LEARNING NOTES

DRAFT 1

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BACKGROUND

The South African Young Academy of Science (SAYAS) hosted an inaugural, interdisciplinary Colloquium on Water Security in South Africa. The colloquium was specifically designed to address three themes, namely:

The colloquium will be divided into three thematic sessions:

- Public expectations and municipal obligations regarding water quality (Theme 1)
- Water re-use: health and infrastructural considerations (Theme 2)
- Water security and governance: challenges and advances (Theme 3)

Each thematic session was facilitated by experts: Theme 1 was facilitated by Chris Buckley and Chris Fennemore; Theme 2 by Thor-Axel Stenström and Stefan Schmidt and Theme 3 by Nora Hanke and Mark Dent.

The objective of SAYAS in organising the colloquium was to involve students, academics, civil society representatives, municipal managers and politicians in dialogue around issues of water security. The expected outcome of the colloquium was to generate a consensus statement on selected issues pertaining to water security in South Africa. Ultimately, the outcomes of the colloquium will hopefully influence policy and practice in all levels of government, civil society and academia.

The idea to hold a Water Security Colloquium arose out of an extremely urgent need to address water security in the South African context. SAYAS sees ensuring water security as key to advancing South Africa's developmental goals. The organisation regards water security as the ability to meet the present water needs of the current generation without impeding on the future generation's health and sustainability. A major objective of the colloquium was to ensure that science informs policy and strategy around water security in the country and that all the relevant stakeholders contribute to our understanding of the status of water security in the country.

It was also noted that in addressing water security issues, other challenges such as good governance, poverty alleviation, infrastructure and environmental protection would also have to be considered.

COMMUNICATION AND DOCUMENTATION STRATEGY

Guidelines:

Prior to the start of the first session, all participants were consulted on the guidelines for the communication and documentation strategy which involved decisions on the freedom of facilitators, anonymity, negative/positive contributions, avoiding dominance of particular individuals/sectors, use of video footage. The facilitator(s) also made the participants aware of the documentation strategy:

1) Each of the sessions featured an idea board situated at the front of the venue, in full view of all participants. The board was separated into 3 categories: a) challenges, b) solutions/ recommendations, and c) gaps in knowledge.
2) During the course of each session the facilitators and rapporteurs, and/or the documentation team recorded ideas emerging from the discussions than ensue beneath the 3 categories (these were written on colour coded cards and stuck on the wall beneath the label for the appropriate category). At the end of the session, the idea board was digitized and participants were asked to indicate their support for the various ideas within each category using stickers: multiple responses were allowed but not multiple selections of individual ideas. These data were then translated into frequencies, which were in turn used to rank the ideas for each theme, within categories (challenges; solutions/ recommendations, and gaps in knowledge), in order of importance (see Table 1-4).
3) The participants were informed that the proceedings of the colloquium will take the form of a consensus document to be released to various tiers of government and academic institutions (all participants will be recognised as contributors). This document will also be abridged for publication in the South African Journal of Science (with the facilitators and rapporteurs being acknowledged as the authors).
4) For participants that wished to add to/argue/elaborate on any of the points/issues that emerged from the discussions they were allowed to submit written contributions that were later captured by the documentation team.

Framing session - at the beginning of each thematic session the facilitator and rapporteur were given 30 min to frame/ contexualise the theme, in order to focus the discussion that follows. This framing tool took the form of a presentation (of a few slides) and involved both the facilitator and rapporteur or just one of them.

Facilitating discussion - the facilitator/s carefully directed an open discussion on the theme, with the intention of identifying the challenges, specific solutions/ recommendations and gaps in knowledge. The discussion at each of these sessions was set against the back-drop of the following riders: water scarcity, water re-use, water quality, climate change adaptation and mitigation, governance, health, food security, urbanisation and rural livelihood strategies.

