint strategy for its development and management.

**1.3 Current Context in Botswana and South Africa**

Water is quickly becoming a limiting factor for development in the border region between South Africa and Botswana. The Botswana side[4] is dominated by urban development with high economic growth and population increase in and around the capital Gaborone, while the South African side[5] is

[4] More or less coinciding with the Southern and South-East Districts, including the greater Gaborone area
[5] In the Crocodile-West and Marico Water Management Area in North-West Province

characterized by stalling economic growth, mostly rural settlements with unaddressed issues of water supply needs for basic and economic needs. The area is semi-arid, with a mean annual rainfall of 400 to 600 mm, but dominated by seasonal and irregular rainfall. Climate projections foresee uncertain trends in rainfall volumes in the future, but a likelihood of increase in intensity of rainfall events (Taylor et al., 2009). Floods are recurrent with the latest major flood occurring on the South African side in early 2009.

While infrastructure so far has kept up with urban growth in Botswana, through the Gaborone Dam and a couple of long-distance water transfer schemes from northern parts of the country as well as from South Africa, the situation is presently dire with a recurrent escalating drought, further exposing the exigency of growing water demands and under-performing water management and disaster management systems. The drought also has affected agricultural livelihoods, with almost total crop failure throughout the country. The southern part of the country is one of the most affected areas.

The South African side relies heavily on groundwater for most uses, with some irrigation schemes presently using larger shares. There are currently plans for limited growth in the agricultural sector for emerging farmers as social inequalities are addressed (Pietersen et al., 2011). Also, the North-West dolomite aquifers, of which the Ramotswa Aquifer constitutes the extreme part, receive considerable interest from national water planners because of rising water demands on the South African side, which includes the cities of Mafikeng, Zeerust and Lichtenburg. On the Botswana side, groundwater from the productive Ramotswa dolomite aquifer has hitherto been discounted due to previous pollution from pit latrines (Beger, 2001), but is currently re-introduced for emergency supply. Practically all collected urban wastewater from Gaborone is presently reused for peri-urban crop production or golf courses.

In this context, there is a need to understand the role that aquifer resources in the region (likely shared across the border) could play in addressing multiple-level water insecurity, drought and flood proneness and livelihood insecurity. The knowledge of this adaptation potential and the characteristics of these aquifers is limited. If the resource is large and easily rechargeable, it can play a significant role in buffering variability in climate, both floods and droughts, and addressing increasing demands for water. However, in some parts, the resources are already under stress from pollution and over-abstraction (Pietersen et al., 2011). Hence, the concept for the buffering capacity of these aquifers has to be based on a stringent perspective of long-term sustainability, through resource protection, pro-active replenishment (through managed aquifer recharge, MAR) and cross-border collaboration.

### 1.4 Project Objectives

The overall objective of RAMOTSWA is to support a long-term joined vision and cooperation on the shared groundwater resources of the upper Limpopo region where the states share significant and valuable freshwater underground resources as well as space for enhanced subsurface water storage. The project will facilitate and promote joint management and better groundwater governance focused on coordination, scientific knowledge, social redress and environmental sustainability, in order to reduce poverty and inequities and to increase prosperity, livelihoods and water and food security in face of climate chance and variability.

The specific objectives of RAMOTSWA are to:

A. Increase the recognition of the importance and vulnerability of the transboundary Ramotswa Aquifer

B. Improve the understanding of the socio-economic importance of the aquifer area and the inequalities in water access and security across the population
C. Improve the understanding of the extent and hydrogeology of the transboundary aquifer resources under present and future climate and population projections
D. Assess the feasibility and best options for managed aquifer recharge (MAR) for securing the water buffer and controlling the water quality, using wastewater, flood and storm water
E. Assess the feasibility and best options for small-scale irrigation (ag-water solutions)
F. Establish national and cross-border dialogue and cooperation on the Ramotswa Aquifer and further encourage international cooperation on transboundary aquifers in the SADC region
G. Develop tools for shared and harmonized management and monitoring of the groundwater resources, aligned with national water resources management processes
H. Develop human and institutional capacity for shared and harmonized management and monitoring of the groundwater resources1.5

### 1.5 Project Plan and Phasing

RAMOTSWA implementation is planned in two phases. Phase 1 is covered under the present contract with RESILIM. Phase 2 is envisaged to be covered under an upcoming grant from the US Global Development Lab. The present Inception Report covers both phases, but with emphasis on Phase 1. It is recognized that changes may occur to Phase 2. Project Phase 1 runs from **28 July 2015 to 27 Feb. 2017**. Phase 2 is planned to be three years, 2016-2018.

The two phases comprise the following components (see Gantt chart, Figure 1):

- Phase 1: Inception/multi-stakeholder engagement, baseline assessment/transboundary diagnostic analysis (TDA), hydrogeological characterization, joint information management system on RAMOTSWA (RIMS), training on TDA, RIMS, and geophysics, hydrogeological modelling, and MAR
- Phase 2: Water buffer and MAR assessment, agricultural water management option assessment, hydrogeological modelling, Strategic Action Plan (SAP) development

| Phase | | | 2015 | | 2016 | | | | 2017 | | | | 2018 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st | 2nd | Component | 1 | 2 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 1.1 | 2.1 | Multi-stakeholder engagement | 1+2 | | | | | 8 | | | | 6a | | | | 9 |
| 1.2 | | Socio-economic and institutional baseline assessment | | | 4 | | | | | | | | | | | |
| 1.3 | | Hydrogeological characterisation | | | | 6 | | | | | | | | | | |
| | 2.2 | Buffer assessment and MAR solutions | | | | 1 | | | | | | | 7a | | | |
| | 2.3 | Ag-water solutions | | | | | | 2 | | 4b | | | | | | |
| | 2.4 | Hydrogeological model | | | | | | | 3 | | | 6b | | | | |
| 1.4 | 2.5 | Extended Joint Information Management System (RIMS) | | | | | 5 | | | | 5 | | | | | |
| 1.5 | 2.6 | Training and outscaling | | | 3 | | 7 | | | 4a | | | | 8 | | |
| | 2.7 | SAP development | | | | | | | | | | | 7b | | | 10 |
| 1.6 | 2.8 | Coordination and scientific documentation | | | | | | | | | | | | | | |

**Fig. 1. Gantt chart for RAMOTSWA Phase 1 and 2. Numbers inside the chart refer to milestones. Note, Phase 2 is pending**

## 2. PHASE 1 OF RAMOTSWA

The following part of the report only deals with Phase 1 of RAMOTSWA.

## 3. SCOPE

### 3.1 Scope Statement

This project has been designed and co-developed to address the following scope:

> *During the RAMOTSWA Phase 1, an assessment of the socio-economic, environmental and institutional conditions of the greater Ramotswa transboundary aquifer area (RTBAA) will be carried out. Data collected will be collated and summarized in a joint information management system (RIMS). Air-borne geophysics will be carried out to improve the understanding of the hydrogeological conditions of the aquifer. Training will be carried out on TDA and RIMS, as well as geophysics, MAR and hydrogeological modelling. A preliminary Strategic Action Plan for the Ramotswa Aquifer will be developed.*

### 3.2 Geographic Scope

The Ramotswa Aquifer is located in the upper part of the Limpopo River Basin (Figure 2). The focus area of the RAMOTSWA is the greater Ramotswa transboundary aquifer area (RTBAA). This area is loosely defined and includes the known dolomite areas, as demarcated by existing surface geology maps in and around the Ramotswa-Lobatse-Dinokana area (Figure 3). As the aquifer has not been thoroughly investigated, including its extent, the more precise outlining of the focus area may change during the course of the project. In terms of the planned hydrogeological assessments, a buffer zone of approximately 5 km around the outer rim of the aquifer (as known pre-project) will be included for the geophysical investigations, in order to understand better the boundaries of the aquifer, and to include possible lateral extension of the aquifer underground (Figure 4). In terms of the socio-economic assessment of the RTBAA, units of analysis will be determined by most appropriate political boundaries, such as municipalities (South Africa) and districts (Botswana) (Figure 4). In addition, specific communities around the RTBAA will be targeted for socio-economic assessments. Due to the continued extension of the dolomite formations into South Africa in both the northeastern and southeastern part of the study area, a natural cut-off of the transboundary part of the system will be determined by the dolorite dikes that crisscross these formations and tend to separate them into compartments (not shown).


**Fig. 2. Map of location of the Ramotswa Aquifer in the upper part of the Limpopo River Basin and crossing into South Africa and Botswana**

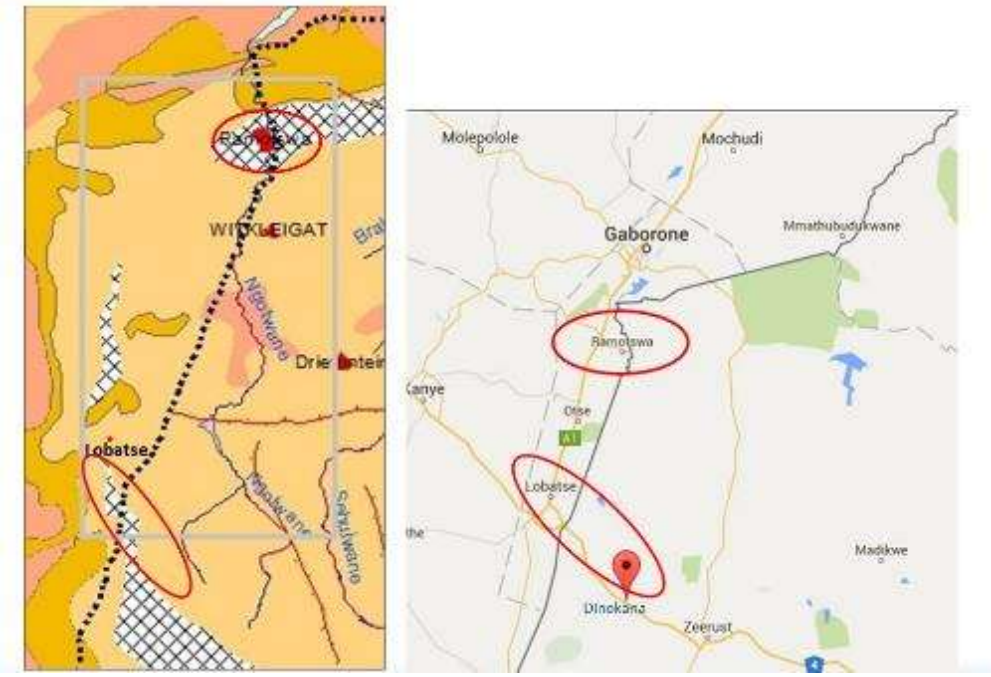


**Fig. 3. Close-up of aquifer location. The hatched areas on the left indicate dolomite formations, while the red circles indicate the major shared parts of the aquifers. The black lines are the border between Botswana and South Africa**

