Snowy 2.0 Biosecurity Risk Management Plan

Revision: A

Date: 20/05/2024

Certificate of Approval

Title: Snowy 2.0 Biosecurity Risk Management Plan

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Approval Record

	Name	Title
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Document Revision Table

Rev.	Date	Description of modifications
A	20/05/2024	N/A

Department of Planning and Environment

Our ref: SSI-9687-PA-142

Chris Buscall
Environmental Lead
Snowy Hydro Limited
Monaro Highway
Cooma NSW 2630

25/10/2023

Subject: Snowy 2.0 Main Works – Staging of Biosecurity Risk Management Plan

Dear Mr. Buscall

I refer to your letter dated 28 September requesting approval to submit the Biosecurity Risk Management Plan in two stages, as permitted under Schedule 4 Condition 3 of the Infrastructure Approval for Snowy 2.0 Main Works (SSI-9687).

The Department has carefully reviewed the letter and is satisfied that information provided meets the requirements of the relevant conditions.

Accordingly, as nominee of the Planning Secretary, I approve the request to stage the submission of Biosecurity Risk Management Plan in two stages:

- Stage 1 - A Biosecurity Risk Management Plan addressing all requirements of Schedule 3, Condition 22 with Condition 22(c) being provided (Section 8) as preliminary plans for the installation and use of the fish screens and barriers only.
- Stage 2 - An updated Biosecurity Risk Management Plan which will confirm information provided in Stage 1 and provide detailed design plans for the installation and use of the fish screens and barriers in Section 8, satisfying Condition 22(c).

The Stage 1 Biosecurity Risk Management Plan must be submitted by 1 December 2023 and the Stage 2 Biosecurity Risk Management Plan must be submitted prior to 1 December 2024.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 3406.

Yours sincerely

Nicole Brewer
Director
Energy Assessments
As nominee of the Planning Secretary

Acronyms and Definitions

AEP	Annual exceedance probability
Aperture	The minimum clear space between the edges of the opening in the screening surface
Approval	Infrastructure Approval for Snowy 2.0 Main Works issued under Section 5.19 of the *Environmental Planning and Assessment Act 1979* (Dated: 20th May 2020) (SSI 9687)
AqHMP	Aquatic Habitat Management Plan
Biosecurity Act	*Biosecurity Act 2015* (NSW)
Biosecurity Regulation	*Biosecurity Regulation 2017* (NSW)
BRMP	Biosecurity Risk Management Plan
BRUV	Baited remote underwater video
CoA	Conditions of Approval
CSU	Charlies Sturt University
Cumecs	Cubic meters per second (m^3/s) (Discharge)
DAWE	Department of Agriculture Water and the Environment, now Department of Climate Change, Energy, the Environment and Water (DCCEEW)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water (formerly the Department of Agriculture Water and the Environment (DAWE))
DPE	NSW Department of Planning and Environment (formerly Department of Planning, Industry and Environment (DPIE) and now Department of Planning, Housing and Infrastructure)
DPH	Days post hatch
DPHI	Department of Planning, Housing and Infrastructure (formerly DPIE and DPE)
DPI	NSW Department of Primary Industries, formerly part of the Department of Planning, Industry and Environment, now part of Regional NSW.
DPIE	Department of Planning, Industry and Environment, now known as Department of Planning, Housing and Infrastructure (DPHI) and the Department of Energy the Environment, Climate Change and Water (DEECCW)
eDNA	Environmental DNA
EHNV	Epizootic Haematopoietic Necrosis Virus
EIS	Snowy Hydro's Environmental Impact Statement for Snowy 2.0 Main Works (EMM, 2019)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	Fisheries Management Act 1994
GL	Gigalitres (1GL is equivalent to 1,000 megalitres (ML))
KNP	Kosciuszko National Park
m/s	Metres per second (Velocity)
M-E Tunnel	Murrumbidgee-Eucumbene Tunnel. A one-way tunnel linking Tantangara Reservoir with the Eucumbene Reservoir
NPWS	National Parks and Wildlife Service
NSW	New South Wales
Pre-Connection	The period of time before Talbingo and Tantangara Reservoirs are hydrologically linked in an upstream direction via Snowy 2.0
PHES	Pumped Hydroelectric Station
Post-Connection	The period of time after Talbingo and Tantangara Reservoirs are hydrologically linked in an upstream direction via Snowy 2.0
ROW	River Outlet Works
RtS	Response to Submissions for the Snowy 2.0 Main Works EIS (EMM, 2020)
Snowy 2.0	A PHES that will link the existing Tantangara and Talbingo reservoirs via a new underground tunnel
RFMP	Recreational Fishing Management Plan
TARP	Trigger, Action and Response Plan
TFMP	Threatened Fish Management Plan

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1. Introduction

This document is known as the Biosecurity Risk Management Plan (BRMP) for Snowy 2.0 Main Works.

It has been prepared to meet the requirements of Schedule 3 conditions 20, 22 and 23 of the Infrastructure Approval for Snowy 2.0 Main Works issued under Section 5.19 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (Dated: 20th May 2020) (CSSI 9687) (the NSW Approval) and the relevant requirements of Annexure A, Part A, Conditions 12-16 issued under sections 130(1) and 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). (Dated: 29th June 2020) (EPBC 2018/8322) (the EPBC Approval).

This document, alongside the associated Threatened Fish Management Plan (TFMP) and Recreational Fishing Management Plan (RFMP), will underpin the NSW Department of Primary Industries consideration of necessary instruments under the *Biosecurity Act 2015* that will be issued prior to the operation of the Snowy 2.0 Pumped Hydropower Station.

1.1. Project Overview

Snowy Hydro Limited (Snowy Hydro) owns, manages, and maintains the Snowy Mountains Hydroelectric Scheme (the Scheme). The Scheme currently includes 16 major dams, nine power stations, one pumped power station, 145 km of interconnected tunnels and pipelines, and 80 km of aqueducts. The Scheme, principally located within the Kosciuszko National Park (KNP), is one of the largest and most complex hydro-electric schemes in the world.

The pumped hydro-electric expansion of the Scheme (Snowy 2.0) will link the existing Tantangara and Talbingo reservoirs via a new underground tunnel and a pumped hydro-electric power station (PHES). Snowy 2.0 will provide an additional 2,000 MW of dispatchable generating capacity, along with approximately 350,000 MWh of large-scale energy storage that will be available on demand as quick-start electricity generation at critical times of peak demand.

For almost 70 years Snowy Hydro has responsibly operated the Snowy Scheme within KNP. Snowy Hydro is committed to avoiding and minimising potential impacts from Snowy 2.0, as they do for the existing business.

1.2. Project Approval

This project was designated Critical State Significant Infrastructure (CSSI 9687) and assessed under Part 5 of the EP&A Act. Under sections 5.23 and 5.24 of the EP&A Act, certain separate approvals and licences are not required. The project was approved by the NSW Minister for Planning and Public Spaces under Section 5.19 of the EP&A Act on the 20th of May 2020.

A referral (EPBC 2018/8322) was also prepared and lodged with the Commonwealth Minister for the Environment under the EPBC Act and the proposal was subsequently determined to be a controlled action under that Act. The project was approved by the Department of Agriculture Water and the Environment (DAWE), now the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under sections 130(1) and 133(1) of the EPBC Act on the 29th June 2020.

Transferring water through the PHES between Talbingo and Tantangara reservoirs requires authorisation under the *NSW Biosecurity Act 2015* (Biosecurity Act) and *NSW Fisheries Management Act 1994* (FM Act). Appropriate authorisation instruments will be issued to Snowy Hydro by NSW DPI once the following three aquatic management plans have been approved by the NSW Director General of DPI:

- Threatened Fish Management Plan
- Recreational Fishing Management Plan
- Biosecurity Risk Management Plan (this plan).

Conditions that relate to aquatic species and recreational fisheries were included within the Main Works Infrastructure Approval in Schedule 3, Conditions 20-27 (SSI 9687) (Table 1) and in the EPBC Approval in Annexure A, Part A, Conditions 12-16 (Table 2). The requirement to prepare this plan is contained in Condition 22 of the NSW Approval and will inform the consideration of a biosecurity instrument that will be issued prior to the operation of Snowy 2.0.

Full details of the Conditions of Approval and supporting information can be found at:
https://www.planningportal.nsw.gov.au/major-projects/project/12891

Table 1: Relevant Conditions of Approval for Snowy 2.0 Main Works

Condition	Requirement	Where addressed
Schedule 3, Condition 20	The Proponent must: (a) minimise the biosecurity risks associated the development, including the movement and/or spread of weeds, pests and pathogens;	Snowy 2.0 Biodiversity Management Plan, Appendix F - Weed, Pest and Pathogen Management Plan; Snowy 2.0 BRMP (this Plan)
	(b) minimise the impact of the development on threatened fish species and their habitat, particularly the Macquarie Perch, Stocky Galaxias and Murray Crayfish; and	Snowy 2.0 Aquatic Habitat Management Plan (AqHMP); Snowy 2.0 TFMP
	(c) minimise the impact of the development on recreational fishing in Tantangara Reservoir and Lake Eucumbene.	Snowy 2.0 RFMP
Schedule 3, Condition 21	Prior to the commencement of commissioning, the Proponent must install: (a) a fish barrier on Tantangara Creek to prevent so far as is reasonably practicable Climbing Galaxias reaching the existing population of Stocky Galaxias in the upper reaches of the creek; and (b) fish screens at the southern end of the Tantangara Reservoir to prevent so far as is reasonably practicable the movement of pest fish (in all its forms: eggs, larvae, juveniles and adults) and spread of disease to the mid-Murrumbidgee River and Lake Eucumbene.	Incorporated into project design. Snowy 2.0 BRMP (this Plan; Part 2)
Schedule 3, Condition 22	**Biosecurity Risk Management Plan** Within 2 years of the commencement of construction, the Proponent must prepare a Biosecurity Risk Management Plan for the development to the satisfaction of the Director-General of NSW DPI. This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with DPIE, NPWS and DAWE;	Snowy 2.0 BRMP (this Plan) Certificate of Approval; Section 1.5
	(b) include a detailed biosecurity risk management framework for minimising the ongoing biosecurity risks of the development required in condition 20(a) above, including: • developing systems to prevent spills from the Tantangara Reservoir so far as is reasonably practicable; and • pest fish and disease surveillance and eradication/management measures to protect the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment and the salmonid fishery in Lake Eucumbene;	Part 1 Section 6 Section 4 and 5; Appendix D and E
	(c) include detailed plans for the installation and use of the fish screens and barriers required in condition 21 above, including: • minimising the environmental impacts associated with installing the screens, • testing the effectiveness of the screens before they are used; and • maintaining and improving the effectiveness of the screens and barriers over time;	Part 2
	(d) include a program to monitor, evaluate and publicly report on these plans, including: • carrying out monitoring using epidemiologically designed surveys; and • conducting fish, disease and eDNA surveys.	Part 1; Section 4, 5 and 7

Condition	Requirement	Where addressed
Schedule 3, Condition 23	The Proponent must implement the approved Biosecurity Risk Management Plan for the development.	Snowy 2.0 BRMP (this Plan); Section 1.8
Schedule 3, Condition 24	**Threatened Fish Management Plan** Within 12 months of the commencement of construction, the Proponent must prepare a Threatened Fish Management Plan for the development to the satisfaction of the Director-General of NSW DPI. This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with DPIE and DAWE; (b) include the establishment and use of an expert advisory committee to provide advice to the proponent on the implementation of the plan; (c) describe the detailed measures that would be implemented to comply with condition 20(b) above; (d) include a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of $5 million over 5 years from the commencement of the program that provides for: • population monitoring, surveillance and research on the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment; • habitat surveys to identify suitable receiving sites for stocking insurance populations of Stocky Galaxias and Macquarie Perch; • captive breeding, stocking and monitoring of Macquarie Perch and Stocky Galaxias with the aim of achieving self-sustaining populations of these species; • habitat enhancement for the Macquarie Perch in the mid-Murrumbidgee catchment in accordance with the National Recovery Plan to increase the existing population's resilience to the potential biosecurity risks from the development (e) include a review after 5 years of the commencement of the captive breeding program in (d) above and detail the trigger, action and response plan for the extension of the program; (f) include a program to minimise the impacts of the development on the Murray Crayfish in Talbingo Reservoir, including: • population monitoring and surveillance for Murray Crayfish; • relocating any Murray Crayfish from the disturbance area of the development prior to disturbing the relevant area; and • habitat enhancement for the Murray Crayfish habitat in the vicinity of the disturbance area at the Talbingo Reservoir, including the use of woody debris salvaged during construction; and (g) include a program to monitor and publicly report on the progress of each program/plan and the effectiveness of these measures.	Snowy 2.0 TFMP; Snowy 2.0 AqHMP
Schedule 3, Condition 25	The Proponent must implement the approved Threatened Fish Management Plan for the development.	Snowy 2.0 TFMP
Schedule 3, Condition 26	Within 12 months of the commencement of construction, the Proponent must prepare a Recreational Fishing Management Plan for the development to the satisfaction of the Director-General of NSW DPI. This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with DPIE, NPWS and relevant recreational fishing groups; (b) describe the detailed measures that would be implemented to comply with condition 20(c) above, including:	Snowy 2.0 RFMP

Condition	Requirement	Where addressed
	• a program involving the spending of $5 million over 5 years from the commencement of the program to develop the capability to restock, and to restock, the Tantangara Reservoir and Lake Eucumbene with salmonid fish; • a program to monitor the impacts of the development on recreational fishing in Tantangara Reservoir and Lake Eucumbene; • a review after 5 years of the commencement of the restocking program and detail the trigger, action, and response plan for the continuation of the restocking of Tantangara Reservoir and/or Lake Eucumbene salmonid fish; (c) include a program to monitor and publicly report on the effectiveness of these measures.	
Schedule 3, Condition 27	The Proponent must implement the approved Recreational Fishing Management Plan for the development.	Snowy 2.0 RFMP
Schedule 4, Condition 4	Within 3 months of the following, unless the Planning Secretary agrees otherwise, the Proponent must review and (if necessary) update the approved strategies, plans and programs for the development to the satisfaction of the Planning Secretary: (a) the submission of an incident report under condition 6 below; (b) the submission of an independent environmental audit report under condition 10 below; and (c) any modification to the conditions of this approval; or (d) a direction of the Planning Secretary under condition 4 of schedule 2. Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.	Section 1.8
Schedule 4, Condition 7	Within 7 days of becoming aware of any non-compliance with the conditions of this approval, the Proponent must notify the Department via the Major Projects portal of the non-compliance. This notice must set out the non-compliance, the reasons for the non-compliance (if known) and what actions have been taken, or will be taken, to address the non-compliance.	Section 1.9
Schedule 4, Condition 8	The Proponent must provide regular reporting on the environmental performance of the development on its website in accordance with the requirements in any approved strategies, plans or programs.	Section 7
Schedule 4, Condition 12	From the commencement of the development of the Main Works until the completion of the ecological rehabilitation of the areas used for operations, the Proponent must: (a) make copies of the following information publicly available on its website: • the documents referred to in the definition of the Exploratory Works and Main Works; • current statutory approvals for the development; • approved strategies, plans or programs; • a comprehensive summary of the monitoring results of the development, reported in accordance with the requirements in the conditions of this approval, or any approved strategies, plans and programs; • a monthly summary of complaints; • a record of all incidents and non-compliances; • any independent environmental audit, and the Proponent's response to the recommendations in any audit; • any approved audit action plan;	Section 1.5

Condition	Requirement	Where addressed
	• any other matter required by the Planning Secretary; (b) keep this information up to date.	

