RESEARCH **13** **2016-152** AND **2018-189**

WHAT ARE THE CARP VIRUS BIOCONTROL RISKS AND HOW CAN THEY BE MANAGED?

NATIONAL CARP CONTROL PLAN

The socio-economic impact assessment and stakeholder engagement

This suite of documents contains those listed below.

NCCP TECHNICAL PAPERS

1. Carp biocontrol background
2. Epidemiology and release strategies
3. Carp biocontrol and water quality
4. Carp virus species specificity
5. Potential socio-economic impacts of carp biocontrol
6. NCCP implementation
7. NCCP engagement report
8. NCCP Murray and Murrumbidgee case study
9. NCCP Lachlan case study

NCCP RESEARCH (peer reviewed)

Will carp virus biocontrol be effective?

1. 2016-153: Preparing for Cyprinid herpesvirus 3: A carp biomass estimate for eastern Australia
2. 2018-120: Population dynamics and carp biomass estimates for Australia
3. 2017-148: Exploring genetic biocontrol options that could work synergistically with the carp virus
4. 2016-170: Development of hydrological, ecological and epidemiological modelling
5. 2017-135: Essential studies on Cyprinid herpesvirus 3 (CyHV-3) prior to release of the virus in Australian waters
6. 2020-104: Evaluating the role of direct fish-to-fish contact on horizontal transmission of koi herpesvirus
7. 2019-163 Understanding the genetics and genomics of carp strains and susceptibility to CyHV-3
8. 2017-094: Review of carp control via commercial exploitation

What are the carp virus biocontrol risks and how can they be managed?

9. 2017-055 and 2017-056: Water-quality risk assessment of carp biocontrol for Australian waterways
10. 2016-183: Cyprinid herpesvirus 3 and its relevance to humans
11. 2017-127: Defining best practice for viral susceptibility testing of non-target species to Cyprinid herpesvirus 3
12. 2019-176: Determination of the susceptibility of Silver Perch, Murray Cod and Rainbow Trout to infection with CyHV-3
13. 2016-152 and 2018-189: The socio-economic impact assessment and stakeholder engagement
    Appendix 1: Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns
    Appendix 2: Findings of community attitude surveys
    Appendix 3: Socio-economic impact assessment — commercial carp fishers
    Appendix 4: Socio-economic impact assessment — tourism sector
    Appendix 5: Stakeholder interviews
    Appendix 6: Socio-economic impact assessment — native fish breeders and growers
    Appendix 7: Socio-economic impact assessment — recreational fishing sector
    Appendix 8: Socio-economic impact assessment — koi hobbyists and businesses
    Appendix 9: Engaging with the NCCP: Summary of a stakeholder workshop
14. 2017-237: Risks, costs and water industry response
15. 2017-054: Social, economic and ecological risk assessment for use of Cyprinid herpesvirus 3 (CyHV-3) for carp biocontrol in Australia
    Volume 1: Review of the literature, outbreak scenarios, exposure pathways and case studies
    Volume 2: Assessment of risks to Matters of National Environmental Significance
    Volume 3: Assessment of social risks
16. 2016-158: Development of strategies to optimise release and clean-up strategies
17. 2016-180: Assessment of options for utilisation of virus-infected carp
18. 2017-104: The likely medium- to long-term ecological outcomes of major carp population reductions
19. 2016-132: Expected benefits and costs associated with carp control in the Murray-Darling Basin

NCCP PLANNING INVESTIGATIONS

1. 2018-112: Carp questionnaire survey and community mapping tool
2. 2018-190: Biosecurity strategy for the koi (*Cyprinus carpio*) industry
3. 2017-222: Engineering options for the NCCP
4. NCCP Lachlan case study (in house) (refer to Technical Paper 9)
5. 2018-209: Various NCCP operations case studies for the Murray and Murrumbidgee river systems (refer to Technical Paper 8)

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Community and stakeholder perspectives on carp control: assessing social acceptability, anticipatory impacts, and potential socio-economic impacts

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Executive Summary

Introduction

In 2016 the Australian Government announced a $15 million investment to develop the National Carp Control Plan (NCCP, or 'Plan'). The Plan focuses on evaluating the feasibility of releasing the carp virus. Critical to the success of the Plan and any subsequent investment in carp control is support from the diverse stakeholders who depend on or have an interest in carp, freshwater health and fisheries, as well as from people living and spending time in the regions where carp control measures will be implemented. This report provides results of two projects that examined:

- Stakeholder and community needs, concerns and expectations regarding carp control, focusing on understanding acceptability of carp control and factors influencing social acceptability
- Potential socio-economic impacts of carp control, and measures to reduce negative and maximise positive socio-economic impacts
- The types of information, consultation and engagement needed by different stakeholders in the process of developing the Plan, and
- Key needs for assessment of socio-economic impacts and community attitudes beyond the life of the NCCP.

To enable readers to access results of both the first and second projects in a single document, this final report for Project 2 integrates results of both Project 1 (*FRDC Project 2016-152 Building community support for carp control: understanding community and stakeholder attitudes and assessing social effects*) and Project 2 (FRDC Project 2018-189 *NCCP: Socio-economic impact assessment and stakeholder engagement*).

Methods

Data collection occurred via:

- Key stakeholder interviews and workshops – three rounds of discussion were held, with a total of 125 stakeholders involved altogether (including members of specific groups referred to in the next dot point), and one general stakeholder workshop
- Interviews and workshops with representatives of specific groups likely to experience impacts: koi, native fish aquaculture, commercial fishing, tourism and recreational fishing stakeholders. Three specific workshops were held, in addition to interviews and participation of these groups in the general stakeholder workshop (listed in the previous dotpoint).
- Community attitudes surveys – four surveys conducted in 2016, 2017, 2018 and 2019. All collected nationwide samples, with two having over-representation of rural and regional areas and the other two being representative of the nationwide population distribution. These surveys tracked overall attitudes, and collected data enabling more specific analysis of the types of factors influencing attitudes, and of the potential impacts of carp control. A total of just over 24,000 individuals participated in surveys in which they provided their views about carp control

and the carp virus. When identifying overall views of the whole population, data were weighted so findings were representative of the adult population.

Results and discussion

Key stakeholders

An initial round of phone interviews was conducted in 2017 with 23 representatives of stakeholder groups with differing interests in carp control. This included representatives of environmental groups, commercial carp fishers, Traditional Owners, farming groups, koi organisations, water providers, native fish breeders, recreational fishing organisations, tourism businesses, animal welfare organisations, and freshwater scientists. All stakeholders supported investing in action to reduce carp numbers, although some specified they supported action as long as it was not at the expense of investment in other action to improve health of freshwater areas. Most stakeholders expressed *conditional support* for the Plan. This meant they would support the eventual Plan *if* the process of developing it and its content adequately addressed key questions and concerns. A smaller number of stakeholders either actively opposed the Plan or unconditionally supported the Plan. Stakeholder support for carp control was contingent upon carp control strategy and action including:

- Multiple measures to control carp, rather than relying solely on use of the virus
- Identification of how to best integrate carp control with other actions to improve environmental health in freshwater and estuary areas
- Development of detailed guidance on the planned timing and management of carp control actions, particularly virus release
- Clear identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios
- Identification and mitigation of social and economic impacts of carp control on specific groups
- Appropriate involvement of different groups in decision making processes
- Sound governance, including clear commitment of funding and other resources to carp control and identification of responsibilities of different agencies, and
- Development of appropriate monitoring and evaluation strategies.

In 2018, 17 of the 23 key stakeholders interviewed in Round 1. were re-interviewed, to identify how their views about carp control were changing (and for some to identify more detailed data on potential socio-economic impacts). As part of the interviews conducted for the SEIA, a further 28 stakeholders were interviewed who were not interviewed in Round 1. These discussed their views about carp control in general as well as potential for specific impacts on the group they were part of or represented (e.g. recreational fishing, koi, native fish aquaculture, commercial fishing or tourism).

Key findings of this round of stakeholder interviews were that there were similar levels of conditional support for carp control to the levels identified in the first round of interviews. However, several stakeholders had identified additional questions or concerns they needed addressed before they would

support implementing actions to control carp. In particular, several were expecting detailed information about carp control, including technical details, some had found initial communications about carp control overly simplistic, and many wanted greater engagement with NCCP research. A number of actions were identified and implemented by NCCP staff to address these concerns.

The third round of stakeholder discussions focused on enabling stakeholders to hear emerging results of research conducted in the NCCP and discuss whether and how these changed their views about options for carp control. Key findings were that the initial strong (but conditional) support of many (but not all) stakeholders for virus release had reduced since the start of the NCCP. This was particularly the case for those involved in natural resource management, some recreational fishers, and representatives of environmental non-government organisations. While still conditionally supportive, these stakeholders felt the emerging results suggested a need for further investigation of several areas before a final decision was made, particularly related to long-term efficacy of the virus in reducing carp populations, and ability to achieve meaningful improvement in ecological health after a reduction in carp populations.

Community attitudes

Views of the general community about the acceptability of '[r]educing numbers of carp (a pest fish) by releasing the carp herpes virus' stayed relatively stable during 2016 to 2019. In data collected in the four community attitude surveys, between 50% and 54% of rural and regional residents supported release of the carp virus, as did 44% to 46% of the broader population including those living in large cities. Between 16% and 17% of rural/regional residents found virus release unacceptable, and 19% of the broader population. Around one-third of people were either unsure or answered 'neither acceptable or unacceptable', with these responses slightly more common amongst residents of large cities. Overall, prior to knowing the specific actions to be implemented, people were 2.5 times more likely to find virus release acceptable as unacceptable. The findings suggest there is potential for attitudes to change rapidly in response to new information, particularly amongst those who were uncertain (don't know), ambivalent (neither acceptable or unacceptable) or had strongly held views about virus release (very high acceptability or unacceptability).

Key factors likely to influence views about acceptability of virus release are:

- Awareness of carp invasion: awareness was moderate to high, however a significant minority were either unaware of carp invasion or did not feel carp invasion caused significant problems.
- Views about importance of addressing carp invasion: 56% felt it was moderately or highly important to invest in carp control, while 44% did not .
- Perceptions of potential and negative impacts: There was high uncertainty about whether benefits of virus release would outweigh negative impacts, and relatively high levels of concern about potential negative impacts in particular.
- Confidence in implementing institutions: Many people were uncertain or lacked confidence in the ability of government to successfully implement virus release, while confidence was higher in some non-government organisations.

Socio-economic impact assessment

Socio-economic impact assessment (SEIA) has evolved considerably since its original conception as a single 'point-in-time' assessment done just before implementation of a project or policy. Best practice SEIA is now recognised to be an ongoing process that begins during project design stages and continues prior to, during and post-implementation of an action. The NCCP was a 'project design' phase: as such, the stages of SEIA appropriate to conduct at this point focused on producing recommendations for designing carp control actions that minimise potential negative impacts and create as much potential for positive impacts as possible. Specifically, to produce recommendations that could inform design of the Plan, the SEIA:

(i) identified the 'anticipatory' impacts announcement of development of the NCCP had for different groups
(ii) identified potential socio-economic impacts of carp control using the virus, and how to design the Plan to reduce negative and increase positive impacts, through identifying:
    a. Groups with potential to be impacted
    b. Existing conditions and status of these groups
    c. Potential socio-economic impacts of carp control (positive and negative) for different groups, and the conditions under which these impacts would and would not occur
    d. Recommendations for designing carp control to reduce potential negative impacts and increase potential positive impacts
    e. Recommendations for future stages of SEIA.

The SEIA focused in particular on identifying groups with higher likelihood of experiencing impacts, and the nature of those impacts, as well as likelihood of the impacts on these groups having further, flow-on effects for communities more generally. Six groups with high likelihood of experiencing direct impacts from carp control were identified: commercial carp fishers (and to a lesser extent some other commercial fishers); native fish aquaculture businesses; Traditional Custodians of regions experiencing carp invasion; the tourism sector; recreational fishers; and koi hobbyists, breeders and associated organisations. While these are not the only groups with potential to experience impacts, they are those with the greatest likelihood of experiencing significant impacts. Stakeholders interviewed in early stages of the project felt that other groups such as farmers, rural landholders and water managers had less potential to experience significant long-term impacts. Five of these groups (all except Traditional Owners) formed the focus of much of the impact assessment conducted in this project; a separate NCCP project was established to further identify concerns, needs and opportunities for Traditional Owners.

A more limited assessment was conducted of the potential for communities more generally to experience impacts, either due to flow-on effects of the direct impacts on groups such as the tourism industry or fishing, or due to direct amenity impacts. A detailed assessment of community-scale impacts should be undertaken once decisions are made about the scope, location and nature of carp control activities to be implemented.

For each of the five specific groups examined, the type and scale of activities that could be impacted was first identified, through assessing existing conditions. While this type of assessment is often referred to as 'baseline assessment', we refer to it as assessment of 'existing conditions' in recognition that 'baselines' are constantly shifting over time. When assessing existing conditions, only limited quantification of some aspects, such as numbers of jobs in different sectors and economic value of

activities was undertaken. This was for two reasons. First, in early stages it was identified that some groups are experiencing rapid change: this means that by the time carp control actions are implemented in future, it is likely that detailed data on jobs and economic activity would be out of date. While such data would still form a useful part of understanding trends and change in each group over time, it was decided, in consultation with NCCP staff, that available resources were better directed to identifying how to design carp control actions to reduce negative and increase positive socio-economic impacts. This in turn required focusing on identifying potential for socio-economic impacts to occur, the conditions under which they could occur, and actions that could reduce risk of negative impact and increase potential for positive socio-economic impacts, rather than on precisely quantifying the current size and scale of the activities of different groups. Assessment of existing conditions therefore focused on identifying the nature of activities, broad size and scope of activities, and factors influencing capacity of members of different groups to adapt to implementation of carp control.

When assessing potential socio-economic impacts and identifying recommended actions, two important assumptions were made: (i) that negative impacts of a virus release on amenity and/or water quality would be short-term in nature in any specific location, meaning they would usually last for a small number of weeks, and at most a small number of months (one to three), and (ii) that investment in carp control would be done in a way that enabled long-term improvement in environmental health to occur in multiple locations, which would in turn improve aspects of amenity such as riverbank vegetation, water quality (e.g. reduced turbidity), and/or native fish populations. The nature of socio-economic impacts will differ significantly from that identified in this study if either assumption does not hold.

Traditional Owners

This project included only a very limited assessment of potential impacts of carp virus release for Traditional Owners, as a separate NCCP project was established to examine this. A large number of Aboriginal Nations are affected by carp invasion: based on data drawn from the 2016 Australian Census of Population and Housing and mapping of carp density, at least 109,500 people who identify as Aboriginal and/or Torres Strait Islander live in areas affected to a moderate to high degree by carp invasion, with at least 50,000 living in local government areas which have high carp density in some waterways. These numbers are likely to be underestimates, as they rely on Census data that is known to undercount Aboriginal and Torres Strait Islanders.

A key challenge relates to engagement, with many representatives of Indigenous Nations having very high demands on their time and lacking both time and resources to engage with members of their Nations on issues such as carp control. Many existing activities conducted to care for Country also receive no or little resourcing. Concern was expressed about lack of involvement of Indigenous people in deciding the scope of work to be conducted for the NCCP and during the NCCP.

Key potential socio-economic impacts of carp control identified in interviews and workshops were (i) disempowerment through lack of involvement or (if suitable involvement is enabled), empowerment through active, meaningful and appropriately resourced involvement; (ii) impacts on health of Country, with potential for both negative and positive impacts; (iii) impacts on cultural activities, with potential for short-term disruption during carp control and long-term positive impacts if environmental improvement occurred; (iv) impacts on culturally important sites, particularly damage during carp control activities; (v) impacts on employment and income, with potential for both negative impacts due to disruption of existing business activities in the short-term or lack of opportunity to gain income/employment as part

of carp control, and positive impacts if there is improvement in environmental health and amenity, and opportunity to be directly involved in carp control activities.

To increase potential for positive impacts and reduce negative impacts, it is recommended that (i) views of Traditional Owners inform recommendations made by NCCP, (ii) meaningful engagement occurs throughout planning and implementation of any carp control, supported by sufficient resourcing and provision of time for engagement; (iii) Aboriginal businesses that currently depend on areas affected by carp invasion be identified and consulted; (iv) transparent and appropriate processes be developed with and approved by Traditional Owners for identifying cultural sites and activities requiring protection, and processes of ensuring protection; (v) appropriate, resourced engagement occur with Traditional Owners to identify how best to support health of Country when designing and implementing carp control actions; (vi) Traditional Owners be resourced to undertake appropriate on-Country activities to support health of country potentially affected by carp control actions, and (vii) ensure all employment and income-earning opportunities associated with investment in carp control are available to Aboriginal businesses.

Commercial fishers (carp fishers, other commercial fishers)

Around 44 commercial carp fishers in Australia had active permits to fish for carp as of 2018. Many of these also have other commercial fishing licences or permits, or engage in commercial aquaculture. A core group of fishers (7-10) have businesses and household incomes with significant reliance in income from carp harvest. Many of this group report strong market interest in expanding harvest of carp for a range of products, particularly from export markets. Commercial carp fishers have been limited in their ability to expand carp harvesting in Australia due to factors including regulatory constraints that cause difficulty achieving reliable harvest volumes to supply markets (affecting some but not all fishers), difficulty achieving timely permission to fish and access sites where carp are aggregating, and lack of coordinated cross-jurisdictional strategies to support commercial live harvest.

Some commercial carp fishers have experienced significant negative impacts during the NCCP process, particularly those who harvest larger volumes of carp and rely on carp harvest for a significant proportion of household income. These anticipatory impacts included uncertainty about the future resulting in psychological distress, stress, mental health impacts, reduced business opportunities, inability to invest in or sell businesses, difficulty or inability obtaining or servicing finance, and loss of market access. These impacts are likely to continue until a decision is made about future carp control that provides more certainty about the future of commercial live carp harvest, and potentially beyond this. Implementation of carp control, specifically virus release, has potential to result in impacts including (i) reduced consumer interest in consumption of products ; (ii) reduced market access due to domestic or export regulatory constraints; (iii) increased business costs depending on costs of meeting regulatory/biosecurity requirements; (iv) improved opportunities if live carp harvest forms part of carp control action and/or coordinated carp harvest strategies are developed, or fishers are involved in clean-up activities (not all are willing or interested in the latter), and (v) potential for fishers (the public face of carp fishing) to be blamed by the public for any problems associated with carp control activities. There is potential for a relatively small number of carp fishers (<10) fishers to lose business viability if the virus is released. This would have significant negative social and economic impacts for these fishing households.

There is some potential for impacts on other commercial fishers, particularly through loss of market access if consumers are unwilling to consume produce perceived to have come in contact with the virus, if fishers experience increased regulation/biosecurity requirement, or displaced carp fishers increase competition in other fisheries.

Actions to reduce potential for negative impacts on commercial carp fishers (and other commercial fishers), and increase potential for positive opportunities, are (i) provide a clear timeline for decision making to help enable planning for the future; (ii) provide regular communication about progress to reduce uncertainty of fishers; (iii) ensure carp fishers knowledge is acknowledged, respected, and drawn on where possible; (iv) identify collaborative research opportunities that involve fishers and enable them to contribute their knowledge; (v) provide clear advice and communication to markets and financial institutions if requested to do so by fishers; (vi) provide support to maintain current markets and to build demand in alternative markets, in collaboration with fishers; (vii) provide clear advice to fishers on potential impacts on market access from regulatory requirements; (viii) identify costs of adhering to any regulatory requirements applying due to potential presence of virus, and support cost reduction where appropriate; (ix) establish cross-jurisdictional group to identify and implement appropriate regulatory reform to enable fishers to better contribute to reducing carp populations through live fishing; (x) trial live harvest methods and assess their potential contribution to carp population reduction; (xi) ensure clear communication about who is responsible for actions that cause carp kills and how to contact relevant authorities, and have a plan to ensure safety of those involved in clean-up activities; (xii) provide assistance for those fishers whose livelihood is threatened, to support transition to new business activities or employment; and (xiii) monitor whether carp fishers are shifting effort into other fisheries, and ensure that support provided to carp fishers does not result in displacement of other fishing effort.

Native fish aquaculture businesses: Inland freshwater species account for around 6.4 per cent of Australia's aquaculture by value, although onshore aquaculture accounted for around 28% of total aquaculture employment recorded in the 2016 Census (some onshore aquaculture involves saltwater species). However, parts of the native fish aquaculture industry have grown rapidly in recent years, particularly Murray cod aquaculture production. Freshwater native fish aquaculture operators supply a number of markets, including producing fingerlings for restocking of natural waterways and impoundments, supplying fingerlings and fry for growing on in domestic or overseas operations, and growing stock to table fish size for both domestic and export markets. The sector is experiencing several constraints to growth, including often complex regulatory conditions and restocking program requirements, a lack of public investment in research and development, and limited industry coordination that reduces representation and advocacy for the industry.

While most native fish aquaculture businesses were not materially affected by announcement of the NCCP, many reported increased uncertainty about the future. Additionally, several felt a sense of frustration or disempowerment resulting from what they viewed as a lack of opportunities to contribute their knowledge and expertise to research conducted prior to or during the NCCP. Specific potential impacts of virus release were (i) increased business costs if businesses need to test for virus presence in fingerlings being transported to other locations (domestic or in other countries), or need to implement specific biosecurity measures to ensure virus-free water; (ii) loss of market access due to reduced consumer demand, a concern often raised in relation to export markets where current price premiums received by Australian producers rely on the 'clean, green' image of Australian produce; (iii) loss of market access due to domestic or export regulatory constraints imposed on transport or sale of produce harvested in waters in which the carp virus may be present; (iv) opportunity for expanded business opportunities - those businesses that supply restocking programs could experience increased demand for their produce, if restocking is increased after carp control actions are implemented. However, for businesses to be able to benefit from this, they need sufficient lead time and clarity about the type of restocking to be done, as there is typically a long lead time to undertake any expansion of business operations or ramp up production of particular species and grow them to a specified size.

Many of the recommended actions are identical or similar to those recommended for the commercial carp fishing sector: (i) a clear timeline and regular communication be provided on an ongoing basis; (ii) regulatory implications be identified and communicated clearly and businesses be assisted to develop low-cost processes for meeting any additional regulatory requirements; (iii) campaigns be developed and resources to maintain consumer confidence in consumption of produce; (iv) investment be made in marketing and diplomatic strategies into export markets to reduce risk of impacts; (v) producers be provided clear advice on potential impacts on market access from regulatory requirements, and support where regulatory requirements have significant impact; (vi) decisions about restocking be made early with sufficient lead time to ensure businesses can supply stock requested; (viii) appropriate programs and processes are used to contract businesses for restocking; (ix) the current regulatory system and key constraint areas be identified with investment to streamline and reduce costs of regulation for businesses, assisting in offsetting any additional regulation associated with carp control; and (x) those whose business activities are reduced significantly be supported.

Tourism industry

In Australia, as of 2017-18 the tourism industry was estimated to generated $131.4 billion of spending nationally by both domestic and international visitors, and to directly employ 598,200 people across 288,614 businesses nationwide. The focus of our assessment was on tourism in regional communities in which carp invasion has occurred. In regional areas identified as having a moderate to high density of carp in 2016, excluding those where tourism is likely to depend largely on saltwater or non-freshwater related attractions, an estimated 78,000 people worked in tourism in 58 regional local government areas (LGAs) that had 10% or more of their employment dependent on tourism. While many tourism jobs do not depend directly on freshwater-related activities, interviews with tourism representatives and the survey of tourism businesses suggest that, based on past experience of events related to freshwater such as blackwater events, there is potential for changes in visitation that affect a wide range of types of tourism businesses in these LGAs, not only those directly dependent on freshwater. The interviews also suggest that freshwater areas are a common focus of tourism in many of these LGAs, particularly of activities such as houseboats, kayak/canoeing hire and guide businesses, recreational fishing related businesses, water skiing, and many nature tourism businesses; accommodation located on riverbanks and lakes; restaurants, cafes and takeaway food shops; and some hire and retail shops.

Conditions in the industry were reasonably positive as of 2018 (prior to many being significantly impacted by drought). Most tourism businesses interviewed reported that wild carp had minimal impact on tourist business operation or viability, or on tourist visitor numbers. Many tourism businesses operating in freshwater inland regions, particularly those reliant on close contact with rivers, lakes and wetlands (e.g. houseboat operators, fishing guides, nature-based or adventure tourism, and accommodation with water frontage), had past experience coping with reductions in tourist visitation resulting from poor water quality and changed water flow events. For some, these past experiences had increased adaptive capacity with the development of regional or local government support in the form of communication materials, business assistance and support to assist the industry to recover. For others, the events have created significant stress that has impacted on capital reserves and financial viability and reduced their capacity to cope with subsequent events. These past experiences have also resulted in development of processes and materials by the tourism sector that provide important examples to draw on when developing any strategies for supporting tourism businesses as part of the Plan.

The NCCP process had relatively few impacts for the tourism sector. Potential future impacts of carp control include impacts resulting from both actual impacts on amenity, and perceived impacts on amenity, with visitation highly dependent on tourist perceptions, irrespective of the accuracy of these perceptions. Specific potential impacts include (i) increased tourism business opportunities over the longer term (positive): many tourist operators hope carp control will improve water quality, native fish populations and overall environmental amenity and through this increase tourism opportunities in the long-term; (ii) negative impacts of virus release on amenity, causing short-term downturn in visitation while issues such as fish death and poor water quality occur; (iii) negative impacts of virus release on perceived amenity, which has potential to have much larger impacts affecting areas that do not experience an actual decline in amenity as well as those that do. The extent of impact on tourism businesses depends in large part on the length of time and extent of impacts.

Recommended actions to reduce negative and increase positive impacts are to (i) identify and protect tourism sites of importance, (ii) invest sufficiently in robust proactive communication to offset potential decline in visitation; (iii) invest in campaigns to encourage increased visitation associated with action to support environmental recovery after reduction in carp populations; (iv) invest in communication to ensure tourists are aware when an area has recovered after an impact on amenity, and to clearly communicate risk of low amenity for a future booking; (v) support the tourism industry to develop approaches to building confidence in tourism bookings, such as implementing refund schemes if an area is affected by a fish kill when a tourist planned to visit; (vi) actively track impacts on tourism visitation to identify areas where impacts occur; (vii) ensure clean-up activities source accommodation, food and other resources from local businesses where possible to reduce potential downturn in revenue during implementation of carp control; (viii) ensure appropriate investment in achieving improved environmental health, (ix) invest in communications to raise public awareness of long-term improvements in environmental health in order to support visitation; (x) invest in citizen involvement in actions to improve environmental health after reductions in carp populations, with these programs supporting visitation after virus release when visitation is most likely to decrease; and (xi) monitor length of impacts on visitation. If long-term reduction in visitation occurs, consider providing support.

Recreational fishers

Freshwater and estuary recreational fishing are key drivers of visitation to many inland areas. Across Australia, as of 2000 there were an estimated 3.36 million Australians aged five or over who went fishing at least once a year. These 3.36 million fishers spent 20.6 million days fishing between May 2000 and April 2001, in 23.2 million separate fishing events. Just under 20% of recreational fishing effort at that time occurred in freshwater dams and rivers across the country, with an estimated 2.7 million fishing events (fishing trips) in freshwater rivers and 1.9 million fishing events in freshwater lakes or dams (Henry and Lyle 2003). These figures will be updated in 2020 with the release of new figures from the 2019-20 National Recreational Fishing Survey. Within the recreational fishing sector, a relatively small number of fishers focus on carp fishing (coarse fishing, defined as fishing involving targeting a fish considered undesirable for consumption or game fishing). While the development of the NCCP did not have direct impacts on recreational fishing activity or financial impacts for those operating a business that depends partly or wholly on recreational fishing, the proposed release of the carp virus was described as polarising for sections of the recreational fishing community and has contributed some disharmony in relationships across the sector, with widely varying views about whether virus release should occur.

Potential socio-economic impacts were (i) increased fishing success and enjoyment for fishers if carp control actions led to long-term improvement in recreational fishing conditions; (ii) increased revenue for fishing-related businesses (if carp control improved fishing conditions); (iii) opportunities for recreational fisher involvement in actions such as monitoring carp numbers, assisting with clean-up, and actions to increase likelihood of environmental recovery; (iv) reduction in carp numbers for coarse fishers (negative impact), with particular concern expressed that this may reduce access to fishing for some groups who find carp particularly easy to target; (v) reduced fishing opportunities and/or fishing activity if virus release led to water quality problems or other issues that then reduced fishing opportunities for native fish in some areas; (vi) and potential for significant reduction in business activity for some recreational fishing suppliers or guide businesses, although this was considered relatively unlikely to happen, as it would require virus release to result in a real or perceived inability to fish in a relatively large area for a long period of time.

Recommended actions to maximise positive and minimise negative impacts are to (i) coordinate carp control actions with investments in environmental recovery, to ensure carp control achieves meaningful improvement in fishing conditions; (ii) identify opportunities for recreational fisher engagement in programs involving in implementing and monitoring carp control, and programs seeking to improve environmental health; (iii) engage coarse fishers in citizen science projects tracking change in carp population, and invest in identifying alternative fishing opportunities to carp that can be used by groups who currently target carp; and (iv) invest in communication to ensure accurate understanding of safety of fishing, of being in contact with water in areas where virus is released, and of consuming catch.

Koi hobbyists, breeders and supply businesses

Koi keeping is a relatively small hobby in Australia, with koi able to be kept legally as pets in New South Wales, Western Australia and the Australian Capital Territory. In community survey conducted for this project, around one in one hundred people indicated either currently keeping koi or having done so in the past, with around one in two hundred indicating currently keeping koi in their household. The sector conservatively generated annual expenditure of at least $20 to $52 million Australia-wide in the form of koi keeping costs (power, fish food, maintenance of water quality etc), purchase of new fish, and spending on equipment such as koi ponds, water pumps etc. This would in turn be associated with further generation of value through supply chains, meaning this is an estimate of part of the value of the koi industry only. Similar to other countries in which koi are a cultural tradition, many people engaged in koi keeping in Australia spend years (often decades) breeding specific lines of koi for particular characteristics. With relatively small numbers of koi breeding businesses in Australia, and a ban on importing koi from other countries, the domestic hobby is reliant on Australian breeders. Social interaction is a core part of the culture of koi keeping, with koi enthusiasts often visiting each other's ponds and reporting strong positive social outcomes from their engagement in koi keeping.

Current constraints and challenges experienced in the sector include rising costs of electricity and some koi supplies in recent years, that have reduced affordability of the hobby; high reliance on a relatively small number of breeders and hobbyists for stock; limited opportunities for commercial breeders to achieve economies of scale.

The NCCP process created uncertainty for many involved in the koi sector, particularly koi breeding businesses and koi associations, due to uncertainty about ability to continue successful koi breeding and koi shows in future if the virus was released. Some decline in auction sales of koi was observed after the

initial announcement of the NCCP, followed by a rebound, and some breeding businesses reported delaying new investment until the future was more certain.

Key potential impacts of carp virus release for the koi sector were (i) higher day-to-day business costs due to need to introduce biosecurity measures to reduce spread of the virus amongst koi populations, with the extent of impact depending on the availability of cost-effective biosecurity measures; (ii) higher koi keeping costs for hobbyists, again associated with costs of biosecurity measures; (iii) reduced social interaction between hobbyists with associated loss of social connection; (iv) psychological and financial impacts of loss of koi if this occurs due to the virus, which can be significant and long-lasting, with potential for businesses to lose viability and for significant mental health impacts for both businesses and hobbyists; and (v) potential decrease in overall engagement in koi keeping in Australia.

The actions recommended to reduce negative impacts are to (i) provide a clear timeline for decision making to help enable planning for the future and reduce uncertainty; (ii) provide clear and accurate advice on conditions under which the virus could be transmitted to koi and measures to reduce risk for breeders, sellers and hobbyists; (iii) invest in identification of appropriate biosecurity measures and their level of likely effectiveness; (iv) identify costs of effective biosecurity options, and invest in reducing costs where feasible for breeders, sellers and koi keepers; (v) clearly communicate biosecurity options and their likely effectiveness to all involved in the koi sector; (vi) assist koi industry to implement phone support for hobbyists and breeders to increase use of appropriate biosecurity measures, and to refer those experiencing distress to appropriate services; (vii) establish clarity around regulations regarding transportation and sale of koi if the virus is released; (viii) identify how to ensure safe social interactions between koi hobbyists can continue, and clearly communicate this, to reduce impact; and (ix) potentially provide support for koi breeders to diversify businesses beyond koi, to reduce total impact.

Other groups

Other groups with potential to be impacted by carp control actions were not examined in detail, as representatives of these groups generally felt there was either little to no risk of significant direct impacts for them, felt that impacts would not require specific action to address, or felt confident that impacts would be readily able to be addressed. The other groups with particular potential to experience impacts identified in interviews were local government, water supply managers (stock, domestic and irrigation infrastructure), farmers, rural landholders, and recreational users other than fishers. It is possible that these groups, or others not identified in this study may experience socio-economic impacts not identified in this preliminary assessment. Future assessment should focus on ensuring processes are in place to enable rapid identification of emerging or unexpected impacts on a range of groups, something recommended as part of monitoring and evaluation needs discussed in this study.

Overall community impacts

The socio-economic impact assessment (SEIA) conducted for this project focused predominantly on identifying impact that could affect specific groups. This was done as the first step in reducing potential for impacts that affect communities as a whole is to reduce potential for specific groups in those communities to be impacted (many impacts on communities occur as a result of indirect 'flow-on' effects of the direct impacts on these groups). Only limited assessment of potential for community-wide impacts in specific areas was undertaken, as at this initial stage of developing recommendations for carp control, it was only possible to identify the broad range of communities with potential to experience impacts. More precise identification of specific communities likely to be impacted to a greater or lesser extent

(positive or negatively) is possible once decisions are made about the location, nature and timing of any future carp control activities.

Communities have potential to be affected by carp control through (i) flow-on effects of impacts on specific groups described previously in this report, if these impacts cause downturns in employment and economic activity that affect other areas of local economies (ii) direct amenity impacts, with potential for shorter term negative amenity impacts after virus release, and longer-term positive amenity impacts if reduction of carp population led to long-term improvement in health of rivers, lakes and wetlands.

A downturn in overall economic activity and employment large enough to have noticeable flow-on impacts through a local community would occur only in situations in which (i) tourism, recreational fishing, commercial freshwater/estuary fishing, and/or freshwater aquaculture contribute significantly to local employment, and (ii) one or more of these groups is impacted substantially by virus release for an extended period of time, leading to job losses. To assess overall likelihood of this, we assessed which activities contributed, either individually or jointly, to 10% or more of employment in any of the 164 LGAs across Australia recorded as having moderate to high densities of carp . Of these LGAs, 48 were located in large urban cities (specifically, areas of Melbourne, Sydney and Brisbane, as well as the Australian Capital Territory), and considered unlikely to experience any significant impact at community level from change in tourism or fishing/aquaculture. Of the remaining 115 LGAs, only three had more than 0.5% of their employment in 2016 generated by fishing, aquaculture and seafood processing: East Gippsland (0.8% of employment generated by fishing, aquaculture and seafood processing, with only part of this reliant on inland activities and much on marine fisheries), Murrundindi (0.7%) and The Coorong (0.6%, with high reliance on activities occurring inland). In comparison, 60 LGAs relied on tourism for more than 10% of their employment in 2016. After removing two LGAs with high dependence on snow-related tourism unlikely to be significantly affected by carp control, 58 LGAs were identified as meeting the threshold of having more than 10% of jobs dependent on tourism and/or fishing/aquaculture and experiencing carp invasion at more than low levels.

These 58 LGAs have potential to be impacted by virus release. However, it is unlikely all, or even a large proportion of these LGAs would experience significant impacts. Significant impacts would occur only if the tourism industry (possibly in combination with fishing/aquaculture) experienced an extended and significant decline in activity and employment associated with virus release. The highest risk of this occurring would be if negative misperceptions resulted in loss of visitor numbers for tourism industry for an extended period of time, rather than being contained to actual impacts of carp virus release. The actions recommended in this report focus on reducing this risk.

An increase in employment associated with improved environmental health is possible if reduced carp populations occur and are followed by improvement in environmental health. This would occur predominantly in communities where (i) carp densities are high enough to cause environmental damage, and (ii) there is potential for increased visitation for recreational fishing, tourism, and freshwater or estuary related recreational activities resulting from improvements in aspects of environmental health such as native fish populations, riverbank vegetation or turbidity of water. Broadly, the potential for growth in employment is most likely in the 58 tourism dependent LGAs identified above.

Reduced amenity for residents has potential to occur if carp control actions result in large amounts of dead carp or reduced water quality and associated impacts. This could affect any community in which there are sufficient volumes of carp either present in waterbodies and waterways to create negative amenity impacts if the virus causes a large kill of carp, or contributes to a blackwater event that causes a

fish kill that include species other than carp. Just under 8.4 million Australians live in a local government area (LGA) in which waterways and waterbodies have a moderate to high density of carp, and of these just under 5.3 million live in an LGA in which part or all of the waterways and waterbodies have at some point experienced high levels of carp invasion. Many of these are residents of Melbourne and parts of Sydney, as well as those living in the rural and regional areas in which carp invasion has occurred. This means that there are large numbers of Australian who may experience some degree of impact on the amenity of their local area in the short-term after a release of the carp virus. Increased amenity for residents is possible if reduced carp populations are achieved, followed by improvement in environmental health. If this occurs, it could increase wellbeing of residents through improved amenity of outdoor areas and increased recreation in those areas.

Actions recommended to reduce negative impacts on communities and increase potential for positive impacts are to (i) implement the actions recommended elsewhere in this report to reduce risk of jobs being lost in specific industries; (ii) ensure investment in carp control is accompanied by other measures to improve long-term environmental health; (iii) ensure clear communication prior to carp control actions that prepares residents for potential impacts on amenity and reduces risk of misperceptions about potential impacts; (iv) provide ongoing communication during periods of carp kills or poor water quality, to ensure communities have best possible information about progress and likely length of effects of impacts on amenity; and (v) enable residents to assist by reporting on aggregations of dead carp or water quality concerns and ensure feedback is provided on actions taken in response to these reports.

