Ruamāhanga Whaitua Committee

Sediment management options for the Ruamāhanga whaitua – for discussion 9 April 2017

What is the problem?

Sediment discharged into rivers and streams can negatively impact a range of values, including ecosystem health and the way people use water for spiritual, cultural and recreational purposes. Sediment affects ecosystem function through:

- reducing the ability of light to penetrate water affecting the ability of plants to grow,
- impacting the health of fish by abrading skin and gills and making predators and prey difficult to see, and
- filling the interstitial spaces in stream beds, making them less suitable for macroinvertebrate communities to survive and thrive.

People wishing to use rivers and lakes are affected impacts on visual clarity and the muddiness of the river and lake beds to walk on.

For Lake Wairarapa, the load of sediment already in the lake from many years of sediment deposition means there is a large load of attached phosphorus available for resuspension and dissolution in the water, significantly impacting ecosystem health.

Sediment and erosion have long been recognised as issues for water quality in the Ruamāhanga whaitua. In particular, hill country farmers in the northern and eastern parts of the valley have worked to reduce sediment loss from steep land, including through the GWRC administered subsidies under the WRECI scheme.

This memo lays out the most recent information on the sources of sediment in the catchment and briefly covers what the Committee's scenarios show by way of change in sediment through different sediment mitigation methods. The memo then outlines the key options for improving sediment management in the Ruamāhanga whaitua and, based on a set of identified principles and drivers, sets out some options for a policy approach to sediment management for discussion at the 9 April 2018 Committee workshop, and ultimately to help inform the Committee's soon to be drafted WIP.

Where is the sediment coming from?

Modelling by Jacobs using SedNetNZ shows that under the current state the total load of sediment lost from land and moving through water in the whaitua is around 1.3 million tonnes per year (Table 1).[1] Of that, most ends up moving through Lake Onoke (the rest going straight from the South Coast streams to the ocean). The SedNetNZ analysis shows which erosion process the sediment is derived from. In the whole whaitua under the current (i.e. baseline) state, around 79% comes from hill slope erosion (i.e. gully, landslide, surficial or earthflow process) and 21% from bank erosion of rivers, streams and lakes. Stream bank erosion on non-native land accounts for about 17% of the total sediment load loss per year in the entire whaitua. A map of the FMU boundaries used in this analysis is shown in Appendix 1.

[1] NB. All sediment loads in this memo are based on the Jacobs SedNetNZ analysis

Table 1 and 2. Baseline (current state) total and percentage sediment loss from erosion processes in the Ruamāhanga whaitua

	Baseline - annual loss (T/yr)		
	Non-native land	Native land	All land
Gully	6610	4123	10733
Landslide	540720	51144	591864
Surficial	112394	321480	433874
Earthflow	14459	84	14543
Netbank	227435	45613	273048
Total hill slope	674183	376831	1051014
Total erosion	901618	422444	1324062

	Baseline - % loss from		
	Non-native land	Native land	All land
Gully	1%	1%	1%
Landslide	60%	12%	45%
Surficial	12%	76%	33%
Earthflow	2%	0%	1%
Netbank	25%	11%	21%
Total hill slope	75%	89%	79%

Around 68% of the total Ruamāhanga whaitua sediment load comes from 'non-native' land, with 32% coming from 'native' land (predominantly those areas in DoC estate in the Tararua and Aorangi forest parks). Five FMUs – the Taueru, Huangarua, Eastern hill streams, Whangaehu and Kopuaranga – contribute over 65% of the total load coming off non-native land. The Taueru and Huangarua alone contribute about 40% of the entire non-native load.

Table 3. Contribution of sediment load from 'top 5' sediment producing FMUs in the Ruamāhanga whaitua

FMU name	% load FMU contributes to entire Ruamāhanga load	% load FMU contributes of Ruamāhanga 'non-native' load
Taueru	17.4	25.5
Huangarua	10.9	16.0
Eastern hill streams	6.4	9.4
Whangaehu	5.4	7.9
Kopuaranga	5.1	7.4
Top 5' together	**45**	**66**

What do we know about the future?

As part of the scenario modelling, a series of sediment mitigations were applied across the whaitua to mitigate the effects of bank and hill slope erosion.

