Water Administration System (WAS PH3) Progress report

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Nico & Nicolaas Benadé
(NB Systems Cc)

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Key Partners

1. **Strategic Water Partners Network (SWPN)** – is a Public Private Partnership with the Department of Water and Sanitation and various corporates including Nestle, Sasol, SAB and Coca-Cola. The mandate of the SWPN is to identify and implement initiatives and projects that will assist in addressing the projected 17% gap in water supply and demand by 2030. SWPN will be responsible for the funding and governance of the project.

2. **Landbank SA** - donated funds to purchase and install 28 loggers which are used to measure the inflow into the respective schemes where needed. They also funded three laptops which are used to run the WAS at three government water schemes that don't have the required hardware.

3. **NB Systems Cc** – owns the IP for the WAS program which was developed by Dr Nico Benadé. They are responsible for the implementation, maintenance and continued development of the WAS and project manage the implementation of the Phase 3 implementation.

Contents

Chapter 1

Introduction

1.1 Introduction and background

1.1.1 Irrigation water management

While 12% of South Africa's land can be used for crop production, only 22% of this is high-potential arable land. However, the greatest limitation is the availability of water as most of the country has uneven and unreliable rainfall. Around 1.3-million hectares are under irrigation, and around 62% of South Africa's water is used for agriculture nationally.

Irrigation agriculture is the largest water user in South Africa and with the increasing competition between existing user sectors, the available water cannot meet the demand under current water use practices and operating conditions in all water use sectors. It is therefore imperative that the available water supplies are used efficiently and effectively to avoid supply shortages and intermittent water supplies.

1.1.2 Current water management system and problems to be addressed

Currently each irrigation scheme is responsible for the management and monitoring of the water resource available to that scheme. For each scheme there is a Water Use Association, Irrigation Board or Government Water Scheme that will collect all the water orders, calculate water losses (seepage and evaporation) and then schedule water releases according to the orders received for that week.

A manual system is often used to manage these processes. In the manual system, orders are collected by water bailiffs on a weekly basis for the week to come. All orders are captured into a spreadsheet for the scheme and in order to fulfil the water orders, the bailiffs are required to calculate the losses (evaporation and seepage) that will take place over the length of the canal as well as the lag time for water to reach its destination at the given flow rate.

This inform the water releases required in terms of volumes and times to be released from the schemes storage dams. Only the obligatory amounts of water required by the scheme should be release and the principle of water on demand ensures that water is used in the most efficient manner. However, if the release of water is not managed properly (i.e. the operator opens the sluices too early or closes them too late), incorrect filling of orders etc. then significant volumes of water can be lost due to these operational inefficiencies. The sustainability of the scheme is therefore at risk as well as placing strain on the overall availability of water for the country.

There is often no effective monitoring system in place to measure the

actual releases against the orders that are placed when using the manual method. Also the current method of using spreadsheets to capture orders and manage releases introduces the risk of human error and the potential for manipulation when reporting to the Department of Water and Sanitation (DWS).

A further risk which has been highlighted by some of the Water Use Associations is the continuity of the current systems in operation. There are often only one or two persons who know how the spreadsheets relate to one another and how calculations are performed within them. The WUAs are therefore totally dependent on these individuals, and should they leave or pass away, there is no-one else who knows how to operate the program.

1.1.3 The Water Administration System

A proposed solution to improve monitoring and measurement of releases in these irrigation schemes is to install the Water Administration System (WAS) with robust logging equipment. The WAS is designed to be a water management tool for irrigation schemes, Water User Associations (WUAs), Catchment Management Agencies (CMAs) and water management offices that wish to manage their water usage, water distribution and water accounts.

The main aim during the development of the WAS program was to minimise water losses for irrigation schemes that operate on the demand system and that distribute water through canal networks.

The Water Administration System (WAS) therefore provides a methodology to improve efficiency and accuracy of water release management and accounting. WAS is a proprietary, locally developed, integrated irrigation water management tool used for water distribution management and calculation of canal and dam operation procedures for a given downstream demand, with the aim of minimising water losses for irrigation schemes that operate on the demand system and that distribute water through canal networks. What makes the WAS program unique is that it is an integrated system including the water allocations, water use, water distribution and billing information.

Annexure 1 describes the WAS functionality and modules in more detail. The WAS was born out of public (WRC) funded research with the intention to commercialize it. The WAS system is specifically mentioned in the National Water Resources Strategy 2013 as follow: "Create an enabling environment to facilitate technology transfer about water use efficiency and productivity improvement technologies, such as the water accounting system (WAS) developed by the WRC for irrigation schemes". DWS has indicated to SWPN that it wishes to have the WAS rolled out to additional schemes.

1.1.4 SWPN funding support to WAS

The SWPN identified the WAS system as a technological solution which can be implemented in the agricultural sector to assist with addressing the gap between water supply and demand in the country, as per its mandate.

The SWPN pilot project focused on the implementation of the water release module of the WAS system, with the main purpose of reducing water losses. During the implementation of the first phase of the WAS system, 4 large irrigation schemes were supported with the roll out of the WAS system water release module (Sand-Vet, Vaalharts, Hartebeespoort (West Canal) and Orange-Riet).

In Phase 2 five further schemes were supported: Impala; Hartbeespoort (East canal); Loskop; Lower Olifant's River; Nzhelele; and measurement activities were supported on the Orange-Riet irrigation scheme.

Building on the successes of the WAS Project Phases 1 and 2, SWPN has supported the upscaling of the roll-out of the WAS to 13 additional irrigation schemes in Phase 3 of the project.

The yearly water savings since 2014 (at the start of phase 1) are reported in Table 3.1. The estimated water savings for Phase 3 are also shown in the same table.

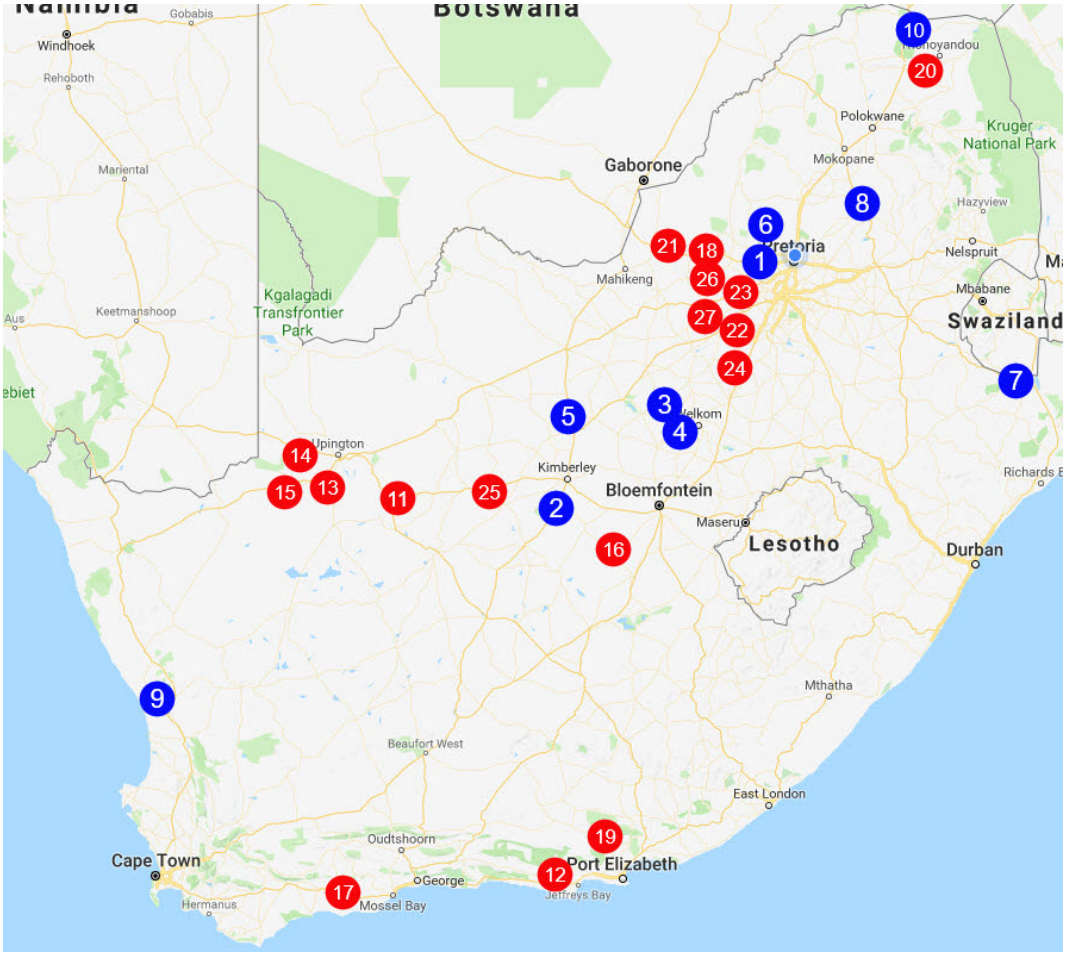


Figure 1.1: Locality map of the irrigation schemes included in each phase

Phase 1	
1	Hartbeespoort IB: West
2	Orange Riet WUA
3	Sand-Vet WUA: Sand
4	Sand-Vet WUA: Vet
5	Vaalharts WUA
Phase 2	
6	Hartbeespoort IB: East
7	Impala WUA
8	Loskop IB
9	Lower Olifants WUA
10	Nzhelele GWS
Phase 3	
11	Boegoeberg WUA
12	Gamtoos IB
13	Kakamas WUA: Augrabies
14	Kakamas WUA: Left bank
15	Kakamas WUA: Right bank
16	Kalkfontein WUA
17	Korente Vette IB
18	Lindleyspoort GWS
19	Lower Sundays River WUA
20	Luvuvhu GWS
21	Marico Bosveld GWS
22	Mooi River GWS: Boskop
23	Mooi River GWS: Klerkskraal
24	Mooi River GWS: Lakeside
25	Oranje Vaal WUA
26	Schoonspruit GWS: Elandskuil
27	Schoonspruit GWS: Rietspruit

Figure 1.2: Schemes included in each phase as shown on Figure 1.1

1.1.5 Was Phase 3

The primary objective of the project is to reduce water losses and the overall water demand of selected schemes through the implementation of the WAS water release module.