Monitoring and evaluating social dimensions of future carp control action

We recommend that future SEIA (including monitoring and evaluation) focus on:

- Further 'baseline' assessment of current socio-economic conditions for communities experiencing carp invasion and specific groups with potential to be impacted by carp control actions. This should be undertaken when specific carp control actions have been determined and timing of implementation is known, as this will enable more specific, detailed and quantified assessment than was feasible during development of the Plan.

- Design full monitoring and evaluation program in collaboration with stakeholders. This should include planning of real-time collection of data, particularly in initial stages, and how this will be used to inform decisions about allocation of resources such as clean-up and communications activities. This will ensure the monitoring and evaluation is collaborative and agile, and rapidly identifies emerging issues so they can be responded to before they cause significant impacts.

- Monitoring and evaluation needs vary for different stages of decision making, design and implementation of any future carp control strategy.

- Implement rapid monitoring methods during initial 1-2 years of implementation that enable identification of emerging issues and are linked to response systems, ensuring that monitoring can be used to inform rapid adaptation of implementation that reduces potential for negative socio-economic impacts

- Implement longer-term formal assessment of impacts on key communities and industries, initially at one year after implementation, then two years, four years, seven years, and ten years. This enables ongoing consistent tracking of outcomes.

Conclusions

Support for use of the carp virus is less strong than overall support for carp control. Amongst both the community and key stakeholders, overall there is conditional support from most, with outright support and outright opposition less common. However, depending on the type and range of carp control actions included (with most stakeholders strongly preferring multiple control methods be used), and the extent of other investment in ecological recovery, clean-up and communication, the views of many have potential to change, and may range from opposition to support.

A number of groups and communities have potential to be specifically impacted by virus release if it occurs, and some have already experience socio-economic impacts during the development of the NCCP. All groups highlighted that the optimal approach to reducing direct impacts is to ensure involvement of representatives in processes of developing on-ground strategies, so they can ensure the actions designed and implemented reduce risk of negative impacts to things such as culturally important sites, recreational and tourism areas, and enable continued operation of businesses dependant on areas affected by carp invasion or dependent on koi. This type of involvement also significantly reduces the sense of uncertainty or disempowerment that can otherwise result for many groups if they feel their voices are not being heard or acted on.

Specific pathways of impacts differ somewhat for different groups: impacts on commercial fishers and native fish aquaculture businesses depend in large part on whether carp control changes market demand, changes access to markets, or increases business costs. Negative impacts on tourism and recreational fishing result both from actual and perceived impacts on amenity and ability to use areas important to tourism and fishing. Key to a full assessment of impacts in future is clarity about the specific range of actions to be implemented; identification of any regulatory constraints that may accompany carp control actions and how these may affect operations of different businesses or activities; what additional costs may be experienced due to implementation of biosecurity requirements; and the capacity of businesses to cope with any changes in regulation or increases in cost.

Almost all the potential positive impacts identified in the impact assessment are conditional on there being an improvement in environmental health following a reduction in carp populations. If carp reduction is not followed by improvement in environmental health, most positive socio-economic impacts will not occur, highlighting the importance of ensuring actions to reduce carp populations are coordinated with actions to maximise potential for this reduction to contribute to improvements in environmental health. Investment in improving environmental health may occur as a part of carp control, or carp control may be coordinated with other existing programs already being implemented to improve health of areas affected by carp invasion.

While more specific assessment of socio-economic impacts is recommended once the specific actions to be invested in are determined, it is just as important to ensure the actions invested in include processes that enable rapid identification of and response to socio-economic impacts that may emerge during and after implementation of carp control action. Given this, we recommend that investment in monitoring and evaluation be 'front heavy', meaning it is highest during initial stages of implementation, and can rapidly inform on-ground actions to reduce impacts. This can then be followed by longer-term monitoring of outcomes, which are likely to be more positive due to the earlier investment in rapid monitoring and response to any emerging challenges.

Implications

- There is strong support for investment in carp control amongst the general public, once made aware of problems of carp invasion, and many people are willing to support carp control, even if it causes some negative short-term impacts.

- Twice as many support as oppose the release of the virus, however, many are uncertain and there is high potential for community attitudes about virus release to shift rapidly (to support or opposition).

- Perceptions of the potential for negative impacts of virus release influence levels of support more than awareness of carp invasion or trust in organisations.

- Views of the broader public are highly influenced by the views of key stakeholder groups they trust.

- There is tentative and conditional support for release of the virus amongst many, but not all, stakeholders.

- Stakeholders have high levels of knowledge and expect detailed information and meaningful engagement in future development of carp control strategies.

- The extent to which negative or positive socio-economic impacts occur as a result of actions to reduce carp populations depends on the nature of the actions used to control carp and investment in measures designed to reduce potential for or mitigate negative impacts

- The NCCP process has resulted in significant impacts already for some, predominantly commercial carp fishers, and in uncertainty about the future for others, particularly those involved in fishing, aquaculture and tourism activities in areas affected by carp invasion

- Carp control actions could cause loss of income or employment for specific groups, particularly commercial carp fishers, inland native fish aquaculture businesses, koi and tourism businesses

- Loss of income or employment is unlikely to be of a scale that has significant flow-on impacts to the broader local economy in most cases; however, some LGAs could experience negative impact if carp control activities led to a substantial decline in tourism visitation over a long period

- There is potential for relatively large numbers of people to experience short-term impacts on local amenity as a result of actions to reduce carp

- Many negative social impacts can result from negative perceptions even if these negative perceptions are inaccurate

- Positive socio-economic impacts predominantly depend on improvement in environmental health and amenity occurring after a reduction in carp populations.

Recommendations

To increase likelihood of carp control having a social licence from *stakeholder*s, who in turn have a strong influence on public opinion, we recommend:

- Further research into long-term effectiveness of carp control actions

- Further investment to identify actions that increase likelihood of a reduction in carp populations being followed by improvement in environmental conditions and amenity

- Development of carp control strategies that include multiple measures to control carp, rather than relying solely on use of the virus

- Development of strategies that integrate carp control with other actions to improve environmental health in freshwater and estuary areas

- Development of detailed guidance on the planned timing and management of carp control actions, particularly virus release

- Clear identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios

- Identification and appropriate mitigation of potential social and economic impacts of carp control on specific groups

- Appropriate involvement of different groups in decision making processes

- Sound governance, including clear commitment of funding and other resources to carp control and identification of responsibilities of different agencies, and

- Development of appropriate monitoring and evaluation strategies to ensure socio-economic outcomes can be identified (see subsequent SEIA recommendations).

To increase the likelihood of community support for carp control actions, we recommend that:

- A range of organisations trusted by the community are involved in signing off carp control actions, to build confidence in those actions
- Investment is made in increasing awareness of carp invasion and the problems it results in
- There is investment in communication to address common concerns about issues such as transmissibility of the virus to humans or animals, impacts on water quality, and costs versus benefits of action.

The key focus of the SEIA conducted for this report was identifying how carp control could be designed to reduce potential negative social and economic impacts and increase potential for positive impact. To achieve this, carp control actions should include:

- **Active involvement** of Traditional Owners, tourism sector, native fish aquaculture, local government, recreational fishers, water managers, farmers and other relevant stakeholders in prioritisation of clean-up areas and ensuring safe and appropriate access to areas for clean-up.
- **Active monitoring and communication** with potentially impacted businesses and local government areas prior to, during and after virus release, ensuring sectors such as tourism have access to the information they need to put in place strategies to reduce impacts.
- **Proactive communication strategies** to reduce risk of longer-term reduction in visitation of areas or reduced consumption of some products as a result of negative perceptions.
- Identification of **regulatory implications** of virus release for commercial carp fishing, commercial fishing, recreational fishing and aquaculture in areas where virus release will occur, as well as for

transport and sale of koi in any area, and impacts of these, as well as development of strategies to assist affected businesses adapt to changes.

- Ensure carp control is co-ordinated with **long-term investment in measures to improve environmental health** following a reduction in carp populations.
- **Provide opportunities for involvement** of potentially impacted groups in carp control and environmental recovery activities, e.g. citizen science activities such as engagement in clean-up activities, , and supporting environmental recovery measures such as restocking of native fish.
- **Acknowledge impacts** on those who experience them: impacts are more damaging psychologically when not recognised and acknowledged, and recognition assists people to process and adapt to impacts.
- **Support those experiencing significant impacts.** While assessment suggests relatively small numbers of businesses are likely to experience long-term impacts, there is potential for some to experience these. A support program that can be applied for by those who experience significant long-term impacts is important.
- **Identify cumulative impacts**, meaning where carp control actions may combine with other unrelated stresses being experienced by a sector to potentially cause a 'tipping point' for business viability or a person's wellbeing.

Keywords

Carp, carp virus, community attitudes, stakeholders, social licence, socio-economic impact assessment

Introduction

In 2016 the Australian Government announced a $15 million investment to develop the National Carp Control Plan (Plan). The Plan is being developed through research and consultation with stakeholders and community members. It focuses on evaluating the feasibility of releasing the carp virus Cyprinid herpesvirus-3 (referred to as the 'carp virus' from here) for reducing carp numbers. The Plan will be submitted to the Australian Government in December 2019, and the Government will draw on the Plan recommendations to make decisions about and inform development of future carp control strategies.

If the carp virus is found to be a feasible strategy for reducing carp numbers, it would potentially be delivered over a large geographic area, in waterways and waterbodies that are essential to Australia's traditional owners, primary industries, household water consumption, and millions of recreational users each year.

Critical to the success of the Plan and any subsequent use of its recommendations in carp control actions is widespread support from the diverse range of stakeholders who depend on or have an interest in carp, freshwater health and fisheries, as well as from people living and spending time in the regions where carp control measures will be implemented.

Support for the recommendations made in the Plan, and for action to control carp more broadly, will depend on a range of factors, including:

- The extent to which people believe investing in carp control is an appropriate and effective way of improving environmental health
- Expected benefits versus costs of proposed carp control methods for different groups and communities
- Trust in the processes and evidence used to develop the Plan and subsequent carp control actions, and in the agencies tasked with implementing carp control, and
- The perceived environmental, economic and social risks of actions proposed for carp control.

Researchers at the University of Canberra were commissioned to develop understanding of community and stakeholder attitudes across these areas and to evaluate anticipatory and potential socio-economic impacts of the Plan, focusing on potential use of the carp virus, while also examining views and preferences about carp control more broadly. This work aims to inform development of recommendations that will have support from communities and stakeholder groups, through guidance on how these actions could be designed in ways that appropriately address the needs, concerns and priorities of community and stakeholders.

The University of Canberra project was commissioned to conduct two research projects:

- Project 1 (subject of a separate Final Report, the key findings of Project 1 are also included in this report so readers do not have to refer to both reports): Building community support for

carp control: understanding community and stakeholder attitudes and assessing social effects

- Project 2 (subject of this Final Report): Socio-economic impact assessment and stakeholder engagement.

Overall, the two projects aimed to contribute to increase likely social acceptability of future action to reduce carp populations through:

- Identifying and understanding stakeholder and community needs, concerns and expectations regarding carp control, so these are considered throughout the development of the Plan and integrated in the recommendations under the Plan

- Identifying potential socio-economic impacts of carp control for different stakeholder groups and communities, and measures to reduce negative and maximise positive socio-economic impacts, and

- Understanding the types of information, consultation and engagement needed by different stakeholders in the process of developing the Plan.

- Identifying a framework for ongoing monitoring and evaluation of socio-economic impacts and community attitudes beyond the life of the NCCP.

This work has been used to inform both the process used to develop the Plan (including communication, consultation and engagement with stakeholders and communities) and will be drawn on to inform development of the content of the Plan. The work will inform evaluation of the feasibility of carp virus and strategies for minimising negative and maximising positive impacts of any carp control actions recommended in the Plan.

This document reports on final results of both projects, incorporating results of Project 1 and Project 2. Project 1 contained multiple components of work, which were adjusted after the first stages of the project to reflect priority needs identified in the first part of the project. The findings emerging during Project 1 triggered development of Project 2, to enable investigation of further areas. To assist in understanding the history of the project and the scope of work, Table 1 summarises key components of work, when they were conducted, when changes were made to the scope of the project and why, and which components of work were undertaken as part of the second University of Canberra project that followed this one.

Table 1 Project 1 and 2 activities – summary, timeline and reporting

Timing	Activity or project modification	Associated output	Included in Final Report of Project 1?
Sep-Nov 2016	Inclusion of questions about carp control in 2016 Regional Wellbeing Survey	Report: Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns	Yes – Appendix 1 (also included in Final Report of Project 1).
Sep-Dec 2017	Interviews with key stakeholders	Report: Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns	Yes – Appendix 1 (also included in Final Report of Project 1).
Spring 2017	Project modified: Initial interviews with stakeholders indicated a level of fatigue with general consultation, and a need to examine potential impacts on specific groups in more depth than had originally been planned. A modification to the project was approved, with the two stakeholder collaborative workshops and round of stakeholder interviews originally planned replaced with interviews/workshops with four specific groups: commercial carp fishers, koi hobbyists and breeders, native fish aquaculture businesses, and the tourism industry. To enable the additional work, one round of previously planned community attitude survey work was removed from the work program.		
Dec 2017	Community attitudes survey	Presentations given to NCCP. The original project specified a report would be produced, however the rapid additional collection of data and need to provide ongoing updates to NCCP staff meant this was amended to providing presentations on findings in powerpoint form.	This project Appendix 2 summarises key findings given in presentations (also included in Final Report of Project 1)
Jan-June 2018	Interviews and workshop with commercial carp fishers	Report: National Carp Control Plan socio-economic impact assessment: Commercial carp fishers (Second edition)	Provided in Appendix 3. First edition was provided in Final Report of Project 1.
Mar-May 2018	Interviews with tourism industry members	Report: National Carp Control Plan socio-economic impact assessment: Tourism Sector (Second edition)	Provided in Appendix 4. First edition was provided in Final Report of Project 1.
June-Sep 2018	Second round of interviews with key stakeholders	Informed development of National Carp Control Plan Communication and Engagement Strategy & Operational Plan 2019	Summary of stakeholder views is provided in Appendix 5.
Aug-Nov 2018	Interviews and workshop with members of native fish aquaculture industry	Report: National Carp Control Plan socio-economic impact assessment: Native fish breeders and growers industry (Second edition)	Provided in Appendix 6.
Dec 2018	Stakeholder engagement recommendations	Included in National Carp Control Plan Communication and Engagement Strategy & Operational Plan 2019	No – the strategy and operational Plan is a separate document. Appendix 5 provides a summary of key input made to the document.
Nov-Dec 2018	Tracking survey – community attitudes	Presentations given to NCCP	Appendix 2 summarises key findings given in presentations
Apr-May 2019	Final community attitudes survey	Results reported in final editions of reports for recreational fishing, tourism, native fish aquaculture, commercial	Tracking data reported in Appendix 2. Specific analyses reported in final editions of

Timing	Activity or project modification	Associated output	Included in Final Report of Project 1?
		carp and koi reports (Final Report 2). Tracking data on acceptability of carp control reported in Appendix 2.	commercial carp, native fish breeders, tourism, koi and recreational fishing reports, included as Appendices 3, 4, 6, 7 and 8 to this report.
Mar-Sep 2019	Interviews with recreational fishers and recreational fishing businesses	Report: National Carp Control Plan socio-economic impact assessment: Recreational fishing sector	Report included in Appendix 7.
2018-2019	Interviews with koi stakeholders and vet sector and participation in workshop	Report: *National Carp Control Plan socio-economic impact assessment: Koi hobbyists and businesses.* This report was originally to be produced in first edition as part of the first report; amendment to the project in 2019 expanded the scope of interviews to be conducted, resulting in this milestone (producing the report) being shifted into Project 2.	Report included in Appendix 8
Jun 2019	Stakeholder workshop	Report: Engaging with the National Carp Control Plan: summary of a stakeholder workshop	Report included in Appendix 9.
Jun-Jul 2019	Additional impact assessment reporting (i)	The existing work was reviewed to produce a summary of findings for Traditional Owners	Reported in results section of this report
Jun-Jul 2019	Additional impact assessment reporting (i)	The existing work was reviewed to produce a summary of findings identifying communities potentially vulnerable to impacts.	Reported in results section of this report
Aug 2019	Socio-economic discussion paper	Analysis of potential community-wide impacts conducted, and discussion paper produced summarising results of both projects.	Report included in Appendix 10
May-July 2019	Final phone discussions with stakeholders, to follow up June workshop discussions	Summary of findings informed socio-economic discussion paper and summary of stakeholder workshop.	A summary is provided in this report as part of the findings section, as well as detailed
2019	Identify future monitoring and evaluation needs	Recommendations for future monitoring and evaluation of socio-economic dimensions of carp control	Included in results and recommendations sections of this report (as well as in the Project 1 final report)
2018-2019	Communications support	The project team provided some review of key communications materials and input to some discussion papers	Activities are summarised in the findings section.

As a complex project with multiple dimensions, the main body of this Final Report focuses on synthesising and summarising key findings to enable rapid understanding of key findings of the

project. The individual Appendixes then provide detailed data and findings for each individual aspects of this project.

The report is structured as follows:

- **Introduction** (this section): Explains the scope of work undertaken across the two projects this first project formed part of, and where different results are reported; and explains structure of the report

- **Objectives:** Describes overall objectives of Projects 1 and 2

- **Scope of socio-economic impact assessment**: Explains the nature and scope of the SEIA undertaken

- **Method:** Summarises methods used, and identifies where more detailed data on methods can be found for different parts of the project in different Appendices.

- **Results:** The results focus on synthesis of the four key areas examined in Projects 1 and 2:

    - **Key stakeholders.** What are the views of key stakeholders about carp control, and what does this mean for likely support for future actions to control carp using the virus if a decision is made to release the virus? This section synthesises findings from three waves of stakeholder interviews, conducted by phone, face-to-face and email depending on preferences of stakeholders, and provides a summary of findings of the stakeholder workshop conducted in June.

    - **Community attitudes.** What are the views of the broader community about carp control, and did these change during the period in which research was being conducted for the National Carp Control Plan? This section is identical to that provided in the Final Report for Project 1.

    - **Socio-economic impact assessment.** This section summarises the findings of socio-economic impact assessment for specific groups assessed, and more broadly for communities in which carp invasion has occurred.

    - **Monitoring and evaluating social dimensions of future carp control action.** This section provides recommendations for future monitoring and evaluation of socio-economic impacts of any future carp control actions before, during and after implementation. This section is identical to that provided in the Final Report for Project 1.

- **Discussion and conclusion:** The discussion and conclusions section focus on synthesising the four parts of the findings to identify key challenges and opportunities for carp control in future.

- **Implications:** The implications section focuses on examining what the findings imply about likelihood of achieving future support for carp control, and the conditions under which

support is more and less likely to be achieved. The Final Report for Project 2 then adds implications related to potential socio-economic impacts of carp control.

- **Recommendations:** The recommendations section focuses on recommendations for reducing potential negative impacts, increasingly potential positive impacts, and achieving stakeholder and public support for carp control.

- **Extension and adoption:** This section summarises the types of extension activities undertaken during the project, and the potential future uses of the findings of this project in relation to development and implementation of carp control activities.

- **Project materials developed:** This section lists the different project materials developed; the content of these is then provided in the Appendices.

- **Appendices:** The appendices provide detailed project reports and results produced during Project 1:

    - **Appendix 1: Getting the National Carp Control Plan right:** Ensuring the plan addresses community and stakeholder needs, interests and concerns. This Appendix reports results of first round of stakeholder interviews and first community attitudes survey. It is identical to Appendix 1 in Final Report 1.

    - **Appendix 2: Findings of community attitudes surveys.** This Appendix reports findings of the four waves of community attitudes surveys, using materials presented to the NCCP progressively through the life of the project. It is identical to Appendix 2 in Final Report 1.

    - **Appendix 3: Socio-economic impact assessment - commercial carp fishers (second edition).** This Appendix reports findings and recommendations of socio-economic impact assessment for the commercial carp fishing sector. It updates the first edition provided in Final Report 1 with an updated and expanded report.

    - **Appendix 4: Socio-economic impact assessment – tourism sector (second edition).** This Appendix reports findings and recommendations of socio-economic impact assessment for the tourism sector. It updates the first edition provided in Final Report 1 with an updated and expanded report.

    - **Appendix 5: Stakeholder interviews.** This appendix reports findings of the second wave of stakeholder interviews conducted for the project. It is identical to Appendix 5 in Final Report 1.

    - **Appendix 6: Socio-economic impact assessment – native fish breeders and growers (second edition).** This Appendix reports findings and recommendations of socio-economic impact assessment for the native fish aquaculture sector. It updates the first edition provided in Final Report 1 with an updated and expanded report.

- **Appendix 7: Socio-economic impact assessment – recreational fishing sector.** This Appendix reports findings and recommendations of socio-economic impact assessment for the recreational fishing sector.
- **Appendix 8: Socio-economic impact assessment – koi hobbyists and businesses.** This Appendix reports findings and recommendations of socio-economic impact assessment for the koi sector.
- **Appendix 9: Engaging with the National Carp Control Plan –** summary of a stakeholder workshop. Findings of stakeholder workshop.
- **Appendix 10: Socio-economic discussion paper.** This paper synthesises key results of the overall examination of socio-economic impacts.

Objectives

The objectives of the two projects, as specified in the respective contracts, were:

FRDC Project 2016/152:

1. Quantify and explain community attitudes to potential carp control measures including virus release

2. Inform design of NCCP communication processes, through identifying most effective communication and consultation methods for different stakeholder groups

3. Identify strategies to increase trust in and acceptance of carp virus release, including communication strategies and strategies to maximise positive and minimise negative socio-economic effects of carp control measures proposed in the National Carp Control Plan

4. Produce full protocol for continued monitoring and evaluation of community and stakeholder attitudes during future implementation of the National Carp Control Plan.

FRDC Project 2018/189:

1. Communication and engagement with stakeholders contributes to integration of stakeholder perspectives into development of the Plan

2. Potential socio-economic impacts of carp control are identified and implications for design of recommendations in the Plan identified

3. Stakeholder workshop successfully enables dialogue between stakeholders and scientists that results in better understanding of carp control challenges and opportunities

4. Discussion papers enable a wide range of stakeholders to access information about key considerations for carp control.

Overall, these objectives aimed to contribute to increasing the social acceptability of future actions implemented to reduce carp populations, through ensuring actions are implemented to reduce potential negative impacts, increase potential positive impacts, and address concerns and needs of different groups.

Scope of socio-economic impact assessment

Assessing the potential social and economic impacts of a proposed future action – as is the case with carp control in Australia - is challenging. This is because the type and extent of impacts experienced will depend on how well the action is designed and implemented, particularly whether specifically designed strategies are put in place to reduce risk of negative social and economic impacts. Impacts will also depend on the extent to which those experiencing impacts have the capacity to cope with and adapt to the changes it causes.

Social and economic impact assessment (SEIA) emerged in the 1960s as part of the field of environmental impact assessment, as it became apparent that many projects had social and economic as well as environmental impacts. At first, SEIA was only conducted after a decision had been made to implement a project and involved identifying who would be impacted in different ways by actions that had already been decided on. However, conducting impact assessment only after decisions were made, and without also examining existing social and economic conditions, meant that there was little scope to use this knowledge to change how the project was implemented in order to minimise negative and maximise positive social and economic impacts. In many cases, it would have been possible to reduce negative impacts had the potential for them to occur been recognised *before* decisions were made about how to implement the project. It was also common for projects to have low social acceptability when they were not designed with consideration of their potential social and economic impacts (Esteves et al. 2012, Schirmer 2018). As the field evolved, practices changed, due also to recognition that:

1. **Social and economic impacts of a project begin during its development**. The period in which a project is being developed but is not yet implemented is often associated with high uncertainty about how the eventual project will impact a person or community's future. This is often associated with 'anticipatory' social and economic impacts as people, businesses and communities delay decisions about their future due to uncertainty about the nature of the proposed project, and experience psychological impacts associated with this uncertainty (Loxton et al. 2013a,b, Vanclay 2012, Walker et al. 2000). Concerns about the potential risks and impacts of a proposed action are often highest during this anticipatory period, as people identify a wide range of possible outcomes that could occur depending on whether and how the project is implemented (Loxton et al. 2013a, Schirmer 2018).

2. The **processes used to develop and implement a project also have social and economic impacts**. For example, if a group is excluded from consultation processes during development of a project, they are likely to experience negative psychological impacts resulting from the exclusion, will be less likely to support the ultimate decisions made due to the lack of procedural justice they have experienced, and the ultimate design of the project is less likely to address potential for impacts on that group (Gross 2008, 2011).

3. The **broader social and economic conditions** households and communities are experiencing influence the social and economic impacts of a project, and people's perceptions of those

impacts (Williams and Schirmer 2012). In SEIA literature this is typically referred to as the challenge of 'cumulative effects', in which the action being planned may interact with other events occurring at the same time (Franks et al. 2010a,b; Loxton et al. 2013b, Schirmer 2018). For example, a business already experiencing stress will be less able to cope with a temporary shut-down of work due to effects of a project compared to one that is operating profitably.

4. Impacts depend on the **vulnerability and adaptive capacity** of those impacted: the extent of impact depends on the resources a person, business or community have to draw on to adapt to the change, with multiple factors across socio-ecological systems influencing vulnerability to experience impacts and capacity to adapt to impacts, ranging from the access of a household to financial resources, the ability of a business to access or develop alternative markets, the ability of a community to cope with a downturn in economic activity, and the institutional systems, such as regulatory and policy settings, that enable and constrain adaptation (Yohe and Tol 2002, Gallopin 2006).

5. **Baseline assessment –** the assessment of conditions prior to implementing a change, based on the idea of impacts then being defined as a deviation from the baseline caused by the action implemented – are often problematic. In particular, the action being implemented will typically be only one of many that is contributing to social and economic change amongst a given group or in a particular community, and social and economic conditions typically change over time, often significantly. This raises the question of what type of baseline assessment should be taken and when: at a minimum, care is needed to ensure that changes affecting groups/communities other than the action being implemented are identified, and that baseline assessment be dynamic, identifying not only conditions at one point in time but trajectories of change prior to implementation of an action (see for example Joyce et al. 2001, Schirmer 2011, Esteves et al. 2012).

6. **Socio-economic change is not the same as socio-economic impact.** The socio-economic changes caused by a project will impact different people in differing ways, depending on their individual circumstances. Socio-economic impacts are defined as the experience of change, including how socio-economic change affects a person or community's way of life, culture, economy, business and job opportunities, community cohesion and character, health and wellbeing, personal rights, property rights, safety and security of their future, amongst others (Vanclay 2002).

This more complex understanding of social and economic impact processes has led to substantial changes in how best-practice SEIA is implemented. International guidance on best-practice SEIA recommends that SEIA begin during the process of researching and designing a potential project, and then continue through implementation of the project and monitoring of its outcomes. The goal of SEIA has also changed: instead of focusing principally on mitigating harm, SEIA focuses on proactively informing the design of programs and projects to ensure their social and economic benefits are increased as well as to minimise their negative impacts. This is more likely to result in a project that is considered socially acceptable and given a 'social licence to operate' (Vanclay et al. 2015).

SEIA is thus now viewed as an ongoing process, which should inform all stages of project development. During development of a project, SEIA focuses on identifying how to best design a project to maximise positive and minimise negative impact, rather than quantifying specific impacts; once the project is designed quantification of impacts can occur, and impacts are then monitored during implementation of the project, with this knowledge used to modify the project or implement mitigation actions as the project progresses.Scope of assessment

The stages of the SEIA process are, broadly, the following (adapted from sources including Joyce et al. 2011, Esteves et al. 2012 and Vanclay et al. 2015):

1. Development (actions being developed and designed, with final decisions not yet made about what actions will proceed):
    a. Ensuring stakeholders have a voice in development of actions that may affect them
    b. Identifying anticipatory impacts caused by the process of developing the action
    c. Scenario analysis – what impacts could occur, for which groups, under what scenarios? This can require analysis of existing conditions, particularly vulnerability and adaptive capacity of groups
    d. Recommendations – how can the action be designed to minimise negative impacts, mitigate those that do occur, and increase potential for positive impact?
2. Pre-implementation (decisions about actions made but not yet implemented):
    a. Complete baseline assessment (which may have begun during the development stage), ensuring that it is up-to-date and identifies tejectories of change as well as current conditions
    b. Design impact mitigation measures
3. Implementation (action implemented)
    a. Monitor and evaluate impacts
    b. Adapt action as needed to address impacts emerging.

This project was conducted as part of what was effectively a scoping phase for developing potential carp control actions. As such decisions about the exact type of carp control to be undertaken had not yet been undertaken. At this stage of socio-economic impact assessment and attitude assessment, research should focus on identifying (i) current conditions, and (ii) factors influencing attitudes and impacts, so these can be considered as part of developing recommendations about future carp control. This report therefore focuses on part 1 of the process of SEIA, as this is the stage that accompanies the actions being undertaken by the NCCP. It also includes some recommendations for the second and third stages and how they should be conducted once decisions about carp control actions are made.

The social assessment conducted therefore focused on identifying:

- *Current views* about acceptability of carp control, and whether these changed during the period in which the NCCP was conducting research
- What actions or conditions would be likely to change views about acceptability of carp control
- *Potential* socio-economic impacts that could occur, for whom, and under what circumstances, and
- What actions could be implemented to reduce the risk of *negative impacts* and increase potential for *positive impacts.*

While current attitudes towards carp control and virus release were quantified, no attempt was made to quantify likely future levels of support for release of the virus. Instead, the focus was on identifying what factors would most affect future levels of support, so that these could inform design of any future actions to control carp, in ways that provided the best opportunity for public support for the carp control actions invested in. The actual levels of future support for (or opposition to) carp control will depend on a wide range of factors including trust in the organisations implementing carp control actions, trust in the validity and robustness of research on potential environmental, social and economic impacts, views about likely impacts, views about the extent to which carp control is necessary and a high priority compared to other investment in improving environmental conditions, and views about the likely effectiveness (short term and long term) of the methods used to reduce carp populations.

Similarly, detailed quantification of likely impacts was not undertaken, for two reasons. Firstly, at the time of this initial assessment biophysical research was continuing into the extent to which there are risks of significant loss of amenity, reduced water quality or other negative impacts in the period after virus release, and the potential for long-term positive impacts on environmental health post-virus release. Secondly, decisions about the ways carp control would occur in future had not yet been made. QInstead, the potential impacts and conditions under which they had potential to occur were identified.

What was possible was identification of (i) the types of groups and activities that could potentially be impacted, (ii) the scale and extent of the existing activities/groups that have potential to be impacted, and (iii) the factors that most strongly influence the extent and nature of potential impacts. This knowledge was then drawn on to identify key recommendations for designing future carp control action to minimise negative impacts and increase positive social and economic outcomes.

Methods

This section explains the methods used in the project, using a narrative approach of explaining the step taken, particularly:

- How the stakeholders and communities potentially impacted by carp control were identified
- Stakeholder interview and workshop methods
- Community attitude survey methods.

Identifying stakeholder groups and communities

The first part of the project involved identifying the people and communities with potential to be impacted by carp control involving a release of the carp virus. These were initially identified using three methods:

- A review of the human activities occurring on, in and linked to waterways and waterbodies in which carp invasion has occurred, to identify the range of groups and communities potentially affected by actions to control carp.
- Review of public discussion about the proposal to release the virus, principally using searches of traditional media, social media and online discussions. This helped identify other groups with potential to be impacted by virus release or with a strong interest in carp control, even if they were not directly linked to areas experiencing carp invasion.
- Surveys of the general public identified views about both carp control and virus release and were also used to identify if any specific groups indicated high concern about potential impacts, indicating a need for further in-depth investigation.

The key groups and types of communities identified using these methods as having potential to be impacted by carp control are summarised in the list below. While not an exhaustive list, these represent the specific groups with the greatest potential to experience impacts (negative and positive):

- Traditional Owners
- Commercial carp fishers and businesses involved in processing carp
- Other commercial fishers operating in inland fisheries, or in fisheries in which carp fishers also hold licences
- Native fish aquaculture industry operating in areas experiencing carp invasion
- Tourism businesses operating in areas experiencing carp invasion
- Koi hobbyists, breeders and businesses supplying the koi sector
- Irrigators in areas experiencing carp invasion
- Other farmers and other rural residents living adjacent to areas affected by carp invasion
- Recreational fishers in areas experiencing carp invasion (including those who target carp)

- Other recreational users of areas experiencing carp invasion (ranging from those who actively use water areas such as swimmers and kayakers, to those who use park and picnic areas adjacent to water bodies invaded by carp)
- Domestic water consumers who rely on water from areas experiencing carp invasion, and
- More broadly, communities located in areas experiencing carp invasion.

Key stakeholder interviews and workshops

After identifying the groups listed in the previous section:

- An initial group of 23 key stakeholders, including two to three representatives of each group identified in the previous section, were interviewed in 2017 in a first wave of 'key stakeholder interviews', to further identify potential for impacts.
- A second round of follow-up interviews was undertaken in 2018, including re-interviewing 10 of the original 23 stakeholders, and interviewing a number of additional stakeholders, to identify whether and how views about carp control were changing, and to discuss engagement with the National Carp Control Plan to date
- A third round of data collection occurred prior to and during a stakeholder workshop held in June 2019, the report of which is provided as part of the Final Report for project 2. This focused on identifying overall views about carp control and whether they were changing, and discussing initial results of a range of National Carp Control Plan research with stakeholders to identify their questions, concerns and views about implications of the findings for carp control action.

In addition to these interviews, a large number of further interviews were undertaken with representatives of specific groups identified as having highest potential to experience impacts (positive or negative) if future action is implemented to reduce carp numbers. These are described in the next section. When these interviews are included, in total across the project approximately 125 stakeholders were either interviewed (for a general 'stakeholder' interview or to identify potential impacts on a group they represent or belong to), or participated in a workshop, with some doing both.

Appendices 1 and 5 provide further detail about the methods used in stakeholder interviews, Appendix 9 provides details of the June 2019 stakeholder workshop, and Appendices 3, 4, 6, 7 and 8 provide details of the people interviewed from specific groups for whom potential socio-economic impacts were assessed in detail.

Assessing potential socio-economic impact on specific groups

Based on the first round of stakeholder interviews and the earlier assessment of potential for impact, six groups were identified with the highest potential to experience direct *negative* impacts immediately after a virus release. Some of these groups also have potential to experience longer-term positive impacts if carp control results in improved environmental health:

- Traditional Owners and Custodians of the areas in which carp invasion has occurred, and where carp control actions would take place.
- Commercial carp fishers, as well as other commercial fishers operating in areas where carp invasion occurs.
- Tourism industry operating in areas experiencing carp invasion.
- Native fish aquaculture breeders and growers, predominantly but not solely those operating in areas affected by carp invasion.
- Koi hobbyists, breeders, and associated organisations
- Recreational fishers and businesses associated with recreational fishing who utilise or depend on areas in which carp invasion has occurred.

A separate NCCP project led by researchers with expertise in engaging with Aboriginal and Torres Strait Islander peoples was established to consult with Traditional Owners. The results of this project are reported in a separate document to this one. However, this project did include participation of Aboriginal and Torres Strait Islander people. At the request of some of those participants, a specific section in the findings summarises key issues identified by those who participated in the study in interviews, surveys or workshops. This ensures that input captured in this project can be considered together with the more in-depth insights from the separate project commissioned by the NCCP.

A specific socio-economic impact assessment was conducted for each of the remaining five groups, each involving slightly different methods based on the optimal ways identified of collecting data required for assessment:

- Commercial fishers: Data were collected through semi-structured interviews with commercial fishers (2017-18), a workshop with fishers and representatives of fishers (2018), the May 2019 community attitudes survey (which collected data on willingness of consumers to consume carp products), and the June 2019 stakeholder workshop. The specific report for this group provides a detailed description of these methods (Appendix 3). Originally a survey of those in the sector was planned, however this was not undertaken as it became apparent that the best use of available resources would be to focus on identifying risk of negative impacts occurring and how best to reduce then (for example through identifying potential consumer reactions to virus release and how these might affect markets for live-harvested carp) , rather than on providing highly specific quantification of existing levels of activity that is likely to change by the time any carp control is implemented. Instead, limited quantification of current size and scope of the industry was undertaken, with a recommendation to conduct a more detailed quantitative assessment closer to the time of implementing carp control activities.
- Native fish aquaculture: Data were collected through semi-structured interviews with people involved in the sector, principally business owners (2017-18), a workshop with members of the sector, the May 2019 community attitudes survey (which collected data on willingness of consumers to consume aquaculture products), and the June 2019 stakeholder workshop. The

specific report for this group provides a detailed description of these methods (Appendix 6). Similar to carp fishers, originally a survey of those in the sector was planned, however this was not undertaken for the same reasons as those described above for carp fishers. Instead, available data were used to provide a limited assessment of current size and scope of the industry, and survey resources focused on identifying potential consumer reactions to better identify risks of change in demand for product. In addition, existing secondary data on the size and scope of the sector were drawn on.

- Tourism sector: Data were collected through semi-structured interviews with tourism businesses and representative organisations, a survey of tourism businesses that focused on identifying potential for impacts from carp control for both businesses directly dependent on freshwater and others located in areas experiencing carp invasion, and adaptive capacity of businesses, the May 2019 community attitudes survey (which collected data on likely visitation behaviour associated with carp control action), and the June 2019 stakeholder workshop. The specific report for this group provides a detailed description of these methods (Appendix 4). In addition, existing secondary data on the size and scope of the sector were drawn on.

- Recreational fishing sector: Data were collected through semi-structured interviews with recreational fishers, recreational fishing businesses, and representatives of fishing organisations, community attitudes surveys (which identified whether people were recreational fishers, and their views about carp control and virus release and the June 2019 stakeholder workshop. The full report is provided in Appendix 7.

- Koi sector: Data were collected through semi-structured interviews with koi hobbyists, koi breeders, and associated businesses, as well as aquatic vets, through attending the annual Sydney koi show, a workshop with koi representatives, two community attitudes surveys (which identified whether people were koi owners or had been, and their views about carp control and virus release, as well as likelihood of entering the koi hobby if the virus was released), and the June 2019 stakeholder workshop. Analysis is provided in Appendix 8. A survey of the sector was not conducted, as interview participants indicated high reluctance to participate even in interviews, and suggested surveys would be better done once decisions were made about carp action, when more detailed quantification of impact could be achieved from such a survey.

