aquaflex
SOIL MOISTURE SENSORS

Aquaflex Handbook

IRRIGATION MANAGEMENT MADE EASY

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Conditions of Use

AQUAFLEX must be installed and operated as specified in the AQUAFLEX User Manuals. In particular, AQUAFLEX user's attention is drawn to the following warnings:

AQUAFLEX, and AQUAFLEX components, only provide data on soil moisture and temperature. Use of this data is entirely at the discretion of the user. The use of data generated by AQUAFLEX should therefore be subject to current best practice principles of soil moisture management and agronomic management. These must include regular checks on the integrity of AQUAFLEX and the data it is producing plus regular visual inspections of crops, plants or other materials being monitored by AQUAFLEX.

The AQUAFLEX system may have other sensors connected to it (e.g. air temperature, rain gauge information etc). Use of the data from these sensors is entirely at the discretion of the user. The use of data generated by AQUAFLEX should therefore be subject to current best practice principles of agronomic management for these sensors. These must include regular checks on the integrity of the sensors and the data it is producing plus regular visual inspections of crops, plants or other materials being monitored by the sensors.

Neither Streat Instruments nor its Distributors shall be liable (whether in contract, tort or otherwise) for any loss (including but not limited to loss of profits and consequential loss) of any kind whatever arising out of any published material or in connection with the performance or use of AQUAFLEX.

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IRRIGATION MANAGEMENT MADE EASY

Introduction

Congratulations on your purchase of an Aquaflex Soil Moisture Measurement system.

This system will provide you with significant benefits for many years to come.

The purpose of this handbook is to ensure you get the maximum benefit from your Aquaflex system. It covers such topics as Interpreting your Aquaflex Data, Post Installation care etc.

We welcome your feedback and suggestions as we strive to provide excellent customer service.

Yours sincerely

Jim Herbison
Managing Director

Contents

1. Determining Irrigation Parameters

Field Capacity and Refill Point.

The Field Capacity and Refill Point need to be set individually for each Aquaflex Sensor site.

Field Capacity (FC) is defined as the maximum amount of water the soil can hold against the forces of gravity.

Imagine holding a sponge under a tap; it will absorb the water up to a point and then the water drips out the bottom. If you turn the tap off the sponge will continue to drip for a time, the point at which it stops dripping is Field Capacity (when the pores of the sponge can hold onto the water against the force of gravity).

This is the top line of the band seen in the graph shown in Figure 1.

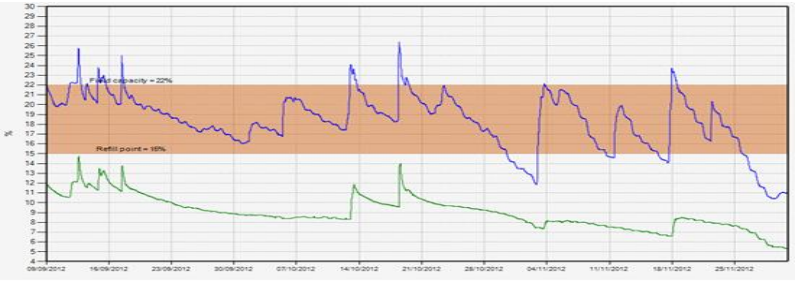


Figure 1, the graph above shows a double sensor installation – and the drainage through the profile, past the root zone is confirmed by the increase in soil moisture in the lower (green) sensor.

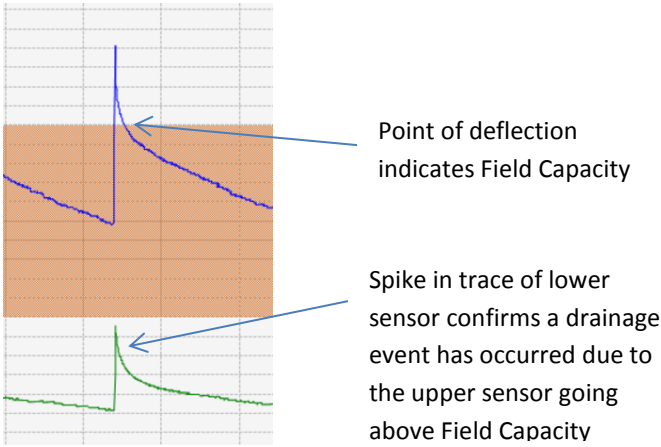
Permanent Wilting Point (PWP) is the water content of soil when most plants growing in that soil wilt and fail to recover upon rewetting.

The **Refill Point** (RP) - sometimes called Stress Point - is half-way between Field Capacity and Permanent Wilting point and is initially set as two/thirds of the Field Capacity value. This is the lower line of the band seen in the graph shown in Figure 1.

The area between the Field Capacity and Refill Point is referred to as **Readily Available Water** (RAW) – this water is easy for the plants to extract from the soil and this area is where maximum production can be obtained.

How to determine the Field Capacity and Refill Point.

Field Capacity is detected by observing a rainfall or irrigation event that causes the soil moisture to peak and then drop down almost immediately, indicating drainage through the profile.