BAU2080 Mitigations

- Stock exclusion from streams
- Riparian planting
- Afforestation (small amount)
- Pole planting (under WRECI programme managed by GWRC)

SILVER2080 Mitigations

- BAU2080 mitigations
- More substantive afforestation
- More substantive pole planting
- Constructed sediment treatment wetlands

The relative contribution to reducing sediment loads under these scenarios is shown in Table 4.

Table 4. Reductions in annual sediment loads by mitigation measure under the BAU2080 and SILVER2080 scenarios

BAU2080	**Reductions in load from baseline (T/yr)**			
	Retirement/ afforestation	**Pole planting**	**Stock exclusion + planting**	**Constructed wetlands**
Per mitigation	407	152663	181948	0
Total	**335019**			
% of total	0.1%	45.6%	54.3%	0.0%
SILVER2080	**Reductions in load from baseline (T/yr)**			
	Retirement/ afforestation	**Pole planting**	**Stock exclusion + planting**	**Constructed wetlands**
Per mitigation	110075	265228	181948	51672
Total	**608924**			
% of total	18.1%	43.6%	29.9%	8.5%

Overall, the scenario modelling shows that some sizeable reductions in sediment loads are possible through mitigation measures (Table 5). While under the current state annual sediment loss from non-native land is twice as from native land, under the SILVER2080 scenario the contributions for both are approximately equal.

Table 5. Total and relative loads from non-native and native land for baseline, BAU2080 and SILVER2080 scenarios

	Baseline	**BAU2080**	**SILVER2080**
Entire Ruamāhanga load (tonnes/year)	1324062	988814	715726
Total 'non-native' load (tonnes/year)	901619	579999	333859
Total 'native' load (tonnes/year)	422443	408815	381867
% 'non-native' load (tonnes/year)	68	59	47
% 'native' load (tonnes/year)	32	41	53

It is also useful to recall the information from the economic modelling of the various mitigation packages. While it is difficult to specifically unpick the role of sediment mitigation practices, the economic analysis showed that annual mitigation costs of pole planting and retirement would be (respectively) approximately 9 and 84 times greater under the SILVER2080 scenario than under the BAU (see Figure 1). Further, this analysis showed that reductions in net agricultural revenue were greatest in the Eastern hill river FMUs (such as the Taueru).

Figure 1. Copy of Table 1. Summary of on-farm economic analysis from the Narrative for Ruamāhanga Whaitua Scenarios – Economic impact on the agricultural sector, presented to Committee 19 November 2017

