Regional Water Allocation Framework :
Technical Report to Support Policy Development - Volume 1

horizons regional council

one plan
MO TE ITI MO TE RAHI

Regional Water Allocation Framework : Technical Report to Support Policy Development – Volume 1

horizons
regional council

May 2007

Authors
Raelene Hurndell – Environmental Scientist - Water Quantity, Jon Roygard – Manager Science,
Jeff Watson – Manager Resource Data

Acknowledgements to
Charles Pearson – Hydrologist (NIWA, Christchurch);
Joe Hay – Freshwater Biologist & Dr. John Hayes – Senior Freshwater Fisheries Scientist
(Cawthron Institute, Nelson);
Horizons Regional Council Hydrology Team

May 2007
ISBN: 978-1-877413-92-5
Report No: 2007/EXT/809

CONTACT	**24hr Freephone 0508 800 800**		help@horizons.govt.nz		www.horizons.govt.nz
SERVICE CENTRES	**Kairanga** Cnr Rongotea & Kairanga-Bunnythorpe Rds Palmerston North **Marton** Cnr Hammond & Hair Sts **Taumarunui** 34 Maata Street **Woodville** Cnr Vogel (SH2) & Tay Sts	**REGIONAL HOUSES**	**Palmerston North** 11-15 Victoria Avenue **Wanganui** 181 Guyton Street	**DEPOTS**	**Levin** 11 Bruce Road **Taihape** Torere Road Ohotu
POSTAL ADDRESS	Horizons Regional Council, Private Bag 11025, Manawatu Mail Centre, Palmerston North 4442 | **F** 06 9522 929				

CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

This report has been prepared as a technical support document for the new regional plan being developed by Horizons Regional Council - the One Plan. This document describes the framework used by Horizons Regional Council to make resource management policy decisions for surface water management in the Manawatu-Wanganui Region.

In response to steadily increasing demand for surface water in the Manawatu-Wanganui Region, Horizons has derived a framework to ensure pragmatic and consistent decision-making around sustainable surface water management, while achieving instream management objectives for the Region’s waterways. This framework allows numerically defined core allocation limits to be set across the Region, where previously few such limits were defined.

The Water Management Zones (WMZs) project (McArthur *et al*., 2007) provides the spatial context for this water allocation framework.

To guide the development of the water allocation framework, Horizons established some general rules and policies, although some exceptions may apply:

- Total consented takes (cumulative allocation) in a WMZ shall not exceed 20% of the Mean Annual Low Flow (MALF) at the flow recorder for the WMZ; and takes (or allocation) from any one waterway or at any one point in the catchment shall not exceed 20% of the MALF at that point. This prevents the total WMZ allocation from being abstracted from a single stream or point in the catchment and ensures protection of smaller streams from over-abstraction.

- In order to monitor water use and assess the effects of water takes on the instream environment, fully telemetered water metering will be required under certain conditions. If the amount of water proposed to be taken by a new application, when assessed in combination with all other water takes upstream, exceeds 15% of the MALF at the flow recorder for the WMZ or sub-zone, then full telemetry will be required on that take and any subsequent takes in that zone or sub-zone.

- When the minimum flow and allocation limit for a stream, river or WMZ has been estimated or calculated, and that stream, river, or WMZ approaches full allocation Horizons will determine the instream habitat requirements and review the minimum flow and core allocation. This may or may not result in a change to the minimum flow and core allocation limits for that stream or WMZ.

- The Horizons Water Allocation Work Programme will be reviewed to address allocation issues in priority catchments, and minimum flows and allocation limits will be adjusted according to the findings of reviews as they are completed. These changes will be made through the statutory plan change process.

Table A sets out each WMZ and sub-zone with its relevant minimum flow and core allocation limit and a description of how these limits were derived. Where One Plan Policy 6.19 (see Appendix F of this report) applies, the WMZs are listed with a brief description of the method.

Outcomes from this framework project include the setting of numerically defined minimum flows and core allocation limits for water allocation policy, wherever sufficient information was available to do so. This will enable debate around minimum flows to occur at the policy level, rather than on a consent by consent basis, and aid decision-making around resource consents. The process also highlighted priorities and directions for future work, such as the Low Flow Gauging Project.

Table A: Summary of the water allocation framework showing the minimum flows and core allocation limits in each water management zone and sub-zone[1]

Water Management Zone	Water Management Sub-zone	Minimum flow (m^3/s)	Core allocation limit (m^3/s)	Flow monitoring site
Upper Manawatu *(Mana 1)*	Upper Manawatu (Mana 1a)	1.600	0.204	Manawatu at Weber Rd
	Mangatewainui (Mana 1b)	1.600	0.063	Manawatu at Weber Rd
	Mangatoro (Mana 1c)	0.702	0.204	Mangatoro at Mangahei Rd
whole zone *(Mana 1)*			**0.204**	
Weber-Tamaki *(Mana 2)*	Weber-Tamaki (Mana 2a)	1.600	0.251	Manawatu at Weber Rd
	Mangatera (Mana 2b)	1.600	0.047	Manawatu at Weber Rd
cumulative allocable volume *(Mana 1 + Mana 2)*			**0.251**	
Upper Tamaki (Mana 3)	Upper Tamaki (Mana 3)	0.238	0.078	Tamaki at Water Supply Weir
Upper Kumeti (Mana 4)	Upper Kumeti (Mana 4)	0.055	0.005	Kumeti at Te Rehunga
Tamaki-Hopelands (Mana 5)	Tamaki-Hopelands (Mana 5a)	2.980	0.971	Manawatu at Hopelands
	Lower Tamaki (Mana 5b)	0.360	0.138	Tamaki at Stephensons
	Lower Kumeti (Mana 5c)	0.055	0.059	Kumeti at Te Rehunga
	Oruakeretaki (Mana 5d)	0.293	0.105	Oruakeretaki at S.H.2 Napier
	Raparapawai (Mana 5e)	0.074	0.024	Raparapawai at Jacksons Rd
cumulative allocable volume *(Mana 1 + Mana 2 + Mana 3 + Mana 4 + Mana 5)*			**0.971**	
Hopelands-Tiraumea (Mana 6)	Hopelands-Tiraumea (Mana 6)	2.980	1.049	Manawatu at Hopelands
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6)*			**1.049**	Manawatu at Hopelands
Tiraumea (Mana 7)	Upper Tiraumea (Mana 7a)	2.140	0.475	Tiraumea at Ngaturi
	Lower Tiraumea (Mana 7b)	2.140	0.550	Tiraumea at Ngaturi
	Makuri (Mana 7d)	2.160	0.108	Makuri at Tuscan Hills
whole zone *(Mana 7)*			**0.550**	Tiraumea at Ngaturi
cumulative allocable volume *(Mana 7 + Mana 8)*	Mangatainoka and Tiraumea		**0.839**	
	Upper Mangatainoka (Mana 8a)	0.400	0.060	Mangatainoka at Larsons Rd

[1] An expanded version of this table including brief explanations of methods used and derivation of cumulative allocation limits is in Appendix A of this report. Zones and sub-zone which do not appear in Table A fall into One Plan Policy 6.17 and are listed in the table in Appendix A.

Water Management Zone	Water Management Sub-zone	Minimum flow (m^3/s)	Core allocation limit (m^3/s)	Flow monitoring site
Mangatainoka (Mana 8)	Middle Mangatainoka (Mana 8b)	1.580	0.105	Mangatainoka at Pahiatua Town Bridge
	Lower Mangatainoka (Mana 8c)	1.580	0.289	Mangatainoka at Pahiatua Town Bridge
	Makakahi (Mana 8d)	0.345	0.066	Makakahi at Hamua
	Mangaramarama (Mana 8e)	1.580	0.009	Mangatainoka at Pahiatua Town Bridge
whole zone *(Mana 8)*			**0.289**	
Upper Gorge (Mana 9)	Upper Gorge (Mana 9a)	10.530	2.340	Manawatu at Upper Gorge
	Mangapapa (Mana 9b)	0.023	0.008	
whole zone *(Mana 9)*			**2.340**	Manawatu at Upper Gorge
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9)*			**2.340**	
Middle Manawatu (Mana 10)	Middle Manawatu (Mana 10a)	14.160	3.150	Manawatu at Teachers College
	Upper Pohangina (Mana 10b)	2.315	0.460	Pohangina at Mais Reach
	Middle Pohangina (Mana 10c)	1.960	0.460	Pohangina at Mais Reach
	Lower Pohangina (Mana 10d)	1.960	0.525	Pohangina at Mais Reach
whole zone *(Mana 10)*			**3.150**	Manawatu at Teachers College
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10)*			**3.150**	
Lower Manawatu (Mana 11)	Lower Manawatu (Mana 11a)	14.160	3.180	Manawatu at Opiki Bridge
	Turitea (Mana 11b)	0.050	0.264	
whole zone *(Mana 11)*			**3.180**	Manawatu at Opiki Bridge
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10 + Mana 11)*			**3.180**	
Oroua (Mana 12)	Upper Oroua (Mana 12a)	1.050	0.405	Oroua at Kawa Wool
	Middle Oroua (Mana 12b)	1.050	0.430	Oroua at Kawa Wool
	Lower Oroua (Mana 12c)	1.050	0.530	Oroua at Kawa Wool

Water Management Zone	Water Management Sub-zone	Minimum flow (m^3/s)	Core allocation limit (m^3/s)	Flow monitoring site
	Kiwitea (Mana 12d)	0.145	0.048	Kiwitea at Haynes Line
	Makino (Mana 12e)	0.080	0.025	Makino at Boness Rd
whole zone *(Mana12)*			**0.530**	
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10 + Mana 11 + Mana 12)*			**3.710**	
Coastal Manawatu (Mana 13)	Coastal Manawatu (Mana 13a excluding 13a1)	12.588	5.300	
	Coastal Manawatu (Mana 13a1 (Mainstem of Manawatu River in Mana 13a downstream of S24:111-767))	12.588	7.065	
	Upper Tokomaru (Mana 13b)	0.220	0.050	Tokomaru at Horseshoe Bend
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 11 + Mana 12 + Mana 13)*			**7.065**	
Upper Rangitikei (Rang 1)	Upper Rangitikei (Rang 1)		0.000	
Middle Rangitikei (Rang 2)	Middle Rangitikei (Rang 2a)	5.250	0.260	Rangitikei at Mangaweka
	Pukeohahu-Mangaweka (Rang 2b)	12.790	0.670	Rangitikei at Mangaweka
	Middle Moawhango (Rang 2d)	MALF	0	Moawhango at Moawhango
	Lower Moawhango (Rang 2e)	MALF	5% of MALF[2]	Moawhango at Moawhango
	Upper Hautapu (Rang 2f)	0.745	0.112	Hautapu at Alabasters
	Lower Hautapu (Rang 2g)	0.670	0.085	Hautapu at Alabasters
cumulative allocable volume *(Rang 1 + Rang 2)*			**0.670**	
Lower Rangitikei (Rang 3)	Lower Rangitikei (Rang 3a)	14.550	1.510	Rangitikei at Onepuhi
	Makohine (Rang 3b)	0.036	0.008	Makohine at Viaduct
whole zone *(Rang 3)*			**1.510**	
cumulative allocable volume *(Rang 1 + Rang 2 + Rang 3)*			**1.510**	

[2] Insufficient hydrological data available to determine MALF at this point in time.

Water Management Zone	Water Management Sub-zone	Minimum flow (m^3/s)	Core allocation limit (m^3/s)	Flow monitoring site
Coastal Rangitikei (Rang 4)	Coastal Rangitikei (Rang 4a)	10.230	6.410	Rangtikei at McKelvies
	Tidal Rangitikei (Rang 4b)	10.230	6.410	
cumulative allocable volume *(Rang 1 + Rang 2 + Rang 3 + Rang 4)*			**6.410**	
	Upper Manganui o te Ao (Whai 5d)		0.000	
	Lower Manganui o te Ao (Whai 5e)		0.000	
Upper Whangaehu (Whau 1)	Upper Whangaehu (Whau 1a)	9.790	2.175	Whangaehu at Karioi
	Waitangi (Whau 1b)	0.475	0.105	Waitangi at Tangiwai
	Tokiahuru (Whau 1c)	4.340	0.960	Tokiahuru at Whangaehu Junction
whole zone *(Whau 1)*			**2.175**	
cumulative allocation *(Whau 1 + Whau 2)*			Is equal to cumulative core allocation for Whau 2[3]	
Lower Whangaehu (Whau 3)	Lower Whangaehu (Whau 3a)	13.240	2.940	Whangaehu at Kauangaroa
	Upper Makotuku (Whau 3b)	0.100	0.023	Makotuku at SH49a Bridge
	Lower Mangawhero (Whau 3e)	2.520	0.560	Mangawhero at Ore Ore
cumulative allocation *(Whau 1 + Whau 2+ Whau 3)*			**2.940**	
cumulative allocation *(Whau 1 + Whau 2+ Whau 3+ Whau 4)*			Is equal to cumulative core allocation for Whau 4[4]	
Turakina (Tura 1)	Upper Turakina (Tura 1a)	0.345	0.075	Turakina at Otairi Rd
	Lower Turakina (Tura 1b)	0.830	0.185	Turakina at O'Neills Bridge
whole zone *(Tura 1)*	Upper and Lower Turakina		**0.185**	
Ohau (Ohau 1)	Upper Ohau (Ohau 1a)	0.820	0.280	Ohau at Rongomatane
	Lower Ohau (Ohau 1b)	0.820	0.280	Ohau at Rongomatane
whole zone (Ohau 1)			**0.280**	
Owahanga (Owha 1)	Owahanga (Owha 1)	0.040	0.010	Owahanga at Branscombe Bridge
Kai Iwi (West 2)	Kai Iwi (West 2)	0.470	0.105	Kai Iwi at Handley Rd

3 Whau 2 currently falls into One Plan Policy 6.17.
4 Whau 4 currently falls into One Plan Policy 6.17.

Glossary

The following provides definitions of various terms and phrases used in the context of this technical report:

Term	Definition
Catchment	The natural drainage basin of a stream or river.
Consumptive use	The extraction of water from a body of water for use; the water is not returned to the water body.
Core allocation limit	The maximum volume of water that is available for allocation to out-of-stream uses from a defined water body, catchment, Water Management Zone, or sub-zone.
Cumulative allocable volume	The maximum volume of water that is available for allocation to out-of-stream uses from a group of defined Water Management Zones in a catchment.
Environmental flow	The flow that supports the life-supporting capacity of a stream or river (ref).
Extreme low flow	The lowest flow ever recorded in a stream or river – not to be confused with the minimum flow (see definition of minimum flow below).
Instream Flow Incremental Methodology (IFIM)	A holistic method used to determine an appropriate flow regime by considering the effects of flow changes on instream values (Jowett & Mosley, 2004).
Local Water Conservation Notices	Policy instruments originally designed to protect streams and rivers that are recognised as significant regional trout fisheries; deemed to be rules in Regional Plans by the Resource Management Act 1991 (S. 368).
Mean Annual Low Flow (MALF)	The lowest flow occurring each year, averaged over a number of years of hydrological record. In this report, MALF is the one-day mean annual low flow, unless stated otherwise. All MALFs in this report are as recorded in the river (ie. after current abstractions) unless stated otherwise.
Minimum flow	The flow below which flow should not be allowed to drop as a result of abstraction; and the flow at which abstraction may be limited or required to cease in a defined water body, catchment, Water Management Zone, or Water Management sub-zone.
National Water Conservation Orders	Statutory instruments designed to protect outstanding recreational fisheries, wild and scenic characteristics, and wildlife habitat for endangered or important native species.
Normal flow	As defined by the National Water Conservation (Manganui o te Ao River) Order 1988: • the actual flow rate at that point, plus • any abstractions or diversions from the river or stream and its tributaries upstream of that point, less • any discharges into the river or stream or its tributaries upstream of that point, except that no account shall be taken of discharges into the Orautoha Stream at or about map reference NZMS 260 S20:057014 in accordance with the notified use authorising the Raetihi Power Scheme.
Robust hydrological record	A record of accurate hydrological data, at least ten years in length (Henderson & Diettrich, 2007).
Water Management Zones/Sub-zones (WMZ)	Zones within the Horizons Regional Council Region, defined on the basis of ecosystem types, values and activities to achieve common management objectives (McArthur *et al.*, 2007)
Water Resource Assessment (WRA)	A comprehensive assessment of the water resources in a particular catchment or Water Management Zone documented in a technical report.

1. Introduction

1.1 Purpose of this report

This technical support document describes the framework used by Horizons Regional Council to make resource management policy decisions for surface water management in the Manawatu-Wanganui Region. It explains the methods used and provides justification for method selection.

Aquas Consultants Ltd and Aqualinc Research Ltd, under contract to Horizons Regional Council, prepared a series of reports proposing water use guidelines for public water supplies, addressing water demand management for local government in the Horizons Region and investigating 'reasonable use', demand forecasting and priority use. These issues are outside the scope of this technical document, but a full list of these contract reports is included in the Reference section of this document.

1.1.1 Report structure

1. **Introduction** – outlines the policy background and sets the scene for the Region.

2. **Concepts and decision support** – describes supporting projects and the concepts underlying the framework, and introduces the 'Scenarios' that guide method selection within the framework.

3. **Water allocation Scenarios explained** – provides detailed descriptions of the Scenarios introduced in Section 2.

4. **Setting the core allocation limits** – describes the methodology used for determining core allocation limits under each Scenario.

5. **Minimum flows and core allocations by water management zone** – presents a summary of the water management zones and sub-zones to which each Scenario applies.

6. **Cumulative and whole zone core allocation limits explained** – explains what the cumulative and whole zone allocation limits stated in Table A mean and how they were derived.

1.2 Planning context - the One Plan

This report has been prepared as a supporting document to the new regional plan being developed by Horizons Regional Council (Horizons) – the One Plan. The One Plan is being developed as a part of Horizons' commitment to merging its existing regional plans, regional policy statement, and coastal plan into a single plan.

New policy provisions for water allocation management within the One Plan are designed to address issues resulting from increasing pressure on the ground and surface water resource, the inefficient use of water and the potential for adverse effects on aquatic habitats. The focus of the new plan is to provide certainty around water allocation issues by determining instream habitat requirements and allocable volumes for the resource users. Horizons has invested significant time and resources into researching water allocation options for the Manawatu-Wanganui Region. National experience and recent decisions in relation to allocation decisions throughout New Zealand reinforce the approach taken by Horizons Regional Council.

A key aspect of any water allocation framework is the definition of a minimum flow. Minimum flow setting is often subject to debate in policy and resource consent decision-making. To date Horizons has had few numerically defined minimum flows set in policy but has incorporated specified minimum flows in the new regional Plan to enable debate around minimum flows to occur at the policy level, as opposed to a consent by consent basis. The implementation of numerically defined minimum flows at the policy level will aid decision-making around resource consents.

1.2.1 Development of Water Management Zones in the Manawatu-Wanganui Region

This report is best read in conjunction with the document "Development of Water Management Zones in the Manawatu-Wanganui Region – Technical Report to Support Policy Development" (Horizons Regional Council, 2007). The "Water Management Zone Report" (as it is known) contains maps of the water management zones and sub-zones referred to in this technical report.

Water management zones (WMZ) are an underpinning component of the integrated water management framework proposed for the One Plan. They support the policy framework for surface water allocation, surface water quality, and activities in beds of rivers and lakes, including structures and flood protection works. The surface water management zones are linked to the broader management zones defined for groundwater in the Region.

Forty-four water management zones and 117 sub-zones have been defined across the Manawatu-Wanganui Region. The zones are catchment-based and encompass the waterways within the zones, and the surrounding land area.

A range of criteria was applied to derive the water management zones and their subsequent sub-zones. These criteria included but were not limited to National Water Conservation Orders, Local Water Conservation Notices, ecosystem types, geology, hydrology, resource pressures, location of monitoring sites, and the length and availability of monitoring data (both flow and water quality). Historic derivation of water management zones for various purposes eg. the water management zones derived for the Rangitikei River and upper Manawatu water resource assessments were retained for continuity.

1.2.2 General principles

A set of general principles has been developed for the sustainable management of the water resource in the Horizons Region. These principles underlie the framework described by this technical document and are listed below:

In developing the surface water allocation framework for the Manawatu-Wanganui Region, Horizons has aimed to be:

- objective – to be equitable to both the environment and water users;
- precautionary in approach, in recognition of current levels of knowledge about the resource and current levels of knowledge about ecological requirements;
- accessible, in terms of key outcomes, to the community of interest;
- scientifically-based and subject to peer review;
- legally defensible; and
- consistent in approach, across catchments and users (Roygard *et al*., 2006).

1.3 Management objectives for the Horizons Region

A basic principle established in the Flow Guidelines for Instream Values (Ministry for the Environment, 1998) is that instream values and their requirements be assessed in reference to a defined instream management objective.

Horizons has a common instream management objective for all of the region's Water Management Zones – "to maintain and enhance aquatic ecosystem biodiversity and productivity over time compared to current levels, using trout, native fish, aquatic invertebrates, periphyton and ecosystem functioning as indicators of overall ecosystem health" (Roygard et al., 2006).

For many rivers, trout populations are used as an overall indicator of aquatic ecosystem viability over time. Managing flows for trout, which is among the most flow-demanding fish in New Zealand rivers, is seen as a pragmatic approach since there is an expectation that this will also provide adequate habitat for most native species.

Demand for surface water in the Manawatu-Wanganui Region has been steadily increasing in recent years. Consented daily abstraction volumes (excluding electricity supply) for the Region increased by 108% from 1997 to 2004. Use of water for electricity generation throughout the Region is around $55m^3/s$ on average (Horizons Regional Council, 2005). Figure 1 illustrates the trend in demand for water, highlighting the relative increases in demand for the main 'consumptive' uses of surface water in the Region. The largest growth area in water use has been in agriculture, compared with water supply and industry uses.

The Horizons State of the Environment Report (2005) identified catchments under pressure by relating consented volumes to river flows to give an indication of potential stress on the Region's waterways. The areas where water demand is concentrated include the lower Rangitikei River, the Makotuku River, the Manawatu River and several of its tributaries (the Tamaki, Raparapawai, Mangatainoka, Pohangina, Turitea and Oroua Rivers).

The relationship between maximum consented and actual water use varies greatly, as not all the water that is allocated is actually used by consent holders. In stressed and highly allocated catchments, this can mean that water is unavailable for other potential users. In order to accurately determine actual water use, and consequently facilitate efficient water allocation, Horizons has implemented a water metering programme. Water use records are now a standard requirement of any new surface water consent, and consents granted for large takes are required to have water meters with telemetry units installed. Telemetry units allow data on water use to be communicated directly to the Horizons data management system for storage and analysis.

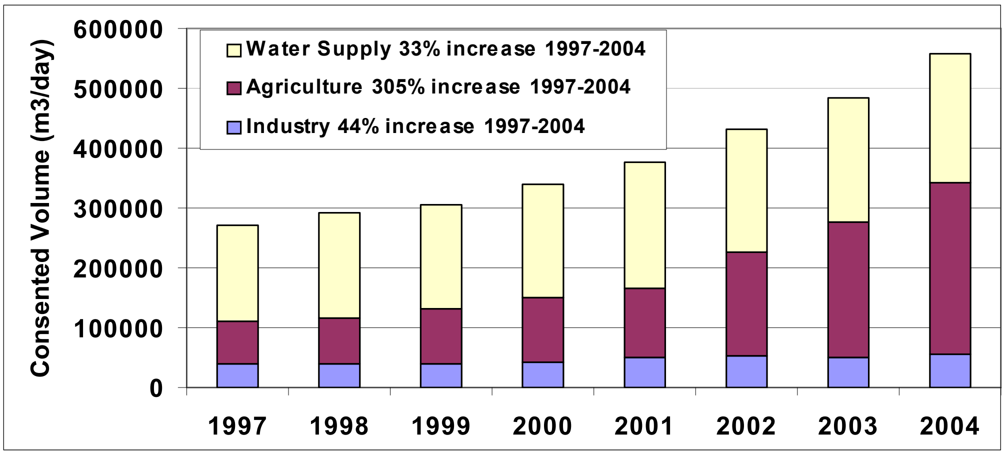


Figure 1: Graph showing the increase in demand for surface water for water supply, agriculture, and industry between 1997 and 2004

The data collected via telemetry fulfils several functions. Through Horizons' WaterMatters website[5], consent holders with telemetered takes can monitor their own water use and compliance within their individual consented limits. They can also see when low flow restrictions for their waterway are likely to begin, and whether other consent holders in their Water Management Zone are complying or not. This website is linked to the Horizons automated compliance software, which is designed to help Compliance Officers monitor water use and keep up to date with the activities of consent holders during periods of restricted water use. Telemetered data collection also allows the acquisition of long-term water use records which are used to assess patterns of water demand, assist technical decision-making on future consent applications, and facilitate naturalisation of river flow data records. Horizons is committed to funding installation of telemetry units with the aim of having reliable water use records for 80% of the total consented volume.

The Horizons river flow monitoring network has also been increased in the pressured catchments with new sites being installed downstream of areas of increasing demand. These sites provide the necessary data for monitoring the effect of abstraction on flows in the river.

5 www.horizons.govt.nz/watermatters/

2. Concepts and decision support

2.1 Background work

The development of a robust, pragmatic, and defensible water allocation framework requires careful planning, commitment of time and resources to research, and input of expertise by the scientific community. Horizons' water allocation framework is the result of a phased project, carried out in partnership with experts in water resource management, hydrology and freshwater science from NIWA, the Cawthron Institute and colleagues from neighbouring regional councils.

This section outlines the key pieces of work that underlie Horizons' water allocation framework. The Water Management Zones project is described in Section 1.2.1, so is not included again here.

2.1.1 Low flow gauging project

Horizons has a ongoing commitment to gathering river flow information across the Region, focussing on smaller streams and rivers, high demand catchments and targeting flows during the low-flow season. This data provides valuable information for building flow relationships with continuous stage monitoring (rated) sites, assessment of consent applications and decision-making around water allocation. As well as the acquisition of new data, this project includes the consolidation of historical flow records (many of which are not available electronically) from Catchment Boards, NIWA, Ministry of Works, etc. into Horizons' databases and information systems. Map 1 shows the location of existing gauging sites across the Region.

2.1.2 Statistical analysis of river flow data in the Horizons Region

Sound analysis of available flow data is crucial to any water allocation decision process. All available flow records for streams and rivers in the Horizons Region were provided to Roddy Henderson at NIWA for analysis and documentation of the results. This has provided Horizons with a set of flow statistics that succinctly describes a flow series from each of Horizons' flow recording sites, and facilitates comparison between sites. The key statistics required for the development of water allocation policy include those that describe the following:

- Mean flow
- Median flow
- Flow variability
- Seasonal variability
- Flow distribution
- Flow extremes
- Biological disturbance indicators

These flow statistics will provide a standard reference for all water allocation related policy and will continue to do so as they are updated over time.

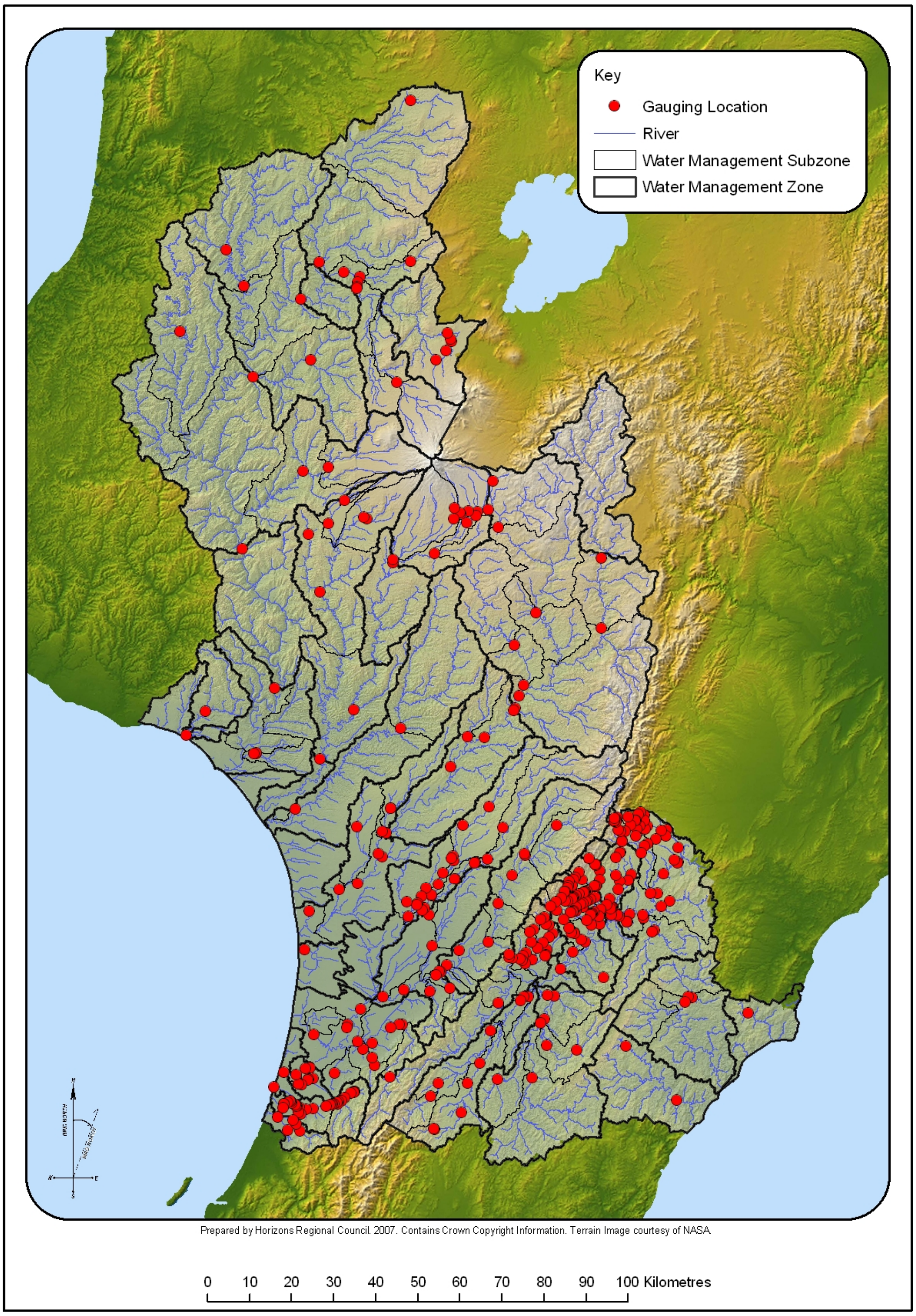


Figure 2: Map showing the existing gauging locations in the Horizons Region

2.1.3 Instream flow assessment options for Horizons Regional Council

Many methods have been used to determine minimum flow requirements in New Zealand and overseas. With the aim of ensuring that the water allocation framework employed scientifically robust methods, Horizons commissioned Joe Hay and John Hayes at the Cawthron Institute to:

- summarize methods available for setting minimum flows; and

- recommend which of these methods (or which combination of methods) could be applied to minimum flow setting within the Horizons Region. This included verification of the applicability of generalised habitat models to the Manawatu-Wanganui Region (by comparisons with existing IFIM predictions for the Region).