The point at which this near-vertical drop in the soil moisture trace starts to deviate from vertical is the point at which the pores within the soil are able to hold onto the water. This is where Field Capacity is set.

Refill Point is initially set at two thirds of Field Capacity.

Note that the Refill Point is not necessarily the trigger to start irrigating but where possible, it is common practice to irrigate such that soil moisture does not drop below the Refill Point.
Below Refill Point the plant has to work harder to extract water from the soil, with consequent stress, which increases as the moisture level continues to fall.

If it is noticed that plant production drops off before Refill Point is reached, this indicates that the value of the Refill Point should be increased; conversely no drop in production is observed when below Refill Point, this would indicate that the Refill Point could be lowered.

Hydrophobicity
When the soil dries out, Field Capacity can change as the soil becomes more hydrophobic – rather like allowing a sponge to dry out, after which it takes a few gentle applications of moisture to get the water holding capacity back up again

Don't let your soil get too dry, or you will lose your water holding capacity

2. Interpreting the graph

Generally, the moisture level should be maintained halfway between Field Capacity and Refill point – indicated by the black line in Figure 2.

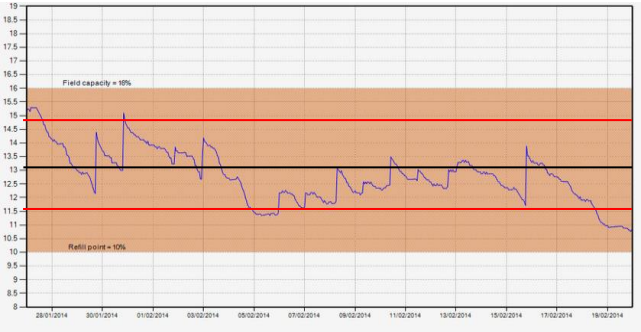


Figure 2 The Black line shows example of target moisture content.

As a general rule, aiming between 25 and 75% (the red lines shown below) in summer leaves a buffer of 25% RAW either way (for rain or an unexpected increase in drying out of the soil).

This is a general guide and in practice its wise to watch the weather forecast and aim to be within the RAW band taking into consideration not only irrigation but forecasted weather.

Hot and dry winds leading to high Evapotranspiration (ET).

If hot dry winds are expected the moisture should be maintained at a high level, (near the Field Capacity) in order to provide as much water storage in the soil as possible.

Rain forecast.

When rain is forecast, accurate soil moisture data can allow judgements to be made relating to the need to irrigate. It may be possible to switch irrigation off and utilise free rain to irrigate.

3. Converting VMC to mm of water

Knowing how many mm of water is required to achieve the Volumetric Moisture Content (VMC) gain required, can be useful and result in more efficient irrigation.

1% VMC equals 1 mm of water per 100mm depth that the sensor is installed in (e.g. if the sensor is installed on a slope from 100mm to 400mm the depth range is 300mm. For this example 1% VMC would equal 3mm of water).

It is good practice to monitor the relationship between VMC and applied water. The table on page 15 can be used to collect this data and calculate the relationship. An example is shown below. The more data that is collected, the more accurate the calculation will be.

Date	Amount of rain or irrigation (mm)	Amount Aquaflex reading <u>changed</u> VMC
14 March	9mm	3%
21 March	15mm	6%
24 March	12mm	4%
	Total A: 36mm	**Total B: 13%**

Calculate: amount of water (in mm) needed to increase moisture by 1%

$$mm\ per\ \% = \frac{Total\ mm}{Total\ \%}$$

$$mm\ per\ \% = \frac{36mm}{13\%}$$

$$mm\ per\ \% = 2.76\ {}^{mm}/_{\%}$$

Next:

Once the conversion number **C** has been determined, and FC and RP are set correctly, the following formula can be used to estimate the amount of Readily Available Water (RAW) in mm.

$$Total\ RAW\ (in\ mm) = (Field\ Capacity\ \% - Refill\ Point\ \%) \times \boldsymbol{C}$$

Important: These calculations and numbers will be different for every soil, every site, and even every irrigation event.

For example, when a small amount of water is applied to a 300 mm depth, the water will infiltrate differently every time depending on the soil moisture status, amount of transpiration, grass cover and other factors.

In very dry conditions, since the Aquaflex Sensor is installed at a minimum of 50mm, it may not register an irrigation of only a few millimetres, because all the water could be absorbed in the top layer of soil and never reach the sensor.

4. Pulling it all together

Irrigating enough to keep up with the weather ahead.

The example in Figure 3 shows the rate of decline of moisture.

Using the mm value determined earlier, it is possible to calculate how many mms are lost per day. Knowing this amount, combined with how much water is applied each day, enables informed decisions to be made regarding the need for, or amount of, irrigation.