Table 2: Snowy 2.0 Main Works, NSW (EPBC 2018/8322) Conditions of Approval for Aquatic Ecology and Biodiversity

Condition	Requirement	Where addressed
Annexure A, Part A, Condition 12	To minimise impacts to the aquatic environment, the approval holder must comply with conditions 20-25 of the NSW approval relating to biosecurity and fish management.	Snowy 2.0 BRMP; Snowy 2.0 TFMP; Snowy 2.0 RFMP; Snowy 2.0 AqHMP
Annexure A, Part A, Condition 13	To minimise potential impacts of pest fish movement on protected matters, the approval holder must, in addition to conditions 22c and 24d of the NSW approval: a. investigate reasonable measures, including the installation of secondary fish barriers, to protect tributaries identified as priority receiving sites for the establishment of stocking insurance populations of the Macquarie Perch and Stocky Galaxias; b. include the findings of the investigation in the Biosecurity Risk Management Plan required by condition 22 of the NSW approval, and the Threatened Fish Management Plan required by condition 24 of the NSW approval; and c. before undertaking any stocking of insurance populations required by condition 24d of the NSW approval, implement those measures determined under condition 13a to protect tributaries identified as priority receiving sites for the establishment of stocking insurance populations of the Macquarie Perch and Stocky Galaxias.	Snowy 2.0 BRMP (This Plan); Section 10
Annexure A, Part A, Condition 14	The Biosecurity Risk Management Plan required by condition 22 of the NSW approval, and the Threatened Fish Management Plan required by condition 24 of the NSW approval, must be peer reviewed by an independent, suitably-qualified expert/s approved by the Department. a. The peer review must be made publicly available on the approval holder's website within 10 business days of finalisation; and b. The peer review must be undertaken prior to approval of the Biosecurity Risk Management Plan and Threatened Fish Management Plan by the Director-General of the NSW Department of Primary Industries.	Snowy 2.0 TFMP; Snowy 2.0 BRMP (This Plan); Section 1.6
Annexure A, Part A, Condition 15	The Biosecurity Risk Management Plan and the Threatened Fish Management Plan must include provisions to make monitoring data (excluding sensitive ecological data) available as part of the monitoring, evaluation and reporting programs required by condition 22d and 24g of the NSW approval.	Snowy 2.0 TFMP; Snowy 2.0 BRMP (This Plan); Section 7
Annexure A, Part A, Condition 16	The approval holder must implement the Biosecurity Risk Management Plan and Threatened Fish Management Plan approved by the Director-General of the NSW Department of Primary Industries until the end date of this approval, unless otherwise agreed by the Minister in writing.	Snowy 2.0 TFMP; Snowy 2.0 BRMP (This Plan); Section 1.8

1.3. Background

This BRMP and the Screens and Barrier described within the document, represent the key measures for Snowy Hydro to minimise the biosecurity risks associated with the development, including the movement and/or spread of weeds, pests and pathogens (See: CoA, Condition 20(a); Table 1). In addition to the TFMP and RFMP, it is also a key measure to minimise the impact of the development on threatened fish species and their habitat, particularly the Macquarie Perch (*Macquaria australasica*), and Stocky Galaxias (*Galaxias tantangara*) and minimise the impact of

the development on recreational fishing in Lake Eucumbene (see: CoA, Condition 20(b) and (c); Table 1). The three management plans are closely linked and have been designed in concert to avoid and minimise the potential aquatic and biosecurity impacts of Snowy 2.0.

A potential biosecurity impact of Snowy 2.0 identified during the impact assessment for the project included the potential transfer and subsequent establishment of pest fish species, in particular the Redfin Perch (*Perca fluviatilis*) (Redfin), Eastern Gambusia (*Gambusia holbrooki*) and Climbing Galaxias (*Galaxias brevipinnis*), from Talbingo Reservoir to Tantangara Reservoir following hydrologic connection between Talbingo and Tantangara reservoirs to facilitate Snowy 2.0 operation (Cardno, 2019). The potential for these species to be entrained during pumping, survive transfer through the power station and subsequently establish within Tantangara Reservoir is uncertain, but in the absence of controls, the possibility cannot be excluded.

Should Redfin establish in Tantangara Reservoir, impacts to salmonids could include predation and/or competition resulting in impacts to the population. Similar, but less likely, impacts could also occur if a population of Eastern Gambusia establish. These impacts could also occur in Lake Eucumbene if Redfin or Eastern Gambusia establish in Tantangara Reservoir and are subsequently transferred and establish in Lake Eucumbene. Should Redfin establish in Tantangara Reservoir, and subsequently be transferred and establish in the mid-Murrumbidgee River downstream of Tantangara Dam, impacts to Macquarie Perch could include predation and/or competition resulting in impacts to the population (Cardno, 2020). If Climbing Galaxias are transferred to Tantangara Reservoir and subsequently migrate and establish in Tantangara Creek, impacts to Stocky Galaxias could include predation and/or competition resulting in impacts to the population (Cardno, 2019).

Redfin (and, to a lesser extent Rainbow Trout (*Oncorhynchus mykiss*)) are known hosts of the fish disease Epizootic Haematopoietic Necrosis Virus (EHNV). The EHNV status of Redfin in Talbingo Reservoir is unknown and an outbreak has never been detected in either reservoir. There is potential that, if present in Talbingo Reservoir, water transfer through Snowy 2.0 could increase the range of EHNV. Several native species, including Macquarie Perch, are susceptible to EHNV under laboratory conditions, although natural disease events caused by EHNV have never been detected in species other than Redfin and Rainbow Trout (Hick et al., 2019; Cardno, 2019).

Snowy Hydro comprehensively assessed the likelihood of these potential impacts and options to avoid transfer of pest fish through Snowy 2.0 as well as options to minimise potential impacts. This information is provided with the Snowy 2.0 Environmental Impact Statement (EIS) and Response to Submissions (RtS) (EMM, 2019; 2020). This assessment found that the most reasonably practicable way to minimise biosecurity risks and impacts to threatened species was to install structures to minimise the potential for pest fish to enter the habitat of threatened species (Tantangara Creek and the mid-Murrumbidgee River below Tantangara Dam), and Lake Eucumbene. As a result, Snowy Hydro committed to designing and constructing:

- A 'Galaxiid barrier' at the downstream extent of the Stocky Galaxias habitat (subsequently imposed as Condition 21(a) of the Infrastructure Approval (Table 1))
- Fish screens at Tantangara Dam and the inlet to the Murrumbidgee to Eucumbene tunnel (M-E Tunnel) to prevent the transfer of all life stages of fish so far as is reasonably practicable from Tantangara Reservoir through the Dam to the mid-Murrumbidgee River and to Lake Eucumbene (subsequently imposed as Condition 21(a) of the Infrastructure Approval (Table 1)).

These controls are described in Part 2 of this BRMP. Once these controls are in place, the likelihood of Climbing Galaxias being transferred to Tantangara Reservoir from Talbingo Reservoir, establishing in the upper Murrumbidgee catchment then migrating upstream of the planned barrier and establishing in upper Tantangara Creek leading to competition with and extinction of Stocky Galaxias was assessed by Cardno (2019) as rare. Similarly, the likelihood of a reservoir spill or a failure of the proposed screens leading to transfer and establishment of Redfin in the mid-Murrumbidgee River downstream of Tantangara Reservoir leading to competition with and impacts to the population of Macquarie Perch or Transfer of Redfin to Lake Eucumbene was also assessed as rare (Cardno, 2019).

The Critical State Infrastructure Assessment Report for the project found that the controls proposed by the project, being the screens at Tantangara Dam and the barrier on Tantangara Creek, were expected to minimise any adverse biosecurity impacts of the project as far as is reasonably practicable. The three management plans, being the BRMP, TFMP and RFMP, are intended to collectively complement these measures to further minimise any adverse biosecurity impacts, should the controls fail (NSW DPIE, 2020).

Measures described in the TFMP are intended to assist NSW DPI Fisheries and DCCEEW in protecting these endangered fish species. Such measures may improve the resilience of Stocky Galaxias and Macquarie Perch to withstand competition from Climbing Galaxias and Redfin respectively, should the controls fail at some point in the future. Similarly, measures described in the RFMP are intended to ensure that any impacts to recreationally

important salmonids in both Tantangara Reservoir and Lake Eucumbene can be minimised via the targeted fish stocking of these reservoirs if and as required.

Tantangara Reservoir represents the potential initial pest fish incursion location associated with the operation of Snowy 2.0 due to the establishment of the hydrological connection with Talbingo Reservoir. It is assumed that all other catchments may only be impacted from the operation of Snowy 2.0, if transfer of pest fish from Talbingo Reservoir and establishment of pest fish populations in Tantangara Reservoir occurs. Similarly, an impact from EHNV due to the project may only occur if EHNV is present in Talbingo Reservoir, and Redfin are transferred and establish in Tantangara Reservoir, and these Redfin are subsequently affected by an outbreak which is able to spread to surrounding catchments including those where aquatic assets such as Macquarie Perch or Stocky Galaxias are present.

1.4. Management Plan Scope

The content of the BRMP is based around the requirements of the CoA provided in Table 1 and Table 2.

This Plan is composed of two main parts:

- *Part One* - describes the biosecurity risk management framework for minimising the ongoing biosecurity risks of Snowy 2.0.
- *Part Two* - includes the detailed plans for the installation and use of the fish screens and barriers required in Condition 21 of the CoA.

1.5. Plan Preparation, Consultation and Approval

This BRMP has been prepared by suitably qualified and experienced persons in consultation with NSW DPI (formerly part of DPIE), the Department of Planning, Housing and Infrastructure (DPHI, formerly DPIE and DPE), the National Parks and Wildlife Service (NPWS) and the Commonwealth DCCEEW (formerly DAWE).

Representatives from NSW DPI Fisheries and Biosecurity and Food Safety have been regularly updated regarding the preparation of this plan, and the TFMP and RFMP, via the establishment of a Working Group and Steering Committee. The working group has met generally monthly since July 2020 with the Steering Committee typically meeting quarterly. An overview of the consultation that was undertaken to develop the BRMP is provided in Appendix A; Table 10.

This plan has been issued to DPI, DPHI, NPWS and DCCEEW for review and comment, with comments incorporated where appropriate. The NSW Fisheries Scientific Committee and Recreational Fishing NSW were also invited by NSW DPI to review and provide comment on the Plan and their feedback has also been incorporated.

Once approved, the current version of the BRMP will be made available on Snowy Hydro's website (www.snowyhydro.com.au).

1.5.1. Plan Staging

This version of the BRMP is to be known as Stage 1.

Stage 2 of the BRMP is to be approved prior to the commencement of construction of the fish screens at Tantangara described in Section 8 of this Plan.

Due to the complexity of design associated with the planned fish screens at Tantangara Reservoir (Section 8), this aspect of the BRMP will be submitted in two stages. Whilst BRMP Stage 1 (this Plan) includes details of all relevant conditions of approval provided in Table 1, BRMP Stage 2 will involve a revision of Section 8 to update the information provided in Stage 1 of the Plan and provide additional detail regarding the design of the screens to be installed at the southern end Tantangara Reservoir ahead of the commencement of construction.

1.6. Peer Review

In accordance with Condition 14 of the EPBC Approval (Table 2) prior to submission of the BRMP to the Director-General of the NSW Department of Primary Industries for approval, this BRMP has been peer reviewed by an independent, suitably-qualified expert approved by DCCEEW.

Details of the review are provided in Appendix B and are also publicly available via Snowy Hydro's website (www.snowyhydro.com.au).

1.7. Plan Implementation

Snowy Hydro will be responsible for the implementation of activities to be undertaken as part of the BRMP for the life of the development. Under the EPBC approval, the BRMP must be implemented until the end date of the approval (31 December 2140) unless otherwise agreed by the Commonwealth Minister[1] in writing.

Works to be undertaken as part of the BRMP will be informed by the outcomes of previous studies and based upon the requirements to successfully achieve the objectives of the BRMP.

1.8. Review and Cessation of the BRMP

The BRMP will be implemented for the life of the development unless otherwise agreed by the Commonwealth Minister and DPHI. This Plan may be reviewed and revised at any time by agreement between Snowy Hydro, NSW DPI and DCCEEW.

Specific events that may trigger a review and update to the relevant sections of the BRMP include:

- A change to the aperture or other key design aspect of the Screens described in Table 9
- A material change to the appearance or dimensions of the fish barrier in Section 9
- If an additional fish barrier/s is to be installed in accordance with Section 10
- The confirmed establishment of a pest fish species with the Snowy 2.0 catchments in a location where it is currently considered absent (Section 4)
- The detection of EHNV within any of the Snowy 2.0 catchments (Section 5).

Amendments and variations to surveillance and management activities set out in the BRMP that remain consistent with the broad principles of the BRMP will be submitted within the relevant Annual Report.

As per Schedule 4, Condition 4, within 3 months of the following, unless the Planning Secretary agrees otherwise, Snowy Hydro will review and (if necessary) update the BRMP for Snowy 2.0:

a) The submission of an incident report related to activities associated with this BRMP;
b) The submission of an independent environmental audit report related to activities associated with the BRMP;
c) Any modification to the relevant conditions of approval; or
d) A direction of the Planning Secretary under condition 4 of schedule 2 of the Infrastructure approval.

1.9. Reporting non-compliance

Within 7 days of becoming aware of any non-compliance with the conditions of approval related to the BRMP, Snowy Hydro will notify the Department of Planning via the Major Projects portal of the non-compliance. This notice will set out the non-compliance, the reasons for the non-compliance (if known) and what actions have been taken, or will be taken, to address the non-compliance.

[1] Minister means the Australian Government Minister administering the EPBC Act including any delegate thereof.

Part 1: Biosecurity Risk Management Framework

This section addresses Condition 22(b) and 22(d) of the Snowy 2.0 Main Works Infrastructure Approval (Section 1.2; Table 1).

A Pest Fish and Disease Response and Control Plan that outlines roles, responsibilities and actions that would be taken by Snowy Hydro should the spread of biosecurity matter occur as a result of operation of the plant is provided in Appendix C.