The specific objectives are:

- To reduce water losses and the overall water demand of selected irrigation schemes in order to progressively close the water gap at the local and catchment level.
- To improve scheme financial management and productivity through more efficient water use.
- To train and capacitate scheme personnel to utilise the WAS in order to sustain and build on the efficiency gains realised through the system.

- To develop a public platform for access to WAS information as a means of promoting peer regulation and incentive based monitoring in the agricultural sector.
- To scope the water saving benefits and costs for further roll out of the water release module in irrigation schemes where the WAS has already been implemented.

1.1.6 Key data on irrigation schemes where WAS has been implemented with SWPN Support

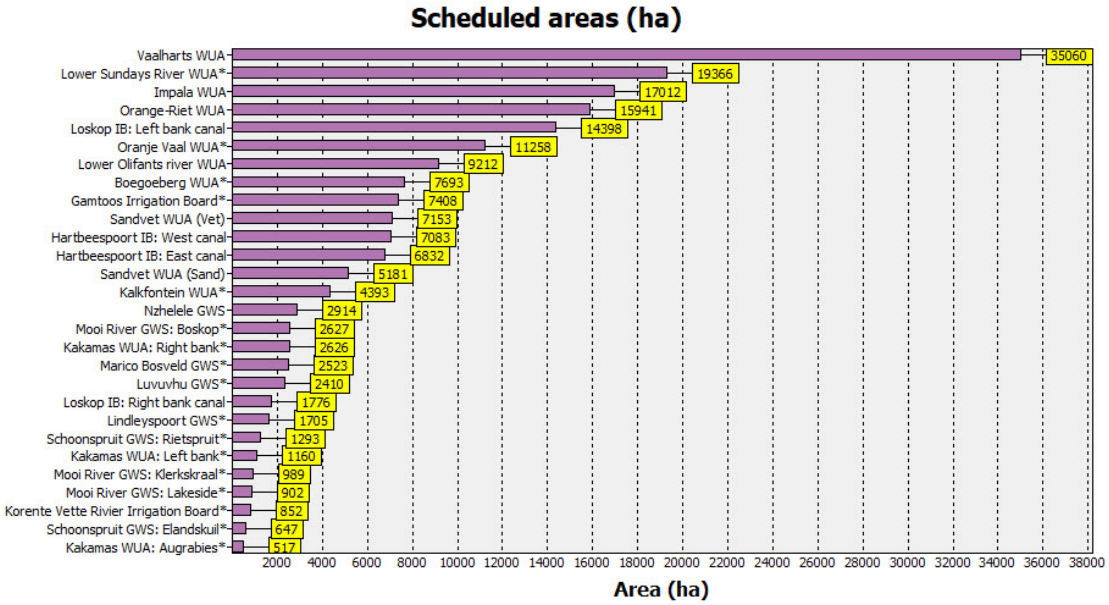


Figure 1.3: Scheduled areas (* = phase 3)

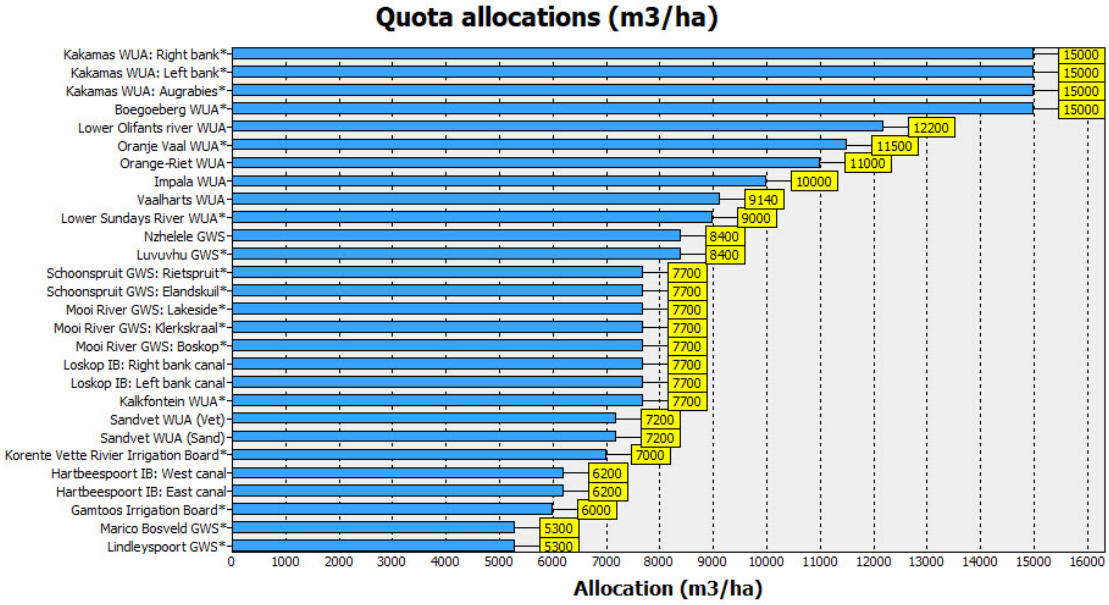


Figure 1.4: Quota allocations (m^3/ha) (* = phase 3)

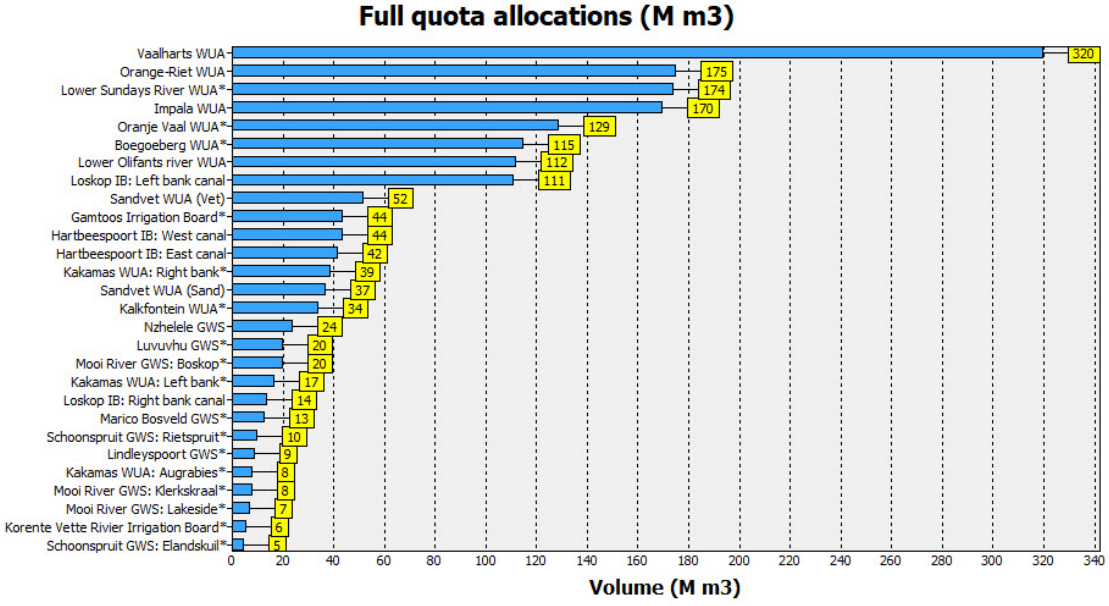


Figure 1.5: Full quota allocations (m^3) (* = phase 3)

Chapter 2

Implementation

2.1 Implementation

2.1.1 Schemes supported

All three phases of the WAS were implemented by NB Systems.

Scheme selection criteria

For the first two phases of the project it was a requirement that the WAS must be installed and up and running at the specific scheme. This criteria was dropped for phase three and the selection criteria included the following:

- The scheme must deliver water on demand through a canal network.
- The infrastructure must be in place to measure, at least, the inflow into the system.
- The scheme management must support the implementation of the WAS program.
- Suitable hardware and access to the Internet must be available to run the WAS program.
- Skilled personnel must be available to operate the WAS program.

