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LEARNINGS FROM TEN YEARS OF HILL COUNTRY FARM PLAN MAPPING

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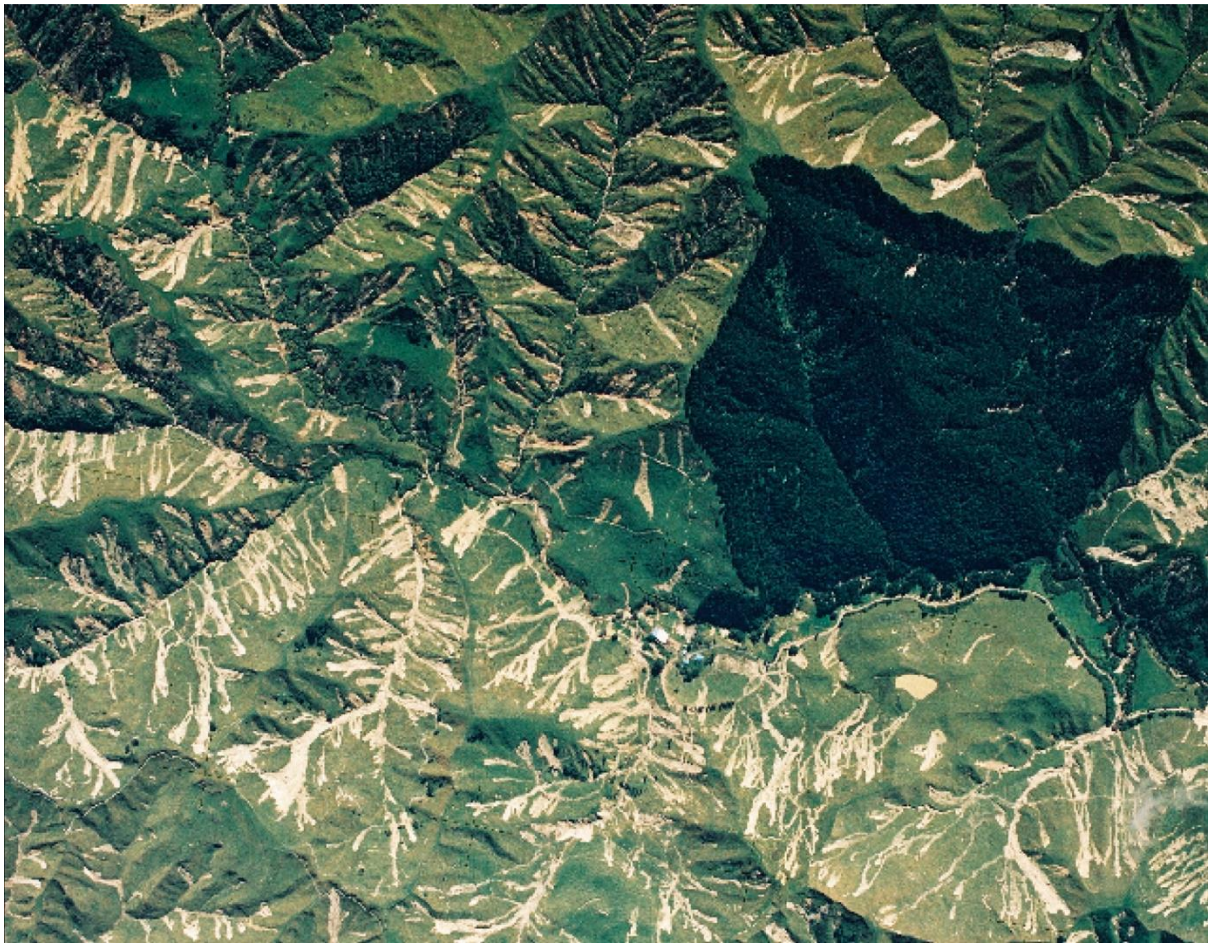
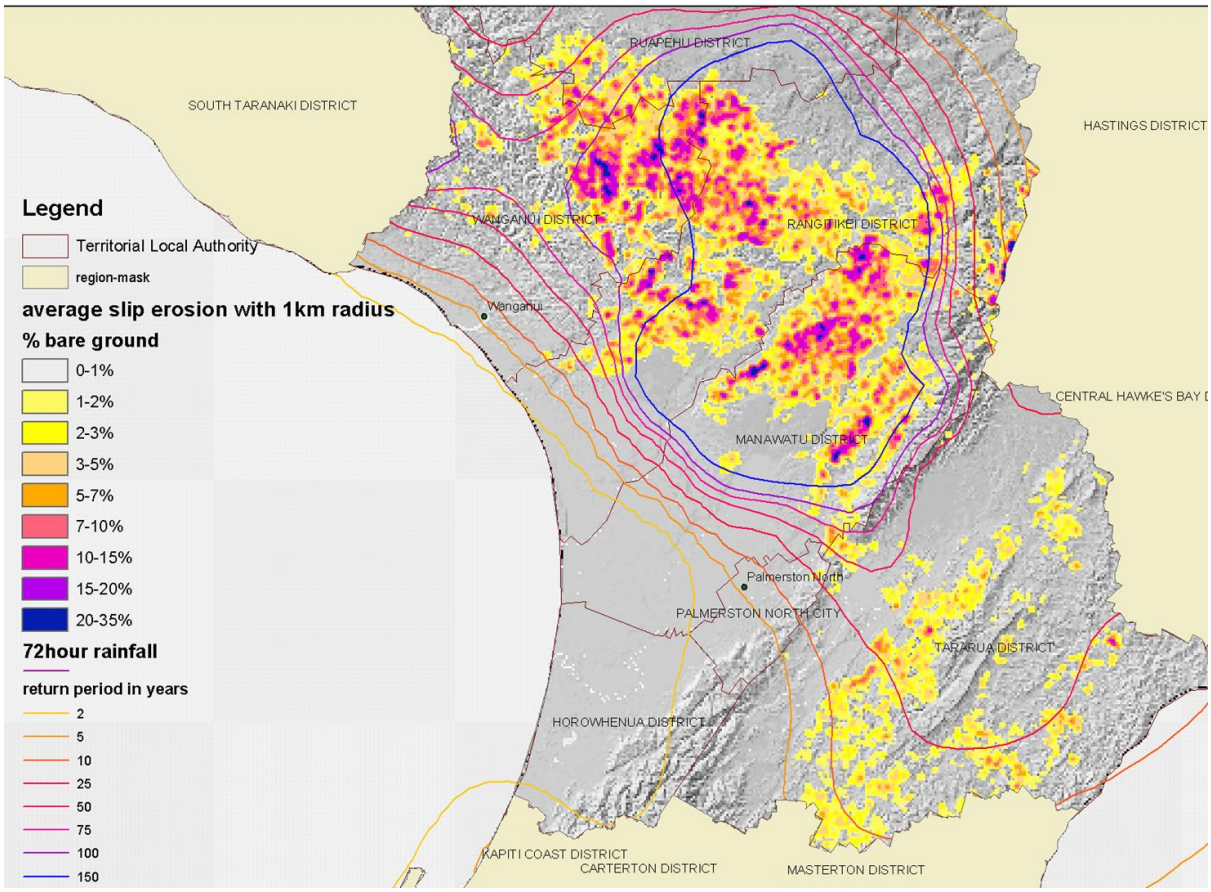
Introduction

In 2004 the Valentines Day storm hit the lower North Island causing massive erosion and flooding.



