River Gravel Management

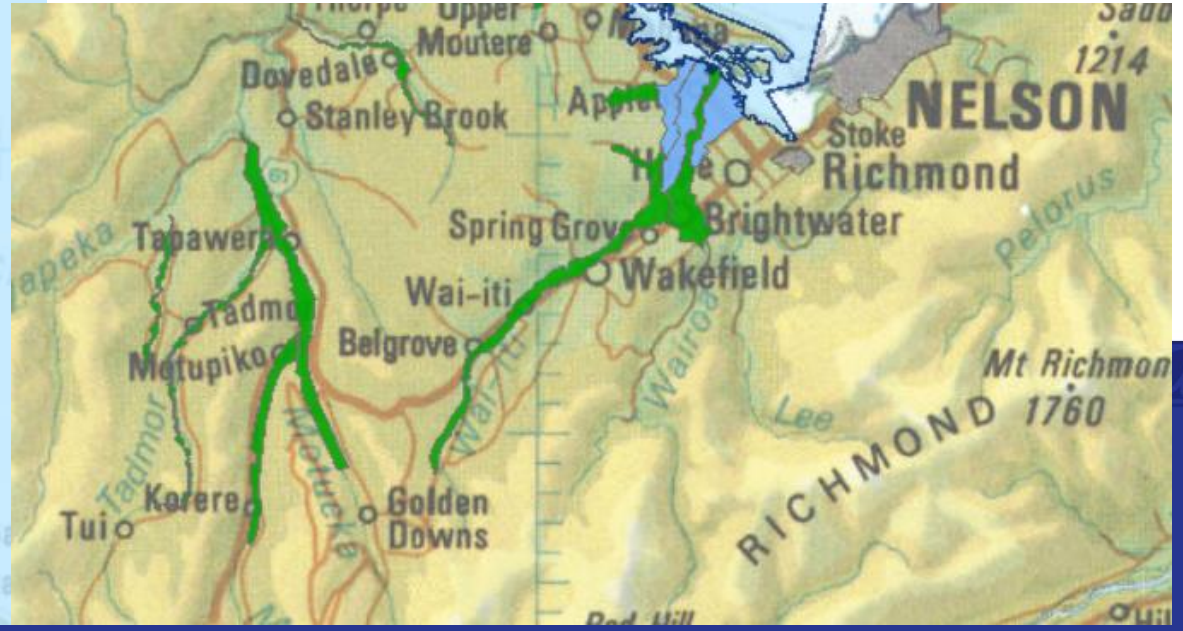
Thriving and resilient Tasman communities

tasman district council | Te Kaunihera o te tai o Aorere

What we do

- For flood protection schemes (X river rated – stop-banked areas)
  - contain the design event
- For other maintained rivers (Y rated)
  - bank erosion repairs and prevention only – no guaranteed flood protection
- All other rivers (Z rated)
  - bank erosion repairs and prevention, with landowner contribution

Rates income 2022/23		
	Upper Motueka, Tadmor, Motupiko	Whole District
River X	-	$585,000
River Y	$30,000	$429,000
River Z	$10,000	$1,022,000
Total	$40,000	$2,036,000



2021/22 – Work summary

	Upper Motueka	Tadmor	Motupiko	Other Rivers	Total
New rockwork	$ 256,278	$ 383,977	$ 329,590	$ 350,650	$ 1,320,495
Machine work	$ 328,853	$ 325,796	$ 314,321	$ 273,645	$ 1,242,615
Willow layering	$ -	$ 409	$ -	$ 1,630	$ 2,039
Willow planting	$ 4,629	$ 3,200	$ 759	$ 55,362	$ 63,950
Native planting	$ -	$ -	$ -	$ 100,732	$ 100,732
Native plant maintenance	$ -	$ -	$ -	$ 43,263	$ 43,263
Fairway spraying	$ 50,763	$ -	$ 15,126	$ 19,995	$ 85,884
Other maintenance, data and admin	$ -	$ -	$ -	$ 299,932	$ 299,932
Total	**$ 640,523**	**$ 713,382**	**$ 659,796**	**$ 1,145,209**	**$ 3,158,910**

Management of gravel

- gravel management is one of several tools for river management

- others include:
  - hard erosion protection (spur groynes, rip-rap)
  - vegetated edge protection (generally willow)
  - vegetated buffers (generally native)
  - channel clearance
  - stopbanks

Management of gravel

In our managed river networks (X&Y) we manage gravel to reduce flooding and erosion by:

- gravel relocation
- fairway spraying
- beach raking
- extracting gravel (or issuing gravel extraction permits)

We also support some of this work in other non-rated (River Z) catchments

Gravel and flooding

- Determining flood capacity is not always simple - not just x-sectional area – but slope, channel roughness, channel shape also
- In large flood gravel mobilises, and beaches are deposited as flood recedes
- Hydraulic modelling best way forward, along with regular river survey
- Flooding not always bad, riparian plantings can control flood debris

Maintaining flood capacity

Gravel extraction one method, we also undertake the following:

- Gravel relocation
- Control of woody weed growth in channel/beach raking (to a small extent)
- Topping up stopbanks
- Protecting stopbanks from erosion
- Control of berm land activities

