VARIABLE IRRIGATION – IS IT FOR YOU?

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Introduction

Variable Rate Irrigation (VRI) is now well proven, some systems are reliable and robust, and has (in some cases) been shown to result on more effective and efficient use of water. What VRI **is not** is a panacea to or the solution for efficient irrigation. If:

- An irrigation system is poorly designed; and/or
- Has poor distribution uniformity; and/or
- Irrigation is poorly managed;

VRI will not improve any of the above. VRI is the 20% of the Pareto principle, more commonly known as the 80-20 rule or the "law of the vital few". That is, 80% of the gains come from the basic essentials (20%) of efficient irrigation. VRI will add the additional 20% efficiency gain.

What is VRI?

Variable Rate Irrigation (VRI) allows the application of the correct depth of water to specific areas under an irrigator – centre pivot or linear move irrigators. The system allows full control to maximise yields and profitability. The varied application depth is achieved by individually pulsing sprinklers on and off, all the while controlling the system speed to adjust the application depth along the length of the centre pivot or linear. Figure 1 conceptualises the VRI system, in this case where banks of four (4) sprinklers are pulsed on and off to apply the specified depth of water.

Notes:

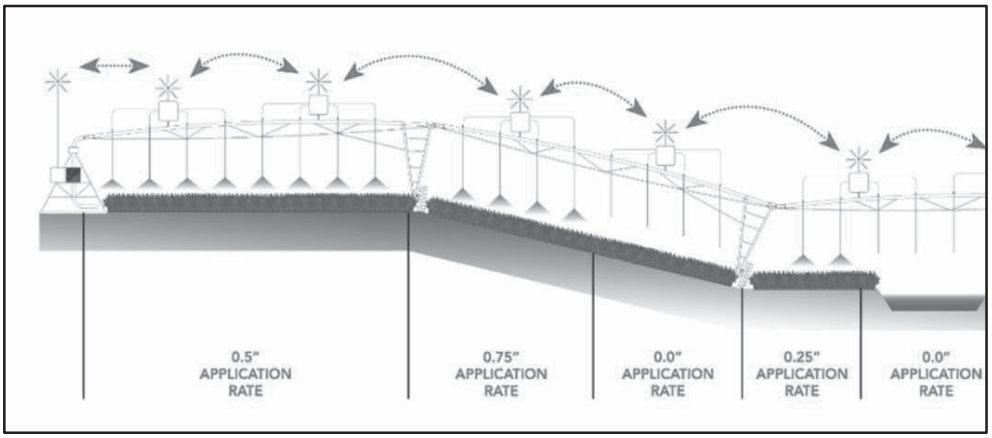


Figure 1. Conceptual illustration of VRI; where ✳ are the nodes controlling the banks of sprinklers (from Precision Irrigation).

VRI can be fitted to new centre pivots and linears or retro-fitted to older pivots and linears.

Why Use VRI?

Setting aside "VRI will not turn an inefficient irrigation system into an efficient system", why is VRI fitted to centre pivot and linear irrigators? VRI is used to exclude or vary irrigation to defined areas (zones) of an irrigated area (a circle or rectangle.

a) Excluded areas include tracks (stock (Figure 2) and tanker tracks), high traffic areas such as water troughs, gateways and drains, ponds and ponding areas, yards and other farm infra-structure areas, and paddocks with different crops (e.g. maize just sown or about to be harvested).

Figure 2. Stock track to be excluded from irrigation.

Figure 3. Drain to be excluded from irrigation.

b) Vary depth of application to different paddocks or crops. There are two reasons for varying application depths:
   - When adjoining paddocks on the same soil type have different growth stages and water requirements such as one paddock for grazing and an adjoining paddock cut for silage or hay; and
   - When adjoining paddocks on the same soil type are different crops and the paddocks have been retained for rotational and certification reasons (arable farming).

Notes:

c) Vary depth of application according to soil water holding capacity differences across the irrigated area. Any differences in soil water holding capacity must be ground truthed before VRI is considered and need to be significant/large to warrant VRI.