Severe slip erosion from the 2004 storm, inland of Whanganui. The effect of pine forest in reducing erosion compared with neighbouring hillsides with the same aspect and slope is obvious.



Extent of slip erosion in the Manawatu-Whanganui Region from Dymond et al; Landcare Research. The 72 hour rainfall return period lines are from NIWA. Areas coloured purple had the same severity of erosion as in the previous aerial photo.

Downstream damage caused by the storm included breached stopbanks, broken bridges and hundreds of flooded houses.

Horizons Regional Council, backed by research and local support, eventually secured ratepayer and government funding to provide hill country farm plans and tree planting assistance to farmers. The Sustainable Land Use Initiative – SLUI for short - is now in its eleventh year. Objectives of the programme are to:

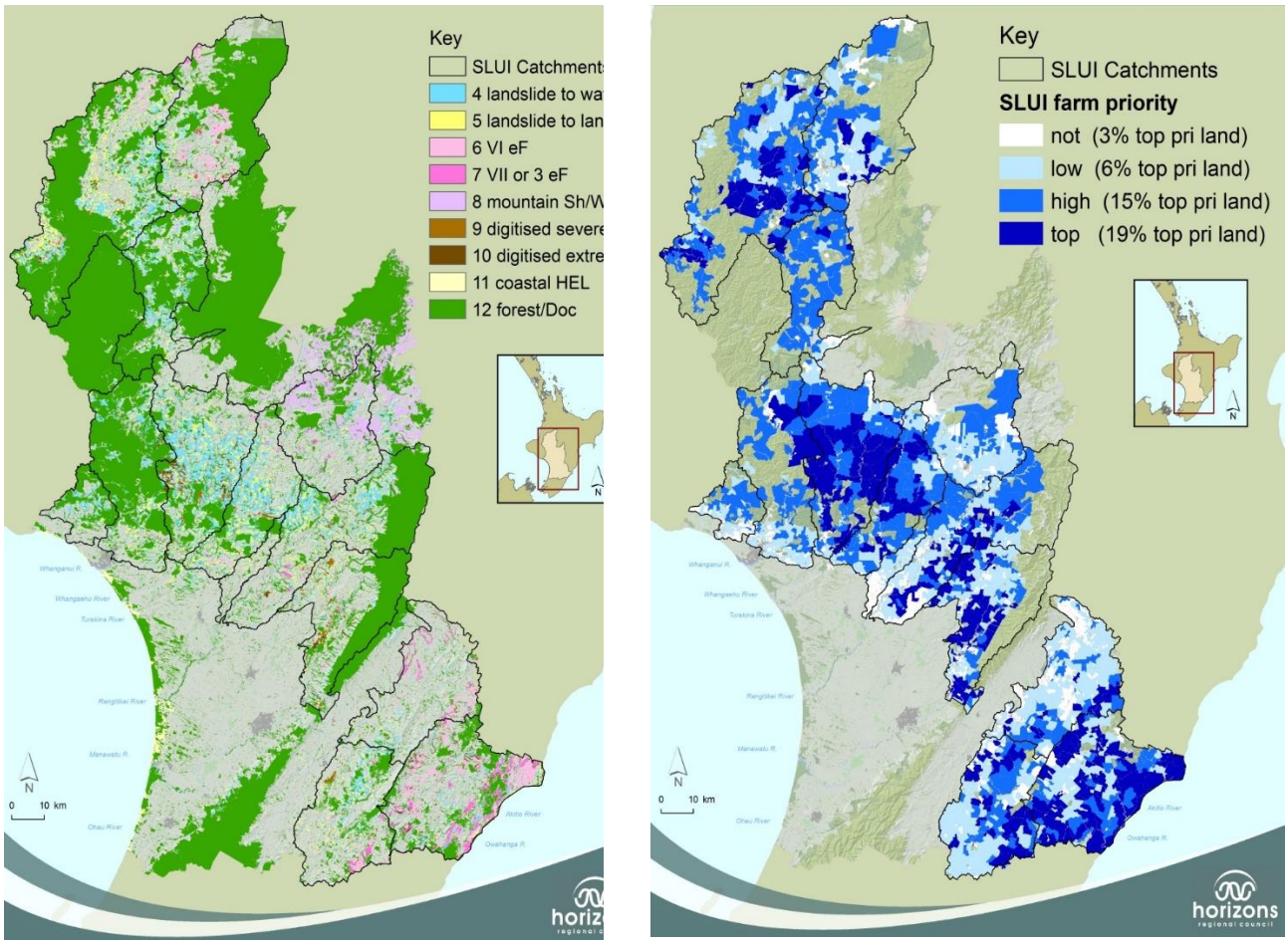
- Reduce erosion rates to close to natural levels
- Build resilience in the rural sector and regional economy
- Protect lowland communities from upstream hill country erosion
- Improve water quality in the regions rivers

The main tools used in SLUI are comprehensive whole farm plans and cost sharing for erosion control works. Farm plans inform decisions on what to do on-farm to address erosion and other environmental issues. Funding enables these decisions to be carried out at sufficient pace to make a difference.

SLUI farm plans

SLUI farm plans are underpinned by farm-scale land use capability and land resource inventory mapping, including soil, rock type, slope, erosion severity and type, erosion potential and vegetation cover and type information. These are set out in maps and tables describing the distinguishing features, strengths and weaknesses of each land use capability or soil unit. This provides evidence for accurate pasture production and yield gap maps, nutrient budgeting, a full farm business analysis and recommended works maps.

