Governing groundwater flows for growing cities facing drought risks (GoFlow)

Cape Town Learning Lab 2 Report, July 2022

Introduction

The second in a series of GoFlow Learning Lab events was held in Cape Town on Thursday 28th and Friday 29th July (8.30am-3pm) at the Sport Science Institute of South Africa in Newlands, Cape Town. This report presents a summary of the presentations, exercises and discussions held during the 2-day workshop focusing on sustainable groundwater flows in the Cape Town city region.

The *Governing groundwater flows for growing cities facing drought risks* (GoFlow) project is designed to integrate natural and social science aspects of sustainable groundwater management. It does so with the aim of strengthening the collaborative capacity to adaptively manage groundwater flows in and around growing urban areas under changing climate conditions. The focus is on the Cape Town and Nelson Mandela Bay city regions as 'learning laboratories' for developing knowledge that could be applied in other urban contexts. The GoFlow project is implemented by the University of Cape Town and funded by the Water Research Commission. The project runs from April 2021 to March 2023.

Participation

We invited a range of knowledge holders relating to groundwater usage, sources, flows, quality, recharge processes and governance arrangements to be part of the Learning Lab event. The list of invitees included people from the City of Cape Town (specifically the Resilience, Bulk Water, and Catchment and Stormwater Management Units / Branches), the national Department of Water and Sanitation (Western Cape regional office), the Western Cape Economic Development Partnership, GreenCape, Umvoto, Geoss, Delta-H, OneWorld, ICLEI, WWF South Africa, Environmental Monitoring Group, South African Faith Communities Environmental Initiative, the PHA Food and Farming Campaign, Consol, Distell Monis, Peninsula Beverages, and the Universities of the Western Cape, Cape Town and Stellenbosch. See Annex 1 for the

list of those who participated in the event. Many thanks for sharing your time with us. We hope that these events will contribute to expanding and strengthening a Community of Practice in the Cape Town groundwater space, building connections across academia, government, civil society and the private sector, between those working in the biogeophysical, engineering and social aspects of groundwater management.

Day 1

Welcome, scene-setting & introductions

The participants that made it to Learning Lab 2 were mostly a new group of people, who hadn't attended Learning Lab 1 at Intaka Island earlier in November 2021. Dr Anna Taylor welcomed everyone and started off the day giving an overview of the context that led to the GoFlow project conception. This project was in response to a call by the Water Research Commission that explicitly focused on the urban environment, as there is a growing recognition of needing to look at urban systems, especially within a drought context. Anna also spoke to what Learning Labs aim to be: a kind of stakeholder workshop designed and facilitated to learn together via structured engagement to build a more consolidated picture and shared understanding of a system, collating, comparing, challenging and confirming what we each know. Learning Labs involve experimenting with different formats and methods to harvest and share information. Learning Labs are also about getting people involved and working in groundwater together. Good governance is built on good relationships.

The group was invited to find someone they haven't met and in pairs, share:

1. Name
2. Group/organisation you work with
3. 1 thing you WONDER about groundwater in Cape Town
4. 1 thing you WORRY about groundwater in Cape Town

Each person was then asked to introduce the person they had just met to the rest of the group. This gave everyone a chance to welcome someone into the group and to share an insight into what participants were wondering and worrying about in relation to groundwater coming into the workshop. What surfaced is captured in the table below:

I WONDER	I WORRY
What the impact will be of permanent dewatering of buildings along the coast (like in Camps Bay) on the quality of the beaches	About inequality and how those can afford to access and use groundwater when others can't
About the access and quality of water in informal settlements	How high-tech managed aquifer recharge will go
How to maintain stakeholder relations and	The 'red tape' creates an inability to make

engagements	and implement decisions
What are effective modalities for collaborative implementation of groundwater projects	That contention between civil society and the state will undermine groundwater mgt
Are we doing enough citizen science to grow an understanding of groundwater status and changes	That our agricultural practices are not as water sensitive and water efficient as they could be
How to best leverage the skills and expertise of the good people that we do have	How to manage groundwater under many many uncertainties
What sort of data are we collecting on groundwater and what is it showing	Whether we are using groundwater sustainably
How to effectively engage diverse stakeholders in water decision-making	That policy clashes undermines good management of groundwater
How has groundwater use affected our rivers and wetlands	About the affordability of accessing groundwater by local communities
How can communities access groundwater sustainably	About the pollution of groundwater and what we are doing to protect the aquifers
What is the recharge rate of Cape Town's aquifers	How to avoid depleting and damaging our shallow aquifer
How do we overcome the silos that we operate in	About overstraction
Do we have the data needed for sound management of groundwater	Regarding the lack of interaction between communities and local government
Whether to work in academia or industry	About the need to start treating groundwater
What type and how much contaminants enter the aquifer and what the mobility of those contaminant are through the aquifer	About human interference in complex natural processes and what that will do to water quality
How communities monitor groundwater	Mapping and delineating the physical bounds of groundwater
What the quality of groundwater is and what the cost and affordability of treatment is	The effects of dewatering on ecosystems
How much groundwater do we actually have	

Because many people had not attended the first Learning Lab, Anna recapped the main activities and information shared at that event, describing the Naming and Framing exercise that was done surrounding the Cape Town groundwater situation. The exercise shed light on what participants believed was 1) moving us forward, and 2) holding us back (*see* *CPT Learning Lab*

1 report). Anna also gave an overview of the previous Learning Lab speakers; and the sessions surrounding the stakeholder mapping, initial influence mapping; the UWMF; hydro-social boundaries; and the scenarios and using UWMF/mass balance. For details see slides:
GoFlow CPT LL 2_28 July 2022_A Taylor.pdf

Based on what was covered in the 1st Learning Lab, Anna went on share the aims for this second Learning Lab to further extend and deepen discussion and knowledge sharing on:

- Utility of urban water metabolism analysis for decision-making, including spatial and temporal comparisons;
- Identifying the actors impacting Cape Town's groundwater across the three main aquifers, assess the strength of ties between them, and their capacity to implement;
- Constructing plausible scenarios of drought risk;
- And building a picture of how this work relates to that of others participating in the Learning Lab.