2.1.2 The implementation comprised

- Capturing distribution sheets, water quotas and user information for all schemes.
- Installing measuring stations. The number varied per scheme depending on the layout.
- Capturing water orders, meter readings and downloading of measuring station data.
- Uploading water use and loss reports to the wateradmin website.
- Generating release volume information for operators.
- Setting up of the required IT capability and platforms.
- Processing data to generate usage and loss statistics.
- Generation of accounts.

- Training of scheme operators to use the WAS system to improve operation of the scheme.

Capturing distribution sheet framework of the scheme

The distribution sheet framework of the total canal network was captured with details such as the position of abstraction points, measuring structures and canal capacities. Access to this information was made possible by each of the schemes.

Measuring Stations

Water flow measurement is the key to effective water distribution management and the minimization of water losses. The simplest and most effective method to determine the global water loss on an irrigation scheme is by measuring the inflow as accurately as possible and subtracting the total water use (water orders).

Measuring stations comprise of a measuring flume, a cabinet or protective structure and a data logger. All together 37 measuring stations were installed under WAS Phases 1 to 3, as shown in Table 2.1. Photo's of the measuring stations can be viewed in the photo gallery of each scheme on the wateradmin website (www.wateradmin.co.za).

The Cello logger that is linked to the Zednet internet interface was found to be the preferred measuring station for the canal inflow measurements. A dedicated WAS data export function was created on the Zednet platform together with an import function in the WAS thereby automating the data transfer process; saving time and reducing human error.

WAS data flow: capturing water orders, meter readings and uploading to the server

Weekly water orders are currently captured for all the schemes included in phases 1 to 3 except for Oranje Vaal WUA which is a new scheme and had to be set-up from scratch. Meter readings are captured or imported from a FTP-site on a monthly basis.

The WAS data flow diagram, as shown in Figure 2.1, displays the different components that is available for a complete roll-out of the WAS on an irrigation scheme that delivers water on demand.

The description of each component is as follows:

1. The WAS-client is a stand-alone application that is used by individual farmers to capture and maintain their own water orders. The software can upload and download water orders to and from the WAS database. This allows farmers to capture and keep a record of their own water orders for multiple sluices and synchronise it with the WAS database remotely through the internet.

   The WAS-client application can be downloaded by a farmer from the ***wateradmin*** website.

2. The WAS is a SQL relational database that is used at scheme level for water distribution and debit accounting management.

3. The ***www.wateradmin.co.za*** website is a multi purpose website that is used for the following:

   - Save water orders that was uploaded by farmers using the WAS-client application.
   - Save water orders that was uploaded by the WAS.
   - Download WAS-client water orders into the WAS.
   - Display water orders, water reports and graphs that were uploaded using the WAS.
   - Display water summary reports that were uploaded using the iScheme software.

4. The iScheme software is a database that is developed and used by NB Systems Cc to retrieve all the water use information that was uploaded to the ***wateradmin*** website using the WAS.

   iScheme then generates a water use history summary of all the schemes into a single report and upload it to the ***wateradmin*** website to be displayed.

5. Zednet is an Internet platform that is used to archive and display measuring station data on the Internet.

   The WAS makes use of the Zednet Application Programming Interface (API) to import measuring station data directly into the WAS database. This functionality makes it possible to generate water use reports automatically in the WAS which in turn are uploaded to the ***wateradmin*** website.

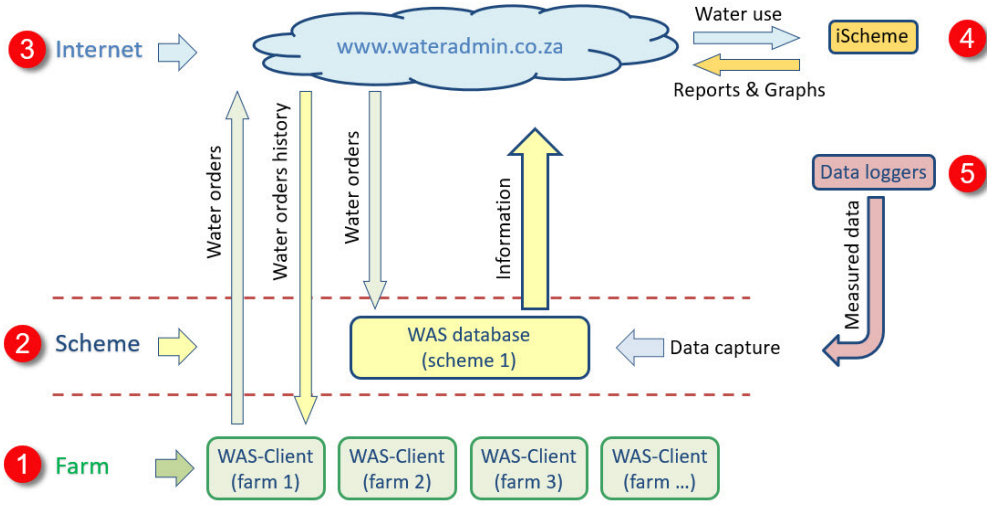


Figure 2.1: WAS data flow diagram

Generating release volume information for operators

Two methods are available in the WAS to calculate water releases which include:

- Twelve hourly distribution sheet that can be setup and calibrated according to the user's requirements. This method is easy to understand and implement which makes it the preferred method among water distribution management personnel.
- Canal network approach that requires a more complicated calibration procedure through the use of cross section properties that are not always available.

Only two schemes, which include Orange-Riet WUA and Kalkfontein WUA, make use of the canal network approach. The rest use the distribution sheet method.

2.2 WAS web interface

The URL to access the WAS web interface is ***www.wateradmin.co.za***. Each scheme in phases 1 to 3 has its own set of web pages that can be accessed through this link.

All of the reports and graphs on the ***wateradmin*** website are generated and uploaded using the WAS and iScheme software. An example of the typical information that is available for each scheme is shown in Figure 2.2.

The WAS system is fully functional. The user interface and usage data can be viewed on ***www.wateradmin.co.za***.

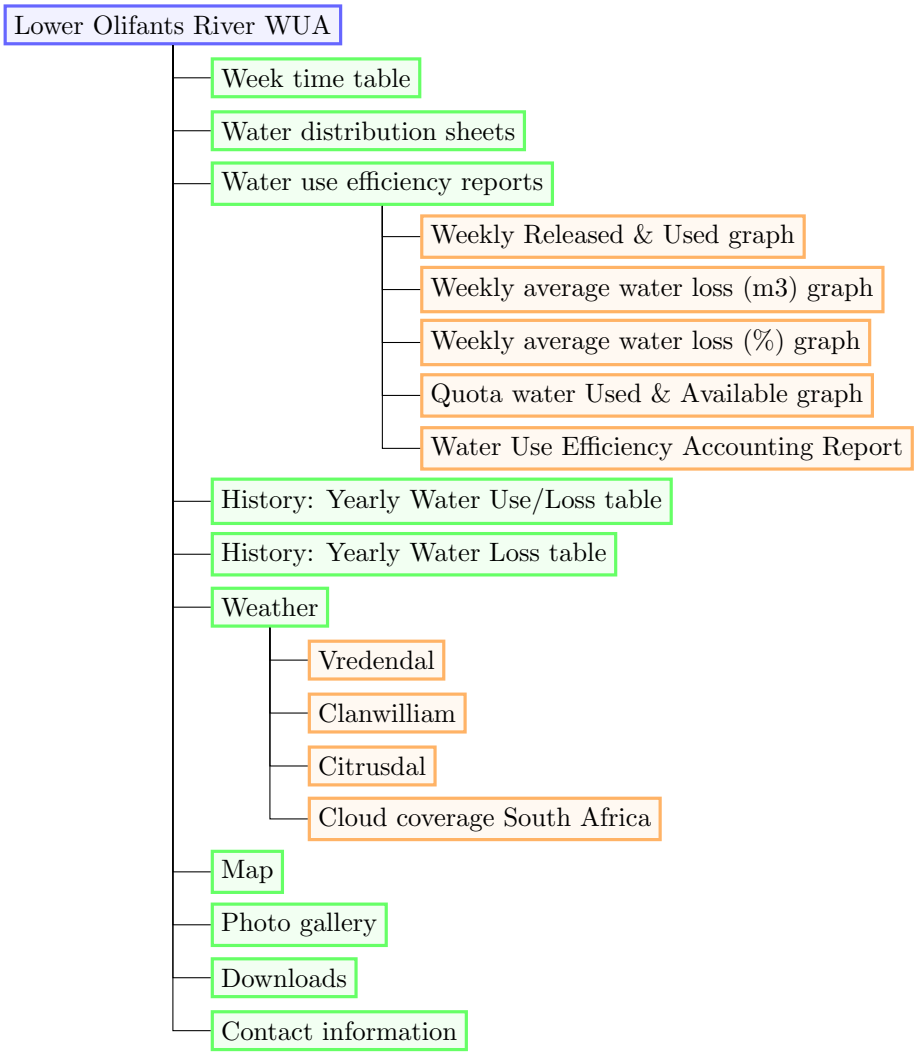


Figure 2.2: Lower Olifants River WUA page

Processing data to generate usage and loss statistics

The process to generate water usage, water loss reports and distribution sheets can be summarised in two basic steps.

