TLM -Tank Level Monitor

User Guide

TLM -Tank Level Monitor

QTech Irrigation Management System

Revision 1.2





WATER-INSIGHT

WATER-INSIGHT

Contents

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Revision Details

1.0	August 2020	First Issue based on V1.01 firmware
1.1	December 2020	Corrected typo in specification
1.2	May 2021	Minor corrections and additions

Introduction

About This User Guide

This document provides assistance with the installation and operation of the Water-Insight Tank Level Monitor. Topics in this document include:

- How to install & test the sensor gateway
- How to install & test the Tank Level Monitor
- Configuration
- Integration with the Water-Insight cloud-based Irrigation Management System (IMS)
- Technical Specifications

IMPORTANT. This guide is valid for Version 1.01 of the firmware or later.

IMPORTANT. In order to use this product a valid user account for the IMS cloud subscription is required.

IMS Systems Overview

The Water-Insight Irrigation Management System (IMS) is a suite of hardware and software products used to configure, control, and monitor telemetry sensors (such as the TLM), Irrigation Point Controllers (IPC), or both.

IMS also supports various other sensor systems including water flow metering, soil moisture, rainfall and soil temperature.

The TLM connects to the IMS system by transmitting the water level to an internet gateway device on the site. The IMS Gateway passes the information via a cellular or broadband connection to the IMS server which then places the information in a database. Users can sign in to their IMS account from the Water-Insight web site (www.waterinsight.co.nz) using a web browser. Once the user is signed in the data is displayed in the user interface called a dashboard.

Before monitoring information can be displayed the sensor must be associated with the user's account. The TLM is supplied pre-configured for the radio channel used by the gateway and both must be added to the user account. Information such as the tank dimensions and water volume are also captured so that probe depths are appropriately scaled to the water volume in the tank.

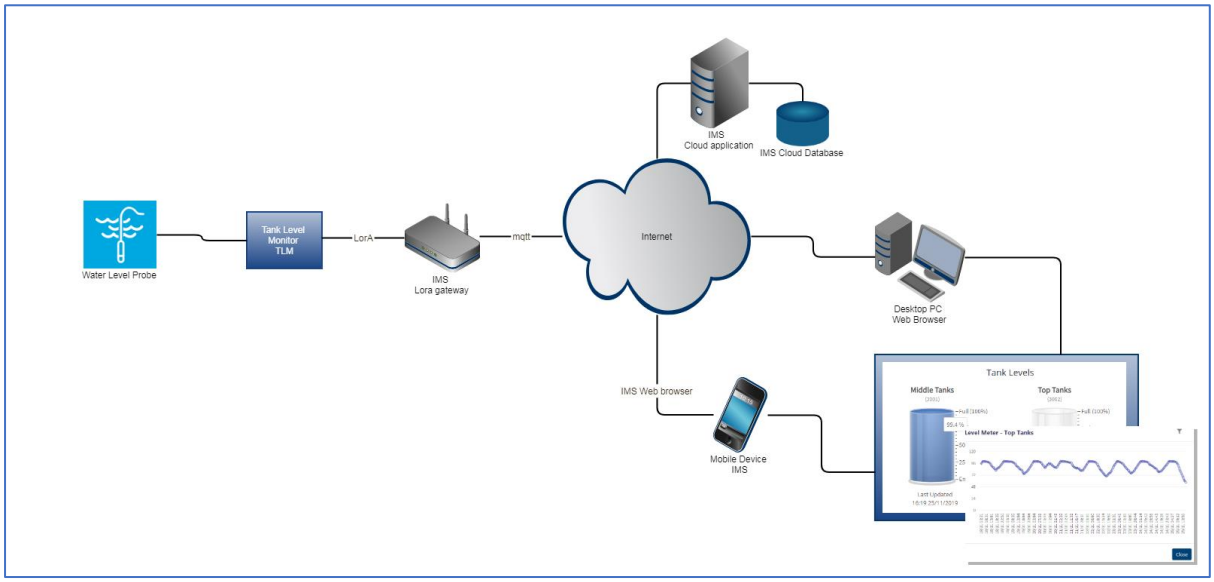

Figure 1: TLM connection to IMS System

Product overview

The Tank Level Monitor (TLM) provides water depth metering using an immersed pressure sensor. The product is supplied in an environmentally protected enclosure complete with battery power source and solar panel battery charging. Level readings are transmitted via radio to a receiver and internet gateway device which form part of the Water-Insight Irrigation Management System (IMS). The information is then made available on smartphones, tablets, or desktop devices via the IMS web application.

Figure 2: Tank Level Meter with solar charging

Features

- Low power, ~6mA in standby
- Weighs approx. 1800 grams
- Replaceable Lithium-ion battery.
- Fits 1 pressure sensor probe.
- Typical use up to 3m depth. Can be supplied with alternate probes for greater depths.
- 900 MHz ISM band (LoRa modulation) capable of more than 3000m[1] line of sight operation to sensor gateway.
- Fully integrated, all in one, rugged stainless-steel brackets and waterproof enclosure with Solar power charging and battery operation.
- Surface mounted on tank.
- Web application for mobile or desktop access, interfaces to Water-Insight IMS.
- IMS provides graphing of levels up to one year with alert notifications and alarms thresholds for critical levels via email, SMS messaging or instant messaging.