In order to achieve this, the programme for the two days was as follows:

LL2 Programme

Day 1

- Welcome, introductions, overview of project & LL1
- Tea (10.30)
- Presentation by Dr Kevin Pietersen (UWC)
- Session on UWMF overview & applications in CPT & NMB
- Lunch (12.30)
- Analysing CPT groundwater governance networks - actors & ties
- Presentation by Klaudia Schachtschneider (WWF)

Day 2

- Welcome & recap from day 1
- Analysing CPT groundwater governance networks - capability to implement
- Tea (10.30)
- Western Cape drought patterns presentation by Dr Chris Jack (UCT)
- Urban water metabolism scenarios
- Lunch (12.30)
- Organisational round robin in relation to turning dials on the Sankey diagram
- Reflections & thanks

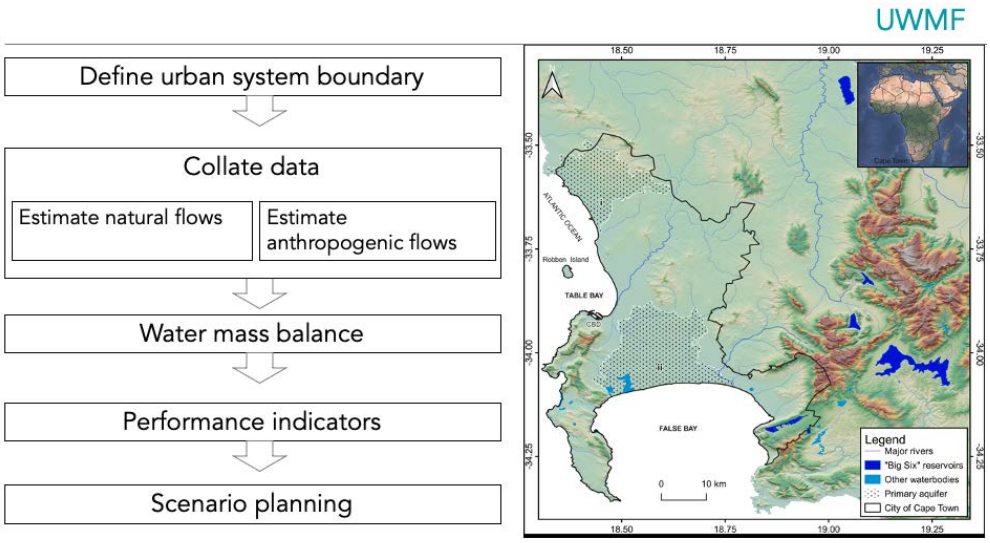
Evolution of groundwater governance

After the tea break, Dr Kevin Pietersen from the University of the Western Cape gave a talk on groundwater governance from his perspective and decades of experience as a hydrogeologist working across various institutions (UWC, WRC, private consulting to World Bank, UN, government etc). Kevin discussed that groundwater is a resource that is subject to the classic case of ‘Tragedy of the Commons’, whereby its distributed nature makes it very difficult to manage. Groundwater is very much part of a social-ecological system, and its governance involves the operation of rules, instruments and organisations that can align stakeholder behaviour and actual outcomes with policy objectives. The big question is how to create and coordinate effective implementation modalities. There is a need to manage groundwater as a 3D space, integrating surface and groundwater systems, with integration across national and local

levels. Yet government departments struggle with horizontal and vertical integration, and with engaging and partnering with civic organisations as part of polycentric governance, including religious leaders and traditional tribal leaders. The fact that groundwater only became a public resource in 1998 means that SA does not have a strong history of groundwater leadership, despite a good national groundwater strategy. Kevin noted that the incentive structures are not aligned with objectives of sustainable and efficient groundwater use. Groundwater is always the victim and groundwater protection is never a focal issue. He went on to discuss the challenges associated with groundwater governance in South Africa, namely the difficulties in leveraging the human capacity in the country and the role of local (Water User Associations and other civil groups) in co-governing local GW resources. Kevin argued the need for a National Groundwater Policy. There was a National Groundwater Strategy prepared in 2010 and updated in 2016, however these have not been formally signed off and implemented. Effective modalities for implementation don't exist. It is a huge problem that Water Users Associations hardly exist and they are supposed to be the forum for the local management of groundwater. Issues of transformation and representation are slowing down the formation of WUAs as there are huge vested interests that dominate. One example that we can look to is Tshiping Water Users Association in the Northern Cape that is dealing with groundwater conflict between mining companies and farmers. For further details see Dr Pietersen's presentation:
GoFlow CPT LL 2_28 July 2022_K Pietersen.pdf

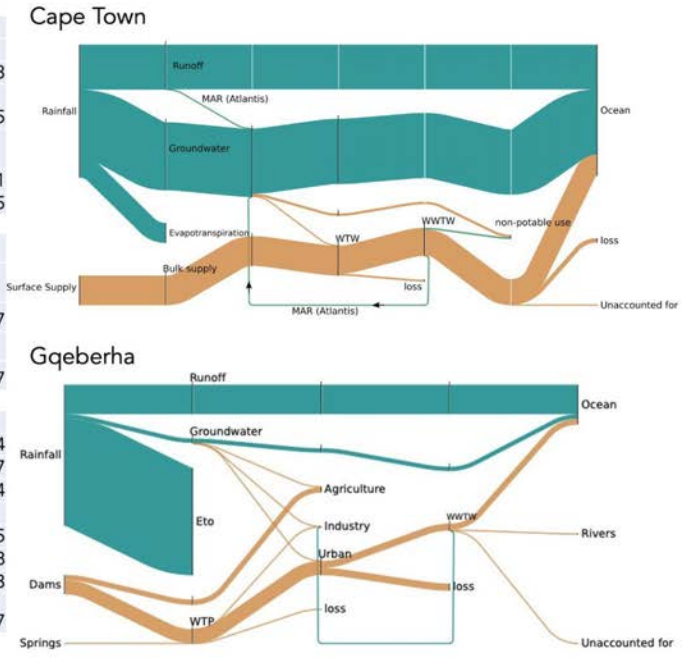
Urban Water Metabolism Framework (UWMF)

As there were only 2 participants who had also been present in the 1st Learning Lab, Dr Ffion Atkins re-introduced the UWMF to the group of new participants. The initial aim of this session was to gain a deeper understanding of how useful the urban water metabolism framework is to various actors in their particular roles. Considering the novelty of the framework to most participants, a comprehensive overview of the framework and its applications was provided. The UWMF was described as a metaphor of considering the city as a system, which quantifies the flows of resources (could be water, plastic, materials, nitrogen, energy etc) that enter a city, how they are used or stored within the city boundary and then the flows of resources that leave the city. Emphasis was placed on getting a better understanding of whether it can bridge the diverse understandings of complex systems. Using Cape Town as a case study, detail was given on what conducting an urban water metabolism analysis entails:



Emphasis was also placed on performance indicators and their role in guiding cities towards their water management objectives. Cape Town has committed to becoming a water sensitive city and this analysis can be one of many tools that provides the details of whether the decisions that are being made today are moving the city towards or away from such a goal. The initial results of the analysis done for Nelson Mandela Bay Municipality were also presented which allowed for some reflection on the comparisons between the two very different regions and cities.

