FLAG MEETING NOTES: 29th July 2015

Purpose:	Takaka Freshwater and Land Advisory Group (FLAG)– Meeting12a WaterWheel
Date:	29th July 2015
Time:	10.30am-4.00pm
Venue:	Takaka Fire Station
Present:	**FLAG members:** Graham Ball (GB) Greg Anderson (GA) Mirka Langford (MLa) Piers MacLaren (PM) Martine Bouillir (MB- council representative on FLAG) **Other :** Mary-Anne Baker (MAB - Environmental Policy Planner TDC) Joseph Thomas (JT -Resource Scientist - Water & Special Projects TDC) Trevor James (TJ- Resource Scientist TDC) Andrew Yuill Tim Kerr (Aqualinc) Julian Weir (Aqualinc)
Apologies:	Neil Murray (NM) Mike Newman (MN) Tony Reilly (TR) Mik Symmons (MS) Kirsty Joynt (KJ) Hika Rountree (HR) Margie Little (MLi)
Notes taken by:	Mary-Anne Baker (supplemented by other staff)
Definitions and Abbreviations	FLAG = Freshwater and Land Advisory Group NPS-FM 2014 = National Policy Statement for Freshwater Management 2014 NOF= National Objectives Framework TRMP = Tasman Resource Management Plan (the Plan) TWMC = Takaka Water Management Catchments SOE = State of the Environment WCO = Water Conservation Order application for Te Waikoropupu Springs and recharge area **Unconfined aquifer** = are those where permeable strata are open to the ground surface. Surface water (rainfall and/or river flow) is able to seep from the ground surface directly to the aquifer. **Confined aquifer** = are those where permeable groundwater bearing strata are separated from the land's surface by an impermeable layer (such as silt or clay) that prevents surface water from directly seeping into the aquifer. Groundwater migrates to confined aquifers from an unconfined recharge area located elsewhere.
Note: records of discussion points have been grouped into similar topics and are not necessarily in the order discussed at the meeting.	
FLAG MEMBERS PLEASE NOTE: If you have any questions or need anything between meetings, then please contact Mary-Anne Baker by email: marya@tasman.govt.nz or by phone ddi 03 543 8486.	

Purpose of Meeting

Understand role of WaterWheel in FLAG decision making.

Check in

No check-in topics raised.

Updates

Model developers are from Aqualinc. Big picture is given by model at catchment level.

FLAG now looking at detail of each water body and the model has correlative limitations and won't give limits at water body scale?
Need to look at caveats for model in relation to understanding limitations.

There may be opportunity to further develop backing model to give the wheel more utility. JT and JW working on areas where improvements can make model assumptions more robust.

TJ: WaterWheel is a good tool to provide information to community
The rest of the group generally agreed that this is where it has value.

Takaka catchment too complex for the WaterWheel – hard to see where connections are.

Problems with scaling some of the attributes – e.g –how do you provide a scale for temperature for example?

JW - we might be able to model parts of the catchment in more detail.
Return to this idea after detailed look at water body specific limits.

Biggest challenge is managing land use change to more dairy (potentially).

If there are relationships between land use and water quality we need to know what they are and how the model deals with the relationships.

Also need to know levels of uncertainty. There is a danger of relying on "numbers' when we do not fully understand relationships

PM: cautioned that "correlation does not equal causation"

TK: Fascinating catchment in terms of detail and relationships – will be very difficult to develop general models as each catchment is different. He is looking for criteria settings for wheel and issues of validity of model could be incorporated into criteria. We will describe underlying assumptions as we work through the wheel. Uncertainty of model is probably greater than experts' opinion... experts have more detailed knowledge about possible scale of impacts.

JW: Direction and approximate magnitude of changes can be provided.

Should we decide about usefulness of WaterWheel now or at the end of the day?

WaterWheel helps understand catchment and inter-relationships – discussion of that is valuable and a learning experience. Selection of attributes reflects values and understanding about what is important.

AY: agrees WaterWheel provides understanding causes and relationships. Display of material is good for public. If we are to use model we need to understand how it works. Model (the 'model' is made up of several models – flow, quality, expert knowledge) and outputs displayed in WaterWheel graphics.

Understanding limitations of the supporting models and the WaterWheel depiction of the relationships is a very important aspect of this work

Errors / uncertainties
JW and JT are working on better articulation of the understanding around how sensitive the correlations are and what the errors or uncertainties are.

Action: JT/JW to report back to the FLAG on how these uncertainties can be better understood and articulated.