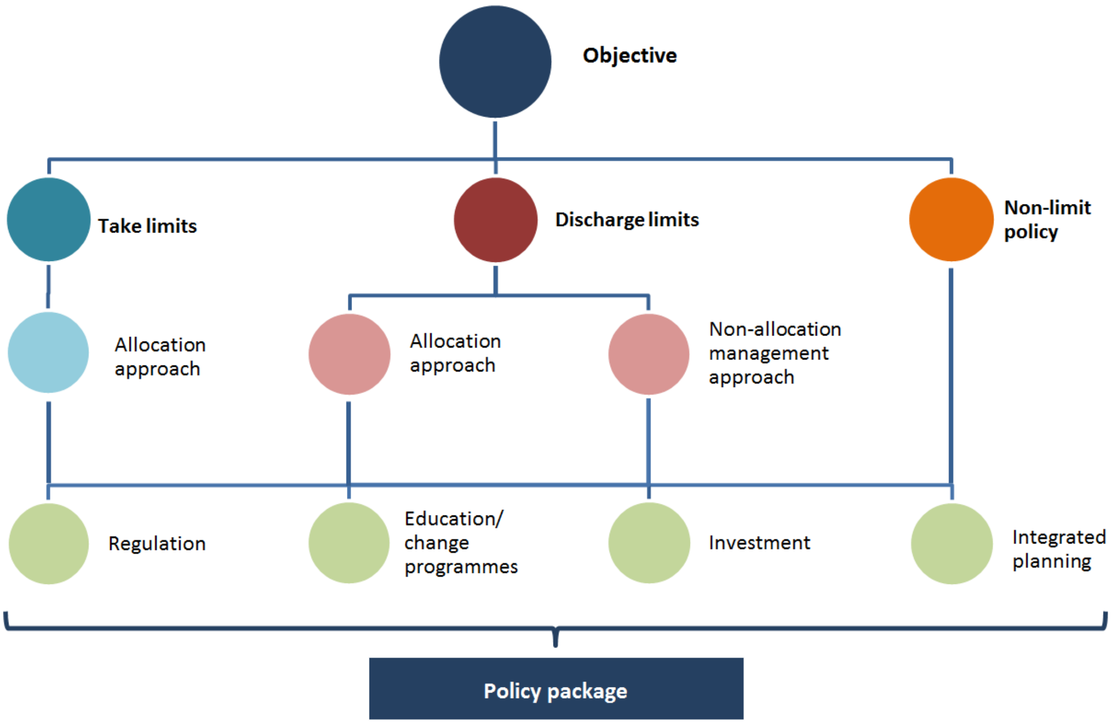
Parameter	Base	BAU	Silver 2025	Silver 2040	Silver 2080	Gold 2025	Gold 2040	Gold 2080
Net agricultural revenue (% change)								
Total agricultural net revenue	$192,504,691	-0.6%	-11%	-21%	-22%	-19%	-24%	-24%
Total dairy net revenue	$59,452,530	-1.3%	-13%	-15%	-16%	-16%	-18%	-18%
Total S&B net revenue	$74,721,075	-0.4%	-16%	-39%	-43%	-34%	-46%	-46%
Total other land use net revenue	$58,330,085	0.0%	-2%	-3%	-3%	-2%	-3%	-3%
Eastern Hill Rivers FMU	$43,489,735	-1.3%	-11%	-29%	-33%	-25%	-35%	-35%
Valley Floor Streams FMU	$44,296,246	-0.7%	-11%	-13%	-13%	-13%	-14%	-14%
Western Hill Rivers FMU	$39,053,737	-0.8%	-12%	-21%	-23%	-20%	-25%	-25%
Mitigation costs ('000 $/yr)								
Total cost		1,516	20,528	39,848	42,971	36,188	46,806	46,806
Cost of mitigation bundles		863	15,732	29,359	32,483	27,231	32,267	32,267
Cost of 10m riparian planting		0	0	0	0	1,546	4,051	4,051
Cost of pole planting		588	1,976	5,054	5,054	1,977	5,054	5,054
Cost of retirement		65	2,820	5,434	5,434	5,434	5,434	5,434
Dairy mitigation costs		799	7,488	9,136	9,382	9,505	10,506	10,506
S&B mitigation costs		715	12,196	29,191	32,065	25,608	34,735	34,735
Other land use mitigation costs		2	844	1,521	1,524	1,075	1,565	1,565
Mitigation costs ($/ha/yr)								
Dairy mitigation costs		27	249	304	312	316	349	349
S&B mitigation costs		4	74	177	194	155	210	210
Other land use mitigation costs		0	5	9	9	7	10	10

At the same time, it is also useful to note that the drivers of sediment are changing and are likely to continue to change into the future. For instance, it is possible that drivers for afforestation will increase as carbon farming, manuka honey production and other farm-forestry diversification increases. Programmes such as the Government's Billion Trees programme may contribute to this. Further, the Committee has also heard extensively about the benefits of riparian planting as a means to achieving freshwater objectives such as improvements in periphyton and macroinvertebrate community health.

What options are there for an objectives and policy approach?

In developing an approach to maintain and improve water quality in the Ruamāhanga whaitua, the main approach has been to use freshwater quality attributes to set objectives for change, understanding what the current state is, how water is valued and cared for, and understanding something of what different mitigation practices might give us by way of impacts on a range of values. The objective is then delivered on by a broader set of policy levers, as described in the policy package diagram in Figure 2.

Figure 2. Policy package diagram



The sediment attributes that could be used to set freshwater objectives for streams and rivers include visual clarity, euphotic depth, turbidity and deposited sediment cover. In the Ruamāhanga our ability to set objectives in rivers and streams is affected by a lack of regular and representative monitoring sites, with sediment data only being collected regularly at three locations across the whaitua. Further, a relationship between sediment amounts in a river needs to be established with the sediment loads being lost from the catchment in order to set objectives using these attributes.[2] A lack of data across the catchment and a lack of data to establish these types of relationships means this is currently difficult for the Ruamāhanga.

