Notes on Managing Phosphorus losses

and Appendix Note on Cleaning Drains and Natural Watercourses

Field days June 2015

North Canterbury Sustainable Farming Systems SFF Project

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Notes from P days - The Hermitage and Teece Family Farm
11th and 12th June 2015

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Introductions

All were welcomed and Professor McDowell, the Mayor, and other community representatives were introduced.

Collectives

Michael Bennett (ECAN staff) introduced the Regional Plan and the role of Collectives in this. The Plan requires all farmers in the Waiau, Jed or Hurunui catchments to be either part of a Collective or make an application for resource consent by 1 January 2017.

A 'Collective' is essentially a farmer owned system of administering (logging and auditing) farm environment plans.

Collectives will undertake additional actions depending on structure and purpose (whether an irrigation scheme, catchment collective, or industry certification system). An industry certification system for example might undertake activities with a region-wide benefit (like educational field days), while a catchment collective might participate in funding bids to support a localised enhancement project.

There are various advantages of the Collective approach, but the key ones are:

- Community based governance of common resources to align actions, so that all can benefit from rivers maintaining a good state.
- Stronger and more effective basis for advocacy to ECAN (whether in terms of plan implementation, or the plan review.)

Practice to reduce phosphorus losses

Rich McDowell made an initial presentation on practices to reduce phosphorous (P) and nitrogen (N) loss from farm systems. (See www.landcare.org/.....)

To manage P losses we must understand hydrology, soil types and management practices.

Critical source areas

A huge part of good management of P and sediment comes down to successfully dealing with critical source areas, or places on the farm where P is more likely to accumulate and then be mobilised by water. The basis of most of the practices described during the day comes down to manipulating source and movement potential of P.

Optimum Olsen P

Olsen-P is a measure of how much P is available to plants in soil solution, and also of how much P is likely to be lost to water (as a soluble form). For both economic and environmental reasons, Olsen P should be maintained at an economic optimum (no more), particularly on sheep and beef farms where it is harder to extract a financial return for the fertiliser applied.

Slope

There is a doubling of erosion potential, and therefore potential P loss, with each step from flat – rolling – steep.

Fertiliser type

Lower solubility fertilisers such as reactive phosphate rock release soluble P gradually over time, rather than all at once as occurs with high solubility P fertilisers such as super phosphate. This means that there is a significantly reduced impact if there is a rainfall event following application of RPR compared to high solubility fertiliser.

Overseer

At the Hermitage day there was some discussion of Overseer and its ability to predict P-loss to water. The limitations of Overseer are that it does not account for spatial factors (i.e. critical source areas) which are important for P, and that it does not model many of the practices we know to be useful in managing P loss. It is essential to combine an Overseer output with another tool such as a Farm Environment Plan.

Upgrades of the Overseer should not result in triggering the 10% rule or having to make an application for resource consent because we have to use the same version to compare past and future, and because the margins of error in Overseer are such that such a fine comparison will not be meaningful.

It should only be *bona fide* land use changes that are of interest to ECAN (and this will only be strictly limited in the Hurunui upstream of SH1).

It was noted that the accuracy of Overseer will keep improving (as should the manner in which regional plans apply it).

Hermitage

Site 1 – Silage pit.

Site 2 – Lucerne on rolling clay downs.

Site 3 – Greenfeed under irrigation. Note rock drains.

Teece

Site 1 – Steep slope de-vegetated by a fire, now an area of high erosion risk that needs to be managed.

Site 2 – Greenfeed on rolling hill. Note proximity to vineyard limits spraying.

Site 3 – Flat area with high water table and tile drains. Some of these soils have suffered from severe compaction and have low productivity. It is essential that the drainage network is maintained (weeds sprayed or cleaned out) to be able to continue to use these areas.

Site 4 – Centre Pivot on an area with a mixture of soil types nearer the river.