Attribute Selection, Modelling and Use of WaterWheel

GA: In Te Waikoropupu Springs people would notice decreases in clarity – but it's very difficult to correlate nitrate with growth of periphyton. We are assuming there is a connection with clarity.

TK: Have selected attributes for the identified values. Knowing which attribute is the perfect one is a bit of an iterative process.

In relation to clarity in Te Waikoropupu Springs – the group thought initially that other attributes would be indicators, not just nitrate.

How can we decide if each of the attributes are measured at a specific spot in the catchment. These points are all in different catchments. How can they be related to land management?
e.g Managing activities in the limestone won't impact on the springs. The WaterWheel conflates outputs in each catchment when they are not related/connected.

Model has separate flows to reflect each of the water bodies and can reflect management decisions – can have wheels in different catchments.

The groundwater/surface water model can predict what changes may occur because flows are modelled for each water body (i.e. each major stream and each aquifer). In this way the model can predict what may happen in local areas or for specific water bodies.

WaterWheel is values focussed – e.g. cultural values in TWS and swimming at Payne's Ford.

Are we choosing the right attribute to reflect values?
In springs if nitrate is really of concern then it is useful – but most people see clarity as issue. (you can't see nitrate)

We need to be able to predict change if use other attributes
The underlying issue is partly related to understanding correlation between attributes.

The model needs to be further refined to reflect connections between water bodies.

FLAG could set different limits for attributes in different water bodies.

WaterWheel shows entire catchment – if we want to maintain water quality at Te Waikoropupu Springs, but improve economic outputs – we could target development in other areas.

There is also a scaling challenge. A % change from 0.01 results in a different outcome than saying doubling a level.

Looking at Upper Takaka allocation – can the model show roughly what the effects would be of any land use changes?

JW: The FLAG has already been given coarse scenarios – can also run other more refined scenarios following more detailed limit setting.

Other models used in the WaterWheel – clarity: using empirical model from McDowell showing relationship between pasture cover, intensity and clarity.

There is not a lot of land likely to change to pasture in the Takaka Valley?
The model is not looking at change to pasture as much as increased intensity of land use.

At public level – need to know if water clarity at a swimming hole is going to change, and reduce swimming opportunities as a result of any land use changes.

There are water quality effects also from natural events – how are they accounted for?
TK – we are looking at average conditions for most attributes (but can use 95th percentile if want to maintain a higher quality level).

Clarity Attribute (recreation value)

To represent recreation value.

- Measured at key swimming hole – Payne's Ford above the Waingaro confluence
- Measured by Black disc – related to pasture cover and intensity. Reduction in stream flow reduces clarity.
- Values already used:
  - Status quo – lowest value at Harwoods 3.1 m
  - Natural state 6m (high value where no abstraction)

How is clarity affected where the measuring point is below a dry reach?
Clarity at Harwoods has no correlation with clarity at Payne's Ford.

- Could postulate a correlation if there is evidence
- Conclusion is that there is no correlation. Clarity at Paynes not likely to change with change in land use as it is groundwater fed – more likely to be affected by nitrate and temperature – which leads to periphyton growth.
- We do have clarity values for Payne's Ford and we could get better correlation with Waingaro flows.
- Clarity at Payne's Ford is more linked to changes in land use affecting nitrate levels in groundwater.

Trigger value nationally set at 0.75m.

AY: Water clarity can change over season. But it's much higher than 0.75 and he can see bottom when the water is 5m deep.

TJ: Survey results show people want to see their feet and wouldn't swim if clarity only about 1m. May be influenced by natural tannins or what people are used to.

TK: suggestion for grading:
0.1 – 0.75 – 1.6 – 2.5 – 6

Looked at actual data which shows results ranging between 2.8 – 8.

GA – local conversations showed people happy with water except for cow poo on rocks.

What about flood effects?
We are looking at flow for swimming, and people don't swim when it is flooding.

Have we picked the wrong attribute? What can affect clarity that we can manage?
We could manage Nitrate in groundwater, but the correlation between this and clarity are too hard to correlate.

Don't we need to know why we get low clarity?
Not really – we are setting what we want water to be and need to monitor and check if we are meeting our objective. If we don't, then we might need to work out why and do something about it if necessary.

We probably wouldn't see land use change impact because it is a bit insensitive to change.

The important thing is trend to make sure we are not declining – 95th percentiles and medians to help show overall state. Data is collected at normal/base flow.