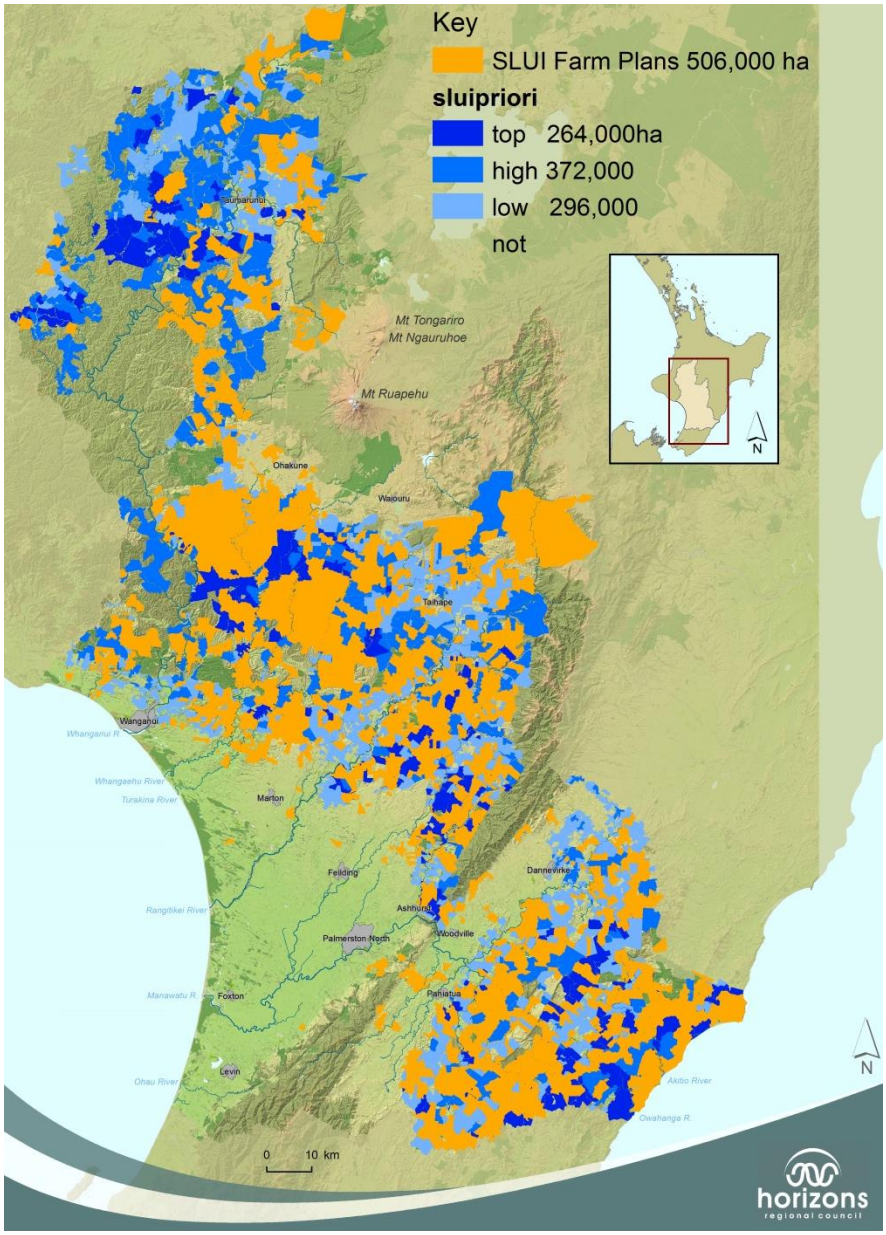
In ten years over 650 farm plans have been prepared, covering half a million hectares of land and 32,000 ha of tree planting and retirement has been done in partnership with landowners. This would not have been achieved without strong reliance on building a strong helping relationship between the council Land Management Advisors and farm managers.



The Highly Erodible Land Layer (left) was created by Landcare Research (Dymond et al 2006) for Horizons. It shows land that is steeper than a threshold slope angle for landslides. This informed a farm prioritisation layer (right). Farms with greater than a certain area of highly erodible land or of digitised severe erosion were assigned a priority of high or top, respectively.

The farm prioritisation was subsequently found to have accurately ranked the amounts of top priority land mapped at farm scale within the farm plans in that Not and Low priority farms

contained only 3% and 6% top priority land once mapped, whereas High and Top priority farms contained 15% and 19% top priority land.



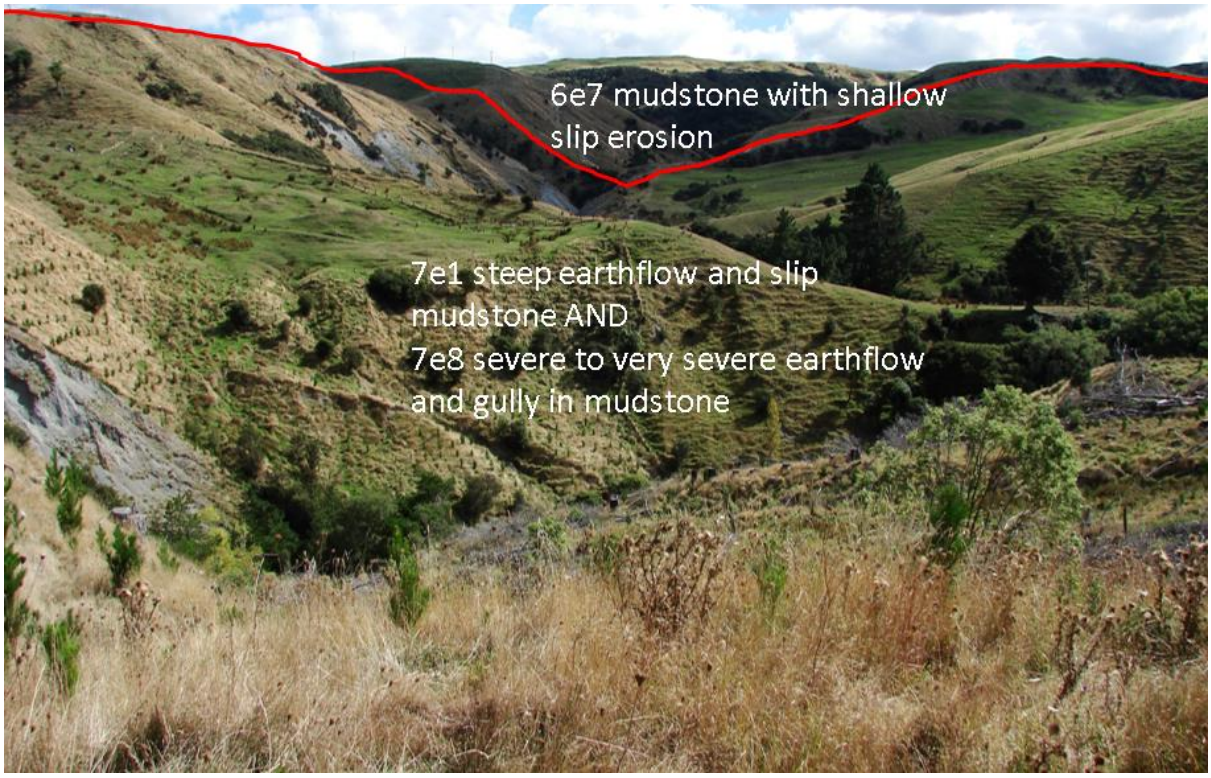
The farm prioritisation layer enables the area of farm plans mapped to be reported in context to the original SLUI farm plan objective. This was to have farm plans covering 50% of the highly erodible land.

