Riverscape AND *Flow*

ASSESSMENT GUIDELINES

Boffa Miskell

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Executive Summary

2.0 Executive Summary

These guidelines have been prepared to assist those involved in the assessment of river landscapes (riverscapes) as an input to water allocation decisions. They are designed to further the understanding of managers, decision makers and landscape specialists involved in water allocation investigations.

The guidelines update and expand on the landscape components of the 1998 MFE flow guidelines. The research for this update is based in part on the findings of FRST funded water allocation program (WAP) research carried out between 2003 and 2009.

Section 3 discusses the history of riverscape assessment and research. This is followed by section 4 which describes riverscape values. Section 5 introduces riverscape assessment approaches, leading into section 6 which recommends a Riverscape Assessment Methodology. This section suggests appropriate approaches to address 'landscape' (which includes natural character and amenity values) as one of the instream issues that should be considered in any investigation leading to water allocation decisions. The methodology section of this report is likely to be of particular assistance to landscape architects and other consultants directly involved in water allocation investigations where 'landscape' values require detailed assessment. It starts with the initial scoping of 'landscape' issues requiring assessment, addresses the preparation of an assessment brief, and then describes the process of river description, analysis and evaluation. Finally, it comments on the integration of findings from this assessment process with that of other in-river values.

The guidelines recognise different levels of investigation complexity and suggest appropriate techniques tailored to the significance of the water allocation issue. The process can be applied to a range of investigations including regional river assessments as well as resource consent applications.

Observations from the WAP research findings and from its practical application in a range of actual water allocation projects are included to illustrate the issues peculiar to riverscape assessment. A number of technical appendices provide specific assessment material which can be used to aid site investigations and assessment.

Section 03

Introduction

3.1 PURPOSE

The purpose of these guidelines is to assist those investigating the perceptual aspects of environmental flows in regulated rivers leading to establishment of flows that sustain instream values. The guidelines address 'landscape' issues raised by flow rate, flow duration and other flow regime changes. The guidelines reflect advances in thinking since the Ministry for the Environment 'flow guidelines for instream values' in 1998[1]. They are cognisant of the possible content of the Proposed National Policy Statement (PNPS) for Freshwater Management and the Proposed National Environmental Standards on Ecological Flows and Water Levels (NES)[2]. Where appropriate, the method section of these guidelines takes a similar approach to the 'Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels' prepared for MFE also in 2008[3].

3.2 BACKGROUND

The 'Flow Guidelines for Instream Values' prepared in 1998 for the Ministry for the Environment (MFE) provided, at that time, a long-overdue guide for resource managers. However, an evaluation of the guidelines[4] in 2001 identified a number of weaknesses including the need to update those parts that had become outdated. The sections addressing landscape, natural character and amenity values were considered to be too general.

These 'landscape' guidelines incorporate findings from the Water Allocation Programme (WAP) Research (2003 – 2009) and other recent advances in understanding of 'landscape' issues. They should assist the decision making process leading to wise allocation of water resources within Aotearoa New Zealand's rivers.

The principle audiences for the guidelines are:

a) Regional and Unitary Council decision makers, resource management staff and other professional and technical personnel involved in river use and management and in particular statutory landscape related issues

b) Landscape professional or technical personnel involved in assessing landscape considerations in water allocation decision making

Tangata Whenua and environmental groups may also find these guidelines helpful when seeking information to assist statutory involvement.

Throughout these guidelines the term **'landscape'** when placed in inverted commas, is used to encompass the range of biophysical, sensory and associative considerations including matters addressed in RMA s6 and s7[5] In particular landscape aspects of natural character, outstanding natural features and landscapes and visual amenity values are all included in the umbrella term - 'landscape'. The term **riverscape** has been used when referring to river 'landscapes' and as such the use of this term in these guidelines implies more than visual concerns.

[1] Flow Guidelines for Instream Values Volumes A & B Ministry for the Environment 1998

[2] Proposed National Environmental Standard on Ecological Flows and Water Levels – Discussion Document , Ministry for the Environment, 2008

[3] Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels – A report prepared for the Ministry for the Environment by Beca Infrastructure Limited 2008

[4] Evaluation of Flow Guidelines for Instream Values – A report prepared for the Ministry for the Environment by Boffa Miskell Limited June 2001

[5] Resource Management Act 1991 section 6(a) natural character, section 6(b) outstanding landscapes and natural features, section 6(f) heritage and s7(c) amenity values are of particular relevance.

3.3 STATUTORY CONTEXT

Under the Resource Management Act 1991 (RMA), regional and unitary councils are responsible for allocating the use of freshwater. The PNPS and PNES once introduced, will provide a national context for these responsibilities. The concept of identifying, protecting, enhancing and restoring 'notable' values is integral to the PNPS. The management of natural character and outstanding natural features and landscapes are matters of national importance (RMA s6) and they are key considerations in defining environmental flows.

3.4 RESEARCH BACKGROUND

These guidelines have been prepared by a landscape assessment team at Boffa Miskell Ltd in Christchurch[6]. The guidelines are the final output from the landscape component of a FRST funded research project (2002 – 2009) led by NIWA titled "Water Allocation Programme: Protection of Instream Values" (FRST Contract COIX0308)[7] .

The first stage of this research advanced the understanding of the perception of rivers under a variety of flow conditions. The work explored the variables of river type, reach, flow rates and viewer group, based on results from an on-line survey with about 450 participants from a variety of stakeholder groups. It explored the perceptions of and preferences for instantaneous low flows (a single flow at a given time), as would be experienced by a one-time visitor to a river.

The second stage of the research addressed the perceptual significance of changes resulting from extended low flow duration and other flow regime changes. This is an area of landscape research that had received little attention previously. The effects of modifying flow regimes and particularly extending the period that rivers would naturally sit at low flow levels are major considerations in flow allocation decisions with significant implications for 'landscape' values.

[6] Allan Rackham, Dip LA, MPhil, FNZILA. Experience includes regional river assessments for Marlborough, Canterbury and Otago, several water conservation orders, hydro related investigations including Tongariro, Manapouri and Waitaki and numerous other water allocation investigations for government departments, regional and district councils and for developers. He was the author of the landscape sections of the 1998 MFE Flow Guidelines for In-stream Values and leader of the WAP.

Yvonne Pfluger, MLA, MNRMEE, CEnvP. Experience includes preparation of river restoration and river landscape management plans in Austria for the European Union, and hydro related investigations in New Zealand. Member of an expert panel carrying out minimum flow assessments for several Canterbury Rivers on behalf of the Regional Council. Involvement in the WAP research included design of research format (on-line survey, questionnaire and focus group discussions), contribution to scientific papers and guidelines.

Contribution to various aspects of the WAP research: Charlotte Jackson, Sarah Hamilton, Sue McManaway, Judi Foster, Roland Foster, Rob Greenaway.

[7] Several aspects of this research are of relevance to these guidelines:

- A detailed literature review – see selected references appended to this report
- A study of the language/ terminology used in river descriptions and evaluations – see Appendices 3 and 4.
- A visual database of several hundred photographs of known flows in selected Canterbury rivers – representative viewpoints were selected for seven rivers and photographed in a range of known flows – see illustrations.
- An on-line questionnaire exploring respondents' flow preferences and their ability to estimate flows
- Photographic guidelines for river assessments – see Appendix 2
- Focus groups findings on the potential of visual surrogates as proxies for on-site river assessments – see Appendix 6
- Focus groups findings on the assessment of natural character of rivers

Modified flow regimes may result in:

a) extended periods of low flow conditions within a river channel expressed in reduced wetted width and exposed banks, less vigorous flow, dead periphyton or other indicators etc;

b) Mid and long term physical and biological changes such as armouring of river bed, loss of riparian wetlands, establishment of woody vegetation on banks and islands, and increased periphyton growth and other aquatic vegetation.

Outputs of this research include scientific papers on the aesthetic value of rivers[8], and on the use of graphic material as proxy for on-site river flow and natural character assessments[9] . The findings of this research have been submitted for publication. Several other research projects have been carried out by NIWA as part of the WAP. A parallel research project exploring issues of Maori perception of flows has been undertaken by Tipa Associates[10] .

Many findings from the WAP research have been tested and refined in a number of recent waterway investigations within the South Island including numerous smaller Canterbury rivers and streams as well as larger rivers, such as the Waitaki.

3.5 LIMITATIONS OF GUIDELINES

These guidelines complement the ecological flow component of the draft ecological guidelines prepared by Beca (2008) and the proposed NES. Those documents offer advice on setting ecological flows, but *"no guidance on the process of how to set environmental flows"*. Environmental flows are defined as *"the flows required in a waterbody to provide a given set of values which are established through a regional plan or other statutory process"*. These 'landscape' guidelines are limited to 'landscape' considerations and as such provide another piece of the jigsaw that will, contribute to the process of setting environmental flows, and ultimately, to better river management.

The limitations inherent in the guidelines result from

1) The still nascent state of river landscape assessment theory and practice.

2) The limitations imposed by the guideline's focus on river flows. River flow is clearly only one of a number of issues that affect a river's 'landscape' quality. For example, others include catchment management, riparian development and pollution.

3) The overlaps and interrelationships between 'landscape' and many other values, such as recreation, tangata whenua and heritage.

4) A generic assessment process may not necessarily suit all rivers and management situations.

5) An emphasis on South Island research and examples.

6) The need to appeal to a broad audience of varied experience and understanding. In writing a practitioners' guide, we have assumed a reasonable level of familiarity with both the statutory resource management context and the practice of 'landscape' assessment.

[8] Larned S, Rackham A.M., Pflüger Y. The aesthetic value of river flows: an assessment of flow preferences for large and small rivers, Manuscript submitted for publication

[9] Pflüger Y., Rackham A.M. Evaluation of graphic material as proxy for on- site river flow and natural character assessments, Manuscript submitted for publication

[10] Eg. Tipa, G. (2009) and Biggs B.J.F., Ibbitt R.P, Jowett I.G. (2008) – see reference section

Section 04

Landscape and Riverscape Values

4.1 'LANDSCAPE'

What is meant by 'landscape' and the way that we understand and value it is constantly evolving. However, there is general agreement that landscape means more than just 'the view'. Put simply, landscape can be explained as a reflection of the relationships between people and place.

The term 'landscape' is not actually defined in the RMA or the New Zealand Coastal Policy Statement (NZCPS). However, various descriptions have emerged through evolving practice and case law. For example,

- According to the New Zealand Institute of Landscape Architects, *"the landscape reflects the cumulative effects of natural and cultural processes";*
- The Environment Court has provided elements of a working definition of landscape, often referred to as the 'Amended Pigeon Bay' or 'WESI' criteria[11].
- The Environmental Defence Society provides a useful summary of landscape in the *Community Guide to Coastal Development* (2005:50) that includes the following points:

'Landscape involves natural and physical resources, including land, water, air, plants, animals and structures, and various factors relating to the viewers and their perception of the resources.

Landscape provides a linkage between individual natural and physical resources and the environment as a whole, through considering a group of such resources together, and emphasising that our attitudes to these resources are affected by social, economic, aesthetic and cultural conditions.'

- A recent paper prepared for the NZILA education foundation and drawing on the experience of a wide number of experienced practitioners proposed the following definition:

"Landscape is the cumulative expression of natural and cultural elements, patterns and processes within a geographical area."

Landscapes are multi-dimensional due to the many inter-related factors involved, including:

- The numerous inherent factors, such as biophysical systems or human land uses;
- The values we place on those factors and landscapes;
- The differences in value held by individuals, communities, stakeholders or the nation about landscapes.

Whether we occupy a landscape, visit it, look at it or just read about it, we develop a relationship with it – even a sense of identity from it – and place values on it in ways that reflect our culture. It is recognised, for example, that tangata whenua have a unique relationship to landscape and rivers which may influence decisions about landscape management. These multiple understandings of landscape are further complicated by the inevitable changes in people's perceptions that occur over time and by the fact that all landscapes are dynamic to some extent.

Landscape change:

- may reflect natural or human-induced processes. e.g. erosion or land use change
- is not always predictable e.g. flood, earthquake
- can occur at a range of scales and timeframes e.g. from small incremental changes over a long time to larger sweeping change in a short time.

As society changes, pressures on landscapes and the values we attribute to them also change. Many of the effects on landscape occur from interrelated drivers of change – including agriculture, forestry, housing, transport and energy requirements among others. This diversity of complex issues can make the management of landscape and natural features a challenging task. These observations on 'landscape' also apply to riverscapes.

[11] C32/1999 - Pigeon Bay Aquaculture Ltd v CRC and C180/1999 - Wakatipu Env. Society v QLDC

4.2 RIVERSCAPE VALUES

Rivers are particularly dynamic and complex features set within a landscape context. Rivers are often critical landscape features as they have been, and may still be, highly influential in forming the wider landscape. They are often a visual, ecological and recreational focus and provide physical links throughout their catchments. Riverscapes have natural character, amenity and landscape values that will require consideration in water allocation decisions.

Natural Character Values

The Resource Management Act considers as a matter of national importance *"the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development."*

There is no definitive definition of natural character in the legislation. Nevertheless, it is generally accepted that natural character is a term used to describe the naturalness of river environments and has both ecological and landscape connotations. A definition that has been adopted by some landscape architects and other resource management practitioners is:

'Natural character is a term used to describe the naturalness of river environments.

The degree or level of natural character within an area depends on:

1. *The extent to which natural elements, patterns and processes occur*
2. *The nature and extent of modifications to the ecosystems and landscape/riverscape.*

The highest degree of natural character (greatest naturalness) occurs where there is least modification. The effect of different types of modification upon the natural character of an area varies with the context, and may be perceived differently by different parts of the community.'

The natural character of rivers may be affected by structural modifications (eg the construction of groynes, stop banks or bridges), changes in appearance resulting from particular flows (in the most extreme case a dewatered river channel), or by longer term effects of flow regime changes such as vegetation encroachment onto river beds, the loss of river braids etc.

Natural elements incorporate all key river elements, such as the water, bed and banks, as well as particular attributes occurring within the river environment, such as geological formations, native vegetation and fauna. Natural patterns take the outline of the channel and the riparian edge into account, as well as the effects of patterns created by humans on adjacent land, such as shelterbelts. Natural processes include river dynamics, such as erosion, freshes and floods, and regeneration processes of riparian vegetation. Bridges, stopbanks and groynes are examples of built modifications that may be in or close to the river bed. Roads, structures and buildings occurring further from the river on adjacent land may also have effects on the natural character of a water body. To make an assessment of natural character more manageable it may be helpful to cluster attributes. The following groupings have been used in the WAP research:

- Shape of river bed and channel
- Riparian vegetation
- River flow
- Water quality
- Man-made structures in and adjacent to the riverbed

These guidelines focus on the perceptual rather than ecological aspects of natural character.

Amenity Values

Amenity values have been defined in the RMA as "those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes".

Therefore a river's amenity values include those qualities and characteristics which contribute to people's appreciation of a river's pleasantness, aesthetic coherence and cultural or recreational attributes[12].

Generally, it is the visibility and visual nature of flow changes that are the main amenity focus of riverscape assessments required to assist water allocation exercises. Information about specific recreational values is generally provided by experts in the recreation/ tourism fields and/ or by stakeholders through community consultation. The requirements of specific recreation uses are not addressed in these guidelines.

Landscape Values

The protection of outstanding natural features and landscapes from inappropriate use, subdivision and development is a matter of national importance (RMA s6b). A number of ways in which landscape is valued are recognised by the Environment Court (eg decisions C32/1999 and C180/1999). These considerations apply equally to riverscapes which may be identified in regional or district plans as outstanding natural features and landscapes.

- *natural science factors - the geological, topographical, ecological and dynamic components of the landscape*
- *aesthetic values including memorability and naturalness*
- *expressiveness (legibility) - how obviously the landscape demonstrates the formative processes leading to it*
- *transient values - occasional presence of wildlife; or its values at certain times of the day or of the year*
- *whether values are shared and recognised*
- *tangata whenua values*
- *historical associations.*

Fig 1: The natural character of the Avon River, including its landscape context and the channel outline, have been substantially modified reducing its natural character, but the visual amenity is considered high.

Fig 2: The landscape context of the mid Waipara River contains impressive limestone features. In the gorge section the formative processes and shaping forces of the river are highly legible. This riverscape has high landscape value.