Appendices 3, 4, 6, 7 and 8 provide more detail descriptions of the stakeholders interviewed and methods used to collect and analyse data for each of these five specific sectors.

Surveys examining community attitudes

Community views about carp control in general, and specifically about releasing the carp virus, were assessed through four surveys, summarised in Table 2. All surveys collected stratified samples, meaning some groups or regions were deliberately oversampled to ensure results could be reported for that group or region. A total of just over 24,000 individuals participated in surveys in which they provided their views about carp control and the carp virus (in total around 29,000 survey responses were achieved, however approximately 3,000 people participated in two or three of the surveys

between 2016 and 2019 rather than only one). When identifying overall views of the whole population, data were weighted so findings were representative of the adult population.

The specific content of each survey is provided in Appendix 1 (Survey 1) and Appendix 2 (Surveys 2, 3 and 4). Appendix 1 also describes the process used to design and test survey questions, which was followed for all four surveys. For each survey, small numbers of participants opted not to answer some questions while answering others. The number of respondents indicated in Table 2 therefore indicates the number who completed all or almost all survey questions, while the number of survey respondents reported when presenting results varies slightly from this overall number (sometimes slightly higher for questions that all respondents answered, and sometimes slightly lower).

All the surveys repeated one item with consistent wording: participants were asked to rate how acceptable they would find 'Reducing numbers of carp (a pest fish) by releasing the carp herpes virus', on a scale from 1 = very unacceptable to 7 = very unacceptable with a 'don't know' option also provided,. This question was asked before any information was given about carp or the carp virus, meaning responses reflect whatever level of knowledge the person had before completing the survey, and hence reflected current knowledge and perceptions without having influenced them apart from explaining that carp are a pest fish species.

The surveys then varied in the topics asked about other than overall acceptability. The first and third surveys focused on asking a small number of questions about acceptability and then identifying if these views varied amongst different groups. The second survey asked a more detailed set of questions focused on identifying factors influencing social acceptability of carp control. The fourth survey asked questions that focused further on identifying potential impacts of carp control for specific sectors such as tourism, as well as tracking overall views about carp control.

Table 2 Surveys used to assess community perceptions about carp control

Survey	Timing	How were participants recruited?	Sample size[a]	Stratification of sample	Where is more detail about methods provided?
Survey 1	Oct-Nov 2016	A small number of questions about carp were included in the larger 2016 Regional Wellbeing Survey. This reduced risk of bias to those with an interest in carp, as questions about carp were a very small part of a much larger general survey about community and household wellbeing and liveability. Participants could complete the survey online or on a paper form.	12,081	Deliberately oversampled: - Rural and regional areas - Farmers - Murray-Darling Basin	Appendix 1
Survey 2a	Oct-Nov 2017	A panel of questions was included in the 2017 Regional Wellbeing Survey, which around 2/5 of participants were asked to complete. Participants could complete the survey online or on a paper form.	5,137	Deliberately oversampled: - Rural and regional areas - Farmers - Areas experiencing carp invasion	Appendix 2
Survey 2b	Dec 2017	A stand-alone survey was conducted that asked the same questions asked in the 2017 Regional Wellbeing Survey. Participants were recruited via an online panel survey provider; all completed the survey online.	1,184	Deliberately oversampled: - Aboriginal and Torres Strait Islander peoples - People with cultural and linguistic diversity, with a focus on those with Asian cultural background - Residents of large urban not highly sampled in Regional Wellbeing Survey	Appendix 2
Survey 3	Nov-Dec 2018	Two tracking items were asked of a panel of participants in the 2018 Regional Wellbeing Survey. Participants could complete the survey online or on a paper form.	6,093	Deliberately oversampled: - Rural and regional areas - Farmers - Areas experiencing carp invasion	Appendix 2
Survey 4	April 2019	A stand-alone survey was conducted that both tracked perceptions and identified perceptions of impact, replicating and extending 2017 survey questions. Participants were recruited via an online panel survey provider; all completed the survey online.	4,697	Used an Australia-wide random sample stratified by state and territory, and by whether person lived in capital city or other parts of state/territory.	Appendix 2

[a] This number represents the number of respondents who completed almost all questions on the survey (>97%). Some individual questions had higher response rates and others slightly lower, resulting in the number of respondents reported for individual questions varying through the presentation of results.

Results and discussion

The results focus on the four key areas examined in the project:

- **Key stakeholders.** What are the views of key stakeholders about carp control, how did these views change as National Carp Control Plan research and discussions continued, and what does this mean for likely support for future actions to control carp using the virus if a decision is made to release the virus?

- **Community attitudes.** What are the views of the broader community about carp control, and did these change during the period in which research was being conducted for the National Carp Control Plan? This section is identical to that provided in the Final Report for Project 1.

- **Socio-economic impact assessment.** This section summarises the findings of socio-economic impact assessment for specific groups assessed, and more broadly for communities in which carp invasion has occurred.

- **Monitoring and evaluating social dimensions of future carp control action.** This section provides recommendations for future monitoring and evaluation of socio-economic impacts of any future carp control actions before, during and after implementation. This section is identical to that provided in the Final Report for Project 1.

These four areas are presented, with a focus on synthesising the evidence produced in multiple individual reports that are provided in Appendices to this report. As significant discussion is provided in these individual reports, results and discussion are combined here in the main body of the Final Report.

Key stakeholders

The project focuses on identifying stakeholder concerns, views and needs, and identifying the potential impacts of releasing the virus on different groups. A key part of achieving this was engaging with key stakeholders, with three rounds of data collection conducted.

- An initial round of phone interviews was conducted in 2017 with 23 representatives of stakeholder groups with differing interests in carp control. This included representatives of environmental groups, commercial carp fishers, Traditional Owners, farming groups, koi organisations, water providers, native fish breeders, recreational fishing organisations, tourism businesses, animal welfare organisations, and freshwater scientists.

- A second round of stakeholder interviews was conducted in 2018 with 10 representatives of stakeholder groups, asking if views had changed, and identifying views about progress of the National Carp Control Plan, and in particular stakeholder engagement, to that point.

- A multi-stakeholder workshop was conducted in June 2019, with stakeholders asked to provide input on their views about carp control prior to the workshop and discuss their views at the workshop, providing a third round of views; some stakeholders were further followed up by phone after the workshop to discuss their views about carp control after having had the opportunity to discuss emerging findings of National Carp Control Plan research at the workshop.

Round 1 stakeholder discussions (2017)

The findings of the initial round of interviews conducted in 2017 is reported in detail in Appendix 1. provided a baseline understanding of the views of stakeholders at the early stage of the Plan development. All stakeholders – irrespective of the type of group they represented – strongly supported investing in action to reduce carp numbers, although for some there was concern that this should not be at the expense of other actions being invested in to improve health of freshwater areas.

A majority of stakeholders expressed *conditional support* for the Plan. This meant they would be likely to support the eventual Plan *if* the process of developing it and its content adequately addressed key questions and concerns they had about carp control. A smaller number of stakeholders actively opposed the Plan, and a similarly small number unconditionally supported the Plan.

In these initial interviews, it was identified that stakeholder support for any future carp control strategy was contingent upon the strategy including the following elements:

- Multiple measures to control carp, rather than relying solely on use of the virus

- Identification of how to best integrate carp control with other actions to improve environmental health in freshwater and estuary areas

- Development of detailed guidance on the planned timing and management of carp control actions, particularly virus release
- Clear identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios
- Identification and appropriate mitigation of potential social and economic impacts of carp control on specific groups
- Appropriate involvement of different groups in decision making processes
- Sound governance, including clear commitment of funding and other resources to carp control and identification of responsibilities of different agencies, and
- Development of appropriate monitoring and evaluation strategies to ensure outcomes can be identified.

When discussing the recommendations being developed in the Plan, stakeholders also clearly identified a need to be able to engage with scientists undertaking research for the Plan, and in particular to be able to discuss and provide their views on the emerging findings of Plan research. To enable this, in June 2019 a workshop was organised in which stakeholders were both provided with presentations on emerging findings and discussed these findings as well as their views on implications of the emerging findings for future carp control action.

See Appendix 1 for a detailed analysis and presentation of findings of these interviews.

Round 2 stakeholder discussions (2018)

In 2018, 10 of the 23 key stakeholders interviewed in Round 1. were re-interviewed, to identify how their views about carp control were changing. A further 7 of the 23 were interviewed as part of ongoing socio-economic impact assessment, and as part of these interviews were asked to describe their overall views about the National Carp Control Plan, particularly communication, engagement and whether and how their views about carp control had changed since the National Carp Control Plan was announced and began its research. As part of the interviews conducted for the socio-economic impact assessment, a further 28 stakeholders were interviewed who had not been interviewed in the Round 1 stakeholder interviews, and provided their views on these topics as well as discussing potential for specific impacts on the group they were part of or represented (e.g. recreational fishing, koi, native fish aquaculture, commercial fishing or tourism).

Key findings of this round of stakeholder interviews were that there were similar levels of conditional support for carp control to the levels identified in the first round of interviews. However, several stakeholders had identified additional questions or concerns that would need to be addressed to their satisfaction before they would provide support for implementing actions to control carp. In particular, it was identified that key stakeholders were expecting detailed information about carp control, including technical details, and some had found initial communications about carp control to be overly simplistic. This highlighted a tension in communication needs, with several key stakeholders finding communications to be overly simplified and reporting that this had resulted in

an increase in concern about carp control actions, as it reduced their confidence that sufficient evidence would be available or drawn on in making decisions. This concern was also in part a result of the length of time required for the various research projects being undertaken in the National Carp Control Plan to be completed: while it was always recognised that the NCCP would have a period of time in which research was being conducted and there would be limited flow of information to stakeholders, this 'vacuum' of information meant that any information published about carp control from sources other than the NCCP was receiving high attention from many stakeholders, even when underpinned by relatively little evidence. This was both useful and frustrating for stakeholders: reading online discussions, discussion papers published in journals, and engaging in discussions was assisting them to identify new questions, ideas and concerns about carp control. However, at this point, these queries could not typically be answered by the NCCP, while some information being published from the NCCP was viewed as overly simplified and did not address stakeholder concerns (while potentially having high usefulness for many of the general public who, when compared to key stakeholders, typically had low awareness of carp invasion, environmental problems resulting from carp invasion, or potential options for carp control).

While overall views about support for carp control had not changed significantly since the first round of interviews, the interviews did identify both concerns about and recommendations for improving the effectiveness of engagement and communication about the NCCP.

Key concerns related to communication and engagement raised by stakeholders were:

- Some were wanting more active engagement in discussions about carp control, and felt disillusioned that opportunities for this engagement had not occurred

- Concerns about whether the scope of research in the NCCP would be sufficient to answer questions about feasibility of the carp virus, and concern about the focus of the NCCP on assessing feasibility of the carp virus rather than on identifying the broader range of actions that may need to accompany virus release or other carp control actions in order to achieve successful environmental recovery.

- Some felt early communications about the NCCP suggested that virus release was a 'done deal' and were concerned that there would be low trust in the NCCP if there continued to be a perception of a bias towards virus release in its communications. In particular, some felt that communications products were overstating the potential benefits of reducing carp populations and failing to acknowledge that carp were one of multiple contributors to environmental degradation in areas where carp invasion was occurring

- A strong desire for more engagement with scientists and the research they were conducting, so key stakeholders could discuss findings and identify whether they felt the research was robust, and whether they could support its findings when discussing carp control with the organisations they represented. This engagement needed to be detailed, enabling stakeholder to discuss content and detail, rather than only high level findings, and to enable direct discussion with scientists.

- A desire for stakeholders to have a stronger role in helping shape recommendations about some aspects of carp control, particularly biosecurity and strategies to address potential for impacts on

specific groups. Several identified that they were being invited to discussions about developing strategies for cleaning up dead carp after a virus release, and had found these highly productive, wanting further engagement of this type around other aspects of developing recommendations about carp control.

- Some also wanted to be able to have a role in helping communicate about the activities of the NCCP and carp control more broadly.

A detailed presentation identifying key stakeholder concerns and specific engagement needs of different groups was developed based on the Round 2 discussions. This is provided in Appendix 5. It was discussed with key personnel involved with the NCCP, and its recommendations informed design of the content of the *National Carp Control Plan Communication and Engagement Strategy & Operational Plan 2019*. This document identified a number of communication and engagement activities that responded to the specific issues identified in Round 2 of stakeholder interviews. It was produced as a formal document that was a report to the Australian Government, and as such forms a separate document to this report.

The key actions implemented in part as a response to findings of this round of stakeholder discussions, as well as a large number of other discussions being held by NCCP staff, included:

- More regular provision of information on research progress to stakeholders via newsletters (undertaken during 2019, with direct emails to stakeholder lists as well as ongoing updates produced in FISH magazine)

- Development of Discussion Papers that summarised key emerging evidence, which stakeholders were invited to read and provide feedback on

- Ongoing workshops by NCCP staff with a range of stakeholders

- Development of a group of stakeholders asked to assist in discussions about biosecurity recommendations for the koi sector

- Involvement of scientists in presenting findings to stakeholders at workshops, in particular (but not solely) at the June 2019 stakeholder workshop.

Some other actions were suggested (see Appendix 5) and discussed but not enacted, including establishing a stakeholder advisory committee, and more direct involvement of stakeholders in formulation of some of the Plan's recommendations.

Round 3 stakeholder discussions (2019)

The third round of stakeholder discussions focused on (i) enabling stakeholders to hear emerging results of research conducted in the National Carp Control Plan and discuss their views about options for carp control based on having heard these emerging findings, and (ii) identifying how views were changing about carp control at the National Carp Control Plan research was drawing to a close.

The third round of discussions took place principally via the stakeholder workshop held in June 2019. All stakeholders interviewed in Rounds 1 and 2 were invited to attend, excluding three who had

moved to new roles and for whom a new representative attended for their organisation. Prior to the workshop, stakeholders were asked to complete a brief survey and describe their views about carp control; during the workshop they discussed research and its implications for carp control. After the workshop, brief follow up conversations were held by phone with 12 stakeholders whose views had not been fully identified during the workshop.

A stakeholder workshop was held in June 2019 to discuss emerging research findings from several projects conducted as part of the National Carp Control Plan (NCCP). Participants were asked to discuss emerging research findings, with a focus on identifying their views about what they mean for developing recommendations about the future control of carp, with a focus on feasibility of the carp herpes virus (carp virus) as a method for carp control.

At the workshop, much discussion focused on the scope of the NCCP. The NCCP is focused principally on assessing the feasibility of carp virus release as a carp biocontrol strategy. Its terms of reference do not include investigating other carp control measures or investigating complementary measures that could increase the potential for improvement of environmental health in association with any reduction in carp populations. The NCCP is therefore investigating a specific approach to carp control (carp virus release) rather than developing a final plan for carp control. It is being prepared to show how the virus could be used as a biological control agent for carp, and whether it is a feasible option to consider. It is possible governments may consider other approaches to carp control and ecological restoration or using the virus as part of a suite of actions to achieve ecological restoration outcomes, but this is yet to be determined.

The report *Engaging with the National Carp Control Plan: summary of a stakeholder workshop* provides a detailed report of this third round of stakeholder discussions. The key findings that emerged from the workshop related to both the types of evidence and content stakeholders want to see underpinning recommendations made in the Plan, the scope of work needed to develop a 'shovel ready' carp control program, and engagement of stakeholders. Not all key messages listed below were agreed to by all attendees; unless otherwise stated they were agreed to by multiple workshop participants. Several other topics of discussion were also raised at the workshop with less evidence of agreement amongst attendees; these are documented in the report from the workshop but are not presented here as key messages emerging from the workshop.

Key messages related to three themes: (i) communication and engagement, (ii) developing recommendations from Plan research, and (iii) future development of a comprehensive carp control strategy.

Theme 1: Communication and engagement

Key messages related to communication and engagement focused on enabling people with an interest in carp control to have a clear understanding of how future decisions will be made about actions for carp control and to identify opportunities for ongoing engagement and participation in the process. Four key messages emerged from the workshop related to this theme:

1. **Meaningful Traditional Owner engagement is needed:** Lack of engagement with Traditional Owners was identified as a critical gap that requires addressing as an urgent priority.

2. **Stakeholder communication and engagement**: Participants wanted further opportunities to engage with scientists and discuss potential carp control strategies, particularly around many of the specific topics raised at the workshop. Potential to have input on discussion papers being produced by the NCCP was viewed positively.

3. **Need for improved partnerships for future work on carp control:** The Plan is focused on feasibility of virus release and has included stakeholder consultation as part of assessing this. Future development of a 'shovel ready' carp control strategy should focus on establishing more formal partnerships with the wide range of organisations with interest in carp control. This should include both people and organisations directly acting on and those affected by carp control actions.

4. **Clear communication is needed about decision-making processes that will occur after the Plan is submitted to government:** It was clarified at the workshop that the Plan is a 'road map' that will be at a broadscale level, and that full development of a carp control strategy would require substantial additional investment beyond the Plan. Workshop participants have asked for clearer guidance on the processes of decision-making that will occur after the Plan is submitted to government. In particular, clarity was sought about the agencies and committees that would be involved, the timeframe for the decision about whether governments would release the virus, and the length of time expected for planning for any release, or for implementing other carp control measures, after such a decision was made.

Theme 2: Developing recommendations from Plan research

The second theme focused on expectations for the interpretation of Plan research findings. This was focused on communication of the uncertainties across data, risks, and potential outcomes that could occur under different scenarios. This was highlighted as essential to allow interpretation of the science to support the development of robust and realistic recommendations about future carp control.

5. **The benefits being sought need to be clearly articulated in the Plan:** The reduction in carp populations needed to achieve environmental health outcomes (benefits) should be a key part of the virus feasibility assessment and the recommendations made in the Plan. In other words, the ultimate objective of reducing carp populations – improving environmental health – should be the focus, rather than assuming all levels of reductions in carp will result in improved environmental health. There is a need to document specific, measurable environmental health goals or benefits being sought from reducing carp populations, and of the carp population thresholds required to have a reasonable probability of achieving these environmental health outcomes. Stakeholders strongly felt this was preferable to assessing feasibility based solely on whether the virus will achieve reduction in carp populations, as they felt the objective of reducing carp populations was to achieve improvements in environmental health outcomes (for example, water quality or native fish populations), and therefore that the environmental health outcomes sought should be clarified and feasibility assessed against these objectives.

6. **Acceptable levels of risk need to be clearly identified:** When assessing feasibility of the carp virus, thresholds considered to represent 'acceptable' and 'unacceptable' risk in relation to

potential environmental, economic and social impacts need to be clearly identified and defined.

7. 'Best case' and 'worst case' scenarios that reflect uncertainties in estimates should be explicitly used to inform the recommendations made about any future use of the virus: The Plan stated that recommendations in the Plan would be based on best to worst case scenarios of impact from virus release. Attendees supported this and wanted to ensure that worst case scenarios reflected the level of uncertainty inherent in estimates of things such as carp biomass, water temperature, water flow, likelihood of virus recrudescence, and existing nutrient levels in different parts of river and lake systems. Several stakeholders requested that estimates be communicated in ways that clearly identify levels of uncertainty in the estimations and results, for example as ranges (which was done in several presentations, but not all).

8. Feasibility criteria should include consideration of impacts and feasibility of mitigating the impact, effectiveness of the virus and over both short-term and long-term, and opportunity costs over time: Workshop participants made several suggestions for increasing the clarity and specificity of criteria to be used to assess the feasibility of the carp virus. These included more explicit assessment of cost-effectiveness, focus on both short-term and long-term outcomes, and definitions of both what is an effective level of carp reduction and what is considered an acceptable level of risk for different types of risk. A range of specific suggestions are provided in the workshop report.

9. **Some stakeholders seek use of a wider range of estimates of carp biomass when examining potential impact of virus release:** Some attendees queried estimates of carp biomass, feeling they were lower than they would expect and therefore they felt the current 'worst case' scenario estimates were not enough to cover all potential scenarios. Further discussion about biomass modelling and recognition of potential for a wider range of biomass estimates were requested by some attendees.

Theme 3: Future development of a comprehensive carp control strategy

In the workshop participants focused much of their discussion on identifying the elements they felt were needed to develop a comprehensive carp control strategy that went beyond the Plan's focus on the feasibility of the carp virus.

10. **There is strong support for investing in carp control:** All workshop participants strongly supported investing in carp control, irrespective of their views about the feasibility of the carp virus. Where there are differences of view it is not about whether carp control is desirable, but about how best to investigate and make decisions about future carp control strategies. This means workshop participants supported continued investment in developing carp control strategies. There was significant concern raised about the risks of a 'do nothing' approach if future investment in carp control does not occur. There were several stakeholders who strongly support future carp control that involves the release of the carp virus. Most stakeholders wanted future carp control strategy investment to include examination of a wider range of aspects of carp control than the Plan was asked to examine in its terms of reference.

11. **Carp control should be accompanied by complementary strategies to improve environmental health:** Before carp control strategies of any kind are implemented, they should be accompanied by forward planning for complementary strategies to improve environmental health and minimise potential negative impacts. The purpose of carp control is to improve health of freshwater and estuarine systems carp have invaded; maximizing potential improvements in ecological health resulting from carp control requires careful planning and investment before carp control actions occur. This requires substantial lead time to ensure adequate preparation for actions that may increase potential for improvement in environmental health if carp populations are reduced (for example, plans for native fish stocking, water flows, or other complementary actions). While recognizing that these complementary strategies are not part of the terms of reference of the Plan, workshop participants sought reassurance they would form part of future strategies to control carp that draw on the Plan's recommendations.

12. **Carp control strategies should be integrated with other actions to improve health of freshwater and estuarine systems**. Carp are one of multiple pressures affecting the health of the waterways they have populated in Australia. Workshop participants outlined multiple programs and strategies currently being used across different jurisdictions to invest in improving the health of areas affected by carp, for example native fish recovery strategies riparian health action programs, and others. There was agreement that future carp control action plans should be explicitly linked to these other actions so they can complement each other, increasing likelihood of improvements in environmental health resulting from both carp control and other actions. Concern was expressed about taking action to control carp without aligning this with other investments occurring at the same time. Several participants felt substantially more positive impact could be achieved by explicitly integrating carp control with other environmental recovery investments such as the Native Fish Management and Recovery Strategy being developed by the Murray-Darling Basin Authority. Some felt the focus of the Plan on feasibility of the virus was problematic without also examining complementary actions needed to achieve benefits from reducing carp populations, for the following reasons:

    i. The virus will not be effective on its own to address threatening processes associated with waterway health and native biodiversity

    ii. Carp suppression on its own is less likely to deliver environmental, economic or social outcomes – and more likely if accompanied by other measures

    iii. Presenting the virus as the "main game" may have unintended implications for resource allocation away from essential strategies required to achieve critical outcomes for waterways and biodiversity.

13. **Multiple carp control measures should be considered.** Many workshop attendees wanted a broader range of carp control measures to be actively investigated in addition to assessment of the feasibility of the carp virus. Some felt that options such as live harvest (supported by investment in tracking of carp aggregations using methods such as Judas carp and citizen science reporting tools, including the Carpmap tool used as part of the Plan), role of native

fish restocking and genetic control should be more thoroughly investigated. For some, this was because they felt these could provide viable alternative options to virus release. For others, this was because they felt these could complement virus release, particularly in areas where feasibility of the virus is limited, or in the longer term over which they felt initial efficacy of virus would decline. Much of the workshop discussion focused on clarifying the role of the Plan, versus the future development of 'shovel ready' carp control strategies. The Plan's focus is on assessing feasibility of the carp virus. Workshop participants called for additional investment beyond the investment made in the Plan, to better understand how other carp control methods could work to either complement or, for some, be used instead of, release of the virus.

14. **The feasibility of the carp virus should not be considered in isolation of other carp control and environmental recovery measures**. Some workshop participants felt the feasibility of the carp virus cannot be assessed in isolation from other carp control measures and environmental recovery measures. This is because the effectiveness of the virus in part depends on whether virus release occurs in combination with other actions that may have potential to increase or reduce overall effectiveness of the virus in reducing carp populations. Ideally, the Plan should identify areas to be investigated in which complementary actions have potential to increase effectiveness of any use of the virus, as well as identifying any actions that may reduce effectiveness of the virus in reducing carp populations.

15. **Several stakeholders feel the terms of reference for the Plan are interpreted too narrowly and/or should be broader.** Consideration of the feasibility of the virus out of the context of an integrated approach to pest management, waterway and biodiversity restoration objectives has limited legitimacy for many stakeholders. Several workshop participants questioned the current interpretation of the Plan's terms of reference, and/or felt the terms of reference should be broader than they currently are, to enable development of a full carp control plan that includes multiple aspects of carp control rather than focusing solely on the feasibility of the virus. Others agreed that it was important to focus limited resources on answering questions about feasibility of the virus but felt that future carp control strategies should have a broader focus, as noted in previous key messages. Several stakeholders asked that their concerns about the focus of the Plan on 'virus feasibility' alone be communicated to government, together with their preference for terms of reference for a carp control strategy to focus on a holistic approach to carp control based on environmental health objectives rather than objectives focused on reducing carp populations. Related to this, some argued that because the Plan is not currently placed in the context of more fundamental questions about what the virus should achieve, the Plan may provide recommendations about the wrong question. A key message related to the this is that assessment of feasibility of the carp virus is different to the question of "should the virus be implemented?"

Changes in stakeholder views over time

This section of the report adds to the findings reported in detail in the workshop report by summarising how views had shifted from the time of the first round of interviews to this third set of discussions. It focuses specifically on stakeholder views about emerging findings of NCCP research, about the scope of the NCCP, and about criteria that should be used to assess feasibility of the carp

virus. Both at the workshop, and in the subsequent brief phone interviews conducted to follow up those stakeholders who had not had significant opportunity to speak at the workshop, there was also a focus on identifying how views about carp control had changed since the first round of interviews were undertaken. The key themes emerging from this were:

- Several reported that their initial strong (but conditional) support for virus release had reduced since the start of the NCCP. This was particularly the case for those involved in natural resource management, particularly in river areas, for some recreational fishers (but not all), and for representatives of environmental non-government organisations. While still conditionally supportive, these stakeholders felt that emerging results suggested a need for further investigation of a range of areas before a final decision was made. In particular, the following areas were raised as areas in which they would want further reassurance before feeling able to support virus release:
    - Efficacy of the virus in achieving reduction of carp populations
    - Likely rebound in carp populations after initial virus release, and potential long-term reduction in carp populations given this
    - Investigation of best ways to deliver water flows to increase efficacy of virus release
    - Investigation of how best to combine different carp control measures, including potential use of harvest of live carp as part of carp control
    - Potential for virus particles to be transported by a range of vectors, such as birds, amphibians, and fish other than carp, and potential for this to result in unintended virus spread
    - Trials of efficacy of live harvest strategies in the period before any virus release could be implemented, to better assess what optimal design could achieve, and compare this to likely long-term reduction in carp populations resulting from virus release.
- Concern about potential for release of the virus to result in poor water quality due to high volumes of fish death and associated potential for blackwater events had decreased for many stakeholders, although not all. While concern about potential for impacts on water quality, and through this environmental health, was the most common concern expressed in interviews conducted in Round 1, by Round 3 concerns were more focused on questions about whether the long-term reduction in carp populations would be sufficient to make a meaningful difference, whether it would be possible to implement action that ensured positive change in ecological health after a reduction in carp populations, and whether there would be investment in an integrated set of carp control actions or reliance solely on use of the virus, with a preference for use of integrated measures.
- Those who had low support for virus release at the time the first round of stakeholder discussions – particularly those engaged in native fish aquaculture, commercial fishing, and some aquatic vets - had not typically increased their support since that time. However, these stakeholders typically emphasised a desire to see investment in a comprehensive carp control

strategy that integrated multiple actions, while also highlighting concern that they felt the use of the carp virus was not the optimum approach. Some felt that the virus may form a part of this type of integrated approach, while others did not.

- Stakeholders who had expressed unconditional support for virus release at the time of the first round of interviews typically still did so, and believed that the evidence being produced was sufficient to support virus release. These stakeholders included some of those in government roles, involved in water management, and some involved in farming.

The change in key stakeholder views over time suggests that overall, there remains conditional support for virus release amongst many stakeholders, opposition amongst a smaller number, and unconditional support amongst another relatively small group. Many of those who conditionally support the concept of virus release do not feel the research conducted as part of the NCCP is sufficient to fulfil the conditions they would have for support. They feel NCCP research has worked well to answer some key questions, but want to see investigation of further areas, and development of a carp control strategy that integrates a range of carp control methods, and is coordinated with investment in ecological restoration action more broadly.

Community attitudes

Community views about carp control in general, and specifically about releasing the carp virus, were assessed through four surveys, with sample sizes and data collection methods summarised earlier and Appendices 1 and 2 providing further detail on survey methods and items included in surveys.

Acceptability of reducing numbers of carp by releasing the carp virus

All the surveys repeated one item with consistent wording: participants were asked to rate how acceptable they would find 'Reducing numbers of carp (a pest fish) by releasing the carp herpes virus', on a scale from 1 = very unacceptable to 7 = very unacceptable with a 'don't know' option also provided,. This question was asked before any information was given about carp or the carp virus, meaning responses reflect whatever level of knowledge the person had before completing the survey, and hence reflected current knowledge and perceptions without having influenced them apart from explaining that carp are a pest fish species.

Figure 1 shows responses to the 'acceptability' question, grouped based on whether the sample was focused on rural and regional areas (defined as those outside Australia's six most populated cities), or included a larger sample of people living in the 'big six' cities. It shows that there was high consistency over time: between 50% and 54% of rural and regional residents supported release of the carp virus, as did 44% to 46% of the broader population including those living in large cities. Between 16% and 17% of rural/regional residents found virus release unacceptable, and 19% of the broader population. Around one-third of people were either unsure or answered 'neither acceptable or unacceptable', with these responses slightly more common amongst residents of large cities.

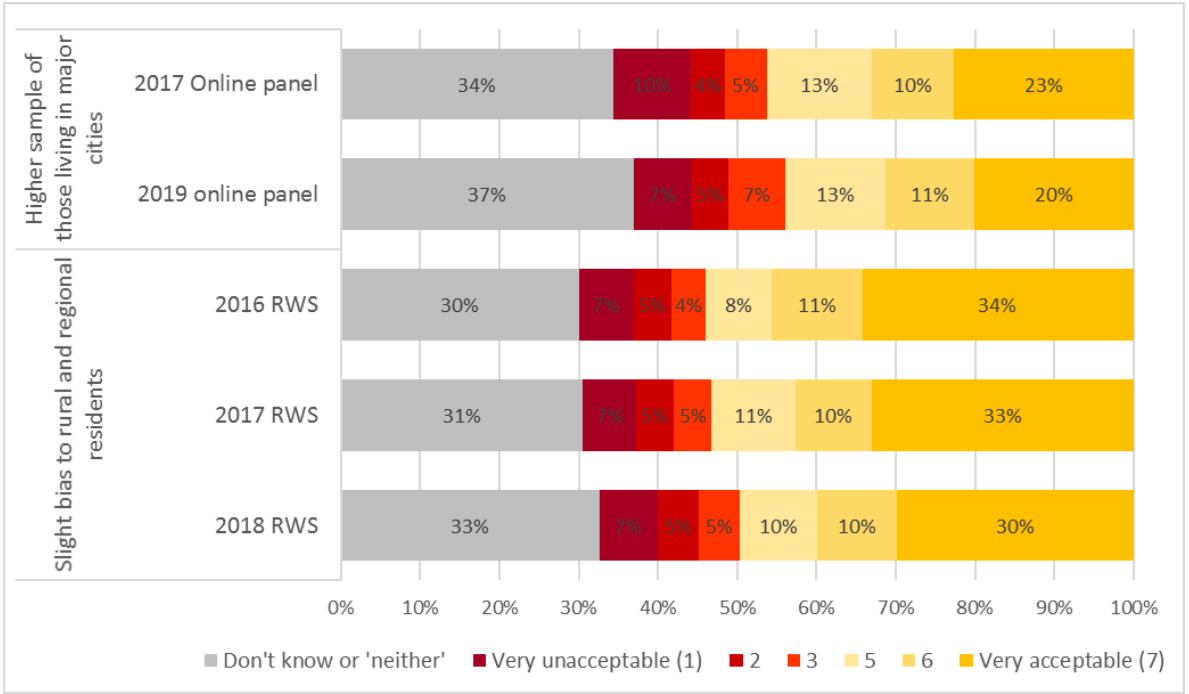

Figure 1 'How acceptable would you find reducing numbers of carp (a pest fish) by releasing the carp herpes virus'

These findings suggest initial positive response by the broader community to the proposal to release the virus: prior to knowing the specific actions to be proposed, people were 2.5 times more likely to

find virus release acceptable as unacceptable. Views around acceptability did not change significantly between 2016 and 2019. This is not unexpected, given that no major announcements about potential future actions were made beyond the initial announcement of the NCCP.

The findings also suggest high potential for attitudes around acceptability of virus release to change rapidly. People are more likely to change their views rapidly in response to new information if, prior to receiving that information, they are uncertain (don't know), ambivalent (neither acceptable or unacceptable) or have extreme views (very high acceptability or unacceptability). A large proportion of respondents were uncertain or ambivalent, and hence their views subject to change. Of those who supported use of the virus, the majority indicated the highest level of acceptability, despite having limited information about the proposed actions. This indicates low complexity of understanding about carp and the specific details of carp control, with high strength of attitude often associated with lower complexity of understanding of that issue in multiple studies (Mylek and Schirmer 2019). Low 'integrative complexity' about an issue is associated with less stable attitudes and a higher likelihood of rapid attitudes shifts in response to new information or campaigns about an issue (Mylek and Schirmer 2019). This means that the survey findings suggest an overall positive disposition towards the concept of the carp virus, with high uncertainty and high potential for change in attitudes depending on the nature of carp control actions ultimately implemented.

Factors influencing acceptability of carp control

Many factors influence levels of acceptability or 'social licence' for an activity. Key factors identified in the literature were assessed as part of the second and fourth surveys, and drew on theory on social licence for environmental action proposed by Schirmer et al. (in review) in a separate study examining environmental watering, namely:

- **Awareness of the problem:** An action intended to address a problem is unlikely to be considered acceptable if a person does not perceive that there is a problem to be addressed. In the context of carp control, this means that social licence likely requires at least some level of awareness that (i) carp invasion has occurred, and (ii) carp cause environmental problems.

- **Importance of the problem:** To support investing in action to address a problem, a person often needs to not only be aware of the problem, but to believe it is important enough relative to other issues to warrant investment.

- **Perceived effectiveness of the proposed action:** An action is unlikely to be supported if there is concern about its potential effectiveness in achieving desired outcomes.

- **Perceived negative impacts of the proposed action:** Concerns about the potential for negative impacts from an activity will reduce support for that action. This can include concern the action will impact directly on the person who is being asked about support, and can also result if they are concerned the action may have negative impacts on others, even if it does not have direct impacts for them personally. Importantly, concern about negative impacts can reduce support even if the concern is not underpinned by evidence – the perception of a negative impact can have important impacts, even in the absence of those impacts eventuating.

- **Confidence in those implementing the action** to address potential negative impacts and achieve effective outcomes.

Table 3 summarises key findings related to the different factors often argued to influence whether members of the public give social licence to a particular activity.

Table 3 Factors likely to influence social licence for carp control using the virus

Factor likely to influence social acceptability	Overall findings
Awareness of carp invasion	Awareness is moderate to high, however a significant minority are either unaware of carp invasion or do not feel carp invasion causes significant problems
Importance of carp invasion	Carp invasion is considered a reasonably important problem to address by a small majority of people, while a44% do not consider it a moderate to high priority.
Perceived effectiveness of the proposed action	There is high uncertainty about whether benefits of virus release would outweigh negative impacts, suggesting a lack of confidence in effectiveness. However this requires further assessment after actions are decided on and when community members can be given detail of the specific actions being invested in, to make a more informed judgment.
Perceived negative impacts of the proposed action	There are relatively high levels of concern about potential negative impacts, and this is likely to be a significant influence on overall levels of social licence given to use of the virus.
Perceived positive impacts of proposed action if it is successful	Findings are the same as for perceived effectiveness
Confidence in those implementing the action	Many people are either uncertain or lack confidence in the ability of government to successfully implement virus release. This relatively low confidence is likely to negatively affect social licence. Confidence is higher in some non-government organisations, indicating a need to ensure a range of organisations have opportunity to assist in design and implementation if virus release occurs, to help improve confidence.

Awareness and importance of carp invasion

To support action to address a problem, people typically need to be aware the problem exists, and agree that it is a very important problem. In 2016, just after announcement of the NCCP, the first survey asked people to rate the extent to which they felt pest fish species such as carp were a problem in their local area. In total, as reported in detailed in Appendix 1, 37% felt pest fish species such as carp were a moderate to large problem in their local area, while 39% felt that decline in native fish species was a moderate to large problem.

The fourth survey asked a slightly differently phrased question: it asked to what extent participants felt a range of issues, one of which was ‘invasion of carp (a pest fish species not native to Australia)’ were problems for the health of Australia’s freshwater areas. This means the responses are not directly comparable to the earlier survey, as the fourth survey asked about all of Australia rather than the local area only, and asked specifically about carp rather than about ‘invasion of pest fish species e.g. carp’.

As shown in Figure 2, 55% of respondents considered carp invasion a moderate to very big problem, while only 20% were unsure and 25% felt it was not a problem or a small to small-moderate problem. This indicates that there is now relatively high awareness of carp invasion, including in many urban areas. While it is not possible to compare the two sets of data, the relatively high awareness in the fourth survey suggests that over the life of the NCCP there may have been some increase in awareness of pest fish species as a problem, however there was an equally large difference in the proportion of people considering decline in numbers of native fish a moderate to large problem (62% in the fourth survey compared to 39% in the first), suggesting most of the difference between the two surveys relates to the different phrasing of questions rather than change in awareness.

Overall, the findings suggest relatively high awareness of carp invasion as an issue, although 45% of Australians remain either unsure whether carp are a problem or do not consider them a significant problem for freshwater areas.