2. Surveillance Catchments

The pest fish and disease surveillance activities and management measures referred to in this BRMP will occur within the following catchments (surveillance catchments) (Figure 1):

1. Tantangara Reservoir
2. Upper Murrumbidgee Catchment (including Tantangara Creek)
3. Mid-Murrumbidgee catchment
4. Lake Eucumbene
5. Talbingo Reservoir.

3. Aquatic Assets

The key aim of the pest fish and disease surveillance programs in the BRMP are to identify if a pest fish or disease incursion occurs within an area of habitat of threatened species or recreationally important salmonids, where they are not already present. For the program, the key aquatic assets include:

- Stocky Galaxias
- Macquarie Perch
- Salmonids.[2]

3.1. Current Distribution

The known distribution of the aquatic assets within the surveillance catchments as of February 2024 is provided in Table 3. A table of the distribution of all fish species in the surveillance catchments and surrounding areas as at 2019 was provided in the EIS and is replicated in Appendix D (Cardno, 2019).

Table 3: Known distribution of aquatic assets within the surveillance catchments

	Talbingo Reservoir	Tantangara Reservoir	Upper Murrumbidgee catchment	Upper Tantangara Creek	Mid-Murrumbidgee River	Lake Eucumbene
Stocky Galaxias	-	-		Present*	-	-
Macquarie Perch	-	-	-	-	Present	-
Salmonids	Present	Present	Present	-	Present	Present

* Stocky Galaxias are currently only known to occur in Upper Tantangara Creek (part of the Upper Murrumbidgee catchment), above the Tantangara Creek Waterfall where salmonids are absent.
- Not detected.

[2] Note: Whilst salmonids are a recreational fishing asset, they are also an invasive species with the potential to severely impact native freshwater species, including the Stocky Galaxias and the Macquarie Perch. Salmonids are recorded as a threatening (and limiting) species in the Conservation Advices of both the Stocky Galaxias and the Macquarie Perch.

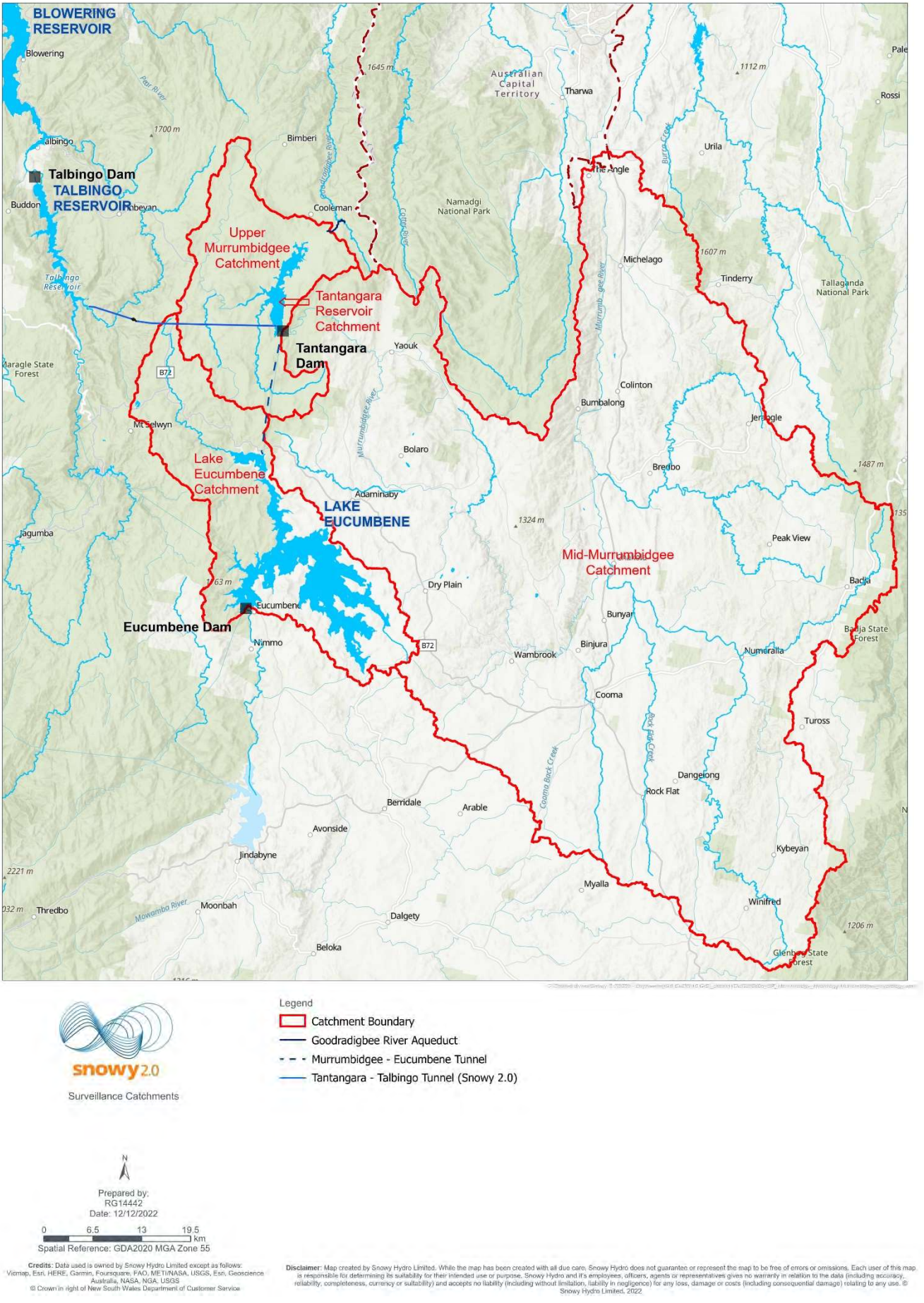


Figure 1: Overview of surveillance catchments

4. Pest Fish Surveillance and Management

This section outlines the pest fish surveillance and management activities that will be undertaken as part of the BRMP. The pest fish surveillance activities and management measures described in the BRMP are based on advice provided by Dr Tarmo Raadik and Associate Professor Mark Lintermans (Raadik and Lintermans 2022).

4.1. Target Pest Species

Species of fish which have been identified as target pest species for surveillance as part of the BRMP include:

- Redfin Perch (*Perca fluviatilis*) (Redfin), exotic, notifiable under Schedule 1 of the *NSW Biosecurity Regulation 2017*
- Eastern Gambusia (*Gambusia holbrooki*), exotic
- Climbing Galaxias (*Galaxias brevipinnis*), native but considered translocated outside of its natural range into the Murray and Tumut River catchments.

4.1.1. Current Distribution

The known distribution of the target pest species within the surveillance catchments as of February 2024 is provided in Table 4. A table of the distribution of all fish species, including pest fish, is provided in Appendix D.

Table 4: Known distribution of target pest fish species within the surveillance catchments

	Talbingo Reservoir	Tantangara Reservoir	Upper Murrumbidgee catchment	Mid-Murrumbidgee River	Lake Eucumbene
Redfin	Present	-	-	-	-
Eastern Gambusia	Present	-	-	Present	-
Climbing Galaxias	Present*	-	-	-	-

* Climbing Galaxias has been detected within the Yarrangobilly River, a hydrologically connected tributary. The species has not been recorded in Talbingo Reservoir using traditional physical sampling and eDNA sampling techniques (Cardno, 2019).
- Not detected.

4.2. Objectives

The objectives of the pest fish species surveillance and management activities in the BRMP are to:

- Understand the pre-connection distribution of pest fish in the surveillance catchments
- Undertake ongoing surveillance activities to identify potential pest fish incursions into these catchments once Snowy 2.0 is operational
- Undertake appropriate management actions in response to an incursion to minimise further spread and impacts to the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment and the salmonid fishery in Lake Eucumbene.

4.3. Incursion Pathways

The establishment of a novel hydrological link between Talbingo and Tantangara reservoirs due to Snowy 2.0 provides a new incursion pathway for pest fish species (Cardno, 2019). From Tantangara Reservoir, there is the potential for pest species incursions to spread to connected waterways including upstream into the Upper Murrumbidgee catchment and downstream into the mid-Murrumbidgee River and Lake Eucumbene. Transfer to these catchments is intended to be prevented so far as is reasonably practicable through the control measures described in Part 2. As such, pest fish incursion into these locations may only occur from the operation of Snowy 2.0 if these controls are ineffective or, in the case of the mid-Murrumbidgee River, if the reservoir spills.

Other potential pest fish incursion pathways, not related to Snowy 2.0 that may occur during the life of the project include human assisted transfer of pest fish and natural colonisation. The pathways of human-assisted dispersal and natural colonisation of pest fish do not rely on the Snowy 2.0 connection, may operate at any time, and include any of the pest fish species (Raadik and Lintermans, 2022; Table 5).

Table 5: Potential incursion pathways for pest fish species into the surveillance catchments, including species, connection phase and probability of incursion

Incursion pathway and connection phase	Incursion details	Pest species	Possibility of incursion	Surveillance catchments
1. Through **new water connectivity pathways** created by Snowy 2.0	Primarily via the tunnel connecting Tantangara Reservoir and Talbingo Reservoir (Snowy 2.0) If primary incursion occurs, secondary incursion may occur: - via existing M-E Tunnel - Through Tantangara Dam Note: Prior to the operation of Snowy 2.0, the tunnel and dam outlet are to be fitted with fish screens - via overland cross-catchment movement or existing diversion tunnel between Tantangara Reservoir and Goodradigbee River system	Redfin Climbing Galaxias Eastern Gambusia	Low but possible	Tantangara Reservoir; mid to upper Murrumbidgee River system; Lake Eucumbene Tantangara Reservoir; upper Murrumbidgee River catchment (including Tantangara Creek if controls fail); upper Goodradigbee River system Tantangara Reservoir; upper sections of mid Murrumbidgee River catchment
2. Human-assisted dispersal – the deliberate, or uninformed, illegal release of fish into new locations	Release of pest fish into any waterway in the mid to upper Murrumbidgee River catchment or Lake Eucumbene	Redfin Climbing Galaxias Eastern Gambusia	Very low, but possible	Mid to upper Murrumbidgee River catchment, including Tantangara Reservoir and all tributaries Lake Eucumbene (for Redfin) Tantangara Reservoir and Murrumbidgee River downstream of reservoir
3. Natural colonisation – range expansion from existing pest fish population centres	Redfin colonising upstream in Murrumbidgee River Climbing Galaxias moving across catchment divide between Tumut or Eucumbene catchments to Murrumbidgee catchment	Redfin Climbing Galaxias	Extremely low (extremely limited upstream potential) Extremely low, but can potentially move across catchment divides	Murrumbidgee River main stem and tributaries upstream of current extent of range Upper Murrumbidgee River tributaries adjacent to the Tumut River or Eucumbene River catchment boundaries

(Source: Raadik and Lintermans, 2022).

4.4. Surveillance Program

A surveillance program will be used to monitor potential incursion of pest fish species throughout the surveillance catchments (see Section 2). This program for pest fish surveillance is focussed on identifying potential pest fish incursions following the establishment of a two-way hydrologic connection between Talbingo and Tantangara reservoirs. In addition, although studies for Snowy 2.0 established the current distribution of the target pest species throughout the surveillance catchments with a reasonable degree of certainty (Table 4; Appendix D), pre-connection

sampling will also occur to improve levels of confidence regarding the potential distribution of these pest species in these catchments.

Periodic eDNA surveillance has occurred since 2017 and sites from this program will be maintained with appropriate modification post-connection (Griffith et al., 2017; Cardno, 2019; Robinson et al., 2019; Weeks et al., 2019; Griffith et al., 2020 and 2022).

Full details of the surveillance program are provided in Appendix E.

4.4.1. Monitoring Methods

Pest fish species incursions will be monitored using a variety of methods that will be effective at detecting:

1. Each of the target pest fish species
2. A range of life-history stages of the pest fish species (i.e. larval, juvenile, adult) that may be present in the early stages of an incursion or at low abundances
3. Pest fish species inhabiting specific habitats (i.e. deep, shallow, lotic (flowing) and lentic (still – impoundments) (Raadik and Lintermans, 2022).

Different methods and amount of sampling effort will be undertaken in different surveillance catchments, depending on the specific pest fish species, the current likelihood of incursion, incursion location (e.g. habitat), life history stages and abundance of individuals (Raadik and Lintermans, 2022). The primary surveillance method will be eDNA screening in combination with varying amounts of physical sampling using a range of equipment including backpack and boat-based electrofishing and larval light traps. Other techniques such as baited remote underwater video (BRUV), fyke nets and gill nets may also be used as required.

Important in the use of eDNA is the need to ensure that the detection probabilities for the target pest fish species are maximised (e.g. highly specific for target species, able to detect very low concentrations of DNA, methods optimised for maximum extraction of DNA from collected water samples, etc.). As such, the use of single species DNA probes will be continued in preference to meta-barcoding approaches. Where appropriate, probes will continue to be optimised. Sample collection and analysis will be sufficient to ensure high confidence in results.

4.4.2. Response to Positive Detection

The criteria, trigger levels and action in response to a positive detection of a target pest fish species is provided in Table 6.

Table 6: Criteria, trigger levels, and response activities, for each alert level for pest fish surveillance and a positive detection in surveillance catchments

Alert level	Action
1 **(Normal)**	No detections of pest species - continue surveillance program as per Appendix E.
2 **(Alert / investigate)**	*Trigger*: target pest fish detected by eDNA, angler/public report, unverifiable but suspect BRUV image. *Response:* - Snowy Hydro to notify NSW DPI[3] - Undertake rapid pest fish confirmation sampling in relevant catchment (see Section 4.5).
3 **(High alert / rectify)**	*Trigger:* Pest fish detection confirmed by physical sampling or verifiable BRUV image(s). *Response:* - Snowy Hydro to notify NSW DPI and DCCEEW[3] - Initiate investigations to determine the incursion pathway (see Section 4.5) - Enact pest fish management/control measures (see Section 4.6).

(Source: Raadik and Lintermans, 2022)

[3] Note: If the detection relates to a pest or disease listed in Schedule 1 of the *Biosecurity Regulation 2017*, which includes Redfin and EHNV, Snowy Hydro commit to notifying NSW DPI in accordance with Part 6 within 1 working day after they first suspect or becomes aware of the presence.

4.4.3. Surveillance Program Review

Snowy Hydro will regularly review the surveillance program detailed in Appendix E (i.e. locations, methods, effort, frequency) to ensure that it remains effective over time and provides confidence in the results.

A review of the surveillance program will also occur following the detection, spread or establishment of a target pest species at a novel location within the surveillance catchments. This will necessitate a re-evaluation of the potential risk of incursion to connected, adjacent catchments and fish assets being protected, which will influence which sites are monitored, at what frequency and for which target pest fish species. The amount of modification required to the program will depend on factors such as the:

- Number and localities of pest fish incursion
- Species of pest fish
- Degree and rate of spread of the pest fish incursion
- Success of any management actions (see Section 4.6).

