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Part A: Irrigation in Canterbury Region: Application of the River Values Assessment System (RiVAS)

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Peer reviewed by: Dr Nick Brown

9.1 Introduction

9.1.1 Purpose

This section describes testing the River Values Assessment System (RiVAS) described by Hughey et al. (herein) with irrigation as the river value. The attributes and indicators derived for irrigation are applied to Canterbury rivers as a case study.

9.2 Significance Assessment Method

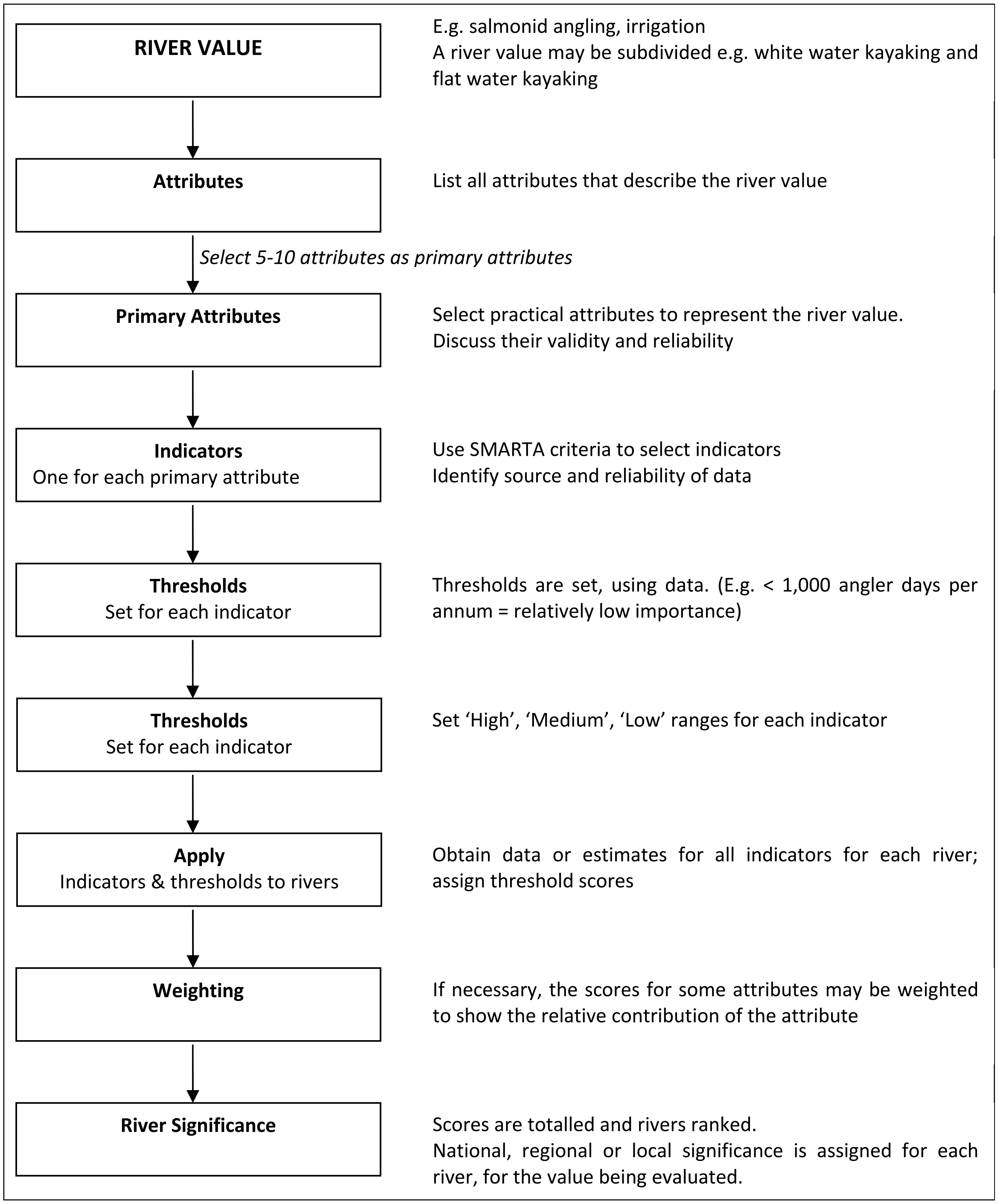
The RiVAS aims to outline assessment criteria and significance thresholds for river values, for application within national and regional planning under the Resource Management Act (RMA). It involves the development of attributes and indicators in conjunction with an Expert Panel. In this project the RiVAS for irrigation has been developed in conjunction with a group of experts on irrigation and water resource management and tested in a case study setting of the Canterbury region. Figure 9-1 provides a summary of the RiVAS process.