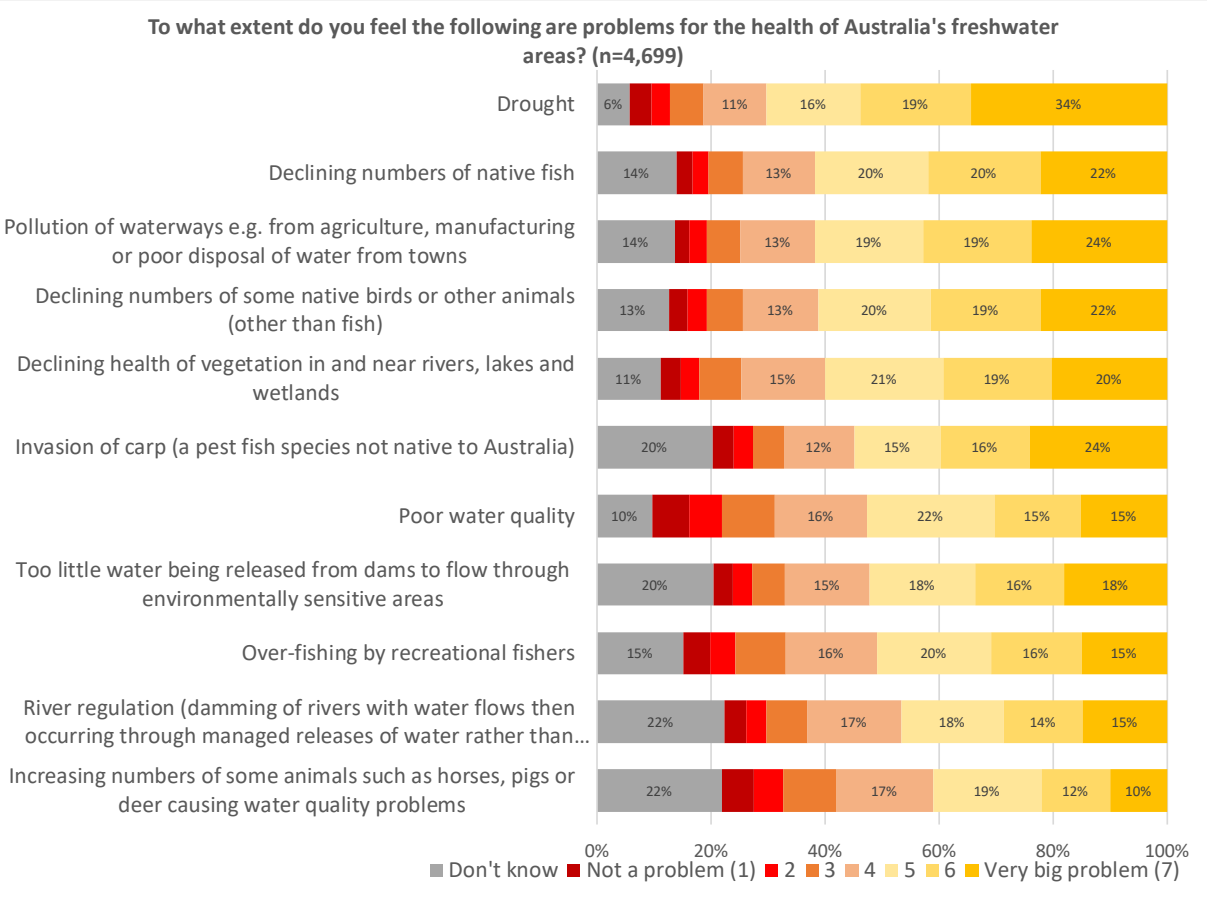

Figure 2 Awareness of different challenges affecting health of Australia's freshwater areas

The fourth survey also asked participants to rate the extent to which they felt governments (state or federal) should prioritise investing in a number of actions that can improve the health of freshwater and estuary areas, one of which was reducing numbers of carp. The findings, shown in Figure 3, show that between 50% and 67% of participants considered investing in all the area a high or very high priority, with 56% nominating investing in reducing carp populations as a high or very high priority.

Reducing erosion, improving clarity of water, improving vegetation health near rivers, lakes and wetlands, improving conditions for swimming and recreation, and increasing populations of water-reliant animals were all given higher priority (some only to a relatively small extent) compared to reducing carp populations.

This suggests that around 44% of the population do not give a high priority to investing in carp reduction, while 56%. If carp control is viewed as assisting in achieving other outcomes such as improving clarity of water, improving vegetation health, improving swimming and recreation conditions, and increasing populations of aquatic animals, it is likely to be given higher priority. The results also suggest that support for carp control is likely to be higher if carp control actions are clearly linked to achieving outcomes considered of high priority, such as being integrated with broader actions to reduce erosion, increase water clarity, and improve vegetation health and animal populations.

It is important to recognise that whether carp control is considered a high priority will also depend on the extent to which improving health of freshwater areas is considered important relative to other issues occurring in the local area. This was examined by asking survey participants the extent to which they agreed or disagreed that 'in my local area, there are more important issues to worry about than the condition of rivers, lakes and wetlands.' In total, 31% of people felt that there were more important issues than improving condition of rivers, lakes and wetlands (Figure 4), indicating they would be less likely to support investing in reducing carp populations (as one way of improving condition) if it was viewed as reducing investment in other issues they felt were higher priorities.

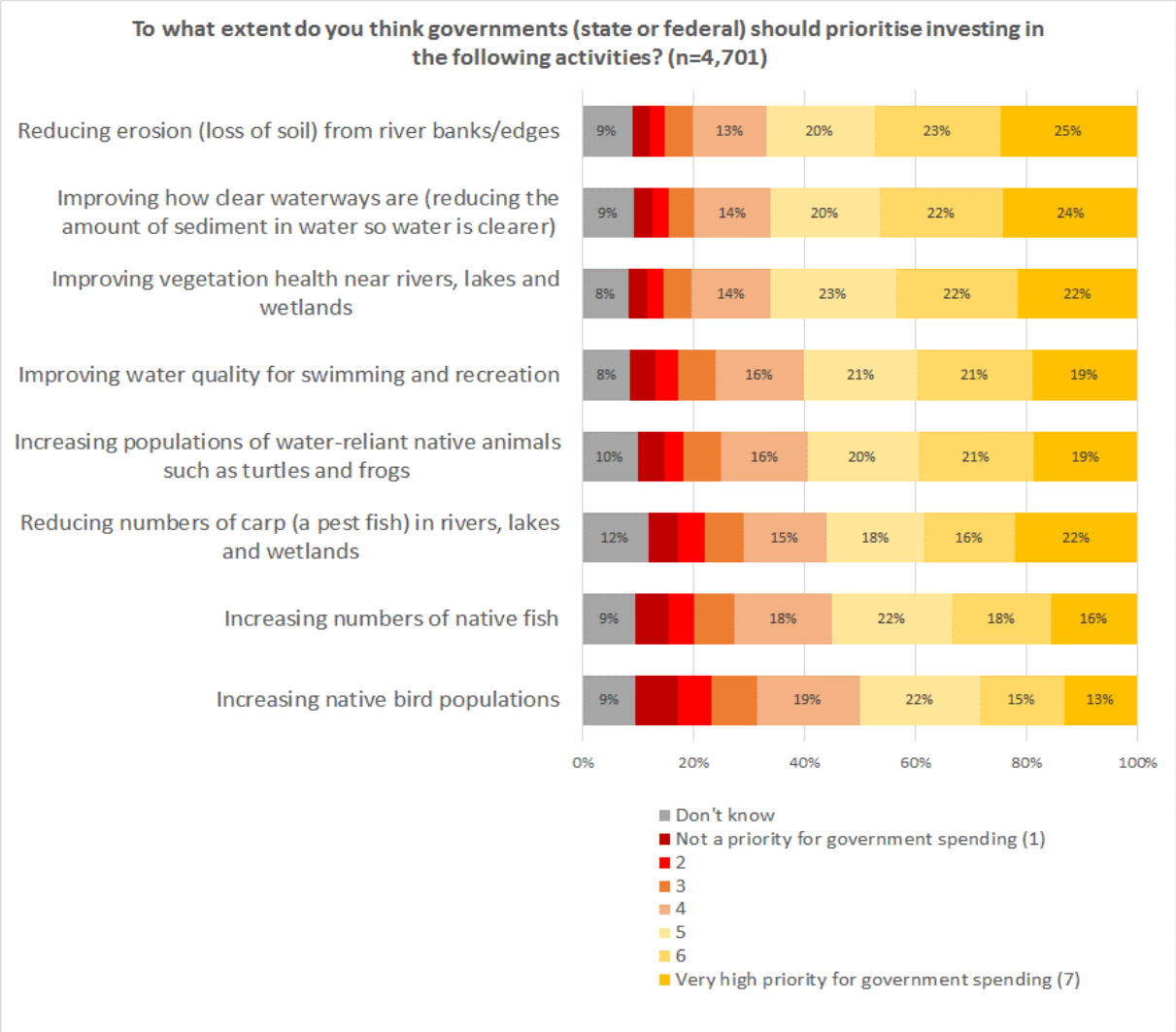

Figure 3 Views about priorities for government investment in actions to address

Overall, the findings suggest moderate awareness of carp invasion and priority given to reducing carp populations, with a small majority both considering carp invasion a significant problem and giving it reasonably high priority as an issue for government investment. However, a relatively large minority are unaware of carp invasion or do not consider it a significant problem, and do not give it high priority.

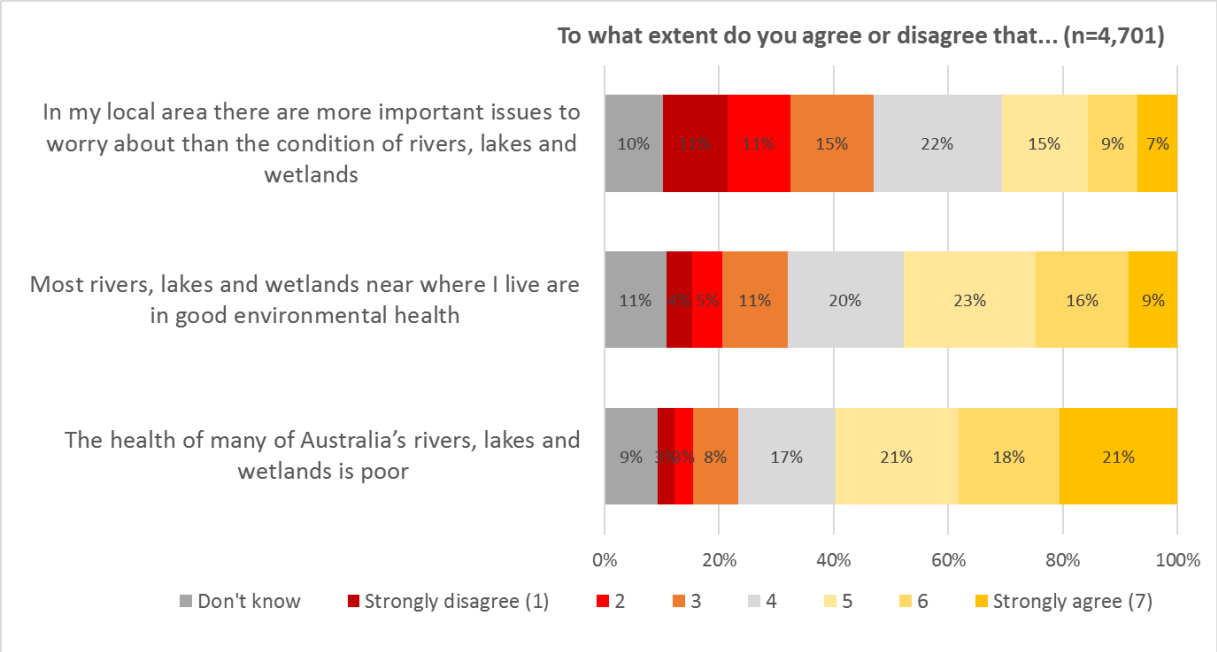

Figure 4 Views about importance of improving condition of rivers, lakes and wetlands

Perceived effectiveness of proposed action

It was difficult to assess views about the potential effectiveness of proposed carp control actions, as this research was conducted when decisions had not yet been made about what carp control actions should be implemented than how. Assessment of this issue was therefore restricted to asking survey participants the extent to which they agreed or disagreed that 'I doubt the benefits of releasing the virus would outweigh potential negative impacts', and 'I support virus release even if it causes short-term issues lasting 2-3 months in some areas'. The first item identifies if there is confidence in effectiveness, while the second provides a different and less direct assessment of whether there is confidence that the benefits of the release would be worth some short-term impacts.

As shown in Figure 5, there is high uncertainty about both statements. While 24% of people did not have doubts about whether benefits of releasing the virus would outweigh negative impacts, 23% were unsure, 17% neither agreed or disagreed, and 35% agreed that they doubted this. This indicated low current confidence in likely effectiveness of virus release, which has potential to reduce support for use of the virus. Almost one-third (32%) would not support release of the virus if it caused short-term issues lasting 2-3 months, while slightly more – 36% - would support it even with short-term impacts.

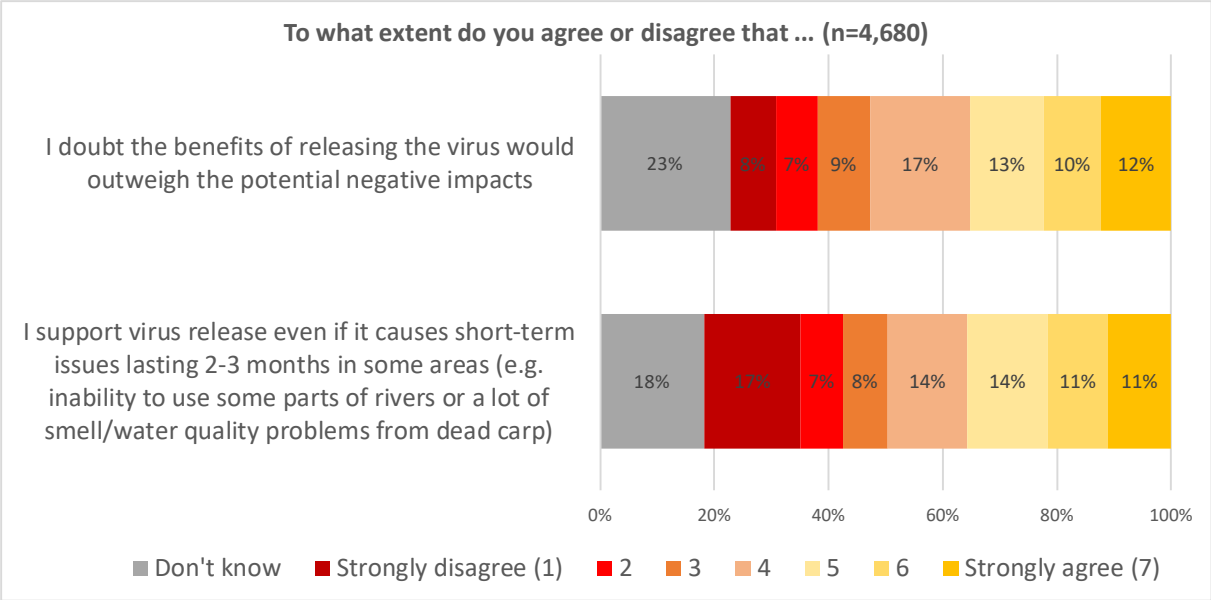

Figure 5 Views about benefits versus negative impacts of virus release

Perceived negative impacts of proposed action

One widely acknowledged factor influencing views about acceptability of an activity is perception of the impacts of that activity; other factors are also important but for this paper perceptions of impacts are of most relevance. To examine this, two surveys (one in 2017, the second in 2019) asked about perceptions of impacts of release of the carp virus. This helped identify the impacts of highest concern, which were (from the 2019 survey, shown in Figure 6):

- 63% of respondents were concerned 'large amounts of dead carp in the water could cause water quality problems'
- 59% were concerned 'it may not be possible to effectively clean up the dead fish'
- 59% were concerned 'the virus may have unintended effects not predicted by scientists'
- 57% were concerned 'the virus could be transmissible to fish or animals other than carp, despite research finding it is not'
- 49% were concerned 'the virus could be transmissible to humans, despite research finding it is not'

Concerns about negative impacts were relatively strong, with somewhat fewer people uncertain or 'sitting on the fence' compared to views about whether benefits outweighed costs and higher proportion indicating concern compared to a lack of concern. This suggests that concerns about negative impacts are one of the areas that will most strongly affect ultimate levels of social licence given to virus release if it occurs.

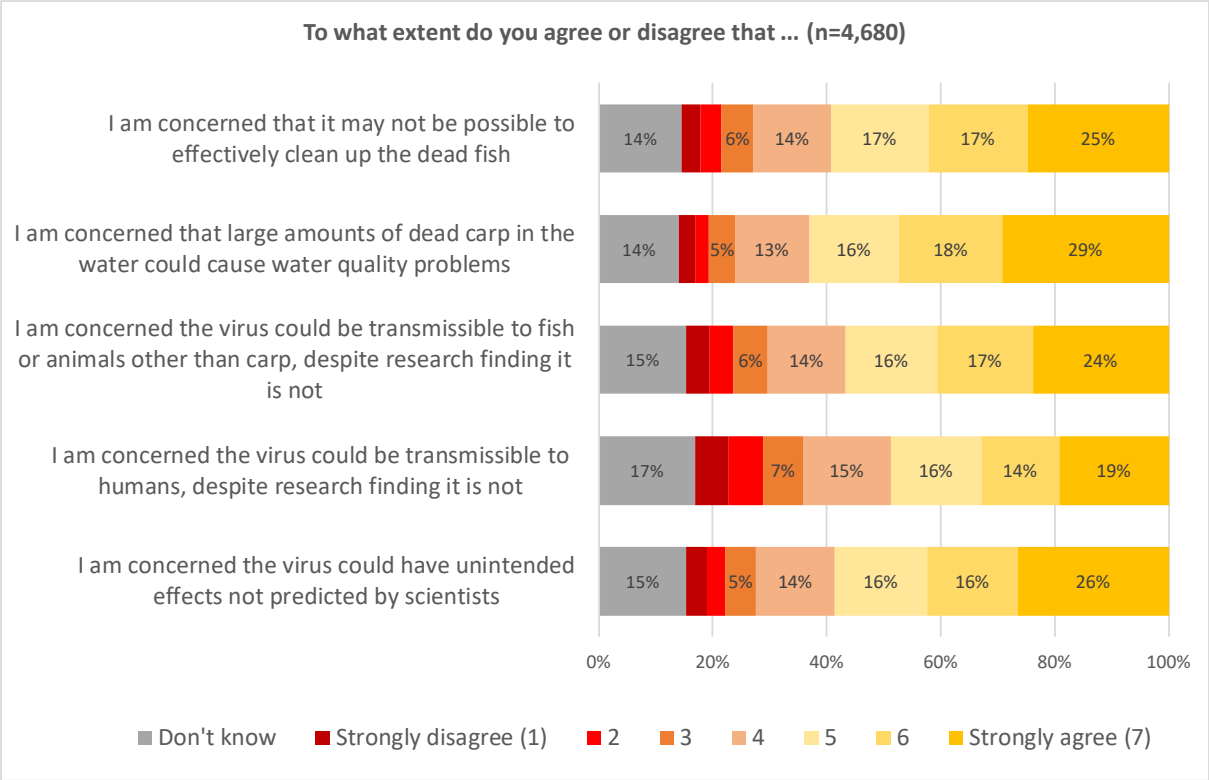

Figure 6 Perceptions of potential negative impacts of virus release

Forty one percent felt short-term problems caused by virus release lasting 2-3 months were worth it if there was longer-term environmental benefit, while 24% disagreed and 35% were unsure. These findings highlight the importance of the research conducted by the NCCP, which is investigating the extent to which there are risks of impacts such as water quality problems, feasibility of clean up, and examining current knowledge about transmissibility of the virus.

In addition to overall perceptions about carp control and the carp virus, the final survey conducted in 2019 specifically assessed potential consumer responses to virus release, through asking questions designed to identify likely changes in current behaviour in relation to:

i. visiting regions perceived to be affected by poor water quality of presence of a disease under circumstances where regulatory authorities had advised visiting was safe

ii. consuming fish caught in areas perceived to be affected by poor water quality or presence of a disease even with advice from regulatory authorities that the fish were safe to eat, and

iii. using other products such as pet food or fertiliser made from products harvested in these areas.

Responses to these questions supported assessment of the likely impacts of virus release on consumer perceptions and behaviour, and through this contributed to assessment of potential impacts of virus release on the tourism, recreational fishing, and inland aquaculture and commercial fishing sectors.

Survey respondents were asked how likely they would be to visit an area and undertake different activities or consume different products under three scenarios: (i) current conditions, in which the inland area often has reasonably good water quality but experiences some fish kills and poor water quality events reasonably regularly over time, (ii) an area where fish kills have occurred 50km away and which authorities say it is safe to swim and fish, and (iii) an area which had good current water quality but a 10% chance of a fish death event occurring at the time the person planned to visit (Table 4).

Table 4 Preferences for visiting inland areas and activities and consumption, under three scenarios

% of 2019 survey participants who agreed that…	Scenario 1: 'Business as usual' – you plan to visit an area with good current water quality, but risk of outbreak of blue-green algae or poor water quality every 3-4 years lasting 2-4 weeks causing water closure, fish deaths and smell	Scenario 2: Recent poor water quality or fish kills have occurred 50km from place you plan to visit, authorities say it is safe to fish and swim in the area you will visit	Scenario 3: You plan to visit an area with good current water quality, but a disease affecting fish in nearby areas that could cause fish deaths in the area you will be visiting, with around a 10% risk of this and no ability to predict if it will occur during your visit
I would be likely to visit an area like this during summer	45%	29%	27%
When planning to visit an area like this, I would typically book well ahead (at least a month or two ahead if not more)	46%	37%	36%
I wouldn't risk visiting a place like this in case there was poor water quality	46%	59%	57%
I would feel safe eating fish caught from the local rivers and lakes	34%	22%	21%
I would use fertiliser products made from pest fish (e.g. carp) caught in this area	41%	35%	31%
I would consider pet food safe if it was made from pest fish (e.g. carp) caught in this area	34%	27%	25%
I would feel safe swimming in this area if the local authorities say it is safe	53%	32%	31%
I would feel safe fishing in this area if local authorities say it is safe	52%	33%	29%

The findings show that many people are currently unlikely to visit inland areas and consume products from them, with only 45% likely to visit areas described as experiencing typical conditions for inland rivers in areas invaded by carp currently, 34% feeling safe consuming fish caught from these areas and 52% feeling safe fishing. Under the second and third scenarios, there was around a one-third

reduction in most of the activities asked about compared to the first, with people less likely to visit, to eat fish, swim or engage in recreational fishing. There was a smaller reduction in the proportion willing to use fertiliser from these areas. This suggests relatively high concern about potential negative impacts, which is likely to reduce acceptability of virus release in addition to changing behaviour, as these questions act as a form of 'revealed preference' and indicate that many people have a risk-averse approach suggesting concern about potential for negative impacts. This highlights that support for virus release would require substantial investment in communications to address these concerns, both those actively held and those suggested by the change in visitation and other behaviours reported in the fourth survey by participants.

Data on hypothetical future scenarios are not accurate predictors of actual behaviour but do often indicate the direction and nature of likely change. In particular, while there is a known 'intention-behaviour gap' with fewer people actually behaving in ways they indicate they intend to, multiple studies have found that intention still remains a strong predictor of likelihood of changing behaviour (Hassan et al. 2016, Grimmer and Miles 2017). The findings of interviews with tourism businesses about past experiences of visitation change associated with changing amenity perceptions, as well as of community surveys asking about likely visitation behaviour, suggest a likely initial reduction in visitation and fishing due to negative perceptions of the impacts of virus release even in areas declared to be currently safe, likely (based on the magnitude of intended behaviour change in community surveys) to be no greater than a decline of one-third, and likely a smaller decline than this. Although not explored in this survey, interviews with tourism operators suggest that, based on experience of past water quality changes, it is reasonable to assume visitation will rebound to an extent after the initial response as time passes and familiarity increases of the actual impacts of virus release (if, as assumed in this report, virus release principally results in relatively short-term impacts over limited spatial areas). If virus release led to widely publicised large fish kills or poor water quality events this may increase negative perceptions and reduction in visitation, again based on reports of tourism businesses about factors affecting the scale and nature of visitation change in response to past events affecting water quality. However, if it was accompanied by few negative impacts and proactive, positive communication strategies, visitation and activities may not decline significantly, or would decline only for a short period, and concerns about negative impacts may be relatively short-term.

Perceived positive impacts of proposed action

Over the longer term, if reduction of carp and other actions result in improved environmental health, for example reduced water turbidity, increased native fish populations or increases in aquatic vegetation health, there is potential for growth in visitation and participation in activities explored in the survey. This is based on the assumption that some of those who do not currently visit these areas may be more interested in visiting them if environmental amenity improves.

Figure 5 provided data on the proportion of people who felt positive impacts were likely to outweigh negative impacts. This suggests high uncertainty about the extent to which positive impacts are likely to occur. Further assessment of positive impacts was not feasible during this project, as to be meaningful ideally this assessment should describe the specific actions that will be invested in and the amount of resourcing being committed to them to enable an assessment of perceptions of

positive impacts based on the type and level of investment in action being made. Future work should examine this dimension further.

Confidence in those implementing the action

As shown in Figure 7, 31% of participants in the fourth survey reported feeling confident that virus release could be managed well by government, wile 34% did not feel confident, 18% were unsure and 17% were neutral (neither agreeing or disagreeing). For those with low confidence, this low confidence is likely to reduce support for use of the virus. There is high potential for change in views about this topic, given the high proportion of people with neutral or uncertain views and the high proportion of people who indicated they felt they had limited knowledge of carp-related issues in general, with substantial evidence that views are more likely to change when the person who has formed them does not feel they have a strong knowledge basis for the view (Pretty et al. 1997).

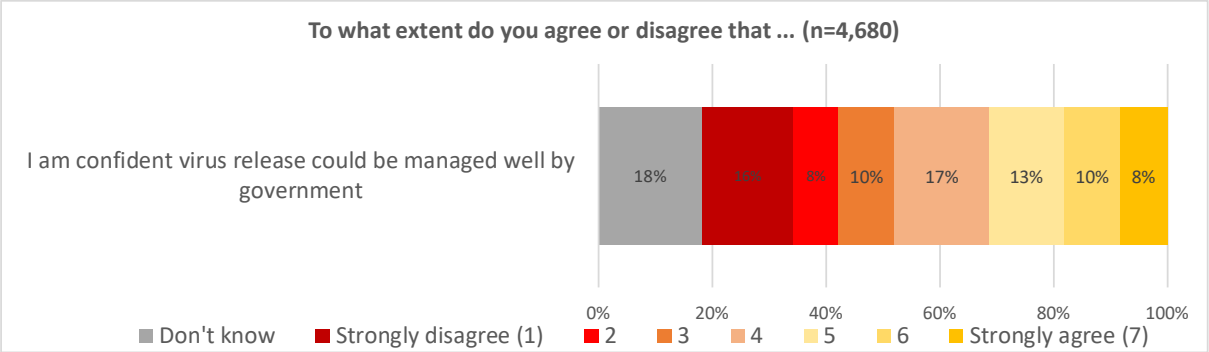

Figure 7 Confidence in ability of government to manage virus release

Survey participants in 2019 were also asked how confident they felt in the ability of different organisations to successfully implement carp control activities, if adequately funded to do so. As shown in Figure 8, there were relatively similar levels of confidence in most organisations, and for all more people had confidence than lacked confidence. However there were relatively high levels of uncertainty, and commercial contractors, volunteers and water managers were trusted slightly more than government organisations.

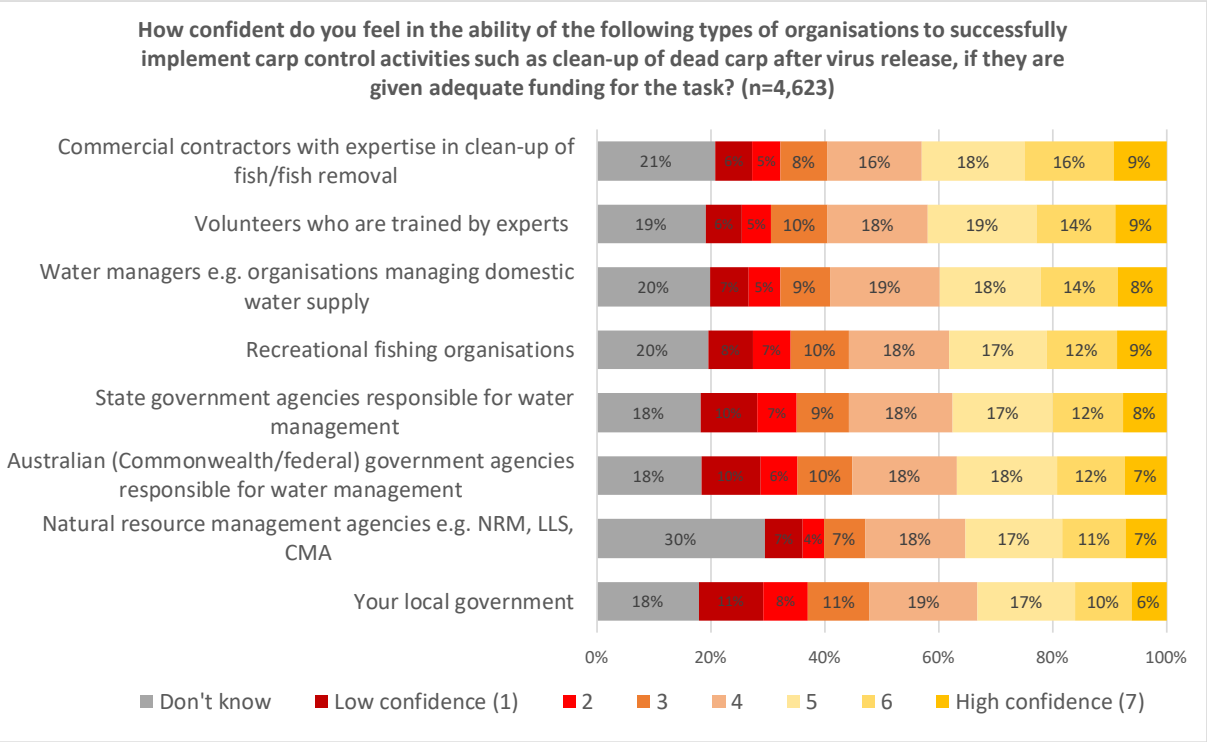

Figure 8 Level of confidence in ability of different organisations to implement carp control if resources adequately

Overall, as summarised in Table 3 earlier, this suggests moderate confidence but high potential for views to change given the high levels of uncertainty expressed.

Socio-economic impact assessment

This section identifies potential socio-economic impacts that could occur for

- Groups identified in early stages of this project as having potential to experience direct, specific impacts, namely:
    - Commercial carp fishers and other commercial fishers
    - Native fish aquaculture businesses
    - Traditional Custodians of regions experiencing carp invasion
    - Tourism sector
    - Recreational fishers
    - Koi hobbyists, breeders and associated organisations
- Residents of communities in which carp invasion has occurred, who may experience impacts via:
    - Flow-on effects resulting from impacts that affect the groups listed above
    - Direct impacts on activities undertaken in or near waterways and waterbodies in which carp invasion has occurred, and/or which experience changes in conditions (positive or negative) as a result of actions to reduce carp populations.

For each of the groups examined, the type and scale of activities that could be impacted is first identified. This is done through identifying (i) existing conditions, and (ii) factors that may enhance or limit capacity to adapt to the specific types of changes that may occur as a result of virus release. When examining existing conditions, the current scope and scale of activities relating to each group or industry was examined and the overall trajectory for each, for example whether different sectors are growing and would be expected to continue growing under current conditions. This is done in brief and, as noted earlier, a decision was made to focus assessment of existing conditions on identifying broad scale and scope of activities rather than more detailed quantification, which we recommend occur closer to the date of carp reduction activities being implemented to ensure it is current at the time. Thus the focus is on describing the overall size of the sector and nature of the activities forming part of it, as well as identifying what is known about current trajectories of different sectors. These existing conditions should be recognised as likely to change: most groups examined have potential to experience substantial change over the next two to three years, for example through growth of native fish aquaculture, growth in inland tourism in some regions, and rapidly growing and changing cultural and economic activities engaged in by Aboriginal peoples in regions affected by carp invasion.

While current levels of activity are important, understanding these does not provide an understanding of potential socio-economic impacts. To understand potential impacts, it is important to examine:

1. **Current adaptive capacity and vulnerability:** what capacity do groups have to adapt successfully to changes that may result from a release of the virus, and what stresses or challenges are they experience that may reduce their capacity to cope and adapt (or in other words, increase their vulnerability)? Assessment of adaptive capacity focused largely on identifying existing constraints that may limit ability to adapt (for example, sectors experiencing high regulatory barriers or low access to finance may have fewer options to switch to alternate activities or markets), as well as specific capacity to adapt developed as a result of past experience (for example, development of industry-wide communication action networks by the tourism industry that can be used to response to negative visitor perceptions associated with water quality events). When assessing vulnerability and adaptive capacity, we drew largely on interviews in which participants were asked about current challenges and opportunities in their sector both generally, and more specifically related to both the presence of carp and the occurrence of changes in water quality and environmental health. Responses given identified adaptive capacity and vulnerability challenges linked to a range of scale, consistent with the understanding of these concepts as being driven by socio-ecological systems that operate across scales (Yohe and Tol 2002, Gallopin 2006). Thus the issues reported range from specific challenges at the business scale, to issues operating at an industry, community, national and in some cases international scale. For simplicity the term 'current capacity' is used when discussing factors relevant to vulnerability and adaptive capacity.
2. **Potential socio-economic impacts:** The types of changes that might result for each group from virus release, and the socio-economic impacts these changes might lead to. With only limited information available at the time of assessment, assessing potential socio-economic impacts of virus release required (i) identifying the areas of sensitivity – what types of changes would cause significant positive or negative impact, and (ii) assessing likely impacts based on making some assumptions about the potential impacts of virus release. This resulted in identification of key potential impacts, the circumstances under which each could occur, and the potential scope of impact.
3. **Recommended actions:** Actions that can reduce potential for negative impacts and increase potential for positive impacts.

When assessing potential socio-economic impacts and identifying recommended actions, two important assumptions were made. It was assumed that:

- Negative impacts of a virus release on amenity and/or water quality would be short-term in nature in any specific location, meaning they would usually last for a small number of weeks, and at most a small number of months (one to three). This assumption was made as it is considered unlikely a decision would be made to release the virus if short-term negative impacts are likely to occur for a longer period.
- Investment in carp control would be done in a way that enabled long-term improvement in environmental health to occur in multiple locations, which would in turn improve aspects of amenity such as riverbank vegetation, water quality (e.g. reduced turbidity), and/or native fish populations. This assumption was made as it was considered unlikely an investment would be made in carp control unless there was significant evidence that the actions being invested in have a high probability of improving environmental health in the long-term.

These two assumptions are important: the nature of socio-economic impacts of carp control would differ significantly from that summarised in this section if either was changed. In particular, negative impacts would be much more substantial if carp control actions had negative effects on water quality or amenity for periods longer than a few weeks, and if there was only limited or no improvement in environmental health long-term in many locations. Impacts would be more positive if the amenity and water quality impacts were less widespread than was assumed in the assessment, and if improvement in environmental health occurred more rapidly.

The following sections provide a summary of current activities, current capacity, potential socio-economic impacts and recommended actions for the following groups:

- Traditional Owners
- Commercial fishers
- Native fish aquaculture
- Tourism
- Koi sector
- Recreational fishers

For each of these group, the scope of the assessment is first identified: more detailed assessment was undertaken for some groups than for others. This is followed by assessment of current activities, current capacity, socio-economic impacts occurring during the NCCP process, potential socio-economic impacts and recommended actions for the following groups. Where appropriate, key needs for further assessment to be undertaken when likely carp control actions are known are also identified. As there is a more detailed Appendix providing a report for each of these groups, which provides references and details of analysis, the information provided in this report focuses on summarising these Appendices.

This is followed by a section identifying a number of other groups with potential to experience impact such as farmers. For each identified group, a brief assessment is given identifying why the risk of negative impact was considered relatively low and hence the group was not assessed in as much detail as those listed above.

Finally, potential socio-economic impacts for communities are identified through both examining (i) the potential for impacts on specific groups or sectors to have impacts at the community scale, and (ii) potential for the occurrence of impacts that affect a wider range of businesses and residents in communities experiencing carp invasion.

Traditional Owners

Scope of assessment

This project included only a very limited assessment of potential impacts of use of the carp virus for Traditional Owners. This assessment was based on discussions with six representatives of Indigenous Nations whose Country is affected by carp invasion, discussions at the June 2019 workshop attended by two further representatives, and analysis of survey responses from 240 people identifying as Aboriginal and Torres Strait Islander in the community surveys conducted for this project.

The assessment is limited as, based on initial identification of Traditional Owners as a group who have high potential to be impacted by actions to control carp, a separate NCCP project was established that is undertaking more in-depth work. Given this, we did not proceed with further assessment of potential impacts as the other project is examining concerns, needs and opportunities in more depth. However, it is important to document the limited assessment that did occur as part of this project, and this is done in this section.

This section identifies a number of areas of potential impact on Traditional Owners. These are unlikely to be a comprehensive list, as they were identified based on a limited sample.