Practices

Erosion

Typically Canterbury hill country farms require a much greater focus on erosion control, particularly with pallic soils which are very vulnerable to problems with erosion. Good practice in dealing with erosion prone areas is to establish and maintain a healthy pasture sward or plant poplar poles at appropriate location or density (care with timing prevent a wasted effort from lack of moisture).

Managing very dry soil

With large areas of bare ground, hydro-phobosity (water repellence) can be a problem with certain hill country (esp. pallic) soils following hot dry conditions. Water will run straight off following rainfall, taking any fertiliser, dung etc deposited during the dry period with it. Good practice is to avoid application of fertiliser in late spring/summer on slopes prone to drying out. Targeted applications of Calcium (gypsum or lime) may also help.

Winter Feed

40% of N and P and sediment comes off the 10-15% of the farm where forage cropping is undertaken. Managing the effects of wintering blocks comes down to suitable location (areas where connectivity to surface water is less) and grazing management. Good practices include:

- Grazing downslope (i.e. towards low point) – effectiveness varies depending on conditions with 0%, 5%, and 50% reductions in measured loss on the same paddock over three years.
- Standoff pad (if available) - 30-40% reduction in P loss.
- Aluminium sulphate at 30 kg/ha – binds P to soil 30-40% reduced P loss. At this time aluminium sulphate is not available as a fertiliser product.
- Back fencing vs free access has shown inconclusive results – anecdotally there is a huge benefit from reduced tracking, walking up and down, etc, but it has also been observed that ‘it can bugger a small area worse’.

Land drainage

Drains are generally an environmentally positive practice because they improve management of soil conditions, reduce soil compaction erosion, all of which will reduce movement of sediment and phosphorous.

There is a lot that can be achieved through manipulation or design of subsurface drains. Back fill with 20cm layer of gravel rather than putting the pipe in the bottom of the trench to create a sediment trap.

There is an example of a farmer who used smelter slag to fill an artificial drain trench and 90% of P knocked out for 17 years, unfortunately there is no known low-cost and safe source of P-absorbent drain filling material in Canterbury.

Strategic use of conventional tillage

Significant reductions in P-loss have been measured following ploughing (and re-grassing) of critical source areas.

In other areas (i.e. uphill of the area with no clover) we can plant a pure clover sward and the clover not in competition with ryegrass is able to express itself. This type of system change has resulted in 10 to 15% increases in production and a 40% reduction in P losses.

This works because it drops the Olsen P (plant available or soluble P), which is fine if not trying to maintain clover in the sward. Ryegrass really only needs an OP of 12 to 15 – it is the Legumes that need P to make pastures economic.

This practice needs to be in the right location to be effective (i.e. not erosion prone) as increased loss of soil from conventional till will reduce beneficial effect.

Some cultivars of Lucerne can be productive at a low Olsen-P, which is worth thinking about if establishing Lucerne on rolling clay downs like those at Site 2 on the Hermitage day.

Managing soil compaction

Compaction is a huge issue with 10% reductions in losses for every 1% reduction in soil pores due to reduced root penetration.

The solution is to aerate compacted soils. Perhaps a crop of fodder beet (cut and carry?) then a return to pasture.

Irrigation efficiency

The goal of efficient irrigation is to achieve full watering, while minimising excess application (and in turn excess drainage). The economic and environmental benefits include:

- Reduced leaching or runoff of phosphorous and nitrogen. This is important because excess drainage is a significant driver of loss of P and N runoff or leaching;
- Maximum irrigated area for a given water take and pumping cost.

Subsurface loss or P leaching to groundwater

Recent research shows significant connections between practices on land and loss of P to groundwater (Winter forage crops in Southland with P loss rates of 4, 8, and 65 kg/ha/yr from paddock to groundwater).

Factors that lead to P leaching include:

- Low anion storage capacity (ability of the soil to bind P);
- Low plant available water (i.e. stony);
- High rates of phosphorous deposition (fertiliser or dung);
- Rainfall and/or irrigation to create a lot of drainage (high rates of transport by water);
- Sand or gravel aquifer.