It is intended that RiVAS is applicable to all river values[1]. Hughey et al. (Chapter 3, herein) anticipate that the implementation of the method may be varied to accommodate the particular characteristics of each river value, but that once applied for a specific river value (e.g., irrigation) the method for that value will be consistent across New Zealand.

The members of the National Expert Panel who developed the irrigation attributes and indicators and carried out the Canterbury case study were: Dr Terry Heiler (Irrigation NZ), Murray Doak (MAF), Simon Harris (Harris Consulting) and Claire Mulcock (Mulgor Consulting). Lynda Weastell (ECan) contributed to the development of the attributes and indicators, but did not participate in the Canterbury case study. Ken Hughey sat in on part of the panel deliberations and provided guidance on application of the methodology. Dr Nick Brown undertook a peer review of the project. Information on the panel members and reviewer is given in Appendix 9A-1.

1 **River value:** A river-related tangible resource (e.g. birdlife), activity (e.g. salmonid angling), or resource use (e.g. irrigation) *(*Hughey et al. Herein*)*

Figure 9-1
Summary of RiVAS Method
(from Hughey et al. Herein)



9.3 Application of the Method

9.3.1 Step 1: Defining categories for the river value and river segments

The RiVAS enables assessments to be undertaken for categories[2] of river values or for individual river segments. No categories were identified for irrigation, and therefore the assessment for irrigation was developed with no sub-categories.

Consideration was given to segmenting rivers where there are major differences in upper and lower catchment attributes relating to irrigation. For example: one or more of: mean annual rainfall greater than 1200 mm; average slope greater than 15 degrees; altitude greater than 600 m. In Canterbury, the mountain rivers may be usefully divided into 2 segments: above and below gorges (e.g., Waimakariri, Rakaia, Rangitata, and Waitaki). However, because of the transportability of water among different parts of a region, and because of the need to make the method nationally applicable, the Expert Panel decided that for the purposes of irrigation assessment it was not necessary to use river segments.

9.3.2 Step 2: Identifying attributes

The first major task for carrying out the RiVAS in respect of irrigation was to identify the major attributes of irrigation. The attributes are the facets of the river value that, taken collectively, describe that river value. For example, salmonid angling includes the attributes of level of use, anticipated catch rate, perceptions of scenic attractiveness, etc. Consideration was given to identifying at least one attribute for each of the four 'well-beings', i.e., social, economic, environmental, cultural.

The panel assessed a draft list of the major attributes of irrigation considered necessary to describe the nature of the river for irrigation purposes. These were divided into two 'attribute clusters' (c.f. Booth et al., application to salmonid angling, herein) – supply and demand.

The panel assessed the draft list for usefulness, made amendments and added further attributes. The agreed attributes are listed below in Table 9-1.

2 **River value category**: A specific type or style of the river value. For example recreational values can be categorised into. whitewater kayaking, flatwater kayaking; wilderness fishery, lowland fishery.

Table 9-1
Description of Attributes

Attribute	Description
Cluster: Supply attributes	
Size of resource	A description of the magnitude of the flows in the river
Technical feasibility of abstraction	How difficult it is to access water for irrigation.
Technical feasibility of storage	Whether storage is likely/feasible in this location. Storage was considered to be significant storage on- or off- river that would improve seasonal and inter-year reliability, but did not include small on-farm storages.
Hydrological reliability for run of river	How often flows in the river are available for abstraction.
Hydrological reliability for storage	The reliability of the resource from a storage point of view.
Timing/seasonal availability	The availability of water during the irrigation season, which is a combination of volumes and reliability over the September to April period.
Cluster: Demand Attributes	
Soil moisture deficit	The need for irrigation during the irrigation season, being a combination of rainfall and potential evapotranspiration (PET)
Potentially irrigable area	This is the area which could feasibly be irrigated from the resource. It comprises the river riparian areas as well as neighbouring areas where water could be transported through schemes.
Receiving environment	Whether the potentially irrigated areas have environmental impacts, both positive (such as recharge) and negative (such as water quality), which affect the desirability of irrigating in that location.
Alternative water supply	Whether the soil moisture deficits can be overcome from other sources – such as groundwater.
Socioeconomic benefit	The impact for users and the wider community from the likely land uses to which the water will be put.