River behaviour

- Bed levels at any one point are highly dynamic – beds mobilise up to 3m depth in flood - hence we monitor average bed levels
- Rivers seek to maintain an ideal long profile and fills ‘holes’ by eroding bed upstream
- By controlling bank erosion we encourage bed erosion in transport zone
- Gravel will always build up on the inside of meanders due to flow characteristics

Consenting of gravel river works

Global river works consents (issued March 2016)

- gravel relocation & beach raking

Land and aerial spraying consents (Dec 2015)

- fairway spraying

Extraction of gravel (Nov 2019)

- extracting gravel (or issuing gravel extraction permits)

Gravel relocation

- Main benefit is not to increase flood capacity, but improve alignment to reduce pressure points
- Keeps gravels mobile
- A risk of being a temporary solution - subsequent floods may relocate gravel
- Potential benefit in improving bird habitat

Fairway spraying (& beach raking)

- Fairway spraying is to prevent
- woody weeds that lock up gravels
- Maintains gravel as a mobile bed
- Mechanical raking has similar
- benefits but more expensive

Gravel extraction

Our role is to extract or allow gravel extraction only for river management purposes, where it is the best practicable option, to:

- increase flood capacity
- maintain river alignment and prevent erosion
- maintain movement of sediment

This is explicitly stated in our consent

Gravel extraction

- Two types of control for gravel extraction in our consent:
  - “gravel envelope” rivers, where we know historical mean bed levels
  - all other rivers, TRMP limits apply

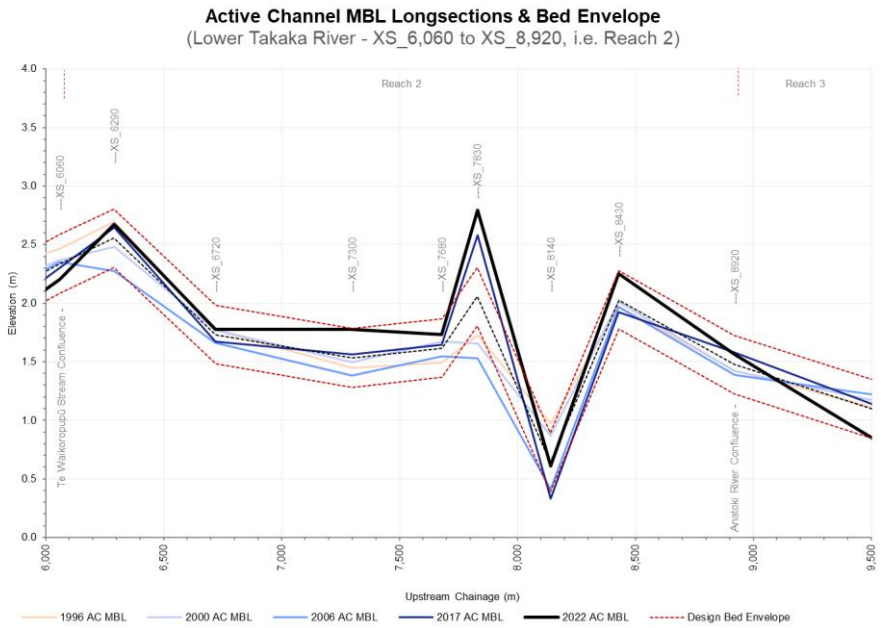
(i) Any gravel extraction outside of the Mean Bed Level envelope river reaches exceeding the annual rates given below:

	Maximum annual gravel extraction without SSEMP (m^3)
Golden Bay Rivers	
Anatori River	1000
Aorere River	1000
Parapara River	500
Pariwhakaoho River	400
Anatoki River	1000
Takaka River	1000
Motueka Rivers	
Motueka River (middle, between the upper and lower MBL envelope reaches)	1000
Riuwaka River	100
Wangapeka River	100
Tadmor River	80
Buller Rivers	
Buller River	2000
Matakitaki River	1000
Howard River	1000
Mole Stream	1000
All other rivers	500
River reaches upstream of MBL envelope reaches	500

Gravel extraction

- The gravel envelope approach attempts to identify whether particular rivers or reach are accumulating (aggrading) or losing gravel (degrading)

- Where rivers are aggrading, sustainable extraction is possible



Risk of over extraction

- Over extraction leads to more hard bank protection works, risk to bridges and other assets & loss of groundwater
- Generally speaking, our rivers are not rapidly aggrading
- Our active riverbeds can often only provide a fraction of industry demand on a sustainable basis