The resultant report recommended a ‘tiered approach’ to instream flow assessment and minimum flow setting, similar to that recommended to Environment Southland by Jowett and Hayes in 2004 (work supported by the Ministry for the Environment).

The structure and principles of the water allocation framework are based on the recommendations of this report.

2.2 Surface water allocation policy theory and concepts

The overall objective of the water allocation framework is to allocate water in a way that meets the needs of the community, the economy, and the environment.

This water allocation framework is based on the concepts of:

- an environmental flow maintained by a minimum flow;
- a core allocation limit; and
- a management flow that sets the upper limit of the core allocation.

Water allocation methods described in this report are based on a core allocation amount, which is available at all flows above a minimum flow that provides protection for instream values. Figure 2 illustrates the concepts listed above. Any further or ‘supplementary’ allocation is available only at high flows (eg. > median), to encourage water storage for later use (water harvesting).

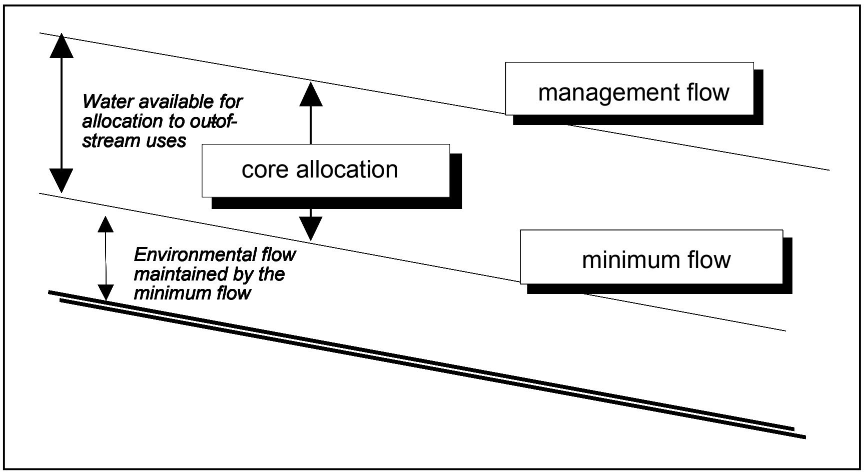


Figure 3: Conceptual approach to water allocation methodology.
(Adapted from Wood, 1995)

The **minimum flow** is a flow determined to provide a level of protection for environmental values. The environmental values are maintained by specifying the minimum flow below which flow should not be allowed to drop as a result of abstraction. It is noted that the flow can drop below the minimum flow level naturally. The minimum flow as defined above differs from the extreme low flow which is the lowest flow ever recorded in the river.

The minimum flow defines the point at which abstractions become restricted in order to protect instream values. Previous frameworks for surface water management have used ‘stepped’ or multi-level restrictions. By comparison with these, the use of a single threshold in this framework provides for a simpler management regime. The single minimum flow also provides a fixed point from which to determine the certainty of supply in terms of how often water will be available for abstraction, or conversely, the frequency with which restrictions are likely to occur.

Abstraction when the flow is at or below the minimum flow is limited to permitted takes (as defined by Policy 6-19 of the One Plan – Appendix F of this report)) and consented takes for:

- reasonable domestic water supply;
- reasonable stock water supply; and
- essential takes as set out by One Plan Policy 6-19 (see Appendix F).

This provision to continue to allow abstraction for these purposes at flows below the minimum flow provides the opportunity to allocate water “in a way, or at a rate, which enables people and communities to provide for their social and cultural well-being”, while the definition of the minimum flow is to safeguard “the life-supporting capacity of air, water, soil and ecosystems” as required by the Resource Management Act (1991).

To assist with understanding of the different levels of allocation permitted at different flows the following groups of abstraction types are defined:

- Permitted takes as defined by One Plan Policy 6-19 (see Appendix F). These can abstract at all flows.
- Essential takes that are consented to abstract (at reduced rates) at flows below the minimum flow, as defined by One Plan Policy 6-19 (see Appendix F).
- **Core allocation** takes that are within the core allocation ie. are consented to abstract at flows above the minimum flow.
- **Supplementary allocation takes** that are within the supplementary allocation and are able to abstract at or above a specified (by consent) flow.

Table 1 describes the result of the allocation regime at various flows in the natural flow regime.

Table 1: Water allocation methodology effects on flows in the river

Flow recorded in the river from	Flow recorded in the river to	Permitted and essential takes	Core allocation takes	Supplementary allocation takes	Lowest possible flow after allocation	Maximum possible flow after allocation[2]
Extreme low flow (lowest flow recorded in the river)	Less than and equal to minimum flow	Available for abstraction	Not to be abstracted at these flows	Not to be abstracted at these flows	Lowest flow in the river minus the reasonable need for domestic and stock water	Minimum flow minus the reasonable need for domestic and stock water
Minimum flow	Minimum flow + core	Available for abstraction. Included in core allocation	Available for abstraction until minimum flow is recorded	Not to be abstracted at these flows	Minimum flow minus the reasonable need for domestic and stock water	Minimum flow
Minimum flow + core	Median flow + core + supple-mentary	Available for abstraction. Included in core allocation	Available for abstraction	Not to be abstracted at these flows	Minimum flow	Median flow + supplementary
Median flow + core + supple-mentary	Maximum flow	Available for abstraction. Included in core allocation	Available for abstraction	Available for abstraction	Median flow + core	Maximum flow minus supplementary

[1] Limited industrial use may also be consented for abstraction below this flow where there is strong community support.

[2] May be as high as the natural flow dependent on how much the abstractors are utilising the available allocation.

Central to the water allocation framework is the definition of its key parts:

- a minimum flow that provides protection for instream values;
- a core allocation limit, which is available for allocation at flows above the environmental flow; and
- a supplementary allocation limit and a flow at which this is available for allocation.

The methodologies used by Horizons Regional Council to define minimum flows and core allocations are presented in the sections that follow. Supplementary allocation is not addressed in this technical report as this is specifically addressed in the One Plan by Policy 6-18: Supplementary water allocation (see Appendix F).

2.3 Establishing minimum flows and allocation limits

A key aspect of any water allocation framework is the definition of a minimum flow. Minimum flow setting is often subject to debate in policy and resource consent decision-making. To date Horizons has had few numerically-defined minimum flows set in policy, but has incorporated specified minimum flows in the new regional Plan to enable debate around minimum flows to occur at the policy level, as opposed to a consent by consent basis. The implementation of numerically-defined minimum flows at the policy level will aid decision-making around resource consents.

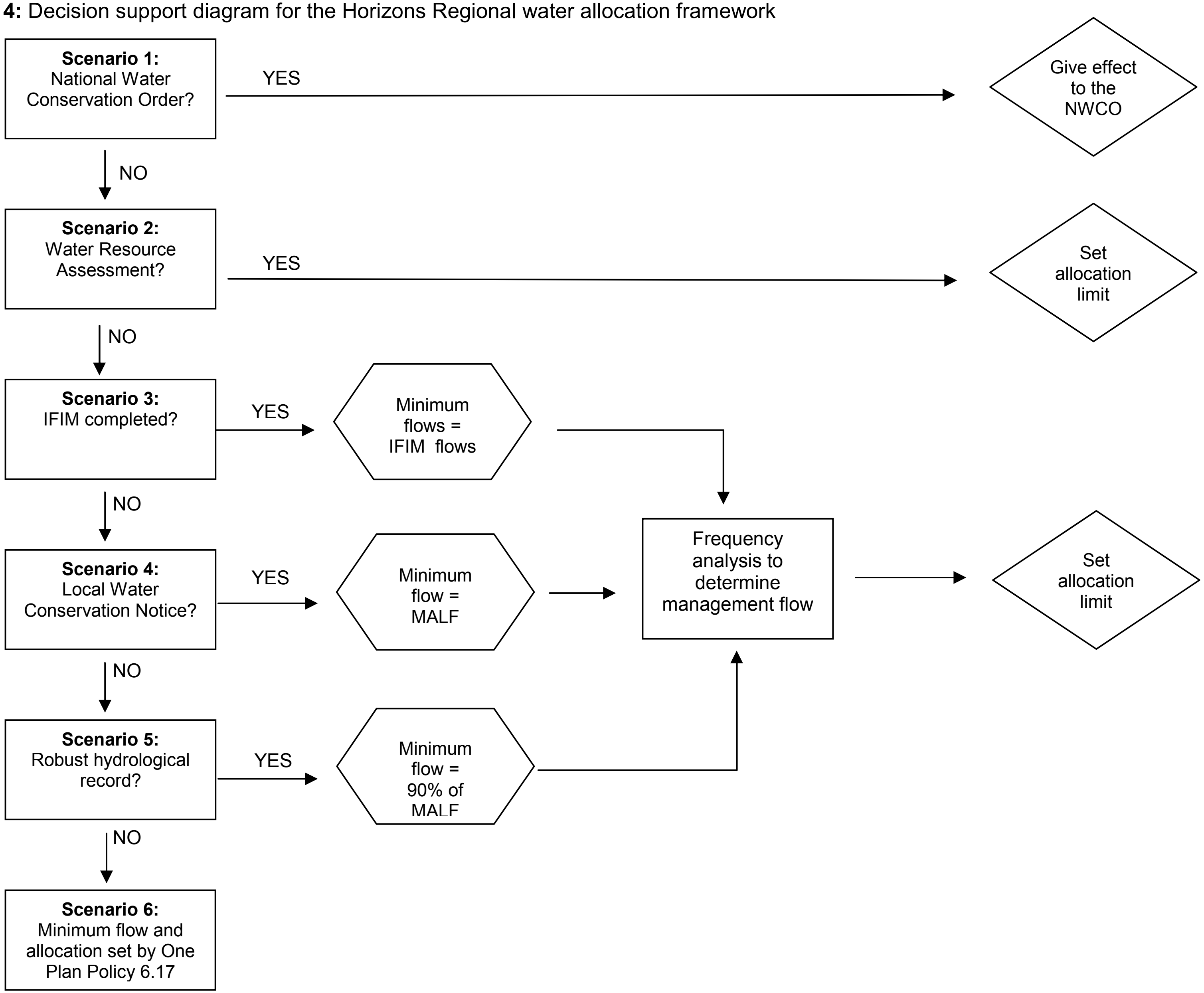
There is a range of methods available for determining minimum flows. The selection of method varies depending on the amount and quality of hydrological data available, the instream values of the waterway in question, demand for water, and the existence of specific statutory policies (ie. National Water Conservation Orders or Local Water Conservation Notices).

Horizons has developed a ‘decision support framework’, to ensure consistency is exercised in determining the appropriate methods to be used in setting minimum flows and allocation limits in the Horizons Region. As part of this ‘decision support framework’ Horizons has identified six possible hierarchical ‘Scenarios’ that may apply in the Region. These Scenarios dictate how the minimum flow and core allocation will be determined in each WMZ (ie. depending on which particular Scenario applies). The Scenarios are listed in Table 2 (p. 12) and are shown as part of the decision support framework in Figure 3 (p. 13). Each Scenario is explained in detail in Section 3 of this report. Table 2 provides a quick reference summary of the key aspects of the Horizons water allocation framework. The information summarised in Table 2 is covered in detail in Sections 3 and 4 of this report. Figure 3 is a flow diagram which illustrates the decision-making process within the water allocation framework. Sections 3 and 4 of this report elaborate on the process and explain the Scenarios and methods in detail.

Table 2: Table summarising key points of water allocation methods applied in the Horizons Water Allocation Framework

Scenario	Brief description	When applicable	Example
1	NWCO – minimum flows and core allocations set to achieve the original intention of the NWCO	When a NWCO applies within a WMZ or sub-zone	NWCO for the Upper Rangitikei (Rang 1) "the quantity and rate of flow of natural water shall be retained in its natural state"; therefore the core allocation limit is 0 and no minimum flow is required.
2	WRA – minimum flows and core allocations determined as a result of a thorough resource assessment	When a WRA has been completed for a WMZ or sub-zone	Upper Manawatu Catchment Water Resource Assessment defines minimum flows and core allocations for WMZs Mana 1 to Mana 6.
3	IFIM – minimum flow set at flow recommended based on an IFIM study and core allocation based on balance between instream requirements and surety of supply	When an IFIM study has been completed for waterways within a WMZ or sub-zone and has not so far been incorporated into a WRA	IFIM results for the Oroua River (Mana 12a – 12c) set the minimum flow at 1.05 m^3/s (to provide for habitat requirements of relevant trout life-stage) and the core allocation is determined by analysis of the flow distribution (surety of supply for water users).
4	LWCNs – minimum flows set at MALF and core allocation determined to reflect relative value of fishery	When a LWCN applies within a WMZ or sub-zone	LWCN for Upper Mangatainoka restricts abstraction that would have a significant adverse effect on the river. The minimum flow is set at MALF (considered to be a conservative minimum flow) and the core allocation restricted to 15% of the MALF, consistent with the levels of allocation allowed by the LWCN.
5	Hydrological statistics – minimum flow is 90% of the MALF and core allocation limit is 20% of the MALF	When Scenarios 1-4 are not applicable and a robust hydrological record exists for the WMZ or sub-zone	A robust hydrological record exists for the Manawatu at Teachers College flow monitoring site – this data is used to determine the MALF (15.375) for the Middle Manawatu River (Mana 10a) - minimum flow is MALF * 0.9 = 14.162 and core allocation is 15.275 * 0.2 = 3.150 m^3/s.
6	One Plan Policy 6-17 (see Appendix F) – minimum flow is MALF and core allocation is 20% of MALF	When Scenarios 1-5 are not applicable	Method considered to be the default approach when no other method is applicable.

Figure 4: Decision support diagram for the Horizons Regional water allocation framework



3. Water allocation scenarios explained

This section provides detailed information about each of the Scenarios introduced in Section 2. These Scenarios are hierarchical, with Scenario 1 taking ultimate precedence and subsequent Scenarios being considered in order, as laid out in and Figure 3 (p. 13).

3.1 Scenario 1: National Water Conservation Orders

There are several rivers, or reaches of rivers, in the Horizons Region that are protected by National Water Conservation Orders (NWCO), established under Section 20D of the Water and Soil Conservation Act 1967, and continuing under the Resource Management Act 1991. These Orders are designed to protect outstanding recreational fisheries, wild and scenic characteristics and wildlife habitat for endangered or important native species, and take precedence over any other policy. For specific detail refer to the Orders (Appendix D). Where these Orders exist, the minimum flow and allocation limits are set based on the intention of the NWCO to ensure that the objectives of the Order are not compromised by consented water abstraction. The stated flow requirements for the NWCOs in the Horizons Region are presented in Table 3.

Where there is no NWCO in place, Scenario 2 is considered (as shown in Figure 3).

Table 3: Flow requirements for rivers protected by National Water Conservation Orders in the Manawatu-Wanganui Region

River	Flow Requirement
National Water Conservation (Manganui o te Ao River) Order 1988	For the— (a) Manganui o te Ao downstream of its confluence with the Waimarino Stream, (b) Waimarino Stream, and (c) Orautoha Stream— water abstraction shall not reduce the normal flow by more than 5%, and in any case shall not reduce the rate of flow below the mean of the annual minima of the 7-day flow[6].
National Water Conservation (Rangitikei River) Order	For the upper Rangitikei River, including— (a) The Rangitikei River itself from its source (map reference U19:723-313) to its confluence with the Makahikatoa Stream (map reference U21:725-888), and (b) All rivers and streams contributing water to the Rangitikei River upstream of that confluence— the quantity and rate of flow of natural water shall be retained in its natural state.
	For the middle Rangitikei River, including— (a) The Rangitikei River from its confluence with the Makahikatoa Stream (map reference U21:725-888) to the Mangarere Bridge (map reference (T22:483-496), (b) The Whakarekau River plus any or all of its tributaries, and (c) The Kawhatau River or its tributaries, namely, the Pouranaki and Mangakokeke Stream— the rate of flow of the natural waters shall not be less than 95% of the river flow at that point.

[6] The term "normal flow" in rivers affected by the Water Conservation (Manganui o te Ao River) Order 1998 is defined in the Order. This definition is reproduced in the Glossary of this report.

MAP

3.2 Scenario 2: Water Resource Assessments

Water Resource Assessments (WRAs) are comprehensive documents that describe a catchment (including geology, hydrology, land use, water quality and ecology); identify the values within the catchment; set out minimum flows and allocation limits for the catchment; and provide recommendations for ongoing water management within that catchment.

To date, Horizons has completed WRAs for the Rangitikei catchment, the Ohau catchment, and the Upper Manawatu catchment. The WRAs specifically set out minimum flows and allocation limits for the catchments and Water Management Zones addressed, so where a WRA exists, the minimum flows and allocation limits are set as stated in the WRA.

Where no WRA has been completed for a catchment, or WMZ, the framework looks to any IFIM studies that have been completed to propose appropriate minimum flows (Scenario 3).

3.3 Scenario 3: Instream Flow Incremental Methodology

Instream Flow Incremental Methodology (IFIM) is a habitat assessment method used where the instream management objective is the protection of particular aquatic species, making retention of appropriate habitat a key consideration. It uses models of the hydraulic and morphological characteristics of a stream to determine the amount of habitat available for various species at a range of flows. IFIM is well suited to the physical and ecological characteristics of New Zealand rivers (Ministry for the Environment, 1998).

IFIM studies have been carried out on a number of rivers and streams in the Horizons Region. Some of the results from these studies have been incorporated into WRAs, where appropriate. Where the IFIM results have not already been used in determining minimum flows and allocation limits through a WRA, they provide proposed minimum flows for the water allocation process.

To determine the allocation limits for the streams and rivers that fall into Scenario 3, analysis of the flow distribution is used to estimate how many days per year minimum flows might be expected to occur, with a range of allocation limits, and therefore give an indication of the surety of supply for out-of-stream water users, as well as the frequency of potential habitat restriction for instream values. The allocation limits are set to ensure a balance between meeting the instream flow requirements and providing a reasonable certainty of supply for abstractive users. This process is explained in Section 4.

3.4 Scenario 4: Local Water Conservation Notices/Regional Plan Rules

Local Water Conservation Notices were statutory instruments established under Section 20H of the Water and Soil Conservation Act 1967. The objective of the Notices was to protect the waters of specific rivers and their tributaries for regionally important fisheries and angling features. The Notices restricted or prohibited the granting of resource consents by regional councils to dam, take water from, and discharge contaminants to these rivers and streams. The Resource Management Act 1991 (S. 368) deemed that these LWCNs become provisions in Regional Plans and are effectively replaced by the rules and policies in these Plans.

The LWCNs in the Horizons Region were replaced by SW Policy 3 and SW Rule 2 of the Horizons Regional Council Land and Water Regional Plan, 2003. This Plan, in turn, will be superseded by the One Plan. Where a LWCN has applied in the Region, for simplicity, they are still referred to as LWCNs in this report.

The minimum flows and allocation limits set out in the One Plan for the streams and rivers covered by the original LWCNs reflect an interpretation of the intention of those LWCNs and of SW Policy 3 and SW Rule 2 of the Land and Water Regional Plan, 2003.

For rivers specifically protected by LWCNs, and subsequently the Land and Water Plan (2003), the minimum flows are set at the mean annual low flow (MALF) which is considered to be a conservative minimum flow, appropriate where fishery values are high or limited information is available about the waterway in question.

Jowett (1990, 1992) found that the amount of instream habitat for adult brown trout at the MALF was correlated with adult brown trout abundance in New Zealand rivers. It follows that adult trout habitat at the MALF acts as a bottleneck to brown trout numbers. To set the minimum flow below MALF in rivers and streams that have the protection of LWCNs would compromise the original intention of the LWCNs.

The allocation limits for the streams and rivers subject to LWCNs have been derived on a case by case basis and reflect the intent of each LWCN. The minimum flows and allocation limits for these waterways are detailed in Section 5.4.

Where none of Scenarios 1 to 4 apply to a river, stream, or WMZ, hydrological statistics may be used to set the minimum flow and core allocation limit, where the data record is sufficiently robust.

3.5 Scenario 5: Robust hydrological record

Where Scenario 1 through 4 do not apply, but a long-term (10 years or more is considered to constitute a robust length of record by Henderson & Diettrich, 2007), good quality hydrological data record or flow series is available, this is used to set the minimum flow.

Hay & Hayes (2007) recommended a tiered approach to instream flow assessment and minimum flow setting depending on demand for abstraction and the relative significance of instream values. In the case where total abstraction demand is a small proportion of river flow they suggested using the MALF, or a proportion of it, to set minimum flows. On this basis the MALF is the key statistic used where Scenario 5 applies.

As explained above (Scenario 4), MALF is considered to be the potentially limiting factor for brown trout populations. However, minimum flows recommended by IFIM studies[7] are usually lower than MALF. A comparison between the MALFs and the IFIM recommended minimum flows for streams and rivers in the Horizons Region was undertaken. This comparison shows that the IFIM recommended minimum flows range from 47.1% to 93.3% of the MALF for the reach or stream in question, when the critical species is brown or rainbow trout[8]. The mean percentage of MALF represented by the IFIM recommended minimum flows is 77.1% and the 90th percentile is 93.0%. These values are summarised in Table 4.

The flow series for the Rangitikei River has been naturalised to allow for the effect of the Tongariro Power Development to be removed from the recorded flow data (Roygard & Carlyon, 2004).

Table 4: Minimum flows recommended by IFIM studies compared to MALF for the Horizons Region

IFIM study reach	MALF (m^3/s)	Suitability Criteria	IFIM recommended minimum flow (m^3/s)	Percentage of MALF represented by IFIM flow
Manawatu at Hopelands Bridge	3.700	Brown trout adult (Hayes & Jowett, 1994)	2.980	80.5
Manawatu at Weber Rd	1.875	Brown trout adult (Hayes & Jowett, 1994)	1.600	85.3
Manawatu at Maunga Rd	1.113	Brown trout adult (Hayes & Jowett, 1994)	0.970	87.2
Manawatu at Ormondville Takapau Rd	0.222	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.200	90.1
Manawatu at State Highway 2	0.140	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.130	92.9
Mangapapa Stm at Oxford Rd	0.030	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.028	93.3
Raparapawai Stm at Gaisford Rd	0.080	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.074	92.5
Raparapawai Stm at Maharahara Rd	0.080	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.074	92.5
Oruakeretaki Stm at State Highway 2	0.350	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.293	83.7
Kumeti Stm at State Highway 2	0.070	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.064	91.4
Kumeti Stm at Te Rehunga	0.059	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.055	93.2
Tamaki Rvr at State Highway 2	0.460	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.360	78.3
Tamaki Rvr at Water Supply Weir	0.260	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.238	91.5
Mangatoro Stm at Weber Rd	0.700	Brown trout yearling - small adult feeding (Roussel *et al.* ,1999)	0.330	47.1
Mangatoro Stm at Weber Rd (If management based on large brown trout habitat)	0.700	Brown trout adult (Hayes & Jowett ,1994)	0.590	84.3
Rangitikei at Otara	16.310	Rainbow trout habitat (Bovee unpub., cited in Hay & Hayes, 2004)	9.500	58.2
Rangitikei at Onepuhi	17.930	Rainbow trout habitat (Bovee unpub., cited in Hay & Hayes, 2004)	14.550	81.1
Rangitikei at Hamptons	17.930	Rainbow trout habitat (Bovee unpub., cited in Hay & Hayes, 2004)	10.230	57.1
Oroua at Kawa Wool	1.3500	Brown trout adult (Hayes & Jowett, 1994)	1.050	77.8
Pohangina at Mais Reach	2.300	Brown trout adult (Hayes & Jowett, 1994)	**1.960**	**85.2**
			Mean % of MALF	**82.2**
			90th percentile	**92.9**

(Adapted from Roygard *et al.*, 2006)

Figure 4 further illustrates the relationship between MALF and the associated IFIM recommended low flows presented in Table 3.

[7] based on the retention of 90% of the adult brown trout habitat available at MALF.

[8] very few IFIM based minimum flow recommendations in the Horizons Region have been focused on maintaining rainbow trout habitat. This is because the IFIM studies carried out to date in this Region have been in rivers where brown trout predominate in the fishery, with the exception being the Rangitikei River. There are also rainbow trout in several other rivers in the Horizons Region, and rainbow trout are generally considered to have higher flow demands than brown trout.

Figure 4 shows that on average IFIM recommended minimum flows were approximately 82% of the respective MALFs for streams and rivers in the Horizons Region with MALFs less than 5 m^3/s ($r^2 = 0.99$). Figure 5 shows this relationship changes to 0.66 when the results from the three reaches Rangitikei River are included, although the r^2 reduces to 0.96. It is worth noting that the only points on this plot (Figure 5) with a MALF >5 m^3/s are three reaches from the Rangitikei. Since these three reaches all represent the same river, they may not be statistically independent.

Only the results from streams and rivers in the Horizons Region with MALFs less than 5 m3/s have been included in Figure 4. The only IFIM results available from a river with a MALF of greater than 5 m3/s represent three reaches of the Rangitikei River and therefore may not be statistically independent, so these have been excluded from the analysis. Rivers such as the Rangitikei are likely to have high instream values and will be subjected to a detailed investigation (Water Resource Assessment or similar) before any decision can be made to allocate water outside of the conservative limits set by One Plan Policy 6.17.

The relationship between the IFIM recommended flows and the MALFs in the Horizons Region, illustrated by Figure 4, suggests that where minimum flow and core allocation limits must be set using hydrological data only, the minimum flow for a stream could be set at approximately 80% of the MALF, under the assumption that this should provide sufficient trout habitat at that minimum flow (and by extension of this assumption, that sufficient habitat would also be provided for generally less flow-demanding native fish species).

This principle has been adopted by Horizons; however, given the range within the IFIM/MALF relationship and with a view to further work, a conservative approach to water management is preferred. Where no instream habitat data, WRAs or NWCO are available the minimum flow is set at 90% of the MALF.

This approach is only likely to be applied where abstraction demand is relatively low, so the number of abstractors affected is likely to be relatively small. More in-depth flow assessment would be required if abstraction pressure increased. This precautionary approach has been adopted in recognition that, in order to apply this method, certain assumptions must be made regarding the actual response of instream habitat to reduced flows in cases where Scenario 5 applies.

It is noted that this cautionary approach increases the frequency of restrictions to water abstractors.

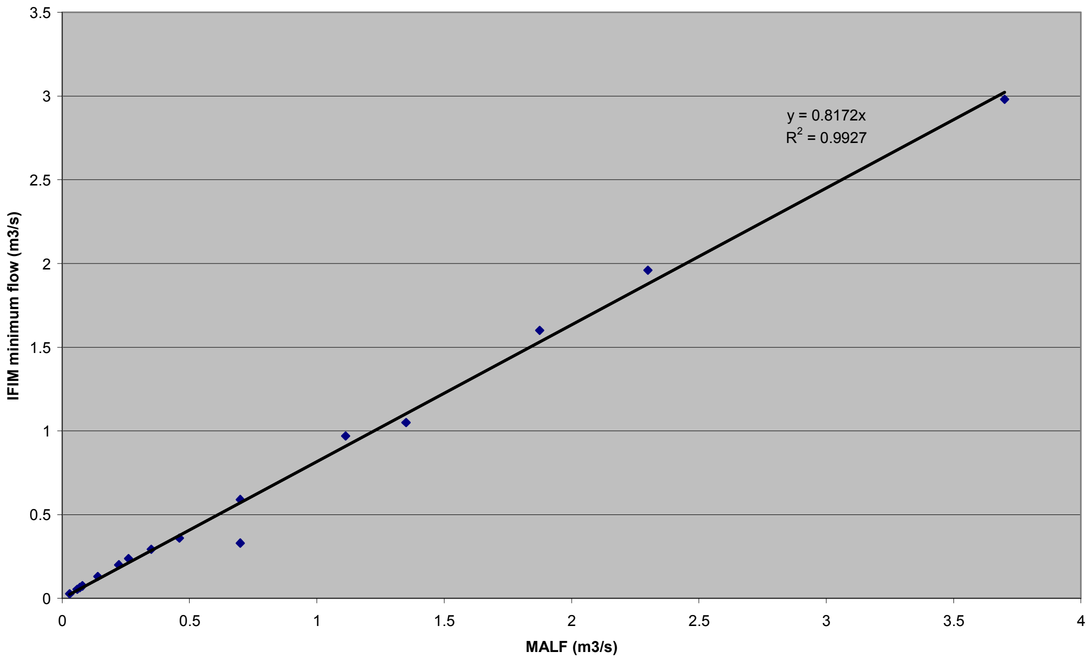


Figure 5: Relationship between MALF and IFIM recommended flows for the Horizons Region for rivers with mean annual low flows of less than $5m^3/s$

3.6 Scenario 6: None of the other scenarios apply

When there is little or no information available about a river or stream in the Region and Scenarios 1 through 5 do not apply, the minimum flow and core allocation default will apply as stated in the One Plan Policy 6-17(b):

"*Where information described in (a) is not available, the minimum flows and core allocations set out in schedule B shall generally be a minimum flow equal to the estimated or calculated one-day mean annual low flow, and a core allocation equal to a percentage of the minimum flow as specified in schedule B."* (Horizons Regional Council, 2007).