There was some general discussion about the purpose of setting the states. Difference between desired and actual will drive management responses.

Clarity is worse in drought and also during flood flows. For bathing water survey we always monitor at base flows not when it is dangerous for swimming. The relationship between base flow and drying reaches is not known.

Clarity usually reduced by suspended particulates, dissolved material (e.g tannin). In Payne's Ford clarity is most likely to be affected by runoff, earthworks.

Group discussion - decided on these thresholds:
"green" lower limit set to 75th percentile of available observations (6.5 m).
"red" upper boundary set to 2.0 m.
"yellow/orange" boundary (i.e. the mid point) set to half of the values above [~4.3].

Clarity Level Attribute Grading

- Measured using black disc.

Units: metres (75th percentile)

Green	Yellow	Orange	Red
>6.5 [6.5-8.0]	6.5-4.3	4.3-2.0	<2.0 [2.0-0.0]

Fish Habitat (fishing and food gathering value)

- Brown trout, eel and inanga.
- Trout most sensitive to changes in habitat.

Indicator being used is % change in fish habitat - using Wetted Usable Area for brown trout.

- Steep decline in habitat as flows reduce.
- The amount of water is the most critical attribute for fish
- The impact is estimated using MALF
- Scenarios:
  - The natural state has no trout.
  - No consumptive use: +1% increase in habitat
  - Double irrigation: -1% decrease
  - All groundwater irrigation: -3% decrease
  - No Cobb: -7% decrease
  - No Waingaro recharge to groundwater: -3% decrease

- Haven't modelled effect of surface takes from Waingaro. (Small waiting list currently)
- Relationship is primarily flow related

- Location is Takaka River – but we need to confirm exact location...which needs to take into account drying reach.
- Also need to consider other fish needs for food, clean water, etc

Observations that trend in lower Takaka River at Waitapu is towards lots of green algae – not as much fishing there.

Lower river is more popular for whitebait, some Kahawai.

This is possibly not a very sensitive attribute –flows can change quite a bit before fish abundance is affected.

How much water can be taken from Waingaro before we get an impact on trout? How long can flow be low? What do the fish do?
They move to refuges, movement to other areas depends on time of year and fish stage. Food supply is most limiting.

Are we happy with current fish habitat? Is there room to change habitat?
FLAG would like to keep habitat the same, so we don't lose fish.

Decided on these thresholds:
100%loss – 10% loss – 5% loss No change - 1

Fish Habitat Level Attribute Grading

Units: Percentage loss in Wetted Usable Area of brown trout habitat

Green	Yellow	Orange	Red
0-1%	1%-5%	5%-10%	>10% (10-100%)

Attribute - Nitrate (Ecosystem Health, Cultural and Spiritual values)

- Brief overview of model assumptions about flow through aquifers – including the constraints inherent in the assumption of homogeneity.
- Not a lot known about mechanisms of nitrate movement beyond the root zone and attenuation as it moves through the ground and into water bodies.

We also need to look at mass loads in the catchment, and relative proportions.
Model does provide a reasonable estimate of nitrate concentrations expected.

- Springs water a mix of sources – deep and shallow sources combine.

If the water was stratified –would we get higher nitrate level in Te Waikoropupu Springs? How sensitive is the correlation?
Nitrate would not be in deeper layers. 50% of the uplands area contributes to deep aquifer and this has low Nitrate. There is also contribution from Takaka River and the lowland rainfall.
We could conclude Nitrate in springs is therefore coming from lowland farming with about a year's delay.

Note however, that farming intensity is increasing higher over time, but nitrate levels not equally steeply rising.

Can we know what changes on land use impact on nitrate?
One of the scenarios doubles irrigation – which increases nitrate to about 6.

If we double irrigation, then what is the change in cows numbers?
It is calculated that there are 0.5 more cows per hectare with irrigation.

Location of cows and soil type are important.

Note that any tipping point of effects on nitrate increases stygofauna are unknown. Are there any indicators for this?
Process of breakdown urea to nitrate not fully known.

AY: Stygofauna use oxygen to break down organic matter. Need to ensure no more than 1mg/ l to protect them (according to NIWA) – we need to pay particular attention to organic carbon, ammonia, dissolved oxygen and nitrate.
Bugs (invertebrates) tolerance to nitrate has been shown to be higher in hard water.

Nitrate levels important for Periphyton .

Public perception – management of the springs is about clarity. Iwi also concerned about contaminants.

Also needs to bear in mind relationship with Phosphorus and the role of the ANZECC guidelines as just general guidelines for lowland rivers.

