



water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Strategy and Guideline Development for National Groundwater Planning Requirements



Capacity Building Component 1



DECEMBER 2008



Title: **Capacity Building Component 1**
Authors: A Taigbenu University of the Witwatersrand
WR Nyabeze WR Nyabeze & Associates
R Titus Water Geosciences Consulting
K Witthuser Water Geosciences Consulting

Project Name: **Strategy and Guideline Development for National Groundwater Planning Requirements**

DWA Contract Number WP 9390

DWA Report Number P RSA 000/00/11609/4

Status of Report: Final

ILISO Consulting (Pty) Ltd
Approved for ILISO Consulting (Pty) Ltd

Director:
ILISO Consulting (Pty) Ltd
Dr Martin van Veelen

Project Manager:
Department of Water Affairs
Mr Fanus Fourie

Department of Water Affairs
Water Resources Planning Systems

Approved for the Department of Water Affairs

Director:
Water Resource Planning Systems
Dr Beason Mwaka

Deputy Director:
Water Resource Planning Systems
Mr Elias Nel

Published by
Department of Water Affairs
Private Bag X313
Pretoria
0001
Republic of South Africa
Tel: (012) 336-7500

Copyright reserved

No part of the publication may be reproduced in any manner without full acknowledgement of the source

This report should be cited as:

Department of Water Affairs, 2009. Strategy and Guideline Development for National Groundwater Planning Requirements. Capacity Building, Component 1. RSA 000/00/11609 - Activity 9 (NGS04), dated December 2008

Disclaimer:

Although the information contained in this document is presented in good faith and believed to be correct, the Department of Water Affairs makes no representations or warranties as to the completeness or accuracy of the information, which is only based on actual information received, and makes no commitment to update or correct information.

Professional Service Provider:



203 Witch-Hazel Avenue
Highveld Technopark
0157

PO Box 68735
Highveld
0169

Tel: 0861 245 476
Fax: (012) 665 1886



Pentagon House
Cnr Cliffendale & Plettenberg Road
Faerie Glen

PO Box 40161
Faerie Glen
0043

Tel: 083 290 7253
Fax: 086 6842 611



54 Irene Avenue
Somerset West
7130

54 Irene Avenue
Somerset West
7130

Tel: (021) 852 0847
Fax: (021) 852 0847



Unit 126 Phase 4
Midrand Business Park

PO Box 863
Witkoppen
2068

Tel: (011) 315 6791
Fax: (011) 312 2148

ACKNOWLEDGEMENTS

We would like to acknowledge the contributions of the Project Management Committee and the Project Steering Committee in this report.

Note on the Department of Water Affairs (DWA)

The Department of Water Affairs (DWA) was until recently known as the Department of Water Affairs and Forestry (DWAF). The Department of Water Affairs is part of the Ministry of Water and Environmental Affairs, under a single Minister. The acronyms “DWA” and “DWAF” both appear in this report, the latter mainly as references to past work done when the Department was known as the Department of Water Affairs and Forestry.

Strategy and Guideline Development for National Groundwater Planning Requirements

TABLE OF CONTENTS

1. INTRODUCTION	1-1
2. PURPOSE OF THE REPORT	2-1
3. DESCRIPTION OF THE PROCESS.....	3-1
3.1 TEAM INTERACTIONS	3-1
3.2 MEETINGS WITH STAKEHOLDERS	3-1
3.3 QUESTIONNAIRE SURVEYS	3-1
3.4 PRESENTATIONS AND FEEDBACK FROM THE PSC	3-2
3.5 E-MAIL AND TELEPHONIC COMMUNICATION	3-2
4. RESULTS.....	4-1
4.1 INSTITUTIONS INVOLVED IN CAPACITY BUILDING IN GROUNDWATER.....	4-1
4.2 SURVEY OF COURSE OFFERINGS.....	4-7
4.3 TIMELINE OF GRADUATES IN THE PAST 10 YEARS.....	4-19
4.4 PLAN FOR INVOLVEMENT OF HDIS IN NGS ACTIVITIES.....	4-19
5. ISSUES FOR INCORPORATION INTO THE CAPACITY BUILDING COMPONENT OF THE NGS..	5-1
5.1 FUNDING	5-1
5.2 EMPLOYMENT.....	5-1
5.3 TRAINING PERSONNEL.....	5-1
5.4 LABORATORY AND FIELD EQUIPMENT	5-2
5.5 TYPES OF COURSES.....	5-2
5.6 PARTNERSHIP & NETWORKING	5-2
6. REFERENCES.....	6-1

LIST OF FIGURES

FIGURE 4-1: TIMELINE FOR HYDRO GEOLOGY GRADUATES.....	4-19
---	------

EXECUTIVE SUMMARY

This activity identified eleven universities in the Southern Africa Development Community (SADC) which have experienced an increasing number of hydrogeology postgraduate students completing their studies in the past ten years. These are Rhodes University, Tshwane University of Technology, University of Western Cape, University of the Free State, University of Pretoria, University of Stellenbosch, University of the Witwatersrand, University of Venda and the University of the Western Cape, University of Botswana and University of Dar es Salaam. Of these universities, nine are in South Africa. The programmes offered fall into three main categories namely conventional (formal undergraduate or postgraduate), modular and ad-hoc (or continuing professional development). In the past 10 years the University of the Free State produced the most post-graduates (about 60) followed about the University of the Western Cape (about 20).

The sustainability of these capacity building initiatives is affected by a number of factors which include financial assistance to meet the running costs, better job prospects for graduates, low numbers of dedicated trainers and the huge capital cost associated with laboratory and field equipment. Current efforts to address some of these constraints include partnerships and networking within WaterNet, AfricaArray, CAPNet, AGWNet, and FETWater. The many benefits of these partnerships and networks are:

- Enabling of staff to participate in teaching, research and other related activities in institutions in the SADC region, thereby enhancing interaction between staff and students in the region.*
- The reduction in training cost through sharing of training resources.*
- Enhancement of the capacity to address cross-border (transboundary) water issues.*
- Increased chances of attracting funding through multi-institutional research and teaching activities*
- Achievement of synergies of capacity and expertise*
- Attainment of better leverage in addressing groundwater problems.*

The Water Research Fund for Southern Africa, the Water Research Commission and the Construction Education and Training Agency also offer opportunities for funding in research and training. However, there are many identified constraints to networking among them:

- Weak IT infrastructure in some SADC countries.*
- Lack of adequate human capacity to roll out regional and Africa-wide initiatives.*
- Lack of technical and administrative manpower to sustain these networks.*

The four firms involved on this project have 24 HDI staff of which 13 are involved on the NGS. A plan (including costs) is presented to involve them in eight activities on the Roll-out of the Artificial Recharge Strategy.



