Greater Heretaunga and Ahuriri Land and Water Management Collaborative Stakeholder (TANK) Group

TANK

Meeting 34:
18 October 2017

HAWKE'S BAY
REGIONAL COUNCIL

Karakia

Karakia

Ko te tumanako

Kia pai tenei rā

Kia tutuki i ngā wawata

Kia tau te rangimarie

I runga i a tatou katoa

Mauriora kia tatou katoa

Āmine

Water is a taonga and the purpose of our meeting is to……….

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Agenda

9:30am	Notices
9:45am	Presentation overview (Mary-Anne)
9.50am	Values and context
10.30am	Native birds and habitat needs (Matt Brady)
10.45am	Aquatic habitat and flows (Thomas)
11.00am	Considerations for flow setting (Joe Hay)
11.45am	Habitat requirements (Thomas)
12:30pm	**LUNCH**
1.00pm	Modelling; context and results (Jeff and Rob)
2.30pm	Decisions on low flow/allocation regimes for further analysis
3:00pm	**COFFEE BREAK**
4:00pm	**CLOSE MEETING**

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Meeting objectives

For the Ngaruroro and Tutaekuri Rivers:

1. Agree relevant values for water quantity management
2. Understand the effects of surface water takes on water quantity attributes.
3. Agree on allocation and minimum flow/trigger flow options for further assessment
4. Agree on abstraction restriction options for further assessment

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Engagement etiquette

- Be an active and respectful participant / listener
- Share air time – have your say and allow others to have theirs
- One conversation at a time
- Ensure your important points are captured
- Please let us know if you need to leave the meeting early

Ground rules for observers

- RPC members are active observers by right (as per ToR)
- Pre-approval for other observers to attend should be sought from Robyn Wynne-Lewis (prior to the day of the meeting)
- TANK members are responsible for introducing observers and should remain together at break out sessions
- Observer's speaking rights are at the discretion of the facilitator and the observer should defer to the TANK member whenever possible.

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Presentation overview

1. Overall context; managing water flows and sw abstraction
   - The NPSFM and
   - Community values for water quantity and their attributes
   - Management options – limits, reductions, water storage
2. The river instream values
   - Native birds (Matt Brady)
   - Aquatic habitat for fish (Thomas Wilding)
3. Considerations for setting flow and allocation limits (Joe Hay)
4. Updating the flow information (Thomas W)
5. Low flow management regime (Jeff and Rob)
   - Choosing management scenarios for further analysis (economic/social/cultural)
   - Choosing restriction regimes for further analysis
   - Modelling augmentation options

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Managing effects of abstraction on water flows

What these decisions mean for the river values

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Water Quantity Management; NPSFM

1. **Recognise Te Mana o te Wai**
2. **To safeguard the life-supporting capacity**, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the taking, using, damming, or diverting of fresh water
    - And protect the significant values of outstanding water bodies
3. **Set environmental flows and/or levels**
    - Include how much is available for abstraction (limit) and include a minimum flow
4. **Avoid (or phase out) over-allocation**
    - Over-allocation is where freshwater objectives not being met
    - This can be in terms of the river values as well as abstractive values
5. **Provide for economic well-being** – within the sustainable limits
6. **Allocate water efficiently**

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Sustainable water yield

How big is the pie?

- *How much above defined flows can be abstracted?*

The bigger the pie;

➔the more the impact on flow regimes
➔the sooner the flow restriction

Water allocation

How big is my slice?
Do we all get the same size?

The bigger the slice;

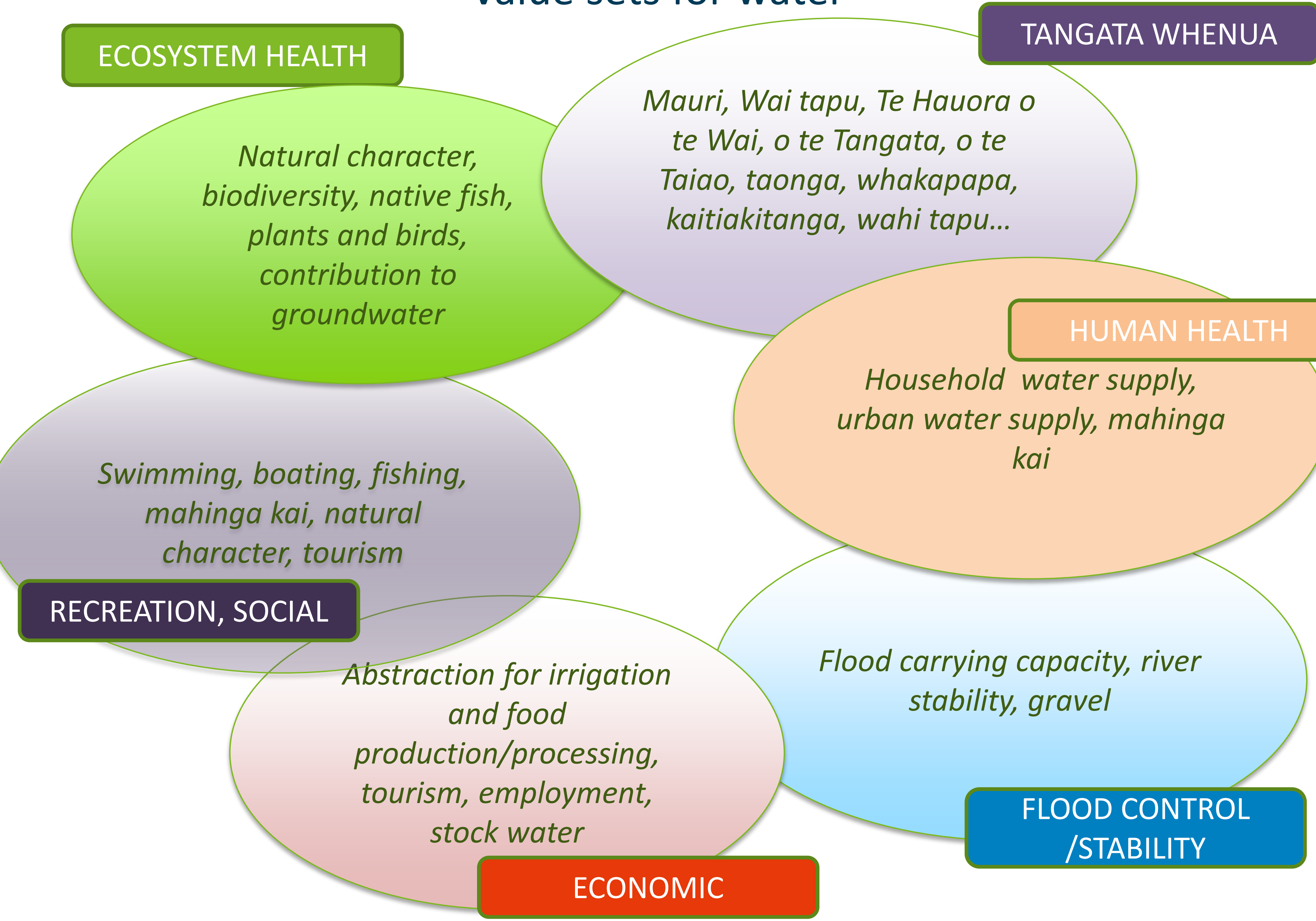
➔ the fewer people get access
➔ are there priority end uses?

Water augmentation

How can we get more pie?

Taking at higher flows
Storing for later use
Reticulating
Saving/conserving/ rostering

Value sets for water



Values we hold for the Rivers

- Some **quantitative** detail about various values is available
  - *E.g fish and fishing, swimming (Rivas assessments, angling surveys, native fishery, birds)*
- **Qualitative** information about others *(i.e cultural values in Ngā Ngaru o Ngā Upokororo, Tutaekuri River)*

- Information also provided about
  - Value of primary production to local and regional economy
  - Conservation Order application data – new evidence being collated for these values
- Further information to understand impacts of water management regimes on economic /cultural/social 'value' of water abstraction – yet

- **Interim report** – agreement to assess effects of policy options on all values

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The TANK group will need to decide on **minimum flows, allocations** and a **flow management regime** that provides for these agreed values at the agreed levels of protection

From the RMA;

ENVIRONMENT includes—

a) ecosystems and their constituent parts, including people and communities; and
b) all natural and physical resources; and
c) amenity values; and
d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) or which are affected by those matters

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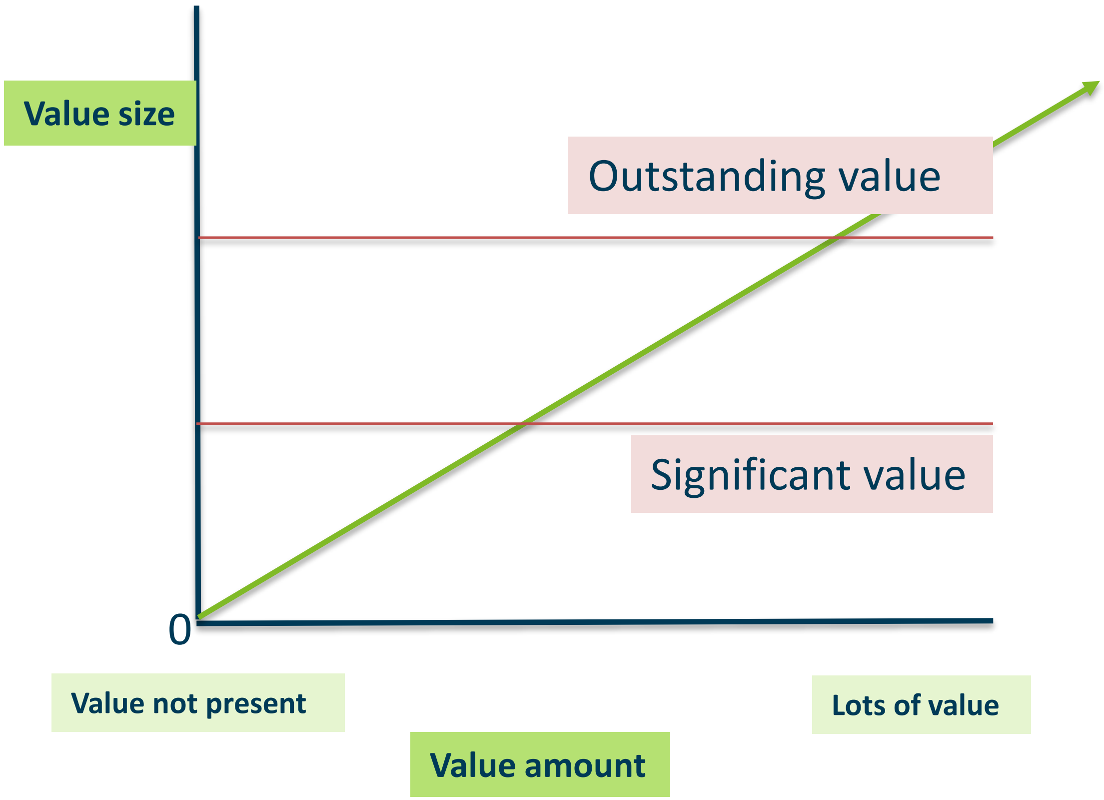
Significance of Values
Other processes

NPS FM – Protect the **significant values** of outstanding freshwater bodies

- RPS commitment
- Plan change process underway to identify outstanding freshwater bodies

WCO – some values may be **outstanding**. Other regulatory tools to manage them may be appropriate.

Significance of values



Value	Criteria for "significant"
Attribute 1	X per y
Attribute 2	More than #
Attribute 3	……….

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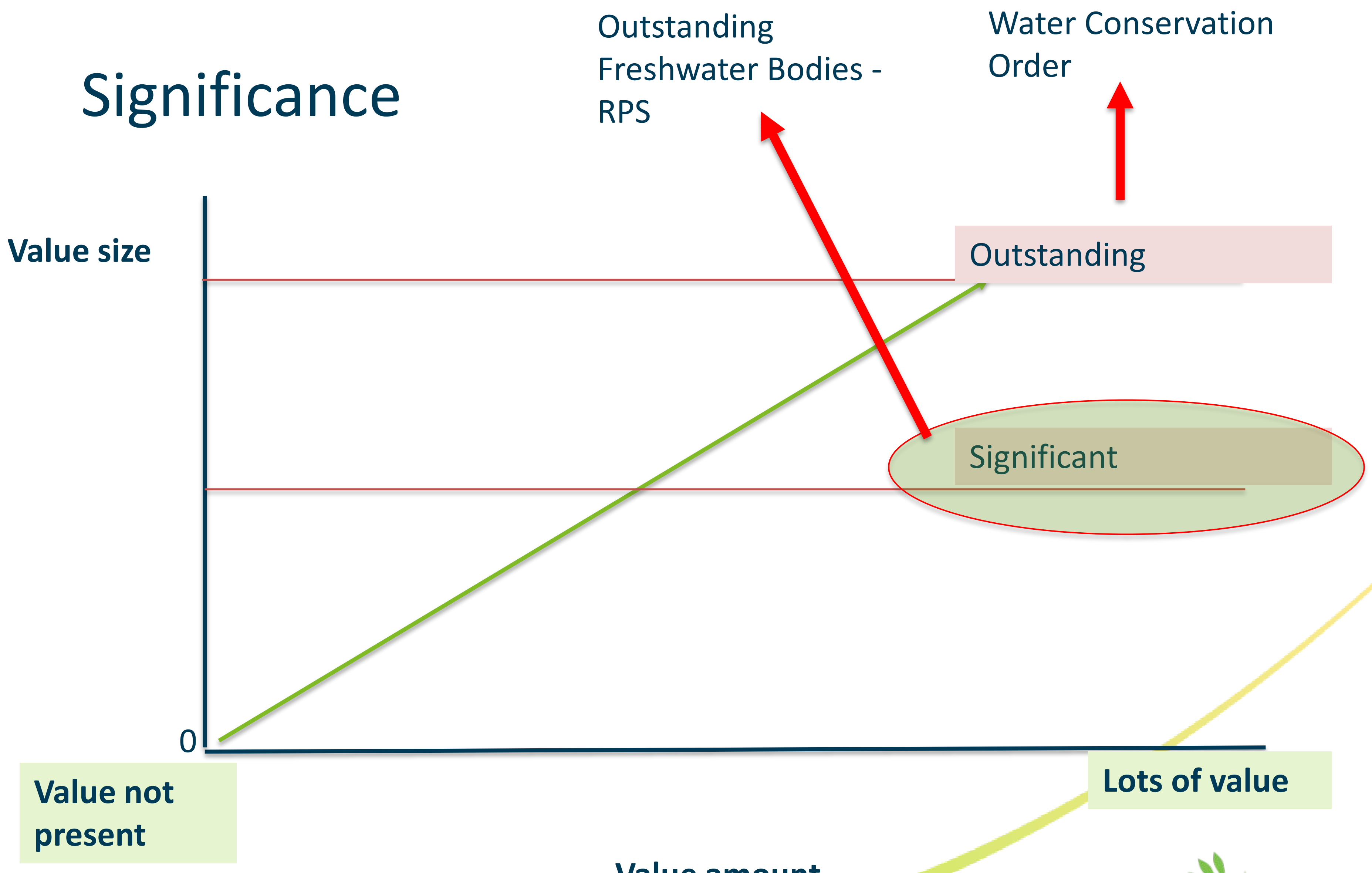
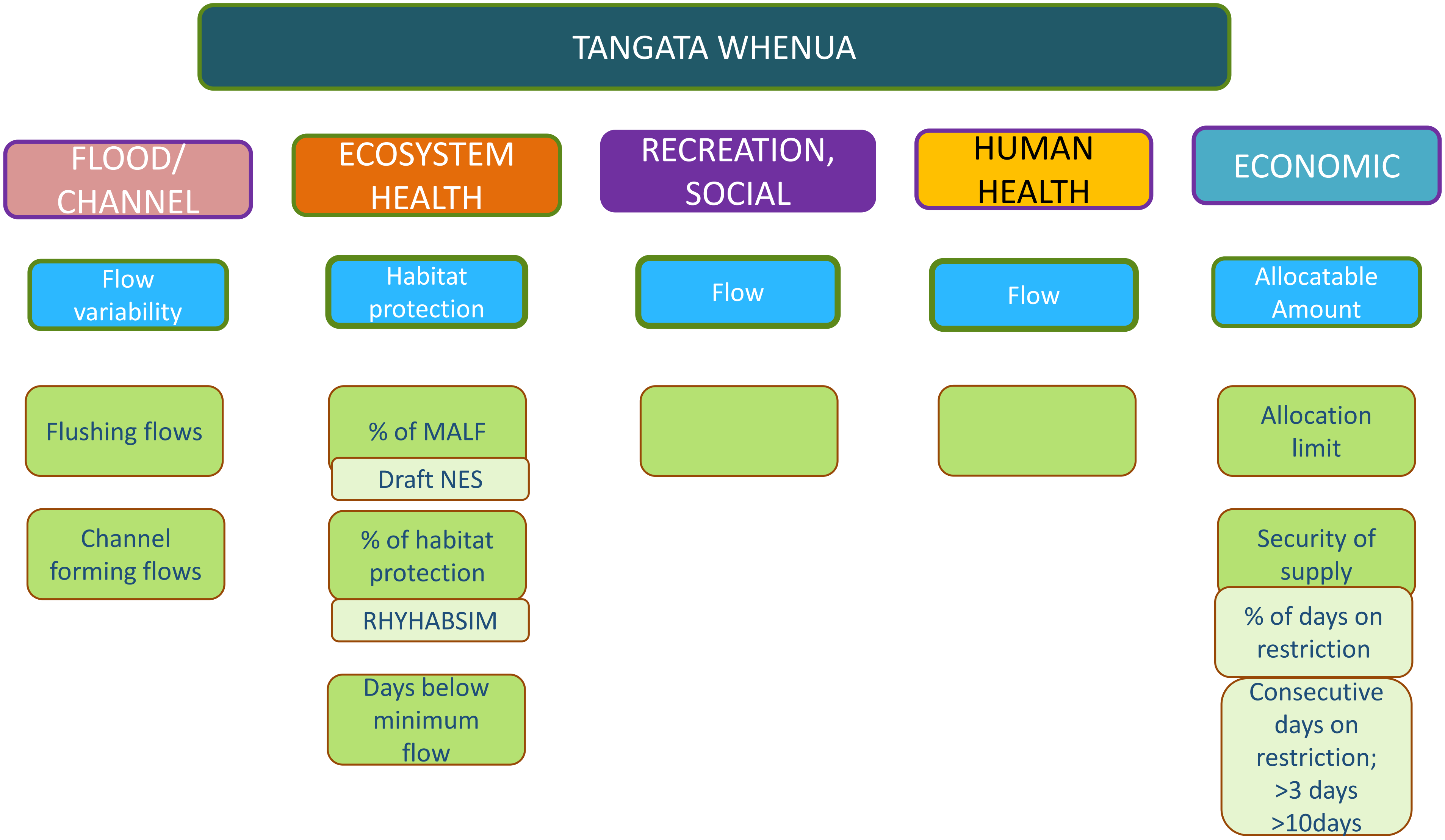
Significance

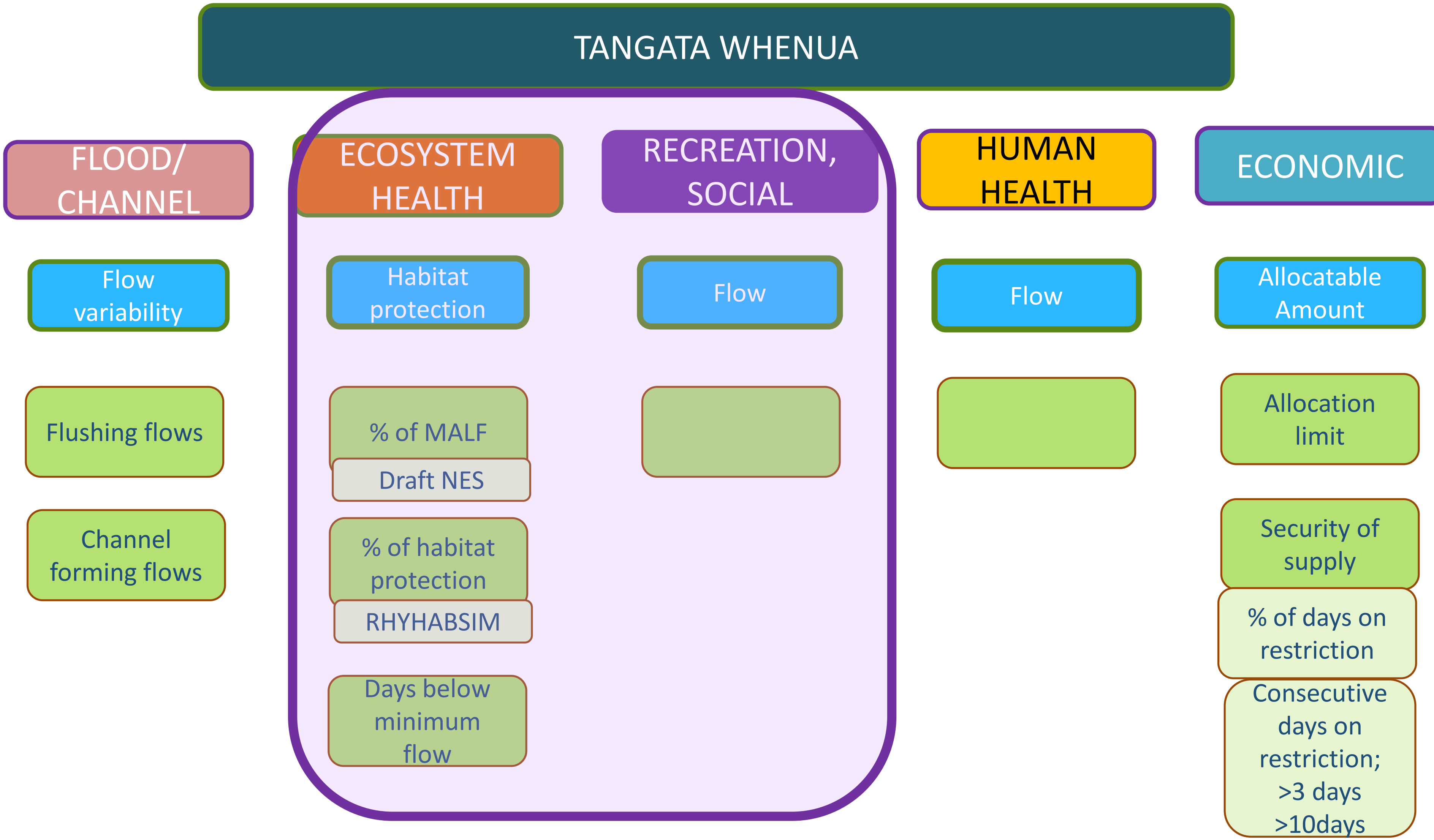


Attributes for water quantity
(measurable characteristics of freshwater)

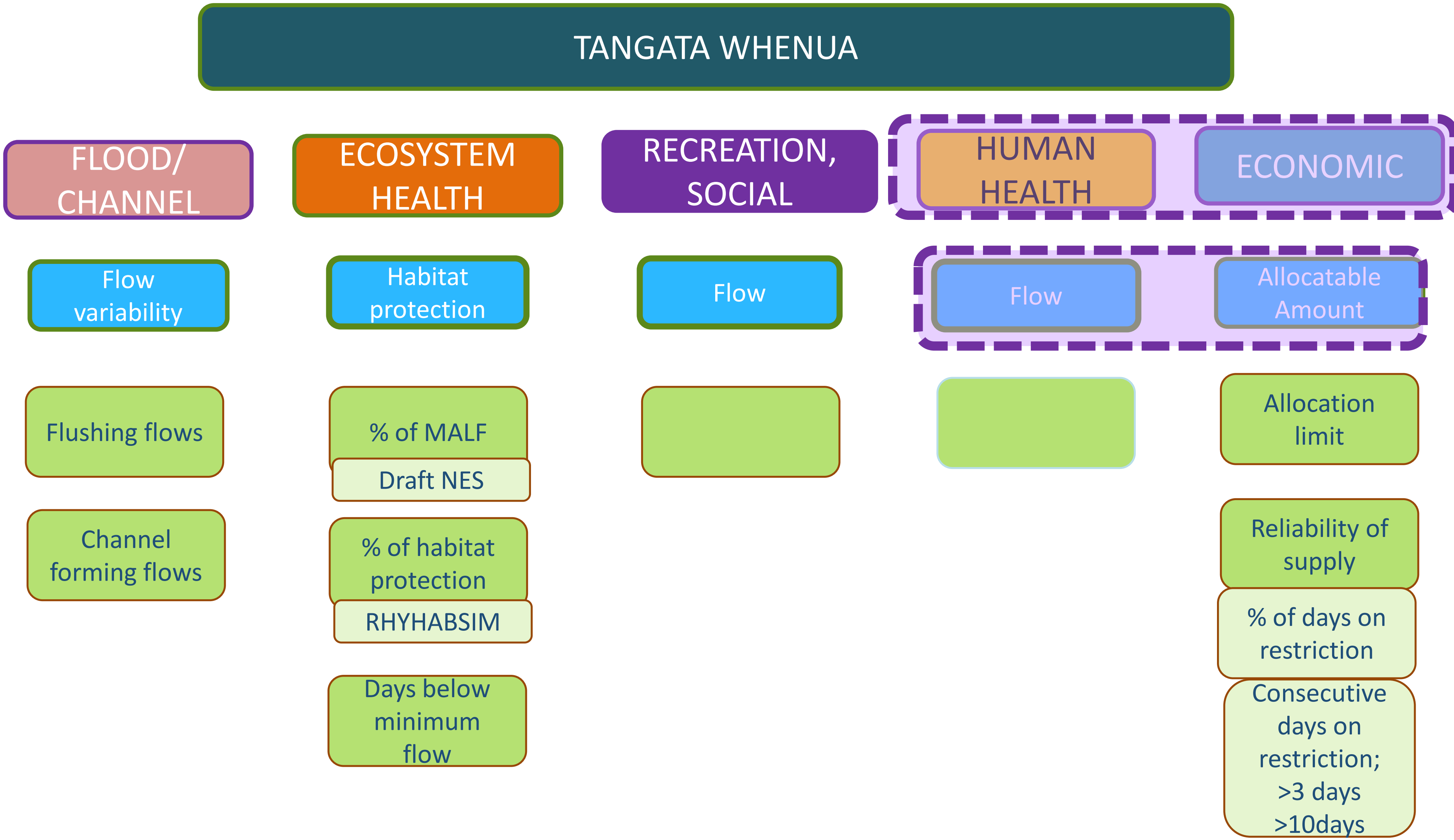
Attributes for values



Attribute groups for different values



Attribute groups for different values



The NPSFM already requires us to recognise Te Mana o te Wai and manage flows to safeguard the life supporting capacity and ecosystem processes.

There are no rules or thresholds to help decide what that means.
The management flow choice may be influenced by deciding one value is more important than another.

1. Does the TANK Group wish to assign significance to the values for which it is to make decisions about flow/quantity?

2. Does the TANK Group continue to agree these values are equally important in deciding water allocation and minimum flows?

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Values matrix – Ngaruroro River

VALUES	ECONOMIC		ECOSYSTEM HEALTH			SOCIAL RECREATION MAHINGA KAI	SPIRITUAL CULTURAL	Other
	Attributes							
scenario	Reliability	Allocation limit	Habitat protection (%)	Days below minimum flow	% MALF			
1								
2								
3								
4								

The economic costs may be calculated;

- by impacts of changes in reliability of supply or
- costs of augmentation to improve reliability of supply.

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Values matrix – Ngaruroro River

VALUES	ECONOMIC		ECOSYSTEM HEALTH			SOCIAL RECREATION MAHINGA KAI	SPIRITUAL CULTURAL	Other
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1								
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The economic costs may be calculated by impacts of changes in reliability of supply or costs of augmentation to improve reliability of supply.

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Attributes for Ecosystem Protection

	Habitat protection
	80 -100% habitat protection for torrent fish expected to minimise the risk of torrent fish populations falling below natural levels. Also provides very high level of protection for other native fish
	60-80% habitat protection for torrent fish expected to reduce (relative to the status quo) the risk of torrent fish populations falling below natural levels. Also provides higher level of protection for other native fish (habitat protection level for smelt >90%)
	<60% habitat protection for torrent fish expected to continue current risk that torrent fish population are below natural levels. Provides higher level of protection for other native fish (habitat protection level for smelt >90%)
	44% habitat level of protection for torrent fish, 86% level of protection for smelt. Flows remaining below 2400 L/s for extended periods increase the risk of measurable effects on the torrent fish population, especially if fish densities are high going into summer.

Attributes for reliability of supply

	10 consecutive days restriction no more than 1/17 years **RP>10**	≤5% days on no restriction	1x times 3 consecutive days restriction less than 12 times in 17 years	Protects investment into irrigated land use activities at a high level of security
	10 consecutive days restriction no more than once in 10 years **RP 5- 10**	>5 % < 10% days on no restrictions	2-3 times 3 consecutive days restriction between 4 and 6 times in 10 years	Protects investment into most existing irrigated land uses. In some years there may be insufficient water for sensitive crops
	10 consecutive days restriction 2 or more times within a 10 year period **RP <5**	More than 10% days on no restriction	4 or more times 3 consecutive days restriction more than 6 times in 10 years	Some irrigated land uses not economically viable at this level of security. Land use change likely to occur

Assessing costs of water storage options to meet proposed minimum flows

				Protects investment into irrigated land use activities at a high level of security for least cost
				Protects investment into most existing irrigated land uses. In some years there may be insufficient water for sensitive crops
				Some irrigated land uses not economically viable at this level water augmentation and costs. Land use change likely to occur

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Restriction regimes and effects on flows

1. **Previous decisions**
   - Cease take not favoured
   - Develop a more responsive, managed approach

2. **Options for restriction regimes;**
   a. user groups to meet minimum flow by voluntary rostering etc
   b. staged reductions - cease take
   c. staged reductions - no cease take
   d. flow sharing
   e. cease take at minimum flow

3. **Restriction regimes and minimum flows** impact on;
   - Abstraction (reliability)
   - River attributes (days where flow reduced below specified minimums)
   - Cost of water augmentation to improve security of supply/mitigate effects of abstraction

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High flow abstraction triggers

1. High flow allocations have impact on river flows, form and functions

2. There is a range of existing flow allocation triggers for both rivers

3. Recommendation already made for rationalising number of flow control sites where possible.

4. High flow allocation regime (policies, limits and flows) for;
   - Mitigating effects of abstraction (gw and sw) on flows
   - Mitigating low reliability of supply for sw takes
   - Providing for new uses
     - **options still under development by WAG**

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Native Birds

Matt Brady; Department of Conservation

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Birds on the Ngaruroro

Black-billed gull (Larus bulleri)

Birds on the Ngaruroro

Black-billed gull (Larus bulleri)

From 83 Species of Birds utilize the Ngaruroro Rivers estuary tributaries, wetlands

67 found at estuary
61 Wetlands
58 Riverbeds

However I would consider 52 as water birds

Above the cableway there is an extra species which is a river specialist the Whio

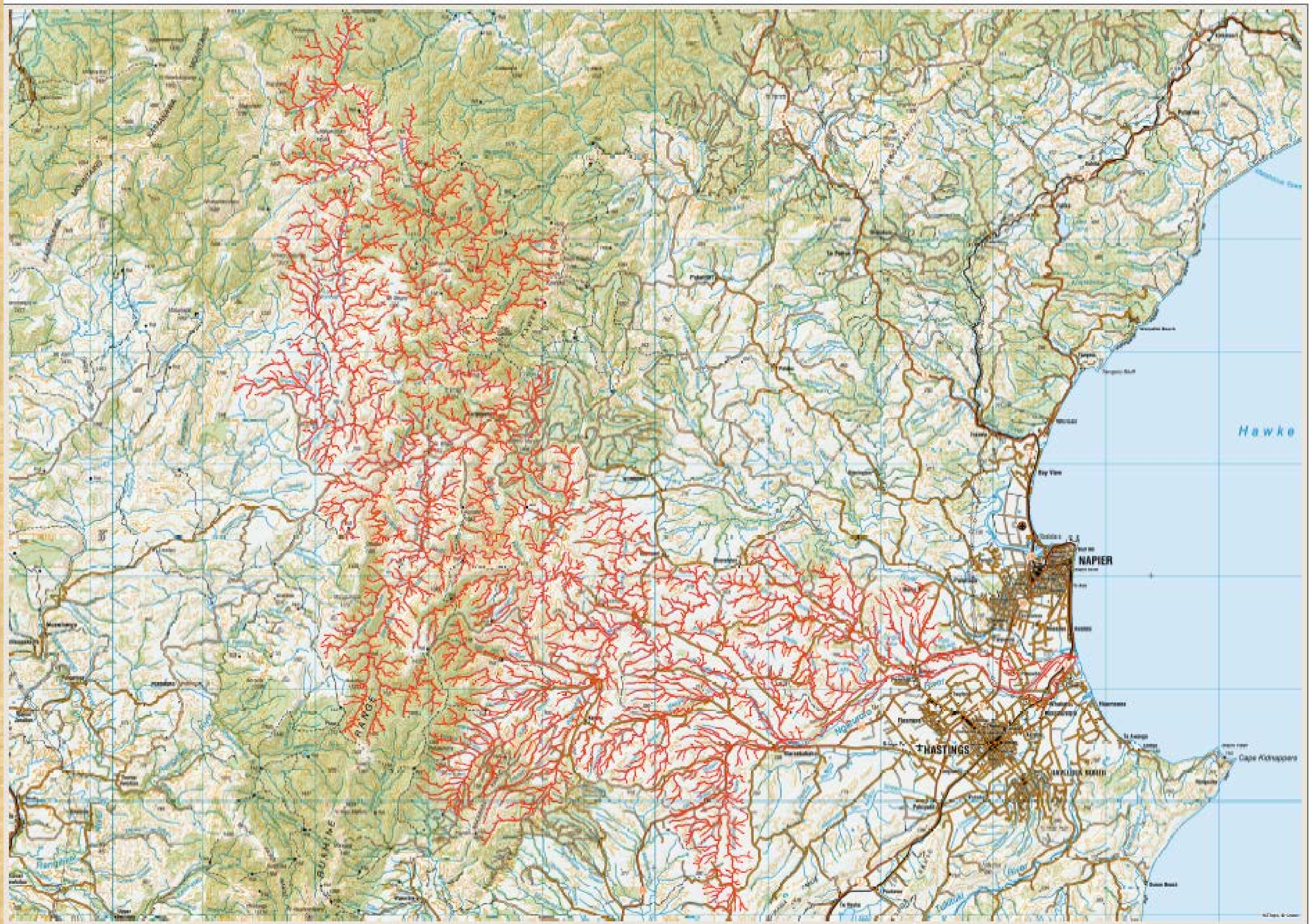
16 species are considered threatened. Of those only 1 the New Zealand Falcon isn't associated with Rivers and estuaries

North Island Brown Kiwi are at risk-declining

South Island Pied Oystercatcher

Haematopus finschi

One of the few known north Island Breeding sites



3180km
of
Waterways

Braided River Birds

Of the 52 water species about 15 species that would commonly utilize the braided rivers

This includes two of the threated species that DOC are particularly interested in

Black-billed Gulls - Nationally Critical (70% decline in 30 years)

Banded Dotterel – Nationally Vulnerable, Ngaruroro may hold as much as 2% of the National population (Stephenson 2010)

Breeding August till January
BBG Nesting braided river gravel beds

Feeding primarily on invertebrates taken from rivers and adjacent pasture, BBGs small fish (whitebait)

Banded Dotterel (Charadrius bicinctus)

Needs

River edge,
Ample food supply
Islands
No Weeds
No Disturbance
Predator free

<u>On Flow regimes</u>

Currently our understanding of the relationship between braided rivers and avifauna is not sufficient to accurately assess effects of altered flow regimes or to prescribe optimal flow but to hypothesize potential effects.