Current activities and trajectories

A large number of Aboriginal Nations are affected by carp invasion. To identify the number of people identifying as Aboriginal and/or Torres Strait Islander who live in areas affected by carp invasion, two data sources were overlaid:

- Spatial data on recorded occurrences of carp in Australia to 2016, using geospatial data available from Argent (2016). These data on occurrence of carp do not represent a record of carp densities, but do provide a useful record of all locations in which carp have been observed to occur in Australia. These data were classified into two categories: low to moderate numbers of observations, versus high to very high numbers of observations. This was based on the classification in Argent (2016) identifying whether observations, originally drawn from the Atlas of Living Australia, represent low versus high probable densities of carp populations. GIS analysis was used to identify the local government areas in which carp observations had occurred, and whether the observations were at low, moderate or high density using the classification provided in Argent (2016). The unit of the local government area (LGA) was chosen as many people will interact with water bodies and waterways located in their local LGA or nearby, and it is an important governance boundary.
- Data from the Australian Bureau of Statistics 2016 *Census of Population and Housing*, downloaded from the TableBuilder Pro database. This was used to identify the number of people who lived in LGAs who identified as Aboriginal and/or Torres Strait Islander.

Based on the data drawn from the 2016 Australian Census of Population and Housing and mapping of carp density, at least 109,500 people who identify as Aboriginal and/or Torres Strait Islander live in areas affected to a moderate to high degree by carp invasion, with just over 50,000 living in local government areas which have high carp density in some waterways (data sources: ABS 2016; Argent 2016). It is important to note that these numbers will be an underestimate of the total number of people who are Aboriginal or Torres Strait Islander, with Harding et al (2017) estimating that the 2016 Census underestimated the total Aboriginal and Torres Strait Islander population by 17.5%. Undercounting of people identifying as Aboriginal and Torres Strait Islander is recognised to result from a range of factors, particularly lack of trust in government processes that have had negative impacts for Aboriginal and Torres Strait Islanders, and concerns about the use of government data currently and into the future (see Andrews 2018 for a discussion).

In addition to those living in carp-affected regions, it is expected that many Aboriginal people living outside these regions will follow Country that is affected by carp invasion. Those who follow Country

will typically have cultural responsibilities to care for carp-affected Country despite not currently living on that country. This means that many people living outside areas affected by carp invasion have potential to be impacted by actions implemented to reduce carp numbers, as they will regularly visit the Country they follow to engage in activities such as ceremonies, caring for Country and other activities (see for example Dockery and Colquhuon 2012, who identified that ceremony and caring for Country are key drivers of mobility of many Aboriginal people). With many Aboriginal and Torres Strait Islanders having moved to regions other than their home Country for employment or other reasons such as members of the family having been removed from Country in the past, there are large numbers who may live in other areas but follow Country in carp-affected areas and often visit these areas.

Key current activities and trajectories important to understanding potential impacts of carp control, were identified by interviewees and workshop participants. These predominantly fell into four key areas, each important in differing ways:

- *Rights:* In many regions experiencing carp invasion, Traditional Owners are seeking to increase their rights to Country in a range of ways, from Native Title Tribunal cases through to negotiation of access to important sites located on privately owned land. Ensuring respect for and protection of both current and future rights is a very high priority. Three interviewees raised this as a key issue, for example through identifying that ensuring protection of cultural sites that Traditional Owners are seeking access to or rights to manage is critical when implementing any carp control activity. This is an important issue for large numbers of members of Indigenous Nations living in carp-affected regions, but it was not possible to estimate how many, or conduct a thorough identification of the range of important issues related to rights that have potential to intersect with carp control action.
- *Cultural activities, caring for Country:* A wide range of cultural activities, including activities involving caring for Country, ceremony and social activities, are undertaken in and near waterways experiencing carp invasion. These activities vary widely across Nations, and are engaged in by many members of those Nations. There has been ongoing work in many areas to increase capacity to undertake activities on Country, and to increase engagement in cultural activities, over recent decades. In particular, substantial ongoing work is occurring to reconnect many people with Country through increasing the number and type of activities they can engage in. Carp control has potential to impact ability to engage in these activities, both in the short-term and long-term, in both negative and positive ways, depending on how it is undertaken.
- *Culturally important sites:* Interviewees emphasised that large numbers of sites of cultural importance are located on and near waterways affected by carp invasion, many of which are not formally documented in available databases. Many of these have high potential to be disturbed if people are unaware of their presence and engage in activities such as removing dead carp where a site is located.
- *Economic enterprise:* Growing numbers of Aboriginal owned and operated businesses are operating in regions affected by carp invasion. These include tourism businesses, businesses harvesting traditional foods and making crafts and other products, and agricultural enterprises, amongst others. Interviewees identified a number of activities conducted by Aboriginal owned and operated businesses they felt would be potentially affected by carp

invasion and by carp control activities, particularly businesses involving cultural education, tourism, and some producing traditional foods.

Current capacity and challenges

When discussing current capacity and challenges, two key issues were identified: capacity to engage, and availability of appropriate resources to support engagement and active involvement of Indigenous Nations in both development of carp control actions, and in implementation of these actions.

Capacity to engage is a key challenge. Many representatives of Indigenous Nations have very high demands on their time, and receive regular requests to engage in a wide range of processes, often with little resourcing provided to compensate for the time and other costs involved if they are to engage meaningfully. Lack of time to appropriate consult within different Nations was identified as a common issue in most processes seeking to develop actions to occur on the land and water areas of different Nations. This means appropriate resourcing and provision of sufficient time is essential to enabling effective engagement in both the NCCP and any subsequent processes. It is also critical to ensure sufficient time is provided to enable consultation within different Nations to occur, and for different Nations to come together to form shared views if they identify this as an important step.

Lack of resourcing for action to care for Country was also commonly identified as a significant constraint, not only in terms of funding but also in terms of having rights to water to enable implementation of actions important for the health of Country. Interviewees identified that many existing activities conducted to care for Country either receive no or little resourcing. This was a current constraint: the opportunity identified together with it was high levels of knowledge and understanding of local areas that has potential to be drawn on to ensure carp control action is accompanied by actions that can increase health of Country in the long-term. However, enabling this opportunity, for example through engaging members of Indigenous Nations in monitoring or implementing carp control actions and subsequent environmental recovery action, would require provision of appropriate resourcing as current capacity is low due to the existing lack of sufficient resources.

Socio-economic impacts during the NCCP process

Both interviewees and workshop participants identified that the NCCP process had resulted in impacts for Indigenous Nations. Specifically, most were concerned about lack of consultation and direct involvement of Traditional Owners in the processes of:

- Developing the initial terms of reference for the NCCP and having input into the scope of assessment undertaken (discussed further in Appendix 9)
- Developing specific actions.

This was the key impact identified as occurring during the NCCP, and disempowerment and disenfranchisement were identified as impacts that have profound impacts for those who have experienced multiple generations of disempowerment and for whom any process that reinforces that disempowerment can have significant negative impacts.

Potential socio-economic impacts – what could happen and under what conditions

The following potential socio-economic impacts were identified:

- Disempowerment through lack of involvement: This negative impact has potential to occur if Traditional Owners do not have a meaningful role in developing and implementing carp control actions. Concern was expressed that negative impacts had already occurred (described in the previous section).
- Empowerment through active, meaningful and appropriately resource involvement: This positive impact had potential to occur if Traditional Owners have meaningful and formalised roles in making decisions and, where appropriate, implementing carp control actions, that enable fulfilment of obligations to protect Country. When discussing this, interviewees and workshop participants emphasised the importance of meaningful roles, which had genuine influence and ideally decision-making power through formalised roles in the governance of carp control action. They also emphasised the importance of involvement being sufficiently resourced: empowerment is unlikely to occur if unrealistic demands are made that Indigenous Nations cannot meet due to a lack of access to the time and financial resources needed.
- Impacts on health of Country (potential for both positive and negative impacts): Any change to the health of Country impacts the wellbeing of Aboriginal people who follow that Country. Any environmental impacts of carp control activities on health of Country (positive or negative) will directly impact the wellbeing of Traditional Owners who care for that Country. Interviewees identified potential for both positive and negative impacts. In the short-term, there was concern that there could be negative impacts on health of Country, particularly water quality, aquatic species including some totem species which had limited spatial distribution and were viewed as being at high risk from poor water quality events. In the long-term, potential for positive impacts through reduction of carp populations were identified, particularly recovery of native fish species and aquatic plant species of cultural importance. However, two interviewees emphasised that long-term positive impact would be much more likely to occur if there was meaningful involvement by Indigenous Nations in identifying the types of recovery action needed, and the areas where some species may require specific protection or support during any process of virus release.
- Impacts on cultural activities (potential for both negative and positive impacts): In the short-term, current cultural practices and activities have potential to be disrupted if virus release results in fish kills or water quality problems. The extent of impact resulting from this depends on how long this impacts access to sites, impacts water quality, and whether this results in longer-term impacts on populations of species important to cultural activities. In the longer-term, potential for positive impacts on some cultural activities was identified if reduction in carp populations occurred and was followed by an improvement in environmental health, particularly those that involve water-based activities, native fish or aquatic plants. More broadly, improved aquatic health may enable fulfilment of some aspects of caring for Country.
- Impacts on culturally important sites (potential for both negative and positive impacts): Very similar potential impacts were identified as for cultural activities. In addition, concern was raised about the potential for culturally important sites to be damaged when waterbodies

are accessed either to release virus, clean up dead fish, or if other carp control actions such as live harvest are implemented, as part of those actions. This would occur only if there was a lack of appropriate time and resourcing given to identifying these sites, and in particular if local members of Indigenous Nations did not have a meaningful role in identifying potential impacts of accessing sites on their Country.

- Loss of employment and income (negative impact): Negative impacts on existing employment and income for members of Indigenous Nations could occur if fish kills or water quality impacts disrupt jobs and income earning opportunities, such as tourism activities, cultural guide activities, or growing or harvesting native foods. This negative impact was typically associated with the potential short-term impacts of virus release, but also identified as having potential to occur if long-term environmental benefits did not result from a reduction in carp populations, particularly if there was invasion of other pest species instead.
- Lack of employment and income opportunities from carp control (negative impact): A potential negative impact identified was lack of ability for Aboriginal-owned and -operated businesses to access employment and income earning opportunities generated by carp control activities, such as clean-up, monitoring of waterway health, and ecological restoration activities, amongst others. A lack of access to these opportunities could act to disempower Aboriginal businesses.
- Growth in employment and income opportunities: Opportunity for employment and income from carp control was identified as a potential positive impact by most interviewees. Opportunities to be involved in activities such as clean-up, monitoring of waterway health, and ecological restoration activities were viewed as having potential to provide economic opportunity that was coupled with enabling fulfilment of obligations to care for Country. In the longer-term, growth in economic opportunities related to tourism and food ventures was identified if reduction in carp populations resulted in improvement in ecological health of areas affected by carp invasion.

Recommended actions

Actions recommended to reduce negative and enable positive impact from carp control activities for Traditional Owners are:

- Ensure views of Traditional Owners inform recommendations made by NCCP.
- Ensure meaningful engagement can and does occur throughout planning and implementation of any carp control, which requires ensuring sufficient resourcing and time is provided. Recommendations of the NCCP should include identifying the resourcing needs required going forward.
- Identify Aboriginal businesses that currently depend on areas affected by carp invasion. Identify strategies for reducing potential negative impact on these businesses in consultation with them, as well as potential for positive opportunities.
- Establish transparent and appropriate processes for identifying cultural sites and activities requiring protection. These processes should be are developed with Traditional Owners and approved by them, and include identifying resources needed to ensure sites are identified and protected when carp control occurs.

- Appropriate, resourced engagement with Traditional Owners to identify how best to support health of Country when designing and implementing carp control actions.
- Resource Traditional Owners to undertake appropriate on-Country activities to support health of country potentially affected by carp control actions.
- Ensure employment and income-earning opportunities associated with investment in carp control are available to Aboriginal businesses; provide support to enable investment in skills building or capital equipment.

Further assessment

As identified earlier, more comprehensive assessment is being undertaken as part of a separate project. The recommended actions include a number of areas for further assessment that, if conducted as part of developing on-ground strategies for carp control and during implementation, will reduce potential for negative impacts.

Commercial fishers (carp fishers, other commercial fishers)

Scope of assessment

An assessment of existing conditions and of potential impacts was undertaken for commercial carp fishers, and the full report is provided in Appendix 3. As Appendix 3 provides a detailed assessment, this section provides a summary only of key findings. A total of 18 commercial carp fishers were interviewed or participated in workshops. In addition, a further three representatives of commercial fishers and three fisheries managers were either interviewed or attended a workshop. The focus of the assessment was on commercial carp fishers, however potential impacts on other commercial fishers with potential to be affected was also identified through identifying potential displacement effects if commercial carp fishers shift their fishing effort to other fisheries, and identifying potential impacts of changes in water quality or changing consumer preferences on other commercial fishers. The methods used for the assessment are described in detail in Appendix 3.

Current activities and trajectories

There are around 44 commercial carp fishers in Australia who have active permits to fish for carp (this was current as of 2018 and will fluctuate over time). Many of these also have other commercial fishing licences or permits, or engage in commercial aquaculture. Dependence on income earned from carp fishing varies, with most commercial carp fishers having a relatively small proportion of household income derived from carp fishing. A core group of fishers (7-10) have businesses and household incomes with significant reliance in income from carp harvest. Many of this group report strong market interest in expanding harvest of carp for a range of products, particularly from export markets. A further 10-15 licence holders rarely actively use their carp harvesting permit/licence either currently or historically, while the remainder do actively utilise their carp harvest licence/permit, but income from carp harvest constitutes a relatively small proportion of total household income.

Current commercial use of carp in Australia ranges from sale of carp products for human consumption, to production of pet food, and production of products such as fertiliser and leather. Internationally a wide range of products are made from carp, including salted roe, gefilte fish, a range

of processed fish food products for humans and animals (including fishmeal for use in aquaculture), and fertiliser (liquid and pellet).

Current capacity and challenges

Commercial carp fishers have been limited in their ability to expand carp harvesting in Australia due to a range of factors, including regulatory constraints that cause difficulty achieving reliable harvest volumes to supply markets (affecting some but not all fishers), difficulty achieving permission to fish and access sites where carp are aggregating in a timely fashion, and lack of coordinated cross-jurisdictional strategies to support commercial live harvest. Views varied about the potential for expanding markets for products derived from commercial harvest of carp: many felt there was high potential, particularly in international markets, as they had significant demand from prospective customers. Others felt the potential to expand domestic or international markets was limited by the relatively higher costs of harvesting carp in Australia compared to growing them in aquaculture operations internationally. Several reported having experienced multiple past changes to fisheries licences and permits that have created stress and reduced their ability to cope with further change. This suggests that adaptive capacity is significantly constrained, with relatively high vulnerability to impacts on carp harvest.

Socio-economic impacts during the NCCP process

Some commercial carp fishers have experienced significant negative impacts during the NCCP process, particularly those who harvest larger volumes of carp and rely on carp harvest for a significant proportion of household income. The impacts occurring during the NCCP process have included:

- Uncertainty about the future resulting in psychological distress, stress, mental health impacts: The announcement of the NCCP and resultant extended period of assessment created distress and uncertainty for commercial fishers. For those whose livelihood depends largely on harvesting live carp, the NCCP represented a proposal that would have significant impacts on their livelihood, with the nature of those impacts uncertain during the period of the NCCP, and likely to remain uncertain for some time after the NCCP, until decisions about future carp control are made and implemented. This uncertainty has adverse impacts on mental health, particularly for those living in households with a high proportion of their livelihood dependent on commercial carp harvest. The adverse impacts reported included high levels of stress and anxiety about the future, fear about the future, a sense of powerlessness by individual carp fishers to influence events affecting their future, depression, loss of sleep for extended periods of time, and for some a sense of hopelessness about the future at times.
- Reduced opportunities: Several commercial carp fishers were investigating a range of carp control actions that could involve harvest of live carp, and/or new processing options and markets for live harvested carp, at the time the NCCP was announced. They reported that the proposal to release the virus often reduced ability to discuss these options, with decreased potential to obtain research funding to investigate different harvesting techniques, or to obtain funding to support development of new processing or new markets. The focus of the NCCP on evaluating feasibility of virus release and limited examination of other options for

carp control contributed to the impact of reduced opportunities. Several wanted formal trials of live carp harvest that drew on their knowledge to produce hard data on the effect of well-designed live harvest on carp volumes.

- Inability to invest in or sell business: Many carp fishers reported they were unable to actively invest in their business during the NCCP due to uncertainty about the future affecting market interest, access to finance and ability to make decisions. This impact will continue until a clear decision is made about future carp control action, as while the future of carp fishing is uncertain there are a lack of interested buyers for carp fishing businesses.
- Difficulty or inability obtaining or servicing finance: Some fishers reported inability to access finance and concern from their financial institutions about their future ability to service existing debt if a virus release affects viability of their business.
- Loss of market access: Some current customers of carp fishers have withdrawn previously expressed interest in expanding the volume of carp they purchase. Overall, fishers reported lower interest from prospective customers and markets. However, some reported no impact, or felt that the impact had reduced over time after announcement of the NCCP, with some reporting they were actively working to source new markets and expand live carp harvest in the next one to three years.

Potential socio-economic impacts – what could happen and under what conditions

The impacts that have occurred since announcement of the NCCP are likely to continue until a decision is made about future carp control that provides more certainty about the future of commercial harvesting of live carp. Some may continue beyond this point, as there may remain uncertainties about the viability of future live carp harvest for some time after carp control actions are implemented, until the extent of reduction in population, or issues associated with virus release (if this occurs) such as regulation of transport of produce from areas in which the virus is released.

In addition to the continuation of many of the impacts arising during the 'anticipatory' phase where the future of live carp harvest is uncertain, the following potential socio-economic impacts were also identified:

- Reduced consumer interest leading to reduced market interest (negative impact): Many of those interviewed, particularly those harvesting carp for human or pet consumption, felt that release of the carp virus was likely to lead to a decline in willingness to consume live harvested carp. This was due to consumer concerns about the virus. The community attitudes surveys conducted for this project support this concern, identifying that a high proportion of the population express concerns about things such as a perceived risk of the virus transmitting to humans, and reduced willingness to consume products harvested from areas in which the virus was released. This could affect both domestic and international markets, and as it is related to perceptions, would likely affect carp harvested in areas where the virus had not been released as well as those where it was, and would cause impacts due to these perceptions even if the product is demonstrated to be safe. Products such as fertiliser made from carp would be less likely to experience a reduction in demand, although a temporary decline in demand is possible.
- Reduced market access due to domestic or export regulatory constraints (negative impact): Most fishers were concerned that virus release may result in the imposition of new

constraints on things such as transport of harvested goods between areas, or additional requirements to conduct tests or otherwise demonstrate product safety. Some were concerned they may be completely unable to access some markets if regulatory constraints were implemented that either substantially increased business costs or time, or that simply reduced market access by restricting sale of carp for some end uses or in some regions.

- Increased business costs (negative impact): Business costs may increase if there is a need for businesses to test for virus presence in harvested carp, implement new practices to reduce risk of virus transmission, or if volume of carp harvested reduces. The latter is not considered a high risk due to the expectation that while the virus would reduce carp numbers to a lower level, fishable aggregations of carp would still occur.
- Improved opportunities (positive impact): Some carp fishers identified that a carp control strategy could provide positive opportunities for commercial carp fishers. In particular, drawing on the extensive knowledge carp fishers have of carp behaviour and harvesting techniques could contribute to carp control and provide economic opportunity for fishers. However, this would occur only if the carp control strategy included actions such as actively involving carp fishers to draw on their expertise and knowledge, developing and implementing a more enabling regulatory environment for live carp harvest to better enable live harvest to contribute to carp control actions, and/or providing specific support for harvest of live carp to form part of carp control actions. Some also felt that involvement in clean-up of dead carp could provide positive opportunities, however others felt they would be unwilling to be involved in clean-up for a range of reasons, including concern about becoming the 'face' of carp control efforts (see next point below), and concern that this would not adequately draw on and utilise expertise of carp fishers.
- Impact on public reputation (negative or positive): If a large-scale carp kill results in problems such as loss of amenity (e.g. smell, presence of rotting fish), poor water quality or other negative impacts, commercial fishers were concerned they may be blamed as they are often the public 'face' of carp fishing. This was considered particularly likely to occur if fishers become involved in clean-up activities.
- Substantially reduced business income, loss of business: There is potential for a relatively small number of carp fishers (<10) fishers to lose business viability if the virus is released. This would have significant negative social and economic impacts for these fishing households.

Potential impacts on commercial fishers other than carp fishers were also identified. The following impacts were identified that could affect commercial fishers other than carp fishers if the virus is released:

- Loss of market access due to restrictions on sale of goods harvested from waters the virus could be present in. This could affect any commercial fishers operating in waters in which the virus could be present, predominantly those fishing in inland freshwater areas and estuary areas. Whether it occurs depends on whether any restrictions occur.
- Loss of market due to restrictions on sale of goods harvested using carp bait or other bait that may have been exposed to the virus, due to concerns about potential for presence of virus particles on harvested produce. This could affect rock lobster fishers in particular.

- Reduced consumer demand for produce perceived to have potential to have come into contact with the virus (irrespective of whether produce is safe)
- Reduced income due to increased competition from displaced carp fishers: Many carp fishers also hold licences/permits to fish in other commercial fisheries. If they shift effort into these other fisheries as a result of reduced ability to harvest carp, this may have flow-on effects on those currently operating in the fisheries that carp fishers increase effort in. Specifically, this could increase competition in the commercial fisheries to which effort has shifted, with varying impacts depending on the fishery involved and the type of management mechanisms in place.

If any of these occurred, they would result in similar types of impacts to those listed in the above table being experienced by these broader groups of fishers.

Recommended actions

The following actions can reduce potential for negative impacts on commercial carp fishers (and other commercial fishers), and increase potential for positive opportunities to result from implementation of carp control actions:

- Provide a clear timeline for decision making to help enable planning for the future.
- Provide regular communication about progress to reduce uncertainty of fishers.
- Ensure carp fishers knowledge is acknowledged, respected, and drawn on where possible.
- Identify collaborative research opportunities that involve commercial carp fishers and enable them to contribute their knowledge and be engaged in meaningful ways.
- Provide clear advice and communication to markets and financial institutions if requested to do so by fishers.
- Provide support to maintain current markets and to build demand in alternative markets, in collaboration with fishers. This may for example involve investing resources to develop appropriate campaigns that assist in maintaining consumer confidence in consumption of carp or other products harvested from areas in which virus release has occurred. With multiple examples of live fish harvest (carp and non-carp) from virus-affected areas in other countries, there is a large body of evidence to draw on regarding safety that can be used to support communication strategies.
- Provide clear advice to fishers on potential impacts on market access from regulatory requirements. If regulatory requirements will reduce or close some markets, provide support to businesses impacted by this change in circumstances to assist transition.
- Identify costs of adhering to any regulatory requirements applying due to potential presence of virus. Support cost reduction where appropriate e.g. through investment in developing low-cost methods for detecting virus presence. If the costs of complying with regulatory requirements affect business viability, provide support to businesses impacted by this change in circumstances to assist transition.
- Establish cross-jurisdictional group to identify and implement appropriate regulatory reform to enable fishers to better contribute to reducing carp populations through live fishing. Trial live harvest methods and assess their potential contribution to carp population reduction.

- Ensure clear communication about who is responsible for actions that cause carp kills and how to contact relevant authorities. Have a plan to ensure safety of those involved in clean-up activities.
- Provide assistance for those fishers whose livelihood is threatened, to support transition to new business activities or employment.
- Monitor whether carp fishers are shifting effort into other fisheries, and ensure that support provided to carp fishers does not result in displacement of other fishing effort.

Further assessment

There is potential for change in carp harvesting activities, the types of products produced from harvested carp, and markets accessed, in the next one to three years, based on reports of fishers. Given the dynamic nature of live carp harvest and markets supplied, once the timing of carp control actions is known, it is important to conduct a more detailed and quantified assessment of status of the sector (e.g. number of jobs, economic value, volume harvested, market types) at a point in time closer to the implementation of these actions. This should include assessing both the commercial carp fishing sector, and identifying the different products other than carp being harvested or produced in areas in which carp control actions are going to occur. This can then provide an accurate baseline for assessing potential impacts of actions once decisions are made about the type of carp control actions to be implemented and the timeframe in which they will be implemented.

Native fish aquaculture businesses

Scope of assessment

A detailed assessment of existing conditions and of potential impacts was undertaken for the native fish aquaculture sector, and the full report is provided in Appendix 6, including a detailed description of the methods used for assessment. As Appendix 6 provides a detailed assessment, this section provides a summary only of key findings. A total of 12 operators of native fish aquaculture businesses were interviewed or participated in workshops. The focus of the assessment was on potential impacts of virus release on those aquaculture businesses operating in freshwater and estuary areas in which carp invasion has occurred, and where virus release could occur. Available secondary data, combined with interviews, was used to examine the overall size and scope of the sector and recent trajectories of change. Community surveys were used to further assess likelihood of changes in consumer demand associated with virus release, after interviewees identified this as a key concern.

Current activities and trajectories

Inland native fish aquaculture is a relatively small component of the aquaculture industry in Australia – inland freshwater species account for around 6.4 per cent of Australia's aquaculture by value (ABARES 2017), although onshore aquaculture accounted for around 28% of total aquaculture employment recorded in the 2016 Census (some onshore aquaculture involves saltwater species). However, parts of the native fish aquaculture industry have grown rapidly in recent years. For example, Murray cod aquaculture production in NSW grew by 212 per between 2013-14 and 2017-18, from 85.3 tonnes to 265.9 tonnes. The total market value for Murray cod produced in NSW

increased over this same period from $1.44 million to $4.89 million (represented in nominal terms) (NSW DPI n.d.). This production occurs almost entirely in areas affected by carp invasion.

Freshwater native fish aquaculture operators supply a number of markets. These include:

- Producing fingerlings for restocking of natural waterways and impoundments for both biodiversity restoration and recreational fishing purposes.
- Supplying fingerlings and fry for growing on in domestic or overseas operations.
- Growing stock to table fish size for both domestic and export markets.

Fish consumption markets are highly sensitive to any change in product quality: in particular, Australian producers exporting to other countries reported that their business viability relies on receiving price premiums based on their 'clean and green' image.

Current capacity and challenges

Despite many inland native fish aquaculture businesses achieving significant growth over the last decade, the sector is also experiencing several constraints to growth. Common constraints identified by both those interviewed for this study, and in the National Aquaculture Strategy, are:

- Complex regulatory conditions and restocking program requirements
- A lack of public investment in research and development
- Limited industry coordination reducing representation and advocacy for the industry.

These constraints results in sometimes challenging conditions under which not all potential markets are profitable, and there can be high vulnerability to changes that have even a small impact on business viability For example, several businesses stopped participating in a NSW restocking program in recent years due to concerns about legal liability and high transaction costs that meant they could not achieve a positive return; meanwhile the Victorian government restocking program was described as positive and supportive of industry viability.

Socio-economic impacts during the NCCP process

While most native fish aquaculture businesses were not materially affected by announcement of the NCCP in the form of difficulty accessing finance or reduced market interest, most reported increased uncertainty about the future. For some, this uncertainty led to delaying decisions about business investment until a point when there is greater certainty about future carp control action. Others have not changed their investment activity, with expansion in the sector overall during the period of the NCCP.

The anticipatory impacts experienced by those involved in native fish aquaculture were typically much less acute than those experienced by commercial carp fishers. The principle impact reported was uncertainty about the future of the business. For example, while some described experiencing uncertainty about the future, typically interviewees did not report this leading to issues such as ongoing high levels of depression or anxiety, although increased stress and some anxiety about the future was reported. They also did not typically experience loss of market interest during the NCCP process, or substantially increased difficulty accessing finance.

Additionally, several felt a sense of frustration or disempowerment resulting from what they viewed as a lack of opportunities to contribute their knowledge and expertise to research being conducted prior to or during the NCCP. This related in particular to trials examining whether the virus would affect species other than carp. Industry members identified a number of areas they felt needed further investigation in relation to this, relating not only to whether the virus could directly infect other species, but also to the length of time the virus can stay viable in water or when being carried by other species (e.g. as particles on scales). These issues directly inform the likely need for regulation, future costs and viability of native fish aquaculture businesses.

Potential socio-economic impacts – what could happen and under what conditions

Similar to commercial carp fishers, many of the potential negative impacts identified of a release of the carp virus related to potential for regulatory constraints or for negative market perceptions. However, many involved in native fish aquaculture – principally those supplying restocking programs – also saw potential for positive opportunities for this sector from carp control, depending on whether restocking was invested in as part of encouraging improved environmental health after a reduction in carp numbers. However, for these positive impacts to occur forward planning is required, to enable sufficient investment across the industry to meet any increase demand for restocking, as well as for regulatory reform and biosecurity measures to be planned and implemented.

Specific potential impacts identified were:

- Increased business costs (negative): Business costs may increase if there is a need for businesses to test for virus presence in fingerlings being transported to other locations (domestic or in other countries), or for businesses to implement specific biosecurity measures to ensure virus free water (for example using specific techniques to ensure no presence of virus in water or on produce).
- Loss of market access due to reduced consumer demand (negative): Market access may be reduced through domestic or international consumers being unwilling to consume product they perceive to be affected by a virus (even if it is not). This is particularly a concern in relation to export markets, where some businesses reported a high likelihood of reduced market interest if any factor was perceived to affect the 'clean, green' image of Australian produce. In Australia, research on consumer perceptions identified a likely initial reduction in willingness to consume table fish grown in areas perceived to have potential to be affected by the virus. However, it also identified that overall low awareness of these products meant investment in marketing campaigns would likely result in net growth in demand for produce through increasing overall awareness in products, despite some consumers being unwilling to consume produce from areas perceived as virus-affected.
- Loss of market access due to domestic or export regulatory constraints imposed on transport or sale of produce harvested in waters in which the carp virus may be present (negative).
- Opportunity for expanded business opportunities (positive): Those businesses that supply restocking programs could experience increased demand for their produce, if restocking is increased after carp control actions are implemented. However, for businesses to be able to benefit from this, they need sufficient lead time and clarity about the type of restocking to be

done, as there is typically a long lead time to undertake any expansion of business operations or ramp up production of particular species and grow them to a specified size.

- Opportunity to address existing regulatory constraints (positive): While not an objective of the NCCP or carp control, similar to carp fishers, some involved in the native fish aquaculture sector felt that including work to reduce regulatory complexity in their sector could assist them in engaging in restocking activities, and more broadly could support maintenance and growth of the sector.
- Impacts of reduction in or loss of business: There is potential for some businesses to experience loss of business viability. This would occur under specific circumstances: if an unpredicted water quality event resulting from virus release caused large loss of stock; if regulatory constraints substantially reduced markets or increased business costs to a point of non-viability; or if there was a large negative impact on consumer perceptions resulting in large loss of markets. The actions listed in the next section are recommended to reduce the risk of substantial loss of business activity. As noted above, there is also potential for increase in business if there is increased demand for fingerlings for stocking, or a successful communication campaign that increases overall awareness of the sector's products and expands markets for them as a result.

Recommended actions

Many of the recommended actions are identical or similar to those recommended for the commercial carp fishing sector:

- Provide a clear timeline for decision making to help enable planning for the future.
- Provide regular communication about progress.
- Identify regulatory implications. Provide clear guidance on required processes for businesses. Assist businesses through actions such as investing in developing low-cost processes for meeting any additional regulatory requirements.
- Develop appropriate campaigns to maintain consumer confidence in consumption of produce: this has high potential to offset any decline in consumption related to negative perceptions of produce grown in areas in which the carp virus would be released. It may also increase overall awareness of the sector and hence expand consumer interest in consuming the products produced, particularly table fish.
- Invest in marketing and diplomatic strategies into export markets to reduce risk of impacts.
- Provide clear advice to fishers on potential impacts on market access from regulatory requirements. If regulatory requirements will reduce or close some markets, provide support to businesses impacted by this change in circumstances.
- Make decisions about restocking early and ensure sufficient lead time to ensure businesses can supply. Use appropriate programs and processes to contract businesses for restocking, ensuring regulatory conditions are clear and businesses are given an appropriate operating environment.
- Review current regulatory system and key constraint areas; invest in reform to streamline and reduce costs of regulation for businesses.
- Provide assistance for those whose business activities are reduced, to support transition to new business activities or employment.

Further assessment

The lead time and resources required to enable restocking after implemented of carp control actions should be investigated in detail. This should be done as part of developing on-ground carp control strategies, to ensure suitable allocation of resources ahead of implementation of carp control to enable native fish aquaculture businesses to invest in and grow the stock needed. In particular, the types of species to be restocked need to be assessed, as for some species there are very few (sometimes only one) aquaculture business able to currently produce stock, with limited capacity.

Similar to commercial carp fishers, the often rapid change in the aquaculture sector means that a more comprehensive assessment of activity in the sector should be undertaken once the timing of carp control actions is known, to ensure an accurate assessment of sector activity that has potential to be affected by carp control actions.

Tourism industry

Scope of assessment

An assessment of existing conditions and potential impacts was undertaken for the tourism sector, and the full report is provided in Appendix 4, including a detailed description of the methods used for assessment. As Appendix 4 provides the full assessment undertaken, this section provides a summary only of key findings. A total of 24 people were interviewed, including individual tourism business operators and representatives of state and regional tourism organisations and peak industry groups. The focus of the assessment was on potential impacts of virus release on tourism businesses operating in freshwater and estuary areas in which carp invasion has occurred. An online survey of 69 tourism businesses in these areas was also conducted, to better identify how businesses had coped with past water-related events such as blue-green algae outbreaks and low-water events, their vulnerability and adaptive capacity, and to identify potential impact mitigation strategies. Secondary data, together with data from interviews and the survey, were used to identify the broad scope and scale of tourism activities in areas experiencing carp activities.

Current activities and trajectories

In Australia, as of 2017-18 the tourism industry was estimated to generated $131.4 billion of spending nationally by both domestic and international visitors, and to directly employ 598,200 people across 288,614 businesses nationwide. The focus of our assessment was on tourism in regional communities in which carp invasion has occurred. In 2017-18, an estimated 44% of tourism spending occurred in regional areas of Australia (not all of which experience carp invasion), generating $51 billion in spending in those communities.

Data on employment in tourism from Tourism Research Australia were overlaid with spatial data on carp invasion from the 2016 State of the Environment Report (Argent 2016) to estimate the likely number of regional tourism jobs based in areas in which carp invasion has occurred. Employment generated by tourism in major cities such as Melbourne was excluded, even if carp invasion was occurring, as based on interviews with tourism industry representatives it was considered unlikely a significant proportion of tourism activity in these areas was highly reliant on freshwater areas.

In regional areas identified as having a moderate to high density of carp in 2016, excluding those where tourism is known to depend largely on saltwater or non-freshwater related attractions (such as skiing), an estimated 78,000 people were employed in tourism across 58 regional local government areas (LGAs). This estimate excludes the many people employed in tourism who work in areas in which low densities of carp were identified, and excludes some smaller LGAs for which tourism employment statistics are not reported. It is therefore an underestimate of total tourism employment in carp affected areas, but indicates likely magnitude of employment in those areas with higher densities of carp located outside major cities.

Many of these 78,000 jobs will not depend directly on tourism activities occurring in freshwater areas, however a significant proportion will; it was beyond the scope of this assessment to identify the extent of dependence on freshwater activities given the complexity of doing so. For example, many tourism representatives explained that in many LGAs, all tourism visitation tends to change when there are adverse water quality events, even for tourism businesses not directly dependent on freshwater, as many tourists opt to cancel their entire visit (which often involves multiple activities, only some of which involve interaction with freshwater areas), rather than only their freshwater-related activities. This suggests that even though not all tourism jobs depend directly on freshwater, in LGAs where freshwater-based tourism contributes to the tourism industry (according to interviewees, this was in all or almost all of the 58 LGAs identified), there is potential for all the industry to experience impacts as a result of actual or perceived changes in water quality or amenity more broadly.

In most of these 58 LGAs, 10% or more of local employment depends on tourism. The types of tourism businesses that can depend on freshwater are diverse in these regions. They include (but are not limited to) those directly using freshwater and estuary areas, such as houseboats, kayak/canoeing hire and guide businesses, recreational fishing related businesses, water skiing, and many nature tourism businesses; and those reliant on areas adjacent to freshwater and estuary areas, such as accommodation located on riverbanks and lakes; restaurants, cafes and takeaway food shops; and some hire and retail shops. December and January are peak months for most businesses (76% in December and 83% in January). Most autumn and spring months, and February, are peak or shoulder seasons for the large majority of businesses. The winter months are off-peak for around half of businesses, but are peak times for some (9% to 16%) and shoulder for others (18% to 25%). Most tourism businesses (74%) earned half or more of their total annual revenue during their peak months, and 28% earned three-quarters or more of their revenue during peak season.

Current capacity and challenges

Conditions in the industry were reasonably positive as of late 2018: results of the survey of tourism businesses identified that 89% of businesses were confident they would be operating in one year's time, and 85% that they would be operating in five years. Most – 77% - felt confident they could adapt to change in the tourism industry, and 66% felt their business revenue was likely to grow in the near future. Just over half were in a better position compared to previous years. While 42% felt well supported by tourism industry organisations, 27% did not, indicating this is an area of stress for some. Only 36% reported having adequate access to finance, with others either not having adequate finance or being unsure if they did. Twenty three per cent reported that their business was under a lot of stress at the time of completing the industry survey. More than half – 55% - found it difficult to

recruit workers with the right skills for their business, indicating this is a key constraint area for many. Only 13% reported lower than average revenue during 2018, while 33% reported similar and 55% higher than average revenue.

Most tourism businesses interviewed reported that wild carp currently have minimal impact on tourist business operation or viability, or on tourist visitor numbers. In the survey, 34% of businesses reported carp had negative impacts on their business, 39% reported neither positive or negative impacts, 11% reported positive impacts, and 16% were unsure whether or how carp affected their business. The negative impacts reported were principally related to the impacts of carp on local amenity in the form of turbid water, reduced native fish populations, and the impacts of dead carp being left on riverbanks by fishers. Most businesses supported investment in controlling carp, and felt that reducing carp numbers would have benefits both for their business and their region more generally through improving water quality in natural water bodies such as rivers, lakes, and wetlands.