Another critical driver for managing sediment in freshwater in the whaitua is the health of Lake Onoke and Lake Wairarapa. For Onoke, sedimentation rates are a key indicator of the ecosystem health of the lake. Currently rates are considered very high, being estimated at around 12.5mm/year on average between 1994 and 2010.[3] Similarly to rivers, GWRC does not currently have suitable data to establish robust relationship between total sediment loads reaching Lake Onoke and sedimentation in the lake.

The lack of suitable data and methods to establish robust objectives for sediment attributes in river and in lakes in the whaitua suggests two things:

[2] For an example of relationships established between sediment loads from land and euphotic depth and visual clarity, see this summary of recent research out of Northland: https://www.landcareresearch.co.nz/publications/newsletters/soil/issue-26,-october-2017/increasing-water-quality-in-rivers-by-soil-conservation-actions-on-land

[3] http://www.gw.govt.nz/assets/Ruamahanga-Whaitua/LakeOnoke-Background-and-Monitoring-Summary.pdf

- that using river or lake objectives to establish catchment load limit is not suitable or even possible at this point in time, and
- there is a need to collect better information on sediment so that objective and limit setting may be undertaken in more specific terms in the future.

Suggested policy approach to managing sediment

An alternative approach to setting objectives based on water quality parameters and setting load limits based on these is to look at the losses of sediment across the catchment and to establish load reductions (or targets) for each FMU based on what is possible and feasible to achieve. It is this approach that the Project Team recommends progressing. The principles behind such an approach are as follows:

- Recognition that focusing on sediment load reductions from land will have a positive effect on river and lake outcomes for a range of attributes and values
- In particular, reducing sediment loads will have significant co-benefits for other objectives the Committee is seeking, most particularly in relation to macroinvertebrate community health and periphyton outcomes
- The SedNetNZ modelling provides a useful illustration of where significant issues and opportunities to prioritise and target sediment mitigation activities
- In particular, the modelling identifies that the previously largely un-tackled issue of stream bank erosion has a significant role in determining sediment loads across the catchment and most particularly for the streams in the Valley Floor
- Connection with the Committee's previously expressed interest in non-regulatory mechanisms for improving water quality and a focus on catchment community's role in water quality improvement in the whaitua
- Working with Land Management staff within GWRC to share information from the modelling and to discuss and identify options for inform and later implement the Committee's WIP recommendations.

This approach would mean that instead of an objective based on a specific water quality outcome that is to be achieved in a water body, the objective would be an expression of how much change in sediment load is being sought and over what time frame.

The policy approach outlined below is also informed by recent research out of Horizons that looks into the effectiveness of sediment mitigation works on erosion prone country under the SLUI programme. This tends to indicate that while erosion mitigation measures such as pole planting may have been broadly taken up under the SLUI programme, only a very weak improvement in water quality has been seen.[4] The suggestion from this research is that sediment mitigation programmes can be effective at improving water quality but need to be much more extensive across the landscape than has previously been seen. This may also suggest that the current scattergun approach to where mitigations occur – i.e. where landowners put their hand up to undertake works

[4] http://www.horizons.govt.nz/HRC/media/Media/Water/Horizons-Ecoli-Sediment-Trends_Final-2018.pdf

– may be made more effective by having a further prioritisation within sub-catchments to identify key source areas and priorities for interventions.

A note on allocation

In February 2017 the Committee discussed the principles behind allocation of contaminants and how that influences the policy levers available for their management. As part of this discussion, it was identified that the conditions for being able to allocate sediment from diffuse sources (such as hill and stream bank erosion) were not met.[5] It is currently neither possible to attribute where sediment has come from definitively, nor possible to accurately measure or the amount of sediment lost from a person's activities. This is the case nationally. As such, the only option available to the Committee to achieve sediment load limits is to take a 'non-allocation' approach.

