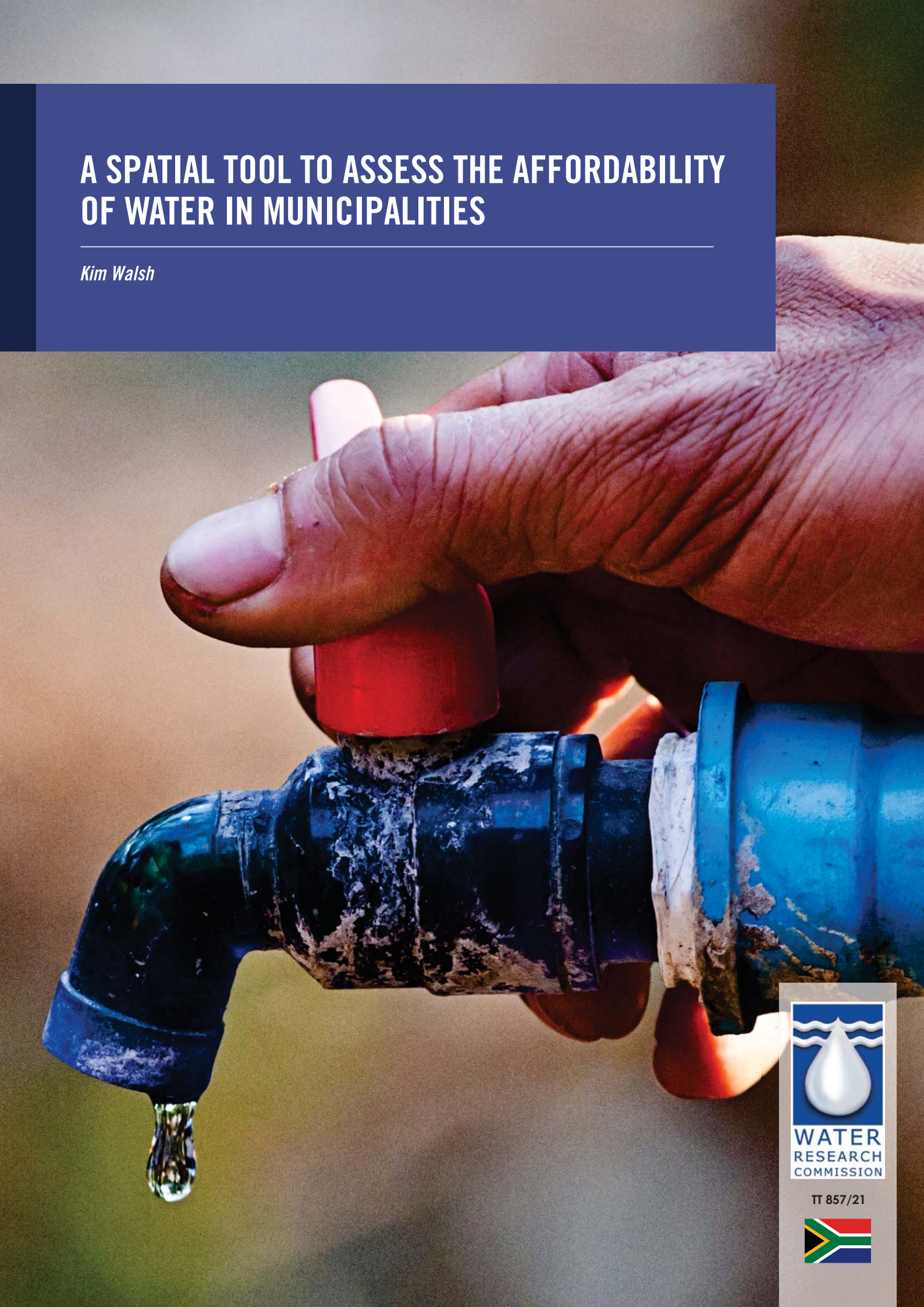
A SPATIAL TOOL TO ASSESS THE AFFORDABILITY OF WATER IN MUNICIPALITIES

Kim Walsh



WATER RESEARCH COMMISSION

TT 857/21

A spatial tool to assess the affordability of water in municipalities

FINAL REPORT TO THE
WATER RESEARCH COMMISSION

by

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WRC Report no. TT 857/21
ISBN 978-0-6392-0280-8

October 2021


WATER
RESEARCH
COMMISSION

ACKNOWLEDGEMENTS

The authors would like to thank the following members of the reference group for assistance and the constructive criticism at the start of the project: Jay Bhagwan (WRC), Abrie Vermeulen (Pegasys), Louisa Dunker (CSIR) and Sibusiso Ndlovu (DWS).