[12] MFE guidelines, p29
[13] RMA Amendment Act 2003

The concept of Heritage Landscapes has received increased attention in recent years[13] . 'Historic heritage' is defined in section 2 of the RMA as being *'those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures'.* The definition also states it can be derived from cultural qualities, among others, and includes 'surroundings associated with the natural and physical resources.'

In a New Zealand Historic Places Trust (NZHPT)[14] paper heritage landscapes were considered to differ from historic sites or buildings in that they can:

- Cover large areas
- Have many owners or interested stakeholders
- Have natural and cultural values
- Be dynamic systems, and
- Be a composite of layers of human history and interaction

Rivers have provided a focus for Maori and European settlement and activities including trading, communication links and food gathering and as such may be identified as the focus of important linkages within or between heritage landscapes. Consequently, it is important that riverscape assessment address landscape issues in addition to natural character and amenity values.

Figure 3 shows the components of riverscape assessments covered in these guidelines[15] . These values will lead to the identification of 'flows for amenity and natural character values' referred to in the proposed NES discussion document. The NES diagram is reproduced as Figure 4.

Figure 3

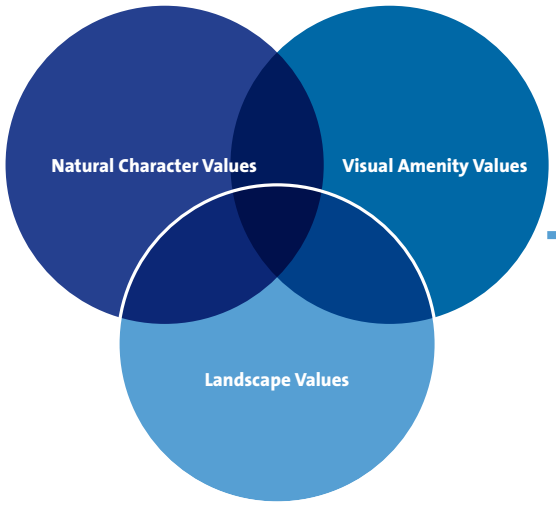
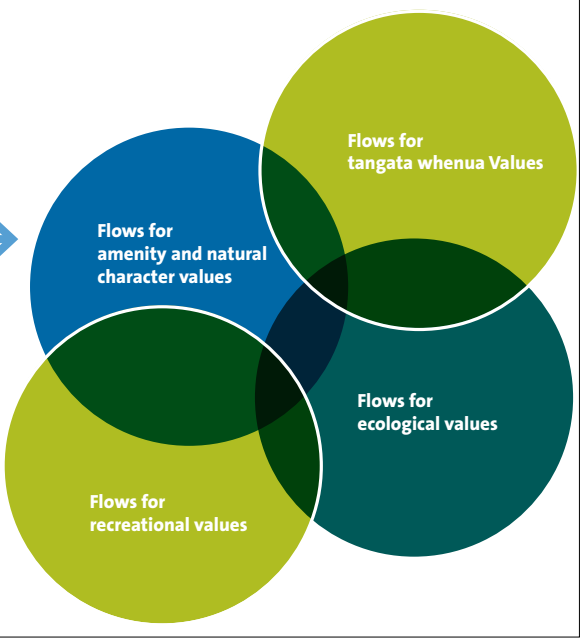


Figure 4

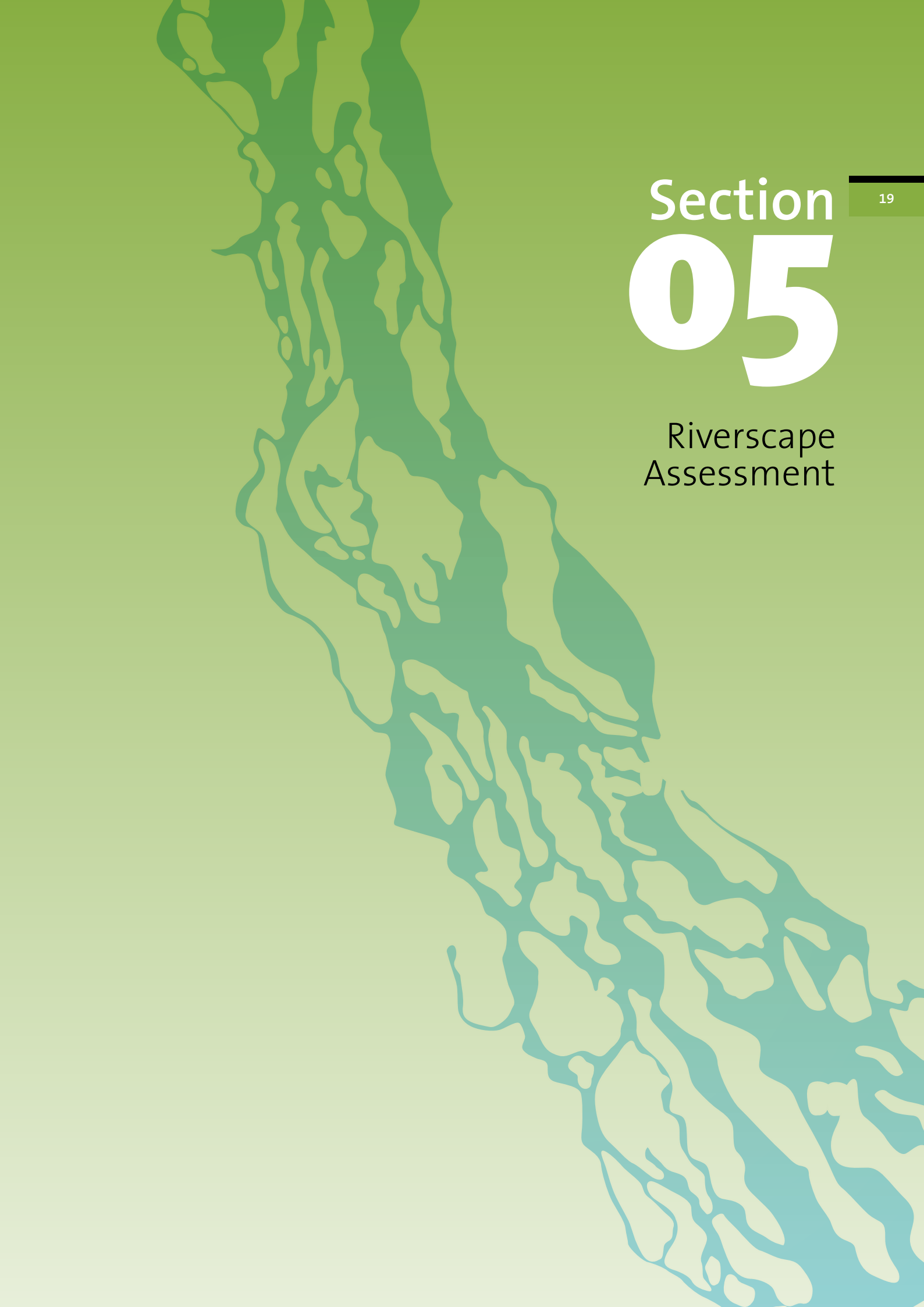


[14] New Zealand Historic Places Trust, 2003 Heritage Landscapes Think Tank – report on Proceedings

[15] Refer to Ministry for the Environment. 2008. Proposed National Environmental Standards on Ecological Flows and Water Levels, Discussion document, Fig 3, p.8.This figure show the other components of environmental flows or water level: ecological, recreation and tangata whenua values.

Section 05

Riverscape Assessment



5.1 BACKGROUND TO RIVERSCAPE ASSESSMENT

Riverscapes are important socio-economic resources, but quantification and assessment of 'landscape' attributes is fraught with difficulty. Unlike landscape ecology, which has a clear empirical basis, landscape assessment (including the characterisation and valuation of human perception and use of landscapes) must address complex interactions between empirical data, sensory perception and cognition, and socio-economic contingencies (Zube 1987). After more than a century of practice, standardized methods and organizing principles for terrestrial landscape assessment are still under development (Daniel 2001, Kronert et al. 2001, Sheppard et al. 2004). Landscape assessments applied to rivers (riverscapes) are at an even earlier developmental stage.

Environmental values[16] of rivers addressed in these guidelines include the natural character, landscape and visual amenity values of riverscapes. Historically in New Zealand there has been little focus on riverscape research compared with investigations into the ecological values of rivers. Overseas, much of the riverscape research does not directly address the significance of flow rates and regimes and perceptual responses to these, concentrating instead on riparian and wider landscape influences.

Biophysical elements that comprise riverscapes have been identified (e.g., channel morphology, flow regime, riparian vegetation; Leopold & Marchand 1968, Brown & Daniel 1991), but considerable uncertainty remains concerning the dependent variables, such as natural character, landscape and amenity values, used in assessments. All of these variables are challenging to assess due to, firstly the dynamics and complexities of the resource and secondly the difficulties in differentiating sensory responses and unequivocally attributing those responses to particular riverscape elements.

The lack of a strong research base in New Zealand is understandable. There are comparatively few professional landscape assessors and the majority of these are non-specialist landscape consultants. River investigations have rarely been the focus of research either by these practitioners or by landscape academics. Recent work by Lincoln University is an exception (eg Kerr and Swaffield 2007). Nonetheless, the issue of riverscape values and the potential effects on these, resulting from water allocation, has been a key consideration in many river resource management debates[17]. With allocation pressures likely to continue[18], concern for 'landscape' values will remain an integral part of environmental flow setting in New Zealand.

Despite the difficulties and deficiencies, riverscape assessments are widely used in river management and planning in other countries[19]. However, standardised methods for conducting assessments and predicting impacts are lacking, and there is little consensus on the biophysical, perceptual or other elements that should be used as indicators of riverscape quality. Riverscape assessments may focus on elements such as riparian vegetation and river planform (Meitner 2004), or on relatively simplistic flow-related elements such as wetted width and discharge (Brown & Daniel 1991).

The WAP research project provided an opportunity to explore issues beyond the historical research focus on the aesthetic quality of flows. The need to investigate more sophisticated riverscape values, such as long term natural character modifications, parallels the management shift that has occurred in New Zealand and elsewhere, away from a reliance on minimum low flow setting to a more sophisticated management of environmental flow regimes[20].

[16] The RMA definition of: "Environment" includes –
(a) Ecosystems and their constituent parts, including people and communities; and
(b) All natural and physical resources; and
(c) Amenity values; and
(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters:

[17] refer to eg Water Conservation Orders for the Kawarau, Buller, Rakaia and Rangitata Rivers; and/or hydro electric power scheme proposals for the Wairau, Waiau, Waitaki and Tongariro Rivers

[18] Biggs B.J.F., Ibbitt R.P, Jowett I.G. 2008. Determination of Flow Regimes for protection of in-river values in New Zealand: an overview. Ecohydrology and Hydrobiology 8:17-29

[19] eg assessments of naturalness and recreation and scenic value are all required for designating rivers under the United States Wild and Scenic Rivers Act of 1968 (Palmer 1993)

[20] Refer to Proposed National Environmental Standards on Ecological Flows and Water Levels, Discussion document, Ministry for the Environment, March 2008

Sophisticated assessments of flow-related elements are needed to avoid or minimize the negative impacts of diversions, dams, and other flow alterations. While vegetative and geomorphological elements can be assessed using standard techniques for static landscape elements (eg. Chen & Lin 2007), assessments of flow attributes are more complex and must account for temporal variation in flows as well as spatial interconnections and variation. The WAP research findings have advanced our understanding of how these issues may be addressed and have been incorporated in to these guidelines.

5.2 ASSESSMENT APPROACHES

Riverscape assessments may be carried out for a variety of reasons ranging from small site-scale assessments of river values or the effects of minor flow changes, through to sophisticated assessments of sensitive rivers subject to major flow modifications.

Landscape assessment approaches may involve:

- descriptive assessments, which describe natural and cultural patterns and processes and aid the interpretation of landscape character;
- evaluative appraisals, which judge comparative qualities; and
- preferential judgements, which assess personal subjective reactions to specific landscapes.

Descriptive and evaluative assessments are usually undertaken by professional landscape architects, although the process followed may include stakeholder or community involvement. Preferential judgements are more likely to be undertaken by researchers looking for both pragmatic understanding of management issues or more abstract questions relating to how people value landscapes. These approaches can be combined to gain a better understanding of both the objective attributes and features of the landscape and associated human perceptual qualities (Daniel 2001).

The use of expert assessors is particularly appropriate in situations where complex landscape dynamics are considered to be important factors (e.g. in determining natural character) and where expert evidence will be required in council hearings or the environment court. It requires a certain level of knowledge and understanding of natural processes if the results are to be meaningful. This is generally the case with river based landscape assessments where some understanding of the eco-hydraulics is important. The skilled landscape assessors may well be part of a multidisciplinary investigation team that includes experts in these areas.

These guidelines are designed to inform expert landscape assessors about suitable assessment methods and relevant techniques. The final choice of methods and selection of techniques will be tailored to the particular assessment needs. However, these guidelines provide a starting point and they will alert assessors to potential pitfalls and provide direction towards effective processes.

Section 06

Riverscape Assessment Methodology

6.1 RIVER ASSESSMENT METHODOLOGY

These guidelines are set out as an eight step assessment process. A simplified guidesheet outlining the tasks involved in the river assessment process is provided in Appendix 6.

Step 1. Scope 'landscape' as an instream value and water allocation issue

Step 2. Select an appropriate level of riverscape assessment approach

Step 3. Develop a brief

Step 4. Prepare river landscape descriptions

Step 5. Analyse and characterise river landscape

Step 6 Evaluate river landscape

Step 7 Describe, illustrate and evaluate modelled flow changes

Step 8 Integrate findings with other in-stream values.

Each of these 8 steps will be addressed in significant riverscape assessments eg. major irrigation or hydroelectricity projects. Where important rivers may be affected by substantial flow alterations each step will need to be comprehensive, rigorous, explicit and reproducible. These guidelines refer to these as level 1 investigations. Where rivers have lesser 'landscape' qualities, or proposed flow changes are less significant, investigations will be more selective, and may be implicit and qualitative in part. These are referred to as level 2 studies. Level 3 studies will be appropriate where riverscape values are limited, or other in-river values are clearly pre-eminent, or where flow modifications are minor (discussed further in section 6.3). Regardless of the level of investigations it is probable that essentially the same process will be followed, either explicitly or implicitly. It will be the depth of investigations within each step that will vary.

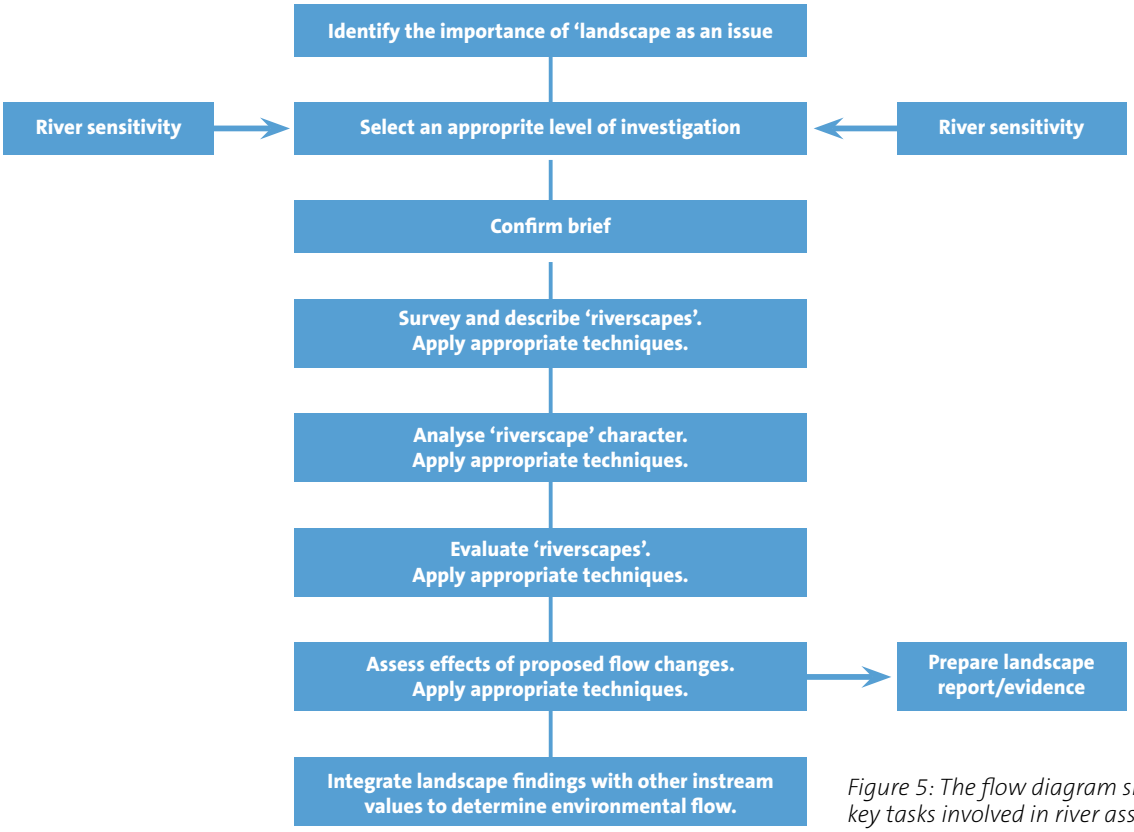


Figure 5: The flow diagram shows the key tasks involved in river assessment.