Recommendations on sediment management approach

Overall policy approach:

- Reduce sediment loss from stream bank erosion across all freshwater management units in the Ruamāhanga whaitua through extensive stock exclusion and riparian planting

- Reduce sediment loads in line with good management practice and what is feasible and practicable in the FMUs producing the greatest sediment load off non-native land, as modelled under the baseline (current state). These 'top 5' FMUs are:
    - Taueru
    - Huangarua
    - Eastern hill streams
    - Whangaehu
    - Kopuaranga

- Set sediment load reduction targets (i.e. a limit to be met in the future) for all freshwater management units based on the reductions from the two policy approaches above

- Across the whaitua, improve management of critical source areas and high-risk land uses in line with good management practice

- Improve information on sediment loss and impacts on river and stream health across the Ruamāhanga whaitua, including by:

    1. Improving information, including via modelling, of sediment loads lost from land use activities, including to identify how loads are changing over time, and

    2. Developing suitable monitoring programmes to establish in-river sediment loads and/or concentrations, including in order to establish relationships to sediment loads off land, and

    3. Recording progress of actions to mitigate sediment loss, including riparian planting and hill slope erosion practices, and

    4. Ensuring this data is publically available and provided in a fit for purpose and transparent manner, and

[5] See Examining options for allocating discharge limits in the Ruamāhanga – starting out (ENPL-6-1225)

5. Establishing sedimentation rates (plus other information on impact of sediment on lake health) for Lake Onoke, including to establish a relationship between catchment loads and lake health

- In the ‘top 5’ FMUs, further sub-FMU scale planning with local communities to establish the locations of highest priority to undertake sediment mitigation works on. Funding and support of sediment mitigation activities by GWRC aligns with these identified priority areas and the suitable mitigation approaches
- GWRC develops and rolls out a clear and accessible freshwater accounting system for measuring progress towards achieve FMU sediment targets, including by progressively improving sediment loss data for critical FMUs
- GWRC expands support of extensive, whaitua-wide riparian planting for management of stream bank erosion and for in-stream benefits (e.g. shade to reduce periphyton), including through:

  1. Priority in Farm Environment Plan design and implementation, and
  2. Increasing funding for riparian planting, as well as improving access to and awareness of these funds, and
  3. Producing plants (e.g. Akura nursery) or assisting communities to produce plants fit for such a programme

Reducing sediment in 'top 5' producing FMUs

The following outlines the key steps to establishing an approach to identifying the target reductions for sediment loads in the five FMUs that currently produce

- Direction: reduce loads to at least that provided under BAU
- Note that the BAU2080 includes both stock exclusion and riparian planting

FMU name	Total loads per FMU		Total change from baseline to BAU2080	% change from baseline to BAU2080
	Baseline	BAU2080		
Taueru	229931	143803	-86127	-37%
Huangarua	144136	98439	-45698	-32%
Eastern hill streams	85169	57728	-27441	-32%
Whangaehu	71510	50271	-21239	-30%
Kopuaranga	67149	60274	-6875	-10%
			-410516	

- Recognise that drivers towards some mitigation options (e.g. retirement) will be stronger than have been in the immediate past with things like carbon farming and manuka honey becoming more viable and attractive, and Billion Trees etc
- Recognise that for these FMUs, at least half the potential change happens not under BAU2080 but under Silver2080
- Identify **target** reductions for these five FMUs based on loads that are closer towards Silver2080 outcome – test 10%, 20%, 50% and 100% of Silver2080 load