The need for farm scale Land Use Capability mapping

Ten years of working with farmers to do works on SLUI farm plans confirms that a farm plan based around accurate resource maps provides the best basis for communicating, discussing and recommending actions on farm to address the erosion issue and other on-farm environmental issues. A key point is that the accuracy of environmental recommendations and the measurement of progress is only as good as the accuracy of the soil or land use capability mapping that underpins it.

Farm scale Land Use Capability mapping can be used to answer the following questions:

- Are recommendations in a farm plan appropriate and consistent with those on other farms with similar landforms and issues?
- Are modelled sediment or nutrient reductions accurate?



This picture shows **regional scale** New Zealand Land Resource Inventory (NZLRI) Land Use Capability Units for a severely eroding farm.

6e7 mudstone is moderately steep mudstone land recommended for spaced planted poplars and willows. There is, however, some steep land (i.e. not 6e7 and not suitable for pole planting) visible within the mapped unit. The land mapped at regional scale as 7e1 and 7e8 at the front of the farm contains some 6e10 (6e mudstone with deep seated earthflow erosion that is suitable for pole planting and drainage), some 6e1 (loess covered mudstone that is not eroding at all), plus the regional scale mapping has not differentiated the top priority very severely eroding 7e8 from the high priority severely eroding 7e1. Land use recommendations based on this mapping will therefore be a bit inappropriate.

This has important implications for modelling of the effect of any land use actions on sediment reductions. According to Dymond et al 2014:

- 7e8 has a sediment discharge in the order of 20,000 Tonnes/km^2/year
- 7e1 has a sediment discharge in the order of 4,000 Tonnes/km^2/year

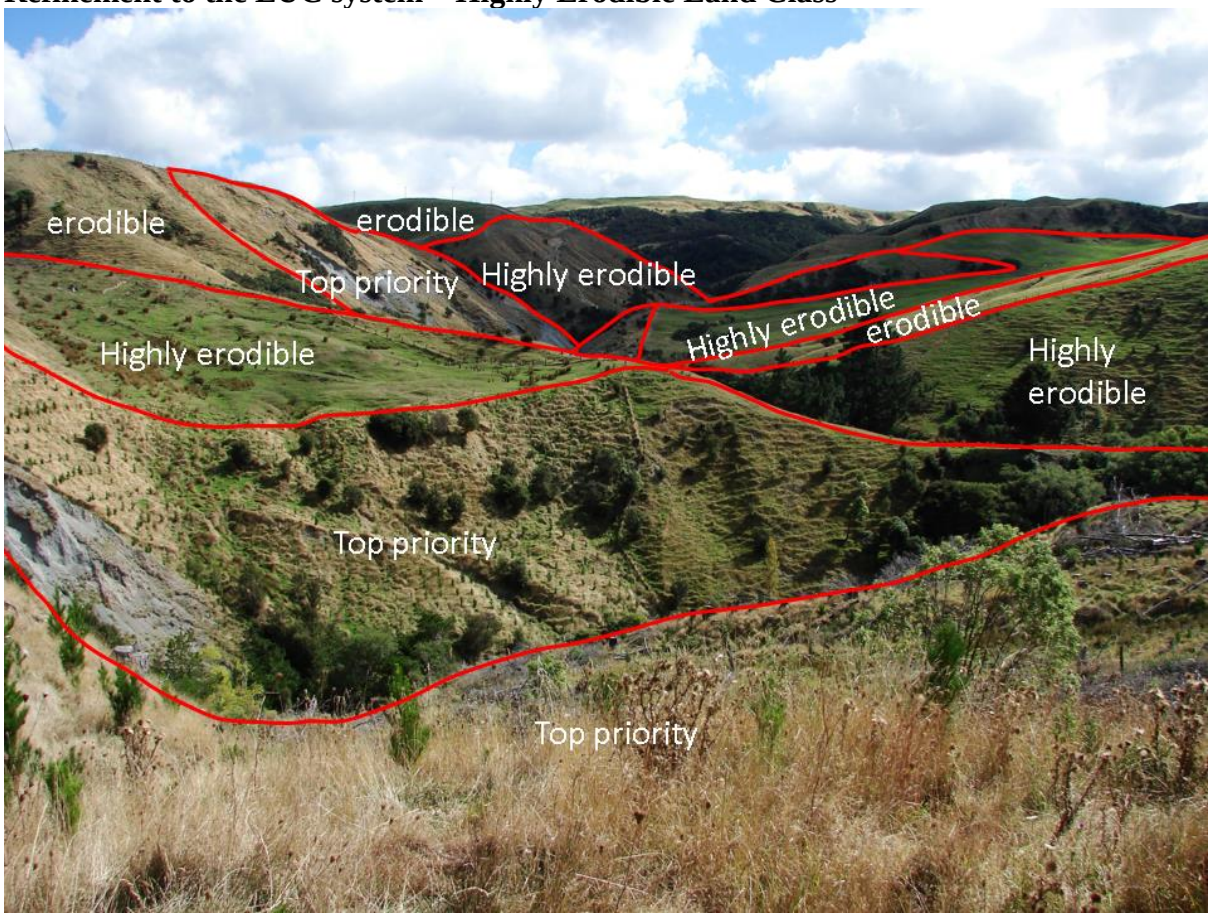
- 6e10 has a sediment discharge in the order of 6,500 Tonnes/km^2/year
- 6e7 has a sediment discharge in the order of 750 Tonnes/km^2/year
- 6e1 has a sediment discharge in the order of 63 Tonnes/km^2/year

This picture shows **farm scale** Land Use Capability units mapped in the SLUI farm plan. It confirms that farm scale mapping is essential in order to get recommended land actions that are consistent with the mapped LUC and will produce results that make sense on the ground.

There are, however, still some areas where the farm scale LUC can be improved for use in recommending environmental actions on-farm. LUC was conceived in relation to issues of erosion of the land and soil resources rather than for effects of land management on water quality; so the inventory does not include factors relating to connectivity of the land with waterways. LUC unit therefore does not always predict the right areas for sediment delivery or stream retirement at farm scale.

For example; the Southern Hawkes bay-Wairarapa 6e10 unit is mapped where there is historic deep-seated earthflow erosion that is slight to moderate, and with potential to be severe. Unfortunately, 6e10 units with moderate severity deep seated earthflow erosion can have very significant sediment delivery while other 6e10 units that are not currently active may be some of the most stable and productive parts of a farm. As a result, the 6e10 unit therefore can have a wide range of land management recommendations, ranging from 'do nothing' to intensive planting and drainage.

Refinement to the LUC system – Highly Erodible Land Class



The Highly Erodible Land (HEL) Class was invented to create a simpler and more accurate classification of priority for action within farm plans than the LUC unit. LUC polygons may be classed as;

- Top Priority land if they have
    - existing or recent severe erosion,
    - moderate or greater erosion severity entering a waterway, or
    - potential for very severe erosion.