9.3.3 Step 3: Selecting and describing primary attributes

From the list of attributes identified in Step 2, 'primary' attributes were selected to represent irrigation. Primary attributes are described as 5-10 of the attributes that can best be used to represent the river value under consideration. The Expert Panel discussed the validity and reliability of each attribute, i.e., its strengths and weaknesses as a means to represent the river value, i.e., irrigation. In practice the list of attributes was sufficiently small that all were included as primary attributes, although 'timing/seasonal availability' was incorporated with reliability measures. There are some interlinkages between attributes that means they are not completely independent of each other, but the panel felt that there was a need for the additional descriptive information that each provided to the overall assessment.

9.3.4 Step 4: Identifying Indicators

This step defines one indicator that can be used to measure each primary attribute. The indicator needed to provide a cost-effective and quantitative measure of the attribute and, where possible, fit with the 'SMARTA' criteria, i.e., indicators that are **s**pecific, **m**easurable, **a**chievable, **r**elevant, **t**imely, and may be **a**lready in use.

One indicator was identified for each primary attribute, based on:
- Existing data, especially reliable, nationally available data; and
- Expert Panel judgement.

Difficulties in devising measurable indicators included:

- Data availability – availability of information was a key criterion for the Expert Panel. For each attribute the indicator with the most readily available information was selected, provided it gave sufficiently accurate information to discriminate among resources. Thus, for example, soil moisture ultimately came to be represented by average annual rainfall from long term rainfall site, because long term annual PET was found to vary little across the region, and total rainfall was closely correlated to irrigation season rainfall in the case study catchments. These assessments may need to be altered for regions where there is a marked difference between summer and winter rainfall.
- Feasibility – where an indicator was identified but it was not feasible to collect information, the panel tended to go to Expert Panel assessment as the preferred approach. An example is the measure of socio economic benefit, for which the preferred indicator was differences in land value with and without irrigation. It was decided however that this information would be too difficult to collect and so the panel went for expert assessment as the selected indicator. Similar reasons led to expert assessment for feasibility of abstraction, feasibility of storage, and receiving environment impacts.
- The receiving environment attribute is an expert assessment of the likely environmental effects of applying irrigation, with 1 being low risk and 5 being high risk. The panel attempted to use a 1 – 3 ranking that would then translate directly to the threshold score, but found that they needed a wider range of scoring options.
- The issue of whether or not the assessment used a *de novo* approach (see step 6), was found to be important when considering the availability of storage. The attribute was agreed as 'technically feasible storage'. However, in the Canterbury case study there are two major rivers with water conservation orders that prohibit damming of the main stems, as well as regional policies that mean that development of storages on the main stems are not realistic options. The panel concluded that in this case, their approach would be to exclude feasible storage options that were clearly unlikely to be considered possible to consent. This is consistent with the Canterbury Strategic Water Study stage 3 approach to evaluating water storage options across the region.

An assessment of the indicators using the SMARTA criteria is given in Appendix 9A-2.

9.3.5 Step 5: Determining Indicator Thresholds

Once the values had been determined, the next step was for the panel to set 'break points' for each indicator for categories of high, medium and low (High importance = 3; Medium importance = 2; Low importance = 1). These break points are known as "indicator thresholds" and are applied to an indicator to determine high, medium and low relative importance for irrigation in each river. The indicator thresholds allow mathematical calculation in subsequent steps.

The thresholds were developed by the panel in an iterative fashion using the case study data. The key areas of difficulty in setting thresholds were in relation to irrigable areas, size of resource and soil moisture deficits. Because the case study region had a large range of values in two of the indicators (mean annual flow varied from less than 1 to over 300 cumecs; irrigable area from less than 1,000 to over 100,000 ha), and because nationally the range of rainfall and PET is very large, it was difficult to define points at which the significance thresholds should be implemented. It is considered likely that the lower boundary of significance may need to be adjusted for each of these to suit the region being investigated. However the upper boundaries (defining the "3" score) should remain constant because of the importance of these attributes in defining national significance, and the need therefore to retain consistency across regions.