PREDICTION	POTENTIAL EFFECTS	POTENTIAL CONSEQUENCES
1. Lower flows	• Lower food availability • Increased weed encroachment • Less food-producing habitat • Increased access to islands by mammalian predators	• Greater competition for food • Less breeding and feeding habitat • Increased cover for mammalian predators and their prey • Lower productivity and survival
2. Fewer channels (braids)	• Reduced area of feeding habitat • Increased access to islands by mammalian predators	• Fewer habitat choices – greater competition for food • Less-optimal breeding habitat • Lower productivity and survival
3. Fewer islands	• Fewer islands safe from predators	• Lower productivity and survival
4. Increased channel stability	• Reduced accessibility to preferred foods • Increased weed encroachment	• Less breeding and feeding habitat • Increased cover for mammalian predators

O'Donnell 2016

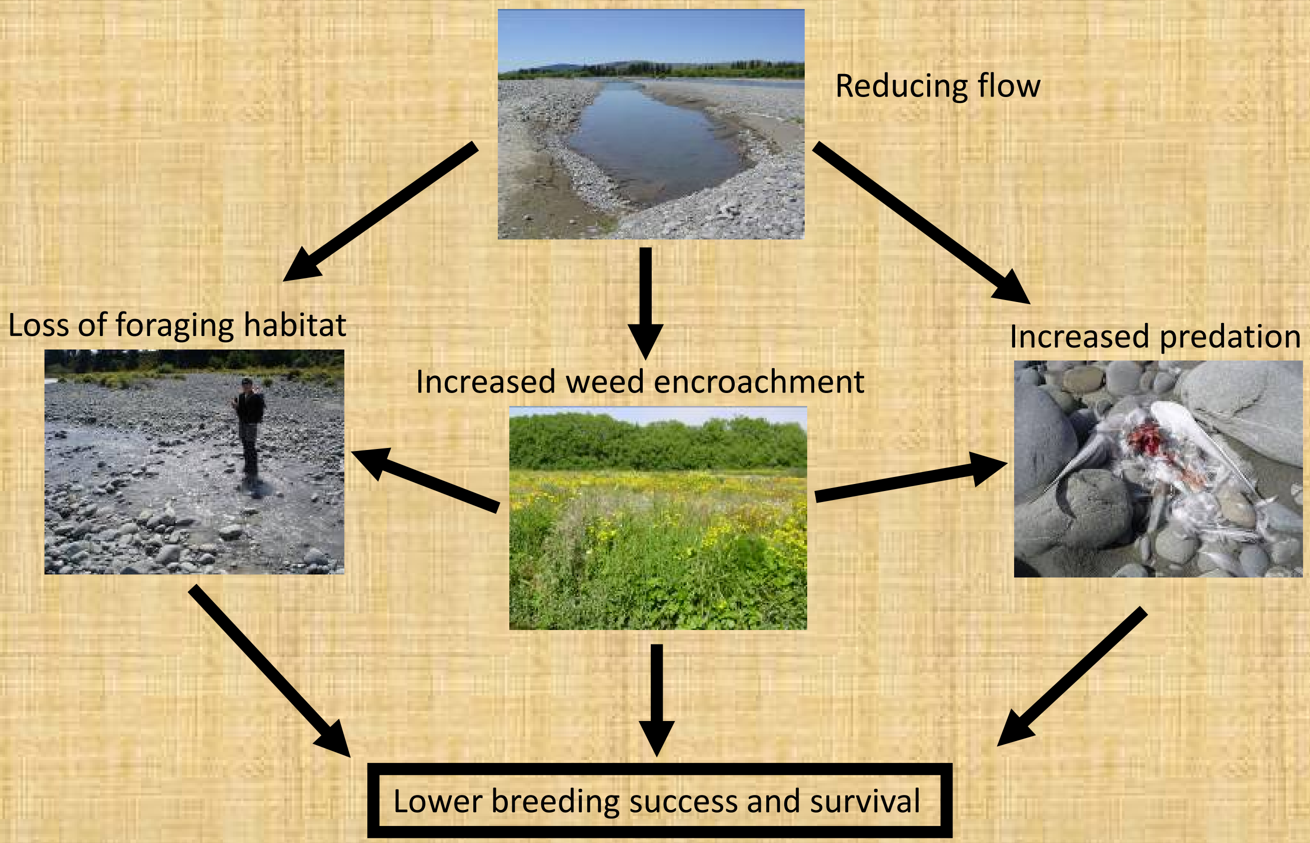
Sources indicate that reduced flow regimes have detrimental effects

Glova Showed 1985 that slow is positively correlated with food producing habitat

And O'Donnell 2011 Shows declines in black-fronted tern numbers is highest on rivers that had much reduced flow

However the present lack of quantifiable data and information on flow regimes requirements for avifauna is an impediment for setting limits for regional plans

Flows and threatening processes



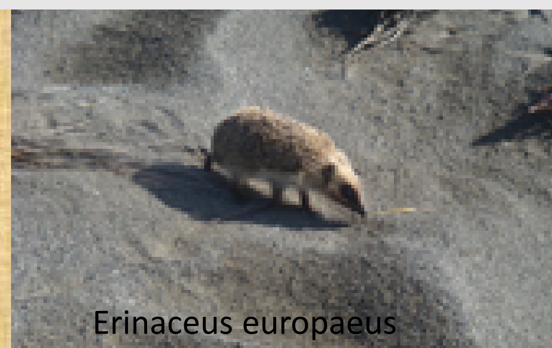
Predators


Rattus rattus


tus

Possum
Norway Rat
Dogs
Harrier Hawke
Black Backed Gulls


Mustela nivalis


Erinaceus europaeus


Mustela furo

Whio (Hymenolaimus malacorhynchos)

Nationally Vulnerable (1000-5000individuals)

Whio are now sporadically distributed in forested headwaters along the main rangers of both Islands.

We estimate around 50-60 inhabit the Ngaruroro Catchment.

Habitat needs - high water clarity and quality, coarse substrate, narrow width pool and riffles with forested margin. (gradient 50-80m per km)

Diet is almost exclusively freshwater invertebrates but have been know to eat berries on stream margins

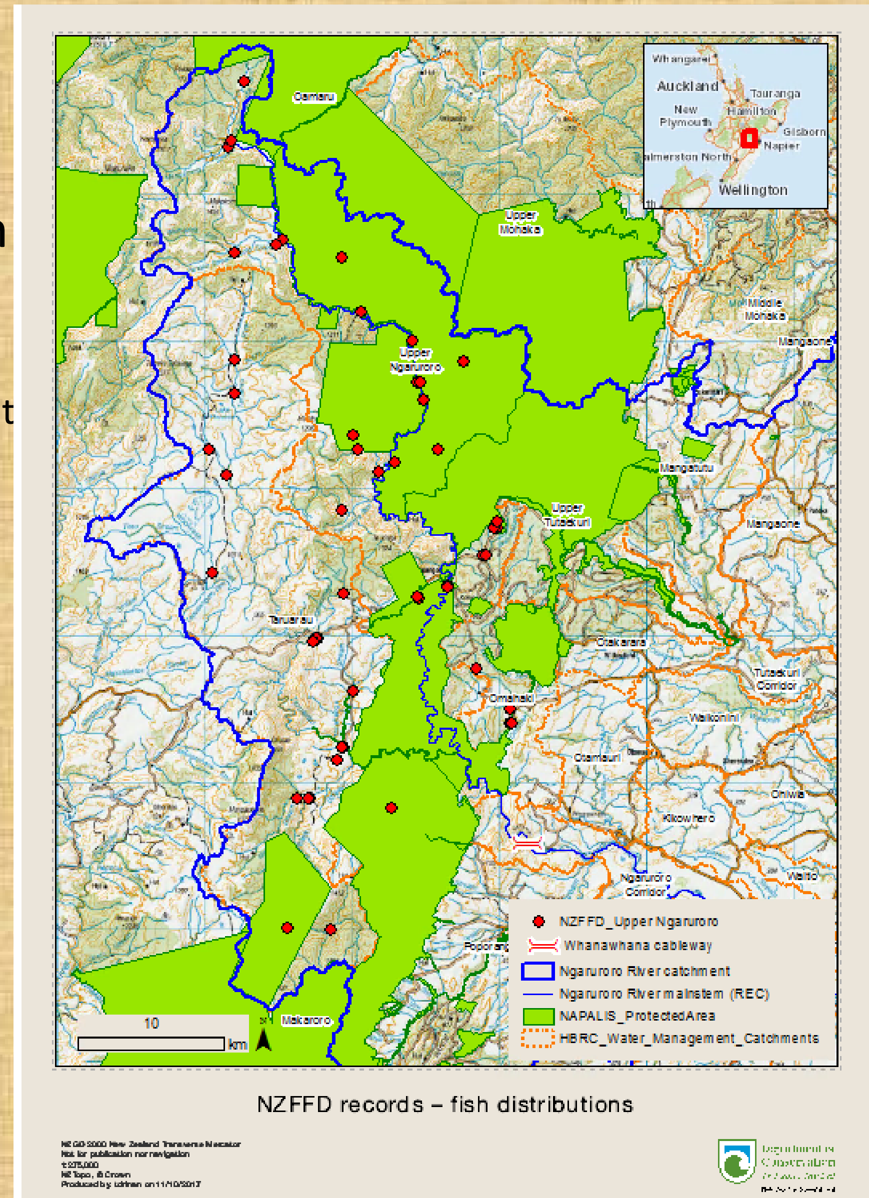
Threats habitat loss and Predation

No Guarantee of security in the high country

Total Ngaruroro Catchment above the forest park exit
100771ha

Total in Public conservation Land
35700ha

Total in Private Hands
65071ha



Whio (Hymenolaimus malacorhynchos)

Traditional distribution was from mountain tarns to lowland bush edged rivers and lake

All they need is segments of river/streams with a gradient 50-80m per km, a forested margin good water quality and predator control.

Altitude isn't a prerequisite

Blue Ducks don't have an Altimeter

Opportunities Abound

The wetland lakes and margins of the Ngaruroro and its catchment create habitat for many other species including the Nationally Critical Bittern, the relic crake populations, the declining fern bird and the resurgent Dabchick.

Storage and Recharge Lakes correctly designed can create habitat for diving and dabbling species

Te Tua Staion pond

Sediment and Nutrient filtration can be a Constructed Wetland Habitat

Good land management practices such as fencing and riparian planting can lead to habitat for water birds and Forest birds

We need to ensure that the policy mechanism and education is place so as to enable these options.

We need to ensure that the education and policy mechanisms are in place so as to enable and incentivize these options.

This is not just down to TANK other instruments are been developed for example HB Regional Biodiversity Strategy and Predator Free 2050

Fish and habitat in the Tutaekuri and Ngaruroro

Thomas Wilding

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Background to habitat surveys

- Problems with the old RHYHABSIM survey (Twyford Hearings - irrigation consents)
- Peer review by Cawthron (Joe Hay) recommended improvements, including more cross-sections and better habitat suitability curves for trout
- Joe Hay also helped with study design
- New RHYABSIM surveys completed (2009-2012) to inform TANK plan change

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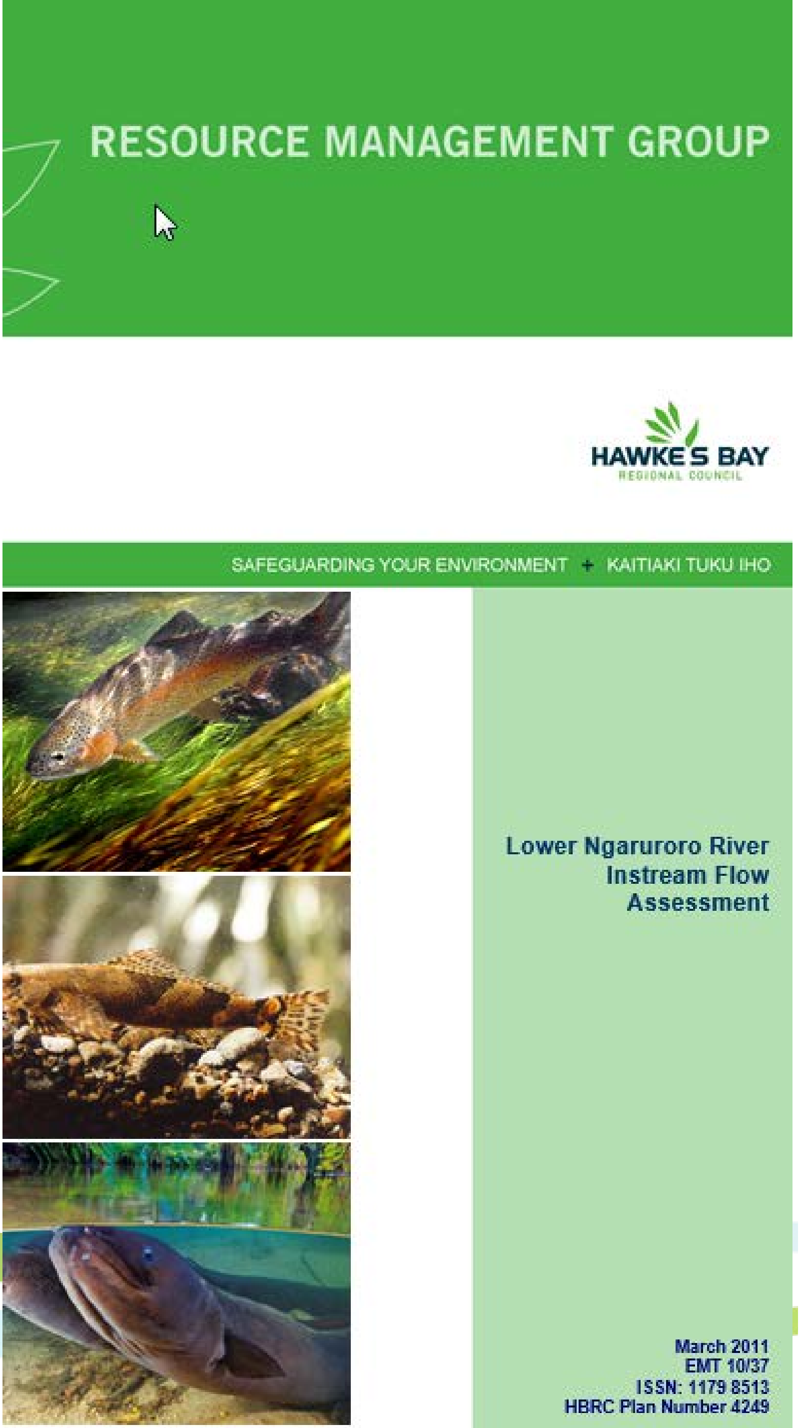
Ngaruroro River


RESOURCE MANAGEMENT GROUP

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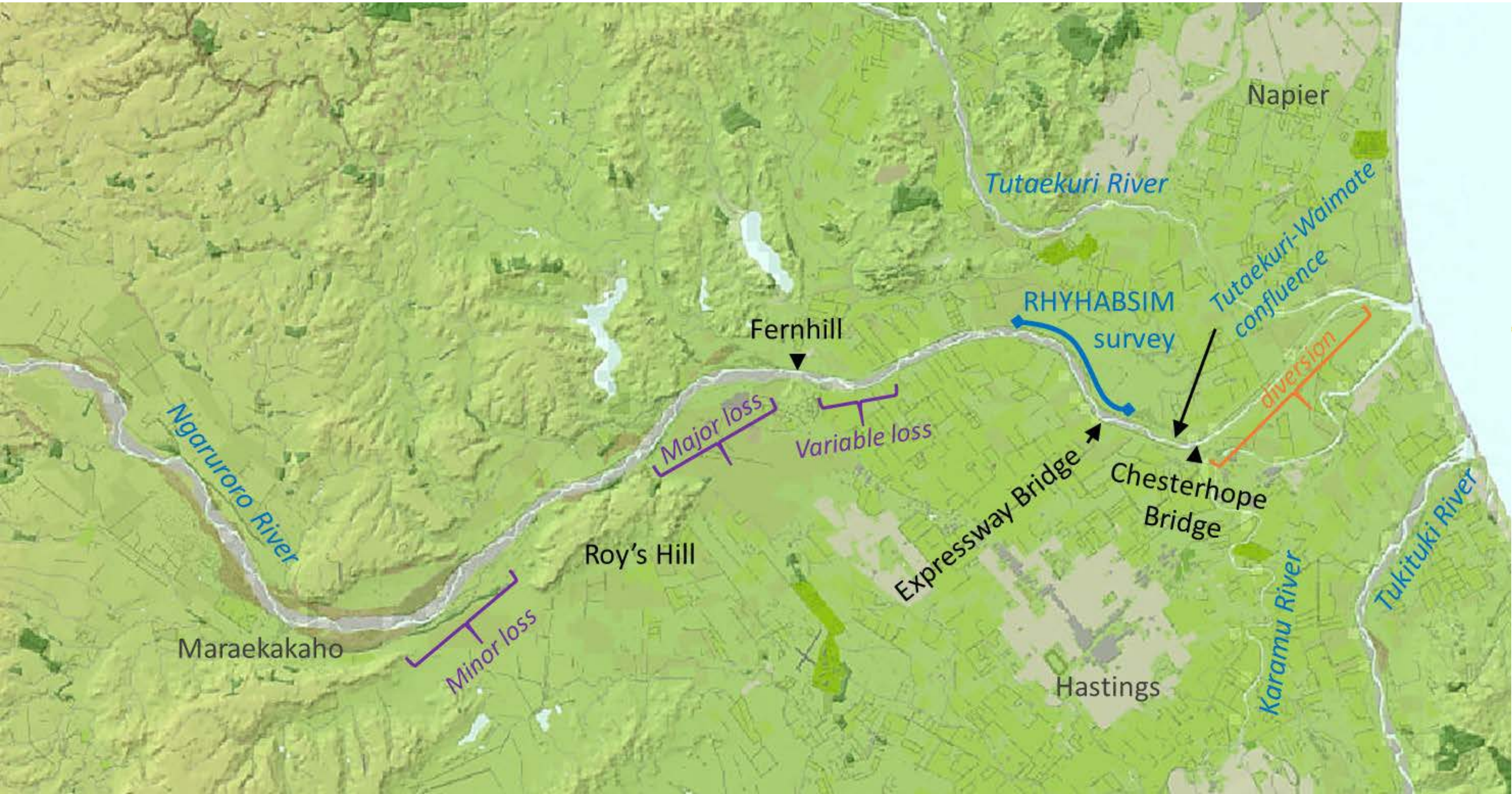
SAFEGUARDING YOUR ENVIRONMENT + KAITIAKI TUKU IHO

Lower Ngaruroro River
Instream Flow
Assessment

March 2011
EMT 10/37
ISSN: 1179 8513
HBRC Plan Number 4249

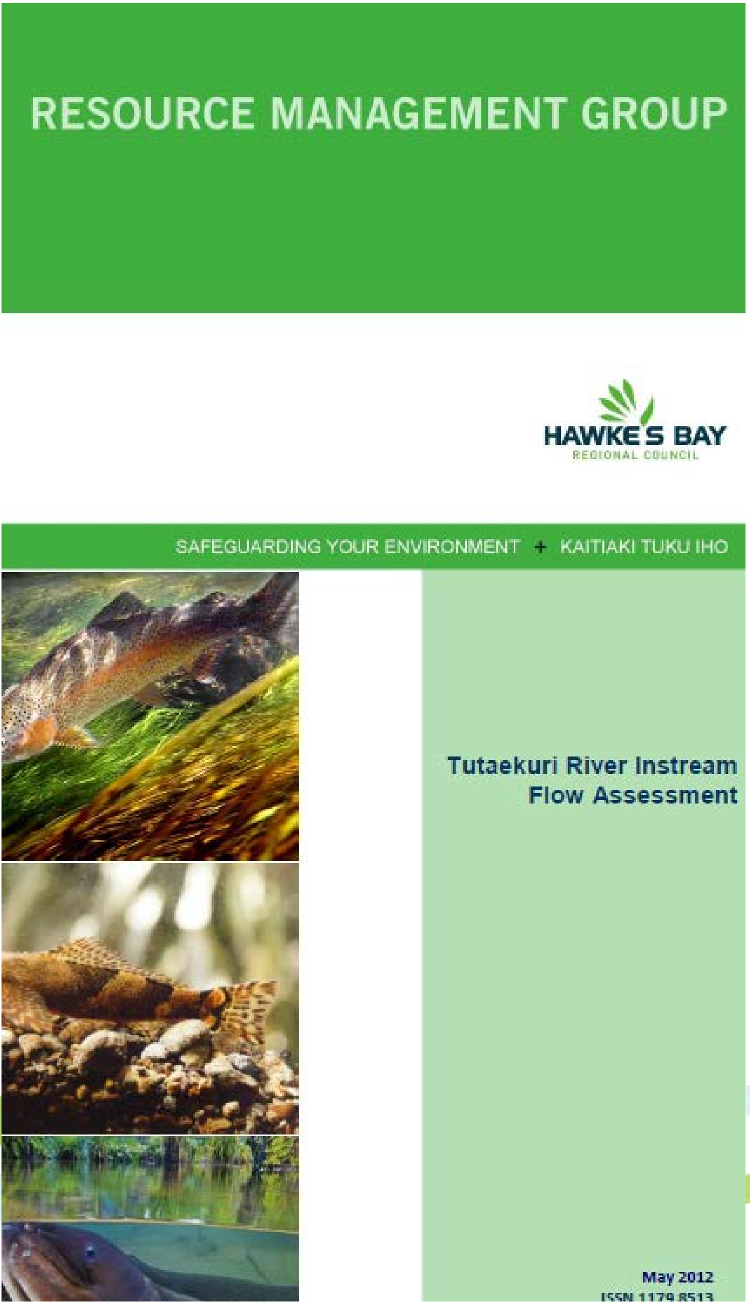
The river that sustains us



	Habitat Modelled
Shortfin eel	Yes, two size classes
Longfin eel	yes
Common bully	Yes
Upland bully	Yes
Torrentfish	**Yes**
Redfin bully	**Yes**
Inanga	**Yes**
Crans bully	Yes
Common smelt	Yes
Lamprey	**Yes**
Koaro	**Yes**
Dwarf galaxias	Yes
Bluegill bully	**Yes**
Giant bully	No HSC available
Black flounder	No HSC available
Yelloweyed mullet	No HSC available
Grey mullet	No HSC available
Rainbow trout	Yes, two size classes
Brown trout	Yes, two size classes
Koura	yes

Ngaruroro fish

Tutaekuri Survey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SAFEGUARDING YOUR ENVIRONMENT + KAITIAKI TUKU IHO

Tutaekuri River Instream Flow Assessment

May 2012

ISSN 1179 8513

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	Habitat Modelled
Longfin eel	Yes, two size classes
Shortfin eel	Yes, two size classes
Common bully	Yes
Torrentfish	Yes
Redfin bully	Yes
Inanga	Yes
Crans bully	Yes
Common smelt	Yes
Koaro	Yes
Bluegill bully	Yes
Giant bully	No HSC available
Black flounder	No HSC available
Yelloweyed mullet	No HSC available
Grey mullet	No HSC available
Rainbow trout	Yes, two size classes
Koura	yes

Tutaekuri fish

Study design

*"habitat modelling …began with consultation of stakeholders… **DOC**, **Fish and Game**… and **local Iwi representatives**. Scientists from… **NIWA** and the **Cawthron**… for technical expertise…"*

*"upper Tutaekuri survey was initiated to specifically address increasing abstraction pressure in the **upper reaches and tributaries**"*

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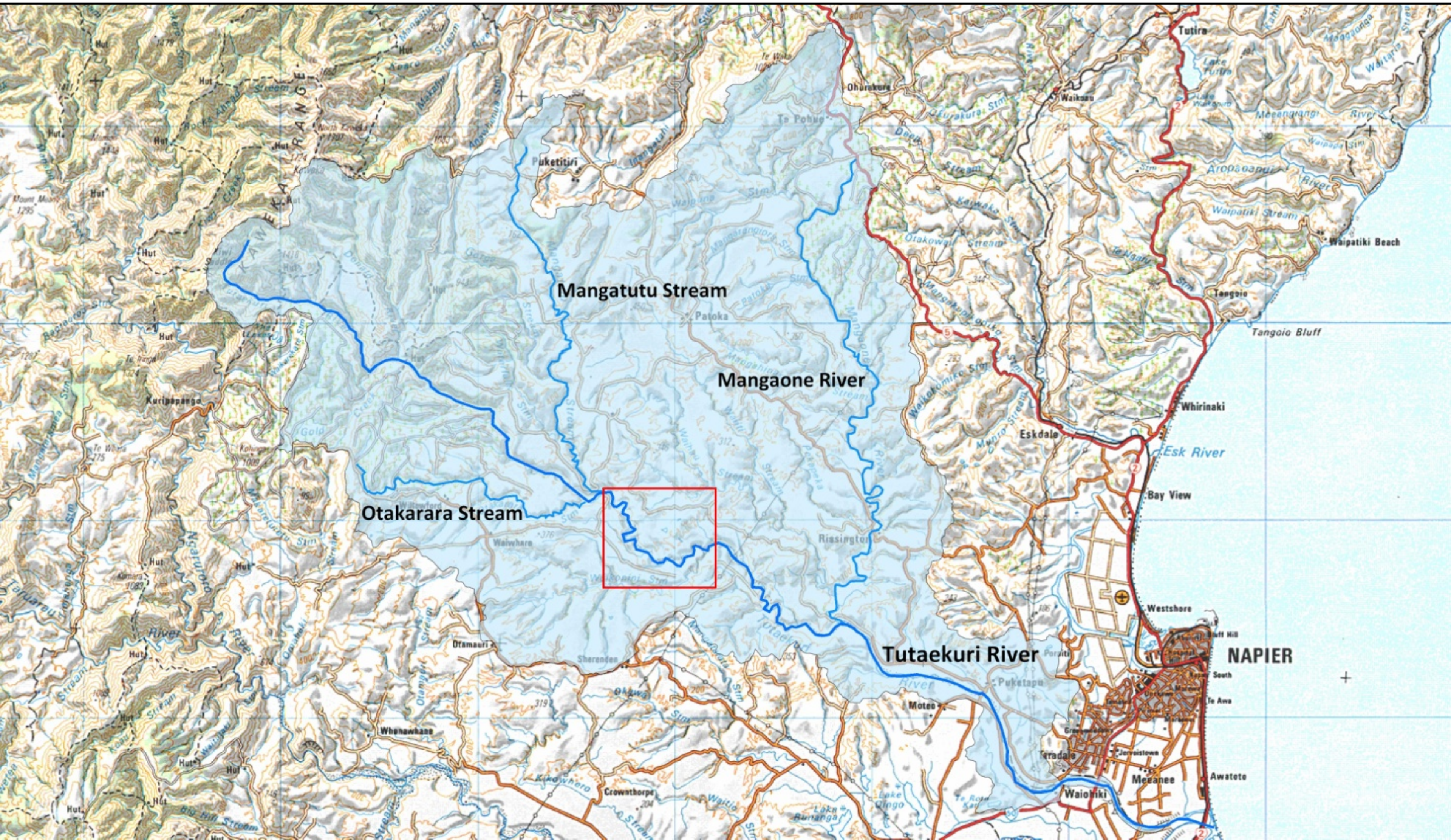
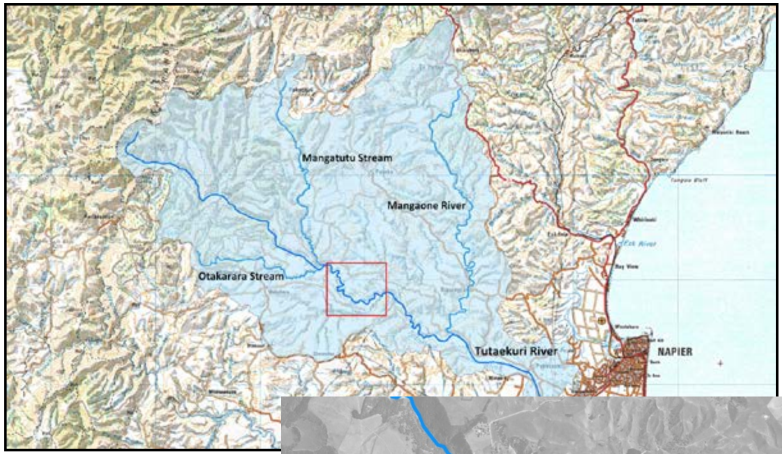
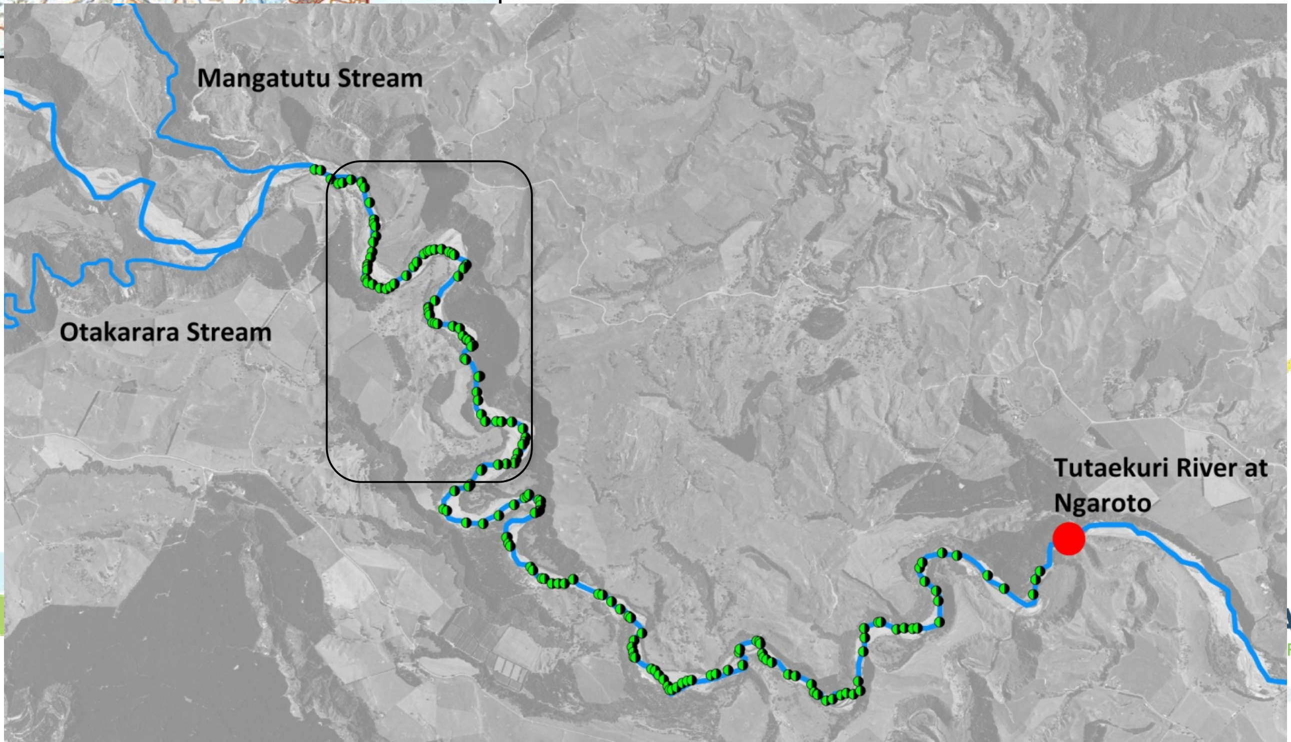
Tutaekuri study reach

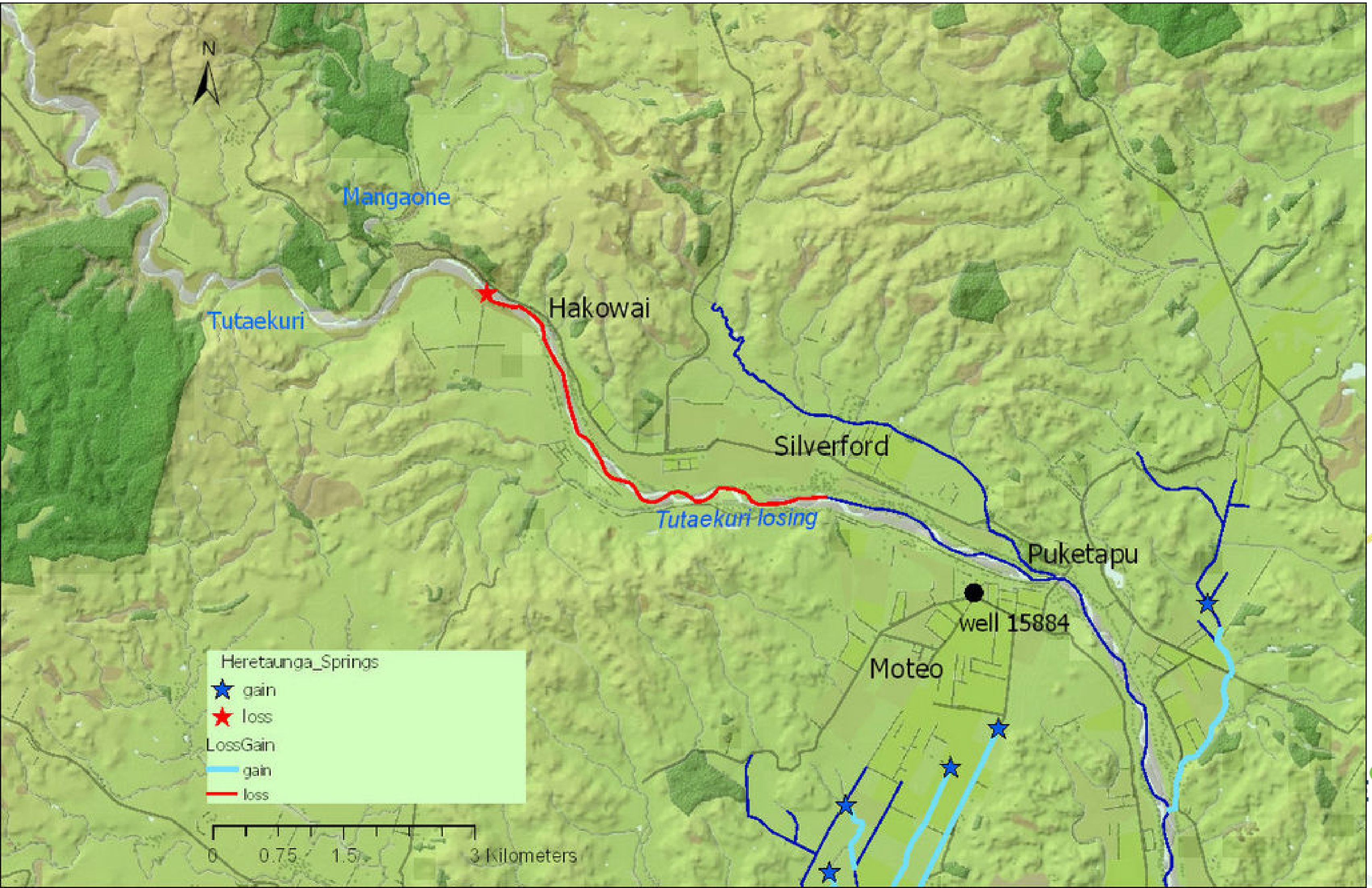


Tutaekuri River





Loses 800 L/s to groundwater
-> Moteo springs



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Summary

- Ngaruroro and Tutaekuri sustain valued fish communities
- New RHYABSIM surveys completed (2009-2012) to inform TANK plan change
- Cawthron (Joe Hay) helped guide and improve those surveys

Considerations for setting flow and allocation limits - TANK

Joe Hay; Cawthron Institute

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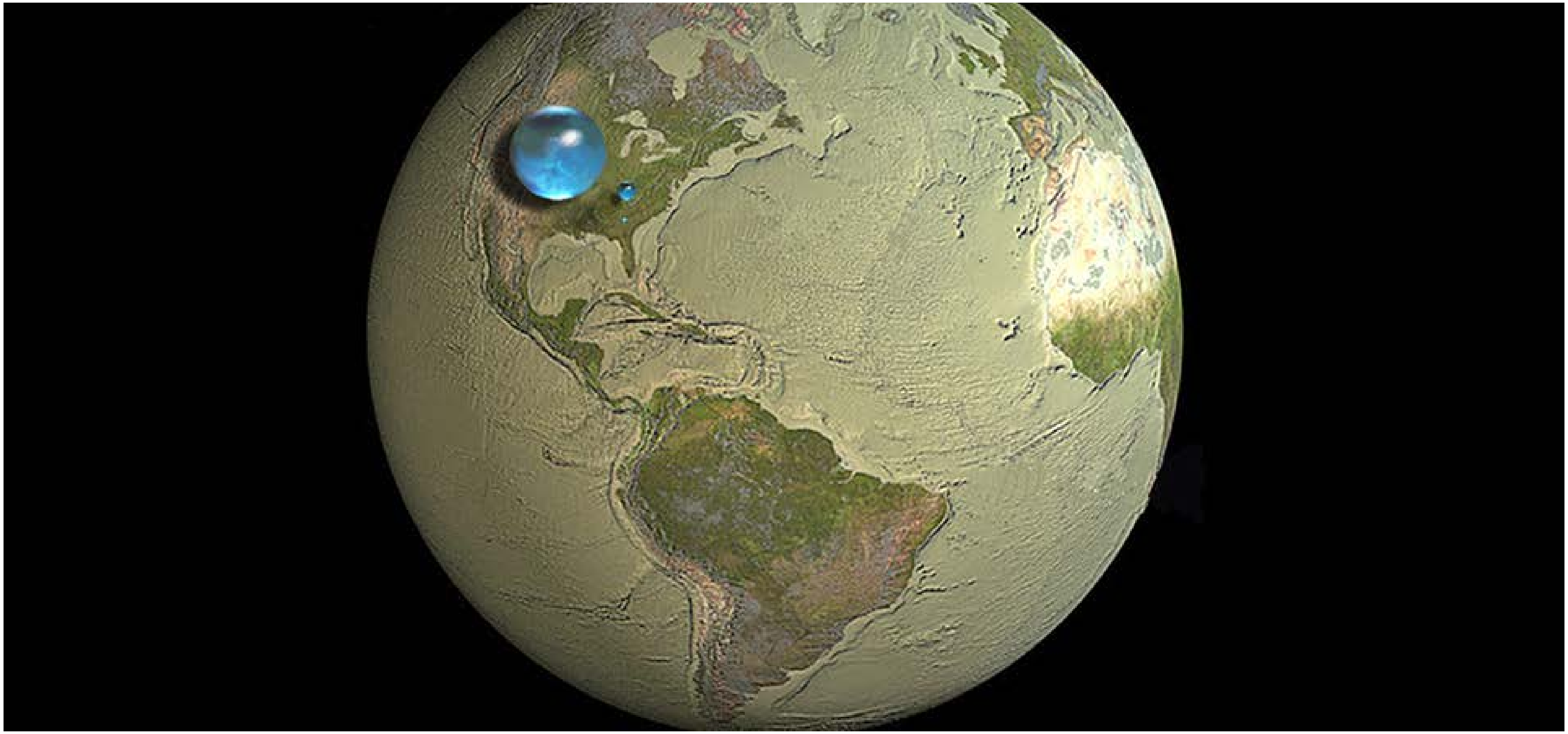
CONSIDERATIONS FOR SETTING FLOW AND ALLOCATION LIMITS - TANK

JOE HAY

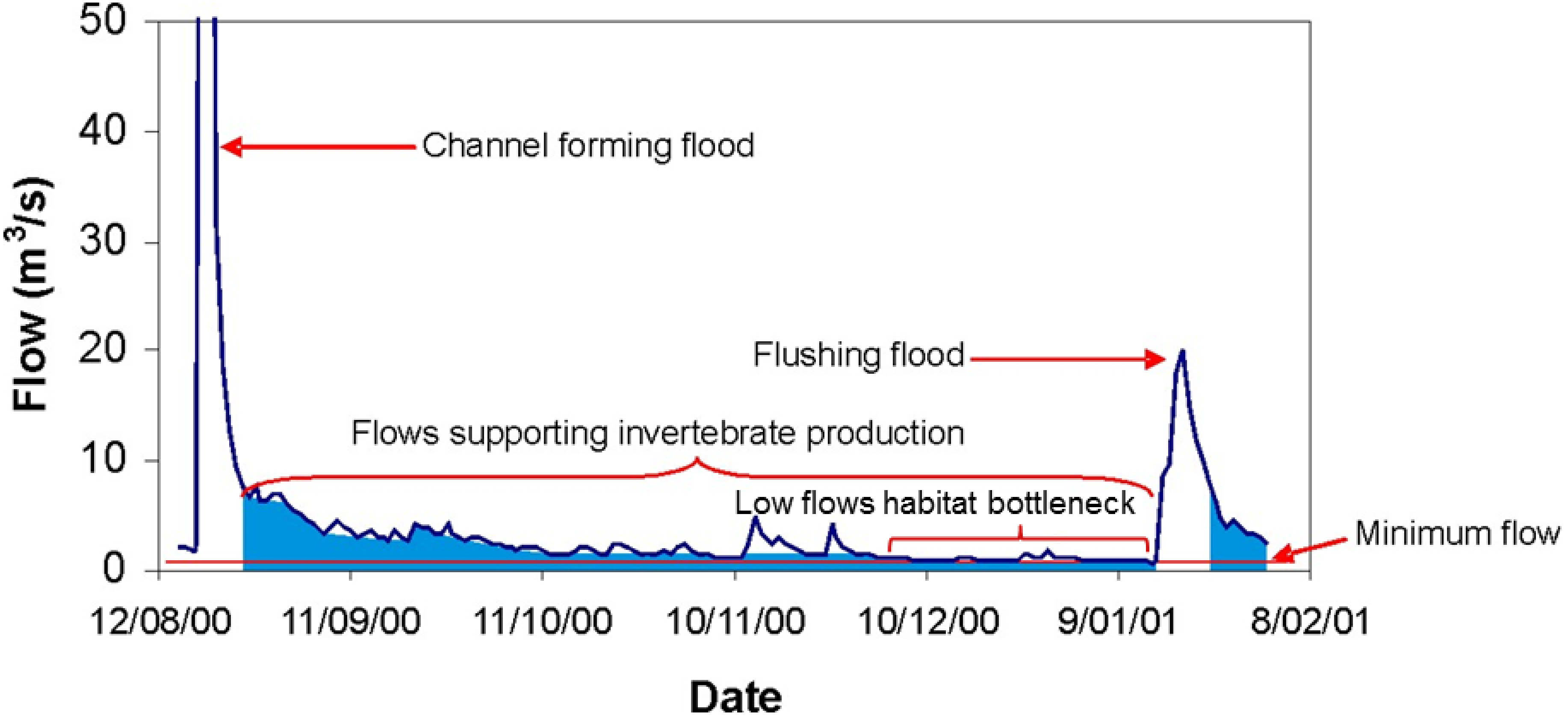
18 OCTOBER 2017



FLOW IS A DEFINING FEATURE OF STREAMS

- Flow a “master variable” in streams.
- Influences many aspects of stream ecology, including:
  - Channel form, the habitat template
  - Transport of sediment, nutrients and food down a river system
  - and the distribution and behaviour of organisms.

RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES



Flow a “master variable” in streams

RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES

- **Channel forming floods**
  - Large floods to maintain channel form, large scale sediment transport, and control encroachment of woody weeds.
  - ~ mean annual maximum flow,
  - flows > 10 x mean flow or 40% of the mean annual maximum flow begin to move a substantial portion of the bed (Clausen & Plew 2004).

RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES

- **Flushing flows**
  - Smaller floods/freshes to flush fine sediment, periphyton and other aquatic vegetation. Maintain quality of benthic invertebrate habitat.
  - Usually about 3–6 x median flow (or 3–6 x low flow in highly regulated rivers) (Biggs & Close 1989; Clausen & Biggs 1997).

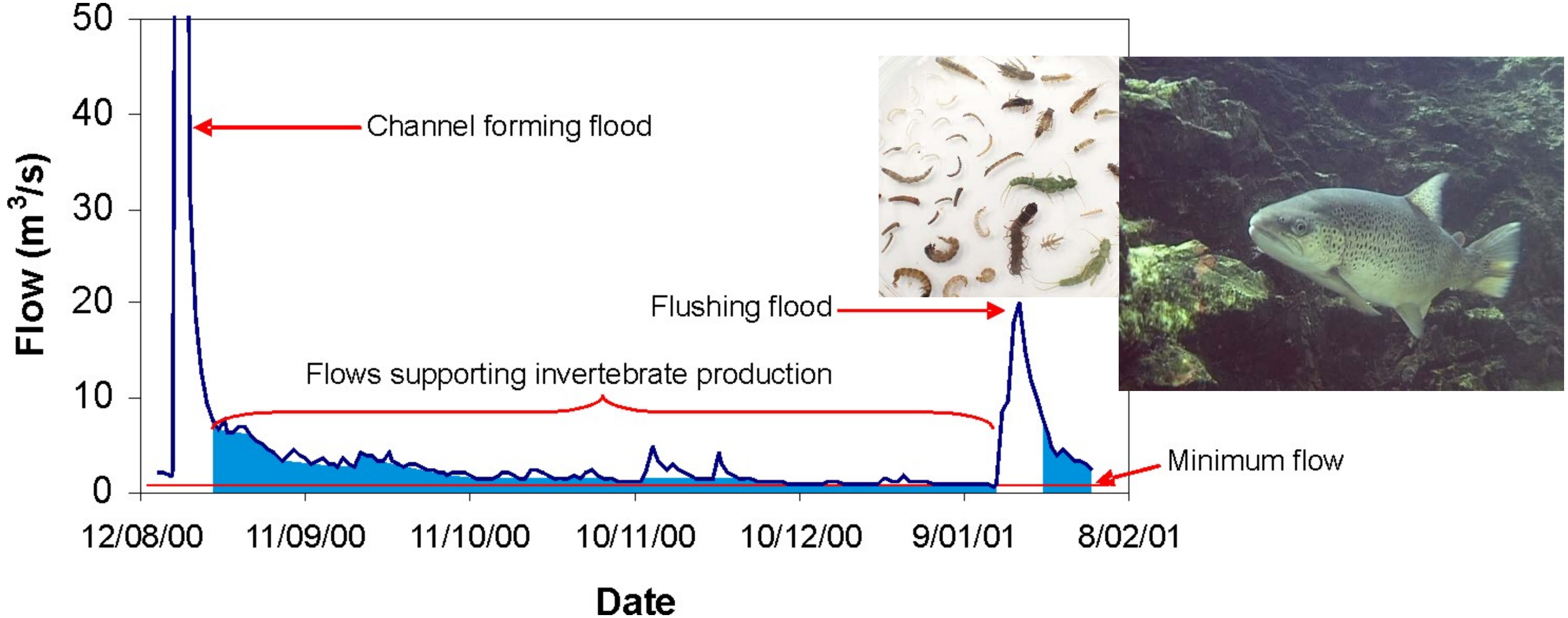
Moawhango River before and after a flushing flow, from Jowett & Biggs (2006)

RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES

- **Low flows**
  - The period of minimum wetted habitat (i.e. minimum living space).
  - The MALF is a convenient low flow statistic for indexing low flows that potential limit trout and native fish populations (Jowett 1990, 1992, Jowett et al. 2008), at least where suitable habitat declines below MALF.

RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES

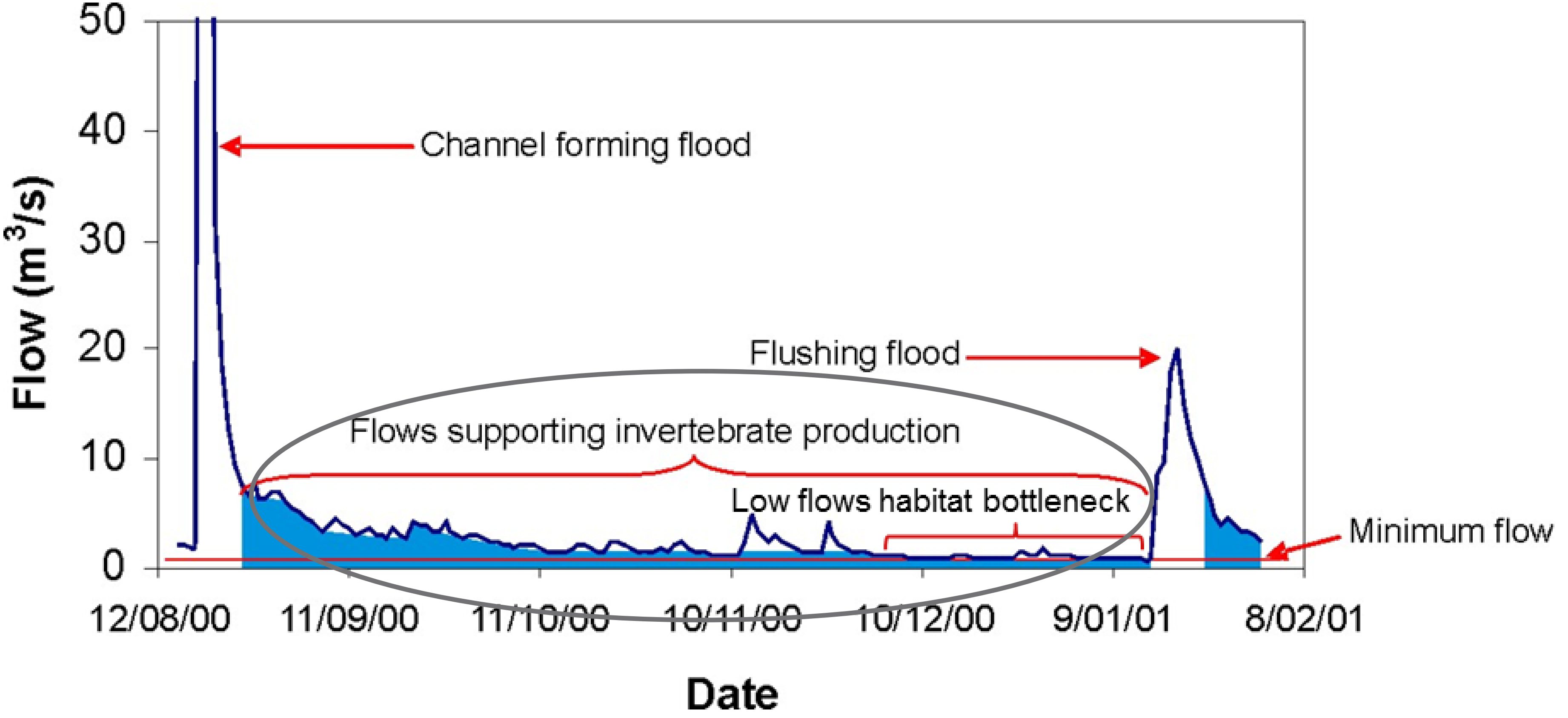
- **Flow recessions**
  - Temporary increase in productive habitat following high flow events.
  - Able to be utilised by benthic invertebrates, which may help define carrying capacity for fish and bird populations.
  - Median flow (or seasonal median) can be viewed as providing an approximation of ‘typical’ habitat availability during flow recessions to support invertebrate productivity (Jowett 1992).



RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES

- **Flow variability (at a range of scales)**
  - Flow variability an important predictor of fish community structure and trout abundance in NZ rivers (Crow et al. 2013; Jowett 1990; Jowett & Duncan 1990).
  - May also provide an opportunity and stimulus for fish migrations and/or spawning, for example:
    - Flows in the order of 2-4 times the median or preceding base flow (Snelder et al. 2011).
    - Whitebait galaxiid species spawn above the baseflow water level during high flow events; larvae hatch and are carried downstream by subsequent high flows (Allibone & Caskey 2000, Charteris et al. 2003, Franklin et al. 2015).
  - May provide for connectivity (e.g. wetlands, side-braids, ox-bows)

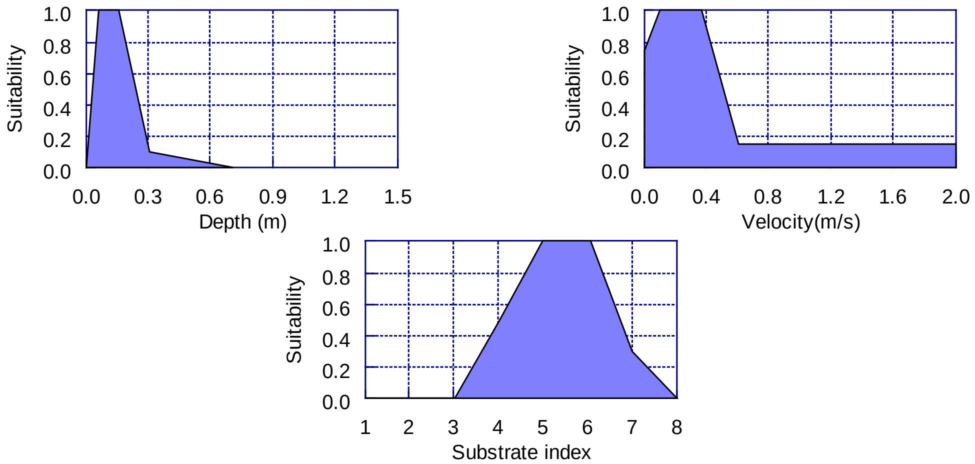
RECOGNISED ECOLOGICALLY RELEVANT FLOW FEATURES



Main influence of run-of-river abstraction

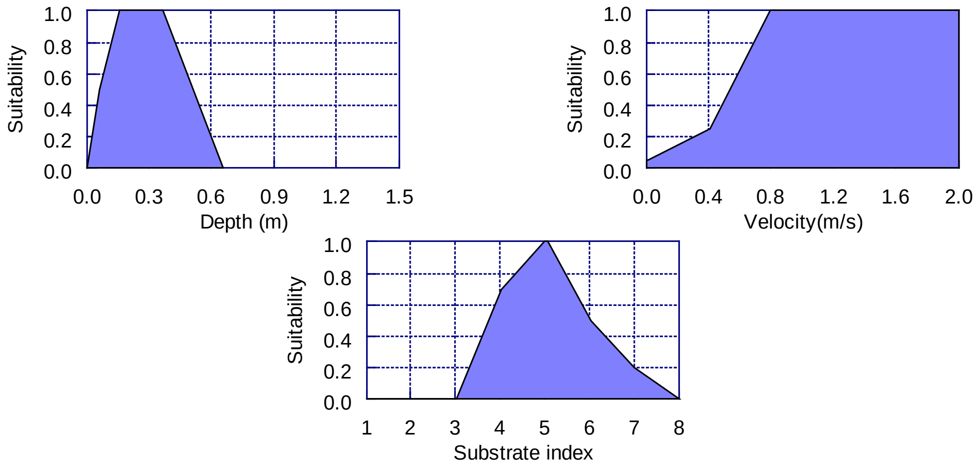
FLOW REQUIREMENTS OF DIFFERENT SPECIES: PHYSICAL HABITAT (SPACE)

Upland bully



Slow water species

Torrentfish



Fast water species

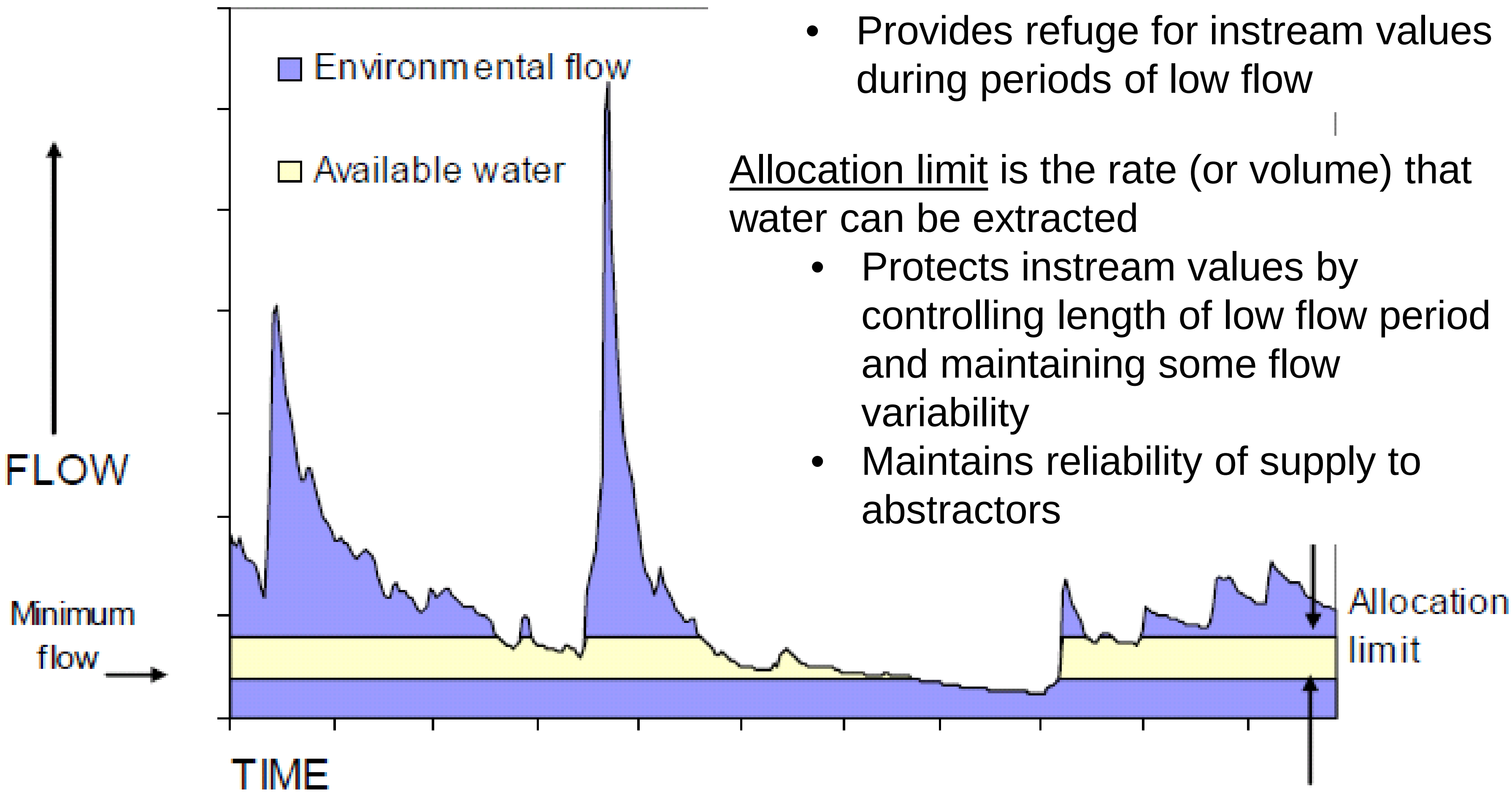
FLOW REQUIREMENTS OF DIFFERENT SPECIES: SPACE AND FOOD

- Both space and food are key determinants of fish communities.
- Influence of flow changes different for drift-feeding and benthic foraging fish.

- Food and space requirements and availability can differ with flow, time-of-day, season, temperature, etc.
- Altering space and/or food can have major impacts on fish abundance, the size of fish that can be supported, and fish behaviour.
- However, depends on how close to carrying capacity a given population is…

HABITAT TEMPLATE IN A BRAIDED RIVER

KEY COMPONENTS OF FLOW MANAGEMENT (REQUIRED BY NPS-FM)



Minimum flow is the flow at which abstraction must be restricted or cease

- Provides refuge for instream values during periods of low flow

Allocation limit is the rate (or volume) that water can be extracted

- Protects instream values by controlling length of low flow period and maintaining some flow variability
- Maintains reliability of supply to abstractors

DETERMINING ENVIRONMENTAL FLOW NEEDS – WHERE DO WE START?

1. Identify instream values
2. Define instream management objectives
3. Focus on critical values
   - those that have highest value and highest flow needs
   - in larger rivers these are typically salmonids and birds
4. Focus on critical flow related environmental requirements (attributes)
   - physical habitat (space)
   - food
   - water quality (temperature, oxygen, etc.)
   - fish passage

MFE 1998 - Flow Guidelines for Instream Values

SELECTION OF FLOW ASSESSMENT METHODS – RISK MGMT.

- Selection of methods depends on instream values, river size & degree of hydrological alteration (e.g., NES Flows & Water Levels; Beca 2008)

Table III
Methods Used in the Assessment of Environmental Flow Requirements for Degrees of Hydrologic Alteration and Significance of Instream Values

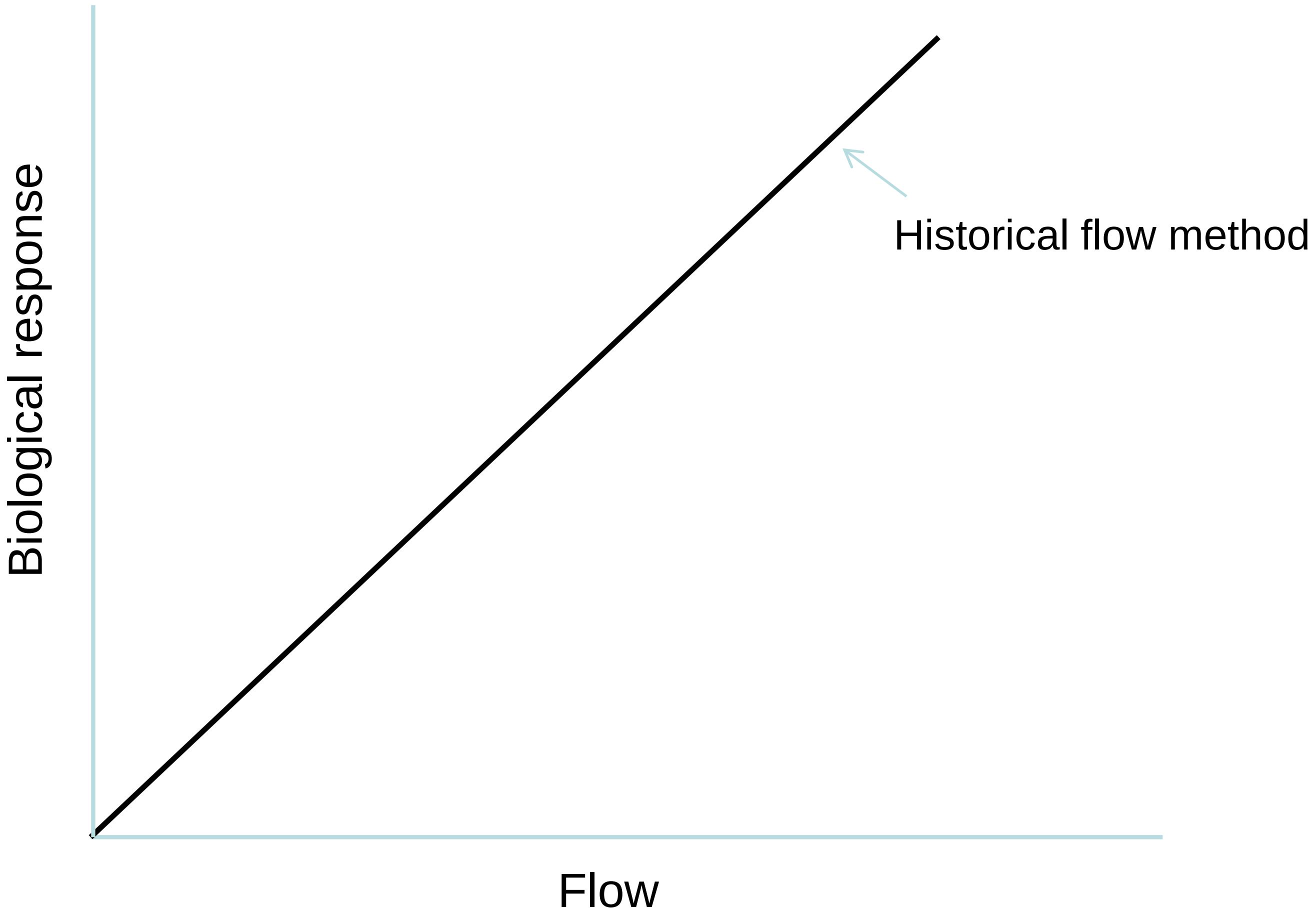
Degree of hydrologic alteration	Significance of Instream Values: Low	Significance of Instream Values: Medium	Significance of Instream Values: High
Low	Historic Flow Method Expert Panel	Historic Flow Method Expert Panel	Generalised Habitat Models 1D Hydraulic habitat model Connectivity/Fish passage
Medium	Historic Flow Method Expert Panel Generalised Habitat Models	Generalised Habitat Models 1D Hydraulic habitat model Connectivity/Fish passage	1D Hydraulic habitat model 2D Hydraulic habitat model Dissolved Oxygen Model Temperature Models Suspended Sediment Fish bioenergetics model Groundwater model Seston flux Connectivity/Fish passage
High	Generalised Habitat Models 1D Hydraulic habitat model Connectivity/Fish passage Periphyton Biomass Model	Entrainment Model 1D Hydraulic habitat model 2D Hydraulic habitat model Bank stability Dissolved Oxygen Model Temperature Models Suspended Sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/Fish passage Periphyton Biomass Model	Entrainment Model 1D Hydraulic habitat model 2D Hydraulic habitat model Bank stability Dissolved Oxygen Model Temperature Models Suspended Sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/Fish passage Periphyton Biomass Model

- More complex (expensive) methods with increasing value and/or degree of hydrological alteration

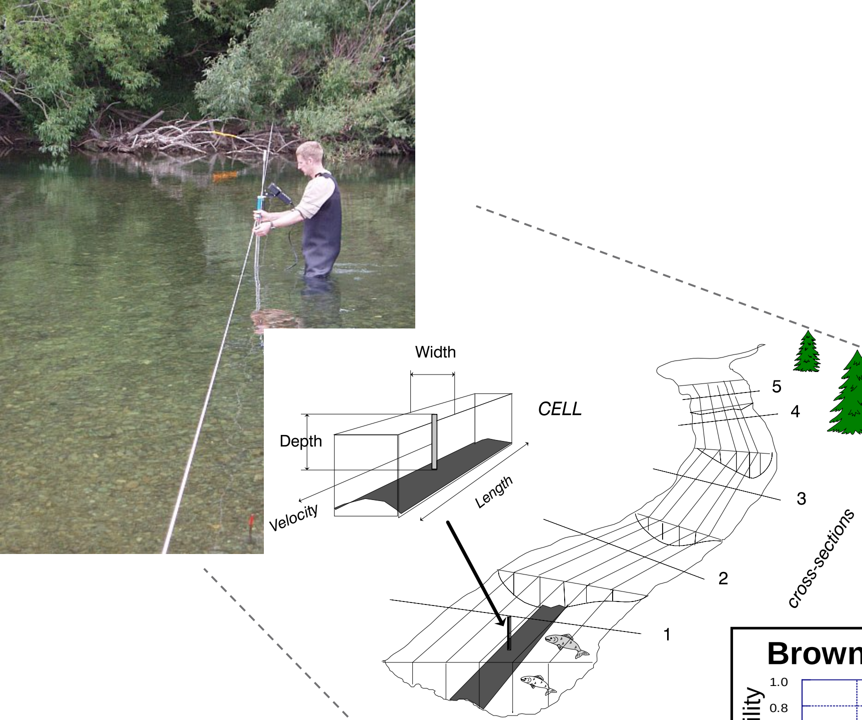
TWO MAIN INSTREAM FLOW ASSESSMENT METHODS USED IN NEW ZEALAND

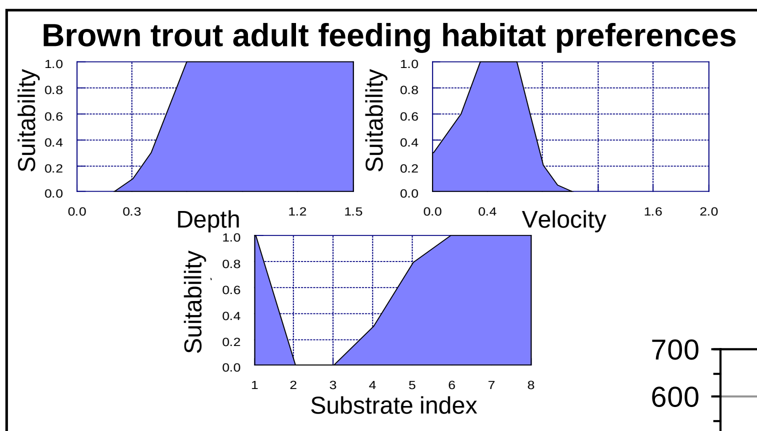
- Historical flow methods
- Habitat methods

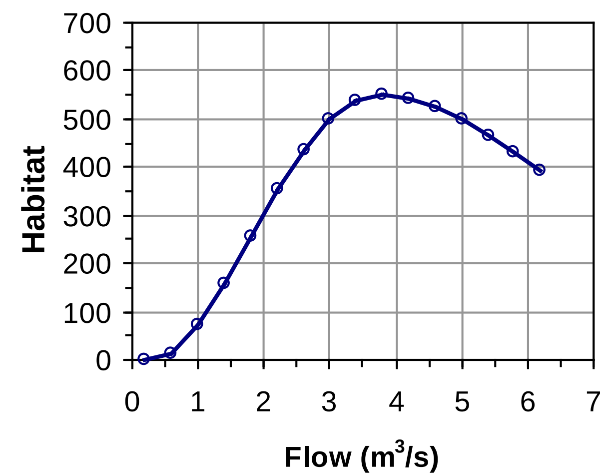
- Historical flow methods



Habitat methods

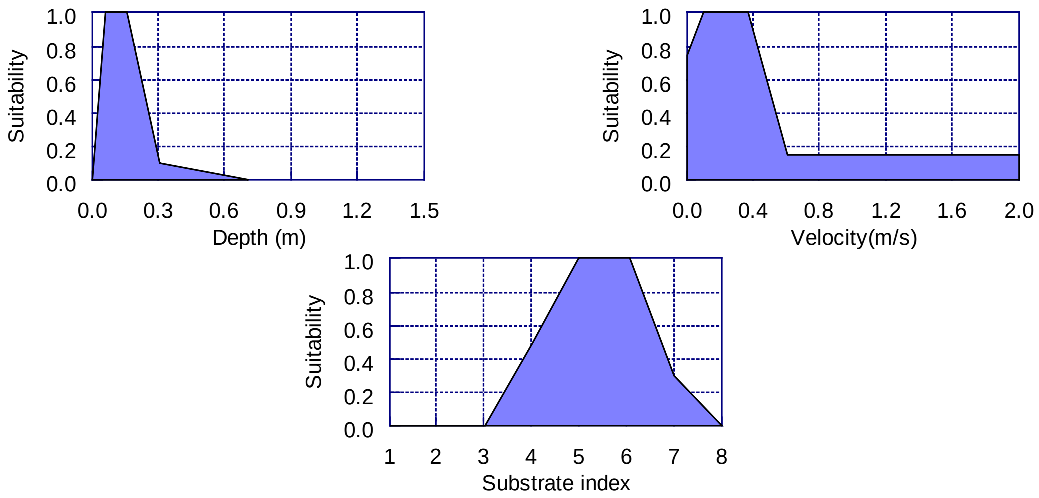






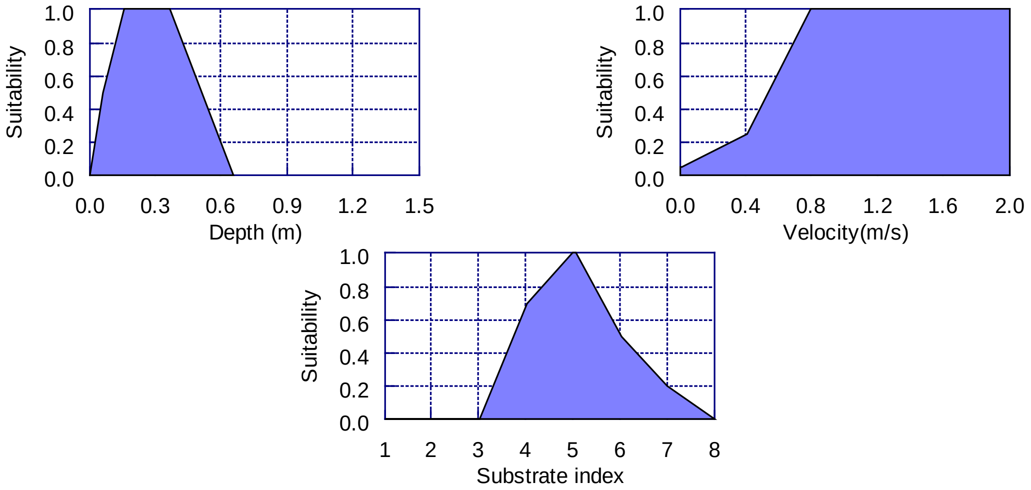
HABITAT SUITABILITY CRITERIA FOR DIFFERENT SPECIES

Upland bully



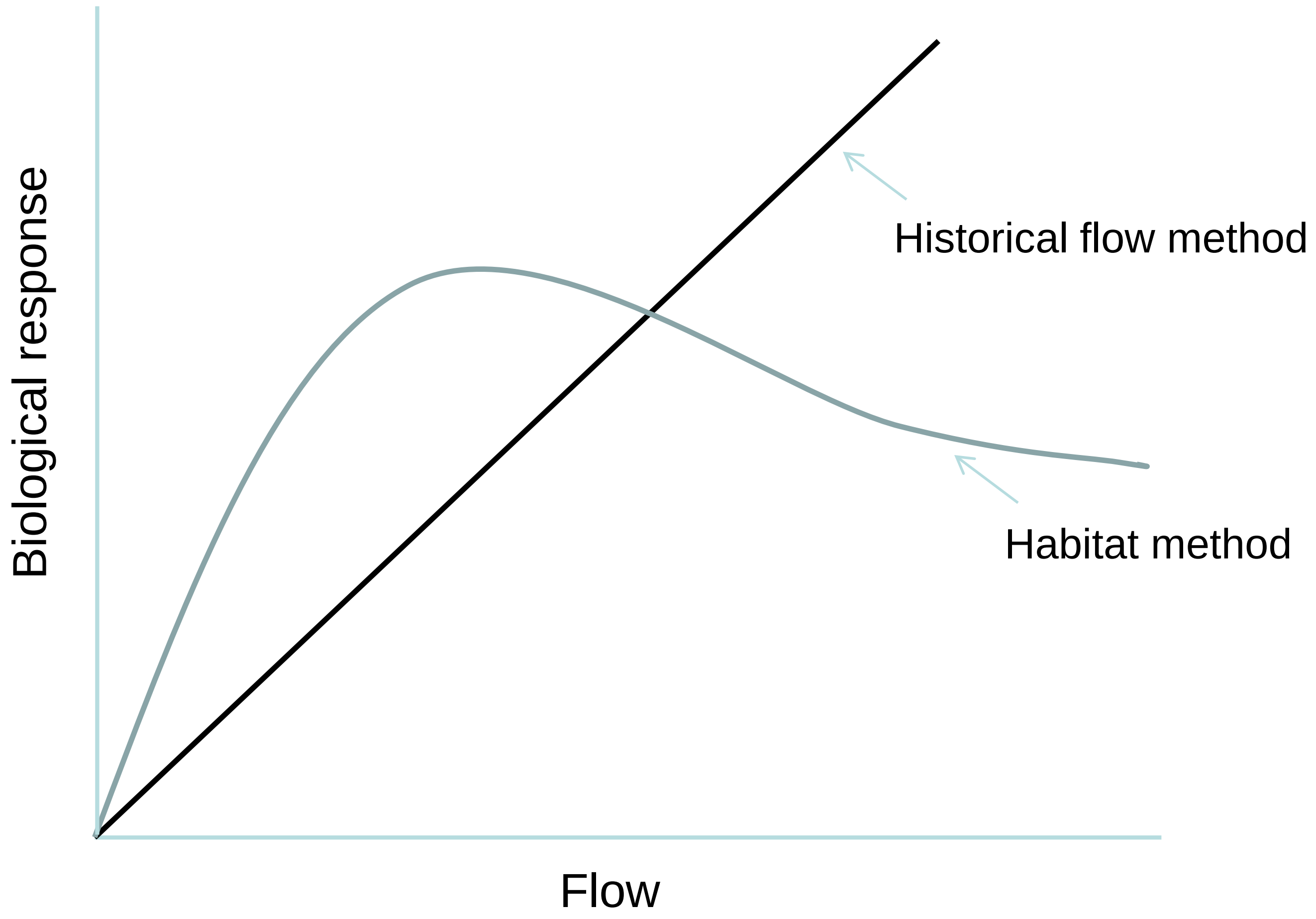
Slow water species

Torrentfish

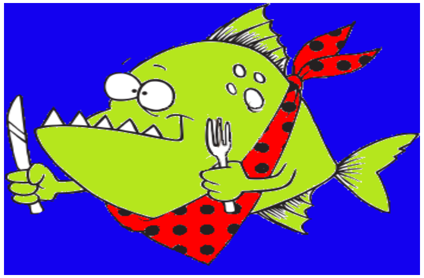


Fast water species

HABITAT METHODS VS HISTORICAL FLOW METHODS

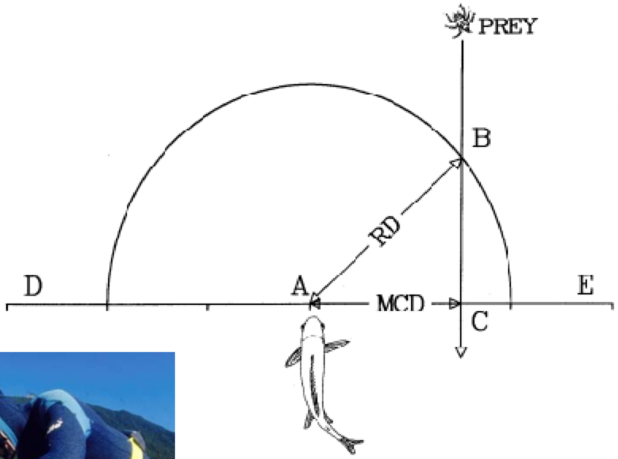


A NEW TOOL: BIOENERGETICS



Concern that importance of food and feeding not adequately addressed by habitat methods ➔