Changes made to the program will consider the guidance provided by Raadik and Lintermans (2022) and any advice provided by NSW DPI. Where appropriate, any new advances in technology and sampling will be considered for adoption as part of this program where there is a clear benefit in terms of sampling efficiency or detection capability.

Any proposed changes to the surveillance program described in Appendix E based on the outcome of a review will be submitted to NSW DPI prior to the commencement of subsequent sampling event(s) where practicable. Any unplanned deviations from the surveillance program, including the reasons for any changes, will be described in the relevant Annual Report (see Section 7).

4.5. Determining Pest Fish Species Incursion Pathway

Identifying the incursion pathway and the specific details associated with the incursion or potential incursion of any pest fish species into and throughout the surveillance catchments will be a key early step following the detection of an incursion. It will be used to determine the severity of the incursion, what management measures might be appropriate and who has responsibility for management of the incursion. It is also important for the assessment of the efficiency of control measures to restrict incursion or spread (e.g. fish screens, and weirs) and to inform the revision of existing, or development of additional, management strategies aimed at preventing incursion or spread (Raadik and Lintermans, 2022).

If the potential pest fish incursion is unverified (i.e. Alert Level 2; Section 4.4.2), the priority will be establishing its authenticity by undertaking seasonally appropriate targeted sampling in the catchment where the incursion is suspected as soon as is reasonably practicable in close consultation with NSW DPI.

Any pre-connection incursions will be highly unlikely to be directly related to the Snowy 2.0 development. Pest fish incursions post-connection are more likely to be due to the operation of the scheme, but also possibly via human-mediated dispersal. Natural colonisation is also possible although this is considered to be very unlikely (see Section 4.2).

Determining the pest fish incursion pathway post-connection of Snowy 2.0 will be challenging however, the following information identified by Raadik and Lintermans (2022) will be important to assist in the investigations:

- Date and location/s of incursion (the earliest detected if possible)
- Life history stages present
- Estimate of abundance
- The geographic spread of the population
- Tissue samples of each species for provenance testing via DNA analysis[4].

The first four factors contribute to an understanding of the temporal nature of the incursion while examining the provenance of the pest fish may provide an understanding the pathway of incursion if the pest fish can be linked back to a known population (e.g. if Redfin individuals from an incursion are only genetically matched to those from Talbingo Reservoir then they are likely to have originated from that location). Genetic tracing in the context of this surveillance plan (e.g. within < 1 year of incursion) may be easier than if undertaken many years after an introduction but does rely on the populations of target pest fish being sufficiently genetically divergent to determine

[4] Genetic variation between populations will be determined by DNA barcode analysis (e.g. single nucleotide polymorphisms (SNPs))

point of origin. Combining the five areas of investigations will provide a weight of evidence approach to assist in the determination and identification of the incursion pathway. Initiation of data collection activities for the above five datasets will occur as a response to a positive detection of a pest fish species within the surveillance area.

Efforts to collect genetic tracing material for pest fish species will be made in the following catchments which represent the most likely source for incursions:

- Climbing Galaxias – Tumut (Yarrangobilly), Snowy River and Upper Murray systems.
- Redfin – Talbingo, Murrumbidgee System below the ACT and potentially other locations in geographic proximity.

It is acknowledged that despite the results of active investigations there is a possibility of being unable to definitively determine the incursion pathway or pest fish cannot be matched confidently to a source population (e.g. no or little genetic diversity between populations, low genetic diversity in founder population, etc.). In this instance, further discussion with NSW DPI will seek to resolve an appropriate response to manage the incursion.

4.6. Pest Fish Management Measures

Following verification of a pest fish species incursion and notification to NSW DPI, Snowy Hydro will be responsible for management actions that commence under this Plan if the incursion is deemed to be caused by the operation of Snowy 2.0 (see Section 4.5).

The management response will vary based on the location of the incursion, pest species involved, and the aquatic asset being protected (Macquarie Perch in the mid Murrumbidgee, Stocky Galaxias in the upper Murrumbidgee River, and salmonids in Lake Eucumbene) (Raadik and Lintermans, 2022). There are formal governance and legislative arrangements that may apply in the event of a pest fish incursion/emergency. These arrangements, including relevant response control measures, will vary in scale and nature of the incursion. This could include a Control Order or General Biosecurity Direction that may require Snowy Hydro Limited to resource or collaborate to ensure certain actions or activities are implemented in response to the detection.

Before specific management actions are identified, the status of the incursion will be assessed (i.e. surveys will be undertaken to determine the abundance, life-stage and distribution of pest fish species). Once this preliminary data has been obtained, the following broad options for management will be considered and a management plan will be prepared:

1. *Eradication* – complete removal of pest fish
2. *Population size reduction* – partial removal of pest fish to reduce density or particular size class strength
3. *Beneficial measures* - other measures to reduce impacts from pest fish on the aquatic assets. For example, installation of barriers, habitat augmentation to reduce aggressive/predatory interactions, reduction in preferred pest fish habitats (i.e. spawning, juvenile or adult habitat, etc.) and bolstering the populations of aquatic assets by translocation or stocking (Raadik and Lintermans, 2022).

Whilst pest fish eradication is often seen as the best outcome, success of eradication programs can often be limited, and restricted to smaller waterbodies rather than large reservoirs or rivers (Raadik and Lintermans, 2022). Therefore, whether eradication is appropriate/feasible will be situation specific and informed by the following considerations:

- The degree of risk to the existence of the aquatic asset (species, distinct genetic lineage, or subpopulations)
- Characteristics of the incursion location:
    - Remoteness (ease of access)
    - Waterbody characteristics (width, depth, volume, lotic or lentic, system complexity (single stream reach, wetland or lake, stream system including tributaries, etc.), aquatic habitat complexity, etc.) (constraints in undertaking eradication)
    - Closeness to the target aquatic asset distribution (degree of urgency for action).
- Incursion characteristics (early, late (established), fish abundance and life history stages, degree of spread)
- Ability to contain current incursion
- Available eradication methods and assessment of feasibility of use (e.g. non-target species impacts, efficiency, etc.)
- Likely effort/cost
- Incursion pathway and potential for recurrence (Raadik and Lintermans, 2022).

As recommended by Raadik and Lintermans (2002), the following methods will be considered for pest fish management:

- *Physical removal* - active (electrofishing) or passive (nets, traps, etc.). Can be effective for Redfin and Climbing Galaxias, though limited for Eastern Gambusia. May result in non-target impacts, particularly to Stocky Galaxias.
- *Chemical eradication* - the application of an ichthyocide to the target body of water. Can be effective for Redfin, Climbing Galaxias and Eastern Gambusia, although it does not discriminate between native and pest fish species
- *Harvest regimes* – Increase harvest pressure on a species or selected size range, often by angling or selective netting. Possibly effective for Redfin
- *Habitat manipulations* (e.g. manipulating water levels).

The selection of potential beneficial measures (i.e. activities to improve the protection or resilience of the target aquatic assets), will be location and species specific, and may also depend on the effectiveness of management outcomes. These measures may include, but are not restricted to:

- Barriers to prevent the incursion of pest fish into the distribution of the aquatic asset (e.g. instream barrier (physical or behavioural) to prevent the upstream incursion of Redfin or Climbing Galaxias from Stocky Galaxias habitat)
- Structural habitat augmentation – to increase instream protection of aquatic assets by reducing negative interactions (e.g. increasing the amount of habitat complexity)
- Reducing or removing instream spawning habitat for specific pest fish species (e.g. manipulating flow to reduce quiet water habitat, removal of shallow water aquatic vegetation, preventing access to spawning habitat)
- Bolstering the population of an affected aquatic asset by translocation of individuals or stocking individuals from a hatchery
- Reducing competition/predation on an affected aquatic asset by ceasing the stocking of another fish species already present within the catchment/location (e.g. ceasing stocking of salmonids into Macquarie Perch habitat following incursion/establishment of Redfin or Eastern Gambusia) (Raadik and Lintermans, 2022).

Based on the above, indicative pest fish management options for the surveillance catchments are proposed in Table 7. Management activities may be required under an appropriate instrument under the *Biosecurity Act 2015*. Consultation on the most appropriate measures will occur between NSW DPI, Snowy Hydro, and other key stakeholders, noting that any management activities undertaken will necessarily be adaptive. All activities undertaken, including monitoring the level of success, will be documented in the relevant Annual Report (see Section 7).

Table 7: Indicative pest fish management options and beneficial measures for aquatic assets for the surveillance catchments.

Surveillance catchment	Target Pest fish	Pest fish management	Justification	Potential Beneficial measure
Tantangara Reservoir	Redfin Climbing Galaxias Eastern Gambusia	Priority 1 – Eradication acknowledging that this may be very difficult and only likely to be worthwhile if live transfer from Talbingo Reservoir is considered to be infrequent. Electrofishing, Fyke nets. If established: Priority 2 – Population reduction to minimise the risk of incursion to other catchments. - continue program of beneficial measures	Considered main pathway for pest fish incursion via Snowy 2.0 scheme. Population management may minimise the risk of secondary incursion to upper and mid Murrumbidgee River and/or Lake Eucumbene.	- Fish screens on Tantangara Dam and outlet to Eucumbene. - Bolster trout by stocking if population impacted. - Encourage recreational fishers take/humanely dispatch Redfin for population reduction.
Upper Murrumbidgee (Tantangara Creek above the fish barrier)	Climbing Galaxias	Priority 1 – Eradication. Electrofishing, Chemical (limited) If established: - Retain annual eradication to maintain buffer zones to Stocky Galaxias populations - Continue program of beneficial measures.	Protection of high value native conservation species Stocky Galaxias. Protection of largest known population of Stocky Galaxias. Protection of one of only two known populations of Stocky Galaxias.	- Climbing Galaxias barrier on Tantangara Creek - Establish additional populations of Stocky Galaxias outside of upper Murrumbidgee catchment. - Prevent Climbing Galaxias incursion outside of upper Murrumbidgee /Tantangara Reservoir catchments (i.e. to Goodradigbee catchment).
Mid Murrumbidgee	Redfin Eastern Gambusia	Priority 1 – Eradication. acknowledging that this may be very difficult. Electrofishing, Fyke nets. Priority 2 (if established) – Population reduction. - Continue program of beneficial measures.	Protection of high value native conservation Macquarie Perch population.	- Regular bolstering of Macquarie Perch by stocking if population impacted. - Habitat augmentation
Lake Eucumbene	Redfin	Priority 1 – Eradication acknowledging that this may be very difficult. Electrofishing. If established: - Continue program of beneficial measures.	Valuable recreational salmonid fishery.	- Regular bolstering of trout by stocking if population impacted. - Encourage recreational take of Redfin for population reduction.

(Source: Raadik and Lintermans, 2022).

5. Disease Surveillance and Management

This section outlines the disease surveillance and management measures that will be undertaken as part of the BRMP. The disease surveillance activities described in the BRMP are based on advice and reports provided by Dr Ben Diggles (Diggles, 2022a; Diggles, 2022b) and Dr Paul Hick at the Elizabeth Macarthur Agricultural Institute.

5.1. Target Diseases

EHNV and *Lernaea cyprinacea* (Lernaea), also known as anchorworm, have been identified as the two targeted diseases on which to focus BRMP disease surveillance and management measures.

It is acknowledged that there could be other pests and diseases that emerge and/or spread over time into the surveillance catchments. If monitoring undertaken for this Plan or any other general surveillance carried out by Snowy Hydro in operating the Scheme, detects any unusual signs or symptoms that could indicate a new disease or pest of concern, Snowy Hydro will notify NSW DPI.

EHNV is a viral fish pathogen of international concern. It is restricted to south-eastern mainland Australia where it has caused sporadic outbreaks of high mortality disease in Redfin since the 1980s, and low mortality disease in farmed Rainbow Trout. Experimental studies indicate that several native Australian fish species, including Macquarie Perch, are susceptible to EHNV although natural disease events caused by EHNV have never been detected in species other than Redfin and Rainbow Trout (Hick et al., 2019).

Previous outbreaks of EHNV have been detected in nearby Blowering Reservoir, however, an outbreak or evidence of infection has never been reported within Talbingo Reservoir, including following limited surveillance undertaken for the Snowy 2.0 EIS (Cardno, 2019; Hick et al., 2019; Diggles, 2022a). If EHNV is present in Redfin in Talbingo Reservoir, water transfer through Snowy 2.0 could increase the range of EHNV which consequently may result in impacts to threatened species including Macquarie Perch or Stocky Galaxias, located downstream and upstream of Tantangara Reservoir respectively (Cardno, 2019).

Given that EHNV is predominantly a disease of Redfin, which are only located within Talbingo Reservoir at present, the priority for the disease surveillance program is to identify whether EHNV disease is currently present within the Talbingo Reservoir Redfin population. As noted in Section 2, an impact from EHNV as a result of the project may only occur if EHNV is present in Talbingo Reservoir, and Redfin are transferred and establish in Tantangara Reservoir, and these Redfin are subsequently affected by an EHNV outbreak which is then spread to surrounding catchments including those where aquatic assets such as Macquarie Perch, Stocky Galaxias or salmonids are present.

Lernaea is an introduced ecto-parasitic copepod. The life cycle of Lernaea involves the infection of fish hosts by free living waterborne larvae which hatch from eggs shed into the water by adult female worms while they are attached to their fish host. The holdfast of the adult copepod can cause considerable damage to fish gills, muscle and internal organs, resulting in significant impacts and even mortalities in many fish species (Diggles, 2022a). The species is considered ubiquitous throughout much of the Murray-Darling River system, including the mid and lower sections of the Murrumbidgee River downstream of Tantangara Dam (Diggles, 2022; Lintermans, 2022). The distribution of this parasite is probably best explained by the current distribution of goldfish (*Carassius auratus*) and European carp (*Cyprinus carpio*). As Goldfish are present in Talbingo Reservoir and Lake Eucumbene, Lernaea is potentially present in these waterbodies, however, there are no published reports of infection by Lernaea in fishes in either Talbingo or Tantangara reservoirs, or from Lake Eucumbene (Diggles, 2022a).

5.1.1. Current Distribution

A literature review by Diggles (2022a) determined the current known distribution of EHNV in catchments within and proximal to Snowy 2.0 as follows and identified in Figure 2:

1. **Blowering Reservoir** and the Tumut River (downstream of Talbingo Reservoir): EHNV is endemic
2. **Tumut River**: EHNV is potentially established in the environment around trout farm “A” on the Tumut River
3. **Mid-Murrumbidgee:** EHNV is potentially established in the environment around trout farm “C” on the mid-upper Murrumbidgee River near Adaminaby.

The presence or absence of EHNV in other water bodies in the region, including Talbingo and Tantangara reservoirs, remains unknown.