6.2 SCOPE 'LANDSCAPE' AS AN INSTREAM VALUE AND WATER ALLOCATION ISSUE (STEP 1)

The aim of this step is to assess the likely significance of riverscape issues, and so to set the scope and level of subsequent investigations. In some cases this may be obvious, but where this is not the case a simple ranking of naturalness and probable amenity and landscape values will be appropriate. This step may be carried out by the agency involved in managing the resource and responsible for allocation decisions or in some instances it may fall to a specialist consultant to provide advice. The following checklist may assist the parties to determine the importance of a river landscape and its likely influence on water allocation decisions at the outset of investigations. This is not a rigorous or comprehensive ranking system requiring detailed investigations. Existing familiarity or easily accessed knowledge such as the River Environment Classification (REC by NIWA, see Appendix 1) will be adequate. There is no suggestion of equivalent value between criteria. Its purpose is solely to provide a checklist and an indication of importance. This will inform the need for investment in further analysis and should assist in the preparation of briefs and budgets.

	River Channel	Riparian Area	Wider Landscape Context
Elements*			
Patterns*			
Processes*			

* **Elements** relate to the components of the riverscape and whether they are a product of nature or of human construction e.g. Native plant communities will be strongly natural whereas stop banks and groynes would not.

* **Patterns** relate to the composition of elements e.g. trees planted in straight lines with geometric boundaries will be less natural in appearance than the same plants occurring in natural patterns following the topography and soil types. Artificial structures may also vary in their appearance i.e. depending on their shape and materials.

* **Processes** underpin elements and patterns. The modification or replacement of natural processes such as erosion, deposition, plant succession and so on with human processes e.g. cultivation, flood control, dewatering will result in reduced natural character.

Natural character

Allocate scores to each box using a simple ranking system, e.g.

1 = Strongly natural
2 = Partially modified
3 = Strongly modified

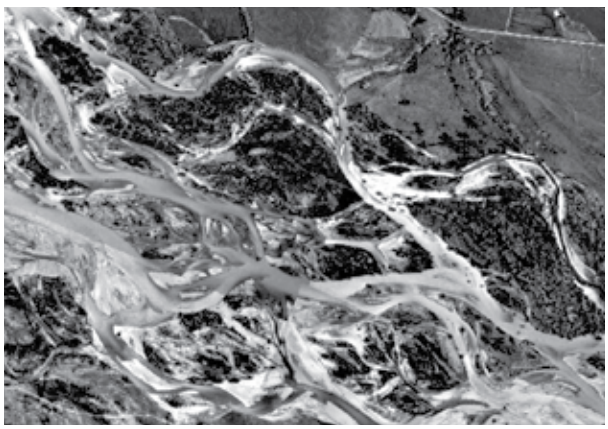


Fig 6: The aerial photograph shows the Lower Waitaki River taken in 1966 (both images provided by Meridian Energy).

Fig 7: This image shows the same river reach in 2001. The braiding of the river has reduced as a result of upstream hydro development and subsequent flood reduction, river engineering works, in particular willow planting, and farming activities encroaching onto the fairway.

The identification of ranking 1 in any of the above areas is likely to suggest that natural character considerations will be a significant issue. This will also be the case with a total score of less than 12. An absence of rank 1 scores, a predominance of rank 3s and/or a total score of greater than 20 will suggest that an in-depth assessment of natural character may not be justified.

Natural character	Total score
Strongly natural	<12
Partially modified but retains some natural qualities	13-19
Strongly modified	>20

Note: At the time of preparing these guidelines there is a FRST funded project on the significance of in-river values currently underway. The results of that study may suggest appropriate modifications or refinements to this table[21] .

Fig 8: River access points in close proximity to settlements are often popular recreation areas. These and other public viewpoints, such as roads or walkways, should be given consideration in an assessment of river amenity.

Amenity values

Allocate scores using a simple ranking system and combine for total score (see table below).

Hydrological characteristics and river profiles

1 = Cross section and flow type usually vulnerable to flow changes, e.g. stable spring fed river with shelving banks

2 = Cross sections and flow type of moderate vulnerability to flow changes

3 = Cross sections and flow generally robust to the visual effect of flow changes, e.g. a braided river, or river subject to extreme flow variation including extreme natural low flows

Recreation importance

1 = River of significant importance for active in-river recreation (fishing, jet boating, kayaking etc.)

2 = River of known importance for informal recreation (scenic viewing, walking etc.)

3 = River rarely used for recreation (e.g. restricted access, unsuitable water quality)

Public exposure

1 = River flows through locations or settlements with large numbers of viewers

2 = Visible to the public at particular locations

3 = Largely hidden from public view

Rivers with rank 1 in any of these three categories are likely to involve significant amenity value issues. The absence of any 1 rankings and a total of 8 or 9 will suggest that significant amenity concerns are unlikely.

Amenity values	Total score
Major amenity values	3-5
Moderate amenity values	6-7
Minor amenity values	8-9

[21] FRST funded project titled: Developing a significance classification framework for water body uses and values, led by Hughey K, Lincoln University.

Landscape values

Allocate scores using a simple ranking system and combine for total score (see table below).

Natural science and legibility value

1 = Recognised as having exceptional natural science values that are readily apparent in the landscape

2 = Significant ecological values that are not exceptional but add to the landscape experience

3 = Little or no special ecological value or values that are not apparent in the landscape

Cultural / heritage importance

1 = Recognised as important cultural/ heritage feature (e.g. statutory acknowledgement area, heritage status in district plan etc.)

2 = Of cultural/ heritage interest and significance but not statutorily recognised

3 = Of little or no known cultural/ heritage significance

Scenic/ aesthetic Importance

1 = Highly scenic river, widely recognised for its beauty

2 = Attractive river

3 = River of little or localised aesthetic merit

Landscape status

1 = Identified as outstanding landscape or natural feature in district/ region

2 = Within an area with lesser or more sporadic but relevant landscape recognition

3 = No statutory recognition of landscape importance

Rarity

1 = The only river of its type in the region

2 = A particularly good (e.g. unmodified) example of a river type

3 = A typical example of its type

The identification of ranking 1 in any of the above criteria is likely to suggest that 'landscape' considerations will be a significant issue requiring detailed assessment. A total score of 5-8 will also indicate a river where 'landscape' issues are likely to be very significant. A river scoring a total of 9-12 may justify more targeted landscape assessment. An absence of rank 1's and a predominance of rank 3's (total score 12-15) may suggest that in-depth landscape assessments are unnecessary.

Landscape values	Total score
High landscape quality	5-8
Moderate landscape quality	9-12
Minor landscape quality	13-15

These tables are not designed to be used as a landscape assessment tool. They should only be used to assist the agency or consultant to clarify the likely significance of the particular riverscapes under investigation. They provide an explicit justification for the need for 'landscape' study and will assist with budget setting. Budgets will relate to the appropriate rigour and complexity of investigations. In situations where all these values are considered to be minor the agency may consider that further riverscape assessment is unnecessary. In all other cases it will be necessary to select an appropriate assessment approach.

6.3 SELECT APPROPRIATE RIVERSCAPE ASSESSMENT (STEP 2)

This step involves the selection of an appropriate riverscape assessment which will depend on a combination of the significance of 'landscape' as an in-river value (based on Step 1) and the degree of hydrological alteration proposed (based on hydrological information). A table is provided to assist in the identification of an appropriate level of assessment.

The logical steps followed in a riverscape assessment are similar regardless of the complexity of the assessment. However, the depth and sophistication of assessments will vary greatly depending on 1) the importance of the river and 2) the significance of flow alterations. Step 1 will have given a good indication of the likely significance attached to a riverscape. Step 2 clarifies the depth of investigations that are likely to be appropriate given the scale of flow modifications proposed. This selection stage may be carried out by the agency involved in managing the resource and responsible for allocation decisions or in some instances it may fall to a specialist consultant to assist with advice. The following table provides a suggested hierarchy of investigations:

		Significance of Riverscape Values		
		Low	Medium	High
Degree of hydrological alteration[22]	Minor	Level 3	Level 3	Level 2
	Moderate	Level 3	Level 2	Level 1
	Major	Level 2	Level 1	Level 1

Appropriate assessment methods and techniques will vary with the level of investigations for example:

Level 1

Expert and public evaluations based on comprehensive flow data, accurate visual and descriptive material for river catchment, representative reaches and locations. Assessment includes material from a range of observed flows and/or visual simulations. Potential use of focus groups and public surveys.

Level 2

Expert and possible public assessment based on flow data, visual and descriptive material from a range of flows.

Level 3

Reliance on expert assessment based on knowledge and available material. Assessment of riverscape appearance extrapolated from visual material from a single flow.

The selection of an appropriate level of landscape investigations should be assisted by this table. However, broader issues of relative significance to other investigations will also influence selection. For example, the flow requirements of a waterway that were tailored to satisfy an exceptional trout fishery may also result in adequate instream flows to satisfy landscape values. In such cases it may be reasonable to focus on the trout investigations and reduce the sophistication of the landscape investigations. However, experience suggests that in many situations riverscape issues are likely to be elevated to a significant consideration. Where this is possible it will be false economy to downplay the importance of early steps in any landscape assessment.

[22] It may be appropriate to adopt the definition of the degree of hydrological alteration used in the proposed NES described on page 54 of the NES discussion document.

6.4 DEVELOP A RIVERSCAPE ASSESSMENT BRIEF (STEP 3)

The purpose of this task is to prepare a brief that provides the agency and potential consultants with a clear understanding of what the riverscape assessment investigations will entail. A series of topic headings are provided as a checklist for brief formulation The brief may be written by the agency or a specialist consultant.

Preparing a riverscape assessment brief is often a daunting task for the non-specialist. This section provides a checklist which can be used as a starting point for brief writing. In each situation the brief will need to be refined and tailored to the specific waterway(s) and investigation objectives. In many instances it will be productive for the client to work with the selected expert to further refine and elaborate on the brief. Where no comprehensive brief is provided by the client, the expert will need to go through the same process of brief preparation, to clarify the process to be followed and outputs to be provided. This should then be agreed with the client.

If steps 1 and 2 have been followed, and this checklist is used as a starting point, the task of preparing a brief should be relatively straight forward.

Riverscape Assessment Brief

Terms of Reference – many organisations have standard contracts and conditions of appointment. The title of the contract will be specified. Client contacts etc should be clearly set out with contact numbers and other relevant details.

Confidentiality – the extent to which the consultant can divulge the extent of investigations and outcomes. Extensive site work is likely to be involved and investigators need to be clear as to what information they may divulge if asked.

Overall objectives of assessment – this should explain the purpose of the landscape assessment and set out linkages to other investigations. It may include general information on the sort of outcomes expected. For example to specify a flow regime that will satisfy riverscape values capable of being defended in a plan or consent hearing.

Scope – this should clearly state what must be covered and what must not be covered by the investigations. Because 'landscape' embraces a wide range of considerations, clear instructions on the breadth of studies required will be essential. Boundaries with other investigations need to be clearly demarcated e.g. ecology and 'landscape', recreation and 'landscape'.

Scale – the geographical area to be considered should be identified and ideally a map(s) provided.

Stakeholders – depending on the nature of the investigations a list of known stakeholders may be provided. If stakeholders consultation is required, their contact details should be provided.

Methodology – If steps 1 and 2 have been completed by the client then appropriate investigation levels may be specified. Integration issues with other investigations may be outlined. It is generally inappropriate for the brief to be too directive as to methodology and techniques. It is the consultant's proposed methodology and techniques that should be key considerations in tender selection.

Information sources - list any relevant existing information, background reports etc held by or known by the client that would assist the investigations. Hydrological data held by the client should be made available and hydrological expertise within the client organisation should be identified.

Statutory context – any statutory requirements or limitations should be identified.

Timeline – a realistic timetable setting out any key milestones e.g. council presentations, reporting dates should be provided.

Consultation requirements – specify what level of stakeholder/ public input is considered appropriate and the form this should take. For example, consultation may be limited to the findings or it may be used to inform the process.

Outputs – These should be clearly specified e.g. electronic or hard copy versions of maps and other graphics, number of copies required, number of presentations and so on. If evidence preparation for council hearings or environment court is required this should be stated.

Budget – It is often very helpful to consultants if a budget or budget indication is provided by the client. A loose brief and no budget indication in a competitive tendering situation is likely to result in highly variable and not directly comparable proposals which will make tender selection problematic. In investigations of this nature a tight brief and indicative budget will provide a good basis for competitive tendering.

Major investigations, particularly for territorial local authorities will often involve competitive tendering. In some instances open tendering may be required but generally with specialist areas such as this there are advantages in selective tendering. Whenever competitive tendering is involved it will be important that the agency clarifies the weight it will place on proposal attributes such as price, consultant experience and skills, approach and methodology, and so on. Appropriately skilled consultants who have a clearly thought through approach that will address the issues and lead to useful outcomes should be selected.

6.5 PREPARE RIVERSCAPE DESCRIPTIONS (STEP 4)

Analysis and evaluation of riverscapes must be based on a thorough understanding of the landscape. This will involve both desktop and site investigations. The purpose of this step is to ensure that adequate information is collated that will provide a strong foundation for the assessment process. These guidelines set out a range of data sources and survey procedures that will assist with this task. This work will be carried out by a landscape specialist.

Desktop Review

To provide a more general context for preparing riverscape descriptions the landscape specialist will find the River Environment Classification (REC) System developed by NIWA to be particularly helpful. This approach (there are also other landscape classification systems that may be used e.g. ecoregions[23]) assists in gaining a general understanding of river hydrology and morphology. The 1998 MFE flow guidelines provide useful background material on the REC approach.

Depending on the nature of the investigations, river type information may need to be set within a description of the surrounding landscape types. In many instances this information will be available from Regional or District Plans or from a review of landscape assessments of the area. A desktop review of relevant site specific information is usually part of the information gathering process carried out prior to on-site assessments. This desktop analysis can help to provide a general understanding of a river catchment and its landscape values. Some of this information may be available from councils; some may have to be sourced elsewhere. The Landcover Database (Terralink) or Land Resource Inventory (Landcare Research Ltd) provide information about land cover, land use and underlying physical character (including geology, soils and slope) within the catchment. Google Earth and other sources of aerial photography are often highly informative, particularly when building an understanding of a river's landscape context. The use of these and other

[23] Snelder T. H, Cattaneo F., Suren A. I., Biggs B. J. F. 2004. Is the River Environment Classification an improved landscape-scale classification of rivers?, Journal of the North American Benthological Society 23(3):580–598

available resources is an effective way to prepare for site investigations and to target appropriate/ representative river reaches or assessment sites. Linkages to other in-river values investigations e.g. recreation may also indicate likely information sources particularly if these studies are underway or have been completed. The use of GIS to import and collate data will be essential in many investigations.

Hydrological data on flow regimes and current minimum flows are necessary to enable assessors to understand the effects of flow on a river's natural character and amenity values. Information about existing water abstraction or human flow modifications, (e.g. dams) is necessary to understand the naturalness of the existing flow regime. In order to gain an adequate understanding of a river's current/ natural flow regime it will be necessary to obtain hydrological information, including:

- long term hydrological statistics, such as mean, median and mean annual low flows;
- The approximate river flow for each assessment site on the day(s) of any on-site investigations (to allow for comparison with the long- term hydrological information.)
- On managed rivers (e.g. hydro) it will be necessary to know precise times of the days as flows can fluctuate hourly.