Other sources of gravel

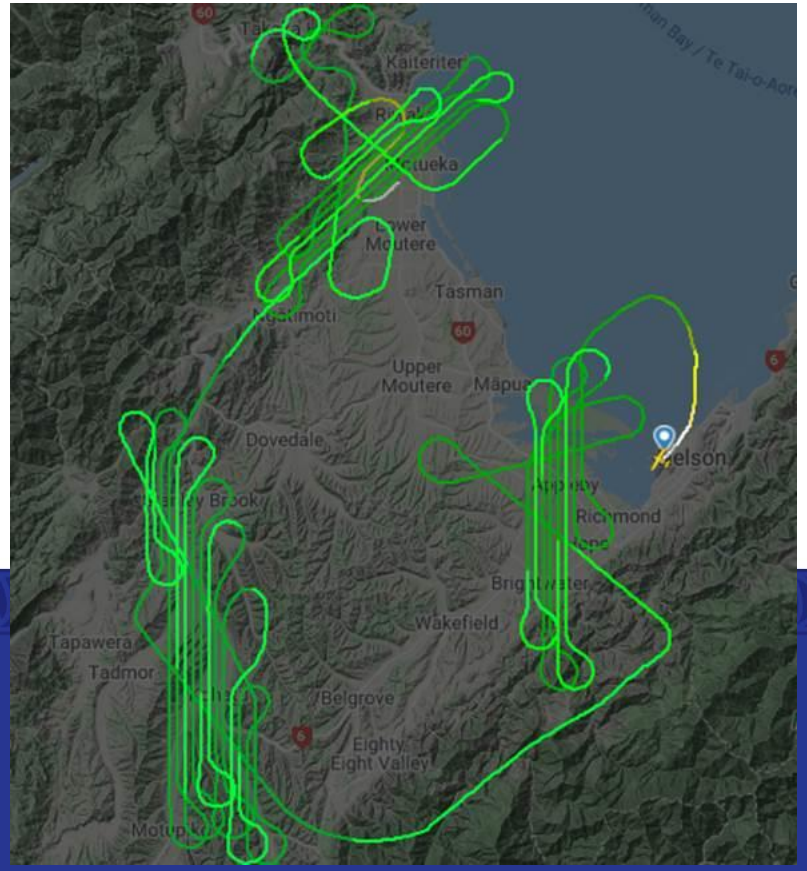
- Active river channels can only supply a fraction of demand, we are still building a long term picture of sustainable volumes
- Industry needs consistency of supply
- Land based extraction pits give opportunity for wetland creation, not subject to changes in river behaviour

Gravel envelope method

- Similar to many other regional authorities
- Used in larger rivers only – requires regular survey of river bed
- Based on historical max and min bed levels to produce a ‘design envelope’
- We managing to a bed level - not volume
- We review following subsequent surveys to identify natural degradation or aggradation

Gravel envelope data requirements

- Five yearly survey of active channel or following flood events (>Q20)
- LIDAR for analysing changes to berm in X areas
- Quality aerial photography
- Used to determine average bed levels to determine trends over time