For the example below 1% Volumetric Soil Moisture = 4mm applied

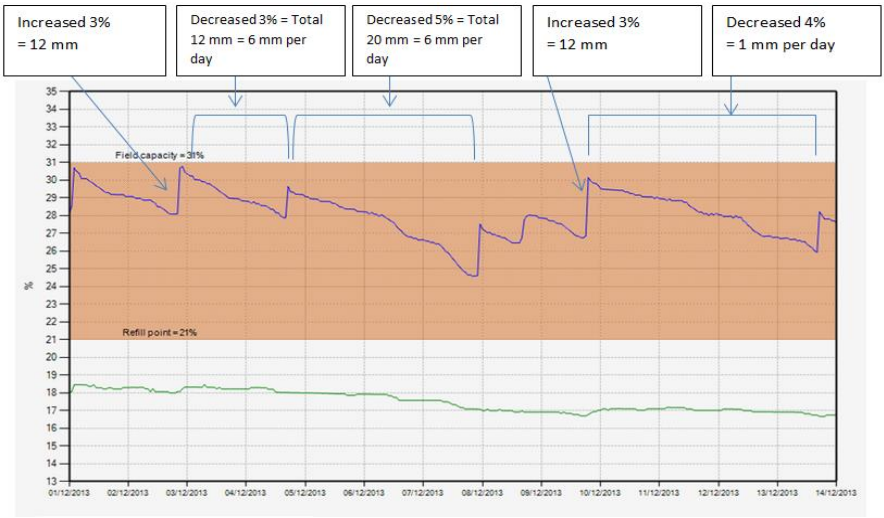


Figure 3, this graph indicates good irrigation management for warm weather ahead, near the Field capacity but with no moisture increases seen in the lower sensor.

5. Ground Temperature

Your Aquaflex measures soil temperature at the depth of the block at the data cable end of the sensor (normally at around 100 to 150mm).

Low temperature may inhibit growth as can lack of water so having both Soil Moisture and Soil Temperature data allows you to decide when to irrigate – especially in the shoulders of the season.

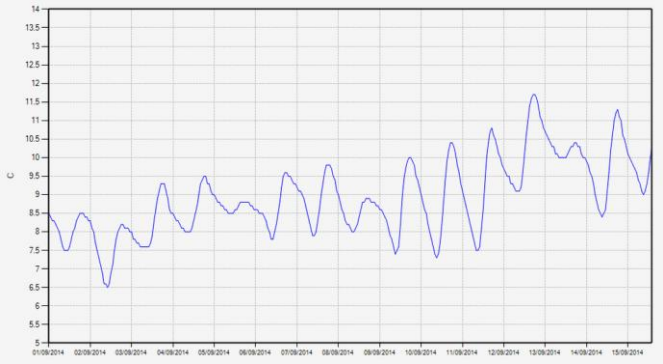


Figure 4, this graph shows soil temperature.

For the shoulder seasons

Soil temperature should be monitored closely at these times.
As a general rule a soil temperature of **10 degrees Celsius at 9 am** indicates it is OK to irrigate (provided the soil moisture indicates irrigation is required of course).

You know your farm better than anyone else and often if it has been a dry winter you might be better to irrigate slightly earlier than this (depending on your water temperature as well) in order to avoid starting the season below refill point.

6. Post Installation Care

In order to maximise the investment in Aquaflex there are some simple steps that can be taken to ensure the longevity of the Aquaflex Sensor(s).

- Mark both ends of the Aquaflex sensor with cobble stones or similar for easy detection.
- Record GPS information for the sensor location, make a map showing how the sensors have been installed and to what depths (it is useful to tape a copy of this inside the Aquaflex Box on the Fencepost).
- Keep livestock off the area the sensor is installed in for a week or two.
- Install a hot wire or similar protection around the Aquaflex Box on the fencepost to avoid damage by livestock
- Shortly after installation give the area over the Aquaflex Sensor a heavy roll after an irrigation or rainfall (roll along the length of the sensor, NOT across it). This helps return the soil to its original compaction.
- The surface above the sensors should be level; top dress any depression and sow new grass seed if required.
- Take care not to damage the sensor when re-grassing, ploughing, sowing new crops etc.
  Aquaflex NZ have GPS locations and Sensor location plans for each Aquaflex Sensor they have installed directly.

Locating an Aquaflex Sensor.

Figure 5, white markers show the ends of the Aquaflex sensor

Even shortly after installation it is very hard to identify the location of the Aquaflex Sensors. In figure 5 above, white standards mark the sensor location - but the use of these is not practical in all situations.

To locate an Aquaflex Sensor:

- Refer to the Installation Map that should have been provided by the installer (check in the Aquaflex Box on the Fencepost).
- Look for the cobblestones that would have been placed at each end of the sensors to identify the sensor location.

Further Information

For further information, questions or feedback please view our website

www.aquaflex.co.nz

Glossary

- ET - Evapotranspiration
- FC – Field Capacity
- PWP – Permanent Wilting Point
- RP – Refill Point
- RAW - Readily Available Water
- VMC - Volumetric Moisture Content of soil

Notes

Notes

VMC to mm per %

Date	Amount of rain or irrigation (mm)	Amount Aquaflex reading changed VMC
	Total A: _____ mm	**Total B: _____ %**

A divided by **B** = **C** (amount of water (in mm) needed to increase moisture by 1%)

$$mm\ per\ \% = \frac{mm}{\%}$$