	Cape Town	Gqeberha
Inputs	(Mm3/a)	
Precipitation (within boundary)	1381.9	1050.3
Bulk water supply (surface water dams)	324.9	80.805
Centralised GW Abstraction (external)		
Centralised desalination		11
Agricultural irrigation		48.5
Internal		
Centralised GW Abstraction (internal)	3.3	
Recycled water (potable use)	0	1.7
Managed aquifer recharge	0	
Groundwater recharge	456.7	32.7
Output		
Surface runoff (hydro)	708.1	219.4
Groundwater discharge	426.5	32.7
Evapotranspiration	205.2	797.4
Decentralised rainwater harvest		
Decentralised GW Abstraction *	26.9	6.5
Waste water effluent	234.8	54.8
Known losses	48.6	4.3
Recycled water (non potable use)	18.8	1.7

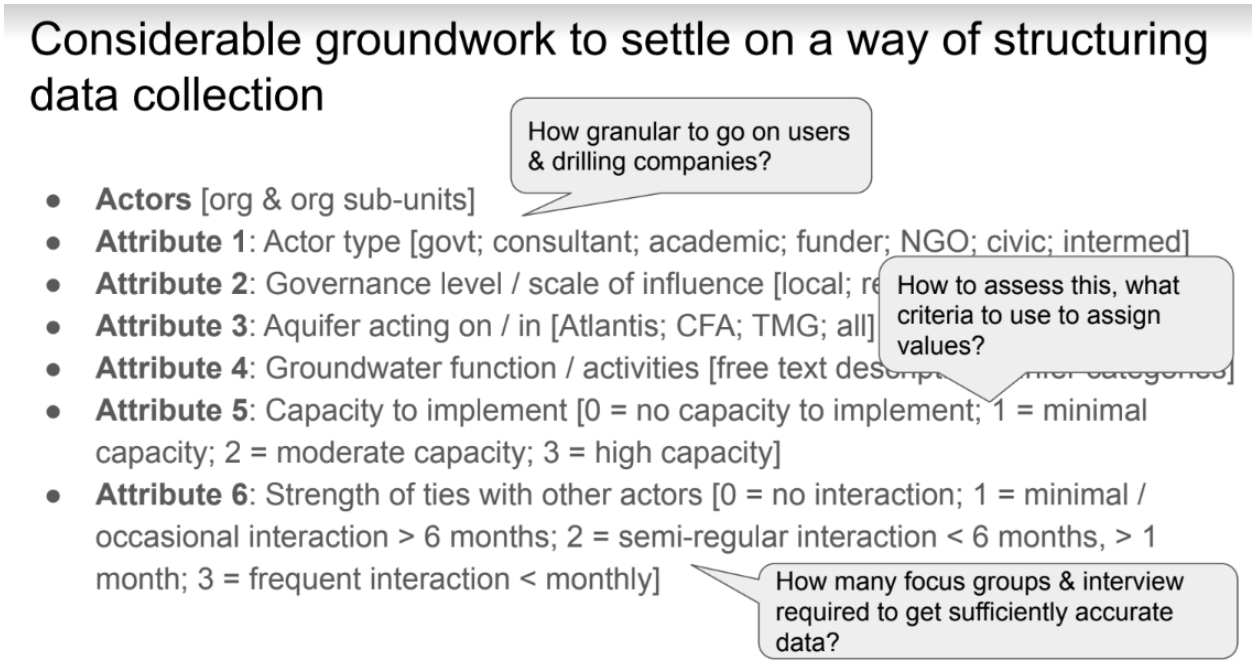


Participants were also asked to reflect on the sankey diagrams to gain a better understanding of their interpretation and understanding of what the UWMF does, and its potential usefulness to

them in their roles in groundwater. See all questions and answers in Annex 2. The presentation can be found here: GoFlow CPT LL2_29 July 2022_F Atkins.pdf

Groundwater governance: actors & ties

After lunch, Dr Anna Taylor picked up on the groundwater governance theme and reiterated how important it is, in addition to understanding the physical stocks and flows in the urban water system, to understand the social dimensions of groundwater. She highlighted how most existing groundwater governance studies globally and in South Africa have focussed on the national scale and on rural contexts, with less attention on cities. Yet many South African cities are increasingly relying on groundwater as part of their water supply mix, so it is important to get a nuanced handle on this. In this project, we are therefore experimenting with various methods to analyse organisational and intra-organisational groundwater governance networks to go beyond the stated formal rules and understand what is shaping patterns of actions and behaviour. Anna explained what is going into developing and testing a participatory social network analysis, introducing the six attributes of actors that are being explored and the key questions emerging, as shown in the image below:



Anna then introduced a group exercise focussing on attribute 6: strength of ties with other actors. She asked participants to join one of three groups based on the aquifer they worked directly on or knew best - Cape Flats aquifer, Table Mountain Group Aquifer, and Atlantis Aquifer. Each group was given a set of cards with actors. They were first asked to sort the cards into actors of relevance to the aquifer (i.e. active in using or managing groundwater in the aquifer), eliminating actors not directly active and setting aside actors they were not sure of their relevance. They were then asked to prioritise the most important / influential actors and rate the strength of their ties with each other on a scale of 0 to 3, from no interaction to frequent

interaction more regularly than once a month. The groups worked together to produce a matrix of actors and ties per aquifer as shown in the photos below.

