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RiVAS and RiVAS+: Opportunities for Application of a Multi-Criteria River Value Assessment System Approach Which Considers Existing and Potential States

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RiVAS and RiVAS+: opportunities for application of a multi criteria river value assessment system approach which considers existing and potential states

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Summary

The River Values Assessment System (RiVAS) uses a combination of expert panels and multi criteria analysis to identify primary attributes (or main features) of river values (e.g., whitewater kayaking, native birds) and their key indicators. The resulting data set is used to rank rivers for their existing (instream) and potential (out-of-stream) significance. The RiVAS method has been applied to seven values and tested across a range of councils with most focus in Tasman District. The tool has demonstrated utility and is very cost effective to implement. Further development has now led to RiVAS+ to consider potential significance for instream values, using the same attributes and indicators, and also identifying the interventions needed to achieve these potential future states (e.g., water quality improvements, willow removal, increased flows). RiVAS+ enables instream uses to be considered on the same basis as out-of-stream opportunities. RiVAS+ can be undertaken more-or-less concurrently with RiVAS and enables a range of applications. First, it allows decision makers to gain an understanding of the difference between existing relative importance or significance of a value and its potential (if restored or developed). Second, it enables better evaluation of potential restoration or development options in a range of circumstances including where water resource development is planned. Finally, with further input it might be possible to quantify the cost of the interventions which would then allow better consideration of mitigation and other options in resource management policy and decision making processes. In this paper we demonstrate the method and the opportunities.

Key words: River values, prioritisation system, existing and potential, interventions, New Zealand

1. Introduction

For decades hearing panels associated with local and central government, and the Environment Court, have sought an objective method for ranking the comparative worth of rivers for the range of in- and out-of-stream uses. Historically, Teirney et al. (1982) for recreational trout and salmon fisheries, and Egarr and Egarr (1981) for whitewater kayaking, identified lists of rivers and streams for their relative existing use importance for these values. More recently, the relative importance issue was addressed under the Water Programme of Action, part of the Labour Government's 2003 Sustainable Development Programme of Action, run by Ministry for the Environment (MfE). The programme identified the need for the Department of Conservation (DoC) to identify water bodies of national importance (WONI) and a list of water bodies that would protect the full range of freshwater biodiversity values. In a complementary way MfE (2004) listed water bodies important for recreation, and MfE and MAF (2004) produced lists of waters of national importance for: the biodiversity dimension of natural heritage; geodiversity and geothermal features; recreation; irrigation; energy; industry and domestic; and tourism. But, despite much work in this context, there remained no objective framework that clearly identified the criteria upon which importance could be determined for specific values, or which potentially allowed for comparison between values.

From 2007-2010,a FRST-funded[1] river values project addressed these challenges and produced the River Values Assessment System (RiVAS) tool. Essentially this tool enabled the production of ranked lists of rivers, or sections thereof, for a wide range of values based on evaluating existing worth (for salmonid angling, native birdlife, natural character, tangata whenua, whitewater kayaking and river swimming) and potential worth (for irrigation) (see Hughey and Baker 2010a,b). While this philosophy to dealing with existing and potential worth was consistent with all previous ranking systems it was not without criticism. In particular, criticism about the different basis for evaluating instream and out-of-stream uses led to further research into considering how all values could be evaluated for their existing and then for their potential importance.

In this paper we describe the approach now being trialled in a second FRST-funded[2] research project to address the above expressed need. We first summarise how RiVAS works, then describe how, with the addition of interventions, RiVAS can be quite simply modified to perform both tasks thus leading to the new tool, RiVAS+. Finally, the potential application of RiVAS+ is shown through trial application to salmonid angling and to whitewater kayaking.