Consensus document - Rapporteurs at each of these sessions captured the outcomes of these discussions which will help to generate the consensus statement. Guidelines for the full document will be decided upon by the facilitators and rapporteurs whilst guidelines for the abridged version of the document to be submitted to the journal have already been stipulated.

INTRODUCTORY SESSION

Facilitator: Sershen Naidoo

Naidoo emphasized that the objective of the colloquium was to engage students, academics, civil society representatives, municipal managers and politicians in dialogue around water security in South Africa.
Additionally, Dr Urmilla Bob stated that water security is a crucial focus of research at the University of KwaZulu-Natal and academic institutions around the country. She also suggested that colloquium shed light on the roles of the different stakeholders impacting on water security: the municipality, government, academics, civil society and the private sector.

In addition, Bob and Naidoo stressed the importance of stakeholder participation and consultation in developing the country's water strategy. Participants were also informed that the next colloquium (to be held at the same time next year) would focus on food security. The colloquim was put in context by alerting the audience to the numerous stories in media on water and sanitation (particularly around service delivery) between May 1st and June 15th, 2014.

KEYNOTE ADDRESS: Water Security Dimensions in South Africa: A Personal Perspective

Speaker: PROF. ROLAND SCHULZE

The keynote address was delivered by Professor Ronald Schulze (see associated presentation). Professor Roland Schulze posed the following questions by way of introduction: is anyone in the real world taking scientists seriously? Are scientists actually making a contribution to water security? According to Schulze, water security encompasses the landscape and the

channel components of the hydrological system. He also made the participants aware of the following: despite the country's large dams, people living very close to these dams are sometimes water insecure; a portion of South Africa is semi desert; large tracts of land suffer from degradation, impoverished water security, low rainfall, dysfunctional infrastructure, and fragile ecosystems.

Water security management is complex from both a supply and demand perspective. However, what South Africa has to its favour is an innovative, modern water law through the national Water Act of 1998 that is coupled with an integrated approach to dealing with water issues. Nature has, however, been unkind to South Africa in terms of water security. Rainfall concentration varies across the country. There are complex interactions between topography and rainfall. Evaporation is generally very high by international standards. Stream flows are generally very low. History has also been unkind in terms of water security. Historically, water security was impeded by the way the country was divided. Population and resources do not match up.

We have been blessed by water engineering ingenuity of the top order but who does the work: consultants. There have been many large dams that have been built over the years. But we have re-plumbed natural flows. There are many causes of poor water quality in South Africa and even more consequences. Catchment integrity is highly compromised in many areas and there are hydrological impacts on farming practices.

Prof. Schulze's account included an in-depth explanation of the reasons for our current water security issues. Water Security, according to Schulze, is a problem in South Africa at large. Contributing factors to this include alien invasive plants, dysfunctional infrastructure, acid mine drainage, untreated sewage, chemical waste, poor water quality and climate change. According to Schulze, whilst there are policy's put in place to address Water Security such as the National Water Act, these policies cannot be applied practically. There is disjuncture between the Act and our current water situation. Water Security, according to Schulze, implies the need for significant Municipal water infrastructure systems. The problem, according to Schulze, is the focus on local content as opposed to local context. As researchers there is no conversion of outcomes to outputs. A further problem is the lack of communication between government departments and a shortage of skills.

A few recommendations made by Prof. Schulze include, shifting from upstream/downstream thinking to upslope/downslope thinking and looking at Water Security in a more integrated way, i.e. socio-ecological approach. Ultimately the solution to addressing Water Security is to have proper water management systems in place. What is also key is to provide educational awareness around water related issues to civil society.