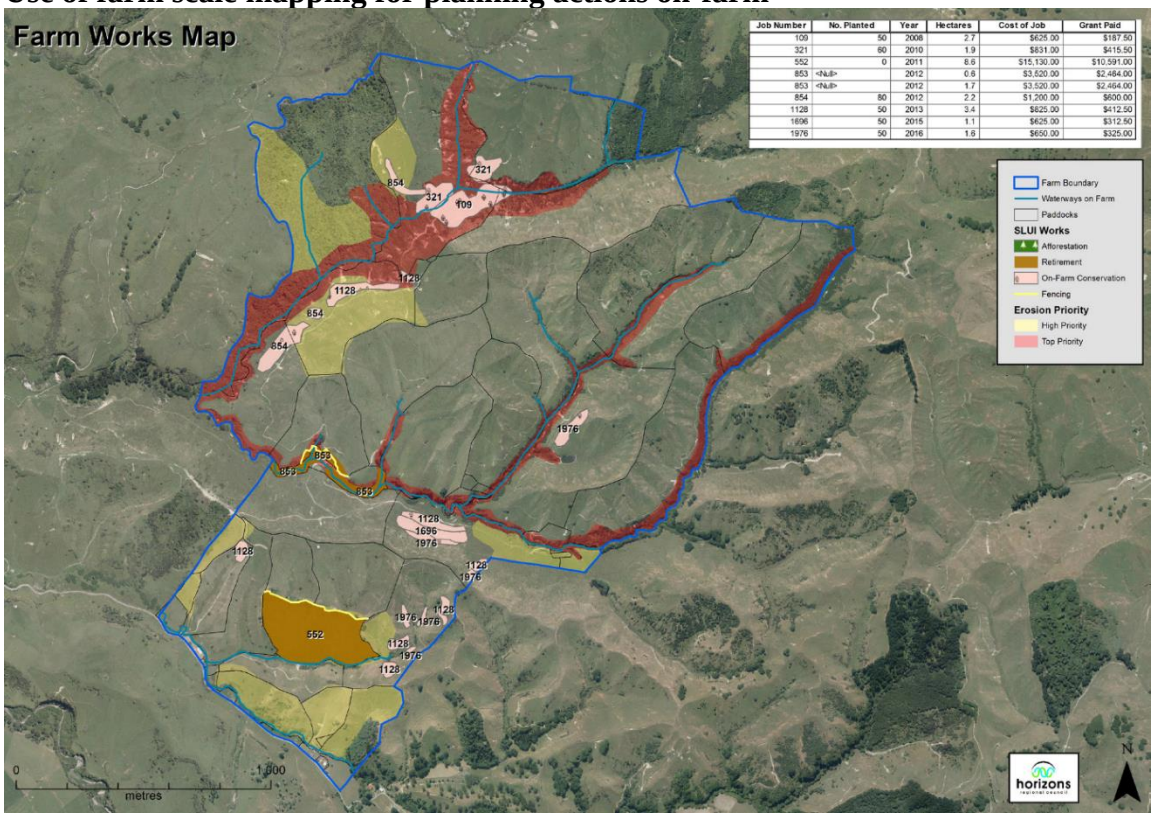
These are the top priority units for erosion control on the farm and in the region. The bulk of them are severely eroding or riparian 7e units but class 8e and 6e are also included.

- Highly Erodible land includes
    - other 7e land with potential for severe erosion but less access to waterways,
    - land with borderline slight/moderate erosion severity entering a waterway, and
    - some 6e units that are highly connected to waterways.

This land would be eligible for assistance with afforestation or retirement, but is not a top priority sediment source.

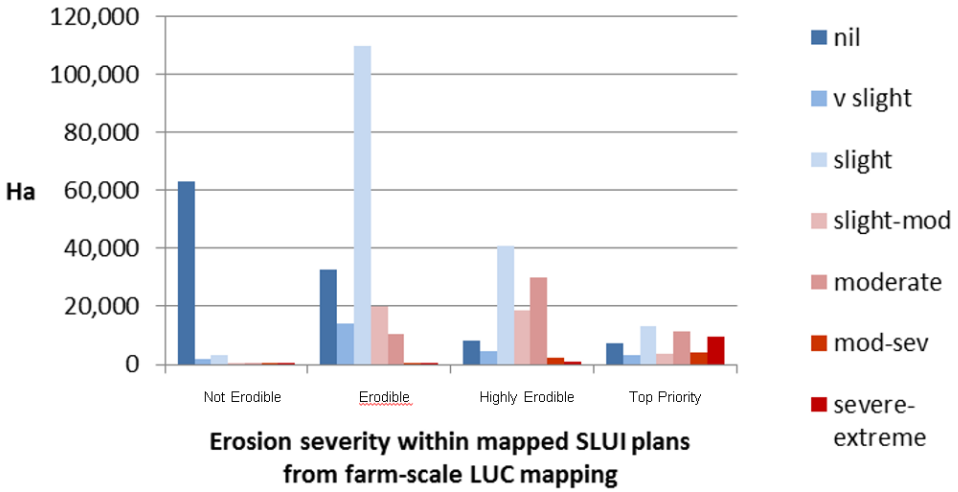
- Erodible land is other 6e land without a strong connection to a waterway. It can have slight or very slight erosion to water. It includes ephemeral waterways within Classes 1 to 5e.
- Not Priority land has no erosion to waterways. It may include some LUC units with potential for cropping erosion or very slight slip erosion that does not reach waterways.

Use of farm scale mapping for planning actions on-farm



This shows how we have been using the farm scale LUC mapping to support conversations between farmers and Environmental Management Advisors as part of the our SLUI farm plan five year review process. Works done to date are shown in relation to top priority sediment sources and highly erodible land. This provides sound context for realistic planning of future work on the farm.

Use of Highly Erodible Land Class from farm-scale mapping to predict erosion severity