There are noted challenges to growing the tourism industry in many regional areas of Australia in general, with relatively less investment in significant tourism projects in regional areas compared to cities, and regional investments in expanding tourism being more likely to require government support. Many tourism businesses operating in freshwater inland regions, particularly those reliant on close contact with rivers, lakes and wetlands (e.g. houseboat operators, fishing guides, nature-based or adventure tourism, and accommodation with water frontage), need to cope with reductions in tourist visitation resulting from poor water quality and changed water flow events. All business operators who participated in interviews, workshops or the survey had experienced one or more of these events, including many experiencing very low water levels in 2019 due to low water inflows in much of eastern Australia. For some, these past experiences have increased adaptive capacity with the development of regional or local government support in the form of communication materials, business assistance and support to assist the industry to recover. For others, the events have created significant stress that has impacted on capital reserves and financial viability and reduced their capacity to cope with subsequent events. The past experiences of water quality or flow events will therefore have increased the capacity of some businesses to cope with potential impacts of carp control and reduced the capacity of others. They have also resulted in development of processes and materials by the tourism sector that provide important examples to draw on when developing any strategies for supporting tourism businesses as part of the Plan.

Socio-economic impacts during the NCCP process

The NCCP process was described as having relatively few impacts for the tourism sector. While many businesses reported feeling in 'limbo' when considering making short to medium term business investment decisions, because of the uncertainty about short-to medium terms water quality impacts of virus release and potential for business down-turn, this was not typically described as having significant practical impacts. Few reported significant impacts on investment decisions to date. Most wanted greater certainty about what carp control would happen in future and when, so they could prepare for any potential impacts.

Potential socio-economic impacts – what could happen and under what conditions

When assessing potential socio-economic impacts, the key issue identified in relation to the tourism industry is that socio-economic impacts don't result only from *actual* occurrence of issues such as a

decline in water quality or fish kills occurring. Instead, they often result from consumers believing these are affecting an area (even if they are not), or fearing they might occur in an area and as a result choosing to visit an alternative destination instead. Interviewees described a large gap between consumer perceptions of a water-related event and what is being experienced on the ground. This perception gap was reported to often be driven by the way events are represented in the media, with 'worst case' images often feeding negative perceptions and driving downturn in visitation. Most reported that after a significant water event, tourist visitation can take months to years to recover. This has implications for the capacity of a business to cope with subsequent events or down-turns.

Specific potential impacts identified were:

- Increased tourism business opportunities over the longer term (positive): In many cases, tourist operators in freshwater inland areas are closely connected economically, socially and emotionally to the natural environment. The proposal for national coordination of control carp has been experienced positively by many in the sector as they hope carp control improve water quality, native fish populations and overall environmental amenity; and through this increase tourism opportunities in the long-term.
- Impacts of virus release on amenity – actual (negative impacts in short-term): Businesses are likely to experience downturn in visitation in areas in which virus release results in a reduction in amenity in the form of fish deaths or poor water quality. Downturn in visitation has been associated with all past negative water quality and fish kill events, and particularly affects businesses dependent directly on water-based activities such as houseboat businesses. Forward bookings often decline when a potential loss of amenity in future has been identified. This is likely to result from any decline in amenity, irrespective of how short-lived or restricted in area.
- Impacts of virus release on amenity – perceived (potential for negative impacts in both short-term and long-term): Most businesses felt that while actual decreases in amenity would reduce visitation, the largest impacts would result from tourist perceptions of reduced amenity that are likely to extend well beyond actual impact on amenity. Businesses reported that past events affecting water quality or amenity more broadly have resulted in downturns in visitations that typically extend into areas unaffected by the issue that is occurring, and continue for long periods of time after there is no longer an amenity issue. This results from tourists building negative perceptions driven by media coverage that give the impression of more widespread amenity impacts than are actually occurring, and tourists avoiding areas that are unaffected due to being highly risk averse when planning holidays, and hence avoiding areas they feel have any potential to be impacted. This typically leads to longer-term and more widespread downturn in visitation than would have occurred had tourists had an accurate understanding of amenity impacts. Survey results presented earlier in this report support the likelihood of a downturn in visitation affecting areas beyond those actually experiencing loss of amenity.
- Impacts of short-term business downturn: It is likely that short-term reductions in visitation will occur in association with virus release. Most tourism businesses can cope with a short reduction in visitation lasting no more than one or two months. However if this is accompanied by other events also causing downturn (e.g. drought or a flood), some

businesses will experience significant negative impacts and have to reduce employment and turn to measures such as drawing on financial reserves to cope. A downturn in visitation lasting for a longer period is more difficult for most businesses to cope with.

- Impacts of long-term business downturn: If long-term reduction in visitation occurs, many businesses would find it difficult to cope, and reduction in tourism employment and closure of some businesses is likely to result, with flow-on impacts to communities with reliance on tourism employment (see 'overall community impacts' section).

Recommended actions

Recommended actions to reduce impacts focus on early identification and protection of tourism sites of importance, investment in robust communication to offset potential decline in visitation, and investment of resources in campaigns that encourage increased visitation associated with action to support environmental recovery after reduction in carp populations:

- Provide a clear timeline for decision making to help enable planning for the future.
- Provide regular communication about progress.
- Ensure carp control investment includes sufficient investment in high-quality, proactive and well-coordinated communication to the public, including to tourists, that actively involves the tourism industry.
- Ensure the tourism industry is actively involved in each local area in determining priorities for clean-up to reduce potential impacts on tourism businesses.
- Ensure communications are clear and do not create negative perceptions that reduce visitation to areas not affected by issues such as fish kills or water quality problems.
- Invest in communication to ensure tourists are aware when an area has recovered after an impact on amenity, and to clearly communicate risk of low amenity for a future booking.
- Support tourism industry to develop approaches to building confidence in tourism bookings, such as implementing refund schemes if an area is affected by a fish kill when a visitor planned to visit.
- Actively track impacts on tourism visitation and identify areas where short-term impacts from virus release are adding to other existing negative impacts. Consider provision of support in these areas.
- Ensure clean-up activities source accommodation, food and other resources from local businesses where possible to offset some effects of downturn in visitation during implementation of carp control.
- Coordinate carp control actions with investments in environmental recovery being made by others, and ensure appropriate investment in achieving improved environmental health.
- Invest in communications to raise public awareness of long-term improvements in environmental health, if they occur, in order to support visitation.
- Ideally, invest in citizen involvement in actions to improve environmental health after reductions in carp populations, with these programs supporting visitation after virus release when visitation is most likely to decrease.
- Monitor length of impacts on visitation. If long-term reduction in visitation occurs, consider providing active support for affected tourism businesses.

Further assessment

Given the dynamic nature of regional tourism, it is important to conduct a more comprehensive assessment of existing conditions at a point in time close to the implementation of these actions. This can then provide a more current basis for assessing potential impacts of actions once decisions are made about the type of carp control actions to be implemented and the timeframe in which they will be implemented.

This more detailed assessment should focus in particular on identifying those tourism activities more and less likely to experience direct impacts as a result of the specific carp control actions to be implemented, and the locations in which changes in visitation are most likely to occur. It should also identify which types of tourism businesses have potential to benefit from demand generated by clean-up activities, and which do not, to better identify which businesses will have negative impacts of a short-term decline in visitation offset by an increase in demand related to implementation of carp control actions. This should be partnered with investment in developing effective communication and visitation campaigns designed to minimise negative impacts on visitation, and in the long-term to increase visitation.

Recreational fishers

Scope of assessment

For recreational fishers, assessment focused on identifying potential impacts on recreational fishing activities of carp control. Only limited work was undertaken examining the current activities and scale of recreational fishing in areas experiencing carp invasion, as a separate project underway in 2019 to 2021 is assessing recreational fishing activity in detail and, when finalised, will provide this type of information. The full report is provided in Appendix 7, including a detailed description of the methods used for assessment. A total of 27 recreational fishers were interviewed and/or participated in workshops held as part of the project. In addition, surveys examining community attitudes to carp control included large samples of recreational fishers (more than 1,500 recreational fishers participated across the different survey), and specifically identified those that fished in areas more likely to be experiencing carp invasion. This enabled specific examination of views of recreational fishers about the potential impacts of release of the virus, and of carp control more broadly, using survey data. This section provides a summary of key findings.

Current activities and trajectories

Freshwater recreational fishing is a key driver of visitation to many inland areas, and estuary fishing is also common. The data on recreational fishing suggest that many who fish in carp-affected areas will also spend time fishing in oceans and other areas where carp invasion is not an issue. Across Australia, as of 2000 there were an estimated 3.36 million Australians aged five or over who went fishing at least once a year. These 3.36 million fishers spend 20.6 million days fishing between May 2000 and April 2001, in 23.2 million separate fishing events. Just under 20% of recreational fishing effort at that time occurred in freshwater dams and rivers across the country, with an estimated 2.7 million fishing events (fishing trips) in freshwater rivers and 1.9 million fishing events in freshwater lakes or dams (Henry and Lyle 2003). These figures will be updated in 2020 with the release of new figures from the 2019-20 National Recreational Fishing Survey; it is expected there has been some

decline in recreational fishing participation, but that participation remains in the millions across Australia.

Within the recreational fishing sector, a relatively small number of fishers specifically focus on carp fishing (coarse fishing, defined as fishing involving targeting a fish considered undesirable for consumption or game fishing). Recreational fishing is a significant driver contributing to tourism revenue in inland areas, and changes in fishing conditions are one factor that contributes to changing visitor numbers.

Current capacity and challenges

Recreational fishers have been highly engaged in discussions about carp control and in actions to raise awareness of carp invasion, for example through conducting regular 'carpmuster' competitions in which fishers seek to catch as many carp as possible from a given area on the competition day, with prizes given for categories such as largest carp caught. This has led to high interest in being actively involved in discussions and actions aimed at reducing carp populations. Two key challenges/constraints were identified by interviewees. The first was the challenge maintaining the voluntary contributions recreational fishers make to efforts to improve environmental health such as carp control, with a desire for improved resourcing to enable the recreational fishing sector to increase its contributions. More broadly, limited available resourcing to expand the value of economic activity associated with inland recreational fishing was identified. The second was changing participation in recreational fishing organisations and possibly in recreational fishing more broadly, with several noting that the age of those formally engaged in recreational fishing organisations is becoming older over time, and a need to ensure involvement of younger fishers. Decline in environmental health in inland areas was raised by several as a constraint to maintaining recreational fishing activities and the associated economic value they generate.

Socio-economic impacts during the NCCP process

The feedback across interviews indicated the period of the Plan development has not had any direct impacts on recreational fishing activity or financial impacts for those operating a business that depends partly or wholly on recreational fishing. However, the proposed release of the carp virus within the development phase of the Plan was described as polarising for sections of the recreational fishing community and has contributed some disharmony in relationships across the sector, with widely varying views about whether virus release should occur.

Potential socio-economic impacts – what could happen and under what conditions

Recreational fishers were somewhat likely to feel virus release, and carp control more broadly, would have a positive impact on the recreational fishing sector, with fewer identifying potential negative impacts. However, many were concerned about potential for virus release to have negative impacts more generally for environmental health.

The main focus of recreational fishers when discussing carp control was on ensuring positive impacts on environmental health from carp control actions, with improvements in recreational fishing considered a beneficial side effect of achieving overall improvement in health of waterways and waterbodies currently affected by carp invasion. The key concerns expressed by recreational fishers

typically focused on (i) whether there was sufficient evidence that virus release would be safe for other fish species, both in terms of virus transmission and water quality impacts, (ii) whether carp populations would be reduced long-term or would rebound over time, and (iii) what co-investment was needed in actions other than reducing carp numbers in order to increase likelihood of improvement in environmental health after any reduction in carp populations. Potential impacts on recreational fishers were usually raised as secondary considerations after first raising these issues.

The potential impacts identified were:

- Increased fishing success and enjoyment for fishers (positive impacts): Many recreational fishers supported release of the virus as they felt this could lead to long-term improvement in recreational fishing conditions through improved environmental health, increased native fish stocks, and reduction in unwanted catch of carp. Many felt this would result in increased benefits of recreational fishing in the form of enjoyment and wellbeing.
- Increased revenue for fishing-related businesses (positive impacts): Some felt that improved environmental conditions had potential to increase recreational fishing effort (increased numbers of fishing trips to areas previously affected by carp by larger numbers of fishers). If this occurred, it would positively impact on tourism revenue and revenue for recreational fishing businesses. This impact would occur if carp reduction led to improvement in environmental health, and supported growth in numbers of native fish.
- Opportunities for recreational fisher involvement (positive impact): Many recreational fishers wanted to be given opportunities to have a role in carp control, through actions such as assisting with monitoring carp numbers in citizen science projects, assisting with clean-up, and assisting with actions to increase likelihood of environmental recovery. These were considered to have positive benefits for encouraging fishers to be engaged in meaningful activities, leading potentially to increased social contact and wellbeing related to this engagement.
- Reduction in carp numbers for coarse fishers (negative impact): Some coarse fishers were concerned they might lose access to a species that is relatively easy to target, with carp acting as a good species to catch for people with little experience in fishing, and being specifically targeted in some specialised programs such as programs supporting people with disabilities to fish. Not all felt this was a concern, given there were expected to be carp available after virus release albeit in smaller numbers, and some felt it would be possible to identify other ways to achieve similar outcomes for fishers who needed easily targeted species.
- Reduced fishing opportunities and/or fishing activity (negative impact): This impact would occur if virus release led to water quality problems or other issues that then reduced fishing opportunities for native fish in some areas. This was usually considered likely to be a short-term impact immediately after virus release affected carp in a given area, which most felt would have relatively limited impact on recreational fishers. Some were concerned about potential for longer-term reductions. There was also potential for fishers to reduce fishing activity in areas where the virus has been released due to perceptions that it is unsafe to be in contact with waters or fish in these areas. Survey results presented earlier in this report suggest potential for an initial reduction of up to 1/3 of fishing effort in areas perceived to have reduced amenity or risk of it, with many people choosing to fish elsewhere. Fishing

activity is likely to recover reasonably rapidly unless there are ongoing negative perceptions that extend beyond the period in which there are impacts on fishing opportunities and amenity.

- Significant reduction in business activity for some recreational fishing suppliers or guide businesses (negative impact): This impact was considered unlikely to occur to an extent where it causes significant harm to businesses. Significant impact on businesses would occur if virus release led to a real or perceived inability to fish in a relatively large area for a relatively long period of time (several months). This impact would need to extend longer than the typical impacts of existing events such as blue-green algae outbreaks, which recreational fishing businesses have typically already established mechanisms to cope with.

Recommended actions

The following actions have potential to reduce negative impacts and increase opportunities for positive opportunities for the recreational fishing sector:

- Coordinate carp control actions with investments in environmental recovery, and ensure that overall levels of investment in achieving improved environmental health (whether made as part of carp control actions or other programs that coordinate with a carp control program) are sufficient to achieve meaningful improvement in environmental health.
- Identify opportunities for recreational fisher engagement in programs involving in implementing and monitoring carp control, and programs seeking to improve environmental health. This also has potential to offset negative impacts of any short-term inability to fish in specific areas through encouraging long-term engagement of fishers in a range of activities.
- Engage coarse fishers in citizen science projects tracking change in carp population. Invest in identifying alternative fishing opportunities to carp that can be used by groups who currently target carp.
- Invest in communication to ensure accurate understanding of safety of fishing, of being in contact with water in areas where virus is released, and of consuming catch.

Further assessment

As noted earlier, a project funded separately to the NCCP is assessing engagement in recreational fishing activity, and will produce findings from 2020 (see nationalrecsurvey.com.au for details). This project will produce data that can provide an assessment of the level of recreational fishing activity and associated spending occurring in different areas. The data collected can provide a basis for more detailed assessment of recreational fishing activity in areas experiencing carp invasion when available.

Koi hobbyists, breeders and supply businesses

Scope of assessment

A detailed assessment of current conditions and of potential impacts was undertaken for the tourism sector, and the full report is provided in Appendix 8, including a detailed description of the methods used for assessment. As Appendix 8 provides a detailed assessment, this section provides a summary only of key findings. A total of 34 people involved in the koi industry, including koi breeders, koi

keepers, vets and those involved with koi associations were interviewed or participated in workshops. Two international koi associations were contacted and discussed impacts of virus outbreaks on koi hobbyists in (i) Japan and (ii) Malaysia, to provide an understanding of typical responses to virus outbreak in those countries. Five people considering starting to keep koi, recruited to participate in the study at the 2019 Sydney koi show, were asked whether and how the potential for future release of the virus would affect their decisions about entering the hobby. A further 154 current koi keepers and 308 people who had in the past kept koi or lived in a household where a person kept koi, were surveyed as part of collecting broader data on community attitudes, enabling an understanding of views of koi hobbyists about carp control and the carp virus. These were identified as part of broader samples of the overall community, and hence many of those who had a knowledge of koi were people who had kept koi in the past and fewer kept them currently.

Current activities and trajectories

Koi keeping is a relatively small hobby in Australia, with koi able to be kept legally as pets in the states of New South Wales and Western Australia and in the Australian Capital Territory, and not in other parts of Australia. It is difficult to estimate the total size of koi keeping as a hobby in Australia, or its total economic value. In surveys of the general community conducted for this project, around one in one hundred people indicated either currently keeping koi or having done so in the past, with around one in two hundred indicating currently keeping koi in their household. Given that koi keeping often occurs as a household activity, this suggests that somewhere between one in every 300 people and one in every 200 households has a current association with keeping koi. If this is correct, between 40,000 and 78,000 people across Australia live in households where koi are currently kept as pets.

For many of these koi keepers, koi are relatively substitutable for other fish species. However, for enthusiastic koi hobbyists this is not the case, with at least 2,000 highly enthusiastic koi hobbyists being members of koi societies in Australia, and the number of 'keen' hobbyists who would find it difficult to switch to keeping other species likely to be substantially higher than these 2,000 members.

Based on an estimate of annual spending of $600 by smaller hobbyists and $3,000 by enthusiastic hobbyists (many of whom in reality spend significantly more than this on the hobby, for many extending into tens of thousands of dollars), the industry conservatively generated annual expenditure of at least $20 to $52 million Australia-wide in the form of koi keeping costs (power, fish food, maintenance of water quality etc), purchase of new fish, and spending on equipment such as koi ponds, water pumps etc. This would in turn be associated with further generation of value through supply chains, meaning this is an estimate of part of the value of the koi industry only.

Similar to other countries in which koi are a cultural tradition, many people engaged in koi keeping in Australia spend years and decades breeding specific lines of koi for particular characteristics. With relatively small numbers of koi breeding businesses in Australia, and a ban on importing koi from other countries, the domestic hobby is reliant on Australian breeders. Social interaction is a core part of the culture of koi keeping, with koi enthusiasts often visiting each other's ponds and reporting strong positive social outcomes from their engagement in koi keeping.

Current capacity and challenges

When asked about current conditions and the status of koi keeping as a hobby in Australia, koi hobbyists identified a number of constraints and challenges, particularly:

- Rising costs of electricity and some koi supplies in recent years have reduced affordability of the hobby
- As importing koi into Australia is banned, there is 100% reliance on a relatively small number of breeders and hobbyists for stock, with high risk of loss of unique breeding lines with any disease outbreak
- As the hobby is relatively small in Australia, there is limited opportunities for commercial breeders to achieve economies of scale that can enable investment in large-scale biosecurity measures.
- The small size of the hobby and large distance between the two key areas in which it is permitted reduces ability for hobbyists to interact at places like shows, although a large number of auctions and several shows are held each year.

The close knit nature of much of the koi hobbyist community was identified as a strength of the local hobby community.

Socio-economic impacts during the NCCP process

The NCCP process created uncertainty for many involved in the koi sector. Uncertainty about the future resulting in psychological distress, stress, mental health impacts was principally occurring for koi breeding businesses and koi associations, due to uncertainty about ability to continue successful koi breeding and koi shows in future if the virus was released. While koi shows have continued as usual during the anticipatory period, some decline in auction sales of koi was observed after the initial announcement of the NCCP, followed by a rebound, and some breeding businesses reported delaying new investment until the future was more certain. Most breeders did not report a decline in demand, but did have many customers expressing uncertainty about their likelihood of staying in koi keeping if the virus was released. To a lesser extent, this has caused some impacts for koi hobbyists, with some reporting delaying investment in new koi or equipment for koi keeping, and a small number of people interviewed

Potential socio-economic impacts – what could happen and under what conditions

Many people interviewed from the koi sector preferred to discuss their concerns about the use of the virus more generally, particularly concerns about potential for virus mutation and water quality impacts that would have an impact on a range of species. It was typically only after discussing these concerns that they were willing to talk about potential impacts on koi keeping and associated businesses in Australia. The impacts listed below are specifically related to the impacts of a decision to release the carp virus: other carp control methods were not considered likely to cause any meaningful impact for the koi sector.

Key potential impacts identified for the koi sector specifically (excluding broader concerns about impacts described elsewhere in this study) were:

- Higher day-to-day business costs (negative impact): Introduction of biosecurity measures to reduce spread of the virus amongst koi populations has a high likelihood of increasing costs for koi breeders and sellers. The extent of impact depends on the cost of effective biosecurity measures.
- Higher koi keeping costs (negative impact): Koi hobbyists are likely to incur higher koi keeping costs if they need to introduce biosecurity measures to reduce risk of their koi being exposed to the carp virus, and if they have to invest in new stock if their existing koi contract the virus. An increase in costs is likely to lead to some hobbyists ceasing koi keeping; the proportion who stop keeping koi will vary depending on the extent to which costs of keeping koi increases, as well as the complexity of implementing biosecurity measured.
- Reduced social interaction (negative impact): Internationally, koi associations report that virus outbreaks have led to long-term reduction in the amount of social visits between koi hobbyists and breeders, due to the need for increased biosecurity. Large reductions in social interaction were reported to occur during outbreaks, followed by some recovery in social visits, but not to previous levels. Reduced numbers of koi at koi shows was also reported, although internationally koi shows have generally continued successfully in countries affected by the virus, albeit with substantial decline in numbers of koi shown during any period when virus outbreak is occurring or has recently occurred.
- Psychological and financial impacts of loss of koi - hobbyists (negative impact): Koi hobbyists are often highly psychologically attached to their pets, similar to other animal owners. Loss of koi due to the virus, or having to destroy koi known to have been exposed to the virus, will have significant negative psychological impacts, causing high distress. Several referred to reports of koi hobbyists in other countries experiencing significant mental health impacts from loss of koi. Several koi hobbyists interviewed described that they felt they could not remain in the hobby if their current koi – often bred over long periods – had to be destroyed due to the virus, due to both the psychological and financial impact of the loss.
- Psychological and financial impacts of loss of koi – businesses (negative impact): Koi breeders are typically highly psychologically attached to koi breeding and their koi, as well as financially dependent on koi, with many (but not all) breeders relying on koi breeding for a large part of their income. As many koi breeders have built breeding lines over several years or multiple decades, it is very difficult to replace stock, particularly with limited availability of many varieties of koi with specific coloration, patterning or scalation. Loss of koi due to virus outbreak would therefore result in loss of business for many breeders, due not only to the loss of the existing stock, but also to the substantial financial costs and time required to rebuild suitable breeding stock of similar value to those lost.
- Overall impact on koi keeping in Australia in longer term (negative to stable): Many interviewees felt that overall, koi keeping would reduce in size as a hobby in Australia if the carp virus is released. This would result from reduced interest in entering a hobby where the pet may catch a lethal virus, and existing hobbyists not remaining in the hobby if they lost their pets. Internationally, there is a lack of clear evidence about total impacts on the number of people keeping koi. As the hobby does not have as significant a cultural history in Australia as in many other countries, it is likely Australian hobbyists would have a higher likelihood of exiting the hobby than those in other countries with strong cultural traditions of koi keeping. In the May 2019 community attitudes survey, participants were asked the extent to which they agreed or disagreed that 'I am less likely to consider keeping koi in future if the virus is

released'. Of those who currently kept koi or had done so in the past, 11% were unsure whether they would be less likely to keep koi. Of the 89% who had an opinion, 58% said they were less likely to keep koi in future, while 42% disagreed with this. Of those who had never kept koi, 32% were unsure, and of the remaining 68%, just over half (55%) felt they would be less likely to keep koi in future if the virus was released. While stated intentions do not necessarily translate into actual behaviour, this does suggest high potential for some reduction in koi keeping associated with virus release.

Recommended actions

The actions recommended to reduce negative impacts are:

- Provide a clear timeline for decision making to help enable planning for the future and reduce uncertainty.
- Provide clear and accurate advice on conditions under which the virus could be transmitted to koi and measures to reduce risk for breeders, sellers and hobbyists.
- Invest in identification of appropriate biosecurity measures and their level of likely effectiveness.
- Identify costs of effective biosecurity options, and invest in reducing costs where feasible for breeders, sellers and koi keepers.
- Clear communication of biosecurity options and their likely effectiveness to all involved in the koi sector.
- Assist koi industry to implement phone support for hobbyists and breeders to increase use of appropriate biosecurity measures, and to refer those experiencing distress to appropriate services.
- Establish clarity around regulations regarding transportation and sale of koi if the virus is released.
- Identify how to ensure safe social interactions between koi hobbyists can continue, and clearly communicate this, to reduce impact.
- Potentially provide support for koi breeders to diversify businesses beyond koi, to reduce total impact. This support could take a range of forms, from low interest loans to direct grants or hosting seminars and workshops to build business ideas.

Further assessment

Many of the potential impacts on koi owners depend on whether cost effective biosecurity measures can be implemented that meaningfully mitigate risks of the carp virus affecting carp. The key need for further assessment is to assess both the likely effectiveness of different biosecurity measures and the cost and complexity associated with implementing them. This should be paired with assessing the capacity of hobbyists and breeders to implement these measures in terms of being able to cope with the costs involved. This assessment, combined with improved understanding of the potential mechanisms by which the virus could be carried into koi ponds or otherwise transmitted to koi, is central to then more fully assessing the likely socio-economic impacts of virus release in Australia if it occurs.

Other groups and organisations

Scope of assessment

Other groups with potential to be impacted by carp control actions were not examined in detail, as representatives of these groups generally felt there was either little to no risk of significant direct impacts for them, felt that impacts would not require specific action to address, or felt confident that impacts would be readily able to be addressed. In addition, some identified that the only impacts they were concerned about were ones that would be caused by issues such as reduced water quality, which were being assessed as part of the NCCP's biophysical research – if these were highly likely to occur, it was considered likely the virus would be deemed not feasible to release. This was identified through interviews and discussions with 23 people representing local government, water supply managers, farmers, irrigators, and recreational users of areas invaded by carp other than fishers, as part of stakeholder interviews and the June 2019 workshop. Given this, only a brief identification of potential impacts was undertaken for these groups, reported below.

Potential socio-economic impacts – what could happen and under what conditions

Potential socio-economic impacts are briefly summarised below for different groups. Many of these potential impacts are also described in Appendix 1, 5 or 9, as several were discussed in stakeholder interviews and the stakeholder workshop described in detail in these Appendices:

- Local government: Relatively few local government representatives felt there was significant likelihood of major impact at a community wide-scale, but most were concerned about amenity impacts for residents and tourists in particular, and how these might affect tourism and local economic activity. A second key concern was whether local government would be expected to provide specific services, and whether adequate resourcing would be available to achieve this. Key issues and opportunities identified were potential for (i) loss of local amenity in short term, (ii) growth in local amenity in long term, (iii) potential for local government to be asked to bear costs of clean-up and rehabilitating sites, (iv) uncertainty about whether local governments would be appropriately resourced to undertake these roles.
- Water supply managers – stock and domestic: For this group, the key concern was whether release of the virus would result in water quality problems or higher incidence of either blue-green algae or diseases associated with high organic matter, particularly botulism or salmonellosis, that could affect human or stock health. All interviewed felt confident these risks could be managed appropriately, with processes already in place enabling successful management of similar incidents when they occur. The greatest remaining concern was that of perceptions: water managers felt that even if water was safe, there was a reasonably high risk that negative perceptions would lead to unwillingness of consumers to use domestic or stock water for periods of time associated with water release.
- Water supply managers - irrigation water managers: In addition to the potential impacts described by water supply managers, irrigation water managers identified a need to address risk of irrigation intakes being affected by dead fish, which in some circumstances have potential to block intake pipes. All interviewed felt this could be readily managed using existing techniques such as barrages around intake pipes.

- Farmers – dryland and irrigators: Most farmers did not feel virus release would have significant negative impacts for farmers, although potential for short-term water quality and amenity issues were identified by some. Most interviewees felt these would not be significant for the majority of farmers, although some stock managers wanted further information about any risk of botulism or risks to stock from any water quality problems if they resulted from release of the virus. One interviewees wanted further information about whether there would be any risk of stock carrying virus particles when being transported, or of biosecurity measures needing to be implemented when transporting stock and associated costs of these measures. Several felt long-term improvement in environmental health had potential to have benefits for farmers, in the form of better water quality in particular. See also below.
- Rural landholders bordering waterways/ waterbodies (including farmers): Access across rural properties for clean-up of dead fish was raised as a potential impact for this group, with landholders wanting clear and appropriate procedures to reduce risk of damage to their land and water in any processes involving accessing waterways from their land. Amenity impacts were also a concern, with many wanting forewarning of likely amenity impacts so they could take action to respond to these ahead of time.
- Recreational users other than fishers: Recreational users of waterways, waterbodies and adjacent areas such as parks may be impacted by short-term reduction in amenity and closure of some areas for use if there are high volumes of dead fish or loss of water quality. These impacts could take the form of reduced recreational activity, or having to travel longer distances to access some types of recreational opportunity, as well as discomfort from reduced amenity for those living or working near areas affected by fish kills or poor water quality. In the long-term recreational users other than fishers may be impacted positively by increased amenity if improved environmental health results from reduction in carp populations.

Recommended actions

- Local government: Ensure roles of local government are clear, ensure local government can lead identification of sites of local significance for prioritising in clean-up, and sufficiently resource any actions local government needs to assist with such as signage for closure of areas, clean-up and disposal of dead carp.
- Water supply managers – stock and domestic: Ensure processes already used to address short periods of poor water quality will be 'fit for purpose' to use to address any water quality problems arising from carp kills, and provide additional resourcing if needed. Invest sufficiently in communication campaigns enabling an understanding of water quality impacts and safety of use of water.
- Water supply managers - irrigation water managers: Ensure allocation of resources to enable rapid deployment of appropriate methods to reduce risk of dead carp blocking intakes, and ability to rapidly respond if blockage occurs.
- Farmers and rural landholders:
    - Clear communication ahead of time about virus release plans, and ongoing rapid communication about observations of dead carp and water quality post-release.

Provide ‘real time’ information can provide both reassurance where there are few or no problems, and opportunity for rapid response when there are.
    - Where clean-up activities may cause damage to a crop or pasture (e.g. loss due to vehicles driving over these areas), consider potential to provide resources for farmers to address this damage in return for access.
    - Identify any biosecurity measures that may be needed for farmers or rural landholders when transporting produce, stock or items that have potential to carry virus particles. Communicate clearly about these and enable any conditions to be readily met without significant impact in terms of time required for transport or cost of transport.
    - Clear processes for communicating with all rural landholders about access to their land or waterways for clean-up activities, with farming organisations involved in establishing appropriate processes.
- Recreational users other than fishers:
    - Clear communication about the periods of time in which amenity is likely to be impacted or areas inaccessible, followed by clear communication about when amenity has improved and areas are once again useable to limit the amount of time in which recreational activity is affected.
    - Identification of important recreation areas and prioritisation of clean-up investment where appropriate.

Further assessment

It is possible that the groups listed in this section, or other groups, may experience socio-economic impacts not identified in this preliminary assessment. Further assessment should focus on ensuring processes are in place to enable rapid identification of emerging or unexpected impacts on a range of groups. This is discussed further in the section of this report identifying future monitoring and evaluation needs.

Overall community impacts

Scope of assessment

The socio-economic impact assessment (SEIA) conducted for this project focused predominantly on identifying pathways of impact that could affect specific groups, consistent with recommendations of the SEIA literature that when predicting impacts, it is important to ‘scale up’ by identifying immediate impacts on specific groups, and then identifying how these flow-on to create indirect (secondary and tertiary) impacts for others, for example for local communities (Schirmer 2011). In general, to identify overall impacts on communities, it is first necessary to identify the specific direct impacts likely to result from an activity, and how these ‘impact pathways’ flow-on to affect others, particularly communities. In this case, that activity is carp control using the carp virus, and the previous section identified and examined the specific groups most likely to experience significant direct impact as a result of release of the virus.

Following identifying these direct impacts, the 'scaling up' approach to SEIA (Schirmer 2011) focuses on identifying whether and in what circumstances the impacts experienced by specific individuals or groups may be sufficiently large to result in flow-on impacts that affect others living or working in the same communities or industries. As noted in the Methods section, only limited assessment of the likely impacts on communities was possible at this stage of development of carp control actions, as until the nature, timing and location of carp control actions are known, it is not possible to precisely identify the communities likely to experience greater and fewer impacts.

For this project, the primary focus was therefore on identifying direct impacts on specific groups, rather than on attempting detailed assessment of likely flow-on effects of these direct impacts for communities. This was because at the stage of designing an activity, the most effective approach to reducing impacts on communities is to focus on identifying how the activity can be designed to reduce impacts on specific groups that would in turn be the key causes of flow-on impacts affecting communities more broadly. The previous sections focused on this, and identify a range of actions that have potential to reduce the risk of communities experiencing community-wide impacts as a consequence of release of the virus.

This section briefly assesses the risk of community-wide socio-economic impacts and the circumstances in which they could occur, drawing on secondary data and results of the interviews and surveys conducted for this project. First, the potential for direct impacts to flow on to affect broader communities is examined, with consideration of both the potential for impacts on groups such as the tourism industry to have broader impacts on a community, as well as of the potential for broader direct impacts on residents of communities. This is followed by identifying the specific communities, in the form of local government areas, with higher potential to experience some impacts, and a summary of recommended actions and future assessment needs.

Potential socio-economic impacts – what could happen and under what conditions

To assess potential impacts, the first step was to identify the types of socio-economic impacts that could occur, and the conditions under which they had potential to occur. Based on the interviews with stakeholders and members of specific groups, the following were identified as potential socio-economic impacts:

- Downturn in economic activity and employment in a local community
- Increase in employment associated with improved environmental health
- Reduced amenity for residents, and
- Increased amenity for residents.

Overall, communities have potential to be affected by carp control actions principally through (i) flow-on effects of impacts on the specific groups and business sectors described previously in this report, (ii) direct amenity impacts, with potential for shorter term negative amenity impacts after virus release, and longer-term positive amenity impacts if reduction of carp population led to long-term improvement in health of rivers, lakes and wetlands. Short term negative impacts could occur specifically during periods of large carp kills both in the communities where carp (and potentially water quality) are initially affected by the virus, and in any downstream communities affected by large volumes of dead fish floating downstream or poor-quality water flowing downstream.

Downturn in economic activity/employment in a local community

A downturn in overall economic activity and employment large enough to have noticeable flow-on impacts through a local community would occur only in situations in which two conditions are met:

1) tourism, recreational fishing, commercial freshwater/estuary fishing, and/or freshwater aquaculture contribute significantly to local employment.
2) one or more of these groups is impacted substantially by virus release for an extended period of time, leading to job losses.

These two criteria need to both occur. In their absence, while it is possible that individuals or small groups in a community will experience significant impacts, it is unlikely these will be large enough to then have flow-on effects on large numbers of others in the community, for example through an overall reduction in demand at local supermarkets or retail shops, or outmigration of people from a community. In other words, the flow-on impacts on communities from impacts on specific groups such as tourism businesses or native fish aquaculture - will be significant only where a community has relatively high dependence on employment generated by those specific groups. Individual impacts remain very important to consider, however it is critical to identify that in those cases where those directly affected make up a very small proportion of the community and its economic activity there is unlikely to be significant impact for the broader community or economy. In other cases, those impacted may represent a significant proportion of local economic activity or population, and the impacts they experience flow-on to affect other businesses and people in the community to a significant extent.

Identifying whether these conditions are likely to be met requires specifying what is considered a 'significant' contribution to local employment in the form of a contribution large enough to have flow-on impacts to other parts of the local economy if that employment is disrupted.

There is no clear or set 'threshold' when an impact can be said to be large enough to have potential to noticeably impact an entire community or economy, beyond the people directly affected. We selected a threshold of 10% of jobs depending on an industry. This threshold was chosen as it is unlikely that a majority of the jobs in a sector would be lost due to carp control actions, and hence this represents a conservative threshold as direct impacts would be unlikely to exceed a small percentage of jobs in the economy. It is likely that in most cases, a community meeting this threshold will not experience significant negative impacts if appropriate communications strategies are implemented to ensure only a small proportion of total employment dependent on fishing, aquaculture or tourism would be affected by carp control actions, and only for limited periods of time.

We assessed which activities contributed, either individually or jointly, to 10% or more of employment in any local government areas in Australia in which carp invasion had occurred. This was done by using spatial data from the 2016 State of the Environment on spatial location of carp invasion and different densities by local government area (LGA), overlaid with:

- data on employment in fisheries and aquaculture from the 2016 Census of Population and Housing (generated using TableBuilder Pro), and

- data from Tourism Research Australia on tourism employment by local government area (Tourism Research Australia 2019a), which is described in more detail in Appendix 4.

These data shed light on jobs generated by the commercial fishing, aquaculture, and tourism industries, three of the groups examined in detail in this report. Koi breeders are also included in aquaculture statistics. Koi keeping as a hobby is spread across many communities including concentrations in larger cities, and it is considered unlikely that impacts on koi keeping would flow-on to have community wide impacts. Recreational fishing activity often contributes to counts of tourism expenditure and jobs, with many recreational fishing businesses included in tourism industry statistics. Hence data on tourism provides some indication of economic dependence on recreational fishing, although this should be recognised as being relatively limited.

The data were used to identify the number of local government areas in which more than 10% of jobs depend directly on industries with potential to be affected by carp control actions, particularly release of the carp virus if it occurs.

A total of 164 LGAs across Australia were recorded as having moderate to high densities of carp at points in time, based on Argent (2016) (as carp populations fluctuate, this is a broad definition that recognises populations are highly dynamic over time). Of these LGAs, 48 were located in large urban cities (specifically, areas of Melbourne, Sydney and Brisbane, as well as the Australian Capital Territory), and were considered unlikely to experience any significant impact at community level from change in tourism or fishing jobs.