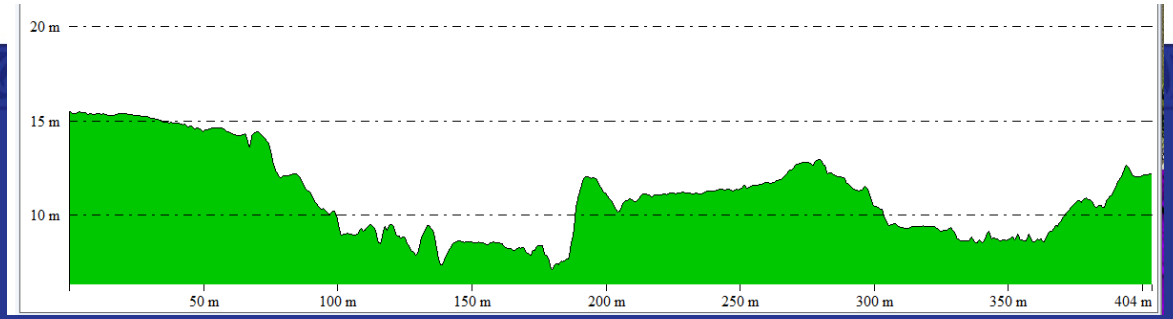
Gravel envelope data requirements

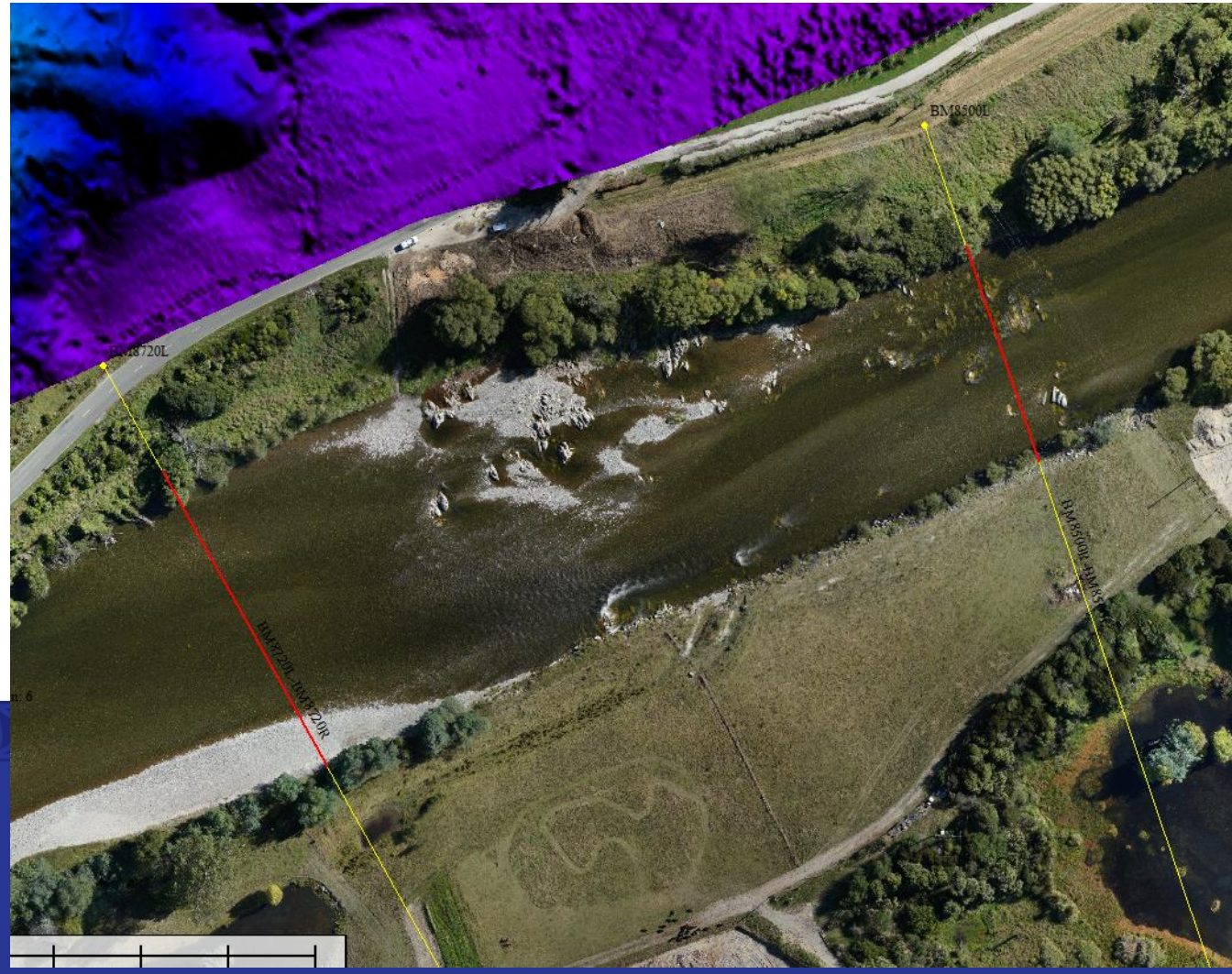
- We now collect aerial photos each time we survey and use GIS to assist with analysis

- We have begun to undertake ‘full surface capture’ surveys using LiDAR rather than just surveying the ground line at each cross section

GIS Overlays

- Terrain model overlaid with aerial photo
- Cross section locations are yellow Lines
- Active Channel Widths shown by red Lines
- Green plot shows model section halfway between the two





Improved gravel budgeting

- Since 2018 we have been using a new tool that combines river survey data to calculate actual inter-cross section volumes, as well as factoring in any gravel extraction undertaken
- Allows us to account for the extraction and get a better idea of what the ‘natural’ behaviour of the river would be in the absence of any river management intervention
- This means we identify the long term trend (aggradation or degradation) that the river would show if we didn’t extract any gravel

Gravel Analysis Template

- This is the spreadsheet tool we are using
- It’s the repository for much of the data

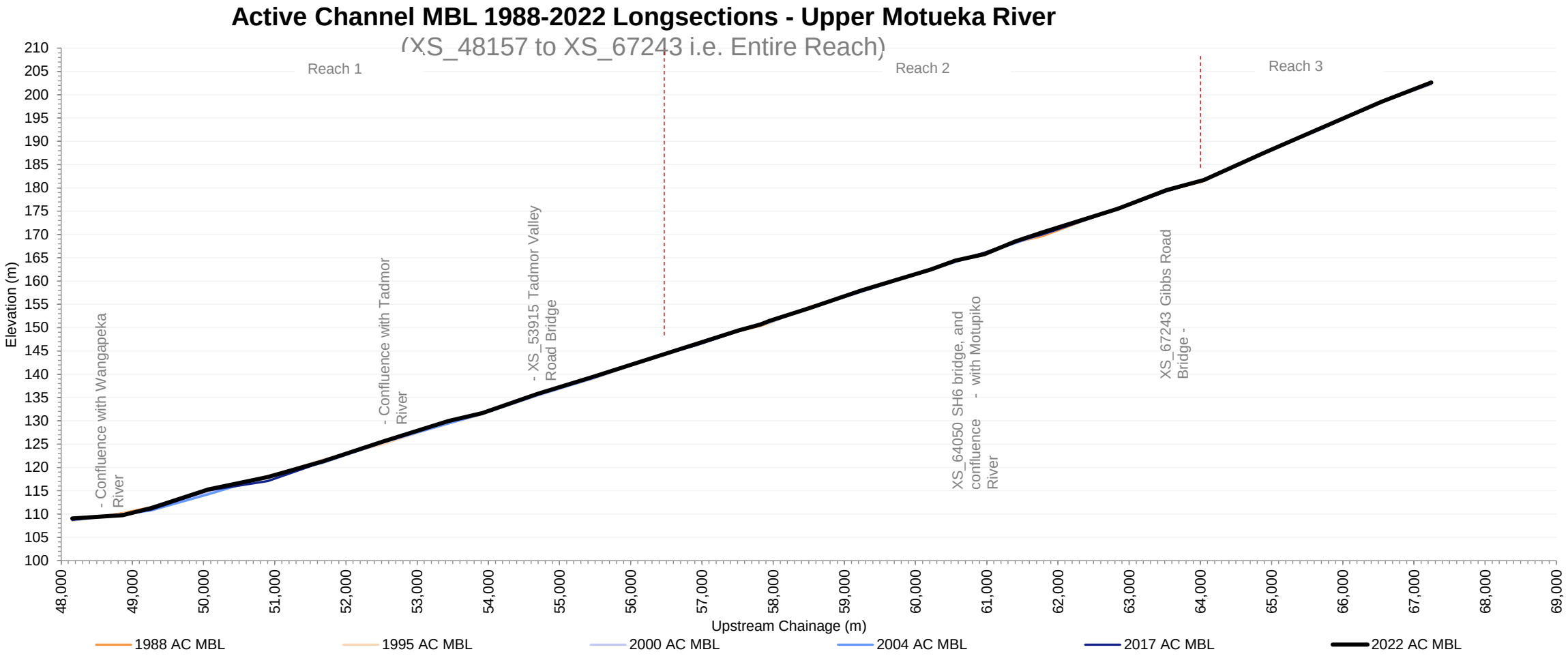
- Two key outputs are a trend line and summary page