1. Capture water orders and meter readings
2. Import measuring station data

Once this information is captured or imported into the WAS database, the following reports and graphs are automatically generated and can be uploaded to the ***wateradmin*** website where needed:

- Water usage reports per user, group of users and for the scheme as a whole
- Water distribution sheets
- Water use efficiency accounting reports and graphs

The integration between WAS and the ***wateradmin*** website is operational for all of the schemes included in phases 1, 2 and 3. The number of reports and graphs available on the ***wateradmin*** website will be different for each scheme depending on their specific needs.

Generation of accounts

Monthly invoices are automatically generated by the WAS and e-mailed in a pdf-format. The debit accounting module in the WAS is not used by the Government owned schemes which are using their own accounting system. To date accounts are being generated for users on ten schemes which include a number of sub-schemes.

Training of scheme operators to use WAS system to improve operation of the scheme

Formal training sessions have been given to personnel on all the schemes included in phase 3 of the project as shown in Table 2.2. Training includes the following:

- Training courses
- Workshops

- Remote training sessions using Team Viewer
- Telephonic support

More training courses and workshops will be held until the end of the project.

Measuring stations			
	Description	Logger	Note
	Phase 1		
1	Hartbeespoort IB: West canal	Cello: Installed	
2	Orange-Riet WUA: Scheiding main canal	Cello: Installed	
3	Sand-Vet WUA: Allemanskraal dam canal	Cello: Installed	
4	Sand-Vet WUA: Erfenis dam canal	Cello: Installed	
5	Vaalharts WUA: Main canal	Cello: Installed	
	Phase 2		
1	Hartbeespoort IB: East canal	Cello: Installed	
2	Impala WUA: Grootdraai canal	Cello: Installed	
3	Impala WUA: Transvaal canal	Cello: Installed	
4	Loskop IB: Left bank canal	Cello: Installed	
5	Loskop IB: Right bank canal	Cello: Installed	
6	Lower Olifants River WUA: Bulshoek dam canal	Cello: Existing	
7	Nzhelele GWS: Main canal	Metrolog 420: Installed	No reception, DWS extract data manually
8	Orange-Riet WUA: Scheiding main canal	Cello: Installed	
	Phase 3		
1	Boegoeberg WUA: Main canal	Cello: Installed	No reception, extract data manually
2	Gamtoos IB: Kouga dam main canal	Cello: Installed	
3	Gamtoos IB: Loerie dam	Cello: Installed	
4	Kakamas WUA: Left bank	Cello: Installed	
5	Kakamas WUA: Right bank	Cello: Installed	
6	Kakamas WUA: Inflow at Augrabies	Cello: Installed	Discharge table outstanding
7	Kalkfontein WUA: Main canal	Cello: Installed	
8	Korentte Vette IB: Left bank canal	Cello: Installed	No reception, extract data manually
9	Korentte Vette IB: Right bank canal	Cello: Installed	No reception, extract data manually
10	Korentte Vette IB: Nofo canal	Cello: Installed	
11	Lindleyspoort GWS: Main canal	Cello: Installed	No reception, extract data manually
12	Lower Sundays River WUA: Korhaansdrift	Cello: Installed	
13	Lower Sundays River WUA: Kirkwood	Cello: Installed	
14	Luvuvhu GWS: Luvuvhu canal	Cello: Installed	
15	Luvuvhu GWS: Latonyanda canal	Cello: Installed	
16	Marico Bosveld GWS: Marico Bosveld dam canal	Cello: Installed	No reception, extract data manually
17	Marico Bosveld GWS: Kromellenboog dam	Cello: Installed	
18	Mooiriver GWS: Lakeside dam canal	Cello: Installed	
19	Mooiriver GWS: Boskop dam canal	Cello: Installed	
20	Mooiriver GWS: Klerkskraal dam canal	Cello: Installed	
21	Oranje Vaal WUA: Main canal	Cello: Installed	
22	Oranje Vaal WUA: Buclands canal	Cello: Installed	
23	Schoonspruit GWS: Rietspruit dam canl	Cello: Installed	
24	Schoonspruit GWS: Elandskuil dam canal	Cello: Installed	
25	Vanderkloof WUA: Ramah canal	Cello: Installed	

Table 2.1: Measuring stations Phases 1 to 3

Implementation of WAS Phase 3					
	Scheme	Installed	Data available	Base line loss	Training received
1	Boegoeberg WUA	Yes	Yes		Yes
2	Gamtoos IB	Yes	Yes	Yes	Yes
3	Kakamas WUA	Yes	Yes		Yes
4	Kalkfontein WUA	Yes	Yes		Yes
5	Korentte Vette IB	Yes	Yes		Yes
6	Lindleyspoort GWS	Yes	Yes		Yes
7	Lower Sundays River WUA	Yes	Yes		Yes
8	Luvuvhu GWS	Yes	Yes		Yes
9	Marico Bosveld GWS	Yes	Yes		Yes
10	Mooiriver GWS	Yes	Yes		Yes
11	Orange/Vaal WUA (Douglas)	Yes	Yes		Yes
12	Schoonspruit GWS	Yes	Yes		Yes

Table 2.2: Implementation phase 3

Chapter 3

Results

3.1 Results

The objective of the WAS is to reduce water losses due to inefficient operation of the releases. As at September 2018 no measures have yet been introduced to improve efficiency as the project is still at the stage of establishing baseline measures. Measures to improve efficiency will follow once a baseline is established.

The implementation of the water release module requires an independent determination of the baseline water loss in order to evaluate the success of implementation. The determination of the baseline water loss depends on accurate historical release data from a reliable measuring station at the inflow into the scheme and a complete set of water ordered data for the corresponding period.

The water losses and savings, as shown in Table 3.1, has been calculated through the use of the Water Use Efficiency Accounting Report (WUEAR) in the WAS. The volumetric water losses are the critical indicator for water distribution managers and the DWS particularly when determining the potential for water loss reduction.

3.1.1 Benefits of WAS demonstrated

The benefits recorded to date with the installation of the WAS are:

- Demonstrated water savings of 927 891 m^3 per week in Phase 1
- Improved monitoring of actual releases and in certain cases, monitoring is now in place where there was previously no data recorded
- Reduced the risk of only a handful of people understanding the complex release calculations
- A single, standard platform using the DWS methodology for reporting – saving significant time for the Irrigation Schemes when submitting reports to the DWS
- The use of the Cello loggers and Zednet Platform as a robust platform to monitor and capture live data that is imported into WAS
- Recently developed website, where all schemes and DWS can track real time water releases and improvements in water management

Scheme	2014		2015		2016		2017		2018	Savings
	x1000m3	%	x1000m3	%	x1000m3	%	x1000m3	%	x1000m3	x1000m3
Phase 1										
Hartbeespoort IB: West canal			50 093	47.7	51 318	52.4	36 611	51.6		13 482
Orange-Riet WUA	112 532	42.6	103 036	34.0	98 397	33.6	76 182	41.3		36 350
Sandvet WUA (Sand)					2 623	22.0	4 133	21.6		-1 510
Sandvet WUA (Vet)			22 027	48.7	16 047	38.5	18 972	29.6		3 055
Vaalharts WUA	121 987	29.5	132 729	26.9	93 940	23.8	69 329	25.5		52 658
Sub-total	234 519		307 885		262 325		205 227			104 035
Phase 2										
Hartbeespoort IB: East canal			51 439	55.5	43 110	56.0	33 682	55.4		17 757
Impala WUA	65 865	34.2	58 460	32.4	18 121	13.2	24 209	16.3		41 656
Loskop IB: Left bank canal					54 028	40.7	27 507	24.7		26 521
Loskop IB: Right bank canal					2 881	31.7	2 887	22.6		-6
Lower Olifants river WUA	31 290	23.2	27 769	23.2	25 094	23.1	18667	21.2		12 623
Nzhelele GWS							957	23.0		
Sub-total	97 155		137 668		143 234		107 909			98 551
Phase 3										
Boegoeberg WUA										11 540
Gamtoos Irrigation Board							7 469	12.2		4 445
Kakamas WUA: Augrabies										776
Kakamas WUA: Left bank										1 740
Kakamas WUA: Right bank										3 939
Kalkfontein WUA										3 383
Korente Vette Rivier IB										596
Lindleyspoort GWS										904
Lower Sundays River WUA										17 430
Luvuvhu GWS										2 024
Marico Bosveld GWS										1 337
Mooi River GWS: Boskop										2 023
Mooi River GWS: Klerkskraal										761
Mooi River GWS: Lakeside										694
Oranje Vaal WUA										12 947
Schoonspruit GWS: Elandskuil										498
Schoonspruit GWS: Rietspruit										995
Sub-total	0		0		0		7 469		0	66 032
Total	331 674		445 553		405 559		320 605		0	268 618

Table 3.1: Water savings & estimated savings for Phase 3 (m^3)

3.1.2 Baseline water loss & water savings

The DWS method to calculate and report on the percentage of water lost is as follows:

$$Water\ loss(\%) = \frac{(A - B)}{A} \times 100$$

where

A = Released volume (m^3)
B = Ordered volume (m^3)

The baseline water loss for phases 1 & 2, as shown in Table 3.1, has been calculated through the use of the Water Use Efficiency Accounting Report (WUEAR) in the WAS. The percentage water loss is calculated relative to

the total of water released as has been the practice by the DWS over the years.

