Somewhere over the Rainbow

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Key Points

- During floods in 1950s a new 15km flowpath (avulsion) of the Thomson River formed across prime agricultural land. A weir was built at the divergence to push flows down the original course and provide an irrigation channel offtake. Scientific understanding indicates a high risk of another avulsion from the perched Thomson channel, if not managed effectively.
- A Waterway Management Plan (WMP) was developed using an evidence-based participatory method involving collaboration with the local community, technical experts and agency representatives. Activities included: establishment of inter-agency and community based working group, public meetings, one-on-one community interviews, socio-economic study, flood modelling, and benefit:cost analysis (using INFFER). The WMP aims to raise community and agency awareness of the risk of another avulsion and contains agreed options to address this risk, as well as enhancing the values of the Rainbow Creek and Thomson River.
- The community's understanding of the largescale waterway processes impacting their land has increased, and their contributions significantly shaped the WMP. The identified agreed actions are supported by the community and fully costed, making a strong business case with an 180% return on investment.
- The project had a high level of local community participation working collaboratively with agencies, scientists, and technical experts, to develop a transparent, cost-effective management plan that addresses the economic and environmental waterway management risks. The WMP has been accepted and supported by the local community, which, only a few decades earlier, officially declared war on the state government and its agencies for the same issues.

Abstract

The Thomson River – Rainbow Creek Waterway Management Plan (WMP) was developed through a collaborative process that has drawn on the collective knowledge of the local community, agency representatives, technical specialists and waterway planners. Benefit: Cost analysis (INFFER) of the actions in the WMP ensured a cost-effective program of works.

The WMP provides a clear vision for the management of the area, and a detailed cost-effective process to achieve it. The main outcome for the WMP is to mitigate the risk of a new avulsion forming, but in so doing it will also significantly contribute to the social, recreational and economic objects of the community. The risks to private and public assets from an avulsion are considerable. Developing the WMP collaboratively with stakeholders enabled and empowered them to evaluate those risks and assess the benefits of interventions. This was especially important for the target community due to its colourful history with a previous avulsion. The WMP provides a strong business case for managed intervention, with clear objectives and achievable outcomes that have triple bottom line benefits. Implementation of the WMP will cost approximately $4M and has a benefit cost ratio to be 1.79 (BCR), meaning a benefit of $7M from the $4M investment.

Keywords

Waterway management plan. Avulsion risks. Cost benefit. Community engagement.

Introduction

The Thomson River and Rainbow Creek, in Victoria's south east, provide essential resources for agriculture, communities and the natural environment. Rainbow Creek was formed in the 1950s through floodplain processes, triggered by floodwaters in the Thomson River, that carved a new 15 km long river channel (avulsion). The avulsion lead to significant loss of agricultural land, liberating hundreds of thousands of tonnes of sediment into the Thomson River and the downstream receiving waters of the Gippsland Lakes. The development of Rainbow Creek had a significant impact on the farming communities of Cowwarr and Heyfield districts.

The Rainbow Creek channel is the preferred course for the Thomson River because it sits lower in the floodplain, has a greater channel capacity and is twice as steep (half as long). The construction of Cowwarr Weir in 1959 at the divergence point of the Rainbow changed the way water was delivered, providing flow to both the Thomson River and Rainbow Creek. Water from Cowwarr Weir provides significant value to the community by providing an irrigation offtake and expansion of the Macalister Irrigation District. Landholders along both water courses benefit from direct stream pumping, and the urban water authority has a town water supply offtake on the old Thomson River course.

Figure 1: Map of Thomson River (top) and Rainbow Creek (bottom) system. River direction west to east

A geomorphic assessment of the Thomson River found that the artificial flow management at Cowwarr Weir and the fluvial geomorphic processes inherent in the area, meant that under a "do nothing" management approach the Thomson River would undertake another avulsion towards Rainbow Creek (Alluvium 2011; Rutherfurd 2019). This would result in impacts to the community and environment such as land loss and sediment liberation, damage to irrigation infrastructure, private dwellings, and roads, and impacts to irrigation and urban water supplies.