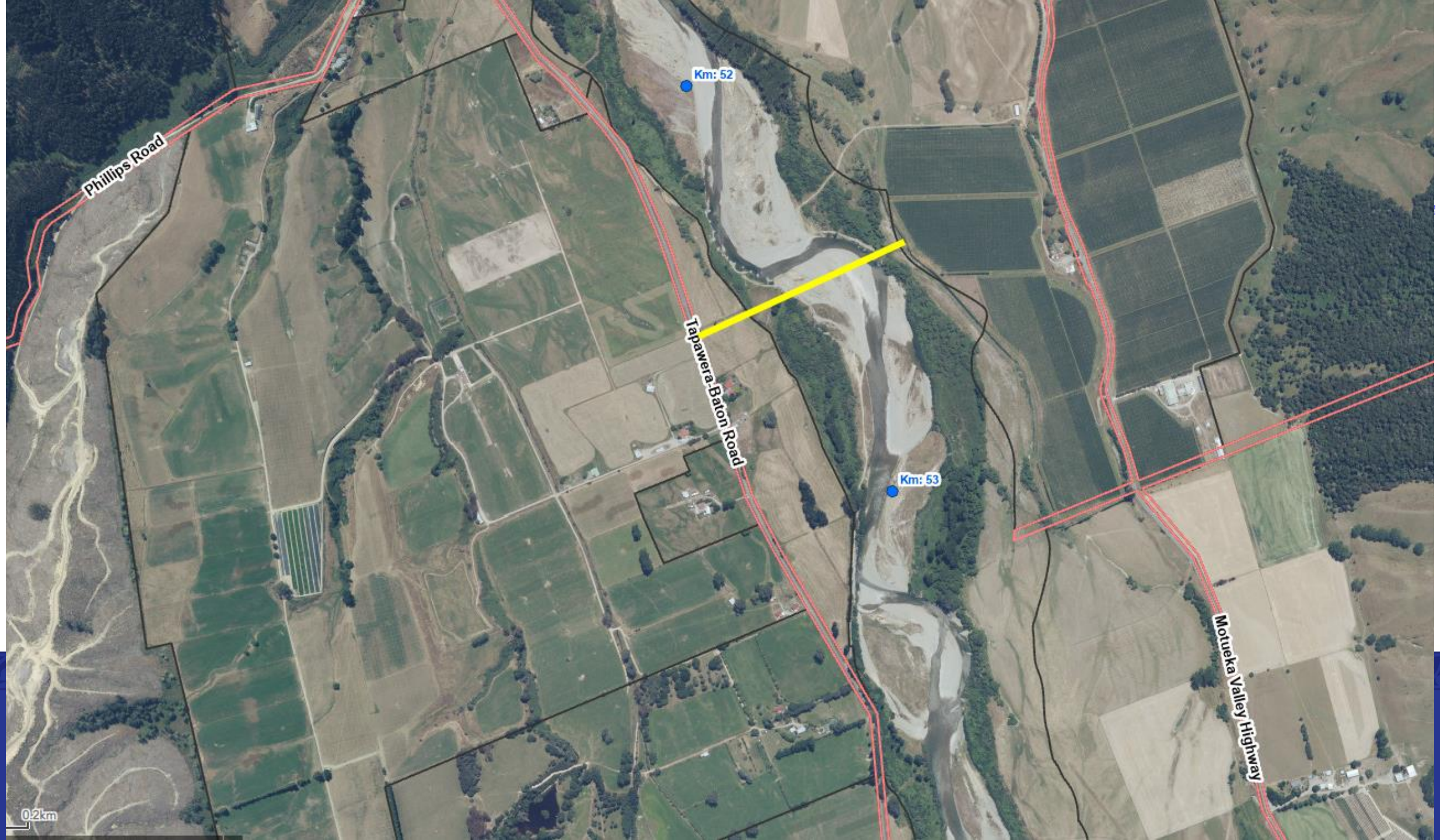
- Every time a survey is completed the tool is updated with the new cross-section, volume and extraction data to provide analysis of the last period which is used to forecast extraction for the next period