Supply Options

The TLM is supplied in a kit consisting of:

- TLM housed in solar power enclosure and bracket (tank surface mount)
- Integrated 3 dBi whip antenna
- Level (pressure) probe (3m cable length standard issue), includes cover plate and/or cable gland for fixing to tank.
- IMS Gateway(if required) incl. LAN patch cable, mains power adaptor and external antenna (5m cable).

[1] Subject to factors such as terrain, weather and elevation.

Hardware

The product consists of a fully enclosed housing with integrated solar panel attached to an adjustable mounting bracket with a 3 dBi antenna side mounted on the bracket.

Figure 3 TLM Unit

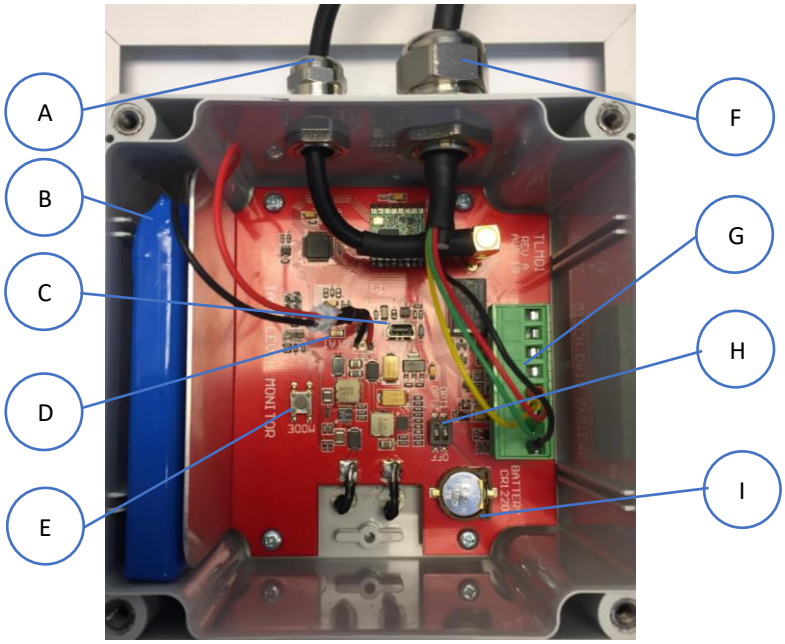

Figure 4. Internal view

Feature	Function
A	Antenna cable gland
B	Battery
C	USB connector socket
D	STAT indicator LED
E	Mode pushbutton
F	Probe cable gland
G	Probe connector
H	Option switch (unused)
I	Real Time Clock (RTC) coin cell battery (unused)

Installation

Overview

Follow the TLM setup workflow www.ims.qtech.co.nz/tlm to step through the process of account creation (if needed), adding & testing a new gateway (if needed) and adding and testing the Tank Level Monitor.
The physical installation of a gateway and a TLM are also described in this manual.

Once installation is complete, tank level data is accessed by signing in to your IMS account www.ims.qtech.co.nz.

Required Tools

- Screwdriver or electric drill/driver (pozi-drive & 8mm hex socket)
- Hole saw/drill/masonry drill for sensor probe cable
  - Plastic tank – 16mm to fit cable gland
  - Concrete tank – large enough to feed cable through(~10mm)
- Adjustable spanners to tighten cable gland
- General purpose cable ties or other means of tying cables back
- An internet connected phone/tablet/PC running a web browser (Google Chrome, Microsoft edge, Apple Safari or similar).

Installation Information

In order to accurately record the water level, the following information is required:

Item	Description
Top Water Level (D)	This is the effective maximum depth of water in the tank. If there is an overflow outlet, measure from this to the base of the tank. Record the measurement in mm
Probe Offset (P)	This is the distance from the tip of the probe to the base of the tank (when installed). Often the probe tip will be set at about 100 mm from the base of the tank to avoid sludge getting into the probe. Record the measurement in mm when fitting the probe.
Tank Height (H)	Take tank height from the manufacturer's datasheet. Record in mm
Tank Volume (V)	Take tank volume from the manufacturer's datasheet. Record in litres

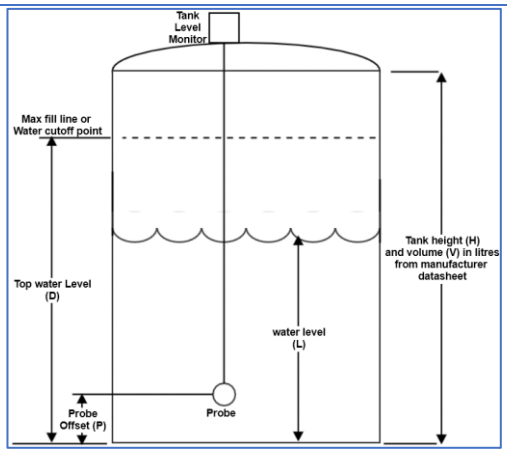

Figure 5. Tank & Probe measurements

Sensor Wiring

The pressure sensor is wired as shown.