Process-based modelling of invertebrate drift dispersion, trout drift foraging and net rate of energy intake (NREI)



NREI = Energy Intake – Energy losses & costs

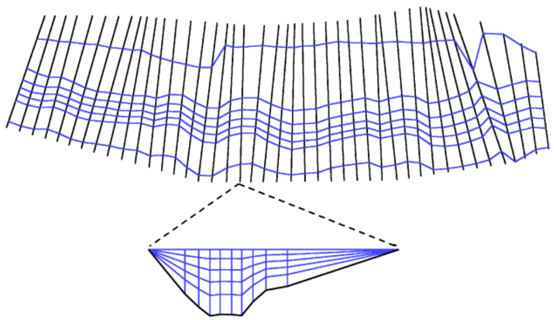
Energy losses & costs include:

- excretion
- metabolism
- swimming & foraging costs

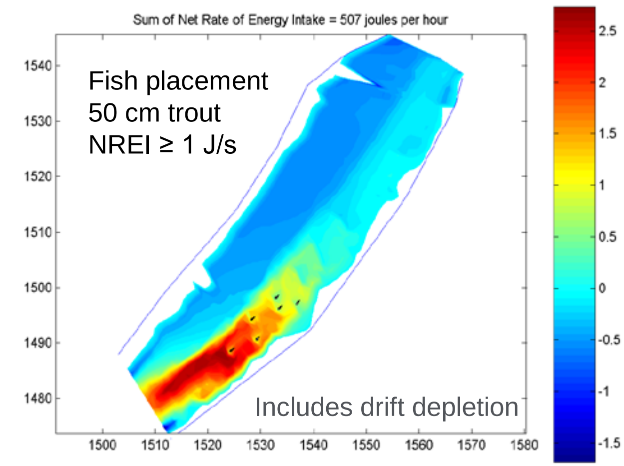
Process-based modelling for estimating NREI & trout abundance

Hydraulic model (e.g. RHYHABSIM)

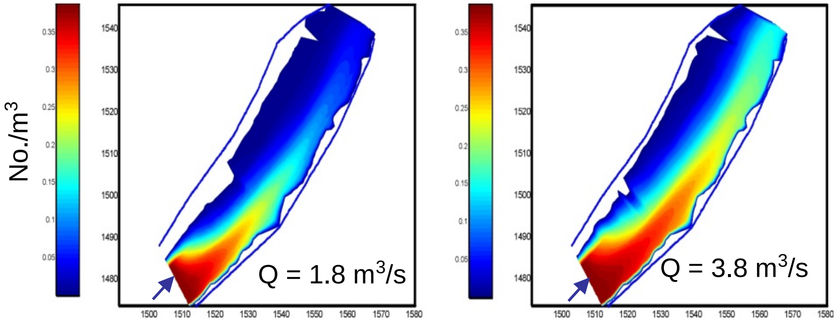
Stream-tubes model



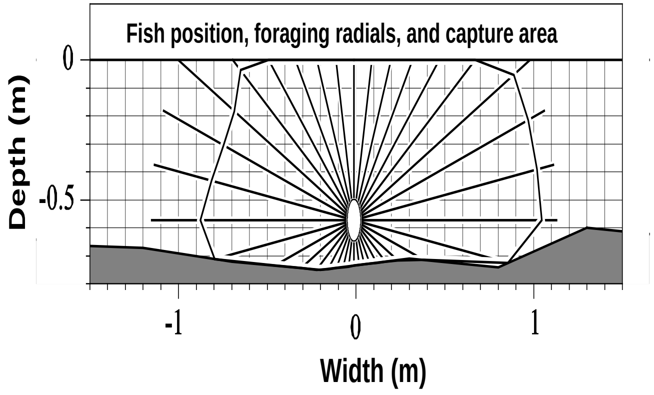
NREI model



Drift dispersion model

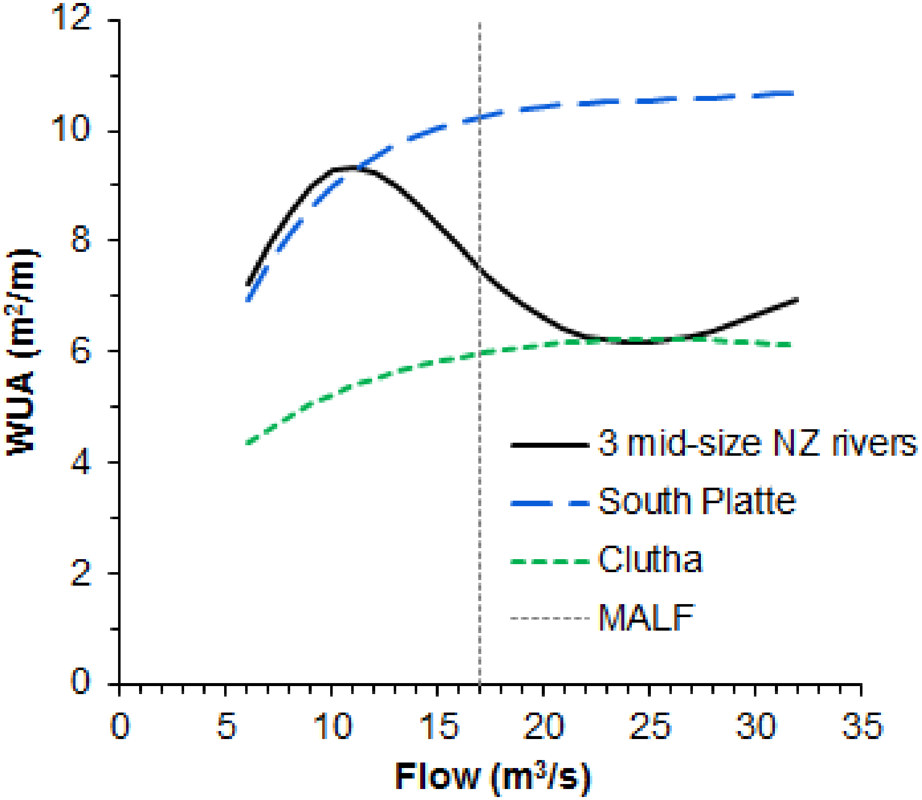


Foraging model

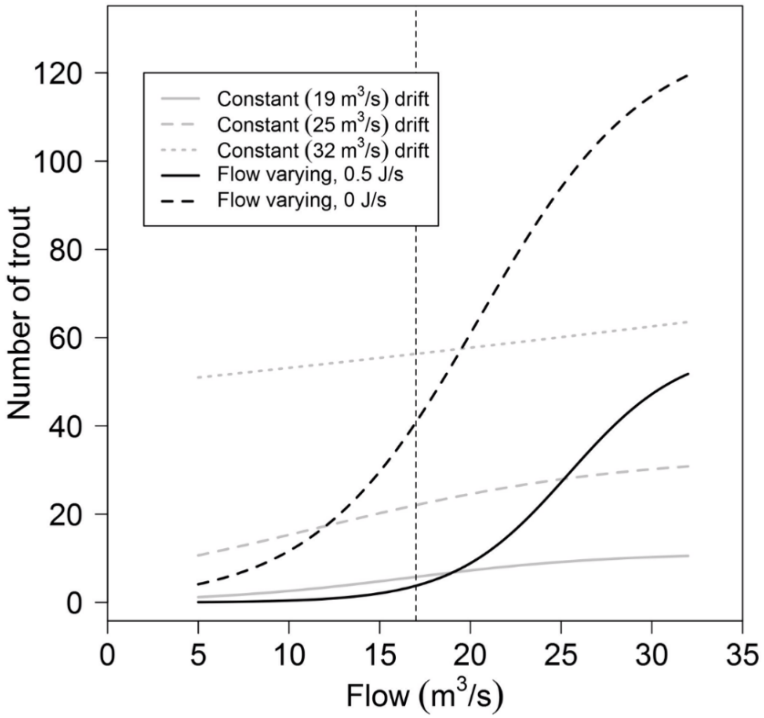


Comparison of NREI model vs WUA – Mataura R.

Habitat method
WUA

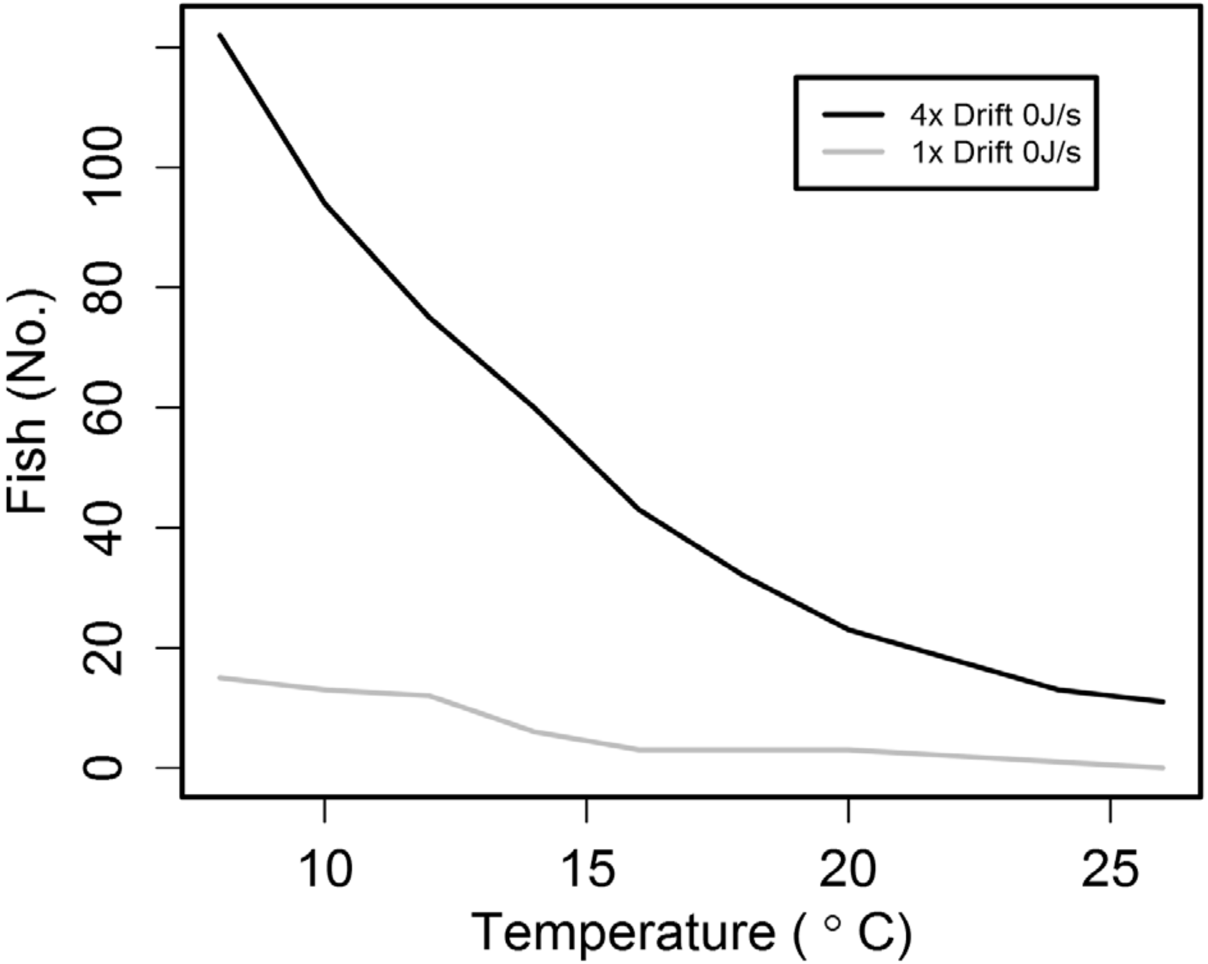


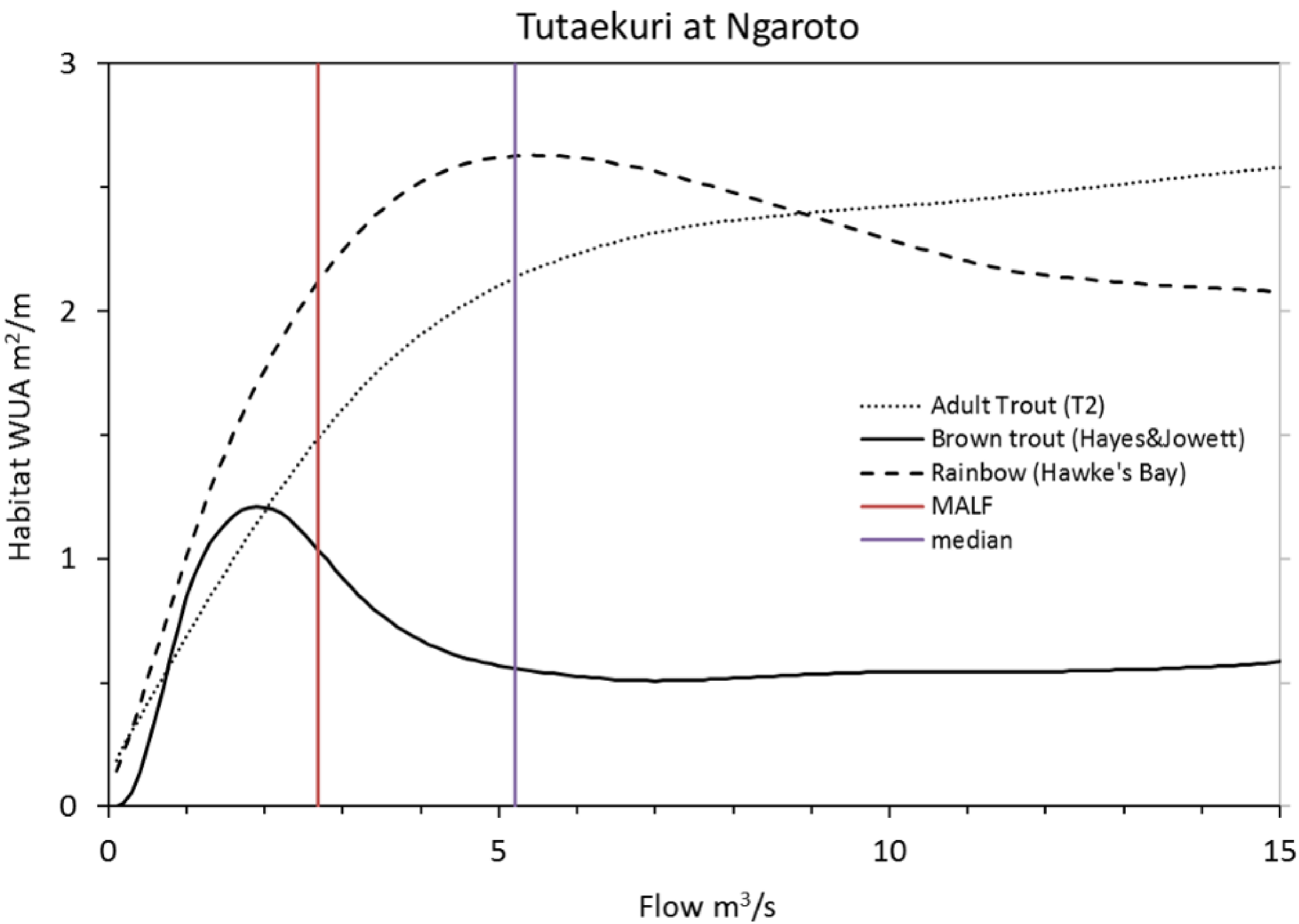
Bioenergetics
NREI



MALF = 17 m^3/s
Median Q = 46 m^3/s

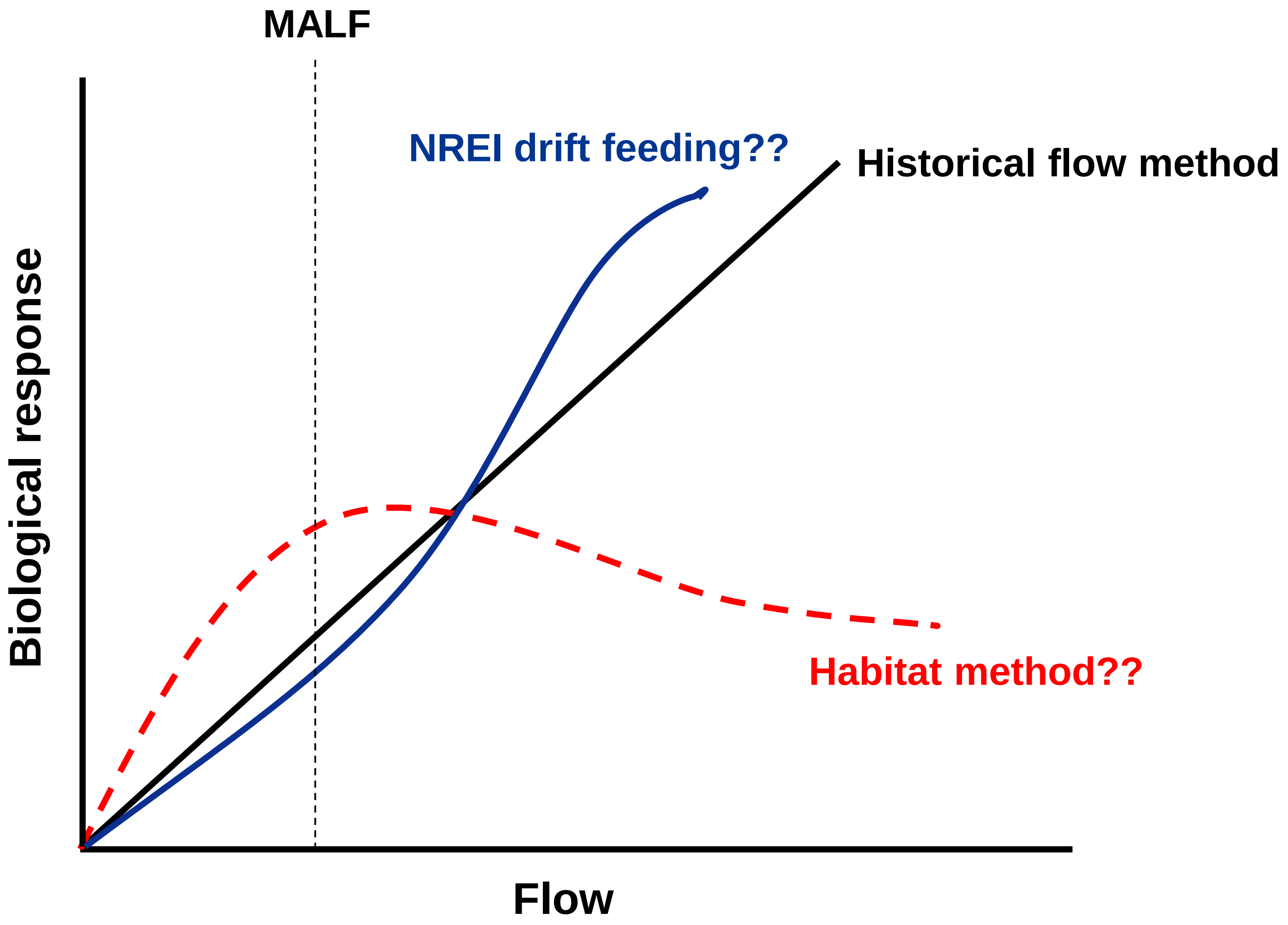
IMPACT OF WATER TEMPERATURE OF ENERGETICS





Tutaekuri at Ngaroto
Habitat WUA m2/m
Flow m3/s
0
1
2
3
0
5
10
15
Adult Trout (T2)
Brown trout (Hayes&Jowett)
Rainbow (Hawke's Bay)
MALF
median

ASSUMED BIOLOGICAL RESPONSE TO FLOW CHANGE



NREI RESULTS HIGHLIGHT IMPORTANCE OF ALLOCATION LIMIT IN CONJUNCTION WITH MINIMUM FLOW

- When identifying critical instream values and mgmt. objectives

    Particularly if drift feeding fish, then need to consider maintenance of flows to support feeding opportunity, as well as space and food supply

- Consider mechanisms to maintain low to median flow range, e.g. reduced allocation limit, increased minimum flow, flow sharing, abstraction step-down
    - Flows become decreasingly important for drift feeding and benthic invertebrate production the further they exceed the minimum flow

TECHNICAL ASSESSMENT METHODS

- Historical flow methods

Non-specific
Assume status quo is best
Assume linear proportional response to flow
Easily applied

- Generalised habitat modelling

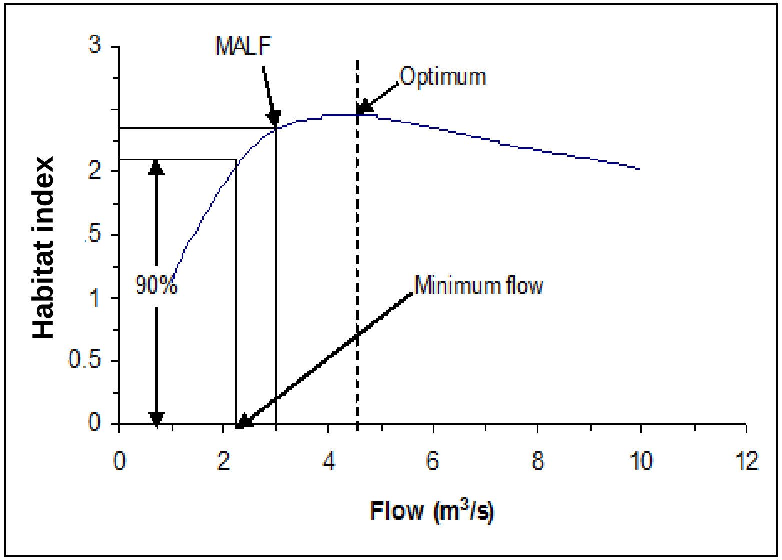
- Hydraulic habitat modelling
- Water quality modelling
- Coupled drift and bioenergetics modelling (NREI)
- ++ others

Linked with specific values
Assume habitat (or WQ or food) limiting
Non-linear flow response
Data hungry
Expensive
Controversial

SETTING LIMITS?

HABITAT RETENTION ANALYSIS – RISK MGMT. AGAIN

- Change in habitat from reference flow
  - Relative to MALF for fish, or median flow for invertebrates (based on Jowett 1992; Jowett et al. 2005, Jowett et al. 2008)



  - Assumed risk of adverse effects increases with greater deviation from natural flow statistic (or habitat optimum).

  - Same retention approach can be applied to flow directly (historical methods) or fish NREI (bioenergetics methods)

MINIMUM FLOW – PROTECTION LEVELS

- Risk management continued

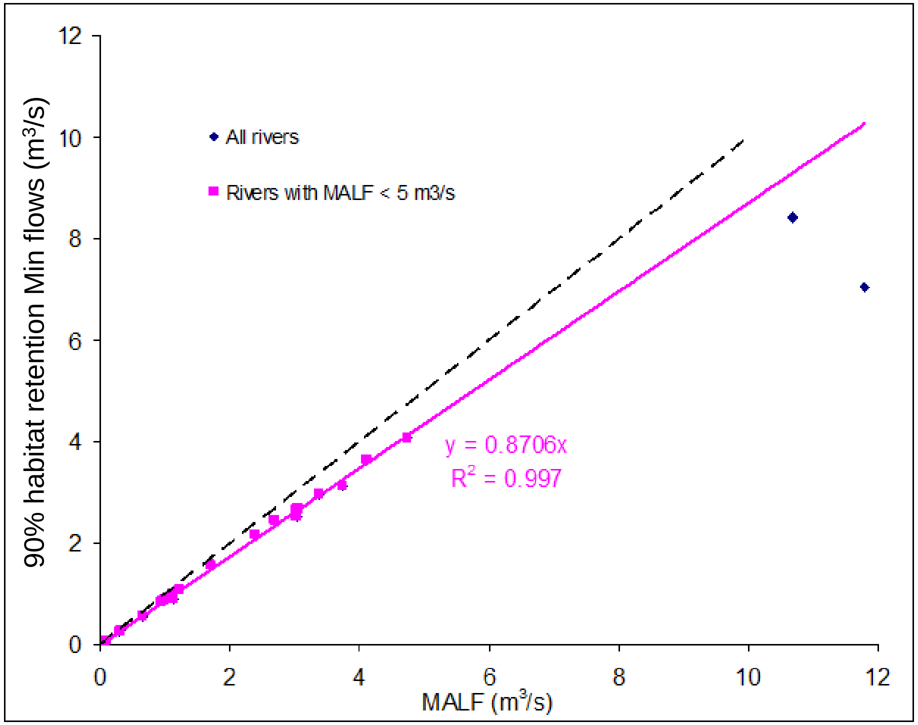
Suggested significance ranking (from highest (1) to lowest (5)) of critical values and levels of habitat retention. Table taken from Jowett and Hayes (2004).

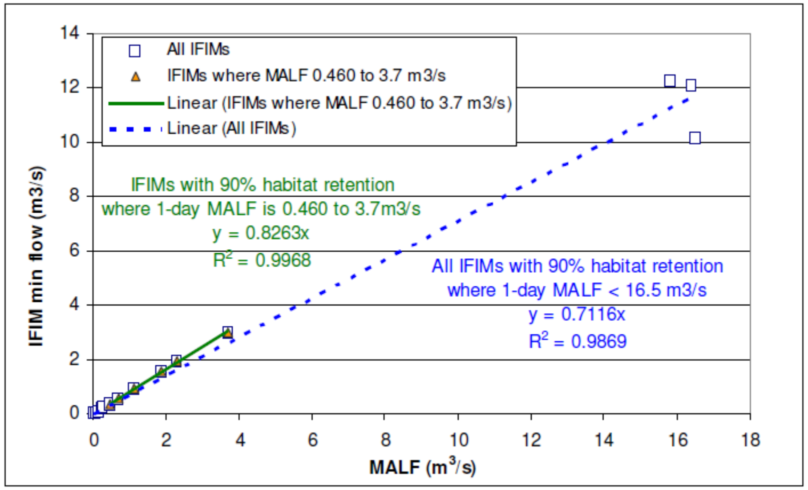
Critical value	**Fishery quality**	**Significance ranking**	**% habitat retention**
Large adult trout – perennial fishery	High	1	90
Diadromous galaxiid	High	1	90
Non-diadromous galaxiid	-	2	80
Trout spawning/juvenile rearing	High	3	70
Large adult trout – perennial fishery	Low	3	70
Diadromous galaxiid	Low	3	70
Trout spawning/juvenile rearing	Low	5	60
Redfin/common bully	-	5	60

Were not meant to be hardwired rules!

COMPARISON WITH HISTORICAL METHOD

- Varying retention level approach can be applied with historical methods
- Commonly historical flow methods used to guide broad-scale flow management decisions (e.g. in Regional Plans)
- Historical methods tend to produce more conservative minimum flows for a given retention level, at least where MALF > 460 l/s (e.g. Roygard 2009; Hay 2010)





ALLOCATION LIMITS

- Maintenance of invertebrate production (food for fish) more dependent on allocation limits or flow sharing rules than minimum flow
- Scenarios can be assessed using invertebrate habitat retention relative to median flow, or benthic process models (e.g. BITHABSIM)
- Often based on risk management and security of supply analysis (how many additional days of flow restriction are acceptable, for water users and the environment?)
- Minimum flow and allocation limits require balancing:
  - For a given minimum flow higher allocation increases the frequency and duration of the minimum flow:
    - Thereby increasing the likelihood of adverse ecological effects (e.g. by reducing benthic invertebrate production (fish food supply) and feeding opportunities for drift-feeding fish)
    - But also lowers security of supply to abstractors.
    - A lower minimum flow increases risk of adverse effects for in-stream values so consideration should be given to reducing the allocation rate to offset this risk.

ALLOCATION LIMITS – PROTECTION LEVELS

- Allocation precedents:
  - Beca 2008 considered the following as high degree of flow alteration:
    - Abstraction > 40% of MALF, or any flow alteration from impoundments, irrespective of region or source of flow
    - Total abstraction of 20–30% of MALF, depending on instream values and baseflow characteristics
    - Abstraction that increases duration of low flow to about 30 days or more.

    ➔ Allocation < 30% of MALF have been viewed as reasonably environmentally conservative in recent years (e.g. Horizons' One Plan)

  - Further support now for importance of conservative allocation limits from bioenergetics model results (especially the value of flow sharing or allocation rationing)
  - The water immediately above the minimum flow is of most value

ALLOCATION LIMITS AND MINIMUM FLOW – PROTECTION LEVELS

- Additional support for these protection level precedents from proposed a presumptive standard (Richter et al. 2012):
  - Suggest that altering natural flows <10% can be considered environmentally conservative, the natural structure and function will be maintained with minimal changes.
  - Moderate levels of ecological protection will be provided when flow changes are limited to < 20 % (i.e. there may be some measureable changes in structure and minimal changes to ecosystem function).
  - Higher levels of flow alteration will have increasing risk of adverse effects.

PROTECTION LEVELS – RECENT ADVICE TO TDC AND NCC

- Minimum flow and allocation limits based on historical flow method (% of MALF).

- High value then accept minimal risk
  - minimum flow provides 90-100% habitat retention at naturalised MALF
  - allocation limit 10-20% of MALF

- Lower value then accept more risk
  - minimum flow provides 70-80% habitat retention at naturalised MALF
  - allocation limit 20-30% of MALF

COMPARISON WITH EXISTING ALLOCATION AND MINIMUM FLOWS

River	Naturalised MALF (l/s)	Allocation (l/s)	Existing min flow (l/s)	Proposed min flow - HBRC reports 2011, 2012 (l/s)
Ngaruroro	4700	2000	2400	4200
	% MALF	43	51	89
Tutaekuri	3900	350	2000	3200
	% MALF	9	51	82

Note: Values shown are approximate

OTHER CONSIDERATIONS

- Flow statistics – 7Day or 1Day
- Naturalising flow statistics

- Cumulative allocation
    - Consented and permitted
- Minimum flow equals cease take?
- Restriction trigger and number of steps?
- Security of supply
- Supplementary allocation (high flow harvesting)?