2. RiVAS – a summary

Hughey (2009) summarised the key background and need for a prioritisation tool. The RiVAS tool is described in detail in Hughey and Baker (2010a,b) and its core component steps can be summarised as:

A. Define the value to be evaluated, e.g., birdlife, irrigation.
B. Establish (and explicitly justify) a National Expert Panel and choose (and explicitly justify) peer reviewers. The National Expert Panel considers both the national context as well as application at a regional scale. The members (scientists, consultants, policy makers or lay people) are nationally respected for their expertise, and ultimately their ability to produce work that can be tested at the Environment Court. For national level panels, i.e., those initially identifying the attributes, indicators and thresholds, it is now agreed there is a role for central government agencies and national level non-government organisations. For regional level panels there is a similar requirement for credibility over the choice of relevant expertise but a national level input is probably unnecessary – these panels populate an existing assessment framework for particular regions.
C. Choose assessment criteria
   - Step 1: define river value categories, i.e., kayaking can be subdivided into flat water and white water; and river segments;
   - Step 2: identify all of the value's attributes – economic, social, environmental, and cultural, depending on what is appropriate;
   - Step 3: select and describe primary attributes – reduce to a list of 10 or less, for manageability;

[1] Prioritising River Values - FRST Envirolink Grant 612-TSDC41
[2] Integrated Valuation and Monitoring Framework for Improved Freshwater Outcomes. Grant C09X1003.

Step 4: identify indicators – choose objective/quantitative over subjective; evaluate each against SMARTA[3] criteria – the main aim is to quantify where possible with a majority of indicators represented by scientifically defensible data.

D. Determining significance

Step 5: determine indicator thresholds – quantify these where possible including the need to think nationally: at the national level it is advised to be guided by criteria set in legislation (if such exists) or determined in the Environment Court, e.g., the 5% level for a national important population of a 'threatened or at risk' bird species; or established through WCOs;

Step 6: apply indicators and their thresholds – these are converted to 1=low; 2=medium; 3= high, e.g., for birdlife a species achieving the 5% threshold in terms of proportion of the population on that river is accorded a '3';

Step 7: apply weighting to the primary attributes – preferably equal weighting, but otherwise as needed. This part of the process is considered very carefully by the National Expert Panel and is subject also to peer review;

Step 8: determine river significance – sum the total scores and determine overall importance, e.g., in relation to water conservation order criteria. Also in this case a set of decision support criteria can be identified such that a particular indicator might be so important that if it achieves a '3' then the river is automatically of national important, e.g., the 5% threshold for 'threatened and at risk' species;

Step 9: outline other factors relevant to the assessment of significance, e.g., there may be particular legal or policy issues surrounding the river that need to be noted such as a Water Conservation Order.

Having completed these steps, the final task is to rank order and display the list of rivers (or defined segments) from most to least important. It was this approach that was first trialled on multiple values in multiple councils, and then applied to the same set of values in Tasman District Council. It is this approach also that provides the reference point for considering how best to deal with existing and potential worth in a cost-effective and policy relevant way.

3. RiVAS+: Study approach and methods

We first ran a full-day workshop in Nelson on 25th March involving: Ken Hughey (Lincoln University), Jim Sinner (Cawthron Institute), Kay Booth (Lindis Consulting), Mary-Anne Baker (Tasman District Council), Neil Deans (Nelson/Marlborough Fish & Game), John Hayes (Cawthron Institute), and John Quinn (NIWA). At the workshop we determined the following:

1. RiVAS was very useful and its fundamental building blocks (primary attributes and indicators, multi criteria approach, expert panels) were applicable to both existing and potential values;
2. If RiVAS was to be applied to the same value for both existing and potential worth then the gap to be filled concerns 'interventions', i.e., those actions required to change a value, measurably, from its existing level to a potential level;
3. A brief trial application (using the above conclusions) to salmonid angling on a few rivers in Tasman District worked but identified issues around the source of 'potential' data (especially for instream values).

Apart from the need for a list of 'interventions' the method involved an additional series of steps to those identified for RiVAS (summarised in section 2), namely:

[3] SMARTA = Specific, Measurable, Achievable, Relevant, Timely, Already in use

Step 10: Identify potential interventions and rivers for potential state assessment

In order to identify rehabilitation/development scenarios, the question is asked 'What actions could be taken to alter river conditions that are credible and practicable?' The intention is to avoid 'pie in the sky' scenarios that, for example, are not realistic because of the cost, including the opportunity cost to other users. Scenarios chosen for assessment should be those that are likely to appeal to users and offer overall benefit to society. We consider a 10-year timeframe should be considered and the assumption is made that interventions will be successful.