The majority of the Thomson River and all of Rainbow Creek resides on private land holdings, and any new avulsion would cut across private land. The success of any management action would require the understanding and support of the community. A collaborative and transparent method to address the risk was developed. Instead of focusing only on the avulsion risk, a more wholistic approach was used to develop a waterway management plan that captured the interests and objectives of all stakeholders.

The Independent State of Rainbow Creek

The West Gippsland Catchment Management Authority (WGCMA) wanted to ensure the development of the WMP was done in a sensitive and collaborative manner. The Rainbow Creek formation bisected 28 properties

and subsequent channel deepening, widening, and elongation continues to cause loss of private land. Floods during the 1970s saw significant channel changes and further land loss. In 1979 landholders, also fed up with bureaucratic inaction associated with land tenure and dealings with State Rivers and Water Supply Commission, lodged a formal declaration of war against the state of Victoria and succession from the state to form the Independent State of Rainbow Creek[1]. Although this only lasted until the mid-1980s, negative sentiments around the management of waterflows and bank erosion remain today.

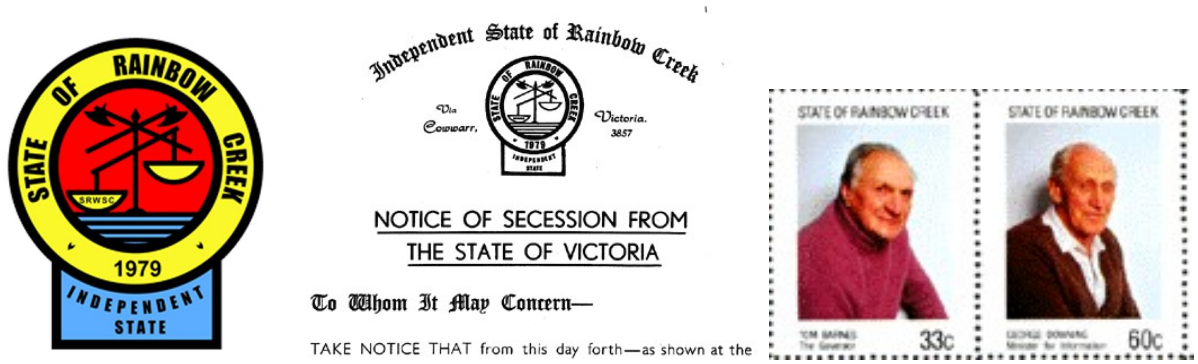

Figure 2: Left to right: the common seal, notice of secession, and printed stamps for the Independent State of Rainbow Creek

Aware that landholders were likely unaware of the current avulsion risks, the WGCMA sought to approach community engagement in a sensitive, respectful, and collaborative manner.

Method

The development of the WMP involved a structured planning approach undertaken over a twelve-month period from December 2018 and December 2019. This involved the following inter-related activities (see Figure 3):

- Capturing current knowledge and community values associated with the waterway (e.g. history, past flood events, interactions and uses of the waterway)
- Establishing a vision and objectives for the waterway and associated values
- Modelling and technical advice on avulsion risk
- Identifying on-ground works options and enabling actions (e.g. structural works, riparian protection, flow management)
- Economic analysis of the benefits and costs of alternative management scenarios
- Decision making on preferred scenario for implementation
- Developing a works-plan and arrangements for monitoring, evaluation, reporting and improvement