The water loss values in Table 3.1 has been converted from the corresponding water years for each scheme to calendar years. Each value represents a yearly water loss in x1000 m^3 and %.

The water savings per year are the difference between the water loss for the current year minus the water loss for the previous year. The total water savings per scheme are the cumulative savings for consecutive calendar years.

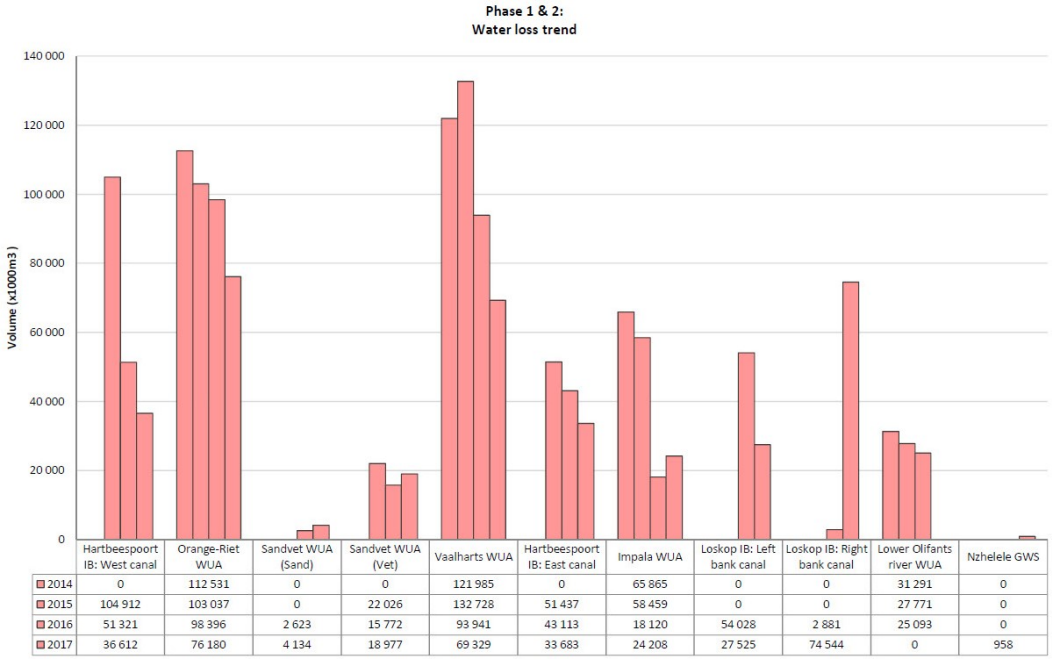
	Hartbeespoort IB: West canal	Orange-Riet WUA	Sandvet WUA (Sand)	Sandvet WUA (Vet)	Vaalharts WUA	Hartbeespoort IB: East canal	Impala WUA	Loskop IB: Left bank canal	Loskop IB: Right bank canal	Lower Olifants river WUA	Nzhelele GWS
2014 ordered		151 773			290 934		126 445			106 374	
2014 released		264 304.0			412 919.0		192 310.0			137 665.0	
2015 ordered	23	199 637	20 371	23 184	361 496	41 238	121 994			92 013	
2015 released	104 935.0	302 674.0	18 238.0	45 210.0	494 224.0	92 675.0	180 453.0			119 784.0	
2016 ordered	46 544	194 017	9 307	25 215	301 580	33 862	118 884	78 829	6 197	83 503	
2016 released	97 865.0	292 413.0	11 930.0	40 987.0	395 521.0	76 975.0	137 004.0	132 857.0	9 078.0	108 596.0	
2017 ordered	34 365	108 476	15 035	45 193	202 643	27 067	124 511	83 950	9 864		3200
2017 released	70 977.0	184 656.0	19 169.0	64 170.0	271 972.0	60 750.0	148 719.0	111 475.0	84 408.0		4 158.0

Figure 3.1: Yearly Ordered & Released Phases 1 & 2

3.1.3 Projected water loss reduction

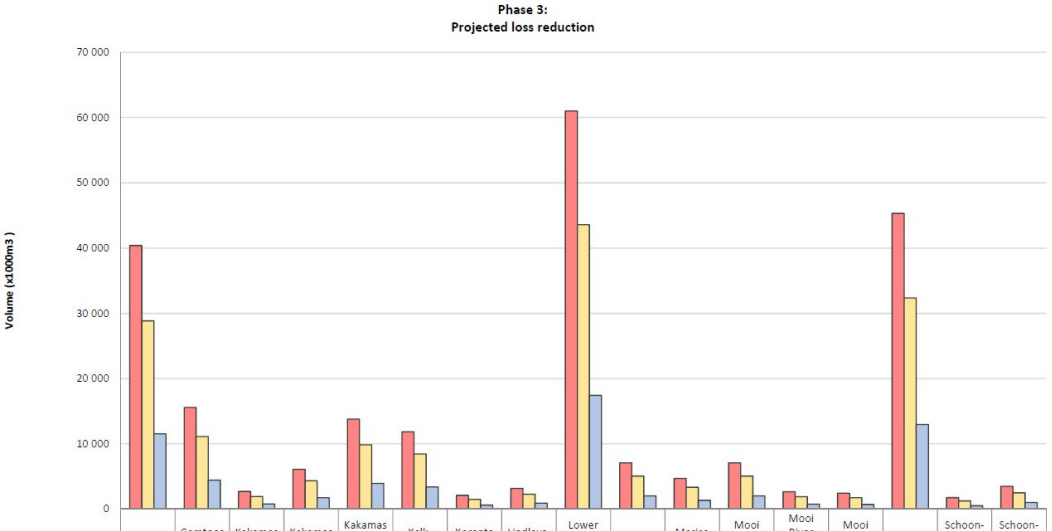
The projected water loss reduction of 66 Mm^3 for phase 3 is shown in Table 3.1 and in Figure 3.3. The estimate for the savings in phase 3 is based on a 10% reduction of the full water quota allocations combined.

This is a conservative estimate compared to the 15% savings that were realised in phases 1 & 2.



	Hartbeespoort IB: West canal	Orange-Riet WUA	Sandvet WUA (Sand)	Sandvet WUA (Vet)	Vaalharts WUA	Hartbeespoort IB: East canal	Impala WUA	Loskop IB: Left bank canal	Loskop IB: Right bank canal	Lower Olifants river WUA	Nzhelele GWS
2014	0	112 531	0	0	121 985	0	65 865	0	0	31 291	0
2015	104 912	103 037	0	22 026	132 728	51 437	58 459	0	0	27 771	0
2016	51 321	98 396	2 623	15 772	93 941	43 113	18 120	54 028	2 881	25 093	0
2017	36 612	76 180	4 134	18 977	69 329	33 683	24 208	27 525	74 544	0	958

Figure 3.2: Water loss trend Phases 1 & 2



	Boegoe-berg WUA	Gamtoos Irrigation Board	Kakamas WUA: Augrabies	Kakamas WUA: Left bank	Kakamas WUA: Right bank	Kalk-fontein WUA	Korente Vette Rivier IB	Lindleys-poort GWS	Lower Sundays River WUA	Luvuvhu GWS	Marico Bosveld GWS	Mooi River GWS: Boskop	Mooi River GWS: Klerkskraal	Mooi River GWS: Lakeside	Oranje Vaal WUA	Schoon-spruit GWS: Elandskuil	Schoon-spruit GWS: Rietspruit
Assumed loss (35%)	40 388	15 557	2 714	6 090	13 787	11 840	2 087	3 163	61 004	7 085	4 680	7 080	2 665	2 430	45 314	1 744	3 484
Reduced loss (25%)	28 849	11 112	1 939	4 350	9 848	8 457	1 491	2 259	43 574	5 061	3 343	5 057	1 904	1 735	32 367	1 246	2 489
Savings	11 540	4 445	776	1 740	3 939	3 383	596	904	17 430	2 024	1 337	2 023	761	694	12 947	498	995

Figure 3.3: Projected loss reduction Phase 3

Appendix A

The WAS system

The WAS database can handle any number of abstraction points and measuring stations on canal networks, pipelines and rivers from a small water office up to CMA level where thousands of abstractions and measuring stations are managed.

What makes the WAS program unique is that it is an integrated system including the water allocations, water use, water distribution and billing information. WAS will generate monthly invoices automatically using water usage or scheduled areas information captured in the database. Different user names and passwords can be used to control access to certain information in the database.

WAS makes use of nine modules, as shown in Figure A.1, which are fully integrated, making it possible to cross-reference relevant data and information. These modules can be implemented partially or as a whole, depending on the requirements of the user.