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1 INTRODUCTION

Palmer Development Group (PDG) was appointed by the Water Research Commission to develop a web-based tool to assess water affordability for residential customers in local municipalities in South Africa. The tool was developed between March 2019 and September 2020. This report is the final report for the study.

2 BACKGROUND AND PROBLEM STATEMENT

The affordability of water is currently not well understood by municipalities, who are tasked with supplying this service. In particular, tariffs are designed without fully assessing the impact that they will have on affordability. This is in part explained by limited research in the country on the various approaches for measuring and testing water affordability at the municipal level and this in turn is partly due to a lack of datasets that contain the water tariffs, consumption and income information typically required to assess affordability.

A recent study by the Water Research Commission (WRC report number K5_2584) addressed both challenges by developing a dataset to study affordability and using it to test several approaches to measuring affordability in four case study municipalities. A key innovation of the study was to match the datasets necessary to determine affordability spatially at the small area layer (SAL) level. This is a geographic unit that typically contains between 150 to 200 households. The findings of K5_2584 created a baseline for future assessments into affordability of water for residential customers and demonstrated the importance of this type of analysis in understanding affordability and consumption across different locations within a municipality. A clear gap that emerged from the findings was the need for a simple method or tool that municipalities can use to replicate the analysis.

3 APPROACH AND KEY ANTICIPATED OUTCOMES

Project K5_2883 aimed to address the problem statement described above through the development of a simple, user-friendly tool that will be freely accessible to municipalities to conduct their own affordability assessments. Although initially focused on replicating the spatial link between Census and billing data to obtain income data, the WRC noted at the inception meeting that the simplest form of the tool should enable any potential user to assess affordability. Hence, the tool design should ensure that a user can enter their own income data if billing information cannot be spatially joined to Census.

It was anticipated that two key outcomes would be achieved through the tool. Firstly, an improvement in the understanding of affordability constraints faced by residential customers in the municipality and secondly, an improvement in the understanding of the effects of tariff design on affordability and cost recovery. An additional outcome discussed at the inception meeting was the potential for the tool to be integrated into the regulatory environment through a requirement for municipalities to assess the affordability of their tariffs prior to approval by Council. Application of the tool by all municipalities would then enable the development of a "State of Affordability Report" which provides a comprehensive overview of the constraints across the country. The tool would therefore serve as a catalyst to bring affordability into a benchmarking process that informs how tariffs are designed and regulated.

4 OVERVIEW OF THE TOOL

The tool developed is called Tariffic and can be accessed at www.tariffic.site.

Tariffic has been developed using the following primary technologies:

- Microsoft ASP.NET Core 3.0 (C#)
- Angular 9.1.12
- Microsoft SQL Server 2019
- Visual Studio Community Edition 2019

There is an installation and user guide available for the tool and user instructions are not repeated here. Rather, this section provides an overview of some of the theoretical underpinnings of the tool and the data required, and presents a summary of the outputs.

A key feature of the tool is its flexibility. It can draw on billing data and/or Census data, or it can simply be specified based on user knowledge of a municipality or municipalities. It can do detailed spatial analysis within a specific municipality, or it can be used to compare several municipalities at a higher level of spatial aggregation. The tool has thus been specifically designed to meet the needs of a range of users.

4.1 Affordability metric applied

Tariffic uses the water bill as a percentage of income as a measure of affordability.

The bill as a percentage of income that is regarded as affordable is referred to as the affordability threshold. The user can set the affordability threshold in Tariffic and can, in fact, choose to set a number of thresholds to represent a range of affordability.