Nitrate Level Attribute Grading

Units: mg/L Nitrate Nitrogen

Green	Yellow	Orange	Red
<0.37 (0-0.37)	0.37-0.5	0.5-1.0	>1.0

Attribute - Number of Cows (Livelihood and Economic value)

- Dairy average annual income high compared to other industries such as tourism. (Also find that NZ is not that efficient in terms of production for amount of time spent compared to other countries).
- Cows are an attribute for economics - not water quality/quantity. It is not a linear relationship.
- Scenarios (cow numbers):
  - Current 12300
  - Natural state: 0
  - Double irrigation: 13500
  - Irrigated : stocking rate = 3.3 cows/ha: 24300
  - Not irrigated: stocking rate = 2.8 cows/ha: 11200

How many cows is a good state for the economy?
Don't want it to decline – But if we don't have dairy – could have beef – or other crops. Dairy could be worst case for both nitrate and e-coli. More irrigation means more money – doesn't matter what the end use is so much.

Cost of irrigation and getting access to water will mean more costs.

How much growth should there be?
Status quo – was it arrived at only by accident?

What is value of freshwater to sea ecosystem?
90% of water flows out anyway.
What about value of other inputs to sea – nutrients are actually valuable to aquaculture.
Natural sea upwellings much more significant (than river flows).

Is more irrigation good for the GB economy?
Within limits. As long as environment not damaged.

There is an aim to that we make farm systems and industry more resilient – this includes irrigation to level climatic variations and provide resilience for weather / climate change.

Or we could change farm systems.

Is over-investment in current system also a potential concern?
This is a market driven / landowner decision.

How much could water allocation be reduced by?
It may have to be related to an individual's water take. Could be variable.

Would not like to see current economic activity reduced. Dry land dairy farmer might make as much profit, but irrigated farm might also employ more people and have more resilience.

So does that mean cow numbers are not that good an indicator?
We are actually looking at economy of whole bay not individuals.

And does this money actually get into Takaka?

Altering irrigation doesn't have a huge impact on cow numbers, but the value of each cow is different.

Can we work out difference between them and provide a dollar total value?

Don't want to lose economic activity from the current level - How much extra growth should be provided?

Social and community impacts might be caused by increased economic activity.

Action: MLa to get additional information about the variation in value of irrigated cow v non-irrigated cow.

[post meeting note: this attribute was changed to a Milk Solids estimate following extra work by Tim and Mirka]

Note that some farms only partly irrigate; On average there are 28 non irrigated farms and 15 irrigated farms.

The 'non irrigated cow' in the Takaka Catchment produces on average 360 kg MS year
The 'irrigated cow' produces 424 kg MS year All this leading to a total of 5.7 million kg milk solids/year.

The long term average pay out is $6. So the non-irrigated cow is worth $2160/year, whereas the irrigated cow makes $2544/year.

There are 7831 non irrigated cows and 6624 irrigated cows.
Scenarios – no irrigation – 4.8million kg MS/year – or reduction of 16%
Double irrigation - 6.4 million kg MS/year – increase of 12%
Natural state – no cows
Minimum -100% to maximum of +50% which equates to 80% additional irrigated area

Tim noted that the FLAG was accepting of a small reduction but 10 % was too much. The placement of the 0 % (status quo) at midway was an arbitrary call on Tim's part to enable increased allocated water supply to be a noticeable change to the milk solids. (Can be changed if need be.)

[Milk Solids Estimate (replacement for Cow Numbers)] Level Attribute Grading

Units: change in kg Milk solids per year

Green	Yellow	Orange	Red
50 to 10%	10 to 0%	0 to -10%	-10 to -100%

Attribute - Stream flow quantity (Ecosystem health value)

- Payne's Ford above Waingaro confluence and above the Oxbow.
- Originally used MALF

What is the difference between this and the fish habitat?
Same indicator – different aspect of ecosystem.

Number of days a year that there is no flow might be a better attribute?

Minimum/maximum dry days per year (long term average)

- Scenarios (number of dry days per year as a long term average):
    - Natural state: 113
    - No Cobb dam: 109
    - No Waingaro recharge: 59
    - Double irrigation: 52
    - All irrigation from groundwater: 47
    - No consumptive use: 40
    - Status quo: 41

Don't want to see more dry days.

Why is status quo such a turning point?
Just happens to be that way. Comes back also to when we look at sensitivity of model. Localised limitations. Eg system reacts differently in extreme (drought) situations. This summer had 1 in 50 year low flow in Kotinga – lots more loss from river to groundwater.