Of the remaining 115 LGAs, shown in Table 5, only three had more than 0.5% of their employment in 2016 generated by fishing, aquaculture and seafood processing: East Gippsland (0.8% of employment generated by fishing, aquaculture and seafood processing, with only part of this reliant on inland activities and much on marine fisheries), Murrundindi (0.7%) and The Coorong (0.6%, with high reliance on activities occurring inland). In comparison, 60 LGAs relied on tourism for more than 10% of their employment in 2016. After removing two LGAs with high dependence on snow-related tourism unlikely to be significantly affected by carp control, 58 LGAs were identified as meeting the threshold of having more than 10% of jobs dependent on tourism and experiencing carp invasion at more than low levels, the criteria needed for there to be potential for significant socio-economic impact[1]. This is not an exhaustive list, as carp populations can vary and other regions may be

[1] Excluding those known to not depend highly on freshwater areas for tourism activity, the LGAs with potential to be impacted identified were Hay (NSW), Alpine (Vic), Mansfield (Vic), Snowy Monaro Regional (NSW), East Gippsland (Vic), Federation (NSW), Hepburn (Vic), Inverell (NSW), Goondiwindi (QLD), Renmark Paringa (SA), Snowy Valleys (NSW), Albury (NSW), Horsham (Vic), Campaspe (Vic), Moree Plains (NSW), Berri and Barmera (SA), Mildura (Vic), Edward River (NSW), Murray River (NSW), Greater Shepparton (Vic), Northern Grampians (Vic), Berrigan (NSW), Central Goldfields (Vic), Mount Alexander (Vic), Benalla (Vic), Swan Hill (Vic), Hilltops (NSW), Indigo (Vic), Wellington (Vic), Murrindindi (Vic), Yankalilla (SA), Tweed (NSW), Loxton Waikerie (SA), Moira (Vic), Narrabri (NSW), Alexandrina (SA), The Coorong (SA), Wangaratta (Vic), Barossa (SA), Warrumbungle Shire (NSW), Ararat (Vic), Macedon Ranges (Vic), Gunnedah (NSW), Mount Barker (SA), Wodonga (Vic) and Murray Bridge (SA).

impacted depending on timing of carp control and spatial distribution of carp populations at the time as well as water flow conditions. However, several included in this list are likely to have a significant proportion of tourism businesses that are not highly dependent on freshwater areas. The extent to which tourism jobs depended on freshwater and hence could be affected by virus release could not be assessed as part of this study, as it fell outside the scope of work able to be undertaken and would require significant investment. However, many tourism businesses reported that during past events involving poor water quality, most tourism businesses experienced some downturn. While this downturn was typically more severe for those directly reliant on freshwater, it also affected other tourism businesses, particularly where tourists had a perception that a region was affected by low amenity overall – something that is an identified risk related to virus release. This means that there is some potential for all types of tourism businesses to be impacted, albeit with more direct and larger-scale impacts on those directly reliant on freshwater or estuary areas, or located near these areas.

These 58 LGAs are those considered to have potential to be impacted by virus release. However, it is unlikely all, or even a large proportion of these LGAs would experience significant impacts at the community level. Experience of significant impacts would result only if the tourism industry experienced an extended and significant decline in activity and employment associated with virus release. The highest risk of this occurring would be if negative misperceptions resulted in loss of visitor numbers for tourism industry for an extended period of time, rather than being contained to actual impacts of carp virus release. The actions recommended elsewhere in this report were identified as they have potential to reduce this risk.

Table 5 List of local government areas in which past records indicate carp invasion at moderate to high levels at some times, and proportion of employment dependent on (i) fishing and aquaculture and (ii) tourism

State	Local government area	Total population, 2016 (ABS CPH)	Total employed people, 2016 (ABS CPH)	% employment dependent on fishing and aquaculture and seafood processing (ABS CPH)	% jobs dependent on tourism (Tourism Research Australia data)[1]
New South Wales	Albury (C)	51080	22901	0.0%	14.9%
New South Wales	Balranald (A)	2290	980	0.0%	No data
New South Wales	Bathurst Regional (A)	41301	18166	0.0%	13.7%
New South Wales	Berrigan (A)	8462	3282	0.0%	13.8%
New South Wales	Bogan (A)	2689	1172	0.0%	No data
New South Wales	Bourke (A)	2633	998	0.0%	No data
New South Wales	Brewarrina (A)	1645	498	0.0%	No data
New South Wales	Cabonne (A)	13391	6028	0.0%	No data
New South Wales	Central Darling (A)	1831	562	0.0%	No data
New South Wales	Cobar (A)	4650	2011	0.0%	No data
New South Wales	Coonamble (A)	3919	1421	0.0%	No data
New South Wales	Cowra (A)	12464	4810	0.0%	14.1%
New South Wales	Edward River (A)	8847	3807	0.0%	14.4%
New South Wales	Federation (A)	12279	4968	0.0%	17.4%
New South Wales	Forbes (A)	9589	3940	0.1%	No data
New South Wales	Gilgandra (A)	4234	1781	0.0%	No data
New South Wales	Greater Hume Shire (A)	10357	4610	0.0%	No data
New South Wales	Griffith (C)	25635	11713	0.0%	14.7%
New South Wales	Gundagai (A)	11144	4376	0.0%	No data

State	Local government area	Total population, 2016 (ABS CPH)	Total employed people, 2016 (ABS CPH)	% employment dependent on fishing and aquaculture and seafood processing (ABS CPH)	% jobs dependent on tourism (Tourism Research Australia data)[1]
New South Wales	Gunnedah (A)	12214	5378	0.0%	10.6%
New South Wales	Gwydir (A)	5255	2081	0.0%	No data
New South Wales	Hay (A)	2945	1294	0.0%	24.7%
New South Wales	Hilltops (A)	18497	7562	0.1%	13.1%
New South Wales	Inverell (A)	16485	6391	0.1%	16.9%
New South Wales	Kyogle (A)	8939	3237	0.0%	No data
New South Wales	Lachlan (A)	6195	2470	0.0%	No data
New South Wales	Leeton (A)	11167	4705	0.0%	No data
New South Wales	Liverpool Plains (A)	7689	3014	0.0%	No data
New South Wales	Moree Plains (A)	13158	5522	0.0%	14.6%
New South Wales	Murray River (A)	11682	4996	0.0%	14.0%
New South Wales	Murrumbidgee (A)	3838	1718	0.0%	No data
New South Wales	Narrabri (A)	13083	5653	0.1%	12.5%
New South Wales	Narrandera (A)	5853	2326	0.2%	No data
New South Wales	Oberon (A)	5301	2244	0.0%	No data
New South Wales	Queanbeyan-Palerang Regional (A)	56027	29393	0.0%	7.4%
New South Wales	Snowy Monaro Regional (A)	20216	9860	0.1%	21.6%
New South Wales	Snowy Valleys (A)	14398	5990	0.1%	15.2%
New South Wales	Tamworth Regional (A)	59662	25999	0.0%	18.1%
New South Wales	Tenterfield (A)	6624	2363	0.0%	16.4%
New South Wales	Tweed (A)	91374	35730	0.2%	12.7%
New South Wales	Unincorporated NSW	1054	598	0.0%	No data
New South Wales	Upper Lachlan Shire (A)	7694	3530	0.0%	No data
New South Wales	Wagga Wagga (C)	62383	29834	0.0%	12.3%
New South Wales	Walgett (A)	6112	2057	0.0%	No data
New South Wales	Warren (A)	2730	1147	0.0%	No data
New South Wales	Warrumbungle Shire (A)	9380	3332	0.1%	11.3%
New South Wales	Wentworth (A)	6798	2790	0.3%	No data
New South Wales	Western Plains Regional (A)	50075	22139	0.0%	No data
New South Wales	Yass Valley (A)	16143	8075	0.0%	8.6%
Queensland	Balonne (S)	4378	2149	0.0%	No data
Queensland	Bulloo (S)	352	220	0.0%	No data
Queensland	Gold Coast (C)	555724	260550	0.0%	15.8%
Queensland	Goondiwindi (R)	10628	4859	0.1%	16.1%
Queensland	Ipswich (C)	193737	84281	0.0%	6.6%
Queensland	Logan (C)	303384	131953	0.0%	8.4%
Queensland	Murweh (S)	4309	2046	0.0%	No data
Queensland	Paroo (S)	1642	725	0.0%	No data
Queensland	Scenic Rim (R)	40078	16927	0.2%	13.3%
South Australia	Adelaide Hills (DC)	38864	19513	0.0%	9.0%
South Australia	Alexandrina (DC)	25871	10079	0.2%	12.2%
South Australia	Barossa (DC)	23560	11163	0.0%	11.9%
South Australia	Berri and Barmera (DC)	10545	4311	0.0%	14.5%
South Australia	Goyder (DC)	4134	1696	0.0%	No data
South Australia	Karoonda East Murray (DC)	1088	481	0.0%	No data
South Australia	Loxton Waikerie (DC)	11481	4991	0.1%	12.7%
South Australia	Mid Murray (DC)	8641	3283	0.0%	8.3%

State	Local government area	Total population, 2016 (ABS CPH)	Total employed people, 2016 (ABS CPH)	% employment dependent on fishing and aquaculture and seafood processing (ABS CPH)	% jobs dependent on tourism (Tourism Research Australia data)[1]
South Australia	Mount Barker (DC)	33394	16380	0.1%	10.5%
South Australia	Murray Bridge (RC)	20862	8471	0.1%	10.2%
South Australia	Onkaparinga (C)	166766	74902	0.0%	No data
South Australia	Renmark Paringa (DC)	9475	4068	0.1%	15.8%
South Australia	The Coorong (DC)	5386	2293	0.6%	12.0%
South Australia	Unincorporated SA	3524	1674	0.0%	No data
South Australia	Victor Harbor (C)	14661	4647	0.2%	17.2%
South Australia	Yankalilla (DC)	5160	1984	0.3%	12.8%
Victoria	Alpine (S)	12335	5491	0.1%	22.9%
Victoria	Ararat (RC)	11599	4711	0.0%	10.8%
Victoria	Baw Baw (S)	48477	21260	0.0%	9.9%
Victoria	Benalla (RC)	13863	5659	0.0%	13.2%
Victoria	Buloke (S)	6202	2483	0.0%	No data
Victoria	Campaspe (S)	37054	15948	0.0%	14.8%
Victoria	Cardinia (S)	94130	44950	0.0%	6.6%
Victoria	Central Goldfields (S)	12993	4352	0.0%	13.5%
Victoria	East Gippsland (S)	45041	17002	0.8%	19.5%
Victoria	Frankston (C)	134144	63409	0.0%	7.9%
Victoria	Gannawarra (S)	10548	4405	0.0%	No data
Victoria	Greater Bendigo (C)	110479	48673	0.0%	12.3%
Victoria	Greater Geelong (C)	233426	103579	0.1%	12.0%
Victoria	Greater Shepparton (C)	63839	26975	0.0%	13.8%
Victoria	Hepburn (S)	15327	6347	0.0%	17.2%
Victoria	Hindmarsh (S)	5725	2301	0.0%	No data
Victoria	Horsham (RC)	19641	9109	0.0%	14.8%
Victoria	Indigo (S)	15953	7488	0.0%	13.0%
Victoria	Latrobe (C) (Vic.)	73257	29492	0.0%	11.2%
Victoria	Loddon (S)	7512	2836	0.0%	No data
Victoria	Macedon Ranges (S)	46103	21735	0.0%	10.6%
Victoria	Mansfield (S)	8589	3782	0.0%	22.5%
Victoria	Mildura (RC)	53878	22504	0.0%	14.5%
Victoria	Mitchell (S)	40916	18409	0.0%	6.1%
Victoria	Moira (S)	29108	11810	0.0%	12.6%
Victoria	Moorabool (S)	31820	14629	0.0%	No data
Victoria	Mornington Peninsula (S)	154996	67498	0.0%	13.8%
Victoria	Mount Alexander (S)	18762	7557	0.0%	13.4%
Victoria	Murrindindi (S)	13730	5954	0.7%	12.8%
Victoria	Nillumbik (S)	61274	32577	0.0%	7.6%
Victoria	Northern Grampians (S)	11436	4858	0.0%	13.8%
Victoria	Pyrenees (S)	7240	2667	0.0%	No data
Victoria	South Gippsland (S)	28700	12186	0.2%	10.3%
Victoria	Strathbogie (S)	10272	4372	0.0%	9.7%
Victoria	Swan Hill (RC)	20587	8565	0.0%	13.1%
Victoria	Wangaratta (RC)	28310	12621	0.0%	11.9%
Victoria	Wellington (S)	42986	17946	0.1%	13.0%
Victoria	West Wimmera (S)	3905	1863	0.0%	No data
Victoria	Wodonga (C)	39347	18197	0.0%	10.2%
Victoria	Yarra Ranges (S)	149542	74415	0.0%	8.4%

State	Local government area	Total population, 2016 (ABS CPH)	Total employed people, 2016 (ABS CPH)	% employment dependent on fishing and aquaculture and seafood processing (ABS CPH)	% jobs dependent on tourism (Tourism Research Australia data)[1]
Victoria	Yarriambiack (S)	6675	2628	0.0%	No data

[1] 'No data' indicates that too few tourism businesses are recorded for Tourism Research Australia to produce estimates of numbers of tourism businesses by job ranges required to estimate employment numbers.

Increase in employment associated with improved environmental health

This has potential to occur if reduced carp populations are achieved, and this reduction in population is followed by improvement in environmental health. It would occur predominantly in communities where (i) carp densities are high enough to cause environmental damage, and (ii) where there is potential for increased visitation for recreational fishing, tourism, and freshwater or estuary related recreational activities resulting from improvements in aspects of environmental health such as native fish populations, riverbank vegetation or turbidity of water. Broadly, the potential for growth in employment is most likely in the 58 tourism dependent LGAs identified in the previous section, as these have the highest dependence on jobs likely to fluctuate with changes in amenity and environmental health, combined with carp densities that at least some of the time have potential to cause damage. However, the more specific modelling of carp biomass and damage thresholds undertaken in other NCCP should be used to more specifically identify potential locations in which improved environmental health could occur, to better identify the locations in which increased employment resulting from improvement environmental health is a possibility.

There is also potential for a short-term increase in employment associated with clean-up activities. However, this is unlikely to represent more than a very short-term increase and unlikely to have significant impacts on communities more generally given that it is likely to last only a short number of weeks in any given community. It may however, as identified elsewhere, have potential to offset short-term decline in tourism expenditure, reducing short-term specific impacts on some tourism businesses.

Reduced amenity for residents

This has potential to occur if carp control actions result in large amounts of dead carp or reduced water quality and associated impacts of that reduced water quality. This could affect any community in which there are sufficient volumes of carp either present in waterbodies and waterways to create negative amenity impacts if the virus is effective in creating a large kill of carp, or contributes to a blackwater event that causes a fish kill that include species other than carp.

A large number of people live in communities located on or near waterways where carp invasion has occurred. Using spatial data from the 2016 State of the Environment on spatial location of carp invasion and different densities, overlaid with data on human population from the 2016 Census of Population and Housing, just under 8.4 million Australians live in a local government area (LGA) in which waterways and waterbodies have a moderate to high density of carp, and of these just under 5.3 million live in an LGA in which part or all of the waterways and waterbodies have experienced

high levels of carp invasion. Many of these are residents of Melbourne and parts of Sydney, as well as those living in the rural and regional areas in which carp invasion has occurred. This means that there are large numbers of Australian who may experience some degree of impact on the amenity of their local area in the short-term after a release of the carp virus. It was not possible to assess the proportion of this large number likely to be more directly impacted, for example due to living close to waterways or waterbodies in which carp kills may occur, or due to high frequency of recreational use of areas in or adjacent to these waterways or waterbodies.

Reduced amenity could also occur in communities downstream of those with large carp populations if virus release causes a large carp kills, or contributes to a blackwater event that causes a broader fish kill event extending to species other than carp, if dead fish flow downstream. In regions where the virus is less likely to be effective (e.g. with very cold or warm temperatures or other conditions identified as less conducive for virus effectiveness as part of other NCCP projects), reduced amenity is less likely to occur.

The extent of impact in different communities will range widely. Impacts on amenity could occur in the form of reduced access to recreational areas for a period of time, smell and visual impacts of fish kills and poor water quality. Some amenity impacts may occur via perceptions of safety: data on community perceptions presented earlier in this report suggest that a significant proportion of people will at least initially have fear about the virus being transmissible to humans or animals that could results in some level of concern associated with reduced liveability for local residents. This can be mitigated through investment in communication activities to address misconceptions, reducing the potential impacts to those experienced as a result of issues such as smell and visual impacts of dead fish and poor water quality, and disruptions to recreational activities.

Increased amenity for residents

This has potential to occur if reduced carp populations are achieved and this is followed by improvement in environmental health. If this occurs, it can increase wellbeing of residents through improved amenity of outdoor areas and increased recreation in those areas. This has potential to affect residents living in any regions where carp invasion has caused environmental damage.

Recommended actions

Actions recommended to reduce negative impacts on communities and increase potential for positive impacts are:

- Implement the actions recommended elsewhere in this report to reduce risk of jobs being lost. In particular, this requires implementing proactive communications strategies to maintain visitation for tourism, the principal industry in which loss of jobs could cause significant impacts at community scale.
- Ensure investment in carp control is accompanied by other measures to improve long-term environmental health, as most positive impacts are associated with long-term environmental improvement.
- Develop communications strategies to increase knowledge of changes in ecosystems and encourage increased visitation.

- Ensure clear communication prior to carp control actions that prepares residents for potential impacts on amenity and reduces risk of misperceptions about potential impacts (e.g. transmissibility to humans).
- Provide ongoing communication during periods of carp kills or poor water quality, to ensure communities have best possible information about progress and likely length of effects of impacts on amenity. Involve residents in assisting with reporting on aggregations of dead carp or water quality concerns and ensure feedback is provided to those reporting concerns on actions taken.

Further assessment

This preliminary assessment has given a very broad assessment of the range of communities with *potential* to experience impact. Not all of these will experience either negative or positive impacts. Once the specific types of carp control action and associated action to reduce risk of negative impacts, and to enable environmental recovery and positive impacts, are known, more specific assessment will be possible. At this point a more specific assessment can better identify the communities with highest likelihood of experiencing both short-term and long-term impacts (negative and positive). This should then inform identification of areas in which investment should be made in enabling rapid identification of emerging or unexpected impacts on a range of groups during the implementation of carp control actions. This is described further in the section of this report identifying future monitoring and evaluation needs.

Monitoring and evaluating social dimensions of future carp control action

This section provides recommendations on future socio-economic monitoring and evaluation needs. These recommendations were developed based on the findings of the assessment done for this project.

Monitoring and evaluation needs vary for different stages of decision making, design and implementation of any future carp control strategy. Table 6 summarises the key monitoring and evaluation needs, and why they are needed at particular stages.

Table 6 Recommended monitoring and evaluation strategy

Stage	Monitoring and evaluation needs
Decision made about type of carp control actions to be implemented & resourcing of the strategy	Based on planned timing of carp control activities, identify optimal timing to quantify activities of sectors potentially impacted by carp control activities, and conduct a more detailed assessment of existing conditions to extend and expand the assessment documented in this report.
	Design full monitoring and evaluation program in collaboration with stakeholders. This should include planning of real-time collection of data, particularly in initial stages, and how this will be linked to ensure it directs allocation of resources such as clean-up and communications activities. This will ensure the monitoring and evaluation is designed to be collaborative and agile, with the monitoring design to rapidly identify emerging issues so they can be responded to before they cause significant impacts.
Initial implementation (first 1-2 years)	Rapid monitoring methods that enable identification of emerging issues and are linked to response systems, ensuring that monitoring can be used to inform adaptation of implementation
Longer-term implementation (3-10 years and longer as needed)	Formal assessment of impacts on key communities and industries, initially at one year after implementation, then two years, four years, seven years, and ten years. This enables ongoing consistent tracking of outcomes.

Assessment of existing conditions (further 'baseline' assessment

The positive and negative impacts identified in the two projects conducted by UC during the development of NCCP recommendations are *potential* impacts: whether they occur, and to what degree, depends on the ultimate decisions made about the design and implementation of future actions to reduce carp populations. While these projects are recommending actions that can be undertaken to reduce incidence and extent of negative impacts, and increase potential for positive impacts on key groups and on communities in which carp invasion has occurred, they do not quantify the likely extent and nature of impacts under different scenarios. This is not possible until decisions have been made about the types of action to be implemented. Once this is known, it will be important to quantify current activity in areas such as the tourism, commercial fishing and native fish aquaculture sectors. As implementation of carp control may take some time to occur, an up-to-date assessment of size of these sectors should take place once timing of likely carp control actions is known. This is particularly important for sectors where activities have been changing rapidly, such as the growing native fish aquaculture industry, parts of which many, if current trajectories continue, grow significantly in size year-on-year.

It is therefore recommended that once decisions are made about design of future carp control programs, further assessment of the size of the sectors that may be affected is undertaken. By this time an accurate set of data on recreational fishing activity in areas affected by carp will also be available through the National Recreational Fishing Survey which is being conducted through 2019 and 2020. This will enable a more accurate assessment of the number of businesses and people potentially affected in the short-term and long-term, and design of investment in the types of strategies recommended in this report.

Designing 'pre-monitoring and action to avoid impact', through monitoring that informs implementation actions

Ideally, future carp control programs should identify specific points in time at which social and economic impacts will be evaluated, and include scope to adapt the design of the program to respond to and address any unexpected impacts that are identified from this ongoing monitoring and evaluation. This can help to ensure future carp control is both designed to address known likely impacts, and can respond to impacts that were not predicted or assessed as unlikely if they emerge.

For this to occur, monitoring needs to occur with sufficient frequency to enable timely response to the emergence of unexpected types or extent of social and economic impacts. Most social and economic impacts will emerge as a consequence of four factors: (i) reduced amenity due to carp kill, (ii) reduced water quality, (iii) impacts of clean-up efforts and of fish kill or water quality on sites with high cultural and recreational values, and (iv) perceptions of both safety of visiting and using areas where virus release has occurred, and of consuming produce from these areas.

Rapid monitoring methods: responsive reporting systems operated collaboratively with key stakeholder groups

For the first two areas, monitoring should focus on rapid consultation with communities in which reduced amenity or water quality impacts occur, to identify whether these impacts are approaching thresholds where they cause significant social and economic impacts, as well as monitoring how rapidly local businesses recover from these events to identify if any further action may be needed to support recovery. This consultation requires appropriate resourcing to ensure it does not present high burden for those asked to participate in it.

For the third, there is a need to design carp control to have active involvement of groups including Traditional Owners, tourism businesses/peak organisations, so they can proactively identify sites requiring protection and reduce the risk of negative impacts. This will also assist in reducing impacts of (i) and (ii) discussed above. It is preferable to focus investment on 'pre-monitoring and action to prevent impact' rather than monitoring impacts post-release. Active involvement before and during carp control will better enable prevention of impacts compared to monitoring after implementation of control actions have occurred.

Rapid monitoring methods: community perceptions

To address the fourth area of social and economic impact requires engagement and monitoring of community perceptions about safety. This should be done intensively in initial stages of carp control. If the virus is released, we recommend monitoring every 6-8 weeks in the 4-6 months prior to virus release as this is when anticipatory impacts will occur and many perceptions will be formed, and

every 6-8 weeks immediately after virus release implementation. Beyond the first six months of virus release, it is likely that monitoring can be reduced in frequency, to once every six months, as perceptions are likely to form and 'solidify' in the initial period prior to and just after implementation of a carp control program.

Intensive monitoring at the frequency recommended should be explicitly used to inform investment in communication strategies that focus on building an accurate understanding of safety of visiting areas in which carp control is occurring, and of consuming produce harvested in those areas. As perceptions are commonly formed based on distribution of messages in traditional and social media that cross large geographic areas, monitoring should focus on a sample of (i) people living in areas experiencing carp invasion and (ii) people living in other areas who may visit areas experiencing carp invasion, for example for tourism. We do not recommend monitoring aims to specifically identify views of people living in different individual communities, as evidence to date suggests perceptions will be formed at a broader scale and be relatively consistent across different communities. This means sample sizes do not need to be large, and monitoring of perceptions can be done effectively using samples of 1,000 to 2,000 people nationwide.

Rapid monitoring methods: enabling community reporting

To complement the community surveys, we recommend implementing (i) an email address, website and free-call phone number that community members can use to report social and economic impacts they believe may be occurring in their community, and (ii) regular update surveys of local government, tourism, native fish aquaculture, commercial carp fishing, koi and recreational fishers. The latter involves conducting a brief email or online survey comprised of 5-10 questions with a sample of these groups on a monthly basis to gauge any emerging issues. This again enables rapid tracking of potential impacts and response to them, including response to address inaccurate perceptions and prevent rapid spread of inaccurate perceptions, as well as investment to mitigate negative impacts where appropriate.

Longer-term monitoring methods: specific impact assessment for identified communities and groups

The short-term monitoring described in the previous sections should be prioritised in the first one to two years of implementation, and longer as needed to ensure this monitoring can be used to guide rapid response that reduces potential for negative impacts.

Accompanying this should be a longer-term monitoring project that uses consistent methods to track effects of carp control on (i) key groups and (ii) communities in which carp control occurs. This longer-term monitoring should be undertaken one, two, four, seven and ten years after implementation, and potentially longer: the ultimate length of time monitoring is undertaken for should be determined principally based on time frames in which potential improvement in ecological condition occurs, so that monitoring and evaluation both track short-term impacts of carp control and longer-term outcomes of a reduction in carp populations and any associated improvement in ecological condition. This can capture both positive and negative impacts to provide a long-term understanding of socio-economic benefits and costs of carp control.

Tracking for key groups should consistent of:

- Tourism industry: tracking tourism industry activity in areas where carp control actions have occurred compared to those where they have not, to identify if there are differing trajectories for the tourism industry. A lack of specific data on tourism businesses reliant on water areas, and limited data on tourism by region, means that some data should be collected via direct survey of a sample of businesses dependent on water areas in areas in which carp control activities are and are not implemented. Data from Tourism Research Australia on tourism activity by region should also be used to identify any major differences in trends between regions where carp control is implemented and where it is not.

- Commercial carp fishers and other commercial fishers operating in areas experiencing carp invasion: We recommend direct interviews with these fishers at one year, two, four, seven and ten years, to track outcomes. The interviews should collect both quantitative data on business and household social and economic conditions, and on the psychological wellbeing of commercial fishers and their households. This is likely to be more effective and efficient than using other methods of data collection.

- Native fish aquaculture: The same methods recommended for commercial fishers should be used, together with tracking production and sales data where possible, including exports and domestic sales.

- Koi hobbyists, breeders and associated businesses: There are no regularly available data for this group, suggesting a need to ensure a regular survey of (i) members of koi associations and (ii) the broader koi owning public. The latter can be achieved through existing omnibus surveys as part of monitoring of community attitudes, by including questions asking about koi ownership, and changes experienced in association with carp control action.

- Recreational fishing: Impacts on recreational fishing businesses can be assessed in the same way as tourism businesses. Impacts on fishers can be monitored as part of community surveys, as participants can be asked about their fishing activities and whether they have changed.

- Traditional Owners: Consultation with Traditional Owners should be used to identify an appropriate monitoring strategy that is led by First Nations.

- Communities: A tracking survey of residents of communities in which carp control has been undertaken can be used to identify changes over time.

- Other groups: Short-term monitoring may identify other groups, as well as specific communities, that are experiencing impacts (positive or negative). A monitoring and evaluation program should set aside resources to enable inclusion of up to 2-3 additional groups in monitoring, ensuring that those who emerge as affected groups in initial monitoring can be monitored long-term.

Conclusions

The individual reports produced for this project contain a large volume of discussion, and the synthesis of findings also provided discussion. This section therefore focuses on conclusions. Key conclusions of this project are that there is strong support for the investment of resources in carp control from key stakeholders, and moderate to strong support from the broader community. However, a significant minority of the community do not feel carp invasion causes significant problems or feel other issues are more important to address.

Support for use of the carp virus is less strong than overall support for carp control. Amongst both the community and key stakeholders, overall there is conditional support from most, with outright support and outright opposition less common. Twice as many have some degree of support for use of the virus as oppose its use. However, these views represent a starting point that has high potential to change. It is not possible to identify overall levels of likely support until a full carp control strategy is developed that includes detail about proposed implementation, clean-up and ecological recovery actions to be invested in, and the level of investment that will be made. Depending on the type and range of carp control actions included (with most stakeholders strongly preferring multiple control methods be used), and the extent of other investment in ecological recovery, clean-up and communication, the views of many have potential to range from opposition to support.

Amongst stakeholders, many reported increased conditionality of support as the NCCP progressed, particularly in relation to whether the use of the virus would be effective in reducing carp populations over the long term, and whether it would be possible to invest in action to ensure reduction in carp populations was followed by an improvement in ecological health.

While stakeholders expressed reduced concern over time about the potential for virus release to cause large negative impacts on water quality due to high volumes of dead carp in waterways, this concern remained very high amongst the general community, many of whom also have limited willingness to accept short-term impacts on amenity of their area. Addressing concerns about negative impacts of virus release is the most important action needed to achieve social licence for carp control actions amongst the community. Amongst key stakeholders, the key actions needed are to increase confidence in the potential to achieve positive outcomes (in the form of reduce carp populations and improvement in ecological health); in the design, implementation and resourcing of any future carp control and associated actions; and in the evidence underpinning these actions.

A number of groups and communities have potential to be specifically impacted by virus release if it occurs, and some have already experience socio-economic impacts during the development of the NCCP.

A key area of impact identified by all groups to differing extents was that related to involvement in processes of developing and implementing carp control actions. All groups highlighted that the optimal approach to reducing direct impacts is to ensure involvement of representatives in processes of developing on-ground strategies, so they can ensure the actions designed and implemented reduce risk of negative impacts to things such as culturally important sites, recreational and tourism areas, and enable continued operation of businesses dependant on areas affected by carp invasion or

dependent on koi. This type of involvement also significantly reduces the sense of uncertainty or disempowerment that can otherwise result for many groups if they feel their voices are not being heard or acted on.

Specific pathways of impacts differ somewhat for different groups: impacts on commercial fishers and native fish aquaculture businesses depend in large part on whether carp control changes market demand, changes access to markets, or increases business costs. The extent to which these three things occur depend on the costs of meeting any additional regulations or other constraints, and the extent to which market access and consumer demand is successfully maintained through resourcing of communication and marketing strategies to offset negative impacts. Negative impacts on tourism and recreational fishing result both from actual and perceived impacts on amenity and ability to use areas important to tourism and fishing. Reducing risk of negative impacts requires both forward identification of key sites to be prioritised in clean-up activities (to reduce actual amenity impacts) and investing in communication strategies that reduce inaccurate perceptions about ability to visit areas, ideally combined with tourism and fishing campaigns that build on activities seeking to reduce carp and support environmental recovery after a reduction in carp.

Key to a full assessment of impacts in future is clarity about the specific range of actions to be implemented, meaning not only whether virus release will occur and using what approach over what time period, but what other actions to reduce carp populations will be invested in, and what actions to promote environmental recovery will be invested in. A more specific assessment of likely impacts is not possible until this is known, at which point it will be possible to more precisely identify groups and communities likely to experience impacts. Additional information critical to being able to fully assess likely socio-economic impacts is what regulatory constraints may occur as a result of carp control actions and how these may affect operations of different businesses or activities; what additional costs may be experienced due to implementation of biosecurity requirements; and the capacity of businesses to cope with any changes in regulation or increases in cost.

Almost all the potential positive impacts identified in the impact assessment will occur only if there is improvement in environmental health following a reduction in carp populations. A reduction in carp populations alone is not sufficient for these positive outcomes, such as increased tourism visitation or recreational fishing, to occur. Investment in improving environmental health may occur as a part of carp control, or carp control may be coordinated with other existing programs already being implemented to improve health of areas affected by carp invasion. To enable positive socio-economic impacts, ideally careful and coordinated investment to support improvement in environmental health before, during and after a reduction in carp populations should occur. Investing before a reduction may include actions such as preparing restocking strategies and identifying other actions likely to increase the likelihood and the speed of improvement in conditions that occurs after any reduction in carp population. Investing during carp control actions means identifying and implementing actions that similarly protect existing assets and seek to increase likelihood and speed of subsequent improvement in environmental health.

While more specific assessment of socio-economic impacts is recommended once the specific actions to be invested in are determined, it is just as important to ensure the actions invested in include processes that enable rapid identification of and response to socio-economic impacts that may emerge during and after implementation of carp control action. Given this, we recommend that

investment in monitoring and evaluation be ‘front heavy’, meaning it is highest during initial stages of implementation, and can rapidly inform on-ground actions to reduce impacts. This can then be followed by longer-term monitoring of outcomes, which are likely to be more positive due to the earlier investment in rapid monitoring and response to any emerging challenges.

Implications

The key implications of the research conducted for this project focus on implications of findings related to community and stakeholder views about carp control. The Final Report for Project 2 considers implications for managing socio-economic impacts of carp control.

Social licence for carp control and virus release – general community

- There is strong support for investment in carp control amongst the general public, once made aware of problems of carp invasion. This provides a positive starting point: many people are willing to consider use of a range of methods for carp control, even if they cause some negative short-term impacts.

- There is tentative support for virus release, with twice as many supporting as opposing the concept of virus release. However, many are uncertain and the evidence suggests there is high potential for community attitudes towards virus release to shift rapidly (to support or opposition)

- Support for carp control (as opposed to support for use of virus release to achieve carp control) is high and more stable than support for virus release – the National Carp Control Plan has raised expectations that future investment will occur in carp control, and there is likely to be concern if investment in carp control (whether involving use of the virus or not) does not eventuate.

- Virus release is less strongly supported if the virus is released in a person's local area than when asked about in general, suggesting high sensitivity to localised impacts, including short-term impacts, and highlighting that support will be contingent on effective clean-up and strong proactive communication to communities.

- Concern about negative impacts of the virus is a key driver of levels of support, more so than awareness of carp invasion or trust in organisations. Addressing concerns about negative impacts is a key action needed for the broader community.

The broader community is likely to be highly influenced by the views communicated by key stakeholder groups they trust. This means that views of these stakeholders will have a significant influence on whether the broader community supports carp control actions proposed in the future, whether involving virus release or other actions. Key stakeholders have a more complex and in-depth understanding of both carp control and virus release, and different needs to the community when it comes to achieving a social licence for implementing carp control actions. Overall, the findings suggest that further investment in addressing key concerns and priorities of stakeholders is needed before implementation of carp control action can occur with strong social licence. This in turn means that this investment is needed to enable a high likelihood of social licence for carp control in the broader community, given that the views of key stakeholder groups about the actions implemented will have an important influence on attitudes in the general community.

Social licence for carp control and virus release – stakeholders

- All stakeholders strongly support investment in action to reduce carp numbers as part of broader work to improve environmental health of areas affected by carp invasion

- There is tentative and conditional support for release of the virus amongst many, but not all, stakeholders. This support is conditional on the virus being shown to be (i) effective in reducing carp populations in the long-term as well as the short-term, (ii) concerns about potential for negative impacts on water quality, amenity and environmental health being addressed, and (iii) development of an integrated set of actions to reduce carp populations and improve environmental health, rather than reliance primarily or solely on use of the virus.

- Smaller numbers of stakeholders unconditionally support or oppose virus release, and these stakeholders are unlikely to change their views

- Uncertainty about virus release increased for many stakeholders through the life of the NCCP. This was a result of (i) increased uncertainty about the likely efficacy of the virus in achieving widespread reduction in carp populations, particularly in the long-term, and (ii) many stakeholders wanting to see an integrated carp control strategy that incorporated multiple actions to reduce carp and was coordinated with action to restore environmental health. These conditions need to be met for many stakeholders to support implementation of carp control actions, particularly release of the virus. Concerns about potential shorter-term impacts on water quality decreased during the life of the NCCP for some, but not all, stakeholders, based on evidence emerging from NCCP research.

- Stakeholders have high levels of knowledge about different aspects of carp control and expect detailed information: communication and engagement needs to ensure that the knowledge of stakeholders continues to be drawn on in future development of carp control strategies, and that stakeholders are able to engage with detailed information that provides the evidence they need regarding proposed carp control actions.

Socio-economic impacts

- There is potential for both negative and positive socio-economic impacts, and the extent to which both negative and positive impacts occur depends in large part on the nature of the actions used to control carp and associated measures invested in
- The NCCP process has resulted in significant impacts already for some, predominantly commercial carp fishers, and in uncertainty about the future for others, particularly those involved in fishing, aquaculture and tourism activities in areas affected by carp invasion
- Loss of income or employment could occur for some specific groups, particularly commercial carp fishers, inland native fish aquaculture businesses, koi breeders and other businesses, and tourism businesses
- This loss of income or employment is unlikely to have significant flow-on impacts to the broader local economy in most cases; however, there are multiple local government areas with a relatively high dependence on tourism employment where community-wide impacts

on employment and economic activity could occur if carp control activities led to a substantial decline in tourism visitation over a period of several months or longer.

- There is potential for relatively large numbers of people to experience short-term impacts on local amenity; the extent of impact can be reduced through clear communication that reduces fears about issues such as perceived transmissibility of the virus to humans or other animals, and about the length of time amenity issues are likely to last for.
- Key to reducing risk of negative impacts is resourcing communication and marketing strategies that aim to reduce inaccurate perceptions about safety of consuming produce or visiting areas where carp control is occurring. This is needed irrespective of how safe these actions are, as in the absence of this type of investment there is a very high likelihood of negative perceptions leading to negative impacts even if those perceptions are not 'correct'.
- Positive socio-economic impacts predominantly depend on improvement in environmental health and amenity occurring after a reduction in carp populations: a reduction in carp population alone will not be sufficient for most potential positive socio-economic impacts to occur.