The focus upon 'potential' may require identification of additional rivers, missed in Step 1 because currently they are not used or are of low significance (or worth). For example, the Pukaki River in the Mackenzie Basin currently has very low worth to birdlife, but the addition of some permanent flow (the intervention) would improve its worth dramatically. Ideally, ALL listed rivers would be assessed for both current and potential river conditions. In practice, however, one can exclude assessment of potential worth for rivers where there are no practical interventions that would change the value in a significant way (e.g., a lowland spring fed stream will never have worth to whitewater kayaking no matter what the 'realistic' intervention).

Steps 11-13: Apply Steps 6-8 to potential state assessment

There may be no data for the indicators in the potential scenarios (especially for instream values[4]), unless the potential restoration is to a prior state where indicator scores were known. The Expert Panel may therefore choose to focus solely on the indicator threshold scores (1-3), leaving data columns in the spreadsheet blank. Some data estimates will be more inexact than others (e.g., the Expert Panel may have no knowledge of places with no current access) and this can be indicated. Where the indicator relates to rarity (e.g. threat status of a native plant or animal), an improved future state (i.e., where rarity has decreased) may be reflected in a lower score. The indicator itself remains valid. In this situation it is necessary, when assessing a given river's future, to assume that management of other rivers in the region has not changed, i.e., how this river in a potential state would compare with other rivers in their current state. Given there is considerable estimation required for 'future' data, trends in data should be recorded to indicate the direction of change for each indicator.

Based on a successful 'very' preliminary application to four salmonid angling rivers in Tasman District, we decided to then apply the draft methodology to a range of other values with Tasman District Council (and other councils as feasible, namely Hawkes Bay and Gisborne). To date, the first full application of RiVAS+ is whitewater kayaking in Tasman. The following description of this application also incorporates some of the initial salmonid angling trial work.

4. Results – application of RiVAS+ to whitewater kayaking and to salmonid angling in Tasman

The same Expert Panel that assessed whitewater kayaking in 2010 for the RiVAS exercise (see Booth et al. 2010) reassembled to undertake the RiVAS+ task. The 52 river sections identified in the 2010 assessment were used as the basis for the RiVAS+ analysis. The Expert Panel considered every river section for its potential worth.

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[4] For 'development' (out-of-stream) values, e.g., hydro or irrigation, it is a simple task of quantifying the indicators for each primary attribute.

A list of potential interventions was first developed at the 25th March workshop when examining the potential of Tasman rivers for salmonid angling; it was subsequently revised for the whitewater kayaking trial and has been extended further since to take account of interventions for other instream interests and for irrigation and hydro (Table 1).

The first 'very' preliminary application of RiVAS+ was to five salmonid angling rivers in Tasman (Table 2). When interpreting the table note that step 6A shows for each river the existing and potential in terms of where the indicators change; step 6B shows the resulting change in threshold scores. The application demonstrated that:

- Realistic interventions could be identified
- These interventions when applied to rivers improved the 'score' for at least some rivers
- Some changes in score could lead to significant changes in the importance of rivers.

The subsequent full application of RiVAS+ to whitewater kayaking found that there were differences for a number of rivers between existing and potential (as demonstrated by rivers with the greatest changes in Table 3), but the magnitude of change was small for all bar three rivers, and only large for the Lee (a nearly 100% increase from 9=existing to 17=potential).