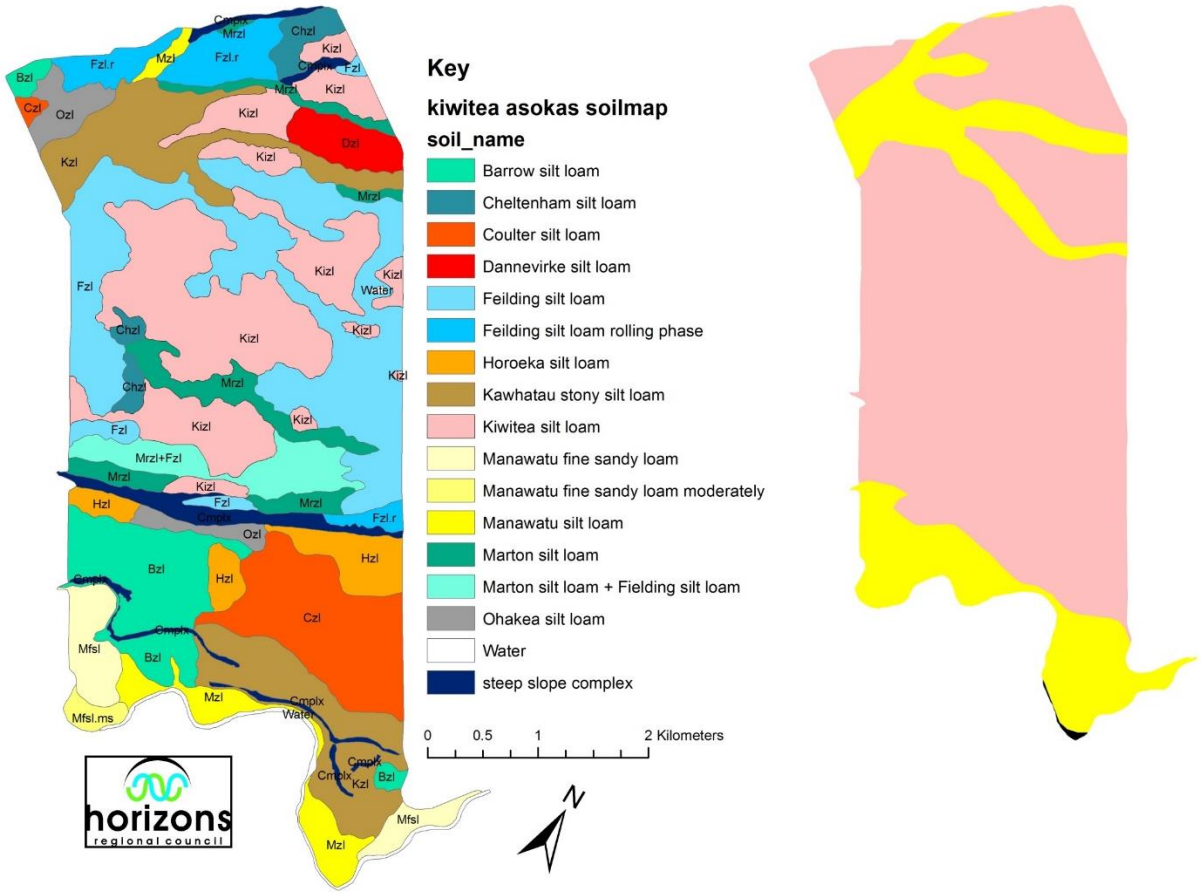


Erosion severity within mapped SLUI plans from farm-scale LUC mapping

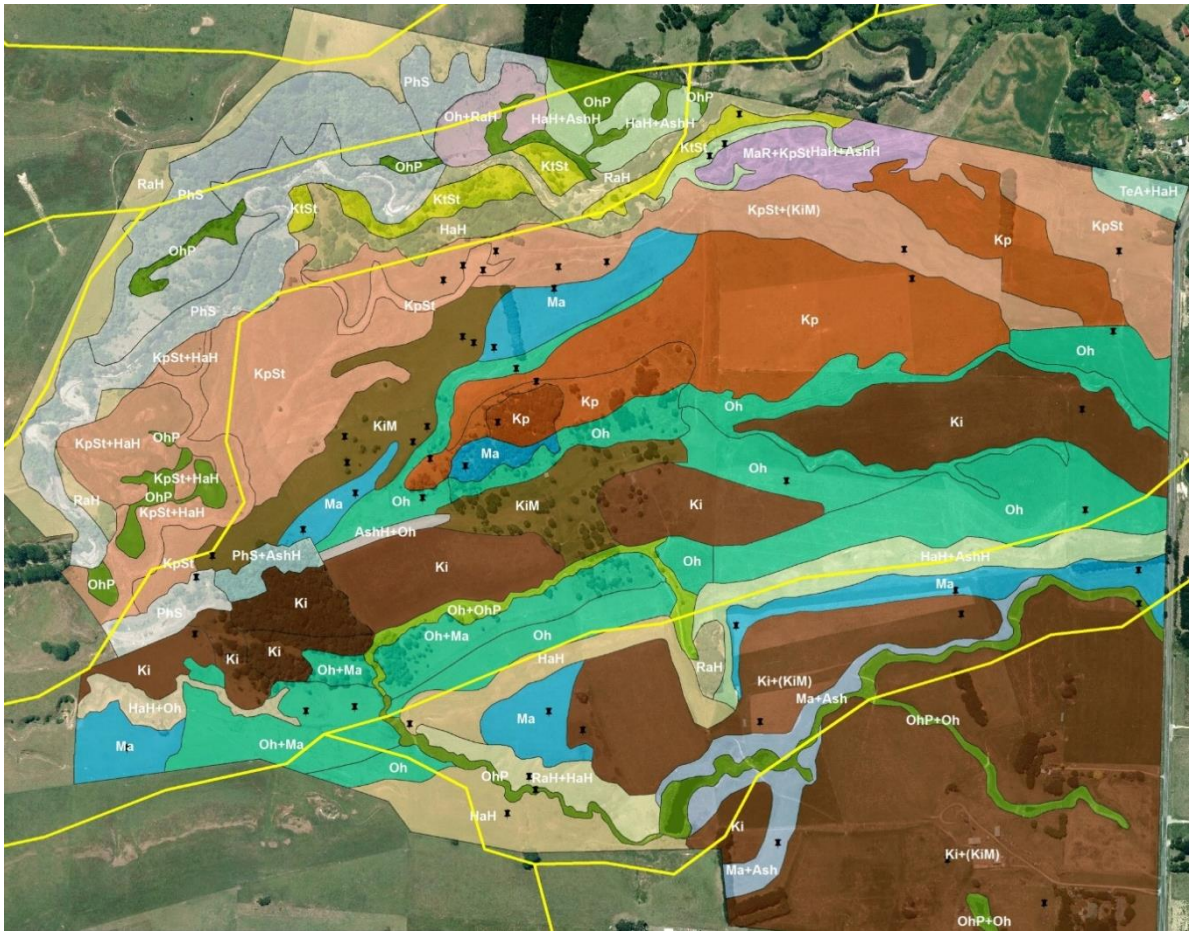
This shows a strong relationship between Highly Erodible Land Class and erosion severity. Top priority land has a wide range of erosion severities present, depending on whether the land is currently planted in trees, Highly Erodible land has mainly slight to moderate erosion,

Erodible land has mostly slight erosion and Not erodible land has virtually no erosion. This is a better relationship than with LUC unit.