Prof. Schulze then went on to address a few predictions should our current water insecurity issues not be addressed. With climate change variability in rainfall and runoff will change. Some regions will be more sensitive to climate change and the water temperature is also expected to increase. So, to ensure water security in a changing climate:

- Supplies must be sustained into the future and this needs forward planning.
- Wastewater treatment works must be fully operational. Currently in South Africa, 26% are rated as good or excellent whilst 44% are rated as poor or critical. The infrastructure functionality gap shows that there is a poor water security prospect in our country if we do not address the current challenges.
- There is a need for significant municipal water infrastructure investment.
- There is a need for good financial governance, including the need for municipalities to collect outstanding debt. The culture of non-payment must be dealt with vigorously.
- Having skilled technocrats in place in local government.
- Removing alien invasive plants.
- Reducing non-revenue water user.

Some take home messages from recent climate change research:

- There is a need to prioritise water security in the context of climate change.
- When climate change is translated into a human discomfort index, the number of uncomfortable days will increase significantly.
- Evaporation from dams and the soil is projected to increase from open water bodies.
- Variability is projected to increase - more so over time. Projected increases in the standard deviation of annual precipitation.
- Some regions are going to be more sensitive than others to climate change.
- A strong amplification/intensification between changes in rainfall and change in runoff.
- Water temperatures are projected to increase significantly into the future. What are the consequences?
- Are water engineered systems the solution to water security effects?
- Different development scenarios can have different water security ramifications and what can climate change superimpose on these?

In wrapping up, Professor Schulze noted problems with water and sanitation in S.A. and had some closing remarks:

- Authorities don't understand complete hydrological cycles.
- Authorities land in their jobs by default and not by design.
- Ideas are there, but we don't have people to implement them.

- We have a good Water Act, but it does not translate to realisations.
- We have a schools shortage in S.A., not an ideas shortage.
- We have a lot of local content, but little local context.
- As researchers, we don't convert outputs to outcomes.
- We suffer from legal pluralism whilst competing for finite resources.
- There are scale mismatches between the management arena and natural resources dynamics.

We must also consider the implications of biofuel crops on water availability; land grabbing (or water grabbing); mountain ecosystems (the water towers of SA); and groundwater. Water Security should also be viewed in light of uncertainties of demand, expectations, the water value chain, cultural stigmas regarding re-use and socio-ecological systems.

Some comments made by participants:

A few thoughts that emerged from the participants following the keynote address:

- What is the role of decision-makers. It was suggested that the decision makers are not the key individuals in addressing water related issues as they do not have first-hand knowledge of the water issues currently faced.
- The concept of people and water are used separately whereas this should be looked at mutually as people use water and water is impacted upon by people.
- Academics are measured by outputs and not outcomes/impact on communities.
- Local government and its individual departments are characterised by silo mentality.
- Children (7-9) should be taught about water.
- It often takes a crisis to trigger a reaction about water.
- Investment in water: short- (governance), medium- (governance) and long-term (ecological infrastructure).
- Municipal efficiency and effectiveness would reduce the risk of water security.
- Population growth vs water as a finite resource.
- Cultural issues and stigmas with regards to drinking recycled water.
- Community engagement is required for people to understand water insecurity.
- Modern technology can assist in securing water.
- Education around water issues is critical at all levels.
- Knowledge Management is important in dealing with water security.
- Water security is a political issue and we must tackle the urban rural divide.
- Communities need to take responsibility for reporting maintenance issues.
- Maintenance is a critical issue.

- Often water is available but inaccessible.
- Many wetlands need to be rehabilitated.