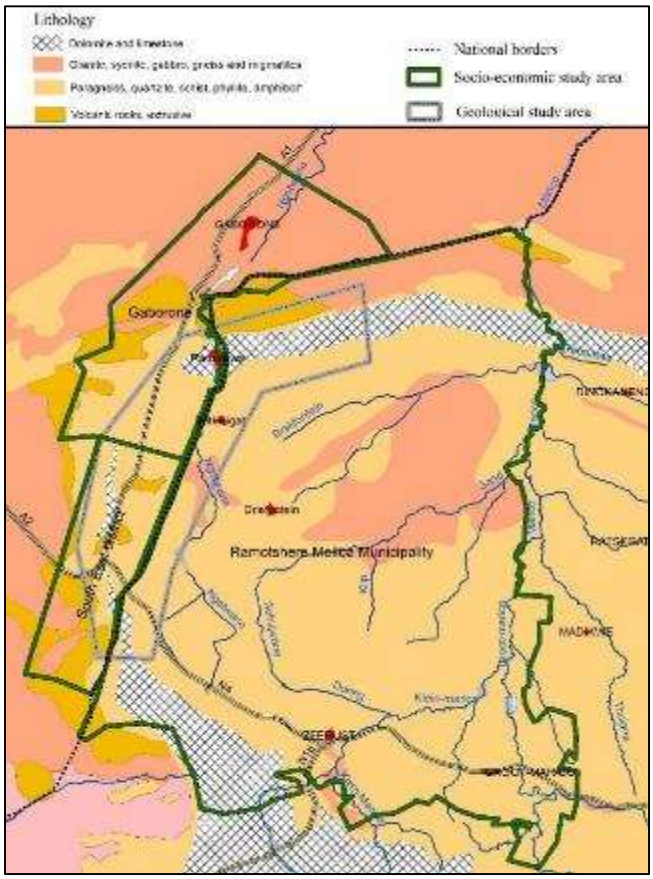


**Fig. 4. Map showing the focus area for the socio-economic studies (green line) and for the hydrogeological studies (grey line)**

Figure 5 shows the more detailed geology of the area. As the aquifer conditions are very complex, the outline of the aquifer may change significantly from the delineation in Figure 4. The aquifer may be disconnected and comprising separate compartments.

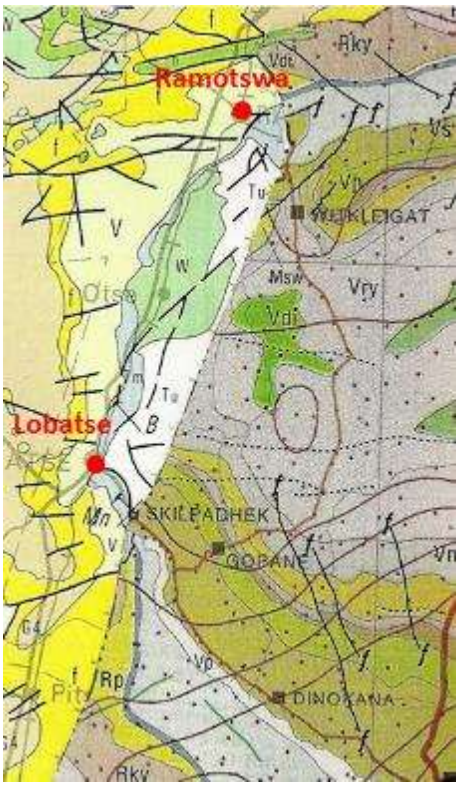


**Fig. 5. The detailed geology of the area, as interpreted from stitched geological maps from South Africa and Botswana (1:1 million)**

Finally, Figure 6 shows the hydrological catchment for the Gaborone Dam, which encompasses a significant part of the aquifer. The reason for also using this area in our assessment, is that it indicates the major flow routes and sources of surface water in the area. As much of the water supply on the Botswana side is linked to Gaborone dam and other smaller dams in the catchment, it is important to understand these systems and the linkages to the underground aquifer systems. The Ramotswa wellfield, where most of the water from the Ramotswa Aquifer is presently being abstracted on the Botswana side is located within this catchment. The catchment constitutes the very upper part of the Limpopo River Basin.

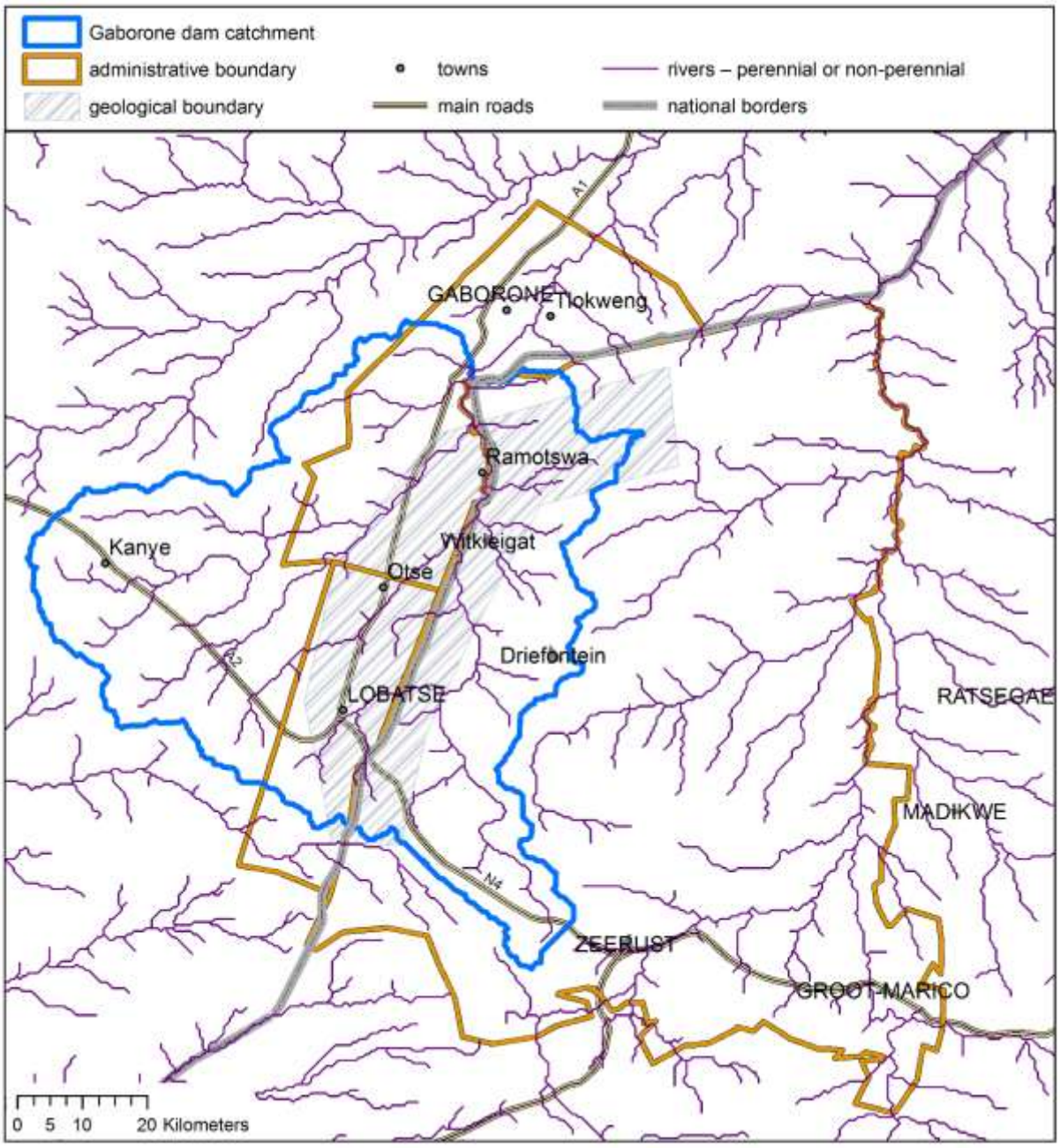


**Fig. 6 The catchment area of the Gaborone Dam**

## 4. MILESTONES ANF DELIVERABLES

Table 1 gives the milestones and deliverables of Phase 1.

**Table 1. Milestones of RAMOTSWA, Phase 1**

| No. | Milestone/Deliverable | Explanation/Details of Deliverables | Deadline |
|---|---|---|---|
| 1 | Preliminary Workplan | One report indicating the preliminary workplan | 05 August 2015 |
| 2 | Inception report | One report summarizing discussions and decisions derived from the Inception Workshop | 31 August 2015 |
| 3 | Training material 1 (TDA, social assessment) | Training material encompassing: Theory/intro notes, comparable cases, and tools to conduct a TDA | 29 February 2016 |
| 4 | Transboundary Diagnostic Analysis (TDA) | One report on the baseline conditions in the Ramotswa TBA area (RTBAA), with respect to the institutional setup, socio-economic, water | 31 March 2016 |
| 5 | Joint Information Managemetn System (RIMS) | Digital database on data and maps colleted (primary and secondary) as part of the project. | 30 June 2016 |
| 6 | Report on hydrogeology | One report on the hydrogeology of the RTBAA, based on the airborne geophysics as well as secondary data. This will give information on the extent, permeability, and yields of the TBA | 30 June 2016 |
| 7 | Training material 2 (geophysics, modelling) | Training material (theory/intro notes, comparable cases, and tools ) to conduct geophysics (in particular airborne electromagnetics) and to do hydrogeological modellling | 15 September 2016 |
| 8 | Joint Strategic Action Plan (SAP) | One report outlining the stakeholder-consulted priorities for future water management and/or infrastructure invetments in the RTBAA | 20 December 2016 |

A more detailed Gantt chart for Phase 1 is given in Annex 2.