4. Setting the core allocation limits

Once the minimum flow for a stream or river has been determined through either an IFIM study, the interpretation of a Local Water Conservation Notice (SW Policy 3 and SW Rule 2), or hydrological statistics, a core allocation limit must be established. As illustrated in Figure 1, the amount of water available for allocation, or the core allocation, is the difference between the minimum flow and the management flow. NWCOs and WRAs state a predetermined core allocation, so no further work is required to establish core allocation limits when these Scenarios apply (ie. Scenarios 1 and 2).

Ensuring a balance between environmental protection and surety of supply for out-of-stream users is important in setting allocation limits for surface water bodies, as restrictions on abstractions will apply to consented takes when the minimum flow is reached during a flow recession. Also, it is generally recognised that minimum flows must be set in conjunction with appropriate allocation rules to ensure that a degree of the natural flow variability is maintained, in order to maintain ecological function (ie. extensive periods of "flat lining" at the minimum flow should be avoided).

Frequency and duration analysis of the hydrological record can be used to quantify the risk to the environment and to users of a minimum flow occurring. Effectively, when the core allocation is fully allocated to users and that allocation is fully utilised, the frequency of occurrence of the management flow becomes the frequency of occurrence of the minimum flow. Different levels of the management flow (and therefore core allocation volume) can be experimented with, to investigate the likely risk to the environment and water users presented by different allocation scenarios.

In this way water is allocated *"in a way, or at a rate, which enables people and communities to provide for their social and cultural well being"* while the definition of the minimum flow will safeguard *"the life-supporting capacity of air, water, soil and ecosystems"* as required by the Resource Management Act 1991.

Where long-term flow records are available, the historic flow record for each relevant flow recorder is run through a simple statistical process (automated, using Excel Visual Basic Code) that determines the number of days flow is below a specified flow for each month of each year. Table 5 provides an example of an output table. Output tables for all WMZs and sub-zones are set out in Volume 2 of this report (Regional Water Allocation Framework – Technical Report to Support Policy Develoment: Volume 2 – appendix to Volume 1).

This process is run for a range of potential core allocation limits eg. 10% of MALF, 15% of MALF, 20% of MALF, 25% of MALF and 30% of MALF, and the results are output to tables (See Volume 2 of this report). These proportions of the MALF were selected based on the guidance of Hay & Hayes (2007), as discussed below. The output tables show the average and range of the number of days per year when restrictions may occur. These tables also identify the likely timing of restrictions. Table 6 provides a summary of the outputs of flow distribution analysis, showing an average number of days of restriction expected and a range for each potential allocation volume.

Hay and Hayes (2007) suggested that 10% of MALF constituted a low level of abstraction, with relatively limited information required to set minimum flows at this level of demand. They also suggested 30% of MALF as a threshold of allocation demand where more detailed instream analysis is required to make sound water allocation decisions. However, analysis of the frequency tables generated for this framework project indicated that for some of the Region's rivers 30% of the MALF as an allocation limit would result in minimum flows occurring on up to 60 days per year (0–460.5) (Lower Turakina–Tura 1b), which is obviously undesirable. On the other hand, in some cases a core allocation equivalent to 30% of MALF was seen as appropriate, eg. the Oroua WMZ (Mana 12).

In setting minimum flows for this water allocation framework, 20% of MALF was recommended as an allocation limit. In some cases, lower or higher allocation limits were recommended, eg. where instream values are very high, as in the Mangatainoka Water Management Zone (Mana 8).

All proposed minimum and associated management flows determined for the Horizons Region, regardless of the method by which they were derived, were subjected to this flow distribution analysis to identify the potential for restrictions on water users during the summer months when peak water demand occurs in coincidence with low river flows.

Table 5: Example of the output from analysis of the flow distribution showing the number of days that flow was at or below MALF at Tiraumea at Ngaturi for each month and year of record

Flow Statistic	MALF	Flow	2.380									
Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	TOTAL
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	6.5	0.0	7.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	2.8	7.8	1.6	0.2	0.0	0.0	12.5
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	13.4	8.1	4.9	5.2	1.2	0.0	32.8
1984	0.0	0.0	0.0	0.0	0.0	13.2	14.7	24.8	21.3	23.4	14.3	0.0	111.8
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0	7.3
1986	0.0	0.0	0.0	0.0	0.0	0.0	2.5	6.6	0.0	0.0	0.0	0.0	9.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	11.4	12.6	0.0	0.0	26.8
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	24.5	23.2	8.4	0.0	68.8
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	26.0	14.1	0.0	0.0	40.9
1998	0.0	0.0	0.0	0.0	0.0	0.0	1.5	14.3	10.1	3.8	0.0	0.0	29.7
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.1	13.0	0.0	0.1	0.0	17.6
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	8.6	0.2	0.0	16.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	1.8
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	13.2	37.4	82.3	120.1	99.0	30.7	0.0	382.7
Average	0.0	0.0	0.0	0.0	0.0	0.5	1.4	3.2	4.6	3.8	1.2	0.0	14.7
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	13.2	14.7	24.8	26.0	23.4	14.3	0.0	111.8

Table 6: Summary of results from the flow distribution analysis of for all proposed minimum flows and core allocation limits

Sub-zone	Minimum flow		MALF		Minimum flow + 5% of MALF as core		Minimum flow + 10% of MALF as core		Minimum flow + 15% of MALF as core		Minimum flow + 20% of MALF as core		Minimum flow + 25% of MALF as core		Minimum flow + 30% of MALF as core	
	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)	Average (days per year)	Range (days)
Upper Tiraumea (Mana 7a)	5.3	0 – 82.6	14.7	0 – 111.8	N/A	N/A	14.7	0 – 111.8	22.5	0 – 125.8	**29**	**0 – 132.4**	35.6	0 – 136.9	40.9	0 – 142.2
Lower Tiraumea (Mana 7b)	5.3	0 – 82.6	14.7	0 – 111.8	N/A	N/A	14.7	0 – 111.8	22.5	0 – 125.8	**29**	**0 – 132.4**	35.6	0 – 136.9	40.9	0 – 142.2
Makuri (Mana 7d)	21.8	0 – 59.9	21.8	0 – 59.9	**33.9**	**0 – 81.6**	44.7	0 – 100.2	54.3	0 – 113.5	64.1	0 – 127.5	74.6	0 – 145	83.1	0 – 162.1
Upper Mangatainoka (Mana 8a)	7.7	0 – 50.4	7.7	0 – 50.4	N/A	N/A	11.2	0 – 58.9	**13.2**	**0 – 64.6**	15.1	0 – 69.4	17.1	0 – 74.2	19	0 – 76.8
Middle Mangatainoka (Mana 8b)	14	0 – 79	14	0 – 79	N/A	N/A	17.5	0 – 84.6	**19.4**	**0 – 90.8**	21.1	0 – 96.6	23.1	0 – 100.5	25.5	0 – 103.6
Lower Mangatainoka (Mana 8c)	14	0 – 79	14	0 – 79	N/A	N/A	17.5	0 – 84.6	**19.4**	**0 – 90.8**	21.1	0 – 96.6	23.1	0 – 100.5	25.5	0 – 103.6
Makakahi (Mana 8d)	15.1	0 – 59.6	15.1	0 – 59.6	N/A	N/A	18	0 – 67.3	**19.4**	**0 – 70.6**	20.8	0 – 73.2	22.1	0 – 80.1	23.3	0 – 86.2
Mangaramarama (Mana 8e)	14	0 – 79	14	0 – 79	N/A	N/A	17.5	0 – 84.6	**19.4**	**0 – 90.8**	21.1	0 – 96.6	23.1	0 – 100.5	25.5	0 – 103.6
Upper Gorge (Mana 9a)	6.8	0 – 43.8	11.7	0 – 52.9	N/A	N/A	11.7	0 – 52.9	14.1	0 – 57.1	**16.9**	**0 – 61**	20.2	0 – 66.4	23.4	0 – 71.8
Mangapapa[9] (Mana 9b)	-	-	-	-	N/A	N/A	-	-	-	-	-	-	-	-	-	-
Upper Mangahao (Mana 9d)	9.2	0 – 78.6	11.7	0 – 88	N/A	N/A	11.7	0 – 88	13.1	0 – 90.8	**14.6**	**0 – 93.1**	16.4	0 – 96	18.1	0 – 99.1
Lower Mangahao (Mana 9e)	9.2	0 – 78.6	11.7	0 – 88	N/A	N/A	11.7	0 – 88	13.1	0 – 90.8	**14.6**	**0 – 93.1**	16.4	0 – 96	18.1	0 – 99.1
Middle Manawatu (Mana 10a)	7.4	0 – 63.7	12.2	0 – 71	N/A	N/A	12.2	0 – 71	14.9	0 – 73.5	**17.6**	**0 – 76.6**	20.4	0 – 82.8	23.4	0 – 90.4
Upper Pohangina (Mana 10b)	1.8	0 – 12.7	5	0 – 20.1	N/A	N/A	3.4	0 – 16.6	4.9	0 – 19.8	**6.6**	**0 – 26.3**	8.7	0 – 35.3	11.2	0 – 41.5
Middle Pohangina (Mana 10c)	1.8	0 – 12.7	5	0 – 20.1	N/A	N/A	3.4	0 – 16.6	4.9	0 – 19.8	**6.6**	**0 – 26.3**	8.7	0 – 35.3	11.2	0 – 41.5
Lower Pohangina (Mana 10d)	1.8	0 – 12.7	5	0 – 20.1	N/A	N/A	3.4	0 – 16.6	4.9	0 – 19.8	**6.6**	**0 – 26.3**	8.7	0 – 35.3	11.2	0 – 41.5
Lower Manawatu (Mana 11a)	3.6	0 – 23.7	7.8	0 – 34.5	N/A	N/A	7.8	0 – 34.5	10.5	0 – 44.2	**13**	**0 – 50.6**	15.7	0 – 56.7	18.8	0 – 61.1
Upper Oroua (Mana 12a)	2.9	0 – 19.2	6.8	0 – 33.8	N/A	N/A	5.4	0 – 31.7	7.1	0 – 34	8.8	0 – 36.4	10.9	0 – 38.5	**13.3**	**0 – 40.1**

[9] Frequency analysis not possible for this site at time of writing due to short data record

Middle Oroua (Mana 12b)	2.9	0 – 19.2	6.8	0 – 33.8	N/A	N/A	5.4	0 – 31.7	7.1	0 – 34	8.8	0 – 36.4	10.9	0 – 38.5	**13.3**	**0 – 40.1**
Lower Oroua (Mana 12c)	2.9	0 – 19.2	6.8	0 – 33.8	N/A	N/A	5.4	0 – 31.7	7.1	0 – 34	8.8	0 – 36.4	10.9	0 – 38.5	**13.3**	**0 – 40.1**
Kiwitea (Mana 12d)	11.2	0 – 72.8	15.2	0 – 81.2	N/A	N/A	15.2	0 – 81.2	17.3	0 – 86.5	19.3	0 – 90.5	**21.6**	**0 – 93.5**	24.1	0 – 96.4
Makino (Mana 12e)	12.7	0 – 60	12.7	0 – 60	N/A	N/A	20.7	0 – 72.3	24.9	0 – 86.9	28.9	0 – 91	**32.8**	**0 – 96.2**	37.1	0 – 100
Upper Tokomaru (Mana 13b)	7.9	0 – 62.8	10.6	0 – 74	N/A	N/A	10.6	0 –74	12	0 – 78.2	**13.3**	**0 – 82.1**	14.7	0 – 85.1	16.3	0 – 88.3
Upper Hautapu (Rang 2f)	13.5	0 – 97.9	13.5	0 – 97.9	N/A	N/A	17.8	0 – 107.2	**19.8**	**0 – 111.3**	22.4	0 – 116.2	25	0 – 119.5	27.7	0 – 122.2
Lower Hautapu (Rang 2g)	8.8	0 – 86.3	13.5	0 – 97.9	N/A	N/A	13.5	0 – 97.9	15.5	0 – 102.3	17.8	0 – 107.2	19.8	0 – 111.3	22.4	0 – 116.2
Makohine (Rang 3b)	5.7	0 – 50.7	8.8	0 – 56.6	N/A	N/A	8.8	0 – 56.6	10.3	0 – 59.6	**12.9**	**0 – 62.8**	14	0 – 67.9	15.4	0 – 73.9
Upper Whangaehu (Whau 1a)	1.6	0 – 34.1	13.5	0 – 110	N/A	N/A	13.5	0 – 110	22.3	0 – 130	**32.6**	**0 – 151.5**	45	0 – 177.4	58.8	0 – 207.1
Waitangi (Whau 1b)	7.4	0 – 83.6	17.6	0 – 110.1	N/A	N/A	17.6	0 – 110.1	30.2	0 – 118	**42.4**	**0 – 135.6**	57.9	0 – 155.9	70.4	0 – 162.9
Tokiahuru (Whau 1c)	0.8	0 – 10.9	13.6	0 – 85.1	N/A	N/A	13.6	0 – 85.1	27.6	0 – 112.8	**44.2**	**0 – 130.5**	64.3	0 – 145.9	87.7	0 – 166.1
Lower Whangaehu (Whau 3a)	5.5	0 – 64.4	16.7	0 – 85.8	N/A	N/A	16.7	0 – 85.8	25.2	0 – 92.9	**32.9**	**0 – 102.6**	41.8	0 – 111.8	50.7	0 – 121.4
Upper Makotuku (Whau 3b)	8.6	0 – 51	17.7	0 – 79.3	N/A	N/A	17.7	0 – 79.3	23.9	0 – 85.6	**25.8**	**0 – 92.4**	30.7	0 – 99.3	34.9	0 – 104.6
Lower Mangawhero (Whau 3e)	8.9	0 – 113.7	17.4	0 – 127.6	N/A	N/A	17.4	0 – 127.6	21.8	0 – 133.1	**26.6**	**0 – 136.5**	31.0	0 – 139.2	36.3	0 – 142.4
Upper Turakina (Tura 1a)	6.7	0 – 32.6	13.8	0 – 42.9	N/A	N/A	13.8	0 – 42.9	19.3	0 – 51	**23.6**	**0 – 61.3**	34.7	0 – 84.9	31.1	0 – 76.7
Lower Turakina (Tura 1b)	4.5	0 – 30.8	8.6	0 – 35.2	N/A	N/A	8.6	0 – 35.2	26.2	0 – 196.5	**38.1**	**0 – 285.7**	49.7	0 – 383.1	60	0 – 460.5
Owahanga (Owha 1)	9.6	0 – 27	11.8	0 – 31.2	N/A	N/A	11.8	0 – 31.2	12.7	0 – 32	**13.5**	**0 – 33.6**	14.3	0 – 35.3	15.4	0 – 37.5
Kai Iwi (West 2)	6.9	0 – 61.3	18.1	0 – 108.8	N/A	N/A	18.1	0 – 108.8	24.7	0 – 131.8	33	0 – 151.9	42.8	0 – 166.1	53	0 – 178.3

Table 7: Results from the analysis of the flow distributions for minimum flows and core allocation limits selected for each Water Management sub-zone

Sub-zone	Minimum flow		Management flow	
	Average (days per year)	Range (days)	Average (days per year)	Range (days)
Upper Tiraumea (Mana 7a)	5.3	0 – 82.6	**29**	**0 – 132.4**
Lower Tiraumea (Mana 7b)	5.3	0 – 82.6	**29**	**0 – 132.4**
Makuri (Mana 7d)	21.8	0 – 59.9	**33.9**	**0 – 81.6**
Upper Mangatainoka (Mana 8a)	7.7	0 – 50.4	**13.2**	**0 – 64.6**
Middle Mangatainoka (Mana 8b)	14	0 – 79	**19.4**	**0 – 90.8**
Lower Mangatainoka (Mana 8c)	14	0 – 79	**19.4**	**0 – 90.8**
Makakahi (Mana 8d)	15.1	0 – 59.6	**19.4**	**0 – 70.6**
Mangaramarama (Mana 8e)	14	0 – 79	**19.4**	**0 – 90.8**
Upper Gorge (Mana 9a)	6.8	0 – 43.8	**16.9**	**0 – 61**
Mangapapa[10] (Mana 9b)	-	-	-	-
Upper Mangahao (Mana 9d)	9.2	0 – 78.6	**14.6**	**0 – 93.1**
Lower Mangahao (Mana 9e)	9.2	0 – 78.6	**14.6**	**0 – 93.1**
Middle Manawatu (Mana 10a)	7.4	0 – 63.7	**17.6**	**0 – 76.6**
Upper Pohangina (Mana 10b)	1.8	0 – 12.7	**6.6**	**0 – 26.3**
Middle Pohangina (Mana 10c)	1.8	0 – 12.7	**6.6**	**0 – 26.3**
Lower Pohangina (Mana 10d)	1.8	0 – 12.7	**6.6**	**0 – 26.3**
Lower Manawatu (Mana 11a)	3.6	0 – 23.7	**13**	**0 – 50.6**
Upper Oroua (Mana 12a)	2.9	0 – 19.2	**13.3**	**0 – 40.1**
Middle Oroua (Mana 12b)	2.9	0 – 19.2	**13.3**	**0 – 40.1**
Lower Oroua (Mana 12c)	2.9	0 – 19.2	**13.3**	**0 – 40.1**
Kiwitea (Mana 12d)	11.2	0 – 72.8	**21.6**	**0 – 93.5**
Makino (Mana 12e)	12.7	0 – 60	**32.8**	**0 – 96.2**
Upper Tokomaru (Mana 13b)	7.9	0 – 62.8	**13.3**	**0 – 82.1**
Upper Hautapu (Rang 2f)	13.5	0 – 97.9	**19.8**	**0 – 111.3**
Lower Hautapu (Rang 2g)	8.8	0 – 86.3	**17.8**	**0 – 107.2**
Makohine (Rang 3b)	5.7	0 – 50.7	**12.9**	**0 – 62.8**
Upper Whangaehu (Whau 1a)	1.6	0 – 34.1	**32.6**	**0 – 151.5**
Waitangi (Whau 1b)	7.4	0 – 83.6	**42.4**	**0 – 135.6**
Tokiahuru (Whau 1c)	0.8	0 – 10.9	**44.2**	**0 – 130.5**
Lower Whangaehu (Whau 3a)	5.5	0 – 64.4	**32.9**	**0 – 102.6**
Upper Makotuku (Whau 3b)	8.6	0 – 51	**25.8**	**0 – 92.4**
Lower Mangawhero (Whau 3e)	8.9	0 – 113.7	**26.6**	**0 – 136.5**
Upper Turakina (Tura 1a)	6.7	0 – 32.6	**23.6**	**0 – 61.3**
Lower Turakina (Tura 1b)	4.5	0 – 30.8	**38.1**	**0 – 285.7**
Owahanga (Owha 1)	9.6	0 – 27	**13.5**	**0 – 33.6**
Kai Iwi (West 2)	6.9	0 – 61.3	**33**	**0 – 151.9**

[10] Frequency analysis not possible for this site at time of writing due to short data record

5. Minimum flows and core allocations by water management zone

This section works through the Scenarios (as described in Sections 2 and 3 of this report) and presents a summary of the WMZs and sub-zones to which each Scenario applies.

5.1 Scenario 1 - Minimum flows and core allocations determined by National Water Conservation Orders

There are two National Water Conservation Orders (NWCOs) in place in the Horizons Region. The details of these are set out in Table 3 These Orders are designed to protect outstanding recreational fisheries, wild and scenic characteristics and wildlife habitat for endangered or important native species.

The Horizons Regional Water Allocation Framework gives effect to the National Water Conservation Orders in the Horizons Region by setting core allocations for the WMZ sub-zones to which the NWCOs apply.

A Water Resource Assessment has been completed for the Rangitikei River, including the reaches specified in the NWCO (Roygard & Carlyon, 2004). The management of these reaches of the main stem is set out by the WRA document and summarised in Section 5.2.2 of this report. This water allocation framework extends the analysis to include the tributaries.

Table 8: Sub-zones with minimum flows and core allocation limits determined by NWCO requirements

Sub-zone name	Sub-zone code	Minimum flow $m^{3/s}$	Minimum flow monitoring site	Core allocation limit $m^{3/s}$
Upper Rangitikei	Rang 1		N/A	0.000
Middle Rangitikei	Rang 2a	5.250	Rangitikei at Pukeokahu	0.260
Pukeohahu-Mangaweka	Rang 2b	12.790	Rangitikei at Mangaweka	0.670[11]
Upper Manganui o te Ao	Whai 5d		N/A	0.000
Lower Manganui o te Ao	Whai 5e		N/A	0.000

[11] Core allocation limit for the whole of Rang 2.

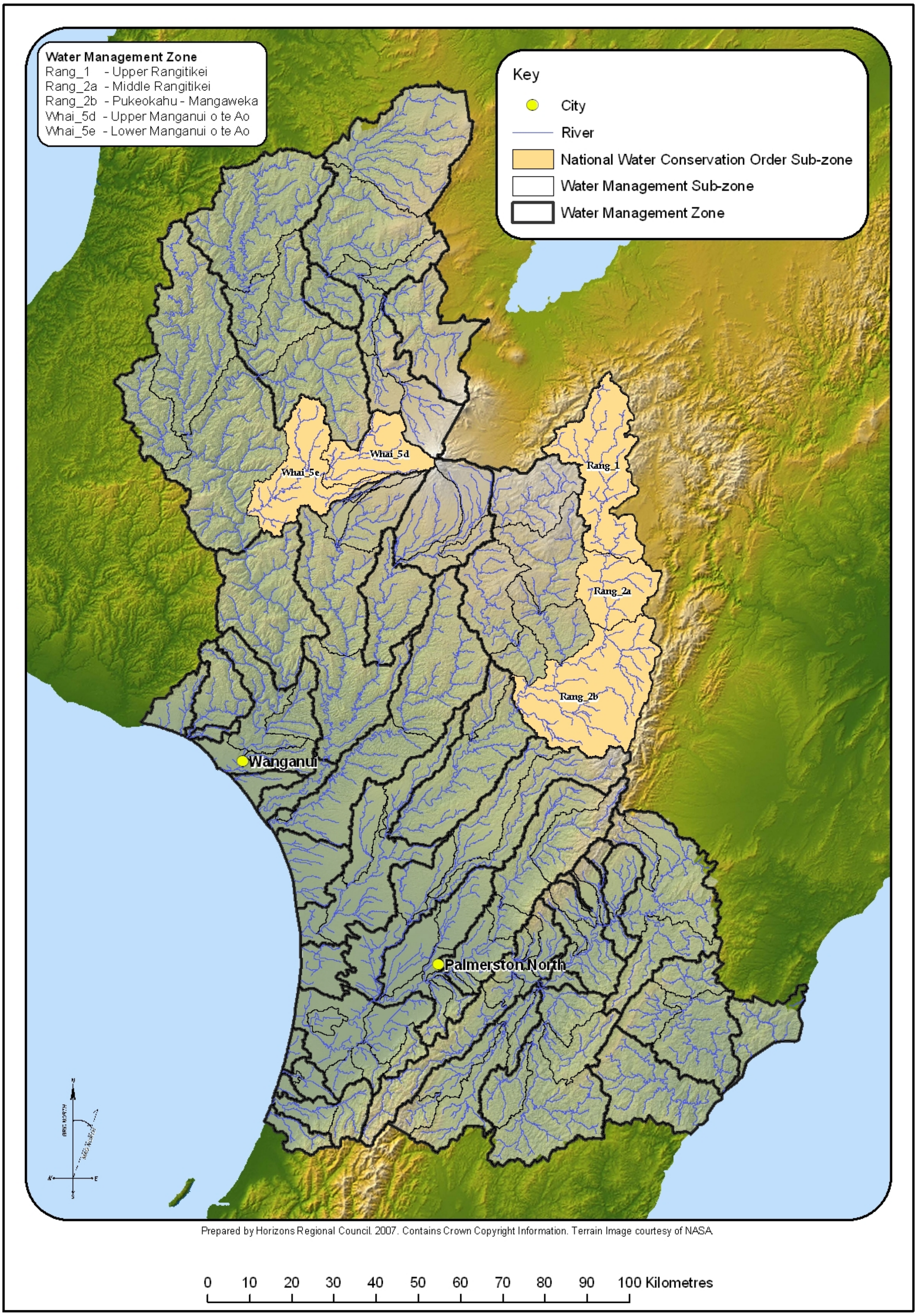


Figure 6: Map showing Water Management sub-zones with minimum flows and core allocation limits determined by NWCO requirements

5.2 Scenario 2 - Minimum flows and core allocations determined by Water Resource Assessments

5.2.1 Ohau catchment

The Ohau River (Figure 2) has been identified as a pressured catchment with respect to allocated surface and groundwater resources. The Ohau River supplies drinking water for the township of Levin (Horowhenua District Council) and water for irrigation of farmland, as well as providing instream habitat for trout and native fish.

In 2003, Horizons completed a Water Resource Assessment of the Ohau River and catchment (Horizons Regional Council, 2003). This report compiled all available information on the surface water resources in this catchment and proposed suitable allocation limits and minimum flows for the Ohau River.

The available information included the results of a recent IFIM study carried out by NIWA for HRC on the Ohau River. These results showed that flows between 700 and 800 l/s in the Ohau provided approximately 80% of optimal habitat for trout rearing and spawning. At flows below 600 l/s at the HDC water supply take, the lower river dries up at the SH2 Bridge.

Flow variability was an important consideration in determining what the core allocation for the Ohau River should be and the number of days between significant freshes was a key factor. Allocating more than 280 l/s from the river would increase the period between freshes to more than 50 days. This could seriously affect the ecological balance and water quality of the stream.

All factors considered, the minimum flow for the Ohau River was set at 820 l/s and the core allocation at 280 l/s. These figures provide for the maintenance of instream habitat while allowing water to be taken from the river to provide for the reasonable needs of people and animals in the catchment.

The minimum flow and core allocation for the Ohau River is included in Table 8.

5.2.2 Rangitikei catchment

As part of the development of water allocation management recommendations for the main stem of the river, the Rangitikei Water Resource Assessment developed water allocation options for four surface water management zones in the Rangitikei catchment - the Upper Rangitikei, Middle Rangitikei, Lower Rangitikei and Coastal Rangitikei zones (Figure 3). Allocation regimes were developed for the entire catchment. The Middle Rangitikei water management zone includes the Hautapu River which is covered by a Local Water Conservation Notice (Section 3.4). It is noted that the Middle Rangitikei is also covered by the provisions of a NWCO, and its requirements are to be considered in all decision-making for this part of the catchment.

The management objective for the Upper Rangitikei zone is to preserve the recreational, fisheries and wildlife features outlined in the National Water Conservation (Rangitikei River) Order. In this zone, in compliance with NWCO provisions, no water abstraction is permitted beyond reasonable needs for domestic and stock water purposes.

Management objectives for the Middle, Lower and Coastal zones of the Rangitikei are based on maintaining habitat requirements for rainbow trout. The trout fishery in the Rangitikei River is highly valued. By providing minimum flows for rainbow trout the needs of the majority of the native fish populations should also be provided for: the large drift-feeding trout generally have greater depth and velocity requirements than native fish. Also, since rainbow trout are recognised as having higher velocity requirements than brown trout, the habitat requirements of brown trout should also be met by provision of minimum flows to maintain rainbow trout habitat.

The Middle, Lower, and Coastal Rangitikei zones are influenced by the Tongariro Power Development (TPD) abstractions. The TPD, owned by Genesis Power Limited, is a major extractor from the headwaters of the Rangitikei River, abstracting the equivalent of approximately 16% of the mean annual low flow recorded at the Rangitikei at Mangaweka recorder site (Henderson, 2003). The allocation regime accounts for this abstraction as a part of the overall water resource assessment. To exclude this would be inconsistent with the many other consents held for abstraction from the Rangitikei River. The minimum flow recommendations for this catchment were developed based on flows naturalised to account for the TPD abstractions.

Minimum flows have been determined based on legislative requirements, water quality standards, requirements for recreational users, requirements for natural character, and instream habitat requirements as assessed by instream flow incremental methodology (IFIM).

The core allocation volumes (excluding TPD) for the Upper, Middle, Lower and Coastal Rangitikei management zones are 0, 0.67, 1.51, and 6.41 m^3/s, respectively. Since the allocation volumes for each zone were derived from flow data at their respective monitoring sites, and since flow is cumulative down through the catchment, the allocable volumes for the downstream zones include the flows allocable in the upstream zones (ie. allocable volume is also cumulative down through the catchment).

Therefore, total allocation in the entire catchment (all zones) is not to exceed 6.41 m^3/s, and total allocation in the Middle and Lower Rangitikei zones is not to exceed 1.51 m^3/s. These allocation volumes and the related minimum flows are set out in Table 8. This report further defines allocation limits for sub-zones that were not covered by the WRA, as the scope of the WRA was restricted to the main stem of the Rangitikei River only.

5.2.3 Upper Manawatu catchment

The Upper Manawatu catchment (Figure 4) is the area upstream of the Tiraumea confluence and is composed of six WMZs. Some of the larger zones have been split into sub-zones for ease of management. Water demand in this catchment is high, with the majority of available land used for farming. Conversion to high water demand land use activities has been a feature of development in this area over the last decade.

A comprehensive water resource assessment was completed by Horizons in 2006, as part of the water allocation project for the Upper Manawatu catchment (Roygard *et al.*, 2006). The report described the catchment (including geology, hydrology, land use, water quality, and ecology); identified the values within the catchment; set out minimum flows and allocation limits for the catchment; and provided recommendations for ongoing water management.

The minimum flow and allocation limit recommendations stated in the water resource assessment were based on the results of IFIM habitat surveys, which were carried out in the main stem of the Manawatu River in 1999 (Bee, 1999), and in several of the upper Manawatu tributaries in 2000 (Bee, 2000). These IFIM projects were reviewed and reanalysed for Horizons by Joe Hay and John Hayes at the Cawthron Institute in 2005, and the results used to guide the definition of minimum flows and allocation limits for the Upper Manawatu catchment, its zones, and sub-zones.

The minimum flows and allocation limits for the Upper Manawatu catchment are presented in Table 8.