For the 'risk to the receiving environment' attribute the rankings of 1- 5 were assigned to the threshold scores of 1 – 3:

- Rank 1 and 2 = 3 (low risk);
- Rank 3 and 4 = 2 (medium risk);
- Rank 5 = 1 (high risk).

The high, medium and low thresholds for each indicator as determined by the Expert Panel are shown below in Table 9-2.

Table 9-2
Summary of Attributes, Indicators, Thresholds and Threshold Scores for Irrigation

Attribute	Indicator (ranges are from the Canterbury case study)	Thresholds
Technical feasibility of abstraction	Expert ranking (range 1 - 3)	Direct transfer (3 = 3)
Technical feasibility of storage	Expert ranking (range 1 - 3)	Direct transfer (3 = 3)
Reliability (ROR)	MALF/Mean annual flow as % (range: 4% - 72%)	>40% = 3 >20% = 2 <20% = 1
Reliability (Storage)	Annual volume million m^3 (range: 32 - 11,000)	> 3000 = 3 >=100 and <= 3,000 = 2 <100 = 1
Size of resource	Mean annual flow cumecs (range 1 - 370)	>70 = 3 > 5 = 2 <= 5 = 1
Soil moisture deficit	Annual average rainfall over irrigable area (mm at nearest long term rainfall site; range: 500 – 1,200 mm)	<=1,200 = 3 > 1,200 = 2 >1,700 = 1
Irrigable area	Irrigable area ha (range 1,000 - 270,000)	> 100,000 ha = 3 > 5,000 ha = 2 <= 5,000 = 1
Receiving environment	Rank 1 - 5 with 1 being low risk and 5 being high risk (expert assessment)	Rank 1 and 2 = 3 Rank 3 and 4 = 2 Rank 5 = 1
Alternative supply	Bypass solution[1]: Ranking using % (based on groundwater availability maps from Lincoln Environmental 2000 for CSWS)	<=30% = 3 > 30% = 2 > 60% = 1
Socio economic benefit	Expert Ranking from 1 (low) to 3 (high)	Direct transfer (3 = 3)

[1] Bypass solution: where a proportion of the irrigable area can be supplied from groundwater this is considered to reduce the demand for supply from the river, i.e., little groundwater available gives the river a 'high' score (3).

9.3.6 Step 6: Applying Indicators and Indicator Thresholds

Most indicators were assessed using objective and quantitative data - this step involved entering data from the relevant data sources. Data were kept in their original format where possible (e.g., irrigable area). This assisted the Expert Panel when evaluating the data, and helps achieve process transparency.

Outcome

Applications of thresholds are given in Appendix 10A-2.

9.3.7 Step 7: Weighting the Primary Attributes

The indicators and their thresholds were applied to case study data for Canterbury during the by the Expert Panel in order to categorise the rivers in the region according to their significance for irrigation. The approach to categorisation can involve some relative weighting of different attributes, depending on their relative importance, and in the case of irrigation, weightings were applied.

The RiVAS is intended to be applied to rivers *'de novo',* i.e., without planning or regulatory constraints because at least in theory, rules and regulations can be changed. However, after considerable discussion the Expert Panel concluded that for the RiVAS to be practical, it was appropriate to partly take into account the existing situation. For the Canterbury case study examples of existing constraints to irrigation that were acknowledged included: water conservation orders on the Rakaia, Rangitata and Ahuriri Rivers, regional policies and rules precluding damming of main stems of major rivers and urban development in the Avon River catchment. This situation may be different for other regions.

A simple aggregation of the scores for each attribute did not provide sufficient discrimination amongst rivers in the case study region. The lack of discrimination was exacerbated by the narrowness of the 1 – 3 range, and the interdependence of some variables.

The scoring range of 1 – 3 was very narrow in the context of a region like Canterbury, where the rivers differ in a major way from very large alpine rivers to small, groundwater streams. This resulted in rivers with substantially different characteristics being given the RiVAS score. However it is accepted that the 1 – 3 range increased the ease of undertaking the analysis, and the weighting criteria and expert input in individual cases were used to partially offset the narrowness of the range.