Table 2 describes the schedule of milestones and deliverables for RAMOTSWA in more detail.

**Table 2. Milestone Schedule (for Phase 1)**

| No. | Milestone Description | Activities | Outputs | Verification of Milestone/ Deliverable | Target Date | Illustrative Target |
|---|---|---|---|---|---|---|
| 1 | Work Plan | • Conduct Inception Meeting<br>• Develop work plan<br>• Compile draft inception report<br>• Get clearance from key national partners<br>• Delineate study area | • Stakeholder-endorsed methodology<br>• Project implementation plan<br>• Presentations<br>• Clearance letters from national partners<br>• Map of study area | • Attendance register<br>• Draft Inception report | 05/08/15 | 1 report, combined with Deliverable 2 |
| 2 | Inception Report | • Negotiate contracts for consultants and sub-contractors<br>• Identifying data needs<br>• Compile final inception report<br>• Plan partner visits<br>• Identifying student research topics | • Project team appointed<br>• Lists of data needs<br>• Plan for partner visits<br>• List of student research topics | • Final Inception report | 31/08/15 | 1 report |
| 3 | Training 1 (TDA, Social Assessment) | • Give training session at Inception Meeting<br>• Disseminate training material at Inception Meeting | • Better appreciation of international water law<br>• Preliminary discussions on institutional models for TBA management | • Training material | 29/02/16 | 40 people trained |

| No. | Milestone Description | Activities | Outputs | Verification of Milestone | Target Date | Illustrative Target |
|---|---|---|---|---|---|---|
| 4 | Transboundary Diagnostic Analysis (TDA) | • Compile existing data and maps on the greater RTBAA | • Baseline sub-reports on hydrogeology, socio-economics, and wastewater reuse<br>• Merged baseline report | • Baseline report | 31/03/16 | 1 Scientific report |
| 5 | Joint Ramotswa Information Management System (RIMS) | • Analysis of data and maps<br>• Harmonization of data and maps | • An online and interactive information management system | • information management system set up and populated with relevant maps and documents | 30/06/16 | 10 institutions informed |
| 6 | Report on Hydrogeology | • Conduct airborne geophysical surveys<br>• Analyse survey results<br>• Estimate hydrogeological parameters<br>• Develop aquifer conceptual model<br>• | • Interpreted maps and transections<br>• Aquifer conceptual model<br>• Hydrogeological parameters | • Report on hydrogeology | 30/06/16 | 1 Scientific report |

| No. | Milestone Description | Activities | Outputs | Verification of Milestone | Target Date | Illustrative Target |
|---|---|---|---|---|---|---|
| 7 | Training 2 (Geophysics, Modelling) | • Conduct training workshop on geophysics and hydrogeological modelling | • Trained staff and students<br>• Training material | • List of trainees<br>• Training material<br>• Feedback from trainees | 15/09/16 | 20 people trained |
| 8 | Draft Joint Strategic Action Plan | • Hold stakeholder workshop<br>• Consult key stakeholders<br>• Share project findings | • Presentations<br>• Discussion guide<br>• Notes from group discussions | • Attendance register<br>• Draft joint strategic action plan | 20/12/16 | 1 draft action plan<br>100 people reached |

## 4.1 Milestones Achieved

### 4.1.1 Inception Meetings

**Inception Meeting in Johannesburg 28-31 July, 2015**

IWMI, together with the South African, Botswana and Namibian governments, and UNESCO-IHP, organized a regional meeting on ***Tools for the Sustainable Management of Transboundary Aquifers in Southern Africa***, which was held at the Birchwood Hotel & OR Tambo Conference Centre, South Africa, on July 28-31, 2015. This meeting was the first Inception Meeting for the RAMOTSWA. It was also the first time countries in the Southern Africa region convened to engage in a broader dialogue on their shared groundwater resources.

The meeting was jointly convened within the frameworks of the UNESCO-IHP Groundwater Resources Governance in Transboundary Aquifers (GGRETA) project and the Resilience in the Limpopo Basin (RESILIM) program, which are funded by the SDC and USAID/CGIAR Research Program WLE, respectively. Ramotswa and Stampriet aquifers were the key transboundary aquifers that were discussed during the meeting.

The objectives of the meeting were to:

1. Raise awareness and promote transboundary aquifer management cooperation in Southern Africa
2. Share the results of the STAS (Stampriet Transboundary Aquifer System) assessment with a broader audience, including regional and national stakeholders
3. Receive suggestions on possible policy and institutional responses to the assessment as well as options for a STAS Multi-Country Consultation Mechanism (MCCM) to improve management of the Stampriet aquifer
4. Present the RAMOTSWA project objective and current knowledge on the aquifer
5. Develop a joint work plan for the RAMOTSWA project

The meeting allowed stakeholders to present and share knowledge, strengthen their engagement, discuss experiences and the way forward for better international cooperation on shared groundwater resources in Southern Africa, and in particular on the STAS and Ramotswa Aquifer. It also included a training/interactive session on hydro-diplomacy, facilitated by UNESCO and UNESCO International Centre for Water Cooperation, hosted at Stockholm International Water Institute (SIWI): From Potential Conflict to Cooperation Potential (PCCP).

The meeting was attended by 60 representatives from the region and various institutions (USAID, UNESCO, RESILIM, DWS, DWA, AMCOW, IAH, SIWI, IWMI, IGRAC, WRC, CGS, SLR, UB, UFS, *inter alia*).

Karen Villholth, Principal Researcher and Project Leader for RAMOTSWA, made a presentation, which provided background information about the Ramotswa Aquifer system and objectives of the project. Yvan Altchenko (Hydrogeologist), Munir Hanjra (Economist, Agricultural Water Management), Sibusiso Nhlengethwa (Research Officer, Statistics), Girma Ebrahim (Post Doc), and Nicole Lefore (Senior Researcher) from IWMI also participated in the meeting. Photos from the meeting, along with the agenda, including all presentations given, and register of attendants, are given in Annex 3.

**Inception Meeting in Botswana 11-12 Nov, 2015**

IWMI-Southern Africa convened the Ramotswa Transboundary Aquifer Project Inception Meeting in Gaborone, Botswana - hosted at the Dept. of Water Affairs (DWA) headquarters on 11-12 Nov, 2015. The objectives of the meeting were to:

1. Present the RAMOTSWA Project to key partners in Botswana
2. Consolidate the outcomes of the first Inception Meeting in Johannesburg
3. Identify key people from Botswana engaged in the implementation of the project
4. Discuss data collection and development of the baseline assessment

The workshop drew participants from the Dept. of Water Affairs (DWA), Dept. of Geological Survey (DGS), Water Utilities Corporation (WUC), Univ. of Botswana (UB), Univ. of the Free State (UFS), Kalahari Conservation Society, SASSCAL (Southern African Science Service Centre for Climate Change and Adaptive Land Management), RESILIM, and USAID. In total, 50 people attended the meeting.

The meeting was inaugurated by the Permanent Secretary of the Ministry of Minerals, Energy and Water (MMEWR), Dr Obolokile Obakeng and the Acting Director General of DWA, Mrs Bogadi Mathangwane. Karen Villholth said in her opening that both Botswana and South Africa are water-stressed countries and pointed to the important role of the Ramotswa Transboundary Aquifer as part of the solution to some of the water issues faced by both countries. She also emphasized the need to raise the groundwater resource debate to international level and integrate groundwater and surface water resources management to improve the water situation. The project will help both countries to learn from each other and optimize the use of shared groundwater resources, and in particular the Ramotswa Transboundary Aquifer.

Other IWMI members who gave presentations were Yvan Altchenko who presented on the hydrogeology and groundwater situation in the Ramotswa Area and Munir Hanjra who presented on the potential of wastewater re-use in the Ramotswa area, in combination with managed aquifer recharge, for agriculture and other uses to enhance food and water security for the region.

On the second day, the IWMI team engaged with key institutions during bilateral meetings:

- DGS, to get understanding of available data on geology
- DWA for hydrogeology maps, water levels/water quality/hydrological data,
- WUC for water abstraction data, water quality and wastewater data,
- UB (Geology and Environmental Science Departments) for ways forward

Despite current and lingering severe water scarcity in the greater Gaborone area - and because of it - the meeting was very successful and achieved high level attention from the Botswana Government and strong engagement from the national partners.

In Annex 4, the agenda, including all presentations given, and attendance list for the Botswana meeting, along with some photos are given.

### 4.2 Milestones To Be Achieved

#### 4.2.1 Transboundary Diagnostic Analysis

The Transboundary Diagnostic Analysis (TDA) forms a baseline assessment of the socio-economic, institutional, hydrogeological and environmental conditions in the study area. The TDA will be reported in one baseline report. It will constitute an integrated analysis of existing and relatively easily available data and information, with the aim to get an overview of the conditions in the border area, with particular focus on water supply, water resources and water constraints for livelihoods and development in the transboundary region.

#### 4.2.2 Ramotswa Information Management System

The Ramotswa Information Management System (RIMS) is the joint information system for the Ramotswa Aquifer, during the project time and beyond. Its development is supported by IGRAC, the International Groundwater Resources Assessment Centre. The main objective of the RIMS is to provide users with an online platform to upload, organise, share, analyse, and visualise information related to the Ramotswa Aquifer. The availability of a common information system facilitates cooperation between aquifer states and also provides a tool for all stakeholders involved in the governance of the aquifer. To enable storage and visualization of the collected data, a web-based information management portal is developed. The newly developed information management portal is integrated into IGRAC's Global Groundwater Information System (GGIS), which is under development and contains information on several TBAs.

Data will be made visible in a public viewer, which is accessible for anyone with an internet connection and a web browser, or data can be uploaded to a password-protected viewer. The password-protected environment is only accessible to authorized users. This part of the viewer can be used to share draft maps between partners (countries) or to store information, which is considered confidential and should only be available to authorised project partners. The philosophy of IGRAC, who is developing the RIMS, on data management in a transboundary setting is that joint fact finding is a crucial step towards building trust between parties. Furthermore, data should always remain in full ownership and the full responsibility of the individual countries. Therefore, countries decide what information and in what detail they want to share data via the RIMS.

To ensure long term use of the RIMS, each country will need to decide and organise a preferred management structure with regards to the up-keeping and sharing of data in the RIMS. There needs to be a mechanism in place to discuss and agree between Botswana and South Africa on the uploading and sharing of harmonised data. As a minimum, each country will have a 'RIMS Manager' that will be responsible for technical up-keeping of data from their own country and will communicate with the neighbouring country on data harmonisation and sharing.