Figure 6. Sensor Wiring

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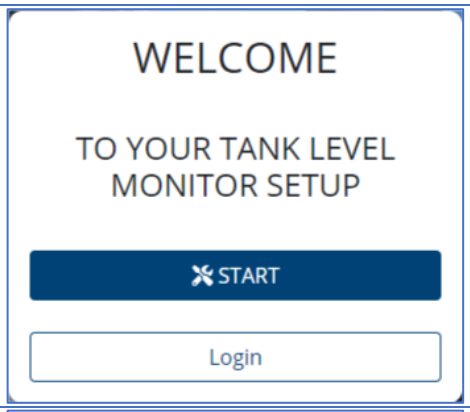
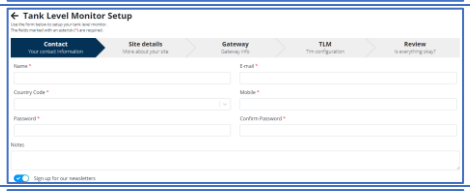
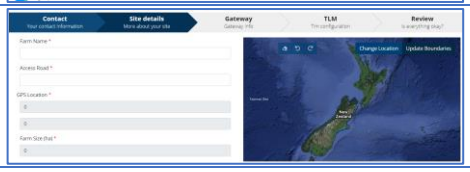
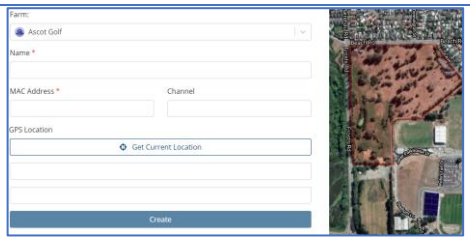
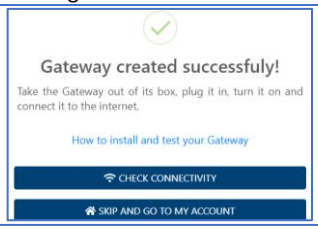
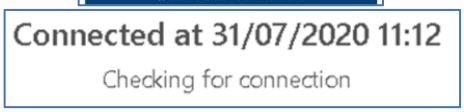
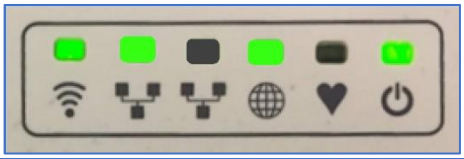
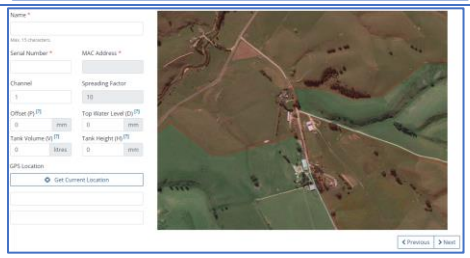
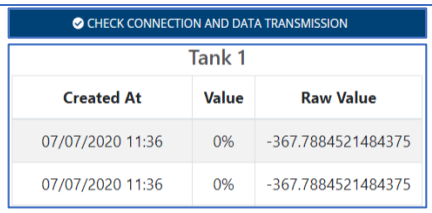
TLM Setup Workflow

IMPORTANT

As per step 10 below, it is essential to test the TLM connectivity while close to the sensor gateway, before installing the TLM on a tank.

Step	Process	Note
1.	- Open a web browser on your phone/tablet/PC and navigate to www.ims.qtech.co.nz/tlm	
2.	- Select **START** to **create** an IMS account – if this is your first IMS device or - **Login** to your existing IMS account - Select **START** (skip to step 5)	
3.	- Enter required account details Name, e-mail, mobile phone number, password	
4.	- Enter "Farm" details Name, Access road (address) - Select Change Location and place the location on the map - Select Update Boundaries and draw the outline of the site boundaries	
5.	**Do you already own a gateway?** Yes, and is already installed (go to step 9) - There is an existing gateway for existing sensors on site Yes, and I need to install it (go to step 6) - You have the gateway that came packaged with your TLM, but need to install it No, what do I do? - A gateway is required, one must be purchased	
6.	**Adding a Gateway** - **Farm** - Choose the Farm/Site this gateway is for - **Name** - Give the gateway a unique identifying name - **Serial Number** – Printed on the gateway label - **MAC address** – Automatically populated based on serial number - **Channel** - must match the TLM (see TLM label) - **GPS Location** - Click on the map to identify the gateway location - Click **Create**	
7.	**Install Gateway** The gateway needs to be mounted - Indoors within 10m of cable run to your Internet access point (router, modem or switch) - Near a mains power socket - Within a 5m cable run to external antenna mounting location - Mount the external antenna provided	**An available internet connection is required in order to view the Tank Level Monitor information** Longer cable lengths (preferably under 30m) are acceptable to connect from the gateway to your Internet access point but are not supplied with the gateway. The antenna should be mounted outside, as high as possible