Affordability = Tariff applied to consumption volume divided by income [1]

To calculate affordability, Tariffic needs to know three things: (1) the customer's consumption amount (in kilolitres), (2) the tariff that should be applied to that customer and (3) the customer's income.

4.2 Consumption volume

For the consumption volume, Tariffic can either use actual consumption values extracted from the municipality's billing system, or a fixed amount applied to all customers (a 'theoretical' consumption amount). The user can specify the level of theoretical consumption to be applied. The level of theoretical consumption is specified in litres per person per day and Tariffic applies the household size to determine what the consumption would be for a household per month.

Theoretical consumption = Number of people in the household x 'theoretical' litres per person per day x 30 days [2]

Household sizes can be obtained for each SAL from Census and uploaded into the tool or the user can simply specify a household size.

4.3 Tariff applied

Tariffic allows for a tariff structure that includes a fixed charge and up to six tariff blocks.

Tariffic can handle multiple tariff types. Each tariff type has its own values for the fixed amount and the tariff blocks. Customers are linked to a single tariff type for Tariffic to know which values to apply. For example, if your municipality has a Domestic tariff and a Lifeline tariff, you can create these two Tariff Types and link customers to the appropriate one. Alternatively, if you're modelling across municipalities, you could use the Tariff Type to store a different tariff each municipality, and then link customers in each region to the appropriate Tariff Type.

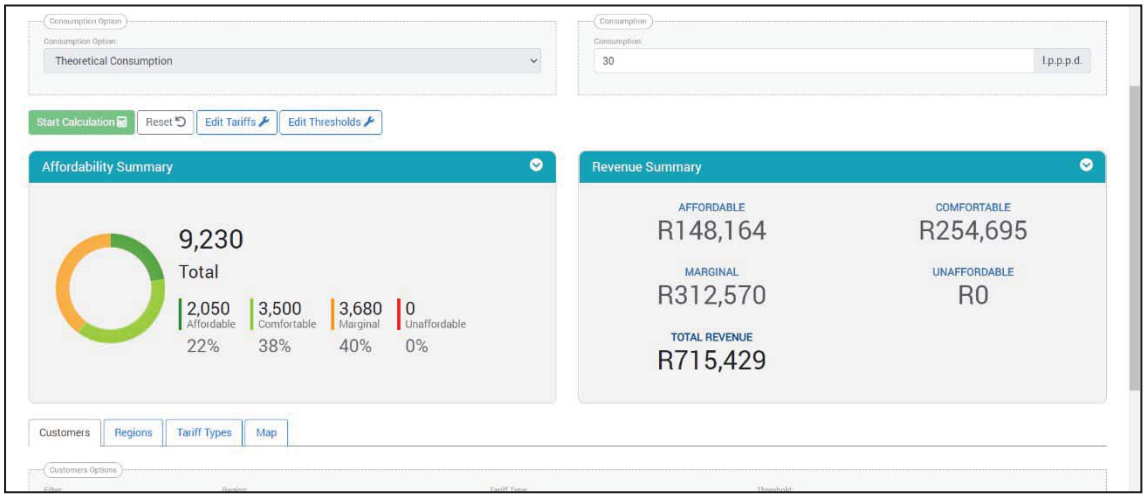
4.4 Income

Tariffic can also draw data on income from Census. If using Census 2011, the user must inflate this data to the year in which the analysis is being run prior to loading it into the tool. The user can also choose to specify an income based on knowledge of the municipality being modelled rather than use Census data.

4.5 Tool outputs

The Tariffic calculator produces a donut chart of affordability showing the percentage of households falling in affordability brackets defined on the basis of the thresholds specified by the user. In the example below, the user has specified three thresholds and thus divided households into four groups (unaffordable, marginal, comfortable and affordable).

It also produces a Revenue Summary that shows a theoretical revenue figure, which would be the total of the bills for all customers in each of the thresholds, along with an overall Total Revenue figure. This can also be presented as a Cash Summary if desired by specifying a cash collection rate for each level of affordability.