THEME 1: PUBLIC EXPECTATIONS AND MUNICIPAL OBLIGATIONS REGARDING WATER QUALITY

Facilitators: Christopher Buckley and Christopher Fennemore

This theme was framed by Chris Buckley (Pollution Research Group in Chemical Engineering, UKZN). Buckley provided statistical data on water and sanitation in South Africa (see associated presentation): in 2004, 42 % of the population of sub-Saharan Africa lacked adequate sanitation. A further 14 % are under nourished and 34 % have sanitation related diseases. Only 5 % of the population have advanced sewage treatment. He went on to highlight that in 2010 the United Nations passed a resolution that recognised the right to safe and clean drinking water and sanitation as essential for the full enjoyment of life and all human rights. This basic right may be infringed upon in parts of Africa as there is a possibility that we may not have enough water to supply. A further shocking finding is the fact that within eThekwini Municipality the sanitation backlog in rural traditional areas is 21,469 households while in informal areas the sanitation back-log is 203,222 households. This finding is based on the fact that people come from rural areas migrate to the cities to find work and this high influx causes high sanitation backlogs. Buckley simplified the need for proper sanitation, by demonstrating that proper sanitation is related to public health. If proper sanitation measures are not accounted for and adhered to then the health of the public is adversely affected.

In keeping with the theme Christopher Fennemore gave an account of the factors influencing Water Quality in the eThekwini Municipality (see associated presentation). Fennemore reiterated the fact that interacting with the public is important in addressing Water Security and Water Quality. Fennemore highlighted the importance of assessing sewage spillage in ensuring good quality of water. However, there are a number of other factors influencing water quality: public awareness, wastewater treatment works, storm water, solid waste, electricity power failure, informal settlements and the natural environment.

Discussion:

<u>Current challenges facing South Africa</u>

Citizen's rights to clean water should be associated with the responsibility of paying and conserving the water. There is high wastage of water and this has a negative impact on the current water supply. A further challenge is the disconnect between Local Government capacity and what National

Government is promising the public. A further challenge to our Water Security is the technical capacity at delivery level. There is a disparity that exists between the skills required to work with water and the skills that are actually being used in delivering water to households and industry.

Some potential solutions

In response to the challenge of the citizens' right to clean water, it was suggested that citizens be made aware of the role they can play in ensuring that Municipalities meet their obligation to supply 'good' quality water. A further solution that emerged is the possibility of broadcasting a mass campaign and outreach programmes in which Society can learn and understand the cycle of water. By gaining this knowledge, citizens will be empowered and will take more responsibility for their water security.

General comments

Legal Concerns: Obligations of the state with respect to the constitution – are municipalities liable for non-delivery/poor water quality? Should municipal officials be held accountable? There is a need to understand the reasons for municipal non-delivery vs. negligence (i.e. lack of engineering skills). Legal action is a final recourse. There is a need to promote active citizenry and civil society engagement around water security. Communities need to be comfortable to report poor service and if there is no action, then a reaction should be decided upon.

People's Rights vs. Responsibilities: The municipality can only provide services relative to the resources available. Promises made by politicians are most often not practical or realistic. On the other hand there is a need for a public awareness campaign and the empowerment of decision-makers. The right to water has responsibilities (pay and conserve water). Are public expectations homogenous and realistic, and what informs them: funding issues, knowledge, infrastructure, communication between politicians and engineers, and technical capacity.

Cost of Violation vs. Cost of Compliance: The cost of violation is often cheaper than the cost of compliance. Industry often focuses on their core business and ignores broader environmental concerns. Sometimes, their lack of understanding and skills impacts on water quality.

Blue and Green Drop Status Issues: Changed the way municipalities do business. However, the rollout of the programme has been significantly successful, it has been accelerated too fast and hence, some municipalities could not cope.

THEME 2: WATER RE-USE – HEALTH AND INFRASTRUCTURAL CONSIDERATIONS

Facilitators: Thor-Axel Strenström and Stefan Schmidt

The second theme was facilitated by Thor-Axel Strenström (SARChI Chair in Water and Wastewater Technology) and Stefan Schmidt (Microbiology, UKZN) (see associated presentation). They reviewed our current situation in terms of poor water quality and availability, lack of adequate sanitation and resources for re-use of water. According to Schmidt we as citizens of South Africa are using so much water that by 2025 South Africa will be a water scarce country. The current water demand is high due to population growth, urbanization, climate change and increase in food prices. In terms of water availability per capita, South Africa is currently under fresh water stress and scarcity. There is therefore a serious need for water re-use in agriculture and industry, ground water recharge, recreational and urban environments.