The literature review by Diggles (2022a) found the known distribution of Lernaea in catchments within and proximal to Snowy 2.0 as follows and identified in Figure 2:

1. **Blowering Reservoir** and the Tumut River: Lernaea is probably present in populations of European carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), as well as other exotic and native fishes
2. **Talbingo Reservoir:** Lernaea is potentially present in populations of goldfish, as well as other exotic and native fishes
3. **Mid-Murrumbidgee:** Lernaea is present within populations of European carp, goldfish, as well as other exotic and native fishes (Lintermans, 2022).

The presence or absence of Lernaea in other water bodies in the region, including Tantangara Reservoir and Lake Eucumbene, remains unknown.

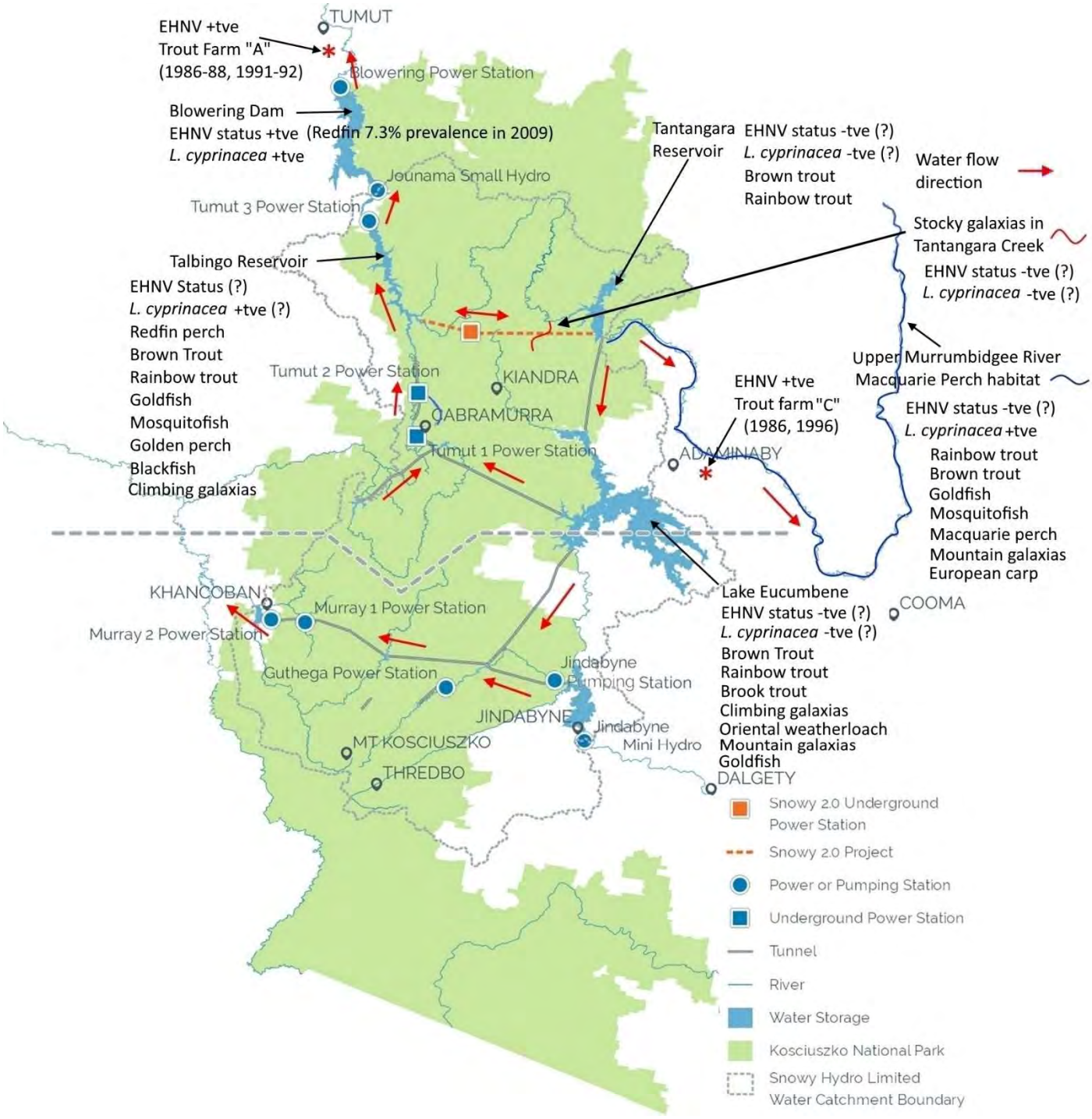


Figure 2: Host and disease status for each major waterbody in the vicinity of the Snowy 2.0 project in relation to the known historical presence/absence of EHNV and *Lernaea cyprinacea*, determine by literature review as of March 2022 (Source: Diggles, 2022a, p. 19)

5.2. Objectives

The primary objective for the disease surveillance activities for the BRMP is to:

- Determine whether EHNV is present in the Talbingo Reservoir Redfin population prior to the connection of Talbingo and Tantangara reservoirs by Snowy 2.0.

A secondary objective is to establish the distribution of Lernaea in the surveillance catchments.

Should EHNV be detected in Talbingo Reservoir, subsequent objectives of the BRMP disease surveillance activities would be to:

- Determine the EHNV status of other waterbodies in the other surveillance catchments including the Upper Murrumbidgee, mid-Murrumbidgee, Tantangara Reservoir and Lake Eucumbene
- Undertake ongoing surveillance activities to identify potential EHNV incursions into or occurrences of EHNV outbreaks in these catchments once Snowy 2.0 is operational
- Undertake appropriate management actions in response to an EHNV incursion or outbreak to minimise further spread and impacts to Macquarie Perch and Stocky Galaxias in the mid to Upper Murrumbidgee catchment and the salmonid fishery in Lake Eucumbene.

5.3. Surveillance Program

EHNV is considered endemic in Redfin populations within waters where it has previously occurred. The presence of EHNV is thought to be maintained as persistent subclinical infection of Redfin, with low grade endemic infection cycles that do not induce high mortality outbreaks (Hick et al., 2019). As surveillance for EHNV undertaken for the EIS was unable to conclusively determine that EHNV is absent from Talbingo Reservoir, the priority disease surveillance activity for the BRMP is to determine the status of EHNV in Talbingo Reservoir through a program of targeted active Surveillance detailed in Appendix F.

Opportunistic surveillance for Lernaea will occur during pest fish and EHNV surveillance activities. This will involve visual examination of captured fish for the presence of Lernaea to provide information on the potential presence and prevalence of this parasite in the surveillance catchments.

If the Talbingo Reservoir Redfin population is deemed to be free from EHNV, no further Active Surveillance will occur under this Program. Passive surveillance for both EHNV and Lernaea will occur throughout the surveillance catchments for the duration of the BRMP (Appendix F).

5.3.1. Monitoring Methods

Targeted active surveillance to determine the status of EHNV in Talbingo Reservoir will be undertaken. Samples collected during these surveillance activities will be analysed for EHNV using quantitative polymerase chain reaction (qPCR) testing techniques at the Elizabeth Macarthur Agricultural Institute (EMAI) or an alternative laboratory approved by the Chief Veterinary Officer (CVO). The most recent manual of diagnostic tests for aquatic animals by the World Organisation for Animal Health (OIE) specifies that qPCR is the recommended method for detection of EHNV in apparently healthy (non-clinically diseased) wild fishes (OIE 2022). Additionally, if analysis capabilities are available, serology testing will also be undertaken on adult redfin.

To declare freedom from disease based on an assumed sensitivity and specificity of the qPCR assay of 95% and 100%, respectively (OIE 2022) and a design prevalence of 2% the number of samples required to be sampled annually for a two year period was determined using the Ausvet's Freecalc software[5]. A minimum expected prevalence of 2% is frequently considered in an endemic non-clinical disease scenario (OIE, 2015) and has been recommended by Hick et al. (2019) and Diggles (2022) as an appropriate design prevalence.

[5] The following parameters (Dse = 0.95, Dsp = 1, 2% (0.02) design prevalence) were entered into Ausvet's Freecalc software https://epitools.ausvet.com.au/freecalctwo, which specified the number of samples required to demonstrate freedom from EHNV infection in a population of fishes that exceeds 10,000 in any given water body with 95% confidence (Type I and II error levels 0.05).

5.3.2. Response to Positive Detection

Notification of a positive test result for EHNV or identification of a fish kill or disease event will be undertaken according to legislative requirements.[6]

If EHNV is found to be present in Redfin within Talbingo Reservoir during the sampling outlined in Appendix F, the surveillance program will be reviewed to determine if additional sampling to determine the EHNV status of other waterbodies in the surveillance catchments is warranted. The outcome of this review and any updates to the Surveillance Program will be presented in the relevant Annual Report (see Section 7).

If a fish kill or other suspected disease event occurs in any of the surveillance catchments, and subsequent testing indicates that the cause of the event is EHNV, as the responsible agency for aquatic biosecurity, NSW DPI will determine the appropriate response. Snowy Hydro will assist in the process and the implementation of the management measures detailed in Section 5.4 where the outbreak is deemed to be caused by the operation of Snowy 2.0.

5.3.3. Surveillance Program Review

If EHNV is not detected in the Talbingo Redfin population at the conclusion of the Surveillance Program detailed in Appendix F, active sampling will cease.

If EHNV is detected in the Talbingo Reservoir Redfin population or in any of the surveillance catchments during active or passive sampling, the Surveillance Program will be reviewed and updated to include monitoring in other surveillance catchments.

5.4. Disease Management Measures

Upon suspicion or confirmation of disease, NSW DPI may consider implementation of an appropriate instrument such as a Control Order or General Biosecurity direction under the *Biosecurity Act 2015* to formalise any requirements for management actions to occur.

The key management measure to prevent the spread of EHNV is to prevent the spread of its amplifying host i.e. Redfin (Hick et. al., 2019). As noted by Hick et al. (2019), exclusion of the movement of live (and dead) fish will reduce, but not eliminate, the risk of transmission of EHNV beyond Tantangara Reservoir. As such the screens on the outlet to the mid-Murrumbidgee River and the M-E Tunnel which are intended to prevent live transfer of Redfin so far as it reasonably practicable, represent the key measures to minimise the potential of an impact from EHNV to occur in Macquarie Perch in the mid-Murrumbidgee River and other aquatic assets, should Redfin establish in Tantangara Reservoir. Other measures to prevent, eliminate or minimise the potential transmission and potential impact of EHNV such as UV treatment of release water were investigated during the EIS and RtS stage of the project but were not deemed to be reasonably practicable (EMM, 2020).

As EHNV can spread with the movement of apparently healthy fish including Rainbow Trout (Hick et al., 2019), ensuring that any fish stocking that occurs within the surveillance catchments as part of the TFMP or RFMP adheres to strict biosecurity protocols and tests fish for freedom from EHNV prior to stocking will also be of high importance.

As noted by Hick et al. (2019), even if EHNV is present in Redfin in Tantangara Reservoir, the probability of an effective dose of EHNV contacting Macquarie perch is low in the absence of a large disease outbreak occurring within Tantangara Reservoir. Should an outbreak of EHNV occur in Tantangara Reservoir, Snowy Hydro will work closely with NSW DPI and the NSW Department of Energy, The Environment, Climate Change and Water (NSW DEECCW Water) to determine whether planned releases to the mid-Murrumbidgee, required under the Snowy Water Licence, should be temporarily ceased or modified to minimise the potential for disease transmission. Other possible management measures to reduce the potential for subsequent disease transmission out of Tantangara Reservoir include the collection of dead or moribund fish from within the waterbody, dispersal of birds and/or restriction of access to the Reservoir. Such measures will only occur in close consultation with NSW DPI and other relevant regulatory authorities.

If an EHNV outbreak occurs in Tantangara Reservoir and the disease is subsequently spread to the mid-Murrumbidgee River and an impact to the population of Macquarie Perch occurs, additional funding for conservation measures for this species may be provided, as per the Trigger, Action, Response Plan (TARP) in the TFMP. Any management activities in response to an EHNV outbreak will necessarily be adaptive. All activities undertaken, including monitoring the level of success, will be documented in the relevant Annual Report (Section 7).

[6] Note: If the detection relates to a pest or disease listed in Schedule 1 of the Biosecurity Regulation 2017, which includes Redfin and EHNV, notification will occur in accordance with Part 6 within 1 working day after Snowy Hydro first suspects or becomes aware of the presence.

6. Tantangara Reservoir Spill Management

A critical element in preventing the potential spread of pest fish through Tantangara Dam into the mid-Murrumbidgee River (should Redfin or other pest fish establish in Tantangara Reservoir) will be ensuring that all water which enters the Murrumbidgee River has passed through the fish screening system fitted to the Tantangara Dam outlet. This means avoiding releases over the Tantangara Dam spillway so far as is reasonably practicable. Developing systems to prevent spills from the Tantangara Reservoir so far as is reasonably practicable is a CoA (Schedule 3, Condition 22 (b); Table 1).

As detailed in the Snowy 2.0 Main Works EIS (Cardno, 2019), Snowy Hydro has a strong track record of managing the headponds of its generation storages to prevent unplanned and uncontrolled spills. The combination of flexible, remotely supervised and controlled assets and in-house weather and inflow forecasting skill has meant that there has never been an uncontrolled spill of the Snowy Scheme's generation headponds, being Geehi, Tumut Pond and Talbingo reservoirs. Changes to the operating function of Tantangara Reservoir from a large diversion and storage pond to the headpond for Snowy 2.0 will be accompanied by a significantly increased generation diversion capacity and flexibility to integrate with the rest of the Scheme's operation, that will provide additional capacity and capability to manage spill risks than currently exists.

The current diversion capacity of the M-E Tunnel is 20 cubic metres per second (cumecs) in pressure flow operation. The generation diversion capacity of Snowy 2.0 from Tantangara Reservoir will be up to 385 cumecs. Combining the capacity of the Snowy 2.0 infrastructure with that of the M-E Tunnel and Tantangara Dam, the maximum capacity that can be routinely relied on to divert water out of Tantangara Dam will be more than 400 cumecs or 34 GL/day.

The highest recorded historical daily inflow into Tantangara Reservoir is 21 GL, which occurred in March 2012. This is equivalent to a 1:60 year Annual Exceedance Probability (AEP) flood. The peak inflow to the reservoir on that day was estimated to be approximately 350 cumecs. The maximum recorded three- and seven-day inflow volumes of 40 GL and 80 GL respectively, also occurred during the same inflow event. Had the same historical event occurred with Snowy 2.0 in place, the event could have been managed in its entirety from any starting storage level. This event also did not result in a spill when there was only the M-E tunnel available.