In some instances gauges may be operated on a river, in particular for the larger waterways. These deliver daily flow and long-term data. If landscape assessment sites are not in close proximity to a gauge, flows have to be gauged manually, or alternatively information needs to be provided about the hydrological relationship between gauging sites and assessment sites to calculate flows. Usually, a hydrological consultant will have been retained and will have this information available. If not, NIWA[24] or regional councils may be able to provide advice on relationships between the flow levels at recorder and riverscape study sites. Flows along the length of a river may vary significantly, particularly if there are tributary confluences or abstraction sites.

[24] Web-based tools such as WRENZ allow some of this information to be obtained reasonably quickly. http://wrenz.niwa.co.nz/webmodel/

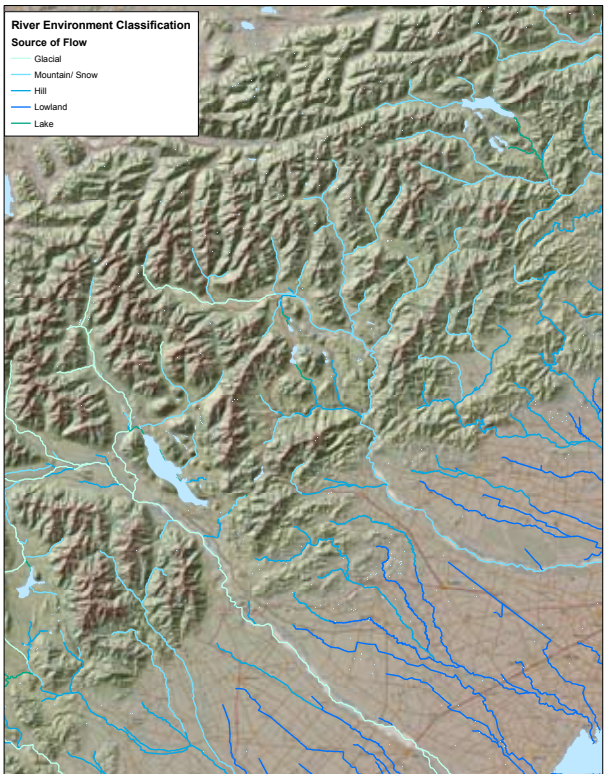


Fig 9: The River Environment Classification (REC by NIWA) is a useful source of information, which can help to get an understanding of waterways in a river catchment before undertaking on-site investigations.

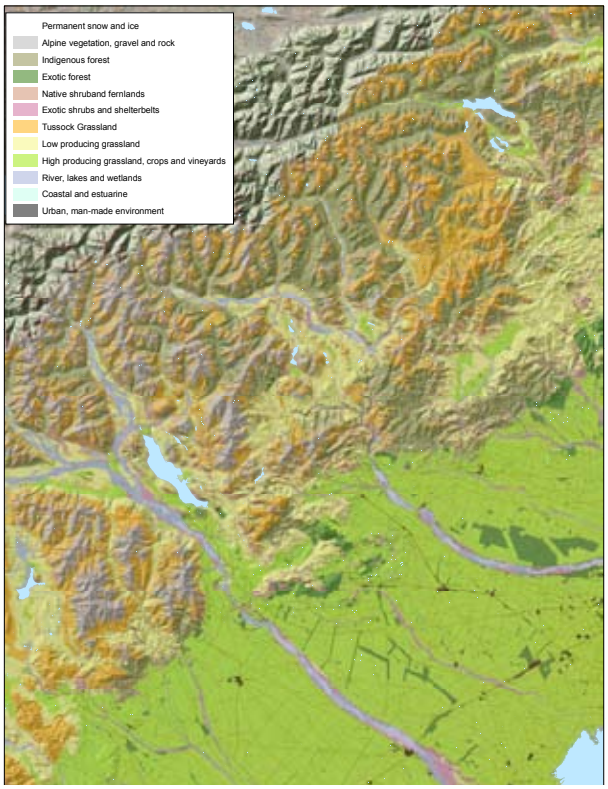


Fig 10: The Landcover Database (LCDB II by Terralink) provides information about the land uses and vegetation found in a river catchment. The proportion of native vegetation in a catchment gives an indication of the naturalness of the landscape context.

Selection of investigation sites

In many water allocation investigations (especially level 2 and 3 investigations) it will not be appropriate for the landscape specialist to investigate the entire length of a waterway in detail. Only in level 1 investigations (high in-stream values and high degrees of hydrological alteration) are aerial overviews and on-river access along the length of the waterway likely to be justified. In level 2 investigations more detailed assessment of natural character, landscape and amenity values is normally undertaken for a limited number of representative sites, eg minimum flow sites identified by councils. If there are existing resource consents, it is generally advisable to consider investigating existing minimum flow sites. It will be necessary to limit detailed site investigations to specific locations along the river. The selection of these will involve considerations such as the ease, reliability and legality of access. If the river is to be viewed in a range of flows then safe access in all conditions will be important.

Public access to many waterways is concentrated at certain points along their length. Generally, it is appropriate to include these high use areas in any assessment particularly if they are also representative of areas up or down stream.

It will be necessary to consider the nature of all human contact to ensure adequate assessment sites. For example jet-boating and bank-side fishing may occur along much of a river, whereas, informal access may be limited to places with vehicle access.

The selection of a number of sites that are representative of all the major lengths of a river and that relate to the experience of all users will be particularly significant in the most important (level 1) investigations. This may involve access to private land. In level 2 and 3 investigations it may be appropriate to select a limited number of accessible key sites.

The WAP and other landscape related flow research[25] has shown that certain river stretches are more sensitive to low flow and perceived landscape impacts than others. For example water level changes in waterways with single thread 'V' cross sections will generally be more apparent than in braided rivers or in river reaches with near vertical banks such as gorge sections. The selection of sensitive stretches will be suitable as flow assessment sites as they will illustrate 'worst case' effects of any flow reductions.

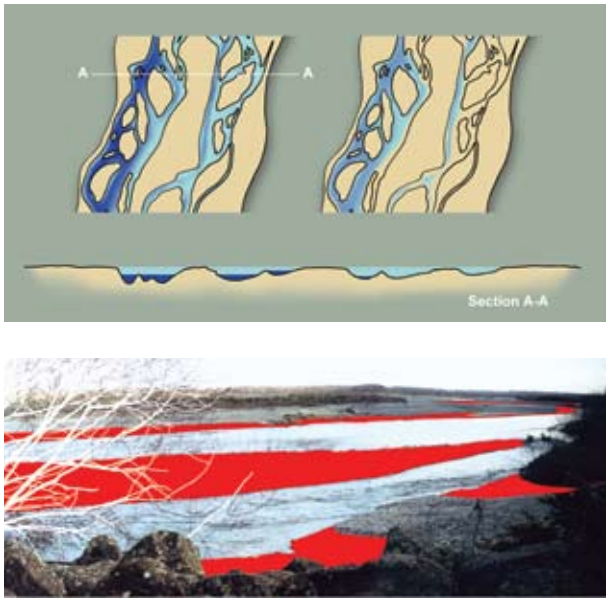


Fig 11: Flow changes in braided rivers are often difficult to detect due to the highly dynamic nature of the channel and their wide river bed.

Fig 12: The wetted surface area changes significantly with a reduction of flow in single thread rivers with shelving banks, which makes differences in flow more detectable than in rivers with steep banks.

[25] eg Flow Guidelines for Instream Values Volumes A & B Ministry for the Environment 1998

To get a good understanding of a river and its catchment, a range of accessible/ representative reaches of a river should be visited before a final decision on appropriate assessment sites is made. In order to avoid bias and flawed evaluations resulting from non-representative selection of assessment sites, areas upstream and downstream of identified sites should be considered. If findings from the on-site investigations show that other river reaches are more appropriate than those identified in desktop studies then additional or alternative sites should be selected. The site selection process must be made explicit in any assessment report.

Fig 13: Rivers vary throughout their catchment. Gorges are frequently formed through mountainous or hilly areas in the upper sections of South Island rivers.

Site investigations

The landscape specialist will require time on site to provide appropriate landscape descriptions or characterisations of the catchment and more detailed material on the specific watercourse(s). Because rivers are highly dynamic and can appear very different in different conditions it is important, in level 1 and 2 assessments at least, that the desktop review and the selection of site investigation locations has been rigorous. The landscape assessor should plan for a number of site visits, firstly to select appropriate locations for detailed assessment and secondly to experience and record the river in a range of conditions. In level 1 investigations on-river and aerial overview visits may also be required.

Fig 14: The landscape context, riparian edge and river channel have to be assessed separately for each river reach, if the river sections differ significantly.

Visit preparation

Prepare a checklist of essentials:-

- maps (NZMS 260, and/or 262 series)
- aerial photographs (these can be particularly helpful in locations with few obvious mapped features
- GPS with pre selected way points as appropriate
- SLR camera with appropriate lenses and solid tripod
- binoculars
- recording device e.g. dictaphone
- safety equipment including mobile phone, fluorescent jacket, sunhat and sunscreen
- didymo spray

Fig 15: The lowland reaches of a river, where the gradient and speed of flow decreases, have generally a different character to the upper sections near the headwaters.

As technology develops many of these items will be combined in sophisticated portable electronic devices such as light weight laptops and cameras with integral GPS.

If access to private land is involved ensure that the landowner has been contacted in advance and that approvals have been given.

Choice of flow for on-site investigations:

Timing for site visits is highly flow and weather dependent, and unusually high or low river flows following extended periods of rain or drought can lead to unexpected delays in assessments. The choice of flow level depends on the objective and desired outcome of an assessment. If minimum flow requirements are to be assessed it is important for the assessor to see the river at a low flow, well below the mean or modal flow[26] , and generally close to mean annual low flow. Experience has shown that it is necessary to carry out at least one on-site assessment during a period of low flows, which should be as close as possible to the current minimum flow. While the general natural character, landscape and amenity values can be described for a river at any flow, it is not feasible to effectively assess the appropriateness of a minimum flow when the river is flowing high. Consequently, where low flows are in question it is strongly advisable, for reasons of efficiency and cost, to plan site work that will directly benefit the evaluative, effects assessment and report/ evidence writing steps later in the investigations process. To achieve this it is necessary to review long-term flow graphs of a river and to define target flow levels that will be relevant to the assessment. For example it may be appropriate to target the present and proposed modal flows so that before and after comparisons can be made. Seasonal flow patterns and the flow regime of a river type (eg glacial, snow, groundwater fed, as explained in the River Environment Classification[27] (see Appendix 1) have to be taken into account. This may mean that site visits have to be planned well in advance. For example it is generally advisable to target late summer months to assess a snow-fed river at a low flow. For rivers with less variable flows this will not be an issue. Nonetheless visit times will be weather dependant and long-range forecasts can be very helpful.

If involved in a multi-disciplinary assessment it may be beneficial to undertake site visits together with experts from other fields (eg hydrologists, river geomorphologists or ecologists). Collaboration between disciplines provides insight into other landscape related river characteristics and values and can be very helpful.

Information recording

This is a key area of the landscape investigations and assessment process, as it underpins later evaluation and effects assessment.

All locations that may be used in the assessment of flows should be recorded, generally by GPS and plotted on GIS or maps of appropriate scale. This is important when other experts, or stakeholders, decision makers etc may wish to re-find the exact locations. Moreover, in important investigations follow-up visits to record the river at different flows are likely. If comparisons between flows are to be robust, identical viewing/recording locations are essential.

[26] Definitions provided by NIWA:
Mean annual low flow (MALF): the mean of a series of annual flow minima.
Mean Flow: the mean or average flow rate over the relevant period of record, also equal to the total volume of water discharged divided by the duration of record.
Modal Flow: the most frequently occurring flow.
Median flow: the flow value at which the flow is less than that value for 50% of the time (and so also is greater than that value for the other 50% of the time).

[27] Snelder T. H, Biggs B. J. F. 2002. Multiscale river environment classification for water resources management, Journal of the American Water Resources Association 38,: 1225 - 1239

Visual record

It is important to establish a photographic record for each site to allow off-site comparison and evaluation. A selection of representative photographs is likely to be required to illustrate findings in river assessment reports, public preference studies or in evidence. Because river appearance varies so much with flow and other variables it is often crucial that the landscape assessor has an accurate and representative visual record of a range of flows in representative reaches for each of the river(s) that are under investigation. It is important to record assessment dates, location and flows with each photograph. Floods occurring between dates of photographic surveys can lead to significant changes in channel morphology, in particular in braided river reaches. These channel alterations have the potential to affect visual cues for flow estimation (eg the extent of exposed gravel banks). Photographs can help to determine if a river channel has changed between assessment dates.

Photographs can be extremely helpful to the assessor as records of what was observed on site visits. In level 1 and 2 investigations it will be important that the photographs are of high quality. The applicability of their context and composition will be vital if they are to be used in comparative assessment work. The objective of these photographs is not to take the most evocative photograph (which may well be desirable in other circumstances) but to provide the most accurate and helpful images to inform comparative assessment. Any distortions that may skew results should be avoided if at all possible. The notes set out in Appendix 2 were developed in conjunction with a professional photographer during the WAP research and relate specifically to river photography where the focus of attention is comparative river flows and the photographs may be used as proxy for on-site assessments.

Fig 16: Landscape context descriptions include land cover and uses surrounding the assessment site, including the floodplains or upper river terraces. When creating a visual record of an assessment site, it is important to photograph the river context, both river banks and channel details.

Fig 17: The riparian edge includes the banks and river margin. A high proportion of native vegetation and absence of man-made structures, such as groynes are indicators for high natural character.

Fig 18: The river flow (velocity and volume), water colour and clarity, as well as bed material and channel outline are important factors to consider when assessing the river channel.

River flow descriptions

To avoid confusion in riverscape descriptions it is very important to be consistent in the use of descriptive terms. A list of definitions was prepared from various sources for the WAP research and is set out in Appendix 3. These definitions provide the assessor with a starting vocabulary and should be taken on site when rivers are described.

To help describe rivers and streams a standardised assessment checklist can be used. The WAP research explored the vocabulary used in existing landscape and river related publications to describe rivers and river flows. From this research a standardised assessment checklist was developed which can be used as a basis for on-site recording of river conditions at a particular site or reach on a particular visit.

A copy of the standardised assessment checklist is found in Appendix 4.

The check sheet is separated into watercourse and riverbed, riparian edges and landscape context. In the WAP research the focus was on river flows and consequently the wetted channel, with less attention given to riparian edges and landscape context. It is well recognised (in the literature and in practice) that the appreciation of riverscapes is influenced by the characteristics and qualities of the adjacent banks and surrounding landscape. However, it is the contribution made by the river and river bed that was the key issue explored in the WAP research. Consequently, further development of riparian and context descriptions will be appropriate.

River descriptors were grouped under the following headings:

- Size/ scale
- Shape
- Channel bed material
- Flow movement
- Surface texture
- Sound
- Appearance

With each assessment sheet, the assessor is required to specify river, reach, specific location, date, time and weather. If available the measured flow should be recorded at the site or at the closest applicable flow recorder. It is necessary to note the representativeness of the assessment site in relation to the wider watercourse. In some instances, eg. a minor water flow in an expansive river channel, it may be appropriate to distinguish between the watercourse and the channel for assessment (i.e. the wetted surface may meander within a straight channel). On site the relevant characteristics are marked on the checklists.

The checklist has been extensively tested in the field by landscape/ river assessors on a wide range of river and flow related projects over the past years. It has been found to be generally applicable, reproducible and useful. The completed sheets are used as a basis for preparing detailed river descriptions. For example the following table of riverscape changes at the same location was based on checklists compiled at different flows. This provides a clear indication of what has changed in the river's appearance (and what has remained constant) as a result of a different flow.

Table 1: Example of riverscape changes reflecting different flow rates.

	235 m3/s	145 m3/s
Size and scale	Large, big, substantial, major river.	Large, big, substantial river.
Shape	Broad, wide, open, expansive single thread. Uniform width spreading across entire breadth of riverbed in places.	Slightly narrower water course occupying a proportion of the riverbed exposing slightly more extensive cobble banks. Evidence of braiding at downstream end of reach.
Channel bed material	Bedrock, boulders and cobbles are generally submerged.	Bedrock, boulders and cobbles are mostly submerged, but with some exposed and protruding.
Flow movement	Constant, steady, swift, powerful and forceful.	Constant, gentle but still swift.
Surface texture	Riffles, rippled surface on runs and swirling.	Predominantly smooth, flat and rippled. Occasional riffles and swirling.
Sound	Gurgling and splashing	Lapping and gurgling
Appearance	Clear, deep blue-green colour. Appears deep. Some sediment and periphyton evident on river margins. Unfordable.	Range of colours from clear deep blue-green through to brown reflecting variable depth. Some periphyton, weeds and sediment evident on river margins. Unfordable.