The VRI process

The decision to install VRI is a process and not a difficult one at that. The simple flow chart in Figure 4 illustrates the thought process.

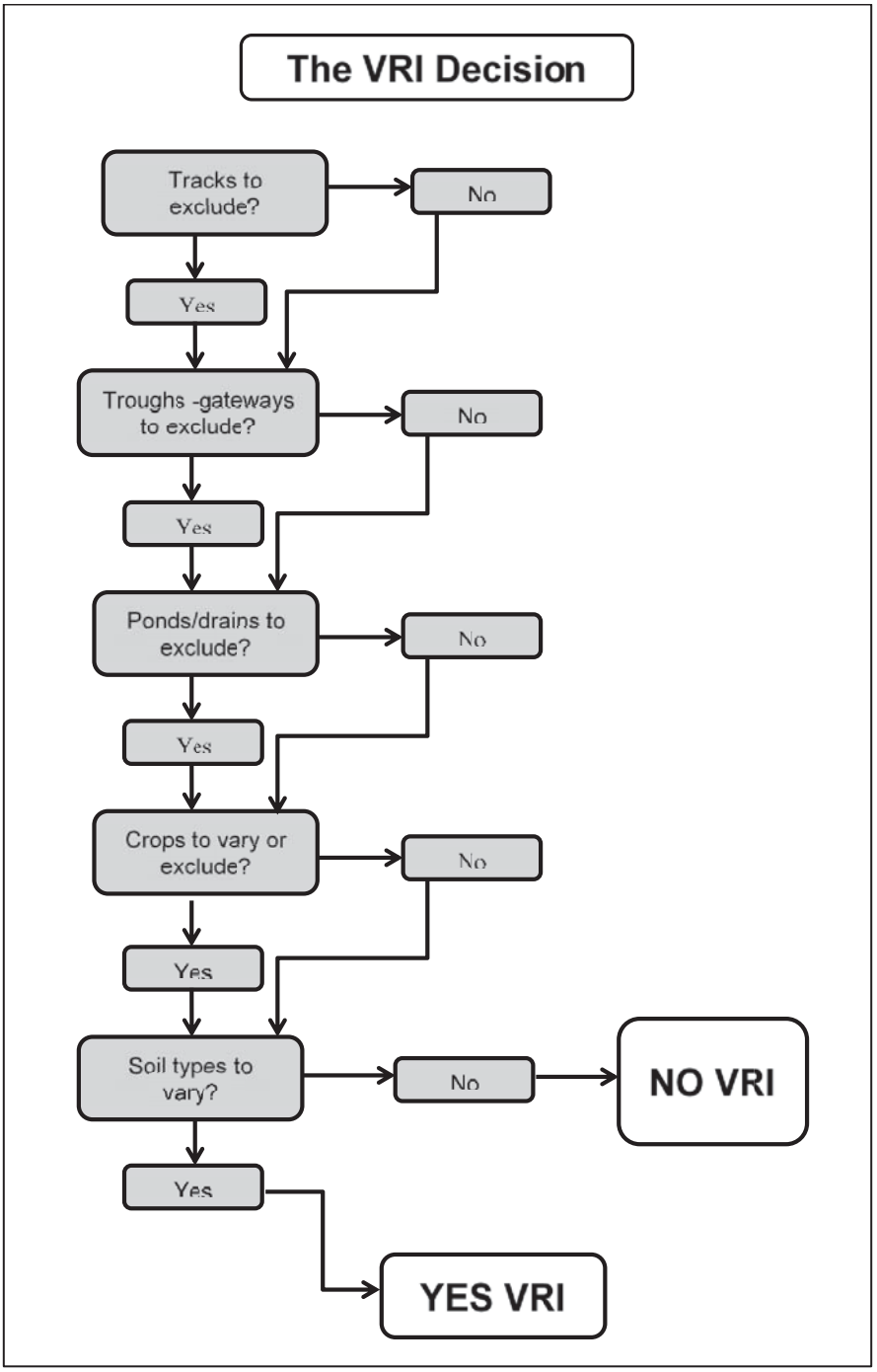


Figure 4. VRI decision flowchart

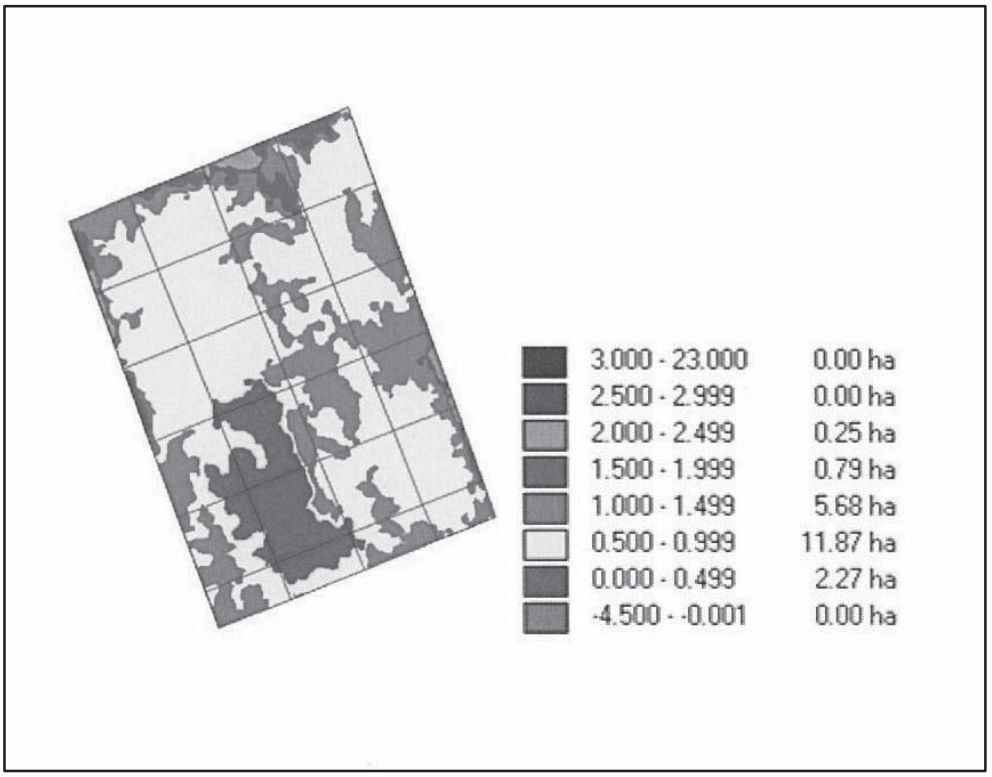
Having reached **"YES VRI"**, two further processes are required:

1. Order VRI for the irrigator; and
2. Create an irrigation plan.

The first is simple; the second requires further work and investigation.

The further work involves:

1. A digital map of the irrigated area with excluded zones (tracks, ponds, drains etc.) and, paddocks; and/or
2. A digital map of soil water holding capacity variability; i.e. an EM (Electro Magnetic) map (Figure 5) that has been ground truthed to establish the variability is related to water holding capacity. This is essential because it may or may not be that EM truly represents water holding capacity.



Notes:

Figure 5. Example EM scan output

In Figure 5 there is little variation in EM in the area scanned – 95% of the area has values that lie between 0 and 1.499. At first glance, the variability would not warrant fitting VRI unless the "zones" had significantly different water holding capacity. There is **no** relationship between EM values and water capacity of the soil 0-60cm (Figure 6).