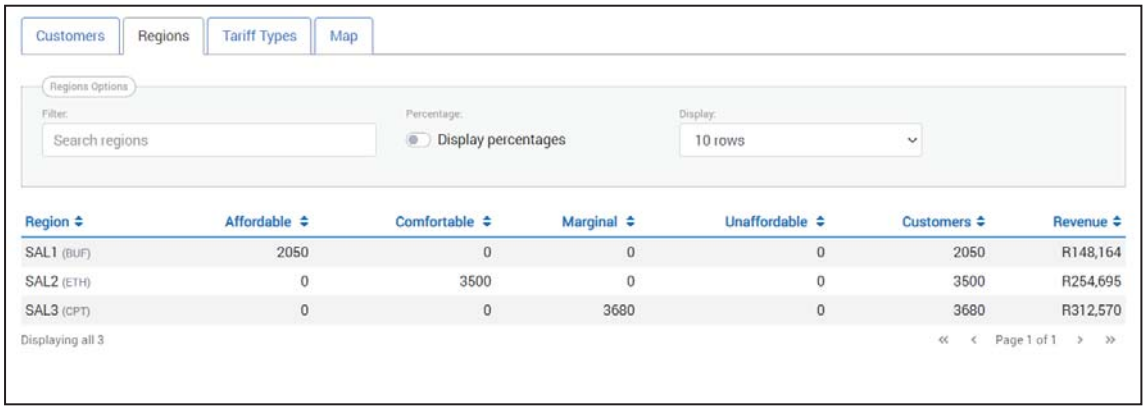


Beneath these two summary boxes are four tabs, each with additional information from the calculation.

The **Customers** tab, shown above, lets you view the results for each customer. You can filter the results using the search box or by selecting a region, tariff type and/or threshold. You can also set the number of rows to display in the table (which defaults to 10 rows at a time).

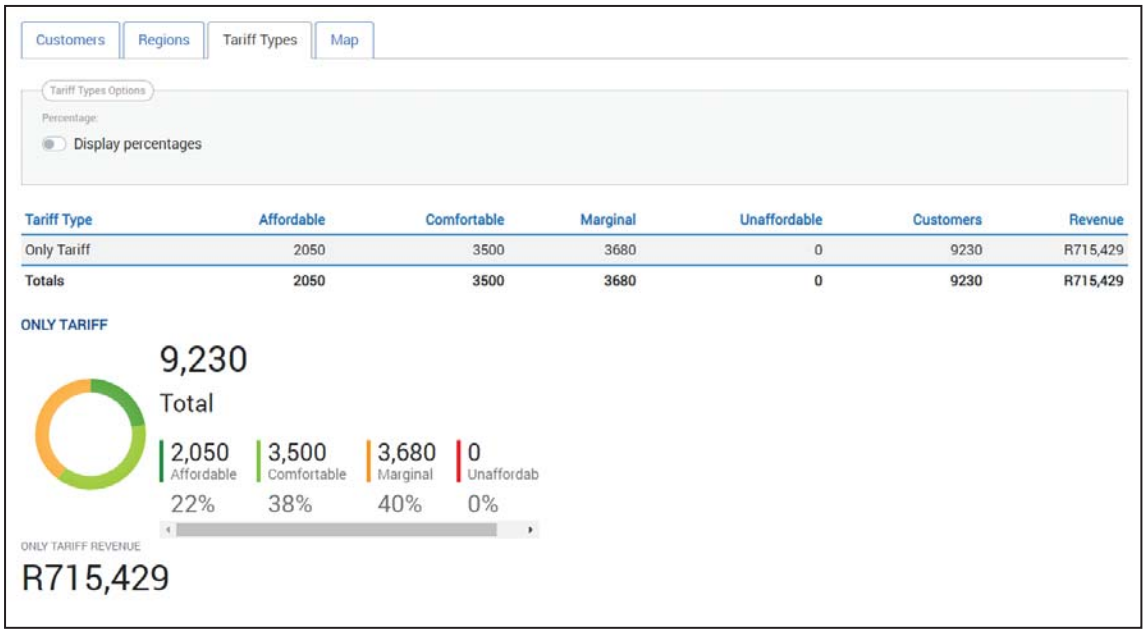
Each customer row shows the customer data, including the **Consumption (kℓ)** (which could be calculated if using the Theoretical option, or from the customer data if not); the calculated **Bill**, the **Bill as %** (of income), and the **Threshold** that the customer was categorised into. The columns of the table are sortable, so you can order the result by any of the columns.