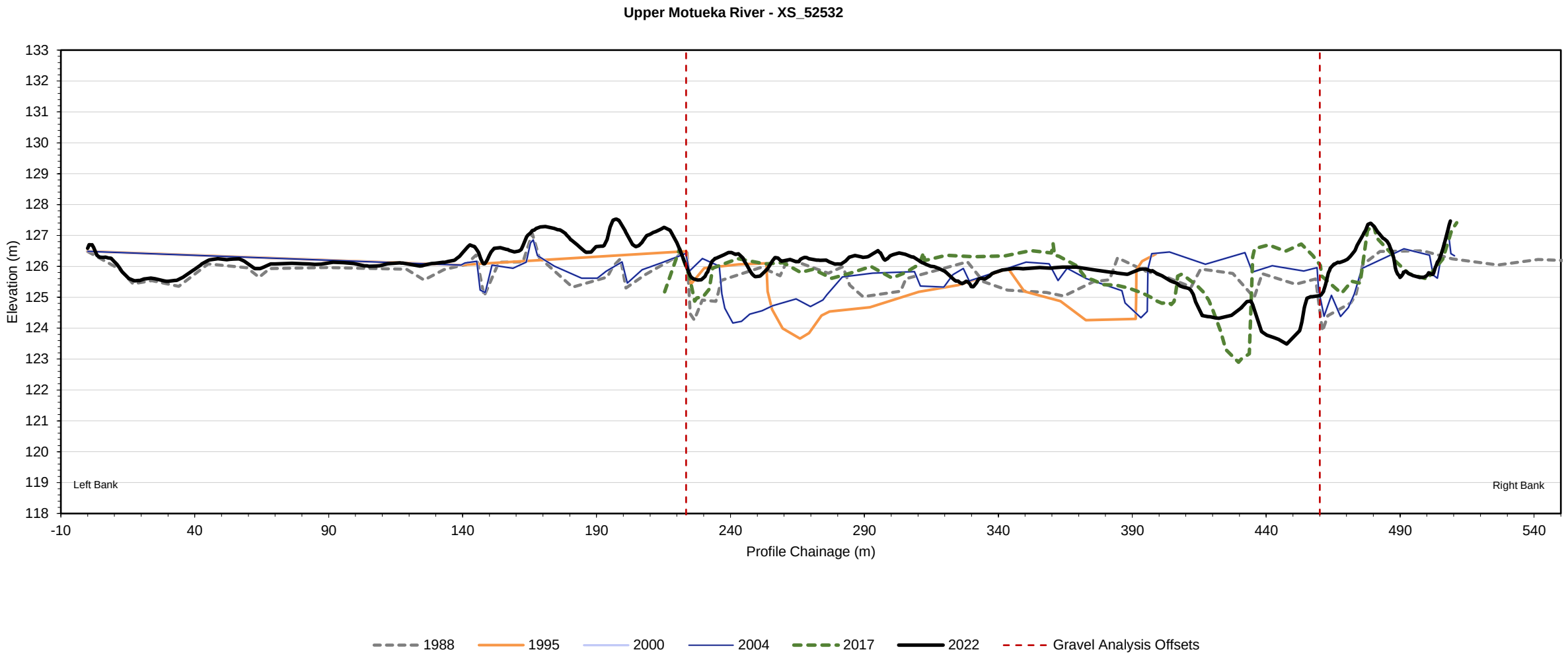
Gravel envelope example

- Following slides relate to one point in the Upper Motueka River:

- Cross section and mean bed levels
- Long section
- Assess trends over time

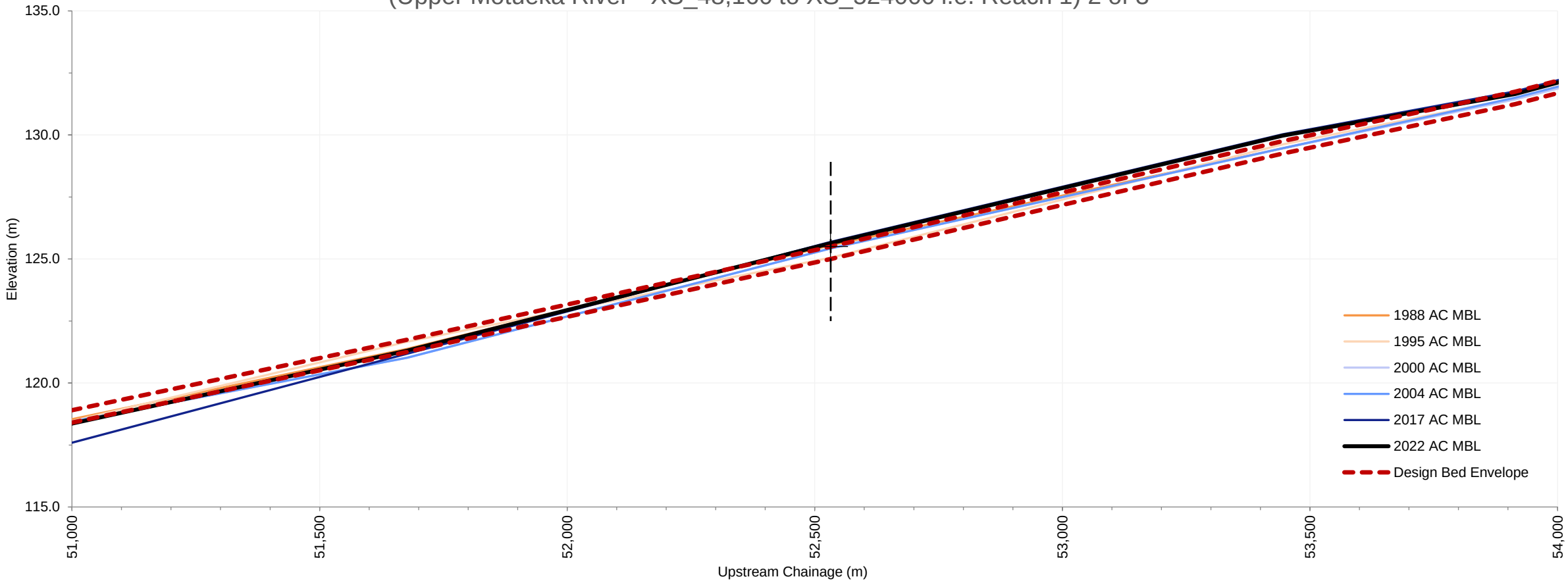

Active Channel MBL 1988-2022 Longsections - Upper Motueka River
(XS_48157 to XS_67243 i.e. Entire Reach)
Reach 1
Reach 2
Reach 3
- Confluence with Wangapeka River
- Confluence with Tadmor River
- XS_53915 Tadmor Valley Road Bridge
XS_64050 SH6 bridge, and confluence - with Motupiko River
XS_67243 Gibbs Road Bridge -
Elevation (m)
Upstream Chainage (m)
1988 AC MBL
1995 AC MBL
2000 AC MBL
2004 AC MBL
2017 AC MBL
2022 AC MBL


Km: 52
Phillips Road
Tapawera-Baton Road
Km: 53
Motueka Valley Highway
0.2km


Upper Motueka River - XS_52532
Elevation (m)
133
132
131
130
129
128
127
126
125
124
123
122
121
120
119
118
Left Bank
Right Bank
-10
40
90
140
190
240
290
340
390
440
490
540
Profile Chainage (m)
1988
1995
2000
2004
2017
2022
Gravel Analysis Offsets

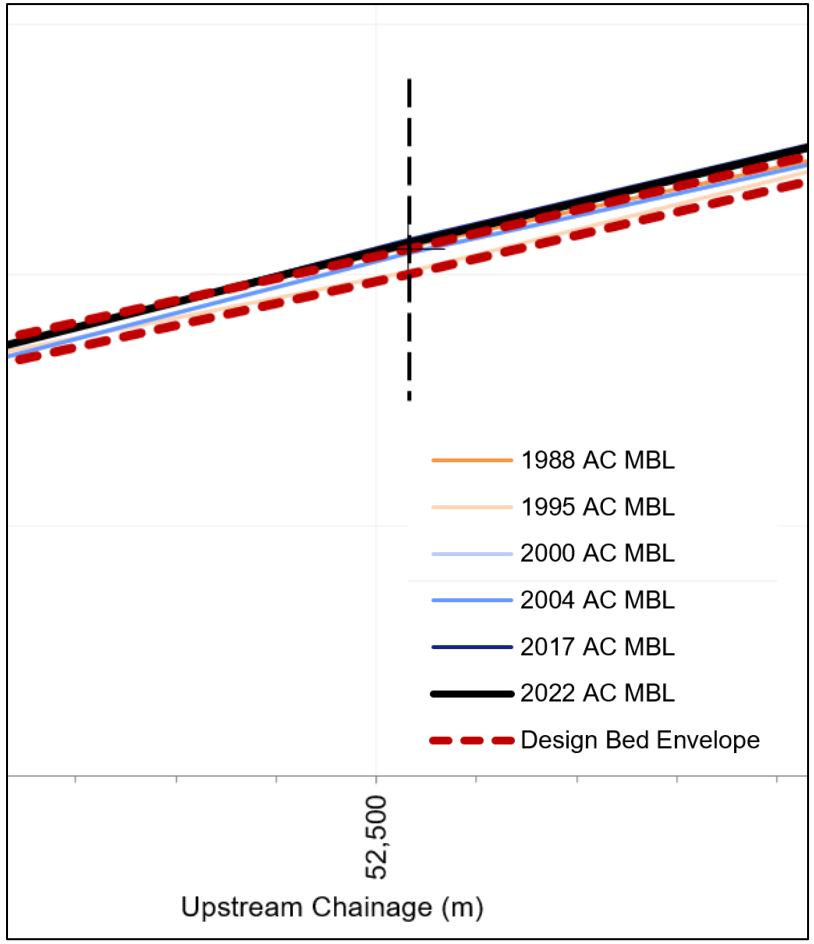
Active Channel MBL Longsections & Design Bed Envelope

(Upper Motueka River - XS_48,160 to XS_524000 i.e. Reach 1) 2 of 3



Gravel envelope

- Our consent limits extraction to the top half of the envelope
- In this example we can extract here as the 2022 bed level (black) is above the envelope mid-line
- We can extract from this area



Gravel envelope

- We can extract from this area
- Rivers staff will make a judgment whether extraction is a good option and on the best location to extract