The facilitators established that the participants were aware that water is recycled, however, many were unaware of the potential impacts of recycled water on human health. Research has found that, water re-use can be hazardous to public health. Water re-use can lead to a number of medical illnesses and Schmidt has found this to be a global issue. According to Strenstrom, one of the impacts of re-use is the sanitation related disease, diarrhoea. Diarrhoea ranks number 2 in the Global Burden of Diseases Scale.

A few solutions that Strenström and Schmidt highlighted were to use the right technology. Using the right technology can produce good enough drinking water. Possible approaches to counteract the impact of microbial contaminants in re-used water are microfiltration, reverse osmosis and UV disinfection. Schmidt emphasised that we cannot just go on with business as usual and when it comes to water re-use we cannot adopt a linear approach. Schmidt also suggested that to prevent contamination of water, onsite pre-treatment should be conducted.

Discussion:

- Other solutions/ technologies for water re-use include Integrated membrane solutions: multiple barrier approach for reclaiming high quality water from municipal sewerage. Innovation Hubs can make significant contributions by introducing local alternative technologies.
- Cost and political will are major considerations when deciding on water re-use strategies. Cost and incentives for re-using water needs to be reviewed to encourage water re-use because water is currently fairly cheap. Suggestion from the participants is to incentivise water re-use.

- Conventional vs. environmental sanitation will become an increasingly important future consideration.
- Waste water re-use needs to be enhanced in agricultural, urban, industrial sectors.
- Engineering and management approach: non-potable urban re-use e.g. for toilet flushing.
- Urban wetlands are low cost, simple, low maintenance systems which can be used. Artificial wetlands can also be created.
- Drip irrigation: e.g. waste water is used to irrigate mulberry trees that generate silkworms. Agricultural drip systems are often touted as expensive but there are cheaper versions that can be developed locally. Perhaps root absorption systems are preferable because the roots use the water and not the leaves. However, there are issues relating to scaling-up these projects.
- Rainwater harvesting is currently not appreciated/exploited by communities.
- Communication and awareness around water re-use can be achieved through Taxi TV and print media to disseminate scientific information.
- Start-up costs are a disincentive for those wanting to develop alternative technologies for re-use.
- Other challenges include: lack of community ownership, lack of trust, community and government attitudes, lack of education and knowledge transference.
- Faith Based Organisations could preach 'the water gospel' and importance of water security.
- "The topic of water security needs to be made 'cool' through the use of social media and cellphone applications such as Whatsapp. It needs to be part of our daily lives" (Nicky McLeod).
- The public may not trust that in water re-use they are getting good clean water. It was further suggested that trust and transparency are interrelated concepts. With gaining trust of the public, Government, stakeholders and Local Government should be transparent.
- If the public are educated and empowered this will change their behaviour and attitude in terms of the use and re-use of water. The ultimate goal is preventing water from being misused.
- A key outcome of the session was that we need to create awareness around water re-use. In line with creating awareness, it was suggested that the contextual background of South Africa should not be neglected. Knowledge and awareness around our current water related issues would have to be made more applicable to the general public and different income groups. The aim should be to get the right information to the right people.

REFLECTIONS ON DAY 1

The second day of the colloquium began with a recap of the key points that emerged during discussions on Day 1:

- Communication between local government and national government and between local government and the public is key to dealing with water security issues. There is presently a lack of communication among stakeholders.
- There is also a need to create public awareness around water issues.
- The objective of the communication and awareness strategies is to get civil society to understand water quality, proper use and re-use. Once this is established the next step would be to encourage civil society to be more responsible and accountable for Water Security in the country.
- Furthermore, it was suggested by Strenström, that the gaps identified should be looked at as potential solutions. Strenström further emphasised that based on our previous discussions knowledge was an overarching theme. This was reiterated by the point that dissemination of knowledge, access of knowledge and transfer of knowledge are the biggest challenges and these should be looked at in greater detail.