The **Regions** results tab is shown below.



The region results are similar to the customer results, in terms of filtering and ordering or the table. There is also an option to display the values as percentages. Each region has the number of (weighted) customers in each of the thresholds, as columns, and the total number in the **Customers** column. A **Revenue** column shows the total revenue for that region.

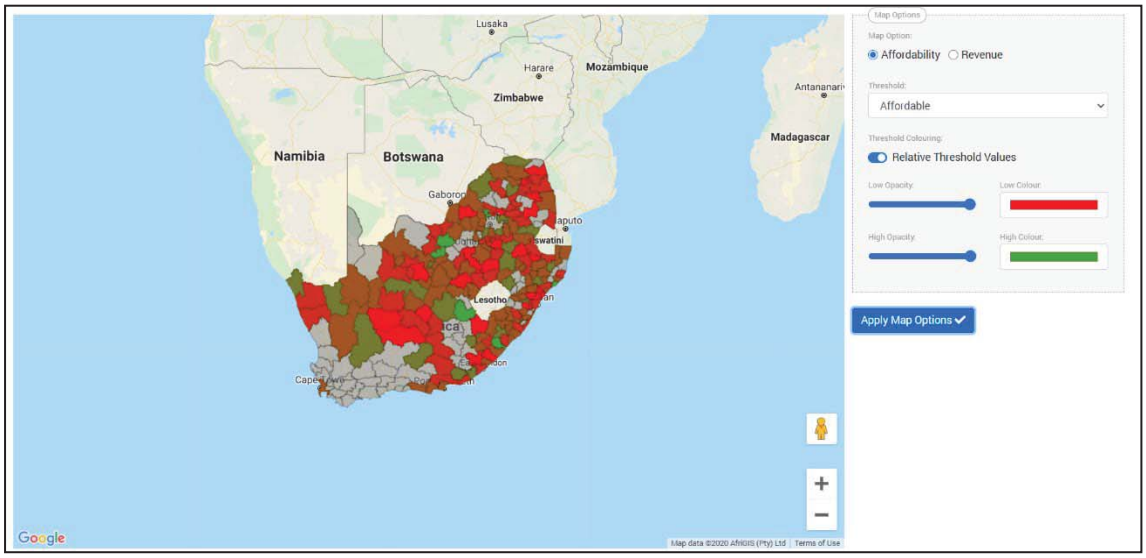
The **Tariff Types** results tab is shown below.



This section will display a row for each Tariff Type (in the screenshot above, there is only one tariff type). As per the Regions tab, the Thresholds are shown as columns, with the

Customers and **Revenue** columns too. There is a toggle for displaying the values as percentages, and a visual representation for each tariff type in a donut graph, beneath the table.

The **Map** tab displays the results of the areas on a Google Map, as shown below. The user can specify the colour ranges and other visual aspects of the maps.



5 KNOWLEDGE SHARING ACTIVITIES

Two knowledge sharing activities were undertaken: a webinar and a master class.

5.1 Webinar

The topic of the webinar was ‘are water services affordable in South Africa?’. The webinar was held on Zoom, and was opened by Jay Bhagwan of the WRC who then handed over to Dhesigen Naidoo to set the scene. Kim Walsh of PDG then gave a presentation on whether water services are currently affordable or not based on the findings of the previous K552584 WRC study. She introduced the new Tariffic tool as part of this discussion. Next, Johane Dikgang presented some findings from University of Johannesburg’s research with the WRC. Hameeda Deedat of the National Labour Economic Institute gave some thoughts on nexus issues of access and affordability, and finally Misaveni Ngobeni of National Treasury gave a Treasury perspective on cost recovery and tariff setting. Presentations are available at: http://wrcwebsite.azurewebsites.net/presentations/

The webinar was well attended and discussion in the chat was active, particularly from SALGA, National Treasury and the Department of Cooperative Governance. Overall, the webinar generated strong debate.