Table 9: Sub-zones with minimum flows and allocation limits determined by Water Resource Assessments

Sub-zone name	Sub-zone code	Minimum flow m^3/s	Minimum flow monitoring site	Core allocation limit m^3/s
Upper Manawatu	Mana 1a	1.600	Manawatu at Weber Rd	0.204
Mangatewainui	Mana 1b	1.600	Manawatu at Weber Rd	0.063
Mangatoro	Mana 1c	0.702	Mangatoro at Mangahei Rd	0.204
Weber-Tamaki	Mana 2a	1.600	Manawatu at Weber Rd	0.251
Mangatera	Mana 2b	1.600	Manawatu at Weber Rd	0.047
Upper Tamaki	Mana 3	0.238	Tamaki at Water Supply Weir	0.078
Upper Kumeti	Mana 4	0.055	Kumeti at Te Rehunga	0.005
Tamaki-Hopelands	Mana 5a	2.980	Manawatu at Hopelands	0.971
Lower Tamaki	Mana 5b	0.360	Tamaki at Stephensons	0.138
Lower Kumeti	Mana 5c	0.055	Kumeti at Te Rehunga	0.059
Oruakeretaki	Mana 5d	0.293	Oruakeretaki at SH2 Napier	0.105
Raparapawai	Mana 5e	0.074	Raparapawai at Jacksons Rd	0.024
Hopelands-Tiraumea	Mana 6	2.980	Manawatu at Hopelands	1.049
Upper Ohau	Ohau 1a	0.820	Ohau at Rongomatane	0.280
Lower Ohau	Ohau 1b	0.820	Ohau at Rongomatane	0.280
Coastal Rangitikei	Rang 4a	10.230	Rangtikei at McKelvies	6.410
Tidal Rangitikei	Rang 4b	10.230	Rangtikei at McKelvies	6.410
Lower Rangitikei	Rang 3a	14.550	Rangitikei at Onepuhi	1.510

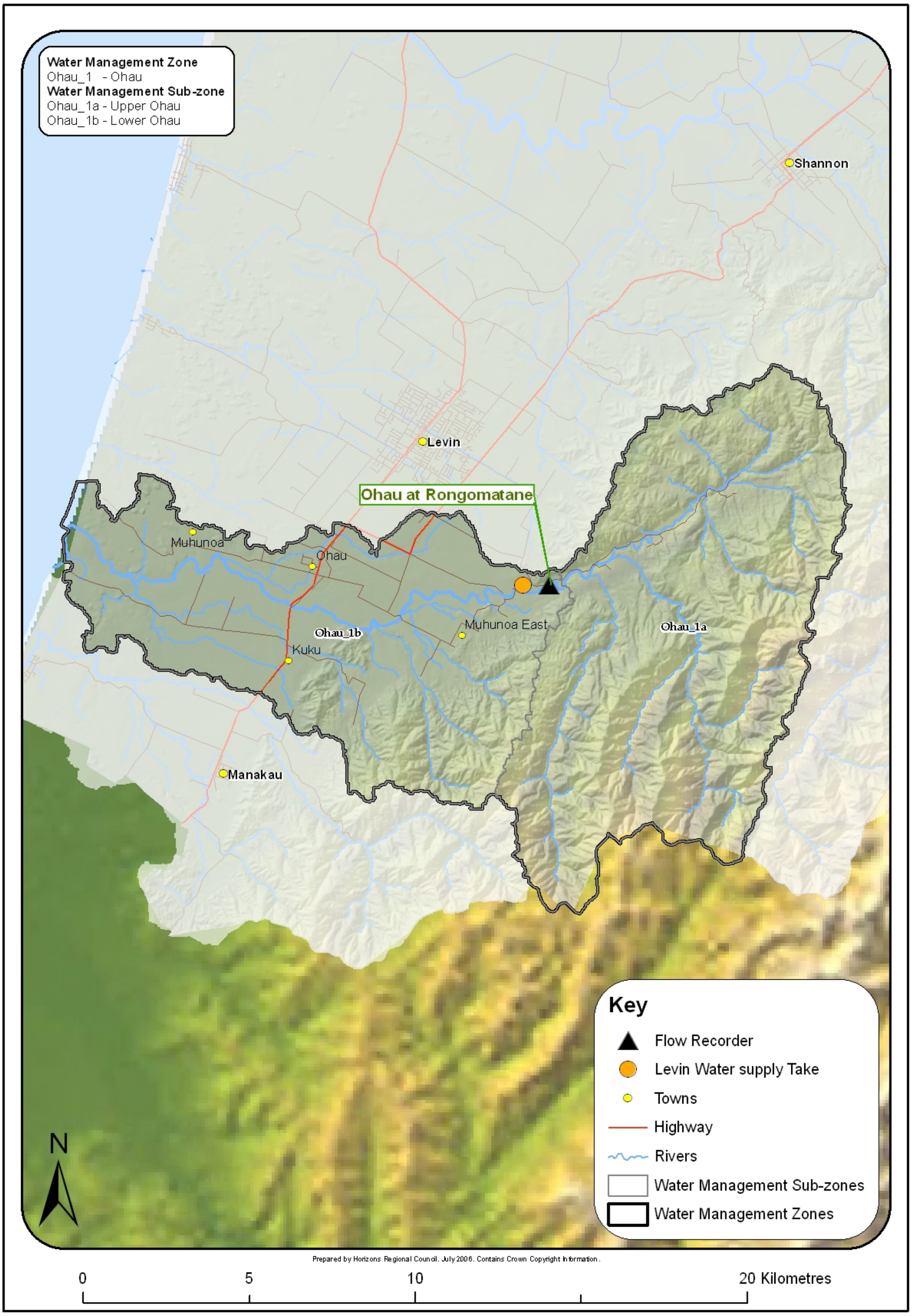


Figure 7: Map showing the Ohau catchment water management zones and sub-zones (Only the Levin water supply take is shown as it is referred to in the text)

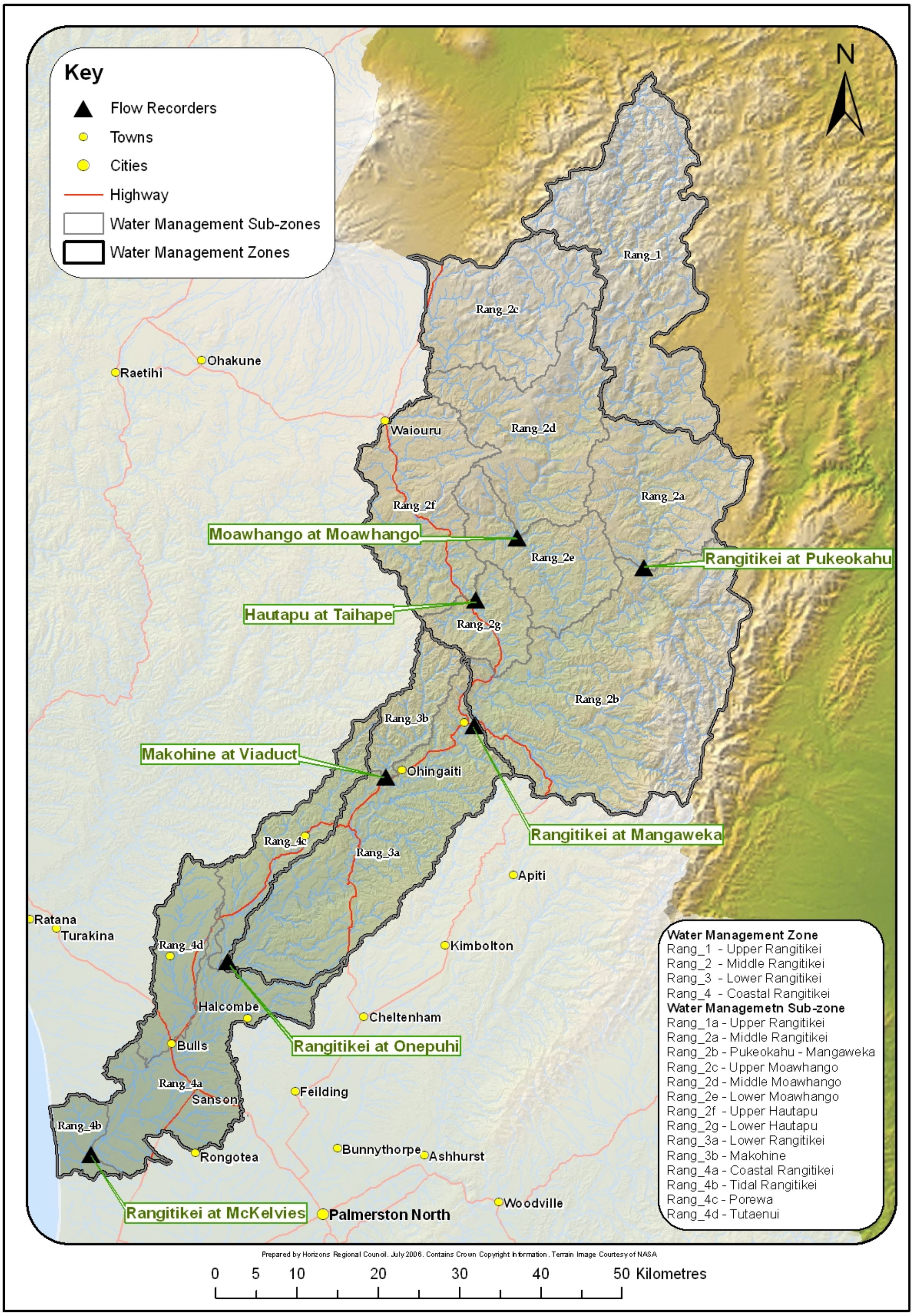


Figure 8: Map showing the Rangitikei catchment water management zones and sub-zones

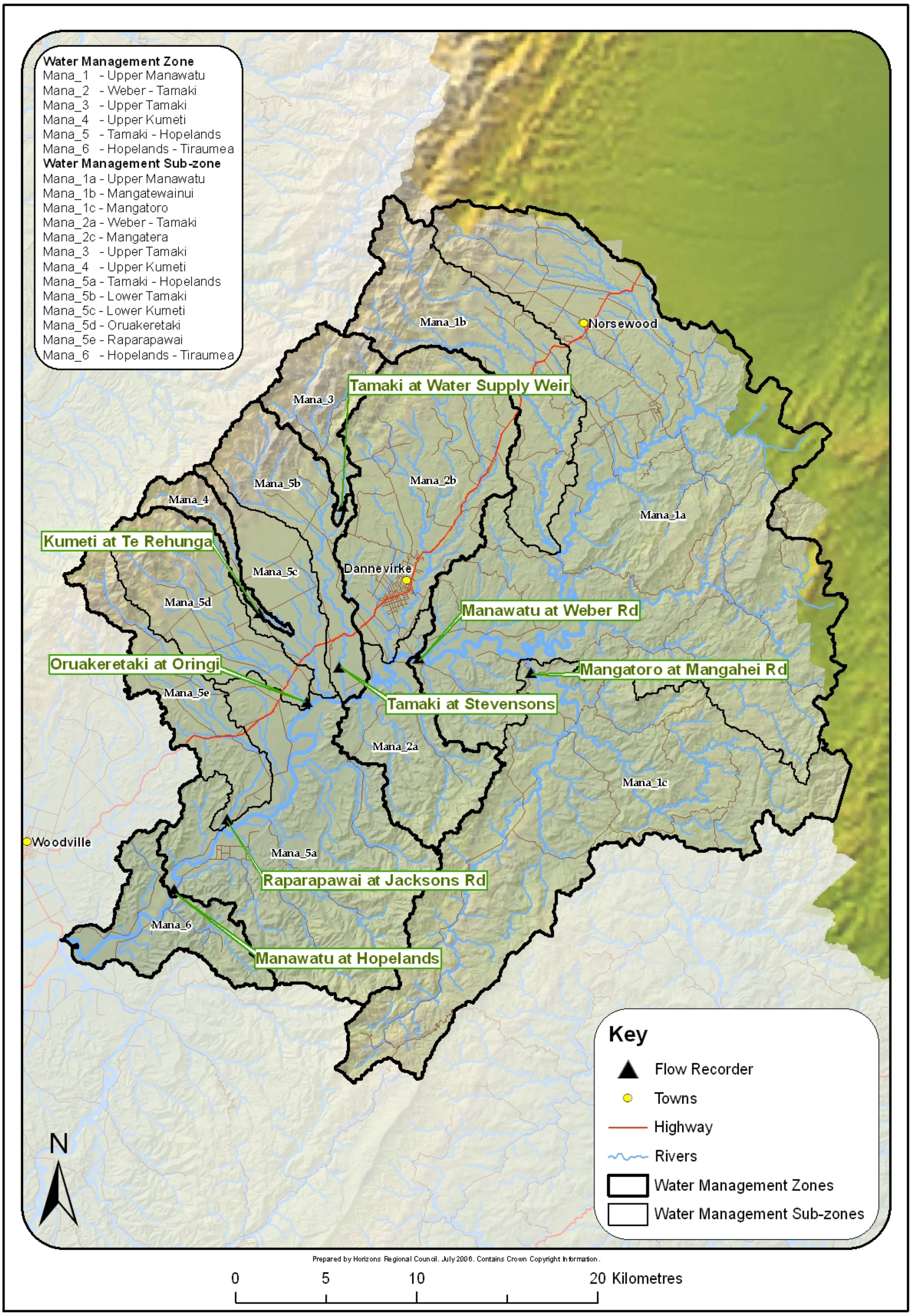


Figure 9: Map showing the Upper Manawatu catchment water management zones and sub-zones

5.3 Scenario 3 - Minimum flows and core allocations calculated using IFIM recommended flows

IFIM habitat modelling studies completed for the Mangapapa Stream (Bee, 2000) and the Oroua (Hay, 2006) and Pohangina Rivers (Hay and Hayes, 2006) have not yet been incorporated into full Water Resource Assessments but the recommendations from these studies have been used in setting minimum flows and allocation limits for these two rivers.

Mangapapa Stream (Bee, 2000)

- **Minimum flow**

The IFIM study on the Mangapapa was carried out on a reach of the river near Oxford Rd, upstream of the flow monitoring site for this water management sub-zone, Mangapapa at Troup Rd. The minimum flow at Oxford Rd, recommended by the IFIM study is 0.023 m^3/s. This corresponds to a minimum flow at Troup Rd of 0.033 m^3/s. Figure 6 illustrates the relationship between paired gaugings at the two sites used to estimate the appropriate minimum flow at Troup Rd.

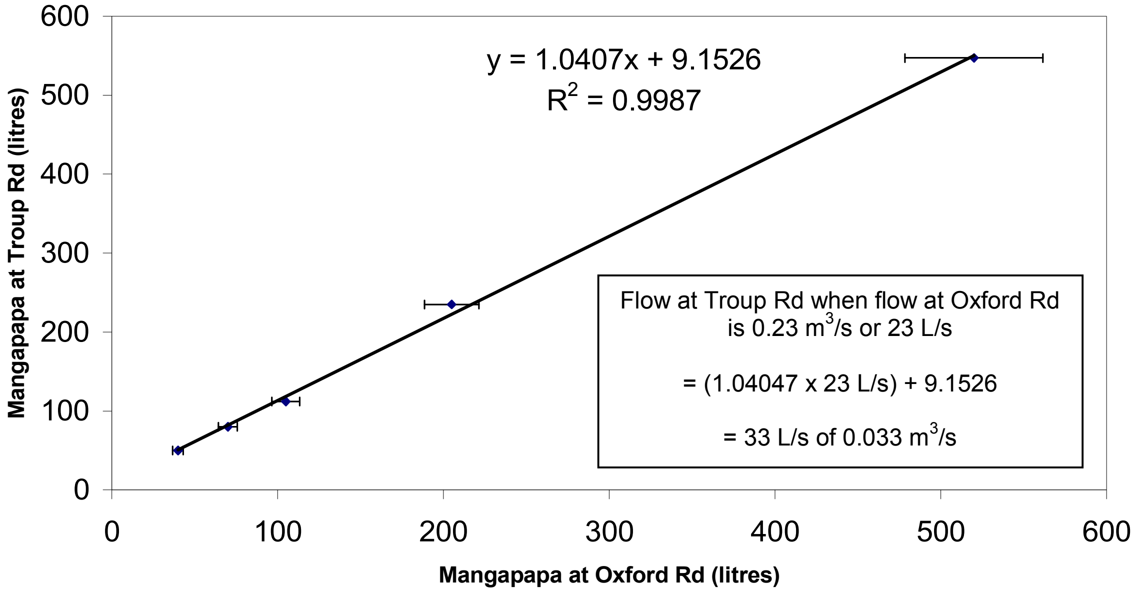


Figure 10: Graph illustrating the flow relationship between Mangapapa at Troup Rd and Mangapapa at Oxford Rd

The Mangapapa is a small stream and is almost completely unusable for adult brown trout. Native species such as longfin eel, dwarf galaxias, and upland bully are however, particularly suited to the Mangapapa Stream (Bee, 2000). It would be unreasonable to manage the Mangapapa Stream for the maintenance of brown trout habitat, therefore the minimum flow has been set to maintain habitat for the native species listed previously.

- **Management flow and core allocation limit**

With respect to the findings of the IFIM study, the core allocation limit for the Mangapapa has been set at 30% of the estimated MALF at Troup Rd.

(MALF * 0.3) + minimum flow = management flow
or
(0.035 m^3/s * 0.3) + 0.032 m^3/s = 0.043 m^3/s
so
Management flow - Minimum flow = core allocation
or
0.043 m^3/s - 0.032 m^3/s = 0.011 m^3/s

Frequency analysis is not possible for the minimum flow and management flow for the Mangapapa Stream at Oxford Rd at this time due to a short data record.

Pohangina River

- **Minimum flow**

The recommended minimum flow for the Pohangina River is 1.96 m^3/s measured at the Mais Reach flow recorder. This flow is predicted to maintain 90% of the available adult brown trout habitat at MALF, as recommended by the IFIM study completed in 2006. Mean annual low flow in this river is 2.32 m^3/s.

The flow record for the Pohangina was not naturalised for this exercise as the consented abstraction in the survey reach was determined to be within the margin of error of the flow gaugings in the reach.

Analysis of the flow distribution determined that this minimum flow could be expected to occur 1.8 days per year on average, with a range of 0–12.7 days at or below the minimum flow.

- **Management flow and core allocation limit**

The Pohangina River is a significant trout river, ranked 7th in a survey of angler use among 58 rivers in the Wellington Fish and Game region (Hay and Hayes, 2006). Although the IFIM survey results give greater certainty as to the instream habitat requirements in the river than can be estimated using non-habitat based methods, because the minimum flow for this river is set below MALF at the Mais Reach flow recorder and the instream values are high, the management flow is set as the sum of the minimum flow plus 20% of the MALF or 2.42 m^3/s. This is set out in the equations below:

(MALF * 0.2) + minimum flow = management flow
or
(2.32 m^3/s * 0.2) + 1.96 m^3/s = 2.42 m^3/s
so
Management flow - Minimum flow = core allocation
or
2.42 m^3/s - 1.96 m^3/s = 0.46 m^3/s

The management flow can be expected to occur 6.6 days per year on average, with a range of 0–26.3 days bearing in mind, that under full allocation the frequency of occurrence of the minimum flow will be equal to the frequency of occurrence of the management flow before abstraction. Hence, if the core allocation is fully allocated and all consents are being fully exercised, the frequency of occurrence of the minimum flow would increase from an average of 1.8 days per year, to an average of 6.6 days per year.

Oroua River

- **Minimum flow**

It was recommended that 80% of adult brown trout habitat be retained for the Oroua River, based on the relative value of the fishery. The minimum flow recommended to achieve this is 1.05 m^3/s at the Oroua at Kawa Wool flow recorder site, based on the IFIM study results.

In order to produce this IFIM recommendation, the flow record for the Oroua was naturalised (ie. the flow record that would have been recorded, had there been no abstraction) to derive a naturalised MALF. The naturalised MALF at this site is 1.35 m^3/s. The process for naturalising the flow record is explained in Appendix A.

- **Management flow and core allocation limit**

The management flow for the Oroua River is 1.39 m^3/s (rounded to 1.40 m^3/s). This is the sum of the IFIM recommended minimum flow plus 30% of the MALF. The allocation of 30% of the MALF is slightly higher than that allocated in most other WMZs, as the information derived from the IFIM study in the Oroua River gives a greater level of certainty as to the level of habitat protection required in this river. The Oroua is not as highly valued as a trout river as some others in the Region and its native fish community is not exceptional. This means that more water is considered to be available for allocation to out-of-stream users. Also, analysis of the flow distribution indicates that allocation of 30% of the MALF would not result in an excessively large number of days of flow restriction for abstractors. The minimum flow and core allocation for the Oroua River are summarised here:

(MALF * 0.30) + minimum flow = management flow
or
$(1.35\ m^3/s * 0.30) + 1.05\ m^3/s = 1.46\ m^3/s$
so
Management flow - Minimum flow = core allocation
or
$1.46\ m^3/s - 1.05\ m^3/s = 0.41\ m^3/s$

Analysis of the flow distribution indicated that the management flow, and thus water take restrictions, are expected to occur 13.3 days per year on average, with a range of 0–40.1 days. In the absence of abstraction the minimum flow could be expected to occur 2.9 days per year on average, with a range of 0–19.2 days.

Kiwitea and Makino Streams

- **Minimum flows**

The Kiwitea and Makino Streams are the major tributaries of the Oroua River. A baseline study of the biodiversity and life-supporting capacity conducted by Fowler *et al.* (1999) found that the life-supporting capacity of the streams was generally low. This may have been related to both water quality and quantity factors. IFIM surveys were completed for these streams in the summer of 1999 to determine what effects low flows and abstraction might have on the life-supporting capacity of the streams, particularly for trout, native fish, and invertebrates (Bee, 1999). Water temperature was found to be a limiting factor for instream species in the Kiwitea Stream and to a lesser extent in the Makino Stream. Water temperature increase and diurnal fluctuation are directly related to decreased flow during hot, dry weather.

The IFIM results for both streams indicated that adult brown trout would have little suitable habitat available at any flow, therefore it would be unreasonable to manage the streams for the maintenance of trout habitat. In these streams, common bully have the next highest flow requirements and the greatest amount of habitat available at MALF. Therefore the IFIM minimum flow recommendations for maintenance of common bully habitat have been selected as the minimum flows for the Kiwitea and Makino Streams.

For the Kiwitea Stream the minimum flow recommended by IFIM to maintain 90% of the optimum habitat for common bully is 0.145 m^3/s. Using the same criteria for the Makino Stream, the minimum flow is recommended to be 0.080 m^3/s. Coincidentally, this recommended flow is also the MALF of the Makino Stream at Boness Rd flow recorder.

- **Management flow and core allocation limit**

In line with the limit set for the Oroua River and the results of the IFIM studies, the core allocation limit for the Kiwitea and Makino was set at 30% of the MALF for both streams.

Kiwitea Stream

(MALF * 0.30) + minimum flow = management flow
or
(0.161 m^3/s * 0.30) + 0.145 m^3/s = 0.193 m^3/s
so
Management flow - Minimum flow = core allocation
or
0.193 m^3/s - 0.145 m^3/s = 0.048 m^3/s

Analysis of the flow distribution indicated that the management flow for the Kiwitea Stream, and thus take restrictions are expected to occur 24.1 days per year on average, with a range of 0–96.4 days. In the absence of abstraction the minimum flow could be expected to occur 11.2 days per year on average, with a range of 0–72.8 days.

Makino Stream

(MALF * 0.30) + minimum flow = management flow
or
$(0.080\ m^3/s * 0.30) + 0.080\ m^3/s = 0.104\ m^3/s$
so
Management flow - Minimum flow = core allocation
or
$0.104\ m^3/s - 0.080\ m^3/s = 0.024\ m^3/s$

Analysis of the flow distribution indicated that the management flow, and thus take restrictions, are expected to occur 37.1 days per year on average, with a range of 0–100 days. In the absence of abstraction the minimum flow could be expected to occur 12.7 days per year on average, with a range of 0–60 days at or below the minimum flow.

The minimum flows and core allocation limits for these rivers and streams, which have minimum flows set based on the results of IFIM studies. are presented in Table 9.

Table 10: Sub-zones with minimum flows and allocation limits determined by IFIM (Scenario 3)

Sub-zone	Minimum flow m^3/s	Minimum flow monitoring site	Core allocation limit m^3/s
Mangapapa (Mana 9b)	0.023	Mangapapa at Troup Road	0.010
Middle Pohangina (Mana 10c)	1.960	Pohangina at Mais Reach	0.460
Lower Pohangina Mana 10d)	1.960	Pohangina at Mais Reach	0.525
Upper Oroua (Mana 12a)	1.050	Oroua at Kawa Wool	0.405
Middle Oroua (Mana 12b)	1.050	Oroua at Kawa Wool	0.429
Lower Oroua (Mana 12c)	1.050	Oroua at Kawa Wool	0.530
Kiwitea (Mana 12d)	0.145	Kiwitea at Haynes Line	0.048
Makino (Mana 12e)	0.080	Makino at Boness Rd	0.025

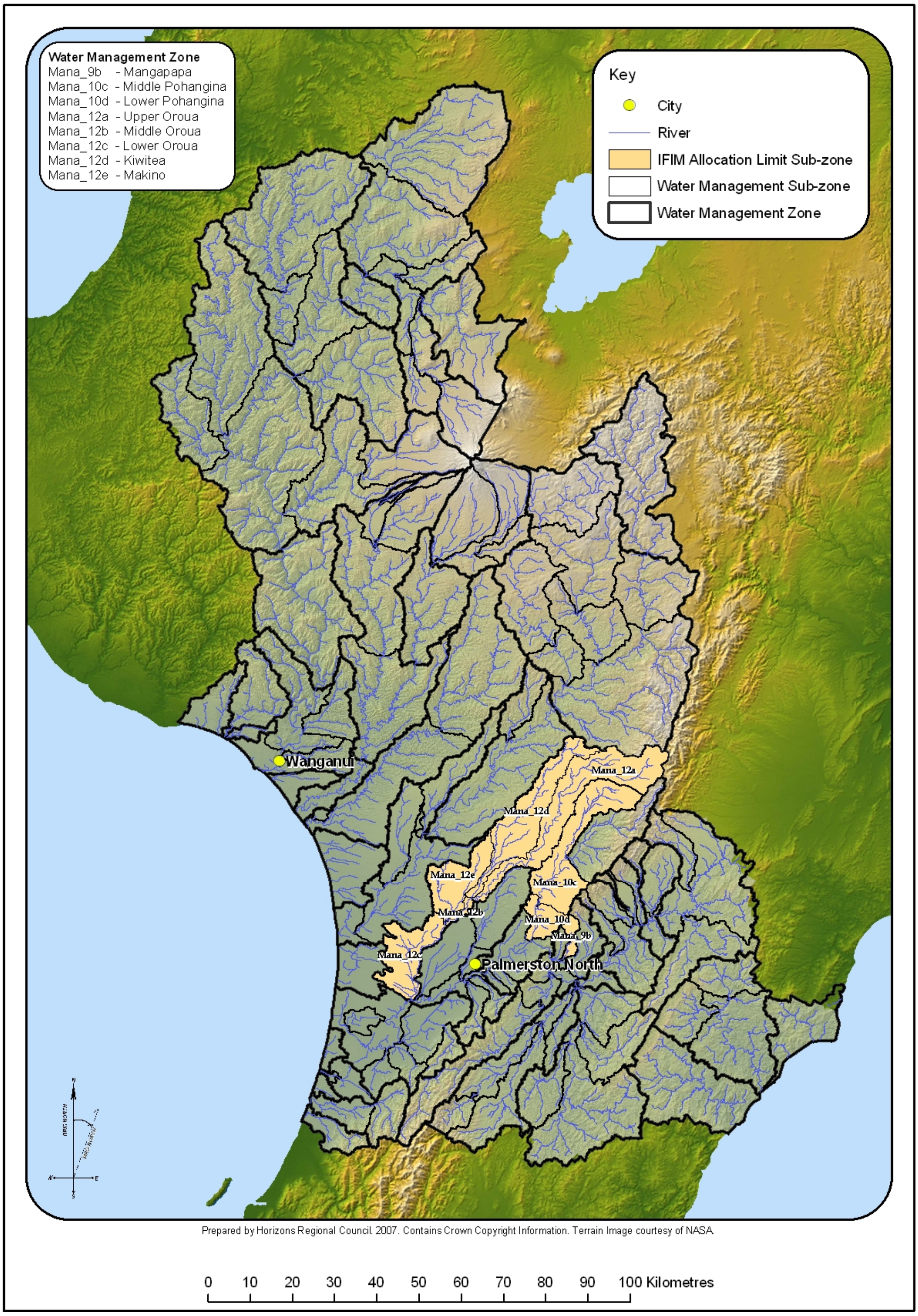


Figure 11: Map showing Water Management sub-zones with minimum flows and allocation limits determined by IFIM (Scenario 3)

5.4 Scenario 4 - Minimum flows and core allocations calculated using MALF (LWCNs/Regional Plans)

Rivers and streams that have been protected by Local Water Conservation Notices and provisions of the LWCNs (Table 10) have been incorporated into the Horizons Land and Water Regional Plan (and subsequently the One Plan), and are all recognised as regionally significant trout fisheries. Work completed by Horizons Regional Council to identify community values in regard to the Region's waterways confirmed the importance of these fisheries to the community[12]. Because these waterways have high instream values it follows that they should be afforded a high level of protection, while providing for the needs of water users in the WMZ (without compromising the values).

The allocation limit for the Hautapu and Mangatainoka Rivers is set at 15% of the MALF, and 5% of the MALF for the Makuri Stream, following an interpretation of the intent of the LWCN. These are more conservative volumes than the majority of the limits set using the "statistics method" (Scenario 5, see Section 3.5 and Section 5.5) or the "default method" (Scenario 6, see Section 3.6), and are justified for these streams given their regional significance as trout fisheries. The 15% allocation limit for the Mangatainoka River includes the water allocated to the Tararua District Council for the Pahiatua public water supply. However, the new allocation limit means that there is now some water available for uses besides the public water supply.

Table 10 lists the Water Management sub-zones where Scenario 4 applies and their respective minimum flows and core allocation limits.