Step	Process	Note
	- Plug one end of the LAN patch cable supplied into the **WAN** socket on the gateway and the other end into an available socket on your internet access point **WARNING** - If you are adding a second TLM sensor to an existing site you only need one gateway.	All radio systems work most reliably when the path between the antennae is clear "line of sight", i.e. free from obstructions such as trees, hills and buildings. If you need assistance installing the gateway, please contact Water-Insight.
8.	**Check Gateway Connectivity** - Plug the mains power adaptor for the gateway into the power socket and power the gateway on - Select **Check Connectivity** - Expect a **Connected at <date><time>** message - This can take 3-4min Connection status can be confirmed from the LED behaviour - **Power** LED ON, **WAN** LED ON (2nd from left, may blink) - **Internet connection** - **Globe** LED **Flashes** (4th from left) - **Connection to IMS** - **Globe** LED **Solid** The **WiFi** LED (leftmost) can be on or off	  
9.	**Adding a TLM** - **Name** – A short name for the tank being monitored - **Serial Number** – Printed on the TLM label (**numeric digits only**) - **MAC Address** – Automatically populated based on serial number - **Channel** – Printed on the TLM label - **Probe Offset(P) (mm)** – The installed sensor position relative to the bottom of the tank. Recommend 100mm - **Top Water Level(D) (mm)** – The effective maximum depth of water in the tank. If there is an overflow outlet measure from this to the base of the tank - **Tank Height(H) (mm)** – As stated in the manufacture's datasheet - **Tank Volume(V) (litres)** – As stated in the manufacture's datasheet - **GPS Location** – click on the map to identify the tank location - Click **Next** to add the TLM	
10.	**Check connection and Data Transmission** Before installing the TLM on a tank, communication with the IMS gateway must be confirmed. - Remove the TLM rear cover and connect the battery (white inline connector) **STAT** LED will give 4 short flashes, then 1 flash every 4s - Submerse the sensor probe in a bucket of water such that at least the whole probe body is covered - Press the **MODE** button for **2s** to enter installation mode **STAT** LED changes to flashing once per second - Click **Check Connection and Data Transmission** - Data should appear approx. every 20s	
11.	- Press the **MODE** button for 2s to exit installation mode and re-install the rear cover	**STAT** LED will return to 1 flash every 4s
12.	- Proceed to **Installing TLM on Tank**	

Installing the TLM on a Tank

The procedure for mounting the TLM on a water tank will vary somewhat according to the construction and size of the tank. General procedures are described here including checks to avoid common mistakes.

Please ensure you follow appropriate health and safety procedures when installing the TLM.

Step	Process	Note
1.	- Loosen TLM bracket knobs to allow free rotation - In the identified location, mount the TLM bracket using the provided mounting holes - Remove the TLM rear cover	Mounting location should give the **solar panel an unobstructed North facing view** (with the cables exiting the bottom of the case) and allow the **sensor probe to be lowered to the full depth of the tank**.
2.	- Drill a hole (16mm if gland is fixed directly to tank) for the sensor probe cable to pass through near the tank lid/access point - Install the cable glad or loosen the cable gland in the cover plate (concrete tank) - Feed the sensor probe cable through the hole/gland. - Fix the cover plate to the tank (if being used) - Do not tighten the bracket knobs yet	For concrete tanks it is especially important that the cover plate is fixed in place to avoid the sensor cable wearing on the hole edges It is recommended to position the sensor probe away from the main outflow pipe. While not essential this will result in optimum system performance.
3.	- Feed the cable through the gland in the TLM case - Wire cable into connector block and install connector - Tighten cable gland in TLM case	Wiring diagram is provided in Figure 6 of this guide
4.	- Connect the battery (white in-line battery connector)	On power up the **STAT** LED will flash quickly a few times then blink once every 4s
5.	- Press the **MODE** button for 2s to enter installation mode - Gradually lower the sensor probe into the tank and confirm the **STAT** LED changes to **rapid flashing** - Lower the probe to the bottom of the tank, then raise back up by 100mm (recommended) and tighten gland to clamp cable in position	The **STAT** LED will flash once per second This mode is used to check that the probe is operating correctly. **STAT** LED behaviour changes once probe is submersed approx. 0.5m and confirms sensor is functional.
6.	- If an internet connection is available, check the sensor readings are updating in IMS. - Readings should be updating every 20s	See **Verifying TLM Operation in IMS** below
7.	- Press **MODE** button for 2s to exit installation mode. - Reinstall the rear cover, tilt solar panel to approx. 45°, align the antenna vertically and tighten the side knobs to fix in place **The unit is now ready for operation in IMS** 	Once exit install mode **STAT** LED returns to flashing every 4s Ensure all cables are secured to prevent movement in strong wind