There were some further problems with aggregation because not all attributes were independent. An example would be those attributes affected by the nature of the resource (reliability, size and storage). This again reduces the ability of a simple aggregation to discriminate, and reinforced he need for weighting of scores.

For these reasons the panel agreed that some weightings were required as some indicators were of lesser importance than others for determining the significance of a particular river for irrigation.

Where a significant soil moisture deficit is indicated, a weighting is applied to emphasise both the size of the resource from a supply perspective, and size of the irrigated area from a demand perspective. The weighting selected is that when the soil moisture deficit threshold for a river is two (medium) or three (high), then the threshold scores for both size of resource and irrigated areas are weighted to power of three. For all rivers, the key secondary attributes of soil moisture deficit, reliability and presence of an alternative supply are all weighted +50%. The other attributes were not weighted. Table 9-3 summarises the weightings.

Table Error! No text of specified style in document.**-1**
Primary Attributes and Weightings

Primary Attribute	**Weighting**
Supply Attributes	
Technical feasibility of abstraction	Not weighted
Technical feasibility of storage	Not weighted
Reliability (Run of River)	Weighted + 50%
Reliability (Storage)	Not weighted
Size of resource	Weighted to the power of 3 where a soil moisture deficit is present, i.e., score = 2 or 3
Demand Attributes	
Soil moisture deficit	Weighted + 50%
Irrigable area	Weighted to the power of 3 where a soil moisture deficit is present, i.e., score = 2 or 3
Receiving environment	Not weighted
Alternative supply	Weighted + 50%
Socio economic benefit	Not weighted

9.3.8 Step 8: Determining the River Significance

There are two parts to determining the river significance: ranking the rivers, and then identifying the river as nationally, regionally or locally significant.

The total weighted scores developed in step 7 were used to order the rivers according to their value for irrigation. The significance rankings for Canterbury rivers, using the case study data, are shown in Appendix 9A-3.

The panel then developed criteria to categorise rivers according to their national, regional and local significance. To determine the level of significance of each river a combination of trigger attributes, predictor attributes or aggregates of attributes can be used, as set out in Hughey et al. (herein). To determine national, regional or local significance for irrigation three 'trigger' attributes were selected: size of water resource, potentially irrigable area and soil moisture deficit.

- *National significance* is defined by the combined presence of a large water resource (>70 cumecs; i.e., Score = 3), a large potentially irrigated area (>100,000 ha; i.e., Score = 3), and a soil moisture deficit (Score >=2).
- *Local significance* is defined by the presence of either a small resource (< 5 cumecs; i.e., Score = 1), a small irrigated area (<5000 ha; i.e., Score = 1) or no significant soil moisture deficit (Score = 1).
- The remaining rivers not defined as nationally or locally significant are, by default, *regionally significant*.

This ranking approach reflects the fact that while there are other significant issues for suitability of a resource for irrigation, there is potential to manage these other issues - for example reliability can be modified by storage. However the absence of water and irrigable land cannot be changed. We therefore consider that these should be the major drivers of determining the significance of the resource for irrigated agriculture.

9.3.9 Step 9: Other Factors relevant to the Assessment of Significance

In this phase the panel considered whether the methodology has appropriately reflected the importance of the different river systems in the case study. In particular, it considered whether there are any of the attributes of the irrigation values which cannot be captured adequately by quantified indicators, and whether these should be included in the final consideration.

The key concerns of the panel relate to consentability, defining potentially irrigable areas and storage:

- While it is understood that it is intended that the assessment should be undertaken as a *de novo* exercise, in practice the status of a resource in a region pertains to the availability of other resources. Thus if a more desirable irrigation resource is not available for reasons of difficulties in the consentability of abstraction, then the status of other more consentable resources in the vicinity become higher. Because it is clear there are some resources which are likely to be considered so iconic that they cannot be used for any significant abstraction, the ranking of other resources is potentially affected. For this reason, the panel considers it appropriate that some expert judgement should be applied to the value of some resources for irrigation purposes to reflect both its expected consentability, and the likely availability of other resources in the region.
- It is difficult to define the areas potentially irrigated from a particular river for regions, such as Canterbury, where water can be moved from catchment to catchment. In this case study we applied some expert assessment in defining the irrigated area for a specific resource. We consider it likely that this will need to be done in other regions where cross catchment transfer is possible.
- Storage has the potential to completely modify the profile of a resource from an irrigation point of view. In concept, most rivers have some potential for storage, but in practice the availability will depend on cost and on consentability. The approach for Canterbury drew heavily on the Canterbury Strategic Water Study, which had undertaken a detailed assessment of potential storage sites. In many regions this work may not have been undertaken, and it may be difficult to make an informed assessment of the suitability of rivers for storage. Because storage is generally considered in the context of a scheme approach to irrigation, it is likely that the suitability of a specific site for storage is less important that the availability of some storage in the vicinity. This grading of a resource for this attribute will therefore need to be considered carefully; and again some judicious expert assessment undertaken.

9.3.10 Step 10: Reviewing Assessment Process and Identifying Future Information Requirements

The panel considered the adequacy of the approach overall, and whether adequate information is available to allow it to make an appropriate assessment. In our view the approach worked satisfactorily for the purposes of assessing resources from an irrigation perspective. The panel had some unresolved concerns about the consentability issue and the extent to which the assessment should be *de novo* or include practical realities of some resources not being available for irrigation. There were also some significant difficulties in resolving storage and irrigated areas. However the final chosen methodology, relying as heavily as it does on irrigated areas and the size of the resource for rankings, should be reasonably resilient to decisions made about other attributes.

The rankings resulting from the Canterbury case study did not provide any surprises for the Expert Panel, and would be those anticipated by informed professionals. It is unlikely, therefore, that the RiVAS would add value for professionals who are experienced in water resources/irrigation development and associated planning and regulatory constraints. The value of the approach may be more apparent when irrigation is considered alongside other 'river values' (salmonid fishing, kayaking, etc.), as it could assist in providing a comparative understanding of potential resource allocation issues.

Future key information requirements that would assist other regions in undertaking this assessment include:

- Seasonal soil moisture deficit maps;
- Seasonal information on rainfall and river flows, particularly 5 year low volumes;
- Mapping of groundwater availability; and
- Potential storage sites related to each river resource.

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Appendix 9A-1
Expert Panel Members and Peer Reviewer

Expert Panel

Terry Heiler is a water resources research and engineering specialist and at the time of the work (2009) was CEO Irrigation New Zealand.

Murray Doak is a Senior Policy Analyst, Natural Resources Group, MAF, with considerable experience in irrigation economics and policy.

Simon Harris, Harris Consulting, is a consultant in resource economics and public policy analysis – he has done much recent work on irrigation scheme proposals.

Claire Mulcock is a resource management consultant and hydrologist with much experience of working with farmers and with irrigation scheme proposals.

Advisors

Ken Hughey

Linda Weastall, Principal Planning Advisor, Environment Canterbury – Linda contributed to development of the attributes and indicators, but did not participate in the Canterbury case study.

Peer reviewer

Dr Nick Brown is an economist specialising in resource economics, national and regional impact analyses, regional economics, cost-benefit analysis and development economics, including involvement in irrigation related work.

Appendix 9A-2
Assessment of indicators by SMARTA criteria

Attribute	Indicator	Specific	Measurable	Achievable	Relevant	Timely	Already in use	Strengths and Weaknesses
Technical feasibility of abstraction	Expert ranking (range 1 - 3)	Yes	Can be assessed from geomorphic data	Can be determined	Influences likelihood of irrigation	Expert assessments practical	Yes	Difficult to assess, and varies by river reach. However important in overall usability of resource
Technical feasibility of storage	Expert ranking (range 1 - 3)	Yes	Can be assessed	Assessments of storage options may be available	Shows whether storage is feasible / likely	Expert assessments practical	Yes	Difficult to assess as site dependent. Problems with de novo approach because of policies preventing dams
Reliability (Run of River)	MALF/Mean annual flow as %	Yes	Yes, or natural flows calculated	Long term records or estimates	Shows how often flows are available for irrigation	Data / estimates available	Yes	Reliability if very difficult to describe fully. No indicator will do justice. However key implications for users.
Reliability (Storage)	Annual volume (million m^3)	Yes	Calculated	Can be determined	Shows whether flows are regularly available for storage	Can be calculated	Yes	Requires complex modelling to properly determine, and very dependent on river rules.
Size of resource	Mean annual flow (cumecs)	Yes	Yes, or natural flows calculated	Data or estimates available	Indicates relative amount of water for irrigation	Data available	Yes	Key indicator as availability is a direct function of size. Easily accessed.
Soil moisture deficit	Annual average rainfall over irrigable area (mm) at nearest long term rainfall site	Yes	Yes	Data available	Strongly influences irrigation demand	Data available	Yes	Key indicator, and reasonably accessible. Can vary somewhat.
Irrigable area	Irrigable area (ha)	Yes	Yes	Data available	Influences magnitude of demand	Data available	Yes	Difficult to determine because of transferability