#### 4.2.3 Hydrogeological Assessment

The hydrogeological assessment done as part of the TDA (Section 4.2.1) will be complemented and expanded by airborne electromagnetic geophysics (AEM). In this approach, a helicopter with a signal-generating and -receiving device connected underneath, will be flying over the RTBAA in a line-wise pattern, picking up information from the subsurface. Electromagnetic geophysical methods detect variations in the electrical properties of rocks - in particular, electrical resistivity, or its inverse, electrical conductivity. Electrical resistivity can be correlated with geologic units on the

surface and at depth using lithologic logs to provide a 3-D picture of the subsurface geology. In the upper crust, the resistivities of geologic units are largely dependent upon their fluid content, pore-volume porosity, effective porosity, and conductive mineral content (Keller, 1989). While there is not a one-to-one relationship between lithology and resistivity, there are general correlations that can be made using typical values, even though values can be found at other localities that may fall outside of the ranges presented herein (Palacky, 1987).

AEM surveys can provide characterization of electrical properties of earth materials from the near-surface (1-3 m) down to depths of 300 to 700 m. Typical AEM systems transmit an electromagnetic (radio-frequency) signal that interacts with the earth to generate (induce) secondary currents (Figure 7). Using numerical imaging and inversion, depth sections of estimated electrical resistivity can be created along flight lines. Interpolations between flight lines provide an estimation of the 3-D distribution of electrical resistivity and are represented as a 3-D resistivity model.

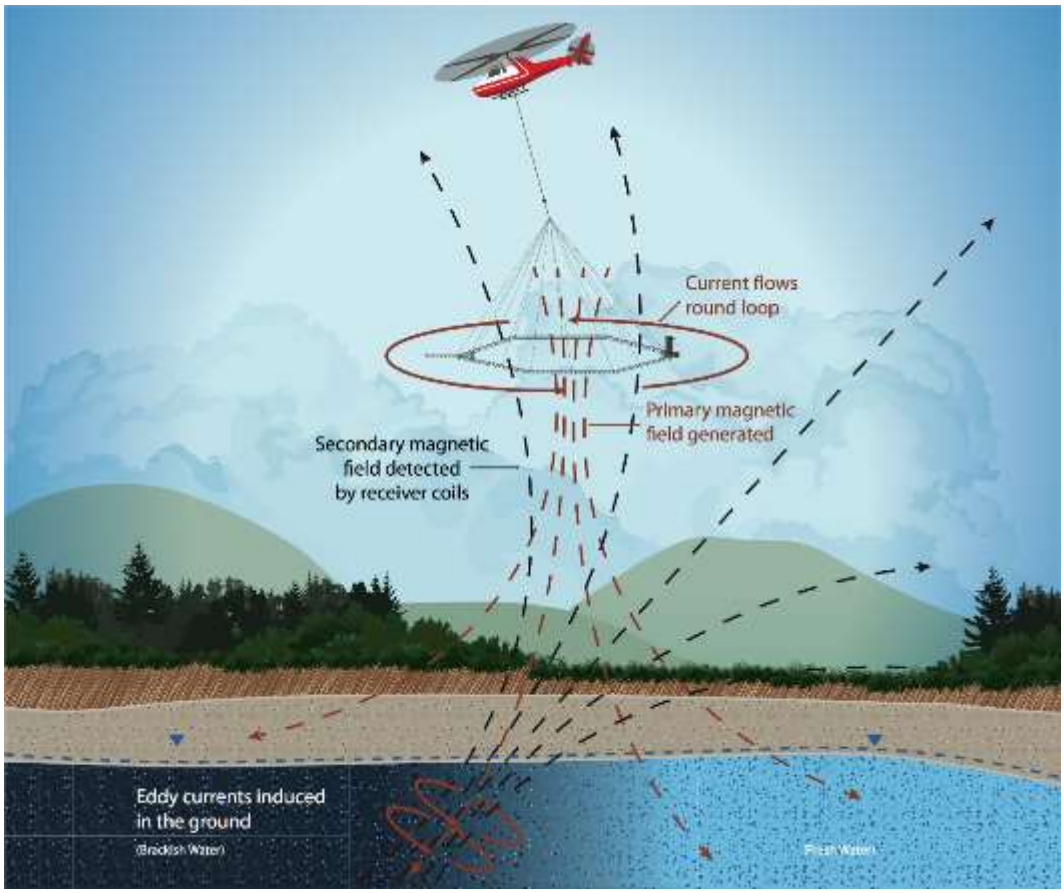


**Fig. 7. Illustration of data acquisition by AEM survey**

The AEM resistivity model combined with ground data of lithology will be used to reveal the character of the deposits across the RTBAA area in a 3-D model. The geologic descriptions from available borehole logs across the area are used as the base ground-truth. Interpretations are then provided as GIS files and as Google Earth files.

### 4.2.4 Training

The RAMOTSWA will include training sessions related to the TDA, RIMS, geophysics, hydrogeological modelling and MAR. The training sessions will target the project staff, the technical and management government officials, selected university students/interns, and key stakeholders

identified as critical for the technical assessment and management of the Ramotswa Aquifer. The training sessions are scheduled to take place in two programs, one on introduction to RIMS and TDA (in Feb. 2016), and one on geophysics, hydrogeological modelling and MAR, and advanced RIMS in Sep. 2016.

#### 4.2.5 Strategic Action Plan

The development of the Strategic Action Plan (SAP) will be an on-going task through the Project. The SAP will be provided as a draft report at the end of RAMOTSWA, Phase 1. The draft SAP will include preliminary recommendations on the strategies for the development of the Ramotswa Aquifer, the potential and options for MAR and the potential and models for agricultural development using the aquifer. In a prospective Phase 2 of the Project, the SAP will be further developed, consulted with stakeholders and consolidated.

## 5. ANTICIPATED OUTCOMES

The key outcomes of the project, which relate to RESILIM's Key Results Areas, are:

- Increased joint understanding of the socio-economic conditions in the TBRAA and the hydrogeological conditions of the Ramotswa Aquifer, including an increased knowledge of the potential of the aquifer to support enhanced resilience in the TBRAA under present and future climate and demographic changes
- Improved capacity amongst key institutions at local to international level to jointly and sustainably manage the Ramotswa Aquifer
- Enhanced cross-border dialogue and cooperation on the Ramotswa Aquifer and further international cooperation on transboundary aquifers in the SADC region

The long-term impact of the project will be enhanced by the potential implementation of recommendations and interventions proposed in the SAP. Leverage for further funding and investment will be sought as part of the project. Furthermore, USAID may use its influence to leverage support from other donors, SADC, as well as member countries. Furthermore, the learnings from this project will be shared to other TBAs in the Limpopo River Basin as well as outside.

## 6. GOVERNANCE AND TEAM

### 6.1 Governance

The project is led by IWMI, from its regional office in Pretoria. The project is being co-funded by USAID through the RESILIM program, and the CGIAR Research Program WLE. The deliverables will be developed by a set of internal stakeholders, including IWMI staff and subcontractors (XRI, Exploration Resources International, and IGRAC), government officials, and a group of national experts who have been appointed for the task, and with the support of and input from a wide range of external local, national and regional stakeholders. There is a need for a bilateral structure (like a Project Steering Committee (PSC)) to oversee RAMOTSWA and to enhance the buy-in from the two governments. The process of establishing such Committee has begun with formal letters to the national Governments inviting them to appoint members for the Committee. Since RESILIM has established links with the bilateral Joint Permanent Technical Committee for Water (JPTC) between

South Africa and Botswana and under LIMCOM, and because expression of interest for the RAMOTSWA derived partly from the JPTC, building on this partnership for the RAMOTSWA and representing JPTC in the PSC, would be obvious.

The project has developed links with a project dealing with another TBA, the Stampriet Aquifer, shared between South Africa, Botswana and Namibia. This project (STAS) is led by UNESCO, funded by the Swiss Agency for Development and Cooperation, and has comparable objectives to the RAMOTSWA. Hence, the two projects are building synergy in terms of engaging and collaborating with the same national partners.

### 6.2 Team

#### 6.2.1 Core Team

IWMI has allocated resources for a core team of internal staff to support the implementation of RAMOTSWA. In addition, XRI and IGRAC is subcontracted by RESILIM to work on the project under IWMI management. Table 3 presents the team.

**Table 3. IWMI Staff and Specialist Team (Consultants/Contractors)**

| Expertise | Name | Country | Organisation |
|---|---|---|---|
| Project Manager | • Karen G. Villholth | South Africa | IWMI |
| Hydrogeological studies | • Yvan Altchenko | South Africa | IWMI |
| Modelling and MAR | • Girma Ebrahim | South Africa | IWMI |
| Socio-economic/institutional studies | • Nicole Lefore | South Africa | IWMI |
| Wastewater reuse | • Munir Hanjra | South Africa | IWMI |
| Socio-economic/institutional studies | • Thinah Moyo | South Africa | UP, University of Pretoria |
| Hydrogeological and environmental studies | • Piet Kenabatho | Botswana | UB |
| Socio-economic/institutional studies | • Bothepha Mosetlhi | Botswana | UB |
| Wastewater reuse and storage | • Hillary Masundire | Botswana | UB |
| Hydrogeological studies | • Modreck Gomo | South Africa | UFS |
| Hydrogeological studies | • Nancy Motebe | South Africa | DWS |
| Geophysics, modelling and MAR | • Jared Abraham or James Cannia | United States | XRI |
| Joint Ramotswa Information Management System (RIMS) | • Geert-Jan Nijsten | The Netherlands | IGRAC |

### 6.2.2 National Partners

The national partners comprise the Department of Water and Sanitation and Department of Water Affairs, under the Govt. of South Africa and Botswana (Ministry of Minerals, Energy and Water Resources), respectively, together with their relevant associated entities, like the Council for Geoscience (CGS), the District Municipalities and Local Municipalities on the South African side, and Department of Geological Survey (DGS) and Water Utilities Corporation (WUC) on the Botswana side. In addition, the Project works closely with the Univ. of Botswana, the Univ. of the Free State, and the Univ. of Pretoria.