Silage pits (Hermitage site 1)

The key thing to know with silage pits is that leachate has a very high oxygen depleting effect which is very damaging to aquatic life. It can also negatively affect water supplies. Silage pits should be 50 metres from any waterway (including temporary) with no silage leachate to run into any waterway. In terms of best practice, avoid areas where storm-water will run into the storage area and be very careful of areas near bores.

Appendix - Note on Cleaning Drains and Natural Watercourses

The following is a follow up on a discussion of 'drain cleaning' that took place at Teece Family Farm Site. This is a summary, not a complete interpretation.

If in doubt as to what is required, please contact Mike Bennett at ECAN (0275057535) or ECAN customer services. We can give advice or do a visit before work commences.

A guidance document will be prepared and circulated to the project mailing list ASAP.

Adverse effects – Why are we doing this?

The key issue with earthworks and vegetation removal in or near drains or waterways is the release of fine sediment and phosphorous. Fine sediment can degrade the ecological health of waterways with a gravel bottom, or lakes in the catchment, that is often very expensive to rectify. Phosphorous supports the growth of algae, slime and weeds.

Good practice

Good practice is to minimise the discharge of sediment to water associated with any activity in or near a water body, a riparian area, or drain.

Ways to do this include:

- Doing works in a way that minimises erosion or slumping;
- Managing critical source areas, for example by leaving these areas in grass when a forage crop is planted;
- Doing works when the waterway or drain does not have water flowing in it (Wait for the right time of year or temporarily dam or divert water).

Drain cleaning

Drain cleaning is permitted as long as associated discharges of sediment do not persist for more than 10 hours in any 24 hour period or 40 hours in a month (Rule 5.141)

The key thing to be aware of is that many drains are in fact natural watercourses whose bed has been modified, which means Rule 5.141 does not apply. For example some of the 'drains' at the Teece Family Farm are, from looking at aerial maps, modified water courses. If in doubt please ask.

Some drains can have high habitat value even if not legally defined as a watercourse. While not required, it is quite positive and worthwhile in environmental terms to look after drains with these features, and attempt to act in a way that minimises adverse effects on habitat values. Think about drains with:

- High populations of eels, freshwater crayfish, trout, watercress, etc;
- Watercress utilised by local Iwi as a food source;
- Water which is spring fed, very clean, and permanently flowing.

Spraying in a natural watercourse

Spraying is permitted in most natural watercourses (some restrictions near surface water takes) (Rule 5.22)

Vegetation removal in a natural watercourse

Vegetation removal is permitted in natural watercourses. There are some conditions around this relating to disturbing flood protection schemes, 'high naturalness' water bodies and so on, but for most situations vegetation removal will be permitted as long as earthworks rules are complied with. Do not deposit woody debris in the bed. (Rule 5.163).

Earthworks in a natural watercourse

Most earthworks in a natural watercourse require a consent. The exceptions are:

- The bed is dry at the time works take place and it returns to its 'original contour' within 30 days (Rule 5.136).
- The work is outside the bed of the watercourse (i.e. it is in the riparian margin). For the purpose of a river (including creeks), the definition of the bed is *the space of land which the waters of the river cover at its fullest flow without overtopping its banks.* In other words land that is under water when the river is really full (but not so full that banks are overtopped).
- Cultivation, digging postholes, and ripping in pipes or cables.

Vegetation clearance or earthworks riparian margin

Vegetation clearance and earthworks within riparian margin (5 metres of the top of the bank in lowland areas) are limited to 500^2 or 10% of the area being worked in unless the work is in accordance with a farm environment plan (Rules 5.167 and 5.168).

Activities that require consents

Some activities require a consent:

- Draining new areas (i.e. installing drains beyond the spatial extent of an existing drainage network);
- Reducing the area of a wetland.

If you are thinking of making an application for resource consent consider the following:

- One hour of pre-application advice is available for free from the consents staff;
- There may be other consents you can apply for at the same time – saving money by combining applications;
- You may want to employ a consultant. It is a good idea to ask others about how things went through the consents process with a consultant they used.