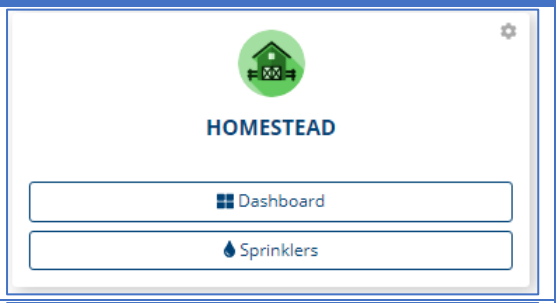
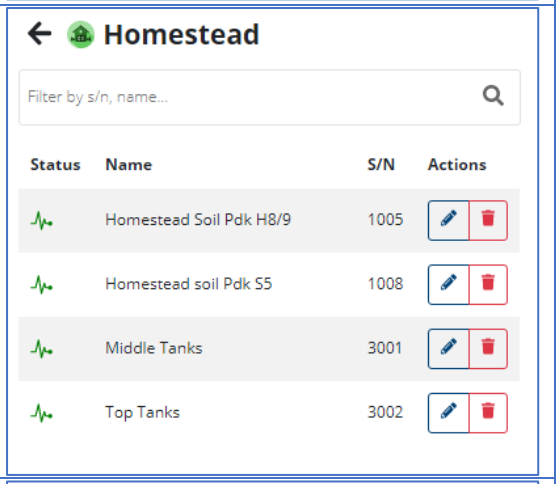
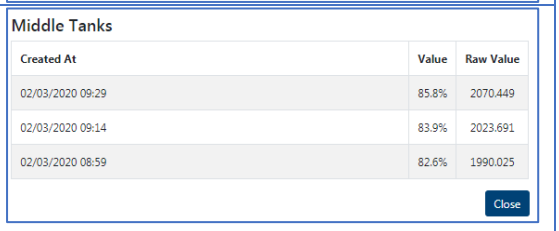
Operation

General

The device operates automatically by sampling the probe transducer at predefined intervals (default 15 mins). It then calculates the probe depth and transmits the result to the IMS gateway.

Verifying TLM operation in IMS

Once the TLM is installed it will direct readings to the IMS gateway which are then displayed on the dashboard in IMS. To verify operation in IMS follow these steps:

Step	Process	Note
1.	- Sign into your IMS account (www.ims.qtech.co.nz) if you have not already. You can do this on your smartphone if you have cellular coverage at the tank site. - Select **Farm Settings** (cog) in the top right corner of your farm card - From the menu select **Manage Assets** - Then click **Sensors** - The Sensors page will be displayed along with a list of existing sensors on your site	
2.	- Click the **status icon** to the left of the tank name. - If the icon is coloured green then data is being received from the tank - If the icon is coloured red then there is a communications issue, contact Water-Insight for support	
3.	- By clicking on the icon the three most recent data transmissions are displayed. Check that the value is consistent with the expected depth of water. **When the TLM is installed on the tank** - Measure the **current water level** from the bottom of the tank - Subtract the installed **sensor position offset** - Confirm this value is consistent with the displayed **Raw Value**	
4.	- Click the **Close** button - click the **Home** icon to return to the top level Farm card - Click the **Dashboard** icon to display a summary view of the tank	Home icon: Dashboard icon:

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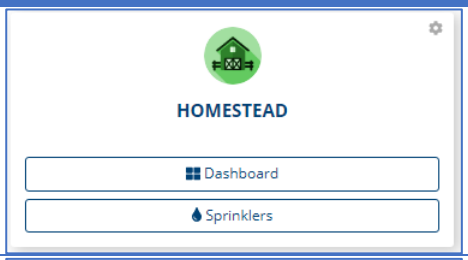
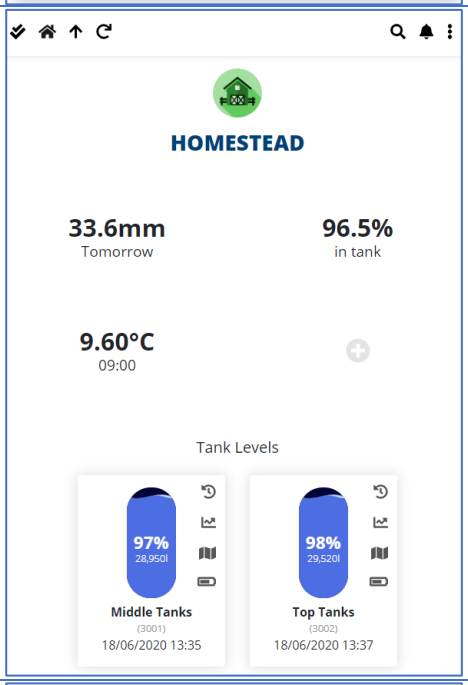
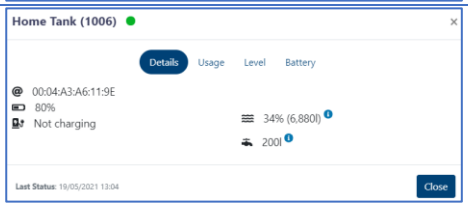
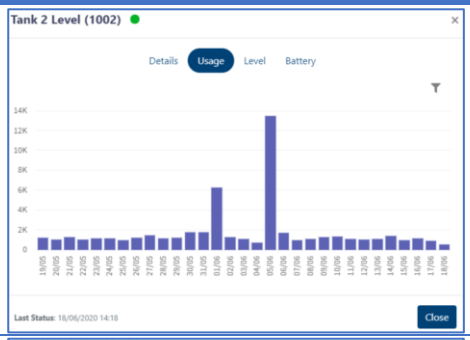
Using the Tank Level Monitor in IMS

This section covers **viewing your tank level data**, **creating alert notifications** and **configuring your IMS dashboard**.

