Final report

Water monitoring in the digital age: Reducing stress and improving the efficiency of the "Water Run".

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Abstract

The stock water “Water Run” run is a daily task in arid Australian climates. In the summer months some farms commit a full time employee to the job. The run usually entails checking stock water trough and tank levels for adequate water while identifying and fixing leaks along the way. At some pastoral farms a complete run around the property can take up to seven days and see staff covering over 200 km. This project aims to identify a cost effective alternative to the Water Run by using durable non-contact radar based sensors to measure water levels and relay that information to the cloud. The system focuses on providing farm staff with the tools to monitor trends and identify problems whether they are on or off farm.

Table of contents

1. Water Monitoring 4.0

1.1 Where is our water? “The Water Run”

1.1.1 The Windy Station Water Run

Romani Pastoral operates 130 stock water troughs across Windy and Warrah Stations. The inspection of livestock water points, storages and extraction points, also known as the “water run” involves a staff member manually checking on the troughs and the tanks to verify water supply. The run can be quite stressful with staff with covering several hundred kilometres per week. The job often eats into their weekends and free time. In early 2019 Tussock Innovation began developing a low cost compact alternative to the traditional tank level monitoring equipment used in Australian agriculture. This product was designed for non-contact water level measurement preventing corrosion and contamination of water while reducing the need for serviceable parts. The sensor design is compact and durable, ideal for use around livestock. For the Romani pastoral project installations included covers for added durability. Staff from both Tussock Innovation and Farm Monitoring Solutions deployed 12 tank and trough sensors across the western side of the Windy Station stock water system and 3 tank sensors to the east and north of the homestead. The deployment route covers approximately 37km as the crow flies and is intended to directly reduce the travel time and distance required by the station staff.

2. Project objectives

2.1 Reducing staff stress and travel time need for the Water Run

2.1.1 Windy deployment

The key to reducing the travel time due to the water run lies in identifying the outliers and hard to reach stock water locations. By design we want to remove the need for staff to inspect these locations unnecessarily. We achieve this by providing a consistent up to date water level data feed directly to staff mobile devices. This innovation also aims to reduce staff stress levels as they know if there are water problems when they occur and if animals have adequate drinking water.
The western range of Windy Station is bordered by Blackville Rd and Roaches Rd it is a key area for livestock water collection and distribution. Situated on the range are key stock water tanks that feed down to troughs along the foot of the range. To inspect this area of the farms stock water network staff travel a 20km return journey.

Figure 1: Waterwatch Tank and Trough Sensor Deployment

3. Methodology

3.1 Deployments

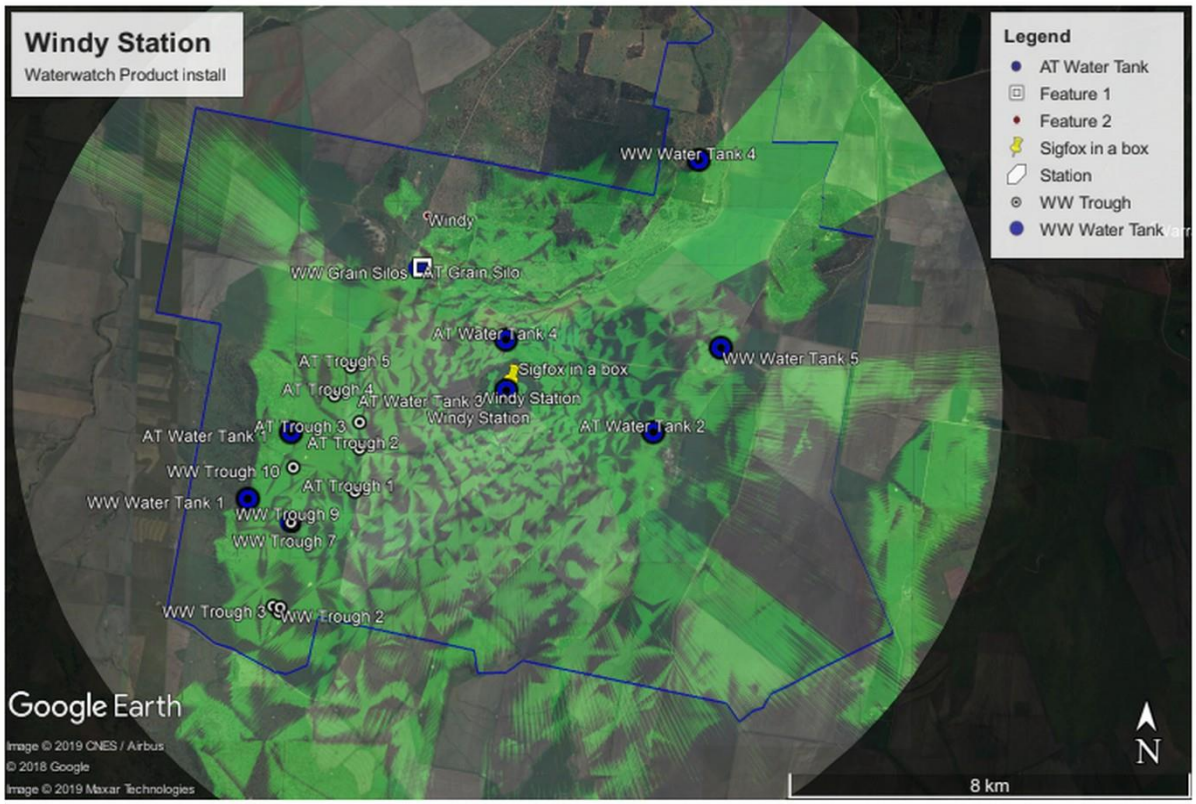
The sensors used in this project are the Waterwatch LS1-R and T35. These sensors are designed to record and report water levels periodically. The communication uses Sigfox technology where 12 bytes of data or up to 6 level measurements are sent in every data packet. Once the data is reported it is sent via a telemetry network to the internet where it is presented using either a mobile or web application.

