



**LANDSCAPE LOGIC**  
LINKING LAND AND WATER MANAGEMENT TO RESOURCE CONDITION TARGETS

Technical Report No. 11

# Management of riparian zones in Tasmanian agricultural catchments



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Cover photo: Meander River near Longridge. Photo: NRM North.

**LANDSCAPE LOGIC** is a research hub under the Commonwealth Environmental Research Facilities scheme, managed by the Department of Environment, Water Heritage and the Arts. It is a partnership between:

- **six regional organisations** – the North Central, North East & Goulburn–Broken Catchment Management Authorities in Victoria and the North, South and Cradle Coast Natural Resource Management organisations in Tasmania;
- **five research institutions** – University of Tasmania, Australian National University, RMIT University, Charles Sturt University and CSIRO; and
- **state land management agencies in Tasmania and Victoria** – the Tasmanian Department of Primary Industries & Water, Forestry Tasmania and the Victorian Department of Sustainability & Environment.

The purpose of Landscape Logic is to work in partnership with regional natural resource managers to develop decision-making approaches that improve the effectiveness of environmental management.

Landscape Logic aims to:

1. Develop better ways to organise existing knowledge and assumptions about links between land and water management and environmental outcomes.
2. Improve our understanding of the links between land management and environmental outcomes through historical studies of private and public investment into water quality and native vegetation condition.



# Management of riparian zones in Tasmanian agricultural catchments

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## Executive summary

This study of riparian land management in the six most intervened catchments in Tasmania identified relationships between landowners' occupations, values, knowledge and conservation activity that will be useful for targeting future natural resource management programs. The catchments surveyed included two in the high rainfall North West (Pet and Inglis–Flowerdale), two in the northern midlands and northern agricultural region (Macquarie and Quamby Brook), and two in the south-east (Jordan and Coal).

While farmers were the largest single occupational grouping, they made up a minority of the 146 survey respondents (39%), the others being trades (23%), retirees (17%) professionals (14%) and investors (2%). The proportion of farmers varied from 15% in Quamby Brook to 76% in the Macquarie catchment. The survey found that existing NRM programs have failed to reach the non-farmers, with only 11% accessing government support for conservation activity in the past five years compared to 42% of farmers. With the exception of the Macquarie catchment (where properties were larger and the majority of landholders were farmers) non-farmers owned between 40% and 68% of the length of all frontages.

As the non-farmers were found to hold high conservation values, there is an opportunity to reach this new and influential audience. The challenge is to build the necessary knowledge, skills and capacity amongst this cohort, given that the best predictors of conservation activity were found to be attending a property management planning course, being a member of a Landcare group, and having sound knowledge of NRM processes. The differences in knowledge, networks and conservation activity between farmers and non-farmers suggests that NRM programs directed at this audience need to develop skills and build social and human capital as a precursor to implementation of recommended practices. A further challenge is reaching an ever changing audience, given that high turnover in property ownership is likely over the next decade with an average age of riparian landholders of 54 years, of whom less than 20% expect to pass ownership to family members, and over two-thirds saying they are likely to subdivide and sell part of the property in the next five years.

Two further challenges are managing the apparent conflicts between recommended management of riparian lands and 'best practice' farming, and providing the knowledge and skills to manage the off-site consequences of increased irrigation. Conservation practices in potential conflict with farming are excluding stock, commonly viewed as the most cost-effective means of controlling weeds and pests, and fencing riparian areas, given the high costs of repairs after floods in high rainfall areas. With a third of respondents planning to increase the use of irrigation in the next five years, this may lead to pressure on rivers and streams in the form of sediment and nutrient loads. This emphasises the need for best practice irrigation to be incorporated into property management planning, including establishment of grassed waterways and adoption of minimum tillage, soil testing and nutrient budgeting.

The survey illustrates the dynamic and diverse nature of landholders who manage riparian lands, and emphasises the value of up to date social data on which to base environmental communication, education and incentive programs.

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The research team sincerely thanks the many landholders, local government representatives, interest group representatives and agency staff who contributed their time and ideas to the research, either as survey respondents, interviewees or participants in workshops exploring preliminary findings.

A summary of this report has been mailed to all survey respondents, interviewees and workshop participants. A copy of the full report is available from the Landscape Logic website at [www.landscapelogic.org.au](http://www.landscapelogic.org.au).

## List of acronyms

CERF	Commonwealth Environmental Research Facilities
CfOC	Caring for Our Country
CRP	Current Recommended Practices
CSU	Charles Sturt University
EMPCA	<i>Environment Management and Pollution Control Act 1994</i>
MBI	Market-Based Instruments
NAP	National Action Plan for Salinity & Water Quality
NGO	Non-government organisation
NHT	Natural Heritage Trust
NRM	Natural Resource Management
PMP	Property management planning

## Findings at a glance

This report draws on a survey of 146 riparian landholders in six Tasmanian catchments plus interviews with landholders, industry representatives and government staff working in those catchments. The six catchments (Pet, Inglis–Flowerdale, Quamby Brook, Macquarie, Coal and Jordan) were selected because they have been subject to significant investment through government programs designed to engage riparian landholders in practice change. They also reflect Tasmania's biophysical and agricultural diversity, with two catchments selected from each of the three Tasmanian Natural Resource Management (NRM) regions.

This aim of this research was to improve understanding of

1. The extent to which riparian landholders are implementing 20 recommended practices that are assumed to lead to improved water quality.
2. Landholder knowledge and understanding of the assumed links between these practices and resource condition outcomes.
3. The factors that influence landholders to implement practices expected to lead to improved water quality.

### Who manages riparian lands?

- The majority of landholders (61%) described themselves as non-farmers, being a mix of trades (23%), retirees (17%) professionals (14%) and investors (2%). However, occupation was highly variable across catchments, with the Macquarie being the only catchment with a majority of farmers (76%) and Quamby Brook having the lowest proportion describing themselves as farmers (15%).
- Those who identifying as farmers had larger properties (median 400ha) compared to 41ha) and managed longer river and creek frontages (median 2km compared to 500m).
- Only 37% of respondents made a net profit from farming in the 2006–07 financial year, with a median of \$15,000 ranging from \$5,000 in the Coal, Macquarie and Quamby Brook catchments, \$15,000 in Inglis–Flowerdale and \$35,000 in the Pet and Jordan catchments. Median off-property income before tax for a respondent and partner was three times the median on-property profit (\$45,000).
- Most respondents were long term residents in their district (median 30 years) and long-term managers or owners of their property (median 20 years) while 27% of all properties were not the respondent's principal place of residence.
- The median age of the farmers in the study was

52 years and non-farmers 56. Given that only 13% of the farmers who responded continue to work on their property beyond 65 (the official Australian retirement age for men), the majority of those surveyed could be expected to retire from farming in the next decade.

### Perceptions of water quality

- The majority of respondents (67%) agreed with the statement 'The water in the river/creek running through my property is in good condition' however this varied greatly with location. A far higher proportion of landholders in the higher rainfall north west (Pet and Inglis–Flowerdale) reporting water quality in good condition (91%) than those in the Coal and Jordan catchments in the drier southeastern (42%) with those in the Macquarie and Quamby Brook catchments being intermediate (66%). The Pet and Inglis–Flowerdale have also experienced high levels of riparian intervention through very active Landcare groups (Inglis–Flowerdale) and major intervention by the Burnie City Council to manage the town's water supply (Pet).
- Optimistic assessment of water quality was significantly linked to only one of the 20 recommended practices included in the survey, 'Limiting stock access to the river or creek frontage or adjoining land to no more than a week at a time in 2008'.
- Most respondents rely on visual assessment of water quality, particularly turbidity, but also use the presence of fish, frogs and platypus. Less than a third (27%) test water quality for stock or irrigation, ranging from 8% in Quamby Brook to 41% in the Coal catchment.

### Values attached to riparian lands

- All respondents placed a high value on the environmental and social benefits of riparian lands, with the only significant difference between farmers and non-farmers being the higher value farmers placed on four of the 15 values, all economic values (irrigation water, improved property value, grazing, and stock shelter in that order).
- The highest rated values of riparian lands across all respondents were
  - Habitat for native fauna
  - Soil conservation (stabilising stream banks and preventing erosion)
  - Aesthetics
  - Stock water
  - Adding to the market value of the property

- A strong stewardship ethic was evident amongst respondents overall with 64% agreeing that 'Reduced production in the short-term is justified where there are long-term benefits to the environment'. This compares with 35% of respondents agreeing with that statement in a survey of river frontage owners in the Goulburn Broken Catchment in Victoria in 2008 (Curtis *et al.* 2008c).
- While riparian areas are highly valued, respondents also reported that they require considerable management effort and are subject to close scrutiny by neighbours and government agencies.
- Farmers were significantly less likely to accept a stronger role for government in ensuring compliance with the EMPCA (*Environment Management and Pollution Control Act 1994*) or a duty of care for biodiversity than non-farmers.

### **Major issues of concern**

- The three highest rated district-scale issues were
  - Balancing the consumptive and environmental use of water
  - The long term community impacts of plantation forestry
  - The impact of declining water quality on native aquatic animals
- The three highest rated property-scale issues were
  - The impact of changing rainfall patterns on property viability
  - The impacts of the rising costs of farming inputs on property viability
  - The right to use surface or ground water for irrigation

### **Knowledge of water quality processes**

- Less than 30% rated their knowledge of processes that contribute to land and water degradation as sound, with significant differences between catchments for six of the 13 topics in the survey.
- Knowledge of water quality processes was found to be significantly related to adoption of current recommended practices, suggesting that knowledge is a powerful influence on landholder behaviour and investment in activities that lead to improved knowledge are likely to lead to practice change.

### **Implementation of practices to manage water quality**

- Over half the respondents had carried out work in three of the 20 recommended practices over the time they had managed the property

(erected fencing to enhance regeneration of native vegetation, erected fencing to manage stock access, and established off-stream watering points for stock).

- More than a third of all survey respondents (38%) had planted trees and shrubs along the waterway or in adjoining wetlands during their management, however much of this revegetation was on a small scale (75,500 trees & shrubs in total established by 99 respondents).
- Only 26% of respondents reported removing willows during the time they had managed the property, with 58% reporting 'not applicable', suggesting that either there were no willows, or that in their view willow removal was not an appropriate activity.
- A third of those growing crops had established permanent grassed waterways in drainage lines in the past five years. A large majority of respondents who grew crops had used minimum tillage or sowed cover crops over winter in the past year. Just over half of all survey respondents said they had carried out soil nutrient testing where they had applied fertiliser in the past five years,
- Approximately two-thirds of all respondents had spent time controlling pest animals and non-crop weeds on their riparian lands in the past 12 months.

### **Confidence in current recommended practices**

- There was a high level of support for four CRP; soil testing to guide nutrient applications, limiting stock access along waterways, removing willows to improve water quality, and installing off-stream watering points. However, there was some ambivalence about the need to control stock access to riparian areas and about the benefits of crash grazing river frontages compared to set stocking for retaining native vegetation.
- Farmers reported that recommended practices for riparian lands were sometimes inconsistent with their views of 'best practice' farming, such as excluding stock access when this is commonly viewed as the most cost-effective means of controlling weeds and managing pest habitat.
- A significant proportion of respondents were concerned about five aspects of riparian management; increased pest plants (44%), the difficulty or cost of installing watering points for stock (40%), increased management time (38%), creating shelter or cover for pest animals (38%), and flood events affecting fencing (33%). These concerns suggest it is likely to be difficult to engage the 39% of respondents who said they had not fenced to manage stock access during



their management period.

- Only half of those who had removed willows during their management period said they had replaced these with natives. This finding reinforces the comments of interviewees who were said that revegetating those areas would complicate management. If willows are not replaced by natives, much of the benefit of willow removal is lost. Indeed, water quality may decline if the removal of shade trees leads to increased water temperatures.

### ***Factors that influence land managers to implement water quality management***

#### *Occupation and income*

- Farming as an occupation, larger property size, succession planning and the time spent working on the property were associated with significantly higher levels of implementation of recommended practices.
- Farmers were significantly more likely to have implemented four of the recommended practices than non-farmers; fenced land for natural regeneration of native vegetation, erected fencing to manage stock access, tested soils for nutrient status prior to applying fertiliser, and tested the quality of the main water source for stock or irrigation purposes.
- There was a significant positive relationship between on-property profitability and two practices implemented during the period of property management; land fenced for natural regeneration of native vegetation, and establishing off-stream watering points for stock.
- Off-property income, which was significantly higher than on-property income, was not significantly linked to implementation of conservation practices.
- Many interviewees reported that the difficult business environment, coupled with continuing dry conditions, had left them with little financial capacity to invest in on-ground NRM work, with several saying they had deferred their NRM activity until business and climatic conditions improved.

#### *Training and incentive programs*

- Involvement in property management planning was one of the best predictors of implementation of recommended practices. Other factors positively correlated with implementation were a high level of knowledge of all the NRM topics in the survey, participation in landcare, and succession planning.
- Most respondents rated their knowledge as less

than sound for each item in the survey.

- Every landholder interviewed said that all recommended practices implemented in their riparian area had been undertaken with financial or logistical support from a locally coordinated project (via landcare, local government, or an NGO).
- Overall, 23% of survey respondents said they had received support through federal or state NRM programs and the regional NRM organisations in the past five years, which was significantly linked to two practices; planting trees and shrubs along the waterway or wetlands during the period of management, and fencing land for natural regeneration of native vegetation.
- Significantly more farmers than non-farmers (42% vs 11%) had accessed support for work on their riparian lands from federal or state governments or regional NRM organisation in the last five years

#### *Values*

- The majority of respondents rated a mix of environmental, social and economic values of their riparian areas, reinforcing the importance of appealing to a wide range of attributes of riparian lands in management programs.
- Respondents who valued riparian areas for shade and shelter for stock were significantly more likely to have erected fencing to manage stock access, installed off-stream watering points for stock and removed willows.
- Those who valued riparian areas for stock water were significantly less likely to have limited stock access to those areas to no more than a week at a time in 2008 for both grazing and access to water.

#### ***Plans for the future***

- A third of respondents planned to increase the use of irrigation in the next five years
- Less than 20% expected to pass ownership of the property to others within their family, and at least two-thirds said they were likely to subdivide and sell part of the property in the next five years.
- Those who planned to expand their property were more likely to have planted trees and shrubs during their period of management, tested soils for nutrient status in paddocks where fertiliser has been applied, had a fertiliser nutrient budget for all or most of the farm, and applied fertiliser using an accredited spreader.
- Those who planned to sell, lease, share farm, or seek additional off-property work were significantly less likely to implement some recommended practices.

## **Implications**

### **1. Engaging non-farmers**

The predominance of non-farmers as managers of riparian lands in these catchments presents both opportunities and challenges for natural resource managers. The opportunity is to reach a large audience that places high value on the environmental role of riparian areas but is not being engaged at present, with only 11% of non-farmers accessed government support in the past five years compared to 42% of farmers. The challenge is to develop the knowledge, skills and capacity of this cohort. The finding that high levels of self-reported knowledge of NRM processes, participation rates in property management planning and membership of landcare groups are significantly linked to implementation of conservation practices suggests that NRM programs that investment in activities that develop skills and build social and human capital have a better chance of leading to implementation of recommended practices.

### **2. Resolving apparent conflicts between conservation and farming practice**

The inconsistencies between recommended practices for riparian lands and 'best practice' farming requires careful consideration and emphasises the dangers of generic prescriptions or recommendations. Practices in potential conflict are excluding stock access (when this is commonly viewed as the most cost-effective means of controlling weeds and pests) and repairing fencing (when the costs incurred in high rainfall areas where floods are more frequent can be high and frequent). Differences were also apparent in the confidence expressed in two other practices, removing willows to improve water quality, and the relative merits of set stocking and crash grazing.

### **3. Best practice irrigation**

With a third of respondents planning to increase the use of irrigation in the next five years, there is likely to be increased pressure on rivers and streams in the form of sediment and nutrient loads. This

emphasises the need for best practice irrigation including established techniques for soil conservation such as grassed waterways, minimum tillage, soil testing and nutrient budgeting to be included in property management planning courses.

### **4. Reaching new owners**

High turnover in property ownership can be expected in the next decade, given the age of land managers and the finding that less than 20% expected to pass ownership of the property to others within their family, and at least two-thirds said they were likely to subdivide and sell part of the property in the next five years with most new owners unlikely to be members of the current owner's family. This emphasises the need for programs to be based on recent demographic data, and to be flexible and adaptable to reach a changing audience who may not have the values, knowledge or skills of current owners.

### **5. Establishing links between perceptions and measurement of water quality**

Riparian landowners rely on visual guides to water quality, notably turbidity and presence of larger aquatic animals (frogs, crayfish and platypus). While these might serve as useful broad surrogates, there is little evidence that they are good predictors of the water quality parameters used by state agencies, regulators and NRM practitioners, and research is needed to develop accessible techniques that can be as widely adopted as soil or crop testing.

### **6. Cost-sharing**

Many interviewees reported that the difficult business environment and dry conditions had left them with little financial capacity to invest in on-ground NRM work, with several saying they had deferred their NRM activity until business and climatic conditions improved. Survey data confirmed the overall low level of on-property profitability and the limited financial capacity of most landholders to implement work without substantial cost-sharing by governments.

## Introduction

### Background

Research presented in this report is part of the social research undertaken in Landscape Logic, one of the Australian Government's Commonwealth Environmental Research Facilities (CERF) hubs. Landscape Logic aims to test the assumed links between recommended property management practices and improved environmental outcomes at the catchment scale. In Tasmania, the focus is on links between property management and water quality outcomes. Another study is being undertaken in Victoria focusing on the links between property management and native vegetation outcomes.

Current recommended practices (CRP) for riparian management that are expected to lead to improved biodiversity and water quality outcomes include the replacement of willows by native vegetation; fencing to manage stock access; buffering streams from cultivation; and installing off-stream watering points for stock. Property management action beyond riparian areas also impact on water quality and is therefore also in the scope of Landscape Logic's Tasmanian research. For example, the rates of fertiliser application and tillage practices on properties influence nutrient runoff and in turn, may affect water quality.

The social research in Landscape Logic is exploring the social acceptability of these recommended practices; landholder understanding of the assumed links between these practices and resource condition; the extent policy instruments

can build long-term landholder commitment to conservation outcomes; and landholder adaptation to climate change (Mazur *et al.* 2008). The first two topics were the focus of research discussed in this report.

This report draws on data collected through a survey mailed to riparian landholders in six Tasmanian catchments; and a series of interviews with other riparian landholders, industry representatives and government staff working in those catchments [Figure 1]. The six catchments, which were identified by the biophysical scientists working in Landscape Logic, provided a diverse sample of catchments across the three Tasmanian Natural Resource Management (NRM) regions where there had been substantial investment through programs attempting to engage riparian landholders in practice change. The six catchments include a diversity of biophysical, socio-economic and agricultural contexts.



*Aerial view of Meander River at Deloraine (note narrow riparian corridor). (Photo: NRM North.)*

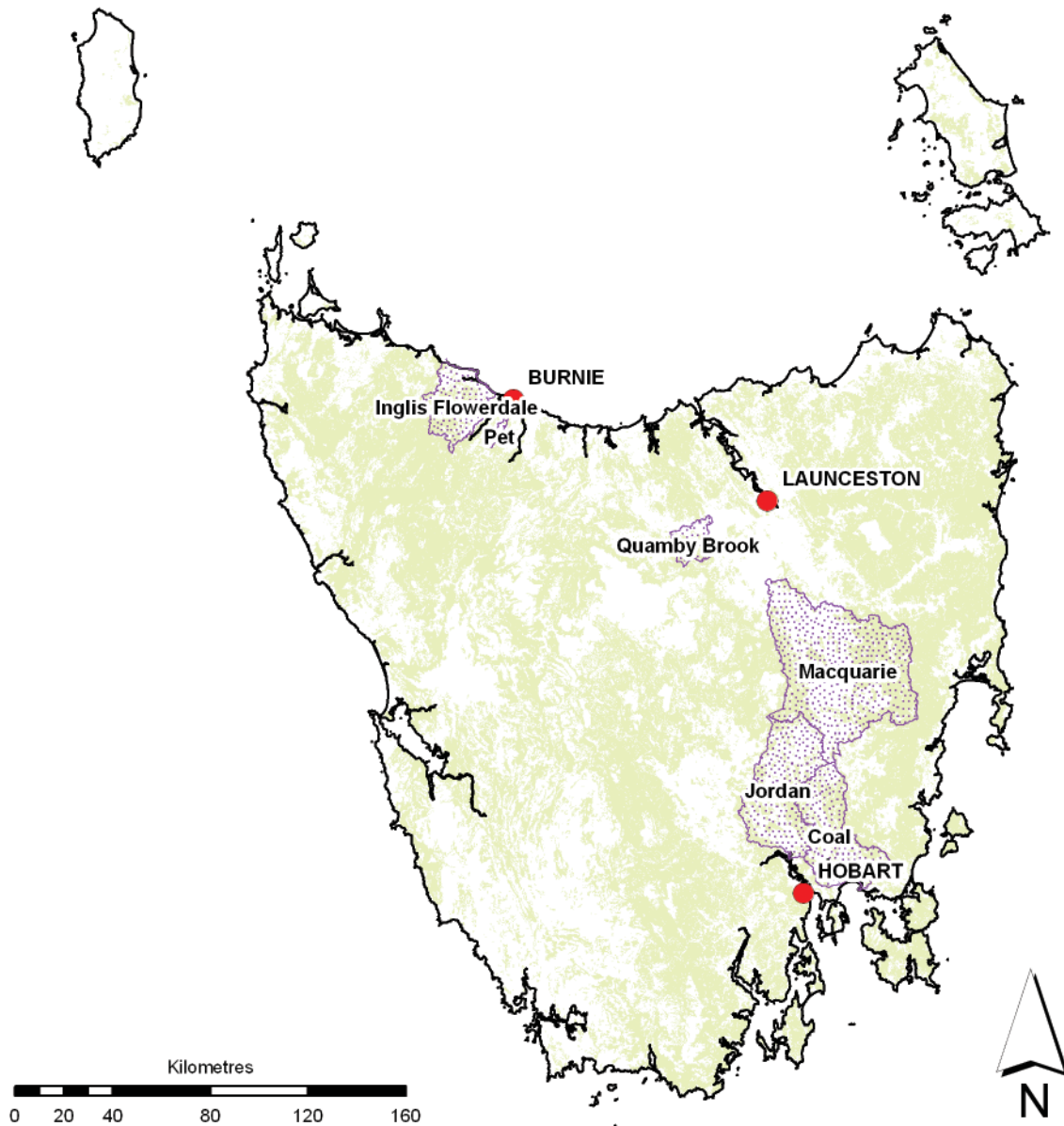


Figure 1. Location of the six selected catchments in Tasmania.

### Research objectives

The objectives of this research project were to provide new knowledge and improved understanding of:

1. the extent landholders with riparian areas are implementing practices expected to lead to improved water quality outcomes in the six catchments;
2. landholder knowledge and understanding of the assumed links between these practices and resource condition outcomes in the six catchments;
3. the factors influencing landholder implementation of practices expected to lead to improved water quality outcomes in the six catchments.

# Methodology

## Introduction

Efforts to improve NRM outcomes can focus on changing specific practices or the mix of on-property enterprises. As Pannell *et al.* (2006) explain, engaging landholders in practice change is complex and difficult, not the least because there is a potentially large set of factors influencing decisions and these vary according to each technology, landholder context and over time. Even the concept of implementation is problematic. For example, when does a trial change in practice represent implementation? Pannell *et al.* (2006) proposed a framework for exploring implementation that addresses four broad sets of factors: the nature of the practice or technology; the personal characteristics of the landholder and their immediate family; the wider social, economic and environmental context of the landholder; and the nature of any intervention or learning process.

The social research team previously investigated the management of river frontages and waterways in the Goulburn Broken (Curtis *et al.* 2001; Curtis and Robertson 2003; Wilson *et al.* 2006; Curtis *et al.* 2008c); and Ovens (Curtis *et al.* 2002; Curtis *et al.* 2008d; Curtis *et al.* 2008e) catchments in Victoria. The research team also has substantial experience examining rural landholder implementation of recommended practices for biodiversity and sustainable agriculture (Curtis and De Lacy 1996, Millar and Curtis 1997; Race and Curtis 1998; Mendham *et al.* 2007; Curtis *et al.* 2006; Curtis *et al.* 2008a).

Drawing on the Pannell *et al.* (2006) framework; the extensive literature on adoption studies in Australia (Vanclay 1992; Barr and Cary 1992; Barr and Cary 2000; Cary *et al.* 2002); the research team's experience; and the ideas and experience of Landscape Logic partners, we developed a mail survey instrument and an interview schedule [see sections below for details] to gather data to address the key research objectives. In summary, the research team collected quantitative and qualitative data using:

1. a questionnaire mailed to a random sample of property owners with river/creek frontage (310 questionnaires posted) located within six selected catchments in Tasmania. The six catchments were the Coal, Jordan, Macquarie, Quamby Brook, Pet, and the Inglis-Flowerdale. A 65% survey response rate was achieved;
2. semi-structured in-depth interviews with 43 landholders (commercial farmers and non-farming landholders) (at least six from each study area) selected to represent the main social and farming characteristics of river frontage owners; and

3. semi-structured in-depth interviews with 14 people identified as representatives, or highly informed members, of additional stakeholder groups (e.g. regional/catchment project managers, regional NRM organisations, significant agricultural industries and state-wide organisations/interest groups).

## Profile of the six study areas

Six Tasmanian catchments were selected for this retrospective research by our Landscape Logic partners (i.e. soil and water scientists at University of Tasmania and staff from the regional NRM organisations). The six catchments were selected because they provided a diverse sample of catchments across the three Natural Resource Management (NRM) regions in Tasmania where there had been substantial investment through government programs in efforts to engage riparian landholders in practice change. These catchments were considered diverse in terms of their biophysical, socio-economic and agricultural contexts. Dr Bill Cotching provided an earlier draft of these edited descriptions of each of the six catchments.

### Coal

The Coal River catchment covers 970km<sup>2</sup> and incorporates the South East Irrigation Scheme, which resulted in the construction of Craighourne Dam in 1986. Land use is predominantly dryland pastures for stock grazing and there are important areas of reserved native vegetation. The lower Coal catchment supports intensive irrigated crops, both annual and perennial horticulture. This area is in a rainshadow with a mean annual rainfall of 640mm, so crops rely heavily on the provision of irrigation water from the Craighourne Dam. The ephemeral nature of the Coal catchment influences a variety of water quality parameters, with the tributary streams often reduced to a series of ponds and stagnant pools. During these periods, water quality is often extremely poor, with elevated conductivity, turbidity and nutrient concentrations, and depleted oxygen levels. In many parts of the lower catchment, native vegetation has either been totally removed or has been replaced by undesirable exotic weed species such as willow and Cumbungi.

### Jordan

The Jordan River is in south eastern Tasmania, and is 120km long and the catchment covers 1253km<sup>2</sup>. It is one of the driest catchments in Tasmania, with approximately 600mm of average annual rainfall. The Jordan River has a semi-ephemeral dry season

flow pattern and unpredictable flooding can occur. Lake Dulverton is artificially maintained by ground-water pumping, and along with Lake Tiberias, is utilised as a local source of irrigation water. The upper catchment consists largely of native forest, while the lower catchment has a long history of agricultural use where the main land uses are sheep and cattle grazing; areas of intensive cropping and dairy farming; and some industrial and urban areas. Many sections of the river have been cleared of native vegetation, with pasture grass adjacent to the riverbanks. Woody weeds – willows in particular – have infested large areas of the Jordan River system. As a highly modified system, the valley, tributaries and mainstream are subject to a growing salinisation problem.

### **Macquarie**

The Macquarie catchment covers 3800km<sup>2</sup> and drains north through the Macquarie River and has the major tributaries of the Blackman, Isis, Elizabeth and Lake Rivers. Water storage is at Tooms Lake, Lake Leake and Woods Lake, which are used to supplement flows in the Macquarie River during summer for irrigation purposes. Large volumes of water from the Great Lake are also discharged from Poatina Power Station into the Macquarie River. The Macquarie catchment is located within the rain shadow of both westerly and easterly weather systems, and is one of the driest areas in Tasmania, with less than 600mm of average annual rainfall. However, flooding can occur with fences being destroyed, requiring regular maintenance. Willows and gorse are a substantial problem in areas surrounding Campbell Town in the Macquarie River. Willow, Hawthorn and pasture grasses dominate the riparian vegetation. Recreational fishing is an important value for the lower Macquarie, with minimal vegetation preferred for ease of access, particularly for fly fishing.

