Using innovative technologies to develop drainage models

Department of Agriculture and Fisheries

Addison Farm Produce, Tasmania

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Key outcomes

- EM38 soil mapping effectively differentiated soil types and characteristics for consideration in drainage design.
- Based on observations of water movement since completion of the drainage system, the drains are effectively removing water from previously waterlogged areas.

Background

The Addisons have progressively implemented various precision approaches since 2012. James has a number of objectives in his approach to farming.

These include creating the best possible seedbed for optimal crop establishment, with minimal inputs, reduce tractor hours, diesel use and soil compaction, and preserve soil carbon. A combination of changes in management and technology have led to improved profitability over time.

"Our focus is improving soil health and avoiding soil erosion as key drivers for our operation, as the soil is the foundation of the entire enterprise."
– James Addison

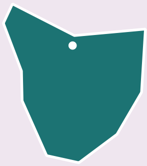
Key drivers for the uptake of precision agriculture (PA) technologies and practices include:

- having more control over the way inputs are applied to crops, and
- using the data collected through crop sensing to assist with daily decision making and management.

Objective

"We wanted to be able to better manage the areas of the field that are heavier in soil texture and prone to waterlogging, to reduce crop loss and increase the productivity of the field."
– James Addison

Some areas of 'Lornebrook' are subject to post-winter waterlogging, often preventing land preparation and spring seeding. The objective was to design and install a drainage system based on soil mapping data to mitigate this management constraint.



Grower: James *(pictured with Bec Addison)* and Mark Addison

Location: Moriarty, Tasmania

What they grow: carrots, peas, potatoes, poppies, onions, green beans, broccoli, cereals

Other enterprises: beef and lamb production

Soils: predominantly red Ferrosol

Topography: undulating

Average annual rainfall: 770 mm (winter dominant)

Precision technologies implemented: RTK GPS tractor guidance, seasonal controlled traffic farming and strip tilled broccoli, variable rate irrigation, GPS section control on the boomspray, daily automated soil moisture monitoring

Activities

AgLogic carried out an EM38 survey of the affected areas. The EM38 survey and elevation data was processed to create a drainage model, considering subsoil and topographic features that might impact on subsurface water flows and surface break outs.

Gibson Ag ground-truthed the EM38 data to refine the proposed drain locations. Ground-truthing focused

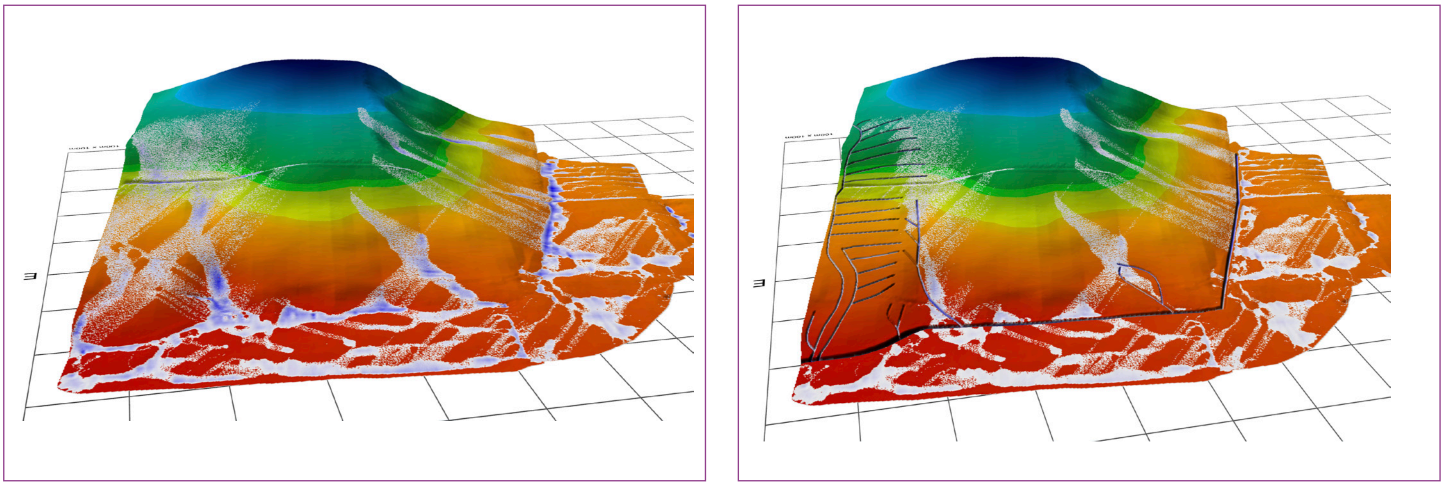


Figure 1. Drainage modelling illustrates water flow in the field pre-drainage works (left) and the location of subsurface drainage works installed (right).

on determining the soil texture and detecting subsoil features such as ironstone reefs.

The EM38 mapping made it easier to direct drains around the ironstone reefs and through the most poorly drained areas of the farm. A total of 3.8 km of drainage pipe with gravel overlay was laid. The series of drains removed excess subsurface water from about 7 ha, and an additional 3 ha benefits from associated mole-ploughing and improvements to surface runoff.

James has observed that the drains run well for 24 to 48 hours after significant rainfall, removing most of the excess water quickly. Prior to the drainage installation, rainfall in late winter or spring made these areas of heavier textured soil too wet to access for cropping.

Costs

The EM38 soil mapping cost $35–38/ha (including image processing). The data processing to model the drainage lines cost approximately $450.

Installation of the drainage works for this case study involved two different pipe diameters. The installation of the 881 m mains 100 mm pipe cost $8.05/m, and the 2984 m of lateral 65 mm pipes cost $6.85/m.