The deployment of sensors took place on the 6th and 7th of November 2019. The deployment techniques were specifically designed for the installation at Windy Station utilising off the shelf components from Tussock Innovation and customised fittings. The installations are documented in the sections below.

3.1.1 Data Telemetry

The telemetry technology used for the installation is Sigfox, a low power communication technology perfect for providing long distance communication to field sensors. The image below is a simulation of the coverage provided by a single base station located centrally at Windy Station. Two Australian providers of technology for this project shared the base station which was provided by the Thinxtra ecosystem. A variety of Sigfox sensors were used in the deployment however only Tussock Innovations Waterwatch sensors are covered in this document. Other sensors can be added in the future.

Figure 2: Simulation of the coverage provided by a single Sigfox base station for Windy



3.1.2 Tank Deployments

The open tank deployments were undertaken using the Waterwatch LS1-R a vertical mounted radar sensor, while the closed top tanks used the T35 horizontal mount option. Each sensor and tank have their GPS location recorded along with the tank dimension and fill limits. The installation fixtures are designed to be cost effective and reproducible at any

location. The key to a correct and robust installation is a vertical mount with clear view of the water and can result in accurate readings to 1mm.

Figure 3: Waterwatch LS1-R Horizontal Mount Radar Level Sensor

3.1.3 Trough Deployments

The trough deployments are non-conventional and vary based on the type of trough and protective material around the trough. The sensor is deployed inside a protective cover adding another layer of durability. This is the first of its kind deployment of Waterwatch radar sensors for trough level monitoring. The focus of the trough sensors is to identify when the water level is outside of its intended level indicating a possible fouled/damaged ballcock or blocked or leaking pipe. High and low level alarms aid in notifying farmers and employees so that they do not need to go looking for issues.

Figure 4: Waterwatch LS1-R mounted under protective cover

Figure 5: Waterwatch T35 mounted under protective cover

Figure 6: Waterwatch LS1-R mounted under a protective cover

3.1.4 Mobile and Web Applications

Figure 7: Waterwatch Mobile Application designed for viewing data and receiving notifications

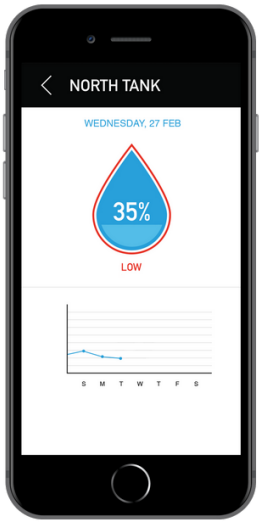
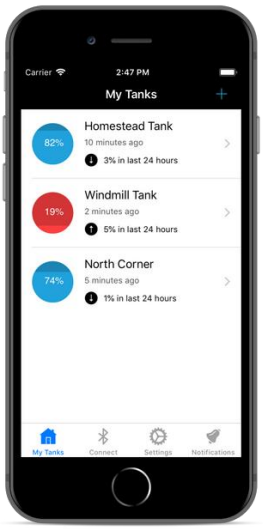