### **Quamby Brook**

The Quamby Brook is a sub catchment of the Meander catchment, encompassing state and privately owned forests, agricultural areas (dairying, cropping and grazing), hobby farms, and urbanised areas (Westbury township). The catchment is 82km<sup>2</sup> in size with a mean annual rainfall of 830mm. Quamby Brook has been described as being severely degraded, with major weed infestation in the riparian zone and poor water quality. Factors thought to have contributed to these issues include land clearing; levee bank construction; willows; live-stock; effluent from a sewage treatment plant and agricultural run-off; Westbury township stormwater; and past industry/forestry practices.

### **Pet**

The Pet and Guide river catchments have an area of 31km<sup>2</sup> and supply potable water for 19,000 residents in the Burnie Municipality. The catchment is primarily used for cattle grazing, both beef and dairy, with a substantial portion used for plantation forestry. Average annual rainfall is approximately 1500mm. Over a hundred years of conventional agriculture and more recent commercial forestry in these catchments has reduced biodiversity values and degraded the water quality through soil erosion, nutrient loads, effluent run-off, and clearing of riparian vegetation.

### **Inglis–Flowerdale**

The Inglis–Flowerdale catchment is located on the north-west coast of Tasmania between Smithton and Burnie. Originating in the Campbell Range at 350m above sea level, the Inglis and Flowerdale Rivers drain approximately 610km<sup>2</sup>. Mean annual rainfall is 1370mm. Forestry (native and pine plantation) dominates the middle and upper catchment, while grazing, cropping and dairy farming dominate land use in the lower catchment. Members of the Wynyard Landcare group have expressed concern about the water quality, stream bank erosion and the adverse effects of willows.

### **The mail survey**

Drawing on the literature identified in section 2.01, our research experience; and the ideas and experience of Landscape Logic partners, we identified a limited number of topics likely to explain differences in the level of implementation of CRP to be included in the mail survey. These topics included:

- values attached to the water way and adjoining wetlands;
- knowledge of natural resource management;
- attitudes about roles and responsibilities of key stakeholders in the management of river/creek frontages and adjoining wetlands;
- assessment of issues relevant to natural resource management, including the condition of the river/creek running through the property;
- confidence in recommended practices;
- management practices implemented;
- involvement in a short course related to property management;
- involvement in government NRM programs;
- constraints to better management of river/creek frontages and adjoining wetlands;
- long-term plans for the property, including disposal or acquisition of land through sale, subdivision or leasing;
- extent of property and succession planning (and

extent property held within family); and

- a range of other social and farming variables, including: property size, occupation, Landcare membership, absentee or resident owner, on and off-property work (available time), on and off-property income, enterprise mix, age (stage of life), and gender.

The preliminary survey instrument was refined after a workshop with Dr Bill Cotching (leader of P4 project team) and input from other Landscape Logic partners, including practitioners from the regional NRM groups and the agriculture industry. A final draft was subsequently pre-tested at workshops with a selection of landholders in Burnie and Launceston.

Landscape Logic P1 staff (led by Professor Tony Norton) provided the social research team with a list of every landholder within the six study catchment areas [Figure 1] who owned a portion of land which contained a minimum of 1ha of vegetation within 50m of any mapped waterway (the state's definition of riparian vegetation). From this list a random selection of landholders (N=338) who owned properties >10ha was drawn. The subsequent database contained approximately 60 names and addresses per catchment – except for the Pet River which only had 30 names in total. The database had 28 landholders who owned multiple properties and these were removed, leaving 310 owners who were to receive the survey.

The survey design and the mail out process employed a modified Dillman (1978) approach. The survey was presented as a distinctive booklet and was mailed with an appealing cover letter. Several reminder and thank you notices were posted to respondents and non-respondents. After three reminder notices, a second mail out was made to all non-respondents. The mail out process was closed with 146 useable surveys and a 65% response rate

[Table 1]. There were 72 surveys where the survey was either “returned to sender” (36) or an explanation was provided and the non-return was deemed acceptable. For example, some respondents said they had multiple properties and therefore only returned one survey (4); some had retired or were too old to complete a survey (9); some owners were incapacitated by illness (1), had died (3), had sold (2), or were travelling overseas (2); others claimed not to own a river/creek frontage (6), claimed not to own the property (1), claimed their property was not in any of the catchments (1), refused to complete the survey (6), or returned the survey but the survey was lost (1). These respondents were all removed prior to calculation of the survey response rate. Another 12 surveys were returned but were incomplete or inappropriately completed and were also removed from the mail out total.

Survey data analysis included in this report consists of descriptive statistics, correlations, chi-square tests, Fishers exact tests, Z tests for proportions, Kruskal Wallis tests, linear modelling, stepwise multiple linear modelling and logistic stepwise generalised linear modelling. Descriptive statistics such as frequencies, means, medians and percentages were used to summarise the responses to particular survey questions. Kruskal Wallis tests (continuous or scale responses) and Z tests for proportions (for percent/categorical responses) were used to see if there were differences across the catchments.

Correlations, linear models, chi-square tests, Fishers exact tests and Kruskal Wallis tests were used in pairwise analysis to see if the relationships or differences observed by the summary statistics were significant.

- Relationship: In the case of correlations, Spearman's Rho was used to identify if there were significant relationships between pairs of

Table 1. Survey response rate. Tasmania riparian landholder survey, 2008

Catchment	Initial mail-out	Return to sender, excused	Un-useable surveys	Surveys returned useable	Response rate %
Coal	57	13	2	22	52.4%
Jordan	59	14	4	21	51.2%
Macquarie	55	17	3	21	60%
Quamby Brook	56	15	1	29	72.5%
Pet	23*	1	0	17	77.3%
Inglis-Flowerdale	60	12	2	33	71.7%
unknown				3	100%
Overall	310	72	12	146	64.6%

\*Pet mail out was to all landholders with properties >10ha as listed on the database provided.

continuous variables. For example property size and amount of work undertaken on the river frontage. In certain cases, the relationship was explored further using a linear model instead of Spearman's Rho, in an effort to quantify the structure of the linear trend.

- **Difference:** The Kruskal Wallis test was used to see if there were any significant differences on a continuous variable based on a grouping variable. For example, fencing along a water frontage based on whether or not the property was the survey recipient's principal place of residence.
- **Dependence:** The Chi-squared tests and Fisher's exact tests were used when comparing two categorical (or grouping) variables depending on the frequencies found in the cross-tabulated counts. These statistics test for dependence in the grouping. For example, farmer/non-farmer compared to Landcare/non-Landcare member.

The statistical tools identified above were used to explore relationships between variables (independent variables) thought to influence the implementation of recommended practices (dependent variables), such as the link between participation in Landcare and the implementation of off-stream watering points for stock. If the values were significant, then those variables were considered as possible predictors of each recommended practice. Each of these possible predictors were then scrutinised for a response rate above 80% to ensure modelling integrity. The final list of predictors was then used in a stepwise modelling process that used Akaike's information criterion as the step criteria and multi-collinearity issues were dealt with at each step. If the dependent CRP variable was continuous then a stepwise linear modelling process was used. If the dependent CRP variable was dichotomous, then a stepwise binomial generalised linear modelling process was used. The modelling process was used to see which variables contributed collectively to implementation of recommended practices.

All data analysis was performed in the package S-Plus and the Z tests on the following website: [www.dimensionresearch.com/resources/calculators/ztest.html](http://www.dimensionresearch.com/resources/calculators/ztest.html)

## **Interviews with landholders and other NRM stakeholders**

### ***Method for in-depth interviews***

In-depth interviews were conducted during April–May 2009 to obtain information that would enhance understanding of the information collected by the mailed survey (survey data collected during August–October 2008), as part of the social research undertaken by Charles Sturt University

(CSU) in Tasmania for Landscape Logic. Our preliminary analysis of the mail survey data indicated the need to use the interviews to further explore landholder confidence in CRP, perceptions of water quality and involvement in Landcare and property planning.

A purposeful sample of landholders was selected for the interviews, with the emphasis on hearing the views of a cross-section of landholders, including large and small-scale landholders, long-time and new residents, commercial and hobby farmers, dairy farmers and wool producers, men and women, younger and older landholders, and participants and non-participants in NRM programs. Potential interviewees were identified from suggestions by staff at the regional NRM organisations, local government, agribusiness and 'stock and station' agents. In total, 43 landholders were interviewed as part of this research, with interviews conducted with 6–8 people who have rural properties in each study area (fully or partly) [Figure 2]. All landholders interviewed had properties with riparian frontage. Data on some personal and property characteristics were collected from each interviewee and a summary is presented in the section below.

The interviews were conducted using a widely accepted approach (Blaikie 1993; Minichiello *et al.* 1995). Interviewees were contacted by phone and mail by CSU researchers 1–2 weeks prior to the interview. Most interviews were of 1–2 hours duration, and were digitally recorded with the interviewee's permission. Interviewees were informed of the research objectives and provided with an overview of some of the key findings from the survey. The subsequent conversations explored the following topics:

- their management of the riparian area and their property;
- the extent CRP for improving water quality were desirable and feasible; and
- their involvement in NRM programs that focus on improving water quality.

In addition to landholders, the research team interviewed 14 other stakeholders from regional NRM organisations, local government, company staff, and representative organisations [Box 1]. Using a similar approach to that for landholders (described above), stakeholder interviews explored the following topics:

- the importance of water quality to their industry/organisation; and
- the characteristics of successful NRM programs.

Quotes have been used to substantiate conclusions drawn from the interview data where it has been possible to do so without compromising interviewee anonymity.



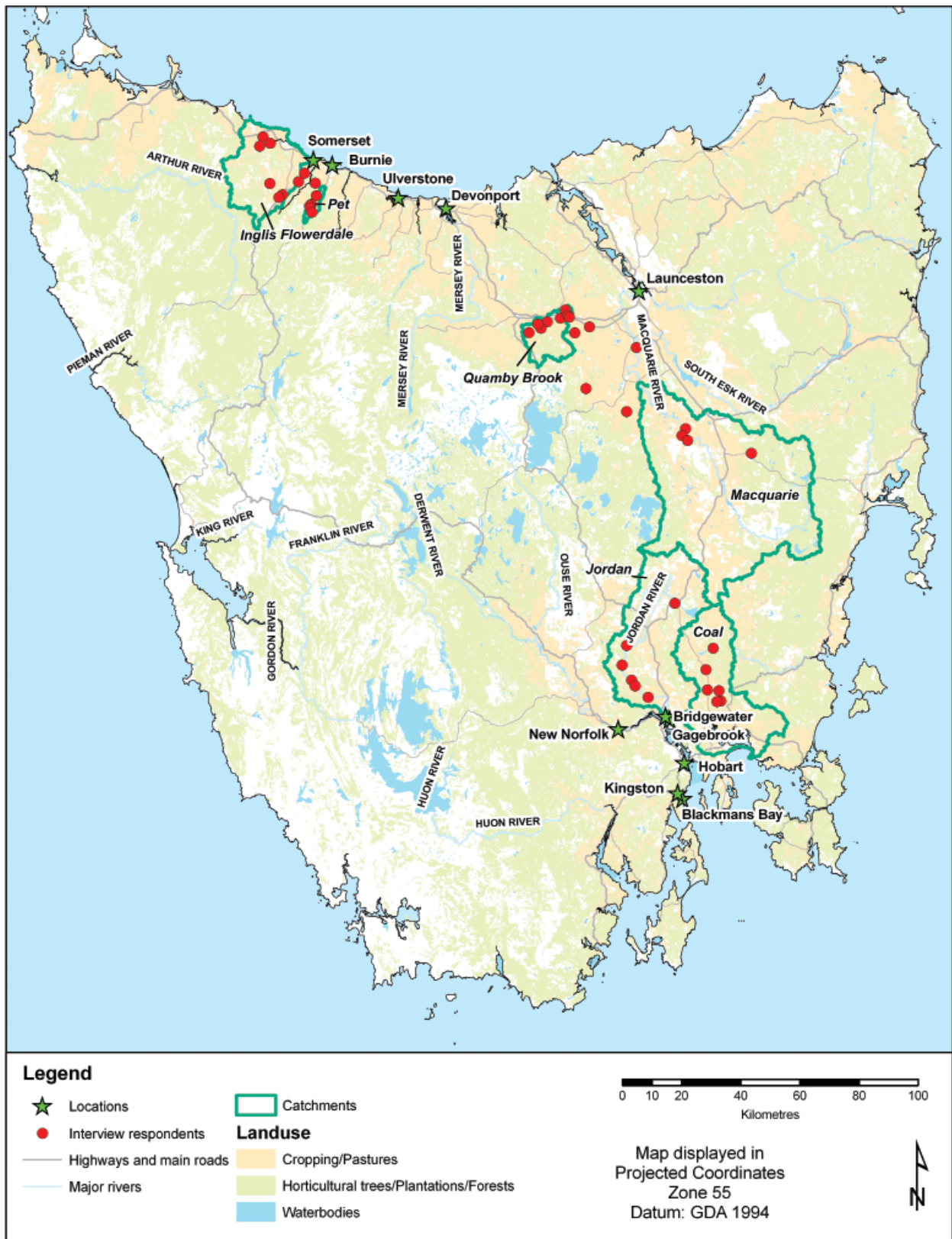


Figure 2. Location of study areas and interviewee properties.

**Box 1: Types of regional and state-wide NRM stakeholders interviewed**

- Local NRM project managers (x 3)
- Regional NRM staff (x 3)
- State-wide NRM facilitator (x 1)
- Agribusiness representatives (x 2)
- Senior managers of corporate organisations with land/water interests (x 3)
- NRM staff hosted by local government (x 2)

## Characteristics of landholders interviewed

Most landholders interviewed identified themselves as farmers (75%) who lived on their property (84%). The proportion of interviewees who nominated their primary occupation as being a 'farmer' (75%) was greater than the proportion of survey respondents who nominated themselves as a farmer (39%). To a large extent this bias in the interview sample resulted from a combination of the recommendations provided by NRM practitioners and the research team's deliberate focus on farmers who were thought to operate larger properties and, therefore, manage larger proportions of the river frontages in the six catchments. Further analysis of the survey data indicated that farmers do own a larger proportion of

the length of river frontage in the six catchments. However, as will be explained, with the exception of the Macquarie catchment, non-farmers own between 40% and 60% of the river frontage surveyed. The landholder interviewees included sufficient numbers of farmers (32) and non-farmers (11) to explore differences between the two cohorts.

Interviewees in the northern catchments (i.e. Pet, Inglis-Flowerdale, and Quamby Brook) had, on average, smaller properties (median property size: 85–120ha) compared to those interviewed in the Coal catchment (156ha) and the Macquarie and Jordan catchments (1,100ha). Interviewees in the Jordan and Macquarie catchments were, on average, of a younger age than interviewees in the other catchments.



Mid Macquarie River showing typical "PPA" (weeds eg. cumbungi, Hawthorne, willow) issues (Photo: R. Sample)

## Findings by research topic

### Assessment of issues at the district and property levels

Survey respondents were asked to assess the importance of a range of social, environmental and economic issues in their local district/catchment zone or on their property [Tables 2 and 3, respectively]. The 23 items covered in the survey were identified through discussions with Landscape Logic partners and survey pre-test participants.

Survey respondents were asked to rate the importance of each issue listed in the survey as either 'Very important', 'Important', 'Some importance', 'Minimal' and 'Not important'. Respondents could also choose 'Don't know/Not applicable'. To simplify the presentation of these data, the response options have been collapsed into three categories – 'Important' (combining very important and important), 'Some' (of some importance) and 'Unimportant' (combining not important and minimal importance), plus 'Not applicable'.

#### Key survey findings

- A large number (11 of 13) of the district scale issues listed in the survey were rated as important by at least fifty per cent of respondents [Table 2].
- Getting the balance between water for consumptive and environmental purposes, the community

impacts of plantation forestry and the impact of declining water quality on native animals were the highest rated issues at the district scale. These findings suggest that most landholders are concerned about a range of social, economic and environmental issues [Table 2].

- The top five rated issues at the district scale include four water-related items, indicating a high level of concern about declining water quality [Table 2].
- The impact of changing rainfall patterns on property viability, the rising cost of farming inputs on property viability and the right to use surface or ground water for irrigation were the highest rating issues at the property level. Again, most landholders are concerned about a mix of social, economic and environmental issues [Table 3].
- There were significant differences across the six catchments for four of thirteen district-scale issues and for three of the ten property-scale issues included in the survey [Appendix, Tables A and B respectively].
- There were significant relationships between 20 of the 23 items exploring concern about issues at the property and district scale and 14 of the 20 items exploring implementation of CRP in the survey. For example, respondents more concerned about salinity threatening the water quality in rivers/streams/wetlands were significantly more

Table 2. Importance of issues at a district scale Tasmania riparian landholder survey, 2008, N=146

Issue	n	Important	Some	Not important	NA	Mean
Getting the balance between water for the environment, agriculture, town water supply and recreation	140	69%	11%	11%	9%	4.10
The long-term community impacts of plantation forestry	139	67%	12%	14%	8%	4.05
Declining water quality threatening native animals, such as the platypus, freshwater lobster, frogs, Burrowing Crayfish	139	61%	12%	19%	7%	3.84
Declining water quality in rivers/streams affecting estuarine health	139	60%	11%	19%	9%	3.79
Nutrient and chemical run-off affecting water quality in rivers/streams/wetlands	139	57%	13%	19%	11%	3.73
Tree dieback	139	56%	12%	19%	12%	3.73
Soil erosion from farmland affecting water quality	139	54%	9%	27%	9%	3.61
Sediment loads entering the local estuary	139	45%	17%	22%	15%	3.53
The effects of increased ground and surface water extraction	139	50%	17%	22%	11%	3.53
Increasing land prices constraining opportunities for farmers to expand their properties	139	52%	17%	22%	9%	3.48
The impact of recent and future clearing of native bush and grasslands	139	50%	17%	23%	10%	3.46
Loss of native vegetation along water courses	139	54%	12%	28%	6%	3.45
Salinity threatening water quality in rivers/streams/wetlands	140	46%	9%	29%	16%	3.39

Note: Mean score where 1 = Not important through to 5 = Very important

likely to report that in the past five years they had tested the quality of the main water source for stock or irrigation on their property. However, many of the relationships identified were counter-intuitive and some at least appear to reflect the effect of landholder differences in occupation as a mediating variable. For example, the finding that those respondents more concerned about new chemical spray regulations for riparian and adjoining areas were more likely to say that in 2008 they had a fertiliser nutrient budget; and applied fertiliser using an accredited spreader, was counter-intuitive. Interestingly, there were a larger number of significant relationships between implementation of CRP and concern about issues at the property scale than for concern about issues at the district scale. Relationships identified at the property scale also appeared to be more useful insights into the factors influencing implementation. For example, respondents more concerned about salinity undermining the long-term productive capacity of their property were significantly more likely to have tested soils for nutrient status in the last five years; and tested the quality of the main water source for stock or irrigation purposes in the last five years.

Interviews with landholders revealed a similarly high importance given to the general topic of 'Getting the balance between water for consumptive and environmental purposes' as by survey respondents. Concerns about achieving an appropriate balance between different demands for water were strongest amongst interviewees in the catchments, or study areas, with severely limited water supplies

and low river flows (e.g. Coal and Jordan), rather than in the higher rainfall areas (e.g. Inglis-Flowerdale and Pet). However, the other topics covered by the survey were only raised by a small number of landholders in reference to specific events or locations. More specific information about the views of landholders and other NRM stakeholders gained via the in-depth interviews is presented in the relevant sections below.

Our interviews with landholders (n = 43), revealed that the presence and/or potential impacts of salinity was not of great concern to most landholders across the six catchments. It is noteworthy that there was no appreciable difference in the level of concern about salinity between high and low rainfall areas, nor between the farmers and non-farmers interviewed. These experiences are consistent with the survey results indicating that the issue of 'Salinity undermining long-term productive capacity' was the issue of lowest concern at the property scale [Table 3].

### Landholder knowledge

Self-assessment is a widely accepted approach to gathering information through surveys about landholder knowledge of NRM topics. One approach is to ask each respondent to rate their level of knowledge for particular topics (Curtis and De Lacy 1996). Another approach is to ask respondents to answer questions or respond to statements that test their knowledge of a particular topic (Shindler and Wright 2000). For this research, the former approach has been used.

The 13 items included in the survey were identified through discussions with Landscape Logic

Table 3. Importance of issues at a property scale. Tasmania riparian landholder survey, 2008, N=146

Issue	n	Important	Some	Not important	NA	Mean
Impact of changing rainfall patterns on property viability	141	67%	15%	11%	7%	3.99
Rising cost of farming inputs undermining financial viability	141	61%	9%	16%	15%	3.93
Having the right to use surface or ground water for irrigation	140	64%	10%	14%	12%	3.92
The cost of managing weeds and pest animals affecting profitability	139	50%	17%	20%	13%	3.50
Uncertain/low returns limiting capacity to investment in property	137	43%	18%	19%	20%	3.41
New chemical spray regulations for riparian and adjoining areas	140	45%	13%	29%	13%	3.33
State/local government planning rules limiting your ability to subdivide	139	40%	14%	34%	12%	3.11
Declining soil health (e.g. declining fertility or structure)	138	29%	21%	33%	17%	2.97
Availability of labour for important on-property work	140	27%	19%	35%	19%	2.81
Salinity undermining long-term productive capacity	140	17%	6%	44%	34%	2.47

Note: Mean score where 1 = Not important through to 5 = Very important

partners and refined as a result of the survey pre-testing. Most of the survey items in this section sought to explore the respondent's knowledge of processes that contribute to land and water degradation, management practices thought to enhance water quality outcomes, a landholder's legal responsibilities and how to access information [Table 4].

In this section, survey respondents self-rated their knowledge by selecting one of six options that ranged from 'No knowledge' to 'Very sound knowledge (could give a detailed explanation)' and included a 'Not applicable' option. To simplify the presentation of data, the six response options have been collapsed into four categories [Table 4]. For the calculation of mean scores per item we have excluded the 'Not applicable' option.

### Key survey findings

- Very small proportions of respondents (<30%) rated their knowledge as sound for each item

included in the survey [Table 4]. Indeed, there was only one item (fertiliser application required for optimum production) where the proportion of respondents who indicated they had sound knowledge was higher than the proportion who said they had no/little knowledge [Table 4].

- Low self-assessed knowledge was consistent across topics exploring knowledge of processes that contribute to land and water degradation, management practices thought to enhance water quality outcomes, landholder's legal responsibilities, and how to access information [Table 4].
- There were significant differences across the six catchments for six of the 13 knowledge items in the survey [Table 5]. Items where there were significant differences included topics exploring knowledge of processes that contribute to land and water degradation, management practices thought to enhance water quality outcomes and landholder's legal responsibilities, but not 'How

Table 4. Knowledge of natural resource management topics. Tasmania riparian landholder survey, 2008, N=146

Topic	n	Very sound to sound knowledge %	Some %	No/little knowledge %	NA %	Mean score
The fertiliser applications required for optimum production across the main enterprises on your property	139	28%	37%	25%	10%	2.98
The role of native bush and perennial pastures in preventing rises in water tables that can lead to salinity	139	19%	49%	23%	9%	2.92
How to interpret soil tests as a way of checking the application of nutrients on your paddocks	140	26%	31%	36%	7%	2.76
The effects that soil pugging by stock has on soil erosion and nutrient loss from farms	139	19%	35%	33%	13%	2.76
The role of stubble retention and stubble mulching in preventing the loss of nutrients from farms	139	21%	35%	32%	12%	2.74
How to prepare a farm or property plan that allocates land use according to different land classes	139	23%	27%	37%	13%	2.67
The elements of water quality critical for public health	139	19%	37%	40%	5%	2.64
The role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks	139	15%	37%	42%	6%	2.52
Your responsibilities under the EMPCA ( <i>Environment Management and Pollution Control Act 1994</i> )	137	11%	34%	47%	9%	2.38
How to access information about government support for landholders to manage river/creek frontages and adjoining wetlands	140	13%	28%	54%	5%	2.35
The main sources of nitrogen that enter waterways in your district	139	12%	31%	50%	6%	2.33
The relative contribution of different sources of phosphorus to water nutrient levels (such as run-off from paddocks and leaching through soils)	139	12%	28%	55%	5%	2.30
The proportion of nutrients entering water courses that is from paddocks on dairy farms rather than dairy sheds	137	7%	22%	41%	30%	2.25

Note: Topics are ranked by Mean score where 1 = no knowledge through to 5 = very sound knowledge

to access information about government support for landholders to manage river/creek frontages and adjoining wetlands'.

- There were significant relationships between all the 13 knowledge topics and 12 of the 20 CRP items explored in the survey, suggesting that knowledge is a powerful influence on landholder behaviour. Indeed, for every knowledge topic there were significant positive relationships with related CRP. For example, higher self-reported knowledge of the main sources of nitrogen that enter waterways in their districts was linked to higher implementation of eight CRP, including

those practices likely to enhance on-property nutrient management: fencing to manage stock access to waterways; establishing off-river/stream watering points for stock; testing soils for nutrient status in paddocks where fertilisers have been applied; having a fertiliser budget for all/most of the farm; and a plan that limits stock grazing of wet paddocks during winter. Higher self-reported knowledge of the relative contribution of different sources of phosphorous to water nutrient levels was linked to higher implementation of seven CRP, including: establishing off-river/stream watering points for stock; soils for nutrient

Table 5. Knowledge of natural resource management topics. Tasmania riparian landholder survey, 2008, N=146

Topic		Coal	Jordan	Macquarie	Quamby/ Brook	Pet	Inglis/ Flowerdale	p value
The role of stubble retention and stubble mulching in preventing the loss of nutrients from farms	n	20	21	27	27	15	32	0.0065
	mean	2.50	2.19	2.36	2.36	2.54	3.14	
The main sources of nitrogen that enter waterways in your district	n	19	21	27	27	16	32	0.0076
	mean	2.00	1.75	2.29	2.29	2.31	2.94	
Your responsibilities under the EMPCA ( <i>Environment Management and Pollution Control Act 1994</i> )	n	18	21	27	27	16	31	0.0099
	mean	2.19	1.89	2.39	2.39	2.20	2.94	
How to interpret soil tests as a way of checking the application of nutrients on your paddocks	n	20	21	27	27	16	32	0.0137
	mean	2.39	2.15	2.52	2.52	2.80	3.30	
The relative contribution of different sources of phosphorus to water nutrient levels (such as run-off from paddocks and leaching through soils)	n	19	21	27	27	16	32	0.0177
	mean	2.12	1.70	2.12	2.12	2.19	2.81	
The proportion of nutrients entering water courses that is from paddocks on dairy farms rather than dairy sheds	n	19	21	27	27	16	31	0.0180
	mean	2.00	1.65	2.38	2.38	1.90	2.71	
The effects that soil pugging by stock has on soil erosion and nutrient loss from farms	n	19	21	27	27	16	32	0.0537
	mean	2.69	2.31	2.39	2.39	2.79	3.17	
The elements of water quality critical for public health	n	19	21	27	27	16	32	0.0559
	mean	2.53	2.20	2.52	2.52	2.60	3.16	
The fertiliser applications required for optimum production across the main enterprises on your property	n	19	21	27	27	16	32	0.0661
	mean	2.81	2.39	2.83	2.83	2.80	3.30	
The role of native bush and perennial pastures in preventing rises in water tables that can lead to salinity	n	19	21	27	27	16	32	0.0680
	mean	2.81	2.79	2.79	2.79	2.44	3.14	
The role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks	n	19	21	27	27	16	32	0.1037
	mean	2.29	2.05	2.42	2.42	2.44	2.91	
How to access information about government support for landholders to manage river/creek frontages and adjoining wetlands	n	20	21	27	27	16	32	0.3678
	mean	2.47	2.11	2.00	2.00	2.13	2.69	
How to prepare a farm or property plan that allocates land use according to different land classes	n	20	21	27	27	16	31	0.4776
	mean	2.88	2.24	2.50	2.50	2.43	2.79	

Note: Topics are ranked in order of the degree of difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Mean Score where 1 = no

status in paddocks where fertilisers have been applied; having a fertiliser budget for all/most of the farm; and a plan that limits stock grazing of wet paddocks during winter. Significant positive relationships existed between self-assessed knowledge and most related CRP, with six exceptions: fencing land for natural regeneration of native vegetation; removing willows; establishing permanent grassed waterways in drainage lines; regularly mulching rip lines in cropped paddocks; limiting stock access to river/creek frontage or adjoining wetlands for grazing; limiting stock for water access to river/creek frontage or adjoining wetlands.