The terminology used in the checklists is in part technical and descriptive, but also includes some evaluative language. The use of visual or perceptual terminology or even poetic language may be appropriate in certain situations, however they should be used with caution. While the checklists have proved useful in a range of river investigations, they can be developed further if necessary.

The written description of the river itself will use the checklist findings to cover channel and watercourse characteristics, such as channel outline and cross/ long sections. The description of the riparian edge covers the area immediately adjacent to the watercourse, including vegetation, bank morphology and any human modifications. Consideration of the landscape context takes larger scale landforms, land uses and built modification of the wider area into account. Photographs to illustrate the landscape character should be included in any report. If a river assessment sheet is used as part of the on-site character assessment, it could be tailored specifically for particular watercourses or assessment briefs. It can then be used to apply standardised descriptors to characterise the river channel, banks and landscape context. The site record sheets may be included as raw data, eg in a supporting appendix to any report/ evidence.

This descriptive phase provides the basis for later analysis, evaluation and reporting (steps 5-7).

6.6 ANALYSE AND CHARACTERISE RIVERSCAPE (STEP 5)

This step in the process typically involves a catchment wide approach, including reach by reach characterisations based on the data collected in step 4. It will be completed by a landscape specialist. The purpose of this step is to structure the raw data and descriptive material generated in step 4. Whether the material is limited to that resulting from a single site visit, which may be all that is necessary in a level 3 investigation, or extensive hydrological, descriptive and visual material generated over an extended period in a level 1 investigation, the landscape specialist will need to structure it in an appropriate way that will assist understanding and aid the evaluative stages that will follow.

Riverscape characterisation is an expert process of interpreting the composite character of a riverine landscape. In landscape assessments generally this will involve the identification and mapping of distinctive types of landscape, and while there are numerous approaches used in characterisations it will often involve a hierarchical analysis with character areas/ units classified at different scales. Riverscape characterisation parallels this approach. Particularly in level 1 investigations, rivers and their surrounding landscape context are likely to be characterised on the basis of the entire catchments, lengths of rivers (reaches) displaying similar characteristics, and significant features or attributes within these.

Scale and reaches

This character mapping can be used as a basis for locating key features and places referred to in the river descriptions e.g. viewpoints, access points, abstraction sites. These features will include any atypical features or attributes.

The catchment scale analysis should ensure that relevant linkages between lengths of river subject to potential flow modifications are considered in the wider river and landscape context. This may be necessary to understand the basis for particular values where these don't discriminate between different parts of river system e.g. mountain to sea cultural concerns. Clearly, any upstream flow modifications will affect the waterway downstream.

In most instances of level 1 and 2 investigations, rivers will be separated into reaches. Each reach is likely to have its own particular hydrological characteristics, geomorphological and ecological characteristics, adjacent land use relationships and other considerations such as the patterns and intensity of development.

Fig 19: Channel and landscape character can vary significantly between reaches. The underlying geology influences the formation of the river channel. A low gradient often leads to sedimentation and deposition of bed load material.

Fig 20: Bed rock confined reaches generally are relatively narrow, single thread channels.

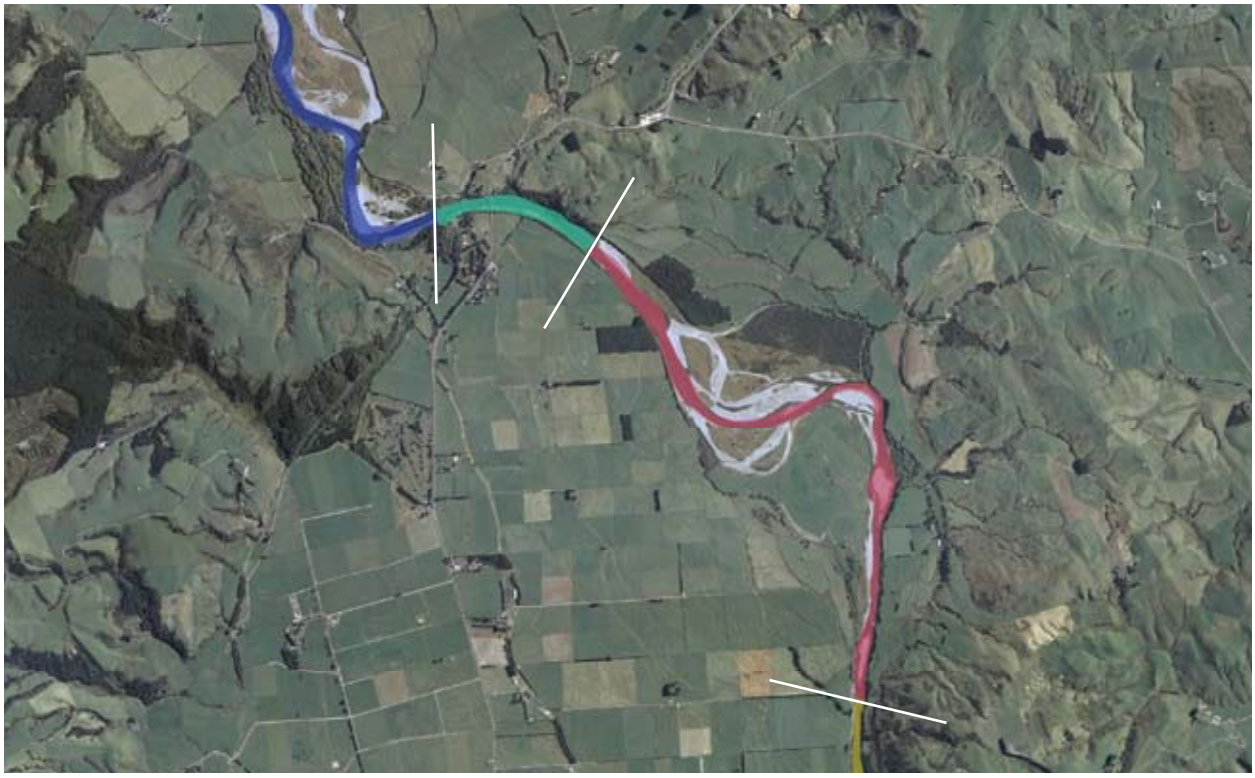


Fig 21: River reaches are primarily defined by their channel morphology.

The scale at which reaches are defined will be dependant upon the inherent variation in a particular river, the diversity of its landscape setting and the purpose of the investigations. Within each reach further variations can be recorded through specific features and spatially linked to any photographic record. Any particular locations that may be vulnerable to flow modifications due to their special sensitivities e.g. a swimming hole, should be set in context.

Supporting material

In many investigations, the landscape report is the main repository of graphic material. Therefore it is important that the riverscape characterisation and evaluation is supported by adequate graphic material. This will include maps, aerial photographs, cross and long sections, and photographs. In high level 1 and 2 investigations these should give a clear indication of the river's appearance at particular flows relevant to the water allocation issues.

Photographs

Analysis of different flows observed and photographed will provide an understanding of how river appearance may vary at different flows. The more comprehensive and diverse the record the more helpful this will be in later evaluative stages. If a range of flows have been photographed and descriptions prepared, these should be incorporated into the characterisation of the reaches and key locations. It is very important to avoid making assumptions about a river's appearance based on observations at a particular flow. This is particularly important in rivers with highly variable regimes.

Hydrological data

At least in level 1 investigations it will be appropriate to complete a desk top analysis of hydrological data to understand and illustrate the current observed flows in relation to natural flows, where these are different. While many water allocation investigations are on rivers with modified flows, it is helpful to have an understanding of the original natural river regime, particularly in terms of understanding its current level of natural character,. In situations where no pre-modification records are available, hydrological specialists will be able to model what would have occurred prior to modification.

River modification

To adequately address landscape issues resulting from future flow modification it will be necessary to understand the consequences of past damming, diversion or abstraction. What may be perceived by many as a natural river with a natural flow, may in reality be a substantially altered flow. A further assessment consideration is the relevance of consented flows (e.g. what is permissible under present permits and consents) if these differ from the status quo. The unravelling of past, present and potential flow regimes and their consequences for riverscape characterisation can be complex and confusing. It will be important that the landscape specialist takes full advantage of hydrological and other relevant expertise available.

In many water allocation investigations other specialists will be using similar hydrological, geomorphological and biological data. They may also generate material helpful to the landscape specialist. Therefore it is important to maintain close contact with other specialists who will often not recognise the value of their analysis to the broad ranging 'landscape' investigations.

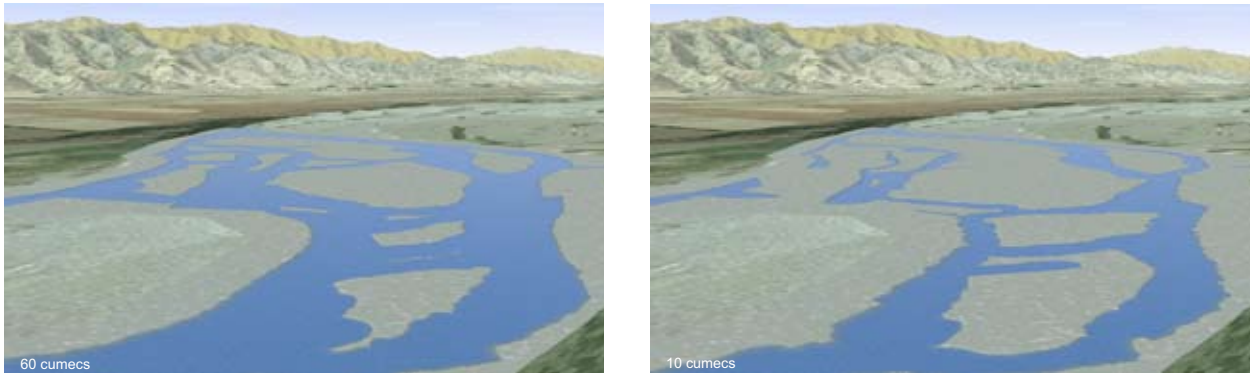


Fig 22: Visual simulations of different proposed river flows can help to visualize the channel outline and appearance of a river at different flows.

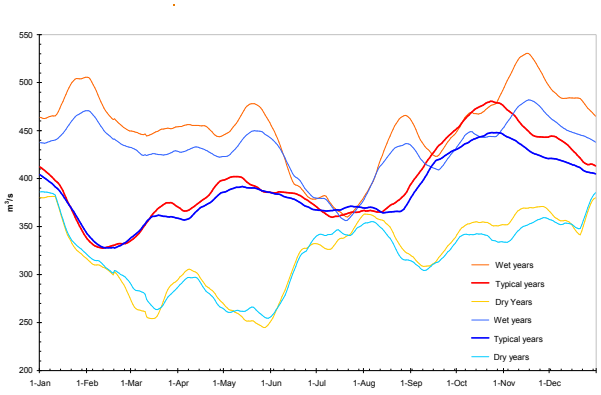


Fig 23: Hydrographs and tables of current and predicted flows contain important data for flow predictions if a change to a regime are proposed.

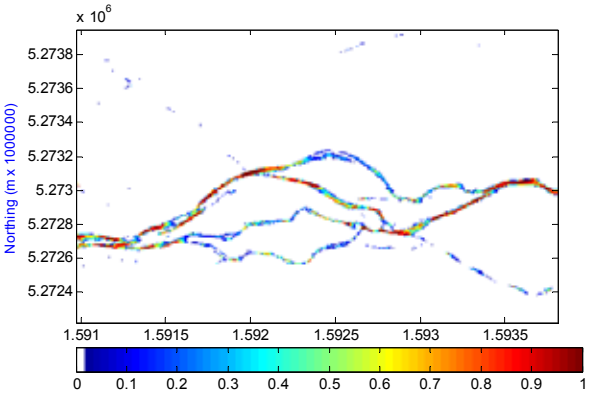


Fig 24: Two dimensional (2-D) hydrodynamic modeling provides information about predicted depths and velocities for flows. This can be used to assess habitat suitability, as well as recreation opportunities, such as fishing or boat passage (provided by ECAN).

6.7 EVALUATE RIVER LANDSCAPE (STEP 6)

Evaluation is the systematic process of identifying and comparing values within the assessment process. This step in the process aims to identify and attribute 'landscape' values inherent to the existing riverscape. The effects of any water allocation proposals will then be evaluated against this river condition (step 7). As discussed in previous sections 'landscape' values are many and varied. The selection of appropriate values requires experience, but will be based largely on the statutory context and the characteristics of the particular waterway.

This stage in the process will be carried out by or managed (if using public/ stakeholder input) by a landscape specialist. In level 1 investigations, with a high public profile, it may be appropriate not to rely on the landscape specialist for evaluation but also to use other assessors to provide a consensus opinion. If handled well this will add rigour to the evaluation.

In most water allocation investigations the landscape specialist will be asked to assess natural character, visual amenity and landscape values. The significant overlaps between these concepts can create assessment difficulties. The biophysical emphasis of natural character and the visual and aesthetic emphasis in amenity values both feed into and inform the biophysical and sensory aspects of landscape. It may ease the assessor's task if natural character and visual amenity values are evaluated initially and then these and other landscape considerations, such as heritage and legibility values are integrated in a final holistic 'landscape' evaluation.

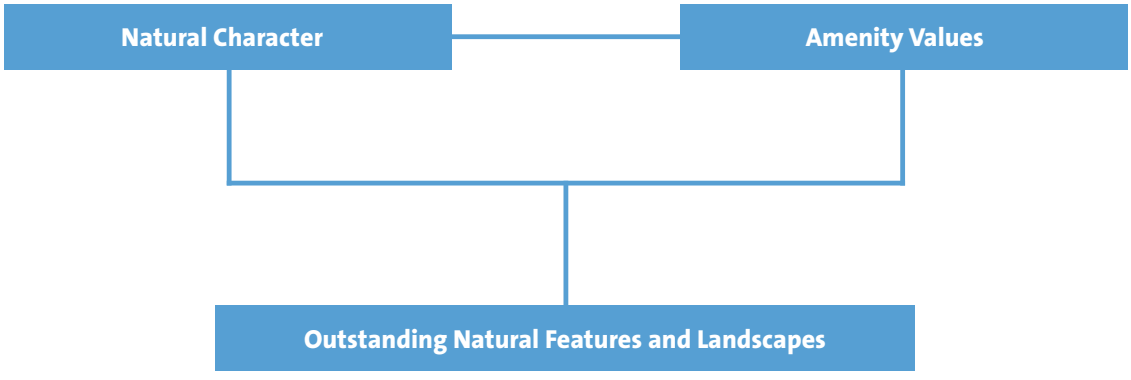


Fig 25: This diagram shows the riverscape value identification process.

Evaluations of riverscape quality may be made by:

- An expert landscape assessor
- A group of expert landscape assessors
- A multi disciplinary expert group and/or
- The public or particular stakeholder groups

The choice of assessors will reflect the level of investigation and the particular focus of the evaluation. For example in a level 1 investigation riverscape quality may be evaluated by a range of assessors including multi-disciplinary experts for natural character, landscape experts for landscape quality and the public/ stakeholders for amenity values. In a level 3 investigation a landscape specialist may complete all these evaluations.

Graphic support material for 'landscape' evaluations

In investigations that involve evaluations using multiple landscape assessors it is highly probable that visual images of the river(s) at known flows will be useful either to help assessors determine values, or to enable direct flow comparisons to illustrate relevant flows and favoured flow outcomes. Logistical practicalities and the difficulties controlling the many variables make reliance on site inspections by assessment panels extremely risky. Poor weather or light conditions or inappropriate flow rates on the day of a planned visit cannot always be predicted and may seriously reduce any assessment value. If images of flows equivalent to the proposed flows have been recorded and photographed during earlier site visits by the landscape specialist then they can be used as surrogates for site inspections when alternative flows are to be evaluated.

Appendix 5 provides guidance on the use of proxy visual material which applies to 'desktop' evaluations where reliance on site visits is inappropriate. It sets out the benefits and limitations of such material – particularly for assessment purposes. However, this imagery will also be important to support and justify the assessor's findings on values, for example in a public forum, report or evidence.