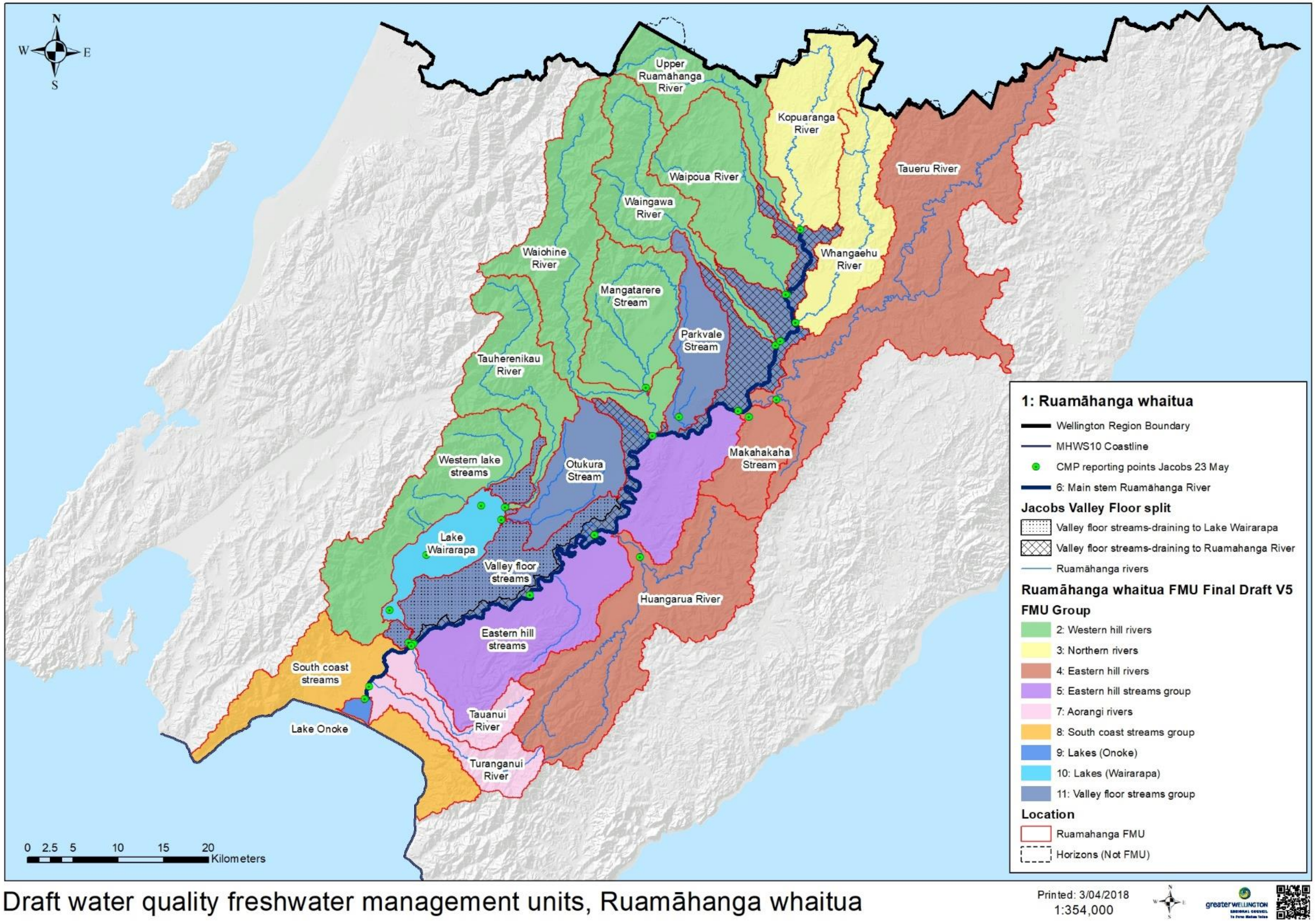
	Total loads (T/yr) per FMU from non-native land uses					
FMU name	**Baseline**	**BAU2080**	**10% SILVER2080**	**20% SILVER2080**	**50% SILVER2080**	**100% SILVER2080**
Taueru	229931	143803	136167	128531	105622	76363
Huangarua	144136	98439	93810	89181	75293	46292
Eastern hill streams	85169	57728	55100	52471	44586	26285
Whangaehu	71510	50271	47795	45318	37889	24765
Kopuaranga	67149	60274	56935	53596	43579	33390
TOTAL OF 5 FMUs	**597895**	**410516**	**389806**	**369097**	**306969**	**207095**
% reduction from Baseline non-native load in 'top 5' FMUs		**-31%**	**-35%**	**-38%**	**-49%**	**-65%**

Comparative loss from native to non-native land (entire whaitua)	**Baseline**	**BAU2080**	**10% SILVER2080**	**20% SILVER2080**	**50% SILVER2080**	**100% SILVER2080**
Native	32%	41%	43%	44%	47%	53%
Non-native	68%	59%	57%	56%	53%	47%

How do we increase effort to reduce sediment in these FMUs?

- Know 'what we can get' from the modelling
- Bring together implementation experts knowledge on what is possible
- What timeframes for reaching these targets?

Appendix 1 – FMU boundaries for sediment load limit work from SedNetNZ analysis



Draft water quality freshwater management units, Ruamāhanga whaitua