Table 1: Potential interventions to enhance river values

1. **Enhance access**
    a. Helicopter access
    b. Vehicle access
    c. Boat access
    d. Foot access
2. **Enhance flow**
    a. Increase minimum
    b. Stabilise (around targeted specific flow)
    c. More natural variability
    d. Restore flood flows
    e. Transfer water between catchments
3. **Improve bed & in-stream habitat**
    a. Maintain channel works (e.g. groynes, other structures) that enhance worth
    b. Remove channel works (groynes, stop banks etc) that detract from worth
    c. Control weeds (in-stream, including active river bed) to enhance worth
    d. Remove hazards (e.g., wire, trees, old structures, forestry slash)
    e. Leave woody debris in river that enhance worth
4. **Remove or mitigate fish barriers**
    a. Culverts
    b. Dams
    c. Flood gates
    d. Chemical
5. **Set back stopbanks**
6. **Improve riparian habitat**
    a. Weed & pest control
    b. Native revegetation
    c. Remove litter
7. **Enhance water quality**
    a. Remove/fence out stock
    b. Reduce non-point source nutrient pollution (e.g., farm nutrient budgets)
    c. Reduce point source pollution (e.g., mining waste)
    d. Reduce sediment input (e.g., forest management practices)
8. **Stock with fish**
9. **Provide amenities**
    a. Boat launching facilities
    b. Car parking
    c. Toilets
    d. Storage facilities (for kayaks etc)
    e. Artificial hydraulic feature (for kayakers, swimmers, anglers)
        i) Slalom course
        ii) Play wave
        iii) Swimming hole
    f. Interpretive signage
    g. Riverside track (for access)
10. **Construct water storage**
    a. In-river
    b. Out-of-river
11. **Develop a run-of-the-river diversion**
12. **Provide telemetered flow monitoring (& communicate readings)**

Table 2: Sample application of existing (RiVAS) and potential (RiVAS+) evaluations to a sample of salmonid angling rivers in Tasman District

		Step 6A: Apply indicators and thresholds										Step 6B: Apply indicators and thresholds										Step 8: River significance			
River	Interventions	Angler days (n) (NAS 2007/8,2001/2,1994/6)	Intensity of use (mean free reach) (NAS 2007/8)	Travel distance (km) (NAS 2007/08,2001/2,1994/6)	Overseas anglers (%) (NAS 2007/8,2001/2,1994/6)	Perception catch rate (0.0-1.0) (FGNZ 2008)	Perception fish size (0.0-1.0) (FGNZ 2008)	Water quality (0.0-1.0) (Expert Panel)	Percptn scenic attract'ness (0.0-1.0) (FGNZ 2008)	Perception wilderness (0.0-1.0) (FGNZ 2008)	Perception importance (0.0-5.0) (NAS 1979)	Angler days score	Intensity of use score	Travel distance score	Overseas score	Percptn catch rate score	Percptn fish size score	Water qlty score	Percptn scenic score	Percptn wilderness score	Percptn importance score	Sum Weights	Rank	River significance	Difference = Existing - potential
Sabine R.		208	28.1	108.2	45%	0.27	0.55	1.00	0.82	0.65	4.21	1	1	3	3	2	3	3	3	3	3	**25**	**2**	National	
Potential	8	↑				↑						2	1	3	3	3	3	3	3	3	3	**27**		National	2
Motueka R.		1642	4.8	33.9	39%	0.35	0.11	0.80	0.32	0.10	3.84	2	3	1	3	2	1	2	2	1	2	**19**	**5**	Regional	
Potential	1*,3,4,6a,7bd*	↑		↑		↑		↑	↑		↑	3	3	2	3	3	1	3	3	1	3	**25**		National	6
Waimea R.		496	5.2	124.5	22%	0.24	0.06	0.50	0.06	0.12	3.00	1	2	3	3	2	1	2	1	1	2	**18**	**7**	Regional	
Potential	1,2ab,3,4,5,6a	↑	↑		↓	↑	↑	↑	↑			2	3	3	2	3	2	3	2	1	2	**23**		National	5
Motupiko R.		66	####	54.2	0%	0.15	0.29	0.70	0.47	0.36	3.25	1	1	2	1	1	2	2	2	2	2	**16**	**8**	Local	
Potential	1,2ab,3,6a,7d	↑	↑			↑						2	2	2	1	2	2	2	2	2	2	**19**		Regional	3
Motupipi R.		Not evaluated by RiVAS as significiance too low										0	0	0	0	0	0	1	0	0	0	**1**	**-**	Nil	
Potential	6ab,7bd	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	1	2	1	1	1	1	2	1	1	1	**12**		Local	11