Attribute	Indicator	Specific	Measurable	Achievable	Relevant	Timely	Already in use	Strengths and Weaknesses
								of water. Key indicator for demand side.
Receiving environment	Rank 1 - 5 with 1 being low risk and 5 being high risk (expert assessment)	Yes	Assessed from a range of criteria	Can be determined	Adverse effects may constrain irrigation development	Can be estimated	Yes	Difficult to assess as determined by land use, local characteristics. May be major constraint on development potential of resource.
Alternative supply	Bypass solution: rank % of irrigable area that can be supplied	Yes	Yes	Data available	Influences magnitude of demand from river	Hard to assess in a timely manner other than by expert	Yes	Difficult to determine in case of groundwater, for both physical reasons (is there alternative water?) and whether that water will be made available.
Socio economic benefit	Expert Ranking from 1 (low) to 3 (high)	Yes	Can be assessed, but not easily	In some cases	Influence on the importance of the resource for the community	Hard to assess in a timely manner other than by expert	Yes	Hard to assess as land use can change over time. However the use of water for high value land uses has major socioeconomic implications.

Appendix 9A-3
Significance Assessment Calculations for Irrigation from Canterbury Rivers

River	Attributes and indicators											Conversion to threshold values										Ranking and scores		
	Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit		Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit	Aggregate	Ranking (weighted)	Significance
	Expert ranking (1 - 3)	Expert ranking (1 - 3)	MALF/Mean %	Annual vol m3	Mean annual flow[i] (m3/s)	Rainfall[ii] (mm)	Irrigable area (ha)[iii]	Rank 1 - 5[iv]	Bypass solution[v] %	Ranking[vi] from 1-3		3 = 3	3 = 3	>40% = 3, >20%=2,<20%=1	>3000=3, <100 = 1	>70 = 3,>5 = 2,	>1700 = 1,>1200 = 2	> 100000 = 3, > 5000 = 2 ha	Rank 5 = 1, 3 and 4 = 2, 1 and 2 = 3	> 60% = 1, > 30% = 2	Direct transfer (3 = 3)	Sum	See note below[vii]	See note below[viii]
Waitaki	3	3	53	11668	370	500	212596	2	0	2		3	3	3	3	3	3	3	3	3	2	29	81.5	National
Rakaia	2	3	43	6402	203	700	270000	2	30	2		2	3	3	3	3	3	3	3	3	2	28	80.5	National
Rangitata	2	2	42	3154	100	700	270000	2	30	2		2	2	3	3	3	3	3	3	3	2	27	79.5	National
Waimakariri	2	2	32	3784	120	700	141000	3	20	2		2	2	2	3	3	3	3	2	3	2	25	77	National
Sth Ashburton	3	3	39	347	11	700	270000	2	30	2		3	3	2	2	2	3	3	3	3	2	26	60	Regional
Waiau	3	1	26	3059	97	900	54206	1	0	2		3	1	2	3	3	3	2	3	3	2	25	59	Regional
Hurunui	3	3	30	2302	73	600	63716	3	0	2		3	3	2	2	3	3	2	2	3	2	25	59	Regional
Opihi	3	3	24	189	6	600	105012	4	10	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Opuha	3	3	27	315	10	600	105012	4	10	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Ashley	3	3	18	378	12	700	141000	3	10	2		3	3	1	3	2	3	3	2	3	2	25	58.5	Regional
Orari	3	2	28	347	11	600	105012	4	10	2		3	2	2	2	2	3	3	2	3	2	24	58	Regional
Nth Ashburton	2	2	32	284	9	700	270000	2	10	2		2	2	2	2	2	3	3	3	3	2	24	58	Regional
Clarence	3	1	26	2271	72	900	1653	1	0	3		3	1	2	2	3	3	1	3	3	3	24	52	Local
Hope	3	1	33	1419	45	1200	54206	1	0	1		3	1	2	2	2	3	2	3	3	1	22	38	Regional
Ahuriri	2	3	38	757	24	500	24000	4	0	1		2	3	2	2	2	3	2	2	3	1	22	38	Regional
Hakatarame a	3	1	18	189	6	500	8077	2	0	1		3	1	1	2	2	3	2	3	3	1	21	36.5	Regional
Pareora	3	2	13	126	4	600	41000	2	0	2		3	2	1	2	1	3	2	3	3	2	22	31.5	Local