### Landholder assessment of river/creek water quality

The survey included one item exploring the respondent's views of the quality of water in the river/creek running through their property [Table 6]. Survey respondents were asked to select one of six response options that ranged from 'Strongly disagree' to 'Strongly agree' and included 'Not applicable'. The latter response option was removed for the calculation of mean scores presented in Table 6. The 'Agree' and 'Strongly agree' categories were combined to calculate the proportion of respondents agreeing with the statement [Table 6].

#### Key survey findings

- In most (4 of 6) catchments, a substantial majority (>60%) of respondents agreed with the statement that 'The water in the river/creek running through my property is in good condition' [Table 6]. If comparable water quality data are available, it should be possible to compare landholder and expert assessments of water quality in these catchments. This information should be of benefit to those seeking to engage landholders in actions to enhance water quality outcomes.
- There was a significant difference in the mean scores across the catchments, with most respondents in the Coal and Jordan catchments disagreeing with the statement and almost all

respondents in the Pet and Inglis-Flowerdale catchments agreeing with the statement. This item was significantly linked to only one of the 20 items in the survey exploring CRP implementation. In that case, a more optimistic assessment of water quality was linked to action to limit stock access to the river/creek frontage or adjoining land to no more than a week at a time in 2008. One interpretation of this finding is that those who have limited stock access to their frontage/ adjoining wetlands have enhanced water quality outcomes for the stretch of water passing through their property.

### Perceptions of good water quality linked to higher rainfall in catchments

Landholder interview data (n = 43) was consistent with the survey data presented above [Table 6] in that there were mixed views about the quality of water in river/streams. Analysis of the interview data suggests that these assessments were more optimistic where there was higher rainfall (>800mm/year), such as the Inglis-Flowerdale, Pet, and Quamby Brook catchments compared to the Jordan and Coal catchments that have lower annual rainfall totals (<600mm/year). Even when landholders reported local rivers were of historically low flows – due to low rainfall and increasing water use, such as in the Quamby Brook and Macquarie catchments – most landholders reported the water quality was still of a good standard. Comments by landholders that illustrate this assessment include:

*... the water quality is fine ... good enough for irrigating vegies*

*... we've certainly not heard any issues from our neighbours about the water quality or down in Wynyard about the estuary*

*... the water quality is probably worse than 100 years ago, but we've got plenty of frogs and trout so it indicates it's probably still pretty good*

*... we've got a good supply (fresh water) for livestock, it's just a bit minerally ... there's been no real change in quality over the past 15 years*

Table 6. Landholder assessment of river/creek water quality on property. Tasmania riparian landholder survey, 2008, N=146

Catchment	Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	Total
n	20	21	21	27	17	32	141
% agreeing with the statement	35%	48%	62%	70%	94%	88%	67%
Mean score	3.13	3.50	3.63	3.81	4.35	4.26	3.84

Note: Mean score is where 1 = Strongly disagree through to 5 = Strongly agree. There is a significant difference between catchments (p value = 0.0037, Kruskal Wallis test)

*It's nice to know it's there. It is one of the reasons we bought the farm, it had good water.*

While many landholders in the higher rainfall catchments reported good water quality, several provided caveats about seasonal variations – usually associated with low (end of summer) and high (high-rainfall storm) flows. Some comments that illustrate the variation in water quality include:

*... sometimes that water is quite muddy, but discolouration is a summer issue ... not in winter when we have high flows and the cattle aren't searching for water ... we use troughs for our cattle*

*... for six months of the year it's drinkable (during winter), but the quality varies ... the small creeks are drying up ... we even get algae in the dams now*

*... we own the bush around the headwaters, so there's no issues with water quality, however we're just not getting enough rainfall to get the runoff ... to dilute what we do have in the creeks*

*... water quality is generally fine here ... it just gets a bit poor when we have low flows*

*... we've got the same water quality, but much less volume.*

A few landholders mentioned concerns about the high level of turbidity and water pollutants, such as:

*... I reckon the turbidity in our rivers had increased over the last 15 years ... it's (turbidity level) always high after heavy rainfall I'm really worried about the use of chemicals by them ... and these chemicals getting into the waterways.*

Most landholders interviewed from the Jordan and Coal catchments where there had been very low

river flows provided less optimistic assessments of water quality. At the time of interviewing (May 2009), the Jordan and Coal rivers were not flowing, and had not flowed for much of the previous three years. Many of the landholders interviewed in these catchments reported that the water was of poor quality largely because of the lack of flow. Some comments by landholders that illustrate this view include:

*... there's not enough water to flush the system out ... it's not so much a water quality problem, but a lack of water problem*

*... we've got less rainfall and more dams ... this is the third year without flowing (the Jordan River).*

### **Long-term property owners provide optimistic assessments of water quality**

Landholders interviewed who had managed their properties for 20 years or longer tended to report that the water quality in local rivers/streams had improved. For example, one landholder said:

*... we've had government departments – independent departments – doing in-stream biota and off-stream biota (tests). If it came up we had issues, we'd do something about it (water quality).*

Indeed, several landholders reported pumping directly from rivers/streams without treatment for domestic consumption. One landholder reported that the water quality had improved greatly from when she was a child, approximately 50 years prior:

*... it's great water now, I have no health problems ... not like when I was a child – we often had skin problems that our doctor said was probably caused by the river water.*

*Upper Jordan River showing NRM project to increase landholder knowledge of the effects of grazing (potential of erosion) on "North Facing Slopes" (Photo: R.Sample)*





Another landholder said:

*It's certainly improved. When we first came here (25 years prior) at this time of the year, if you filled your glass up, you wouldn't be able to see the other side of the glass. It was that black – full of rotting vegetable matter – mostly willow leaves. Now you can see the bottom of the bucket.*

#### **Box 2: Water quality assessments**

Most landholders interviewed in catchments with relatively high rainfall (>800mm/year) (i.e. Inglis–Flowerdale and Pet) were of the view that the water in local rivers/streams was of good quality. Where rivers/streams have stopped flowing, landholders reported poor water quality – largely due to the lack of water to ‘flush out the system’ (i.e. Jordan and Coal). Many long-term property owners reported that water quality in local rivers/streams had improved over the past 20 years, even in rivers with low flows (i.e. Quamby Brook, Macquarie and Jordan).

### **Indicators landholders use to evaluate water quality**

Landholders interviewed said they used the visible appearance of water (i.e. level of turbidity) to evaluate water quality in local rivers/streams. Many interviewees said that heavy rain on land under cultivation or on large areas of forest plantations that had been recently harvested often resulted in high turbidity (cloudiness) in local rivers several days later, temporarily affecting their domestic water supply. Some landholders mentioned that the high rainfall in the northern catchments (i.e. Inglis–Flowerdale, Pet and Quamby Brook) ensured those rivers were regularly flushed. The increasing presence of the rare Green and Gold Frog (*Litoria raniformis*; listed as ‘rare’ under the Tasmanian Threatened Species Protection Act 1995), freshwater crayfish and platypus in waterways was seen as an indication that water quality was improving. As some landholders said:

*We have improved the water quality, the platypus have come back into the stream. The creek has improved immeasurably*

*... we've got plenty of Green and Gold Frogs, and I reckon they're a pretty good indicator of the health of the property.*

While very few landholders reported they had undertaken recent or regular water testing (i.e. to assess soluble, insoluble and biological attributes), most conveyed a strong understanding of the implications of their farm management for the water quality in local rivers/streams (i.e. a ‘systemic’ connection between local land and water resources). Illustrating this understanding, one landholder explained:

*My water supply comes from the bottom end of my farm. Anything I put into the river –*

*I drink. Yes, that is one of the key drivers in maintaining the water quality.*

Further evidence of this ‘systemic’ knowledge was obtained from a few landholders in the midlands (i.e. in Quamby Brook and Macquarie catchments), who reported they were sure the water quality in local rivers/streams had declined over the past three decades due to the assumed impact of local land use, such as livestock having direct access to rivers, cultivation to the edge of riverbanks, increased rural/industrial development, greater extraction of water for irrigation – all combining to reduce the quality of water in local rivers. One landholder in the Macquarie study area reported that he lived on a river that was once famed for its fishing potential (many years prior to his property management in the area), but now no longer supported a vibrant fish population (Tasmania has 12 endemic native freshwater fish, with a total of 25 native fish). Another landholder mentioned:

*I don't know whether it's forestry farther up or the drier seasons, but there's no doubt that the fishing is not as good in the creeks and I don't think we're getting the flow. The more we can do to increase the creeks' life – health – the better off we're going to be.*

Several landholders in the northern study areas mentioned that there was an increase in the number of farm dams, which are likely to be acting as sediment traps after heavy rainfall events, thereby reducing the turbidity in rivers and streams. Yet, outside these events, the increased water retention by an increasing number of farm dams associated with greater property sub-division was reported by some landholders in the southern study areas (i.e. Macquarie, Jordan and Coal) to be contributing to reduced water flow and poorer water quality, as less flushing of the rivers/streams was occurring.

During high rainfall events, land management outside riparian frontage with CRP becomes increasingly important – with increased turbidity in rivers being the most common indicator reported by landholders that water quality was being negatively affected. That is, even in catchments with established CRP along riparian frontage, the neighbouring land-use remains important for water quality. Just a small number of landholders had undertaken water quality tests (including for soluble pollutants), with one landholder very concerned about chemical pollution from large-scale forestry operations.

#### **Box 3: Water quality indicators**

Most landholders rely on the visible (physical) properties of water to assess water quality, most commonly turbidity. Some landholders also use the presence of aquatic fauna (e.g. fish, frogs & platypus) to assess water quality. Very few landholders reported they undertake regular water testing, even when using untreated water from local rivers/streams for livestock and household consumption.

*Multi-use and water quality issues at Craighourne Dam 2009. [Photo: R. Sample.]*



## Values attached to river/creek frontages and adjoining wetlands

Communities are heterogeneous and it is important to identify the range of values attached to river frontages by different stakeholders. We have drawn on a recently developed typology of community types (Harrington *et al.* 2007) to identify those groups with a stake in the management of river frontages in the Tasmanian catchments. The typology developed by Harrington *et al.* (2007) identifies place-based (living within and outside a locality), practitioner, identity and interest-based communities. The stakeholder groups engaged in the interviews and workshops included place-based and other interest-based communities, and representatives of practitioner communities. Of the landholders interviewed for this research, two broad categories emerged – ‘farmers’ (i.e. those with a strong focus on the commercial use of their property) and ‘non-farmers’ (i.e. those without a strong commercial focus on their land-use). The other NRM stakeholders were identified based on their professional roles in relation to NRM, such as local/regional NRM officers or agribusiness representatives [Box 1 in Sect. 2.04].

Values are widely accepted as underpinning behaviour of private landholders (Pannell *et al.* 2006). Social researchers distinguish between the principles or held values that guide our behaviour (Braithwaite and Scott 1991) and those that we attach to particular things, physical goods, activities, services (Lockwood 1999). In previous studies the

research team has found that attached values are a more consistent predictor of conservation behaviour than held values (Curtis *et al.* 2001; Curtis and Robertson 2003). The survey included 15 items exploring the values landholders attached to their river/creek frontage and adjoining wetlands [Table 7]. Only one item in the survey explored value orientations. This is a single item from a stewardship ethic scale that the research team has employed in the past (Curtis and De Lacy 1998). The item: ‘Reduced production in the short-term is justified where there are long-term benefits to the environment’, has been used by the research team in recent surveys (Curtis *et al.* 2006; Curtis *et al.* 2008b; Curtis *et al.* 2008c).

### ***Riparian frontage: a valuable, yet contentious asset***

Several landholders who were interviewed spoke of the high value they placed on having riparian frontage, both for its utilitarian and aesthetic values. For example, direct ownership or management of riparian frontage was seen to provide a degree of security to water for agricultural and domestic usage. This perceived security translated into properties having a higher capital value, compared to similar farmland without direct access to riparian frontage. Most of the non-farmers interviewed expressed their strong appreciation for the aesthetic and biodiversity benefits that riparian frontage offered them, as illustrated by the following comments:

... we moved here because of the river

... it's (the river) a great focus for our property  
... we spend a lot of time there in summer  
... it's great fishing, it's where I go to relax ...  
I could spend all day there.

However, several interviewees – both landholders and NRM agency staff – said that while riparian areas were valuable, these areas were also more difficult to manage and likely to be the focus of regulation, inspections, and arguments with neighbours. That is, river frontage can be highly valuable components of the landscape, but they are equally contested parts of the landscape. Some comments that illustrate this point include:

... it's a handy asset to have, but it come with hassles

... everyone's got an opinion about how you should manage your river country, but they don't want to pay for it.

Survey recipients were asked to indicate the importance of 15 items that spanned the range of environmental, economic and social values that landholders could be expected to attach to their river/creek frontage and adjoining wetlands [Table 7]. Respondents were invited to indicate their view about each item by selecting one of six response options that ranged from 'Not important' to 'Very important' and included 'Not applicable'. To simplify the presentation of data, the six response options have been collapsed into four categories [Table 7]. A summary of responses to the stewardship ethic item has also been presented in Table 7. In this case, the response options were from 'Strongly agree' to 'Strongly disagree'.

Seven of the 15 items exploring attached values have been classified as representing environmental values, six items representing economic values and two items as social values. These sets of items formed three different values indices: environmental, economic and social. For the calculation of mean scores per item we have excluded the 'Not applicable' option [Table 7].

### **Key survey findings**

- Environmental values related to providing habitat for native birds and animals; and vegetation holding the bank and preventing erosion were the highest rated values attached to respondents' river/creek frontages and adjoining wetlands [Table 7].
- The top five values attached to respondents' river/creek frontages and adjoining wetlands included at least one environmental, social and economic value, reinforcing the importance of appeals that address the range of landholder values [Table 7]. Indeed, there was not a significant difference between the mean scores of the set of

environmental (mean = 3.51), social (3.31) and economic (3.14) values.

- Apart from the value of river/creek frontages and adjoining wetlands providing water for stock and adding to the market value of the property, use values were of relatively minor importance for most respondents (<25% for grazing stock; timber for firewood or fences) [Table 7].
- There appears to be a strong stewardship ethic amongst most respondents across all catchments with almost two-thirds (64%) agreeing with the statement that 'Reduced production in the short-term is justified where there are long-term benefits to the environment'. This item has been used in surveys in other areas, including a 2008 survey of river frontage owners in the Goulburn Broken Catchment in Victoria, where a smaller proportion (35%) agreed with this statement (Curtis *et al.* 2008c).
- There was only one item ('I rely on the river for irrigation water') where there was a significant difference in responses across the six Tasmanian catchments [Appendix, Table C]. The proportion of respondents saying they relied on river water for irrigation varied from 50% in the Macquarie catchment to 10% in the Coal catchment.
- There was a small number of significant relationships between nine of the 15 statements in the survey exploring values attached to the property and implementation of 10 of the 20 items exploring CRP implementation. While these findings suggest values are not a powerful driver of landholder behaviour in this study, there were examples where values did predict behaviour. For example, respondents giving a higher rating to the statement that their river/creek frontage or adjoining wetland was important because it provided access to stock for water were significantly less likely to have limited stock access to those areas to no more than a week at a time in 2008 for both grazing and access to water. On the other hand, those who valued these areas because they provide important shade and shelter for stock were significantly more likely to have erected fencing to manage stock access to the waterway or adjoining wetlands; installed off-stream watering points for stock; and removed willows. These somewhat contradictory findings suggest that approaches to landholder engagement that highlight some values while ignoring others might be successful in achieving practice change.
- A more positive response to the item measuring a landholder stewardship ethic was significantly linked to only one CRP item: having a grazing plan that involves keeping stock out of wet paddocks in winter.

Table 7. Values landholders attached to river/creek frontage and adjoining wetlands.  
Tasmania riparian landholder survey, 2008, N=146

Values statements	n	Important/ Very important %	Some %	Minimal/ Not important %	NA %	Mean score ~
Provides habitat for native birds and animals	137	68%	12%	14%	7%	3.95
Vegetation on the frontage helps hold the banks and stop erosion	137	57%	22%	8%	13%	3.88
Reduced production in the short-term is justified where there are long-term benefits to the environment	140	64%				
Agree/Strongly agree	22%	9%				
Disagree/Strongly disagree	5%	3.74				
Is an attractive area of the property	136	57%	15%	17%	10%	3.71
Provides access to water for stock	136	46%	10%	19%	25%	3.68
Adds to the market value of the property	135	46%	21%	17%	16%	3.59
Provides woody matter such as snags that offer protection for fish and other animals that live in the river/creek	135	41%	20%	18%	21%	3.45
Provides a source of nutrients for in-stream plants and animals	134	43%	19%	25%	13%	3.40
Is a habitat corridor (allowing wildlife to move between areas)	137	41%	16%	24%	19%	3.38
I rely on the river for irrigation water	136	24%	6%	14%	57%	3.37
In-stream vegetation traps and stabilises sand/gravel	135	36%	17%	29%	19%	3.23
Acts as a filter catching sediment and/or nutrients before they reach the river	133	35%	10%	28%	27%	3.12
Provides important shade and shelter for stock	135	24%	18%	23%	35%	2.94
Provides a place for recreation for me, my family and friends	135	28%	16%	36%	20%	2.85
Provides additional land for grazing stock, particularly in summer	136	18%	13%	27%	42%	2.72
Provides timber for firewood and fence posts	136	10%	7%	33%	50%	2.13

Note: Topics are ranked by Mean score where 1 = not important through to 5 = very important. Green shading are environmental, yellow are social, white are economic values and the grey shaded statement is a held value reflecting a stewardship ethic.

*Pet River fenced for stock exclusion (adoption of CRP) showing native vegetation recovery (Photo: R. Sample)*



## Attitudes towards natural resource management

Five survey items explored the respondent's attitudes about the roles and responsibilities of key NRM actors in the management of river/creek frontages and adjoining wetlands in their district [Table 8]. Some items had been used in previous landholder surveys, others were identified by Landscape Logic partners or pre-test participants. One of the items ('Landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment') explored respondents' views about the application of a duty of care for biodiversity conservation.

Respondents were provided with six response options, ranging from 'Strongly agree' to 'Strongly disagree', including 'Not applicable'. To simplify the presentation of data, the six response options have been collapsed into four categories [Tables 8 and 9]. For the calculation of mean scores per item we have excluded the 'Not applicable' option.

### Key survey findings

- There was very strong support (70%) for the statement that 'New owners should abide by agreements entered into by previous owners where public (tax-payer) funds have paid for land protection or conservation work' [Table 8].
- There appears to be a strong base of support for a duty of care for biodiversity in that most (61%) respondents agreed that 'Landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment'. By comparison, in the recent survey of river frontage owners in the Goulburn Broken, only 36% agreed with this statement [Table 8].
- Just under half of the respondents agreed that 'Governments must take more responsibility for ensuring landholders meet their responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)' [Table 8].
- While survey responses suggest most respondents are more concerned about achieving long-term environmental outcomes than preserving landholder independence, most respondents (64%) disagreed with the statement that 'In most cases, the public should have the right of access to river/creek frontages that are managed by private landholders' [Table 8].
- A substantial minority of respondents agree that the 'Terms of contracts with large agri-business companies limit the ability of farmers to crop using best-practice conservation technique' [Table 8].

- The item exploring landholder support for a duty of care for biodiversity was only one item where there was a significant difference in responses across the six catchments. Support for this statement was higher in the Quamby Brook and Inglis-Flowerdale catchments and lower in the Pet and Macquarie catchments [Table 9].
- It would be unrealistic to expect strong links between the five survey items exploring the attitudinal statements included in the survey and survey items exploring CRP implementation. As expected, there were few significant relationships between the CRP items and those that were identified appear to be of limited relevance to those seeking to understand the factors influencing practice change.

Survey respondents were also asked if they would invest in, or expand, irrigation operations on their property in the future [Section 3.06, Figure 3]. Almost a third of all respondents (32%) reported that they planned to introduce/expand irrigation on their property in the next five years, with a small proportion 'Not sure' (7%) and just over a third saying they were 'Unlikely' (39%).

Interviewees were sharply divided in their views about proposals to expand irrigation. Some said that the future of agriculture in their district depended on water being made available for irrigation. Others thought any increase in irrigation in their district would result in winners and losers and that these changes would not necessarily be desirable. Farmers with sufficient capital to re-invest in upgrading their farms, agronomic conditions that suit high-intensity cropping (including of pastures), and are in districts where there is sufficient interest and capacity to establish irrigation infrastructure were more likely to support proposals to expand irrigation (higher and more secure allocations). Some comments that illustrate these views include:

*... we need reliable water supplies to survive as farmers, it's as simple as that ...*

*... we can't just rely on mother nature (rainfall) anymore, we've got to take things into our own hands and secure our water supplies.*

Some farmers explained that the development of irrigation in their district would lead to increased land prices and force them to change their farming systems – from low-intensity dryland operations (e.g. wool production) to high-intensity irrigated operations (e.g. high-value crops) – to maintain reasonable rates of return on their capital. Others were concerned about the high cost of converting dryland farms to irrigated operations, including the costs of purchasing water and installing irrigation infrastructure. One landholder also spoke about the threat to his family's legacy of being renowned

wool producers, as he expected wool production would be replaced by more lucrative enterprises. Comments that illustrate these concerns include:

... when the water becomes available for irrigation, we're going to have to change what we do whether we like it or not  
 ... irrigation will change this area ... it'll be good for some of them, but I'm not sure about the rest of us.

While many interviewees acknowledged the benefits of reliable water supplies for farming districts experiencing severe drought, some expressed concerns that increased irrigation would exacerbate environmental issues (e.g. salinity, in-stream ecological processes). One landholder commented:

... it's also a significant erosion issue too, the constant wetting and drying the banks ... a dry bank – consistently dry – doesn't break away as often as a wet bank.

Table 8. Landholder attitudes about NRM roles and responsibilities. Tasmania riparian landholder survey, 2008, N=146

Attitudinal statements	n	Agree/Strongly agree	Not sure	Disagree/strongly disagree	N/A	Mean
New owners should abide by agreements entered into by previous owners where public (tax-payer) funds have paid for land protection or conservation work	140	70%	12%	13%	5%	3.74
Landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment	139	61%	19%	18%	1%	3.55
Terms of contracts with large agri-business companies limit the ability of farmers to crop using best-practice conservation techniques	137	28%	49%	9%	15%	3.38
Governments must take more responsibility for ensuring landholders meet their responsibilities under the EMPCA (Environment Management and Pollution Control Act 1994)	134	42%	30%	24%	4%	3.29
In most cases, the public should have the right of access to river/creek frontages that are managed by private landholders	141	21%	12%	64%	4%	3.21

Note: Mean score where 1 = Strongly disagree through to 5 = Strongly agree.

Table 9. Landholder attitudes about NRM roles and responsibilities. Tasmanian riparian landholder survey, 2008, N=146

Attitudinal statements		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment	n	20	21	21	27	15	32	0.0461
	mean	4.68	4.52	4.29	4.81	3.73	4.81	
New owners should abide by agreements entered into by previous owners where public (tax-payer) funds have paid for land protection or conservation work	n	20	21	21	27	17	31	0.0736
	mean	4.67	4.85	4.38	5.08	4.25	4.94	
Governments must take more responsibility for ensuring landholders meet their responsibilities under the EMPCA (Environment Management and Pollution Control Act 1994)	n	19	21	18	26	15	32	0.2712
	mean	4.31	4.30	3.94	4.38	3.93	4.59	
Terms of contracts with large agri-business companies limit the ability of farmers to crop using best-practice conservation techniques	n	19	21	21	27	15	31	0.3829
	mean	3.94	4.44	4.28	4.55	4.73	4.33	
In most cases, the public should have the right of access to river/creek frontages that are managed by private landholders	n	20	21	21	27	17	32	0.5345
	mean	2.95	3.26	3.19	3.58	2.94	3.22	

Note: Topics are ranked in order of the degree of difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Mean Score where 1 = no knowledge through to 5 = very sound knowledge.

## Short- and long-term property plans

In earlier research the authors have used survey data to explore landholders' long-term plans and to model property turnover. Some of the key findings from this body of research have been that about half of all rural properties will change ownership in the next decade; many landholders are looking to sell all or a part of their property; increasing proportions of new land owners have previously lived outside the district where their new property is located; and increasing proportions of new landowners are absentees and non-farmers by occupation. It is also clear that these trends have an important impact on the implementation of recommended practices, in that new residents, absentee owners and non-farmers are less likely to implement many practices, despite values that would pre-dispose them to conservation activities (Curtis *et al.* 2006, Curtis *et al.* 2008b; Mendham and Curtis In Press).

Tasmanian survey respondents were asked to indicate whether their short-term (next 5 years) and long-term (from 5 to 20 years) plans included disposal or acquisition of land through family succession, sale/purchase, leasing or share farming; if their enterprise and land use would change, including through irrigation; if they would change the extent of off-property work; or place the property under a conservation covenant [Figure 3].

Respondents were asked to indicate the likelihood that they would take up each of the 12 options. Again, there were six response options, ranging from 'Highly likely' to 'Highly unlikely', and including 'Not applicable'. To present these data we have collapsed the six categories into four [Figure 3]. Mean scores have been calculated without including the 'Not applicable' option [Appendix, Table D].