- Scaling limits within catchments

SUMMARY - A COMMON APPROACH

- Historical flow methods to guide broad-scale flow management decisions
- Detailed instream habitat analysis for rivers with high values and/or large flow alteration
- Protection levels based on risk assessment
- Allocation limits balancing security of supply to abstractors and risk to instream life of extending low-flow period


Habitat Requirements

Thomas Wilding

HAWKE'S BAY
REGIONAL COUNCIL

Take home points

Tutaekuri

- Less water use than Ngaruroro
- Even in dry years, there is sufficient flow to maintain a high level of habitat protection for adult trout

Ngaruroro

- Already drops below recommended protection levels for torrentfish
- Increased water use would increase risk of measurable effects on fish populations

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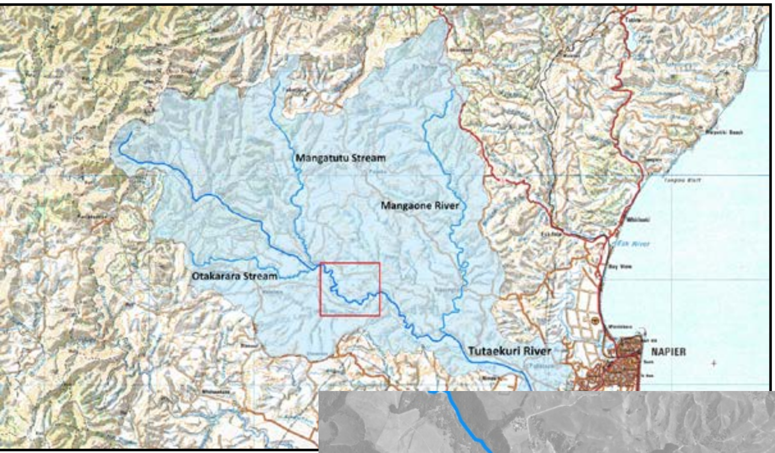
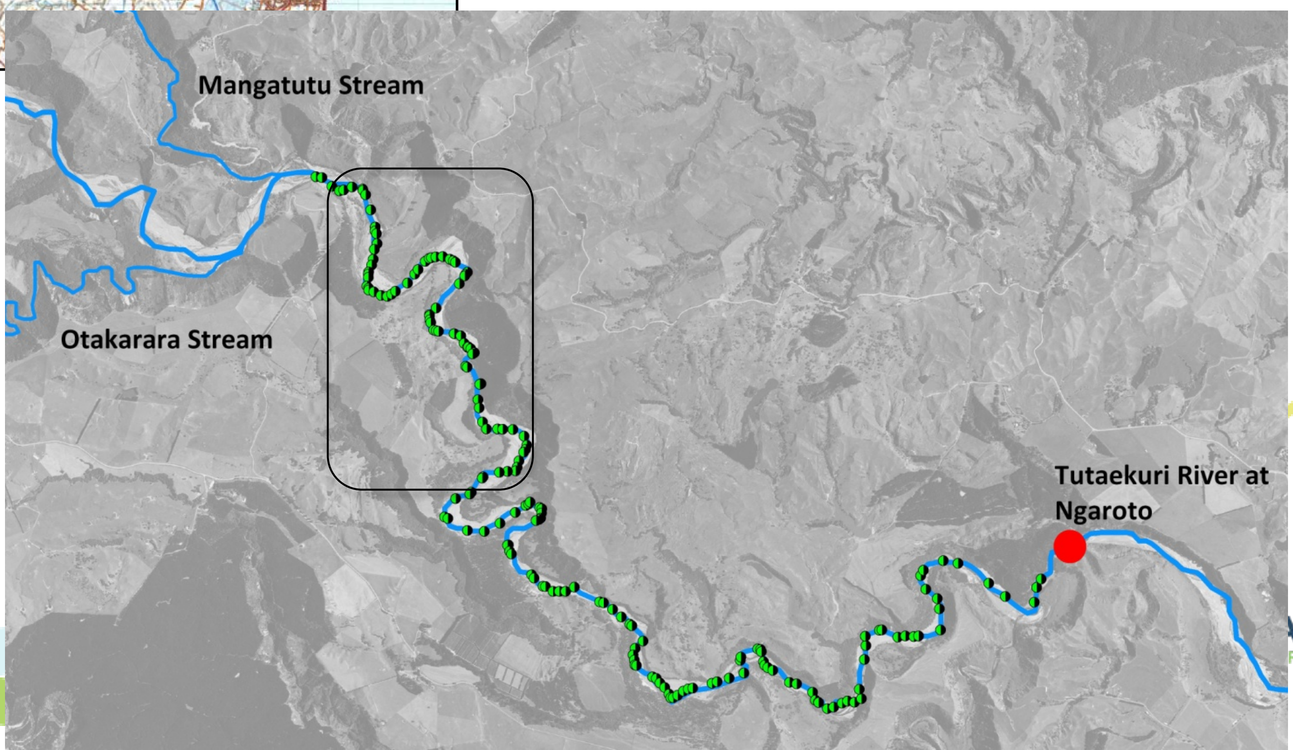
Tutaekuri River





Habitat Protection flows - Tutaekuri

Tutaekuri River - Puketapu nat. MALF 3900 L/s *(was 3800)* exist. MALF 3500 L/s	Flow for 90% habitat	Flow for 80% habitat	Flow for 70% habitat	Habitat protection at 2000 L/s
Fast-water fish i.e. adult trout	3300 L/s (3200)	2800 L/s (2600)	2300 L/s (2100)	65% (68%)
Moderate-water fish i.e. koaro	1600 L/s	1100 L/s	700 L/s	100%
Slow-water fish i.e. common bully	<500 L/s	<500 L/s	<500 L/s	100%
Invertebrates (food producing)	2700 L/s	2100 L/s	1600 L/s	79%

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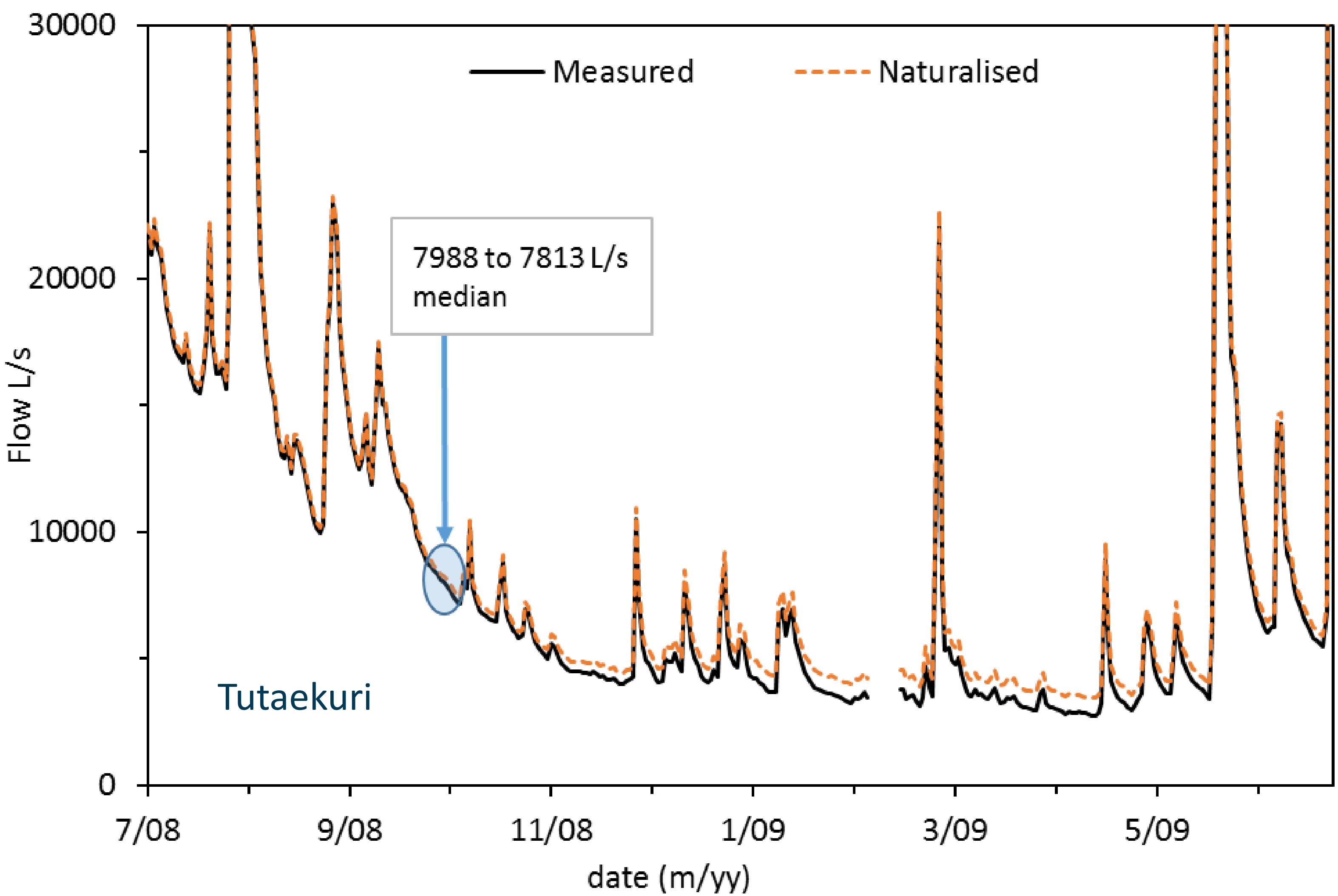
At median flow, water use had negligible effect on invertebrate habitat (3.72 to 3.70 m^2/m) and trout habitat (2.13 to 2.12 m^2/m)



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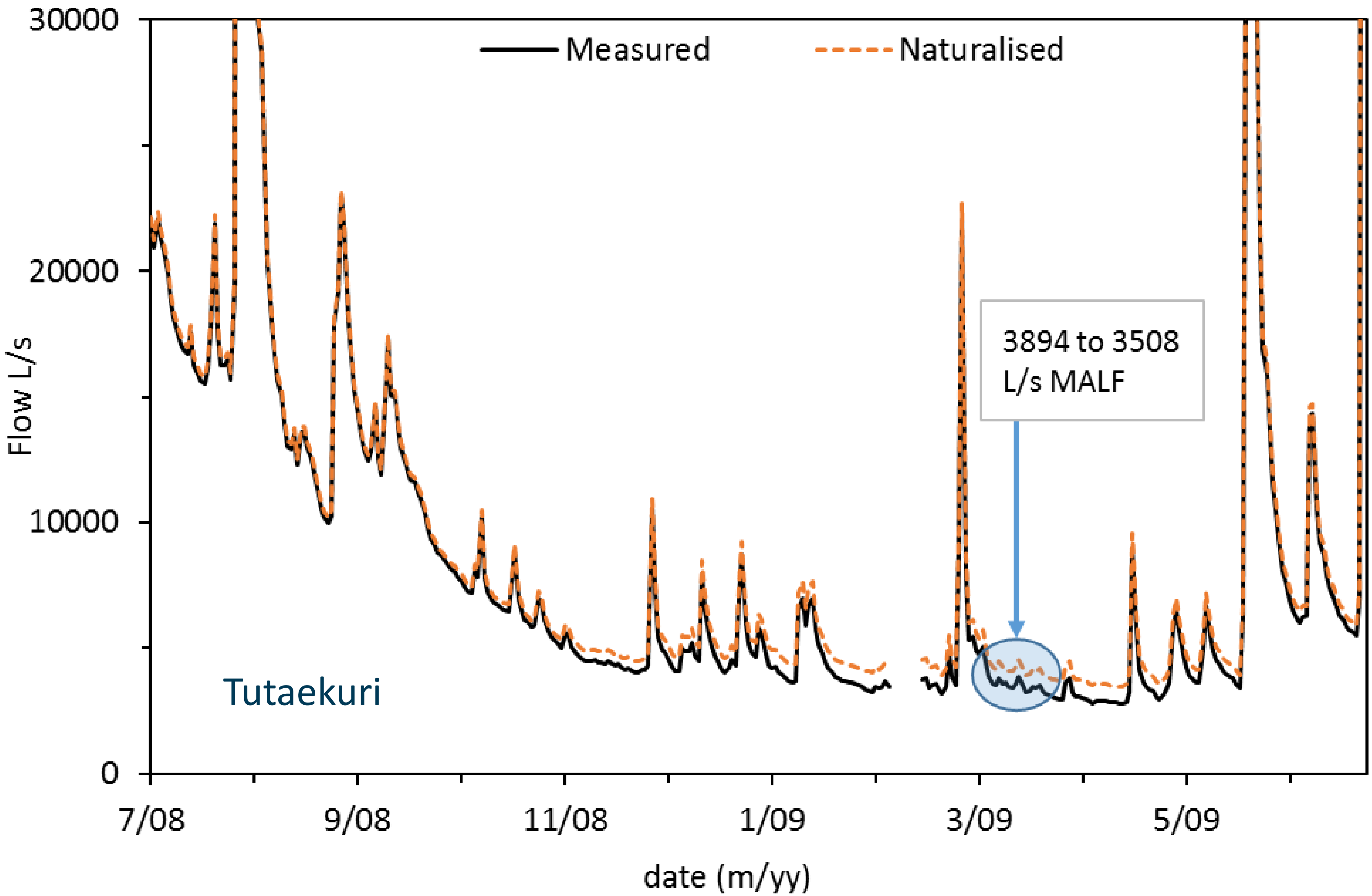
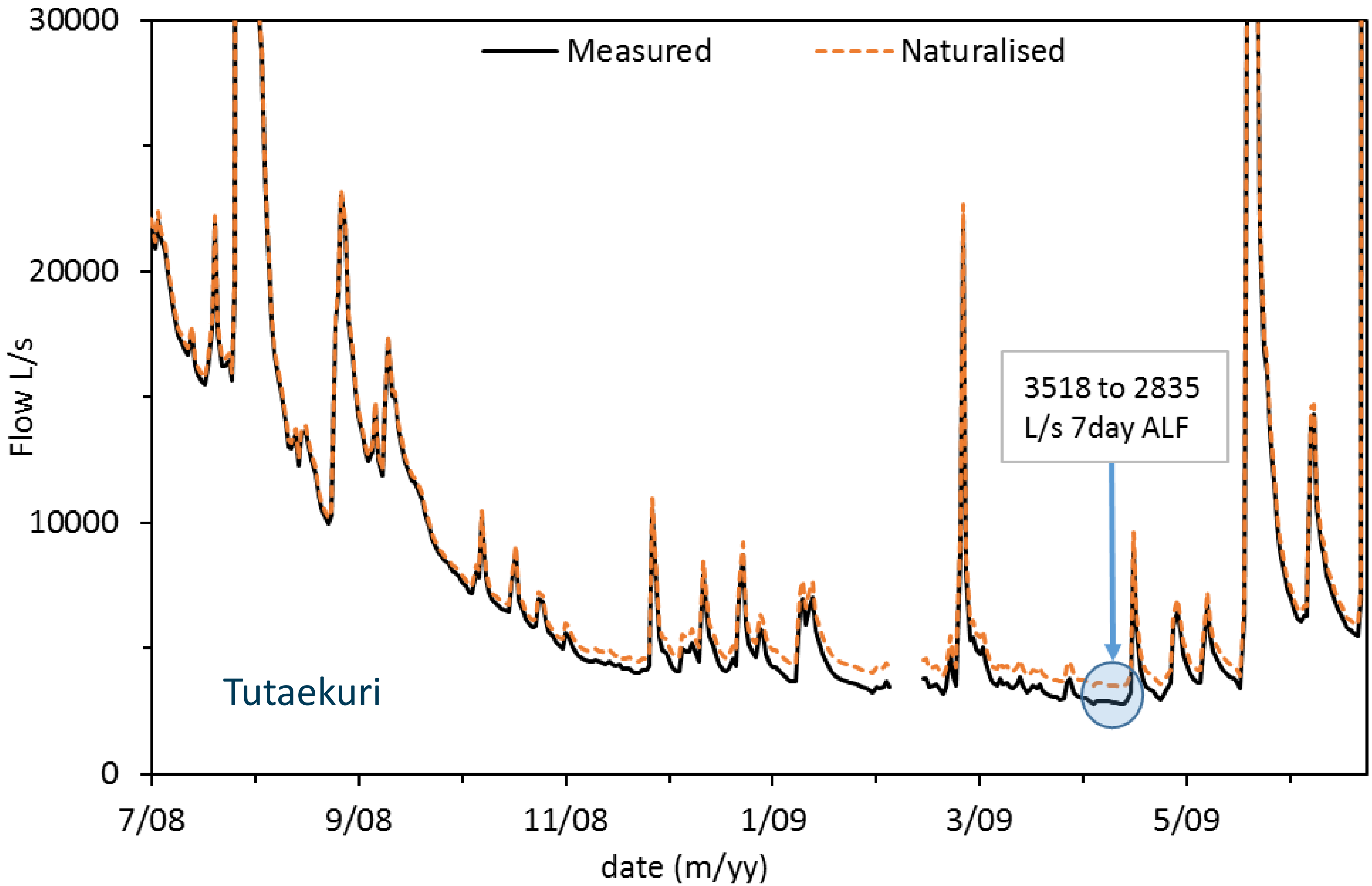
At MALF, water use has reduced trout habitat from 100% to 93% protection level (to 97% for torrentfish, to 97% for invertebrates)



At its worst, water use reduced trout habitat from 94% to 81% protection level (April 2009)



Ngaruroro River

Habitat Protection flows - Ngaruroro

Ngaruroro River - downstream of Fernhill nat. MALF 4700 L/s *(was 4500)* exist. MALF 3800 L/s	Flow for 90% habitat	Flow for 80% habitat	Flow for 70% habitat	Habitat protection at 2400 L/s
Fast-water fish i.e. torrentfish	4400 L/s	4000 L/s	3600 L/s	44%
Moderate-water fish i.e. smelt	2700 L/s	2200 L/s	1800 L/s	86%
Slow-water fish i.e. common bully	1200 L/s	<1000 L/s	<1000 L/s	100%
Invertebrates (food producing)	4200 L/s	3700 L/s	3200 L/s	47%

file

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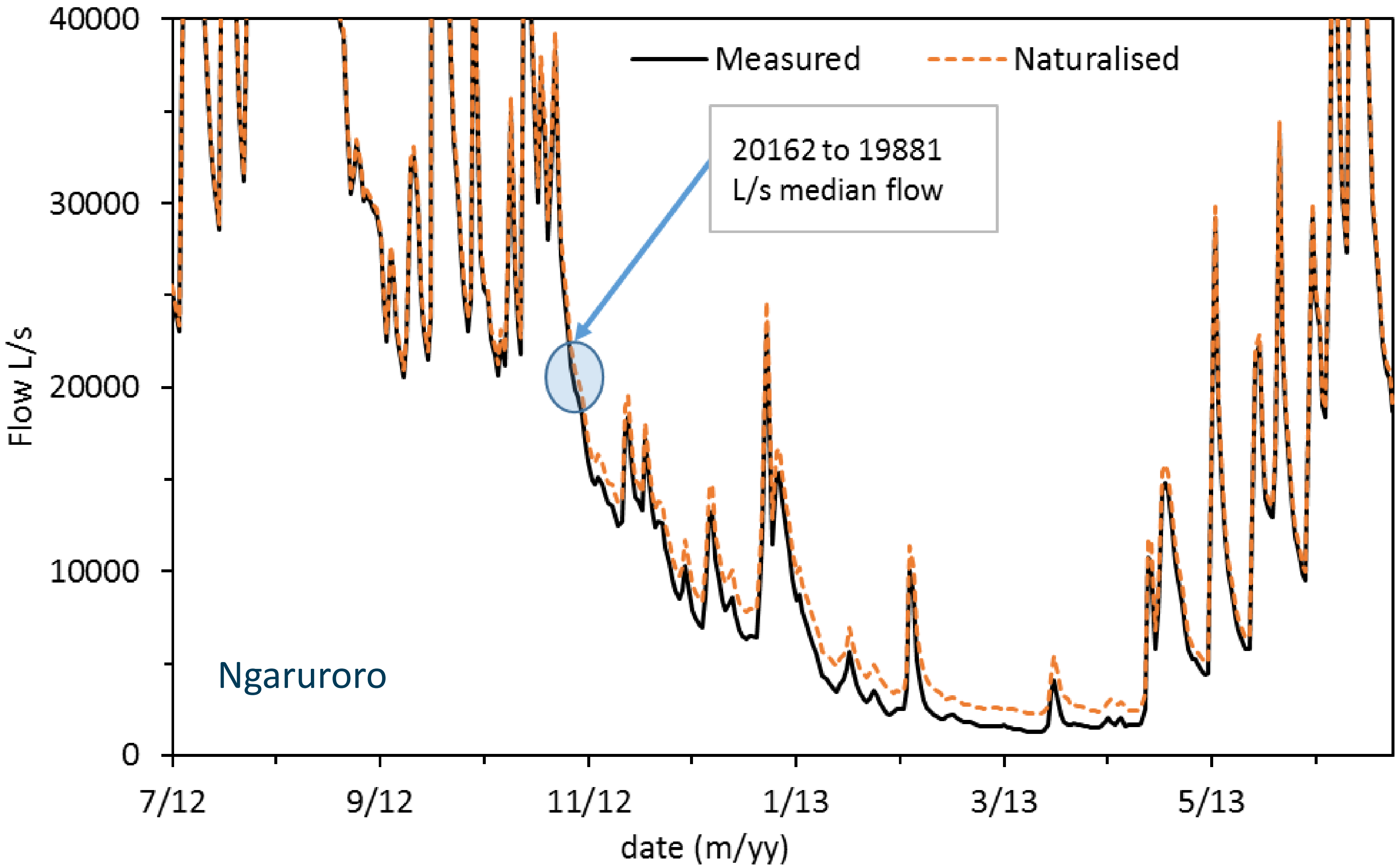
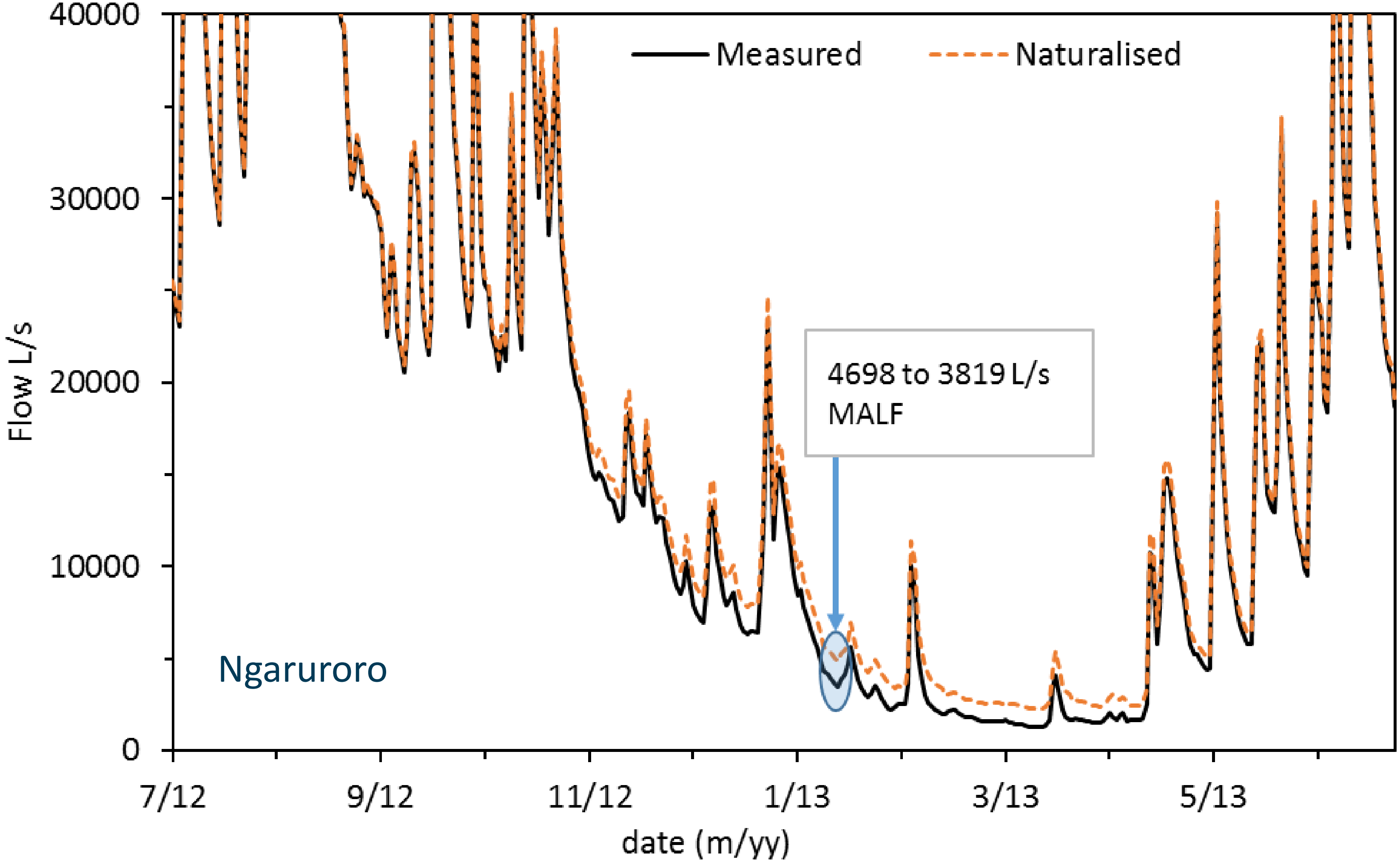
At median flow, water use had negligible effect on invertebrate habitat (9.856 to 9.857 m^2/m) and trout habitat (0.363 to 0.362 m^2/m)

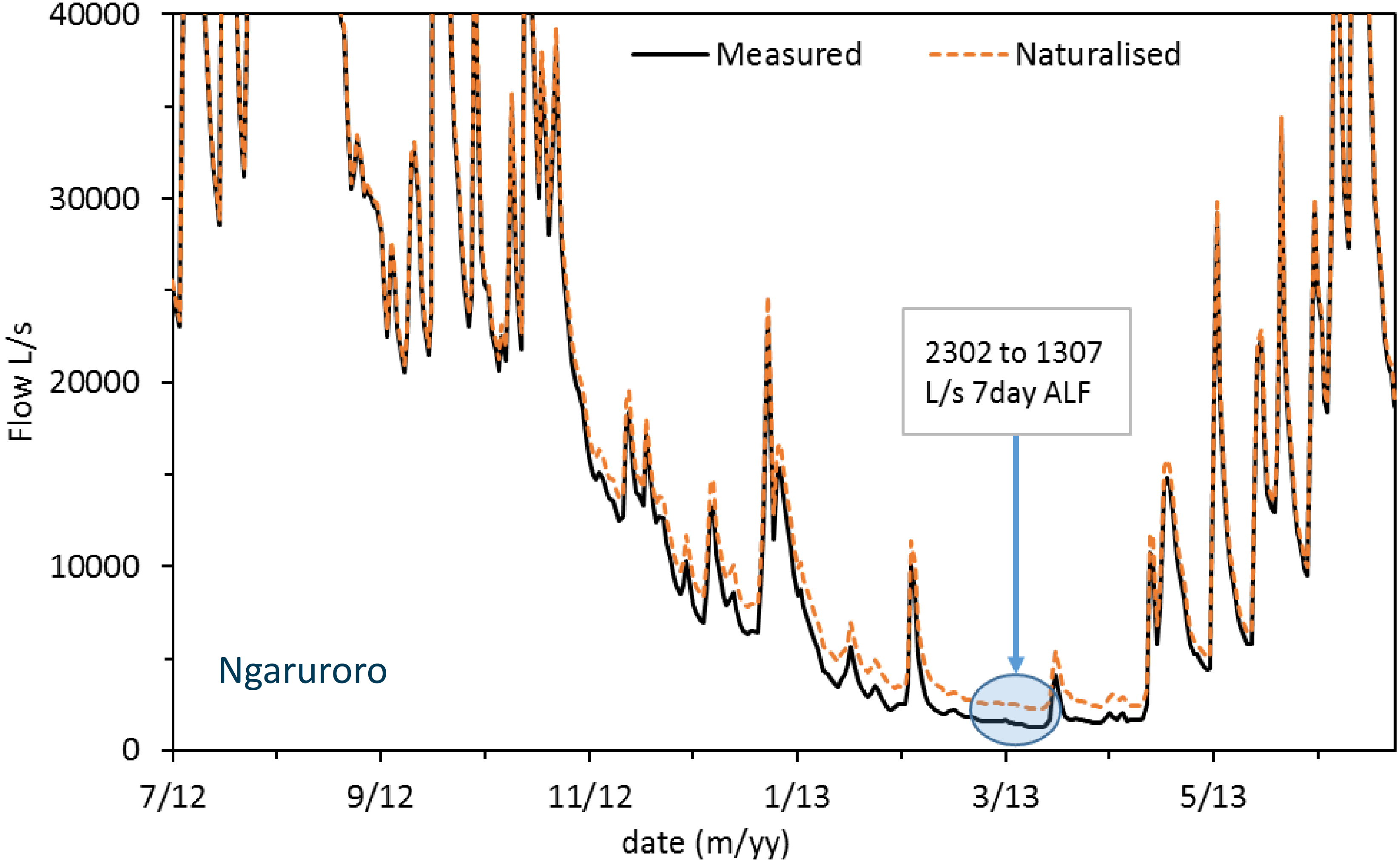


At MALF, water use has reduced torrentfish habitat from 100% to 75% protection level (to 91% for trout, to 83% for invertebrates)



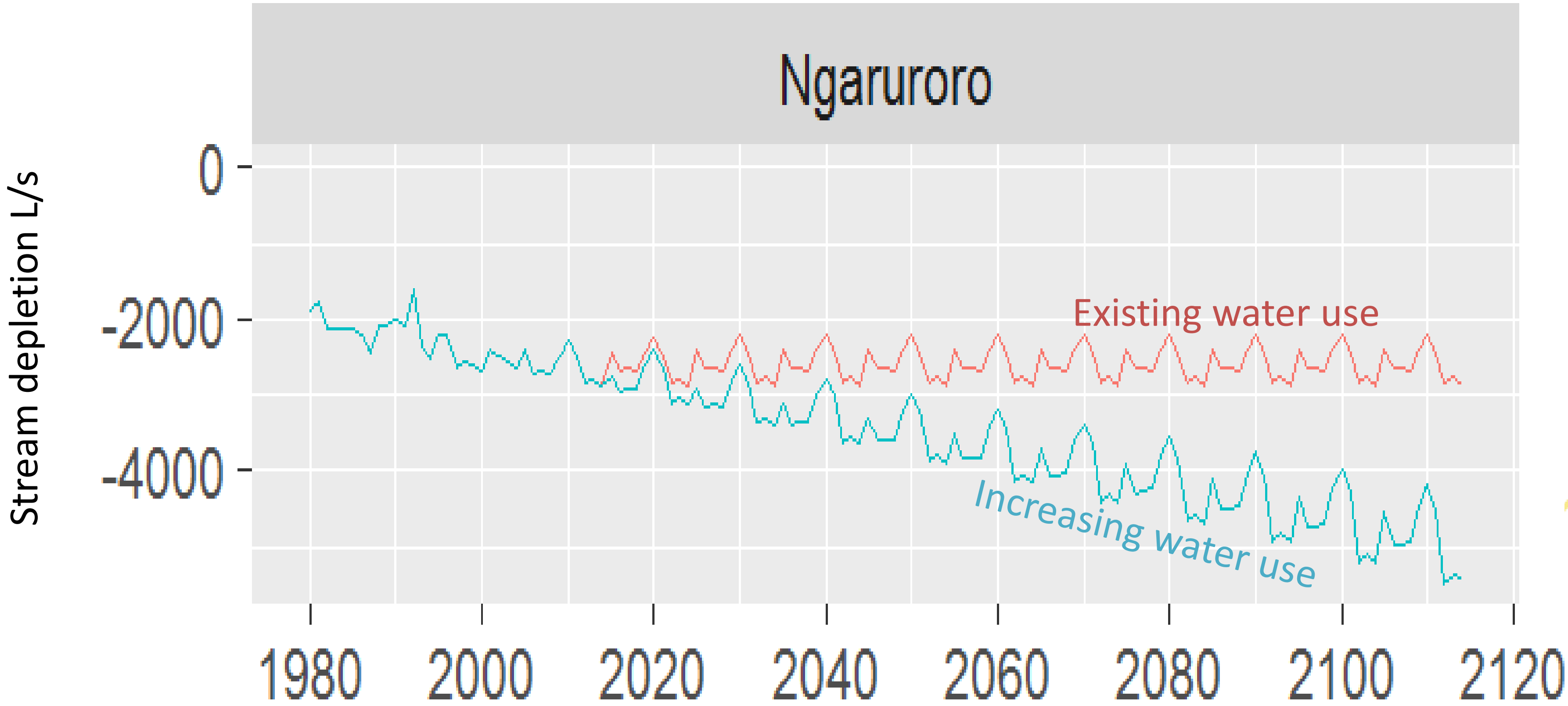
S BAY
COUNCIL

At its worst, water use reduced torrentfish habitat from 42% to 16% protection level (March 2013)



S BAY
COUNCIL

Ngaruroro worse if water use increases



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Summary

- Ngaruroro
  - Already drops below recommended protection levels for torrentfish
  - Increased water use would increase risk of measurable effects on fish populations

- Tutaekuri
  - Less water use than Ngaruroro
  - Even in dry years, there is sufficient flow to maintain a high level of habitat protection for adult trout

Trigger flow summary

	MALF naturalised	Flow for 90% habitat	Flow for 80% habitat	Flow for 70% habitat	Habitat protection at 2400 L/s
Tutaekuri ***adult trout***	3900 *(was 3800)*	2700 L/s	2200 L/s	1800 L/s	86%
Ngaruroro ***torrentfish***	4700 *(was 4500)*	4400 L/s	4000 L/s	3600 L/s	44%

file

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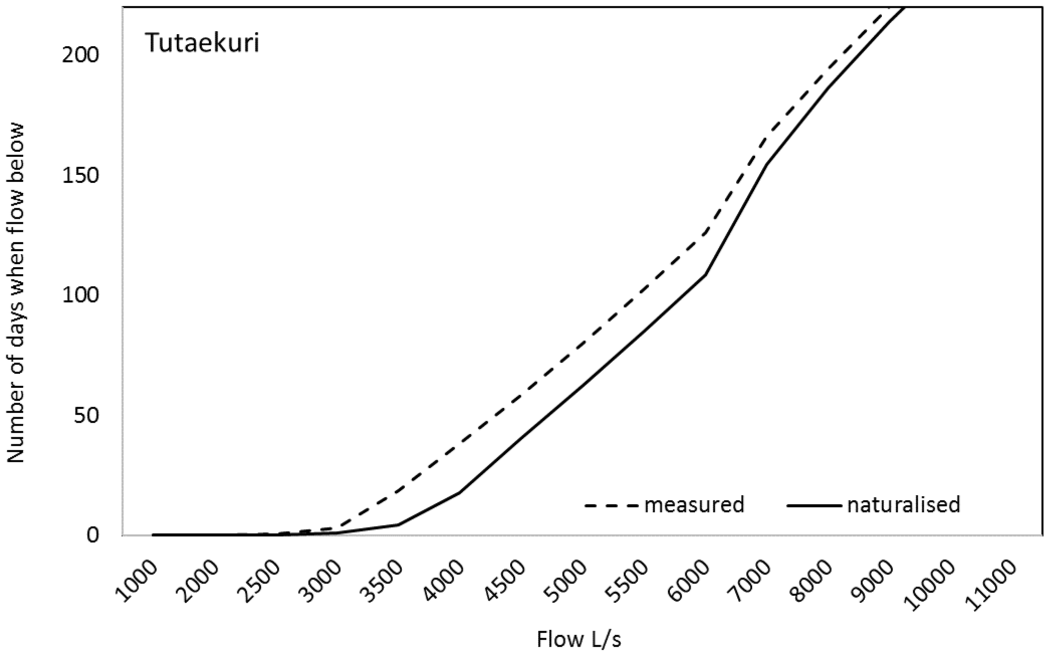
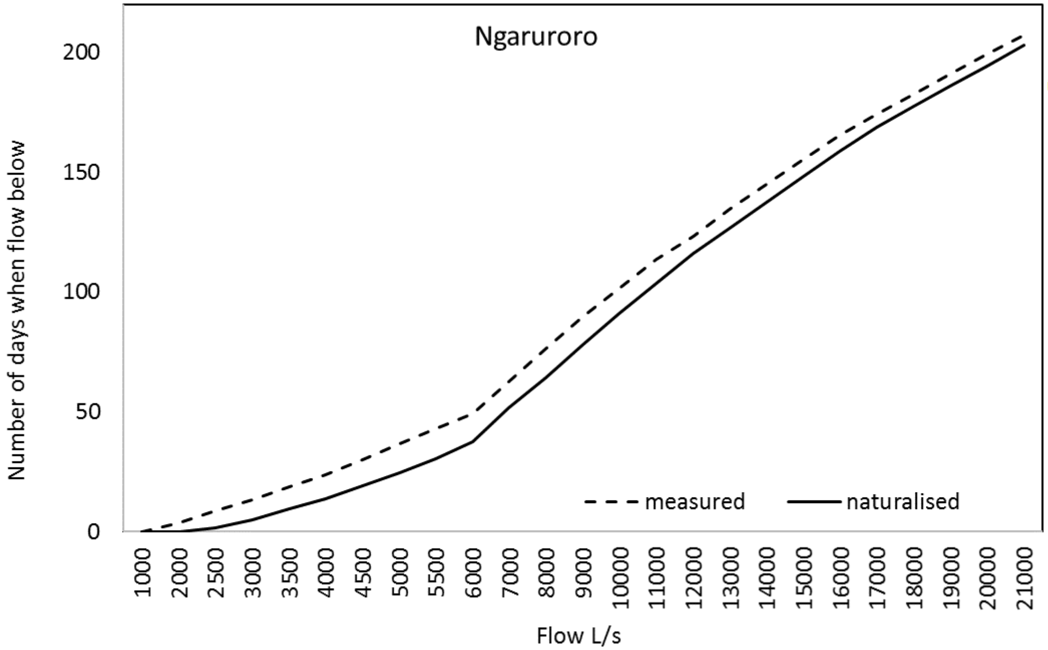
Tutaekuri

- Approximately 17 more days below a given flow, as a result of water use (increments between 3500 and 6000 L/s)



- Approximately 10 more days below a given flow, as a result of water use (increments between 2500 and 10000 L/s)



Modelling results – deciding on scenarios

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Managing effects of water abstractions on the Ngaruroro and Tutaekuri Rivers

Issues;

1. The River flows are affected by the cumulative impact of groundwater and surface water abstraction

2. Reduced flows affect native fish habitats

3. Minimum flow restrictions affect
   - Reliability of supply for abstraction
   - Costs of storage – mitigation options

4. Effects of abstraction on River flows can be managed by;
   - Specifying limits for total abstractions,
   - Staged reductions at specified low flows
   - Storage during high flow and release during drought
   - Improving water quality/aquatic ecosystem health

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Options

A range of scenarios for managing flows in the two rivers has been modelled.