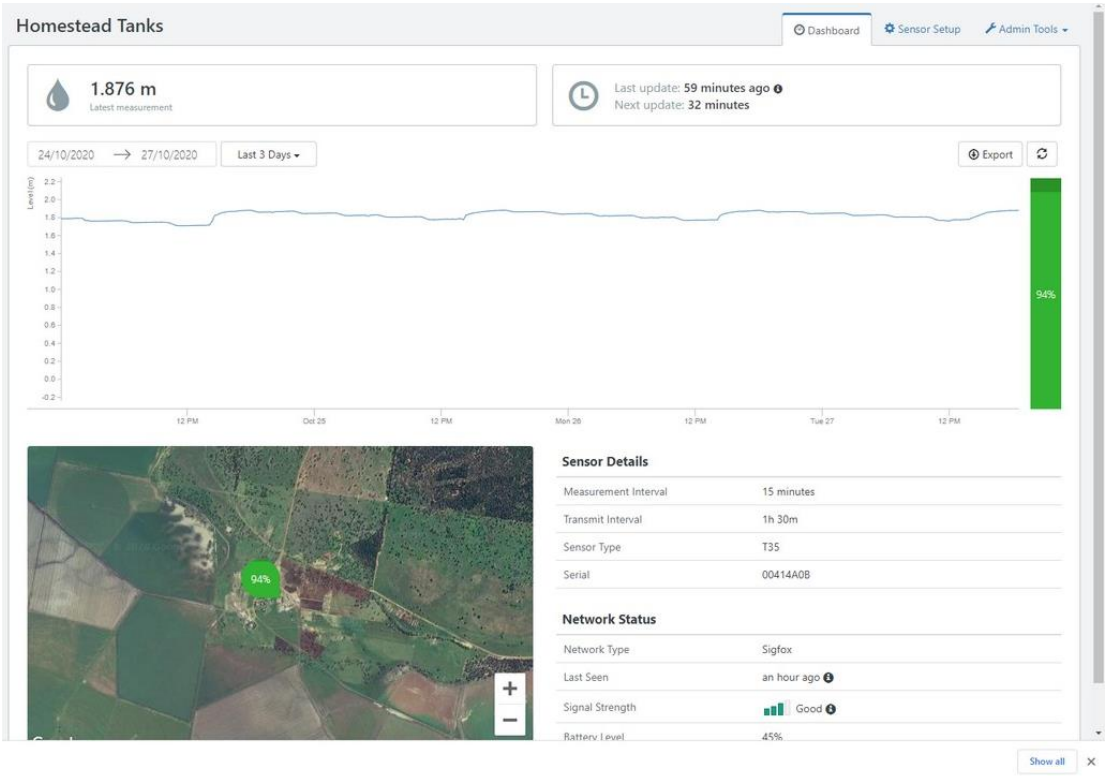
Figure 8: Each tank or trough state is easily identified



Waterwatch mobile and web applications are
used as tools for farm staff to keep up to date with how the water assets are working. These

applications are designed in an easy to use format for both novice and experienced users. For users who prefer Text messages direct to their phone they can enable that feature by setting a notification phone number.

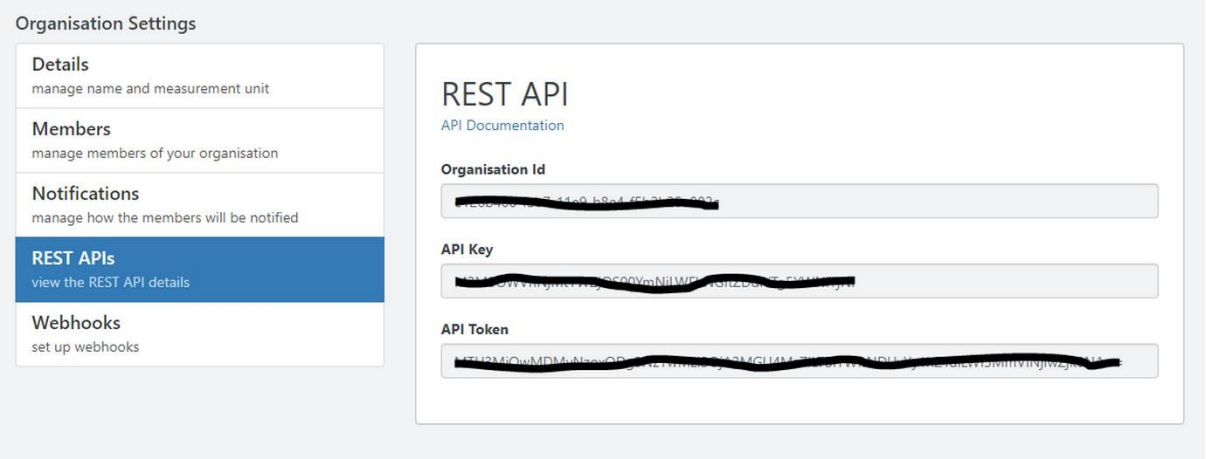
Figure 9: Waterwatch Live dashboard used for controlling sensors, where their data is directed and who to notify during an event



3.1.5 Data Feed to Third Parties

Third parties are able to retrieve the sensor data feed via the Waterwatch Live API.