Key: ↑ Indicator increases in worth; ↓ Indicator decreases in worth

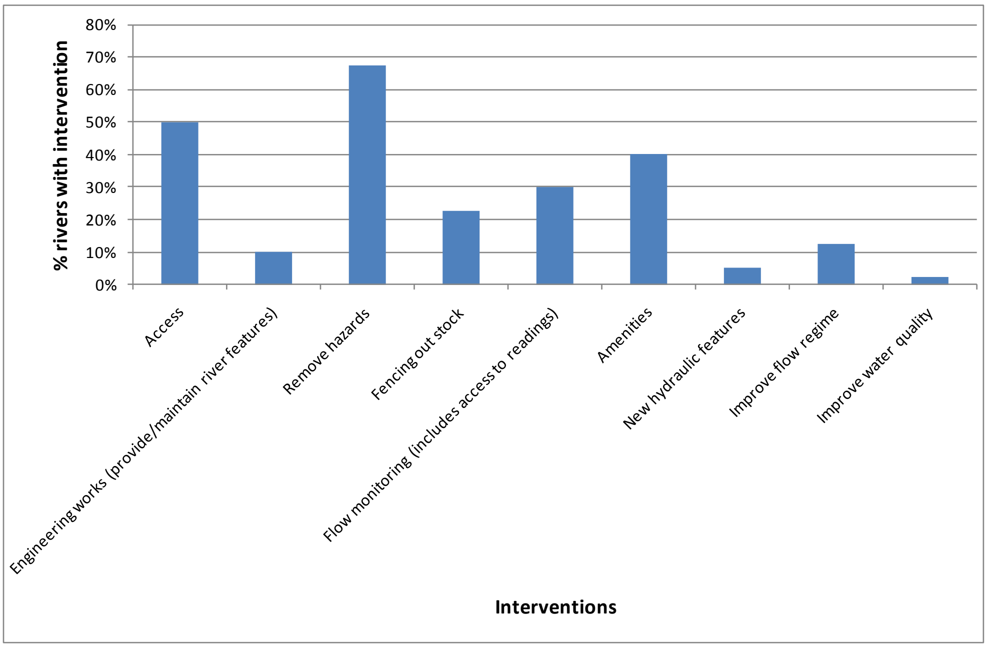
Table 3: Tasman District whitewater kayaking rivers showing greatest potential for change, in order of greatest change (all changes are positive/enhancements)

River	Reach	Interventions	Indicators expected to change	Current worth	Potential worth	Change	Current importance	Potential importance
Lee	Cement Works to Lee Reserve	Flow monitoring, Toilets, Car parking, Slalom course, Play wave, Improve flow regime	Suitability of quality hydraulic features, Flow reliability, Number of users, User catchment, Regional significance	9	17	+8	Low	High
Wairoa	Lee River confluence to WEIS weir	Remove willows, Toilets, Car parking, Improve flow regime	Flow reliability, Number of users, Regional significance	14	16	+2	Moderate	Moderate
Motueka	Blue Gums	Engineering works, Fencing out stock, Toilets, Car parking, Improve flow regime	Suitability of quality hydraulic features, Flow reliability	14	15.5	+1.5	Moderate	Moderate
Matiri	About 2.5km upstream of Matiri River W branch to 8 km downstream confluence of Matiri River W branch	Vehicle access, Flow monitoring, Car parking, Improve flow regime, Improve water quality	Perception of wilderness, Flow reliability, Number of users	18	19	+1	High	High
Motueka	Baton Bridge (Woodstock) to SH60	Engineering works, Remove willows, Fencing out stock, Toilets, Interpretive signage	Number of users	13	14	+1	Low	Moderate

Further analysis of the full data set (52 rivers or segments) provides the opportunity to evaluate which interventions were the most commonly identified (Figure 1). Removal of hazards to kayakers was an intervention selected for 68% of rivers, with ‘access’ and ‘amenities’ respectively being identified for 40% and 30% of rivers. Also of note, 13 out of the 20 access interventions concerned foot access for kayaking.