THEME 3: WATER SECURITY AND GOVERNANCE: CHALLENGES AND ADVANCES

Facilitators: Mark Dent and Nora Hanke

This theme was a highly anticipated topic of discussion, given the fact that issues around governance and water security had emerged during a number of discussions related to the other themes. The session was framed by Nora Hanke and Mark Dent (see associated presentation). Dent began by illustrating that perspectives can change from person to person and that things have to change from what is currently being done to ensure South Africa's water security; there is a need to change and transform the ways in which water related issues are being addressed and practiced. This point was first mentioned by Schmidt when he suggested that "we cannot go on doing business as usual and we cannot use a linear approach". Dent also explained that we must try to understand change on a fundamental level. According to Dent, changing patterns of understanding is most important. He went on to introduce the concept of bounded rationality: it is not possible to be rational outside of your cognitive space. If you do not know what you're doing, you do something irrational. Therefore the problem is irrationality. This leads to blaming others and ultimately, with reference to organizations, this disempowers all sectors and overwhelms role players.

With regards to Governance, Dent highlighted that The Department of Water Affairs (DWA) is key to governing policy on water. With DWA at the centre, other water stakeholders can revolve around DWA to ensure water security. Stakeholders may include non-government organizations, local and national government, the private sector and civil society. Dent suggested that all sectors should engage with each other under the oversight of DWA, however, this is not being done at present. He mentioned that the aim of the

National Water Act is to remove the Department of Water Affairs from the centre and their role would be to mediate.

Dent highlighted that there is a growing awareness within the industrial sector of the need to work together. Furthermore, he echoed earlier suggestions that communication to the public is important. In addition to this, he emphasised the value of using the internet as a tool for communication; also, it is key to disseminate knowledge in a holistic, integrated way to South Africans. Communication and awareness appeared to be a recurring theme. Dent also raised the idea of the influence of the insurance industry on water. He highlighted that there are many policies in South Africa that are put in place to support water initiatives.

A challenge that emerged from Dent and Hanke's presentation was the issue of community engagement and participation. The premise is that if communities understand our current water challenges and advances being made, then they will take responsibility and action accordingly. A gap and potential solution that arose is that of professional development of educators; we should improve their knowledge and understanding around water and water related concepts. The aim should be to provide courses for educators as they are the primary sources of knowledge for school-going children. It was further suggested that such programmes should focus on primary and secondary school education. One of the key suggestions during this highly interactive discussion session included embedding 'water science' in all sectors.

Discussion:

- South Africa needs to govern from a holistic and shared perspective.
- We need to enhance performance through changing patterns of understanding.
- The water sector is not the only sector dealing with water security; there are other departments as well. It is irrational to continuously place the responsibility on the water departments because it:
    - encourages finger pointing and blaming;
    - it feeds a dependency syndrome;
    - it disempowers all sectors and overwhelms Department of Water Affairs.
    - All sectors must engage each other over water, and DWAs responsibility must be to provide oversight. DWA must play a coordinating and facilitating role for all sectors directly and indirectly affected by water security. Currently, there is a systemic risk because DWA is seen as the only custodian of water security.
    - With regards to the reconciliation of the requirement for and availability of water, the National Water Resources Strategy has been developed. However, there are numerous water-related incidences of illness. There is also a failure to keep up with

development of waste treatment infrastructure. As a result there is a risk of job losses in the total supply chain and export market. There are many sectors that will be affected by this.