Currently without Snowy 2.0, a three-day event of a 1:100 AEP magnitude with peak inflows approaching 1,000 cumecs can be managed to avoid spill. With the additional diversion capacity afforded by Snowy 2.0, even with a conservatively high start storage level of 80% the day before the event, a 1:2,000 AEP flood, with peak inflows approaching 2,000 cumecs, will also be manageable without spill.

The ability to manage inflows through Snowy 2.0 is dependent on the station being available for service, and sufficient airspace being available in Talbingo, Jounama and Blowering reservoirs to receive discharges. The likelihood of a full station outage impacting diversion capability over 3 days (conservatively estimated at three days in 25 years) coincidental with a three day 1:100 AEP inflow event is considered to be extremely rare, in the order of 1:37,000,000.

Snowy Hydro has significant discretion over the airspace and release rates from Talbingo and Jounama reservoirs, with the ability to discharge 1,100 cumecs from Tumut 3 power station. Blowering storage, which is downstream of Jounama pondage, is a very large storage at 1,630 GL total active capacity. Snowy Hydro can forecast potential spill risk months in advance and can proactively manage releases into the Tumut valley and nominate an 'airspace' in Blowering Reservoir to flexibly manage inflows of comparable volumes to those set out above.

The requirement to avoid spill from Tantangara Dam so far as is reasonably practical will be set out in the Snowy Hydro operating instruction for Tantangara Reservoir and the operation of Snowy 2.0 and the M-E Tunnel will aim to meet this objective. The operating instruction will also specify that releases through the Power Station, M-E Tunnel and Tantangara Dam River Outlet Works (ROW) are to occur in preference to use of the spillway.

As a result of the above, following the construction of the Snowy 2.0 project, Snowy Hydro will be able to avoid spill from Tantangara Dam to the greatest extent practicable.

Should a spill over Tantangara Dam occur, and if Redfin are established in Tantangara Reservoir, this will trigger notification to NSW DPI and a round of pest fish monitoring in the mid-Murrumbidgee River using the methods and locations specified in Appendix E. The timing of this is to be determined in consultation with NSW DPI.

7. Reporting

Each year, by 31 August, or as otherwise advised to NSW DPI in writing, Snowy Hydro will publish an Annual Report detailing the monitoring data (excluding sensitive ecological data) and outcomes from surveillance and management Activities undertaken as part of this Plan.

Where relevant, the Annual Report will also include planned deviations from the surveillance activities detailed in Appendix E and F for subsequent years as well as any deviations that occurred in the previous year.

This report will be publicly available via Snowy Hydro's website (www.snowyhydro.com.au).

Part 2: Fish Screens and Barrier

This section addresses Condition 22(c) of the Snowy 2.0 Main Works Infrastructure Approval and describes the screens and barrier required under Condition 21 (Section 1.2;Table 1).

Under the *Biosecurity Act 2015* (Biosecurity Act) Snowy Hydro has a biosecurity duty to ensure that, as far as reasonably practicable, a biosecurity risk is prevented, eliminated or minimised. As per Section 21 of the Biosecurity Act, a duty imposed on a person to prevent, eliminate or minimise a biosecurity risk as far as is reasonably practicable is a duty:

- To prevent or eliminate a biosecurity risk as far as is reasonably practicable, and
- If it is not reasonably practicable to prevent or eliminate the biosecurity risk, to minimise the biosecurity risk so far as reasonably practicable.

As per Section 16 of the Biosecurity Act, 'Reasonably practicable' in relation to the prevention, elimination or minimisation of a biosecurity risk, means that which is, or was at a particular time, reasonably able to be done, taking into account and weighing up all relevant matters including:

- The biosecurity risk concerned, and
- The degree of biosecurity impact that arises, or might arise, from the biosecurity risk, and
- What the person concerned knows, or ought to reasonably know, about the biosecurity risk and the ways of preventing, eliminating or minimising the risk, and
- The availability and suitability of ways to prevent, eliminate or minimise the biosecurity risk, and
- The cost associated with available ways of preventing, eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.

Each aspect of the designs presented in this part of the BRMP have been considered, developed, and designed with a focus on what is considered 'reasonably practicable' to prevent, eliminate or minimise biosecurity risks associated with Snowy 2.0.

It should be noted that the design information provided for Part 2 of the BRMP is based on detailed but nonetheless early design studies. There will be additional design phases prior to manufacturing, construction, and installation. As such, the information presented here may be subject to variations. These will undergo rigorous assessment to ensure that they continue to meet their design intent and the biosecurity duty. This is standard practice in design phasing for complex infrastructure projects. As set out in Section 1.5.1 and 8.1.3, the screen design and plans presented in Section 8 below, will be updated in Stage 2 of the BRMP.

Snowy Hydro will continue to keep NSW DPI updated on the screen and weir design and procurement process as they progress. Should any deviations from the design and key aspects presented here be required, these decisions will be made with input and appropriate endorsement from NSW DPI.

8. Tantangara Fish Screens

8.1. Project Overview

As part of the EIS, Snowy Hydro made a commitment to construct fish screens at Tantangara Dam to prevent so far as is reasonably practicable the movement of pest fish (in all its forms: eggs, larvae, juveniles and adults) and spread of disease from Tantangara Reservoir to the mid-Murrumbidgee River and Lake Eucumbene. This commitment was subsequently imposed as Condition 21(b) of the Infrastructure Approval (Table 1).

8.1.1. Biosecurity Risk of Concern

A potential impact of Snowy 2.0 identified during the impact assessment for the project included the potential transfer and subsequent establishment of pest fish species, including Redfin, from Talbingo Reservoir to Tantangara Reservoir following hydrologic connection between Talbingo and Tantangara reservoirs (Cardno, 2019). The potential for these species to be entrained through the intake trashracks at Talbingo Reservoir during pumping, survive transfer through the 27 km of tunnels, rapid 800m depth water pressure change and blade strike through the power station turbines and subsequently establish within Tantangara Reservoir is uncertain, but the possibility cannot be excluded.

If Redfin do establish in Tantangara Reservoir, and in the absence of controls at these intakes, the movement of water through the Tantangara Dam ROW and M-E Tunnel provides a potential pathway for Redfin at various life stages to be distributed into the Murrumbidgee River below Tantangara Dam and into Lake Eucumbene if they occur in the intake vicinity. As set out in the Snowy 2.0 EIS and RtS, the key strategy identified to minimise the potential biosecurity impact from Snowy 2.0 centres on the prevention of movement of pest species out of Tantangara Reservoir so far as is reasonably practicable, thereby minimising the area over which the impact could occur and minimising the potential for impacts to threatened fish species.

8.1.2. Project Objective

The objective of the screen design process was to identify a design that prevents so far as is reasonably practicable the movement of pest fish and disease from Tantangara Reservoir to the mid-Murrumbidgee River and Lake Eucumbene whilst ensuring that Snowy Hydro's Snowy Water Licence (SWL) and operational requirements for the M-E Tunnel and Tantangara Dam ROW can be met.

As noted above, preventing transfer so far as is 'Reasonably practicable' in relation to the prevention, elimination or minimisation of a biosecurity risk, means that which is reasonably able to be done, taking into account and weighing up all relevant matters including the biosecurity risk concerned, the degree of biosecurity impact that might arise, the availability and suitability of ways to prevent, eliminate or minimise the biosecurity risk, and the cost associated with available ways of preventing, eliminating or minimising the risk.

8.1.3. Screen Design Process and Staging

The design process for the Tantangara screens was split into two workstreams. The first component has focused on engagement with screen designers, scientists, engineers and manufacturers to identify the optimal design of the screens to ensure that any structure is operable (i.e. capable of delivering the required volumes of water as and when required) and maintainable in the long term and is capable of meeting the project objective without compromising the operational requirements of the Tantangara Dam ROW and M-E Tunnel (see Section 8.1.2 and 8.2). This process is ongoing and will not be complete until the screens have been installed and completed commissioning.

Following on from the early design work completed for the EIS, eight different suppliers were approached to provide information for the screen design with a focus on how their products and technologies could address the challenging operational and maintenance conditions.[7] The suppliers were then evaluated on their responses as well as their track record and ability to provide large scale screen solutions for the project. From this request for information, three suppliers were selected to participate in a paid early contractor engagement process. This process invited the three suppliers in a competitive environment, to visit the project site, provide input into civil layout and mechanical design and demonstrate the ability of their technology to keep screens clean and in service. Feedback from this process was also used to refine the experimental parameters for the experimental efficacy testing in Section 8.4.

[7] Companies were selected from the Fish Screens Australia Supplier list (https://fishscreens.org.au/) and a number of select experienced overseas screen manufacturers.

Each supplier submitted two rounds of design including civil layouts which were each evaluated against the project's design criteria including fish exclusion requirements and the long-term operational and maintenance requirements.

Following the design evaluations, the three suppliers have been shortlisted to two who have been invited to provide further detail and tender on their product. The selected supplier from this process will become the primary advisor and supplier for the screen design presented in this Plan.

In the second workstream, Snowy Hydro engaged fisheries scientists to research the potential efficacy of different screen options. This primarily involved engaging researchers from Charles Sturt University to undertake world first experiments to obtain key data on the likely effectiveness of the screen options to exclude Redfin (see Section 8.4).

As noted in Section 1.5.1, the screen design information presented in this plan (Stage 1) will be confirmed and updated in Stage 2 of the BRMP. The design details and criteria provided in Stage 1 will form the basis of the next stage of design work that will be provided in Stage 2. In parallel, additional investigations will be undertaken to confirm the design of the structures are practical and they can be safely and reliably operated.

8.2. Screen functional and operational requirements

The Tantangara ROW and M-E Tunnel are critical components of the broader Snowy Scheme (Figure 3). The Tantangara ROW is used to make environmental and base passing flow releases to the mid-Murrumbidgee River to protect the aquatic environment and guarantee reliable water supplies to Cooma township. These releases are known as Snowy Montane Rivers Increased Flows (SMRIF) and Base Passing Flow (BPF) and are codified in the SWL. There are strict penalties if these releases are not met.

The M-E Tunnel transfers inflows from the Upper Murrumbidgee River to Lake Eucumbene where it is stored before being released through Tumut 1, Tumut 2 and Tumut 3 power stations and back into the Murrumbidgee River catchment at Blowering Dam (via the Tumut River). Water storage in Lake Eucumbene provides critical inter-year storage to enable regular and predictable annual releases from the Snowy Scheme to support Australia's agricultural industry.

Ensuring a functional ROW and M-E Tunnel to allow releases through them under all operating conditions is also critical for maintaining the dam safety of Tantangara Dam and avoiding releases over the Tantangara Dam spillway (Section 6).

In designing the screens to meet the project objective without compromising the operational requirements of the Tantangara Dam ROW and M-E Tunnel, the following functional requirements have been considered and incorporated:

- Availability of proven technology capable of preventing the movement of pest fish and disease
- Dam Safety Legislation relevant to the operation of Tantangara Dam
- Safe operation of the M-E Tunnel
- Personnel and public safety
- Existing SWL requirements from Tantangara ROW (environmental volume requirements, water release capacity and water extraction from the near surface)
- Tantangara ROW and M-E Tunnel capacity and functional requirements
- Asset reliability
- Asset durability
- Asset robustness
- Asset redundancy
- Constructability
- Maintenance requirements
- Asset lifespan.

It is critical that the design of the screens ensures that the structure can continue to operate under all possible operating scenarios and heavy debris loads, including bushfire conditions, to comply with the SWL and maintain water supply to Cooma and downstream as well as meet Snowy Hydro's operational requirements for these assets.

The SWL requirement for releases through the Tantangara ROW to be made from the near surface horizons has posed a particular design challenge given the 23m operating range of the reservoir. This requirement means that the

screens must be able to move up and down and draw water from near the surface of the reservoir as the water level changes within the reservoir.

8.2.1. Fish Screen Location

Tantangara Reservoir is located within KNP at an elevation of over 1200 m. It collects inflows from the Murrumbidgee River and the Goodradigbee River Aqueduct and provides a means for storage and diversion of water to Lake Eucumbene via the M-E Tunnel.

The screens will be located at the south easterly portion of Tantangara Reservoir (Figure 4) within the indicative disturbance area identified in the EIS (Figure 5). They will filter water that enters the M-E Tunnel and the Tantangara Dam ROW, located ~23m and ~34m below the reservoir FSL respectively (Figure 3). The screening structure will be serviced by the existing Tantangara Road. Construction will require additional access from the vicinity of the existing Tantangara boat ramp within the construction envelope.

Within the south easterly portion of Tantangara Reservoir there are limited macrophytes present and no drowned timbers. The substrate at the bottom of the reservoir consists of soft unconsolidated muds while the southern bank of the reservoir proximal to the dam wall consists of high vertical relief granite boulders. Water turbulence associated with the operation of Snowy 2.0 is not anticipated to influence the proposed location of the screen. The location of the screens so close to Tantangara Dam means that their installation will not result in the loss of any areas of the reservoir considered of high value to recreational fishing in Tantangara Reservoir.