Viewing Tank Level Data in IMS

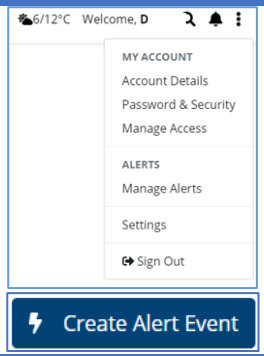
You may need to refresh the page ↻ to ensure the latest data is displayed.

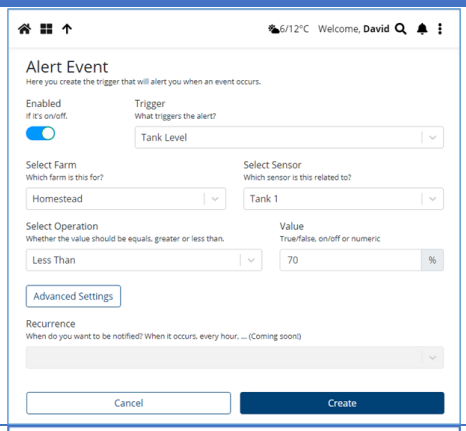
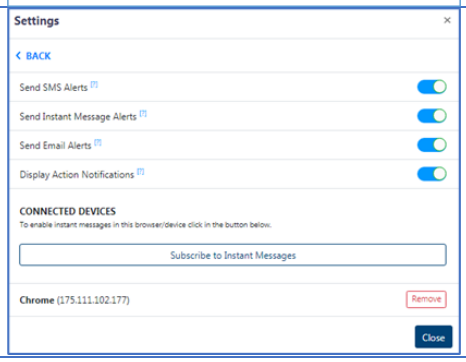
Step	Process	Note
1.	- Sign into your IMS account (www.ims.qtech.co.nz), if you have not already. - Select the **dashboard** button on the **farm card** to display the tank level status.	
2.	- The display will show **Headline** values at the top of the screen followed by individual sensor details. - The screen can be customised to show all the sensors on the farm in a desired order	
3.	- Clicking on the picture of the tank will display its information card **Details** - **MAC address** - **Battery %** (TLM only) - Solar **Charging / Charged / Not Charging / Charging Inhibited** (TLM only) - **Current water level** (corresponding volume) - **Water usage** – Last 24hr usage	 **Charging Inhibited –** when there is no sun or temperature <0°C or >40°C **Charging –** Charging is triggered only when battery falls below 80% **Not Charging –** Charging is not inhibited, battery is below 80% - likely low light condition, may need investigation if unexpected

Step	Process	Note
4.	**Usage** - The data can be **filtered** to show the last day, week, month or year using the **filter icon** - **Day**– Hourly usage displayed - **Week & Month** – Daily usage displayed - **Year** – Monthly usage displayed	
5.	**Level** - Displays a history of all the water level data and any trends. - The data can be **filtered** to show the last day, week, month or year using the **filter icon**	
6.	**Battery** - Displays a history of all the water level data and any trends. - The data can be **filtered** to show the last day, week, month or year using the **filter icon**	

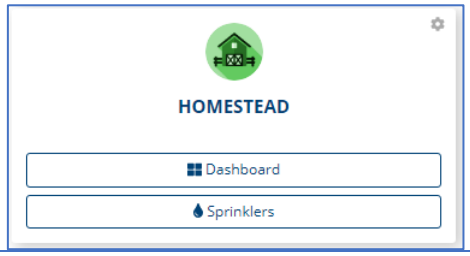
Creating an Alert Notification

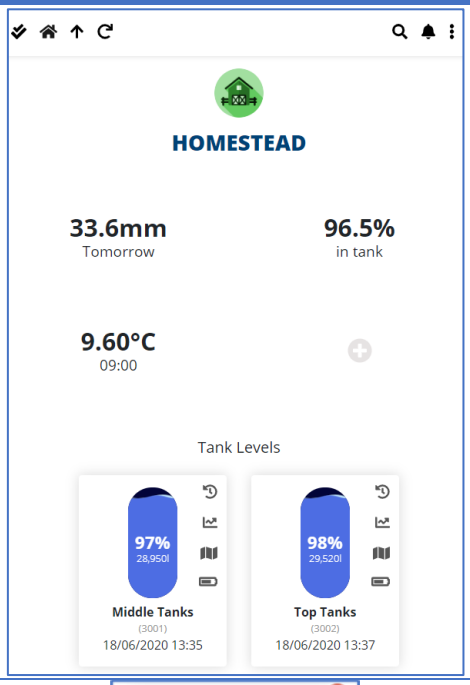
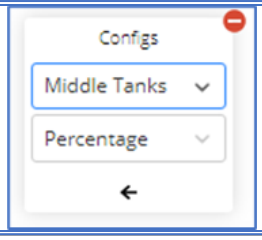
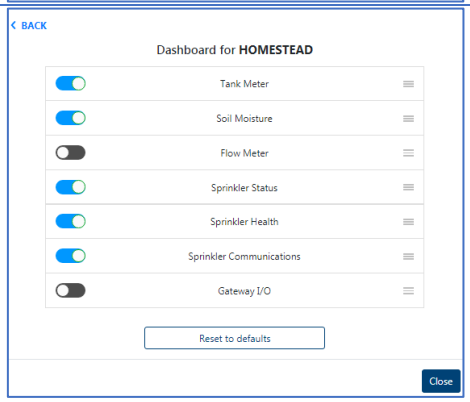
You can receive alert messages on your phone or PC to notify you of a change of state in a tank level. For example, you can be notified if the tank becomes too empty.