### Key survey findings

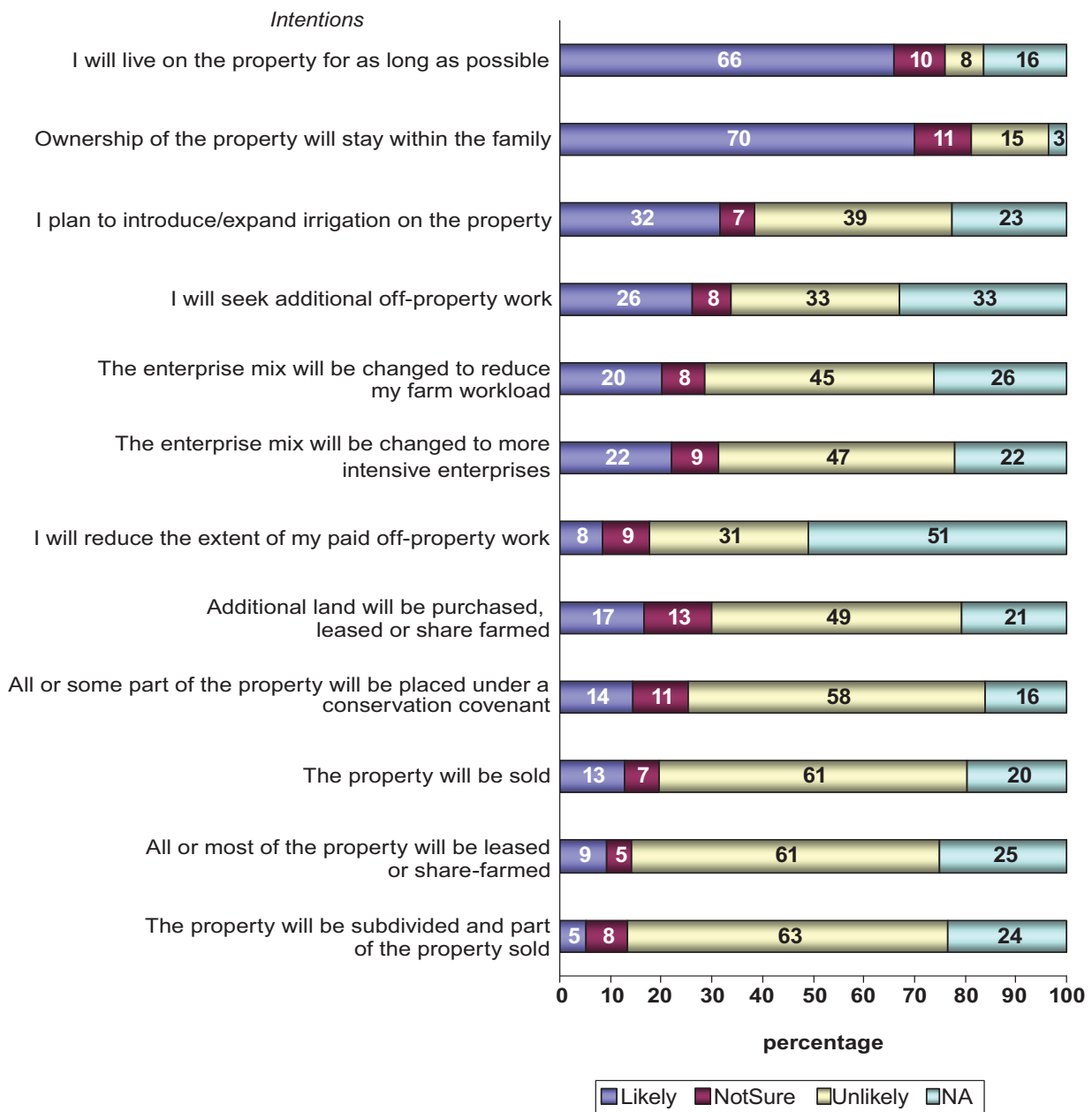
- There were no significant differences (apart from the option that the property would be sold) between responses in each catchment for the short and long-term options. That is, responses were similar regardless of the time-frame. Given this finding, only data for the next five years has been presented in Figure 3 and Appendix, Table D.
- At least two-thirds of all respondents said they were likely to subdivide and sell part of the property in the next five years, suggesting a high level of turnover in property ownership in the short-term [Figure 3].
- Only 12.5% of farmers in Victoria continue working on-property past the official Australian retirement age for men of 65 years (Australian Bureau of Statistics 2007). Consistent with this trend, only 20% of respondents said they would live on the property for as long as possible in the next 5 years and 22% for the next 20 years [Figure 3]. Again, these data suggest there will be substantial change in the individuals managing these rural properties in the short-term.
- Very few respondents (<20%) expect to pass ownership of the property to others within the family [Figure 3].
- While most respondents said they would live on their property for as long as possible [Figure 3], only 12.5% of farmers in Victoria continue working on-property past the official Australian retirement age for men of 65 years (Australian Bureau of Statistics 2007). With a median age for farmers in this study of 52 years [Table 17], the reality is that we can expect there will be substantial change in the individuals managing these rural properties in the next decade.
- A majority (55% in 5 years; 65% in 20 years) of respondents said they were likely to change their enterprise mix to more intensive enterprises [Figure 3]. This interest in intensifying land use is a little surprising given that most landholders are approaching the minimum age to access superannuation and at least half are within 10 years of the official retirement age for men. Interest in more intensive enterprises may be a reflection of the cost-price pressures on primary producers, opportunities afforded by centre-pivot irrigation technologies or emerging cropping opportunities. The likelihood that many landholders will move to more intensive agriculture systems is likely to pose challenges for those responsible for improving water quality.
- Respondents were twice as likely to say they would reduce their off-property work (38%) than increase it (19%) over the next five years [Figure 3].
- One in five respondents (23% next 20 years) said they were likely to place some part of the property under a conservation covenant, confirming the strong conservation values of many respondents.
- Respondents' short and long-term plans were very consistent across the six Tasmanian catchments. There were only two items where there were significant differences: the property will be subdivided and part of the property sold (% likely higher in Jordan and Coal catchments and lower in Macquarie, Pet and Inglis-Flowerdale); and all or part of the property will be placed under a conservation covenant from 5 to 20 years option (% likely higher in Macquarie and Jordan catchments and lower in Pet and Inglis-Flowerdale) [Appendix, Table D].

■ There was a small number of significant relationships between the survey items exploring short and long-term plans of respondents for their property and implementation of CRP (for 12 of 20 items). Most of these relationships were as expected and suggest that landholder plans are a useful predictor of their management. Interestingly, those who planned to expand their property size were more likely to have implemented four CRP: planted trees and shrubs during the period of management; tested soils for nutrient status in paddocks where fertiliser has been applied; had a fertiliser nutrient budget for all/most of the farm; and applied fertiliser using an accredited spreader. Those intending to introduce or expand irrigation were significantly

more likely to implement each of the four CRP listed in the previous example, plus tested the quality of the main water source for stock or irrigation. On the other hand, there was some evidence that those who planned to sell, lease or share farm, or seek additional off-property work, were significantly less likely to implement some CRP. For example, those who said that in the short-term their property will be sold were significantly less likely to have removed willows; and those who said they would seek more off-property work in the long-term were less likely to have established off-stream watering points; or tested soils for nutrient status in paddocks where fertiliser has been applied.

Figure 3. Landholders' short-term property plans. Tasmania riparian landholder survey, 2008, N=146.

### Property plans for the next 5 years





## Involvement in planning processes

There is considerable evidence that landholders involved in property planning are more likely to implement recommended biodiversity and sustainable agriculture practices (Curtis *et al.* 2006, Curtis *et al.* 2008b). It also seems reasonable to assume that landholders who plan for family succession might be more committed to maintaining the health or condition of their property, including its infrastructure. Despite the intuitive appeal of this hypothesis, there is little evidence that planning for family succession influences management. Our Landscape Logic partners were also interested in exploring the potential linkage between landholder involvement in local action planning and implementation. While it is possible that involvement in these planning processes leads to learning and action, it is also possible that individuals who are more knowledgeable and committed also get involved in these planning processes. Items were included in the survey to enable the research team to explore these ideas.

Respondents were asked to indicate the extent of their involvement in property management planning (PMP) or whole farm planning [Table 10]; succession planning [Table 11]; and local action planning, including through an industry association or Landcare group [Table 12]. For the first two items, respondents were asked to select from five response options: 'Completed/ongoing', 'Well advanced', 'Halfway', 'Early stages', and 'Not started'. For the local action planning item, respondents were offered four response options: 'Highly involved', 'Some involvement', 'Little involvement', and 'No involvement'.

### Key survey findings

- Overall, just under half (44%) of all respondents were involved in property management planning (PMP) or whole farm planning, with 24% either well advanced or completed/ongoing and 20% at early or halfway stages.
- There was substantial variation across the six catchments in the proportion of respondents involved in property planning, with higher proportions involved in the Macquarie and Coal catchments and a lower proportion in the Jordan catchment [Table 10].
- The Macquarie catchment appears to have embraced property planning far more than the other catchments and this is reflected in the findings that 77% of respondents said they had at least started a plan and 47% said they had completed or updated the plan in the past five years [Table 10].

- Just under half (49%) of all respondents said they had family members interested in taking on their property in the future [Table 11].
- There was substantial variation across the six catchments in the proportion of respondents with family members interested in taking on the property, with the highest proportion in Macquarie and the lowest in the Pet catchment [Table 11].
- About half (52%) of the respondents with a family member interested in taking over the property said they had started a succession plan. Only one in five said they were well advanced or had completed plans for property transfer to the next generation [Table 11].
- With the exception of the Macquarie catchment, most respondents were not involved in local action planning and those that were involved, were invariably involved to a limited extent [Table 12].
- Landholder involvement in planning processes was one of the best predictors of implementation of the CRP items included in the survey. For example, there was a significant positive relationship between involvement in property management planning and implementation of eight CRP items; involvement in succession planning and 11 CRP items; and involvement in local action planning and six CRP items [Appendix, Table J, K, & L].

## Property management planning

Landholder interviews and discussions during two workshops with NRM practitioners provided important insights into the way PMP had been delivered and evidence of the impact of property planning. PMP was mentioned by several landholders and NRM officers in the northern catchments (Inglis–Flowerdale, Pet & Quamby Brook) as being a helpful process. The NRM officers mentioned they had an intensive investment in PMP in several areas during 2000–2003, with about 300 farmers engaged in a 6–12 month process working with consultants (estimated \$2.1 million investment). An NRM coordinator said:

*... the PMP worked well ... it's a good process for landholders before giving out grants for on-ground works.*

While two landholders explained:

*I think it's good linking Landcare funding to your whole farm plan ... it helps you work through the big picture, rather than just tackling small problems in isolation*

*... it was a good process, got us to hear about some other ideas.*

Different models have been used across Tasmania to provide support for PMP, with the

Table 10. Landholder involvement in property management planning. Tasmania riparian landholder survey, 2008, N=146

Catchment	Stage in development of property plan			% Completed/ updated last 5 years	
	n	% Well advanced/ completed	% Early stages/ halfway		% Not started
Coal	11	45%	9%	45%	17%
Jordan	11	18%	9%	73%	14%
Macquarie	12	42%	25%	33%	47%
Quamby Brook	18	17%	22%	61%	17%
Pet	13	23%	15%	62%	29%
Inglis–Flowerdale	23	13%	26%	61%	22%
Overall	91	24%	20%	56%	25%

Table 11. Landholder involvement in succession planning. Tasmania riparian landholder survey, 2008, N=146

Catchment	Family interested in property		Stage in development of succession plan			
	n	% Family interested	n	% Well advanced/ completed	% Early stages/ halfway	% Not started
Coal	22	45%	11	18%	18%	64%
Jordan	20	45%	8	0%	25%	75%
Macquarie	19	68%	14	36%	36%	29%
Quamby Brook	25	40%	12	0%	50%	50%
Pet	15	33%	6	50%	0%	50%
Inglis–Flowerdale	27	52%	13	15%	38%	46%
overall	131	49%	66	20%	32%	48%

Table 12. Landholder involvement in local action planning. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	% Highly involved	% Little to some involvement	% Not involved
Coal	22	5%	36%	59%
Jordan	20	5%	40%	55%
Macquarie	21	0%	67%	33%
Quamby Brook	26	0%	35%	65%
Pet	16	0%	25%	75%
Inglis–Flowerdale	32	6%	25%	69%
overall	140	4%	36%	59%

general approach used by NRM North described below [Box 4]. Even within NRM North's region, different approaches to PMP have been applied – with

about 132 landholders completing a PMP process since 2002 (estimated investment by NRM North in PMP at \$500,000 to \$750,000 per annum).

#### Box 4: Three stages of PMP applied by NRM North

Stage 1: consists of an on-site assessment (including the use of assessment tools such as FarmSAT or DairySAT), the basic mapping package (see 'Required Inclusions' below), and the provision of relevant extension materials and links to services for identified assets/risks/threats. Stage one is the introductory stage for all PMP's and, alone does not constitute a PMP. There may be instances where property owners with no productive or substantial activity impacting on natural values have a desire to ensure that the natural resources are being maintained effectively. These owners may only complete stage one. If this stage identifies specific activities which have high natural resource issues/values, NRM North will consider investing in those activities.

Stage 2: includes all of stage one but with more detailed technical input using specialists in relevant fields, such as bush and stream management, soil conservation and water management. At a minimum, soil, water and biodiversity assets need to be considered in a manner consistent with the proposed modules. Required inputs are identified in the initial site assessment and in consultation with the land manager and should incorporate future objectives. Each of these areas would then be addressed within the plan with a specific report and supporting map products where applicable. Stages one and two are the essentials for a basic PMP and would include properties with substantial private activity or semi/full commercial activity. Participants will develop individual property/farm action plans, and will have a further option to participate in group planning exercises with opportunities to access regional or other forms of NRM investment (where relevant to group objectives). This level may include training activities identified during the needs analysis as likely to assist in protecting natural assets of high public benefit.

Stage 3: includes all of stages one and two with the addition of more detailed (and accurately ground-truthed) mapping along with supporting activities, such as training and technical advice, aimed to build the sustainability of fully commercial operations. Training activities identified during the needs analysis which have a high private/commercial benefit may be included. Examples of training and technical advice supported include succession planning, business planning, water/irrigation design and management, production and quality assurance and farm forestry. Upon completion participants will develop individual farm action plans, and will have a further option to participate in group planning with a view to accessing regional NRM or other forms of investment (where relevant to group objectives).

NRM North requires that Property Management Planning is conducted in a group learning situation (i.e. where meetings are conducted with the PMP cluster of farmers). Individual farmers still receive personal contact through farm visits.

Different service providers are contracted by NRM North to deliver the PMP support outlined above. While the broad approach is followed by all PMP service providers, the specific mode of delivery and property plans vary.

Source: NRM North, Launceston, Tasmania.

#### Completion of a short course relevant to property management

In a number of the research team's recent studies, involvement in short courses has been a predictor of landholder implementation of CRP (Curtis *et al.* 2006, Curtis *et al.* 2008b). It seems short courses are an effective and efficient approach to effecting practice change. Survey respondents were asked if they had completed a short-course relevant to property management in the past five years. Examples of topics and specific courses such as FarmSAT or DairySAT, Farm Biz, TAFE, property planning, chemical handling and Prograze were provided.

Table 13. Landholder involvement in a short course in the past 5 years. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	% Yes participated	% Not participated
Coal	21	29%	71%
Jordan	21	14%	86%
Macquarie	21	43%	57%
Quamby Brook	26	8%	92%
Pet	17	0%	100%
Inglis-Flowerdale	32	25%	72%
overall	141	21%	79%

#### Key survey findings

- Only one in five respondents (21%) said they had completed a relevant short course in the past five years [Table 13]. By comparison, in a recent study in the Wimmera catchment of western Victoria, 47% (N=475) of respondents said they had completed a relevant short course (Curtis *et al.* 2008b).
- Participation in short courses varied dramatically across the six catchments, from nil participation in the Pet and 8% in Quamby Brook to 43% in the Macquarie catchment [Table 13].
- There was a significant positive relationship between completion of a short course relevant to property management and planting trees and shrubs during the period of management; testing soils for nutrient status in paddocks where fertiliser has been applied; and testing the quality of the main water source for stock or irrigation purposes. These findings confirm other survey findings suggesting that short courses represent a good investment for NRM practitioners seeking to influence on-property management by private landholders. Surprisingly, there was a significant negative relationship between participation in a short course and sowing summer active perennial pastures in the past five years.

## Involvement in Landcare and commodity groups

There is a substantial body of evidence linking Landcare participation with the development/engagement with social and human capital, and in turn, landholder implementation of recommended practices (Curtis and De Lacy 1995; Curtis *et al.* 2008b). Membership of local commodity groups, such as Flockcare, Cropcare, FM500, Target 10 and Best Wool in Tasmania, has also been linked with increased implementation of recommended practices (Curtis *et al.* 2008b).

As part of the background information requested, respondents were asked to indicate if they were a member or involved with a local Landcare group and if they were not, to indicate if they had previously been a member or involved with a Landcare group. Respondents were also asked if they were a member or involved with a local commodity group.

### Key survey findings

About one in five (22%) respondents said they were a member or involved with a local Landcare group [Table 14]. Landcare participation as measured by the proportion of respondents identifying as a Landcare member is much lower in this study than in Victorian studies (typically around 40%) (Curtis and Cooke 2006).

There was a significant difference in Landcare

membership ( $p = 0.0011$ ) across the six Tasmanian catchments, with higher proportions of respondents as members in the Macquarie catchment and lower participation in the Pet and Quamby Brook catchment [Table 14].

It seems there has been considerable attrition in Landcare membership in that 16% of non-member respondents said they had previously been a member, not far behind the proportion that said they are still members [Table 14].

As with the proportion of respondents who were members, attrition rates varied significantly ( $p = 0.0154$ ) across the six catchments. Higher proportions of respondents said they were previously a member in the Macquarie catchment and lower proportions in the Pet and Inglis–Flowerdale catchments. In the Jordan and Quamby Brook the proportion of respondents who said they were previously Landcare members was higher than the proportion who said they were current members.

Fourteen per cent of respondents said they were a member of a local commodity group. There was a significant difference ( $p = 0.0000$ ) across the six catchments in the proportion of respondents who were members of a local commodity group. The Macquarie stood out as the catchment with a much higher level of membership [Table 15].

There was a significant positive relationship between Landcare participation and planting trees and shrubs; fencing land for natural regeneration of

Table 14. Landholder membership of Landcare groups. Tasmania riparian landholder survey, 2008, N=146

Catchment	Member now			Previously a member		
	n	% Yes	% No	n	% Yes	% No
Coal	21	24%	76%	17	18%	82%
Jordan	21	14%	86%	18	22%	78%
Macquarie	21	52%	48%	11	45%	55%
Quamby Brook	26	8%	92%	22	23%	77%
Pet	16	0%	100%	16	0%	100%
Inglis–Flowerdale	32	25%	75%	26	4%	96%
overall	140	22%	78%	110	16%	84%

Table 15. Landholder membership of a commodity group. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	% Yes	% No
Coal	20	15%	85%
Jordan	21	5%	95%
Macquarie	21	52%	48%
Quamby Brook	26	0%	100%
Pet	16	6%	94%
Inglis–Flowerdale	32	9%	91%
overall	139	14%	86%

native vegetation; stock grazing frontages/adjoining wetlands for more than a week at a time in 2008; and stock accessing water from the frontage/adjoining wetlands for more than a week at a time in 2008. However, there were significant negative relationships between Landcare participation and removing willows and replacing them with native vegetation during the period of management; and applying fertiliser through an accredited spreader in 2008. A possible explanation for these findings is that the latter CRP have not been the focus of Landcare activity.

### **Landholder involvement in Landcare and with industry**

Investment in Landcare generally, and local Landcare groups in particular, was reported by most landholders and other NRM stakeholders interviewed as being very important in initiating both the practice and cultural change needed for on-farm NRM in the 1990s. Several interviewees reported the positive work undertaken 10 to 15 years ago, such as via the Rivercare program (during 2000–2005). The following comments reflect these views.

*... Landcare has been good ... paid for all the fences and trees, otherwise we wouldn't have been about to do that*

*It's (the Landcare group) still on the books but really what we've found is we were doing more than just Landcare; we were doing water quality, we were doing soil health, doing more with our own businesses. So we'd go and have a look at someone who had done some minimum till or stubble retention and all that. So we just re-branded the group.*

Many landholders and other stakeholders interviewed reported that the momentum underpinning Landcare over recent years, notably since the conclusion of NHT2, had waned. Comments by farmers interviewed that illustrate this view include:

*We never had the capital available or the time available to do very much until Landcare arrived. If that ceases (NHT funding) I imagine the Landcare groups will gradually disband. It's probably one of my pet dislikes of the present government – that they seem to be abandoning the Landcare funding programs.*

*It's (Landcare) faded ... frustration with the system. There was more and more bureaucracy that came into it and when you added up the costs it wasn't worthwhile. Because I think ... there's not that many programs and ... if I was going to get a program to do a little bit, the paperwork and the federal government stuff is just ... I'm over it.*

*We were thriving ... but we can't access funds now to follow up. The last 3 applications were knocked back. All kinds of gobbledy gook – it's just bureaucracy mucking about. So we've*

*sorta come to a stop, which is frustrating because we need to re-spray regrowth. The more they change things and muck about, the more things are obscure to the laymen.*

*It just faded – I think eventually the funding was cut off. It was basically a riparian based Landcare group and the issues of the management of the river, Hydro involvement and things became bigger than what the local farmers could manage*

*... we were involved in Landcare about 10 years ago with a lot of tree planting, but we've had poor results because of the drought and frost ... and the funding is inconsistent so we've really lost interest in it*

*... having the funding for it (NRM) is the key ... I'm happy to put in the time, but not many of my neighbours are*

*Landcare has become more complicated, so there's less involvement ... too much paperwork for local volunteers ... having the Catchment Officer with the local government worked well, they were able to coordinate activities and organise things*

*... I don't hear much about it (Landcare) now.*

Some landholders reported that the CRP that were eligible for funding via Landcare were too narrow and prescriptive (with funding requirements being too restrictive) – causing these landholders to distance themselves from Landcare, and continue their own version of NRM and farming. Comments that illustrate these concerns include:

*... Landcare doesn't come and talk to us, it's done a lot of harm ... they (NRM officers) need to work in with farmers more, not just make the plans in town ... they need to come out here and talk to us*

*If this is such a community benefit – like forests – the community pays. But I'm not going to do it also on a prescription that says, you've got to do it within 10m of the river, you can't stock it, you can't do fire management, you can't do this, can't do that*

*... I'm not involved in Landcare because I don't agree with it ... when you fence off the bush you get every problem under the sun ... roos, wallabies, possums, gorse.*

Several landholders mentioned their preferred approach was when the local NRM officer was able to authorise funding for NRM works after a single site visit and inspection. Comments that reflect landholders' interest in dealing with a single person include:

*... I deal directly with the Council's Environmental Officer when I want to do some fencing and plant some trees ... that works well for me*

*... I'm not involved in Landcare ... no need, I deal directly with the NRM person, they've been good and I get their newsletter ... those that get out and help are good*

... Landcare is not as active as previously (about 10 years ago), it's less visible ... people like the one-to-one approach.

The hiatus in funding for Landcare (staff and on-ground activity) between the conclusion of NHT2/ National Action Plan for Salinity & Water Quality (NAP) and *Caring for Our Country* (CfOC) was seen to be eroding the goodwill and momentum established by Landcare in rural areas. Even on the eve of CfOC commencing, several experienced NRM program managers were uncertain whether the local-level enthusiasm and activity would be rekindled. An NRM coordinator commented:

*NHT1 was well resourced and capitalised on the initial enthusiasm with Landcare in the late-1980s, but it might have created a dependency on having a high level of outside funding. There's not the same level of resourcing now, so there's been a fall away in local activity. NHT2 had an emphasis on regional planning with local groups, a more strategic approach ... however, the gap in funding between NHT2 and Caring for Our Country has lost momentum ... I'm not sure about the long-term health of Landcare at the local level.*

There were also positive comments about the recent evolution of Landcare to include agribusiness consultants in the delivery of selected NRM programs – encouraging NRM to become part of 'mainstream' farming, illustrated by the following comment:

*... the farm consultants have been good, they help put these (NRM) ideas into a real farm context.*

While acknowledging the greater involvement of agribusiness in NRM, it should be noted that this trend appears to apply largely to farm commodity agribusiness (e.g. stock and station agents, farm consultants), as some stakeholders expressed the concern that some large rural industries were still largely absent from the general NRM dialogue (e.g. plantation forestry, corporate cropping companies). However, it was acknowledged that some individual companies were engaged in NRM activities and discussion at a local level.

**Box 5: Landholder involvement with Landcare and industry**

Landcare activity and influence was reported to be strong under NHT1 and NHT2/NAP. However, interviewees said that this momentum has been lost. If governments view local Landcare activity as important for achieving NRM outcomes, then substantial investment is required to renew these local organisations.

## Farming as an occupation

Recent research suggests that identifying as a farmer by occupation is a powerful influence on landholder knowledge, values, time spent in on-property work and the implementation of recommended practices (Curtis *et al.* 2006; Curtis *et al.* 2008b). Survey respondents were asked to indicate their occupation. Examples provided in the survey included farmer, teacher, accountant, investor or retiree. Responses to this open-ended question were grouped into five occupational categories: farmer, professional, trades, retiree and investor.

### Key survey findings

Farmers were the largest occupational grouping in the study catchment areas but only comprised 39% of all river frontage survey respondents. Indeed, there were almost as many tradespeople as farmers in the respondent group [Table 16]. While the proportion of respondents identifying as farmers is lower than is typical of most catchments surveyed by the research team (around 50% in catchments in Victoria), it is consistent with the findings of the recent study of river frontage owners in the Goulburn Broken catchment (Curtis *et al.* 2008c). A key finding of our recent studies is that river frontage owners are different to the typical dryland landholder.

There was a significant difference ( $p = 0.0012$ ) in the proportion of respondents identifying as farmers across the six catchments, with the highest proportion in the Macquarie catchment and the lowest in the Quamby Brook catchment [Table 16].

Farmers and non-farmers were very different on a range of social and farming variables included in the survey [Table 17], including a number of topics that, in themselves, are important influences on landholder implementation of CRP. For example, farmers were significantly more likely to be involved in property planning, Landcare and commodity group; and to have received government funding for natural resource management activities.

It seems that NRM organisations have focussed most of their efforts to engage landholders in the six catchments in river/creek management on farmers and largely ignored the non-farmer occupation cohort. For example, 42% of farmer respondents compared to 11% of non-farmers said in the last five years that federal or state government programs or the regional NRM organisation had supported work on their river/creek frontage or adjoining wetlands. Similar proportions of farmers and non-farmers were participants in Landcare and farmers were significantly more likely to be involved in property management planning [Table 17].