Streams that fall into this category (ie. Scenario 4) include:

Hautapu River	-	upstream of the Oraukura Stream + all tributaries
Makuri Stream	-	upstream of the Tiraumea River + all tributaries
Mangatainoka River	-	upstream of Tiraumea River + all tributaries (eg. the Makakahi and Mangaramarama).

[12] Identifying Community Values to Guide Water Management in the Manawatu-Wanganui Region – Technical Report to Support Policy Development, Horizons Regional Council, 2007.

Table 11: Sub-zones with minimum flows and allocation limits determined by the requirements of Local Water Conservation Notices

Sub-zone	Minimum flow m^3/s	Minimum flow monitoring site	Core allocation limit m^3/s
Makuri (Mana 7d)	2.160	Makuri at Tuscan Hills	0.108
Upper Mangatainoka (Mana 8a)	0.400	Mangatainoka at Larsons Rd	0.060
Middle Mangatainoka (Mana 8b)	1.580	Mangatainoka at Pahiatua Town Bridge	0.105
Lower Mangatainoka (Mana 8c)	1.580	Mangatainoka at Pahiatua Town Bridge	0.289
Makakahi (Mana 8d)	0.345	Makakahi at Hamua	0.052
Mangaramarama (Mana 8e)	1.860	Mangatainoka at Pahiatua Town Bridge	0.009
Upper Hautapu (Rang 2f)	0.745	Hautapu at Alabasters	0.112

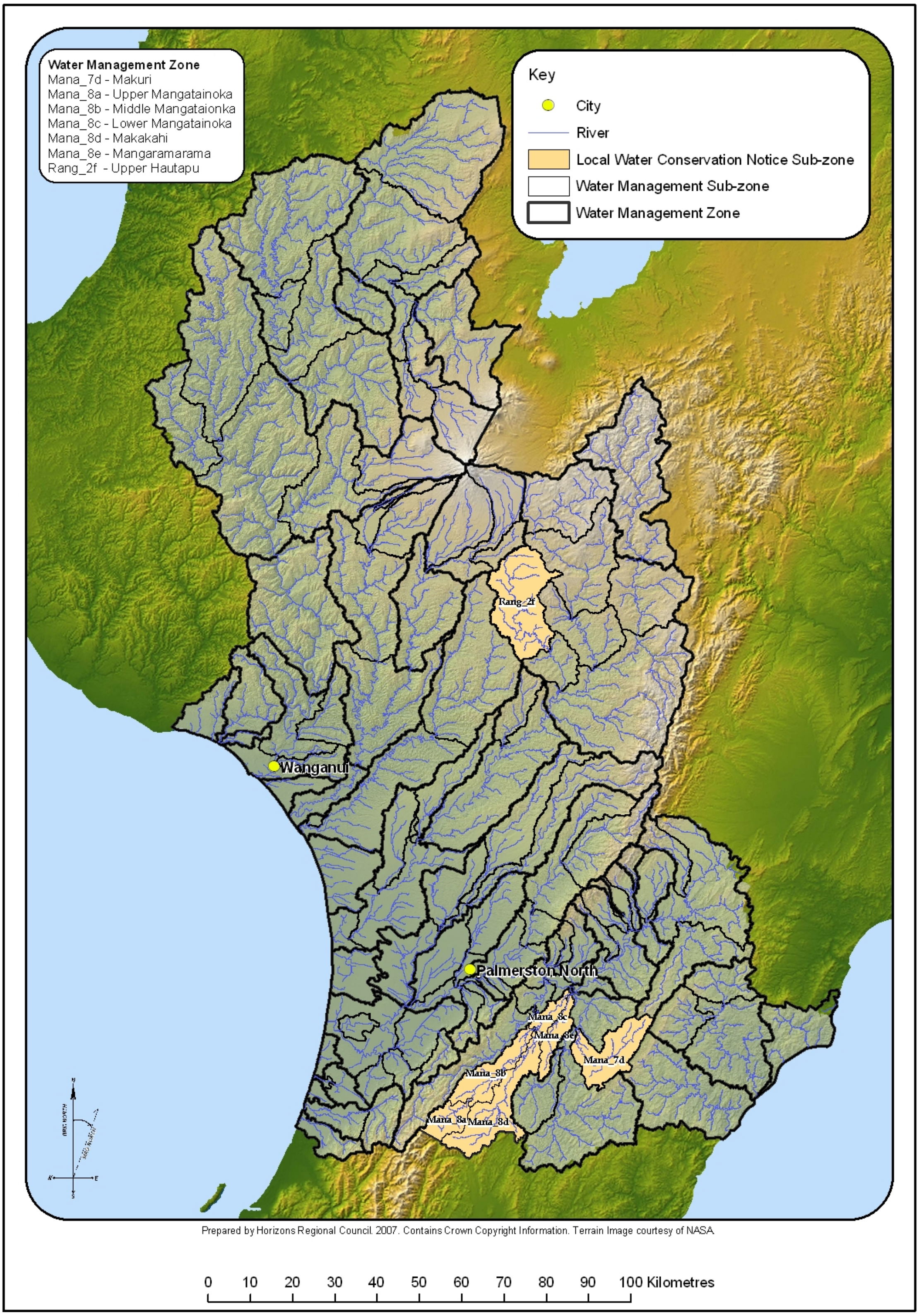


Figure 12: Map showing Water Management sub-zones with minimum flows and allocation limits determined by the requirements of Local Water Conservation Notices

5.5 Scenario 5 - Minimum flows and core allocations calculated using hydrological statistics

This method is known as the "statistics method" and applies where none of the following are available:

- NWCOs
- Water Resource Assessments
- IFIM studies
- LWCNs

But only where there are "robust" hydrological records (ie. greater than 10 years of record), otherwise the "default" (statistics) method applies (see Section 3.6).

Catchment area extrapolation was required to determine MALFs for some of the sub-zones in the Region, due to the current positioning of the flow recorders in the WMZ. The details of this exercise are provided in Appendix B. It is recognised that catchment area extrapolation is less accurate in determining flow statistics than detailed analysis using flow correlations (eg. comparing gauging pairs at two locations). However, the catchment area extrapolation method has been applied here to provide a "best estimate", based on existing data. Results of projects such as the "Low Flow Gauging Project" and ongoing monitoring will enable further investigation of the flow relationships.

Robust hydrological records are available for a number of flow recorder sites relevant to water management sub-zones. Table 11 lists sub-zones where the "statistics method" has been applied.

Table 12: Sub-zones with minimum flows and allocation limits determined using hydrological statistics

Sub-zone	Minimum flow m^3/s	Minimum flow monitoring site	Core allocation limit m^3/s
Lower Manawatu (Mana 11a	14.160	Manawatu at Teachers College	3.180
Middle Manawatu (Mana 10a	14.160	Manawatu at Teachers College	3.150
Upper Gorge (Mana 9a	10.530	Manawatu at Upper Gorge	2.340
Upper Tiraumea (Mana 7a	2.140	Tiraumea at Ngaturi	0.475
Lower Tiraumea (Mana 7b	2.140	Tiraumea at Ngaturi	0.550
Upper Tokomaru (Mana 13b	0.220	Tokomaru at Horseshoe Bend	0.050
Lower Hautapu (Rang 2g	0.670	Hautapu at Alabasters	0.150
Makohine (Rang 3b	0.036	Makohine at Viaduct	0.008
Owahanga (Owha 1	0.040	Owahanga at Branscombe Bridge	0.010
Upper Turakina (Tura 1a	0.345	Turakina at Otairi Rd	0.075
Lower Turakina (Tura 1b	0.830	Turakina at O'Neills Bridge	0.185
Lower Mangawhero (Whau 3e	2.520	Mangawhero at Ore Ore	0.560
Lower Whangaehu (Whau 3a	13.240	Whangaehu at Kauangaroa	2.940
Upper Makotuku (Whau 3b	0.100	Makotuku at SH49a Bridge	0.023
Upper Whangaehu (Whau 1a	9.790	Whangaehu at Karioi	2.175
Waitangi (Whau 1b	0.475	Waitangi at Tangiwai	0.105
Tokiahuru (Whau 1c	4.340	Tokiahuru at Whangaehu Junction	0.960
Kai Iwi (West 2	0.470	Kai Iwi at Handley Rd	0.105

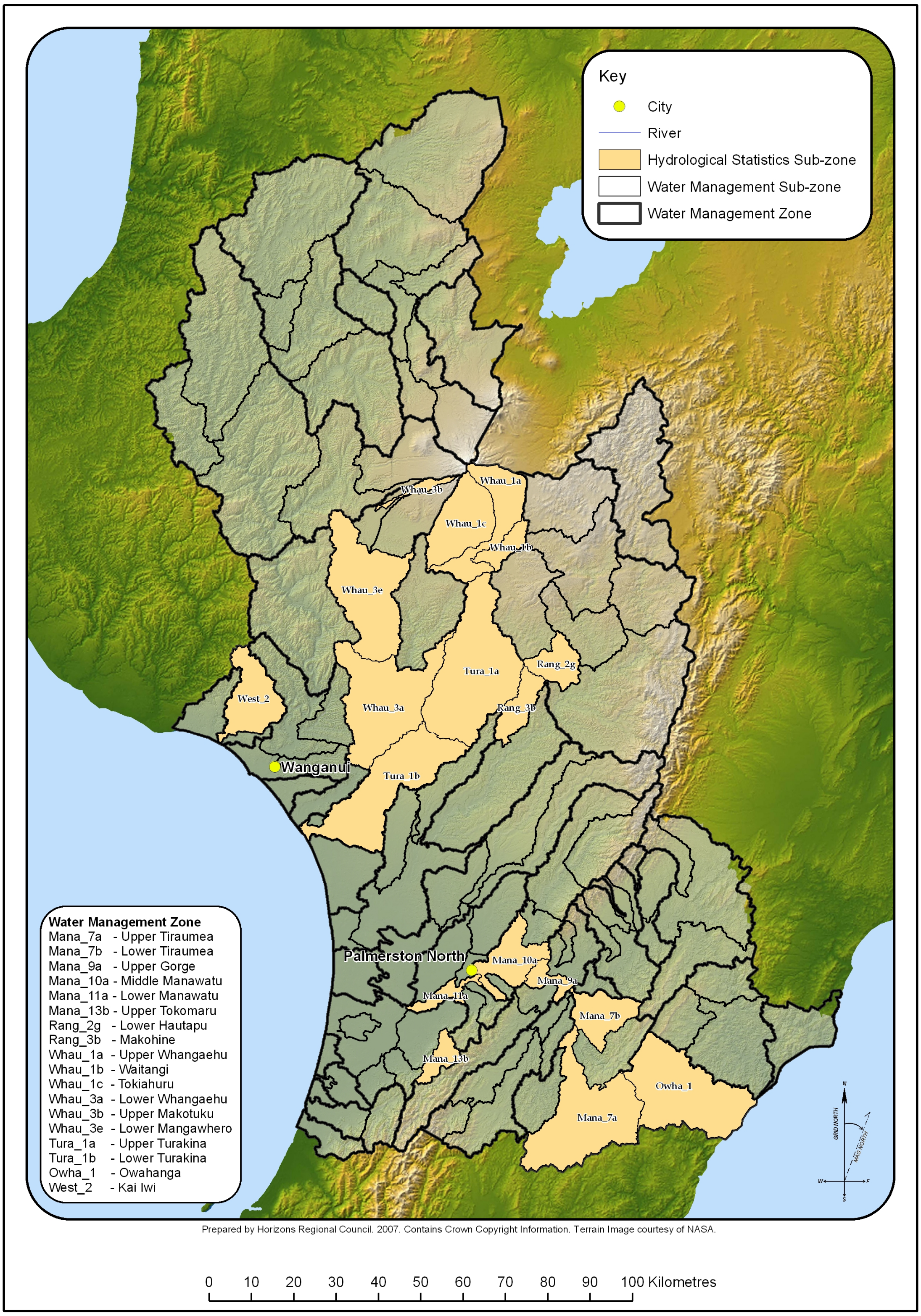


Figure 13: Map showing Water Management sub-zones with minimum flows and core allocations determined by hydrological statistics

6. Whole zone core and cumulative allocation limits

6.1.1 Whole zone totals

Table A (p. i-viii) sets out the water management sub-zones with their respective minimum flows (m^3/s) and individual core allocation limits (m^3/s). Where one or more sub-zones constitute a WMZ, the maximum allocation allowed in that WMZ is stated as a whole zone core allocation limit below the sub-zone group (eg. whole zone [Mana 1]). This whole zone limit is always equal to the greatest sub-zone allocation limit in the WMZ. Effectively this means that allocation may be distributed across the sub-zones, as long as the sub-zone core allocation limit for any individual sub-zone is not exceeded and the whole zone allocation limit for the WMZ is not exceeded, ie. the whole zone allocation limit sets the upper limit for cumulative allocation, tallied over sub-zones, within the given zone). Table 12 shows the Upper Manawatu WMZ example (an excerpt from Table A). The whole zone core allocation limit is 0.204 m3/s. This is the maximum allocation that can occur across all three sub-zones, while all 0.204 m^3/s could be allocated from either Mana 1a or Mana 1c and a maximum of 0.63 m^3/s could be allocated from Mana 1b.

Table 13: Example of whole zone core allocation limit

Water Management Zone	Sub-zone	Minimum flow (m^3/s)	Flow monitoring site	Core allocation limit (m^3/s)	Existing allocation (m^3/s)
Upper Manawatu (Mana 1)	Upper Manawatu (Mana 1a)	1.600	Manawatu at Weber Rd	0.204	0.006
	Mangatewainui (Mana 1b)	1.600	Manawatu at Weber Rd	0.063	0.084
	Mangatoro (Mana 1c)	0.702	Mangatoro at Mangahei Rd	0.204	0.015
Whole zone (Mana 1)				**0.204**	**0.105**

6.1.2 Cumulative allocable volumes explained

In addition to whole zone allocation limits, Table A summarizes the WMZ core allocation limits into cumulative allocable volumes, for groups of WMZs in a catchment. This grouping only occurs where one WMZ flows into the next down a catchment, linked by the main stem waterway or its tributaries. In Table A, the cumulative allocable volume row is clearly labelled to show which WMZs are represented by each total. The principle behind these cumulative allocable volumes is similar to that for the whole zone allocation limits, but on a catchment scale. Table 13 is an excerpt from Table A and provides an example:

Table 14: Example of cumulative allocable volume by Water Management Zone

Water Management Zone	Sub-zone	Minimum flow (m3/s)	Flow monitoring site	Cumulative core allocation limit (m3/s)
Upper Manawatu (Mana 1)	Upper Manawatu (Mana 1a)	1.600	Manawatu at Weber Rd	0.204
	Mangatewainui (Mana 1b)	1.600	Manawatu at Weber Rd	0.063
	Mangatoro (Mana 1c)	0.702	Mangatoro at Mangahei Rd	0.204
Whole zone (Mana 1)				**0.204**
Weber-Tamaki (Mana 2)	Weber-Tamaki (Mana 2a)	1.600	Manawatu at Weber Rd	0.251
	Mangatera (Mana 2b)	1.600	Manawatu at Weber Rd	0.047
Cumulative allocable volume (Mana 1 + Mana 2)				**0.251**
Upper Tamaki (Mana 3)	Upper Tamaki (Mana 3)	0.238	Tamaki at Water Supply Weir	0.078
Upper Kumeti (Mana 4)	Upper Kumeti (Mana 4)	0.055	Kumeti at Te Rehunga	0.005
Tamaki-Hopelands (Mana 5)	Tamaki-Hopelands (Mana 5a)	2.980	Manawatu at Hopelands	0.971
	Lower Tamaki (Mana 5b)	0.360	Tamaki at Stephensons	0.138
	Lower Kumeti (Mana 5c)	0.055	Kumeti at Te Rehunga	0.059
	Oruakeretaki (Mana 5d)	0.293	Oruakeretaki at SH2 Napier	0.105
	Raparapawai (Mana 5e)	0.074	Raparapawai at Jacksons Rd	0.024
Cumulative allocable volume (Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5)				**0.971**
Hopelands-Tiraumea (Mana 6)	Hopelands-Tiraumea (Mana 6)	2.980	Manawatu at Hopelands	1.049
Cumulative allocable volume (Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6)				**1.049**

Upper Manawatu (Mana 1) is the uppermost WMZ in the Manawatu catchment. Weber-Tamaki (Mana 2) is immediately downstream of Mana 1 (ie. the main stem of the Manawatu River flows from Mana 1 into Mana 2). The maximum allocation available in any of the sub-zones comprising either Mana 1 or Mana 2 is 0.251 m^3/s, therefore the cumulative allocable volume (or maximum allocation possible) for Mana 1 and Mana 2 combined is 0.251 m^3/s. As with the whole zone core allocation limits, the allocation can be distributed across either of the WMZs, as long as individual sub-zone limits and WMZ core allocation limits are not exceeded.

In Table 13, WMZs Mana 1 through to Mana 6 follow sequentially down the Manawatu catchment, although Mana 3 and 4 are not directly connected to the mainstem. Therefore, the cumulative allocable volume from the top of Mana 1 to the bottom of Mana 6 is 1.049 m^3/s, ie. the maximum volume of water that can be allocated across all six WMZs is 1.049 m^3/s. The spatial association of the WMZs in this example is illustrated in Map 5, and on page 17 of the WMZs Report.

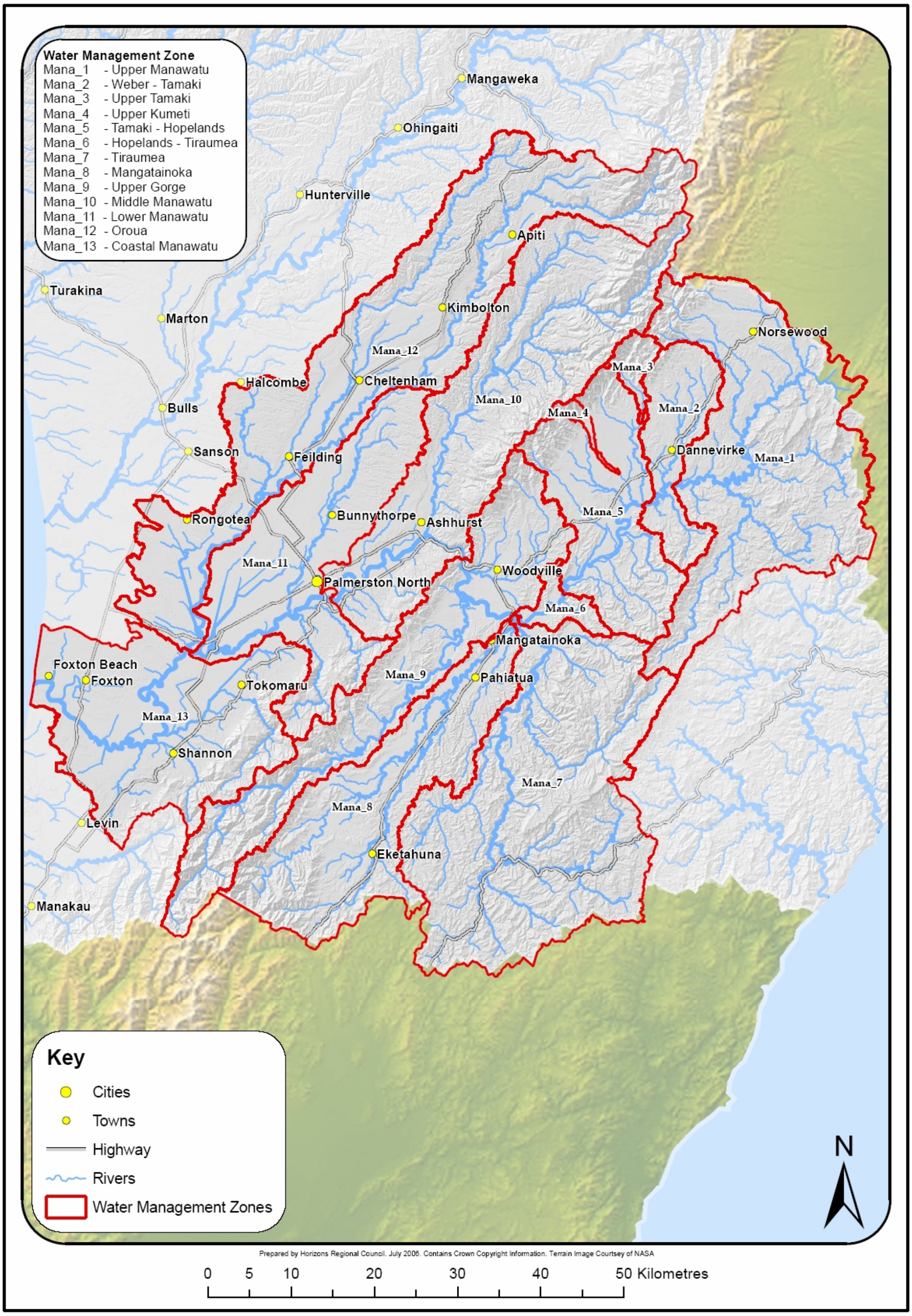


Figure 14: Map showing the Manawatu River catchment and water management zones

6.2 Framework outputs

Eight WMZs have minimum flows and core allocations for all their sub-zones determined by either NWCOs, WRAs or IFIM studies. These limits are considered to be confirmed and are summarised in Table A .

The whole zone totals listed in Table A refer to the maximum volume that can be allocated from the WMZ (as discussed above, Sections 6.1.1), or the cumulative allocation of all the sub-zones in that WMZ. When applications for consent to take water from any sub-zone are processed, the volume of water applied for will be assessed against the whole zone allocation limit.

The sub-zones to which Policy 6.19 (see Appendix F) applies are listed, but the whole zone and cumulative allocable volume totals exclude any allocation from these sub-zones because there is currently insufficient hydrological data to determine minimum flows and core allocations for these zones.

Figure 10 shows the WMZs and sub-zones in the Horizons Region, colour-coded to indicate the Scenario (see Section 3) each falls into and, therefore, the method used to derive minimum flows in that WMZ.

As the Region's economy grows, demand for surface water in some of the Water Management Zones will increase. Horizons recognises the need to keep abreast of this demand and has a process in place to ensure that minimum flows and core allocations for WMZs with increasing demands for surface water abstraction are up-to-date and appropriate.

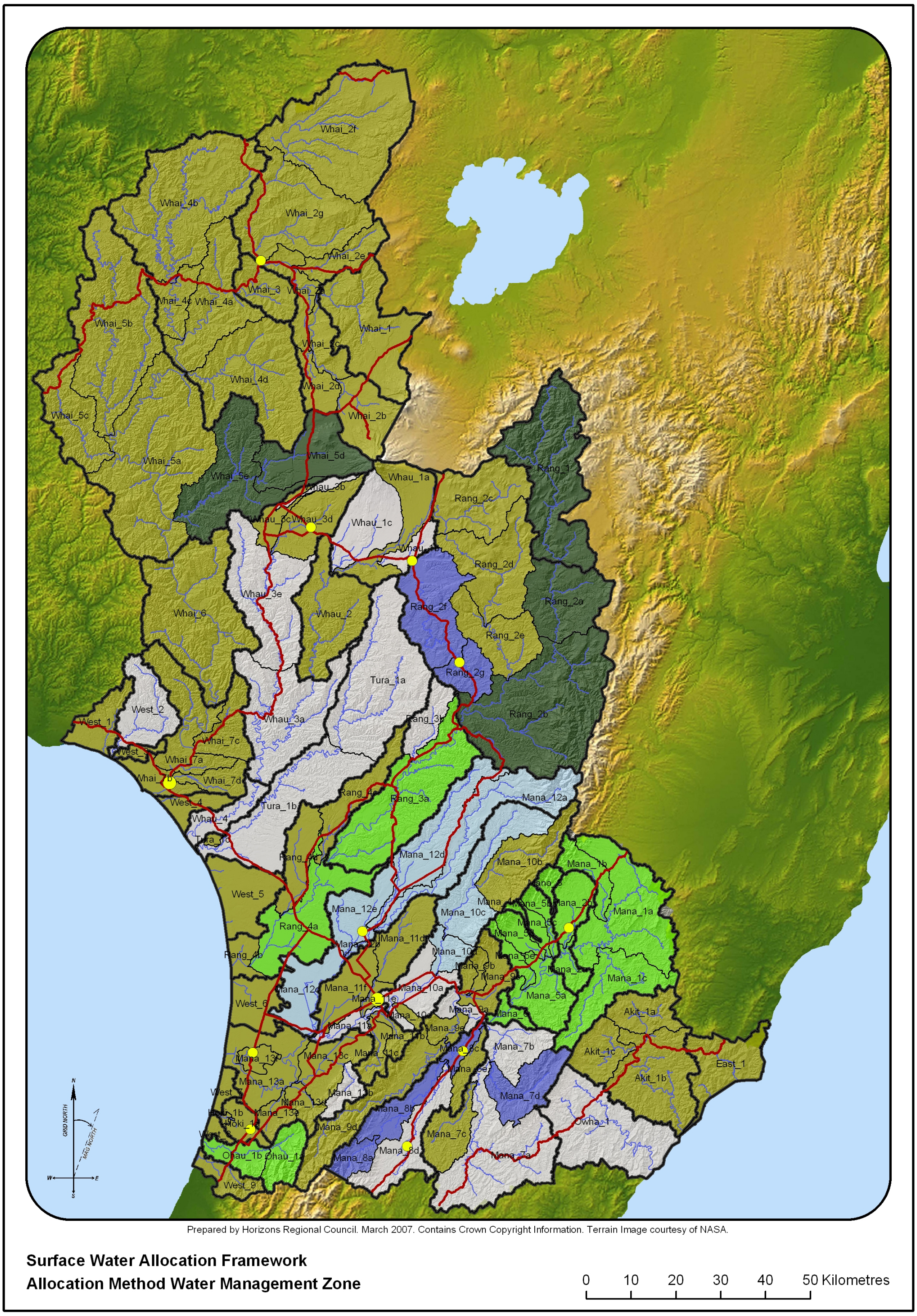


Figure 15: Map showing water management zones and sub-zones colour-coded to indicate the Scenario applied in the water allocation framework

References

Ausseil, O. & Clark M. 2007. Identifying community values to guide water management in the Manawatu-Wanganui Region draft. Technical report to support policy development, Report No. 2007/EXT786. ISBN. 1-877413-76-3.

Bee, A.W. 1999. An instream flow assessment for the Kiwitea and Makino Streams. Horizons Regional Council, Report No. 99/EXT/379.

Bee, A.W., 2000. An instream flow assessment for the Upper Manawatu River tributaries. Horizons Regional Council, Report No. 20/EXT/423.

Death, R., Joy, M. & Death F. 2005. Freshwater fish diversity and distribution in the upper Manawatu River. A review for Horizons Regional Council. Institute of Natural Resources – Ecology, Massey University.

Fowler R.T., Dunning K.J. & Henderson I.M. 1999. Benthic Macroinvertebrate Communities of Selected Rivers in the Oroua Catchment: a baseline biomonitoring survey of benthic community structure. Institute of Natural Resources, Massey University.

Hay, J. 2006. Instream flow assessment for the Oroua River. Prepared for Horizons Regional Council by Cawthron Institute, Cawthron Report No. 1179.

Hay, J. 2007. Instream flow assessment options for Horizons Regional Council. Prepared for Horizons Regional Council by Cawthron Institute, Cawthron Report No. 1242, Horizons Report No. 2007/EXT/772.

Hay, J. & J. Hayes. 2004. Instream flow assessment for the Rangitikei River: additional analyses. Prepared for Horizons Regional Council. Cawthron Report No. 930.

Hay, J. & J. Hayes. 2005a. Review of Horizons' upper Manawatu water resource assessment draft report. Prepared for Horizons Regional Council. Cawthron Report No. 1121.

Hay, J. & J. Hayes. 2005b. Instream flow assessment for the upper Manawatu River and tributaries: additional analysis. Prepared for Horizons Regional Council. Cawthron Report No. 1029.

Hay, J. & Hayes, J. W. 2006. Instream flow assessment for the Pohangina River. Prepared for Horizons Regional Council by Cawthron Institute, Cawthron Report No. 1080.

Hayes, J.W. & Jowett, I.G. 1994. Microhabitat models of large drift-feeding brown trout in three New Zealand rivers. North American Journal of Fisheries Management 14: 710-725.

Henderson, R. 2003. The effect of TPD diversions on the hydrology of the Moawhango and Rangitikei Rivers. Prepared for ECNZ Thermal/Tongariro Generation Group. NIWA Client report CHC98/75 v2.

Henderson R. & Diettrich J. 2006. Statistical analysis of river flow data in the Horizons Region. NIWA Client Report: CHC2006-154.

Horizons Regional Council 2003. Land and Water Regional Plan. Report No. 2003/EXT/559.

Horizons Regional Council 2005. State of the Environment Report of the Manawatu-Wanganui Region – 2005. Report No. 2004/EXT/608.

Horizons Regional Council 2007. Proposed One Plan – The consolidated Resource Policy Statement, Regional Plan and the Regional Coastal Plan for the Manawatu-Wanganui Region. Report No. 2007/EXT/777.

Horizons Regional Council Environmental Information Team 2003. Water Allocation Project Ohau River: Water Resource Assessment – allocation limits and minimum flows. Technical report to support policy development, Report No. 2003/EXT/575.

Jowett I. G. & Hayes, J.W. 2004. Review of methods for setting water quantity conditions in the Environment southland draft Regional Water Plan. Prepared for Environment Southland by NIWA and Cawthron Institute. NIWA Client Report No. HAM2004-018.

Jowett I. and Mosley P. 2004. Analysis of instream values. *Freshwaters of New Zealand*, NZ Hydrological Society & NZ Limnological Society, 2004 (Eds: Harding, Mosley, Pearson & Sorrell).

McArthur K., Roygard J., & Ausseil O. 2006. Development of water management zones in the Manawatu-Wanganui Region. Technical report to support policy development, Horizons Regional Council, Report No: 2006/EXT/733

Manawatu-Wanganui Regional Council, c. 1991, Transitional Regional Plan.