Component 2 of the Capacity Building activity will assess the capacity gaps within DWAF and groundwater management institutions (identified in the Stakeholder Participation and Institutional Assessment activity). The information and findings in this report will inform the capacity building strategy for the National Groundwater Strategy.

Strategy and Guideline Development for National Groundwater Planning Requirements

1. INTRODUCTION

Water legislation in South Africa has triggered wide spread reforms in the sector demanding decentralized management and a shift from a supply driven system to a demand oriented paradigm. This, however, comes at a time of challenges to human capacity in the water sector, such as an ageing workforce, emigration of professionals, and constraints on university training. The supply of skilled people is not keeping up with demand. A key concern of the National Water Resource Strategy is the use and management of groundwater resources. In order to use and manage groundwater in a sustainable manner a cadre of professionals with the requisite knowledge and skills base is required. There is, thus, a need for greater numbers of skilled hydrogeologists entering and staying in the sector, with better training, improved working conditions and clearer career trajectories within the framework of integration.

The lack of adequate capacity in the field of hydrogeology in the Department of Water Affairs and Forestry (DWAF) and South Africa as a whole negatively impacts on all functions of groundwater operations and management as well as on the efficiency of water resource management institutions. Adequate capacity plays a very important role in the realization of the successful implementation of the National Ground Water Strategy (NGS), thereby supporting the South Africa's National Water Act (1998).

More specifically the NGS should facilitate national capacity building in groundwater and also encourage better integration of groundwater training in other programmes. The main thrust of capacity building should be to ensure successful integration without the risk of groundwater being subsumed.

2. PURPOSE OF THE REPORT

This report identifies the relevant existing training institutions and presents their on-going training programmes in groundwater, taking cognisance of involvement of HDIs in these programmes. It identifies the gaps that exist between the number of graduates and the requirements to adequately support the NGS. A capacity building plan is developed for the training of HDIs during the course of the development of the NGS. Lessons from this exercise will provide better understanding of the practical constraints to increased involvement of HDIs in the groundwater sector.

This is one component of the capacity building strategy for the NGS, a second part which is yet to be done will assess the capacity requirements of water management institutions in South Africa to develop and manage (including protecting) groundwater.

3. DESCRIPTION OF THE PROCESS

3.1 TEAM INTERACTIONS

A brainstorming meeting was held by the team to map out the approach required to successfully implement this task. Responsibilities were allocated with time lines on when different aspects should be accomplished. It was also decided that continuous interaction among team members would be facilitated through email exchanges.

3.2 MEETINGS WITH STAKEHOLDERS

The following meetings were held as part of this activity:

- a) Dr Paul Taylor of CAPNET
- b) Ms Verena Meyer of the DWAF Learning Academy
- c) Prof Paul Dirks of the Africa Array

The discussions focused on their course offerings, target groups, training experiences, costs involved and sources of funding. The outcomes of these meetings are presented in section 4.1.

It was recognized at the very onset of embarking on this task that there are linkages with the Activity 1 on Stakeholder participation and Institutional assessment. Hence it was decided that there will interaction with team members of this activity during the inception workshop and thereafter, and that a draft of this report will be made available to activity team members.

3.3 QUESTIONNAIRE SURVEYS

Brief questionnaires were developed to obtain consistent responses and aid analysis and comparison. They were tested before application by one of the team members and the example was circulated with the request for information. Explanations of the various headings of the table were provided. These surveys were done for the assessment of the involvement of HDIs and for the collection of information from identified training institutions.

The responses to the questionnaire provided information on the courses that are being offered not only in South Africa but other parts of the world, particularly the SADC region for benchmarking purposes and to address the concern from the PSC as noted later in this document. The courses were not limited to science- and engineering-based courses of geology, groundwater hydrology, geohydrology, but also courses related to the social, legal, and economic aspects of groundwater.

3.4 PRESENTATIONS AND FEEDBACK FROM THE PSC

The approach and progress on this activity were presented to the Project Steering Committee (PSC) at its scheduled meetings. Useful feedback was provided which influenced the direction of this investigation. For example the PSC noted that the human capacity gap cannot be addressed meaningfully by focusing on a particular category of people. Furthermore such an approach could result in negative perceptions which would not enhance the implementation of the strategy. For example extra effort might be required to prove that the knowledge or skills imparted and, more importantly, its uptake by the participants matches that provided in more widely targeted programmes. In addition those targeted by such a program may shun away from it out of fear that the labeling may not be to their advantage. A suggestion was made at the PSC meeting of 2008 to develop a wider plan for participation of more staff from the JV companies and their sub-consultants. However, monitoring would still be done to identify constraints to the engagement of larger numbers of HDI personnel and to make an assessment on how this can be improved. It was also noted that human resources in the sector are highly mobile and that human resource capacity may have to be reliant on skills from across the African continent and beyond. Already indications are that the real opportunities in dealing with the capacity gap in South Africa lie in regional, continental and international initiatives.

3.5 E-MAIL AND TELEPHONIC COMMUNICATION

In some instances communication was done by e-mail and telephone calls. This was mainly to set to up appointments for meetings and to obtain clarity on important issues.

4. RESULTS

4.1 INSTITUTIONS INVOLVED IN CAPACITY BUILDING IN GROUNDWATER

The following training institutions were identified by the task team.