Recommendations

Achieving a social licence for carp control actions requires building confidence of key stakeholders in the likely effectiveness of the actions being invested in over the long-term, and in the likelihood of a reduction of carp population being followed by improvement in environmental health. To increase likelihood of carp control having a social licence from stakeholders, who in turn have a strong influence on broader public opinion, we recommend:

- Further investment in research identifying likely long-term effectiveness of carp control actions on carp populations
- Further investment in identifying the types of actions that can increase likelihood of a reduction in carp populations being followed by improvement in environmental conditions and amenity
- Development of carp control strategies that include multiple measures to control carp, rather than relying solely on use of the virus
- Development of strategies that integrate carp control with other actions to improve environmental health in freshwater and estuary areas
- Development of detailed guidance on the planned timing and management of carp control actions, particularly virus release
- Clear identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios
- Identification and appropriate mitigation of potential social and economic impacts of carp control on specific groups
- Appropriate involvement of different groups in decision making processes
- Sound governance, including clear commitment of funding and other resources to carp control and identification of responsibilities of different agencies, and
- Development of appropriate monitoring and evaluation strategies to ensure outcomes can be identified.

While both stakeholders and community members support investment in reducing carp populations, stakeholder support became more conditional over time during the life of the NCCP, and attitudes of the broader community have high potential to shift from the initial position in which people were 2.5 times more likely to find virus release acceptable as unacceptable. To increase the likelihood of community support for carp control actions, we recommend that:

- The actions recommended above to build stakeholder support are invested in, as stakeholders in turn influence views of the broader community

- A range of organisations trusted by the community are involved in signing off carp control actions, to build confidence in those actions
- Investment is made in increasing awareness of carp invasion and the problems it results in
- Carp control strategies include investment in communication to address key concerns held by many community members about issues such as transmissibility of the virus to humans or animals, impacts on water quality, and costs versus benefits of action.

While there is potential for negative social and economic impacts from a release of the carp virus, this potential can be minimised through implementation of key strategies design to reduce impacts. This report assumes that virus release would only occur if there is low risk of long-term negative impacts on local amenity: if this is the case, investment in the following can act to reduce potential social and economic impacts from short-term reductions in amenity related to water quality and fish kills:

- **Active involvement** of Traditional Owners, tourism sector, native fish aquaculture, local government, recreational fishers, water managers, farmers and other relevant stakeholders in prioritisation of clean-up areas and ensuring safe and appropriate access to areas for clean-up. This can ensure clean-up activities are prioritised in areas with the greatest risk of social and economic impact, while also ensuring clean-up activities do not themselves create impacts through damaging sites of cultural, recreational or commercial significance. This requires resourcing involvement of these groups, and establishing clear governance of processes of allocating clean-up resources.
- **Active monitoring and communication** with potentially impacted businesses and local government areas prior to, during and after virus release, ensuring sectors such as tourism have access to the information they need to put in place strategies to reduce impacts. This ideally would include 'real time' mapping of any areas affected by poor water quality or dead carp to enable residents, tourists and businesses to accurately understand actual areas affected and reduce risk of people perceived areas to be impacted when they are not. This requires specific allocation of sufficient resources to enable effective monitoring and communication. Real-time monitoring enables early identification of emerging impacts and implementation of action to reduce their extent.
- Invest in **proactive communication strategies** to reduce risk of longer-term reduction in visitation of areas or reduced consumption of some products as a result of negative perceptions. As part of this, ensure existing learnings from the tourism sector about managing communication during negative water events are drawn on when communicating about carp control actions more generally.
- Identify **regulatory implications** of virus release for commercial carp fishing, commercial fishing, recreational fishing and aquaculture in areas where virus release will occur, as well as for transport and sale of koi in any area. Assess impacts in terms of market access, business costs and labour time of these regulatory impacts. Develop strategies to assist affected businesses adapt to changes.
- Ensure carp control is accompanied by **long-term investment in complementary measures to improve environmental health** a reduction in carp populations. Almost all potential positive social and economic impacts will occur only if carp reduction results in improvement

in environmental health and associated amenity such as improved fishing opportunities, clearer water or better vegetated riverbanks, for example.

- **Provide opportunities for involvement** of those potentially impacted to be involved in carp control and environmental recovery activities after a reduction in carp activities. This can include engagement in citizen science activities for recreational fishers and tourists, such as monitoring of areas, and commercial opportunities for engagement in clean-up activities, supporting clean-up activities, and supporting environmental recovery measures such as restocking of native fish, for commercial fishers, tourism businesses and aquaculture businesses.
- **Acknowledge impacts** on those who experience them. Impacts are more damaging psychologically when not recognised and acknowledged, and recognising impacts assists people to process and adapt to impacts. This includes acknowledging the anticipatory impacts occurring during the NCCP and further anticipatory impacts likely to occur prior to any decisions on the nature of future carp control actions. It also includes acknowledging both short-term and long-term impacts resulting from future carp control actions.
- **Include support for those experiencing significant impacts.** While assessment suggests relatively small numbers of businesses are likely to experience long-term impacts, there is potential for some to experience significant impacts. Putting in place a support program that can be applied for by those who demonstrate significant long-term impacts is therefore important for those who do experience extended large-scale impacts. Providing support in the form of phone counselling and potentially short-term financial assistance such as low-interest loans could assist those experiencing short-term impacts on business revenue, particularly if they are experiencing cumulative impacts (see below).
- **Identify cumulative impacts**, meaning identify where carp control actions may combine with other unrelated stresses being experienced by a sector to potentially cause a 'tipping point' for business viability or a person's wellbeing. Put in place support resources such as liaison officers who can assist impacted people and businesses to access existing services that can provide support.

Extension and Adoption

This project was deliberately designed to have a strong focus on 'action research', meaning that findings were rapidly developed and reported on an ongoing basis through the project. The principle groups to which findings were rapidly extended so they could be adopted was NCCP staff and researchers and others involved in NCCP research more broadly. Multiple presentations were given to these groups throughout the project, and the documentation of the project in this report identifies the ways in which findings were used at several points to inform things such as communication strategies.

Specifically, findings of the research were communicated and used through:

- Presentation and discussions at several meetings of NCCP researchers and staff, enabling findings to be drawn on as the NCCP progressed
- Several specific meetings with NCCP staff and, where appropriate, researchers and representatives of government agencies, again to ensure emerging findings were able to be used
- Working directly with NCCP staff to draw on project findings to inform a revised NCCP communications and engagement strategy in 2018
- Asking project participants to comment on draft reports, as well as producing the summary report on socio-economic impacts made available on Bang the Table, and
- Discussions held with stakeholders at workshops, at which project findings to date were always presented and discussed.

Ultimately, this research will be used to inform development of recommendations included in the National Carp Control Plan. It may also be used to inform design and implementation of future carp control strategies, and to provide data that can be further tracked over time as part of monitoring and evaluation of future actions to reduce carp populations.

Project materials developed

A number of specific reports were produced as part of this project intended to inform discussion and engagement with a range of stakeholders. These are provided in the Appendices to the report, and included:

- An initial report on Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns, which was drafted, provided to stakeholders for comment as well as peer reviewed, and then revised based on those comments (Appendix 1)

- A number of presentations of findings of tracking data on community attitudes, presented to NCCP principal investigator meetings and to NCCP staff to enable this information to inform ongoing communication work (Appendix 2)

- The second edition of the report National Carp Control Plan socio-economic impact assessment: Commercial carp fishers (Appendix 3)

- The second edition of the report National Carp Control Plan socio-economic impact assessment: Tourism Sector (Appendix 4)

- Stakeholder interviews informing development of the *National Carp Control Plan Communication and Engagement Strategy & Operational Plan 2019:* Appendix 5 provides a summary of stakeholder views provided.

- The second edition of the report National Carp Control Plan socio-economic impact assessment: Native fish breeders and growers industry (Appendix 6)

- The report National Carp Control Plan socio-economic impact assessment – recreational fishing sector (Appendix 7)

- The report National Carp Control Plan socio-economic impact assessment: koi hobbyists and businesses (Appendix 8)

- The report Engaging with the National Carp Control Plan: summary of a stakeholder workshop (Appendix 9)

- Issues Paper # 5 Understanding potential social and economic impacts of carp control (Appendix 10).

Appendices

The Appendices provide detailed data and findings from different parts of Project 1 and 2. These are in the form they were in at the end of Project 2.

Appendix 1 Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns

This Appendix provides the first report produced from this study, titled Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns. This report was drafted in October 2017, provided to stakeholders for comment and peer reviewed, and then revised based on those comments. The final report amended after receiving comments from stakeholder and expert reviewers is provided.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 2. Findings of community attitude surveys

This Appendix provides the presentations given on findings of tracking data on community attitudes. These results were presented to NCCP principal investigator meetings and to NCCP staff on an ongoing basis to enable this information to be rapidly disseminated and used as part of the NCCP.

Four surveys were conducted on community attitudes (the first was conducted prior to this project being funded; the subsequent surveys were conducted as part of this project). The findings for each are described in turn in this section, including identifying in which other reports produced from this project some of the findings are analysed in more detail. The findings section in the main body of this report summarises key findings about attitudes over time.

Survey 1: 2016 Regional Wellbeing Survey (Oct-Nov 2016)

The methods and findings of this survey are reported in detail in Appendix 1, which should be referred to for these results.

Survey 2a: 2017 Regional Wellbeing Survey (Oct-Nov 2017) and Survey 2b (Stand-alone survey Dec 2017)

This survey collected data in two separate surveys which asked the same questions, but used different methods to recruit participants to see how stable findings about acceptability of virus release and carp control more broadly were when using slightly varied methods to recruit participants. Overall results were highly consistent, confirming that findings of the Regional Wellbeing Survey – the main survey vehicle used to track community attitudes – could be relied on as they had very similar results to those obtained when recruiting participants through an online survey panel run by Qualtrics.

Findings were provided as updates to NCCP staff in presentations that summarised key outcomes. The focus was on descriptive analysis of results, with data from the Regional Wellbeing Survey weighted to be representative of the population using the methods described in Appendix 1, and the online sample survey requiring no weighting as it used quota sampling to obtain a sample representative of the Australian population by gender, age and geographic distribution, as well as obtaining specific additional samples of Aboriginal and Torres Strait Islander respondents, and people with diverse cultural and language backgrounds.

The key findings are provided in the embedded Powerpoint presentation below. Double clicking on this file will run Microsoft Powerpoint and enable scrolling through the entire presentation.

NATIONAL CARP CONTROL PLAN
RESTORING NATIVE BIODIVERSITY

UNIVERSITY OF CANBERRA

BUILDING COMMUNITY SUPPORT FOR CARP CONTROL

Understanding community and stakeholder attitudes and assessing social effects

Jacki Schirmer
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Embedded Presentation 1: Presentation given February 2018 on results of survey wave 2, with comparison to results of survey wave 1

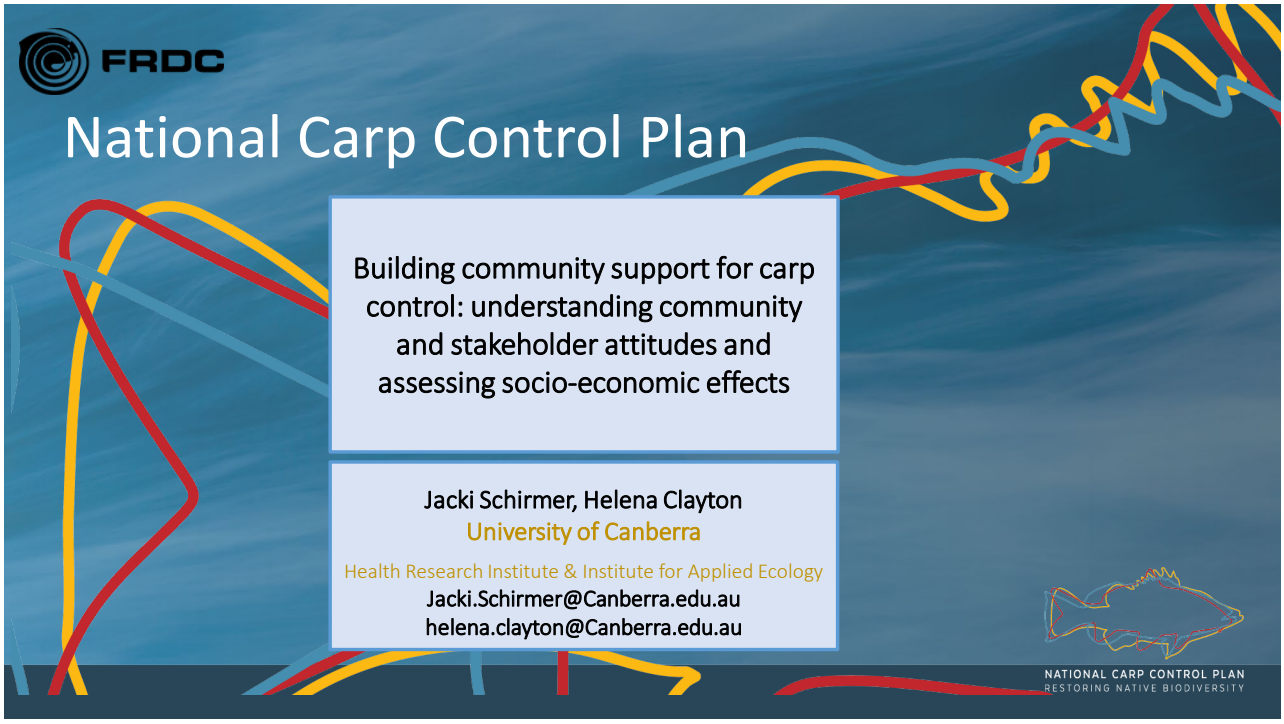
Further analysis of data from this survey is also provided in Embedded Presentation 3 in Appendix 5, which identifies key implications for engagement.

Survey 3: 2018 Regional Wellbeing Survey (Nov-Dec 2018)

This survey was a simple tracking survey of attitudes that only asked the item tracking views about acceptability of reducing carp populations using the carp herpes virus. This tracking data was included in the presentation given on early results of survey 4, and in the main body of this report, and confirmed there was no significant change in overall perceptions occurring over time.

Survey 4: Stand-alone survey (April-May 2019)

Key results of this survey were presented in the main body of this report, and in the assessment reports for specific groups for whom impacts of carp control were assessed. In addition, an update was provided to the NCCP in June 2019 using early results of the survey. This report is embedded below, but does contain initial analysis which in some cases differs slightly to the final results presented in the main body of this report, as data were not yet fully analysed. Where there are differences the data presented in the main body of the report, and in final editions of reports assessing impacts on specific groups, should be relied on.



Embedded Presentation 2: Presentation given to Principal Investigator meeting, June 2019

Appendix 3. Socio-economic impact assessment – commercial carp fishers (second edition)

This Appendix contains the second edition of the report *National Carp Control Plan socio-economic impact assessment: Commercial carp fishers*. This Final Report of Project 1 contained the first edition report which was subsequently expanded and updated in the second edition. This first edition report was provided to commercial fishers for comment and their comments were incorporated into this second, final edition.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Second edition to be inserted here

Appendix 4. Socio-economic impact assessment – tourism sector (second edition)

This Appendix contains the second edition of the report *National Carp Control Plan socio-economic impact assessment: Tourism Sector.* The first edition of this report was included in the Final Report of Project 1, and it was provided to tourism sector stakeholders for comment. Their comments were incorporated into this second, final edition.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 5. Stakeholder interviews

This Appendix (i) summarises findings of the second rounds of stakeholder interviews and (ii) provides copies of presentations given through the life of the NCCP focused on recommendations for communication and engagement with stakeholders.

The first and third rounds of stakeholder discussions are not included in this Appendix:

- the first round of stakeholder interviews were reported in detail in Appendix 1, and the report in Appendix 1 should be referred to for results of these interviews
- the findings of the third round of stakeholder discussions are reported in detail in the report of the June stakeholder workshop provided as an Appendix to the Final Report of project 1, with additional findings summarised in the main body of this report.

Findings of second round of stakeholder discussions

The second round of stakeholder interviews focused on identifying stakeholder views about engagement and communication, which were drawn on to inform the National Carp Control Plan Communication and Engagement Strategy & Operational Plan 2019 (a document this project helped shape, which is available separately to this final report).

The second round of interviews were conducted from June to November of 2018, with 45 Round 2 interviews completed overall. During Round 2, 10 of the original 23 key stakeholders interviewed in Round 1 were re-interviewed, to identify how their views about carp control were changing. A further 7 of the original 23 were interviewed as part of ongoing socio-economic impact assessment, and as part of these interviews were asked to describe their overall views about the National Carp Control Plan, particularly communication, engagement and whether and how their views about carp control had changed since the National Carp Control Plan was announced and began its research. In addition, interviews with 28 new stakeholders were conducted as part of the socio-economic impact assessment, who provided their views on these topics as well as discussing potential for specific impacts on the group they were part of or represented (e.g. recreational fishing, koi, native fish aquaculture, commercial fishing or tourism).

In this Appendix, direct quotes are included from the 10 key stakeholders re-interviewed for the second round, but not from interviews conducted with members of specific groups such as koi hobbyists, native fish aquaculture businesses etc. This is because the views of commercial carp fishers, koi sector, native fish aquaculture sector, recreational fishers and the tourism sector about communication and engagement are reported in the individual reports for those sectors. The aggregate view of stakeholders discussed in this Appendix does, however, incorporate those perspectives, to ensure that views of as wide a range of stakeholders as possible are reported (we have simply elected not to repeat quotes multiple times across different Appendices, and hence include quotes only from those stakeholders not quoted in other Appendices).

Community perceptions of carp control

Round 2 stakeholder interviews found similar levels of conditional support for carp control to the levels identified in the first round of interviews. Overwhelmingly participants identified carp control as a priority issue to be addressed and either fully or partially supported the use of the carp virus. However, several stakeholders had identified additional questions or concerns that would need to be addressed to their satisfaction before they would provide support for implementing actions to control carp. Many interview participants felt that more work needed to be completed prior to the release, particularly regarding the ongoing uncertainty of the science, implementation plans, risks of releasing a virus, and the need for further engagement:

“I feel like you can see the light at the end of the tunnel, but I just don't think we're quite there yet. So, I'd like to see an implementation program and that sort of thing before I said, "Yes. It's definitely a go." [Round 2 Participant 1]

“No [I don’t support the release of the virus]. Not at the moment. But nor do I say they should never release the virus. I just say we don't know enough to make a good decision yet. But a good decision might be to release. And it doesn't mean it doesn't have a negative effect. It just means we know what the negative effect's going to be and we're prepared to manage it or prepared to accept it.” [Round 2 Participant 4]

“There's a great deal of concern and certainly strong reservations from people that I've spoke to about [releasing a virus]. The example of past releases of exotic pets or diseases in certain ecosystems is often raised as a case in point. … I can't provide an organizational response to that at the moment until we've done some more consultation.” [Round 2 Participant 10]

Those stakeholders who had not supported virus release in the first round of interviews had not changed their views: these were principally stakeholders engaged with the koi, native fish aquaculture, and commercial carp fishing sectors. Almost all koi and native fish aquaculture stakeholders interviewed, together with a majority of commercial carp fishers, opposed virus release or were conditionally opposed to it. There were more mixed views amongst those in the tourism and recreational fishing sectors, many of whom wanted much more information and to see key concerns addressed before they could provide support.

Some stakeholders wanted the see the virus released sooner rather than later, particularly those engaged in farming, water management, and some involved in natural resource management work and recreational fishing (although not all). Those stakeholders who held this view felt that the release of the virus would cause some problems, but were confident they could be dealt with during the implementation process and felt there would be significant environmental benefits that outweighed the risks. Typically this view was based on the assumption that the virus would be one of a range of actions intended to reduce carp populations and support environmental health in areas affected by carp invasion:

“I just maintain that I've been positive about this right the way through. But the sooner it rolls out the better and I wish it all the best of luck and all those sorts of things. There will be challenges along the way, I'm sure, but I know a lot of work's gone into preparing for it and I just think there's opportunities there at many levels, as we've discussed, the educational, the spiritual. At every level

there are real benefits there that are going to accrue and the sooner that we can see that happen the better." [Round 2 Participant 8]

"It really is time to do something. Yeah. Like, it's a generational thing. Like, when I think that they're not really making enough of that. To me, it's like, "This is amazing. You know, this could potentially change our rivers from being brown to running much clearer again. You know, what a vision for that, you know. It could make our other fish bounce back. I guess the message that we give people is, "Look. You know, the virus is one of many things. It's gonna have to be followed up with a whole range of other strategies." [Round 2 Participant 7]

Some wanted the virus released quickly and were concerned about waiting too long to do so:

"It's just a long drawn-out process. Most of us make a decision and just do it and move on. If it works, it works. If it's bad, you get slapped on the backside. …Well, it depends how brave people want to be. So you want to sign every I and dot every T, we'll still be talking about it in 20 years time and somebody wants to make a difference, they'll do something sooner." [Round 2 Participant 2]

Other stakeholders however were concerned about moving too quickly to releasing the virus, wanting additional evidence and considerable time invested in reducing risks:

"No, you could generate a catastrophic outcome. .. The other [concern] I call the cane toad effect. You'll never get permission in a generation to release another virus. And so all the viral controls and viruses are massively important for controlling pests of agricultural crops so it's something we do anyway. And so that if you get it wrong, it's not just the consequence, the ecological consequence, it's the social and global consequences. And so impatience is not a good thing." [Round 2 Participant 4]

Overall, more stakeholders expressed concern about moving too quickly to implement the virus, and fewer wanted a rapid process of virus release. On balance, a majority of stakeholders interviewed wanted time pressure to be reduced through increasing the time available for the NCCP.

The carp control plan, past, present and future

Stakeholders interviewed generally supported the process being used for the plan, particularly the focus on ensuring key questions about risk were invested in:

"Look I haven't been closely involved with it, but from what I can see it seems to be fairly comprehensive in terms of the research and everything that's gone into the efficacy and workability of the virus, and the management of it. But it also seems to have ticked the boxes in terms of security and in terms of risk to impact on native species. But I think that's obviously the first box that has to be ticked. If it can't pass that test then it doesn't go any further. I think that the fact that they have that level of confidence that it is a workable solution, I think is commendable." [Round 2 Participant 8]

"I think, from what I said earlier, it's tracking how I would expect something with such big implications and such emotion around it should track. I don't think you want to rush these things. We've got a history of really bad biological control options in Australia, and I don't think any one

wants to move down that path again without fully signing off, and I think, hopefully, if we've learned anything from that, it's to really tick all the boxes first, and I think that's what the program's trying to do. … I'm not surprised at how long it's taking to be honest….” [Round 2 Participant 4]

Some felt that the research initially invested in by the NCCP was insufficient to address their concerns, particularly those in the native fish aquaculture and commercial carp fishing sectors, and some scientists.

Several stakeholders were concerned about what they felt was either overly simplistic communication, or was a gap in communication that had allowed what they felt was misinformation or inaccurate reports to occur in the media. Several were reassured by communication in the second half of 2018 emphasising the lengthy approval process required for a virus release if it occurred:

“I feel it had a wobbly start, but I feel more comfortable that it's heading in the right direction and it's my perception so I hear things from community around. I think people have appreciated the communication that's stopped a lot of the Chinese whispers. It hasn't stopped all of them but it's not as alarming as it has been. I think there's, everyone's going 'there's a long way to go yet and there's lots of gates and hurdles to go through'…” [Round 2 Participant 3]

Most interviewees were trusting of the science supporting the process and decisions, the commitment of the people, but were still concerned about the implementation:

“… I trust the process, and I trust peer review and science, and I think that I have trust within that program that they are trying to do the best they can, in terms of getting the research and ticking the boxes beforehand. So, I trust the program as it stands” [Round 2 Participant 1]

“The organisation [RDA] has a high degree of trust for as long as input in included along the way. Currently there is no reason to not trust them as elements of co-creation has happened, they have listened to feedback.” [Round 2 Participant 3]

“Well I think, yeah ... it would have to be you know, I trust them very greatly, very highly, yeah. I've noticed in speaking to some people, that they're extremely passionate about the cause, or about trying to help fix the problems that carp have created in our waterways. I believe it, for sure.” [Round 2 Participant 6]

“I guess to some extent it's based on reasonably robust science, although I have seen some material recently that certainly is trying to ... what's the word ... pick holes in it, but no, basically I think it's ... I think it's well founded on science and I guess the discussion really isn't about the science of it, it's really about the implementation, isn't it?” [Round 2 Participant 2]

However other stakeholders were less trusting due to concerns about communication they felt oversimplified key issues and downplayed the challenges of virus release:

“No. Because I think they've been guilty of simplifying the issue and ignoring data. And I think politically that's okay because that's what we do all the time. You have to create a really simple message. But I think socially and ethically it's not okay at some point and you have to actually daylight those issues. And so I have concerns that there's been sins of omission.” [Round 2 Participant 4]

Meanwhile others trusted the process and the people, but did not trust the politics and the potential impact of politics on this critical decision:

"…yes, you might be able to tick the research boxes, but will governments implement it… So, I think that's where the distrust, from my point of view, anyway, probably comes in more in the implementation and signing off on it and people, politicians, different agendas, and that sort of thing may or may not get on board. So, I have more trust in the scientific research than I do in the latter stages of release, the actual signing off and saying, "Yes, let's go for it." So, I think that'll be less driven by results and research and peer review and more by popularity and that sort of thing as per politics." [Round 2 Participant 1]

Some concerns were expressed about the quality and consistency of engagement and communications. While most felt the information/consultation sessions delivered in their region early in the life of the NCCP were positive, subsequent lack of communication created a vacuum of information which left them wondering what has happening, and enabled others to fill the space:

"I guess probably the communication of it. I know there have been a couple of rounds of information tours through the regions. I know that we've had a couple up our way, which had been good, but I think particularly of late things seem to have gone a bit quiet. I've had a number of conversations with people who are asking if it's even still happening. There has been a bit of negative media about it in some quarters and that I think has spooked a few people …. There was a steady stream of stories there for quite a while, which was quite encouraging. But the fact that there appears to be a bit of a lull, I think has some people asking question." [Round 2 Participant 8]

"I just think that the time is now. Even if they're not looking at rolling it out straight away. The time is now to get a new story. I really feel that quite strongly, because the longer they lay there ... the voices of, "Oh, they don't know what they're doing. Oh, you know, it's not going to work." They're going to get louder, because there's nothing that we can say in response." [Round 2 Participant 7]

Others were concerned about the narrow inclusion of views in the scientific consultation, with some disciplines perceived to have been excluded from studies despite the need for a holistic understanding of the river ecosystem:

"The scientific consultation has been very narrow and it's been very focused on fisheries people. The risk of that is fisheries people tend to think of separate species systems. And they haven't had enough ecologists. So the preeminent ecologists in Australia have not been engaged. It's been fisheries biologists at a state level. And it's a particular group and they tend to be population biologists not ecosystem ecologists." [Round 2 Participant 4]

Involving stakeholders into the future

While overall views about support for carp control had not changed significantly since the first round of interviews, the interviewees did identify both concerns about and recommendations for improving the effectiveness of engagement and communication about the NCCP.

Most of the participating stakeholders wanted to be involved in development and implementation of the Plan to some extent. Few identified they wanted a significant role in the development or

implementation, while all wanted to be either a) consulted and enabled an opportunity to inform plan development, or b) provided information to stay informed and be able share information through their channels, as well as provide feedback from their networks to the NCCP. Sometimes different requirements were identified for different parts of the process:

“I guess just being kept informed. I don't need to sit on a board or I don't need to sit on the panel, we're just limited on time and we're in the regions and we're out and about a lot. But I guess just providing us with enough information that we can then share it with people in regions, and keep them posted … I see us more as an information conduit if you know what I mean, as opposed to someone who is actively engaged on a committee as such…. The implementation stage is probably where we would want to be more kept in the loop I guess, because if I don't know what the actual result will be of the program… So it's just again, key messaging, is all I would say is probably the extent. But just being kept up to date and informed.” [Round 2 Participant 5]

“I guess there's some merit in being involved in the [implementation] decision-making process because then it's ... you know the tight control team are trying to work with the local community, not just sending dates and saying "This is when we do it. You gotta come along." Maybe if we do it, try and work it out with the local community, when it suits the local community, if that makes sense?” [Round 2 Participant 6]

“We will probably want to influence the decisions. … I think we're going to get to a point where we're going to go, "Okay, it's going along all right. Just keep going. Let us know if anything comes up." It's pretty significant, so we probably need to be on the ground floor. If you want to put it the other way, if stuff starts happening in the river relating to carp, and we don't know about it, we're probably going to get grumpy.” [Round 2 Participant 9]

While many stakeholders were happy with the initial communications processes, a tension around communications was identified with others concerned over the political simplification of the messaging to date and the inability of such messaging to enable community members to make informed decisions without sufficient understanding of the associated risks and warned that future communications need to acknowledge the community’s capacity to understand, while others wanted plain English information:

“I think the communication plan needs to assume people are capable of understanding the complexities. So the simple communication, "Carp are bad, this kills carp," is fine and it creates a political sense or political will but it's not sufficient. So even if people bought it and said, "Okay you've got a social mandate to release this," the reality is not an informed social mandate so it's not okay. So I think there just needs to be more of a recognition of the risks, understanding that people have to understand the risks and how those risks are being managed. Otherwise, they'll get big pushback." [Round 2 Participant 4]

“I think it would be useful to have some plain English information about the scientific, and any studies, that have been done to assess the risk of the transference of the virus to other species, all that kind of thing. Some really plain English communication tools around that stuff would be useful.” [Round 2 Participant 10]

The importance of including stakeholders who were perceived to be missing from current engagement processes was highlighted by several stakeholders, including local government and Indigenous people:

“I think one area that will probably assist you is actually going through the local councils in the regions that are involved and their affiliates as well because, you know, I guess if you're saying where are the likeliest things that complaints will go to down, you know, to impact negatively on the program? Local councils will be pretty involved in that process.” [Round 2 Participant 2]

“I think Indigenous groups are also important. Need to include those guys because they obviously have very close links to the rivers.” [Round 2 Participant 8]

The importance of ongoing communications was raised by some stakeholders, who were concerned about the potential for misinformation if there was no continuity of information provided:

“Keep them on the train, the same communications train … In a vacuum of communications people jump to their own conclusions” [Round 2 Participant 3]

Many stakeholders identified that a key role they could provide was assistance in disseminating information through their often extensive networks. However, doing this successfully required access to consistent and appropriate information:

“Well, I think that the most effective way that they can get information out is to use existing networks. So, it's to look at organizations like mine and say… “What does [person] need?” I need some really good photos. I need a paragraph saying, "This is why we're doing things." And, then i need some short "snippy" quotes that I can really service on social media. And, it would also be really good to have some kind of a regularly updated forum or website so that people can go and look at what's happening, and where.” [Round 2 Participant 7]

Indigenous representatives sought a greater role than the sharing of information, and wanted to be embedded within the consultation processes as key experts and given economic development opportunities as part of the Plan implementation:

“We would like to have a strong role in helping to roll out consultation with First Nations in the [Basin]. We'd like to make sure that their perspectives will shape the outcome. That any perspectives that they want to bring to the conversation in term of traditional ecological knowledge, or other perspectives that might enhance the program, will be accounted for and incorporated. We also want to make sure that, in the rollout of the program, there's opportunities for Aboriginal natural resource management businesses to build capacity, and capitalize on those opportunities, and get contracts.” [Round 2 Participant 10]

Some stakeholders focused on discussing the importance of having appropriate engagement and involvement throughout the process of developing recommendations for the NCCP, and in particular making sure input received clearly influences the recommendations ultimately made:

“Aboriginal communities need to have the opportunity to fully digest all of the information, both the scientific perspectives on the effectiveness of the virus and on the risks associated with the virus. Also, the practicalities of the clean-up and any opportunities that might arise from that. They need

to be able to digest all that stuff, and then make an informed decision that is actually going to be listened to when the final decision is made … If that strong feedback is not going to be factored into the final decision, then communities are going to be disenfranchised again. We don't want that to happen. We talk about free and prior informed consent around any major decisions that are going to impact on our country, our waterways, on cultural values associated with the waterways." [Round 2 Participant 10]

Some stakeholders focused on discussing the type of communication needed to support implementation, rather than on the type of communication required during the remainder of the life of the NCCP. These discussions focused on the need to adequately resource communications and engagement in on-ground carp control strategies, and to ensure people who had expertise and knowledge in consultation and engagement in areas affected by carp invasion were involved from the start (rather than as an 'add-on'):

"I would be looking for, you know, in each community that you're working in there isn't always going be a one size fits all. You're actually going have to tailor the response depending on who the organizations are, and who the champions are. … So, it is actually taking the time to work out who are the bodies in each of those regional areas that people look to. And, then getting there to help you tailor your message so it's right for that community. … you need to be able to enable people to adapt and modify so it resonates in their local community." [Round 2 Participant 7]

"I remember examples of consultation [where] they actually did the consultation through the bush fire brigades. Because the members of the community were all members of the bush fire brigade. So they targeted those. I think a bit of creative thinking along those lines might go a long way. Most of the people in the community that have an interest in the river, often it's recreational. And then when it comes to industry it's obviously through stakeholder groups like ours. But the recreational users, the fishers, the boaters, all those guys, they are the ones I think you need to target…" [Round 2 Participant 8]

"And I think this is what we tend to do wrong as ecologists in particular. We do that as a group of ecologists and we don't have the science communicators or the social scientists in the room, they're an add on thing." [Round 2 Participant 4]

"We probably want to have a discussion about how we would design a community engagement process and make sure it captures the right constituency. I'd respectfully suggest that the three key people you need to have in the room to have that discussion are [three names stakeholders] because we've all got similar but different networks. If information's flowing through those networks, or we're helping you design regional events and even batching them as a new program, then that's going to get you better engagement." [Round 2 Participant 9]

Overwhelmingly stakeholders agreed that face to face forms of communication were essential for implementation in particular given the that carp is an emotional issue due to the combination of water, environment and science. Face to face is particularly important when it came to implementation stages where it was important for those affected to be able to speak directly with experts rather than relying on more passive forms of communication:

“You actually do need to be probably out across the communities where there's going to be an impact. So how you do that at that stage is probably up to you but I think it's just, you get towards release points and you say, well this is what we're going to do and this is how it's going to happen. I think that's more on information sessions. I think that's what you actually do need to be in the communities. [Round 2 Participant 2]

“You can have as much email and Facebook and twitter as you want but it is the shared communication that makes the difference.” [Round 2 Participant 3]

“I think you can't beat face-to-face. And I think in the first instance particularly, you can't beat the face-to-face and be able to answer the questions and those sorts of things. And then once people have a base level of knowledge, then they can go to the website or to different publications and so forth to get more information if they want to.” [Round 2 Participant 8]

Recognising that face to face communications is highly resource intensive, stakeholders also identified that facilitated webinars which are becoming well attended in regional areas, and the production of online video content (and DVDs) which provide readily accessible information. Stakeholders identified websites as an important communication approach, but felt that they should not be the first port of call when communicating about implementation in particular: website information was viewed as good for those with expertise or high interests, but of less utility for the average member of the public. This was accompanied by some stakeholders calling for investment of sufficient resources to ensure the right communication and consultation could occur during any implementation of virus release, if a decision is made in future to release the virus.

Conclusion

All stakeholders felt reducing carp populations was important for the future of Australian waterways. However, almost all stakeholders wanted more information before they could support the release of the carp virus, and several wanted active engagement and the opportunity not only to hear results of research, but to engage in processes of discussion and decision making. Many stakeholders interviewed wanted to be part of the communications process, whether that be through direct consultation that influenced decision making, or by supporting information dissemination and providing a conduit for providing feedback from members of their networks to the NCCP.

Recognising the desire for more involvement and the need for more engagement and communication as the implementation plan is developed and rolled out, stakeholders wanted:

- **Detailed engagement with the science** - dialogue with the scientists so as they could move beyond high level findings to discuss the content and details (eg. online or face to face forums & workshops, field trips)

- **To help shape recommendations** for consideration - particularly important for some aspects of the Plan including biosecurity strategy, clean-up, and strategies to address impacts on specific groups (tourism, koi, commercial fishers, native fish breeders)

- **Input into Plan development** - active and ongoing consultation and engagement on Plan itself, don't restrict engagement to formal consultation at the end of the process.
- **To help communicate information** about development of the Plan - an active role in helping to share communications going forward. Stakeholders would like to receive materials they can use to communicate with their networks (particularly some NRM-focused NGOs, farming and rec fishing organisations)

Presentations given to NCCP meetings related to stakeholder engagement and communication

The three embedded presentations below provide the updates given to NCCP meetings that reported on ongoing findings produced from stakeholder engagement as part of this project.

Embedded Presentation 3 Update given to NCCP May 24 2018, focused on stakeholder engagement needs

Stakeholder and community engagement strategy

Proposals for best practice engagement

Jacki Schirmer, Institute for Applied Ecology, University of Canberra
jacki.Schirmer@Canberra.edu.au

Embedded Presentation 4: Recommendations for best practice engagement, produced based on second round stakeholder interviews, 2018 (click to open presentation and scroll through)

Embedded Presentation 5 Presentation given December 2018 summarising key findings and recommendations, including key recommendations related to stakeholder engagement

Appendix 6. Socio-economic impact assessment – native fish breeders and growers (second edition)

The Appendix provides the second edition of the report *National Carp Control Plan socio-economic impact assessment: Native fish breeders and growers industry*. The first edition of this report was provided to members of this sector for comment and their comments, as well as additional analysis, were incorporated into this second, final edition.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 7. Socio-economic impact assessment – recreational fishing sector

The Appendix provides the report *National Carp Control Plan socio-economic impact assessment: Recreational fishing sector*. This is the first edition of this report, which was produced as part of Project 2.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 8. Socio-economic impact assessment – koi hobbyists and businesses

The Appendix provides the report *National Carp Control Plan socio-economic impact assessment: Koi hobbyists and businesses*. This is the first edition of this report, which was produced as part of Project 2.

The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 9. Engaging with the NCCP: summary of a stakeholder workshop

This Appendix provides the final report from the June 2019 stakeholder workshop. An initial draft of this report was produced, and was then distributed to workshop attendees who provided comments, which were then incorporated into the revised report provided here. The full report is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

Appendix 10. Issues Paper # 5 Understanding potential social and economic impacts of carp control

This Appendix provides the consultation draft of the discussion paper *Understanding potential social and economic impacts of carp control*. This draft was provided for comment on the Bang the Table

interactive site, but has not yet been edited to include or respond to comments. The paper is provided as a separate file, to reduce formatting challenges of the extensive number of Appendices.

References

The reference list includes all references referred to in both the main body of the report and the ten report Appendices.

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