Each of these partners plays a critical role in the implementation of the Project, in supporting and guiding data collection and field work, and in guiding and taking part in the research. A Focal Point for the technical assessment and representing these institutions have been or will be set up on both sides of the border.

## 6.3 Quality Management

Each deliverable will be finalised following an extensive review process, which will involve consultation of internal and external stakeholders. In addition, RESILIM review of draft reports will be requested through programmatic and technical support from RESILIM Manager Mr David Gadd and Chief Scientist Dr Nkobi Moleele. Monthly progress reports will be submitted by the project.

# 7. ENGAGEMENT AND COMMUNICATION

## 7.1 Stakeholder Engagement and Impact Pathways

Several impact pathways to ensure the relevance and uptake of research findings and recommendations will be realized:

- Engagement and consultation of the stakeholders at multiple levels and with diverse interests at early stages in the project and throughout to solicit buy-in, answer to specific demands, and ensure coordination across scales
- Development of targeted awareness raising material
- Training of partners in technical, management and socio-economic aspects

The key to this project having the impact anticipated will be engendering a sense of ownership amongst stakeholders most likely to implement the suggestions. This includes member countries and their government officials, community representatives (including provincial and rural district councils), NGOs and private sector individuals. As such, it is important that these stakeholders are involved in the process of generating the deliverables. This project will have three categories of stakeholders which will be relevant at different phases of the project. Table 4 presents a description of the stakeholders, an indication of the phase in which they will be important and a representation of the role and authority they have in the process, through a RACI chart.

**Table 4. RACI Matrix (Contractual relationships)**

| Category | Stakeholder | Involvement | Responsible | Accountable | Consulted | Informed |
|---|---|---|---|---|---|---|
| Internal | Project Steering Committee[a] | All phases | | X | X | X |
| | IWMI | All phases | X | X | | |
| | RESILIM | All phases | | X | X | |
| | USAID | All phases | | X | | X |
| | Specialist Panel | All phases – varies depending on specialist | X | | | |
| External National and Regional Stakeholders | National and regional government officials | All phases | | | X | |
| | UNESCO-IHP | Inception and concluding workshop | | | X | |
| | LIMCOM | Concluding workshop | | | X | |
| | JPTC | Stakeholder and concluding workshop | | | | |
| | SADC | Concluding workshop | | | X | |
| | ANBO and INBO | Concluding workshop | | | X | |
| | AMCOW/AGWC | Inception and concluding workshop | | | X | |
| External Local Stakeholders | Community representatives | Stakeholder and concluding workshop | | | X | |
| | Private sector individuals | Stakeholder and concluding workshop | | | X | |
| | Potential donors and implementing agencies | Stakeholder and concluding workshop | | | | X |

[a] To be established, see Section 6.1.

### 7.2 Communication

In addition to the extensive engagement processes planned, the following communication protocols and tools are noted:

- **Branding** All communications will be jointly branded with USAID Southern Africa/RESILIM logo, as well as IWMI and WLE logos.
- **External and internal communication** All external communication on the project will be directed to Lara Rall who will be responsible for disseminating these within and beyond RESILIM and USAID. IWMI Communication Officer will also support dissemination related to the project. All internal communication will be copied to the project manager.
- **Document management** A Google Drive[6] is set up to collect, store and share between stakeholders documents developed and gathered through the project. Any document to upload should be sent to Yvan Altchenko (y.altchenko@cgiar.org). The intension is for this information to become available after the project as a way in which to improve and share information between stakeholders beyond the life of the project.
- **Information management** An online information management system (RIMS) containing data, maps, time series data, etc., will be developed. The system will have various functionalities to visualise, analyse and compare data. It will available online, with variable level of access to different stakeholders.
- **Training** The project will include training for the DWA and DWS and other partners in Botswana and South Africa, respectively. It will also encompass training for students at the collaborating Universities (UB and UFS).
- **Awareness raising** Awareness raising will be carried out as part of the engagement with local stakeholders, at workshops and as part of the field surveys.

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**ANNEX 1**

**Abbreviations and acronyms**

| Abbreviation/Acronym | Explanation |
|---|---|
| AEM | Airborne electromagnetics |
| AGWC | African Groundwater Commission |
| AMCOW | African Ministerial Council on Water |
| ANBO | African Network of Basin Organisations |
| CGIAR | Consultative Group on International Agricultural Research |
| CGS | Council for Geoscience |
| DGS | Department of Geological Survey |
| DWA | Department of Water Affairs |
| DWS | Department of Water and Sanitation |
| GGIS | Global Groundwater Information System |
| GGRETA | Groundwater Resources Governance in Transboundary Aquifers |
| IAH | International Association of Hydrogeologists |
| IGRAC | International Groundwater Resource Assessment Centre |
| INBO | International Network of Basin Organisations |
| IWMI | International Water Management Institute |
| JPTC | Joint Permanent Technical Committee on Water (between South Africa and Botswana) |
| KRA | Key results area |
| LIMCOM | Limpopo Watercourse Commission |
| MAR | Managed aquifer recharge |
| MCCM | Multi-Country Consultation Mechanism |
| MMEWR | Ministry of Minerals, Energy and Water Resources |
| NGO | Non-governmental organization |
| PCCP | Potential Conflict to Cooperation Potential |
| PSC | Project Steering Committee |
| RACI | Responsible, Accountable, Consulted, Informed |
| RAMOTSWA | The Ramotswa Aquifer Project |
| RESILIM | Resilience in the Limpopo River Basin |
| RIMS | Ramotswa Information Management System |

| Abbreviation/Acronym | Explanation |
|---|---|
| RTBAA | Ramotswa Transboundary Aquifer Area |
| SADC | Southern African Development Community |
| SAP | Strategic Action Plan |
| SASSCAL | Southern African Science Service Centre for Climate Change and Adaptive Land Use |
| SDC | Swiss Agency for Development and Cooperation |
| SIWI | Stockholm International Water Institute |
| SLR | SLR Consulting |
| STAS | Stampriet Transboundary Aquifer System |
| TBA | Transboundary Aquifer |
| TDA | Transboundary diagnostic analysis |
| UB | University of Botswana |
| UFS | University of the Free State |
| UNESCO-IHP | United Nations Educational, Scientific and Cultural Organization – International Hydrological Programme |
| UP | University of Pretoria |
| USAID | United States Agency for International Development |
| WLE | Water, Land and Ecosystems |
| WRC | Water Research Commission |
| WUC | Water Utilities Corporation |
| XRI | Exploration Resources International |

**ANNEX 2**

## Detailed Gantt chart for RAMOTSWA Phase 1

| | Component | 2015 | | | | | | 2016 | | | | | | | | | | | | 2017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| 1 | Multi-stakeholder engagement | | 1+2 | | | | | | | | | | | | | | | | 8 | | |
| 2 | Socio-economic and institutional baseline assessment | | | | | | | | | 4 | | | | | | | | | | | |
| 3 | Hydrogeological characterisation | | | | | | | | | | | | 6 | | | | | | | | |
| 4 | Joint database development | | | | | | | | | | | | 5 | | | | | | | | |
| 5 | Training | | | | | | | | 3 | | | | | | | 7 | | | | | |
| 6 | Coordination and scientific documentation | | | | | | | | | | | | | | | | | | | | |

**Annex 3**

**Photos, Agenda, and Attendance Register from RAMOTSWA Inception Meeting, Johannesburg**


**Group photo from the Inception Meeting, Johannesburg**



**Group discussion during the working sessions**

# REGIONAL MEETING ON TOOLS FOR THE SUSTAINABLE MANAGEMENT OF TRANSBOUNDARY AQUIFERS

***Groundwater Resources Governance in Transboundary Aquifers (GGRETA Project) – Stampriet Transboundary Aquifer System Stakeholder Consultation meeting***

***and***

***Resilience in the Limpopo Basin (RESILIM) The Potential of the Transboundary Ramotswa Aquifer (RAMOTSWA) Inception meeting***

Birchwood Hotel & OR Tambo Conference Centre

Johannesburg, 28-31 July 2015

**FINAL AGENDA**

## BACKGROUND

The Governments of Botswana, Namibia and South Africa, jointly with the UNESCO International Hydrological Programme (UNESCO-IHP) and the International Water Management Institute (IWMI) are organizing the Regional Meeting on Tools for the Sustainable Management of Transboundary Aquifers. The meeting will be held from 28 to 31 July 2015 at Birchwood Hotel & OR Tambo Conference Centre, Johannesburg, South Africa.

The meeting will cover:

- Stakeholder consultation for the assessment of the Stampriet Transboundary Aquifer System (STAS, shared between South Africa, Botswana and Namibia) - UNESCO-IHP.
- Inception consultation for the Transboundary Ramotswa Aquifer (shared between South Africa and Botswana) – IWMI.

The meeting is being convened within the framework of the UNESCO International Hydrological Programme (UNESCO-IHP) "Groundwater Resources Governance in Transboundary Aquifers" (GGRETA) and the International Water Management Institute (IWMI) Resilience in the Limpopo Basin (RESILIM) - The Potential of the Transboundary Ramotswa Aquifer (RAMOTSWA) projects, funded by the Swiss Agency for Development and Cooperation (SDC) and USAID/WLE, respectively.