Country and relevant institution	Department	Contact person	Contact E-mail	Contact Telephone	Other / Admin	Contact E-mail	Contact Telephone
South Africa:							
University of the Free State – only post graduate	Institute for Groundwater Studies (UFS)	Dr Ingrid Dennis	dennisi.sci@ufs.ac.za	051 401 3481/2175	Dr Dannie Vermeulen	usherb.sci@ufs.ac.za	051 401 2175
University of the Western Cape– post and undergraduate	Earth Science Department	Prof. Abraham Thomas	athomas@uwc.ac.za	021 9593881	Mrs. Wasielah Davids	wdauids@uwc.ac.za	021 959 2223
University of the Western Cape– post and undergraduate	The UNESCO Chair Centre on Groundwater Earth Science Department	Mr Jaco Nel	jmnel@uwc.ac.za	082 809 5701	Henock Solomon	hsolomon@uwc.ac.za	021 959 2683
University of Pretoria– post and undergraduate	Department of Geology	Prof Louis Van Rooy	louis.vanrooy@up.ac.za	012 420 2794	Mrs. Melinda Deswardt	melinda.deswardt@up.ac.za	012 420 2454
University of KwaZulu Natal – post and undergraduate	School of Bioresources Engineering and Environmental Hydrology	Professor R E Sc.hulze	schulzer@ukzn.ac.za	033 260 5489			
University of the Witwatersrand – post and undergraduate	School of Civil and Environmental Engineering	Prof. Akpofure Taigbenu	akpofure.taigbenu@wits.ac.za		Mrs TM Mtselu	TMT@civil.wits.ac.za	011 717 7121
	School of Geosciences	Dr. Tamiru Abiye	tamiru.abiye@wits.ac.za		Mrs Melody Van Wyngaard	e-mail: melody.vanwyngaard@wits.ac.za	011 717 6547
University of Venda - post and undergraduate	Department of Hydrology and Water Resources	Prof. JO Odiyo	odiyo@univen.ac.za	015 962 8577			
Rhodes University- post and undergraduate	Dept of Environmental Science	Prof. Charlie Shackleton	c.shackleton@ru.ac.za	046 603 7001	Jenfred Engelbrecht	j.engelbrecht@ru.ac.za	046-603 7002
	Department of Geology	Dr Steve Prevec	s.prevec@ru.ac.za		The Secretary	geolsec@ru.ac.za	046 603 8309

Country and relevant institution	Department	Contact person	Contact E-mail	Contact Telephone	Other / Admin	Contact E-mail	Contact Telephone
Tshwane University of Technology- post and undergraduate	Department of Environmental, Water and Earth Sciences	Ms Retha Gerber or Ms Zicki Joubert	gerberme@tut.ac.za ; joubertmd@tut.ac.za	012 382 6232	Ms Annalise Minnaar	minnaara@tut.ac.za	012 382-6115 / 6379
Stellenbosch University- post and undergraduate	Department of Geology, Geography and Environmental Studies	Prof. John Clemens	jclemens@sun.ac.za	021 808 3159	Ms. Loxie Conradie, Geology	lcon@sun.ac.za	021 808 3219
Botswana:							
University of Botswana, Gaborone only post graduate	Department of Geology	Dr. Berhanu F. Alemaw	alemaw@mopipi.ub.bw	(267) 355 2539			
Tanzania:							
University of Dar Es Salaam, post graduate	Department of Water Resources Engineering	Dr. S.H.Mkhandi	mtalo@wrep.udsm.ac.tz	(022) 2410029 (Direct)			
Other							
Central University of Technology, Freestate	School for Civil Engineering & Built Environment	The Programme Head: Civil Engineering	info@cut.ac.za	051 507 3082			

The following institutions were also identified as important role players in facilitating training of water professionals through either continuing professional development programmes and/or funding of such programmes.

- a) Framework Programme for Research, Education and Training in the Water sector (FETWater)
- b) Water Research Commission
- c) SETAs
- d) CAPNET
- e) WaterNet
- f) The Water Research Fund for Southern Africa (WARFSA)
- g) The African Groundwater Network (AGW-NET)
- h) DWAF Learning Academy
- i) The University of Western Cape UNESCO Chair of Geohydrology

More specific information about each of these institutions/programmes is presented the following section.

a) Framework Programme for Research, Education and Training in the Water sector (FETWater)

The Framework Programme for Research Education and Training in Water (FETWater) is a programme that supports training and capacity building networks in integrated water resource management in South Africa (UNESCO-DWAF-WMO, 1998).

FETWater was established in collaboration between the Department of Water Affairs and Forestry, the United Nations Educational Scientific and Cultural Organisation (UNESCO), the Flemish Government, the Water Research Commission and numerous education and training providers in South Africa. A Groundwater Network has been established with the purpose to ensure training in Groundwater related programmes.

FETWater can fund student mobility to attend workshops (R 60 000) as well as lecturer mobility between universities to present short courses (R 20 000). The total mobility budget is split evenly amongst tertiary institutions, to get a broad representation. The FETWater support also covers a geophysics short course.

b) Water Research Commission (WRC)

Established under the Water Research Act (Act No 34 of 1971), WRC harnesses the knowledge capital in the water sector in South Africa to facilitate, coordinate and fund water research through institutions where the expertise reside. Its establishment in 1971 is in recognition that water will be one of the limiting factors to the growth and development of South Africa in the 21st century. Since its inception, it has provided strategic direction and leadership by identifying priority areas of research, broadening of the country's water-centred R&D base, and development of human capacity through funding of Masters and doctoral research in the water sector, thereby ensuring appropriate technology transfer takes place. By its activities, WRC supports the implementation of the National Water Act of 1998 and related national water strategy. It is also playing a key role of South Africa in its interaction with SADC and NEPAD (New Partnership for Africa's Development), especially with respect to water resource and water supply and sanitation issues.

The mandate entrusted to the WRC includes:

- Promoting co-ordination, co-operation and communication in the area of water research and development
- Establishing water research needs and priorities
- Stimulating and funding water research according to priority
- Promoting effective transfer of information and technology
- Enhancing knowledge and capacity-building within the water sector.

c) SETAs

SETA stands for Sector Education and Training Authority. The members of a SETA include employers, trade unions and government departments. SETAs are established by the Minister of Labour in terms of the Skills Development Act. The functions of SETAs include the development and implementation of a sector skills plan, registering and promoting learnerships and applying to South African Qualifications Authority (SAQA) for accreditation as an Education and Training Quality Assurance body (ETQA) for qualifications in its sector. A learnership is a structured learning programme which includes practical work experience, and leads to an occupationally-related qualification registered on the NQF. A skills programme is a learning programme which is occupationally based and for which a learner may obtain a credit towards a qualification registered on the National Qualifications Framework (NQF), once the skills programme has been successfully completed.

d) CAPNET

Cap-Net is an international network for capacity building in IWRM. It is made up of a partnership of autonomous international, regional and national institutions and networks committed to capacity building in the water sector. CAP-Net support also covers setting up of training materials and training of network institutions and river basin organizations to be able to conduct capacity building activities.

e) WaterNet

WaterNet is a network of 52 university departments, research and training institutes specializing in the field of water resources in the SADC region, including Kenya and Uganda. The network aims to build regional institutional and human capacity in Integrated Water Resources Management (IWRM) through training, education, research and outreach by harnessing the complementary strengths of member institutions in the region and elsewhere. WaterNet member institutions have expertise in various aspects of water resources management and are based in Southern and East Africa.