Natural character evaluation

Natural character considerations are critical to water allocation decisions. All aspects of a flow regime may have effects on a river's natural character either in the short or long term. Changes to the duration of low flows, minimum flows, floods and freshes, seasonal flow differences and so on may all influence the natural character of a river. All these matters should ideally be taken into account in an evaluation, as they will determine the significance attached to a river's natural character and are likely to contribute to any flow recommendations. It is important to recognise that effects on natural character are not always dependent on minimum flows. For example, in many rivers, floods and freshes are a key determining factor for natural character. They are necessary to maintain the dynamic nature of a river environment and to clear the bed from encroaching weeds, such as willows, gorse or broom.

The WAP research survey, questionnaires and focus groups findings provide an indication of the attributes that influence the experienced assessor's interpretation of the degree of natural character represented in a number of depicted rivers. It is probable that the perception and evaluation of natural character in all rivers will be influenced by these attributes to a greater or lesser extent. The specialist landscape assessor will need to consider them in any evaluation. These attributes may provide the basis for an explicit ranking system if this approach is favoured.

Fig 26: This page shows a number of images used in the natural character survey undertaken as part of this WAP research. The natural character rating shows the median of scores given by focus group participants and the key attributes listed as reason to allocate the rating:

Natural character rating: 12%
Key attributes: modified cross/ long section, stock access

Natural character rating: 70%
Key attributes: localised bank modification, natural context

Natural character rating: 10%
Key attributes: flow modification, man-made structure

Natural character rating: 85%
Key attributes: clear water, swift flow, natural channel

Natural character rating: 95%
Key attributes: unmodified wetland and landscape context, native plant species

Natural character rating: 60%
Key attributes: weed infestation on banks, native vegetation in landscape context

Table 2 summarises river characteristics that have positive/ negative effects on a river's natural character.

Natural character attribute	Aspect of attribute	Positive effect on natural character	Negative effect on natural character
Water and Flow	Waterway shape	Sinuosity and response to natural rock outcrops etc.	Channelisation or evidence of stopbanks containing river alignment
	Flow rate	Substantial flow that appears to fit the nature and scale of the channel	Dewatered bed or 'misfit' flows that suggest upstream diversions
	Flow variability	Flows relate to river type with evidence of floods or freshes	Flows indicate mismatch with substrate, channel form or shape suggesting reduced natural variability.
	Water quality	Clear, rubbish free low flows or turbid high flows	Colouring suggests pollution, human litter, algal infestations.
Riverbed	Exposed riverbed	Extent of the exposed bed appropriate for river type	Unexpected areas of exposed bed not relating to flows
	Bed material	Exposed bed material appropriate for river type	Unexpected bed material not relating to flows
Vegetation		Dominance of native communities in natural patterns (the presence of exotic species in natural patterns will reduce natural character by comparison with indigenous communities).	Exotic species especially when in unnatural patterns. Infestations of weed species such as gorse and broom
Structures and human modifications		An absence of human modifications. However minor structures particularly if constructed from natural/local materials may not influence natural character greatly.	Large artificial in-river structures. The scale and nature of modifications will influence the effect on natural character.
			Proximity, scale and nature of riparian structures.
			Catchment modifications if ecologically or visually linked to the waterway.

Visual amenity evaluation

Visual amenity issues arise in many water allocation investigations where the general public or recreational users have access to an attractive waterway. The WAP research investigated the aesthetic quality of rivers and people's preference for particular flows . The findings are especially relevant to low flow concerns and provide an indication of the likely influences on people's riverscape appreciation.

Similar to previous studies, the online survey found that participants had a preference for high-medium flows for small rivers and medium-low flows for large rivers. Most respondents ranked the highest flows depicted in the small rivers as the most preferred flows; in each case the most preferred flow was well above MALF. Flow preferences for large rivers were more varied. A photo taken at a flow below MALF, showing large areas of dry river channel was ranked least-preferred by most respondents. The analysis of preferences for the four recreation interest groups (kayakers, canoeists, fishermen and jet boaters) indicated a strong preference for high flows and an aversion for low flows in all groups with no significant between-group differences.

Similar to previous studies (Brown and Daniel 1991), the survey indicated that respondents considered scenic beauty to increase with stream flow to a mid point and then diminish. The visual characteristics used to rate the aesthetic quality of river flows varied across river reaches. The only characteristic that was used in all photosets by a majority of survey respondents was the apparent quantity of flowing water. Presumably, this characteristic includes the proportions of wetted and dry channel. River channel shape, water clarity, water colour, and water movement were of moderate importance for ranking flow preferences. Landscape features outside the river channels, including litter, riparian vegetation, and signs of human modification were less important characteristics for respondents at most reaches. The relative importance of visual characteristics was generally consistent across interest groups, but members of the recreational users group were the most likely to use the quantity of flowing water as a cue, members of the resource management group were most likely to use water colour as a cue.

In conclusion, the findings of the online survey emphasised the visual complexity of riparian environments. Flow, while important, is only one factor which contributes to people's experience of river environments. Scenic beauty, or aesthetic value, of a river is influenced by a range of wider landscape attributes, such as vegetation, seasonal colour and light. However, river characteristics that are dependent on flow, such as water colour and clarity, also influence a river's aesthetic appeal. Perceptions of river flows are influenced by the observer's familiarity with river environments and personal interests. People's sensitivity to flow fluctuations is also dependent on river type, channel shape and stakeholder needs or expectations.

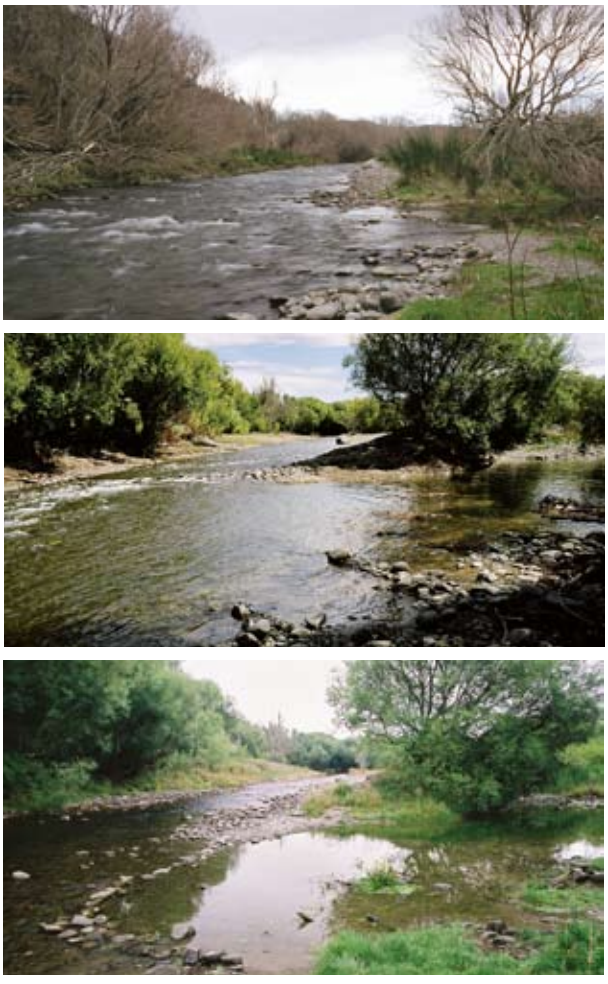


Fig 27: The preference survey undertaken for this research project indicated that most respondents preferred a high flow (above MEANF) for small rivers (see top photo). For large rivers a flow below MEANF was generally preferred.

Landscape evaluation

Since landscape is such a wide ranging consideration, it is inevitable that different assessors favour different approaches and different issues may require different emphases. No definitive list of landscape criteria is available, although it is generally accepted that biophysical, sensory and associative criteria are all relevant. Statutory documents such as Regional Policy Statements, Regional Plans, Iwi Management Plans, Conservation Management Strategies, Reserve Management Plans and District Plans indicate the emphasis that should be placed on different values within a particular situation.

The so called 'Amended Pigeon Bay Criteria' (see section 4.2) are widely used in New Zealand. These list ways in which landscapes may be appreciated, but are not comprehensive. The criteria are not equivalent in importance and there is no ranking of quality. Nonetheless, there is accumulated case law and a level of acceptance of their use as an assessment framework. What is not generally agreed is how comparative landscape quality should be evaluated.

If an evaluation of riverscape attributes is to be robust - whether the evaluation is conducted by an expert, a group or involves the public - the landscape specialist is likely to adopt an explicit approach. This may incorporate a ranking or scoring system. An explicit evaluation may be desirable as the effects of future flow modifications resulting from water allocation decisions will generally be assessed against the quality of the existing resource. The actual choice of evaluation terms and the use of ranking scales will depend upon the level of data available and the complexity and importance of the wider water allocation issues.

For level 3 investigations a single 'landscape' ranking may be adequate using a single scale. The definition for each of these terms (and those in the tables below) will need to be made explicit in each case. They will vary with different riverscapes and will need to be determined based on the findings from earlier steps in the assessment process.

1	2	3
High	Moderate	Low

For level 2 investigations more sophistication would be expected or at least separate rankings for natural character, landscape and amenity values should be considered.

1	2	3	4	5
Very High	High	Moderate	Low	Very Low

In level 1 investigations more refinement is likely to be appropriate and rankings will be appropriate for natural character, landscape and amenity values.

1	2	3	4	5	6	7
Extreme	Very High	High	Moderate	Low	Very Low	Negligible

Fig 28: If rivers have been identified as outstanding natural features and landscapes on a regional and/or district level, they will require detailed investigation if a substantial flow modification is proposed.

The benefit of explicit criteria and a ranking scale is one of transparency and reproducibility. It is an opportunity to consider the level of contribution that individual attributes or groups of attributes make. However, extreme caution will be appropriate if any claims or suggestions as to the objectivity of the rankings are to be made, particularly if scores are to be combined and totalled. It is also important that the evaluative terms used are conceptually linked to the attributes being assessed. Terms, such as uniqueness or rarity for example, relate to a quality that only has relevance in the sense of comparisons with others. Some landscape specialists are reluctant to rank because of the issues of comparable weightings between attributes, criteria selection, comprehensiveness and so on. Nonetheless, even in circumstances where the assessor does not favour using an explicit ranking in their findings, such an evaluation can be useful as an internal check. It can inform and support the assessor's overall qualitative judgement on the significance of a river's or reach's 'landscape' qualities.

There may be considerable variety in the values of different reaches. This will allow the landscape specialist to narrow the focus of an effects assessment to particular, vulnerable, river reaches or locations. If this step is completed in a methodical and explicit way, the evaluation findings should provide a clear indication of the values present in the existing riverscape and enable the consequences of water allocation decisions to be directly compared with these values.

In some situations it may be appropriate to use a common ranking scale to combine natural character, amenity and landscape values, for example a scale based on spatial importance may be appropriate (see scale below).

The use of such scales not only enables comparison between values within a riverscape, but also allows comparison with other waterways elsewhere. Whenever a ranking scale is used the meaning of each rank should be clearly defined.

1	2	3	4	5	6	7
International	National	Regional	District	Local	Limited	None

Fig 29: Assessment of riverscape values requires evaluation of river channel, riparian and contextual landscape qualities and judgement on their relative contributions.

6.8 DESCRIBE, ILLUSTRATE AND EVALUATE MODELLED FLOW CHANGES (STEP 7)

The purpose of this step is to directly compare riverscape values under different regimes. The status quo flow will have been described and evaluated in earlier steps in the process. This will provide a baseline and enable direct comparison of predicted riverscape values under the natural (where different) and modelled flows. This comparison would be completed for all 'landscape' values and the full range of potential flows.

It is important to recognise that rivers are highly dynamic as a result of climatic oscillations, weather variations and the existing flow regime, which may have been modified by past water allocation decisions.

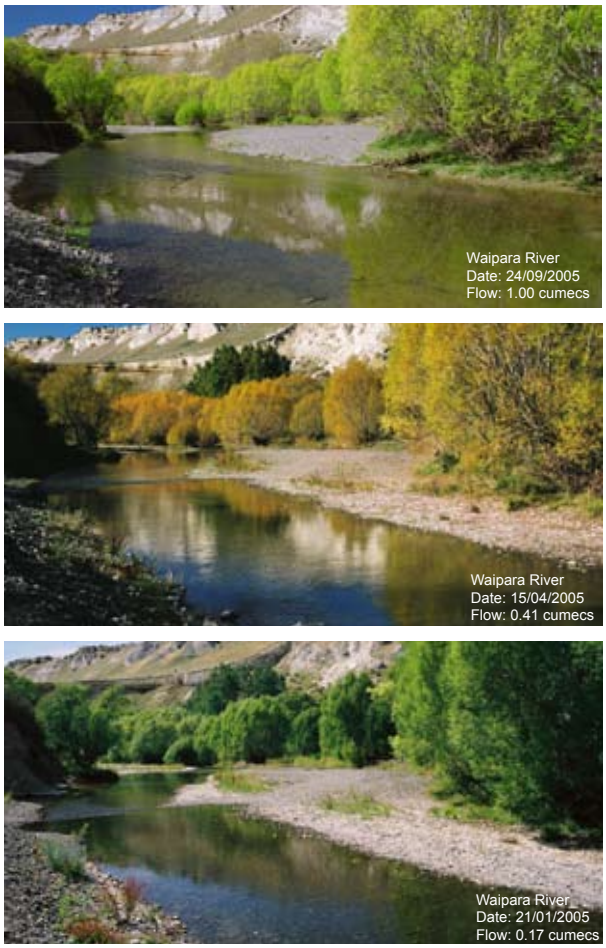


Fig 30: Photo series (showing comparative images of different flows taken from same viewpoint) can assist in the evaluation of flows by experts or the general public.

In some water allocation investigations the effects assessment may need to consider several flow regimes.

- Natural flow regime
- Status quo flow regime
- Consented flow regimes (permitted by regional plan and water permits)
- Proposed flow regime(s)

Comprehensive hydrological data and geomorphological analysis will be necessary to understand what is proposed under various water allocation scenarios. The flow consequences of proposed regime changes will be assessed against the outcomes of step 6. The significance of these changes will depend on the resilience of the riverscape's existing character and values. This can be understood in terms of the inherent sensitivity of a particular river or reach to loss of natural character, amenity values and landscape quality. The key considerations in determining effects are to identify sensitivity of the riverscape to change and the nature and magnitude of the changes proposed. This is particularly difficult when assessing change against a highly dynamic baseline - the case with most riverscapes.

The Resource Management Act recognises a range of types of effects, including

(a) Any positive or adverse effect; and

(b) Any temporary or permanent effect; and

(c) Any past, present, or future effect; and

(d) Any cumulative effect which arises over time or in combination with other effects – regardless of the scale, intensity, duration, or frequency of the effect, and also includes –

(e) Any potential effect of high probability; and

(f) Any potential effect of low probability which has a high potential impact.

Natural character

Natural character effects result from flow regime changes involving both effects of visual changes at a given time and the consequences of change over time. For example, the removal of flood flows may result in long term physical and biological changes within the river channel, such as channel bed armouring, vegetation colonisation and loss of suitable nesting sites for riverbed birds. Appropriate images of the waterway in a range of flows will be helpful in investigations where focus groups or expert panels are used to assess effects of proposed flow changes on natural character. However, the effects of extended low flow durations, loss of freshes, or other regime changes require understanding and knowledge of river behaviour.

In many situations significant adverse effects in natural character will be avoided or minimised if

1) proposed flows are within the natural range of flows,

2) river forming flows such as floods and major freshes are retained,

3) the proposed flow regime mimics the natural fluctuations such as seasonal highs and lows and

4) ecological investigations suggest that any adverse effects on flora and fauna will not be significant.

If these objectives are achieved, substantial reductions in flow rates may be possible without significant adverse effects on natural character. This is particularly the case with large rivers with naturally variable flows. Small watercourses with stable flows and 'V' shaped channels will be most vulnerable to loss of natural character resulting from proportionally similar flow modifications. However, the intrinsic value of natural character may be substantially higher in a large rather than small wartercourse.

Any assessment of effects on natural character resulting from a modified flow regime will need to consider the relative contribution that river flows make to riverscape value. The WAP research suggests that riparian and catchment characteristics, as well as non-flow related river features, such as stopbanks or groynes, also strongly influence the evaluation of natural character. A substantial reduction in flow may have limited adverse effect in situations where other riverscape features are the main determinants of natural character. Inevitably, in water allocation investigations, the focus will be on flows and the effects any flow regime changes will have on the quantity and quality of water in the river. However, it is important that the landscape specialist does not loose sight of the fact that water flow is only one attribute within a riverscape that influences natural character.