The **base case** (or current management regime) will be modelled to understand the current water use impact on the economic, social and cultural wellbeing of the community

Proposals;

1) Cap SW allocation to existing use

2) That the TANK Group identifies **two** further management scenarios that combine **minimum flows with restriction regimes** for further modelling/assessment

Tutaekuri River and Ngaruroro River

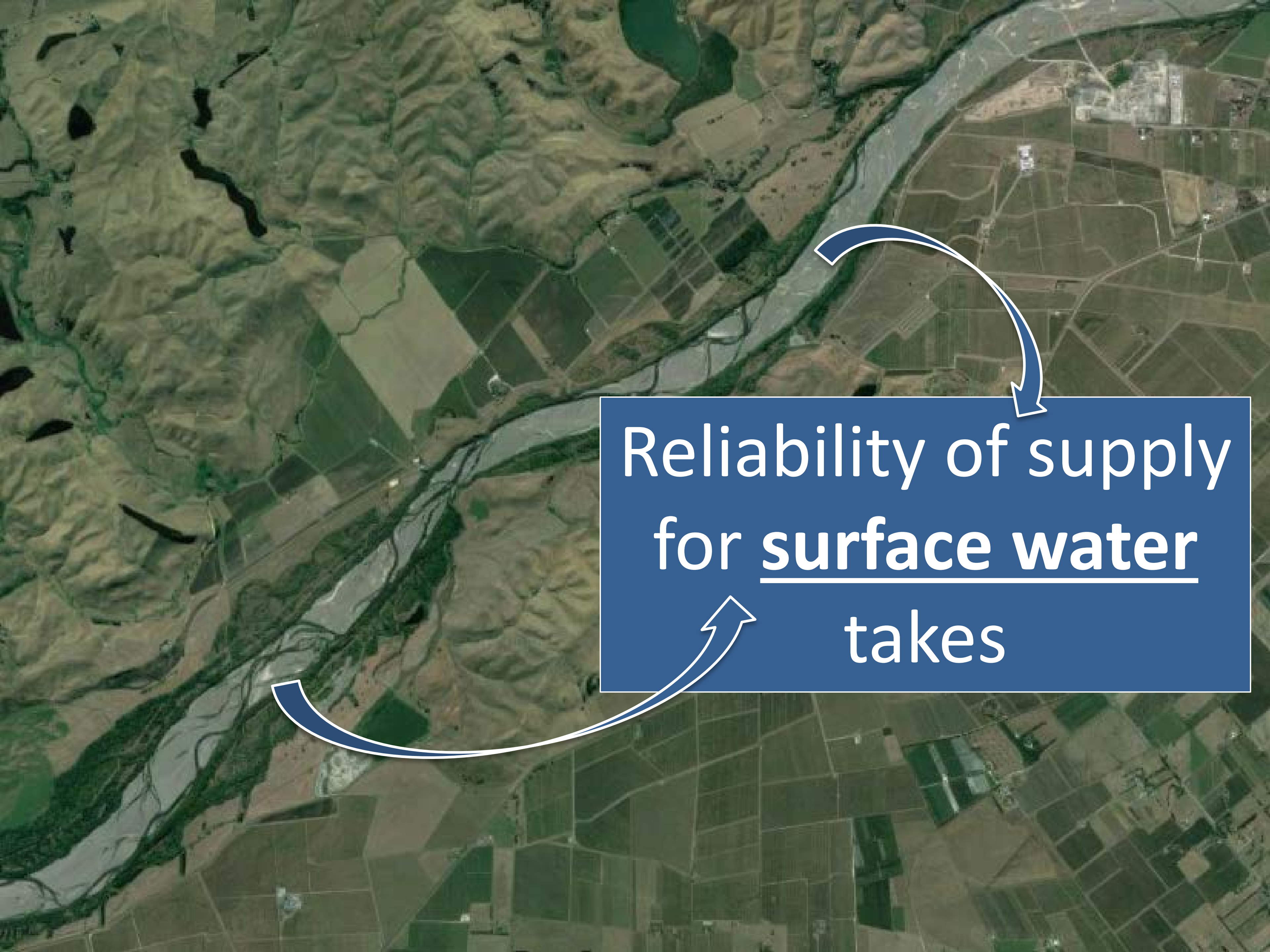
Reliability of Supply for Irrigation

Rob Waldron

HAWKE'S BAY REGIONAL COUNCIL

Outline:

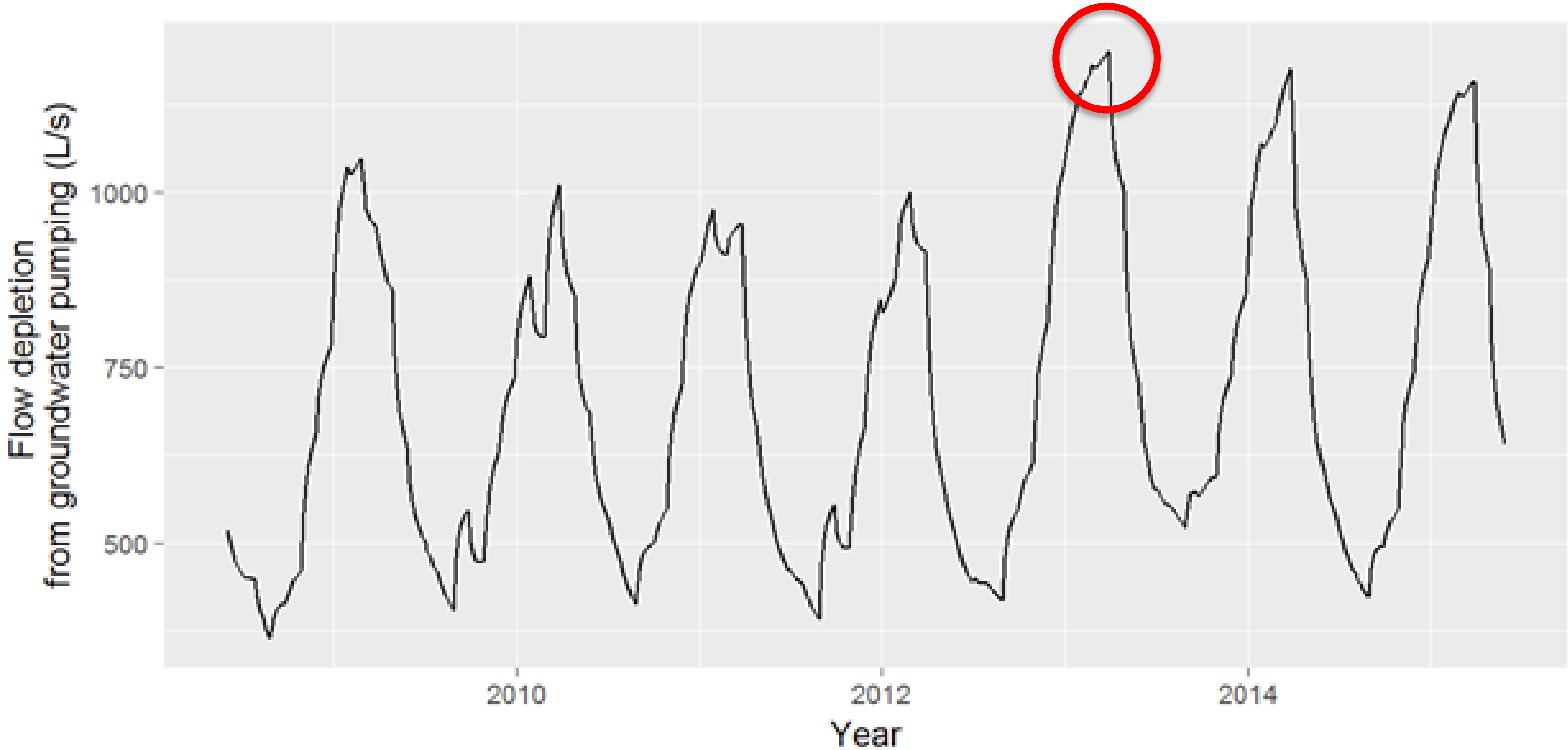
- What is *Reliability of Supply*?
- How is it measured?
- Management scenarios for simulation
- Modelling simulations:
    i. Tutaekuri River
    ii. Ngaruroro River
- Summary of results


Reliability of supply for **surface water** takes

Groundwater flow modelling

Ngaruroro River flow depletion

March 2013:
1,200 L/s flow loss caused by pumping



How much surface water is allocated?

For modelling:

- Ngaruroro River: **1,373 L/s**
  - minimum flow 2,400 L/s

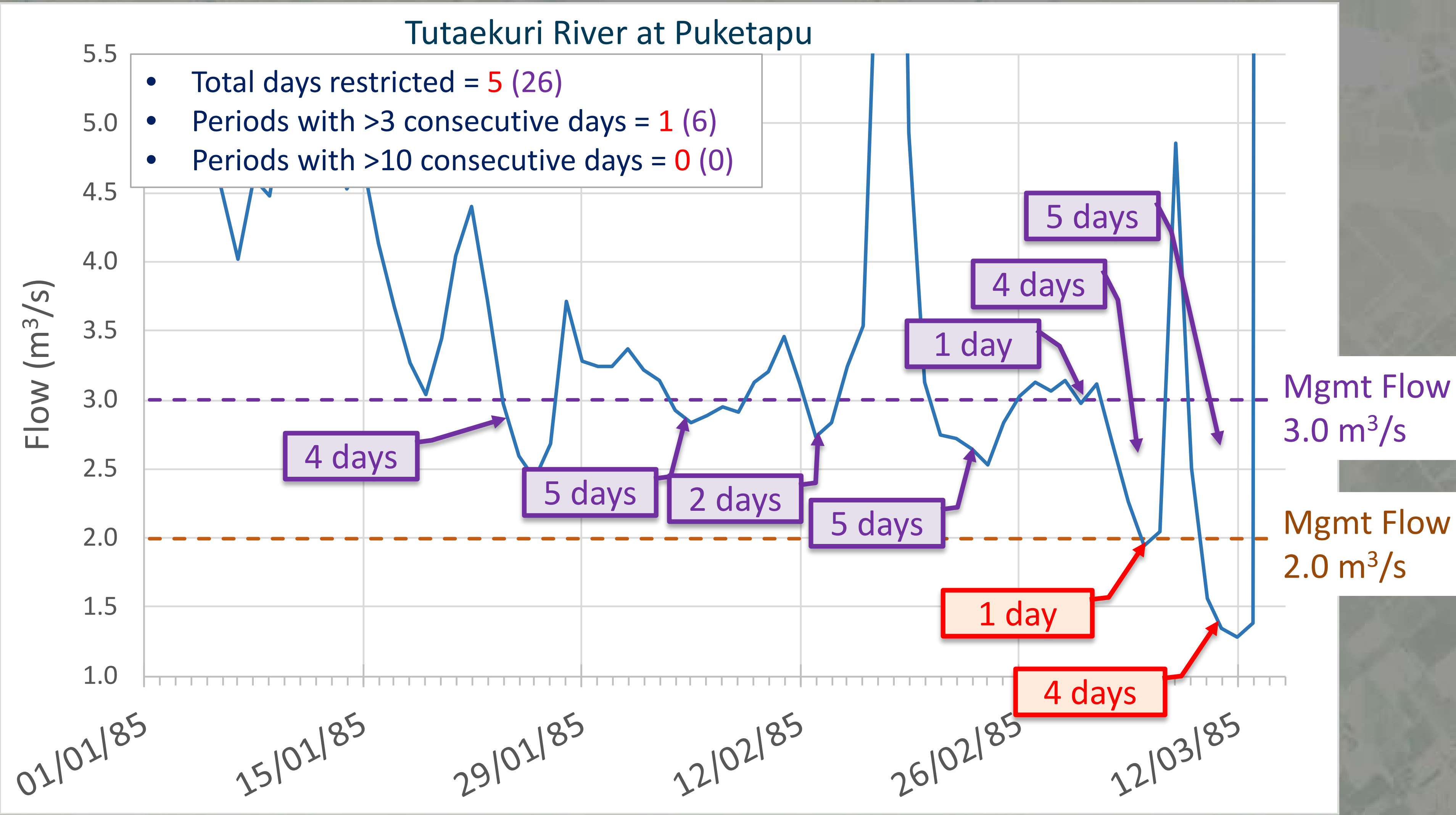
- Tutaekuri River: **343 L/s**
  - minimum flow 2,000 L/s

What is Reliability of Supply for irrigation?

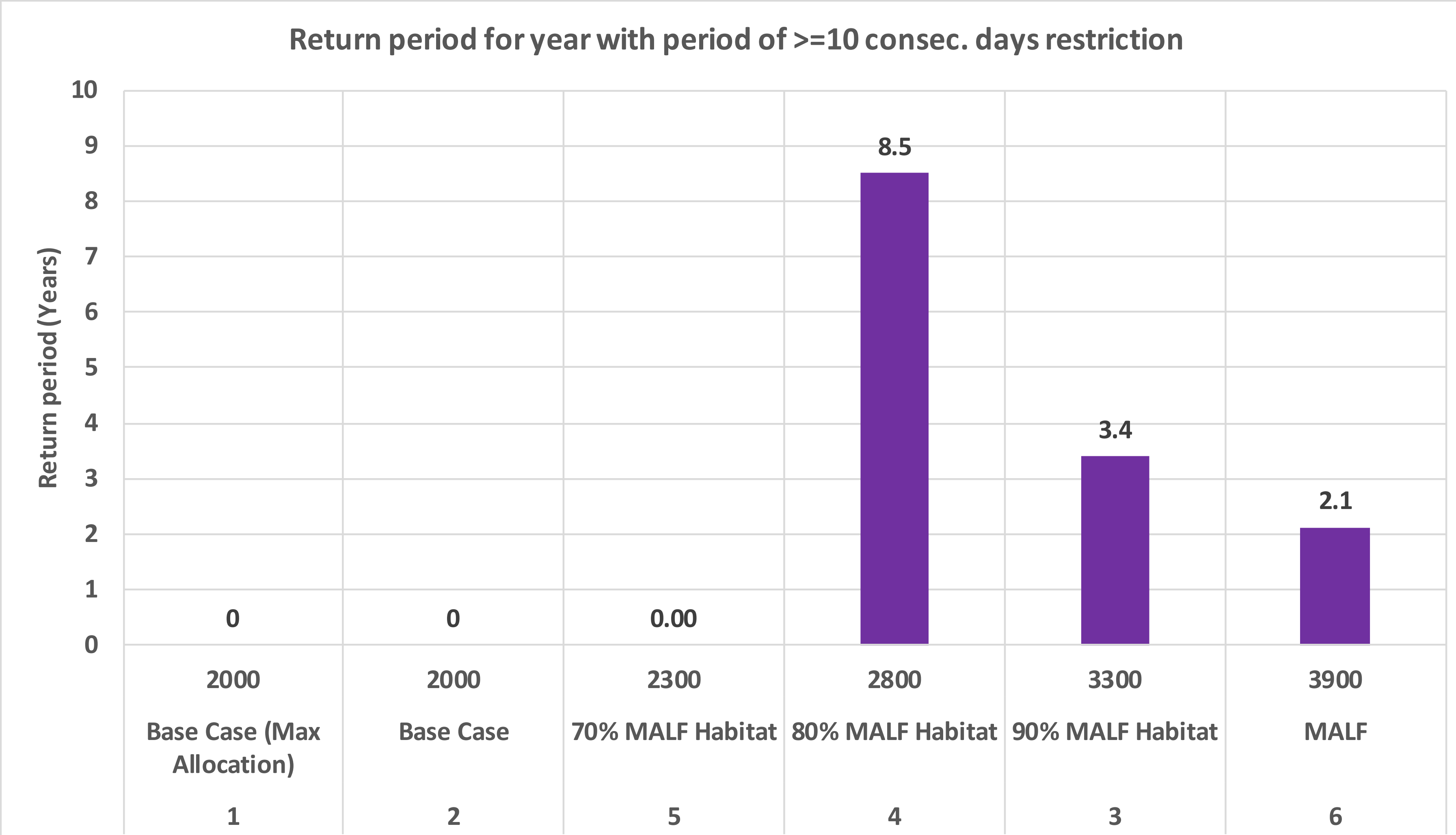
The capacity of a water resource to meet irrigation needs

- A function of water availability and demand for water
- Adequate supply reliability is essential for productive sector irrigation
- Decreased availability or increased allocation will reduce reliability of supply
- Limit setting is commonly driven by balancing **reliability of supply** with requirements for **instream values**

How is Reliability of Supply measured?



Tutaekuri River at Puketapu




Maraekakaho

10 Original Proposed Scenarios

Original Scenario ID	Tutaekuri and Ngaruroro Minimum Flow	Restriction Regime	Modelled Water Use	Flow Augmentation	GW Abstractions
Scenario 1	Current *(Base Case)*	Cease take at minimum flow	Maximum Allocation	None	Current stream depleting GW
Scenario 2	Current *(Base Case)*	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 3	90% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 4	80% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 5	70% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 6	MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 7	90% habitat at MALF	Staged reductions + cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 8	70% habitat at MALF	Staged reductions + cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 9	70% habitat at MALF	Flow sharing + cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 10	No minimum flow	Flow sharing only	Existing Use	None	GW in new Stream Depletion Zone 1

7 Scenarios Modelled

Original Scenario ID	Tutaekuri and Ngaruroro Minimum Flow	Restriction Regime	Modelled Water Use	Flow Augmentation	GW Abstractions
Scenario 1	Current *(Base Case)*	Cease take at minimum flow	Maximum Allocation	None	Current stream depleting GW
Scenario 2	Current *(Base Case)*	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 3	90% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 4	80% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 5	70% habitat at MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
Scenario 6	MALF	Cease take at minimum flow	Existing Use	None	GW in new Stream Depletion Zone 1
New Scenario	WCO - Ngaruroro River 4200 l/s *(Tutaekuri River at current minimum flow)*	Cease take at minimum flow	Existing Use	None	Current stream depleting GW

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Ngaruroro River at Fernhill

Scenario ID	**2**	**3**
Scenario Name	**Base Case**	**90% MALF Habitat**
Modelled Abstraction	**Estimated Demand**	**Estimated Demand**
Minimum Flow (l/s)	**2400**	**4400**
Total % restriction	2.2%	7.1%
Average no. days restriction per year	3.3	10.9
Return period for year with period of >=3 consec. days restriction (Years)	3.4	1.5
Return period for year with period of >=10 consec. days restriction (Years)	17	2.4
Example Dry Year - Climate Equivalent to 2012-2013		
No. days restriction	52	73
No. periods of >=3 consec. days restriction	3	5
No. periods of >=10 consec. days restriction	2	2

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Tutaekuri River at Puketapu

Scenario ID	**2**	**3**
Scenario Name	**Base Case**	**90% MALF Habitat**
Modelled Abstraction	**Estimated Demand**	**Estimated Demand**
Minimum Flow (l/s)	**2000**	**3300**
Total % restriction	0%	5.9%
Average no. days restriction per year	0	9.1
Return period for year with period of >=3 consec. days restriction (Years)	-	2.4
Return period for year with period of >=10 consec. days restriction (Years)	-	3.4
Example Dry Year - Climate Equivalent to 2012-2013		
No. days restriction	0	77
No. periods of >=3 consec. days restriction	0	6
No. periods of >=10 consec. days restriction	0	3

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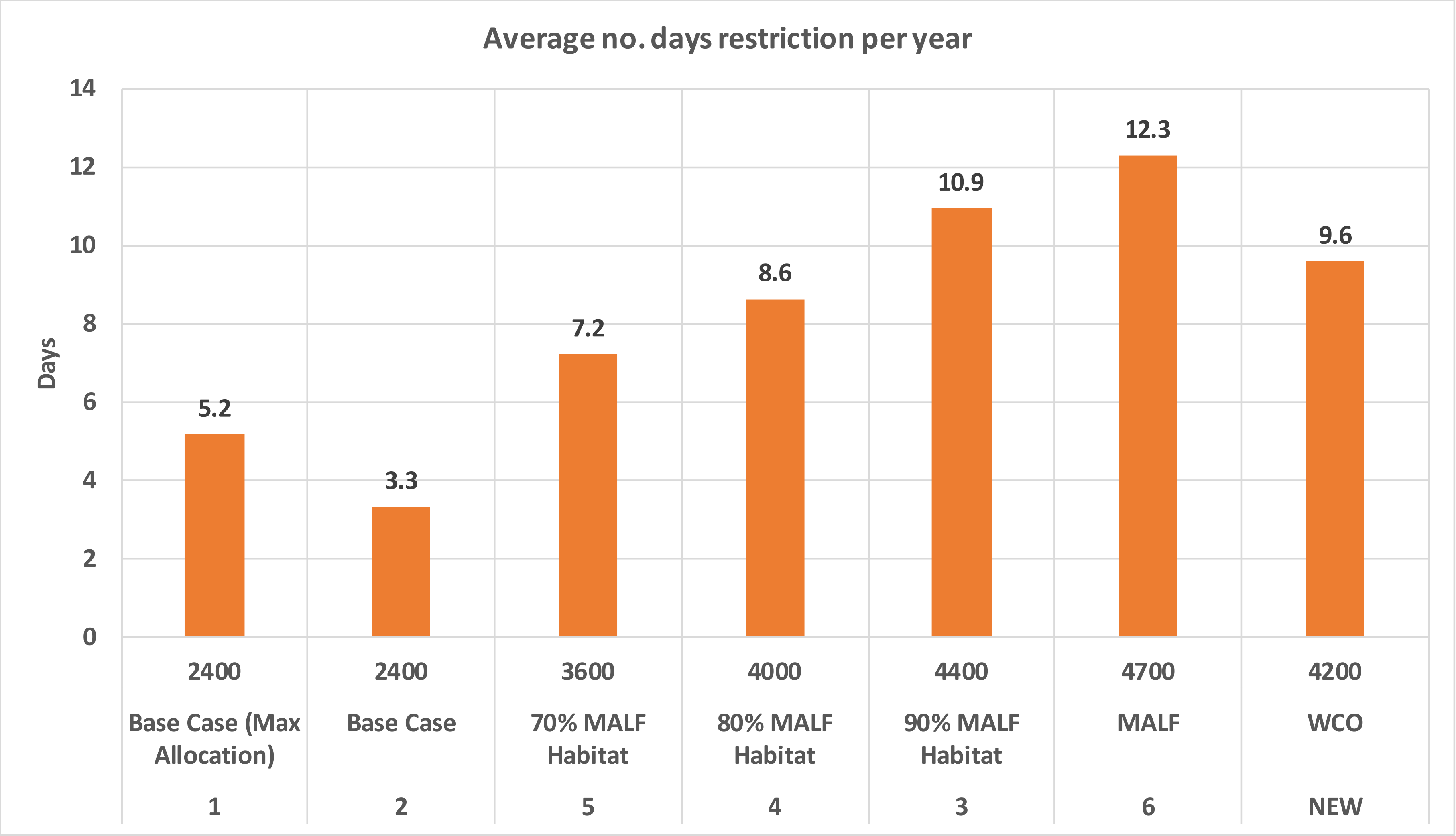
Ngaruroro River at Fernhill

Average number of days restriction increases with higher minimum flows



Ngaruroro River at Fernhill

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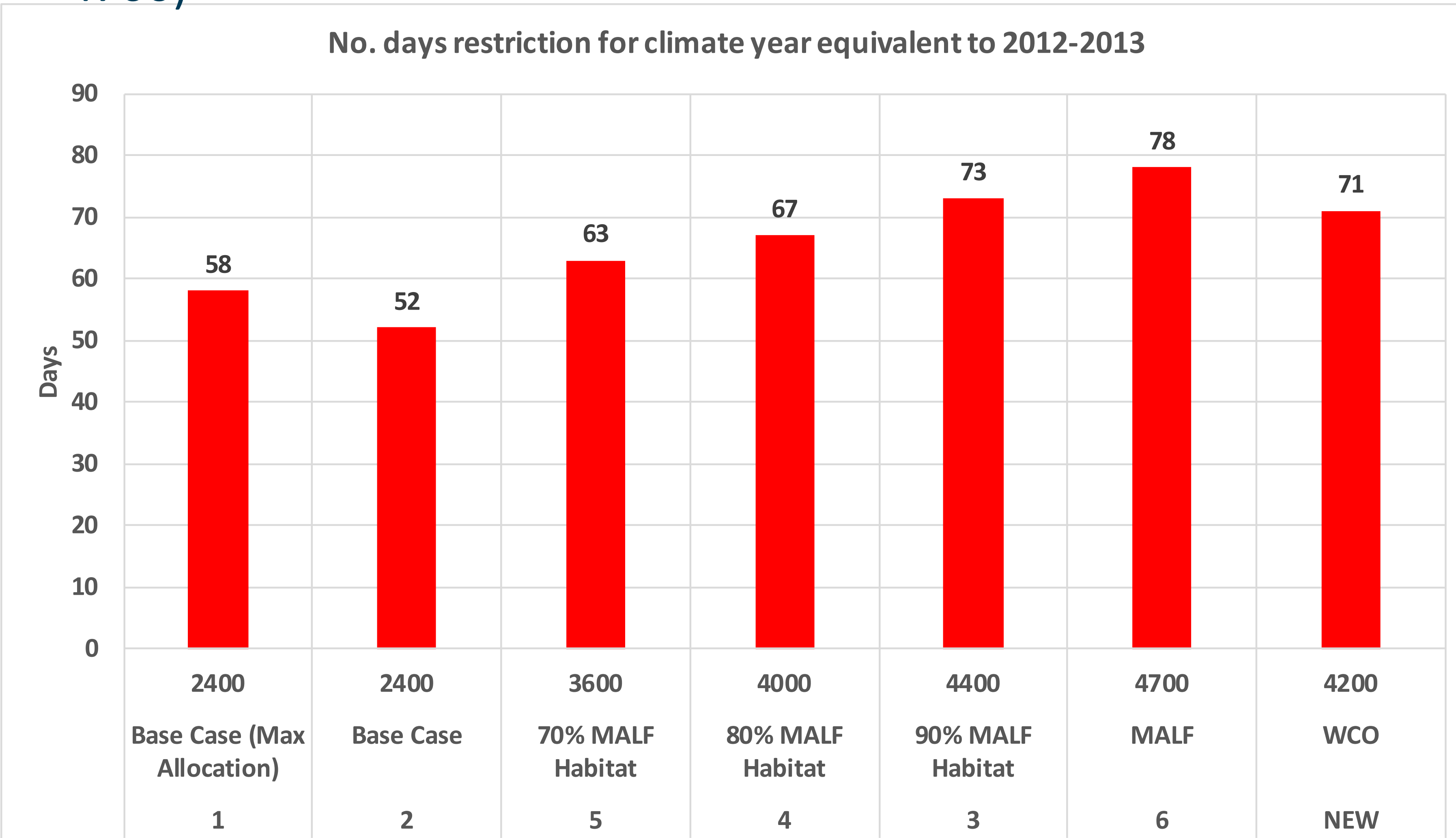
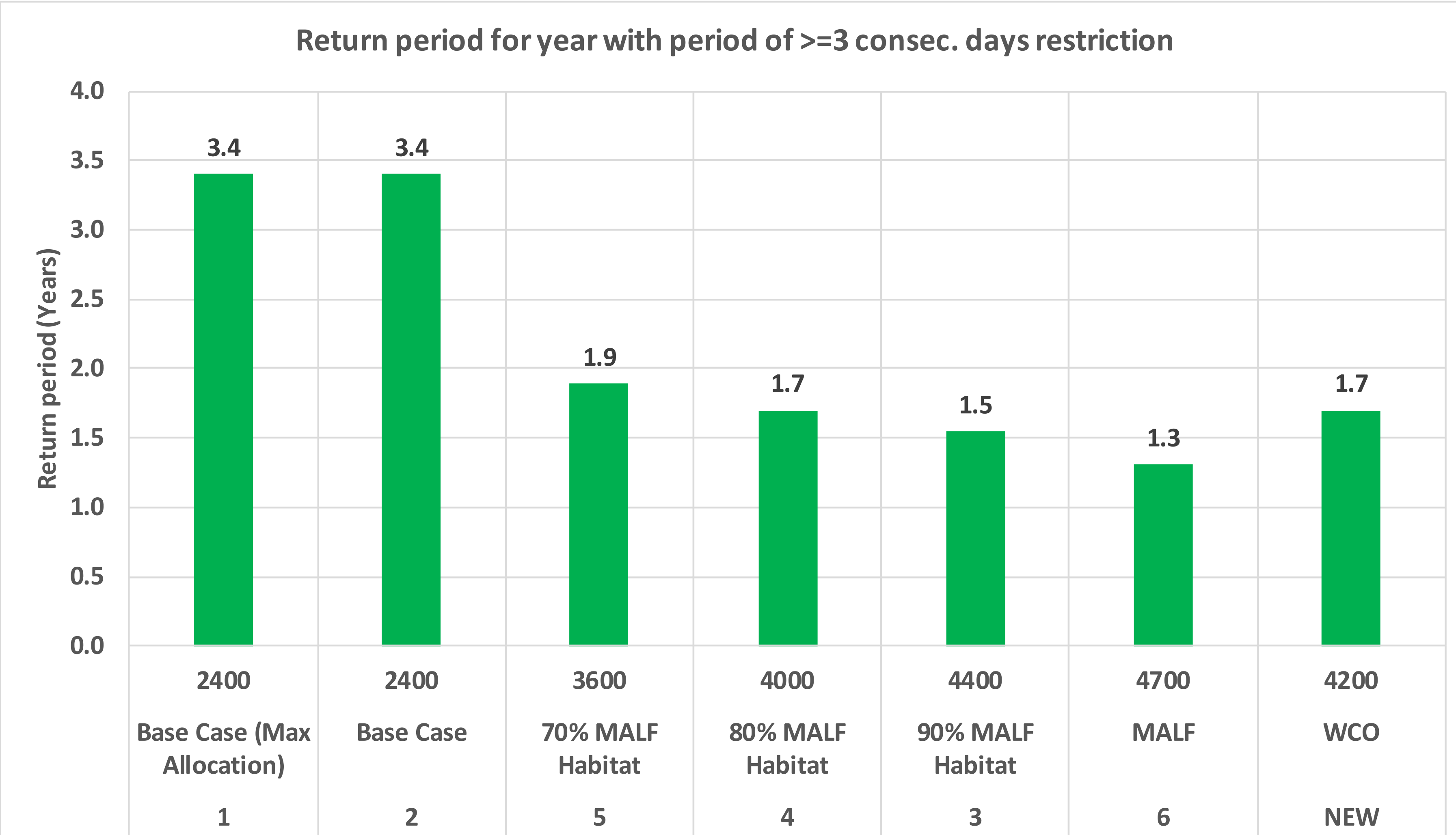
In a dry year, higher minimum flows increase restriction days (up to 26 additional days for a minimum flow set at 4700)



Ngaruroro River at Fernhill

3 or more days of consecutive restriction likely to occur more often with higher minimum flows



Ngaruroro River at Fernhill

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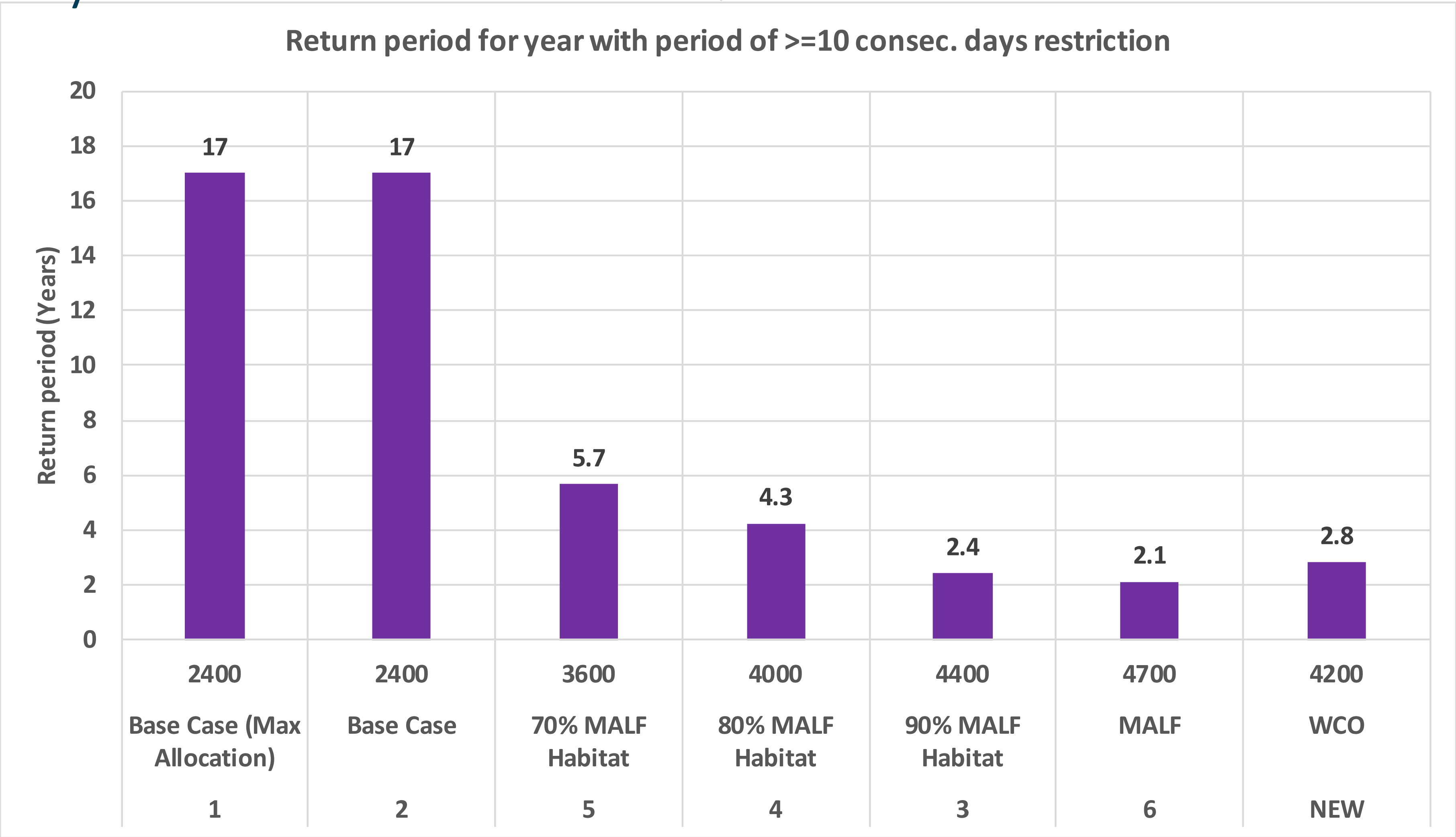
10 or more days of consecutive restriction likely to occur more often with higher minimum flows (once every 2.4 years for a minimum flow at 90% of MALF habitat



Ngaruroro River at Fernhill

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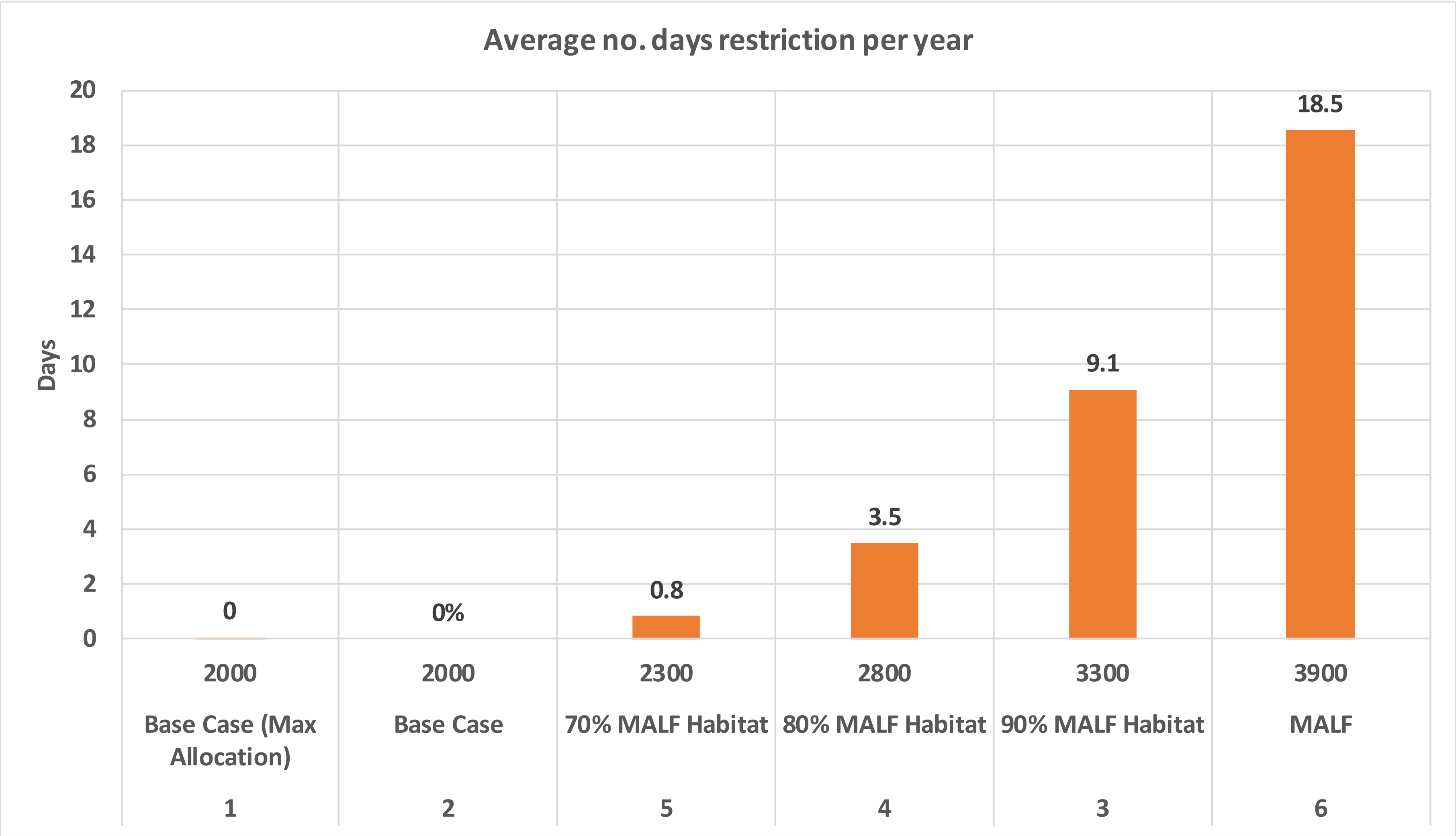
Tutaekuri River at Puketapu

No restriction with current minimum flow.