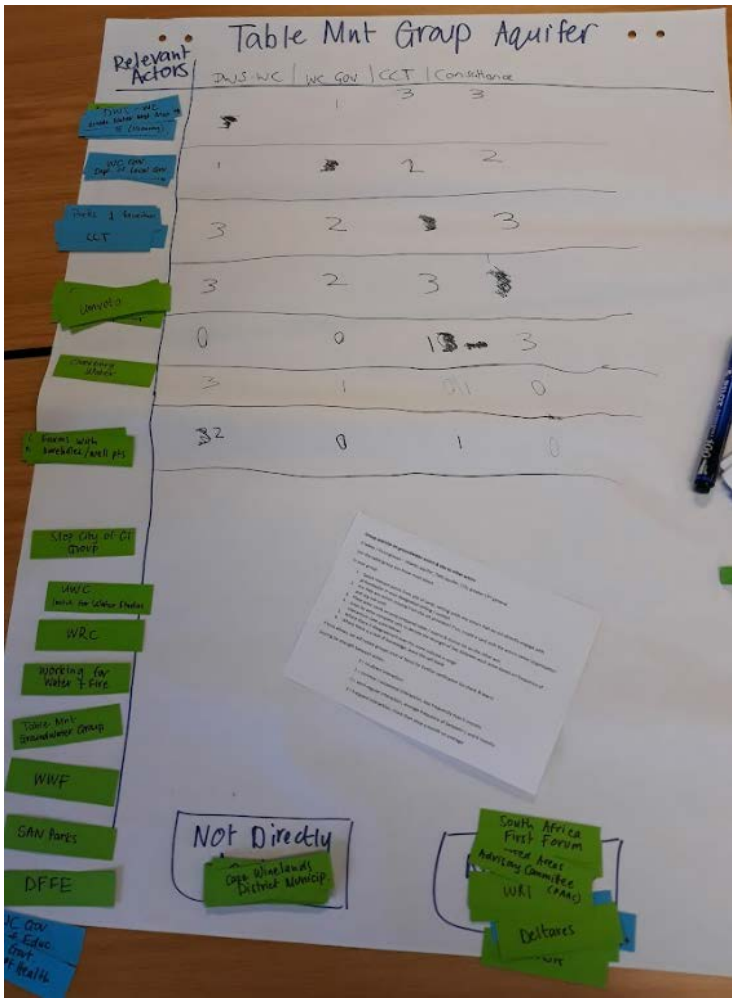


Table Mountain Groundwater Partnership

Dr Klaudia Schachtschneider, the programme co-ordinator for the Table Mountain Groundwater Partnership, gave a presentation on the work that WWF has been doing in the last 2 years to establish the Table Mountain Groundwater Partnership. WWF partnered with AB InBev because their production is reliant on groundwater. Pilots were undertaken in Newlands and Epping to get a handle on numbers of boreholes and groundwater levels. Cape Town has made an application to be a Ramsar Wetlands City, so is increasingly concerned about surface and groundwater interactions. WWF has explored bringing awareness of groundwater through faith-based organisations and schools. Materials that were developed through engagements with churches have been taken up by the World Council of Churches. As a point of reflection, WWF found that the quality of groundwater is a more cross-cutting concern shared between communities than groundwater quantity is, because most don't have wellpoints or boreholes. Raising groundwater awareness in schools was implemented by Greenpop and targeted younger school learners from public schools with an aim to slowly drive GW into the national curriculum. Also commissioned 2 artists - Nardstar and Eske Touborg - to do groundwater inspired murals at Makers Landing at the V&A Waterfront. Work was also focused on groundwater monitoring in various suburbs of Cape Town, involving private borehole owners. It involved a hydrocensus, door-to-door education with 683 boreholes counted. Interestingly, only 333 of which were registered with the City of Cape Town, and 50% of all the boreholes had been sunk during or after Day Zero in 2018. WWF has installed 17 loggers of groundwater levels with volunteers, the data from which are accessible on a publicly available dashboard. There is ongoing work being done CoCT and DHI on how to add groundwater data into the Bulk Water Decision Support System of CoCT. The Table Mountain Water Source Partnership was formally launched on 15 November 2021 with 9 founding members, chaired by DWS, with WWF-SA providing secretariat function. For further details see Klaudia's slides:
GoFlow CPT LL2_29 July 2022_ Klaudia_WWF.pdf

Day 2

We started day 2 by welcoming everyone back into the room, introducing new participants that had joined us, and doing a round of sharing one thing that had stood out for each person from the presentations, exercises and discussions during day 1.

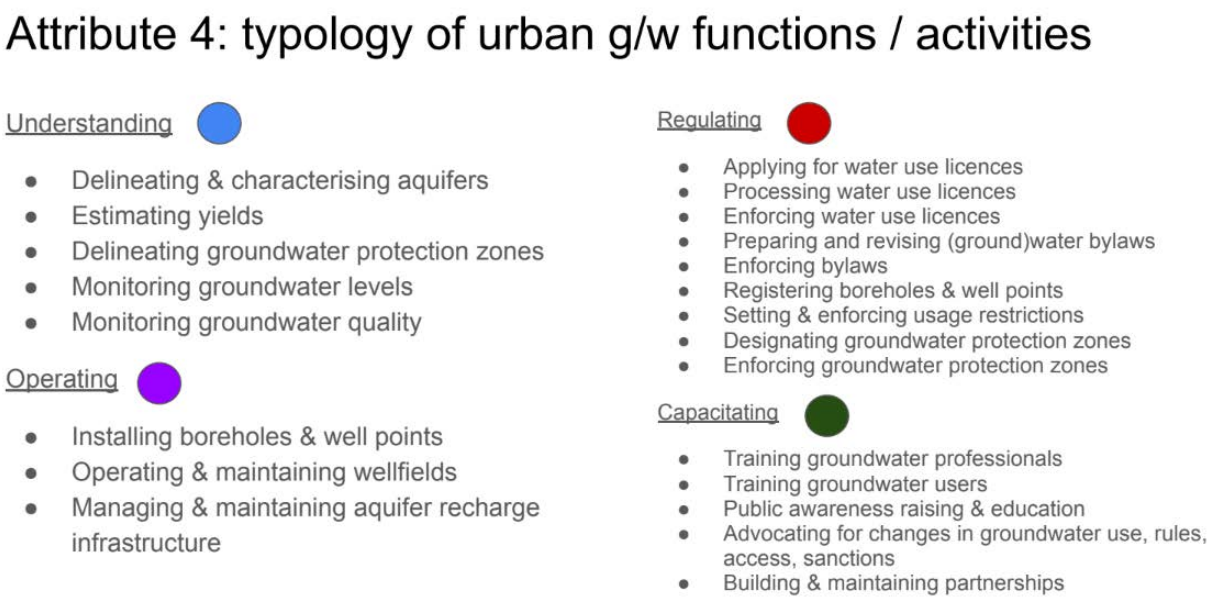
People were struck by the following:

- The components that make up a city's water metabolism and how different the metabolism looked when comparing between Cape Town and Nelson Mandela Bay.
- How the Sankey diagram depicting metabolism really helped to see the big picture.
- The diversity of people in the room worrying about and working on similar or related things.
- The extent to which groundwater is now featuring prominently in the spatial thinking of the city, as opposed to groundwater simply being something that farmers use.
- The large number of actors involved in the groundwater space in Cape Town.
- The need for long experience working in the groundwater space to really understand the multiple facets and complexities of how groundwater is or could be governed. In other

words, we don't want juniors managing our groundwater. They need experienced people to learn with and from.
- The power of visualisation - like the Sankey diagram - yet the importance of understanding what underpins such graphical representations, including data limitations.
- There are more opportunities for collaboration and cooperation than there are for conflict, but I have concerns around our collective inability to leverage the capacity that we do have.
- Scale matters. Issues are scalar.
- The inclusion of faith-based organisations in WWF's groundwater work; they are often excluded but are so important for reach.
- The stakeholder mapping exercise was striking in that it felt a bit like falling through the hole in Alice in Wonderland in the sense that it has us wondering if we really know how these actors actually operate, they should engage but do they really?
- Have a National Groundwater Strategy but implementation is holding us back. The National Groundwater Strategy (2010 and updated in 2016) is still not officially signed off. It is a subsidiary to the National Water Resource Strategy that has not been updated.
- South Africa doesn't have a National Groundwater Policy.
- We have a rich history of groundwater work to build on in South Africa. It is so useful to get an integrated and historical perspective on groundwater governance from someone who knows it first hand.
- WWF-SA is doing amazing work on groundwater issues locally.
- There is insufficient cooperation between government, groundwater users and stakeholders to document boreholes and enforce licences.

Groundwater governance: functions & capacity to implement

We then moved on to focus on the functions and capacity to implement attributes of the governance. Anna presented a typology of groundwater functions that groups activities into 4 types - understanding; operating; regulating; capacitating - as shown in the figure below.

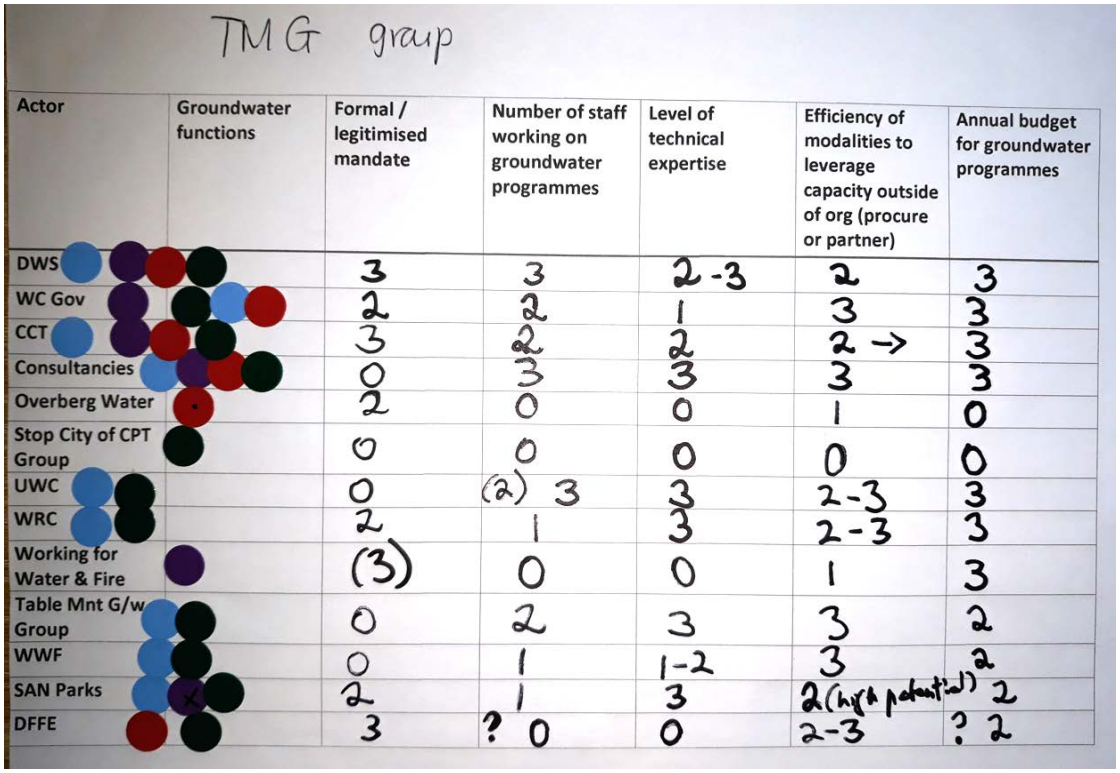


Participants were asked to get back into their three groups based on aquifers. Each group was given a list of actors (based on their exercise in day 1) and asked to indicate using colour coded sticky dots (matched with the dots in the typology image above) the functions that each actor fulfils in the aquifer that their group is focussing on. For details see the slides:
GoFlow CPT LL 2_29 July 2022_A Taylor.pdf

Participants deliberated within their groups and assign a score for each of the dimensions or metrics of the capacity to implement, guided by the following table:

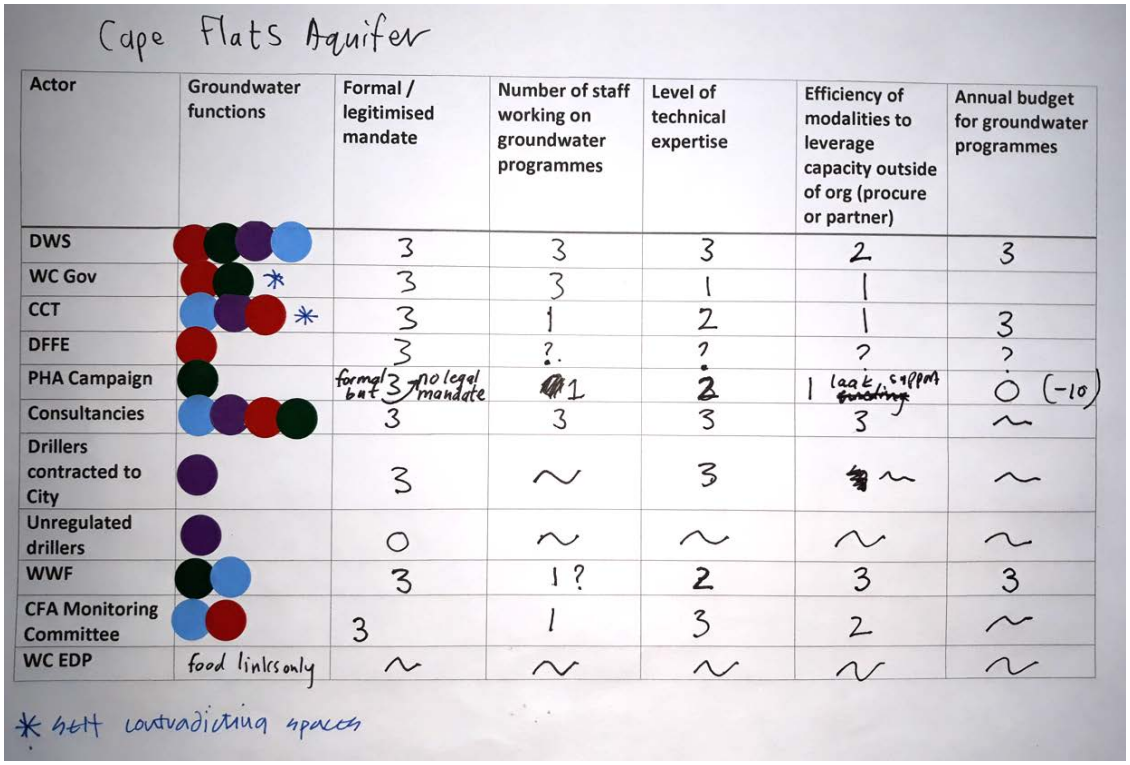
Metric	**0**	**1**	**2**	**3**
Formal / legitimised mandate	None	Contested / unclear	Limited	Clear & widely recognized
Number of staff working on groundwater programmes	No dedicated staff	Less than 5	5 - 10	Over 10
Level of technical expertise	None	Low	Medium	High
Efficiency of modalities to leverage capacity outside of org (procure or partner)	None	Low	Medium	High
Annual budget for groundwater programmes	No dedicated budget	Less than 1 million	1 - 10 million	Over 10 million

The exercise stimulated lots of discussions, debate and sharing of information between participants from organisations who are familiar with different actors and aspects of the system. Based on their deliberations, the groups suggested the following scores:



TM G grap

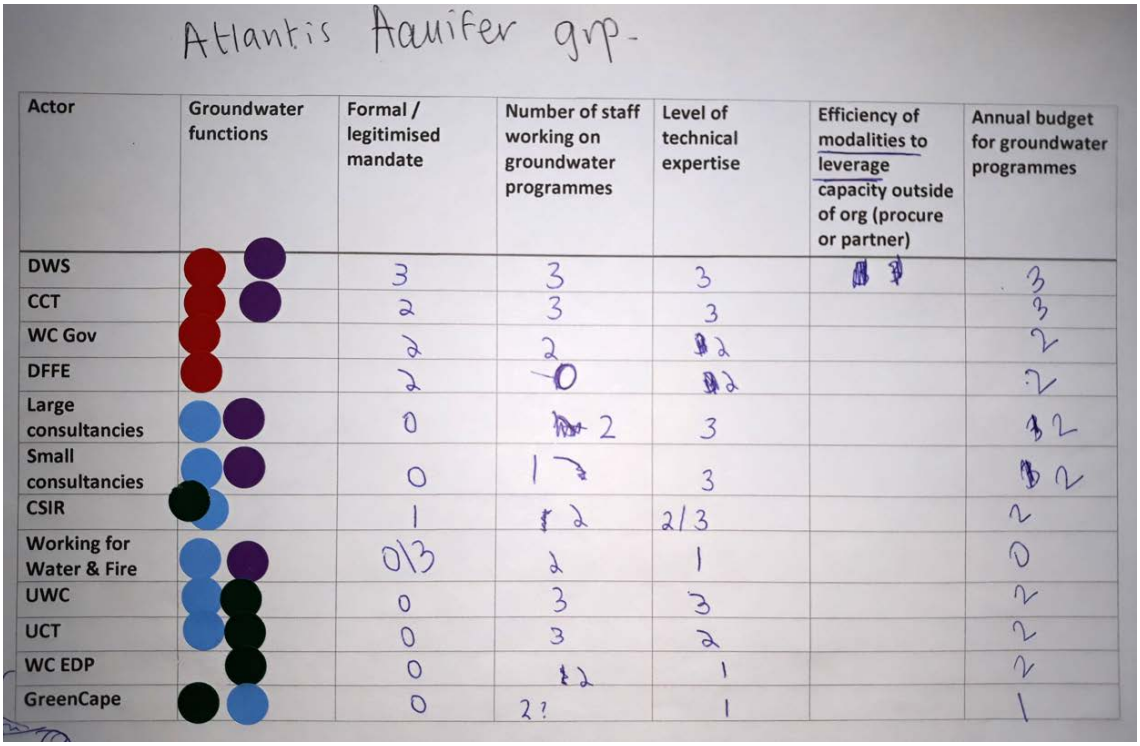
Actor	Groundwater functions	Formal / legitimised mandate	Number of staff working on groundwater programmes	Level of technical expertise	Efficiency of modalities to leverage capacity outside of org (procure or partner)	Annual budget for groundwater programmes
DWS		3	3	2-3	2	3
WC Gov		2	2	1	3	3
CCT		3	2	2	2 →	3
Consultancies		0	3	3	3	3
Overberg Water		2	0	0	1	0
Stop City of CPT Group		0	0	0	0	0
UWC		0	(2) 3	3	2-3	3
WRC		2	1	3	2-3	3
Working for Water & Fire		(3)	0	0	1	3
Table Mnt G/w Group		0	2	3	3	2
WWF		0	1	1-2	3	2
SAN Parks		2	1	3	2 (high potential)	2
DFFE		3	? 0	0	2-3	? 2