## OBJECTIVES

- To raise awareness and promote transboundary aquifer management cooperation in Southern Africa,
- To share the results of the STAS assessment with a broader audience, including regional and national stakeholders nominated by the STAS countries,
- To receive suggestions on possible policy and institutional responses to the assessment as well as options for a STAS Multi-Country Consultation Mechanism (MCCM) to improve management of the Stampriet aquifer,
- To present options for cooperation between the three countries for the management of the STAS,
- To present the RAMOTSWA project objectives, present current knowledge on the aquifer, and
- To develop a joint work plan for the RAMOTSWA project

## DAY 1 - Tuesday, 28 July 2015, Johannesburg

**Objectives:**

- **Presentation of the Stampriet Transboundary Aquifer System (STAS) integrated assessment findings**
- **Presentation of the Ramotswa Transboundary Aquifer Project (RAMOTSWA)**

| | |
|---|---|
| **8:30-9:00** | **Registration** |
| **9:00-10:15** | **Opening of the meeting** |
| | Chair: M.H. Lebeloane |
| *9:00-9:15* | Welcome remarks and opening of the meeting by the Governments of South Africa, Botswana and Namibia:<br>• **Ministry of Water and Sanitation / Dept. of Water and Sanitation (DWS)**, South Africa<br>o *Ms Deborah Mochotlhi*<br>• **Ministry of Minerals, Energy and Water Resources (MMEWR) / Dept. of Water Affairs (DWA)**, Botswana<br>o *Mr Piet Kenabatho*<br>• **Ministry of Agriculture, Water and Forestry / Dept. of Water Affairs and Forestry (DWAF)**, Namibia<br>o *Ms Aino Iiaku* |
| *9:15-10:15* | Welcome remarks by UNESCO-IHP and IWMI:<br>• **UNESCO-IHP** , Presentation of the GGRETA project and objectives of the meeting<br>o *Andrew Ross*<br>• **IWMI**, Presentation of the RAMOTSWA project<br>o *Karen Villholth* |
| *10:15-10:25* | Welcome remarks by Donors:<br>• **SDC / Embassy of Switzerland in Pretoria (Apology)**<br>o *To be defined*<br>• **USAID**<br>o *Graham Paul* |
| *10:25-10:45* | Welcome remarks by Regional Organizations:<br>• **LIMCOM**<br>o *Sergio Sitoe (TBC)*<br>• **ORASECOM**<br>o *Lenka Thamae (TBC)*<br>• **AMCOW**<br>o *Nelson Gomondo*<br>• **SADC**<br>o *Phera Ramoeli (TBC)*<br>• **ANBO**<br>o *Tracy Molefi (TBC)*<br><br>Roundtable for the presentation of the participants and adoption of the agenda |
| **10:45-11:00** | **Coffee break** |

| | |
|---|---|
| **11:00-12:00** | **Transboundary Aquifers Cooperation** |
| *11:00-11:30* | UNESCO-IAH cooperation on Transboundary Aquifers:<br>• Presentation of the Internationally Shared Aquifers Resources Management (ISARM) initiative and IAH Commission on Transboundary Aquifers<br>o *Shammy Puri (IAH)* |
| *11:30-12:00* | Examples of a Multi-Country Consultation Mechanism (MCCM)<br>o *Tales Carvalho Resende (UNESCO-IHP)* |
| *12:00-12:15* | Discussion |
| **12:15-13:00** | **STAS integrated assessment main findings** |
| *12:15-12:45* | Presentation of the STAS main findings:<br>• Integrated Assessment<br>• Preliminary issues and lessons learnt<br>• Preliminary options of Multi-Country Consultative Mechanisms (MCCM)<br>o *Tales Carvalho Resende (UNESCO-IHP)* |
| *12:45-13:00* | Discussion |
| **13:00-14:30** | **Lunch** |
| **14:30-15:30** | **Presentation of the RAMOTSWA project** |
| *14:30-15:15* | Presentation of the RAMOTSWA project:<br>• Background<br>o *Nkobi Moleele (RESILIM)*<br>• Objectives, approaches/work packages and timeframe<br>o *Karen Villholth (IWMI)* |
| *15:15-15:30* | Discussion |
| **15:30-15:45** | **Coffee break** |
| **15:45-17:00** | **Reactions to STAS integrated assessment main findings and RAMOTSWA presentation** |
| *15:45-16:15* | Reactions to STAS integrated assessment main findings and RAMOTSWA presentation |
| *16:15-17:00* | General discussion and feedback |

## DAY 2 - Wednesday, 29 July 2015, Johannesburg

**Objectives:**

- **Parallel sessions to discuss in-depth technical discussions of the STAS assessment and Introduction to current knowledge on the Ramotswa Transboundary Aquifer Area (RTBAA)**

| 9:00-9:05 | **Opening of Day 2** | |
|---|---|---|
| 9:00-9:20 | Welcome remarks and presentation of Day 2 objectives<br>○ *Andrew Ross (UNESCO-IHP) and Karen Villholth (IWMI)*<br>Database/Information management system<br>○ *Geert-Jan Nijsten (IGRAC)* | |
| 9:20-10:30 | **Parallel sessions** | |
| | **In-depth technical discussions of the STAS assessment** | **Introduction to current knowledge on the Ramotswa Transboundary Aquifer Area (RTBAA)** |
| | Overview of the aquifer hydrogeological aspects<br>○ *Jürgen Kirchner (Namibia)*<br><br>Overview of the aquifer socio-economic and environmental aspects<br>○ *Piet Kenabatho (University of Botswana)*<br><br>Discussion:<br><br>(i) *The STAS area* (location map, topography, climate, demography and other general features);<br><br>(ii) *Overview of the STAS* (geology, aquifers, artesian conditions; groundwater recharge/discharge/storage; natural groundwater quality);<br><br>(iii) *The role of groundwater in the area* (wells and boreholes; volumes abstracted by aquifer and by type of use; ecological functions of groundwater; groundwater pollution; excessive losses of water and other problems/threats) | Water resources and hydrogeological Aspects<br><br>Chair: *Kevin Pietersen (SLR, South Africa)*<br><br>Current Knowledge of Water Resources and Hydrogeological Conditions in the Ramotswa Transboundary Aquifer Area, Based on Experience from the North West Province in South Africa<br>○ Nancy Motebe *(Department of Water and Sanitation, South Africa)*<br><br>Critical Issues Related to Management of Extensive Use of Dolomite Aquifers in the North West Province of South Africa<br>○ *Jude Cobbing (South Africa)*<br><br>Ramotswa Transboundary Aquifer Hydrogeology - Current Knowledge and Plans for Remote Sensing-Based Technology Application<br>○ *Yvan Altchenko (IWMI)*<br><br>Hydrogeological and Groundwater Conditions of the Karst Belt in Region 10 of South Africa<br>○ *Rainie Meyer (South Africa)* |
| 10:30-10:45 | **Coffee break** | |

| | | |
|---|---|---|
| 10:45-12:30 | **Parallel sessions (ctd.)** | |
| | **In-depth technical discussions of the STAS assessment** | **Introduction to current knowledge on the Ramotswa Transboundary Aquifer Area (RTBAA)** |
| | Overview of the aquifer assessment – Diagnostic:<br>○ *Andrew Ross (UNESCO-IHP)*<br>Discussion:<br><br>(iv) *Diagnostic* (value and relevance of groundwater – in particular the STAS -; opportunities, problems and threats, both at the domestic and the transboundary levels; uncertainties; recommendations for interventions and other actions).<br><br>(v) *Presentation of potential STAS Multi-Country Consultation Mechanisms options* (core mandate, legal arrangements, structure, funding arrangements, advantages and disadvantages).<br><br>Discussion | Management, socio-economic and environmental aspects:<br><br>Chair: *Jude Cobbing (South Africa)*<br><br>Development and Governance Issues Related to the Ramotswa Aquifer<br>○ *Kevin Pietersen (South Africa)*<br><br>Increasing Water Security for the Ramotswa Transboundary Aquifer Area through Concerted and Efficient Reuse of Recharged and Retrieved Waste Water<br>○ *Hillary Masundire (University of Botswana)*<br><br>Current Knowledge of Water Resources and Hydrogeological Conditions and Groundwater Management Issues in the Greater Ramotswa Transboundary Aquifer Area and Environmental and Socio-Economic Issues of Concern for the Ramotswa Transboundary Aquifer Area<br>○ *Piet Kenabatho (University of Botswana)*<br><br>Discussion |
| 12:30-14:00 | **Lunch** | |
| 14:00-16:00 | **Parallel sessions (ctd.)** | |
| | **Reactions to STAS integrated assessment findings and way forward** | **Introduction to current knowledge on the Ramotswa Transboundary Aquifer Area (RTBAA)** |
| | Reactions to STAS integrated assessment findings:<br>• Reactions from South Africa<br>• Reactions from Botswana<br>• Reactions from Namibia<br><br>Political Economy Analysis and Private sector engagement in water resources management<br>○ *Nick Tondi (SIWI)* | Reactions to RAMOTSWA presentations, feeding into:<br>• Discussion of knowledge gaps in relation to RTBAA<br>• Discussion on stakeholders and multi-stakeholder engagement<br>• Discussion of baseline assessment<br>• Discussion on hydrogeological characterization |

| | | |
|---|---|---|
| | Recommendations for project's potential next phase:<br>• Presentation of the Swiss Development Agency for Cooperation and Development (SDC) - Strategic Framework 2013–2017 Global Programme Water Initiatives<br>○ *Tales Carvalho Resende (UNESCO-IHP)*<br>• Recommendations from South Africa<br>• Recommendations from Botswana<br>• Recommendations from Namibia<br><br>Discussion | |
| **16:00-16:15** | **Coffee break** | |
| **16:15-17:00** | **Reactions to STAS integrated assessment findings and RAMOTSWA Project preliminary decisions** | |
| *16:15-16:30* | Reactions to STAS integrated assessment findings and way forward | |
| *16:30-16:45* | RAMOTSWA preliminary decisions | |
| *16:45-17:00* | General discussion and feedback | |

## DAY 3 - Thursday, 30 July 2015, Johannesburg

**Objectives:**

- **Provide a workshop on hydro-diplomacy capacity building facilitated by UNESCO-From Potential Conflict to Cooperation Potential (PCCP), and UNESCO International Centre for Water Cooperation, hosted at Stockholm International Water Institute (SIWI)**

United Nations Educational, Scientific and Cultural Organization

International Water Cooperation Centre, Stockholm

under the auspices of UNESCO

SIWI

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| **9:00-9:30** | **Opening remarks and presentations** |
| *9:00-9:30* | Presentation of previous UNESCO PCCP workshop results and collaboration with SIWI |
| *9:30-10:00* | Presentation of the UNESCO International Water Cooperation Centre, hosted at Stockholm International Water Institute (SIWI) and its expertise on hydro-diplomacy and groundwater. |
| *10:00-10:15* | Presentation of the methodology of the workshop |
| **10:15-10:30** | **Coffee break** |
| **10:30-12:30** | **Workshop on enhanced negotiation skills and capacity building** |
| | First part of the workshop on hydro-diplomacy |
| **12:30-14:00** | **Lunch** |
| **14:00-18:00** | **Workshop on enhanced negotiation skills and capacity building** |
| | Second part of the workshop on hydro-diplomacy<br><br>Presentation and discussion of the exercise / results |
| **15:45-16:00** | **Coffee break** |
| | Final part of the workshop on hydro-diplomacy<br><br>Presentation and discussion of the exercise / results<br><br>Concluding discussions |