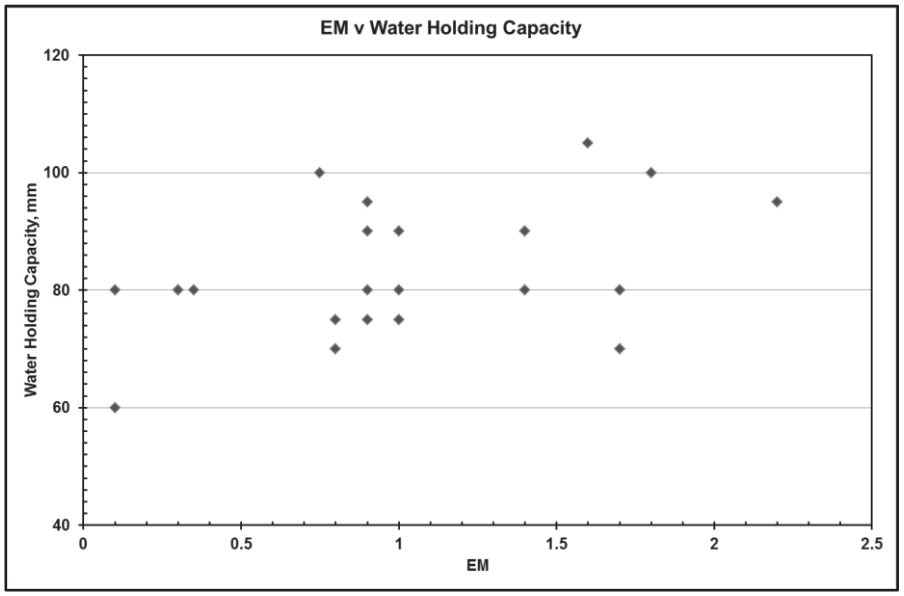


Figure 6. Relationship between EM and water holding capacity for EM scan (Figure 5).

What is required is a relationship such as that shown in Figure 7. In this case the soil variation represented by the EM scan could be used to establish zones for the application of VRI.

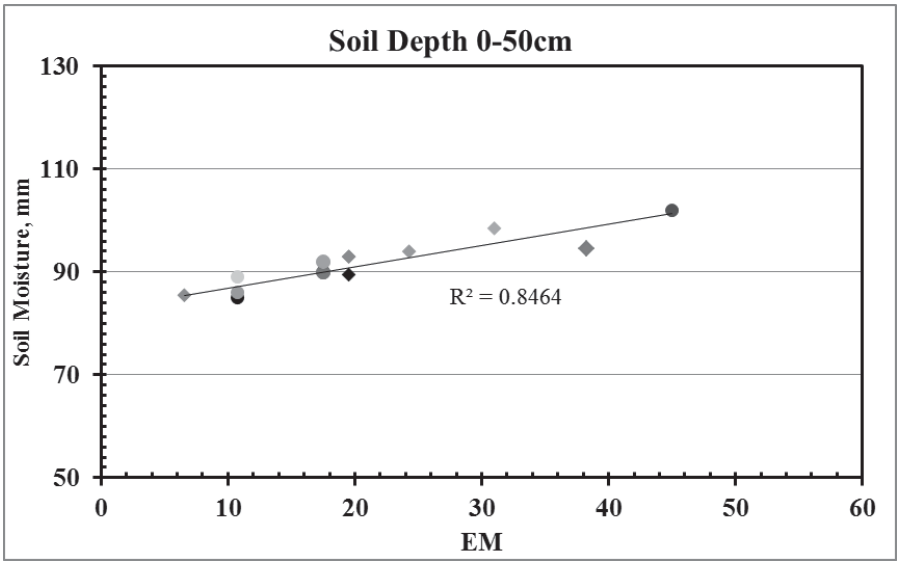


Figure 7. Acceptable relationship between EM and soil moisture.