[1] https://en.wikipedia.org/wiki/Independent_State_of_Rainbow_Creek

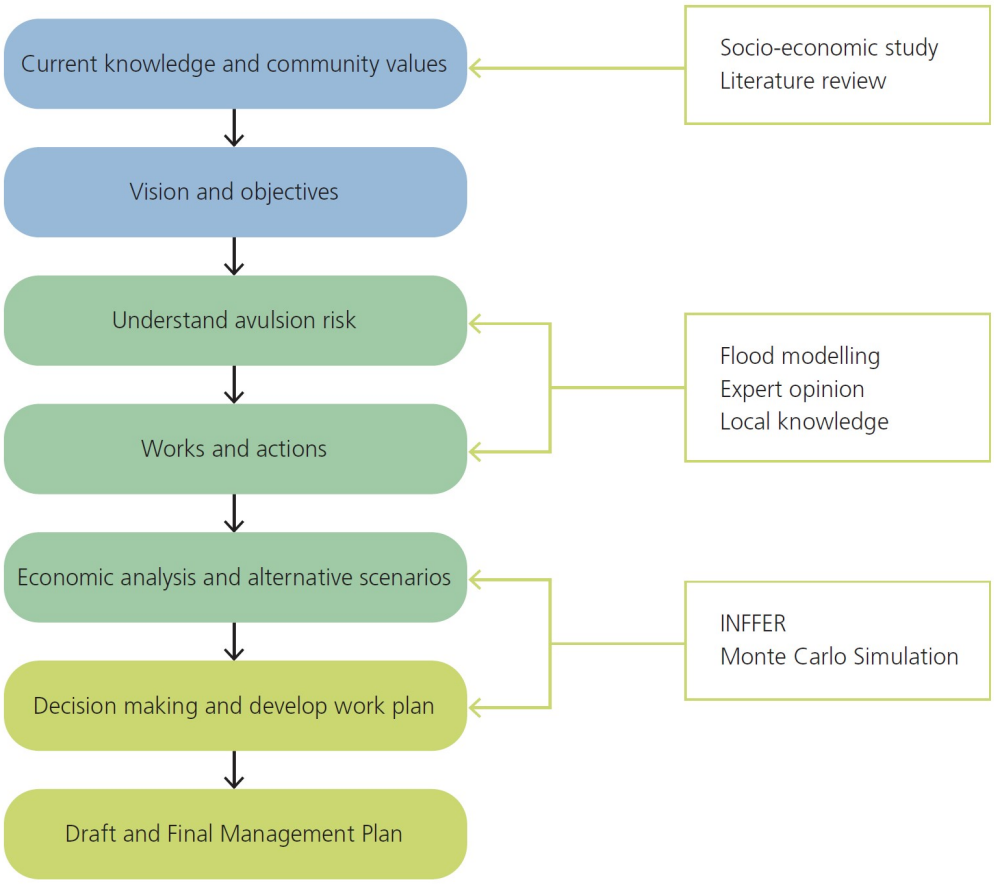

Figure 3: Planning process for development of the Waterway Management Plan

Community views

Consultation with local community members was an important aspect of the collaborative process to develop the WMP. A public meeting was held at the very start of the project to raise awareness within the community of the potential avulsion risk and to explain how the WGCMA were going to collaboratively engage with them to develop a management plan. Initial community views were obtained through this public form and through a series of in-depth interviews conducted with 30 local community members, including 25 of the landholders along the Rainbow Creek and Thomson River. The primary aim of the interview process was to gather information, knowledge and perspectives of local community members to inform the WMP. The interview process focused on exploring the benefits and/or risks of any future management practices for the Thomson/Rainbow System. The results from the interviews were used to confirm the scope of the WMP, to develop the vision and objectives and to identify and assess potential management scenarios.

Community views were also captured and incorporated into the development of the WMP through the Project Working Group and a series of additional public forums (Refer Governance and Community Participation section).

Asset inventory

An inventory of assets associated with the Thomson River and Rainbow Creek was compiled to inform the preparation of the WMP. The inventory included information on built assets (e.g. houses, irrigation infrastructure, roads, bridges etc.) and natural assets (waterways, native habitat etc.). The asset inventory was used to understand the location of private and public infrastructure, the extent of past works, condition of waterways and predicted flood extent. This data was used to help quantify the avulsion risk and estimate the costs and benefits from different management scenarios.