- The Insurance industry has an influence on private security industry (i.e. producer, processor, retailer, consumer, insurers, banks and investors) – this needs to feature more in our thinking around water security.
- Policy and Legislative Frameworks: All the policy and legislative frameworks have requirements for water security. There is an open space for activity and influence by all sectors. We must make all voices count and build on the private, public and civil society strengths.
- Tools vs. collection of thoughts: there needs to be a move from literature to systems thinking and eventually to a sequence of assumptions. It is very useful to view sustainability as an emergent property of stakeholder interaction.
- Education: Are universities relevant and are they taking the knowledge that has been created back to the community? There is a level of community involvement and participation but at the same time it is characterised by information overload. School learners (primary and secondary level) should be agents of change. The educators are key to transferring knowledge. Professional development of educators in water and sanitation is very important.
- Simulation modelling is important in water security.
- There is a need for continuous professional development for municipal officials.
- Loss of institutional memory: a number of skilled individuals are leaving the water sector (for various reasons); we need to ascertain what this movement of intellectual skills and means for governance.
- A number of questions need to be answered in order to understand water security in the context of governance: What is meant by socially robust implementable knowledge? Is Water security a big issue? Do we have human skills capacity to cope? Do we have the finances to cope? Is the lack of water re-allocation a security risk? Is science approaching these matters with appropriate thinking? What is participatory agent based social simulation modelling? What can the ordinary citizen do? Do our governance systems provide a context for coping? Do we have the capacity to ensure sustainable and integrated water delivery services?
- Climate Change is threatening our water sources. It is time for government to view the way water resources are handled nationally as well as review accessibility options.

OVERALL RECOMMENDATIONS

Facilitators: Faizal Bux and Nicola Rodda

Reference to the learning notes for the three thematic sessions suggests that differentiating between idealistic and realistic expectations and promises will be key to managing water provision in South Africa. The responsibility of civil society in the use and management of water is also going to become increasingly important as water resources run out. It may therefore be wise to introduce rising block tariffs and to incentivise water re-use and conservation. This will promote accountability and responsibility in water use. What was also most apparent in all the sessions is that we must increase public and government knowledge on water issues and improve the quantity and quality of human capacity within the water sector to ensure water security.

Overall recommendations of the colloquium include the following:

- Improve public and government awareness around water issues
- Incentivise water re-use and conservation
- Introduce rising block tariffs
- Improve understanding of health and social implications of water re-use
- Improve human capacity development in water sector
- Enhance ecological infrastructure
- Define water security in the context of geography and human demographics
- Strengthen interaction and alliances among stakeholders

The aim of the Water Security Colloquium was three fold. (1) To raise awareness on our current water position in South Africa. (2) To discuss the challenges and solutions to ensuring continuous availability and accessibility of water to all; and (3) to address and inform future policy on water that will lead to better management of water. The colloquium certainly achieved the first two objectives as awareness was raised and participants certainly highlighted their challenges and potential solutions were identified. The third objective remains a work in progress as the information received from this colloquium will now be packaged to inform policy around water. During this intense two day forum participants were exposed to information and issues around water security and water quality in South Africa. The colloquium certainly engaged stakeholders from different sectors (see associated data on participant demographics) but civil society were poorly represented. The next colloquium intended for June will focus on Food Security, in an attempt to address the Food-Water-Energy nexus.

Relative importance of challenges, knowledge gaps and solution/recommendations emerging from each thematic session and participant perceptions of their importance

TABLE 1: Public expectations and Municipal obligations regarding water quality	
Challenges	**Frequency**
Incapacity of decision-makers/Skills deficit in government	24
Unrealistic political promises vs expectations vs reality (finance and infrastructure)	15
Dysfunctional infrastructure	10
Balance between public rights & obligations vs responsibilities	7
Diffused roles and responsibilities in Local Government	6
Capacity of courts/legal system to adjudicate	5
Illegal connections	5
Inadequate prioritization of water security	5
Non-payment for services	3
Research gaps	3
Technical solutions to political issues	3
Political issues associated with service provision	2
Rapid urbanisation	2
Socio-economic implications of lack of service provision	2
Influence of climate change on water availability	1
Knowledge Gaps	
Blue Drop/Green drop Reports	14
Knowledge Creation & Management	13
What informs human choices	11
Communication of best practices	8
Legal implications of service provision	8
Water availability vs accessibility	8
Challenges of uncertainty (demands, expectations, cultural stigmas)	6
Psychological behaviour change	6
Groundwater quantity and quality	4
Industrial cost of compliance vs infringement penalties	3
Hydrological cycle	2
Big users of water	1
Solutions/Recommendations	
Public buy-in and awareness	23
Government awareness	16
Human capacity building	11
Promote re-use of waste water	10
Good governance	9
Ecological infrastructure approach	9
Investment in operations and maintenance	8
Use of ocean water to flush toilets	5
Knowledge sharing across Local government	4
School education programmes	3
Creation of more wetlands	3
Holistic understanding of complexities of water security	2
A more people centred approach	2
Improved water technologies in agricultural production	2
Provide basic service with allowance for user upgrade	2
Improved monitoring and evaluation	1