Ministry for the Environment 1998. Flow guidelines for instream values, Volume A. ISBN 0-478-09023-4.

Roussel, J., Bardonnet, A. & Claude, A. 1999. Microhabitats of brown trout when feeding on drift and when resting in a lowland salmonid brook: effects on Weighted Usable Area. Archiv für Hydrobiologie 1999, Vol. 146, No. 4: 413-429.

Roygard J. & Carlyon G. 2004. Water Allocation Project Rangitikei River: Water Resource Assessment – allocation limits and minimum flows. Technical report to support policy development, Report No. 2004/EXT/606.

Roygard, J., Watson, J. & Clark, M. 2006. Water Allocation Project Upper Manawatu Catchment: Water Resource Assessment – allocation limits and minimum flows: Technical report to support policy development, Report No. 2006/EXT/864.

Resource Management Act 1991. Government Printers. Wellington, NZ.

Stewart, G. 2006a. Assessment of the proposed water-use guidelines for public water supplies. Prepared for Horizons Regional Council by Aquas Consultants Ltd.

Stewart, G. 2006b. Water demand management options and opportunities for Horowhenua District Council. Prepared for Horizons Regional Council by Aquas Consultants Ltd.

Stewart, G. 2006c. Water demand management options and opportunities for Manawatu District Council. Prepared for Horizons Regional Council by Aquas Consultants Ltd.

Stewart, G. 2006d. Water demand management options and opportunities for Rangitikei District Council. Prepared for Horizons Regional Council by Aquas Consultants Ltd.

Stewart, G. 2006e. Water demand management options and opportunities for Tararua District Council. Prepared for Horizons Regional Council by Aquas Consultants Ltd.

Wood, G. 1995. Sustainable low-flow project: the regional report. Hawkes Bay Regional Council.

Appendix A – Expanded version of Table A including brief explanations of methods used and derivation of cumulative allocation limits

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
Upper Manawatu *(Mana 1)*	Upper Manawatu (Mana 1a)	Upper Manawatu Catchment Water Resource Assessment	1.600	90% of habitat at MALF	0.204	Q_{92} (1.804 m^3/s) – minimum flow (1.6 m^3/s) at Manawatu at Weber Rd (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Weber Rd
	Mangatewainui (Mana 1b)	Upper Manawatu Catchment Water Resource Assessment	1.600	90% of habitat at MALF	0.063	30% of MALF at the confluence with the Manawatu River (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Weber Rd
	Mangatoro (Mana 1c)	Upper Manawatu Catchment Water Resource Assessment	0.702	90% of habitat at MALF	0.204	30% of MALF at Mangatoro at Mangahei Rd (Table A , p. iv, Roygard *et al*., 2006)	Mangatoro at Mangahei Rd
whole zone *(Mana 1)*					**0.204**	No more than 0.204 m^3/s may be allocated from this WMZ Q_{92} (1.804 m^3/s) – minimum flow (1.6 m^3/s) at Manawatu at Weber Rd (Table A , p. iv, Roygard *et al*., 2006)	
Weber-Tamaki *(Mana 2)*	Weber-Tamaki (Mana 2a)	Upper Manawatu Catchment Water Resource Assessment	1.600	90% of habitat at MALF	0.251	Core allocation for Mana 1 * 1.23 = 0.251 m^3/s (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Weber Rd
	Mangatera (Mana 2b)	Upper Manawatu Catchment Water Resource Assessment	1.600	90% of habitat at MALF	0.047	Core allocation for Mana 1 * 1.23 – core allocation for Mana 1 (0.204 m^3/s *1.23) – 0.204 m^3/s = 0.047 m^3/s (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Weber Rd
cumulative allocable volume *(Mana 1 + Mana 2)*					**0.251**	Mana 1 flows into Mana 2 – no more than 0.251 m^3/s may be allocated above this point in the catchment (Table A , p. iv, Roygard *et al*., 2006)	
Upper Tamaki (Mana 3)	Upper Tamaki (Mana 3)	Upper Manawatu Catchment Water Resource Assessment	0.238	90% of habitat at MALF	0.078	30% of the naturalized MALF for Tamaki at Water Supply Weir (Table A , p. iv, Roygard *et al*., 2006)	Tamaki at Water Supply Weir
Upper Kumeti (Mana 4)	Upper Kumeti (Mana 4)	Upper Manawatu Catchment Water Resource Assessment	0.055	90% of habitat at MALF	0.005	Q_{92} (0.059 m^3/s) – minimum flow (0.055) = 0.004 m^3/s (Table A , p. iv, Roygard *et al*., 2006)	Kumeti at Te Rehunga
Tamaki-Hopelands (Mana 5)	Tamaki-Hopelands (Mana 5a)	Upper Manawatu Catchment Water Resource Assessment	2.980	90% of habitat at MALF	0.971	Q_{92} (3.951 m^3/s) – minimum flow (2.980 m^3/s) = 0.917 m^3/s) (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Hopelands
	Lower Tamaki (Mana 5b)	Upper Manawatu Catchment Water Resource Assessment	0.360	90% of habitat at MALF	0.138	Mana 3 flows into Mana 5b (Upper and Lower Tamaki catchment) so the cumulative allocation limit for this point in the Tamaki catchment = 0.138 m^3/s. This is derived by adding the core allocation limit for Mana 3 to the core allocation limit for Mana 5a. (0.078 + 0.060 = 0.138). No more than 0.138 m^3/s can be allocated above this point in the Tamaki River catchment.	Tamaki at Stephensons

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
	Lower Kumeti (Mana 5c)	Upper Manawatu Catchment Water Resource Assessment	0.055	90% of habitat at MALF	0.059	Mana 4 flows into Mana 5c (Upper and Lower Kumeti) so the cumulative allocation limit for this point in the Kumeti catchment is = 0.059. This is derived by adding the core allocation limit for Mana 4 to the core allocation limit for Mana 5c. (0.005 + 0.054 = 0.059). No more than 0.059 m^3/s can be allocated above this point in the Kumeti River catchment.	Kumeti at Te Rehunga
	Oruakeretaki (Mana 5d)	Upper Manawatu Catchment Water Resource Assessment	0.293	90% of habitat at MALF	0.105	30% of the MALF at Oruakeretaki at Oringi (Table A , p. iv, Roygard *et al*., 2006)	Oruakeretaki at S.H.2 Napier
	Raparapawai (Mana 5e)	Upper Manawatu Catchment Water Resource Assessment	0.074	90% of habitat at MALF	0.024	30% of the MALF at Raparapawai at Jacksons Rd (Table A , p. iv, Roygard *et al*., 2006)	Raparapawai at Jacksons Rd
cumulative allocable volume *(Mana 1 + Mana 2 + Mana 3 + Mana 4 + Mana 5)*					**0.971**	Mana 3 and Mana 4 are headwater zones of tributaries (not on the main stem) but these tributaries flow into Mana 5 which is. The cumulative allocable volume stated for the downstream point of Mana 5 includes the cumulative allocable volume from the downstream point of Mana 2 and the volumes from Mana 3, 4 and 5 – no more than 0.971 m^3/s may be allocated above this point in the catchment	
Hopelands-Tiraumea (Mana 6)	Hopelands-Tiraumea (Mana 6)	Upper Manawatu Catchment Water Resource Assessment[13]	2.980	90% of habitat at MALF	1.049	(Manawatu upstream Tiraumea confluence Q_{92}) - minimum flow) – upstream allocation (Table A , p. iv, Roygard *et al*., 2006)	Manawatu at Hopelands
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6)*					**1.049**	Cumulative allocable volume at the downstream point of Mana 6 includes the cumulative allocable volume from downstream point of Mana 5 plus volume from Mana 6 – no more than 1.049 m^3/s may be allocated above this point in the catchment	Manawatu at Hopelands
Tiraumea (Mana 7)	Upper Tiraumea (Mana 7a)	MALF * 0.9 + 20% MALF as core	2.140	0.9 * MALF for Tiraumea at Ngaturi = 0.9 * 2.38 = 2.142 m^3/s	0.475		Tiraumea at Ngaturi
	Lower Tiraumea (Mana 7b)	MALF * 0.9 + 20% MALF as core	2.140	Minimum flow to be controlled upstream by Tiraumea at Ngaturi due to lack of appropriate minimum flow monitoring site at the bottom of this sub-zone	0.550	Catchment area extrapolation used to determine appropriate core allocation limit for this sub-zone, based on MALF for Tiraumea at Ngaturi No more than 0.550 m^3/s from this sub-zone.	Tiraumea at Ngaturi
	Mangaone River (Mana 7c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF		
	Makuri (Mana 7d)	LWCN – MALF + 5% as core	2.160	Makuri LWCN MALF at Makuri at Tuscan Hills = 2.156 5% of MALF for Makuri at Tuscan Hills	0.108	Based on original intention of LWCN – allocation reflects relative value of river as trout fishery	Makuri at Tuscan Hills
whole zone *(Mana 7)*					**0.550**	Cumulative allocation limit of Mana 7b - no more than 0.550 m^3/s may be allocated from this WMZ	Tiraumea at Ngaturi

13 Roygard *et al*., 2006

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
cumulative allocable volume *(Mana 7 + Mana 8)*	Mangatainoka and Tiraumea				**0.839**	Mana 7 and 8 are grouped together to give a cumulative allocable volume at the downstream point of Mana 7 (Mana 8 flows into Mana 7 just above the confluence of the Tiraumea and Mangatainoka with the Manawatu River) – no more than 0.839 m^3/s may be allocated above this point in the catchment	
Mangatainoka (Mana 8)	Upper Mangatainoka (Mana 8a)	LWCN – MALF + 15% as core	0.400	15% of MALF for Mangatainoka at Larsons Rd = 0.395 * 0.15	0.060	15% of MALF selected to reflect relatively high instream values - LWCN	Mangatainoka at Larsons Rd
	Middle Mangatainoka (Mana 8b)	LWCN – MALF + 15% as core	1.580	Minimum flow to be controlled downstream by Mangatainoka at Pahiatua Town Bridge due to the lack of a suitable minimum flow monitoring site at the bottom of this sub-zone. (MALF for Mangatainoka at Pahiatua Town Bridge = 1.580)	0.105	Catchment area extrapolation used to determine appropriate core allocation limit for this sub-zone, based on MALF for Mangatainoka at Pahiatua Town Bridge (nearest downstream flow recorder). See Appendix B for details. 15% of MALF selected to reflect relatively high instream values - LWCN	Mangatainoka at Pahiatua Town Bridge
	Lower Mangatainoka (Mana 8c)	LWCN – MALF + 15% as core	1.580	MALF at Mangatainoka at Pahiatua Town Bridge = 1.580 * catchment area extrapolation factor 1.218 (including Mangaramarama) * 0.15	0.289	15% of MALF selected to reflect relatively high instream values - LWCN	Mangatainoka at Pahiatua Town Bridge
	Makakahi (Mana 8d)	LWCN – MALF + 15% as core	0.345	MALF at Makakahi at Hamua = 0.345	0.066	MALF at Makakahi at Hamua =0.345 * catchment area extrapolation factor 1.285 * 0.15 15% of MALF selected to reflect relatively high instream values - LWCN	Makakahi at Hamua
	Mangaramarama (Mana 8e)	LWCN – MALF + 15% as core	1.580	MALF at Mangatainoka at Pahiatua Town Bridge	0.009	MALF at Makakahi at Hamua = 0.345 * catchment area extrapolation factor = 1.285 * 0.15 - MALF at Mangatainoka at Pahiatua Town Bridge = 1.580 * catchment area extrapolation 1.178 (excluding Mangaramarama) * 0.15 15% of MALF selected to reflect relatively high instream values - LWCN	Mangatainoka at Pahiatua Town Bridge
whole zone *(Mana 8)*					**0.289**	Core allocation limit of Mana 8c - no more than 0.204 m^3/s may be allocated from this WMZ	
Upper Gorge (Mana 9)	Upper Gorge (Mana 9a)	MALF * 0.9 + 20% MALF as core	10.530	MALF for Manawatu at Upper Gorge = 11.703 * 0.9	2.340	20% of MALF for Manawatu at Upper Gorge = 0.2 * 11.703 = 2.341 m^3/s	Manawatu at Upper Gorge
	Mangapapa (Mana 9b)	IFIM + 30% of MALF as core	0.023	IFIM – An instream flow assessment for the Upper Manawatu tributaries[14]	0.008	30% of MALF – existing consent for Woodville water supply fits with efficient use guidelines & dam available for storage (Stewart, 2006a)	
	Mangaatua (Mana 9c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Mangahao (Mana 9d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Mangahao (Mana 9e)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
whole zone *(Mana 9)*					**2.340**	Core allocation limit of Mana 9a - no more than 2.340 m^3/s may be allocated from this WMZ	Manawatu at Upper Gorge

14 Bee, 2000

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9)*					**2.340**	The cumulative allocable volume at the downstream point of Mana 9 includes all those cumulative allocable volumes for the WMZs upstream – no more than 2.340 m^3/s may be allocated above this point in the catchment	
Middle Manawatu (Mana 10)	Middle Manawatu (Mana 10a)	MALF * 0.9 + 20% MALF as core	14.160	MALF at Manawatu at Teachers College = 15.735 * 0.9	3.150	MALF at Manawatu at Teachers College = 15.735 * 0.2	Manawatu at Teachers College
	Upper Pohangina (Mana 10b)	MALF + 20% of MALF as core	2.315	Default method applies	0.460	Default method applies	Pohangina at Mais Reach
	Middle Pohangina (Mana 10c)	IFIM + 20% of MALF as core	1.960	IFIM - Instream flow assessment for the Pohangina River	0.460	Core allocation limit = 20% of MALF for Pohangina at Mais Reach (2.315 m^3/s * 0.2 = 0.463 m^3/s)	Pohangina at Mais Reach
	Lower Pohangina (Mana 10d)	IFIM + 20% of MALF as core	1.960	IFIM - Instream flow assessment for the Pohangina River[15]	0.525	MALF = 2.315 * 0.2 catchment area extrapolation factor of 0.132	Pohangina at Mais Reach
	Aokautere (Mana 10e)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
whole zone *(Mana 10)*					**3.150**	Core allocation limit of Mana 10a - no more than 3.150 m^3/s may be allocated from this WMZ	Manawatu at Teachers College
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10)*					**3.150**	Cumulative allocable volume at the downstream point of Mana 10 includes all of those cumulative allocable volumes for the WMZs upstream – no more than 3.150 m^3/s may be allocated above this point in the catchment	
Lower Manawatu (Mana 11)	Lower Manawatu (Mana 11a)	MALF * 0.9 + 20% MALF as core	14.160	Managed from Manawatu at Teachers College. 0.9 * MALF for Manawatu at Teachers College = 0.9 * 15.735 = 14.160 m^3/s	3.180	30% of MALF for Manawatu at Opiki Bridge = 0.3 * 15.900 = 3.180 m^3/s	Manawatu at Opiki Bridge
	Turitea (Mana 11b)	MALF + 20% of MALF as core	0.050	Existing consent conditions for Palmerston North city water supply	0.264	Palmerston North city water supply - 300 l/h/day for 76,000 people – fits within efficient use guidelines(Stewart, 2006a)	
	Kahuterawa (Mana 11c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Mangaone Stream (Mana 11d	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Mangaone Stream (Mana 11e)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	Mangaone at Milson Line
	Main Drain (Mana 11f)	MALF + 20% of MALF as core	MALF	Default method applies	20% o f MALF	Default method applies	
whole zone *(Mana 11)*					**3.180**	No more than 3.180 m^3/s may be allocated from this WMZ	Manawatu at Opiki Bridge

[15] Hay & Hayes, 2006

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10 + Mana 11)*					**3.180**	Cumulative allocable volume at the downstream point of Mana 11 includes all of those cumulative allocable volumes for the WMZs upstream – no more than 3.180 m^3/s may be allocated above this point in the catchment	
Oroua (Mana 12)	Upper Oroua (Mana 12a)	IFIM + 30% of MALF as core	1.050	IFIM – Instream flow assessment for the Oroua River	0.405	30% of naturalised MALF for Oroua at Kawa Wool = 0.3 * 1.350 = 0.405 m^3/s. See Appendix A for details.	Oroua at Kawa Wool
	Middle Oroua (Mana 12b)	IFIM + 30% of MALF as core	1.050	IFIM – Instream flow assessment for the Oroua River	0.430	30% of (naturalised MALF for Oroua at Kawa Wool (1.350) + MALF for Makino at Boness Rd (0.083)) 0.3 * (1.350 + 0.080) = 0.430 m^3/s. See Appendix A for details.	Oroua at Kawa Wool
	Lower Oroua (Mana 12c)	IFIM + 30% of MALF as core	1.050	IFIM – Instream flow assessment for the Oroua River[16]	0.530	Catchment area extrapolation used to determine appropriate core allocation limit for this sub-zone, based on naturalised MALF for Oroua at Kawa Wool and MALF for Makino at Boness Rd. See Appendices A & B for details.	Oroua at Kawa Wool
	Kiwitea (Mana 12d)	IFIM + 30% of MALF as core	0.145	IFIM – An instream flow assessment for the Kiwitea and Makino Streams	0.048	30% of MALF for Kiwitea Spur Rd All = 0.3 * 0.161 = 0.048 m^3/s	Kiwitea at Haynes Line
	Makino (Mana 12e)	IFIM + 30% of MALF as core	0.080	IFIM – An instream flow assessment for the Kiwitea and Makino Streams[17]	0.025	30% of MALF for Makino at Boness Rd =0.3 * 0.083 = 0.025 m^3/s	Makino at Boness Rd
whole zone *(Mana12)*					**0.530**	Core allocation limit of Mana 12c - no more than 0.530 m^3/s may be allocated from this WMZ	
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 10 + Mana 11 + Mana 12)*					**3.710**	Cumulative allocable volume at the downstream point of Mana 12 includes all of those cumulative allocable volumes for the WMZs upstream – no more than 3.710 m^3/s may be allocated above this point in the catchment.	
Coastal Manawatu (Mana 13)	Coastal Manawatu (Mana 13a excluding 13a1)	MALF + 30% of MALF as core	12.588	Tidal method	5.300	MALF of Opiki Bridge 15.9 + MALF of Kawa Wool + Makino * 1.229 to get downstream zone 12c = (1.350 + 0.083) * 1.229 = 1.761 => (15.9 + 1.761) = 17.661. 30% * 17.661. 30% due to differing substrate (muddy) and proximity to sea/tidal area	
	Coastal Manawatu (Mana 13a1 (Mainstem of Manawatu River in Mana 13a downstream of S24:111-767))	tidal method	12.588	Control when flow is very low in the river 0.8 * MALF is close to 99th percentile of Manawatu at Teachers College flow record	7.065	Tidal zone allocation limit - allocation in this zone doesn't have potential to impact as largely as in upstream zones. MALF of Manawatu at Opiki Bridge 15.9 + MALF of Kawa Wool + Makino * 1.229 to get downstream zone 12c = (1.350 + 0.083) * 1.229 = 1.761 = (15.9 + 1.761) = 17.661. 0.40 * 17.661	
	Upper Tokomaru (Mana 13b)	MALF * 0.9 + 20% MALF as core	0.220	0.9 * MALF at Tokomaru All = 0.9 * 0.247 = 0.220 m^3/s	0.050	20 % of MALF for Tokomaru All = 0.2 * 0.247 = 0.050 m^3/s	Tokomaru at Horseshoe Bend
	Lower Tokomaru (Mana 13c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	

16 Hay, 2006
17 Bee, 1999

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
	Mangaore (Mana 13d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Koputaroa (Mana 13e)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Foxton Loop (Mana 13f)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
cumulative allocable volume *(Mana 1+ Mana 2 + Mana 3 + Mana 4 + Mana 5 + Mana 6 + Mana 7 + Mana 8 + Mana 9 + Mana 11 + Mana 12 + Mana 13)*					**7.065**	Cumulative allocable volume at the downstream point of Mana 13 includes all of those cumulative allocable volumes for the WMZs upstream – no more than 7.065 m3/s may be allocated above this point in the catchment.	
Upper Rangitikei (Rang 1)	Upper Rangitikei (Rang 1)	Rangitikei Catchment Water Resource Assessment/NWCO		NWCO	0.000	NWCO	
Middle Rangitikei (Rang 2)	Middle Rangitikei (Rang 2a)	Rangitikei Catchment Water Resource Assessment/NWCO	5.250	NWCO 95% of natural flow MALF = 5.25	0.260	MALF * 0.05, 5.25 * 0.05 is allocation limit	Rangitikei at Mangaweka
	Pukeohahu-Mangaweka (Rang 2b)	Rangitikei Catchment Water Resource Assessment/NWCO	12.790	IFIM flow to maintain minimum flow at Onepuhi	0.670	Q95 - minimum flow (Roygard & Carlyon, 2004, p. 156)	Rangitikei at Mangaweka
	Upper Moawhango (Rang 2c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	Moawhango at Waiouru
	Middle Moawhango (Rang 2d)	MALF + 20% of MALF as core	MALF	MALF	0	No allocation available here after Genesis take for hydroelectric power generation	Moawhango at Moawhango
	Lower Moawhango (Rang 2e)	MALF + 20% of MALF as core	MALF	MALF	5% of MALF	5% of MALF and 5 here?	Moawhango at Moawhango
	Upper Hautapu (Rang 2f)	LWCN – MALF + 15% as core	0.745	LWCN MALF at Hautapu at Alabasters = 0.745	0.112	Based on original intention of LWCN – allocation reflects relative value of river as trout fishery	Hautapu at Alabasters
	Lower Hautapu (Rang 2g)	MALF * 0.9 + 20% MALF as core	0.670	0.9 * 0.745 (MALF at Hautapu at Alabasters)	0.085	Catchment area extrapolation from yield map used to determine appropriate core allocation limit for this sub-zone. See Appendices B for detail.	Hautapu at Alabasters
cumulative allocable volume *(Rang 1 + Rang 2)*					**0.670**	Rang 1 flows into Rang 2 so a cumulative allocable volume is stated for the downstream point of Rang 2 - no more than 0.670 m^3/s may be allocated above this point in the catchment.	
Lower Rangitikei (Rang 3)	Lower Rangitikei (Rang 3a)	Rangitikei Catchment Water Resource Assessment[18]	14.550	Rangitikei WRA/IFIM	1.510	Q95 – minimum flow, to maintain IFIM recommended minimum flow (Roygard & Carlyon, 2004, p. 155)	Rangitikei at Onepuhi
	Makohine (Rang 3b)	MALF * 0.9 + 20% MALF as core	0.036	0.9 * MALF at Makohine at Viaduct = 0.9 * 0.040 = 0.036 m^3/s	0.008	20% of MALF for Makohine at Viaduct = 0.2 * 0.040 = 0.008 m^3/s	Makohine at Viaduct
whole zone *(Rang 3)*					**1.510**	Core allocation limit for Rang 3a - no more than 1.510 m^3/s may be allocated from this WMZ	

[18] Roygard & Carlyon, 2004

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m³/s)	Minimum flow explanation	Core allocation limit (m³/s)	Cumulative allocation limit explanation	Flow monitoring site
cumulative allocable volume *(Rang 1 + Rang 2 + Rang 3)*					**1.510**	Rang 2 flows directly into Rang 3 so the cumulative allocable volume at the downstream point of Rang 3 includes the cumulative allocable volume at the downstream point of Rang 2 plus the volume from Rang 3 - no more than 1.150 m3/s may be allocated above this point in the catchment	
Coastal Rangitikei (Rang 4)	Coastal Rangitikei (Rang 4a)	Water Resource Assessment	10.230	IFIM	6.410	Rangitikei WRA	Rangtikei at McKelvies
	Tidal Rangitikei (Rang 4b)	Water Resource Assessment	10.230	IFIM	6.410	Rangitikei WRA	
	Porewa (Rang 4c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Tutaenui (Rang 4d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
cumulative allocable volume *(Rang 1 + Rang 2 + Rang 3 + Rang 4)*					**6.410**	Rang 4's cumulative allocable volume includes the volume from Rang 3 plus the volume from Rang 4 - no more than 6.410 m3/s may be allocated above this point in the catchment	
Upper Whanganui (Whai 1)	Upper Whanganui (Whai 1)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Cherry Grove (Whai 2)	Cherry Grove (Whai 2a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Whakapapa (Whai 2b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Whakapapa (Whai 2c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Piopioteo (Whai 2d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Pungapunga (Whai 2e)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Ongarue (Whai 2f)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Ongarue (Whai 2g)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Te Maire (Whai 3)	Te Maire (Whai 3)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
`Middle Whanganui (Whai 4)	Middle Whanganui (Whai 4a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Ohura (Whai 4b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Ohura (Whai 4c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Retaruke (Whai 4d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Pipiriki (Whai 5)	Pipiriki (Whai 5a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
	Tangarakau (Whai 5b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Whangamomona (Whai 5c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Manganui o te Ao (Whai 5d)	NWCO		NWCO	0.000	NWCO	
	Lower Manganui o te Ao (Whai 5e)	NWCO		NWCO	0.000	NWCO	
Paetawa (Whai 6)	Paetawa (Whai 6)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Lower Whanganui (Whai 7)	Lower Whanganui (Whai 7a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Coastal Whanganui (Whai 7b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upokongaro (Whai 7c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Matarawa (Whai 7d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Upper Whangaehu (Whau 1)	Upper Whangaehu (Whau 1a)	MALF * 0.9 + 20% MALF as core	9.790	0.9 * MALF at Whangaehu at Karioi, MALF (simulated natural all data) = 0.9 * 10.879 = 9.790 m^3/s	2.175	20% of MALF, MALF for (Simulated natural all data) = 0.2 * 10.879 = 2.175 m^3/s	Whangaehu at Karioi
	Waitangi (Whau 1b)	MALF * 0.9 + 20% MALF as core	0.475	MALF at Waitangi at Tangiwai = 0.9 * 0.526 = 0.473 m^3/s	0.105	20% of MALF at Waitangi at Tangiwai 0.526	Waitangi at Tangiwai
	Tokiahuru (Whau 1c)	MALF * 0.9 + 20% MALF as core	4.340	0.9 * MALF Tokiahuru at Whangaehu Junction = 0.9 * 4.821 = 4.340 m^3/s	0.960	20% of MALF at Tokiahuru at Whangaehu Junction = 0.2 * 4.821 = 0.964 m^3/s	Tokiahuru at Whangaehu Junction
whole zone *(Whau 1)*					**2.175**	Core allocation limit for Whau 1a – no more than 2.175 m^3/s may be allocated above this point in the catchment	
Middle Whangaehu (Whau 2)	Middle Whangaehu (Whau 2)	MALF + 20% of MALF as core	MALF	MALF	20% of MALF	20% of MALF	
cumulative allocation *(Whau 1 + Whau 2)*					Is equal to cumulative core allocation for Whau 2	Whau 1 flows into Whau 2, so a cumulative allocable volume applies for the downstream point of Whau 2 - no more than the core allocation limit for Whau 2 may be allocated above this point in the catchment	
Lower Whangaehu (Whau 3)	Lower Whangaehu (Whau 3a)	MALF * 0.9 + 20% MALF as core	13.240	0.9 * MALF at Whangaehu at Kaungaroa (simulated natural) = 0.9 * 14.711 = 13.240 m^3/s	2.940	20% of MALF at Whangaehu at Kaungaroa = 0.2 * 14.711 = 2.942 m^3/s	Whangaehu at Kauangaroa
	Upper Makotuku (Whau 3b)	MALF * 0.9 + 20% MALF as core	0.100	0.9 * MALF at Makotuku at SH49a Bridge = 0.9 * 0.116 = 0.104 m^3/s	0.023	MALF = 0.116 at Makotuku at SH49a Bridge = 0.2 * 0.116 = 0.023 m^3/s	Makotuku at SH49a Bridge
	Lower Makotuku (Whau 3c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Upper Mangawhero (Whau 3d)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Mangawhero (Whau 3e)	MALF * 0.9 + 20% MALF as core	2.520	MALF at Mangawhero at Ore Ore = 2.803	0.560	MALF at Mangawhero at Ore Ore = 0.2 * 2.803 = 0.560 m^3/s	Mangawhero at Ore Ore

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
cumulative allocation *(Whau 1 + Whau 2+ Whau 3)*					**2.940**	Whau 2 flows into Whau 3 so the cumulative allocable volume stated at the downstream point of Whau 3 includes the volume stated for the downstream point of Whau 2 plus the allocable volume of Whau 3 - no more than 2.940 m^3/s may be allocated above this point in the catchment	
Coastal Whangaehu (Whau 4)	Coastal Whangaehu (Whau 4)	MALF * 0.9 + 20% MALF as core	MALF	Default method applies	20% of MALF	Default method applies	Whangaehu at Kauangaroa
cumulative allocation *(Whau 1 + Whau 2+ Whau 3+ Whau 4)*					Is equal to cumulative core allocation for Whau 4	Whau 4's cumulative allocable volume includes the volume from the downstream point of Whau 3 plus the volume for Whau 4 - no more than the core allocation limit for Whau 4 may be allocated above this point in the catchment	
Turakina (Tura 1)	Upper Turakina (Tura 1a)	MALF * 0.9 + 20% MALF as core	0.345	0.9 * MALF at Turakina at Otairi Rd = 0.9 * 0.382	0.075	0.9 * MALF at Turakina at Otairi Rd =0.9 * 0.382	Turakina at Otairi Rd
	Lower Turakina (Tura 1b)	MALF * 0.9 + 20% MALF as core	0.830	0.9 * MALF at Turakina at SH3 Bridge = 0.9 * 0.925	0.185	0.9 * MALF at Turakina at SH3 Bridge = 0.9 * 0.925	Turakina at O'Neills Bridge
	Ratana (Tura 1c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Whole zone *(Tura 1)*	Upper and Lower Turakina				**0.185**	Core allocation limit for Tura 1b - no more than 0.185 m^3/s may be allocated from this WMZ	
Ohau (Ohau 1)	Upper Ohau (Ohau 1a)	Ohau Catchment Water Resource Assessment	0.820	WRA	0.280	WRA	Ohau at Rongomatane
	Lower Ohau (Ohau 1b)	Ohau Catchment Water Resource Assessment[19]	0.820	WRA	0.280	WRA	Ohau at Rongomatane
Whole zone (Ohau 1)					**0.280**	Core allocation limit for Ohau 1b - no more than 0.280 m^3/s may be allocated from this WMZ	
Owahanga (Owha 1)	Owahanga (Owha 1)	MALF * 0.9 + 20% MALF as core	0.040	0.9 * MALF at Owahanga at Branscombe Bridge = 0.9 * 0.039	0.010	0.2 * Owahanga at Branscombe Bridge MALF =0.039 * 0.2 rounded up to account for extra catchment area d/s recorder	Owahanga at Branscombe Bridge
East Coast (East 1)	East Coast (East 1)	MALF + 20% of MALF as core	MALF	MALF	20% of MALF	20% of MALF	
Akitio (Akit 1)	Upper Akitio (Akit 1a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Lower Akitio (Akit 1b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Waihi (Akit 1c)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Northern Coastal (West 1)	Northern Coastal (West 1)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Kai Iwi (West 2)	Kai Iwi (West 2)	MALF * 0.9 + 20% MALF as core	0.470	0.9 * MALF at Kai Iwi at Handley Road is 0.525 = 0.9 * 0.525	0.105	0.2 * MALF Kai Iwi at Handley Road is 0.525 = 0.2 * 0.525	Kai Iwi at Handley Rd
Mowhanau (West 3)	Mowhanau (West 3)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	

[19] Horizons Regional Council Environmental Information Team, 2003

Water Management Zone	Water Management Sub-zone	Minimum flow and core allocation limit derived using:	Minimum flow (m^3/s)	Minimum flow explanation	Core allocation limit (m^3/s)	Cumulative allocation limit explanation	Flow monitoring site
Kaitoke Lakes (West 4)	Kaitoke Lakes (West 4)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Southern Wanganui Lakes (West 5)	Southern Wanganui Lakes (West 5)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Northern Manawatu Lakes (West 6)	Northern Manawatu Lakes (West 6)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Waitarere (West 7)	Waitarere (West 7)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Lake Papaitonga (West 8)	Lake Papaitonga (West 8)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Waikawa (West 9)	Waikawa (West 9)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
Lake Horowhenua (Hoki 1)	Lake Horowhenua (Hoki 1a)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	
	Hokio (Hoki 1b)	MALF + 20% of MALF as core	MALF	Default method applies	20% of MALF	Default method applies	

Appendix B – Naturalising the flow record for the Oroua River

There are several consented surface water takes from the Oroua River. The largest of these is the Manawatu District Council's (MDC) abstraction for the Feilding public water supply. MDC's water use records for this site provide a summary of their water use. The naturalised flow record was calculated on a daily basis using the flow record at Oroua at Kawa Wool, plus the historic daily water use records for MDC. All available water use records from MDC were used for this analysis.