Modelling

Scientific and technical modelling was undertaken to support a number of key steps in the development of the WMP. This was a collaborative and iterative approach between the modelling team and the WMP development team. This allowed for information from the modelling to be fed back to the WMP development team, which informed changes in understanding and scenario development. The modelling work included:

- Hydrological modelling of water flows under different flood event conditions (a moderate flood (~10% AEP), and a 1% AEP) to identify where potential avulsions may initiate and their subsequent development paths across the floodplain
- The effect of different waterway management options (e.g. revegetation of riparian zones) and issues (e.g. waterway blockages) on floodplain flows (Water Technology, 2019).
- Analysing the effect of potential avulsion pathways on floodplain and waterway assets, especially productive agricultural land and infrastructure (houses, roads etc.) as a means of assessing avulsion consequences and the effectiveness of treatments to reduce avulsion risk.

The use of flood modelling was a crucial input to the benefit: cost analysis using INFFER (described in the next section).

Benefit: Cost Analysis (INFFER)

The Investment Framework for Environmental Resources (INFFER™) is a structured decision-making process to assess the benefits and costs of making investments in the environment. INFFER (Pannell, et. al, 2012) takes into account all factors that need to be considered in making transparent and robust decisions about the most cost-effective options to manage the environment and natural resources. INFFER uses available and relevant knowledge and information (science, expert judgement and local knowledge) to estimate the benefits and costs of alternative management options.

To support the development of the WMP, INFFER was used in a participatory and collaborative process with the Project Working Group to assess the relative cost-effectiveness of alternative implementation options and to identify the preferred option for the WMP itself.

Governance and community participation

The WMP was developed through a collaborative process, led by the WGCMA. The WMP incorporates the views and perspectives of community members, landholders and agency representatives. A Project Steering Group comprising of WGCMA and Southern Rural Water (SRW) was established to oversee the project development process. A Project Working Group, consisting largely of landholders along the Thomson River and Rainbow Creek, was established to collaboratively develop the WMP. A series of Public Forums were also undertaken at key stages of the project to ensure all members of the community had an opportunity to stay informed and provided feedback.

Results

Community consultation

As part of the early stages of the WMP development, extensive consultation was undertaken with community members and landholders. The focus of the stakeholder consultation was on local perspectives, in particular those of landholders on Rainbow Creek (and the Thomson River) and people with community interests, such as local residents and others with long term historical knowledge of Rainbow Creek and the broader Thomson River catchment context. 30 people were interviewed (the majority face-to-face) and the detailed results were reported and used to inform the planning process (Park and Dickson, 2019).

The consultation process identified a range of views on waterway management issues which are summarised in Table 1. Consistent themes emerged in the identification of issues but there was by no means overall agreement

on the importance of all issues. For example, while willows and their impact on flows was seen as a major concern by many interviewees, some respondents valued the willows for aesthetic and functional values.

Table 1: Summary of management issues identified during community consultation.

Issue	Comment
Bank erosion and bed degradation	A complex issue that is understood quite differently by different people. Linked to a number of other issues (e.g. willow, flow impedance, wombat impacts etc.).
Native species (e.g. wattles) impeding flow	Largely related to native species growing in the bed and on the banks, where in some cases they are viewed as 'blockages' to water flow.
Weed invasion	On-going management of weeds was seen as an important future management action.
Willows	As per native species willows growing into the stream viewed as blockages and a risk for flooding.
Uncontrolled public access	Vandalism, litter etc.
Grey water from Cowwarr township	Run-off/infiltration of poorly functioning septic systems.
Aesthetics	Especially in key public access locations such as Cowwarr Park.
Native fauna (wombats)	Tunnelling in banks causing erosion.
Lack of agency coordination/ communication	Lack of clarity about the roles and responsibilities of relevant organisations. Sometimes not notified about changes in flow (environmental flows or other flows).
Carp	Impact on bank stability and water quality.
Uncontrolled stock access to waterway	Acknowledgement that a significant % of the Thomson River and Rainbow Creek has been fenced and revegetated over recent years.
Levee banks and land forming altering flows	Concerns that some levee banks and land-forming has occurred without permission.