For the Lee, the river with the highest expected change, the two most important interventions were ‘improve the flow regime’ and implement a ‘slalom course’. For both of these, the primary intervention is a dam, as a result of which changed flow conditions can be harnessed for kayaking enhancements like a slalom course. The intervention ‘dam/water storage’ was not considered at the whitewater kayaking RiVAS+ assessment, but has now been added to the list of interventions (see Table 1).

Figure 1: Proportions of interventions by total number of rivers evaluated – whitewater kayaking in the Tasman District (N= 40 rivers or segments where realistic interventions could be made)



5. Discussion and conclusions

As shown here, RiVAS+ uses the RiVAS method to record the worth of existing values, but then poses the question: 'what is the potential 'significance' for this value on this river if realistic management interventions are implemented?' We have shown that when applied in a very preliminary way to salmonid angling, and then in a more considered way to whitewater kayaking, RiVAS+ produces a set of rankings that allows potential worth to be compared with existing worth for that value. As such, the method offers immediate opportunities, i.e.,

- It allows all values to be ranked and compared on a 'level playing field', i.e., existing instream vs existing out-of-stream, and potential instream vs potential out-of-stream. This is potentially very important when the worth of out-of-stream developments (e.g., irrigation or hydro) is being compared against the worth of in-stream values (e.g., salmonid angling or native birds).
- Policy makers can consider how patterns of interventions might form the basis for policy or planning initiatives, e.g., around improving access to key resources.
- It enables resource managers to identify interventions that are most likely to lead to the greatest benefit to values in restoration considerations. If these same interventions can be costed then it might be possible to compare the relative cost utility or cost effectiveness of different alternatives (considerable work outside of the brief of this project would be required to achieve this aim).

A further advantage of RiVAS+ is that it remains cost-effective, probably adding in the order of another half day of work to the existing RiVAS method. Our current estimate for applying RiVAS to multiple regional applications is around $2-5,000 per value (where the initial criteria have already been developed at a national level) – RiVAS+ will therefore likely add another $1000 or so to the cost of each application.

There are however a number of significant questions about RiVAS+ that have yet to be fully considered, e.g.,

- RiVAS has the advantage that indicator data for primary attributes is either objective ‘hard’ data, a mix of this data and expert panel opinion, or in a few cases primarily expert panel opinion. Conversely, at least for instream values, there will be no RiVAS+ ‘hard’ indicator data because the situation is hypothetical. Instead all data will be expert panel threshold evaluations. The reliability of these data, in some cases, may be questionable but is still the ‘best available information’. For some values, such as native fish, there are spatially explicit models that could be used to predict fish populations, and hence significance, under restoration scenarios. In principle, such models could also be developed for uses involving human activity, but would be more challenging.
- During preliminary trialling we identified that we should record the two most important interventions for a given river (based on Expert Panel judgement). But, what would this show, e.g., could we quantify the likely contribution of each to achieving the status change? What would it tell us about how the score would change if only some of the interventions were implemented?
- As noted for the potential worth for whitewater kayaking on the Lee River, the relationship between a prerequisite intervention (e.g., water storage dam) and consequent interventions reliant upon the prerequisite condition presents issues. What is the ‘real’ intervention? How should a prerequisite intervention be identified, which in and of itself (in the absence of the subsequent interventions) may decrease potential worth for that river value?
- When assessing a future scenario for a given river, it is necessary to assume that management of other rivers in the region has not changed, i.e., how this river in a potential state would compare with other rivers in their current state. This assumption requires further thought where, for example, there is a strategy to improve habitat on all key rivers for that value in a region, e.g., the targets for the Canterbury Water Management Strategy call for habitat improvements on all key braided rivers in Canterbury for birdlife. If this situation occurs, then it is possible that all rivers will have: greatly improved habitat including better flows, a more diverse bird fauna, and fewer threatened and at risk bird species populations. The implication for RiVAS+, which assesses rivers individually, is that consideration of the river’s regional context may need to be taken into account in some way.

To conclude, we consider both RiVAS and RiVAS+ are cost effective and highly valuable tools for assessing a range of river values, for both existing and potential worth. While more work is required to validate the RiVAS+ ‘potential’ approach, existing findings are extremely promising.

Acknowledgements

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