Tutaekuri River at Puketapu

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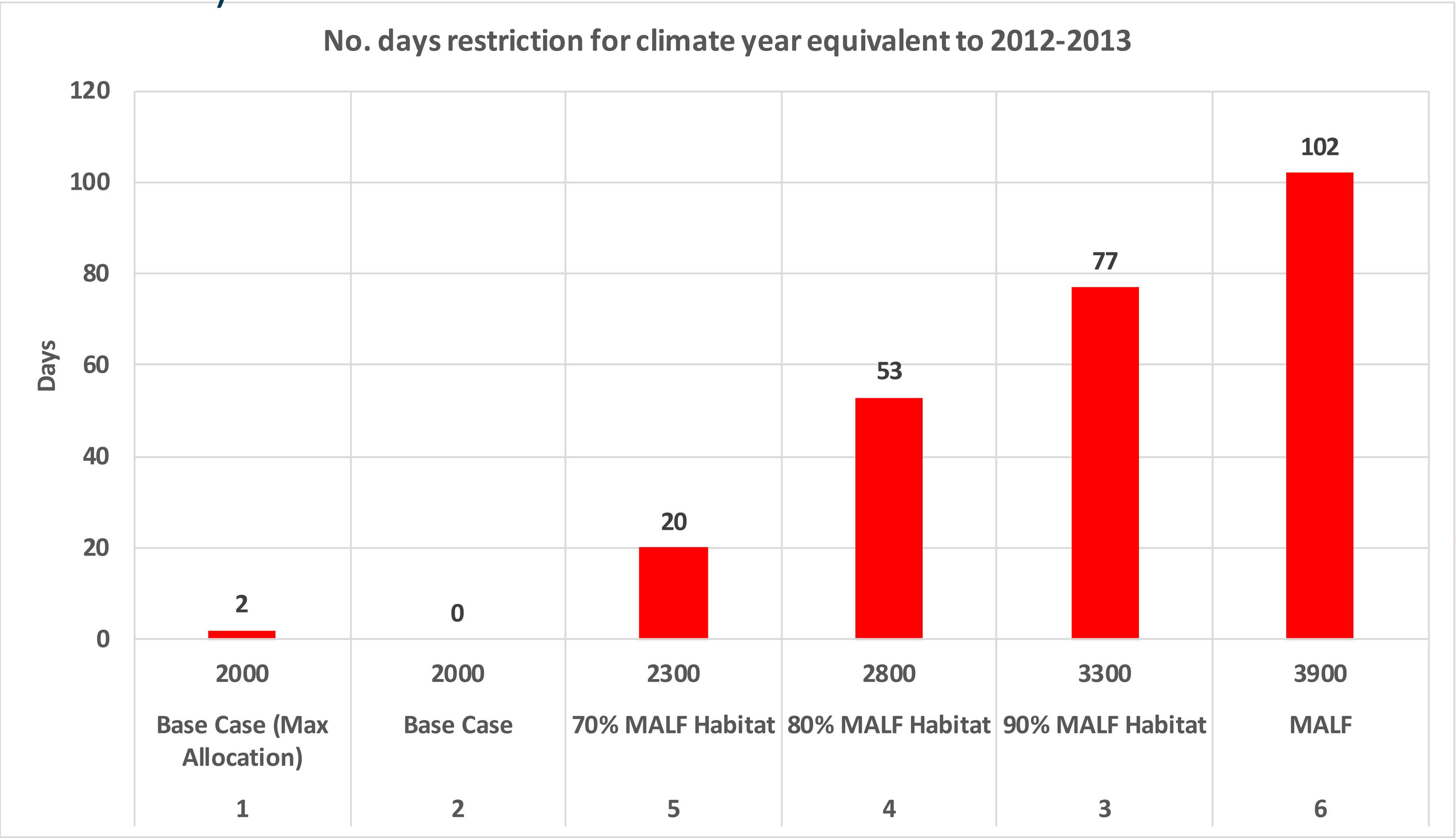
In a dry year, higher minimum flows result in restriction days (20 days for a minimum flow set at 70% of MALF habitat)



Tutaekuri River at Puketapu

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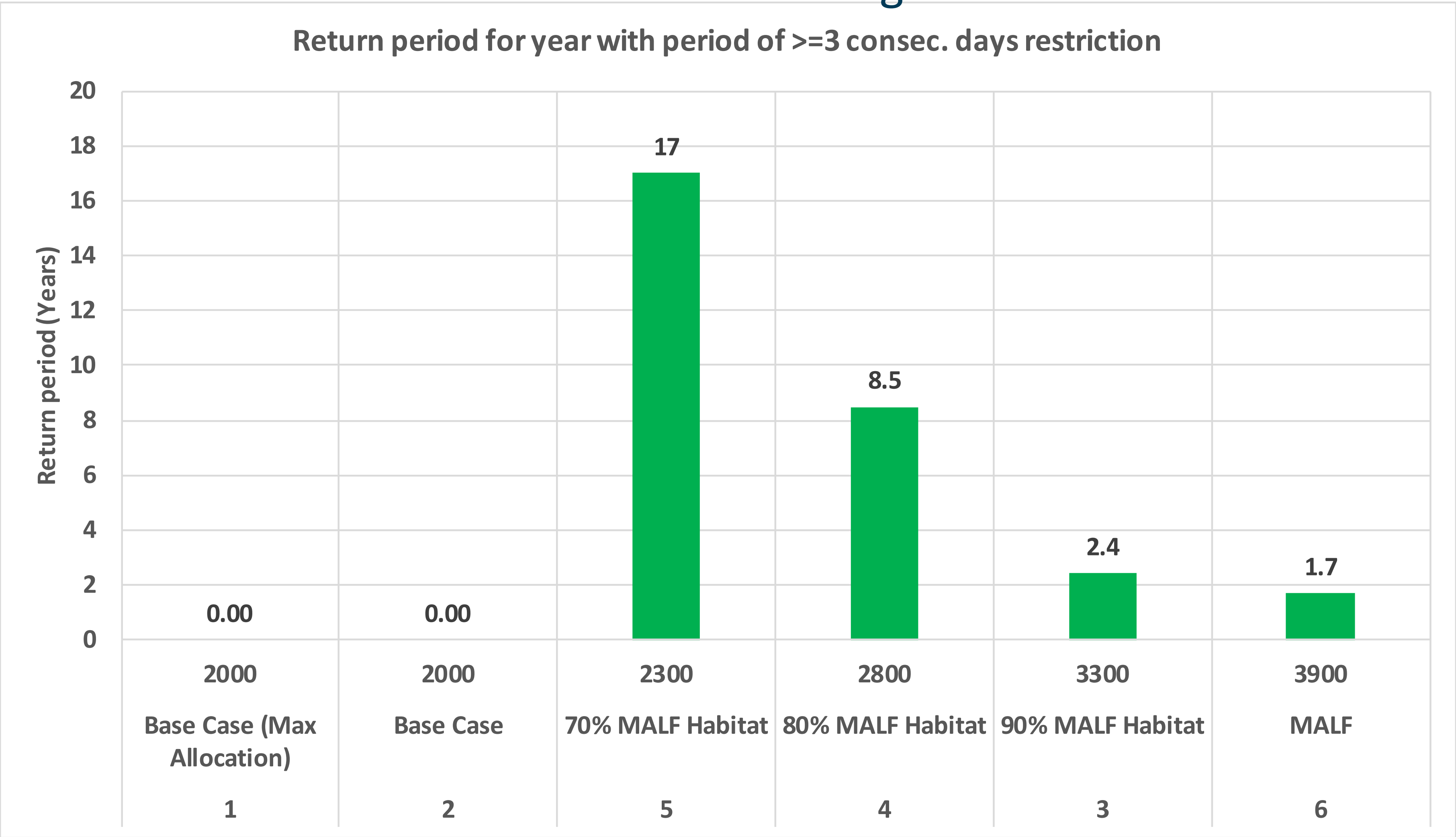
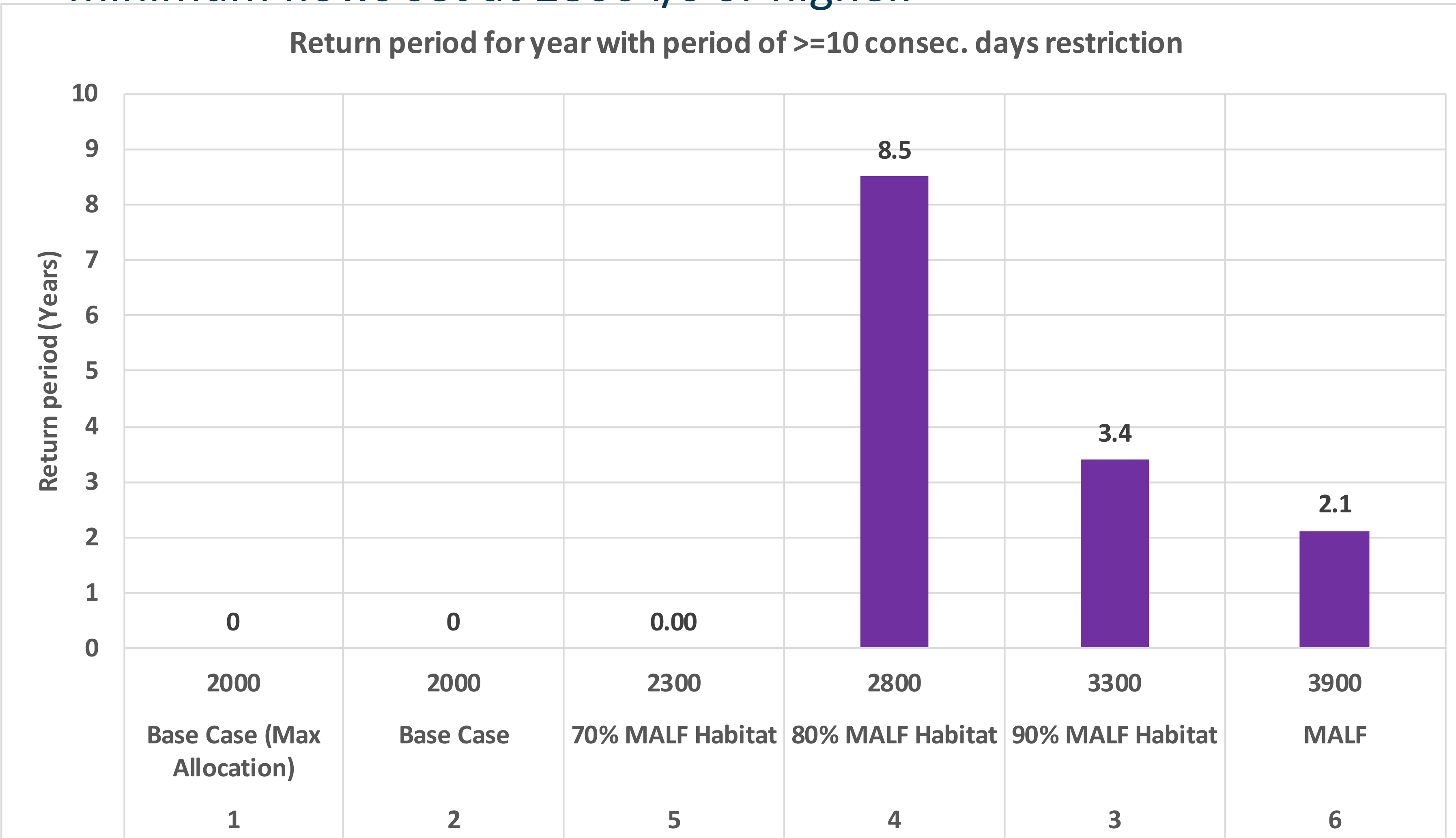
No restriction with current minimum flow. 3 or more days of consecutive restriction likely to occur with higher minimum flows and more often with higher minimum flows



Tutaekuri River at Puketapu

No restriction with current minimum flow. 10 or more days of consecutive restriction only likely to occur with minimum flows set at 2800 l/s or higher.



Tutaekuri River at Puketapu

Questions?

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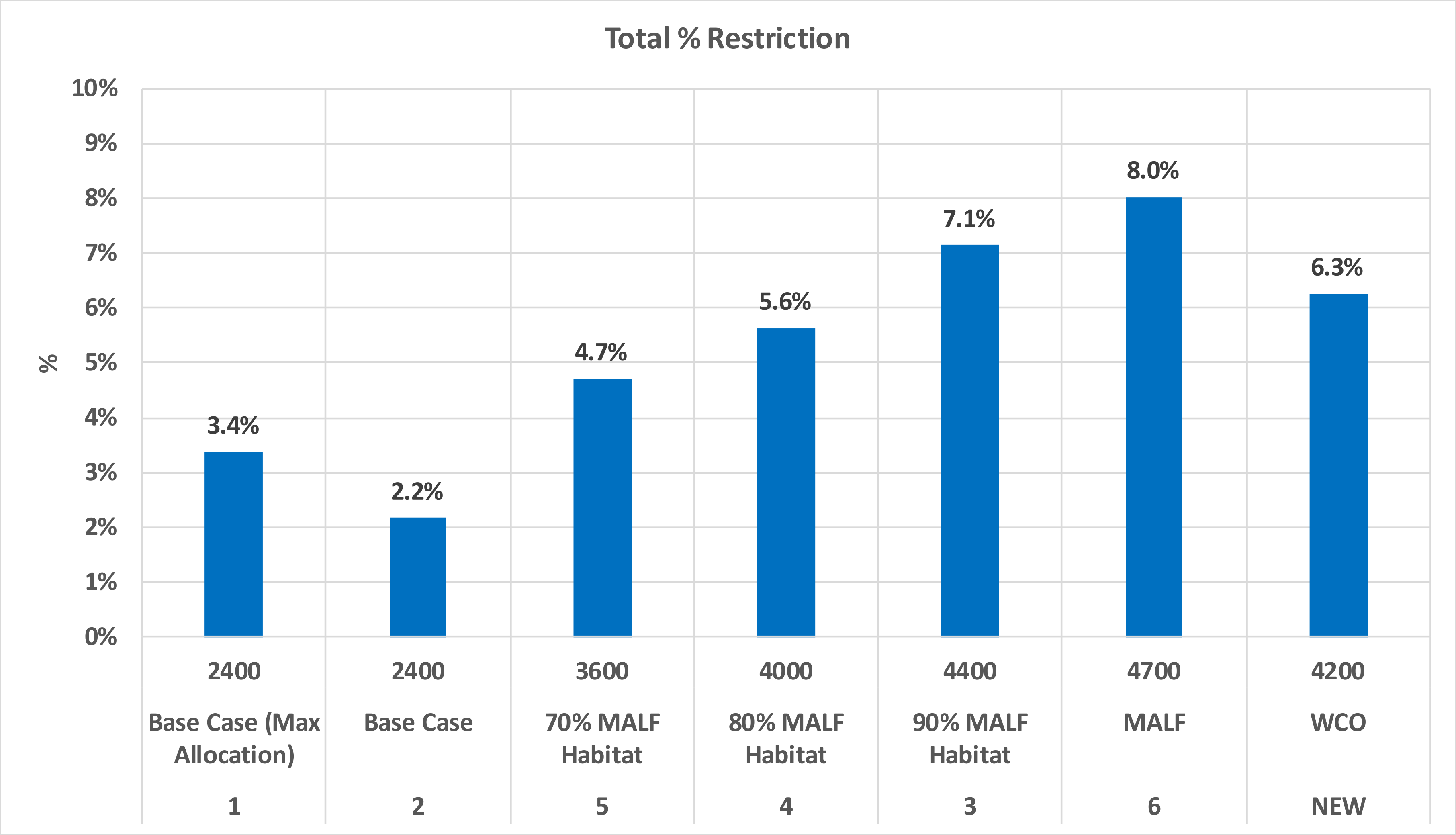

Ngaruroro River at Fernhill

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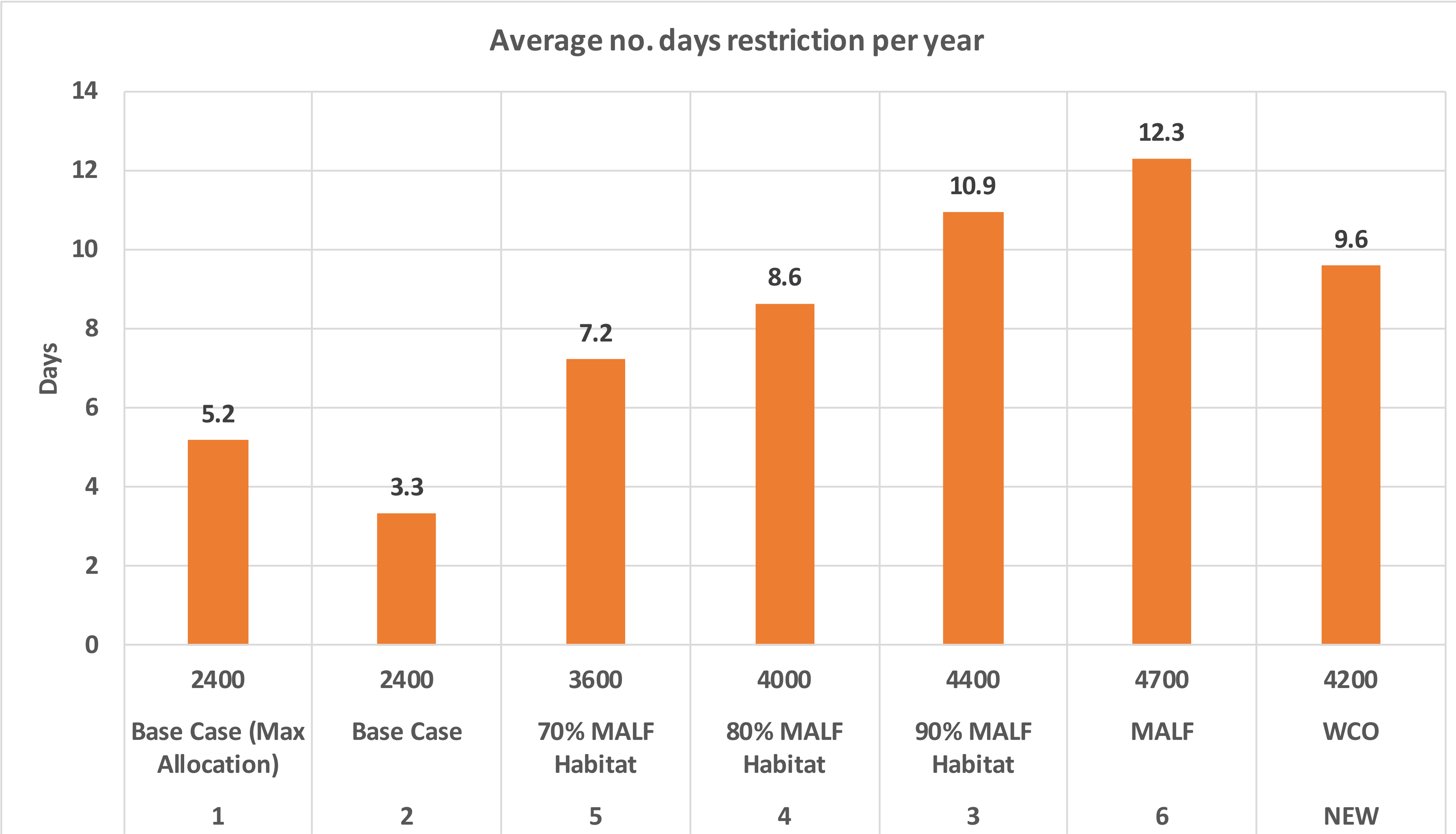

Ngaruroro River at Fernhill

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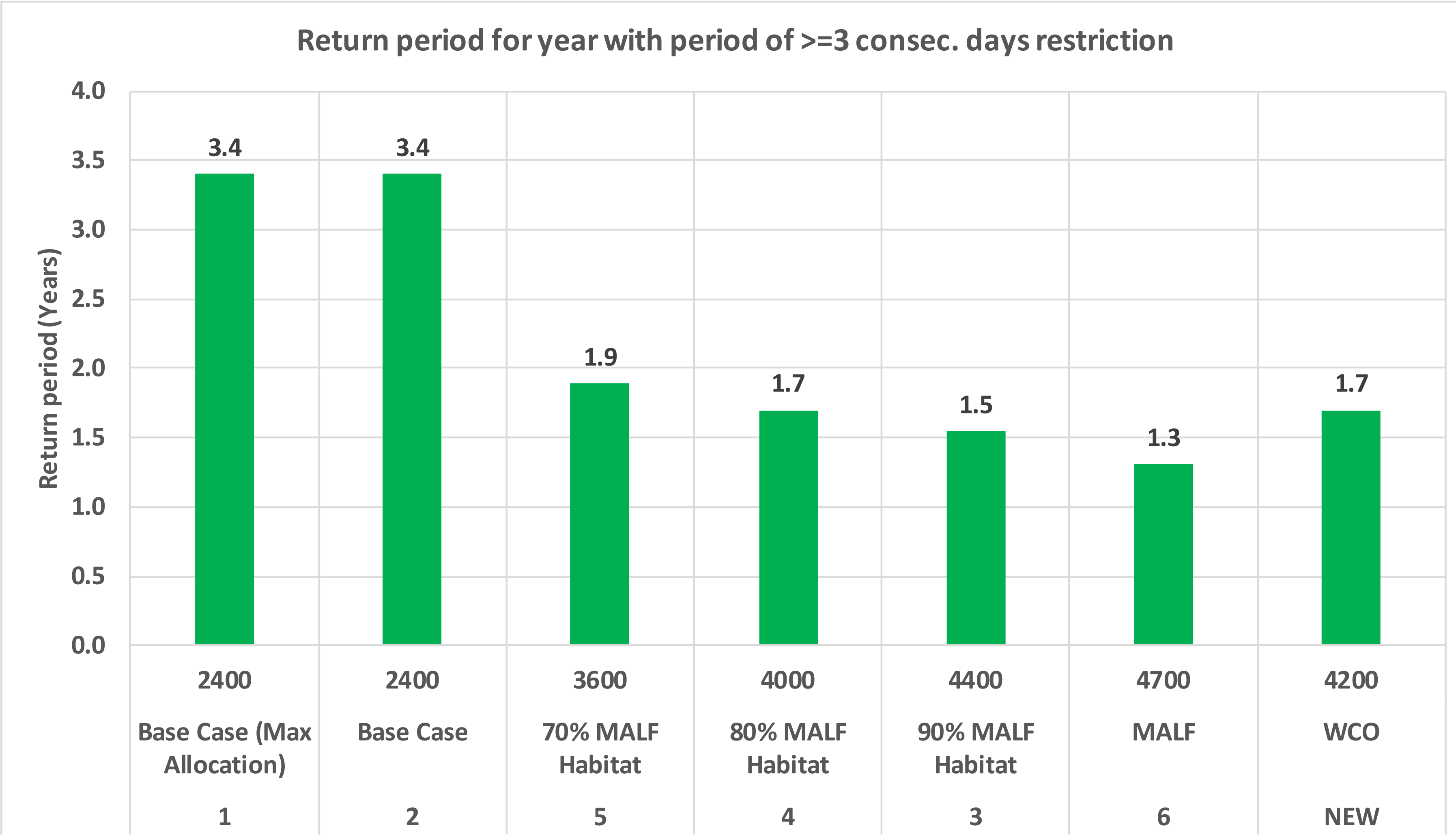

Ngaruroro River at Fernhill

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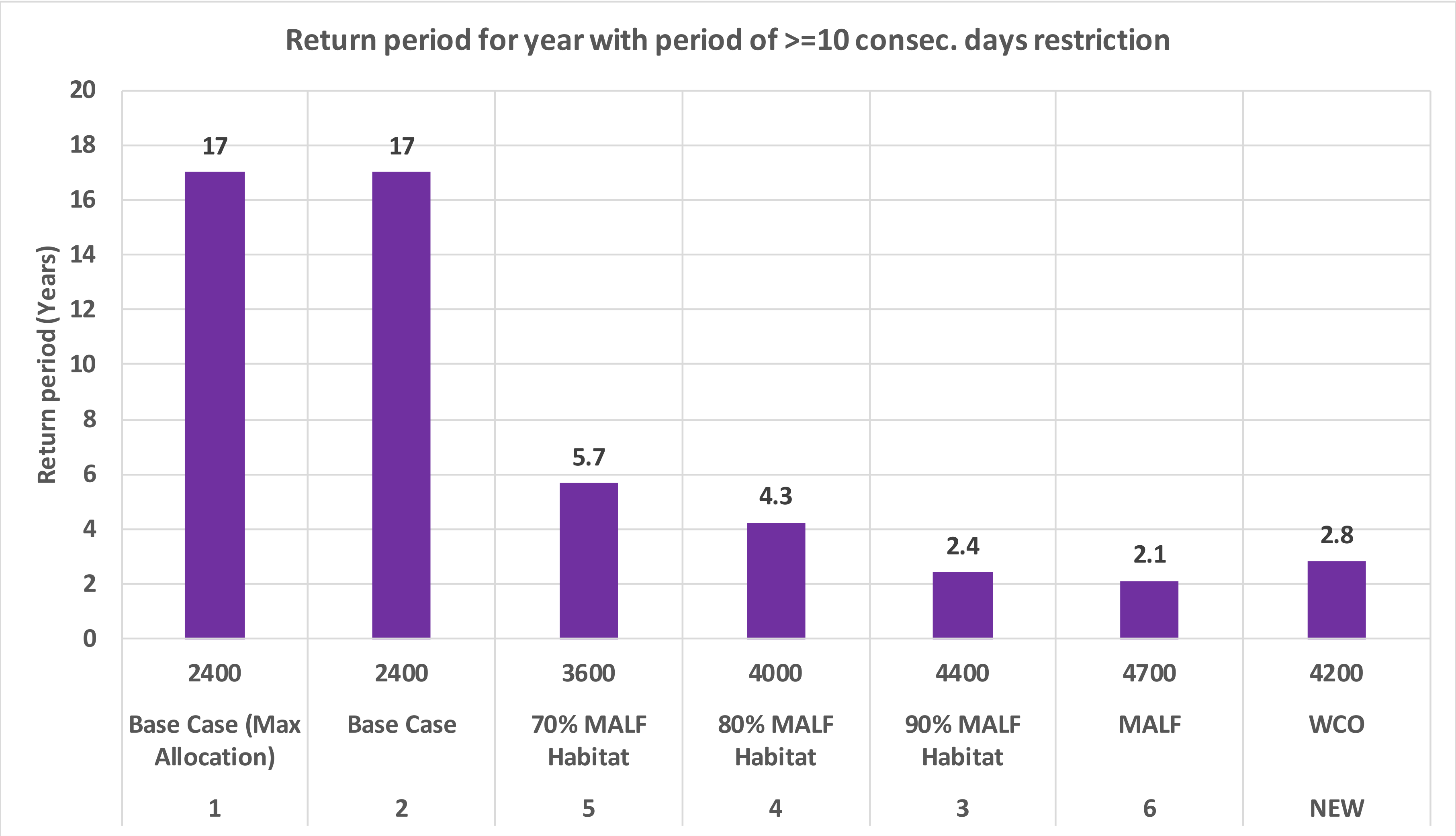

Ngaruroro River at Fernhill

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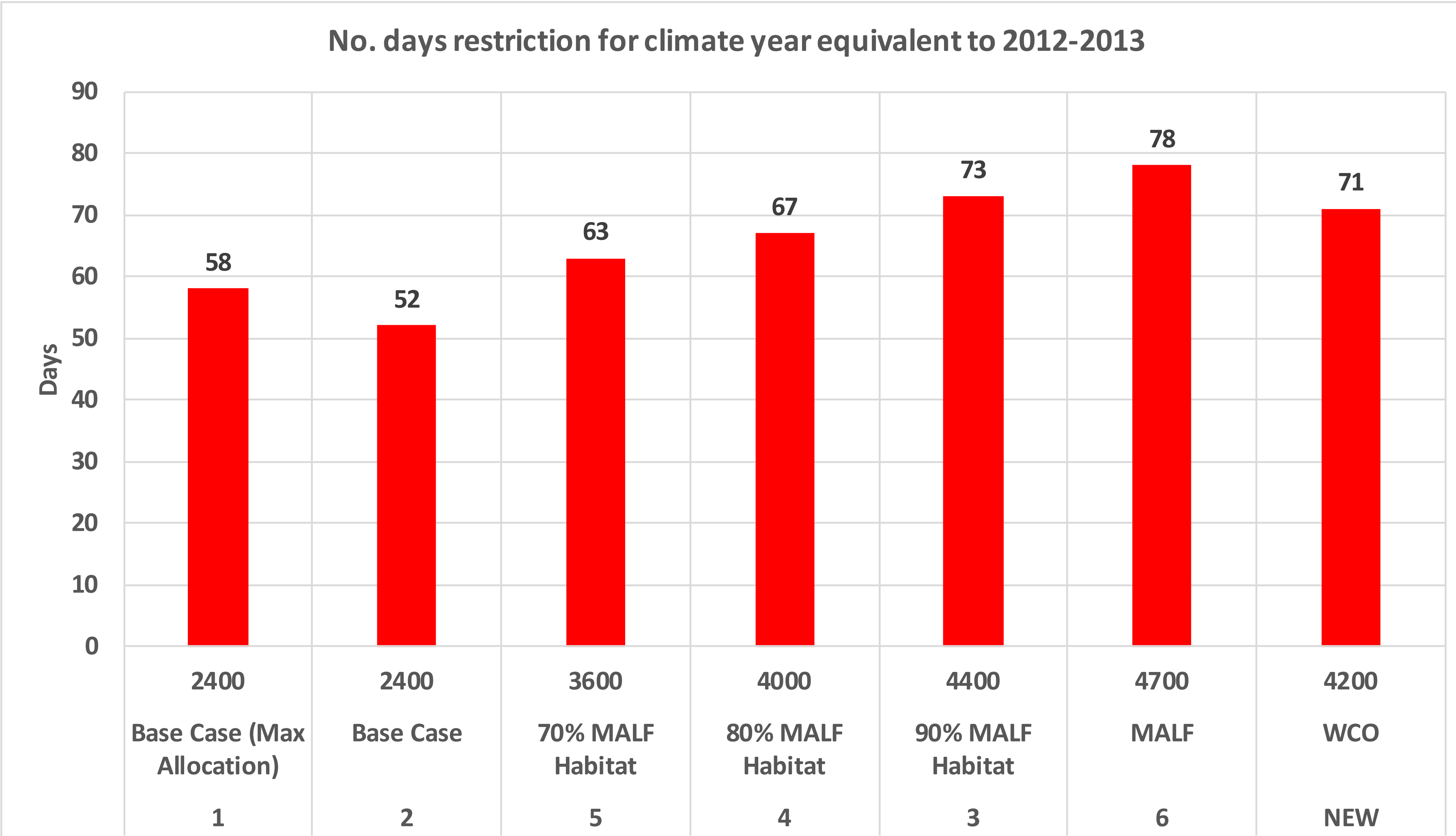

Ngaruroro River at Fernhill

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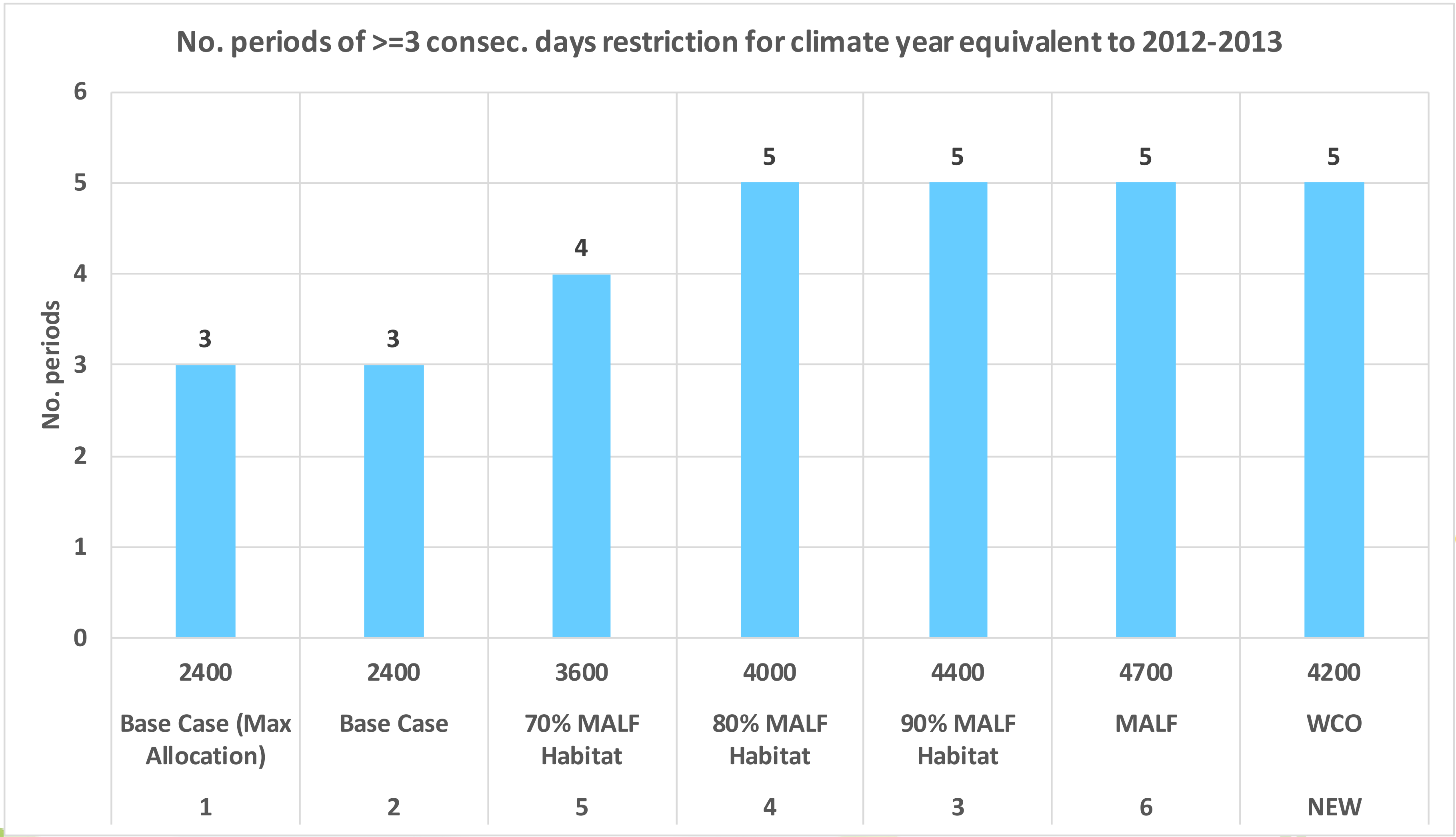