When asked about how likely they believed an avulsion could occur the responses varied from very likely to not possible. As anticipated, further evidence and education on fluvial geomorphology and avulsion risks for the community was required (refer next section).

This community feedback was used by the Project Working Group to build on their own views and aspirations to develop the below vision statement for the system and site objectives.

> *Vision Statement: The Thomson and Rainbow system is managed to reduce the risk of avulsion and improve waterway health with benefits for agriculture, the community and the Gippsland Lakes.*

Avulsion risk assessment

Understanding the avulsion risk required additional technical support as the initial risk assessment scope (Alluvium, 2011) did not include additional work to identify where an avulsion would most likely occur. A 2D Tuflow hydraulic model was generated to help highlight floodplain drainage lines and most likely avulsion pathways. Analysis of the hydraulic model outputs was undertaken by Prof. Ian Rutherfurd in conjunction with the project and modelling teams. This identified five likely pathways, not only between the Thomson and Rainbow but also within the Thomson itself. These were ground-truthed by on-site inspection and talking with landholders about flood behaviour. Inspection of the pathways and re-entry points also included an evaluation on rectification works to halt the erosion process. The information was presented to the Project Working Group and at a community forum and was widely accepted as credible evidence of an avulsion risk and need for management action.

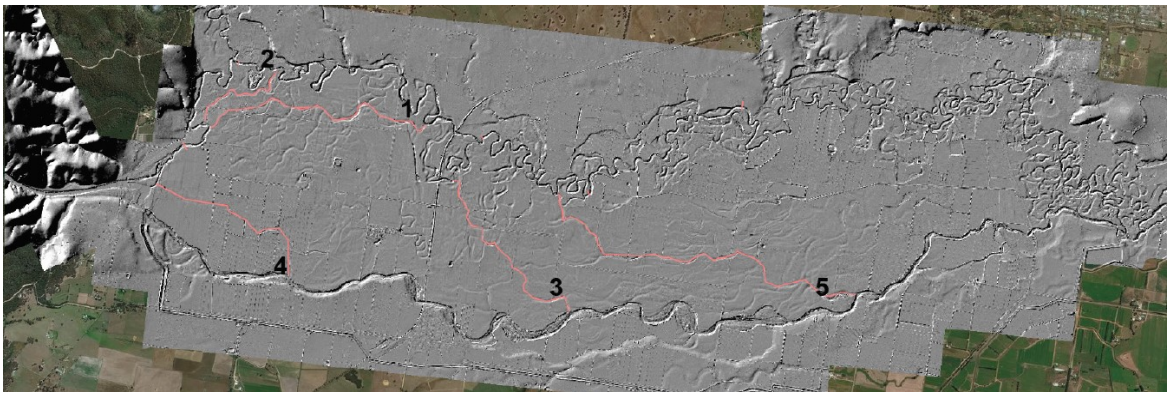

Figure 3: Map of most likely avulsion pathways

INFFER analysis

Understanding the benefits and costs of different management scenarios required a clear description of the current situation for the Thomson-Rainbow system, in terms of both the current extent of works (e.g. % of waterways that are currently fenced and revegetated, % of waterways impacted by willows etc.) as well as future plans under a 'Business as Usual' (BAU) approach to waterway management over the time frame for the analysis (assumed to be 20 years). The BAU is defined as what is expected to happen over the next 20 years in the absence of this Plan.

The implementation of this Plan is designed to generate benefits for the Thomson River and Rainbow Creek and the communities that utilise these significant waterway assets for the values they provide. As outlined earlier, the WMP also aims to reduce the likelihood and consequences of a future avulsion, which produces benefits in terms of reduced economic and social damage to agriculture and local communities.

Three main benefit types were identified in the development of this Plan:

1. Environmental asset improvement – enhancement of the environmental values such as riparian extent and condition, waterway connectivity and improved habitat for threatened and non-threatened species.
2. Reduced consequences of an avulsion – preventing or reducing the consequences of an avulsion will avoid incurring costs associated with avulsion damage (e.g. loss of high value agricultural land and infrastructure, public assets such as roads, bridges, culverts etc. as well as social and community impacts).
3. Other benefits – it is anticipated that there will be additional benefits, for example recreation (fishing, waterplay) and improved amenity (landscape aesthetics) associated with implementation of this WMP.