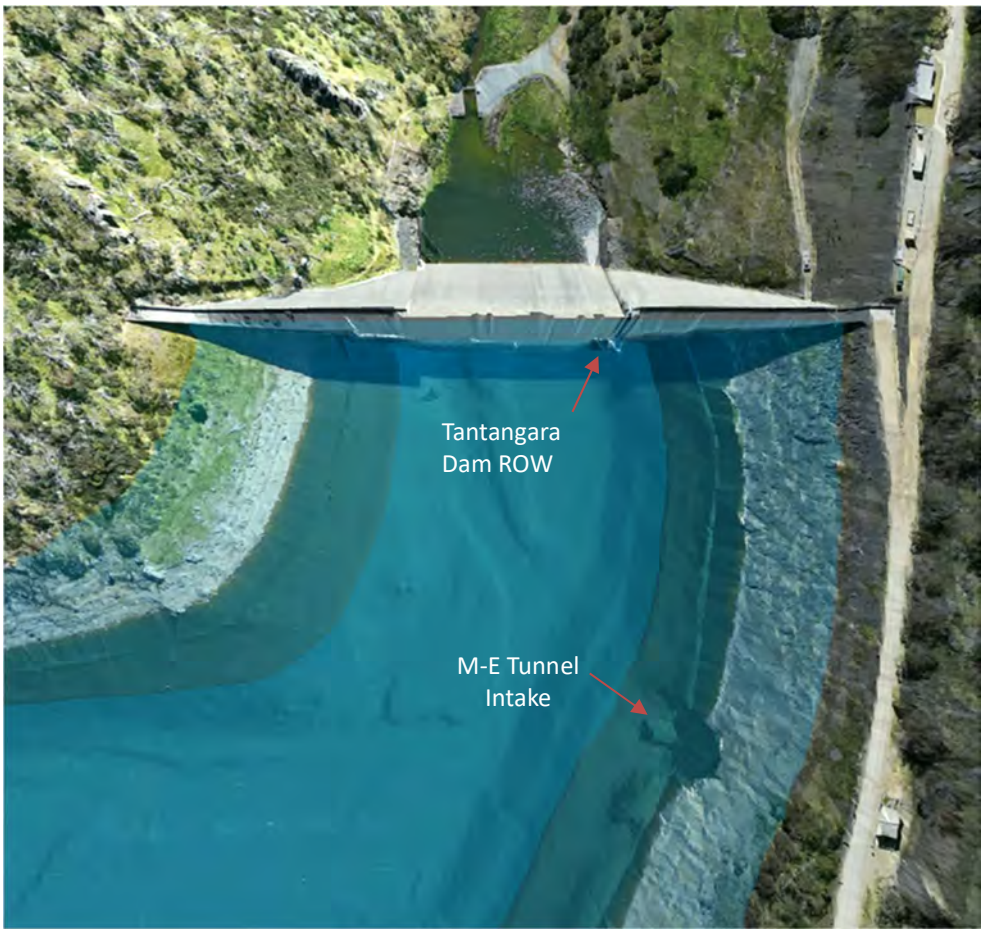


Figure 3: Tantangara Dam, Spillway and ROW and M-E Tunnel Intake

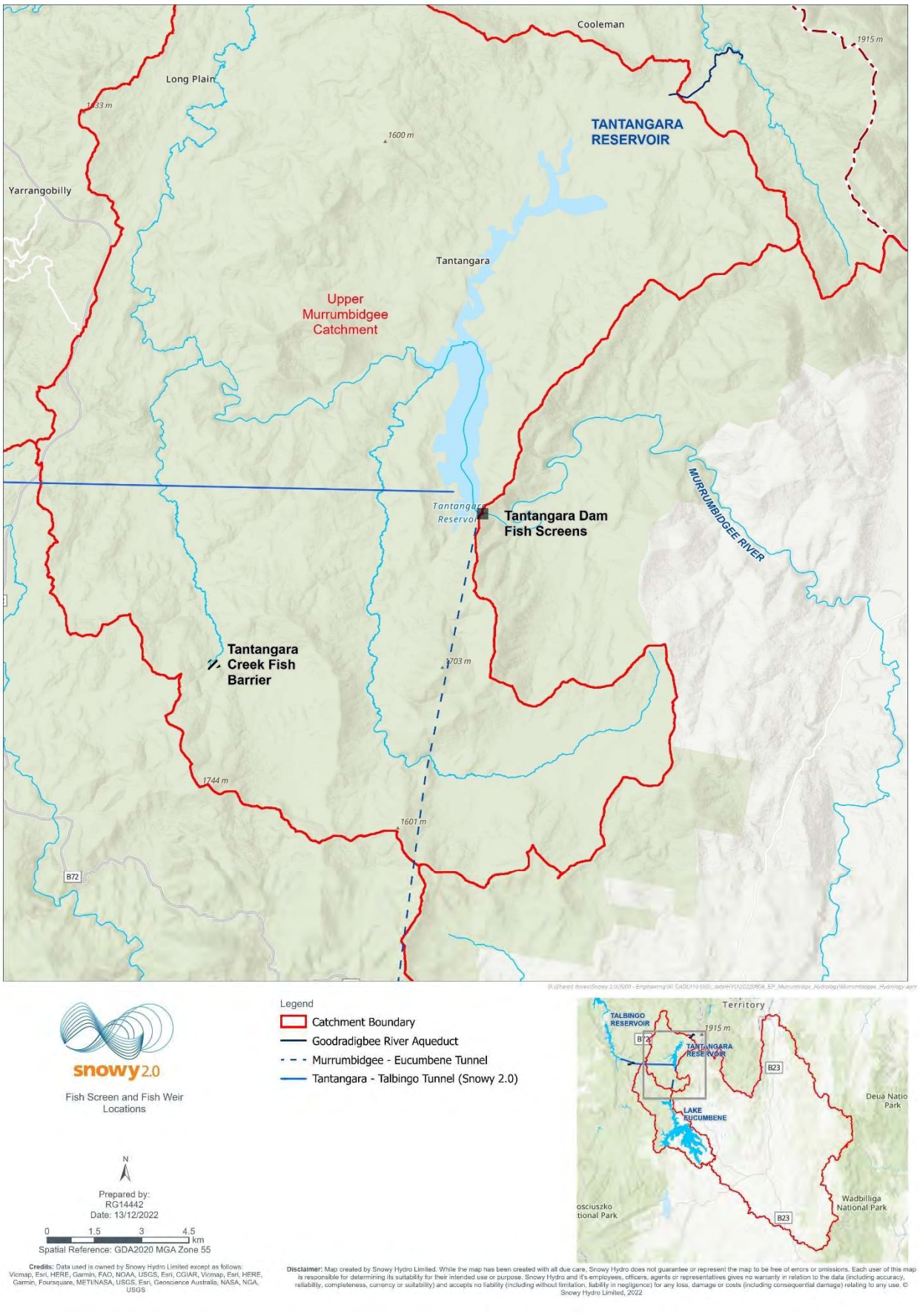


Figure 4: Locality map showing the location of the Tantangara Fish Screens and the Tantangara Creek Fish Barrier

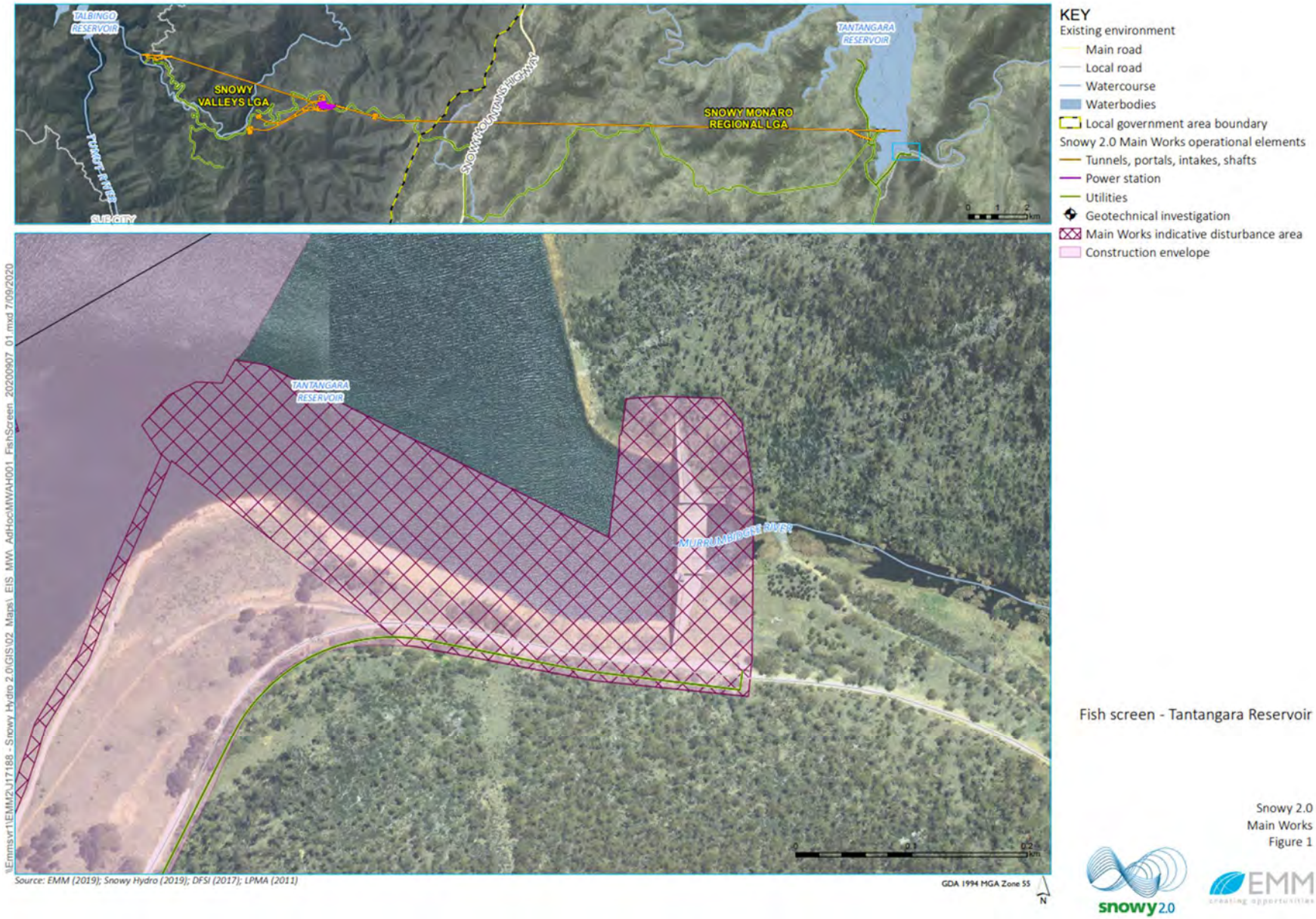


Figure 5: Tantangara Fish Screen Structure Location

8.3. Screen design

Following the screen structure optimisation process it was determined that cylindrical screens will be the most appropriate design option to be installed within the south easterly portion of Tantangara Reservoir (Figure 6). All water delivered to the M-E Tunnel and Tantangara Dam ROW will pass through the screens, into each of the existing structures at the dam and the M-E tunnel and be released in accordance with the SWL and Snowy Hydro's operational requirements.

Figure 6: Example of cylindrical fine mesh wedge wire screen similar to that planned for Tantangara

The screens will be sited on the right abutment of the Tantangara Dam between the dam wall and the existing Murrumbidgee-Eucumbene tunnel intake. The screen configuration will consist of multiple cylindrical screen units arranged in a modular fashion to facilitate partial isolation for maintenance and repairs without requiring the remaining screens to be out of service. Each screen will be attached to a rail, allowing each screen to be moved independently within the operating range of the reservoir as well as being removed from the water for inspections, maintenance, and replacement. The screens will be connected to existing infrastructure via a connection manifold (Figure 8).

Based on available information and analysis of requirements, it is anticipated that between four and six individual screens will be installed with the final number to be specified in Stage 2 of the BRMP.

Major visual impacts from the screen will be minimised by its location proximal to Tantangara Dam and the M-E tunnel infrastructure as well as the fact that most of the infrastructure will be located below the water level during operation.

8.3.1. Screen material

The cylindrical screens will be constructed using wedge wire as the screen material. The selection of wedge wire screen material was an outcome of the early contractor engagement process with all potential suppliers recommending the use of wedge wire screens considering the requirements around continuous operation and reliability. Benefits of wedge wire include its superior strength, durability and cleaning characteristics compared to other materials such as woven wire mesh. Wedge wire has a hard, smooth exterior surface which allows for regular mechanical brush cleaning without damage.

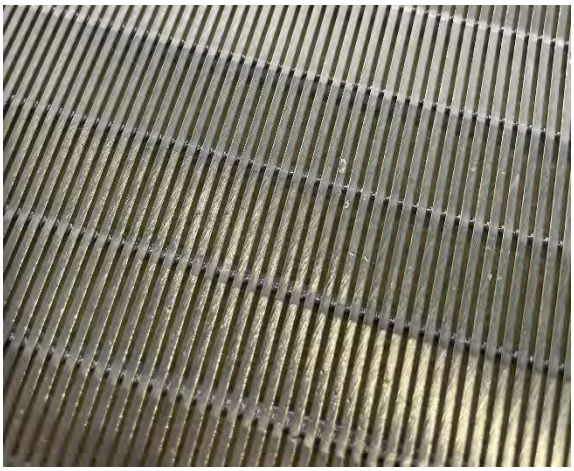


Figure 7: Wedge wire screen material

8.3.2. Screen aperture

The aperture of the wedge wire cylindrical screens is expected to be 0.75 mm, although as noted below, there are remaining concerns about the operability of such a fine aperture screen.

This aperture has been selected by considering, the screen efficacy experiments (Section 8.4), capability of screen manufacturers, experience of precedent projects, the ability to clean and maintain, the likely debris the screens will encounter of its design life, the criticality of maintaining supply, dam safety and the capital costs of the screens, although research on all of these aspects is ongoing. Additional activities such as in-field testing of the operability of screens with this aperture in Tantangara Reservoir will occur as appropriate.

In nominating a preliminary aperture of 0.75 mm, Snowy Hydro have sought to select the finest screen possible with an operational precedent, noting that based on the result of extensive worldwide investigations, the planned screens at Tantangara Reservoir will be the largest screens of this aperture installed and operated by some margin.

Snowy Hydro is aware of only one large capacity screen facility that has been constructed with this aperture. Cayuga Power Plant in the United States[8], capacity 11 cumecs, was decommissioned within two years of commissioning so no detailed information is available regarding the successful operation and maintenance of this facility. Snowy Hydro has reached out to other smaller capacity screen operators with similar, and larger, apertures within Australia, New Zealand and the United States with varying levels of success. Examples from projects in Australia and New Zealand are either of very small capacity, i.e. in the order of 1 cumecs or have utilised screen apertures of 2 mm or above. Engagement with the manufacturers and operators of these facilities have highlighted significant challenges for operation and maintenance, particularly related to screen cleaning. It is self-evident that larger aperture screens are less likely to become blocked and will require less effort to maintain. Given the likely debris conditions in this reservoir (Section 8.3.3) Snowy Hydro does not have confidence that a screen of any aperture less than 0.75 mm could be reliably operated and concerns remain regarding an aperture of 0.75 mm.

Selecting a screen aperture involves striking a balance between the expected effectiveness of the screens (Section 8.4) and the functional and operational requirements of the structures they will service (Section 8.2). Snowy Hydro acknowledges NSW DPI's feedback that the optimal aperture for fish exclusion needs to be balanced with a need to ensure the screens continue to operate effectively. Overly conservative screen parameters can be counter-productive if they result in the screens failing to pass water and screen blinding, subsequently increasing approach velocities and therefore further reducing efficiency of fish exclusion. Consequently, overly conservative parameters can also lead to greater risk of Redfin movement over time, if the screens fail or need to be removed. As the design, procurement and construction process progresses, Snowy Hydro will continue to engage with manufacturers and others to seek the necessary assurances regarding the operability of 0.75 mm screens.

The final design aperture of the screens will be specified in Stage 2 of the BRMP.