Table 16. Landholder occupations. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	% Farmer	% Professional	% Trades	% Retiree	% Investor	% Other
Coal	21	33%	5%	14%	29%	10%	10%
Jordan	20	40%	15%	20%	25%	0%	0%
Macquarie	21	76%	10%	5%	10%	0%	0%
Quamby Brook	26	15%	23%	42%	12%	0%	8%
Pet	16	25%	25%	13%	19%	6%	13%
Inglis–Flowerdale	31	42%	13%	32%	13%	0%	0%
Overall	138	39%	14%	23%	17%	2%	4%

Table 17. Farmers and non-farmers on a range of social and farming variables. Tasmania riparian landholder survey, 2008, N=146

Topic	n Farmer	Median farmer	n non-farmer	Median non-farmer	p value
How old are you?	54	52 years	83	56 years	0.3301
What is the area of your property?	52	400ha	84	41.85ha	0.0000
Estimate the average number of hours per week that you worked on farming/property related activities over the past 12 months	53	56 hr	81	8 hr	0.0000
Estimate the number of days you were involved in paid off-property work in the past 12 months	50	0 days	78	195 days	0.0000
Indicate the approximate figure for the profit (before tax) from your property last financial year (2006–2007)	35	\$15,000	21	\$5,000	0.0002
Indicate an approximate figure for the total off-property income (before tax) for you and your partner last financial year (2006–2007)	30	\$25,000	57	\$55,000	0.0044
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	39	Halfway	52	Not started	0.0001
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	37	Early stages	29	Not started	0.0212
<b>These topics are % answering yes</b>	<b>n Farmer</b>	<b>% Farmer</b>	<b>n non-farmer</b>	<b>% non-farmer</b>	<b>p value</b>
Are you a member or involved with a local Landcare group?	54	41%	84	11%	0.0001
Are you a member or involved with a local commodity group?	54	33%	83	2%	0.0000
Since the start of 2004 (past 5 years), did Federal or State government programs or the regional Natural Resource Management organisation support work on your river/creek frontage or adjoining wetlands?	50	42%	80	11%	0.0001

Note: The degree of significant difference is based on the Proportions test and those shaded are significant

Table 18. Comparison of property level issues of farmers and non-farmers.  
Tasmania riparian landholder survey, 2008, N=146

Property issue	Farmer		Non-farmer		p value
	n	median	n	median	
Availability of labour for important on-property work	52	4	59	2	0.0000
Salinity undermining long-term productive capacity	41	2	51	2	0.0036
The cost of managing weeds and pest animals affecting profitability	53	4	65	4	0.0068
Uncertain/low returns limiting capacity to investment in property	50	4	57	3	0.0014
Declining soil health (e.g. declining fertility or structure)	50	3	63	3	0.1442
Rising cost of farming inputs undermining financial viability	54	5	64	4	0.0001
Having the right to use surface or ground water for irrigation	50	5	69	4	0.0000
Impact of changing rainfall patterns on property viability	53	5	75	4	0.0012
State/local government planning rules limiting your ability to subdivide	48	3	70	4	0.1175
New chemical spray regulations for riparian and adjoining areas	53	4	67	3	0.1117

Note: The degree of significant difference is based on the Kruskal Wallis test and those shaded are significant

Table 19. Comparison of values that farmers and non-farmers attached to river/creek frontage and adjoining wetlands. Tasmania riparian landholder survey, 2008, N=146

Value	Farmer		Non-farmer		p value
	n	median	n	median	
Provides timber for firewood and fence posts	21	2	44	2	0.6841
Provides access to water for stock	45	5	53	4	0.0736
Provides additional land for grazing stock, particularly in summer	34	3	42	2	0.0230
Provides important shade and shelter for stock	40	3	45	3	0.0493
I rely on the river for irrigation water	26	5	31	2	0.0000
Adds to the market value of the property	45	4	64	3	0.0001
Acts as a filter catching sediment and/or nutrients before they reach the river	38	3	56	3	0.5781
Vegetation on the frontage helps hold the banks and stop erosion	44	4	69	4	0.3965
Provides a place for recreation for me, my family and friends	42	3	61	2	0.1206
Provides habitat for native birds and animals	47	4	75	4	0.1878
In-stream vegetation traps and stabilises sand/gravel	42	3	64	3	0.4850
Provides a source of nutrients for in-stream plants and animals	44	3	66	4	0.1437
Provides woody matter such as snags that offer protection for fish and other animals that live in the river/creek	42	4	60	3.5	0.7664
Is a habitat corridor (allowing wildlife to move between areas)	40	3	65	4	0.2625
Is an attractive area of the property	46	4	72	4	0.8479

Note: The degree of significant difference is based on the Kruskal Wallis test and those shaded are significant



Table 20. Comparison of farmers' and non-farmers' attitudes about NRM rights & responsibilities. Tasmania riparian landholder survey, 2008, N=146

Attitudes about	Farmer		Non-farmer		p value
	n	median	n	median	
Landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment	53	4	80	4	0.0397
New owners should abide by agreements entered into by previous owners where public (tax-payer) funds have paid for land protection or conservation work	52	4	77	4	0.8228
Governments must take more responsibility for ensuring landholders meet their responsibilities under the EMPCA ( <i>Environment Management and Pollution Control Act 1994</i> )	50	3	74	4	0.0232
Terms of contracts with large agri-business companies limit the ability of farmers to crop using best-practice conservation techniques	44	3	70	3	0.0049
In most cases, the public should have the right of access to river/creek frontages that are managed by private landholders	52	2	79	2	0.1651

Note: The degree of significant difference is based on the Kruskal Wallis test and those shaded are significant

Table 21. Self-assessment of knowledge topics by farmers and non-farmers. Tasmania riparian landholder survey, 2008, N=146

Your knowledge of different topics	Farmer		Non-farmer		p value
	n	median	n	median	
The role of native bush and perennial pastures in preventing rises in water tables that can lead to salinity	49	3	74	3	0.0295
The proportion of nutrients entering water courses that is from paddocks on dairy farms rather than dairy sheds	34	3	57	2	0.1396
Your responsibilities under the EMPCA ( <i>Environment Management and Pollution Control Act 1994</i> )	48	2.5	72	2	0.3687
The effects that soil pugging by stock has on soil erosion and nutrient loss from farms	50	3	66	2	0.0007
The main sources of nitrogen that enter waterways in your district	53	3	72	2	0.0278
The role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks	52	3	74	2	0.0104
How to interpret soil tests as a way of checking the application of nutrients on your paddocks	53	3	72	2	0.0000
The role of stubble retention and stubble mulching in preventing the loss of nutrients from farms	48	3	70	2	0.0000
The relative contribution of different sources of phosphorus to water nutrient levels (such as run-off from paddocks and leaching through soils)	53	3	74	2	0.0001
The fertiliser applications required for optimum production across the main enterprises on your property	52	4	69	3	0.0000
How to prepare a farm or property plan that allocates land use according to different land classes	49	3	69	2	0.0000
How to access information about government support for landholders to manage river/creek frontages and adjoining wetlands	53	3	75	2	0.0000
The elements of water quality critical for public health	53	3	74	3	0.0220

Note: The degree of significant difference is based on the Kruskal Wallis test and those shaded are significant

## Key survey findings

It seems that those identifying as farmers are very different to non-farmers in terms of their concerns about property issues (7 of 10 items) [Table 18]; values attached to property (4 of 15 items) [Table 19]; attitudes about NRM roles and responsibilities (3 of 5 items) [Table 20]; self-assessed knowledge of NRM (11 of 13 items) [Table 21]. Farmers were significantly more concerned about each of the seven property-related issues where differences existed [Table 18]; less likely to accept a duty of care for biodiversity or a stronger role for government in ensuring compliance with the EMPCA (*Environment Management and Pollution Control Act 1994*) [Table 20]; and more likely to give a higher rating to the economic values of their river/creek frontage and adjoining wetlands [Table 19].

Differences were less obvious between farmers and non-farmers in terms of their confidence in CRP (only significant for 1 of 8 items). Interesting, there

was not a significant difference between farmers and non-farmers on the item exploring a stewardship ethic.

Farmers were significantly more likely to report that they had implemented four CRP items: fenced land for natural regeneration of native vegetation; erected fencing to manage stock access to the waterway/adjoining wetlands; tested soils for nutrient status in paddocks where they had applied fertiliser; and tested the quality of the main water source for stock or irrigation purposes.

Farmers in this study owned larger properties and generally managed longer river/creek frontages (median 2km compared to 500m). However, with the exception of the Macquarie catchment, where properties are very large and most landholders are farmers, non-farmers in this study owned between 40% and 68% of the length of all frontages. In the Coal, Quamby Brook and Pet catchments,

Table 22. Proportion of river frontage managed by farmers and non-farmers

Catchment	n	Landholder %	Median frontage	Frontage owned %
Coal, farmer	7	39%	1200m	49%
Coal, non-farmer	11	61%	500m	51%
Jordan, farmer	4	36%	1250m	53%
Jordan, non-farmer	7	64%	800m	47%
Macquarie, farmer	16	76%	8000m	93%
Macquarie, non-farmer	5	24%	1200m	7%
Quamby Brook, farmer	4	17%	1375m	45%
Quamby Brook, non-farmer	20	83%	500m	55%
Pet, farmer	4	25%	1750m	32%
Pet, non-farmer	12	75%	900m	68%
Inglis-Flowerdale, farmer	12	41%	1150m	59%
Inglis-Flowerdale, non-farmer	17	59%	700m	41%
Overall, farmer	49	40%	2000m	72%
Overall, non-farmer	73	60%	500m	28%
Overall without Macquarie farmers	33	33%	1300m	49%
Overall without Macquarie non-farmers	68	67%	500m	51%

Tasmania riparian landholder survey, 2008, N=146. Note: n = number of respondents who managed a frontage and supplied a distance figure

## On and off-property work and income

### On and off-property work

Two survey items sought information about the number of hours per week worked on farming/property related activities over the past 12 months; and the number of days involved in paid off-property work in the past 12 months.

#### Key survey findings

- Respondents worked a median of 20 hours per week on farming/property related activities in the past 12 months [Table 23]. This figure is consistent with the earlier finding that most respondents were not farmers by occupation.
- The median hours of on-property work across the six catchments varied, but not significantly, with longer hours of on-property work in the Macquarie catchment and shorter hours worked in the Quamby Brook catchment [Table 23].
- Respondents worked a median of 10 days off-property in the past 12 months, but this varied widely across the six catchments. Indeed, the median days of off-property work in Quamby Brook and Inglis–Flowerdale were 195 and 225 days respectively [Table 23].
- More on-property work (longer hours per week) over the past 12 months was linked to significantly higher implementation of five CRP: planting native trees and shrubs; testing soils for nutrient status in paddocks where they had applied fertiliser; testing the quality of the main water source for stock or irrigation purposes; having a fertiliser nutrient budget calculated for all/most of the farm; and applying fertiliser using an accredited spreader. It appears that more on-property work is a good predictor of CRP implementation for both sustainable farming and

biodiversity conservation practices. The exception is that more off-property work was linked with significantly higher implementation of the CRP exploring the extent stock were restricted in their access to the river/creek frontages and adjoining wetlands for grazing and for drinking water.

### On and off-property income

Three survey items explored levels of on and off-property income. The first item asked respondents if their property returned a net profit in the 2006–07 financial year. A net profit was defined as a situation where the amount of income from the property exceeded all paid expenses before tax. This item was completed by most respondents (n=127). Respondents who indicated they had made a net profit were then asked to select the amount of profit from one of eight ranges. For the purpose of data analysis, each respondent was allocated the mid-point of the chosen dollar interval.

Respondents were also asked if they or their partner received a net off-property income after expenses and before tax in the 2006–07 financial year (n=133). Respondents who indicated a net off-property income were then asked to select the amount of income before tax from one of eight ranges. Again, each respondent was allocated the mid-point of the chosen dollar interval.

#### Key survey findings

- Only 37% of respondents said they made an on-property net profit in the 2006–07 financial year. The proportion of respondents reporting a net profit did not vary significantly across the six catchments. Higher levels of profitability were reported in the Inglis–Flowerdale and Macquarie catchments and lower levels of profitability in

Table 23. On and off-property work by landholders. Tasmania riparian landholder survey, 2008, N=146.

Catchment	On-property work Average hours per week last 12 months		Paid off-property work Days worked last 12 months		
	n	median	n	median	% who worked > 1 day
Coal	19	20	19	2	53%
Jordan	21	20	21	0	33%
Macquarie	21	50	18	0	33%
Quamby Brook	25	10	24	195	75%
Pet	15	15	13	0	46%
Inglis–Flowerdale	31	35	31	225	68%
Overall	135	20	129	10	54%

the Quamby Brook and the Pet catchments [Table 24].

- For those reporting a profit, the median profit level was \$15,000 in 2006–07. This is an important finding in that previous research has identified a significant positive relationship between higher on-property (but not for off-property) incomes and implementation of recommended practices (Curtis *et al.* 2006; Curtis *et al.* 2008b). The research team has previously used \$50,000 net profit as the minimum needed to provide for a family and sustain property infrastructure. In this study, only 22% of respondents said they had a net profit above the \$50,000 threshold.
- The median on-property profit varied across the six catchments from \$5,000 in the Coal, Macquarie and Quamby Brook catchments, \$15,000 in Inglis–Flowerdale and \$35,000 in the Pet and Jordan catchments [Table 25].
- The median off-property income before tax for the respondent and their partner of \$45,000 was three times the median on-property profit of \$15,000, suggesting that off-property incomes are higher than on-property incomes for most respondents. Indeed, the median off-property income exceeded the median on-property profit in all catchments with the exception of the Jordan

where they were the same [Table 25].

- In this study there were very few significant relationships between on or off-property income and implementation of the CRP items. Each of the four relationships identified were positive, including between level of on-property profit and land fenced for natural regeneration of native vegetation during the period of management; and establishing off-stream watering points for stock during the period of management.

Most of the farmers interviewed (i.e. identified farming as their primary occupation) reported a decline in their farm business profitability over recent years. The difficult conditions for farm businesses were largely a consequence of:

- declining 'farm gate' returns (i.e. lower financial returns for farm products);
- increasing costs of inputs (e.g. fertilisers, fuel); and
- lower water availability (reduced rainfall, reduced allocation of water for irrigation).

As an agribusiness coordinator explained, farmers who are not profitable are unlikely to invest in activities with little benefit for their "bottom line".

*... most farmers seem willing to go along with the (riparian CRP) if there's support available, but otherwise it's probably lower on their*

Table 24. On and off-property landholder incomes 2006–07. Tasmania riparian landholder survey, 2008, N=146

Catchment	On-property net profit last financial year?			Off-property net income self/partner last financial year?		
	n	% Yes	% No	n	% Yes	% No
Coal	22	36%	64%	21	76%	24%
Jordan	19	32%	68%	19	53%	47%
Macquarie	17	47%	53%	18	56%	44%
Quamby Brook	24	21%	79%	26	73%	27%
Pet	16	25%	75%	16	69%	31%
Inglis–Flowerdale	26	58%	42%	30	73%	27%
Overall	127	37%	63%	133	68%	32%

Table 25. Median of on-property net profit and off-property income 2006–07. Tasmania riparian landholder survey, 2008, N=146.

Catchment	Median on property profit	Median off-property income
Coal	\$5,000	\$35,000
Jordan	\$35,000	\$35,000
Macquarie	\$5,000	\$25,000
Quamby Brook	\$5,000	\$45,000
Pet	\$35,000	\$80,000
Inglis–Flowerdale	\$15,000	\$55,000
overall	\$15,000	\$45,000

*radar than their core business ... they need to know the benefits, is it worth the investment?*

Sheep farming is the dominant land-use in the Macquarie catchment and an important part of the enterprise mix for landholders with larger properties in the Jordan and Coal catchments. The short to medium-term prospects for many wool producers appears difficult, with wool prices predicted to remain subdued for the next decade. Unless these landholders change their enterprises, this forecast suggests that much of the farmland in those catchments will be managed by landholders with limited on-property incomes. It seems that without considerable public investment, these farmers will have limited capacity to implement CRP. The following quotes reflecting the challenging outlook facing wool producers and the implications for NRM.

*I'm inherently very sceptical about the long term viability of the future of farming – for those in the grower part. That's why I'm not so fussed about the riparian, because I'd rather use (stock) management issues to deal with that rather than me personally. Available cash for non-production funding just wasn't there.*

*... when my old man came back here he wanted to grow sheep. He could make a good life out of growing sheep – he gave us a good education ... he had a good lifestyle. Now it's getting harder and harder – all the sheep guys are pretty much gone and the young guys are coming back on the land. If you want to live on the land and pay your mothers and sisters and fathers out, you can't say I want to grow sheep. Whatever makes me money – that's what I'm into, as long as it's sustainable.*

*... if you're paying tax, you're making money but farmers will say – well hang on a minute, I can put that into fencing that creek off or do this or that. It's a tax advantage anyway; it's going to give the property a long term benefit. If they are worried about keeping their head above water it's the last thing they're going to do.*

**Box 6: On-farm income**

Many farmers have experienced low farm income and low water supplies, which has led them to reduce their investment in on-farm NRM. Compounding this situation is the prediction of subdued returns for wool producers over the next decade.



*Sheep grazing is a major land-use in the Meander River catchment. (Photo: R. Sample.)*

## Place and length of residence and family connection to property

Recent research suggests that increased turnover in property ownership is associated with increased proportions of newer (<10 years residence) and absentee owners. This research also indicates that there are important differences in the values, attitudes, knowledge, networks and management practices of newer and longer-term owners and absentee and resident owners (Curtis *et al.* 2006; Curtis *et al.* 2008b).

Survey respondents were asked to provide information about how long they had lived in their local district; how long they had owned or managed at least some part of their property; if the property was their principal place of residence; and whether their property had been owned or operated by others in their family.

### Key survey findings

- Findings from the analysis of survey data suggest the populations in the six catchments are relatively stable in that most respondents had lived in their district for long periods of time (median 30 years) and owned/managed their property for a considerable period (median 20 years). Data from the Wimmera catchment in Victoria in 2007 provides some perspective, where there was a median length of residence of 45 years (Curtis *et al.* 2008b).

- Almost all respondents (>80% overall) were long-term residents in that they had lived in their district for 10 years or more [Table 26].
- The median length of time that properties had been in the family was 30 years, the same as the median length of time respondents had lived in the district [Table 20]. These data mask some significant differences ( $p = 0.0023$ ) across the catchments in that in the Macquarie catchment the median period for family ownership was 70 years while in the Quamby Brook it was 20 years [Table 26].
- Over a quarter (27%) of all respondents said their rural property was not their principal place of residence [Table 26]. This finding is consistent with, although slightly higher, than the level of absentee ownership identified in recent studies in Victoria (22% in Wimmera and 23% in Corangamite) (Curtis *et al.* 2006; Curtis *et al.* 2008b).
- Interestingly, the proportion of absentee owners is not significantly different ( $p = 0.9540$ ) across the six catchments, varying from a low of 24% in the Jordan and Pet catchments to 34% in the Quamby Brook catchment [Table 26].
- In this study there were very few significant relationships between implementation of CRP and the length of property ownership (1 CRP), period of family ownership (1 CRP), length of residence in local district (1 CRP); and residency status (nil).

Table 26. Length of residence of landholders. Tasmania riparian landholder survey, 2008, N=146.

	Years respondent owned/managed property		Years property in family		Lived in district 10 years or more		Absentee owner	
	n	median	n	median	n	%	n	% Yes
Coal	21	20	14	45	17	82%	22	27%
Jordan	21	21	11	62	18	89%	21	24%
Macquarie	21	20	18	70	18	89%	21	29%
Quamby Brook	28	16	16	20	26	81%	29	34%
Pet	17	14	10	27.5	16	81%	17	24%
Inglis-Flowerdale	33	22	20	25	31	74%	32	25%
overall	144	19.5	91	30	129	82%	145	27%



*Heritage issues  
in the Macquarie  
River catchment.  
(Photo:  
R. Sample.)*

### **Property size and land use**

Survey respondents were asked to indicate the total area of land that was owned or managed by them or their immediate family in their local district, including any land leased or share-farmed. They were also asked to describe the farming enterprises on their property; and whether they irrigated part of their farm in 2008.

#### **Key survey findings**

- The median property size was 81ha. With the exception of the Macquarie catchment (median >2,200ha), most properties were less than 150ha [Table 27].
- Grazing enterprises (sheep, beef, dairy, and livestock-cropping mix) comprised the majority (65%) of enterprise types [Table 28]. There were very few cropping only enterprises and with crop and livestock enterprises, 20% of land was potentially under cropping [Table 28].
- As might be expected, there were some obvious differences in the enterprise mix across the six catchments. For example, sheep grazing occupied over 40% of the respondents' land in the Coal catchment but there was no sheep grazing in the Pet catchment. Similarly, beef grazing dominated land use in the Pet catchment but the respondents reported no land under beef grazing in the Jordan catchment [Table 28].
- The proportion of land under forestry also varied

across the catchment, with more than 15% of land under forestry in the Quamby Brook and Jordan catchments but around 5% under forestry in the Coal and Inglis–Flowerdale catchments [Table 28].

- Twenty-eight per cent (n=141) of all respondents said they irrigated some part of their property in 2008. Just under half of all respondents in the Inglis–Flowerdale (45%) and Macquarie (43%) said they irrigated their property. Much lower proportions of respondents irrigated their property in the other catchments (Jordan and Quamby Brook 19%, Pet 18%, Coal 15%).
- As might be expected, there were significant positive relationships between property size and implementation of many (8) of the 20 CRP items included in the survey, particularly those related to sustainable farming. Larger property size was linked to significantly higher fencing of areas to regenerate native vegetation; sowing summer active perennial pasture such as lucerne and phalaris; testing soil for nutrient status in paddocks where applied fertiliser; applying fertiliser using an accredited spreader; minimum tillage cropping; and spending time controlling pest animals and non-crop weeds. At the same time, those with larger properties were significantly less likely to limit stock access to their river/creek frontages and adjoining wetlands for grazing or for drinking water.

Table 27. Property size. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	% of respondents				
		< 40ha	40ha to 150ha	150ha to 300ha	> 300ha	Median
Coal	21	14%	43%	19%	24%	117ha
Jordan	21	29%	29%	10%	33%	57ha
Macquarie	20	5%	5%	5%	85%	2265ha
Quamby Brook	29	45%	38%	17%	0%	41ha
Pet	17	47%	24%	12%	12%	45ha
Inglis–Flowerdale	32	31%	47%	9%	13%	50ha
overall	143	29%	32%	12%	26%	81ha

Table 28. Land use/enterprise types on rural properties. Tasmania riparian landholder survey, 2008, N=146

Catchment	n	Property land uses									
		% Grazing Sheep	% Grazing Beef	% Dairy	% Cropping	% Cropping and livestock	% Horticulture and viticulture	% Forestry	% Bush	% Residential	% Other
Coal	23	43%	9%	0%	0%	22%	0%	4%	0%	9%	13%
Jordan	24	25%	0%	4%	0%	25%	0%	17%	8%	4%	17%
Macquarie	22	32%	5%	0%	5%	41%	0%	9%	0%	5%	5%
Quamby Brook	32	13%	22%	6%	0%	3%	9%	19%	13%	0%	16%
Pet	18	0%	72%	0%	0%	17%	0%	11%	0%	0%	0%
Inglis–Flowerdale	37	3%	41%	11%	5%	11%	0%	5%	11%	0%	14%
overall	160	19%	24%	4%	2%	18%	2%	11%	7%	3%	12%

Note: The overall n figure (160) is greater than the N (146) number of respondents because some respondents gave multiple answers.

### River frontage length and title

Survey respondents were asked to estimate the distance that a river/creek flows along or through their property. For this question they were only asked to provide the distance on one side of the waterway. Survey respondents were also asked whether a part of their river/creek frontage was under a Crown Land Reserve.

#### Key survey findings

- It seems that most respondents (n=137) managed substantial river/creek frontages (median of 800m). As might be expected, the median length of creek frontage was highest in the Macquarie catchment (5km), followed by the Pet (1km), Inglis–Flowerdale (800m), Coal (650m), Quamby Brook (500m) and Jordan (350m).
- Only 15% (n= 131) of respondents to this question said that a part of their river/creek frontage

was under a Crown Land Reserve. The proportion of respondents who said that part of their frontage was Crown Land was not significantly different across the six catchments. The proportion was higher in the Macquarie (24%) and lower in the Coal (5%) and Pet (0%).

- Those respondents with longer river frontages were significantly more likely to have implemented four of the CRP items included in the survey, including: fencing land to encourage natural regeneration of native vegetation; sowing summer active perennial pastures such as lucerne and phalaris; testing soils for nutrient status in paddocks where applied fertiliser; and having a fertiliser nutrient budget calculated for all or most of the farm. At the same time, those with longer frontages were significantly less likely to have restricted stock access to the river frontage/adjoining wetlands for grazing.



## Government and agency support

NRM programs, including those funded through the Natural Heritage Trust and the National Landcare Program, have supported work on private property where there is a demonstrated public benefit. Survey respondents were asked if in the past five years (since 2004), federal or state government programs or the regional NRM organisation had supported work on their river/creek frontage or adjoining land.

### Key survey findings

- Overall, 23% of respondents said they had received support through federal or state NRM programs and the regional NRM organisations in the past five years. Interestingly, this finding is the same as for the question employed in the Goulburn Broken survey of river frontage owners in 2007 (Curtis *et al.* 2008c).
- With the exception of the Quamby Brook catchment (7%), there was a remarkable consistency in the proportion of landholders reporting they had received government assistance for this

work in the past five years (Pet 31%, Jordan 26%, Macquarie 25%, Coal and Inglis–Flowerdale both 24%).

- Those reporting government assistance through federal and state NRM programs and regional NRM organisations were significantly more likely to be farmers by occupation, operate larger properties and be Landcare members [Table 29].
- Somewhat surprisingly, receiving support through federal or state NRM programs and the regional NRM organisations in the past five years was only significantly linked to implementation of two CRP items included in the survey: trees and shrubs planted along the waterway/wetlands during the period of management; and land fenced for natural regeneration of native vegetation. In both cases, there was a significant positive relationship.

### The landholder-agency relationship

Most landholders surveyed and those interviewed said they were willing to enter into a written

Table 29. Comparison of respondents with and without government support. Tasmania riparian landholder survey, 2008, N=146.

Topic	n with government funding	n without government funding	% Yes of respondents with government funding	% Yes of respondents with no government funding	Proportions p value
Is this property your principal place of residence?	31	103	77%	72%	0.7018
Is part of your river/creek frontage under a Crown Land reserve?	28	96	18%	16%	0.7775
Are you a member or involved with a local Landcare group?	30	101	47%	12%	0.0001
What is your main occupation?	30	100	70%	29%	0.0001
Did your property return a net profit (income from your property exceeded all paid expenses before tax) last financial year (2006-2007)?	27	94	56%	33%	0.0568
Topic			Median with government funding	Median with no government funding	Kruskal Wallis p value
What is the area of your property?	30	102	350ha	63.125ha	0.0001
Estimate the distance that a river/creek runs along/through your property	31	98	1300m	700m	0.0525
Indicate the approximate figure for the profit (before tax) from your property last financial year (2006-2007).	17	39	\$15,000	<\$10,000	0.0671
Indicate an approximate figure for the total off-property income (before tax) for you and your partner last financial year (2006-2007).	19	66	\$35,000	\$45,000	0.8897
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	24	61	Early stages	Not started	0.0833

Note: The degree of significant difference across the catchments is based on the Proportions test and the Kruskal Wallis test for significance at 0.05 level and those shaded are significant.

agreement with NRM agencies if they were to accept public funding to support implementing CRP. For the interviewees, this commitment included providing a report on the completion of the on-ground works (if not too onerous) and allowing staff to undertake site inspections of those works. While some landholders, notably those with larger properties, said they were interested in some form of stewardship payment, few expressed interest in entering legally-binding covenants.

There was also concern amongst landholders about the paperwork involved in meeting standards of accountability for the expenditure of public funds. An illustrative comment is provided below.

*... it's a pain in the neck, I've done the work and I don't want particularly to hunt out 3 years old files ... it's now costing me money to go back, it will take \$2,000 worth of energy – my time – to pull together the audit. I'd rather put \$2,000 into the next activity.*

Effectively managing the relationship with landholders is critical if NRM agency staff are to build longer-term commitment amongst landholders to active, ongoing management of riparian areas consistent with the aims of the initial public investment. A number of interviewees had suggestions about how this should happen and some of these are included below.

*How about doing it like they used to in the old days of extension officers, where they come out and check. How about they come out and have a relationship instead of sitting at a goddamn desk. It's not collaborative enough and not flexible enough.*

*Since we started that initial willow removal (in 1999), I don't think we've had 1 person inspect the creek or do anything.*

*In my opinion, I think they (NRM staff) would – on paper and credentials – be very well read but practically very inexperienced. And I think that's where it all falls down. We're getting more and more people out of university who have done a study – nothing against that – but like when I went to Ag college – you've got to have the practical experience with the knowledge.*

*... I don't like this current system where the employees of the government are short-term based. I think that's really unsettling ... it's an appalling way of managing or trying to attract good brains into that movement.*

Several interviewees expressed the view that 'fixed grant' NRM programs (public-private co-investments) were more easily understood by landholders, more likely to engender trust between co-investors, and were more efficient to administer than the Market-Based Instruments (MBI) that employed a tender/auction approach. One landholder raised concerns about missing out on being

involved in an MBI.

*They had a reverse tender process the other day with the Forest Conservation Fund. I put it in, and got the reply 'oh no, sorry your tender was too high, we've got other priorities'. Fair enough, I've got no problem with that – but if it's not that important to the community – if you guys aren't willing to pay that sort of money, and I wasn't over the top, then I can do what I want with it.*

### **Effective programs**

The interviews explored the attributes of effective NRM programs. Landholders mentioned a variety of attributes that appealed to them. Some of these included:

*... having personal contact is important, someone who knows the area*

*... I find the Dairy Tas group and my consultant give me the most reliable information*

*... it's got to be voluntary ... if it's a good program, word-of-mouth soon builds up the level of interest amongst the neighbours*

*... you've got to come at the problems from a farmer's perspective, start by tackling the weeds*

*... need to be flexible to include everyone ... if it's working, don't change it*

*... you can't have 'hard and fast' rules ... if you give a bit, eventually you'll win.*

The Rivercare program was nominated by several landholders and NRM officers as a model of a successful program. This program involved neighbouring landholders working with the assistance of experts to prepare action-oriented plans to improve the management of riparian areas. Interviewees included landholders who had been active in the Pet study area, which won the State Rivercare Award in 2001. Several interviewees reported positively on the Pet project, coordinated by staff at the Burnie City Council.

Drawing on the views expressed by landholders and other stakeholders interviewed, we suggest that some of the key characteristics of an effective local NRM project include:

- time to allow for word-of-mouth promotion and acceptance amongst the local community (>3 years);
- participants to complete a Property Management Planning course before undertaking any on-ground works;
- a credible (trusted) extension officer employed (someone able to establish a rapport with landholders) who speaks the 'farmer's' language (i.e. understands the context for landholders);
- provide adequate resourcing so the extension officer(s) can spend some of their time

- using a one-to-one approach (e.g. initial visit to landholder);
- fund the cost of materials (although being flexible in terms of what materials are most relevant for an individual's needs);
  - use local contractors and/or provision of experienced labour (fencers, spraying contractors);
  - identify a realistic number of landholders to work with (e.g. one NRM officer to actively work with up to 20 landholders per year);
  - follow-up maintenance for work sites (e.g. assistance with pest plant and animal control for initial 3 years); and
  - use simple, non-legal agreements.