Ngaruroro River at Fernhill

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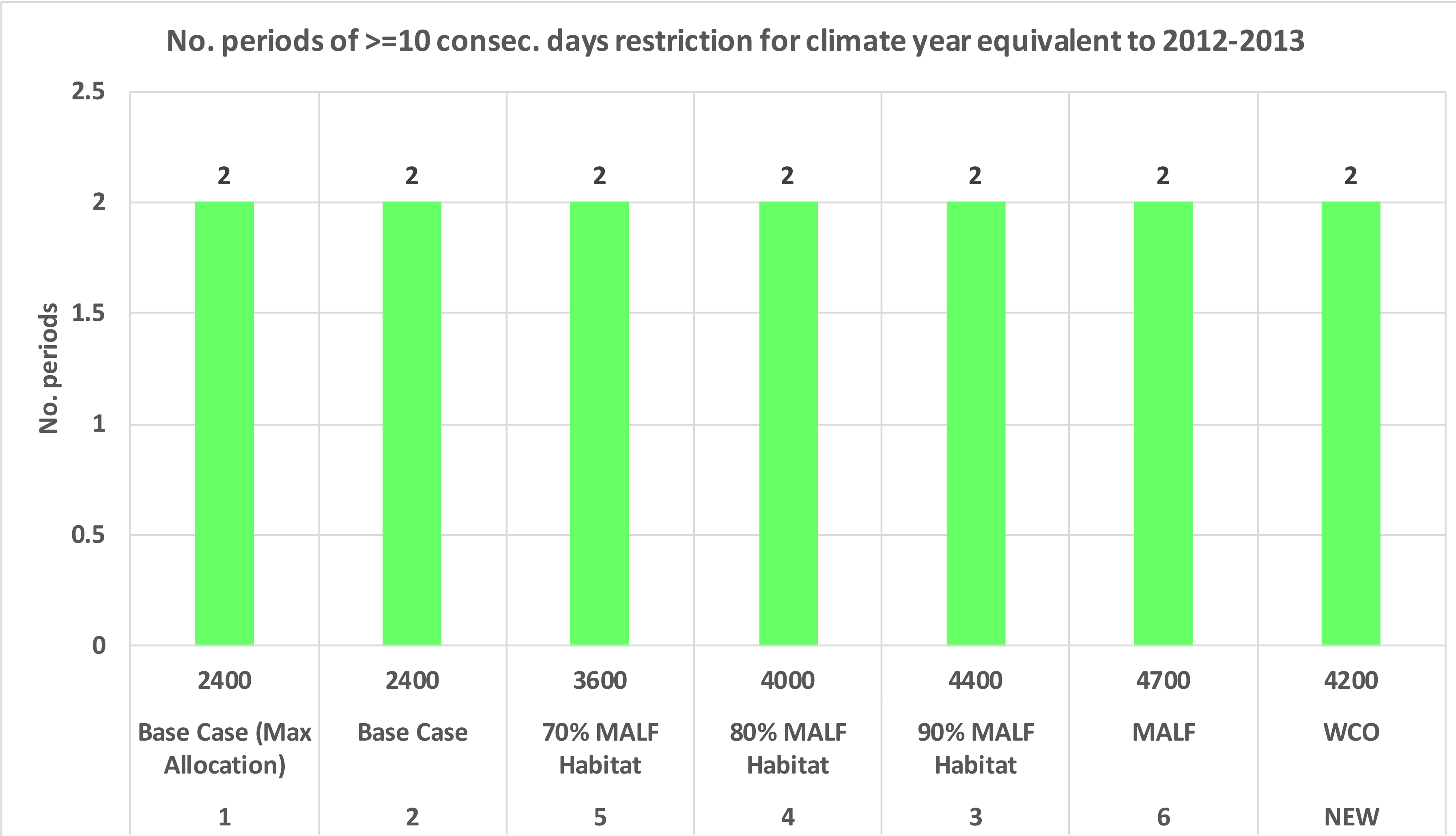

Ngaruroro River at Fernhill

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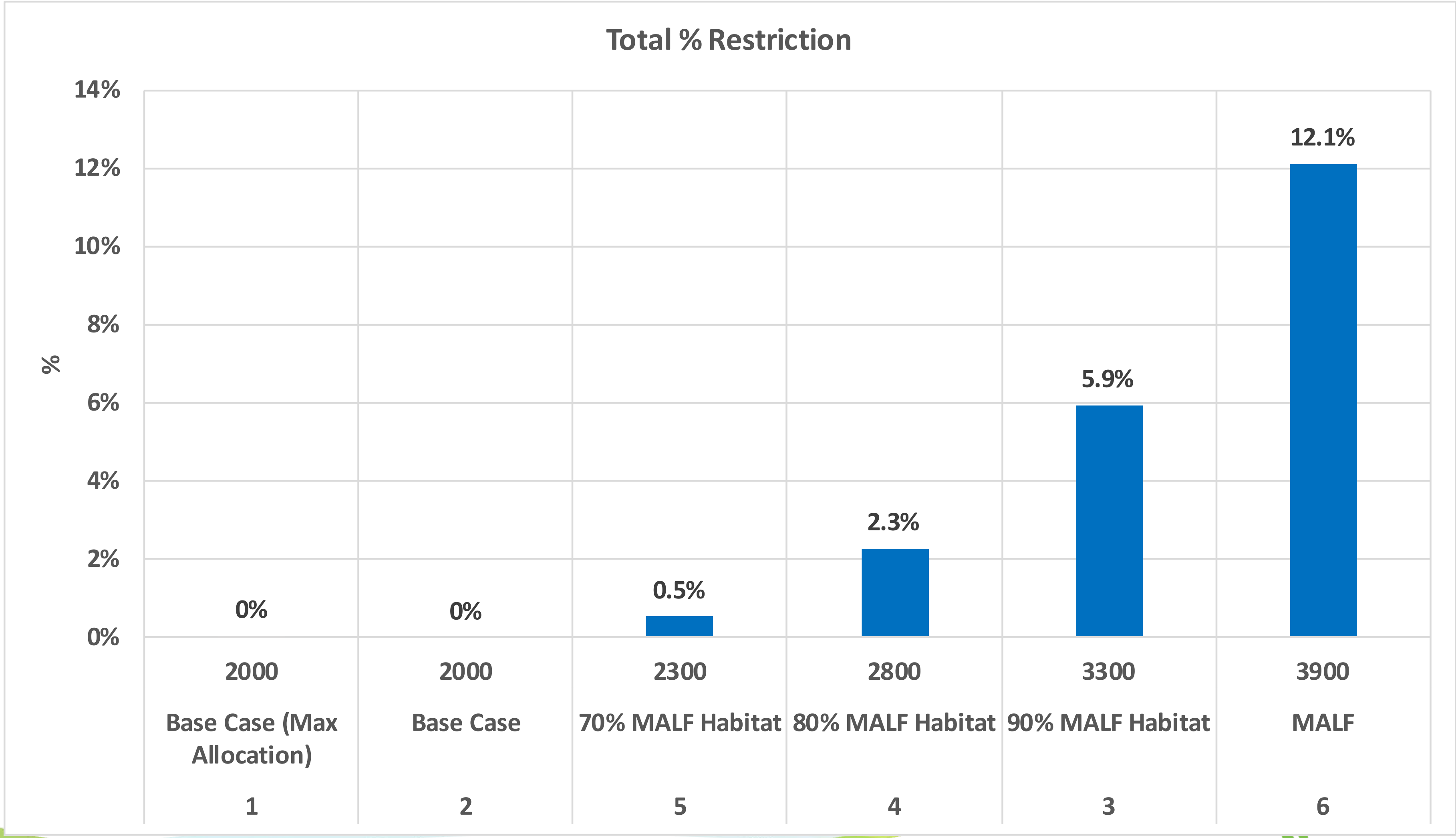
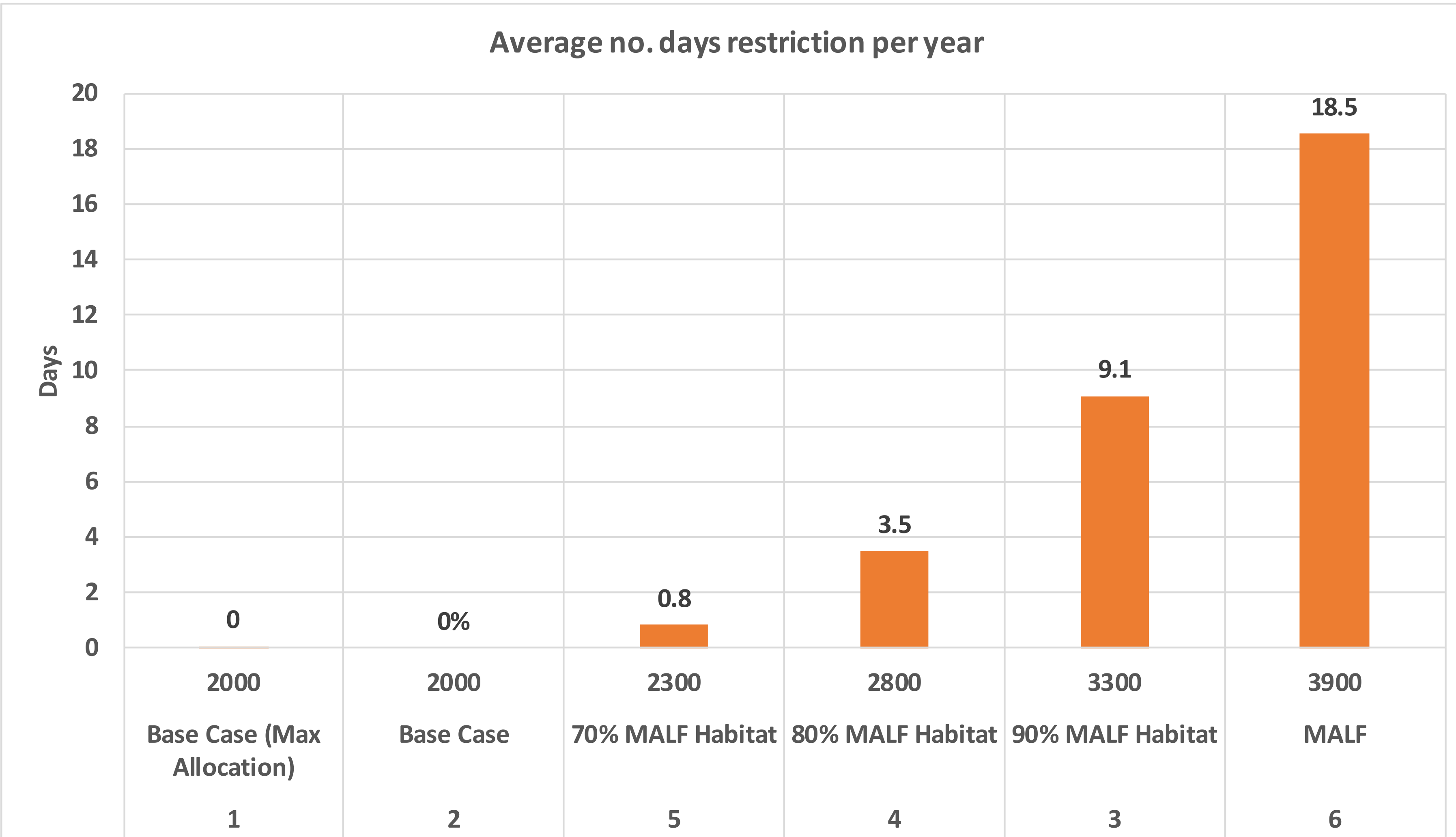


Tutaekuri River at Puketapu

HAWKE'S BAY REGIONAL COUNCIL



Tutaekuri River at Puketapu

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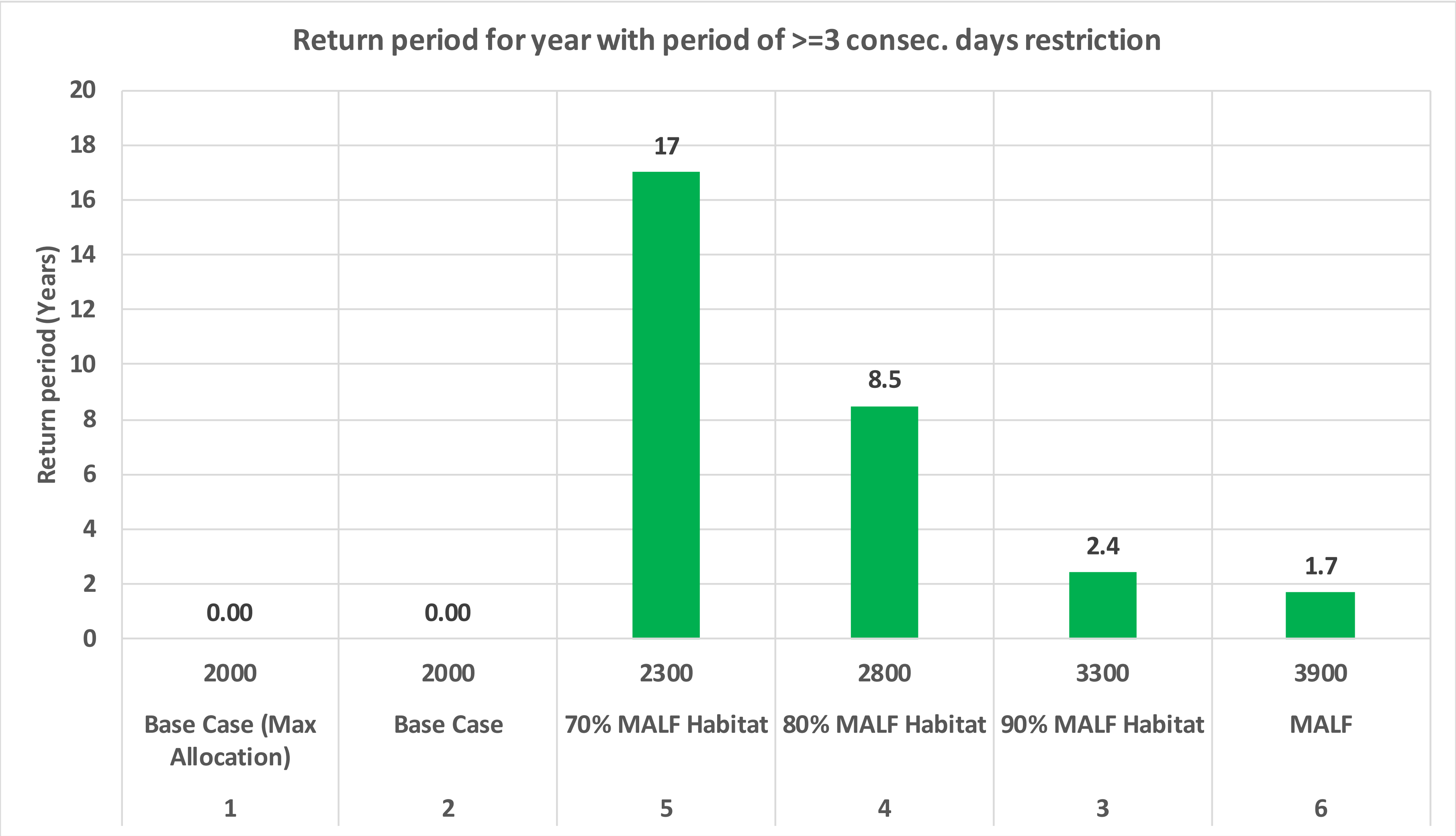

Tutaekuri River at Puketapu

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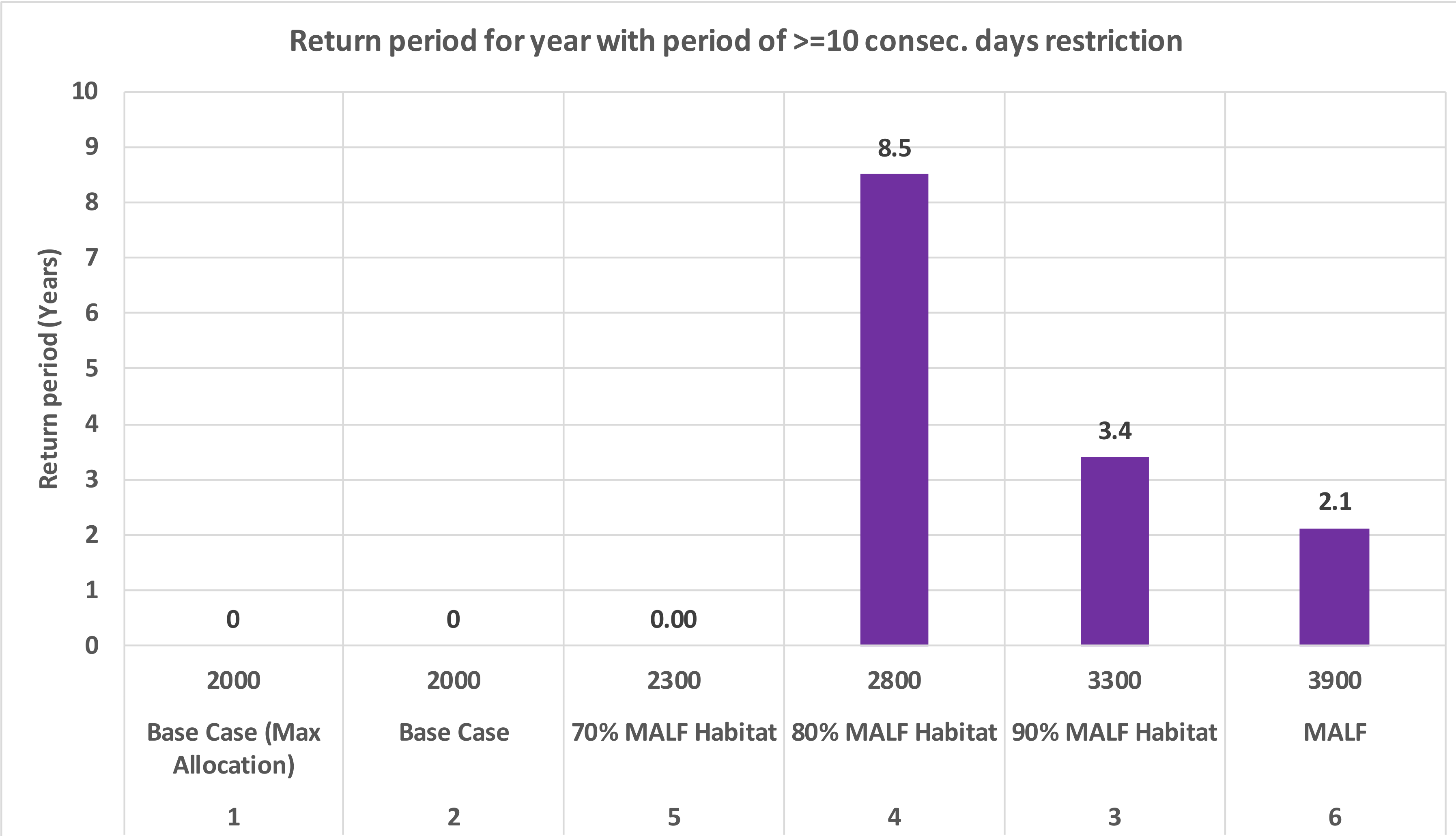

Tutaekuri River at Puketapu

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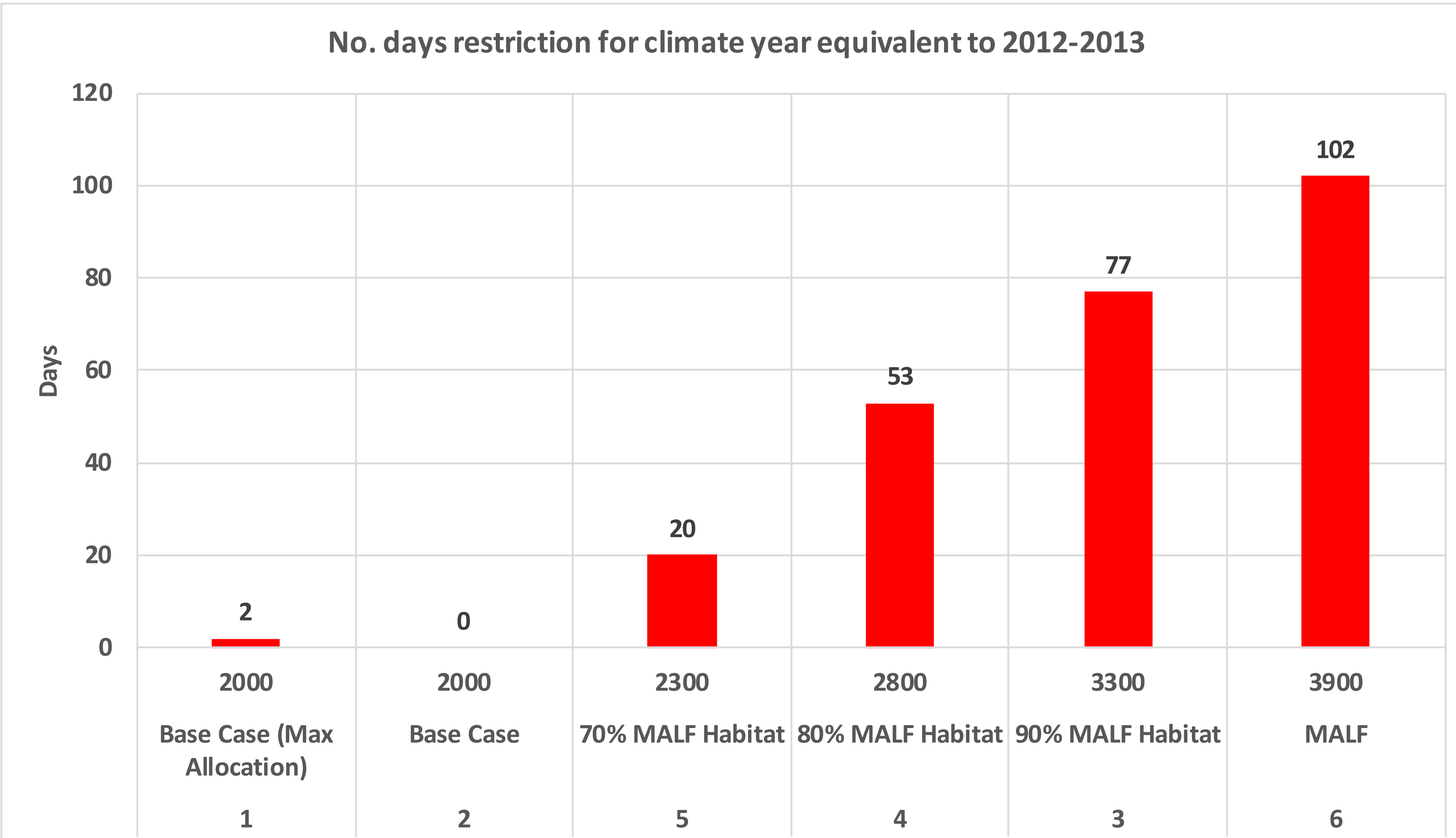

Tutaekuri River at Puketapu

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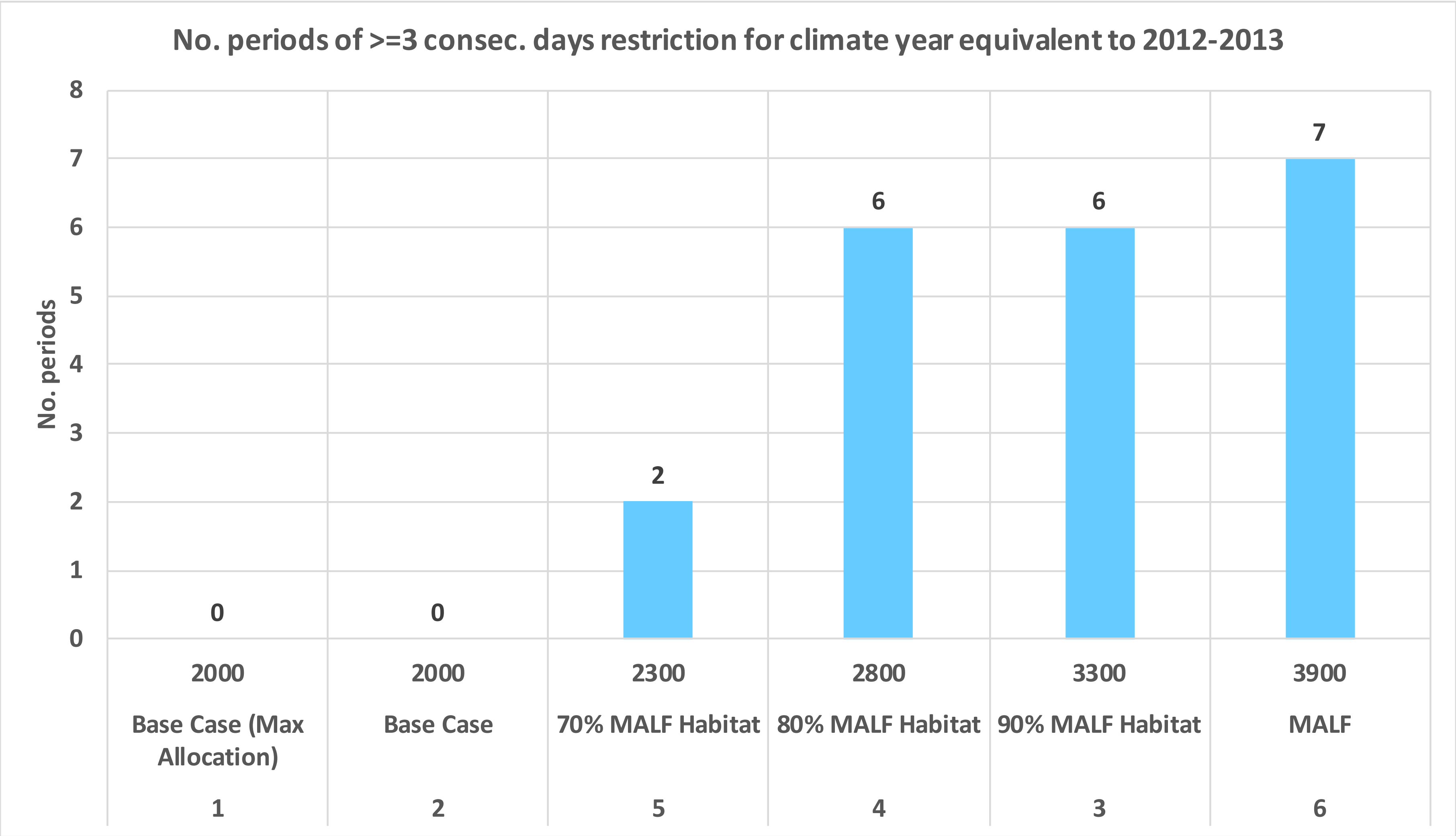

Tutaekuri River at Puketapu

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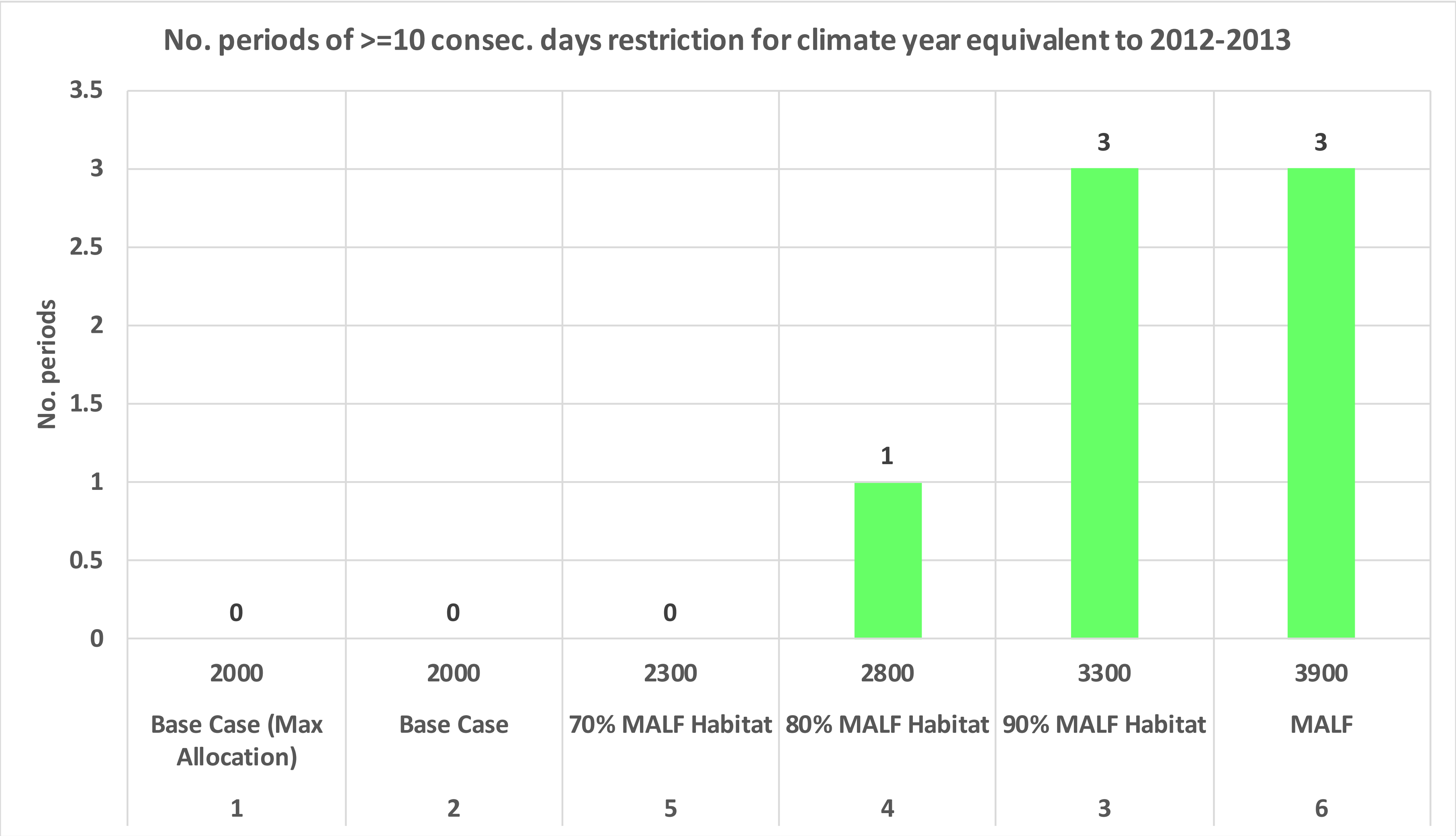

Tutaekuri River at Puketapu

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Ngaruroro River at Fernhill

Scenario ID	1	2	5	4	3	6	NEW
Scenario Name	**Base Case**	**Base Case**	**70% MALF Habitat**	**80% MALF Habitat**	**90% MALF Habitat**	**MALF**	**WCO**
Minimum Flow (l/s)	**2400**	**2400**	**3600**	**4000**	**4400**	**4700**	**4200**
Modelled Abstraction	**Max Allocation**	**Existing Use**	**Existing Use**	**Existing Use**	**Existing Use**	**Existing Use**	**Existing Use**
Full Record Statistics							
Record length (Years)	17	17	17	17	17	17	17
Total % restriction	3.4%	2.2%	4.7%	5.6%	7.1%	8.0%	6.3%
Average no. days restriction per year	5.2	3.3	7.2	8.6	10.9	12.3	9.6
Return period for year with period of >=3 consec. days restriction (Years)	3.4	3.4	1.9	1.7	1.5	1.3	1.7
Return period for year with period of >=10 consec. days restriction (Years)	17	17	5.7	4.3	2.4	2.1	2.8
Example Dry Year Statistics							
Climate Equivalent to 2008-2009							
No. days restriction	12	1	24	28	36	38	31
No. periods of >=3 consec. days restriction	0	0	3	4	3	3	4
No. periods of >=10 consec. days restriction	0	0	0	0	3	3	1
Climate Equivalent to 2012-2013							
No. days restriction	58	52	63	67	73	78	71
No. periods of >=3 consec. days restriction	3	3	4	5	5	5	5
No. periods of >=10 consec. days restriction	2	2	2	2	2	2	2

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Tutaekuri River at Puketapu

Scenario ID	1	2	5	4	3	6
Scenario Name	**Base Case**	**Base Case**	**70% MALF Habitat**	**80% MALF Habitat**	**90% MALF Habitat**	**MALF**
Minimum Flow (l/s)	**2000**	**2000**	**2300**	**2800**	**3300**	**3900**
Modelled Abstraction	**Max Allocation**	**Existing Use**	**Existing Use**	**Existing Use**	**Existing Use**	**Existing Use**
Full Record Statistics						
Record length (Years)	17	17	17	17	17	17
Total % restriction	0%	0%	0.5%	2.3%	5.9%	12.1%
Average no. days restriction per year	0	0%	0.8	3.5	9.1	18.5
Return period for year with period of >=3 consec. days restriction (Years)	-	-	17	8.5	2.4	1.7
Return period for year with period of >=10 consec. days restriction (Years)	-	-	-	8.5	3.4	2.1
Example Dry Year Statistics						
Climate Equivalent to 2008-2009						
No. days restriction	0	0	0	6	35	67
No. periods of >=3 consec. days restriction	0	0	0	0	1	4
No. periods of >=10 consec. days restriction	0	0	0	0	1	2
Climate Equivalent to 2012-2013						
No. days restriction	2	0	20	53	77	102
No. periods of >=3 consec. days restriction	0	0	2	6	6	7
No. periods of >=10 consec. days restriction	0	0	0	1	3	3

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Narrowing down the management scenarios

Mary-Anne Baker

Options

A range of scenarios for managing flows in the two rivers has been modelled.

The **base case** (or current management regime) will be modelled to understand the current water use impact on the economic, social and cultural wellbeing of the community

Proposals;

1) Cap SW allocation to existing use
   a) Tutaekuri
   b) Ngaruroro

2) That the TANK Group identifies **two** further management scenarios that combine **minimum flows with restriction regimes** for further modelling/assessment
   a) Tutaekuri
   b) Ngaruroro

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Restriction regimes considered – Meeting 17

	Scenario
1	Cease take at 3100 or 3200
2	Flow of Y – reduce to 50% Flow of Z – reduce to 30% Flow of 2400 – cease take
3	Total take is 20% or 30% of flow? Cease take at 2400? Or no Min flow
4	Cease take at 1600; improve shading or augment flow with cooler water See HBRC for flow levels on main stem. Further work required to identify possible wording for tributaries.
5	Staged reductions with 2 or 3 tiers Emergency takes continue at some level

Restriction regimes – revised

	Scenario	Description	Explanation
1	Staged reductions/ cease take	Impose staged reductions at specified flows *e.g. three stage reduction with cease take at **specified minimum flow*** *(25% cutback, 50% cutback, 75% cutback, cease take**)***	Start restrictions early but finish later. Choices for when to impose reductions is dependant on time between events – we still need to model the timing/flow trigger for the 3 stages above the minimum • *If time between imposing each restriction stage is too short means big compliance effort for council and operational costs for growers*
2	Staged reductions/ no cease take	Staged reductions (as above) with no cease take flow and allocation continues beyond **specified minimum flow** at a low % of allocation	Amount able to be extracted beyond specified minimum flow a small percentage to be determined by TANK.

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Restriction regimes – revised

Other options not considered for further modelling;

1. **Cease Take at minimum flow**
   - Single cease take difficult for irrigators and
   - creates perverse incentives including over-irrigation

2. **Flow sharing** -
   - difficult to model and **very** difficult for compliance and operation

3. **User groups rostering /sharing**
   - Very difficult to model
   - It is similar to the staged reduction except that users would need to voluntarily and collectively meet reductions in order to meet the specified flow.

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Values matrix

VALUES	ECONOMIC		ECOSYSTEM HEALTH			SOCIAL RECREATION MAHINGA KAI	SPIRITUAL CULTURAL	Other
	Attributes							
scenario	Reliability	Allocation limit	Habitat protection (%)	Days below minimum flow	% MALF			
1								
2								
3								
4								

Key: Reliability

- Strong alignment (green)
- Medium (yellow)
- Low (red)

Key: habitat

- Strong alignment (light blue)
- Medium
- Low
- Very low alignment (dark blue)

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Ngaruroro River Summary

Values	Economic		Ecosystem Health		Restriction regime options	
scenario	Reliability % DAYS ON RESTRICTION	FREQUENCY OF >10 DAY CONSECUTIVE RESTRICTION	Habitat protection (%)		1 Staged reductions Cease take	2 Staged reduction No cease take
1 Base Case/Allocated						
2 Base case /Existing use						
3 90% habitat Use						
4 80% habitat Use						
5 70% habitat Use						
6 MALF Use						
7. WCO 4200 l/s use						

Tutaekuri River						
Values	**Economic**		**Ecosystem Health**		**Restriction regime options**	
scenario	Reliability % DAYS ON RESTRICTION	FREQUENCY OF >10 DAY CONSECUTIVE RESTRICTION	Habitat protection (%)		1 Staged reductions Cease take	2 Staged reduction No cease take
1 Base Case/Allocated						
2 Base case /Existing use						
3 90% habitat Use						
4 80% habitat Use						
5 70% habitat Use						
6 MALF Use						

Breakout/decisions

Allocation Limits for the Ngaruroro and Tutaekuri;

Option 1
Cap allocations

Option 2
Allow use to increase to allocated amounts

Option 3
Reduce allocations

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Breakout/decisions

On your work sheet – for each of your preferred flow scenarios (2-7) decide on your preferred staged reduction scenario for each river

We will then collate and report back on the various combinations.

- is any clear majority combination?
- if not, vote for the most popular.

For reduction scenario 2 – what percentage for continued take below the minimum flow?

Identify any issues arising

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Next meeting – 22 November 2017

- Scenario results from SOURCE model (Rob Waldron, Jeff Smith)
- Water allocation (Malcolm Millar and EAWG subgroup)
  - "Existing use" allocation regime
  - Priority allocations
- Wetland management – recommendations from WWG
- Monitoring Plan (Stephen Swabey)

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Closing Karakia

Nau mai rā

Te mutu ngā o tatou hui

Kei te tumanako

I runga te rangimarie

I a tatou katoa

Kia pai to koutou haere

Mauriora kia tatou katoa

Āmine