An attendance register at the webinar was not taken as it was a large, public forum.

5.2 Master Class

A Master Class on using the new Tariffic tool was held on 3 September. A .pdf document that presented the steps in using the tool was circulated in advance of the Master Class, as well as datasets that attendees could load live during the demo. These were also shared with a number of attendees of the webinar who requested further information about Tariffic.

Ten organisations attended the Master Class. There were several attendees from eThekwini Metropolitan Municipality and so there were about 15 attendees in all. This was notably lower than the 37 registered attendees. Load shedding at the time of the Master Class may have played a part in poor attendance, as well as the fact that it was virtual and free of charge.

Sean Walsh, who developed Tariffic, took attendees through the demo step by step and showed them how to:

- Create an account on Tariffic
- Add Tariff Types
- Add Tariffs
- Import Regions
- Import Customers
- Add Thresholds
- Calculate affordability

Feedback on the Master Class was very positive with a number of attendees indicating concrete interest in using the tool in future.

The attendance register for the Master Class is provided below.

NAME	COMPANY	EMAIL
Stephen Nash	Amthole DM	stephenn@amathole.gov.za
Ronald Gillmer	MISA	ronald.gillmer@misa.gov.za
Jim Gibson		jim.gibson@cluran.co.za
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Dr Michele Kruger	DWS Ministerial Advisor	michele.kruger@mkctsolutions.co.za
Zeus Smith	Center for Water Security and Cooperation in Washington DC	zeus@ourwatersecurity.org
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Johanna Bruhl	University of Cape Town	johanna.bruhl@uct.ac.za
Rudi Botha	Green Cape	rudi@green-cape.co.za

6 RECOMMENDATIONS FOR IMPLEMENTATION OF THE TOOL

There are three primary groups who may be interested in using Tariffic.

The first group is the DWS, who could use it to calculate the affordability of water tariffs in municipalities as an input to their tariff regulation process. DWS was engaged during the course of the development of Tariffic and was represented on the steering committee. The tool was presented to them and its potential uses discussed. They are thus aware of the tool but have as yet made no further contact about hosting it or using it for tariff regulation.

The second is individual municipalities, who could use Tariffic to test proposed changes to their tariff levels or structures to determine the impact on affordability. Several municipalities attended the webinar and/or the Master Class and are thus aware of the tool. PDG has received follow up from at least two municipalities interested in applying the tool. The concern here is continued marketing of the tool so that a broader group of municipalities is aware of it. SALGA may be able to play a role here.

The third group is researchers who may be interested in comparing the affordability of water across the country or in a sub-set of municipalities, or possibly even in other countries as the tool could easily be used (possibly with some minor changes) in other regions and for other services such as electricity. Several researchers attended the webinar and/or Master Class.

The tool is currently hosted by Sean Walsh. PDG and Sean Walsh intend to continue making the system freely available online, within reasonable constraints relating to the cost of the ongoing hosting.

Tariffic currently has no clear owner or future use-case. PDG and Sean Walsh (the developer) have initiated a process with the WRC to transfer the intellectual property rights for the tool. However, if the system does have utility in a local or national government context (e.g. DWS or SALGA, or local municipalities), we would be happy to either transfer the IP to the appropriate party or alternatively to provide them with an appropriate licence to use the system. An extension of this licencing approach would be to open-source the tool and publish it on a public repository such as GitHub. Ultimately what the system needs at this point is a

“champion” who would be willing to promote the use of the tool within the appropriate communities.

It is recommended that;

- further discussions be held with the DWS regarding the tool and its possible application for tariff regulation;
- that there is discussion with SALGA about the tool and its value to municipalities; and
- that an article be written for a national newspaper or similar publication using the tool to conduct a comparison of the affordability of water tariffs across the country as a mechanism to promote the tool to researchers or other interested parties.