## Other social and farming variables

### Gender and age

Women play an important role in decision-making in farming families but their voice is often not heard (Curtis *et al.* 1997). Estimates by Elix and Lambert (2000) indicate that about 30% of Australia's farm workforce is female and that just under 20% of agricultural decision-makers are women. Since the mailing list for this survey was compiled by randomly selecting landholders from lists of rural property owners with riparian land (see earlier section on methodology) no attempt was made to target women property owners or managers.

- As explained earlier, the median age of respondents was 54 years. The median age was very similar across the catchments [Table 30].
- Of the 141 respondents who indicated their gender, 13% (n=18) were women. The proportion of female respondents varied across the catchments from 24% in the Coal to 5% in the Macquarie [Table 30].
- There were few significant relationships (2) between gender and implementation of the CRP items included in the survey.

Table 30. Gender and age of respondents. Tasmania riparian landholder survey, 2008, N=146

Catchment	Gender			Age	
	n	% Male	% Female	n	median
Coal	21	76%	24%	21	55
Jordan	21	81%	19%	21	54
Macquarie	21	95%	5%	21	54
Quamby Brook	26	92%	8%	26	56.5
Pet	17	94%	6%	16	54.5
Inglis-Flowerdale	32	88%	13%	31	52
overall	141	87%	13%	139	54

### Employment of consultants

Separate survey items asked if respondents had employed a consultant to provide advice on any aspect of on-property management in the past year. Overall, 18% of respondents (n=141) said they had employed a consultant in the past 12 months. There was a significant difference ( $p = 0.0002$ ) across the catchments in the proportion of respondents who said they employed a consultant. For example, over half (52%) of the respondents in the Macquarie catchment said they employed a consultant, compared to 25% in the Pet, 19% in the Coal, 12% in Inglis-Flowerdale, 5% in the Jordan and 4% in Quamby Brook catchment.

Employment of a consultant to provide advice for on-property management in the past year was positively linked to implementation of two CRP that related to the longer period of property management; and negatively linked to implementation of three items related to property management in the past five years and one item related to property management in 2008. One interpretation of these findings is that those employing consultants are often the people who need that advice to assist them prepare and implement CRP.

## Confidence in CRP

### Landholder confidence in CRP

Eight statements explored survey respondent confidence in CRP, including soil testing to guide nutrient application, the ability of native vegetation along waterways to trap nutrients, willow removal, watering stock off-stream, fencing river frontages and grazing by stock [Table 31]. Six response options were provided in the survey, ranging from 'Strongly agree' to 'Strongly disagree' and again included a 'Not applicable' option. To simplify the presentation of data, the six response options have been collapsed into four [Table 31]. For the calculation of mean scores per item, the 'Not applicable' option was excluded. Those interpreting data presented in Table 31 should note that for three items (all shaded) the statements included in the survey were presented in the negative. That is, a 'Disagree' or 'Strongly disagree' response reflect confidence in the efficacy of that CRP.

### Key survey findings

- Survey data suggests there are very high levels of support for four CRP, including those related to soil testing to guide nutrient applications; limiting stock access along waterways to trap nutrients in native vegetation; removing willows to improve water quality; and watering stock off-stream to improve water quality [Table 31]. Indeed, there were few respondents who disagreed with the statements exploring confidence in these CRP (maximum of 12% disagreed for watering stock off-stream) [Table 31].
- Despite overall support for limiting stock access along waterways to trap nutrients in native vegetation, there was evidence of some ambivalence about the need to control stock access to protect native vegetation and about the benefits for native vegetation retention of crash grazing river frontages compared to set stocking [Table 31].
- It seems that most respondents are not concerned about the impacts of floods as a constraint to fencing frontages to manage stock access [Table 31].

- There were significant differences across the six catchments for two of the eight statements exploring confidence in CRP: removing willows to improve water quality; and the relative merits of set stocking and crash grazing [Appendix, Table E].
- The eight statements exploring confidence in CRP were very specific and it would be unrealistic to expect them to be relevant to other CRP. Survey findings suggest that confidence in CRP is an important influence on landholder implementation of related practices. In this study, there were four significant positive relationships between confidence and implementation, including for those who agreed that:
  - areas of native vegetation along waterways with limited stock access are able to trap nutrients before they enter waterways were more likely to plant native trees and shrubs along the waterway or in adjoining wetlands during their management period;
  - soil testing to guide nutrient applications is critical to ensuring that excessive nutrients are not applied to farmland were more likely to test soils for nutrient status in paddocks where they have applied fertiliser;
  - intensive grazing is usually better than set stocking for retaining native vegetation in paddocks with river/creek frontages were more likely to establish off-stream watering points for stock during the period of their management; and
  - removing willows helps improve the water quality in rivers/creeks were more likely to

have removed willows and replaced them with native vegetation during their period of management.

### Interviewee perceptions of CRP

Amongst the interviewees there was a broad distinction between the views of farmers (more frequently reporting negative views about some of the CRP) and non-farmers (generally more positive). Indeed, many farmers see the suite of CRP for riparian areas as inconsistent with their views about 'best practice' farming. For example, livestock were commonly viewed as the most cost-effective means of controlling weeds and limiting the habitat for pests on farmland. Many farmers appeared reluctant to accept generic state-wide prescriptions for managing their riparian areas. For example, fencing riparian areas to manage stock access was considered impractical in high rainfall catchments where there were frequent floods.

Nevertheless, many farmers have implemented CRP, particularly those that they believed would assist their property management. CRP thought to have observable on-farm benefits were more likely to be implemented, including the following:

- strategies to optimise on-farm nutrient application and management (i.e. with a strong incentive for farmers to minimise any off-site leakage of fertilisers);
- fencing out steep river banks to minimise injury to livestock (i.e. also preventing livestock access to waterways);
- removing invasive woody weeds, such as willows, to reduce the risk of flooding and improve

Table 50. Confidence in current recommended practices (CRP). Tasmania riparian landholder survey, 2008, N=146.

Statement	n	% Agree	% Not sure	% Disagree	% NA
Fencing river/creek frontages is not practical because floods will damage fences	141	24%	17%	44%	15%
Grazing of domestic stock has had little impact on the existence and diversity of native vegetation on river/creek frontages	140	41%	14%	33%	13%
Allowing limited productive use of river/creek frontages such as crash grazing or farm forestry is an acceptable way to manage these areas	140	31%	32%	29%	8%
Set stocking is usually better for retaining native vegetation in paddocks with river/creek frontages than intensive grazing for short periods	138	29%	39%	22%	10%
The time and expense involved in watering stock off-stream is justified by improvement in river/creek water quality	138	54%	25%	12%	9%
Removing willows helps to improve the water quality in rivers/creeks	141	51%	23%	9%	18%
Soil testing to guide nutrient applications is critical to ensure that excessive nutrients are not applied to farmland	139	69%	17%	5%	9%
Areas of native vegetation along waterways with limited stock access are able to trap nutrients before they enter waterways	137	64%	29%	2%	5%

Note: Shaded statements are in a negative relationship to the CRP.

- access to manage pest plants and animals; and
- installing off-stream water points to improve live-stock health/management.

The following comments suggest that farmers will implement CRP when they believe CRP will assist them achieve their management objectives in riparian areas.

*... we've put in a network of troughs on our property ... it's easier to manage the cows than when we used to rely on the creeks*

*... fencing out our dams has improved the water, it's less muddy ... we've also controlled the erosion by stopping cattle access to the river ... improved the habitat (for native biodiversity)*

*... where we've fenced and planted trees, it has worked well*

*... we've fenced out all our riparian areas ... the benefits are huge for stock management and revegetation*

*... we're happy to fence our creek lines ... we've done about 75% of our creeks during the last 10 years ... we've set up troughs too ... the (CRP) make sense to me ... I'm planning to fence out the whole river on my property, I've started with the higher ground which has less risk of flood damage*

*... we've had no problems with erosion where we've done river work ... some grasses and gorse, but not much to up-keep.*

Several stakeholders thought the popularity of willow removal programs provided an opportunity for NRM programs to build positive relationships with local landholders. Willow removal programs could then be used as a 'stepping stone' to engage landholders in other CRP. Landholders who had undertaken CRP works were more likely to be say they were confident that CRP were underpinned by sound science. However, others mentioned their lack of confidence in the science, as illustrated by these comments:

*... there's mixed messages in the media about the science of all this*

*... I don't think they've thought it through ... what the long-term effects will be of fencing out these areas.*

Even an experienced NRM manager expressed concern about the efficacy of some riparian CRP:

*... we still haven't got the science to be very precise about how to manage riparian areas ... how big should buffers be, what difference to water quality will willow removal make ... I can see why farmers don't trust our advice ... it's too generic and involves too much long-term management. We've got to get beyond the 'cut and paste' approach for weed control ... it's too slow and expensive.*

It seems that landholders will also be reluctant to implement CRP that are thought to result in off-site, or downstream, rather than immediate on-farm



Jordan River showing effects on banks of unrestricted grazing and no PPA action (non-adoption of fencing CRP and no rabbit control) (Photo: R. Sample)

benefits. Indeed, every landholder interviewed who had implemented riparian CRP said that all work had been undertaken with financial and/or logistical support from a locally coordinated project (e.g. via Landcare, local government, or NGO).

The most contentious CRP for many landholders was erecting fences to exclude stock from riparian areas, mainly because excluding stock access would make it more difficult to control pest plants and animals and the likelihood that floods would damage fences and require time consuming and expensive repairs. Concern about flood impacts on fences was particularly strong in the Jordan and Macquarie study areas, where properties were larger and terrain flatter and more flood prone. Comments by landholders that illustrate these concerns include:

*... it takes more management of the riparian zone now it's fenced off ... I've gained a bit because there's not as much time as mustering the stock and whatever but there's more work with weeds*

*... and of course that's when the fencing issue is then an issue of also providing alternative drinking points – and also having to maintain those fences, it's quite a big flood area here – and also control weed growth*

*... it just doesn't appeal to me, once you fence an area out you just attract weeds, becomes a fire risk ... the workload with fenced out areas is too high*

*... there's a lot of good intent, but it's (riparian CRP) more complex and more expensive than most people realise*

*... you go anywhere around here and you'll see areas where they've fenced out the creeks and it's covered in blackberries, gorse and other weeds ... putting up the fence is the easy part, who's going to maintain these areas?*

*... the biggest drawback to fencing off riparian zones is the floods. Fencing areas that are flood prone, you're constantly going back repairing fences.*

Several stakeholders agreed that the on-going maintenance associated with fenced riparian areas was a cause for concern. As one interviewee explained:

*... these areas need a lot of work, they're not areas to 'set and forget'.*

The following comments from landholders reflect positive assessments of the efficacy of CRP for riparian management.

*... I know not long after it was done (excluding stock by fencing out riparian areas) they did a series of tests at the water treatment plant and the level of contaminants dropped dramatically*

*... the turbidity and what not entering the catchment area was quite significant (prior to excluding stock by fencing out riparian areas). They (the Council) reckon they have improved*

*their treatment costs – they have gone down by an incredible percent and the bacteria count is only a fraction of what it was*

*... we've fenced out the creek ... has helped filter out the sediments leading into the dams.*

Willow removal was the most widely-supported CRP amongst landholders interviewed. Landholders supported willow removal because it allowed:

- waterways to provide better drainage during high-rainfall events, limiting flood damage to farmland and infrastructure, and
- better access to the river bank for further pest and weed control.

Willow removal was very expensive and almost exclusively undertaken by contractors with substantial funding provided by NRM organisations. For example, willow removal along the Coal River was undertaken at a cost of \$15,000 per kilometre (includes 3 follow-up sprays over 6 years). Landholders estimated that willows had been removed from 70% to 80% of the Coal River, with initial work beginning in the late 1970s.

The strong support for willow removal amongst landholders is illustrated by the following comments:

*... willows are the worst thing to be introduced into this district ... you couldn't walk up the river 30 years ago ... now the river flows through*

*... my management is to remove the willows – to increase the flow, to stop it flooding my river flats*

*... the willows used to be really bad, choking the river and causing it to change its course*

*... the water quality (in the Coal River) has improved since the willows were removed*

*... I reckon 90% of landholders are happy to have the willows removed, the others don't want to remove willows mainly 'cause of the cost.*

As explained above, willow removal was widely supported by landholders, in part because removing the willows improved access to riparian areas to manage pest plants and animals and to prevent willows choking streams and causing flood damage. However, several landholders interviewed supported willow removal but did not want their riparian frontage fenced to control stock access or the planting of native trees and shrubs to replace the willows. Their preference was to maintain stock access to those areas to control weeds by grazing, as explained in the following quotes.

*... I've fenced the river, but I'm not planting any trees ... I need access for spraying weeds*

*... now we've got rid of the willows, it works well ... I'm not interested in fencing out the river ... stock grazing to the edge of the river keeps everything down.*

The following comments reinforce our earlier statement that while farmers and non-farmers are different, it is possible to engage both groups in practice change.

*... I reckon around here, hobby farmers tend to do more streamside works than commercial farmers [landholder]*

*... hobby farmers are willing, but they don't tend to have the finance so we get a low response rate ... it's easier to involve commercial farmers as they've got more capacity to implement works [NRM officer].*

#### **Box 7: Interviewees' perceptions of CRP**

Improved water quality for downstream beneficiaries did not provide a strong motivation for landholders to implement riparian CRP.

CRP with largely off-site, or downstream, benefits will require greater investment by outside investors than by the landholder, compared to CRP with largely on-farm benefits.

Generic state-wide CRP for the management of riparian areas appear problematic. Landholders want CRP that don't make property management more difficult and that are tailored to their local context. In some cases, different guidelines should be developed for large and small properties with different management issues.

### **Landholder constraints to better management of river frontages**

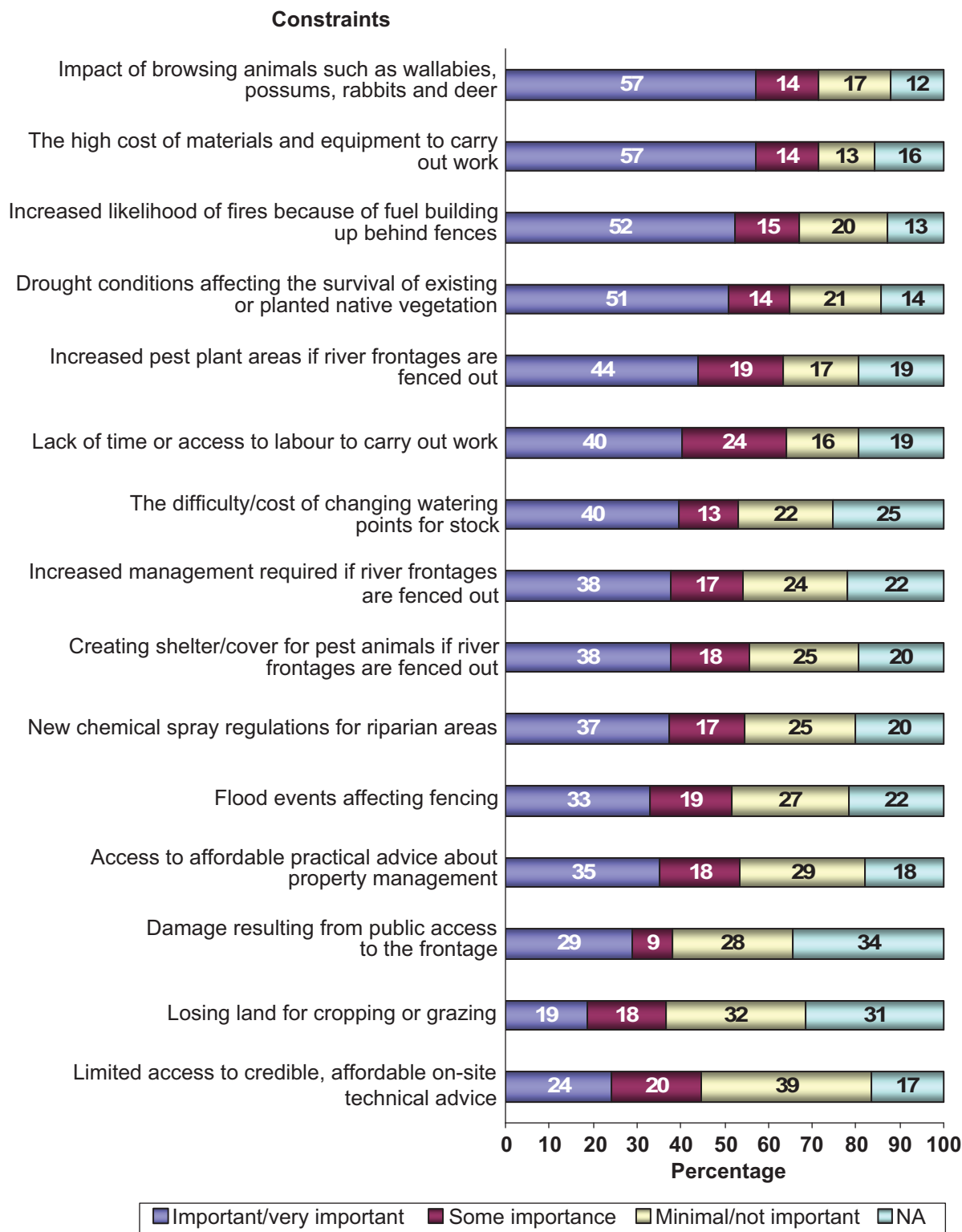
Survey respondents were asked to indicate their views about the importance of 15 possible constraints to the management of river/creek frontages and adjoining wetlands on their property. Again, six response options were provided, ranging from 'Very important' to 'Not important', including 'Not applicable'. Again these options were collapsed to summarise data in Figure 4. Median scores for each item were also calculated without including the 'Not applicable' option [Appendix, Table F].

### **Key findings**

- Four items were rated as 'Important' constraints by a majority of respondents: the impact of browsing animals; the high cost of materials and equipment to implement work; increased likelihood of fires because of fuel building up behind fences; and drought conditions affecting the survival of existing or planted native vegetation [Figure 4].
- Despite most respondents agreeing that areas of native vegetation along waterways with limited stock access are able to trap nutrients, substantial minorities were concerned about increased pest plant areas (44%); difficulty/cost of changing watering points for stock (40%); increased management time (38%); creating shelter/cover for pest animals (38%); and flood events affecting fencing (33%) [Figure 4]. These concerns suggest it is likely to be difficult to engage the 39% of respondents who said they had not fenced to manage stock access to the waterway or adjoining wetlands during their management period [Section 3.19, Table 33].
- There was a significant difference in responses across the six catchments for two of the 15 items exploring constraints to better management [Appendix, Table F]: 'Drought conditions affecting the survival of existing or planted native vegetation'; and 'Creating shelter/cover for pest animals if river frontages are fenced out'.
- There were very few significant relationships between the constraints listed in the survey and implementation of the 20 CRP items. Most of the significant relationships identified related to the CRP item exploring the time spent controlling pest animals and non-crop weeds in the river/creek frontage or adjoining wetlands. Interestingly, in each case, a higher rating for the importance of the constraint was linked to significantly higher implementation of that CRP item. In other words, those more likely to be concerned about the constraint were more likely to be spending time controlling pest animals and non-crop weeds.



Figure 4. Constraints to better management of river frontages.  
Tasmania riparian landholder survey, 2008, N=146.



## Implementation of CRP

The social research team drew on the expertise of our Landscape Logic partners, including practitioners from industry and the regional NRM groups to identify a raft of property management practices expected to lead to improved natural resource management outcomes [Figure 5]. We have labelled these as Currently Recommended Practices (CRP). The 20 CRP items included some that assessed implementation in the last 12 months (7 items), some in the last five years (5) and some over the period of the respondent's management (8). For some items (5), respondents were asked to indicate the amount of work undertaken [Table 32]. For all other items (15), respondents were asked to select from 'Yes', 'No' or 'Not applicable' [Table 33].

Some CRP items included in the survey were relevant to all respondents, but others were only relevant to respondents in particular enterprises or catchments. Where an enterprise or industry "filter" has been applied, this is indicated on the relevant table or figure. Figure 5 includes a summary of the enterprise and catchment filters applied, including to analyses seeking to explain landholder adoption of CRP. Although a summary of implementation for the CRP item 'Established best-practice effluent management system for dairy sheds' is included in Table 33, there was an insufficient number of respondents to include this item in analyses exploring links between CRP implementation and factors expected to influence implementation.

Without baseline data or sound local knowledge, it is very difficult to make assessments about the extent of implementation indicated by data in Tables 32 and 33. Catchment scale data is provided in Appendix, Tables G, H, and I.

### Key survey findings

- Over their management period, most respondents had erected fencing to enhance regeneration of native vegetation; erected fencing to manage stock access to waterways or adjoining wetlands; and established off-stream watering points for stock [Table 32]. Although there is no baseline data in Tasmania, it is possible to compare the Tasmanian findings for the proportion of respondents engaged in erecting fencing to manage stock access with those from the Mid-Goulburn study in Victoria (57% involved in the Mid-Goulburn, 61% in Tasmania). Data presented in Table 32 suggests that for these CRP, most respondents were undertaking substantial amounts of work (as opposed to symbolic work) that could be expected to lead to improved resource condition outcomes. By

comparison, the median of 325 trees and shrubs planted by respondents over the management period suggests that much of the revegetation along waterways or in adjoining wetlands was symbolic [Table 32].

- Almost all dairy farmers who responded to the survey (n= 7) said that during their period of management that they had established best-practice effluent management system for dairy sheds [Table 33].
- More than a third of all respondents said that during their management period they had planted trees and shrubs along the waterway or in adjoining wetlands [Table 32]. Much smaller proportions of respondents said they had removed willows or removed willows and replaced willows with native vegetation [Table 33]. Most respondents to this question had said it was 'Not applicable', suggesting these respondents didn't have willows and/or thought willows should not be removed.
- Just over half of all respondents said they had tested soils for nutrient status where they had applied fertiliser in the past five years [Table 33].
- About a third of respondents with cropping enterprises said they had established permanent grassed waterways in drainage lines in the past five years. At the same time, 28% said they had not implemented the CRP and 41% of respondents said that this CRP was 'Not applicable', suggesting that most respondents might not have drainage lines, their waterways were already grassed, or they were not confident in this CRP [Table 33].
- A large majority of respondents with stock enterprises said they had not sown summer active perennial pastures such as lucerne or phalaris in the past five years or that this CRP was 'Not applicable' [Table 33].
- Most respondents with stock enterprises said that in the past year they had a grazing plan that involves keeping stock out of wet paddocks in winter; and that stock did not graze any part of their frontage or adjoining wetland for more than a week at a time [Table 33].
- A large majority of respondents with cropping enterprises said that in the past year they used minimum tillage practices or sowed cover crops over winter [Table 33].
- Around two-thirds of all respondents said they had spent time controlling pest animals and non-crop weeds in their frontage or adjoining wetlands in the past 12 months [Table 32].

There were significant differences across the six catchments in the proportion of respondents who implemented CRP for six of the 20 items included

in the survey [Appendix, Tables G, H, and I]: native trees and shrubs planted along the waterway or adjoining land during management period; land fenced for natural regeneration of native vegetation during management period; sowed summer active perennial pastures such as lucerne or phalaris in past five years; stock grazed river/creek frontage or adjoining wetlands for more than a week at a time

during 2008; stock accessed drinking water from the river/creek frontage or adjoining wetlands for more than a week at a time in 2008; and applied fertiliser using an accredited spreader in 2008. There was a near significant difference for another CRP item: fencing erected to manage stock access to the waterway or adjoining wetlands during management period [Appendix, Table G].

Table 32. Implementation of selected current recommended practices (CRP). Tasmania riparian landholder survey, 2008, N=146

Topics	n	% responding activity done	Situation at Oct. 2008 (mean)	Situation at Oct. 2008 (median)
<b>Practices undertaken during your management</b>				
Number of native trees and shrubs planted along the waterway or in adjoining wetlands (including direct seeding)	99	38%	763 trees & shrubs	325 trees & shrubs
Area of land fenced for natural regeneration of native vegetation	114	57%	160ha	15ha
Length of fencing erected to manage stock access to the waterway or adjoining wetlands [km]	84	61%	3.4km	2km
Number of off-river/stream watering points established for stock	81	65%	13	6
<b>Practices undertaken this year (2008)</b>				
How much time did you or others spend controlling pest animals and non-crop weeds in your river/creek frontage or adjoining wetlands [number of days worked]?	115	68%	14.5 days	6 days

Note: Only respondents identifying as livestock enterprises in all catchments are included in the Grey shaded n since these CRP pertain to livestock.



Figure 5. Filter applied for analysis of the CRP data. Tasmania riparian landholder survey, 2008, N=146

CRP	Catchments excluded	Enterprises included
<i>Practices undertaken during your management</i>		
Number of native trees and shrubs planted along the waterway or in adjoining wetlands (including direct seeding)	None	All
Area of land fenced for natural regeneration of native vegetation	None	All
Length of fencing erected to manage stock access to the waterway or adjoining wetlands [km]	None	All livestock enterprises (excluded only cropping enterprises)
Number of off-river/stream watering points established for stock	None	All livestock enterprises (excluded only cropping enterprises)
Removed willows	Pet	All
Removed willows and replaced them with native vegetation	Pet	All
Established a best-practice effluent management system for dairy sheds that includes a pond or sump and re-use system	None	Only dairy
<i>Practices undertaken in the last 5 years</i>		
Established permanent grassed waterways in drainage lines	Pet & Quamby Brook	Only cropping enterprises (includes mixed crop and livestock)
Sowed summer active perennial pasture such as lucerne or phalaris	None	All livestock enterprises (excluded only cropping enterprises)
Regularly used mulched rip lines in cropped paddocks	Pet & Quamby Brook	Only cropping enterprises (includes mixed crop and livestock)
Tested soils for nutrient status in paddocks where you have applied fertiliser/soil conditioners in the past	None	All respondents included
Tested the quality of the main water source for stock or irrigation purposes on your property	None	All
<i>Practices undertaken this year (2008)</i>		
Do you have a fertilizer nutrient budget calculated for all/most/some of the farm?	None	All
Do you have a grazing plan that involves keeping stock out of wet paddocks in winter?	None	All livestock enterprises (excluded only cropping enterprises)
Did stock graze any part of your river/creek frontage or adjoining wetlands for more than a week at a time?	None	All livestock enterprises (excluded only cropping enterprises)
Did stock access drinking water from any part of your river/creek frontage or adjoining wetlands for more than a week at a time?	None	All livestock enterprises (excluded only cropping enterprises)
Did you apply fertilizer using an accredited spreader (possibly yourself)?	None	All
Did you crop using minimum tillage practices (maximum of 2 passes) or sow cover crops over winter?	Pet & Quamby Brook	Only cropping enterprises (includes mixed crop and livestock)
Did you sow a ground cover rather than bare fallow?	Pet & Quamby Brook	Only cropping enterprises (includes mixed crop and livestock)
How much time did you or others spend controlling pest animals and non-crop weeds in your river/creek frontage or adjoining wetlands [number of days worked]?	None	All

Table 33. Proportion of respondents implementing CRP. Tasmania riparian landholder survey, 2008, N=146

CRP	n	% Overall Yes	% Overall No	% Overall NA	Land use
<b>Practices undertaken during your management</b>					
Removed willows	112	26%	16%	58%	all
Removed willows and replaced them with native vegetation	110	13%	26%	61%	all
Established a best-practice effluent management system for dairy sheds that includes a pond or sump and re-use system	7	71%	0%	29%	Dairy
<b>Practices undertaken in the last 5 years</b>					
Established permanent grassed waterways in drainage lines	25	31%	28%	41%	croppers
Sowed summer active perennial pasture such as lucerne or phalaris	97	23%	51%	27%	stockers
Regularly used mulched rip lines in cropped paddocks	25	17%	62%	21%	croppers
Tested soils for nutrient status in paddocks where you have applied fertiliser/soil conditioners in the past	130	52%	21%	28%	all
Tested the quality of the main water source for stock or irrigation purposes on your property	130	27%	45%	28%	all
<b>Practices undertaken this year (2008)</b>					
Do you have a fertiliser nutrient budget calculated for all/most/some of the farm?	129	38%	38%	24%	all
Do you have a grazing plan that involves keeping stock out of wet paddocks in winter?	99	58%	26%	16%	stockers
Did stock graze any part of your river/creek frontage or adjoining wetlands for more than a week at a time?	100	38%	52%	10%	stockers
Did stock access drinking water from any part of your river/creek frontage or adjoining wetlands for more than a week at a time?	99	47%	44%	8%	stockers
Did you apply fertiliser using an accredited spreader (possibly yourself)?	132	48%	36%	16%	all
Did you crop using minimum tillage practices (maximum of 2 passes) or sow cover crops over winter?	27	81%	10%	10%	croppers
Did you sow a ground cover rather than bare fallow?	26	43%	47%	10%	croppers

Note: The Pet catchment was removed in Green shaded n due to atypical extensive willow removal and revegetation works for Burnie's water supply. The Pet and Quamby Brook catchments were removed in the yellow shaded n due to insufficient numbers involved in cropping land use.