Looks about like we have the right balance in terms of current abstraction from the upper reaches?
And takes in upper reaches are currently naturally restricted by low flows.
Want to stay in "natural" range of dry days.
Variability year to year within 95th percentile.

The number of dry days important during migration activities for fish. Most of the drying occurs in March which is not as important for migration. Migration occurs in spring.

Extent of drying zone is perhaps more important than the length of time it is dry?
We don't have that data, but the more dry days the bigger the drying zone.

Takaka River dries every year, all the way to the Oxbow. Need to look at maximum irrigation rather than double irrigation.

Some difficulty understanding what changes to this attribute will mean. Need more information and perhaps extra monitoring to see what this means.

Quick review of what the different thresholds mean:

- Green is good
- Yellow – take care something might be wrong
- Orange –alert something is wrong – call to action
- Red – pull back – gone too far

Level Attribute Grading

Units: Number of dry days per year (long term average)

Green	Yellow	Orange	Red
<41			>44

Other summary comments from FLAG

Carry on with WaterWheel - yes/no?
Useful educationally – but possibly not otherwise useful
Wouldn't make a decision on the basis of the model/WaterWheel yet
Overall getting good value. Need now to focus on location specific limits.
Helpful for community

How much more work is necessary?
We need another session like this to complete.
Great learning – but not for limits setting. Like to see it finished, but not at expense of FLAG group
Improvements to technical aspects of model – to link quality/quantity better.

Methods – small group meeting / e-mails

Timing? – spend next while on limit setting at local scale and develop new scenarios for testing.

Can adjust timing of FLAG process to accommodate WaterWheel if necessary desirable.
Look at existing criteria on web to see scenarios with thresholds.

What did 'expert analysis required" mean?

Question about iwi use of CHI tool.
Action: MB about to talk to MKM about FLAG – will mention CHI and how they want to be involved.
Action: AY– has information on cultural values through WCO that will be distributed.

See the model and WaterWheel as a decision support tool –we still need to look at attributes – the ones we can control and see what management affects them.
Some attributes are not numerical and don't lend themselves to this sort of modelling.
Others such as CHIs are subjective and we need to make up our mind on them. Don't want to force fit them and end up with pseudo-science.

See the water flow model as very useful to test break/tipping points, thresholds.
Concentrate on its strengths – less attention on nebulous.

Action: Tim/Julian to provide a certainty/limitations assessment.
Action: Another attribute sub group meeting in September/October [post meeting note this now to replace FLAG meeting on the 21 August].
Action: FLAG to feedback at anytime via e-mail.

Attributes still needing thresholds:

- Recreation - Swimming water quality – periphyton
- Economic – groundwater level, supply security
- Drinking water – drinking water quality
- Cultural – spring flows, CHI
- Ecosystems – dissolved oxygen, Macro-invertebrates.

Action Points – Council Staff/Facilitator/Advisor

No.	What	Who
1.	JT/JW to report back to the FLAG on how these uncertainties can be better understood and articulated.	JT
2.	MB about to talk to MKM about FLAG – will mention CHI and how they want to be involved.	MB
3.	Tim/Julian to provide a certainty/limitations assessment.	TK

Action Points – FLAG members

No.	What	Who
4.	MLa to get additional information about the variation in value of irrigated cow v non-irrigated cow.	MLa
5.	AY– has information on cultural values through WCO that will be distributed.	AY
6.	FLAG to feedback at anytime via e-mail.	ALL

Action Points – FLAG Sub-groups

No.	What	Who
7.	Another attribute sub group meeting in September/October *[post meeting note this now to replace FLAG meeting on the 21 August].*	ALL

Scheduled FLAG and FLAG Subgroup meetings

Date	21 August 2015 – Attribute Subgroup
Time	9.30am -3pm
Venue	Takaka Fire Station
Agenda Items	Attributes for WaterWheel

Date	24 and 25 September 2015
Time	9.30am -3pm
Venue	Takaka Fire Station
Agenda Items	Allocation

Information and resource documents identified during meeting

Date	Title	Author/Source
	none	

**Key documents available electronically will be added to the online PDF document bibliography.*

Issues or topics identified during meeting for future consideration

Topic/Issue Description	Requester
none	

**Issues or topics unable to be addressed at the meeting, but requiring future consideration will be recorded in the Takaka FLAG 'Information Eddy'.*