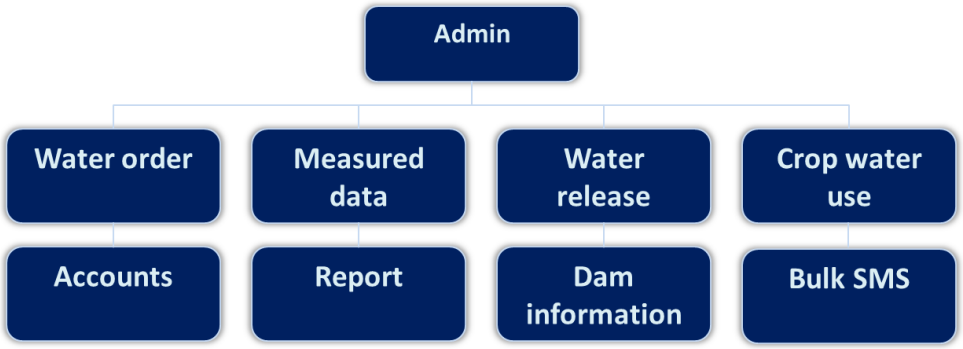


Figure A.1: WAS modules

Water Release Module

The roll out of the WAS under the SWPN has focussed on the module which can be installed to monitor the water releases. The Water release module is used to:

- Minimise water distribution losses in canal networks and river systems.
- Calculate water releases for the main canal, including all branches allowing for lag times and water losses.
- Determine operational procedures for a dam with varying downstream inflows and abstractions in a river allowing for lag times, accruals and water losses.

- Graphical output of all inflows and outflows.
- Water release graphs, which can be superimposed for comparison purposes.
- Handles any type of cross-section.

The diagram below describes the process followed by the WAS water release module to calculate the required releases and measure the total water losses for each scheme.

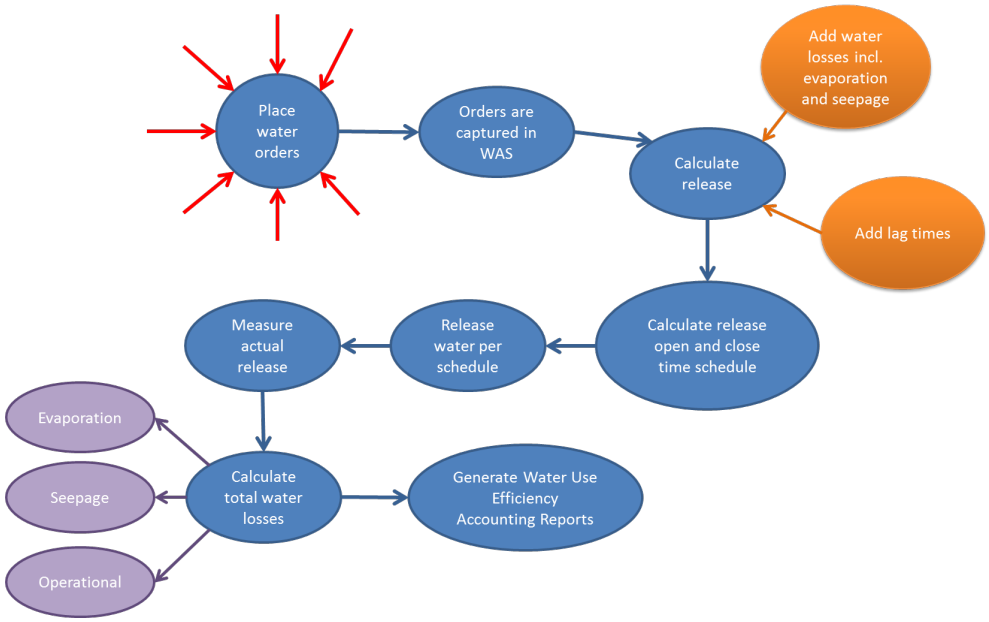


Figure A.2: WAS release calculation

Appendix B

Scheme implementations

B.1 Boegoeberg WUA

Boegoeberg WUA has a total scheduled area of 7 693 ha and an allocation of 15 000 m^3/ha. Their full quota is 115 395 000 m^3 with a total of 1 505 abstraction points. They receive their water from Boegoeberg dam.

Boegoeberg WUA: Implementation report

A number of meetings and training sessions were held with Boegoeberg WUA. A two day training and data capturing workshop was held to get the WAS up and running.

One measuring station was installed at the inflow of their main canal. There was unfortunately no cellphone signal and the arrangement is that they will extract their release data manually.

They are currently capturing their water orders successfully and are in the process of finalising their distribution sheet to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Boegoeberg WUA	Inception meeting & site visit	02 to 05/05/2017
Boegoeberg WUA	Teamviewer training session	05/09/2017
Boegoeberg WUA	Site visit & logger data download training	10/10/2017
Boegoeberg WUA	Teamviewer training session	27/10/2017
Boegoeberg WUA	Data capture & Training	20 to 22/08/2018

Figure B.1: Boegoeberg WUA: Meetings & training

B.2 Gamtoos IB

Gamtoos IB has a total scheduled area of 7 408 ha and an allocation of 6 000 m^3/ha. Their full quota is 44 448 000 m^3 with a total 808 abstraction points. They receive their water from Kouga dam which was basically empty for the last couple of months.

Implementation report

A meeting and training session were held with Gamtoos IB. They have been using the WAS for a number of years. Two measuring stations were installed,

one at the inflow and one at the tail-end of their main canal. Both measuring stations are working fine and data are uploaded to the Zednet platform successfully.

All the abstractions at Gamtoos IB are done through meter readings which are captured on a monthly basis to quantify their water losses through the use of the water use efficiency accounting report in the WAS.

Meetings & Training		
Scheme	**Description**	**Date**
Gamtoos IB	Inception meeting & training	28/08/2017

Figure B.2: Gamtoos IB: Meetings & training

B.3 Kakamas WUA

Kakamas WUA has a total scheduled area of 4 303 ha and an allocation of 15 000 m^3/ha. Their full quota is 64 545 000 m^3 with a total of 537 abstraction points. They receive their water from the Orange river.

Implementation report

A number of meetings and training sessions were held with Kakamas WUA. Three measuring stations were installed, one at the left bank canal, one at the right bank canal and one at the inflow to the Augrabies canal. All three measuring stations are working fine and data are uploaded to the Zednet platform successfully.

They are currently capturing their water orders successfully and are in the process of finalising their distribution sheet to calculate the water release schedules. They have also implemented the WAS-client program to capture their water orders remotely.

Meetings & Training		
Scheme	**Description**	**Date**
Kakamas WUA	Inception meeting & site visit	02 to 05/05/2017
Kakamas WUA	Training session	09/10/2017
Kakamas WUA	Training session	11/09/2018
Kakamas WUA	Teamviewer training session	21/09/2018

Figure B.3: Kakamas WUA: Meetings & training

B.4 Kalkfontein WUA

Kalkfontein WUA has a total scheduled area of 4 393 ha and an allocation of 7 700 m^3/ha. Their full quota is 33 829 103 m^3 with a total of 94 abstraction points. They receive their water from the Kalkfontein dam.

Implementation report

Kalkfontein WUA has been using the WAS since 1994. One measuring station was installed at the inflow of their main canal. The measuring stations is working fine and data are uploaded to the Zednet platform successfully.

They are currently capturing their water orders successfully and their canal network has been set-up and calibrated. They are using the canal network approach to calculate the water release schedules. No additional training was needed to get them up and running.

B.5 Korente Vette IB

Korente Vette IB has a total scheduled area of 852 ha and an allocation of 7 000 m^3/ha. Their full quota is 5 964 000 m^3 with a total of 121 abstraction points. They receive their water from the Korentepoort dam.

Implementation report

An inception meeting and a training session were held with Korente Vette IB. Three measuring stations were installed, one at the left bank canal, one at the right bank canal and one at the inflow of the Nofo canal. All three measuring stations are working and are uploading data to the Zednet platform successfully.

They are currently capturing their water orders successfully and are in the process of finalising their distribution sheet to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Korente Vette IB	Inception meeting & training	19/09/2017
Korente Vette IB	Site visit	20/09/2017

Figure B.4: Korente Vette: Meetings & training

B.6 Lindleyspoort GWS

Lindleyspoort GWS has a total scheduled area of 1 705 ha and an allocation of 5 300 m^3/ha. Their full quota is 9 036 500 m^3 with a total of 121 abstraction points. They receive their water from the Lindleyspoort dam.

Implementation report

Personnel from Lindleyspoort GWS scheme attended two training courses held in Pretoria in September 2018. They are one of the schemes that received a laptop that is dedicated to the use of the WAS.

Their base data has been captured and they are currently in the process of finalising their distribution sheet to calculate the water release schedules.

One measuring station was installed at the inflow into their main canal at Lindleyspoort dam. There is unfortunately no cellphone signal and the arrangement is that they will extract their release data manually. An effort will be made to install an antennae that will hopefully solve the problem.

B.7 Lower Sundays River WUA

Lower Sundays River WUA has a total scheduled area of 19 366 ha and an allocation of 9 000 m^3/ha. Their full quota is 174 295 800 m^3 with a total of 1 070 abstraction points. They receive their water from Gariep dam, Darlington dam, Scheepersvlakte dam and Korhaans weir.

Implementation report

The WAS is fully implemented and operational, water orders are captured on a daily basis and monthly invoices are e-mailed to farmers. However, Lower Sundays River WUA is the only scheme that orders water using a flow rate and duration approach. They also use a unique distribution sheet to calculate their water release schedules.

The flow rate and duration capturing form has been added to the WAS and it is working perfectly. The distribution sheet has also been added to the WAS and it is in its final testing phase. It is foreseen that a number of the other schemes will also take advantage of this new distribution sheet.

Two measuring stations were installed, one at Korhaansdrift and one at Kirkwood. Both measuring stations are fully operational and are uploading data to the Zednet platform.