## Factors linked to landholder implementation of CRP

The survey included 20 items to explore CRP implementation. The overlapping survey items sought information for the period of the landholder's management of their property, during the last five years and during 2008. A large number of the other variables included in the survey were identified as having statistically significant relationships with CRP implementation. In this section of the report we provide a summary of those factors where there appears to be a sensible explanation for such a relationship. A discussion of the implications of these findings for engaging landholders in practice change to achieve NRM outcomes is provided in the conclusions section of the report.

As explained briefly in the section on research methods, efforts to improve NRM outcomes can focus on changing specific practices or the mix of on-property enterprises. In a widely cited synthesis paper, Pannell *et al.* (2006) concluded that landholders readily adopt conservation practices that are consistent with them achieving their goals/objectives. They also noted that a large number of factors can influence adoption and that these factors vary from one technology to another, from one person to another, from one social context to another and over time. Drawing on their backgrounds in economics, psychology and sociology and extensive research experience, these authors proposed a framework for exploring adoption that has four broad sets of factors. This framework and examples of specific factors are as follows:

1. the nature of the practice, including its trialability; observability; complexity and extent of re-skilling; extent it fits with existing farming systems and lifestyle; cost and time for returns to accrue; and whether it is a substantial improvement on what already exists;
2. the personal characteristics of the landholder and their immediate family; including education levels; knowledge; skills; length of experience in area/as a farmer; extent they are risk takers; whether they are introverts/extroverts; level of income; stage of life; if there is to be farm family succession; and extent of their personal network;
3. the wider social context of the landholder, including prevailing norms; information flows through networks; the existence and activities of local organisations; and the level of trust in extension agents; and
4. the nature of any intervention/learning process, such as a regulation; market-based instrument; grant program; and group processes.

Drawing on this framework and given the constraints of a mailed survey, we identified a limited

number of topics likely to explain differences in the level of adoption of CRP to be included in the survey. These topics were:

- values attached to river frontages;
- the extent of a stewardship ethic (one item of a previously published scale);
- assessment of river frontage condition;
- knowledge of river frontage function and factors affecting river frontage condition;
- attitudes about roles and responsibilities of key stakeholders in waterway management;
- occupation;
- absentee or resident owner;
- confidence in CRP;
- involvement in a short course related to property management;
- constraints to better management;
- extent of property and succession planning;
- Landcare membership;
- long-term plans for the property, including disposal or acquisition of land through sale, subdivision or leasing;
- on and off-property work (available time);
- enterprise mix;
- age (stage of life); and
- gender.

Our approach to data analysis has been explained in the methodology section above. It is important to note that we used a range of methodologies in a pairwise fashion to explore relationships between factors expected to influence the adoption of CRP. We have provided a summary of these analyses in the section below. Each of the 20 CRP listed is linked with the range of variables where there is a significant positive link to implementation of that CRP. Please note that in our discussions, we have focused on identifying significant relationships using multiple regression. A synthesis of the information presented below and the key findings from the interviews is provided in the conclusions section that follows.

### **Practices undertaken during your management**

#### **1. Planted native trees and shrubs along a waterway or in adjoining wetlands (including direct seeding)**

*Practices undertaken during your management*

- Higher self-assessed knowledge of the ability of perennial vegetation to prevent water tables rising
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of the role of perennial vegetation in river/creek frontages and

adjoining wetlands in removing nutrients from water running off paddocks

- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Higher self-assessed knowledge of how to access information about government support
- Confidence that the time and expense involved in watering stock off-stream is justified by improvements in water quality
- Confidence that areas of native vegetation along waterways with limited stock access are able to trap nutrients before they enter waterways
- Received support from government NRM programs in past five years
- Member of a Landcare group
- More hours of on-property work
- Intend to expand or introduce irrigation
- Have a property management or whole farm plan
- Family has agreed to a property succession plan
- Currently irrigating at least some of their property.

## 2. *Area of land fenced for natural regeneration of native vegetation*

*Practices undertaken during your management*

- The property has been in their family for longer periods of time
- Identifying as a farmer by occupation
- Landcare membership
- Previous Landcare member
- Membership of a local commodity group
- Employed a consultant to provide advice about property management during the past year
- Reporting an on-property profit
- Reporting a higher level of on-property profitability
- Part of their frontage was a Crown Land reserve
- Involvement in property management or whole farm planning



*Willows on the Flowerdale River. (Photo: R. Sample).*

- Property management plan was completed or in the last five years
- Completed a short course relevant to property management during the past five years
- Family has agreed to a property succession plan
- Involvement in local area planning
- Received support from government NRM programs in past five years
- Currently irrigating at least some of their property
- Larger property size
- Owned/managed longer length of river/creek frontage.

## 3. *Fencing rivers/streams/wetlands to manage stock access*

*Practices undertaken during your management*

- Values frontage/adjoining wetlands for providing important shade and shelter for stock
- Believe that vegetation on the frontage helps to hold the banks and stop erosion
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of the role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks
- Identifying as a farmer by occupation
- Have a property management or whole-farm plan
- Family has agreed to a property succession plan
- Currently irrigating at least some of their property.

## 4. *Establishing off-river/stream watering points during your management*

*Practices undertaken during your management*

- Values the frontage/adjoining wetlands for adding to the market value of the property
- Values the frontage/adjoining wetlands for providing important shade and shelter for stock
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of the role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks
- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Higher self-assessed knowledge of preparing a property plan that allocates land use according to different land classes
- Confident that allowing limited productive use of river/creek frontages such as crash grazing or farm forestry is an acceptable way to manage these areas

- Confident that intensive grazing of river/creek frontages for short periods of time is better than set stocking for retaining native vegetation
- A higher level of on-property profitability
- Reporting a higher level of on-property profitability
- Have employed a consultant to provide advice on property management during the past year
- Plan to purchase, lease or share farm additional land
- Does not plan to seek additional off-property work
- Plan to keep the property in the family (future)
- Have a property management or whole farm plan
- Family has agreed to a property succession plan
- Currently irrigating at least some of their property.

#### 5. **Removed willows**

*Practices undertaken during your management*

- Agree that it is a balance between water for the environment, agriculture, town water supply and recreation
- Values the frontage/adjoining wetlands for providing important shade and shelter for stock
- Confident that removing willows helps to improve the water quality in rivers/creeks
- Don't plan to sell the property
- Involvement in local area planning
- Part of river/creek frontage is not under a Crown Land reserve.

#### 6. **Removed willows and replaced them with native vegetation**

*Practices undertaken during your management*

- Values the frontage/adjoining wetlands because vegetation on the banks helps to stop erosion
- Values the frontage/adjoining wetlands because it provides habitat for native birds and animals
- Values the frontage/adjoining wetlands because woody matter such as snags offer protection for fish and other animals that live in the river/creek
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Not a Landcare group member
- Intend to lease or share farm all or most of the property (future).

#### 7. **Established a best-practice effluent management system for dairy sheds that includes a pond or sump and re-use system**

*Practices undertaken during your management*

- There are an insufficient number of respondents who said they had implemented this practice for this type of analysis to occur.



*Upper Coal River at Coalbrook – willows, blackberries and no riparian fencing. (Photo: R. Sample.)*

### **Practices undertaken in last 5 years**

#### 8. **Established permanent grassed waterways in drainage lines**

*Practices undertaken in last 5 years*

- Future plans do not include leasing or share farming all or most of the property.

#### 9. **Sowed summer active perennial pasture such as lucerne or phalaris**

*Practices undertaken in last 5 years*

- Concerned about the impact of changing rainfall patterns on property viability
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of the role of stubble retention and stubble mulching in preventing the loss of nutrients from farms
- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Not a membership of a local commodity group
- Not employed a consultant to provide advice about property management during the past year
- Not completed a short course relevant to property management during the past five years
- Lived in the local district a longer period of time
- Have a property management or whole farm plan (but not if it was updated in past 5 years)
- Family agreed to a property succession plan
- Involvement in local area planning
- Larger property size
- Longer distance that a river/creek runs along/through the property.



### **10. Regularly used mulched rip lines in cropped paddocks**

*Practices undertaken in last 5 years*

- Do not have an updated whole farm plan that was completed or updated more than five years ago.

### **11. Tested soils for nutrient status in paddocks where you have applied fertiliser/soil conditioners in the past**

*Practices undertaken in last 5 years*

- Concerned about salinity undermining long-term productive capacity of property
- Wants the right to use surface or ground water for irrigation
- Relies on the river for irrigation water
- Values the frontage and adjoining wetlands because they add to the market value of the property
- Does not think that governments must take more responsibility for ensuring landholders meet their responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)
- Higher self-assessed knowledge of the proportion of nutrients entering water courses that is from paddocks on dairy farms rather than dairy sheds
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of how to interpret soil tests as a way of checking the application of nutrients on paddocks
- Higher self-assessed knowledge of the role of stubble retention and stubble mulching in preventing the loss of nutrients from farms
- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property
- Higher self-assessed knowledge of how to prepare a property plan that allocates land use according to different land classes
- Knows how to access information about government support
- Higher self-assessed knowledge of the elements of water quality critical for public health
- Confident that soil testing to guide nutrient applications is critical to ensure that excessive nutrients are not applied to farmland
- Not a membership of a local commodity group
- Not previously a Landcare member
- Have not employed a consultant to provide advice about property management during the past year

- Plans to purchase, lease or share farm additional land
- Works longer hours on-property each week
- Does not plan to seek additional off-property work
- Plans to expand or introduce irrigation
- Prepared a property management or whole farm plan (and completed it in past 5 years)
- Completed a short course relevant to property management during the past five years
- Family agreed to a property succession plan
- Involvement in local area planning
- Larger property size
- Longer distance that a river/creek runs along/through the property
- Currently irrigating at least some of their property.

### **12. Tested the quality of the main water source for stock or irrigation purposes on your property**

*Practices undertaken in last 5 years*

- Concerned that salinity is undermining long-term productive capacity of the property
- Concerned that salinity is threatening water quality in rivers/streams/wetlands in the district
- Higher self-assessed knowledge of responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)
- Higher self-assessed knowledge of how to interpret soil tests as a way of checking the application of nutrients
- Higher self-assessed knowledge of the role of stubble retention and stubble mulching in preventing the loss of nutrients from farms
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property



*Meander River at Baretts Bridge. (Photo: NRM North.)*

- Higher self-assessed knowledge of how to prepare a property plan that allocates land use according to different land classes
- Higher self-assessed knowledge of the elements of water quality critical for public health
- Higher self-assessed knowledge of the ability of perennial vegetation to prevent water tables rising
- Higher self-assessed knowledge of how to access information about government support for landholders
- Confident that soil testing to guide nutrient applications is critical to ensure that excessive nutrients are not applied to farmland
- Not a member of a local commodity group
- Not previously a Landcare member
- Not employed a consultant to provide advice about on-property management during the past year
- Identifying as a farmer by occupation
- Work longer hours per week on-property
- Intend to expand or introduce irrigation
- Prepared a property management or whole farm plan
- Completed a short course relevant to property management during the past five years
- Family agreed to a property succession plan
- Involved in local area planning
- Currently irrigating at least some of their property.

### **Practices undertaken this year (2008)**

#### **13. Have a fertiliser nutrient budget calculated for all/most/some of the farm**

*Practices undertaken this year (2008)*

- Concerned about the cost of managing weeds and pest animals affecting property profitability
- Concerned that the rising cost of farming inputs is undermining property financial viability
- Wants the right to use surface or ground water for irrigation
- Concerned that State/local government planning rules will limit their ability to subdivide the property
- Concerned about the new chemical spray regulations for riparian and adjoining areas
- Higher self-assessed knowledge of the proportion of nutrients entering water courses that is from dairy paddocks rather than dairy sheds
- Higher self-assessed knowledge of responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)
- Higher self-assessed knowledge of the effects that soil pugging by stock has on soil erosion

and nutrient loss from farms

- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of how to interpret soil tests as a way of checking the application of nutrients
- Higher self-assessed knowledge of the role of stubble retention and stubble mulching in preventing the loss of nutrients from farms
- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property
- Higher self-assessed knowledge of preparing a property plan that allocates land use according to different land classes
- Higher self-assessed knowledge of the elements of water quality critical for public health
- Confident that allowing limited productive use of river/creek frontages such as crash grazing or farm forestry is an acceptable way to manage these areas
- Plan to purchase, lease or share farm additional land
- Plan to expand or introduce irrigation)
- Plan to retain property ownership within the family
- Family agreed to a property succession plan
- Male
- Work longer hours on-property
- Longer distance that a river/creek runs along/through the property
- Not currently irrigating at least some of their property
- Not employed a consultant to provide advice about property management during the past year.

#### **14. Have a grazing plan that involves keeping stock out of wet paddocks in winter?**

*Practices undertaken this year (2008)*

- Concerned about the effects of increased ground and surface water extraction
- Concerned about the impact of recent and future clearing of native bush and grasslands
- Holding a stewardship ethic (by agreeing that reduced production in the short-term is justified where there are long-term benefits to the environment)
- Supporting for a duty of care for biodiversity (by agreeing that landholders should expect to be legally responsible for managing their land in ways that do not cause foreseeable harm to the environment)



*CRP riparian revegetation on the Macquarie River.  
(Photo: R. Sample.)*

- Higher self-assessed knowledge of the effects that soil pugging by stock has on soil erosion and nutrient loss from farms
- Higher self-assessed knowledge of the ability of perennial vegetation to prevent water tables rising
- Higher self-assessed knowledge of responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)
- Higher self-assessed knowledge of the main sources of nitrogen that enter district waterways
- Higher self-assessed knowledge of the role of perennial vegetation in river/creek frontages and adjoining wetlands in removing nutrients from water running off paddocks
- Higher self-assessed knowledge of the relative contribution of different sources of phosphorus to water nutrient levels
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property
- Higher self-assessed knowledge of preparing a property plan that allocates land use according to different land classes
- Higher self-assessed knowledge of how to access information about government support for landholders to manage frontages and adjoining wetlands
- Higher self-assessed knowledge of the elements of water quality critical for public health
- Family agreed to a property succession plan
- Plan to live on the property for as long as possible
- Not currently irrigating at least some of their property.

**15. Stock only able to graze any part of the river/ creek frontage or adjoining wetlands for less than a week at a time in 2008**

*Practices undertaken this year (2008)*

- Less concerned about the rising cost of farming inputs undermining financial viability of property
- Less concerned about new chemical spray regulations for riparian and adjoining areas
- Doesn't value the frontage or adjoining wetlands because they provides additional land for grazing stock, particularly in summer
- Doesn't value the frontage or adjoining wetlands because they provide access to water for stock
- Doesn't value the frontage or adjoining wetlands because they add to the market value of the property
- Not confident that the time and expense involved in watering stock off-stream is justified by improvements in river/creek water quality
- Not been involved in local action planning
- Member of Landcare
- Member of a local commodity group
- More hours of off-property work
- Smaller property size
- Shorter length of distance that a river/creek runs through property.

**16. Stock only able to access drinking water from any part of the river/creek frontage or adjoining wetlands for less than a week at a time in 2008.**

*Practices undertaken this year (2008)*

- Less concerned about new chemical spray regulations for riparian and adjoining areas
- Doesn't value the frontage or adjoining wetlands because they provide access to water for stock
- Thinks the water in the river/creek running through their property is in good condition
- Confidence that areas of native vegetation along waterways with limited stock access are able to trap nutrients before they enter waterways
- Doesn't plan to change the enterprise mix to reduce their future workload
- Not been involved in local action planning
- Member of a Landcare group
- More hours of off-property work
- Shorter length of ownership or management of the property
- Smaller property size
- Younger age

**17. Apply fertiliser using an accredited spreader (possibly yourself).**

*Practices undertaken this year (2008)*

- Concerned about the cost of managing weeds and pest animals affecting property profitability
- Not concerned about declining water quality threatening native animals
- Not concerned about nutrient and chemical run-off affecting water quality in rivers/streams
- Concerned that uncertain/low returns is limiting capacity to invest in their property
- Concerned that the rising cost of farming inputs is undermining financial viability
- Concerned about the new chemical spray regulations for riparian and adjoining areas
- Relies on the river for irrigation water
- Does not value the frontage or adjoining wetlands as a habitat corridor
- Higher self-assessed knowledge of the effects that soil pugging by stock has on soil erosion and nutrient loss from farms
- Higher self-assessed knowledge of the role of stubble retention and stubble mulching in preventing the loss of nutrients from farms
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property
- Higher self-assessed knowledge of how to prepare a property management plan that allocates land use according to different land classes
- Does not agree that the public should have right of access to frontages that are managed by private landholders
- Male
- Plans to purchase, lease or share-farm additional land
- Plans to change enterprise mix to reduce farm workload
- Plans to introduce/expand irrigation on their property
- More on-property work
- Family agreed to property succession plan
- Not a member of a Landcare group
- More time in on-property work

- Have not prepared a property management or whole farm plan in the last 5 years
- Larger property size.

**18. Crop using minimum tillage practices (maximum of 2 passes) or sow cover crops over winter. Practices undertaken this year (2008)**

- Not concerned about the long-term community impacts of plantation forestry
- Higher self-assessed knowledge of the effects that soil pugging by stock has on soil erosion and nutrient loss from farms
- Higher level of off-property income for you and your partner
- Family agreed to a property succession plan
- Larger property size

**19. Sow a ground cover rather than bare fallow.**

*Practices undertaken this year (2008)*

- Wants the right to use surface or ground water for irrigation
- Higher self-assessed knowledge of the fertiliser applications required for optimum production across the main enterprises on your property
- Has a family members interested in taking on the property in the future.

**20. Controlling pest animals and non-crop weeds in river/creek frontage or adjoining wetlands.**

*Practices undertaken this year (2008)*

- Concerned that the cost of managing weeds and pest animals affecting property profitability
- Concerned that the rising cost of farming inputs is undermining financial viability
- Higher self-assessed knowledge of responsibilities under the EMPCA (*Environment Management and Pollution Control Act 1994*)
- Plans to subdivide and sell part of the property
- Prepared a property management or whole farm plan (and completed the plan in the past five years)
- Larger property size
- Part of river/creek frontage is under a Crown Land reserve.

# Conclusions

## Introduction

This research project aimed to enhance understanding of:

1. the extent landholders with riparian areas are implementing practices expected to lead to improved water quality outcomes in the six catchments;
2. landholder knowledge and understanding of the assumed links between these practices and resource condition outcomes in the six catchments; and
3. the factors influencing landholder implementation of practices expected to lead to improved water quality outcomes in the six catchments.

In this section of the report we have used these topics to provide the structure for a synthesis of the key research findings and a discussion of their implications for Landscape Logic's regional and state-based NRM practitioner partners.

## Implementation of Current Recommended Practices

The survey included 20 items to explore CRP implementation. These items sought information about work undertaken during the period of the landholder's management of their property, the last five years and during 2008. Over their management period, most survey respondents had erected fencing to enhance regeneration of native vegetation; erected fencing to manage stock access to waterways or adjoining wetlands; and established off-stream watering points for stock. These data suggest that for these CRP, most respondents were undertaking substantial amounts of work (as opposed to symbolic work) that could be expected to lead to improved resource condition outcomes. Around two-thirds of all respondents had spent time controlling pest animals and non-crop weeds in their frontage or adjoining wetlands in the past 12 months.

More than a third of all survey respondents had planted trees and shrubs along the waterway or in adjoining wetlands during their management period. However, much of the revegetation work along waterways or in adjoining wetlands was of a small scale. Small proportions of respondents said they had removed willows or removed willows and replaced willows with native vegetation. Most respondents to this question had said it was 'Not applicable', suggesting these respondents didn't have willows and/or thought willows should not be removed.

Just over half of all survey respondents said they had tested soils for nutrient status where they had

applied fertiliser in the past five years. About a third of respondents with cropping enterprises said they had established permanent grassed waterways in drainage lines in the past five years. A large majority of respondents with cropping enterprises said that in the past year they used minimum tillage practices or sowed cover crops over winter.

Most survey respondents with stock enterprises said that in the past year they had a grazing plan that involves keeping stock out of wet paddocks in winter; and that stock did not graze any part of their frontage or adjoining wetland. Most respondents with stock enterprises had not sown summer active perennial pastures such as lucerne or phalaris in the past five years or said that this CRP was 'Not applicable'.

## Landholder knowledge of NRM topics

Each survey respondent was asked to rate their level of knowledge for 13 topics exploring knowledge of processes that contribute to land and water degradation; management practices thought to enhance water quality outcomes; landholder's legal responsibilities; and how to access NRM information. A key finding was that only a very small proportions of respondents (<30%) rated their knowledge as sound for each item included in the survey. There were significant differences across the six catchments for six of the 13 knowledge items in the survey.

There was a significant positive relationship between each knowledge topic included in the survey and a related CRP. This is a key finding, suggesting that knowledge is a powerful influence on landholder behaviour. For example, higher self-reported knowledge of the relative contribution of different sources of phosphorous to water nutrient levels was linked to higher implementation of seven CRP, including: establishing off-river/stream watering points for stock; testing soils for nutrient status in paddocks where fertilisers have been applied; and having a fertiliser budget for all/most of the farm. These research findings suggest that there is scope to improve knowledge/understanding of key NRM topics and that investment in activities that will accomplish this can be expected to lead to practice change.

## Factors influencing implementation of CRP

Many interviewees reported that the difficult business context, coupled with continuing dry conditions, had left Tasmanian farmers with little financial reserves for investing in on-ground NRM work.

Several interviewees said that they had deferred their NRM activity until conditions (business and climatic) improved. The subdued outlook for returns to wool producers was also contributing to reduced optimism amongst some farmers. Indeed, only 37% of our survey respondents said they made an on-property, net profit in the 2006–07 financial year. For those reporting a profit, the median profit level was \$15,000. The median on-property profit varied from \$5,000 in the Coal, Macquarie and Quamby Brook catchments, \$15,000 in Inglis– Flowerdale and \$35,000 in the Pet and Jordan catchments. Research suggests that landholders are more likely to spend on-property income rather than off-property income to implement CRP. The median off-property income before tax for the respondent and their partner of \$45,000 was three times the median on-property profit of \$15,000, suggesting that off-property incomes are higher than on-property incomes for most respondents. The latter finding is not surprising given that most respondents were non-farmers by occupation.

The low level of on-property profitability and income suggests that landholders in the six catchments have limited capacity to invest in CRP, especially those with high public benefits. In this study, there was a significant positive relationship between on-property profitability and two CRP implemented during the period of property management: land fenced for natural regeneration of native vegetation; and establishing off-stream watering points for stock. Every landholder interviewed said that all CRP implemented in their riparian area had been undertaken with financial and/or logistical support from a locally coordinated project (e.g. via Landcare, local government, or NGO). Overall, 23% of respondents said they had received support through federal or state NRM programs and the regional NRM organisations in the past five years. This finding is the same as for the question employed in the Goulburn Broken survey of river frontage owners in that Victorian catchment in 2007. With the exception of the Quamby Brook catchment (7%), there was a remarkable consistency in the proportion of landholders reporting they had received government assistance. Receiving support through federal or state NRM programs and the regional NRM organisations in the past five years was significantly linked to implementation of two CRP items. In both cases, there was a significant positive relationship: trees and shrubs planted along the waterway/wetlands during the period of management; and land fenced for natural regeneration of native vegetation.

Apart from occupation, a large number of the other variables included in the survey were identified as having statistically significant relationships

with CRP implementation. For example, the following were all positively linked to CRP implementation: awareness of some issues in the survey; a high level of knowledge of all the NRM topics in the survey; participation in Landcare; completion of a short course related to property management; involvement in property planning; higher levels of confidence in CRP; and involvement in succession planning. Landholder involvement in planning processes was one of the best predictors of implementation of the CRP items included in the survey. For example, there was a significant positive relationship between involvement in property management planning and implementation of eight CRP items; involvement in succession planning and 11 CRP items; and involvement in local action planning and six CRP items. These findings provide strong evidence that NRM program investments in activities that build/engage social and human capital will lead to implementation of CRP. The findings in this study therefore affirm the value of many existing NRM policy instruments, and suggest ways of enhancing NRM outcomes in future. For example, 21% of survey respondents said they had completed a relevant short course in the past five years and participation varied significantly across the six catchments. Only 22% of respondents said they were a member or involved with a local Landcare group and participation also varied significantly across the six catchments. By comparison, around 40% of rural properties have a Landcare participant across Victoria. Many landholders and other stakeholders interviewed reported that the momentum underpinning Landcare had waned over recent years, notably since the conclusion of NHT2. Indeed, there appears to have been a high rate of attrition amongst Landcare participants, with 16% of survey respondents indicating they were no longer a Landcare member.

A key finding from this study is that NRM organisations have focussed most of their efforts to engage landholders in river/creek management on farmers and ignored the larger cohort (61%) of non-farmers. For example, 42% of farmer respondents compared to 11% of non-farmers said that in the last five years federal or state government programs or the regional NRM organisation had supported work on their river/creek frontage or adjoining wetlands. There were similar differences in proportions of farmers and non-farmers participating in Landcare; and farmers were significantly more likely to be involved in property management planning. Farmers in this study owned larger properties and generally managed longer river/creek frontages (median 2km compared to 500m). However, with the exception of the Macquarie catchment, where properties are very large and most landholders are farmers, non-

farmers in this study owned between 40% and 68% of the length of all frontages. In the Coal, Quamby Brook and Pet catchments, non-farmers owned most of the river/creek frontage. It seems that NRM practitioners need to do something different if they wish to engage the non-farmer cohort. Survey findings about the issues of concern; values attached to river frontages and adjoining wetlands; attitudes about NRM roles and responsibilities; and knowledge of NRM should all provide NRM practitioners with considerable insight into how they might do this.

Farming as an occupation, larger property size, succession planning and the extent of on-property work are intertwined and all were linked to significantly higher implementation of CRP. However, the suite of CRP for riparian areas is inconsistent with many farmers' views about 'best practice' farming. For example, most survey respondents agreed that managing stock access was important in maintaining water quality. However, around 40% of respondents were concerned about the potential for increased pest plants; the difficulty/cost of changing watering points for stock; creating shelter/cover for pest animals; and flood events affecting fencing. These concerns suggest it will be difficult to engage the 39% of respondents who said they had not fenced to manage stock access to the waterway or adjoining wetlands during their management period.

Many farmers are also reluctant to accept generic state-wide prescriptions for managing their riparian areas. For example, fencing riparian areas to manage stock access was considered impractical in high rainfall catchments where there were frequent floods. Nevertheless, many farmers have implemented CRP, particularly CRP thought to assist their property management. CRP thought to have observable on-farm benefits, included:

- strategies to optimise on-farm nutrient application and management (to maximise the returns from nutrient inputs);
- fencing out steep river banks to manage stock access (to minimise injury to livestock);
- removing willows (to reduce the risk of flooding and improve access to manage pest plants and animals); and
- installing off-stream water points for livestock (to improve livestock health/management).

