Local Land Services

Case study | Hunter

Managing drainage provides multiple benefits

Introduction

In coastal dairy regions of the New South Wales mid-north coast, a combination of flat, low-lying paddocks and intensive rainfall events often result in lost production, both short and long-term. East coast low systems, typically in March and April, can provide rainfall event of 120 to 350mm in several days. These events pose major drainage challenges, sometimes leading to significant inundation for prolonged periods.

Rainfall periods coincide with sowing of the winter ryegrass. Water inundation not only slows progress on planting, but also causes leaching and denitrification of available nitrogen (N), causing flow-on impacts to the establishment and initial daily growth rates of the pasture. If subsoils remain saturated for extended periods, the rooting depth of pasture plants is stunted and N uptake is restricted.

Pat and James Neal

Pat and James Neal operate adjacent dairy farms on Oxley Island, near Taree, NSW, with Pat milking 420 cows and James between 550 to 700 cows, depending on seasonal conditions. The topography of both farms falls from a coastal estuary on one boundary, to low-lying peat soils that overlay shallow water tables. The influence of high tides and flood waters delay the movement of water to the estuary, and the threat of acid sulfate soils limits the depth of drains that can be formed to move surface water.

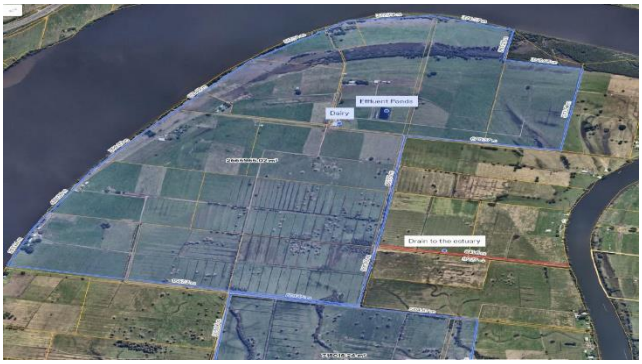

Figure 1. The location of James Neal's dairy farm on the Manning River (left) with surface drainage designed to flow through a major drain into Scott's Creek (right).

Drainage System Design

The Neal's are well known for the installation of hump and hollow parallel drains, used more widely in New Zealand and Tasmania, now covering most of their milking platforms. These drains are unique in that they are a shallow 30cm deep, approximately 2 metres wide and 30 to 40 metres apart.

The way in which formation has occurred varies slightly across the two farms, with Pat using dirt from the drains to create humps in the centre so that the water sheds both ways. Whilst the dirt created from drains on James' farm is used to fill unwanted dips and hollows in the centre areas.

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"We have designed the humps in a way so we do not have to make changes to machinery in different areas of the farm, especially when cutting silage, across the paddock. The way each hump tapers is similar," says Pat.

Figure 2. James Neal's farm only 4 weeks post flood shows the humps out of water but surrounded by full drains. The higher levee areas are green and recovering quickly with lower lying areas still covered in some sediment.

"We have put this system in gradually over ten years using a laser guided grader to make sure we minimise the dirt we remove, avoiding disturbance of underlying acid sulfate soils, and to ensure they drain freely (aprox. slope= 20cm in 100m) and there is no water pooling, " says James.

Figure 3. James Neal explains the design of his drainage system shortly after a 170mm rainfall event in a two day period. The hollow drains are full but adjacent platform area is relatively dry and ready for cows.

The Benefits

The benefits of this system, in contrast to more traditional systems with deeper drains and narrower spacing, are significant when considering the constraints of this farming region.

Ease of physical paddock management

The overall maintenance of shallow drains is easier than traditional systems. Laser levelling means that there is improved connectivity across management areas of the farm, providing better functionality of the drains. Access to the drains, to keep them free from obstructions and sediment build-up, is also an advantage to long-term management.

With surface water runoff improved, the lag time between rainfall events and trafficability of the paddocks is greatly reduced.

"The areas are tractable within two days and we can get on with farming, whether that is bringing the cows on without fear of pugging the soil and damaging the pasture, sowing winter pastures, or applying nutrients,' says Pat.

Figure 4. Pat Neal says the hump and hollow system allows him to get on with farming sooner as the soil has drains rapidly after rainfall events.

"We can get on with farming"

Pat Neal, Oxley Island, NSW

Improved Nitrogen Use Efficiency (NUE)

Reducing the time that paddocks are inundated with water improves pasture response to N applications and therefore overall growth rates. Waterlogged soils are highly conducive to denitrification of soil available N, this means that nitrate N is turned into a gaseous form that is no longer available to the plant and results in greater rates of N needing to be applied to resume production.

While it is difficult to put an exact figure on the economic loss, Queensland University of Technology (QUT) trials conducted as part of the national *More Profit from Nitrogen Program* (2016-2021), measured 4-7kgN/ha/day loss due to denitrification in saturated soils, with a total of 28kgN/ha over 21 days. This can be higher in warmer weather, or if N is applied before the event, or if the waterlogging

follows a long dry-spell when nitrate accumulates in the soil, or a combination of all of the above.

4-7 kgN/ha/day is a conservative measure by QUT of N lost from saturated dairy soils through denitrification processes. This is when soil available nitrate is tuned into a gaseous form of N and is no longer available to the pasture.

High rainfall events also cause fertiliser runoff, especially if the soil is already wet upon application. If rainfall events occur after a dry-spell (such as in March/April after summer), significant amounts (100 to 150mm) are needed before runoff is an issue and N is washed into the soil without off-farm loss. However, when the soil is already wet, runoff may occur with only small rainfall events (25 to 50mm) and losses can be higher as the N dissolves into the runoff water.

The important thing is to recognise when and how N can be lost and respond accordingly based upon weather forecasts and the moisture content of the soil.

"A week-out, if we know we are going to receive 100mm plus rain, we won't apply fertiliser as we know we will lose it. Having confidence in the drainage to quickly shed the water means we know we will be able to get on soon after to make our applications," says Pat.

Nitrogen application decisions

Losses of residual and recently applied N needs to be considered in planning fertiliser before or after a rainfall events.

Pat and James both believe they have greatly improved their NUE by holding-off on applying urea when east coast lows or high rainfall events are forecast.

"We wait until after the event, after the soil has drained and we can get our machinery on and apply fertiliser at typical rates then. That way we haven't lost anything and what we put on is going to remain," Pat says.

By waiting for the hollow drains to effectively move water from the hump areas, James believes productivity is greatly improved.

"You don't lose nitrogen from denitrification and therefore need to replace it. Overall, it means we get a better response from nitrogen applied after rainfall events."

Summary

Effective drainage systems greatly improve pasture productivity and nitrogen use efficiency:

- Rapid surface runoff reduces paddock water inundation and therefore conditions conducive to denitrification and leaching of applied N.
- Quick drying paddocks means less pugging and trampling by cows to improve pasture yield.
- Cows and machinery can re-enter the paddock sooner allowing more timely sowing, grazing and fertilisation, delivering longer-term benefits.
- Shallow drains avoid disturbance to underlying acid sulfate soils to mitigate environmental issues.

For more information

Scan this QR code to access Hunter Local Land Services fact sheet on *Autumn-Winter Nitrogen* (Beale & Griffith, 2021)

Contact your nearest Local Land Services office on 1300 795 299 or visit our website www.lls.nsw.gov.au

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