## DAY 4 - Friday, 31 July 2015, Johannesburg

**Objective:**

- **Discuss potential linkages between STAS integrated assessment and RAMOTSWA project**
- **Make decisions on ways forward for the STAS and RAMOTSWA Projects**

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| **9:00-9:15** | **Opening of Day 4** | |
| | Welcome remarks and presentation of Day 4 objectives<br>• *Andrew Ross (UNESCO-IHP), Karen Villholth (IWMI), Geert-Jan Nijsten (IGRAC)* | |
| **9:15-11:15** | **Parallel sessions** | |
| | **Workplan for follow-up to the integrated aquifer assessment** | **Group work for the RAMOTSWA Project** |
| 9:15 – 9:45 | Workplan for follow-up to the integrated aquifer assessment :<br>• Presentation assessment indicators<br>• Adoption of workplan for follow-up to integrated aquifer assessment | Group work to define project teams, tasks and approaches to apply. Items to consider: requirements / options for stakeholder engagement and training<br><br>3. Water recovery and storage options via RTBAA |
| 9:45 – 11:15 | Plan for 2nd Stakeholder Consultation meeting, *(Stampriet, Namibia, September/October 2015)*<br>• Plan for Final Regional Technical Workshop *(November/December 2015)*<br>• Prospects for a further phase of the project<br><br>Discussion | 9:45-10:45<br><br>1. Water resources and hydrogeology<br>2. Socio-economics, environment, legal/institutional<br><br>10:45-11:15<br>Decisions on workplan, roles and timeline |
| **11:15-11:30** | **Coffee break** | |
| **11:30-12:30** | **Potential linkages between STAS and RAMOTSWA Projects** | |
| *11:30-12:30* | Potential linkages between STAS and RAMOTSWA projects<br>• Observations from Stampriet and recommendations for Ramotswa<br>• Information Management System<br>• Regional cooperation on transboundary aquifers / joint meetings<br>• Impressions from participants | |
| **12:30-13:00** | **Closing remarks for both projects** | |
| | Closing remarks from UNESCO-IHP<br><br>Closing remarks from IWMI<br><br>Closing remarks from Namibia<br><br>Closing remarks from Botswana<br><br>Closing remarks from South Africa | |
| **13:00-14:30** | **Lunch** | |

# REGIONAL MEETING ON TOOLS FOR THE SUSTAINABLE MANAGEMENT OF TRANSBOUNDARY AQUIFERS

*Groundwater Resources Governance in Transboundary Aquifers (GGRETA Project) – Stampriet Transboundary Aquifer System Stakeholder Consultation meeting*

*and*

*Resilience in the Limpopo Basin (RESILIM)*

*The Potential of the Transboundary Ramotswa Aquifer (RAMOTSWA) Inception meeting*

Birchwood Hotel & OR Tambo Conference Centre
Johannesburg, 28-31 July 2015

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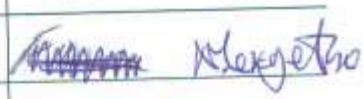
| **Mr. Nelson Lekgetho** | Ministry of Minerals, Energy and Water Resources<br>Department of Water Affairs | nlekgetho@gov.bw |  |
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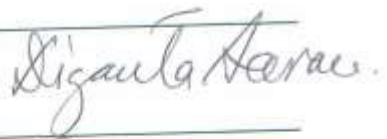
| **Mr. Diganta Sarma** | Namibia Hydrosearch CC | diganta@geonamibia.org<br>diganta.nh@gmail.com |  |
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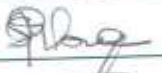
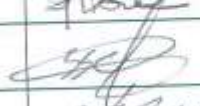
| **Mr. Selebaleng Gaebee** | Department of Water and Sanitation | gaebeeS@dws.gov.za |  |
| **Mr. Sakhile Mndaweni** | Department of Water and Sanitation | MndaweniS@dws.gov.za |  |
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# REGIONAL MEETING ON TOOLS FOR THE SUSTAINABLE MANAGEMENT OF TRANSBOUNDARY AQUIFERS

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Birchwood Hotel & OR Tambo Conference Centre
Johannesburg, 28-31 July 2015

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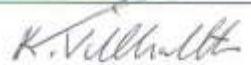
| **Ms. Karen Villholth** | International Water Management Institute<br>(IWMI) Principal Researcher - Groundwater Management | K.Villholth@cgiar.org<br>T: +27 (12) 845 9114 |  |
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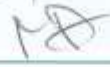
| **Mr. Munir Hanjra** | IWMI<br>Economist – Agricultural Water Management | m.hanjra@cgiar.org |  |
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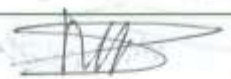
| **Mr. Stephen Donkor** | Stockholm International Water Institute (SIWI) | sdonkor@gmail.com<br>Stephen.donkor@siwi.org |  |
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***Groundwater Resources Governance in Transboundary Aquifers (GGRETA Project) – Stampriet Transboundary Aquifer System Stakeholder Consultation meeting***

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Johannesburg, 28-31 July 2015

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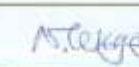
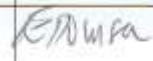
| **Mr. Nelson Lekgetho** | Ministry of Minerals, Energy and Water Resources<br>Department of Water Affairs | nlekgetho@gov.bw |  |
| **Mr. Edgar Sisa** | Ministry of Foreign Affairs and International Cooperation<br>Assistant Director for Multilateral Affairs | esisa@gov.bw |  |
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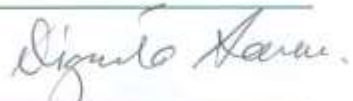
| **Mr. Diganta Sarma** | Namibia Hydrosearch CC | diganta@geonamibia.org<br>diganta.nh@gmail.com |  |
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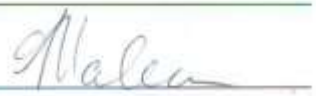
| **Mr. Siep Talma** | Independent Consultant | siep.talma@gmail.com<br>stalma@mweb.co.za |  |
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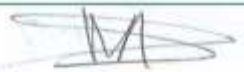
| **Mr. Stephen Donkor** | Stockholm International Water Institute (SIWI) | sdonkor@gmail.com<br>Stephen.donkor@siwi.org |  |
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# REGIONAL MEETING ON TOOLS FOR THE SUSTAINABLE MANAGEMENT OF TRANSBOUNDARY AQUIFERS

***Groundwater Resources Governance in Transboundary Aquifers (GGRETA Project) – Stampriet Transboundary Aquifer System Stakeholder Consultation meeting***

***and***

***Resilience in the Limpopo Basin (RESILIM)***

***The Potential of the Transboundary Ramotswa Aquifer (RAMOTSWA) Inception meeting***

Birchwood Hotel & OR Tambo Conference Centre
Johannesburg, 28-31 July 2015

## ATTENDANCE LIST – 31 JULY 2015

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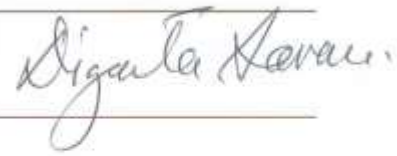
| **Mr. Diganta Sarma** | Namibia Hydrosearch CC | diganta@geonamibia.org<br>diganta.nh@gmail.com |  |
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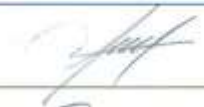
| **Mr. Ralph Mahfoud** | UNESCO<br>Water Sciences Division | r.mahfoud@unesco.org<br>T: +33 (0)1 45 68 39 14 |  |
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**Annex 4**

**Photos, Agenda, and Attendance Register from RAMOTSWA Inception Meeting, Gaborone**


**Group photo from the Inception Meeting, Gaborone**


**Dr. Obolokile Obakeng, PS MMEWR inaugurating the meeting**


**Dr Karen Villholth introducing the RAMOTSWA**

# Resilience in the Limpopo Basin (RESILIM)

# The Potential of the Transboundary Ramotswa Aquifer (RAMOTSWA)

**INCEPTION WORKSHOP ON THE RAMOTSWA TRANSBOUNDARY AQUIFER PROJECT**

Gaborone, 11-12 November 2015 (Department of Water Affairs)

## Programme

**Objectives:**

- **To introduce the Ramotswa Transboundary Aquifer Project to the key stakeholders in Botswana**
- **To discuss the implementation of the Project**
- **To discuss the involvement of other stakeholders and data needs and availability for the Project**

## DAY 1 • Wednesday, 11 November 2015

**Objectives:**

- **To introduce the Ramotswa Transboundary Aquifer Project to the key stakeholders in Botswana**
- **To discuss the implementation of the Project**

| **9:00-10:30** | **Introduction to the Inception Workshop and Official Opening** | **Chair: Dr Piet Kenabatho: National Project Coordinator, Department of Environmental Science, University of Botswana** |
|---|---|---|
| *9:00-9:10* | Introduction of the Workshop Participants | Dr Piet Kenabatho, UB |
| *9:10-9:20* | Welcome Remarks and Objectives of the Workshop | Mrs Bogadi Mathangwane, Acting Director, DWA, Botswana |
| *9:20-9:40* | Official Opening and Project Inauguration | Dr Obolokile Obakeng, Deputy PS, Ministry of Minerals, Energy and Water Resources, Botswana |
| *9:40-9:50* | Remarks from SADC | Mr Obonetse Alfred Masedi, Coordinator, Water Supply & Sanitation Program, SADC Water Division |
| *9:50-10:00* | Remarks from USAID/RESILIM | Mr John K.B. Harris, USAID Agreement Officer's Representative (AOR) |
| *10:00-10:10* | Remarks from IWMI | Dr Karen G. Villholth, Principal Researcher, IWMI, South Africa, Project Leader, RAMOTSWA |
| *10:10-10:20* | Link to RESILIM | David Gadd, Program Manager, RESILIM |
| *10:20-10:30* | Introduction to the Ramotswa Transboundary Aquifer Project | Dr Karen Villholth, Principal Researcher, Project Leader, RAMOTSWA |
| **10:30-11:00** | **Coffee break** | |