Landholder acceptance of these CRP suggests that more effort is needed, including through research with landholders, to identify practical, low-cost CRP that are likely to lead to long-term commitment to ongoing, active management of riparian areas. An important step might be to abandon the idea of pre-1788 resource condition targets in favour of "improved" resource condition targets. That is, develop CRP that are likely to lead to improved

resource condition, but can be approached in steps that can be developed and negotiated over time. For example, in riparian areas where floods damage fences, rather than fencing riparian corridors and excluding stock, a practical alternative might involve establishing riparian paddocks, providing off-stream watering points and rocking areas where stock cross the waterway. Negotiations with the landholder would include discussions about the size of the paddock and the timing and extent of grazing. Monitoring of resource condition trends would be part of a comprehensive evaluation of a pilot project.

Survey data suggest the populations in the six catchments are relatively stable in that most respondents had lived in their district for long periods of time (median 30 years) and owned/managed their property for a considerable period (median 20 years). Over a quarter (27%) of all respondents said their rural property was not their principal place of residence. This finding is consistent with, although slightly higher than the level of absentee ownership identified in recent studies in Victoria. In this study there were very few significant relationships between CRP implementation and the length of property ownership, the length of residence in the local district and residency status.

Survey respondents' short- and long-term plans were very consistent across the six Tasmanian catchments. At least two-thirds said they would live on their property for as long as possible. However, a similar proportion said they were likely to subdivide and sell part of the property in the next five years. Only 12.5% of Victorian farmers continued to work on-property past the official Australian retirement age for men of 65 years (Australian Bureau of Statistics 2007). The median age for farmers in this study was 52 years, suggesting that most will retire from farming in the next decade.

These findings suggest that while these catchments have had very stable rural landholder populations, we can expect a high level of turnover in property ownership in the next decade and that in most cases, the new owners will not be members of the current owner's family. Again, the level and nature of turnover will provide challenges, and potentially, opportunities for NRM practitioners.

There was a number of significant relationships between survey items exploring short and long-term plans and implementation of CRP, suggesting that landholder plans are a useful predictor of their management. Interestingly, those who planned to expand their property size were more likely to have implemented four CRP: planted trees and shrubs during the period of management; tested soils for nutrient status in paddocks where fertiliser has

been applied; had a fertiliser nutrient budget for all/most of the farm; and applied fertiliser using an accredited spreader. On the other hand, there was some evidence that those who planned to sell, lease or share farm, or seek additional off-property work, were significantly less likely to implement some CRP. For example, those who said that in the short-term their property will be sold were significantly less likely to have removed willow.

A small majority of survey respondents said they were likely to change their enterprise mix to more intensive enterprises. This interest in intensifying

land use is a little surprising given that most landholders are approaching the minimum age to access superannuation and at least half are within 10 years of the official retirement age for men. Interest in more intensive enterprises may be a reflection of the cost-price pressures on primary producers, opportunities afforded by centre-pivot irrigation technologies or emerging cropping opportunities. The likelihood that many landholders will move to more intensive agriculture systems is likely to pose challenges for those responsible for improving water quality.



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## Appendix

Table A: Importance of issues at the district issues in the six catchments  
Tasmania riparian landholder survey, 2008, N=146

Issue		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis Flowerdale	p value
The impact of recent and future clearing of native bush and grasslands	n	18	20	21	27	17	33	0.0017
	Important %	56%	55%	33%	70%	29%	52%	
	median	4	4	3	5	2	4	
Tree dieback	n	18	20	21	27	17	33	0.0027
	Important %	61%	70%	86%	67%	24%	33%	
	median	4	5	4.5	4	3	3	
Nutrient and chemical run-off affecting water quality in rivers/streams/wetlands	n	18	20	21	27	17	33	0.0044
	Important %	44%	70%	52%	74%	35%	58%	
	median	4	4	4	5	3	4	
The long-term community impacts of plantation forestry	n	19	20	21	27	16	33	0.0469
	Important %	63%	60%	52%	89%	56%	67%	
	median	4.5	5	4	5	4	5	
Declining water quality in rivers/streams affecting estuarine health	n	18	20	21	27	17	33	0.0576
	Important %	72%	65%	67%	74%	41%	48%	
	median	5.5	4	4	5	3	3.5	
The effects of increased ground and surface water extraction	n	18	20	21	27	17	33	0.1487
	Important %	56%	55%	38%	70%	24%	45%	
	median	4	4	3	4	3	3	
Declining water quality threatening native animals, such as the platypus, freshwater lobster, frogs, Burrowing Crayfish	n	18	20	21	27	17	33	0.3139
	Important %	56%	65%	67%	74%	47%	61%	
	median	4	5	4	5	4	4	
Getting the balance between water for the environment, agriculture, town water supply and recreation	n	19	20	21	27	17	33	0.3176
	Important %	53%	65%	81%	81%	59%	67%	
	median	4	5	5	5	4	4	
Loss of native vegetation along water courses	n	18	20	21	27	17	33	0.5157
	Important %	56%	55%	57%	63%	29%	61%	
	median	4	4	4	4	2	4	
Increasing land prices constraining opportunities for farmers to expand their properties	n	18	20	21	27	17	33	0.5411
	Important %	67%	55%	33%	56%	47%	52%	
	median	4	4	3	4	4	4	
Soil erosion from farmland affecting water quality	n	18	20	21	27	17	33	0.5699
	Important %	50%	45%	57%	70%	35%	55%	
	median	4	4	4	4	3	4	
Salinity threatening water quality in rivers/streams/wetlands	n	19	20	21	27	17	33	0.5769
	Important %	53%	55%	52%	56%	24%	42%	
	median	4	4	4	4	3	4	
Sediment loads entering the local estuary	n	18	20	21	27	17	33	0.6886
	Important %	44%	50%	33%	59%	35%	48%	
	median	4	4	3	4.5	3	4	

Note: Topics are ranked in order of the degree of significant difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Median Score where 1 = not important through to 5 = very important.

Table B: Importance of issues at property scale in the six catchments  
Tasmania riparian landholder survey, 2008, N=146

Issue		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Impact of changing rainfall patterns on property viability	n	21	20	21	27	16	33	0.0001
	Important %	90%	85%	95%	63%	38%	45%	
	median	4.5	5	5	4	3	4	
Uncertain/low returns limiting capacity to investment in property	n	17	20	21	26	17	33	0.0028
	Important %	53%	50%	67%	35%	41%	27%	
	median	4	4	4.5	3	3	3	
New chemical spray regulations for riparian and adjoining areas	n	19	20	21	27	17	33	0.0334
	Important %	47%	30%	57%	52%	12%	58%	
	median	4	3	4	4	2	4	
Availability of labour for important on-property work	n	19	20	21	27	17	33	0.0900
	Important %	16%	25%	62%	11%	18%	27%	
	median	2.5	3	4	2.5	2	2.5	
Salinity undermining long-term productive capacity	n	19	20	21	27	17	33	0.0917
	Important %	26%	25%	33%	7%	6%	9%	
	median	3	2	2	2	1	2	
State/local government planning rules limiting your ability to subdivide	n	19	20	21	26	17	33	0.1711
	Important %	42%	40%	10%	54%	41%	48%	
	median	4	3	2	4	3	4	
Declining soil health (e.g. declining fertility or structure)	n	19	20	21	26	16	33	0.2331
	Important %	26%	30%	43%	27%	13%	33%	
	median	2	3	3	3	2	3	
The cost of managing weeds and pest animals affecting profitability	n	19	20	21	26	17	33	0.5927
	Important %	47%	35%	62%	62%	53%	45%	
	median	4	3	4	4	4	4	
Rising cost of farming inputs undermining financial viability	n	21	20	21	26	17	33	0.6801
	Important %	67%	70%	86%	46%	47%	55%	
	median	4	4	5	4.5	4	5	
Having the right to use surface or ground water for irrigation	n	19	20	21	27	17	33	0.7232
	Important %	63%	75%	67%	63%	47%	64%	
	median	4	5	4	4	4	4	

Note: Topics are ranked in order of the degree of significant difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Median Score where 1 = not important through to 5 = very important.

Table C: Values landholders attached to river/creek frontage and adjoining wetlands in the six catchments  
Tasmanian riparian landholder survey, 2008, N=146

Values		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
I rely on the river for irrigation water	n	20	18	20	26	17	32	0.0418
	mean	3.25	4.00	4.36	2.15	4.00	3.30	
Is a habitat corridor (allowing wildlife to move between areas)	n	20	18	21	26	17	32	0.0596
	mean	2.82	4.67	3.39	3.50	2.88	3.62	
Provides woody matter such as snags that offer protection for fish and other animals that live in the river/creek	n	19	18	20	26	17	32	0.0955
	mean	2.82	2.78	3.11	3.67	3.38	3.93	
Provides access to water for stock	n	20	18	20	26	17	32	0.1295
	mean	3.85	4.10	4.10	3.72	3.73	2.88	
Provides important shade and shelter for stock	n	19	18	20	26	17	32	0.1556
	mean	2.92	3.17	2.88	2.69	3.83	2.57	
Vegetation on the frontage helps hold the banks and stop erosion	n	20	18	21	26	17	32	0.1995
	mean	3.38	3.78	3.74	4.08	3.76	4.13	
Provides additional land for grazing stock, particularly in summer	n	20	18	20	26	17	32	0.2128
	mean	2.27	2.88	3.38	2.33	2.82	2.56	
Reduced production in the short-term is justified where there are long-term benefits to the environment	n	20	21	21	27	16	32	0.2562
	mean	3.68	3.50	3.71	3.92	3.31	3.97	
Adds to the market value of the property	n	19	18	20	26	17	32	0.2671
	mean	3.00	3.50	4.05	3.58	3.69	3.45	
Is an attractive area of the property	n	19	18	21	27	17	31	0.4092
	mean	3.44	3.09	3.70	3.89	3.67	3.90	
Provides a place for recreation for me, my family and friends	n	19	18	20	26	17	32	0.4837
	mean	2.67	3.00	2.65	2.83	2.40	3.22	
Provides a source of nutrients for in-stream plants and animals	n	19	18	19	26	17	32	0.6411
	mean	2.93	3.45	3.47	3.70	34.12	3.50	
In-stream vegetation traps and stabilises sand/gravel	n	20	18	20	26	17	31	0.7527
	mean	2.88	3.60	3.06	3.22	3.07	3.42	
Provides habitat for native birds and animals	n	20	18	21	26	17	32	0.8218
	mean	3.83	3.92	3.76	4.00	3.82	4.10	
Acts as a filter catching sediment and/or nutrients before they reach the river	n	19	18	20	25	17	31	0.8925
	mean	2.82	2.88	3.33	3.25	2.92	3.15	
Provides timber for firewood and fence posts	n	19	19	19	27	17	32	0.9514
	mean	2.40	2.50	2.29	2.21	2.00	2.00	

Note: Topics are ranked in order of the degree of significant difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Mean score where 1 = not important and 5 = very important. Shaded value is the stewardship value.

Table D: Landholders' short and long-term property plans in the six catchments  
Tasmania riparian landholder survey, 2008, N=146

Long-term plans		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
The property will be sold	n	15	16	18	23	15	27	0.1867
	mean	2.00	2.46	2.00	2.10	2.18	1.50	
The property will be subdivided and part of the property sold	n	15	18	18	23	15	27	0.0076
	mean	2.00	2.50	1.17	1.58	1.20	1.19	
Ownership of the property will stay within the family	n	14	18	17	24	15	26	0.6227
	mean	3.86	3.76	3.94	3.58	3.86	4.25	
I will live on the property for as long as possible	n	16	18	16	23	15	26	0.1262
	mean	4.31	4.21	3.67	3.74	4.00	4.55	
All or most of the property will be leased or share farmed	n	15	18	18	23	15	28	0.8410
	mean	1.78	2.00	1.75	1.75	1.40	1.75	
Additional land will be purchased, leased or share farmed	n	16	18	18	23	15	27	0.8125
	mean	2.14	2.00	2.06	2.00	2.70	2.38	
The enterprise mix will be changed to reduce my farm workload	n	16	18	18	23	15	26	0.0770
	mean	2.67	3.09	3.00	1.93	1.85	2.10	
The enterprise mix will be changed to more intensive enterprises	n	16	18	18	22	15	26	0.5558
	mean	2.86	2.27	2.47	2.00	2.00	2.33	
I plan to introduce/expand irrigation on the property	n	16	18	18	23	15	27	0.8290
	mean	3.00	3.00	2.86	2.38	2.44	2.76	
I will seek additional off-property work	n	16	18	18	22	15	26	0.9178
	mean	2.73	2.57	3.00	2.80	2.36	2.83	
I will reduce the extent of my paid off-property work	n	16	18	18	22	15	26	0.3102
	mean	2.70	3.40	2.50	1.92	2.00	1.92	
All or some part of the property will be placed under a conservation covenant	n	16	18	18	23	15	25	0.0640
	mean	2.36	2.50	2.82	2.33	1.78	1.65	

Note: Mean score where 1 = Highly unlikely through to 5 = Highly likely, p.value is the degree of significant difference across the catchments (Kruskal Wallis test for significance at 0.05 level). Shaded area is the only significant difference between the catchments.

Table E: Confidence in current recommended practices (CRP): significant & near significant differences in the six catchments. Tasmania riparian landholder survey, 2008, N=146

CRP		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Removing willows helps to improve the water quality in rivers/creeks	n	21	21	21	27	16	32	0.0316
	% agree	29%	29%	62%	52%	56%	69%	
	% not sure	29%	29%	19%	22%	25%	19%	
	% disagree	19%	14%	0%	11%	0%	6%	
	% na	24%	29%	19%	15%	19%	6%	
	median	3	3	4	4	4	4	
Set stocking is usually better for retaining native vegetation in paddocks with river/creek frontages than intensive grazing for short periods	n	20	21	21	27	15	31	0.0447
	% agree	40%	29%	24%	22%	53%	23%	
	% not sure	35%	38%	19%	52%	27%	48%	
	% disagree	10%	10%	57%	7%	20%	26%	
	% na	15%	24%	0%	19%	0%	3%	
	median	3	3	2	3	4	3	
The time and expense involved in watering stock off-stream is justified by improvement in river/creek water quality	n	19	21	21	27	15	32	0.0606
	% agree	58%	38%	38%	59%	53%	69%	
	% not sure	16%	29%	33%	22%	13%	28%	
	% disagree	0%	19%	24%	7%	33%	3%	
	% na	26%	14%	5%	11%	0%	0%	
	median	4	3	3	4	4	4	

Note: The degree of significant difference across the catchments is based on the Proportions test for significance at 0.05 level.

Table F: Constraints to better management of river frontages in the six catchments.  
Tasmania riparian landholder survey, 2008, N=146

Constraints		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Drought conditions affecting the survival of existing or planted native vegetation	n	19	20	21	25	15	31	0.0000
	median	4	5	4	4	2	3	
Creating shelter/cover for pest animals if river frontages are fenced out	n	19	20	21	25	14	31	0.0140
	median	3	2.5	3	2.5	4.5	4	
New chemical spray regulations for riparian areas	n	19	20	21	25	15	31	0.0864
	median	3	4	3.5	2.5	2.5	4	
Increased likelihood of fires because of fuel building up behind fences	n	19	20	21	25	15	31	0.1530
	median	4	4.5	3	4	4	4	
Losing land for cropping or grazing	n	19	20	21	25	15	31	0.1870
	median	2	3	3	2	3	3	
Limited access to credible, affordable on-site technical advice	n	19	20	21	24	14	31	0.2161
	median	3	3	2	2	3	2	
Damage resulting from public access to the frontage	n	19	20	21	25	15	31	0.3501
	median	2	3	2	4	3	4	
The difficulty/cost of changing watering points for stock	n	19	20	21	25	15	31	0.4024
	median	3	4	4	4	2	3.5	
Increased management required if river frontages are fenced out	n	18	20	21	25	15	31	0.4218
	median	3	4	4	4	3	3	
Increased pest plant areas if river frontages are fenced out	n	19	20	21	25	15	31	0.4628
	median	3	3	4	4	4	4	
Impact of browsing animals such as wallabies, possums, rabbits and deer	n	18	20	21	25	15	31	0.5243
	median	4	4	4	4	4	4	
Flood events affecting fencing	n	19	20	21	25	15	31	0.5640
	median	3	4	3	3.5	3	3	
Access to affordable practical advice about property management	n	18	20	21	25	15	31	0.6311
	median	2.5	4	3	3	3	3	
Lack of time or access to labour to carry out work	n	19	20	21	25	15	31	0.7199
	median	3	4	3	3	4	3	
The high cost of materials and equipment to carry out work	n	19	19	21	25	15	31	0.8495
	median	4	4	4	4	4	4	

Note: The degree of significant difference across the catchments is based on the Kruskal Wallis test for significance at 0.05 level.

Table G: Implementation of selected current recommended practices (CRP) undertaken during current respondents management in the six catchments. Tasmania riparian landholder survey, 2008, N=146.

CRP		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Practices undertaken during your management								
Number of native trees and shrubs planted along the waterway or in adjoining wetlands (including direct seeding) [trees and shrubs]	n	15	11	14	21	14	21	0.0024
	% yes	60%	18%	29%	10%	50%	62%	
	mean	925	110	313	130	864	954	
	median	250	110	100	130	800	500	
Area of land fenced for natural regeneration of native vegetation [ha]	n	16	15	17	23	15	25	0.0082
	% yes	81%	47%	65%	26%	73%	60%	
	mean	37.5	83.0	777.7	27.2	21.9	21.8	
	median	4	40	250	17.5	5	9.44	
Length of fencing erected to manage stock access to the waterway or adjoining wetlands [km] (stockers only)	n	14	9	13	13	14	19	0.0554
	% yes	79%	44%	31%	46%	71%	74%	
	mean	2.7	1.5	7.3	1.1	5.5	3	
	median	2	1.25	3.5	1	4	3.5	
Number of off-river/stream watering points established for stock [number] (stockers only)	n	14	9	10	12	15	19	0.2697
	% yes	64%	56%	40%	58%	67%	84%	
	mean	6	7	9	9	32	12	
	median	6	6	4.5	3	9.5	6.5	
Practices undertaken this year (2008)								
How much time did you or others spend controlling pest animals and non-crop weeds in your river/creek frontage or adjoining wetlands [number of days worked]?	n	16	13	17	24	14	28	0.1764
	% yes	56%	46%	59%	67%	79%	82%	
	mean	10.1	31.2	18.8	17.9	10.6	10.9	
	median	7	8.5	4.5	7.5	5	4	

Note: The degree of significant difference across the six catchments is based on the Proportions test for significance at 0.05 level for all land uses unless indicated otherwise.



Table H: Implementation of current recommended practices (CRP) undertaken during current respondent's management tenure & during the past 5 years in the six catchments. Tasmania riparian landholder survey, 2008, N=146

CRP		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value	
Practices undertaken during your management									
Removed willows  (all land uses)	n	18	19	20	23		32	0.2863	
	% yes	22%	16%	40%	35%		19%		
	% no	33%	16%	20%	9%		9%		
	% na	44%	68%	40%	57%		72%		
Removed willows and replaced them with native vegetation  (all land uses)	n	18	18	19	23		32	0.3738	
	% yes	11%	0%	11%	17%		19%		
	% no	39%	22%	47%	26%		9%		
	% na	50%	78%	42%	57%		72%		
Established a best-practice effluent management system for dairy sheds that includes a pond or sump and re-use system	n	Removed due to insufficient dairy respondents							
	% yes								
	% no								
	% na								
Practices undertaken in last 5 years									
Established permanent grassed waterways in drainage lines  (croppers only)	n	4	6	9			6	0.2982	
	% yes	50%	33%	22%			0%		
	% no	25%	17%	33%			33%		
	% na	25%	50%	44%			67%		
Sowed summer active perennial pasture such as lucerne or phalaris  (stockers only)	n	14	13	16	13	15	24	0.0023	
	% yes	36%	8%	56%	23%	7%	8%		
	% no	43%	54%	25%	62%	67%	54%		
	% na	21%	38%	19%	15%	27%	38%		
Regularly used mulched rip lines in cropped paddocks  (croppers only)	n	4	6	9			6	0.1823	
	% yes	0%	17%	11%			50%		
	% no	100%	50%	56%			33%		
	% na	0%	33%	33%			17%		
Tested soils for nutrient status in paddocks where you have applied fertiliser/soil conditioners in the past  (all land uses)	n	18	19	19	24	16	31	0.1875	
	% yes	56%	37%	58%	38%	75%	52%		
	% no	33%	32%	16%	13%	6%	26%		
	% na	11%	32%	26%	50%	19%	23%		
Tested the quality of the main water source for stock or irrigation purposes on your property  (all land uses)	n	17	19	19	24	16	32	0.0996	
	% yes	41%	21%	42%	8%	19%	32%		
	% no	47%	42%	37%	46%	50%	50%		
	% na	12%	37%	21%	46%	31%	22%		

Note: The degree of significant difference across the catchments is based on the Proportions test for significance at 0.05 level. The Pet and Quamby Brook catchments were removed for two cropping-related items due to insufficient numbers involved in cropping land use.

Table I: Implementation of current recommended practices (CRP) undertaken in year 2008 in the six catchments. Tasmania riparian landholder survey, 2008, N=146

CRP		Coal	Jordan	Macquarie	Quamby Brook	Pet	Inglis-Flowerdale	p value
Do you have a fertiliser nutrient budget calculated for all/most/some of the farm?  (all land uses)	n	17	19	19	24	16	31	0.3620
	% yes	35%	16%	42%	46%	38%	45%	
	% no	47%	47%	47%	13%	63%	29%	
	% na	18%	37%	11%	42%	0%	26%	
Do you have a grazing plan that involves keeping stock out of wet paddocks in winter?  (stockers only)	n	15	13	17	13	15	24	0.3850
	% yes	67%	38%	47%	77%	60%	58%	
	% no	27%	54%	29%	23%	27%	13%	
	% na	7%	8%	24%	0%	13%	29%	
Did stock graze any part of your river/creek frontage or adjoining wetlands for more than a week at a time?  (stockers only)	n	16	13	17	13	15	24	0.0001
	% yes	25%	23%	82%	62%	7%	29%	
	% no	63%	38%	12%	38%	87%	67%	
	% na	13%	38%	6%	0%	7%	4%	
Did stock access drinking water from any part of your river/creek frontage or adjoining wetlands for more than a week at a time?  (stockers only)	n	15	13	17	13	15	24	0.0012
	% yes	47%	38%	82%	62%	7%	42%	
	% no	47%	23%	12%	38%	87%	58%	
	% na	7%	38%	6%	0%	7%	0%	
Did you apply fertiliser using an accredited spreader (possibly yourself)?  (all land uses)	n	19	19	20	24	16	32	0.0445
	% yes	47%	26%	75%	42%	63%	44%	
	% no	37%	47%	25%	33%	31%	41%	
	% na	16%	26%	0%	25%	6%	16%	
Did you crop using minimum tillage practices (maximum of 2 passes) or sow cover crops over winter?  (croppers only)	n	19	20	21			6	0.5098
	% yes	60%	67%	90%			83%	
	% no	20%	17%	0%			17%	
	% na	20%	17%	10%			0%	
Did you sow a ground cover rather than bare fallow?  (croppers only)	n	18	20	20			6	0.1131
	% yes	0%	33%	56%			67%	
	% no	80%	33%	22%			33%	
	% na	20%	33%	22%			0%	

Note: The degree of significant difference across the catchments is based on the Proportions test for significance at 0.05 level. The Pet and Quamby Brook catchments were removed in the last two CRP due to insufficient numbers involved in cropping land use.

Table J: Significant relationships between CRPs undertaken during your management and landholder involvement in planning processes. Tasmania riparian landholder survey, 2008, N=146

<b>Number of native trees and shrubs planted along the waterway or in adjoining wetlands (including direct seeding)</b>			
<b>Planning Process Question</b>	<b>n</b>	<b>p value</b>	<b>test</b>
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	67	0.0231	Linear model
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	46	0.0498	Linear model
<b>Area of land fenced for natural regeneration of native vegetation</b>			
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	76	0.0073	Linear model
Was your whole farm plan completed or updated in the last five years?	93	0.0000	Kruskal Wallis
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	55	0.0234	Linear model
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	109	0.0110	Linear model
<b>Length of fencing erected to manage stock access to the waterway or adjoining wetlands [km]</b>			
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	59	0.0170	Linear model
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	39	0.0088	Linear model
<b>Number of off-river/stream watering points established for stock</b>			
Have you prepared a property management or whole farm plan that involved a map and/or other documents that addressed the existing property situation and included future management and development plans?	52	0.0078	Linear model
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	40	0.0013	Linear model
<b>Removed willows</b>			
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	47	0.0365	Kruskal Wallis

Note: The CRP 'Removed willows and replaced them with native vegetation' did not have any significant relationships with planning processes. 'Established a best-practice effluent management system for dairy sheds that includes a pond or sump and re-use system' was not included due to insufficient number of responses.

Table K: Significant relationships between CRPs undertaken in the last 5 years and landholder involvement in planning processes. Tasmania riparian landholder survey, 2008, N=146

<b>Sowed summer active perennial pasture such as lucerne or phalaris</b>			
<b>Planning Process Question</b>	<b>n</b>	<b>p value</b>	<b>test</b>
Have you prepared a property management or whole farm plan that involved a map and/ or other documents that addressed the existing property situation and included future management and development plans?	52	0.0105	Kruskal Wallis
Was your whole farm plan completed or updated in the last five years?	58	0.0117	Fishers Exact
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	35	0.0261	Kruskal Wallis
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	68	0.0030	Kruskal Wallis
<b>Regularly used mulched rip lines in cropped paddocks</b>			
Was your whole farm plan completed or updated in the last five years?	16	0.0192	Fishers Exact
<b>Tested soils for nutrient status in paddocks where you have applied fertiliser/soil conditioners in the past</b>			
Have you prepared a property management or whole farm plan that involved a map and/ or other documents that addressed the existing property situation and included future management and development plans?	64	0.0052	Kruskal Wallis
Was your whole farm plan completed or updated in the last five years?	78	0.0008	Fishers Exact
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	49	0.0044	Kruskal Wallis
<b>Tested the quality of the main water source for stock or irrigation purposes on your property</b>			
Have you prepared a property management or whole farm plan that involved a map and/ or other documents that addressed the existing property situation and included future management and development plans?	63	0.0290	Kruskal Wallis
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	49	0.0223	Kruskal Wallis
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	90	0.0412	Kruskal Wallis

Note: The shaded property planning questions have a negative relationship with the CRP. The CRP 'Established permanent grassed waterways in drainage lines' did not have any significant relationships with Knowledge Topics.

Table L: Significant relationships between CRPs undertaken this year (2008) and landholder involvement in planning processes. Tasmania riparian landholder survey, 2008, N=146.

<b>Do you have a fertiliser nutrient budget calculated for all/most/some of the farm?</b>			
<b>Planning Process Question</b>	<b>n</b>	<b>p value</b>	<b>test</b>
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	50	0.0073	Kruskal Wallis
<b>Do you have a grazing plan that involves keeping stock out of wet paddocks in winter?</b>			
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	43	0.0267	Kruskal Wallis
<b>Did stock graze any part of your river/creek frontage or adjoining wetlands for more than a week at a time?</b>			
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	87	0.0388	Kruskal Wallis
<b>Did stock access drinking water from any part of your river/creek frontage or adjoining wetlands for more than a week at a time?</b>			
Have you been involved in local action planning – (e.g. with landcare, community development or industry associations)?	88	0.0079	Kruskal Wallis
<b>Did you apply fertiliser using an accredited spreader (possibly yourself)?</b>			
Was your whole farm plan completed or updated in the last five years?	95	0.0348	Fishers Exact
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	54	0.0079	Kruskal Wallis
<b>Did you crop using minimum tillage practices (maximum of 2 passes) or sow cover crops over winter?</b>			
Has your family agreed to a succession plan for managing the transfer of your property to the next generation?	17	0.0457	Kruskal Wallis
<b>Did you sow a ground cover rather than bare fallow?</b>			
Do you have family members interested in taking on your property in the future?	18	0.0359	Fishers Exact
<b>How much time did you or others spend controlling pest animals and non-crop weeds in your river/creek frontage or adjoining wetlands [number of days worked]?</b>			
Have you prepared a property management or whole farm plan that involved a map and/ or other documents that addressed the existing property situation and included future management and development plans?	77	0.0219	Linear model
Was your whole farm plan completed or updated in the last five years?	96	0.0063	Kruskal Wallis

Note: The shaded property planning question had a negative relationship with the CRP.