River	Attributes and indicators											Conversion to threshold values										Ranking and scores		
	Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit		Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit	Aggregate	Ranking (weighted)	Significance
	Expert ranking (1 - 3)	Expert ranking (1 - 3)	MALF/Mean %	Annual vol m3	Mean annual flow[i] (m3/s)	Rainfall[ii] (mm)	Irrigable area (ha)[iii]	Rank 1 - 5[iv]	Bypass solution[v] %	Ranking[vi] from 1-3		3 = 3	3 = 3	>40% = 3, >20%=2,<20%=1	>3000=3, <100 = 1	>70 = 3,>5 = 2,	>1700 = 1,>1200 = 2	> 100000 = 3, > 5000 = 2 ha	Rank 5 = 1, 3 and 4 = 2, 1 and 2 = 3	> 60% = 1, > 30% = 2	Direct transfer (3 = 3)	Sum	See note below[vii]	See note below[viii]
Selwyn	3	3	23	95	3	700	5000	5	20	2		3	3	2	1	1	3	2	1	3	2	21	31	Local
Waipara	3	2	4	95	3	600	60000	3	10	3		3	2	1	1	1	3	2	2	3	3	21	30.5	Local
Tengawai	3	2	14	126	4	600	41000	3	0	2		3	2	1	2	1	3	2	2	3	2	21	30.5	Local
Maerewhenua	3	1	22	95	3	500	74000	2	0	1		3	1	2	1	1	3	2	3	3	1	20	30	Local
Waihao	3	1	9	126	4	600	41000	4	10	2		3	1	1	2	1	3	2	2	3	2	20	29.5	Local
Cust	3	1	24	32	1	700	1000	3	20	2		3	1	2	1	1	3	1	2	3	2	19	23	Local
Okuku	3	1	14	158	5	700	1000	3	0	2		3	1	1	2	1	3	1	2	3	2	19	22.5	Local
Halswell	3	1	67	32	1	700	1000	5	100	2		3	1	3	1	1	3	1	1	1	2	17	20.5	Local
Kaituna	3	1	5	32	1	700	1000	5	80	3		3	1	1	1	1	3	1	1	1	3	16	18.5	Local
Avon	3	1	72	63	2	700	0	5	0	2		2	1	3	1	1	3	1	1	1	1	15	18.5	Local

Red coloured cells show where threshold score has been adjusted by Expert Panel
Shaded columns show the attributes that have been weighted to obtain the total score

[i] From Canterbury Strategic Water Study
[ii] Average Annual Rainfall (mm) over irrigable area (nearest rainfall site)
[iii] From Canterbury Strategic Water Study. Some areas assigned by expert opinion
[iv] with 1 being low risk and 5 being high risk (expert assessment)
[v] Bypass solution ranking from % of irrigable area (maps from CSWS)
[vi] Socio-economic benefit -ranking 1 (low) - 3 (high) Expert assessment
[vii] Irrigated area and size of resource cubed, reliability soil moisture and alternative supply +50%, remainder aggregated. Weighting for irrigable area and size of resource only applies if Soil Moisture deficit is >1, otherwise they receive a 50% weighting.
[viii] National - irrigated area 3, size of resource 3, soil moisture deficit 2 or greater. Local - resource size = 1, irrigated area = 1 or no soil moisture deficit. Remainder regional