Natural character assessment requires knowledge of river processes. For example, a naturally empty channel in an ephemeral stream may appear visually similar to a dewatered channel resulting from a diversion but the effect on the rivers natural character will be very different. It is important that natural character effects are assessed separately from visual amenity effects – naturalness does not always equate to attractiveness. The use of focus groups to explore natural character issues proved to be very effective in the WAP research. In some level 1 investigations a similar approach may be justified.

Visual Amenity

The visual impact of different flows e.g. reduced low flows, is a visual amenity or aesthetic quality issue. Reduced flows may be assumed by some to inevitably reduce visual quality. However, the landscape specialist needs to apply caution. The WAP research explored people's ability to recognise and to estimate different flow rates. This may be important as most resource consent conditions attached to water allocation approvals will specify particular flows based on flow rates.

People's ability to accurately assess a given river flow is generally poor. In the WAP research, river assessors had difficulty estimating illustrated flows. This is the case even when provided with directly comparable flow images, presented side by side and with the flow rate in one of the images provided. Making accurate comparisons between flows experienced at different times is considerably more problematic. Assessors had the greatest difficulty with large rivers and particularly where multiple channels occur. Small waterways with a single defined channel were less problematic but flow estimates were still inaccurate. Because flow rate is a combination of velocity, depth and width it is very easy to under or over estimate flows. A 50% reduction in flows may have little or no impact on river width which is generally the most obvious change.

These findings suggest that there is limited value in seeking comment on flows expressed in cumecs (m^3/sec) without appropriate imaging to enable people to visualise what a particular flow will look like. The WAP research suggests that people generally over estimate low flows and under estimate high flows. These estimations will frequently be wrong by as much as 100%. Therefore it is important that the landscape specialist is cautious if basing effects assessments or drawing conclusions on acceptability of flows based on particular flow rates.

The WAP research also explored people's aesthetic preferences for flows in a variety of river types. If seeking public input on preference, or acceptability of particular flows, it is advisable to provide comprehensive and comparative visual material to illustrate a range of flows. The WAP research found that flow preferences were different in small and large rivers. In small rivers/ streams, preference was for flows well above mean annual low flow (MALF), often at or above mean flow (MEANF). On larger rivers, flows closer to MALF were preferred – possibly reflecting greater sinuosity of water course and improved water clarity at lower flows. Generally, people disliked flood flows, finding the turbidity and water colour unattractive. This aesthetic observation contrasts strongly with experts' assessments of natural character where flood flows were seen as positive.

Fig 31: *The accuracy of flow estimates in the online survey varied with river planform and size among the river reaches tested. Low-flow estimates were generally more accurate than high flow estimates and the most accurate estimates were made for the two study reaches of the Selwyn River (median flows < 5 m3 s-1).*

Fig 32: *The least accurate estimates were for the single-thread reach of the Waimakariri River (median flows 87 m3 s-1), as respondents generally underestimated the high flows depicted.*

The identification of an acceptable low flow may be a requirement of a flow allocation investigation. Different recreation groups e.g. jet boaters, anglers, and rafters will generally have a good understanding of their preferred flows. If the views of the general public or other out-of-river stakeholders are sought, then graphic illustrations of flows are likely to be essential. Experience suggests that only individuals very familiar with a particular stretch of river resulting from frequent use at particular flows will be able to accurately estimate flow rates. In most instances viewers will have difficulty in recognising flow reductions of as much as 25%. It is important that landscape effects assessments accurately set out the changes that would occur to a river from reduced flows and that they do not exaggerate the probable effects on visual amenity. If viewers are unable to detect a meaningful difference in river appearance then visual effects are unlikely to be significantly adverse.

Landscape

The assessment of landscape effects resulting from river regime modifications will reflect natural character changes in terms of biological effects, and visual/ aesthetic changes in terms of sensory values. Associative values – values that may not be apparent from the site e.g. spiritual importance, historical relevance, and place in literature or art - will also need to be assessed.

Overall findings and evaluations of values should be summarised in a comprehensive manner and cross-referenced to additional information. In level 1 and 2 investigations it may be helpful to view the draft reports from the other disciplines, in order to ensure correct interpretation of the existing information (eg hydrology, vegetation and aquatic life of the river) prior to finalising landscape assessment reports. The findings of these reports should ensure that the landscape assessment is based on sound information and where appropriate is in line with other experts' opinions. If the descriptions and evaluations of the existing riverscape environment and flow regime have followed the recommended steps, the effects of flow changes can be assessed against these using similar criteria and format. This will enable a direct comparison between the effects of flow regimes.

6.9 INTEGRATE LANDSCAPE FINDINGS WITH OTHER IN-STREAM VALUES (STEP 8)

This step involves the landscape specialist providing information on a suitable flow regime that provides for riverscape values. This information will be integrated by the water manager with findings on other in-stream values. These guidelines do not address the question of setting environmental flows. This is a task for water managers and other decision makers.

The specialist landscape assessor will recognise that water managers must balance a large number of potentially conflicting demands for river flows, both for abstractive and for numerous in-river uses (Syme et al. 1999). Sensible water allocation decisions require information about the socioeconomic and environmental values of river flows, and this information is often lacking, of insufficient detail or is not directly comparable. The task of the specialist consultant is to offer an appreciation of their findings within the context of other in-river values. Integration will require the clarification of any conflicts or parallels between the landscape assessment results and the findings of other assessments.

The value society places on 'landscape' as an in-river resource appears to be increasing and river managers need more information about 'landscape' quality - flow relationships to make effective water allocation decisions. If the previous 7 steps have been completed at an appropriate level of detail the 'landscape' findings will be robust. In many cases, for example when providing expert evidence, the landscape findings will be presented separate from other values assessments. However, if the overall investigations structure and decision making framework require comparative evaluation of different in-river values, some form of common ranking scale across values may be required. This may use a similar format to that outlined in step 7 (to combine different 'landscape' values). Where this occurs, the landscape specialist should ensure that riverscape values are understood and that the findings of any combined evaluation of in-stream values are reliable.

The final outputs from a landscape assessment will depend on the nature and purpose of the investigations and on the findings of other in-river investigations. In many cases it is probable that flow regimes necessary to support other in-river values will be adequate to support 'landscape' values. In other cases, 'landscape' requirements may be critical to determining water allocation limits. In such cases it is clearly desirable that landscape specialists have followed a logical and explicit assessment process and that their findings are robust and justified. However, it is inevitable that different conclusions may be drawn by different landscape assessors. 'Landscape' is too complex, multidimensional and value based to be reduced to a precise mathematical exercise and even minor differences of emphases may lead assessors to form different conclusions on the significance of rivers and on the effects of water allocations. However if the steps set out in these guidelines have been followed, the findings of any landscape investigation should allow comparison of findings and contribute to decisions that will promote the sustainable management of our rivers.

Section 07

Appendices and References

Appendix 1 River typing and classification

River Environment Classification (REC)[29] system was developed by NIWA (National Institute of Water and Atmospheric Research Ltd.) for classifying river environments. The REC is a system that is based on climate, topography, geology, and land cover factors that control spatial patterns in river ecosystems. REC builds on existing principles for environmental regionalization and introduces three specific additions to the "ecoregion" approach. First, the REC assumes that ecological patterns are dependent on a range of factors and associated landscape scale processes, some of which may show significant variation within an ecoregion. REC arranges the controlling factors in a hierarchy with each level defining the cause of ecological variation at a given characteristic scale. Second, REC assumes that ecological characteristics of rivers are responses to fluvial (i.e., hydrological and hydraulic) processes. Thus, REC uses a network of channels and associated watersheds to classify specific sections of river. When mapped, REC has the form of a linear mosaic in which classes change in the downstream direction as the integrated characteristics of the watershed change, producing longitudinal spatial patterns that are typical of river ecosystems. Third, REC assigns individual river sections to a class independently and objectively according to criteria that result in a geographically independent framework in which classes may show wide geographic dispersion rather than the geographically dependent schemes that result from the ecoregion approach. REC has been developed to provide a multiscale spatial framework for river management and has been used to map the rivers of New Zealand at a 1:50,000 mapping scale.

Summary of criteria categories and mapping characteristics for application of REC to New Zealand Rivers:

1. Climate: warm and extremely wet to cool and dry
2. Source of Flow: Mountain, Hill, Low Elevation and Lake fed
3. Geology: Alluvium, Hard and Soft Sedimentary, Volcanic Basic, Volcanic Acidic, Plutonic
4. Land Cover (the spatially dominant land cover): Bare, Indigenous Forest, Pasture, Tussock, Scrub, Exotic Forest, Wetland, Urban
5. Network Position Low to high order stream
6. Valley Landform: High to low gradient valley slope

[29] Snelder T. H, Biggs B. J. F. 2002. Multiscale river environment classification for water resources management, Journal of the American Water Resources Association 38,: 1225- 1239

Appendix 2 River photography

Selection of equipment

The ability of photographic images to replicate what the human eye can see is limited. However, images taken with a good quality professional or semi professional camera with interchangeable lenses have considerable advantages. The choice of lenses will influence the field of view, the apparent distance to the subject and the width of view represented by a photograph. A 50mm focal length lens has traditionally been used for assessment work. However, a human viewer generally moves through the landscape, constantly turning eyes and head and changing focus. A range of images, including panoramic images, taken at varying focal lengths can provide a more realistic representation of the landscape as experienced by observers in the field. For example, a telephoto lens can be used to isolate a portion of the scene. Caution is necessary in their use, as these lenses reduce the depth of field and tend to flatten perspective. Wide angle lenses (focal lengths ranging from 13mm to 35mm with corresponding fields of view from 118 to 62 degrees) make objects near to the camera seem proportionately bigger, and the background appears to recede, enhancing the sense of space in the images. They may be suitable for contextual photographs. Polarising and other filters may be used to improve the clarity of river images. However, if photographs are to be used for comparative assessment purposes it is crucial that similar camera, lens and filters are used.

Film and digital sensors are less sensitive than our eyes in picking up detail particularly in heavily shadowed or very bright areas. Therefore, detail is often lost in an image with extremes of light and dark. Water scenes are often not easy to photograph as they contain extremes of contrast with the result that an image can have widely differing tones. If photographing in bright sunlight, the combination of a bright sky and reflections off the river will result in areas in shadow being underexposed. In diffused light conditions contrasts are less emphatic, but darker colours often take on a richness and density that is never apparent in strong sunlight, and subtleties of tone and colouring begin to appear. The disadvantage of photographing in overcast conditions is that the resulting image can appear flat and lack the definition that comes from contrast and accents of light.

When photographing landscapes, which encompass water bodies or large areas of bright sky, water reflections can cause incorrect readings on the camera's light meter, resulting in underexposed images. To overcome this problem a manual meter or override on the camera (reading close-up to some mid-tone detail, such as grey rock or grass) should be used to set the exposure. If shots are taken straight into the sun, flare and incorrect exposure may result. A

lens hood can help to combat unwanted reflections which may flare on the lens. The problem of photographing into the light needs to be considered when determining viewpoints and viewing routes. If a specific route will be followed, then consideration should be given to the position of the sun at each viewpoint. Images into the sun may be of limited use.

The use of a solid tripod can greatly improve image sharpness, which is particularly noticeable when photographing rivers in low light conditions requiring longer exposures. Accurate panoramic shots can be taken with a spirit level on the tripod or the camera. A shake free means of firing the camera, such as a cable release or a remote trigger is advisable when using a tripod-mounted camera, especially at long exposure times.

Framing and choice of viewpoint

Image composition and framing are key factors in an image's suitability, if the objective is to evenly depict riverscape attributes (e.g. for comparative assessment). The results of the WAP research emphasise the importance of seeing both banks of the river in at least one image. This will aid the assessor to judge the width of the river. For comparisons the photo frame selection should avoid variables, such as overhanging vegetation, seasonal colours which may introduce inappropriate bias, or distract from the salient river features. Landscape format is appropriate to represent broad expansive landscapes, such as rivers. The portrait image format is suitable to emphasise the vertical character of a landscape. However, mixing formats can distort comparative assessments and should generally be avoided. When framing an image atypical foreground features should be excluded. It is important that each image fairly represents the attributes of the particular location or river reach.

Choice of viewpoint elevation, angle of camera tilt and viewing direction in relation to the river (i.e. across river or along a river parallel with the river bank) will affect the focal point of a photograph. For contextual photographs an elevated viewpoint may be necessary. However, it is very difficult to detect flow differences in elevated images compared with low level images. To predict flows it is necessary to be able to estimate velocity as well as depth and width. The distance to the actual water surface is one of the factors that influences an assessor's ability to compare the velocity of flow, shown by water surface movement (ripples, etc.). In general, low viewpoints increase the impact of foreground features, including water surface features creating a more involving, immediate impression of a river, whereas an elevated viewpoint gives a more detached, more expansive impression.

Table shows information to be conveyed in photographs

Image information	Visual cues	Details
River width	Wetted area, marks of higher flows	Illustrate both banks (in the foreground or midground of the photograph).
River depth	Water level, river bed.	The best perspective to assess depth is from a riverside location at human standing level rather than from an elevated viewpoint. From this preferred perspective the viewer can assess water levels against rocks, vegetation etc.
River velocity	Water's surface textures	To best indicate movement, (such as ripples, eddies, etc.) the texture of the water surface should be visible in the foreground of the photo either looking upstream or downstream (not directly across the river.)

The visual quality of water is largely dependent on the following three factors: sky (from which the water derives much of its colour), reflection (mirroring tones and shapes around it) and movement of the water itself. Atmospheric conditions such as bright sunlight can have a great influence on people's response to photographs as can different ways of photographing rapidly moving water. Blurring or freezing the movement of water is controlled by the shutter speed. For the WAP research, photos and videos were taken in clear weather conditions and slow shutter speeds which best replicated the rivers appearance. If photographs are to be used in comparative assessments it is important to identify the approach at the outset and to be consistent throughout the investigation. In some instances investigations may last several years.

As long as good quality photographs that avoid the obvious pitfalls are used, the key issue for direct comparisons of flows is that photographs are taken from identical locations, in similar conditions and cover the same images and area ie. use identical focal length lenses to photograph identical views or river features

Appendix 3 Definitions

General terms

Landscape: In his report 'landscape' (when placed in inverted commas) is used to encompass the range of biophysical, sensory and associative considerations including matters addressed in RMA s6 and s7 In particular natural character, outstanding natural features and landscapes and visual amenity values are all covered by the umbrella term - 'landscape'.

Riverscape: The term riverscape has been used when referring to river 'landscapes'. The use of this term in these guidelines implies more than visual concerns and embraces natural character and amenity values

Terms used in the River Flow Assessment Sheet (Appendix 4)

watercourse	-	the actual water covered part of a river channel
river fairway	-	the full width of a river channel including areas not covered by water. Synonymous with river channel
riparian edges	-	the banks and immediately adjacent areas of a river channel – width will vary with size and type of river.
landscape context	-	the wider landscape through which the river passes
river catchment	-	the area from which water drains to the river
river	-	a copious flow of water – because of apparent width, depth or velocity would not normally be safely crossed
big river	-	no uniform definition but would generally relate to a river that for reasons of depth or velocity would not be crossed by a vehicle
stream	-	a small river which because of width, depth or velocity, would appear to be fordable
creek	-	narrow inlet on coast or riverbank
drain	-	apparently artificial conduit/waterway
single thread	-	where the river generally flows in a single channel
braided	-	where the river flows in multiple interconnected and often shallow channels divided by deposited material
channelised	-	where the river has been artificially straightened or contained

cobble	-	rounded stones – approx. size of paving cobbles, small fist to football size
boulders	-	large stones – bigger than cobbles – soccer/rugby ball size and above
gravel	-	mix of sand and small water worn stones
mud	-	wet soft earth
shingle	-	small rounded pebbles (pebble- small smooth stone)
sand	-	loose granular substance
bedrock	-	solid rock that underlies loose deposits or may be exposed in places
silt	-	fine sediment
velocity	-	speed of flow
movement	-	direction or manner of flow
pool	-	area of still water in a river/stream
riffle	-	shallow part of a river/stream where water flows brokenly
ripple	-	a ruffling of the water surface – small unbroken waves
rapid	-	a fast flowing and turbulent stretch of stream/river
eddy	-	circular movement of water
torrent	-	a strong and fast moving length of river
run	-	a length of stream/river with a smooth surface generally separated by shallow riffles ('riffle and run')
waterfall	-	a cascade over a precipice or steep incline
chute	-	a sloping and contained waterfall
water	-	absence of
periphyton	-	slime within fairway or in shallow points of the watercourse
riparian vegetation	-	plants within the riparian area
aquatic vegetation	-	plants adapted to growing in the water
rubbish	-	human waste, refuse or litter
debris	-	loose natural materials deposited by floods etc.