Step	Process	Note
1.	First define **what** the alert event is for. - click the **more icon** in the top right corner of the screen then choose **Manage Alerts**. - Click the **Create Alert Event** button	

Step	Process	Note
2.	- Click the enable slider control to activate the alert Configure the **Alert Event** as desired (for example) - **Trigger** for the event is **Tank Level** - The **farm** the event is for is **Homestead** - The particular **Sensor** the event relates to is **Tank 1** - **Evaluation condition** is **Less Than** - **Value** compared to is **70%** - Select **Create**	
3.	Now choose **how** the alert notification is sent - click the **more icon** ⋮ in the top right corner of the screen, choose **Settings**, then **Alerts** - Turn on the slider control for each type of notification type you want	
4.	Your account profile must have your e-mail address and mobile phone number configured for these alert types to operate. - click the **more icon** ⋮ in the top right corner of the screen then select **Account Details**	

Configuring the IMS Dashboard

Step	Process	Note
1.	- Select the **dashboard** button on the **farm card** to display the tank level status.	

Step	Process	Note
2.	**Headline** values are simply very short summary information that is always shown first for an at-a-glance view of critical farm data. - To **add a Headline**, double-click the **add** icon to show a list of available headlines that you can use. Up to four Headlines can be shown.	
3.	- You can further customise the **Headline** (for example if you have multiple water tanks) by double-clicking the Headline. The desired sensor can be selected and you can change the units of measure. - Click the back arrow to complete the process.	
4.	The order in which items are displayed can be changed as well. - Click the **more icon** in the top right corner of the screen then choose **Settings**. - Click **Dashboard Card Order and Visibility**	
5.	- Use the **slider controls** to turn on or off the display of sensors on the farm - Drag the **list order icon** to move items up and down in the list which will control the order in which you see them on the screen. - Click the close button to return to the dashboard	

Technical Specifications

Note. Specifications are subject to change without notice.

TLM Device Specifications

Item	Parameter	Specification
General		
	Dimensions	Approx. 200 x 200 x 250 mm Mounting holes 6 x M6
	Weight	1800 gms
	Temperature	Operating: 0-65 degrees C Storage 0-65 degrees C
	Humidity	0-90% non-condensing
	Ingress Protection	IP66
	Power	Input voltage: Internal 4.3V Li-Po battery, 6000 mAHr rating (rechargeable) Charging Current: 400mA Max. Standby current ~6mA Peak current 220mA for 1s (at default 15min sampling rate)
	Device Management	Via USB
Input/Output	Transducer	Holykell HPT604 Pressure Level Transducer 4 wire 0.5-4.5V output Supply voltage 5.0V (+/- 5%.) 0-3m range (standard issue, other ranges available on request) Accuracy 1% FS
	LED Indicators	STAT – operational status and power (internal)
	Pushbutton	Operating Mode switch (internal)
Radio	Regulatory	ISM band, AS/NZS 4268
	Antenna	Detachable SMA
	Operating Frequency	915 – 928 MHz, factory configured
	Output power	20 dBm max
	Receiver Sensitivity	-134 dBm
	Modulation	LoRa
Communications		
	USB	USB 2.00, Type Mini-B connector Interface (configuration and firmware upgrades)
	Configuration	QTech Workbench (via USB)

Battery

The TLM operates from a nominal 4.3 Volt DC Lithium-polymer battery power supply. Current consumption is nominally less than a few mA. The battery is rated for 6000 mAHr operation. If correctly installed and operating the battery should last at least 3-5 years before requiring replacement.

Warning – Do NOT use Switch Mode Power Supplies (SMPS) with this product.

Antenna

The module is a low power device that is designed specifically for operation in New Zealand and Australia. Each system is supplied with an antenna capable of an operating range of more than 3000 meters, dependent upon

terrain and obstacles such as trees and buildings. All radio systems work most reliably when the path between the radios is clear “line of sight”. This needs to be considered when planning longer range systems.
Please contact Water-Insight for details and advice.

Warning – Do not operate the product without an antenna attached. Do not substitute antennas; use only those antennas recommended by your equipment supplier. Failing to comply with these requirements can damage the product. Never operate the devices in violation of RSM conditions. AS/NZS 4268:2008 specifies a maximum EIRP of 1 watt.

Sensor Probe

The sensor probe is specified according to the expected depth and cable length required for the tank. The standard supply option is for tanks maximum depth of 3m.