Realising the benefits incurs costs, for example, those costs associated with fencing and revegetation to improve waterway health as well as costs incurred to reduce the impact of a future avulsion, such as rock beaching.

Nine management scenarios were assessed in terms of benefits and costs, with the results presented in Table 2. The scenarios were based on differing level of management intervention to assess the benefit:cost ratio against the feasibility, appropriateness, and effectiveness of each option.

Scenario 5 was selected as the preferred implementation option for the WMP. The rationale for selection of this option is:

- The benefit:cost ration (BCR of 1.79). indicates that it is cost effective and that the benefits are close to 80% more than the costs.
- This scenario maximises the overall environmental benefits and while not treating the risk and consequences of an avulsion to the same extent as Scenario 4b, it is significantly more cost-effective than this scenario with a high likelihood of gaining local landholder and community acceptance. Revegetation along avulsion pathways (as in Scenario 4b) involves taking land out of production and needing to reconfigure paddocks and irrigation infrastructure.

- The overall level of up-front costs and on-going maintenance costs are thought to be commensurate with the levels of funding likely to be made available for significant waterway management projects.

Table 2: Results of the INFFER BCA

Scenario	Cost ($M) Upfront over 4 years (annual maintenance cost)	Benefit: Cost ratio (BCR)	Reduced consequence of avulsion	Comment
1 Combined (actions to maximise natural and amenity values and reduce avulsion)	4.562 (0.098)	1.46	**Yes**	High BCR
2a Maximise local natural values (riparian) – Rainbow/Thomson	3.624 (0.052)	1.82	**No**	Highest BCR
2b Maximise local natural values (riparian) – Rainbow	2.078 (0.025)	1.66	**No**	High BCR
2c Sub-maximum local natural values (riparian) – Rainbow/Thomson	2.737 (0.041)	1.70	**No**	High BCR
2d Sub-maximum local natural values (riparian) – Rainbow	1.577 (0.021)	1.63	**No**	High BCR
3 Maximise recreation and local amenity – Rainbow	0.213 (0.013)	0.84	**No**	Recreation benefits not quantified however they are estimated to be very small and not likely to change BCR
4a Reduce avulsion risk – beaching only	0.314 (0.017)	1.48	**Yes**	High BCR both with and without inclusion of risks
4b Reduce avulsion risk – beaching plus fencing and revegetation	1.037 (0.049)	0.40	**Yes**	BCR <1 due to risks (e.g. landholder adoption, socio-politics) associated with works
5 Preferred implementation option for WMP (2a + 4a)	4.031 (0.068)	1.79	**Yes**	High BCR – this scenario addresses the vision and objectives of the WMP

Conclusion

Largescale waterway changes, such as avulsions, have a significant impact on individuals and communities, as well as generate waterway health challenges. In addressing the future risk of an avulsion between the Thomson River and Rainbow Creek, the West Gippsland Catchment Management Authority set itself three main objectives to achieve:

- Develop a management strategy for the avulsion risk
- Raise community awareness of the avulsion risk and gain a level of support and ownership of management actions
- Identify feasible on-ground actions with defensible cost benefits.

Through upfront and honest discussions and engagement with the community, scientific evidence, and a robust cost:benefit assessment process, these objectives were achieved. A clear vision for the area has been set, with affordable and purposeful management actions identified. The Waterway Management Plan provides a strong business case with an almost 80% return on investment. Most importantly, the community that live in the project area are more aware of the natural river processes that exist around them, and fully support the WMP, which is a significant achievement from a community that officially declared war for the very some issues.

Acknowledgments

Prof. Ian Rutherfurd (University of Melbourne) – Technical assessment of avulsion risk and fluvial geomorphology

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