Cape Flats Aquifer

Actor	Groundwater functions	Formal / legitimised mandate	Number of staff working on groundwater programmes	Level of technical expertise	Efficiency of modalities to leverage capacity outside of org (procure or partner)	Annual budget for groundwater programmes
DWS		3	3	3	2	3
WC Gov	*	3	3	1	1	
CCT	*	3	1	2	1	3
DFFE		3	?	?	?	?
PHA Campaign		formal but 3 no legal mandate	1	2	1 lack support functioning	0 (-10)
Consultancies		3	3	3	3	~
Drillers contracted to City		3	~	3	~	~
Unregulated drillers		0	~	~	~	~
WWF		3	1 ?	2	3	3
CFA Monitoring Committee		3	1	3	2	~
WC EDP	food links only	~	~	~	~	~

* both contradicting spaces



Participants were asked to share feedback and reflections on the actor network exercise after testing the method. The participants reflected on the benefits and challenges of the exercise, recognising that many actors have a stake in shaping the trajectory of groundwater, but it is often difficult to know from the outside exactly how they work. They surfaced the following useful points that will be taken into account when using the information gathered and in preparing for the second Learning Lab in Nelson Mandela Bay:

- Struggled a bit between answering for the organisation as a whole versus specific to their work, personel, budgets, etc. specific to the aquifer the group was focussing on
- When rating the capacity of organisations to partner with others should it reflect existing partnering in real terms (i.e. they are actively doing things with others), or that the capacity exists (i.e. they could if they wanted to) but it is latent (i.e. not being exercised)
- When scoring the organisation's budget, does it include salaries?
- Ended up applying the budget question to the organisation as a whole, rather than aquifer specific
- Do need to disaggregate large actors, like the City of Cape Town, into organisational subunits as separate actors
- Not always easy to determine who the money / budget actually sits with
- Got stuck between what organisations 'should' be doing versus what they are doing
- Unsure of details of Western Cape government actors
- Blurry about division of roles between DFFE and DEA&DP
- Shame that we didn't have a representative from DWS participating in this Lab, as they provided a lot of insight at the first Learning Lab

- Problem is not one of lack of capacity but rather of conflicted mandates, for example between housing, environmental protection, economic development and agriculture in Province, and in City

UWMF Scenarios

Dr Chris Jack presented an overview of climate modelling that he and colleagues at CSAG have been working on the past few years. Without going into details of climate modelling or even climate systems of the Western Cape (WC), Chris wanted to present the general narratives of future climate scenarios that he has been exploring. Rainfall anomalies for the period between 1930's and forecasting to 2080's doesn't show a particularly strong trend in decreased precipitation. There is a difference in magnitude across the various models used to predict rainfall, however the variability appears consistent. When looking at the Southern Annular Mode, one of the strongest proxies for drought in the WC and is a measure of how far south the cold fronts are from the coast, there does appear to be much greater alignment across the various models. Climate systems in the WC are diverse and complex, owing to the mountains and varying topography with WC showing statistically significant trends for both drying and wetting. When the trend is broken down into seasons, there is a significant overall trend in drying in the autumn months, between March, April and May. Overall, the usual narrative that there are increasing rainfall events is not clear cut in the WC. However, Chris then discussed the moisture balance (Precipitation - Evaporation), which appears to show strong evidence for drying. For further details and lots of interesting graphs and maps see:
GoFlow CPT LL2 29 July 2022_C Jack.pdf

Dr Ffion Atkins then presented various sets of scenarios that included both climatic and land use changes. While these scenarios are hypothetical, a 10% increase in evapotranspiration with a 10% decrease in rainfall is highly likely.

Scenario	name	Precipitation	Evapotranspiration	Landcover
Control	SC0	No change	No change	No change
Scenario 1 *Climatic changes*	*SC1*	-10%	+10%	No change
Scenario 2 *Landcover changes*	*SC2*	No change	No change	All farmland to residential
Scenario 3 (extreme) *Climatic and Landcover changes*	*SC3*	-10%	+10%	All farm land and residential areas become hard urban space
Scenario 4 (less extreme) *Climatic and Landcover changes*	SC4	-10%	+10%	All farmland becomes residential, Residential becomes hard space

The focus of the session was on looking at how the urban water metabolism of Cape Town would change under the various scenarios through the use of performance indicators. Emphasis was placed on an indicator, developed for Bangalore India, that indicated how much water was available for water supply from stormwater sources. Essentially it is the stormwater flow/total water supplied. This indicator was highlighted for this session as it provided some focus to bring several complex themes together: climate projections, urban water metabolism and indicators. Using the 'Stormwater Potential for Water Supply' indicator was a useful focus as it allowed participants to see how the various climatic and land-use scenarios would change the potential for stormwater to be a viable resource for a city committing to become water sensitive. Landuse scenarios were rather extreme but provided a good basis to understand the role that paving over surfaces has on the overall water budget of a city. See Ffion's presentation here:
GoFlow CPT LL2 29 July 2022_Atkins Scenarios.pdf

Organisation Round Robin

Nazeer Sonday from the Philippi Horticultural Area (PHA) Food and Farming Campaign presented on the importance of soil health in agricultural yields, nutritional value of food produced, and capacity of soil to absorb and hold water. Nazeer highlighted the value of the Cape Flats Aquifer for protecting PHA farmers from drought, and shared information about the Cape Flats Aquifer protection campaign, including seminars in 2014 and 2016, a webinar in November 2021, the production of info pamphlets about threats to the CFA and the Rights of the Aquifer, and hosting an Aquifer Festival in December 2021 that included crafting activities, mural wall-art painting, and performances by local musicians. See slides for photos and further details:
GoFlow CPT LL2_29 July 2022_ Nazeer PHA Campaign.pdf

After this we had an open round of sharing what other organisations represented in the room are doing in the Cape Town groundwater space.