When the unit is in install mode the STAT LED indicator blink rate changes when the probe is immersed in water over about 0.5m of depth. If the indicator does not change at all this may indicate a problem with the unit. Disconnect the battery and remove the probe from the water. Then repeat the installation process. If the problem persists, contact Water-Insight for assistance.

Warning – Do not position the probe on the floor of the tank. Locate it approximately 100 mm above to will avoid sludge and other contaminants entering the probe.

Appendix

Troubleshooting

TLM to Gateway Connection

If no data from the TLM is seen, confirm the following:

- Confirm the sensor gateway is powered, has an internet connection and is connected to IMS (Globe LED solid)
- Confirm the TLM battery is connected and is in installation mode (STAT LED long flash once per second)

If you are still unsuccessful, please contact Water-Insight www.waterinsight.co.nz/contact-us/

Sensor Gateway Internet Connection

- Confirm the gateway is connected to a power supply and turned on.
  - Initially at least the power LED should be lit.
- Confirm the LAN patch cable is connected to the **WAN** socket of the gateway and the other end is connected to a **LAN** socket of your internet access point.
- Confirm your internet access point has an internet connection.
  - Check that another device (laptop, phone, etc) connected to your internet access point can access the internet.

If you are still unsuccessful, please contact Water-Insight www.waterinsight.co.nz/contact-us/

Gateway Antenna Mounting

- Antenna should be mounted outside, as high as possible in clear space.
- All radio systems work most reliably when the path between the antennae is clear "line of sight", i.e. free from obstructions such as trees, hills and buildings.

TLM Charging Behaviour

Charging Inhibited – When there is no sun or temperature <0°C or >40°C
Charging – Charging is triggered only when battery falls below 80%
Not Charging – Charging is not inhibited, battery is below 80%

- Likely low light conditions, may need investigation if unexpected (e.g. possible bird fouling of solar panel)

If it is the middle of the day AND sunny AND unlikely to be outside temperature range AND battery % has been dropping on several successive days
THEN
Confirm TLM solar panel is receiving light (in shadow or bird fouling).
If all the above is ok, this may indicate a charging fault requiring the TLM to be returned for service.

Unknown – Indicates a likely fault with the TLM, please contact Water-Insight www.waterinsight.co.nz/contact-us/

TLM Internal Indicators and Switches

STAT Indicator

The STAT indicator indicates the current operational status of the device. It provides a heartbeat indication that the device is operating ok or it displays a coded error indication for faults.

Code	Meaning
1 short flash, 4s interval	**Normal operating** mode, Processor running, no active errors
1 short flash, 1s interval **Rapid short flashes**	**Installation mode** active. Indicates sensor probe is functional once submersed greater than ~0.5m
1 short Flash, 0.5s interval	Blinks faster when in special mode used for activating USB interface to communicate with **Workbench**. Only used/needed when currently in Data Radio mode. Times out after 2 mins of inactivity back to normal operating mode.
~4 Short flashes on power up	Indicates the device **booting** after power up or watchdog reset. Led should usually then display normal operating mode indication. The unit will transmit a water level reading on power up.

MODE Pushbutton Switch

The mode pushbutton switch has multiple purposes depending on the configured mode of operation of the device.

Action	Meaning
Installation Mode **Press and hold for approx. 2s**	Enter/exit **installation mode**. In this mode the STAT LED can be used to confirm the sensor probe is functional. Readings are taken and transmitted every 20s
Press and hold whilst plugging device into USB host	Device enters **firmware programming** mode so that Workbench can upgrade firmware on the device
Long press (approx. 5s)	Device enters special mode used for activating USB interface to communicate with **Workbench**. This mode also times out after 2 mins of inactivity back to normal operating mode.

TLM Installation Checklist

Following is a checklist of dos and don'ts:

a. Mount the TLM so that the solar panel is north facing and adjusted to about a 45 degree angle
b. Do not allow the internal electronics to get wet
c. Do not unsolder or remove any internal plugs unless instructed to do so by technical support staff.
d. Do not remove the RTC coin cell battery
e. Check that the probe and antenna cable glands are firmly (but not overly) tighten to prevent water ingress
f. Adjust the antenna so that is vertical before tightening the side adjustment knobs
g. For concrete tanks it is especially important to ensure the sensor cable is secured such that it doesn't wear on the tank
h. Ensure all cables are secured to the tank to prevent movement in strong wind.
i. To disconnect the battery gently tease the two halves of the white inline connector apart. Avoid pulling on the wires.

Warranty

Water-Insight is a brand of QTech Data System Limited.

The hardware and software for this product is covered by the QTech Limited Warranty Agreement and software End User License Agreement, respectively.

Please refer to the QTech Limited Product Warranty Agreement, which may be downloaded from the QTech website: www.qtech.co.nz

QTech Data Systems Limited does not warrant the suitability of this product for any particular application as the conditions in which it is used are beyond our control. This is not withstanding warranty of merchantability.

Additional Information and Support

If you have problems try the following:

- Visit the Water-Insight web site for application notes and guides
- Refer to the troubleshooting section if one is present in this document
- Contact the support desk at support@qtech.co.nz
- Phone the support desk, contact details at beginning of this document