2018 analysis

	Short Term Observation based on overall Average MBL Rate of Change	Longer Term Trend based on overall Average MBL Rate of Change	Notes
Motupiko	Degrading	Neglible movement	The lower river has had a relatively high level of extraction
Upper Motueka	Neglible movement	Degrading	Reasonable sized extractions appear not to have affected the bed level much
Lower Motueka	Aggrading	Aggrading slightly less	Reasonable sized extractions appear not to have affected the bed level much
Riuwaka	Slightly aggrading	Aggrading	Note this is due to build of of the berms rather than buildup within the gravel bed channel
Lower Takaka	Neglible movement	Strongly degrading	Only a small ammount extracted
Upper Takaka	-	Neglible movement	Only a small ammount extracted from main stem
Waimea	Aggrading	Strongly aggrading	We have since removed 60,000m3
Wairoa	Strongly degrading	Degrading slightly less	Very little extraction undertaken
Wai-iti	Neglible movement	Neglible movement	Little extraction carried out

Tasman District Riverbed Level Monitoring Results

December 2018 Tasman District (Updated 28/10/2021 with full size plots in appendix)

Abstract

This report looks at the current riverbed levels within main rivers managed by Tasman District Council

Giles Griffith

0

Update example – Upper Motueka

2017

tasman district council

GRAVEL ANALYSIS NOTES (UPPER MOTUEKA RIVER)

1) The Upper Motueka River overall appears to be gaining gravel at a rate of 8,100 m^3 per year.
2) The Upper Motueka River appears to currently be in an aggredation phase; however, results indicate that the river did experience a degradation phase since 1988.
3) Any allocated extraction should only be taken downstream of XS 56355.

Mass Balance for All Reaches

	Reach	Trending Annual Rate (m^3/yr)	Surplus/Deficit since 1988 (m^3)	Surplus Volume only since 1988 (m^3)
1	Cross Section 48,157 to 56,355	6,649	152,233	152,233
2	Cross Section 56,924 to 64,050	1,382	-8,454	
3	Cross Section 64,905 to 67,243	73	-7,400	
Balance for Entire Study Reach		**8,104**	**136,378**	**152,233**

Value 1 - Trending Aggradation Total (m^3/yr) 8,104 *i.e. this is the sum of the trending annual rates, or yearly build-up, in the combined reaches.*

Value 2 - Overall Gravel build-up since 1988 (m^3) 152,233 *i.e. this is the sum of the surplus gravels that have built up in the aggrading downstream reaches since 1988.*

Estimated Sustainable Extraction Rate **8,100** (i.e. Value 1 above rounded down to the nearest 100m^3)

Location Weighting of Sustainable Annual Extraction Rate

	Reach	Percent Weighting	Estimated Sustainable Extraction Rate (m^3/yr)
1		100.0%	8,100
2		0.0%	0
3		0.0%	0
Estimated Sustainable Extraction Rate (m^3/yr)		**100%**	**8,100**

2022

tasman district council

GRAVEL ANALYSIS NOTES (UPPER MOTUEKA RIVER)

Mass Balance for All Reaches

	Reach	Trending Annual Rate (m^3/yr)	Surplus/Deficit since 1988 (m^3)	Surplus Volume only since 1988 (m^3)
1	Cross Section 48157 to 56355	14,347	378,571	378,571
2	Cross Section 56924 to 64050	6,499	201,760	201,760
3	Cross Section 64905 to 67243	2,034	68,559	68,559
Balance for Entire Study Reach		**22,880**	**648,890**	**648,890**

Value 1 - Trending Aggradation Total (m^3/yr) 22,880 *i.e. this is the sum of the trending annual rates, or yearly build-up, in the combined reaches.*

Value 2 - Overall Gravel build-up since 1988 (m^3) 648,890 *i.e. this is the sum of the surplus gravels that have built up in the aggrading downstream reaches since 1988.*

Estimated Sustainable Extraction Rate **22,800** (i.e. Value 1 above rounded down to the nearest 100m^3)

Location Weighting of Sustainable Annual Extraction Rate

	Reach	Percent Weighting	Estimated Sustainable Extraction Rate (m^3/yr)
1	Cross Section 48157 to 56355	65.2%	14,900
2	Cross Section 56924 to 64050	34.8%	7,900
3	Cross Section 64905 to 67243	0.0%	0
Estimated Sustainable Extraction Rate (m^3/yr)		**100%**	**22,800**

Challenges

- Gravel is a very visible aspect of river systems, often blamed for flooding and erosion
- Gravel relocation is expensive and often temporary
- Historic analysis relied on limited cross sections and missed activity between cross sections (now being resolved with full surface survey)

Challenges

- High demand for concrete aggregate and sealing chip
- Excessive gravel extraction can cause more issues than it solves
- Communicating the way we calculate "mean bed level"
- Lack of resources in Environmental Information team (now resolved)

Current status

- High demand for concrete aggregate and sealing chip
- In 2021 we estimated conservatively 250,000 cu.m of gravel available in the lower Waimea over next 5 years
- We issued permits for 110,000 cu.m in the Waimea in 2020/21
- We have re-surveyed all gravel envelope rivers (Waimea/Wairoa, Upper & Lower Motueka, Motupiko, Takaka) plus the Waingaro
- We are now re-assessing sustainable volumes for these rivers

Next steps

- LiDAR and drone survey is now complete and gravel model received
- This survey will enable us to determine whether these rivers are aggrading or degrading and the sustainable level of gravel extraction
- The Waimea/Wairoa and Lower Motueka had full surface capture in May 2021 so we will be able to undertake ‘surface to surface’ comparison with our cross-sectional analysis – expected soon
- We are investigating the costs and benefits of more frequent surveys

Questions ?