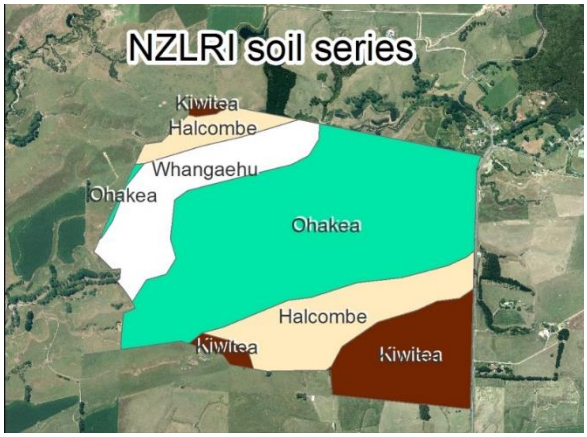
Examples of inaccuracy using regional-scale mapping

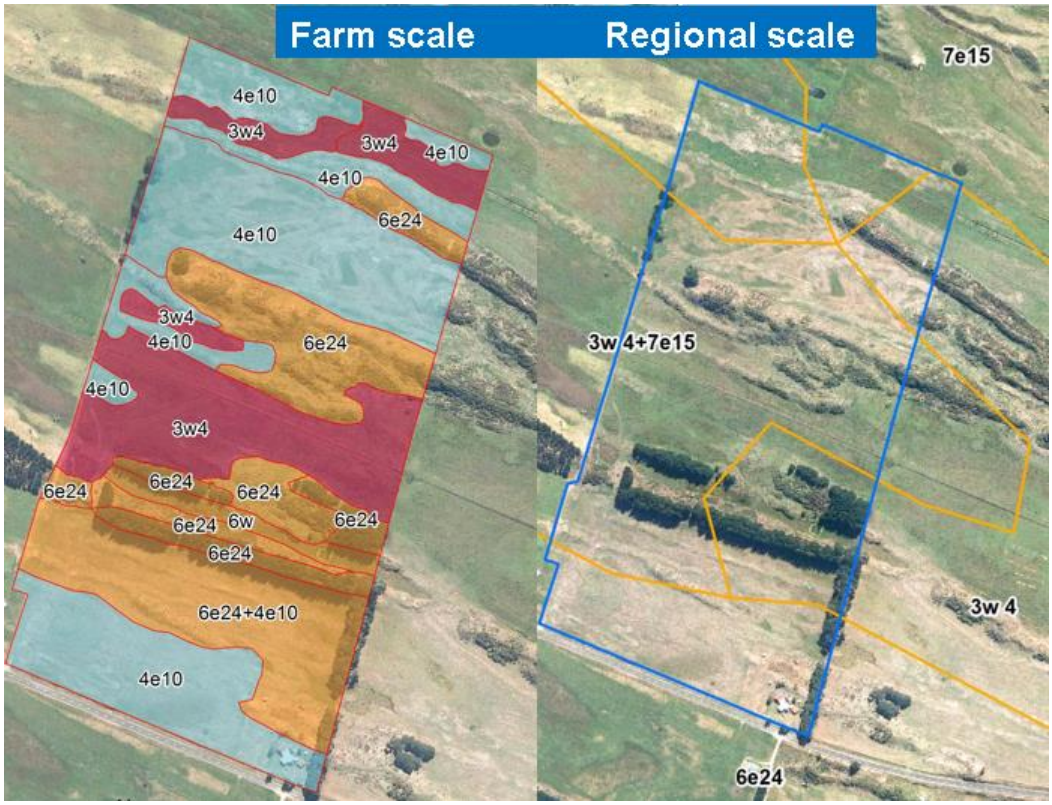


1. This shows a 1:20,000 scale soil map at Kiwitea, Feilding on the left and information from the New Zealand Land Resource Inventory for the same area on the right. Only 25% of the soil series mapped at regional scale were confirmed at farm scale. This had significant effects on the drainage class and P retention of the soils mapped, both pivotal attributes affecting nutrient management.



2. This shows farm scale mapping versus the NZLRI near Waituna West. NZLRI boundaries are shown in yellow. A very large area in the centre of the map was mapped as poorly drained, impermeable Ohakea soil at regional scale. This soil is not prone to nitrate leaching, but is prone to overland flow. At farm scale most of this area was found to be either well drained medium permeability Kopua and Kiwitea soil or well drained very permeable Kopua stony soil.





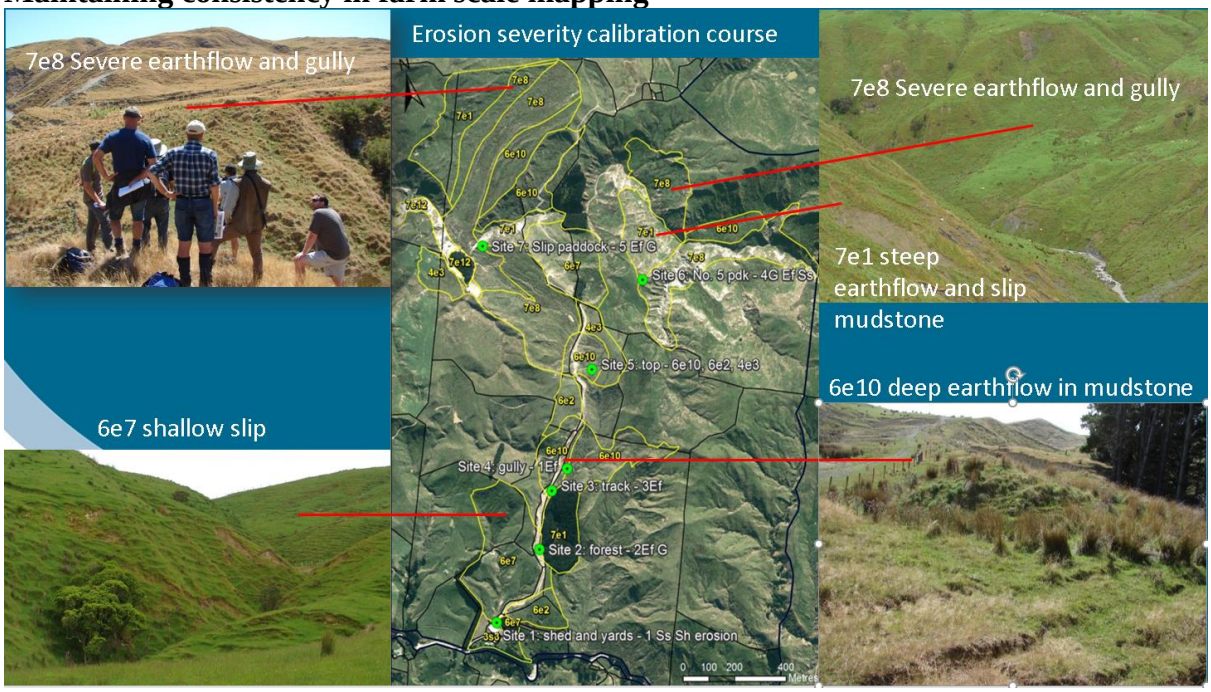
3. This is an example from sand dune country near Foxton, showing regional mapping having very little relevance at farm scale.

These are all typical examples for farm plans mapped in our region.