The water use records for the Feilding public water supply indicate an average take of 0.054 m^3/s with a maximum recorded daily take of 0.118 m^3/s for the period of record available (Jan 01–Dec 06). The 90th percentile daily abstraction rate of 0.083 m^3/s was used for estimation of naturalised MALF, as it represents a near-maximum summer water take .

The Manawatu District Council also takes water from the Oroua River for the Oroua and Kiwitea rural water supply schemes. There are limited abstraction records available for the Kiwitea scheme take (summer 2006 only, Table 14). Based on these limited records, the median abstraction rate of 0.026 m^3/s was used for the naturalisation of the data. The abstraction for the Oroua rural water supply is taken at a fairly constant rate of 5 l/s.

Table 15: Flow distribution for MDC take for Kiwitea Rural Water Supply (m^3/hour)

	0	1	2	3	4	5	6	7	8	9
0	134.38	123.16	122.74	122.55	122.39	122.15	121.91	121.58	121.13	120.68
10	120.24	119.55	119.14	118.90	118.64	118.31	118.05	117.82	117.64	117.49
20	117.31	117.18	116.94	116.51	115.03	112.70	111.55	108.87	108.00	107.62
30	107.10	106.48	105.72	104.01	102.94	101.35	100.13	99.57	99.00	98.56
40	98.20	97.75	97.52	97.34	97.13	96.97	96.81	96.63	96.48	96.28
50	95.75	95.41	95.21	94.99	94.25	93.04	90.92	89.92	87.18	80.74
60	74.11	64.78	56.96	46.55	37.59	29.14	18.42	11.23	7.37	3.66
70	2.94	0.85	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06
80	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04
90	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02
100	0.00									

There is likely to be a relationship between abstraction demand and low flows, such that the naturalised MALF is equal to the sum of the recorded MALF plus the 90th percentile abstraction rate for the Feilding water supply take; the median rate for the Kiwitea rural supply take; and the take for the Oroua rural supply:

Table A: Components of naturalised MALF for the Oroua River at Kawa wool

Component	volume (m^3/s)
Recorded MALF	1.240
Feilding public water supply abstraction	0.083
Kiwitea rural water supply abstraction	0.026
Oroua rural water supply abstraction	0.005
TOTAL (naturalised MALF)	**1.354**

Appendix C – Catchment area extrapolation exercises – Tiraumea, Mangatainoka, Pohangina, Hautapu and Oroua

While the limitations of catchment area extrapolation are recognised, eg. they are likely to over-estimate flows if the extrapolation is to represent lower elevation catchment than that represented by the flow recorder, since rainfall generally increases with altitude, this is the best method available at this stage given the availability of robust data for these Water Management sub-zones. As new data becomes available, the estimates generated by this catchment extrapolation exercise will be updated.

Catchment area extrapolation for Mana 7b (Lower Tiraumea): refer to Figure A

Flow in the Tiraumea River to the Tiraumea/Mangatainoka River confluence was calculated using a catchment area extrapolation. This increases the flow at Tiraumea at Ngaturi by a factor related to the extra catchment area between the flow recorder and the confluence.

- MALF for Tiraumea at Ngaturi is 2.38 m^3/s.
- Proportion of extra catchment area from Tiraumea at Ngaturi to the Tiraumea/Mangatainoka confluence = 15.9%, giving a catchment area factor of 1.159.
- So: MALF at Tiraumea at Ngaturi * catchment area factor = MALF at the Tiraumea/Mangatainoka confluence or:
    - 2.38 * 1.159 = 2.76 m^3/s.
- To maintain the minimum flow at the Tiraumea/Mangatainoka confluence (0.9 * MALF at the Tiraumea/Mangatainoka confluence or:
    - 0.9 * 2.76 = 2.48 m^3/s), the following flow is required at Tiraumea at Ngaturi:
    - minimum flow at the Tiraumea/Mangatainoka confluence/catchment area factor or:
    - 2.48/1.159 = 2.14 m^3/s, ie. 0.9 * MALF at Tiraumea at Ngaturi.

- Core allocation limit for Mana 7b is: (MALF at Tiraumea at Ngaturi * 0.2) minus core allocation limit for Mana 7a, or:
    - (2.38 * 0.2) – 0.48

    => 0.496 – 0.48 = **0.016 m^3/s**
- This can be checked : (2.48 – 2.38) * 0.159 = 0.016

So: **Minimum flow** for Lower Tiraumea is **2.14 m^3/s** at Tiraumea at Ngaturi
Core allocation for Lower Tiraumea is **0.016 m^3/s**

Catchment area extrapolation for Rang 2g (Lower Hautapu): refer to Figure B

The main flow recorder in the Hautapu catchment is at the bottom of the Upper Hautapu Water Management sub-zone. A catchment extrapolation was required to determine the minimum flow for the Lower Hautapu sub-zone.

Two methods were tried – a simple catchment extrapolation based on the MALF for the Upper Hautapu sub-zone (Hautapu at Taihape All) and a slightly more complex method using the estimated flows from a catchment yield map (Tonkin and Taylor, 1979 as cited in Roygard and Carlyon, 2004) Figure C.

Both methods are presented here:

Simple catchment extrapolation

- MALF at Hautapu at Taihape All = 0.745 m^3/s
- Proportion of catchment in Lower Hautapu sub-zone = 35.2%, giving a catchment extrapolation factor of 1.352
- So: MALF for Upper Hautapu * catchment area factor = MALF for the Lower Hautapu or:
  - 0.745 * 1.352 = 1.007 m^3/s
- The minimum flow for the Lower Hautapu using this method is 1.007 m^3/s * 0.9 = 0.906 m^3/s

Yield map method

- According to the yield map, (Tonkin and Taylor, 1979 as cited in Roygard and Carlyon, 2004) Figure C, the Lower Hautapu yields approximately 2.5 $L/s/km^2$ (7 day MALF)
- The 7 day MALF at Hautapu at Taihape All is 0.803 m^3/s
- The ratio between the 1 day MALF at Hautapu at Taihape All and the 7 day MALF at Hautapu at Taihape All is 0.927
- The catchment area of the Lower Hautapu sub-zone is 101.07 km^2, so 101.07 km^2 * 2.5 $L/s/km^2$ * 0.927 = 0.236 m^3/s
- The 1 day MALF for the Lower Hautapu using this method is: the 1 day MALF at Hautapu at Taihape All (0.745) + 0.236 = 0.981 m^3/s

The yield map method is considered to be more accurate than the simple catchment extrapolation, so the estimated MALF as determined by the Yield map method is the MALF used to calculate the core allocation for the Lower Hautapu sub-zone: so the minimum flow (based on Hautapu at Taihape All) = 0.745 * 0.15 = 0.111 m^3/s and:
The core allocation is (0.981 m^3/s * 0.2) – 0.111 = 0.085 m^3/s.

Catchment area extrapolation for Mana 8: Mangatainoka: refer to Figure D

Due to the positioning of the flow recorders in the Mangatainoka catchment, it was necessary to use catchment area extrapolation to determine MALFs and consequent core allocation limits for sub-zones Mana 8b, Mana 8c and Mana 8d based on the available flow data in the catchment. The use of gaugings would be preferable to the catchment area extrapolation method.

Core allocation limit for Mana 8b (Middle Mangatainoka)

The catchment area extrapolation required to determine the core allocation limits for Mana 8b and 8d was carried out using the long-term flow record for the Mangatainoka at Suspension Bridge flow recorder (now closed and replaced with Mangatainoka at Pahiatua Town Bridge) with additional record for Mangatainoka at Pahiatua Town Bridge (using the flow series Mangatainoka at Pahiatua All) (Henderson & Diettrich, 2007). The Mangatainoka at Suspension Bridge flow recorder was sited approximately 2 km upstream of Mangatainoka at Pahiatua Town Bridge.

- The MALF at Mangatainoka at Larsons Road (Mana 8a) = 0.395 m^3/s.
- The catchment area upstream of Mangatainoka at Suspension Bridge = 40,400 ha.
- The area of Mana 8a = 6,681 ha, the area of Mana 8b = 12,074 ha and the area of Mana 8d = 20,390 ha
  - So, the total area of these three sub-zones (Mana 8a + Mana 8b + Mana 8d) = 39,145 ha.
- The difference between the area of the whole Mana 8 WMZ and the combined area of Mana 8a, 8b and 8d = 40,400 ha – 39,145 ha = 1,255 ha.
- This gives a proportional land area difference of 1,255/39,145 = 0.032, giving a catchment area extrapolation factor of 1.03.
- The MALF for the downstream point of Mana 8d can be estimated:
- MALF at Mangatainoka at Suspension Bridge is 1.580 m^3/s.
- MALF at the downstream point of Mana 8b and 8d is estimated as:
  - MALF at Mangatainoka at Suspension Bridge * catchment area factor or:
  - 1.580 m^3/s/1.03 = 1.534 m^3/s
- The core allocation limit for **Mana 8b** = MALF downstream of Mana 8b and 8d minus MALF of Mana 8a minus MALF of Mana 8d * 0.15 or:
  - 1.534 – 0.395 – 0.443 = 0.695 * 0.15 = **0.104 m^3/s**

Core allocation limit for Mana 8c (Lower Mangatainoka)

- The area of Mana 8c = 1,255 ha
- The area between downstream point of 8b and 8d and Pahiatua Tb = 1,255 - 0.03 (from above) so:
  - 1,255 - 0.03 = 1,218 ha
- MALF at Pahiatua at Town Bridge = 1.580 m^3/s
- The core allocation limit for Mana 8c = (MALF at Pahiatua at Town Bridge * catchment area factor) * 0.15 so:
  - (1.580 * 1.218) * 0.15 = **0.288 m^3/s**

Core allocation limit for Mana 8d (Makakahi)

The Makakahi at Hamua flow recorder (in Mana 8d) specifies the MALF for a part of the catchment. This requires adjustment to be representative of the whole zone. This adjustment was completed as follows:

- Catchment area of the whole of Mana 8d = 20,390 ha
- Catchment area of upstream of the Makakahi at Hamua flow recorder = 15,860 ha
- Area downstream of Makakahi at Hamua = 20,390 -15,860 = 4,530 ha
- The area downstream of Makakahi at Hamua = 4,530/15,860 = 0.285 or a 28.5% increase in area. This gives a catchment area factor of 1.258.
- The MALF for the downstream point of Mana 8d can be estimated:
- MALF at Makakahi at Hamua is 0.345 m^3/s
- MALF at the downstream point of Mana 8d is estimated as:
  - MALF at Makakahi at Hamua * catchment area factor or:
  - 0.345 m^3/s * 1.285 = 0.443 m^3/s

- The core allocation limit for **Mana 8d** = MALF * 15%
  or:
  - 0.443 * 0.15 = **0.066 m3/s**

Catchment area extrapolation for Mana 10d (Lower Pohangina): refer to Figure C

- Proportion of extra catchment area from Pohangina at Mais Reach to confluence of Pohangina River with the Manawatu River (Manawatu confluence) = 13%. This gives a catchment area factor of 1.130.
- So: MALF at Mais Reach * catchment area factor = MALF at Manawatu confluence, or: 2.315 x 1.130 = 2.62 m^3/s
- Core allocation limit for Mana 10d is: MALF at Manawatu confluence * 0.2 (20% of MALF as per “statistics method”) minus allocation for Middle and Upper Pohangina, or: 0.524 – 0.427 = 0.097 m^3/s
- So: **Minimum flow** for Mana 10d is **1.96 m3/s** at Pohangina at Mais Reach (IFIM minimum flow)
- Core allocation for Mana 10d is **0.097 m3/s**

Catchment are extrapolation for Mana 12c (Lower Oroua): refer to Figure E

The minimum flow and core allocation limit for Mana 12c is derived using the flow record for Oroua at Kawa Wool, which is situated at the downstream point of Mana 12a. A catchment area extrapolation was required to set the core allocation limit for 12c. The Makino Stream flows into the Oroua River just at the top of Mana 12c, so the MALF for Makino at Boness Rd is included in the equation.

- Total area of Mana 12 = 90,261 ha.
- Area of Mana 12c = 16,869 ha.
- The area of Mana 12 minus the area of Mana 12c is: 90,261 – 16,869 = 73,392 ha. A catchment area factor is given by: 16869/73,392 = 0.230 = 1.230.
- So: (MALF for Oroua at Kawa Wool + MALF for Makino at Boness Rd) * catchment area factor = MALF for Mana 12c, or:
  - (1.350 + 0.083) * 1.230 = 1.763 m^3/s. The core allocation limit for **Mana 12c** = MALF * 0.30, or: 1.763 * 0.30 = **0.529 m^3/s**.

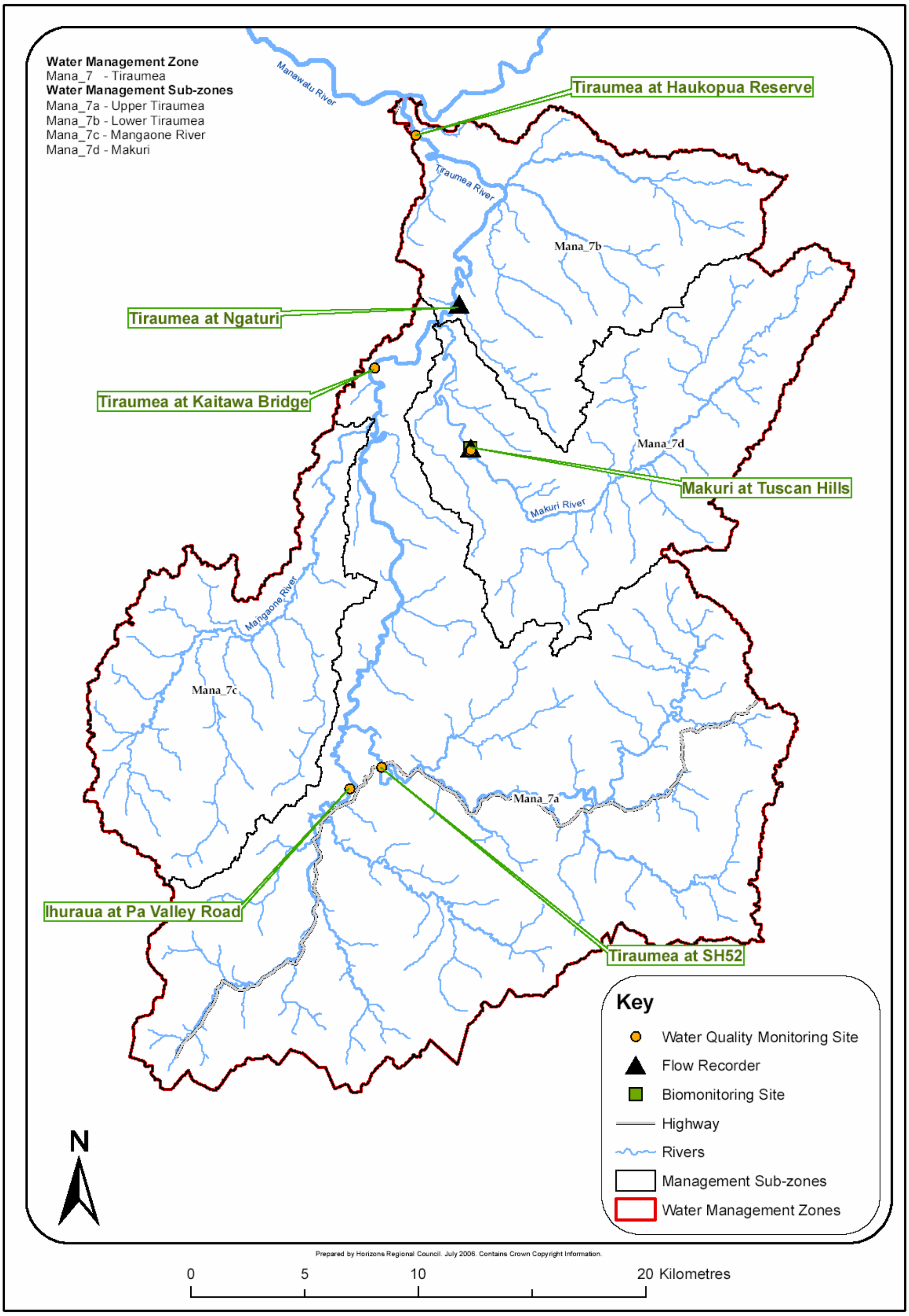


Figure A: Tiraumea Water Management Zone and sub-zones

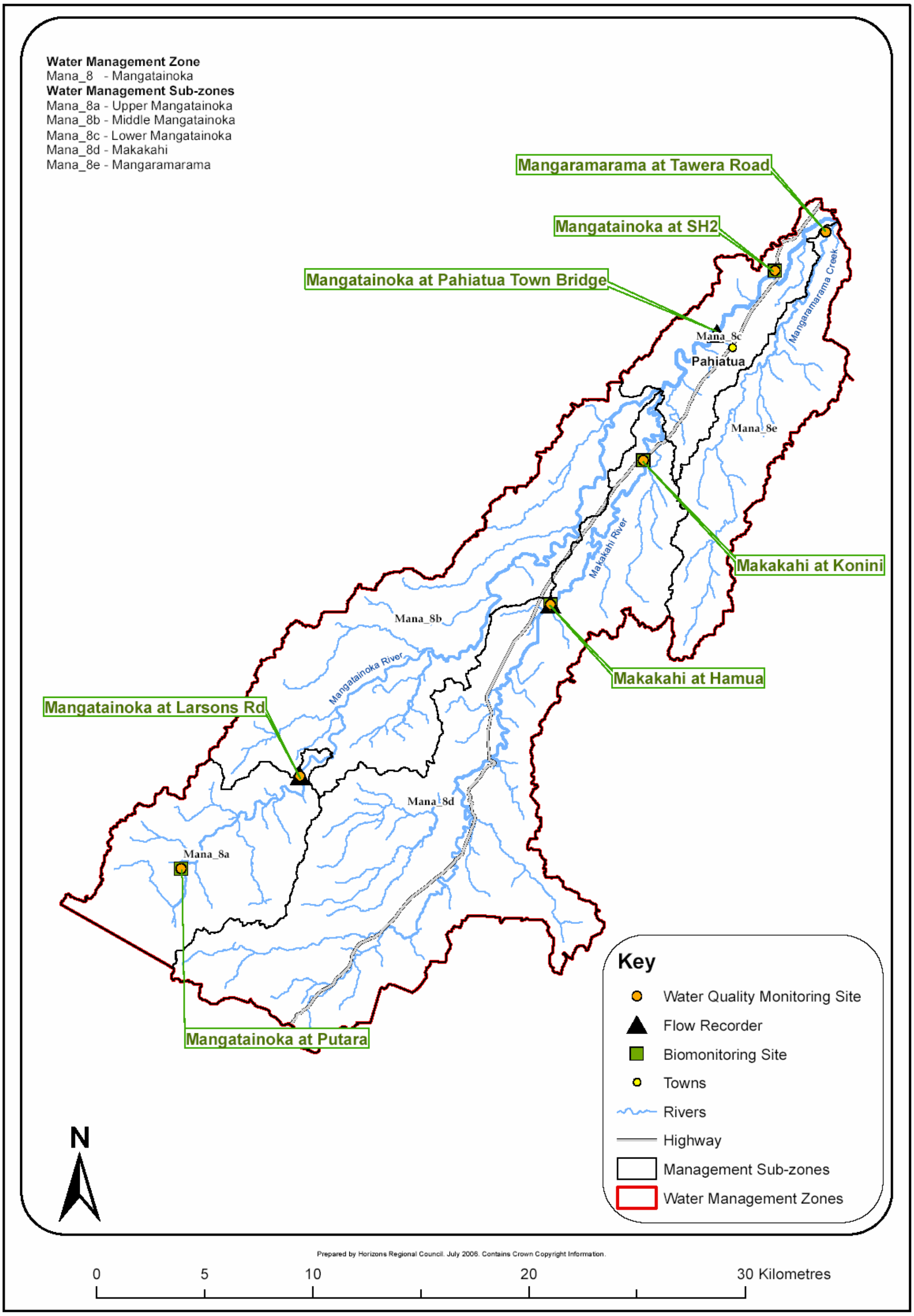


Figure B: Mangatainoka Water Management Zone and sub-zones

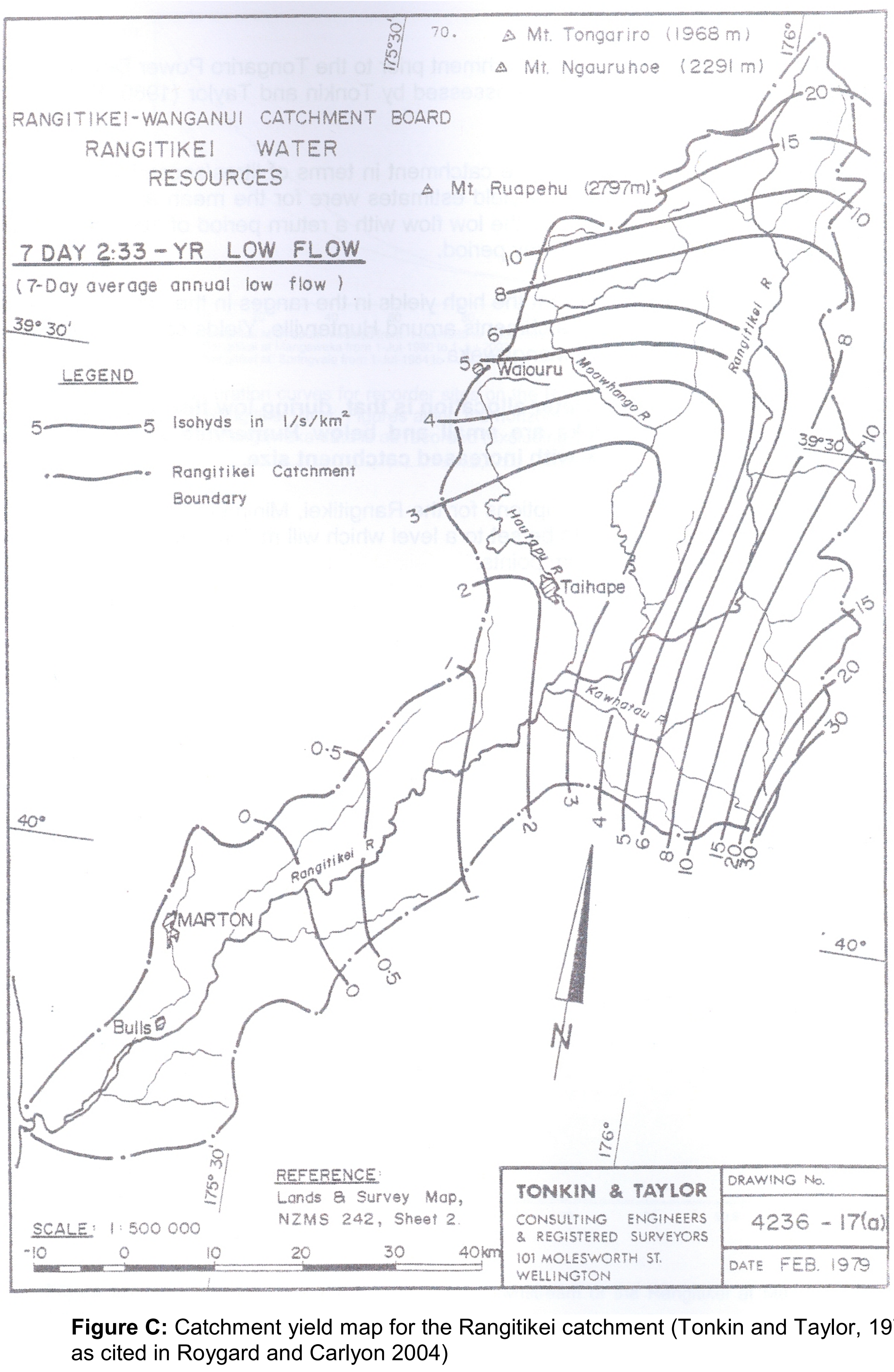


Figure C: Catchment yield map for the Rangitikei catchment (Tonkin and Taylor, 1979 as cited in Roygard and Carlyon 2004)