WaterNet also runs a professional training programme which is aimed at facilitating competency training to meet the needs of SADC, Country Water Partnerships, River Basin organisations, Community Based organisations, and various actors and practicing professionals in the water and related sectors. This is done in close collaboration with the SADC Water Division, and Global Water Partnership-Southern Africa.

Joint capacity building initiatives between members and other regional partners are creating the necessary mechanisms for sustained development of the requisite technical, managerial and negotiation skills required for managing shared water resources.

WaterNet, together with Cap-Net and GWP-SA, are supporting the GWP Country Water Partnerships in an initiative to build capacity at national level to enable the development of national IWRM plans (as part of the implementation of the World Summit on Sustainable Development plan of action on water) (CapNet, WaterNet BGR, 2008a).

f) The Water Research Fund for Southern Africa (WARFSA)

WARFSA was established in 1999 to support the WaterNet initiative through funding research activities in water resources management. Most of the funding for the project has been from SIDA. The specific objectives of WARFSA are:

- To promote and facilitate the implementation of multidisciplinary research projects in the integrated water resources management in the SADC region,
- To promote the utilization of research results for decision making aimed at ensuring sustainable development of water resources,
- To encourage research that leads to better use of precipitation to increase land productivity or availability of water for domestic use.

g) The African Groundwater Network (AGW-NET)

The AGW-NET was established on 22 July 2008 in Pretoria, South Africa (CapNet, WaterNet BGR, 2008b). The network is an Africa wide group of groundwater professionals who have committed to work together to roll out capacity building on groundwater management in Africa. The formation of the group is in response to the results of recent surveys on groundwater management and capacity building needs in West Africa, Southern Africa and the Nile Basin.

The AGW-NET is open to membership from practising groundwater professionals and those from related professions. The group has planned courses along the following themes:

- Assessment tools for groundwater management at basin level linked to IWRM. Monitoring (quality and quantity), drilling and well design
- Gender and sustainable finance for maintenance of groundwater infrastructure in rural settings
- Refresher courses, pump test analysis, hydrochemistry and Groundwater exploration

h) DWAF Learning Academy

Human resource development lies at the heart of the transformation of DWAF. The structure of the Department has been and is being reviewed to give emphasis to the functioning of a new Directorate: Human Resource Development. Formal employment equity and gender policies have been developed and are being implemented. Attention has also been focused on the appointment of previously disadvantaged persons. This, accompanied by a restructured bursary programme, a vigorous in-house training

programme, and opportunities for existing staff to further their education, is laying the foundation for the development of a team of competent personnel in this field.

The main function of the DWAF Learning Academy is to identify young professional who are interested in working in the water sector and placing them on DWAF programmes for training and mentorship. The increasing use of information, more complex technologies and a general rise in the skill requirements of jobs, demand that people must also have rising levels of applied competence. Thus the focus of the Learning Academy is about deepening individual's specialised capabilities and enable them to continue learning and adapting to the constantly changing environment.

i) The University of the Western Cape UNESCO Chair of Geohydrology

The UNESCO Chair of Geohydrology was established in 1998 following the introduction of The National Water Act of the same year by the national Department of Water Affairs and Forestry (DWAF). The chair mainly focuses on groundwater education and research; the protection of water resources and ecosystems as well as the implementation of the Water Act. It aims to assist with implementation of national water policies through the capacity building of the groundwater industry. It is also aimed at contributing to implementation of the NEPAD Initiative.

The UNESCO Chair is guided by UNESCO and the National UNESCO Commission and supported by the DWAF. Extensive networks at national and international levels are established with a focus on Southern Africa.

4.2 SURVEY OF COURSE OFFERINGS

The results from the survey on course offerings were as follows:

Name of Institution	Name of Department	Nature of programme	Name of course	Level of offering
University of the Witwatersrand	Civil & Environmental Engineering	Conventional	Hydrology	Undergraduate (3rd year)
University of the Witwatersrand	Geosciences	Conventional	Principles of Hydrogeology Geohydrology	Undergraduate (3 rd year) Honours (4 th year)
University of Dar-es-Salaam	Water Resources Engineering	Modular	Introduction to Hydrogeology	Masters
University of Venda	Hydrology and Water Resources	Conventional	Hydrology and Water Resources	Undergraduate (4 th year)

University of Botswana	Department of Geology	Conventional	MSc Hydrogeology	Postgraduate
University of the Western Cape	Earth Science	Conventional		Undergraduate (3 rd Year)
University of the Western Cape	Earth Science	Conventional	Geohydrology Environmental Law Catchment Processes	Postgraduate (BSc Hons)
University of the Western Cape	Earth Science	Conventional	Full research MSc in Geohydrology Catchment Processes	Postgraduate (MSc) Postgraduate (PhD)
University of the Western Cape	Earth Science	Ad Hoc	Fractured rock aquifers Groundwater modelling Geochemistry Ecohydrology IWRM	Short courses and workshops
University of Botswana	Department of Geology	Ad-hoc	Short course on Hydrological modelling	Postgraduate
University of Botswana in collaboration with the University of the Western Cape	Department of Geology	Ad-hoc	Short course on Groundwater and pollutant transport modelling	Postgraduate
University of Pretoria	Geology	Conventional	Engineering and Environmental Geology	Postgraduate (4 th year)
University of the Free State	Institute for Groundwater Studies (IGS)	Conventional	BSc (Hons), MSc and PhD in Hydrogeology	Postgraduate

A conventional programme consists of a formal undergraduate or postgraduate programme in either geology, groundwater, hydrogeology or related disciplines offered in a university or technikon. A modular programme is offered in modules by a degree-awarding institution in either geology, groundwater, hydrogeology or related disciplines. Ad-hoc or continuing professional development – CPD programme (this covers courses offered for CPD, in-service training, or as seminars, workshops, fields trips and excursions, etc that are not coordinated for an overall exit outcome)

The conventional programme would be at the level of undergraduate or postgraduate. The modular programs could be part of a conventional programme or stand alone. The ad-hoc programmes included CPD courses, in-service courses and mentorship related courses.