3. A digital map of the irrigated area with soil water zones; for example Figure 8.

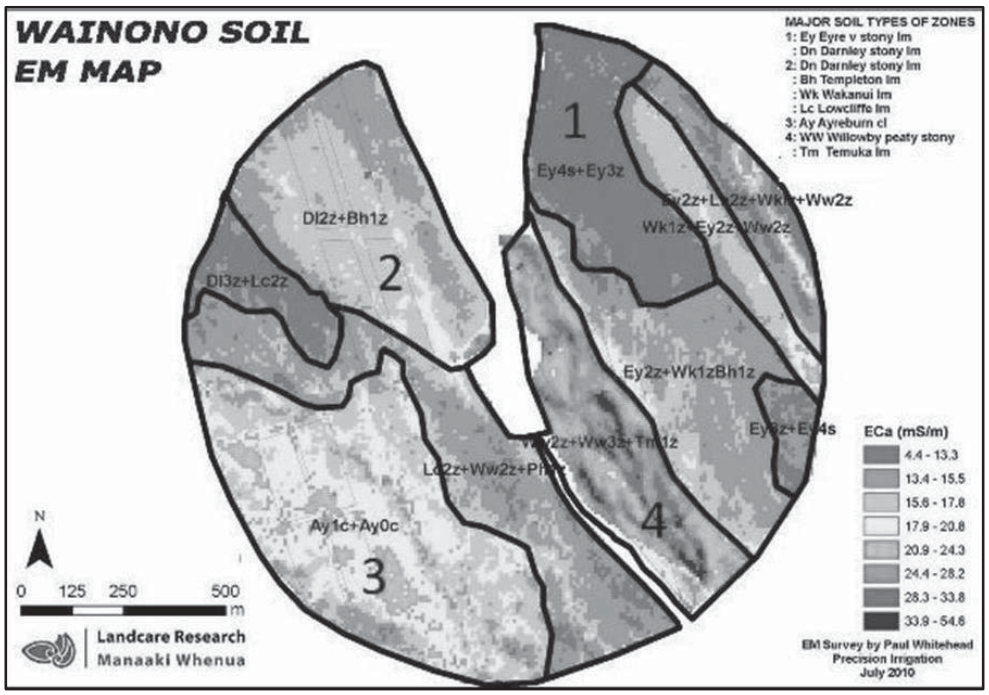


Figure 8. Irrigation zones from soil type and EM scan, Wainono Dairies.

4. Measure soil moisture at representative locations in the soil water zones. The EM raw data needs to be consulted to find locations where the EM value is repeated for 3-4 readings down along a transect and (ideally) in adjacent transects. Soil moisture measurement is essential to determine the application depth for each zone.

Potential gains

Not everyone or in every season will there be gains to be made from VRI. Where will the gains be made (when compared to uniform irrigation):

Notes:

1. Tracks and lane ways are not irrigated resulting in reduced track maintenance and fewer lame cows;
2. High traffic areas such as around troughs gateways can be excluded or receive lower application depths, avoiding or minimising soil pugging;
3. Streams and water races can be excluded;
4. Soil types susceptible to water logging can be excluded or receive lesser application depths, eliminating or reducing drainage (and therefore nutrient leaching);
5. When effluent is applied through the irrigator, VRI permits more precise application; e.g. excluding paddocks just grazed or about to be grazed, waterways and other sensitive areas;
6. Where there are significant variations in soil type soil water from deeper higher water holding capacity soil types can be "mined" in the shoulder seasons (spring and autumn), maximising irrigation efficiency and minimising drainage;
7. Where there are significant variations in soil type soil water from deeper higher water holding capacity soil types can be "mined" following large rainfall events (when all the soil profiles are returned to field capacity), maximising irrigation efficiency and minimising drainage; and
8. Where there are significant variations in soil type and annual volume is "tight", soil water from deeper higher water holding capacity soil types can be "mined" during the irrigation seasons to best manage the allocation.

Summary

VRI is not everyone or every farm. It is a process:

- There must be a reason;
- It will not turn around a poorly operated and/or managed irrigation system;
- It should add some of the 20% of the 80:20 principle;
- The gains or benefits must out way best irrigation management practice;
- In some (maybe many) seasons there could be little if any gain (e.g. 2014-15 when December-March VRI was of little benefit).