Additional costs included $495 for machinery transport to the site and a quantity of gravel at $20/t.

Precision farming systems

The use of soil mapping to improve in-field drainage complements the other PA techniques that James has implemented across his farming system.

James adopted RTK GPS guidance in 2012. This technology was critical for enabling controlled traffic farming (CTF) and strip tillage.

Seasonal CTF was implemented in 2014. Challenges included varied wheel spacings (with contracted machinery) and planting layouts (bed versus broadacre) across different aspects of the rotation.

CTF required RTK guidance in all tractors, widening of a number of implements and simplifying the approach to ground preparation. Operator training was also needed to ensure that everyone using the machinery was aware of the objectives and requirements of seasonal CTF.

Seasonal CTF reduces the area of wheel traffic in the field. Because of the incompatibility of harvest equipment, random harvest traffic is accepted as a necessary compromise.

Figure 2. Subsurface drainage installation in progress at ‘Lornebrook’.

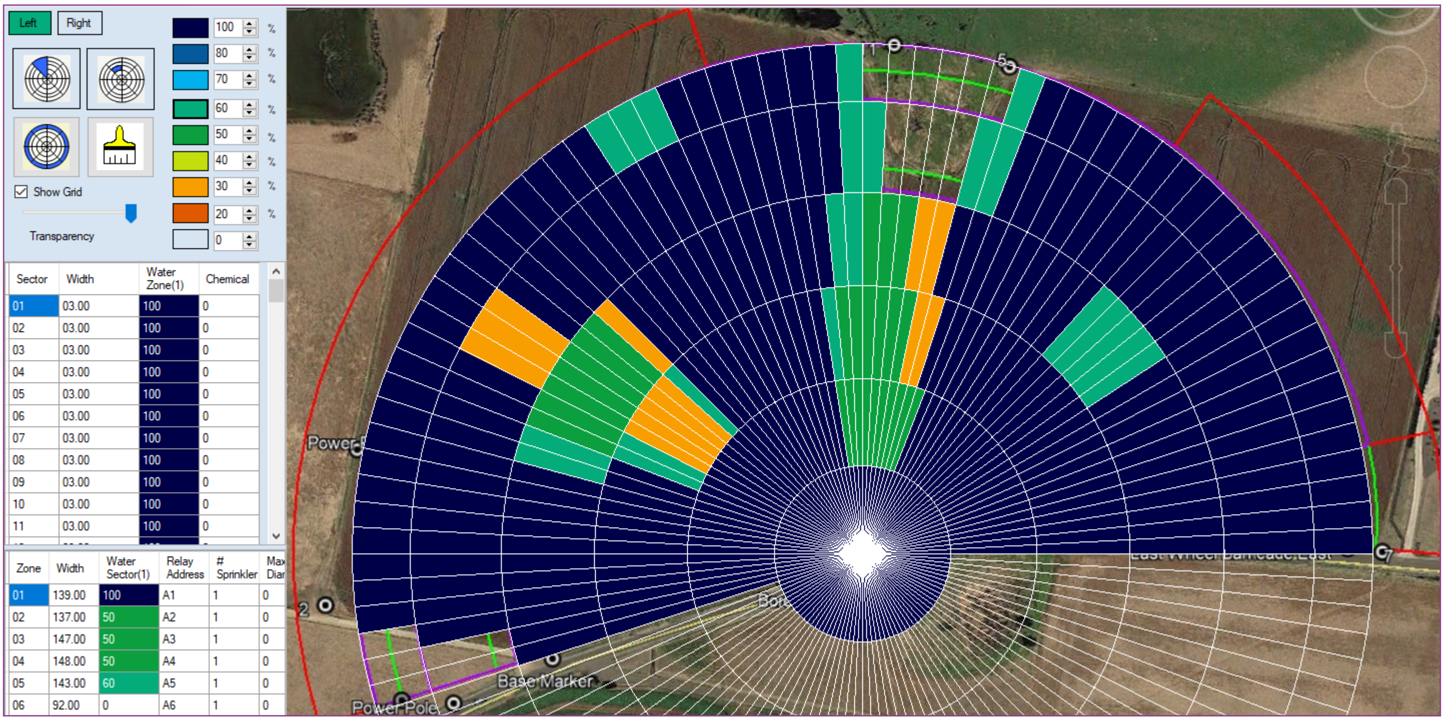


Figure 3. Variable rate irrigation prescription map for a Rienke centre pivot irrigator. The VR irrigation map shows lighter rates (orange and green) over wetter areas and water off completely over a swampy area at the top.

The benefits of decreased trafficking are particularly advantageous in wetter planting seasons. Strip tillage is used in some crops (e.g. beans, broccoli) grown under contract for other companies.

Three pivots are fitted with variable rate (VR) controllers. VR irrigation reduces irrigation run-off and ensures each area of the field recieves the correct amount of water for optimal crop growth on variable soil types and reduces losses to potato rot. Crop variability is reduced and overall crop quality has increased as a result.

Daily soil moisture monitoring is used during the growing season to schedule irrigations and track crop moisture demand. In-field rain gauges are used to accurately measure irrigation applications and rainfall. Data is sent wirelessly to the cloud and is accessible on the office PC and on mobile devices.

The boomspray has GPS section control to reduce overlap when applying agricultural chemicals.

Service providers: AgLogic; Gibson Ag; Serve-Ag

Authors: John McPhee, Tasmanian Institute of Agriculture and Julie O'Halloran, Queensland Department of Agriculture and Fisheries

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Costs presented in this document were accurate as of October 2019. These will change over time and between data processing service providers.

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