The results from the survey on course offerings were as follows:

Name of Institution	Details of course syllabus	Percentage of course related to groundwater	Exit qualification or certificate	Year of inception of programme	Average no. of graduates annually	Percentage of HDIs in programme annually	Funding sources
University of the Witwatersrand	Water cycle, Water Resources, Surface water hydrology, Groundwater.	25%	Honours degree in Civil Engineering	1930's	20	40%	Student fees and government grant
University of the Witwatersrand	Hydrologic cycle, hydrological processes, groundwater flow, groundwater zonation, hydrogeochemistry. Geochemical processes and modelling, Numerical modelling, Isotope hydrology, contaminant attenuation	90%	Honours degree in Geosciences		40		Student fees and government grant
		100%	MSc in Geosciences		26		
University of Dar-es-Salaam	Groundwater occurrence; Geological Processes and Formations; Principles of Groundwater Flow; Methods of Solution of Groundwater Flow Equations; Groundwater Recharge and Discharge	100%	Masters degree in Integrated Water Resources Management	2002	25	100% Black	WaterNet, Nile Basin Initiative, Fees from private candidates

Name of Institution	Details of course syllabus	Percentage of course related to groundwater	Exit qualification or certificate	Year of inception of programme	Average no. of graduates annually	Percentage of HDIs in programme annually	Funding sources
University of Venda	Surface water hydrology, hydrogeology, Water resources management, water quality, water supply and sanitation and meteorology	30 %	Four year undergraduate degree	2000	10	100 %	Student fees, government grant and non-governmental organisations bursaries/ scholarships
University of the Western Cape	Environmental Impact Assessment Geohydrology	25%	BSc Hons in Environmental Water Science	2000	10	99%	Student Fees and Consulting income
University of the Western Cape	GIS Catchment Processes Environmental Law	100%	MSc in Environmental Water Science	2000	2-3	90%	WRC, NRF, International collaboration and Industry research
University of the Western Cape		100%	PhD in Environmental Water Science	1995	1	70%	WRC, NRF, International collaboration and Industry research

Name of Institution	Details of course syllabus	Percentage of course related to groundwater	Exit qualification or certificate	Year of inception of programme	Average no. of graduates annually	Percentage of HDIs in programme annually	Funding sources
University of Botswana	Water cycle, Water Resources, Surface water hydrology, Groundwater.	90% (Some elements of surface water are covered in IWRM, Stochastic hydrology, surface/groundwater interaction and design of structures for flood control)	MSc degree in Hydrogeology	2001	3	100% Black	UNESCO/ANSTI, DAAD, UB Department of Geology (explain abbreviations)
	Short course on hydrological modeling	100%	Course certificate	2007	5-10	30%	Government of Botswana
	Short course on Groundwater and pollutant transport modelling	100%	Course certificate	2008 (to be done in collaboration with UWC)	5-10	Not yet started	NUFU (the Norwegian Programme for Development, Research and Education)

Name of Institution	Details of course syllabus	Percentage of course related to groundwater	Exit qualification or certificate	Year of inception of programme	Average no. of graduates annually	Percentage of HDIs in programme annually	Funding sources
University of Pretoria	Courses related to GW: Environmental management, Geochemistry, Hydrogeological modelling, Contaminant transport, Environmental projects Remaining courses focusing on Geology & Mining	60%	Honours degree in Engineering and Environmental Geology		12	40%	Student fees and government grant
University of the Free State	Groundwater hydraulics, groundwater quality and pollution, groundwater geophysics, groundwater modeling and groundwater management	100 %	BSc (Hons), MSc or PhD in Hydrogeology or Geohydrology	1974	10-15	Approx 30%	Government and private sector

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
University of the Witwatersrand (Civil & Environmental Engineering)	Projected number of students to 2015: 30 per year	Limited job opportunities in hydrogeology; no professional recognition of hydrogeology so prefer a broad degree in engineering or geology	More job opportunities in countries like Botswana.
	Resources – training personnel: 2 staff	Staff are not restricted to teaching only hydrogeology courses because of earlier comment.	None
	Resources – funding From Govt. subsidy and student fees	Govt. subsidy is dwindling on a yearly basis; limit to raising student fees.	None
	Resources – others	None	None
	Partnership & networking Waternet Masters programme	Weak IT infrastructure in some SADC countries which hampers networking.	Enables staff to participate in teaching and other activities of the Waternet Masters programme, thereby interact with students from SADC countries.
University of the Witwatersrand (Geosciences)	Projected number of students to 2015: 10 per year in the area of hydrogeology	Competition from other fields, particularly the traditional field of geology; Better job prospects that are offered by the mining sector	Growing need from groundwater expertise, taking into account greater reliance on groundwater in the future. Lots of job opportunities in the drilling, government, and municipalities and local government water agencies.
	Resources – training personnel: 1 full time staff; 1 honorary staff; 2 technicians	Finance to employ and retain staff; Even when the finance is available, there may be no qualified staff to fill positions.	In the School of Geosciences where a full time staff has just been recruited, opportunities exist when the school is able to demonstrate the benefits of this recruitment.

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
	Resources – funding From Govt. subsidy, student fees, DWAF, NRF, and Council for Geosciences	None	Additional funding opportunities exist.
	Resources – others Laboratories and Groundwater investigation equipment	Finance	None
	Partnership & networking Africa Array, Waternet, etc	Manpower (technical and administrative) constraints in establishing these networks; Time constraints as well.	Attract funding; International collaboration; Capacity to address cross-border (transboundary) water issues; synergies of capacity and expertise; better leverage in address groundwater problems.
University of Dar-es-Salaam	Projected number of students to 2015: 30 per year	The number of experts in this field is limited to build capacity. Teaching facilities are also limited	The demand for groundwater development is increasing.
	Resources – training personnel: 2 staff	Financial resources to support the training at PhD level.	The demand for professional in groundwater is high.
	Resources – funding from development partners	Development partners are reducing their support.	Governments funds are required to support efforts of development partners
	Resources – others	None	None
	Partnership & networking Waternet Masters programme	Networking is limited to only a few institutions in SADC countries	Enables staff to participate in teaching and other activities of the Waternet Masters programme, thereby interact with students from SADC countries.