Challenges, knowledge gaps and solution/recommendations are ranked in decreasing order of importance based on number of participants that considered them important
(values represent frequencies; n=60, multiple responses allowed)

TABLE 2: Water re-use and infrastructural considerations	
Knowledge Gaps	**Frequency**
Knowledge transference to public	14
Scaling up water reuse technology	12
Technical solutions for re-use	12
Antibiotic risks	7
Pathogens and diseases	5
Challenges	
Scaling up reuse technology	11
Lack of public trust and government transperancy	9
Diffusion of learning from pilot studies	7
Public awareness and knowledge	7
Cultural considerations	6
Political will	5
Social implications of reuse	2
Start up costs	1
Solutions/Recommendations	
User friendly knowledge transfer (research to application)	10
Incentivise water re-use r	7
Promote rainwater harvesting	6
Eencourage shared ownership of infrastructure	6
Public education (multi-media)	7
Horizontal wetlands & filtration	2
Grey water flush toilets	2
On-site pre-treatment	2
Innovation hubs to develop reuse technology	2

Challenges, knowledge gaps and solution/recommendations are ranked in decreasing order of importance based on number of participants that considered them important
(values represent frequencies; n=60, multiple responses allowed)

TABLE 3: Water security and governance-challenges and advances	
Knowledge Gaps	**Frequency**
How to ensure an active role of educators	10
Consequences of water insecurity	10
Methods and avenues for knowledge dissemination	4
Participatory agency-based social simulation	2
Impact of systemic risk	2
Enabling governance systems	2
Conflict management	2
Truncated terms of reference	1
Challenges	
Restoring citizen trust	7
Lack of transparency	6
Skills gap/lack of technical capacity	6
Balance: Land & Water reform	5
Knowledge loss (experts leaving country/sector)	4
Silo thinking and planning	4
Translating research to policy	4
Stakeholder engagement	3
Business model for consultancy services	2
Solutions/Recommendations	
Empowering educators	6
Informed decision-making	6
Citizen empowerment	6
Academia should focus on applied research	5
Educate local government councillors	4
Integration of strategic mandates	4
Environmental education	3
Ensure stakeholder analysis & participation	3
Develop mechanisms to manage conflicts	2
Connecting knowledge champions	1
Understand social implication of water insecurity	1
Promote inter-sectoral planning	1
Improved leadership	1

Challenges, knowledge gaps and solution/recommendations are ranked in decreasing order of importance based on number of participants that considered them important (values represent frequencies; n=60, multiple responses allowed)

TABLE 4: Overall recommendations	Frequency
Improve public and government awareness around water issues	26
Incentivise water re-use and conservation	16
Introduce rising block tariffs	15
Improve understanding of health and social implications of water reuse	15
Improve human capacity development in water sector	13
Enhance ecological infrastructure	11
Define water security in the context of geography and human demographics	9
Strengthen interaction and alliances among stakeholders	8

Challenges, knowledge gaps and solution/recommendations are ranked in decreasing order of importance based on number of participants that considered them important (values represent frequencies; n=60, multiple responses allowed)