One of the challenges at Lower Sundays River WUA is a discharge table that is in dispute between them and the DWS. This has an effect on the water use and loss volumes calculated on the water use efficiency accounting reports. An effort will be made to rectify this.

Meetings & Training		
Scheme	**Description**	**Date**
Lower Sundays River WUA	Inception meeting & site visit	29/08/2017
Lower Sundays River WUA	Training session	22 & 23/01/2018

Figure B.5: Lower Sundays River WUA: Meetings & training

B.8 Luvuvhu GWS

Luvuvhu GWS has a total scheduled area of 2 410 ha and an allocation of 8 400 m^3/ha. Their full quota is 20 244 000 m^3 with a total of 145 abstraction points. They receive their water from the Albasini dam.

Implementation report

Personnel from Luvuvhu GWS scheme attended a training course held in Pretoria in September 2018. They are one of the schemes that received a laptop that is dedicated to the use of the WAS.

Two measuring stations were installed, one at the inflow into the Luvuvhu canal and one at the inflow into the Latonyanda canal. Both measuring stations are fully operational and are uploading data to the Zednet platform.

They are in the process of verifying their base data and setting up their distribution sheets to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Luvuvhu GWS	Inception meeting	16/11/2017
Luvuvhu GWS	Site visit	17/11/2017
Luvuvhu GWS	Training course (NB Systems)	27/09/2018

Figure B.6: Luvuvhu GWS: Meetings & training

B.9 Marico Bosveld GWS

Marico Bosveld GWS has a total scheduled area of 2 523 ha and an allocation of 5 300 m^3/ha. Their full quota is 13 371 900 m^3 with a total of 309 abstraction points. They receive their water from the Marico Bosveld dam and Kromellenboog dam.

Implementation report

Personnel from Marico Bosveld GWS scheme attended a training course held in Pretoria in September 2018. They are one of the schemes that received a laptop that is dedicated to the use of the WAS.

Two measuring stations were installed, one at the inflow into the canal at Marico Bosveld dam and one at the inflow into the canal at Kromellenboog dam. The measuring station at Kromellenboog is fully operational and is uploading data to the Zednet platform. There was unfortunately no cellphone signal at the Marico Bosveld measuring station and the arrangement is that they will extract their release data manually. An effort will be made to install an antennae that will hopefully solve the problem.

They are currently capturing their water orders successfully and are in the process of finalising their distribution sheet to calculate the water release schedules.

B.10 Mooiriver GWS

Mooiriver GWS has a total scheduled area of 4 517 ha and an allocation of 7 700 m^3/ha. Their full quota is 34 783 980 m^3 with a total of 491 abstraction points. They receive their water from the Lakeside, Boskop and Klerkskraal dams.

Implementation report

A number of meetings and training sessions were held with personnel from Mooiriver GWS scheme.

Three measuring stations were installed, one at the inflow into the canal at Lakeside dam, one at the inflow into the canal at Boskop dam and one at the inflow into the canal at Klerkskraal dam. All the measuring stations are fully operational and are uploading data to the Zednet platform.

They are currently capturing their water orders successfully and are using their distribution sheets to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Mooiriver GWS	Inception meeting & site visit	10/08/2017
Mooiriver GWS	WAS upgrade & installation on 3 laptops (NB Systems)	23/10/2017
Mooiriver GWS	Workshop	15 & 16/01/2018
Mooiriver GWS	Training course (NB Systems)	20/09/2018

Figure B.7: Mooiriver GWS: Meetings & training

B.11 Oranje Vaal WUA

Oranje Vaal WUA has a total scheduled area of 11 258 ha and an allocation of 11 500 m^3/ha. Their full quota is 129 468 610 m^3. They receive their water from the Orange and Vaal rivers.

Implementation report

Personnel from Oranje Vaal WUA scheme attended a training course held in Pretoria in September 2018. They are the only scheme as part of phase 3 that started completely from scratch.

Two measuring stations were installed, one at the inflow into their main canal and one at the inflow into the Buclands canal. Both measuring stations are fully operational and are uploading data to the Zednet platform.

NB Systems is currently assisting them with the capturing of their base data and setting up their distribution sheet to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Oranje Vaal WUA	Inception meeting	10/09/2018
Oranje Vaal WUA	Training course (NB Systems)	20/09/2018

Figure B.8: Oranje Vaal WUA: Meetings & training

B.12 Schoonspruit GWS

Schoonspruit GWS has a total scheduled area of 1 940 ha and an allocation of 7 700 m^3/ha. Their full quota is 14 938 000 m^3 with a total of 258 abstraction

points. They receive their water from the Rietspruit and Elandskuil dams.

Implementation report

A number of meetings and training sessions were held with personnel from Schoonspruit GWS scheme.

Two measuring stations were installed, one at the inflow into the canal at Rietspruit dam and one at the inflow into the canal at Elandskuil dam. Both measuring stations are fully operational and are uploading data to the Zednet platform.

They are currently capturing their water orders successfully and are using their distribution sheets to calculate the water release schedules.

Meetings & Training		
Scheme	**Description**	**Date**
Schoonspruit GWS	Inception meeting & site visit	10/08/2017
Schoonspruit GWS	WAS upgrade & worksession (NB Systems)	23/10/2017
Schoonspruit GWS	Workshop	15 & 16/01/2018
Schoonspruit GWS	Training course (NB Systems)	20/09/2018

Figure B.9: Schoonspruit GWS: Meetings & training

Appendix C

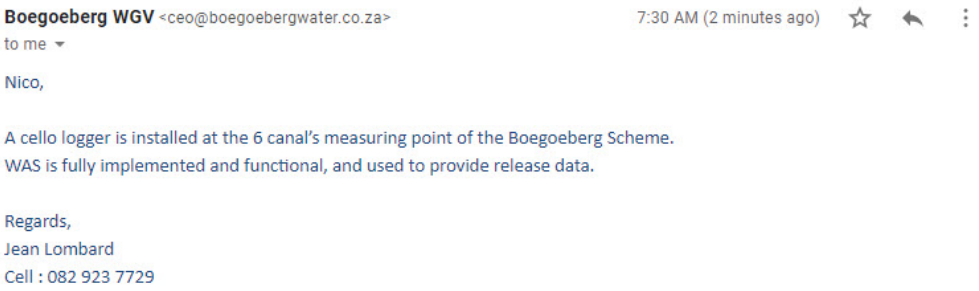
Meetings & Training

Phase 3		
Scheme	**Description**	**Date**
Boegoeberg WUA	Inception meeting & site visit	02 to 05/05/2017
Kakamas WUA	Inception meeting & site visit	02 to 05/05/2017
Mooiriver GWS	Inception meeting & site visit	10/08/2017
Schoonspruit GWS	Inception meeting & site visit	10/08/2017
Gamtoos IB	Inception meeting & site visit	28/08/2017
Lower Sundays River WUA	Inception meeting & site visit	29/08/2017
Boegoeberg WUA	Teamviewer training session	05/09/2017
Korente Vette IB	Inception meeting & training	19/09/2017
Korente Vette IB	Site visit	20/09/2017
Kakamas WUA	Training session	09/10/2017
Boegoeberg WUA	Site visit & logger data download training	10/10/2017
Mooiriver GWS: at NB Systems	WAS upgrade & installation on 3 laptops	23/10/2017
Schoonspruit GWS: at NB Systems	WAS upgrade & worksession	24/10/2017
Boegoeberg WUA	Teamviewer training session	27/10/2017
Luvuvhu GWS	Inception meeting & site visit	16 & 17/11/2017
Luvuvhu GWS	Site visit	17/11/2017
Mooiriver & Schoonspruit GWS	Workshop	15 & 16/01/2018
Lower Sundays River WUA	Training session	22 & 23/01/2018
Boegoeberg WUA	Data capture & Training	20 to 22/08/2018
Oranje Vaal WUA	Inception meeting	10/09/2018
Kakamas WUA	Training session	11/09/2018
NB Systems	Training course	17/09/2018
NB Systems	Training course	20/09/2018
Kakamas WUA	Teamviewer training session	21/09/2018
NB Systems	Training course	27/09/2018

Table C.1: Inception meetings & Training sessions

Appendix D

Confirmation of work



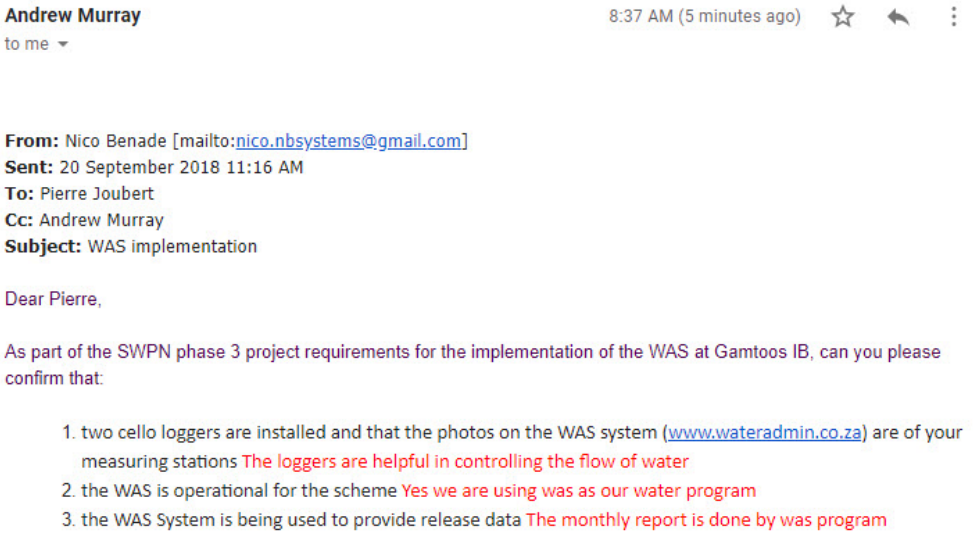
Boegoeberg WGV <ceo@boegoebergwater.co.za> 7:30 AM (2 minutes ago)
to me

Nico,

A cello logger is installed at the 6 canal's measuring point of the Boegoeberg Scheme.
WAS is fully implemented and functional, and used to provide release data.