Figure 40: The API section that is used by other collaborators for the MLA Romani project



4. Results (to-date)

4.1 Results

The Romani farm manager has on a number of occasions mentioned that the Waterwatch tank monitoring sensors have been frequently used during the deployment. We are aware that some upgrades to the product are required and this work is expected to be undertaken in Q3 2021. Farm Monitoring Solutions who were initially involved in the project will hand over support of the project to AxisTech who are also supporting the Sigfox infrastructure. Tussock Innovation the manufacturers of the Waterwatch equipment have provided feedback outlined in other sections of this report.

5. Key Findings

5.1 Users

We currently have a small number of Windy Station farm workers using the Waterwatch system. Our aim is to have higher uptake in individual use of the system however it is possible that only one user is needed to monitor the “Water Run”. We have recently released updated mobile applications to provide a simplified but powerful overview of the farm deployment. This app release also places the deployment of the level sensors in the DIY (do it yourself) market by introducing an install wizard for farmers to follow.

5.2 Hardware Deployment

The initial deployment allowed our team to produce some new creative mounting systems while validating that a low cost radar system could be used to monitor tank and particularly trough installations in a robust fashion. We have had a number of issues with the hardware in this project though. The issues stem from an overly rigid radar calibration regime. The

calibration issues have been remotely diagnosed using sensor diagnostic messages if level measurements are not available. Unfortunately, due to Covid-19 we were unable to travel and upgrade these sensors earlier. Recent upgrades to the software have allowed us to improve on our initial deployment and expanding our operating temperature range to -20 – 85 degrees Celsius. This service upgrade will be supplied by AxisTech in July 2021. We have also subsequently made changes to the hardware to improve the physical internal robustness and serviceability.

5.3 Data quality

Data is generated by these sensors once every 15 minutes. This sample and data rate is higher than realistically needed in an application like tank and trough monitoring and will lead to increased battery depletion. It may be more ideal to set the sensors to a lower data rate which will increase battery life and have a filtering effect on the data that is plotted online. In some instances, the plots contain spikes this can be due to the high resolution of the sampling picking up artefacts like wind chop. We are continually working on improvements to our products and some of these findings have been added to newer firmware. The improvements include filtering and control of the radar to now reach 1mm accuracy.

5.4 Reducing staff stress and travel times

We have had some positive feedback from the Windy Station manager in relation to the remote monitoring nature of the system. He found the western ridge monitoring particularly useful. They are looking forward to having the sensors up and running to their full potential again.

6. Conclusions/recommendations

6.1 Future Deployments

We are happy with the system and data produced when the hardware is operating correctly. All future deployments will be based on a more robust internal circuitry hardware that was deemed necessary during the trail. This includes new connectors, improved battery capacity and system power regulation. With these changes we are able to provide quality tank and trough monitoring system for reducing the stress and time associated with the “Water Run”. In addition, our improvements have pushed out our battery life expectations to 10 years while using an hourly measurement regime. Since deployment we have implemented a number of new hardware features including remote control of alarm levels and sensor sampling times. The radar units can also be remotely tuned for a full range of new level sensing applications.

6.2 Communication Options

We have continued to develop further communication options since installation adding cellular 4g/5g and satellite to the T35 and LS1-R devices. These options may be well suited to smaller or remote deployments where installing on farm base stations is not desirable. The new communication options result in different user outcomes, for example the satellite units can only communicate twice daily and data delivery is not guaranteed. This satellite technology can be used in any location. The cellular LTE M option is only available in locations that Telstra provides coverage. A benefit of the cellular communication is that data delivery is guaranteed, however battery life is not a long as the other two options.

6.3 Data Analytics

We have identified that as the number of sensors deployed increases users can suffer from data overload. Filtering and searching for problems is not how we want our users to spend their time. Instead, we have begun developing an insights engine for Waterwatch Live. This insights engine uses data analytics to generate knowledge specific to the farmer's needs. The insights planed include.

- Which systems are leaking
- Where to go to fix the leaks
- How much water resource is left
- What is being consumed per day
- Is the system being starved of water