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
University of Venda	Projected number of students to 2015: 25 per year	Limited job opportunities in hydrogeology; no professional recognition of hydrogeology so prefer a broad degree combining surface water hydrology, groundwater, and water resources management	Job opportunities will increase as groundwater becomes important for bulk water supply
	Resources – training personnel Improvement in number of training staff currently standing at two	Limited resources for staff training	Staff training at other well resourced institutions in SADC
	Resources – funding From Govt. subsidy, student fees, non-governmental organisations bursaries/ scholarships	Funding from government, NGOs and student fees inadequate to meet the training needs	Increase in government funding
	Resources – Training equipment Donations from research councils, governmental and private organizations	Expensive field equipment	Student attachment in groundwater companies
	Partnership & networking Through sharing of a jointly developed training ground	Limited vision on the benefits of sharing expensive training resources	Promotion of shared cost of training

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
University of the Western Cape	Projected number of students to 2015: 10 MSc completing per year, 2 PhD completing per year	Good quality undergraduate students	Sourcing international students
	Resources – training personnel	Postgraduate supervisors needed	Post docs from Europe or America
	Resources – funding	Postgraduate students need good bursaries to keep them at university	3 year research contracts
	Resources – others	Equipment maintenance and purchasing	Rental
	Partnership & networking	Research opportunities with other institutes to share knowledge and equipment	International collaboration and resources
University of Botswana	Projected number of students to 2015: 5-10 per year	Lack of funding opportunities Low number of applicants	Currently getting students from Botswana, Nigeria, DRC, Ethiopia and Zimbabwe. Number of students depends on start of some planned regional and Africa-wide research and capacity building programs
	Resources – training personnel: 6 core staff with PhDs plus 2 support on research	No constraints at present	Focus on specialist areas which include hydrochemistry, hydrogeology, geophysics, water resources management, structural geology, GIS and remote sensing

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
	Resources – funding Substantial donor funding comes from regional donor funded programmes. Some funding is from the government of Botswana	Some planned regional and Africa-wide research and capacity building programs may take long to start	None
	Resources – others Computers, software, databases with good groundwater data. Monitoring data available.	No constraint	None
	Partnership & networking CAPNet/Waternet- AGWNet (African Groundwater Network) initiative to identify priority areas for groundwater research Collaboration with UWC on Norway funded research programme. Challenge Programme for Water and Food	Cost and lack of seed funding for some activities	Goodwill from collaborating partners:
University of Pretoria	Projected number of students to 2015: 12 per year	Shortage of lecturing staff to train students	Invited lectures on e.g. NGS to assist lecturers

Constraints and Opportunities to Sustain the NGS

Name of Institution	Sustainability issue	Constraints	Opportunities
	Resources – training personnel: 2.5 staff (Engineering <u>and</u> Environmental Geology, i.e. 1.25 for Hydrogeology alone)	Staff teaches undergraduate and postgraduate courses because of staff shortages.	Extraordinary lecturers funded by other sources.
	Resources – funding Government subsidy and student fees	Decreasing government funding	None
	Resources – others WRC funding for research projects	Limited time for research due to lecture duties	None
	Partnership & networking FETWater	Limited funding for student fieldtrips and lecturer mobility	Linkage with other networks
University of the Free State	Student numbers Resources Personnel	Numbers of students with appropriate scientific backgrounds, availability of skilled staff	Demand for skilled hydrogeologists, strong private sector links, relatively secure funding

Additional information was obtained on the identified institutions on expertise available and their areas of specialization. HDI personnel in these institutions were identified and their and their capabilities to deliver the listed courses were assessed as well as their availability to get involved in training and mentoring the HDIs from the firms participating in the NGS project.

4.3 TIMELINE OF GRADUATES IN THE PAST 10 YEARS

The following graph shows the number of postgraduates in hydrogeology or related fields (MSc and PhD) in since 1977. A sharp increase was realised (see “Grant Total” line) in 1989 then 1997 to 2008. The increase was due to contributions from the Universities of Western Cape, Free State and Rhodes and to some extent the University of Pretoria.

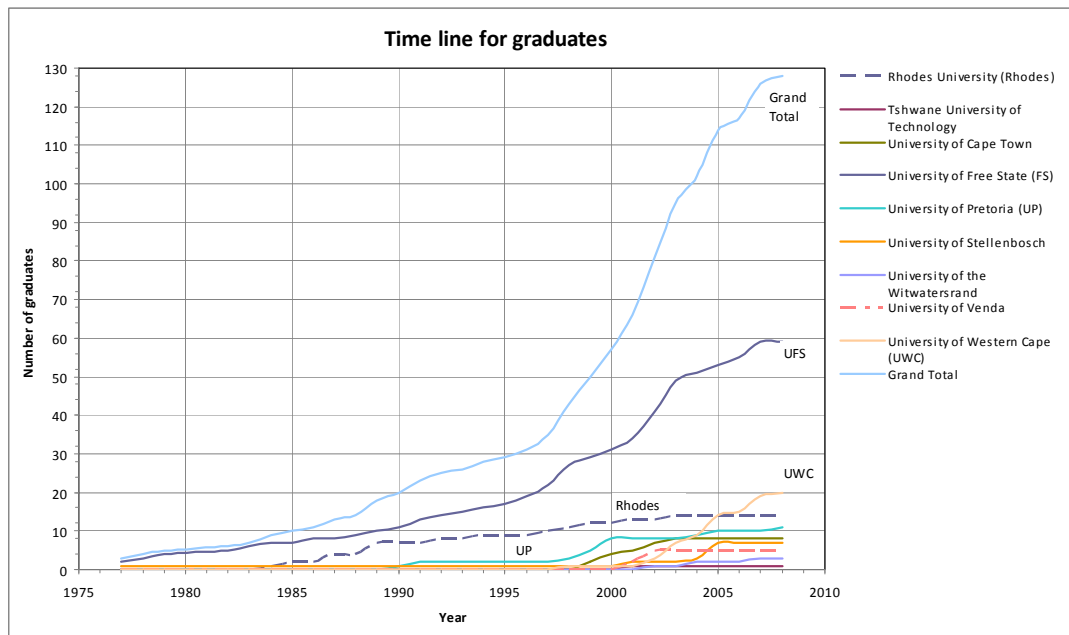


Figure 4-1: Timeline for hydro geology graduates

4.4 PLAN FOR INVOLVEMENT OF HDIS IN NGS ACTIVITIES

The table below lists the number of HDIs submitted by the JV firms and sub-consultants for possible involvement in this project.