Note: Geomorphological definitions tend to be based on quantified scales (eg boulders, cobbles, gravel, sand, etc all have size bounds)

Appendix 4 Riverscape descriptive checklist

The Watercourse and river channel

River attribute	Description		Adjective descriptors (use additional descriptors as necessary)
- size/scale	river stream creek drain		***Size*** enormous, huge, big, large, substantial, considerable, major, sizeable, modest, minor, little, tiny, diminutive ***Scale*** dramatic, expansive, striking, significant, insignificant
- shape	single thread braided channelised		***Cross section*** broad, wide, open, expansive, narrow, intimate, enclosed, confined, contained incised, shelving, entrenched uniform, varied, natural, artificial ***Long section*** linear, straight, meandering, winding, twisting, sinuous, sweeping, curving
- channel bed materials	cobble gravel shingle sand silt	boulders mud pebbles bedrock	fine, coarse, large, small submerged, exposed, protruding uniform, varied
- flow	velocity movement		stagnant, drifting, sluggish, slack, constant, gentle, slow, steady, rapid, lively, brisk, wild, fast, swift, powerful, raging, gushing, energetic, vigorous, forceful, violent
- surface texture	pool ripple eddy run chute	riffle rapid torrent waterfall	calm, smooth, flat, serene, tranquil, ruffled, stirred up, choppy, rough, turbulent, churning, swirling, boiling, wild
- sound	very loud – silent		whispering, lapping, gurgling, bubbling, splashing, sloshing, roaring, rushing
- appearance (water quality)	water vegetation - riparian - aquatic	periphyton (slime) rubbish debris	crystal clear, glassy, clear, cloudy, turbid/muddy, dark, translucent, luminous, shining brown, grey, blue, green, whisky, orange murky, filthy, dirty, polluted, contaminated, discoloured, choked, clogged, slimy, pristine, pure, clean, fresh

Riparian edges

- Riparian Landforms	gorge gully trench chute bend sweep cliffs escarpment	terrace flood plain slope shelf banks wetlands verges	eroding, stripping, slumping, crumbling, deteriorating, flat, gentle, grading, sheer, steep, regular, modified, artificial
- Landcover	paddocks trees bush scrub shrubland shrubs	weeds grass tussock shelterbelts plantation forestry	indigenous, exotic, mature, sparse, dense, isolated, overhanging, clean, clear, farmed, pastoral, planted, revegetated, modified
- Built modifications	bridge railway road river gauges signs	fencing groyne stopbank dam canal buildings	artificial, man-made, modified, transformed, inappropriate / appropriate, grating, changed, contrasting, in-keeping, blends, small / large scale, colours, dominant, prominent

Landscape context

- Landforms	mountains valley basin hill foothill	plain terraces gullies gorges	rolling, gentle, steep, alpine, lowland, open / enclosed, limestone / schist / greywacke / volcanic
- Landcover	paddocks trees bush scrub shrubland shrubs urban industry	weeds grass tussock shelterbelts plantation forestry housing	indigenous, exotic, mature, sparse, dense, isolated, overhanging, clean, clear, farmed, pastoral, planted, revegetated, modified
- Built modifications	bridge road structures	railway buildings	small scale / large scale, prominent, dominant, in-keeping, appropriate, inappropriate

Appendix 5 Research results on use of visual surrogates

The WAP research explored the use of various media to inform potential riverscape assessors. This research was necessary because of the logistical difficulties inherent in relying on site investigation for riverscape evaluation or decision making. It focused on the appropriateness of different graphic media to help experienced observers to understand the depicted river and its flows. Research findings are summarized here as this material may assist landscape specialists to understand the benefits and limitations of various techniques at the outset of assessment. In our view, the opportunity should be taken to record as wide a range of known conditions as possible during any site visits. This material can prove invaluable later in the assessment process particularly where it is used as proxy for site investigations or in desktop evaluative exercises.

In the WAP research, focus groups explored the natural character and landscape depicted in various media. They assessed the significance of this material to their understanding of the river regime. The following media were projected on a large screen to illustrate natural character and landscape attributes of two Canterbury rivers - the Hurunui and the Selwyn:

1) single still image of a river

2) a set of multiple still images

3) a video clip without sound

4) a video clip with sound

5) still images of a river accompanied by flow data

Respondents were asked to indicate the level of understanding of the river environment that they could gain from the different visual surrogates presented during the focus group meetings and in the questionnaire. The scores between 100 (provides full understanding of the river from the medium presented) to 0 (no benefit to understanding of the river) were used to gauge the appropriateness of the visual surrogates as a proxy for site visits.

The ranking and percentage score results for the two rivers (Hurunui and Selwyn River) were very similar with almost identical percentage scores for the different media. The results indicate that single photographic images provided the lowest level of understanding of the river and its flow (55 and 57%). For both rivers the scores were considerably higher (63 and 61%) for multiple images than for a single image. All respondents agreed that videos provided

a better understanding of the river environment than still images (72 and 70%). However, the addition of sound with the video clips did not provide further benefit.

The use of a combination of still photos including contextual landscape panoramas, river details and images that showed both banks of a river coupled with hydrological data provided a greater level of understanding (79 and 78%). These findings suggest that appropriate graphic media can be an effective proxy for site inspections when combined with hydrological data. Landscape specialists need to be very cautious if relying on single images to illicit evaluative responses.

Focus groups discussed these findings and provided further useful commentary. These comments are included as they may assist landscape specialists to select appropriate graphics when attempting to illustrate a river's attributes.

Single image

Since still images cannot convey the movement of water very effectively, respondents found it difficult to assess river flow from a single photograph. They commented on the fact that static impressions cannot capture the dynamic element of moving rivers as well as video. However, for relatively motionless landscapes or slow flowing waterways the difference would be less significant. If a river is to be represented in one still image, the choice of a wide angle photo showing the river with both banks would be most practical. Respondents commented that images showing rivers from viewpoints along the banks looking upstream are generally more effective in showing water surface movement. However, they make it difficult to estimate depth due to surface reflections.

The spatial context of the photo viewpoint has to be chosen carefully to ensure that the visual surrogate is representative of the river type or reach. Several focus group members noted that the surrogate has to display the typical and characteristic elements of a river type (eg mountain, snow-fed river with large substrate, typical riparian vegetation and surrounding land use). It was discussed that a map of the river catchment would help to provide a landscape context, so that conclusions can be drawn about the representativeness of the reach.

The size and scale of a river is difficult to gauge from a visual surrogate if there are no scale references, such as people or other familiar objects, visible in the image. Any single recording of a river whether a still image and video, only represents a snap shot in time.

Multiple images

To get a good understanding of a river environment from a visual surrogate, respondents emphasised the importance of showing the water and flow (quality and surface movement), the depth of the river, the width of the channel, the structure of the river bed banks (substrate), the riparian edge and vegetation, and the surrounding land use. Since it is almost impossible to effectively convey all these elements in one photograph, there are obvious advantages in using a number of images at varying scales and viewing angles, showing different levels of detail and a variety of the river attributes listed above. Respondents found it beneficial to show images of both riffle and run sections where these occurred. In riffle sections with exposed rocks the surface movement can be used as an indicator for the velocity of flow, while run sections allow for views under the surface and an assessment of the depth of the river. If multiple images are taken at different locations along a river, a wider range of representative river sections in the catchment can be shown, but maps are essential to show the spatial relationship of viewpoints and river reaches. When showing multiple images, it is important to clarify whether they were taken at the same or different flows and locations.

Video

While the ratings of the video sequences were higher than for the still images, respondents indicated that the dynamic nature of the video does not provide much additional information about the river environment. The video sequences were taken at similar viewing angles to the multiple still images. The respondents found the visual linkages between individual sites (including zoomed in images of the river and riparian edge) through constant recording, including panoramic sequences, beneficial to their understanding of the river. This interlinking aspect of video allowed them to understand how images spatially relate to each other which is difficult with multiple still images. The use of panoramas in video clips provides information about landscape context, while views into the river show flow movement and depth. The video allowed for a better appreciation of movement and speed of flow, which assisted the focus group members in estimating flow rates. A scale reference for the river is useful in video sequences.

Video with sound

Views on the addition of sound to the video varied between respondents. While some respondents found sound distracting and confusing, others agreed that sound adds to the experience and qualitative understanding of the amenity and natural character of the river. For most participants sound did not provide much additional information, but confirmed assumptions and expectations from the video without sound.

Multiple images and hydrological information

For both rivers, respondents considered the combination of multiple still images and long-term flow information to be the most helpful information to their understanding. The hydrological data on low, mean and flood flows provides a flow regime context for the flows shown in the images. This allowed the river experts, to draw conclusions about the appropriateness of flow rate, water colour and clarity.

Most respondents found that the river flow information provides them with a better understanding of the flow rate, but did not enable them to draw conclusions about any other aspects of natural character, such as riparian edge/ vegetation and landscape context. In order to assess appropriateness of flow in the context of natural character, information about water abstraction occurring on the river would be necessary, in addition to the annual flow data. Representative images of different river flows (eg low, mean and flood flow), showing the banks and the surrounding landscape, and long – term hydrological data provide an important context for natural character assessments.

Preferred methods suggested by focus group participants

The majority of focus group members suggested that the use of appropriately selected and taken multiple still images or a video together with hydrological data would be the most suitable method to provide them with a good understanding of a river. Experts highlighted that it would increase their understanding significantly, if multiple images, taken at a variety of sites along a river, were presented alongside a map or aerial photo of the river catchment which showed the location of each photo. The photos must be representative of the river type. The provision of a scale reference in each photo, such as a human figure, would be helpful to assess river size.

Focus group members concluded that, if a series of images and flow data for several sites along a river and maps are shown, this method could serve as a successful proxy for site visits. At present, large files sizes mean that video images can be problematic if distributing. It is important to note that focus group members all had water allocation investigation experience. This was critical to their understanding and ability to interpret natural character issues from the information provided. Such experience would not necessarily be important if the purpose was restricted to the evaluation of aesthetic quality or visual amenity. In those circumstances, previous river experience and understanding may be unnecessary. Nonetheless, the need for careful selection of appropriate images is likely to be similar.

Appendix 6 Guidesheet for assessment process

Step 1 Scope riverscape as an instream value and water allocation issue

- Complete landscape checklist to determine probable importance of 'landscape' as an in-stream value.
- Conduct initial desktop assessment of riverscape importance – natural character, amenity values and outstanding natural features and landscapes based on REC, existing literature, maps and other readily available resources.

Step 2 - Select appropriate riverscape assessment approach

- Select appropriate approach to riverscape assessment based on desktop assessment combining the significance of landscape as an in-river value (step 1) with the degree of hydrological alteration proposed. Use table to determine the appropriate level of assessment investigations.

Step 3 - Develop a brief

- Prepare a riverscape assessment brief using the checklist as a framework

Step 4 - Prepare riverscape descriptions

Desktop (pre site visit) Review

- Map familiarisation
- REC (or other river typing) familiarisation (see Appendix 1)
- Review RPS and Regional / District Plans
- Review other available relevant data set,s including Google Earth and various national GIS layers (such as the Land Cover Database)
- Review findings (if available) from other environmental flow investigations
- Select investigation sites and record on GIS as appropriate
  - accessible and safe
  - representative of reaches
  - close to flow recording sites
  - low flow reaches (analyse tributaries)
  - popular public access and viewing points
  - good photography locations
- Select appropriate flows or flow range for site visits

Site Investigations

Pre-visit equipment checklist

- Safety equipment, didymo spray etc
- Maps, GPS, camera and tripod, binoculars, etc
- Route plan – to maximise good light conditions for photography
- Access permissions

On-site tasks

- GPS exact locations of viewpoints to be used for comparative flow photography
- Set up viewpoints and carry out photography (follow photographic guidelines)
- Complete description record sheets for all representative sites/reaches
- Complete description record sheets for riparian areas and landscape context

Step 5 - Analyse and characterise riverscape

- Analyse descriptive record sheets, photographs and hydrological data.
- Prepare riverscape characterisation.
    - Characterise river and its landscape (reaches, landscape character areas etc)
    - Identify and characterise representative reaches, tributaries, viewpoints, access points etc.
    - Identify significant, unique, atypical features, attributes within reaches, e.g. rock platforms, bridge sites.
    - Characterise (based on descriptive record sheets) any different flows linking these to hydrological data and photographic/video record.
- Map and illustrate characterisations.
    - Map spatial relationships between catchments, river, reaches. Access points, photographic viewpoints etc.
    - Provide diagrams of cross and long sections as appropriate
    - Illustrate characteristics of reaches and key locations with photographs from specified viewpoints including landscape context, river channel and flow detail.
- Analyse river dynamics based on hydrological data.
    - Explain past hydrological changes e.g. any existing modifications to the natural flow regime resulting form damming, diversion or abstraction.

  - Explain current status quo flows in relation to natural flow and to allowable flows (i.e. these flows possible under existing permits etc) where applicable.
  - Identify and map dam, abstraction and diversion points where relevant.
  - Identify vulnerable locations e.g. low flow sections resulting form existing allocations
- Integrate landscape analysis findings with any relevant findings from other in-stream environmental investigations.
  - Hydrological
  - Geomorphological
  - Ecological
  - Recreation
  - Cultured heritage

Step 6 - Evaluate riverscape

- Review material generated in steps 4 and 5
- Determine appropriate evaluation approach based on level of investigations.
  - Level 3 investigations are likely to rely on the landscape expert making value judgements. This will be largely a qualitative exercise but supported by available quantitative data.
  - Level 2 investigations will justify a more rigorous and explicit evaluation approach by the landscape specialist. In some instances graphic and descriptive material generated in steps 4 and 5 will be used to elicit value responses from other parties e.g. this may well be appropriate where there are affected stakeholders.
  - Level 1 investigations will justify vigorous and explicit evaluations based on a wide range of quantitative data and many involve public, stakeholder, and specialist valuation inputs. It is probable that natural character, amenity values and landscape will be addressed separately and may involve different evaluative methods.
- Determine consistent language and where possible agree explicit criteria and evaluation measures at the outset.
  - Level 3 least sophisticated - Level 1 most sophisticated
- Select who will contribute to the evaluations
  - Expert landscape assessor, other experts, stakeholders, the general public and the appropriate format e.g. site inspections, desk top review, questionnaires, focus groups

  - Consider focus groups for evaluating natural character in level 1 studies
  - Consider the general public for aesthetic/visual preference assessments in level 1 and 2
  - Use landscape and/or river experts for overall 'landscape' assessments
  - Choose appropriate graphic and descriptive material if using outputs from steps 4 and 5
- In desktop evaluations use a combination of multiple still images, video, maps, and hydrological data to maximise river understanding.
- Avoid use of poor or unrepresentative photographic imagery and be cautious of relying on single images of particular locations.

Step 7 - Describe, illustrate and evaluate modelled flow changes

- Identify and describe the baseline and other flows for effects assessment
  - natural
  - status quo
  - consented
  - proposed
- Analyse hydrological and geomorphological assessments of relevant flow regimes
- Assess river/reach sensitivity to flow changes
  - river size
  - river type
  - river cross section
  - river context
- Evaluate effects of flow changes on natural character using steps 5 and 6 descriptors and evaluation criteria
  - short term
  - long term
- Evaluate effects of flow changes on visual amenity values using steps 5 and 6 descriptors and evaluation criteria
  - Ability to recognise and estimate flow changes
  - Need for graphic support material e.g. comparative photographs, simulations
- Evaluate effects of flow changes on landscape using steps 5 and 6 descriptors and evaluation criteria
- Prepare findings on suitability/acceptability of flow changes
- Recommend water allocation limits based on 'landscape' considerations.

Step 8 – Integrate riverscape findings with other in-stream values

- Provide desirable flow regime recommendations using previously agreed format for landscape input
- Provide comparative instream values assessment using common ranking if required
- Confirm appropriate interpretations and integration of landscape assessment findings in combined in-stream values investigations.

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