The basics: remembering to view old aerial imagery

The same piece of land on current (left) and historic imagery. The scale of historic (and therefore potential) erosion is not necessarily obvious from visual inspection or from existing aerial photography and old photography needs to be checked before making land use recommendations.

Maintaining consistency in farm scale mapping



Once you have several mappers operating in an area, or changes in mapping staff over time, it is necessary to moderate and check their outputs to ensure consistency. Otherwise different mappers may invent new units or apply units and inventory factors inconsistently with each other. This could potentially have serious effects on the land recommendations and potential to undermine confidence in the integrity of the dataset. Horizons is documenting example sites for LUC erosion severities and LUC units and putting mapping contractors and staff through a calibration course in order to address this issue.

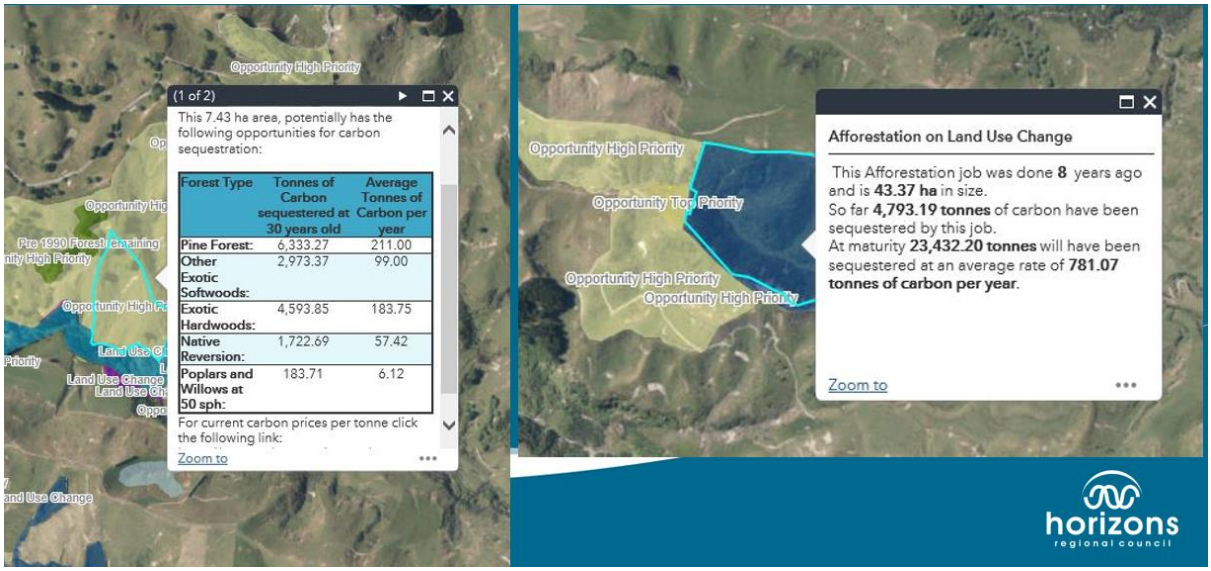
Impact of farm plans on farmers' business:
Whole Farm Plan survey by Willie Smith for AgResearch

Twenty farmers with SLUI farm plans and twenty farmers without were interviewed to ascertain their views on the contribution of farm plans to their environmental, social and economic sustainability of their business.

Key findings were that farmer saw that SLUI farm plans:

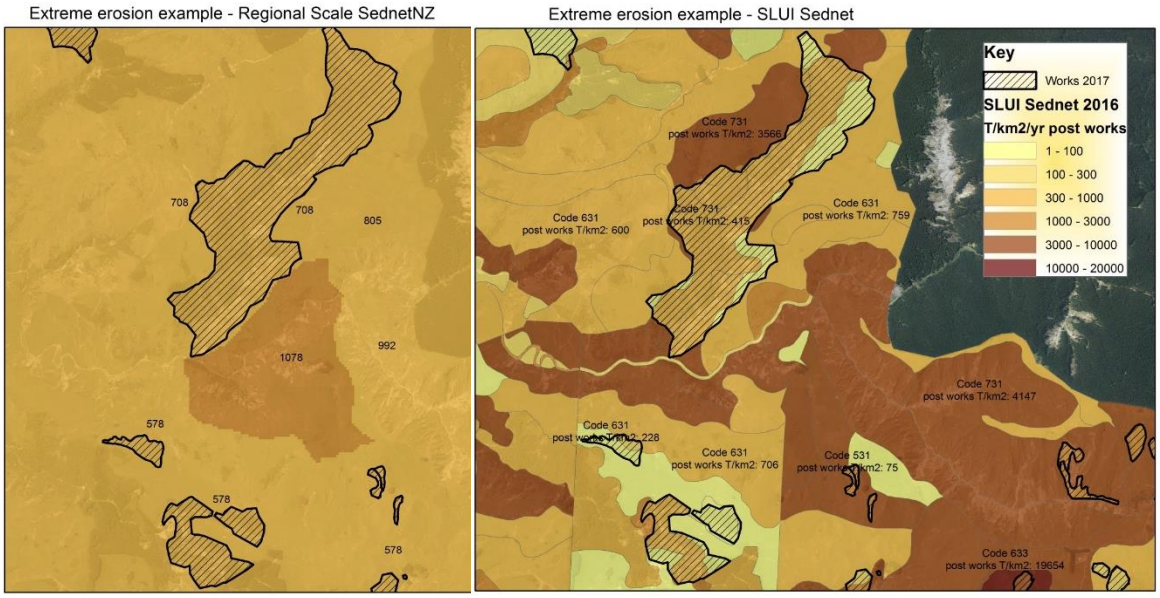
- were a useful vehicle for implementing policy
- provided a framework to improve farm production
- had a positive effect on environmental sustainability for their farm
- farmers felt more resilient to a possible recurrence of a 2004 storm type event on their farm
- farmers saw funding and time as the major limiting factors to getting environmental work done on farm.
- the importance of Council Field officers as knowledge brokers was seen as a vital component to help farmers negotiate the process, understand what was important for them and work towards solutions.

On-line carbon tool



Having accurate farm scale cover and land priority information enabled us to create an on-line tool to show possible sites for carbon accumulation and estimate likely gains from existing trees.

Calculation of sediment reductions



It is obvious from this comparison that regional scale Land Use Capability information is not accurate for calculating sediment reductions from SLUI works or for SLUI farm plans. The LUC units are simply not at farm scale and the resulting sediment outputs of the land are frequently out by a factor of 10 or more. At regional scale the 105 ha of works shown would have a sediment discharge of around 650 tonnes per km2, whereas at farm scale this was 2600.

Conclusion

Farm scale mapping is essential to derive accurate and consistent land recommendations and to provide accurate information about the impacts of actions. Once mapped, it can be used for a variety of on-farm and regional purposes in addition to conservation ones.

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