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

Name of Firm	Number of HDIs in firm			Involved in NGS		
	Female	Male	Total	Female	Male	Total
Iliso Consulting (hydrogeology)	5	3	8	5	3	8
W R Nyabeze and Associates	5	4	9	1	1	2
Groundwater Africa	0	3	3	0	1	1
Water Geosciences Consulting	1	3	4	1	2	3
Sub-total	11	13	24	9	8	14
Sub-Consultants	N/A	N/A	N/A			
Total						

The opportunities available were discussed with the task leaders and the managers in the participating firms to align the availability of the HDIs with the schedules for the proposed tasks. The management and mentoring implications were assessed. Where the person was not already a member of the team they could be involved through training on activities such as demonstrations, planned workshops, professional discussion meetings or site visits etc. The following activities on the Roll-out of the Artificial Recharge Strategy (ROARS) could offer these opportunities:

- a) Activity AR1: Knowledge and awareness
A lecture and presentation materials have been prepared. They are available for use by universities that give course on hydrogeology, IWRM and water supply engineering.
- b) Activity AR2: Regulation
This activity will be initiated late in the project so that the lessons from the project can be incorporated. DWAF HDIs will be targeted for involvement in this activity.
- c) Activity AR3: Planning
Three DWAF HDIs (WC RO) have been involved in identifying potential AR areas, and their continued involvement will be sought
- d) Activity AR4: Implementation
Two sites have been identified namely Langebaan Road and Prince Albert. Three DWAF HDIs (WC RO) have visited the Langebaan injection site and participated in on-site discussions. DWAF HDIs will be asked to participate in the Prince Albert injection tests when they take place next year. Further

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

involvement of DWAF HDIs is planned – particularly in relation to the regulatory aspects regarding implementing AR.

- e) Activity AR5: Management
This activity has not yet been approved. When it starts and when specific tasks have been identified, DWAF HDIs will be asked to participate in this activity.
- f) Activity AR6: Research
An HDI under Dr Murray's supervision will be targeted to do most of this activity. The person has not yet been appointed.
- g) Activities AR7: Implement the Strategy at one AR site
An HDI under Dr Murray's supervision will be targeted to do most of this activity. The person has not yet been appointed.

The involvement of HDI in participating firms and their consultants should be encouraged. The costs involved include travel, subsistence and accommodation. A two day site-visit which includes awareness workshops on activity AR4 could cost about R4000 per person. This workshop and site visits are not only important for awareness but can also contribute in change in mindset and for most participants this will complement the theoretical information presented in the AR Strategy and other marketing /awareness materials.

5. ISSUES FOR INCORPORATION INTO THE CAPACITY BUILDING COMPONENT OF THE NGS

5.1 FUNDING

Current funding of training programmes in higher educational institutions come from fees that are paid by students, government grants to the institutions and bursaries and scholarships that are awarded to students by companies and other organizations. Government grants continue to diminish yearly, and there is a limit to which institutions can raise fees to meet the shortfall. That means more students will require some sort of financial assistance through loans and bursaries to meet the cost of running these training programmes. How readily students can have access to financial assistance will play a significant role in sustenance of these training programmes.

5.2 EMPLOYMENT

Better job prospects presented by traditional fields of civil engineering and geology represent one of the greatest constraints to students opting for a career in hydrogeology. In South Africa where the salaries in the mining sector and the booming construction industry are quite attractive, students prefer to graduate from academic programmes that enable them to become employed in those sectors. A similar study which had a much broader scope covering the entire sub-Saharan Africa supports this: “poor pay appears to be the main reason hydrogeologists leave the profession in Africa. This seems to be linked to better conditions in related professions such as mining geology.” (Water Geosciences Consulting, 2008)

While the foregoing is the case, there is a limit to the employment capacity of the mining and construction industry and related sectors which, when coupled with the greater reliance on groundwater due to depletion of surface freshwater sources, makes for enormous employment opportunities in the field of hydrogeology. These opportunities present themselves in drilling companies, government water agencies, municipalities and water supply utility companies. From the responses received, it seems that the opportunities are of varying levels depending on the country in the SADC region. Botswana seems to have many job opportunities in hydrogeology, hence the course offerings of the Geology Department of the University of Botswana.

5.3 TRAINING PERSONNEL

Most institutions in South Africa have one or two staff who are involved in training of hydrogeologists, except the University of Botswana with six staff. This is quite inadequate for the training of human personnel to support the NGS. Certain institutions cannot afford to have the available staff dedicated to teaching

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

only hydrogeology-related courses; those staff are required to teach other science or engineering courses.

5.4 LABORATORY AND FIELD EQUIPMENT

The huge capital cost associated with laboratory and field equipment in the field of hydrogeology means that most institutions are unable to procure such equipment. Only the University of Botswana expressed satisfaction at the level of funding for equipment, software and monitoring facilities. To address this inadequacy, it may require that equipment be funded for joint use by a number of institutions.

5.5 TYPES OF COURSES

The courses being offered are more aligned towards BSc and MSc graduates and the demand for technician type courses need to be ascertained. This may be addressed by reviewing courses for offer for groundwater and civil engineering technicians.

5.6 PARTNERSHIP & NETWORKING

The responses to the questionnaire do indicate that partnerships and networking are currently taking place within WaterNet, AfricaArray, CAPNet, AGWNet, and FETWater. The many benefits of these partnerships and networks are:

- Enabling of staff to participate in teaching, research and other related activities in institutions in the SADC region, thereby enhancing interaction between staff and students in the region.
- The reduction in training cost through sharing of training resources.
- Enhancement of the capacity to address cross-border (transboundary) water issues.
- Increased chances of attracting funding through multi-institutional research and teaching activities
- Achievement of synergies of capacity and expertise
- Attainment of better leverage in addressing groundwater problems.