Organisation	**Relevant groundwater-related activities**
GEOSS	Working with CCT on Living Urban Waterways, pilot in Sandvlei, Sand River and canals with links to groundwater; Providing help and education around registering boreholes and applying for water use licences, as lots of confusion; Investigating impact of bulk abstractions from TMG aquifer on groundwater-dependent wetlands and streams around Steenbras, with Kogelberg as a control site
PHA Campaign	Got legal case outcome that CCT cannot make any development decision without considering impact on water security and climate resilience; Lobbying for CFA protection zone
ICLEI	Water, energy, food nexus work at the city scale in Cape Town

Zutari	CCT alternative water project; Working with Umvoto to demarcate protection zones; New Water Programme at Steenbras, CFA, Atlantis bulk water; Undertaking long-term monitoring
Environmental Monitoring Group (EMG)	Raising voices of communities to CCT by collecting local evidence; Focus on most vulnerable communities therefore more of a focus on surface water than groundwater, e.g. Kuils river, but link between pollution in rivers (especially building rubble) and quality of groundwater
UCT Future Water	Water Hub as learning site with focus on nature-based solutions for treating water, e.g. artificial wetlands and biofiltration cells, and then testing the quality of vegetables grown using treated water; Monitoring for contaminants of emerging concern (e.g. ARVs); Experimenting with upgrading of stormwater detention ponds; Doing rainwater harvesting as part of UCT Sustainable Campus programme

Participants noted that one of the big challenges many are facing is theft of infrastructure and instrumentation, especially anything manufactured from steel. This is causing widespread losses, costs associated with replacement and increasing security measures, and disruptions in functioning and data collection. This is a recurring theme that has been mentioned in Nelson Mandela Bay and further afield in Windhoek in relation to groundwater infrastructure. It needs to be factored into the governance analysis and recommendations for strengthening governance arrangements.

Reflections and feedback

We ended the Learning Lab with a round of reflections and feedback, asking participants to share what they particularly enjoyed about the event, and what suggestions they have for improving any aspects of it. We reminded participants that these engagements are about experimenting with methods and bringing together different topics with the intention of shared learning, so we value feedback that we can take into further such engagements, most notably the upcoming second Learning Lab in Nelson Mandela Bay. The following feedback was provided:

Enjoyed	**Do better / differently**
Talking to people in real life instead of online	Give more time for thinking through the actors and who does what
Good presentations - high quality information but not overly detailed	Maybe better not to do the actor network exercise as aquifer specific but rather for whole city

Good location	Missing representatives from DWS and Western Cape Govt (e.g. Denver Cloete in Dept of Local Govt, who works under Marius Brandt, and Wilna Kloppers from DEA&DP), as well as others from CCT
Changing focus between social and biophysical aspects of urban (ground)water	Assign people to breakout groups to have more mixed representation (e.g. consultants all in TMG group, PHA Campaign members all in CFA group)
Diversity of people participating and inputs	Invite more civil society organisations (e.g. Obs Residents Association, SAFCEI) - follow up with Nazeer for names)
Time to have relaxed, sideline chats	
No dominant experts, people made to feel like equals and able to share	

Thanks to all participants for their engagement in the two days!

ANNEX 1: Participant list

Name	**Institution**
Candice Lasher Scheepers	City of Cape Town
Nick Hamer	EMG
Julia Denny	EMG/University of California, Santa Barbara
Apiwe Mdunyelwa	EMG
Ashton Mpofu	GreenCape
Zama Ndlovu	GreenCape
Nazeer Sonday	PHA Food and Farming Campaign
Dean Palmer	CFA Monitoring committee (Natural Justice)
Susanna Coleman	CFA Monitoring committee
Notiswa Libala	EDP
Leanne Seeliger	University of Stellenbosch
Kevin Pietersen	University of Western Cape
Anya Eilers	Zutari
Lauren Arendse	ICLEI

Chris Jack	UCT
Ffion Atkins	UCT
Anna Taylor	UCT
Naledi Chere	UCT
Caron von Zeil	UCT / Reclaim Camissa
Tyrel Flugel	Umvoto
Klaudia Schachtschneider	WWF
William Lilly	Consul
Dale Barrow	GEOSS

ANNEX 2: Urban Water Metabolism Framework - understanding and use

Question	Answers
How is your work related to groundwater?	● Supports diverse stakeholders to work together for a collective front to address water related challenges. ● Citizen engagement, small-scale farmer support ● How to move towards GW as an alternative resource ● Working with communities who may be polluting GW unintentionally ● Improving urban water flows with better governance, policy, regulation and access to finance. ● Working as principal hydrogeologist for CCT ● Trying to foster better groundwater governance ● Silica sand mining, extracting the product from the CFA. Groundwater is returned to the aquifer after the separation process. ● Part of CoCT Groundwater Plan; GW central feature ● GW development, protection, characterisation and management; GW consultancy ● Hydrogeologist ● Helping communities have access to water; educating communities on CFA; empowering communities to know their rights ● farmer
What role do you play in the larger urban water cycle	● Supporting collaborative partnerships amongst WCWSS stakeholders, supporting water resilience. ● Engage on government processes; citizen engagement on water governance

	● Building public participation ● As an advocate for people living in informal settlements; as a water user/consumer ● Advocating for more sustainable urban water Systems ● Monitoring groundwater ● Foster partnerships, collective action around water source areas. ● This process is purely mechanical but evaporation takes place on the exposed water bodies ● User embedded in the system ● Contribute to technical understanding ● GW development and supply ● GW user; develop policies and approach for urban GW management ● Household and garden use ● Irrigation; living and advocacy
What key messages come from the Sankey diagram for you? Particular to Cape Town?	● Helps visualise the system and change in the system ● How can we filter down the information to simpler terms ● There is a lot of potential to intervene to create more circular flows. ● Conceptualising volumes and availability of resources which can be utilised considering assumptions and limitations while achieving end goals which are sustainable. ● Diagram helpful at a city level but it is too large a scale for our partners to be able to use. ● Evaporation in general is quite large and impact from our operation might be miniscule. ● Highlight key processes of where water interventions can occur; where water goes and the potential interaction points ● Nice presentation of mass flows; potentially graphic and tangible representation of relative water volumes. ● Water fluxes – how fluxes change over time?; how to diversify water supply mix – visual presentation
How would you engage with the urban water metabolism framework? How does it fit in with your work?	● Currently too academic for our work. Should integrate some social components. Need to think about the language that is easily understandable by all stakeholders. ● To inform understanding of the system; possibly visualise issues with water activists. ● It's not necessarily the framework per se but the engagement around it. ● Too academic, hard to relate. Need more time to understand the concept for me to engage on it. ● Would be helpful to distinguish between potable and non-potable. ● Useful to motivate for further funding in areas where we could engage and strengthen water resilience; visually useful for making the case for further work.

	● As a water use licence holder it could influence our understanding of the requirements of the WUL and the possible influence on wider region ● Future scenario planning (create conversation); bring people together; progress tracking, measure interventions for adaptive management; have to work with unknowns. ● Provides perspective and context – I would potentially use it for that purpose; can be improved by estimating other flows (e.g. unmanaged aquifer recharge) ● Visually present findings/outputs of modelling systems ● As farmer, aquifer activist, water activist and management