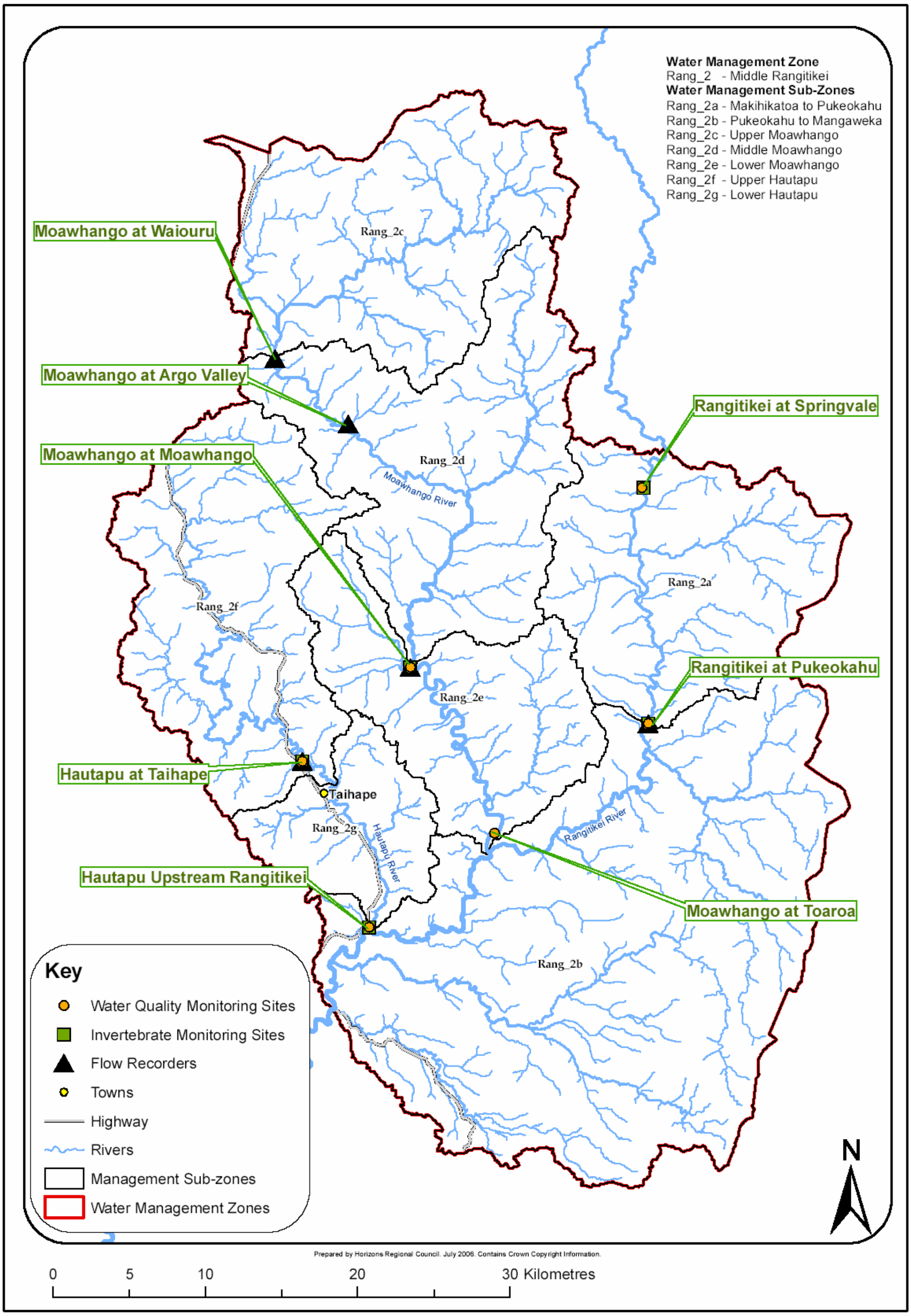


Figure D: Middle Rangitikei Water Management Zone and sub-zones

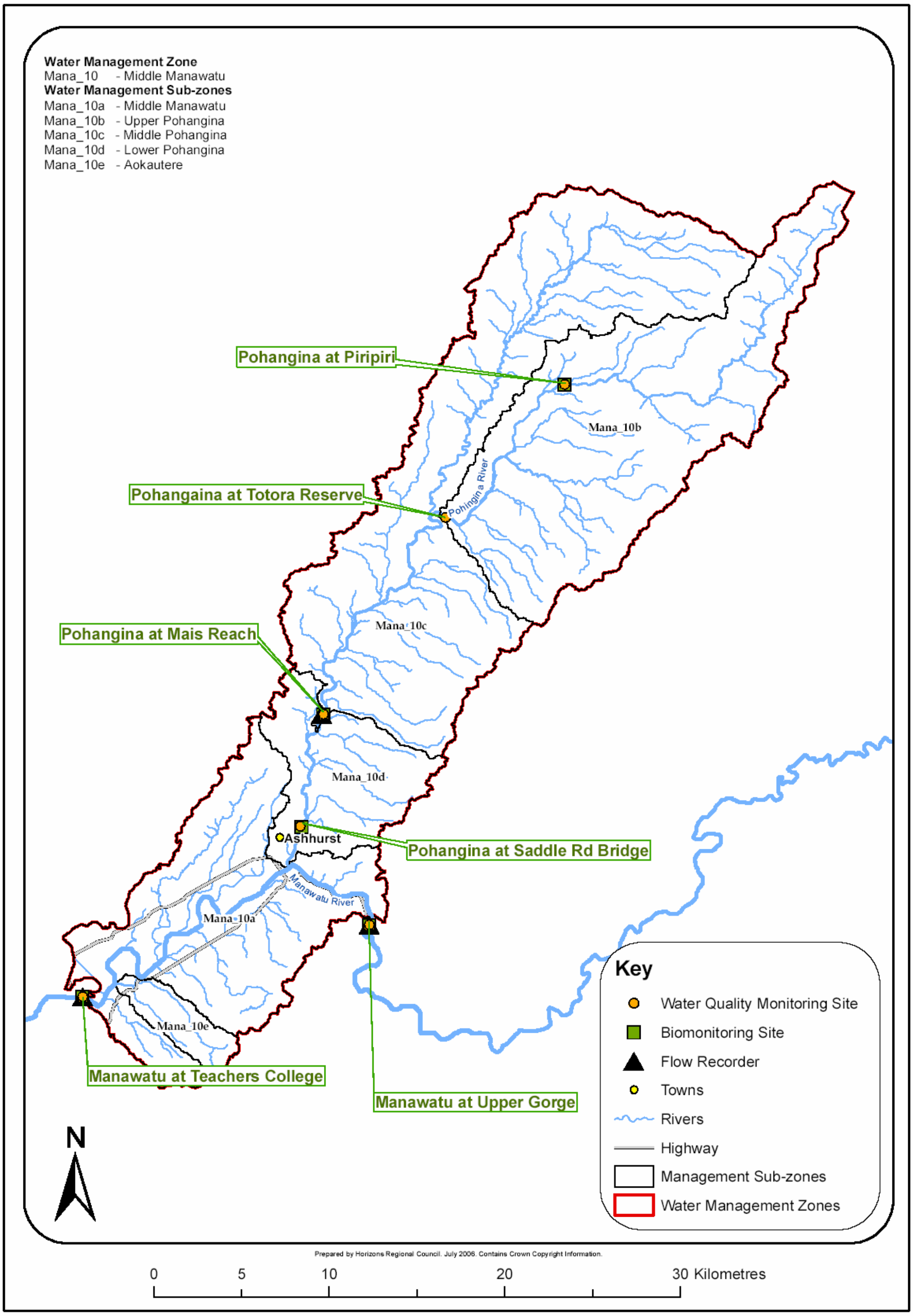


Figure E: Middle Manawatu Water Management Zone and sub-zones

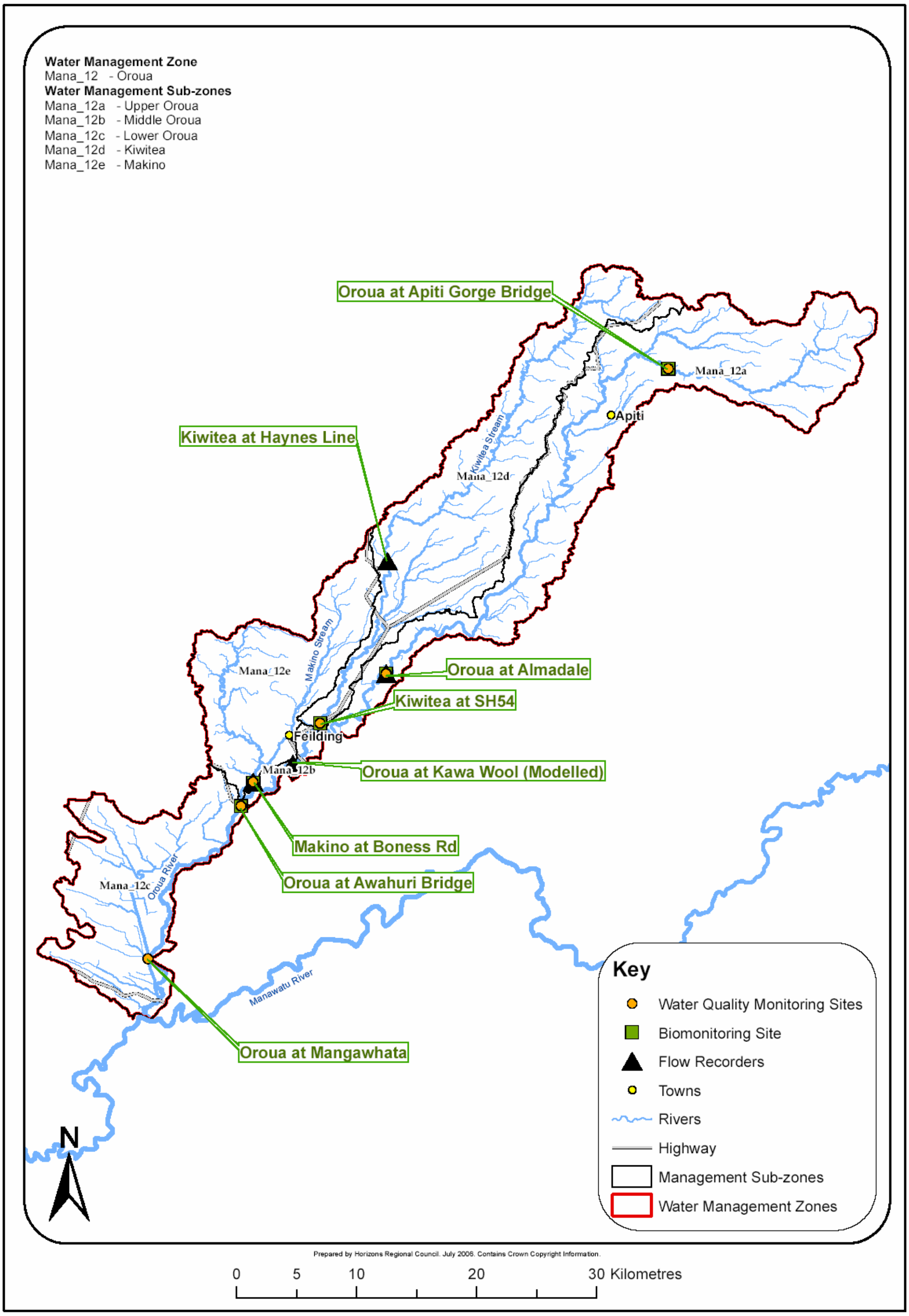


Figure F: Oroua Water Management Zone and sub-zones

Appendix D – Addendum to Cawthron Report Number 1179: Instream Flow assessment for the Oroua River

Prepared for Horizons Regional Council
by Joe Hay
February 2007

Introduction

In my original report I noted that the mean annual low flow (MALF), around which my minimum flow recommendation was based, was influenced by existing water abstractions, and that my minimum flow recommendation may change in response to updated flow statistics. Horizons Regional Council have recently attempted to account for estimated historical rates of abstraction to estimate a naturalised MALF for the Oroua River at the Kawa Wool Site. The naturalised MALF is 1.35 m^3s^{-1}, compared with the previous estimate of 1.2 m^3s^{-1} (which did not account for historical rates of abstraction). In light of this revised MALF this addendum provides updated minimum flow recommendations for the Oroua at the Kawa Wool Site.

Updated minimum flow recommendation

Table 1 is an updated version of Table 5 in my original report. It shows minimum flow recommendations based on instream habitat retention, calculated using the weighted usable area (WUA) predictions for the Oroua from RHYHABSIM and the new naturalized MALF estimate.

Table 1 Flows at predicted WUA optima for brown trout and longfin eel, and flows predicted to retain 80% and 70% of the WUA at the MALF or WUA optimum (whichever is lowest) in the Oroua River (the recommended minimum flow is highlighted in bold)

MALF (m^3s^{-1})	Habitat Suitability Criteria	Flow at WUA Optimum (m^3s^{-1})	Flow at 80% of MALF or WUA Optimum (m^3s^{-1})	Flow at 70% of MALF or WUA Optimum (m^3s^{-1})
1.35	Brown trout adult (Hayes & Jowett 1994)	2.4	**1.05**	0.91
	Brown trout 15-25cm (Raleigh *et al.* 1986)	1.2	0.42	0.29
	Brown trout fry to 15cm (Raleigh *et al.* 1986)	1.0	0.47	0.38
	Brown trout juvenile (Bovee 1995)	3.8	0.85	0.66
	Food producing (Waters 1976)	4.5	1.02	0.89
	Longfin eels >300 mm (Jellyman *et al.*)	1.3	0.12	< 0.1
	Longfin eels <300 mm (Jellyman *et al.*)	> 7.0	0.86	0.57

Based on this re-analysis, a minimum flow of 1.05 m^3s^{-1} for the Oroua River, measured at the Kawa Wool Site, would be expected to retain 80% of the adult brown trout habitat predicted to occur at the naturalised mean annual low flow (1.35 m^3s^{-1}). This minimum flow is 100 ls^{-1} higher than that proposed in my original report (which was based on an estimate of the MALF that did not account for historical rates of abstraction).

I reiterate the provisos made in my original report, that maintenance of flow variability should also be considered when setting allocation limits in conjunction with this minimum flow, and that consideration should be given to appropriate dilution flows required to maintain water quality guidelines in the Oroua River downstream of the Feilding sewage discharge, before the minimum flow suggested above is adopted.

Appendix E – National Water Conservation Orders for the Manganui o te Ao River and the Rangitikei River

THE NATIONAL WATER CONSERVATION (MANGANUI O TE AO RIVER) ORDER 1988

1. Title and Commencement

(1) This order may be cited as the National Water Conservation (Manganui o te Ao River) Order 1988.

(2) This order shall come into force on the 14th day after the date of its notification in the Gazette.

2. Interpretation

In this order, unless the context otherwise requires:

"Act" means the Water and Soil Conservation Act 1967;

"normal flow" at any point in a river or stream means:

- the actual flow rate at that point, plus
- any abstractions or diversions from the river or stream and its tributaries upstream of that point, less
- any discharges into the river or stream or its tributaries upstream of that point, except that no account shall be taken of discharges into the Orautoha Stream at or about map reference NZMS 260 S20:057014 in accordance with the notified use authorising the Raetihi Power Scheme;

"minimum flow" at any point in a river or stream means the mean of the annual minima of the 7 day flow, as estimated by the Rangitikei-Wanganui Catchment Board, where "7 day flow" means the mean flow over any 7 day period.

3. Outstanding Characteristics and Features

It is hereby declared that the Manganui o te Ao River and its tributaries, the Mangaturuturu and Makatote Rivers and the Waimarino and Orautoha Streams, include and provide for:

a. outstanding wild and scenic characteristics;

b. an outstanding wildlife habitat for the blue duck or whio (Hymenolaimus malacorhynchos);

c. and outstanding recreational fishery.

4. Retention of Natural Waters in a Natural State

Because of the outstanding characteristics and features specified in clause 3 of this order, the quantity and rate of flow of natural water in the waters described in the First Schedule to this order shall be retained in their natural state.

5. Partial Retention of Natural Waters

Because of the outstanding characteristics and features specified in clause 3 of this order the rate of flow of the natural waters in the waters described in the Second Schedule to this order shall not:

a. differ from the normal flow by more than 5 percent;

b. fall below the minimum flow.

6. Right to Dam not to be Granted

A right to dam any of the bodies of water specified in the First and Second Schedules to this order shall not be granted under Sections 21 or 23 of the Act.

7. Water Rights and General Authorisations for Discharges

(1) No water rights under Sections 21 or 23 of the Act shall be granted by the National Water and Soil Conservation Authority or by the Regional Water Board (as appropriate) and no general authorisations under Section 22 of the Act shall be made by the Regional Water Board for any discharge into any part of the catchment of the Manganui o te Ao River if the effect of the discharge would be either to cause the waters described in the First and Second Schedules of this order to breach the provisions and standards set out below or (should those waters fail to meet these provisions and standards), to cause the water condition in those waters to deviate further from compliance with these provisions and standards.

After allowing for reasonable mixing of the discharge with the receiving water:

i. the water temperature shall be less than 25 degrees Celsius in the months of October to April inclusive, and shall be less than 13 degrees Celsius in the months of May to September inclusive, and within that range the natural water temperature shall not be changed by more than 3 degrees Celsius;

ii. the acidity or alkalinity of the water as measured by the pH shall be within the range 6.0 to 9.0, and within that range the natural pH of the water shall not be changed by more than 1.0 unit;

iii. the water shall not be tainted so as to be unpalatable or unsuitable for consumption by humans or farm animals;

iv. the water shall not emit an objectionable odour;

v. there shall be no adverse effect on the aquatic community attributable to pollutants;

vi. aquatic organisms shall not be rendered unsuitable for human consumption by accumulation of excessive concentrations of pollutants;

vii. the natural colour and clarity of the waters shall not be changed to a conspicuous extent;

viii. there shall be no visible oil or grease films or conspicuous floating or suspended waste materials;

ix. the concentration of dissolved oxygen shall exceed 80 percent of saturation concentration;

x. there shall be no undesirable biological growths attributable to pollutants.

(2) No water rights under Sections 21 or 23 of the Act shall be granted by the National Water and Soil Conservation Authority or by the Regional Water Board (as appropriate), and no general authorisations under Section 22 of the Act shall be made by the Regional Water Board in respect of any part of the catchment of the Manganui o te Ao River where the effect of such rights or authorisations would be that the provision of this order cannot remain without change or variation **provided that** water rights may be made in respect of any part of those waters for any of the following purposes:

i. research into, and enhancement of, fisheries and wildlife habitats;

ii. the maintenance or protection of roads, bridges and other necessary public utilities;

iii. soil conservation works undertaken pursuant to the Soil Conservation and Rivers Control Act 1941.

8. Scope of this Order

Nothing in this order shall be construed as limiting the effect of the second proviso to Section 21(1) of the Act relating to the use of water for domestic needs, for the needs of animals and for or in connection with firefighting purposes.

FIRST SCHEDULE

a. The Manganui o te Ao River upstream of its confluence with the Waimarino Stream.

b. The Makatote River and the Mangaturuturu River.

SECOND SCHEDULE

a. The Manganui o te Ao River downstream of its confluence with the Waimarino Stream.

b. The Waimarino and Orautoha Streams.

THE WATER CONSERVATION (RANGITIKEI RIVER) ORDER 1993

1. Title and Commencement

(1) This order may be cited as the Water Conservation (Rangitikei River) Order 1993.

(2) This order shall come into force on the 28th day after the date of its notification in the Gazette.

2. Interpretation

In this order, unless the context otherwise requires:

"Act" means the Resource Management Act 1991:

"Middle River" means-

a. The Rangitikei River itself from its confluence with the Makahikatoa Stream (approximate map reference Infomap 260 U21:725-888) to the Mangarere Bridge (approximate map reference Infomap 260 T22:483-496); and

b. The Whakaurekau River plus all its tributaries and the Kawhatau River plus its following tributaries, namely, the Pouranaki River and the Mangakokeke Stream:

"River flow" means for any given point on the Middle River and Upper River-

a. The mean daily flow occurring at that point; plus

b. The sum of abstractions from the Upper and Middle River upstream of that given point expressed as a daily mean, but not including any abstraction from the Moawhango River at the Moawhango Dam (approximate map reference Infomap 260 T20:471-962) for hydro-electric power generation purposes:

"Upper River" means-

a. The Rangitikei River itself from its source (approximate map reference Infomap 260 U19:723-313) to its confluence with the Makahikatoa Stream (approximate map reference Infomap 260 U21:725-888); and

b. All rivers and streams contributing water to the Rangitikei River upstream of that confluence.

3. Outstanding Characteristics and Features

(1) It is hereby declared that the Upper River includes and provides for-

a. Outstanding wild and scenic characteristics; and
b. Outstanding recreational, fisheries, and wildlife habitat features.

(2) It is hereby declared that the Middle River includes and provides for-

a. Outstanding scenic characteristics; and
b. Outstanding recreational and fisheries features.

4. Waters to be Protected

Because of the outstanding characteristics and features specified in clause 3 of this order, the waters of the Upper River and Middle River are, subject to clause 5 of this order, to be protected as follows:

a. The quantity and rate of flow of natural water in the Upper River shall be retained in its natural state;

b. The rate of flow of the natural waters at any point in the Middle River shall not be less than 95% of the river flow at that point;

c. Resource consents under the Act shall not be granted to dam the Upper River or the Middle River;

d. Resource consents under the Act shall not be granted to construct any dam downstream of the Middle River, which has the effect of impounding water in the Middle River upstream of the confluence with the Hautapu River.

e. In granting any resource consents under the Act or making a rule in a regional plan, in respect of the Upper River or the Middle River, the regional council shall ensure that, after allowing for reasonable mixing of the discharge with the receiving water-

   i. The natural water temperature shall not be changed by more than 3 degrees Celsius; and
   ii. The acidity or alkalinity of the water as measured by the pH shall be within the range of 6.0 to 9.0; and within that range the natural pH of the water shall not be changed by more than 1.0 unit; and
   iii. The concentration of dissolved oxygen shall be not less than 80 percent of saturation concentration; and
   iv. There shall be no undesirable biological growths attributable to contaminants.

5. Scope of Order

(1) Nothing in this order shall be construed as limiting any right to the use of water for domestic needs, for the needs of animals, and for or in connection with fire-fighting purposes.

(2) Nothing in this order shall prevent the renewal of any general authorisation granted under Section 22 of the Water and Soil Conservation Act 1967 and deemed to be a provision of a regional plan under Section 368 of the Act, or any resource consent under the Act which is current on the commencement of this order, or the granting of resource consents under the Act in substitution for existing use rights which are current on the commencement of this order.

(3) Nothing in this order shall prevent the granting of resource consents under the Act, or the making of rules in regional plans, in respect of the Upper River or the Middle River, for the purposes of-

a. Research into, and enhancement of, fisheries and wildlife habitats; or
b. Maintenance and protection of roads, bridges, and other necessary public utilities; or
c. Soil conservation, rivers control, or other activities undertaken pursuant to the Soil Conservation and Rivers Control Act 1941.

(4) Nothing in this order shall prevent the granting of resource consents under the Act for the construction of any dam downstream from the Middle River which has the effect of impounding water in the Middle River as far upstream as the confluence with the Hautapu River.

Explanatory Note

This note is not part of the order, but is intended to indicate its general effect.

This order, which comes into force 28 days after its notification in the Gazette, declares-

a. The waters of the Upper Rangitikei River-

i. To have outstanding wild and scenic characteristics; and
ii. To have outstanding recreational, fisheries, and wildlife habitat features; and

b. The waters of the Middle Rangitikei River-

i. To have outstanding scenic characteristics; and
ii. To have outstanding recreational and fisheries features.

The order specifies how the waters are to be protected and the limitations of the protection.

Appendix F – The provisions of the Regional Land and Water Plan (2003) that replace the Local Water Conservation Notices:

SW Policy 3: Maintaining features and characteristics of the Hautapu, Mangatainoka and Makuri Rivers and their tributaries
To grant consents to take and use water from

a. the Hautapu River upstream of its confluence with the Oraukura Stream; or

b. any tributaries of the Hautapu River upstream of its confluence with the Oraukura Stream; or

c. the Mangatainoka River; or

d. any tributary of the Mangatainoka River; or

e. the Makuri River; or

f. any tributary of the Makuri River, including the Makuri-iti River

only where the Council is satisfied that there will be no adverse effect on

g. the recreational fishery value of the river; or

h. any scenic characteristics of regional significance; or

i. any wildlife habitats of regional significance; or

j. any recreational value of regional significance; or

k. the habitat of trout

and for the Makuri River or any tributary of the Makuri River, including the Makuri-iti River that the abstraction will not reduce the rate of flow below 95% of the river flow[20] at that point.

SW Rules 2, 3, 3A and 3B. Takes from the Hautapu, Mangatainoka or Makuri Rivers and their tributaries; and Whakapapa and Whanganui minimum flows
Pursuant to Section 88 of the Act, applications for Non-Complying Activities described in SW Rules 2 and 3; and Discretionary Activities in SW Rules 3A and 3B of this Plan shall include the following information—

a. a statement specifying all other resource consents that the applicant may require from the Regional Council or the District Council in respect of the activity, and whether or not the applicant has applied for such consents; and

b. a description of the site of the proposed activity, including the map reference from NZMS map, scale 1:50,000, and plans of the site

[20] "river flow" in rivers affected by the Local Water Conservation (Makuri River) Notice 1990 is defined in that Notice. This definition is reproduced in the Glossary of this report.

showing the location of the point of abstraction, and neighbouring properties; and

c. a description of the environment including:

   i. the natural flow regime;
   ii. aquatic ecosystems; and
   iii. other in-stream values, such as recreation and amenity

   and the effects of the abstraction on that environment; and

d. the daily volumes of water sought, the rate of abstraction (in litres per second), and methods used to measure and record the abstraction rate; and

e. the measures that will be taken to avoid, remedy or mitigate any adverse effects on:

   i. matters of concern to tangata whenua;
   ii. aquatic ecosystems;
   iii. recreation and amenity values;
   iv. scenic characteristics; and
   v. any value associated with the river specified in the Regional Policy Statement for Manawatu-Wanganui; and

f. a description of

   i. any alternative sources of water;
   ii. the proposed water use;
   iii. the efficiency of the system for the proposed use; and
   iv. water conservation measures to be undertaken; and

g. a description of the consultation undertaken with parties interested in or affected by the proposal, and the applicant's response to the views of those consulted.

Appendix G – One Plan Policies Regarding Water Quantity and Allocation

Policies applying to both Surface Water and Groundwater

Policy 6-12: Reasonable and justifiable need for water

The amount of water taken by resource users shall be reasonable and justifiable for the intended use. In addition, the following specific measures for ensuring reasonable and justifiable use of water shall be taken into account when considering consent applications to take water for irrigation, public water supply* or industrial use, and during reviews of consent conditions for these activities.

(a) For irrigation, resource consent applications shall be required to meet a reasonable use test in relation to the maximum daily rate of abstraction, the irrigation return period and the seasonal or annual volume of the proposed take. When making decisions on the reasonableness of the rate and volume of take sought, the Regional Council will:

- (i) consider land use, crop water-use requirements, on-site physical factors such as soil water-holding capacity, and climatic factors such as rainfall variability and potential evapo-transpiration
- (ii) assess applications either on the basis of an irrigation application efficiency of 80% (even if the actual system being used has a lower application efficiency), or on the basis of a higher efficiency where an application is for an irrigation system with a higher efficiency
- (iii) link actual irrigation use to soil moisture measurements in consent conditions.

(b) For industrial uses, water allocation shall be calculated where possible in accordance with best management practices for water efficiency for that particular industry.

(c) For public water supplies, the following shall be considered to be reasonable:

- (i) an allocation of 300 litres per person per day for domestic needs, plus
- (ii) an allocation for commercial use equal to 20% of the total allocation for domestic needs, plus
- (iii) an allocation for industrial use calculated, where possible, in accordance with best management practices for water efficiency for that particular industry, plus
- (iv) any allocation necessary to cater for the reasonable needs of livestock or agricultural practices that are connected to the public water supply* system, plus
- (v) an allocation necessary to cater for growth, where urban growth of the municipality is zoned and is reasonably forecast, plus
- (vi) an allocation for leakage equal to 15% of the total of subsections (i) to (v) above.

Where the existing allocation for a public water supply* exceeds the allocation calculated in accordance with subsections (i) to (vi) above, the Regional Council will establish, in consultation with the relevant Territorial Authority, a timeframe by which the existing allocation shall be reduced to the calculated amount.

Policy 6-13: Efficient use of water

Water shall be used efficiently, including by the following measures:

(a) requiring water audits and water budgets to check for leakages and water-use efficiency

(b) requiring the use of, or progressive upgrade to, infrastructure* for water distribution that minimises use and loss of water

(c) enabling the transfer of water permits

(d) raising awareness about water efficiency issues and techniques

(e) installing water metering and telemetry to monitor water use.

Policy 6-14: Consideration of alternative water sources

When making decisions on consent applications to take surface water, the opportunity to utilise alternative sources such as groundwater or water storage shall be considered.

Policies for Surface Water

Policy 6-15: Overall approach for surface water allocation

(a) The requirements of water conservation orders shall be given effect under this Plan.

(b) The provisions of this plan will not be inconsistent with the intent of local water conservation notices.

(c) Core allocations of surface water from rivers shall be determined in accordance with Policies 6-16 and 6-17. Takes that comply with the relevant core allocation, when assessed in combination with all other takes, shall be allowed.

(d) Supplementary allocations of surface water from rivers shall be determined in accordance with Policy 6-18.

(e) Takes from rivers shall be apportioned, restricted or suspended in times of low flows in accordance with the provisions of Policy 6-19.

(f) Takes of water from lakes shall comply with Policy 6-20.

Policy 6-16: Core water allocation and minimum flows

(a) The taking of surface water shall be managed in accordance with the minimum flows and core allocations set out for each water management zone* in Schedule B.

(b) The minimum flows and core allocations set out in Schedule B shall be assessed after any takes for hydro electricity generation have been taken. The only exception to this will be the hydro electricity takes from Zone Whau_3c.

Policy 6-17: Approach to setting minimum flows and core allocations

(a) Where good hydrological information, such as a specific water resource study or a long-term flow record, is available it shall be used to set minimum flows and core allocations in Schedule B.

(b) Where information described in (a) above is not available, the minimum flows and core allocations set out in Schedule B shall generally be a minimum flow equal to the estimated or calculated one-day mean annual low flow, and a core allocation equal to a percentage of the minimum as specified Schedule B.

Policy 6-18: Supplementary water allocation

In addition to the core allocations set out in Policy 6-16, a supplementary allocation from rivers may be provided:

(a) in circumstances where water is only taken when the river flow is greater than the median flow, and the total amount of water taken by way of a supplementary allocation does not exceed 10% of the natural flow in the river at the time of abstraction

(b) in circumstances where it can be shown that the supplementary allocation will not:

(i) increase the frequency or duration of low flows
(ii) cause any adverse effects on the values of the waterbody as set out in Schedule D
(iii) limit the ability of anyone to take water under a core allocation.

Policy 6-19: Apportioning, restricting and suspending takes in times of low flow

During times of low flow, takes from rivers shall be managed in the following manner:

(a) **Permitted takes** – Takes that are permitted by this Plan (surface water and groundwater takes) or are for fire-fighting purposes shall be allowed to continue regardless of river flow.

(b) **Essential takes** – The following core water allocation takes shall be deemed essential and shall be managed in the manner described.

(i) takes greater than permitted by this Plan (and therefore subject to resource consent) that are required to meet an individual's reasonable domestic needs or the reasonable needs of an individual's animals for drinking water shall be allowed to continue regardless of river flow
(ii) takes required to meet the reasonable needs of hospitals, other facilities providing medical treatment, marae, schools or other education facilities, or correction facilities shall be allowed to continue regardless of river flow
(iii) takes required for the operation of industries which, if their take were to cease, would significantly compromise a community's

ability to provide for its social, economic or cultural well-being or for its health or safety shall be allowed to continue regardless of river flow, but shall be required to minimise the amount of water taken to the extent reasonable

(iv) public water supply takes shall be restricted to a total public water consumption calculated as follows:

- (A) an allocation of 250 litres per person per day for domestic needs, plus
- (B) an allocation for commercial use equal to 20% of the total allocation for domestic needs, plus
- (C) an allocation which meets the reasonable needs of those facilities and industries listed under subsections (b)(ii) and (b)(iii) where such facilities and industries are connected to the public water supply system, plus
- (D) any allocation necessary to cater for the reasonable needs of livestock that are connected to the public water supply system, plus
- (E) an allocation for leakage equal to 15% of the total of subsections (A) to (D) above.

(c) **Non-essential takes** – Other core water allocation takes, including irrigation takes but excluding the essential takes described under subsection (b), shall be managed in the following manner:

(i) water takes shall be required to cease when the river drops below its minimum flow, as set out in Policy 6-16

(ii) water takes shall be allowed to recommence once the river flow has risen above its minimum flow.

(d) **Meaning of 'core water allocation take'** – For the purposes of this policy, a core water allocation take means a take that has been granted consent in accordance with a core water allocation made under Policy 6-16, or in accordance with a previous core water allocation regime.

horizons
regional council

11-15 Victoria Avenue
Private Bag 11 025
Manawatu Mail Centre
Palmerston North 4442

T 0508 800 800
F 06 952 2929
help@horizons.govt.nz
www.horizons.govt.nz