However, there are many identified constraints to networking. These include:

- Weak IT infrastructure in some SADC countries.
- Lack of adequate human capacity to roll out regional and Africa-wide initiatives.
- Lack of technical and administrative manpower to sustain these networks.



Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

6. REFERENCES

1. Water Geosciences Consulting (2008) *Hydrogeology in sub-Saharan Africa: training and employment opportunities*, A survey conducted on behalf of the Burdon Network of the International Association of Hydrogeologists (IAH) 15pp.
2. CapNet, WaterNet, German Federal Ministry of Economic Cooperation and Development (2008a), Groundwater Capacity Building Initiative Africa, *Capacity Building for Groundwater Management in West and Southern Africa*
3. CapNet, WaterNet, German Federal Ministry of Economic Cooperation and Development (2008b), Groundwater Capacity Building Initiative in Africa. Workshop Report, Pretoria July 21-22 2008
4. Department of Water Affairs and Forestry, RSA United Nations Educational, Scientific and Cultural Organization World Meteorological Organization (1998), DWA/UNESCO/WMO Mission on the Assessment of the Education and Training Needs of the Water Resources Management Services of the Republic of South Africa

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

A-1: COURSE OFFERINGS

Courses in support of the National Ground Water Strategy (NGS) for South Africa

This questionnaire has been drawn up to gather information on courses being offered in various institutions on the understanding that adequate capacity plays a very important role in the realization of the successful implementation of the NGS, thereby ensuring that the necessary skills exist to support South Africa's National Water Act (1998). This inventory should cover courses that are not only being offered in South Africa but other parts of the world, particularly the SADC region for benchmarking purposes. We are aware that your institution offers courses that support the NGS, and for that reason request that you take a few minutes to complete the table below. The courses of interest should not only cover the science- and engineering-based courses of geology, groundwater hydrology, geohydrology, but also courses related to the social, legal, and economic aspects of groundwater. To assist with the completion of the table an example of a course being offered at the University of the Witwatersrand is provided in blue colour. Explanations of the various headings of the table are also provided below.

Thank you for taking the time to complete the table.

PART A:

Name of Institution	Name of Department	Nature of programme (see note 1)	Name of course	Level of offering (see note 2)
University of the Witwatersrand	Civil & Environmental Engineering	Conventional	Hydrology	Undergraduate (3 rd year)

Note 1: Nature of programme

1. Conventional (a formal undergraduate or postgraduate programme in either geology, groundwater, hydrogeology or related disciplines offered in a university or technikon)
2. Modular (a programme offered in modules by a degree-awarding institution in

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

either geology, groundwater, hydrogeology or related disciplines)

- Ad-hoc or Continuing professional development – CPD programme (this covers courses offered for CPD, in-service training, or as seminars, workshops, fields trips and excursions, etc that are not coordinated for an overall exit outcome)

Note 2: Level of course offering

Under Conventional programme

Undergraduate

Postgraduate

Under Modular programme

Part of a conventional programme

Stand alone

Under Adhoc programme

CPD course

In-service course

Mentorship-related course

PART B:

Details of course syllabus	Percentage of course related to groundwater	Exit qualification or certificate	Year of inception of programme	Average no. of graduates annually	Percentage of HDIs in programme annually	Funding sources
Water cycle, Water Resources, Surface water hydrology, Groundwater.	25%	Honours degree in Civil Engineering	1930's	20	40%	Student fees and government grant

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

PART C:

Constraints and Opportunities to Sustain the NGS		
Sustainability issue	Constraints	Opportunities
Projected number of students to 2015		
Resources – training personnel		
Resources – funding		
Resources – others		
Partnership & networking		

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

A-2: DEVELOPMENT OF A PLAN FOR INVOLVEMENT OF HDI PERSONNEL ON NGS ACTIVITIES

1. INTRODUCTION

DWAF identified the need to have more hydrogeological capacity to support the NGS. One of the key concerns is the low numbers of (Historically Disadvantaged Individuals) (HDIs) in the sector. Discussions within the capacity building team, the NGS team and the Project Steering Committee (PSC) have so far come to the conclusion that the human capacity gap cannot be addressed meaningfully by focusing on a particular category of people. In addition such an approach could result in negative perceptions which would not enhance the implementation of the strategy. For example extra effort might be required to prove that the knowledge or skills imparted and more importantly its uptake by the participants matches that provided in more widely targeted programmes. In addition those targeted by such a program may shun away from it out of fear that the labeling may not be to their advantage. A suggestion was made at the last PSC meeting to develop a wider plan for participation of more staff from the JV companies and their sub-consultants. However, monitoring would still be done to identify constraints to the engagement of larger numbers of HDI personnel and to make an assessment on how this can be improved.

Human resources in the sector are highly mobile the sector is reliant on skills from across the African continent and beyond. Already indications are that the real opportunities in dealing with the capacity gap in South Africa lie in regional, continental and international initiatives. For this task the recommendation from the capacity building team is to monitor involvement of personnel from the Southern Africa Region, on this project. A suggestion has been made to change the title of this sub-activity to “Development of a Plan to Build Groundwater Capacity by Increasing the Number of People Participating on NGS Activities”. Approval by the DWAF Project Manager is required.

2. LIST OF PERSONNEL

As part of this Activity 4 we need to compile a list of staff in the four companies involved in this JV and their sub-consultants. I am requesting that you kindly list a table using the format attached. Kindly list staff in your company including sub-consultants who you think could be involved in the various NGS activities and what you see as their possible involvement. This will enable me to discuss with you how best they can be engaged, cost, schedule and even draft a

Activity 09 (NGS Capacity Building (Component 1))

APPENDIX A: SAMPLES OF QUESTIONNAIRES ADMINISTERED

proposal for their involvement which we can share with the rest of the team, the client and other identified stakeholders. Where the person is not already a member of the team one could propose involvement through training on activities such as demonstrations, planned workshops, professional discussion meetings or site visits etc. I have included a column to record the country of origin for each your staff members so that we can respond clearly to the realities mentioned in the introduction to this document.

Full Name	Age (Years)	Gender (M/F)	Highest Academic Qualification	Years Experience	Other Diplomas and/or Certificates	Identified Activity for Involvement	Proposed Involvement