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| **11:00-13:00** | **Status and Current Knowledge of the Ramotswa Aquifer** | **Chair: David Gadd, Program Manager, RESILIM** |
| *11:00-11:15* | Groundwater Development and Management in Ramotswa Wellfields (Botswana) | Mr Thato Setloboko, Head of Groundwater, DWA, Botswana |
| *11:15-11:30* | Geology and Hydrogeology of Ramotswa Aquifer (Botswana) | DGS, Botswana |
| *11:30-11:45* | The AU-EU Project on Ramotswa wellfield and Small Dams in the Notwane catchment | Dr Piet Kenabatho, University of Botswana |
| *11:45-12:00* | Hydrogeology and Groundwater in Ramotswa Aquifer (South Africa) | Mr Yvan Altchenko, Hydrogeologist, IWMI, South Africa |
| *12:00-12:15* | Overview of Wastewater Management Upstream of Gaborone Dam with Focus on Ramotswa and her Hinterland | Mr Jonathan Baumake, Water Utilities Corporation (WUC), Botswana |
| *12:15-12:30* | Potential for Wastewater Re-use in the Ramotswa Area | Dr Munir Hanjra, Researcher International, IWMI, South Africa |
| *12:30-12:45* | Overview of the Socio-economic Issues and Stakeholder Composition in the Ramotswa Area | Dr Bothepha Mosetlhi, Department of Environmental Science, University of Botswana |
| *12:45- 13:00* | Questions and Discussion | All |
| **13:00-14:00** | **Lunch** | |
| **14:00-15:30** | **Methodologies, Data availability and Knowledge Gaps** | **Chair: Mr Thato Setloboko, DWA** |
| 14:00-14:20 | Detailed Presentation of the RAMOTSWA Project:<br>• Objectives<br>• Approaches/Work Packages<br>• Timeframe | Dr Karen Villholth, IWMI |
| 14:20-14:40 | Potential Areas of Research Collaboration and Student Involvement in the Project | Dr Modreck Gomo, Researcher/ Geohydrologist, Univ. of the Free State, South Africa |
| 14:40-15:55 | Socio-economic Approaches to the Project | Dr Bothepha Mosetlhi, Department of Environmental Science, Univ. of Botswana |
| 15:55-15:10 | Potential for Airborne Geoscience Mapping in the Ramotswa Transboundary Aquifer | Mr Matt Bell, Principal Portfolio Manager, XRI, USA *(remotely)* |
| 15:10-15:30 | Ramotswa Information Management System (RIMS) | Mr Geert-Jan Nijsten, Hydrogeologist/Senior Researcher, IGRAC, The Netherlands *(remotely)* |

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|---|---|---|
| **15:30-15:45** | **Coffee break** | |
| **15:45-17:00** | **Closing Session** | **Chair: Dr Karen Villholth, IWMI** |
| 15:45-16:45<br><br>16:45-17:00 | Discussion and Way Forward<br><br>Vote of Thanks and Closing Remarks | Dr Karen Villholth, IWMI<br><br>Mr Tiyapo Hudson Ngwisanyi, Director, Department of Geological Survey, Boswana |

## DAY 2 • Thursday, 12 November 2015, Gaborone and Lobatse

**Objectives:**

- **To discuss the involvement of other stakeholders and data availability for the Project**

| | | |
|---|---|---|
| 08:00-09:30 **(Lobatse)** | Meeting with DGS officers (to get understanding of the available data for the project, e.g. geodata, aeromagnetic data, water levels/water quality, geological and hydrogeology maps) | **Facilitator**: Mr Ngonidzashe Isaac Tobani, Hydrogeologist, DGS |
| 10:30-11:30 **(Gaborone)** | Meeting with DWA officers (Hydrology, & Hydrogeology Divisions) - for hydrogeology maps, water levels/water quality/hydrological data) | **Facilitator:** Mr Thato Setloboko, Head of Groundwater, Department of Water Affairs |
| 12:00-13:00 **(Gaborone)** | Meeting with WUC officers (Hydrology, & Hydrogeology Divisions) - for water abstraction data, water quality data & wastewater | **Facilitator:** Mr Moses Moehadu, Principal Hydrogeologist, WUC |
| 14:30-15:30 **(Gaborone)** | Meeting with researchers at UB (Geology and Environmental Science) | **Facilitator:** Dr Piet Kenabatho, Department of Environmental Science, University of Botswana |
| **15:30-16:30** | **Wrap up and Way Forward** | **Facilitator:** Dr Karen Villholth, IWMI & Piet Kenabatho, UB |

# Attendance List - RAMOTSWA 2nd Inception Meeting, 11 Nov 2015. Please, add your tel. no.!

| No | Name | Title, Institution | Email/ Tel. no | Signature |
|---|---|---|---|---|
| **MMEWR, Min. of Minerals, Energy and Water Resources, Botswana** | | | | |
| 1 | Dr Obolokile OBAKENG | **Deputy Permanent Secretary,** Min. of Minerals Energy and Water Resources | oobakeng@gov.bw Tel. no.: | |
| **UB, Univ. of Botswana** | | | | |
| 2 | Dr Ronald CHAOKA | Univ. of Botswana, **Geology** | Chaokatr@mopipi.ub.bw Tel. no.: | |
| 3 | Dr Tebogo MASAKA | Univ. of Botswana, **Geology** | MasakaT@mopipi.ub.bw Tel. no.: | |
| 4 | Dr Piet KENABATHO | Univ. of Botswana, **Environmental Science** | kenabatho@mopipi.ub.bw Tel. no.: | |
| 5 | Dr Bothepha MOSETLHI | Univ. of Botswana, **Environmental Science** | Bothepha.Mosetlhi@mopipi.ub.bw Tel. no.: | |
| **WUC, Water Utilities Corporation, Botswana** | | | | |
| 6 | Mr Gaselemogwe SENAI | **Director, Sustainability and Water Resources,** Water Utilities Corporation | gsenai@wuc.bw Tel. no.: | |
| 7 | Mr Moses MOEHADU | **Principal Hydrogeologist,** Water Utilities Corporation | mmoehadu@wuc.bw -267- Tel. no.: 73969468 | |
| 8 | Mr Jonathan BAUMAKE | Water Utilities Corporation | JBaumake@wuc.bw Tel. no.: +267 73970027 | |

| No | Name | Title, Institution | Email/ Tel. no | Signature |
|---|---|---|---|---|
| **DGS, Dept. of Geological Survey, Botswana** | | | | |
| 9 | Mr Tiyapo Hudson NGWISANYI M.H. KOKGTSO | Deputy **Director**, Dept. of Geological Survey, Botswana | tngwisanyi@gov.bw / mkokotso@gov.bw Tel. no.: | |
| 10 | Mr Ngonidzashe Isaac TOBANI | **Hydrogeologist**, Dept. of Geological Survey | ntobani@gov.bw or ntobani@gmail.com Tel. no.: 5336744 | |
| **DWA, Dept. of Water Affairs, Botswana** MR SEITSANG SABONE HYDROGEOLOGIST / DWA | | | setsabone@gov.bw | |
| 11 | Mrs Bogadi MATHANGWANE | **Acting Director**, Dept. of Water Affairs | bmathangwane@gov.bw Tel. no.: | |
| 12 | Mr Thato SETLOBOKO | **Head of Groundwater**, Dept. of Water Affairs | tssetloboko@gov.bw Tel. no.: 3607231 | |
| 13 | Mr George THABENG | **Head of Hydrology and Water Resources**, Dept. of Water Affairs | gthabeng@gov.bw Tel. no.: | |
| 14 | Ms Kene DICK | **Principal Water Chemist**, Dept. of Water Affairs | kdick@gov.bw Tel. no.: | |
| 15 Soniso Enkuringwa Head of Water Quality Monitoring Section / DWA | | | Senkuringwa@gov.bw | |
| **SADC, Southern African Development Community** 16. Tracy Moleti Deputy Director - IWD Dept of Water Affairs | | | tsmoleti@gmail.com tsmoleti@gov.bw | 3607155 |
| 15 | Mr Obonetse Alfred MASEDI | **Coordinator, Water Supply & Sanitation Program,** SADC Water Division | omasedi@sadc.int Tel. no.: 72106053 | |
| **NGOs** | | | | |
| 16 | Mr Baboloki AUTLWETSE | **Deputy CEO**, Kalahari Conservation Society | baboloki@kcs.org.bw Tel. no.: | |



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| No | Name | Title, Institution | Email/ Tel. no | Signature |
|---|---|---|---|---|
| **INTERNATIONAL PARTNERS** | | | | |
| **RESILIM, Resilience in the Limpopo River Basin Program** | | | | |
| 17 | Dr Nkobi MOLEELE | **Chief Scientist** | nmoleele@resilim.com<br>Tel. no.: | |
| 18 | Mr David GADD | **Program Manager** | dgadd@resilim.com<br>Tel. no.: +27 71 676 9421 | |
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| 19 | Dr Karen Grothe VILLHOLTH | **Principal Researcher** | k.villholth@cgiar.org<br>Tel. no.: +27 0716884011 | K. Villholth |
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| **UFS, Univ. of the Free State, South Africa** | | | | |
| 23 | Dr Modreck GOMO | **Researcher/Geohydrologist** | gomom@ufs.ac.za<br>Tel. no.: | Gomo |
| **USAID, United States Agency for International Development** | | | | |
| 24 | Mr John K.B. HARRIS | **Agreement Officer's Representative (AOR)** | jkbharris@usaid.gov<br>Tel. no.: +27 72 625 6429. | |

| No | Name | Title, Institution | Email/ Tel. no | Signature |
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| **XRI Geophysics** | | | | |
| 25 | Mr Matt BELL (remotely) | **Principal Portfolio Manager** | matt.bell@xrigeo.com Tel. no.: | |
| **IGRAC, International Groundwater Resources Centre** | | | | |
| 26 | Mr Geert-Jan NIJSTEN (remotely) | **Hydrogeologist/Senior Researcher** | geert-jan.nijsten@un-igrac.org Tel. no.: | |
| **Newcomers** | | | | |
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| 30 | ~~MODREC~~ | | | |
| 31 | Chimbi Leutlwetse | Programme Officer SASSCA | 3980367 chimbizani.leutlwetse@sassca.org | |
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| 35 | BOTHEPHA MOSETURI | → See Above | | |
| 36 | PELOTSHWEU PHOFUETSILE | Deputy Director – DWA | pphofuetsile@gov.bw | |
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1. DGS

| Participant Names | Title ~~Position~~ | Email and telephone number |
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