Regards,
Jean Lombard
Cell : 082 923 7729

Figure D.1: Boegoeberg confirmation



Andrew Murray 8:37 AM (5 minutes ago)
to me

From: Nico Benade [mailto:nico.nbsystems@gmail.com]
Sent: 20 September 2018 11:16 AM
To: Pierre Joubert
Cc: Andrew Murray
Subject: WAS implementation

Dear Pierre,

As part of the SWPN phase 3 project requirements for the implementation of the WAS at Gamtoos IB, can you please confirm that:

1. two cello loggers are installed and that the photos on the WAS system (www.wateradmin.co.za) are of your measuring stations The loggers are helpful in controlling the flow of water
2. the WAS is operational for the scheme Yes we are using was as our water program
3. the WAS System is being used to provide release data The monthly report is done by was program

Figure D.2: Gamtoos confirmation

CEO - Kakamas Watergebruikersvereniging Thu, Sep 20, 2:15 PM (17 hours ago)

to me

Nico Benade
NB Systems.

We at Kakamas Water users Association confirm that three Cello Loggers are installed on the three canals in our region, that the WAS system is in place and running and is used to capture the water use in our area.

Regards.
G v Niekerk

Kakamas
Watergebruikersvereniging
Water Users Association

GJJ van Niekerk
HUB
Email : ceokwgv@isat.co.za
Tel No : 054 431 0725
Faks No : 054 431 0348

Figure D.3: Kakamas confirmation

Marius Thu, Sep 20, 12:41 PM (19 hours ago)

to me

Hi Nico
I confirm, that a cello logger was installed at the Kalkfontein Dam outlet. I use WAS every day, and I use WAS to calculate the release of the water into the canal system.

Regards

MARIUS SCHUURMAN

BESTUURDER
KWGV
POSBUS 287
KOFFIEFONTEIN
9986
TEL 053 2030495
FAKS 053 2030026
SEL 083 4575125

Figure D.4: Kalkfontein confirmation

KORENTEPOORT DAM

From: "Nico Benade" <nico.nbsystems@gmail.com>
To: "Herman Myburg" <korentedam@telkomsa.net>
Sent: 20 September 2018 11:10 AM
Subject: WAS implementation

Dear Herman,

As part of the SWPN phase 3 project requirements for the implementation of the WAS at Korente Vette IB, can you please confirm that:

1. three cello loggers are installed and that the photos on the WAS system (www.wateradmin.co.za) are of your measuring stations
2. the WAS is operational for the scheme
3. the WAS System is being used to provide release data

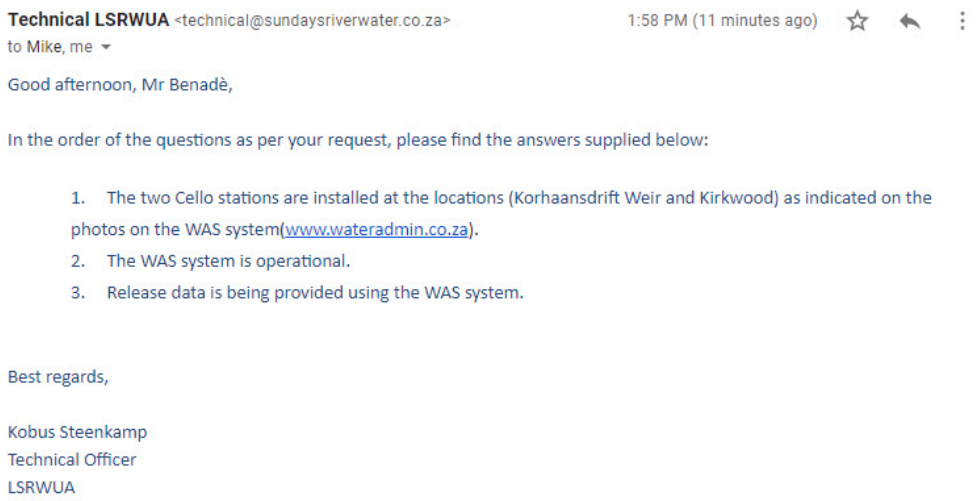
Kind regards,

Nico Benade
082 854 72

HK Myburgh / Manager
KORENTE VETTE RIVIER
BESPROEIINGSRAAD
POSBUS 514 RIVERSDAL 6670
TEL: 028 7133433
FAKS No:

2018/09/20

Figure D.5: Korente Vette confirmation



Technical LSRWUA <technical@sundaysriverwater.co.za> 1:58 PM (11 minutes ago)
to Mike, me

Good afternoon, Mr Benadè,

In the order of the questions as per your request, please find the answers supplied below:

1. The two Cello stations are installed at the locations (Korhaansdrift Weir and Kirkwood) as indicated on the photos on the WAS system(www.wateradmin.co.za).
2. The WAS system is operational.
3. Release data is being provided using the WAS system.

Best regards,

Kobus Steenkamp
Technical Officer
LSRWUA

Figure D.6: Lower Sundays River confirmation

Hlongwane Wander Boy (TZN) <HlongwaneW@dws.gov.za> 2:47 PM (26 minutes ago)
to me

Good day
Yes I have confirmed with Vernon the loggers where installed at Lontanyanda and Luvuvhu canals

From: Nico Benade [mailto:nico.nbsystems@gmail.com]
Sent: 21 September 2018 01:09 PM
To: Hlongwane Wander Boy (TZN)
Subject: Fwd: WAS implementation

Figure D.7: Luvuvhu confirmation

Pretorius Hannes (HBP) <PretoriH@dws.gov.za> 10:10 AM (10 minutes ago)
to me

Dear Mr Benade,

It is hereby confirmed that the following exist and is in partial operation:

1. Three cello loggers (two at Marico and one at Lindleyspoort) are installed and that the photos on the WAS system (www.wateradmin.co.za) are indeed of their measuring stations.
2. The WAS is operational for the Marico Bosveld Government Water Scheme only and not installed on a computer at Lindleyspoort GWS yet.
3. The WAS System is not being used to provide release data at Marico Bosveld GWS or Linleyspoort GWS yet, only for the Administrative part of capturing application, late applications, cancellations and distribution report at Marico Bosveld GWS and needs to be uploaded on the desk top computer at Lindleyspoort GWS.
4. There is a practical challenge in terms of Cell Phone reception at both the schemes.

Kind regards,

J.J. Pretorius (Hannes)
Acting Director: Northern Operations
(Area Manager: Hartbeespoort)
Department: Water and Sanitation
Branch: Infrastructure Build, Operate and Maintenance
Northern Operations
Hartbeespoort Area Office
Private Bag X352, Hartbeespoort, 0216
Old Rustenburg Road, Hartbeespoort Dam
Tel: +2712253-1093/4
Fax: +2712253-1905
Fax to e-mail: +27866101619
Cell: +27828063681
e-mail: pretorih@dws.gov.za

Figure D.8: Marico & Lindleyspoort confirmation

Dear Mr Kemp,

As part of the SWPN phase 3 project requirements for the implementation of the WAS at Mooiriver GWS and Schoonspruit GWS, can you please confirm that:

1. Three cello loggers are installed at Mooiriver GWS and two at Schoonspruit GWS and that the photos on the WAS system (www.wateradmin.co.za) are of your measuring stations
2. the WAS is operational for the scheme
3. the WAS System is being used to provide release data

Kind regards,

Nico Benade
082 854 7255

I confirm that the above information is correct.

Mr G Kemp
CONTROL WATER CONTROL OFFICER
POTCHEFSTROOM OFFICE
018-2949300
082 7826799
20/09/2018

Figure D.9: Mooi river & Schoonspruit confirmation

WAS implementation Inbox ×

Hercules Smith <hercules@oranjevaal.co.za>
to nico, Lizelle

Dear Nico,

I can confirm that two cello loggers are installed and that the photos on the WAS system are of our measuring stations and that the base data is currently being captured in the WAS.

Kind regards,

Hercules Smith
Waterbeheerbeampte/
Water Control Officer

ORANJE VAAL
WATERGEBRUIKERSVERENIGING
WATER USERS ASSOCIATION

hercules@oranjevaal.co.za
+2782 452 3732 | +2753 298 2112

Figure D.10: Oranje-Vaal confirmation