[8] https://isi-screens.com/project/cayuga-power-plant/

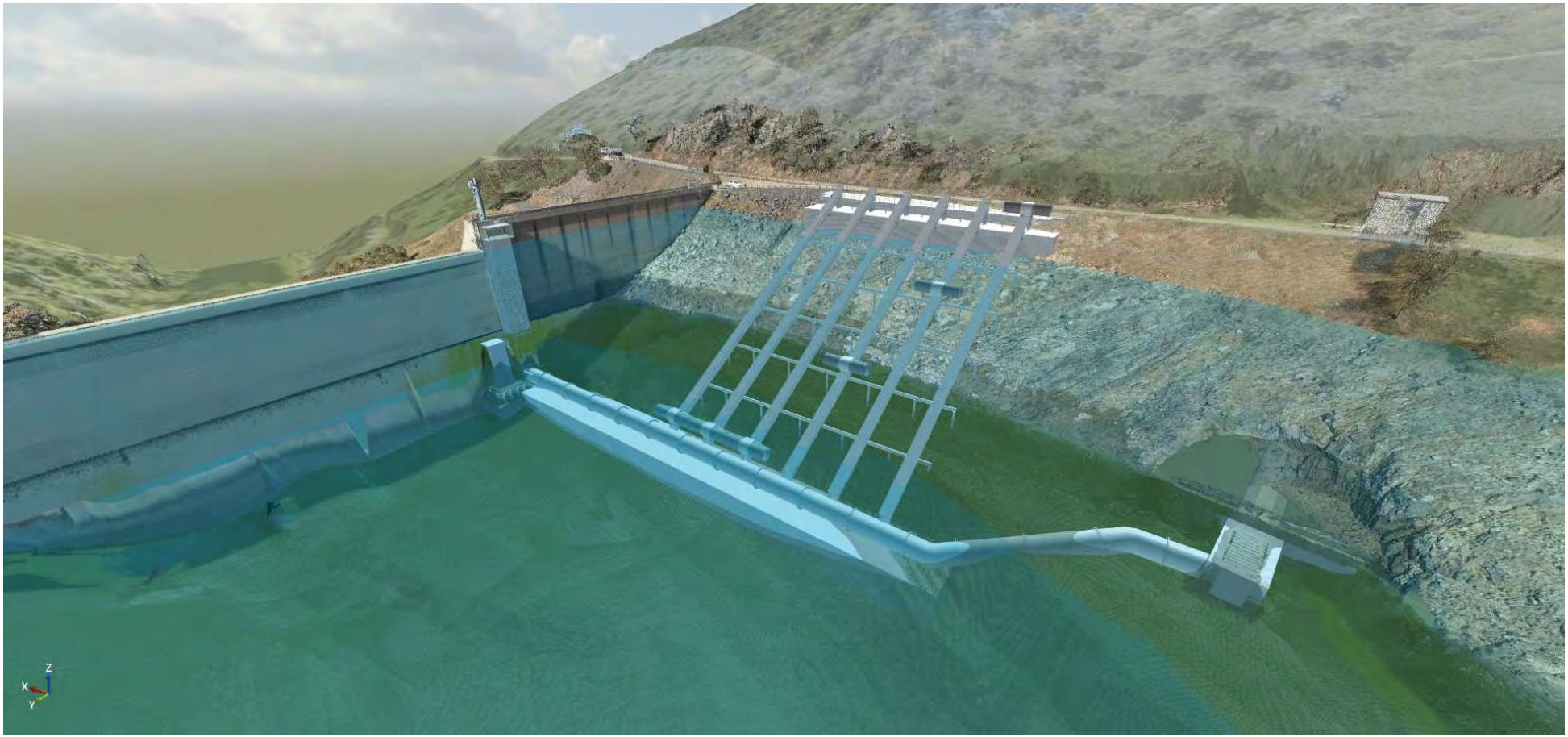


Figure 8: Conceptual design of the Tantangara fish screens

8.3.3. Expected debris and planning cleaning apparatus

Due to the predominantly west north westerly winds that blow across the reservoir, the south easterly portion of the reservoir accumulates a relatively high load of debris compared to the rest of the reservoir. Debris that accumulates in this location includes but is not limited to driftwood, recreational boating and fishing equipment, grasses and other biological material as well as ash and debris from bushfires. Recent experience from the 2019 bushfires across the Snowy Scheme found that ash debris loads into scheme reservoirs were considerable and led to frequent blockages and increased wear on equipment (Figure 9).

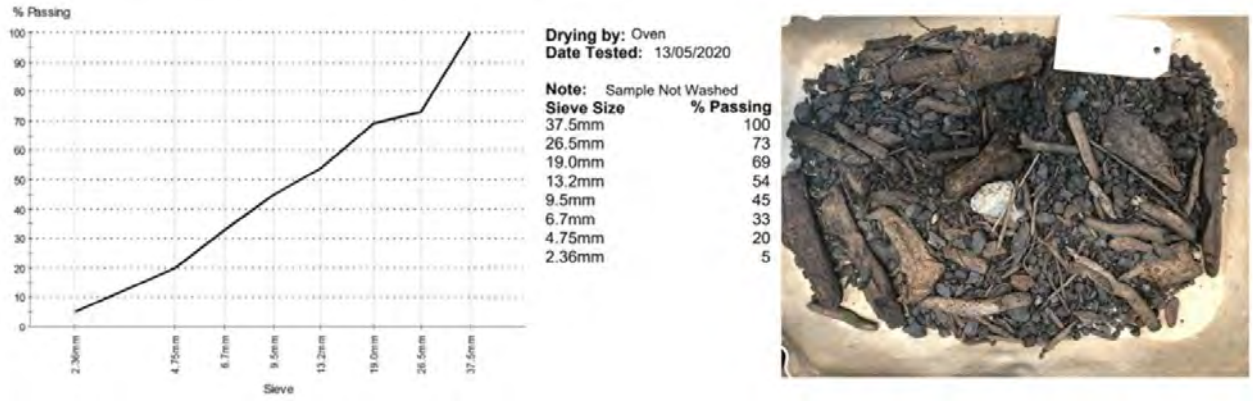


Figure 9: Particle size distribution of analysis of material extracted from Tumut 3 Power Station Unit 1 intake February 2020 post bushfires

Existing intake structures in the south easterly portion of the reservoir have been known to accumulate high loads of wind swept grass likely a species of panicum (potentially hairy panic (*Panicum effusum*)) as well as being subject to biofouling from a variety of organisms that inhabit the reservoir (Figure 10).

Figure 10: Example of biofouling accumulating on the surface of the existing Tantangara ROW coarse screens

To reduce the build-up of debris and biofouling to enable continuous operation a rotating brush system will be installed with each cylindrical screen. The rotating brush system will consist of a series of nylon brushes that clean the external and internal surfaces of the screen.

The brush system will be automated and capable of operating at various frequencies. The frequency of operation will be adjusted according to debris loads, operational requirements as well as ensuring that the design approach velocity is not exceeded.

To date, Snowy Hydro has not managed to obtain good evidence on the effectiveness and reliability of brushes when used on such fine screens as those planned for Tantangara Reservoir, as 0.75 mm aperture screens are not common. As the further design and procurement stages progress, if evidence emerges that such a fine screen may unacceptably threaten the reliable operation of the Tantangara ROW and M-E Tunnel, the aperture of the screens may need to be increased. This will be confirmed in Stage 2 of this BRMP.

Figure 11: Example of brushes used in wedge wire screens (Source: NSW DPI, 2021 p.31)

8.3.4. Approach Velocity

The screens will have a nominal design maximum approach velocity of 0.15 m/s[9].

Such a design maximum approach velocity is generally consistent with values to reduce fish of various taxa and life history stages from being impingement on or entrainment through the screens (Queensland Department of Agriculture and Fisheries, 2020; NSW DPI, 2021).

This maximum velocity is expected to occur infrequently with the average approach velocity more likely to be within the range of 0.03 m/s - 0.075 m/s under normal operating conditions. This assessment is based on analysis of flow frequency duration curves for historical water transfers through the Tantangara ROW and M-E Tunnel.

As shown in Section 8.4, lower approach velocities consistently resulted in lower rates of Redfin larval entrainment for a given larval age and screen aperture.

[9] Measured at approximately 8 cm from the surface of the screen.

8.4. Testing Screen Effectiveness

Snowy Hydro commissioned Charles Sturt University (CSU) to undertake comprehensive testing of the efficacy of various screen and approach velocity configurations to exclude Redfin. Testing focused on the smallest life stages of fish (eggs and larvae) and assessed rates of entrainment assuming fish were located immediately in front of the screens (Doyle et al., 2023).

This innovative project consisted of the following key activities:

1. Developing, commissioning and testing a custom-built laboratory flume for undertaking experimental exclusion trials that were considered representative of conditions expected to be encountered (including the curvature of the screens) (Figure 12)
2. Collecting wild broodstock, captive breeding, and rearing of eggs and larvae at CSU
3. Optimising experimental design parameters including duration of experiments to ensure applicability of results to inform the project
4. Undertaking balanced and replicated experimental exclusion trials for fish eggs and larvae of various ages (days post hatch (DPH))
5. Robust and comprehensive analysis of data from replicated trials to determine rates of entrainment.

Testing was undertaken based on the following experimental factors:

- Screen aperture size – 0.25mm, 0.5 mm, 0.75 mm and 1.0 mm
- Approach velocity - 0m/s, 0.03 m/s, 0.075 m/s, 0.15 m/sec
- Larvae per test - 30
- Replicates per combination of screen aperture and approach velocity - 3
- Age of larvae tested - 1-2 DPH to 33-34 DPH
- 24 hr post entrainment monitoring of survival.

A summary of the screen effectiveness results is presented in the sections below.

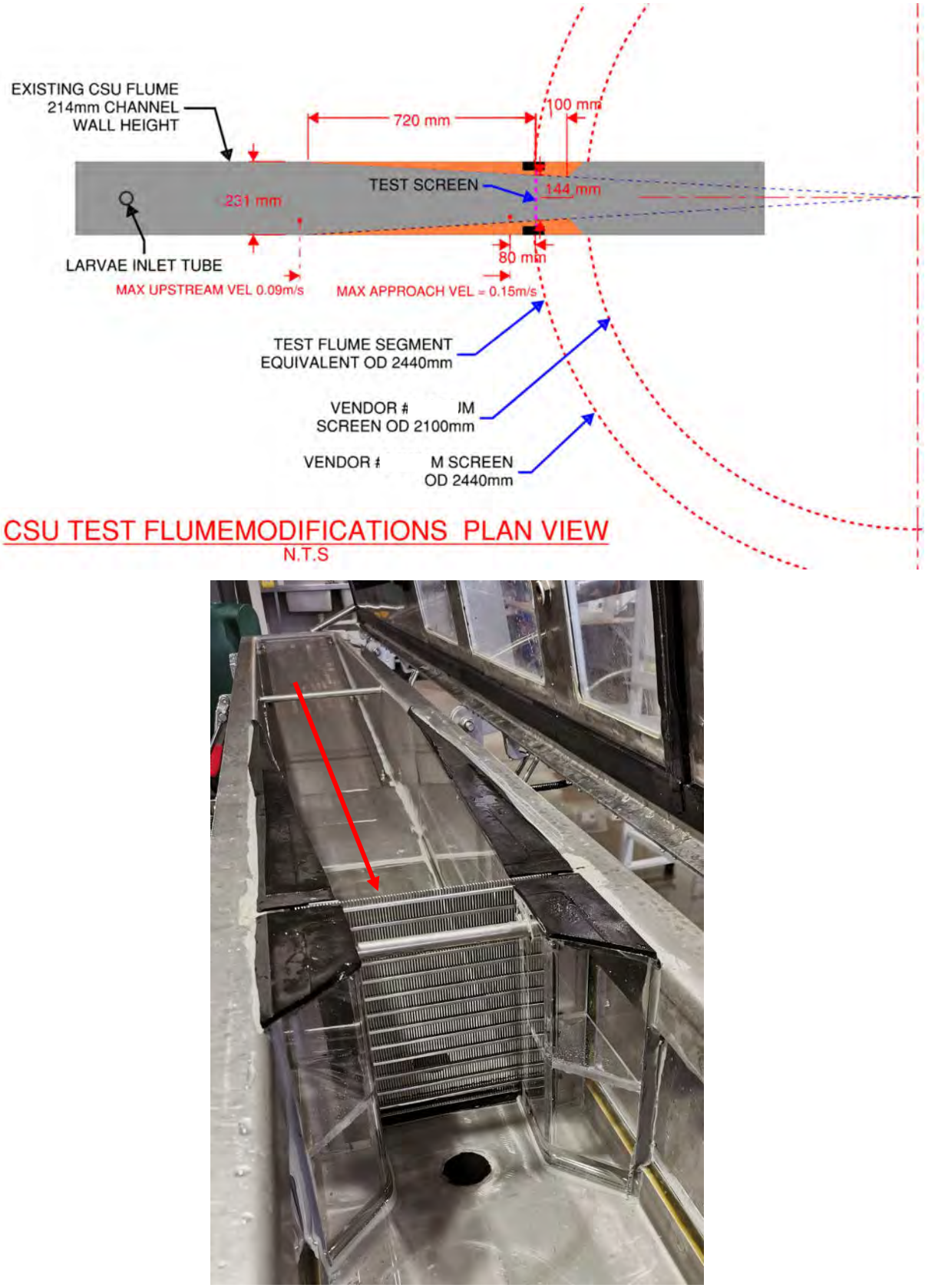


Figure 12: Top: schematic of the experimental flume with the tapered inlet modifications (orange). Bottom: Tapered inlet installed in the experimental flume, red arrow is direction of flow (Source: Doyle et al., 2023).

8.4.1. Eggs

The screen trials found that eggs were not entrained through the screens under all apertures and velocities tested (Doyle et al., 2023; Table 8). As such, it is expected that the screens will prevent the entrainment and subsequent transfer of all Redfin eggs from Tantangara Reservoir to the mid-Murrumbidgee River and Lake Eucumbene.

Table 8: Percentage of fertilised Redfin eggs that were recorded to be entrained through test screens at various approach velocities and screen apertures (Doyle et al., 2023)

Screen Aperture	0.5mm		1mm	
Velocity (m/s)	0.075	0.15	0.075	0.15
Egg (5 DPF)	0	0	0	0

DPF – Days Post Fertilisation

8.4.2. Larvae

The results of the testing by Doyle et al. (2023) identified that none of the screen options assessed are completely effective at excluding all age classes of Redfin larvae. Results for testing on 0.75 mm aperture screens found that larvae were completely excluded between 17-26 days after hatching, depending on the approach velocity of the test (Figure 13). Rates of larvae entrainment decreased rapidly as larvae aged and grew prior to being fully excluded. Larvae entrainment rates through the test screens were dependent on age, aperture size and approach velocity. The proportion of larvae that were entrained was negatively correlated with age for each screen aperture and approach velocity tested (Doyle at al., 2023; Figure 13). Other factors such as level of ossification, swimming ability and behaviour were also considered likely contributing factors to the rate of entrainment (Doyle et al., 2023).

Based on the results of these experiments, if Redfin are transferred to Tantangara Reservoir, and are able to survive and breed to produce larvae, and those larvae enter the immediate vicinity of the screens while they are operational, there will be some risk of entrainment and transfer to the mid-Murrumbidgee River or Lake Eucumbene for a short period of time following hatching. This risk of entrainment will exist for only a portion of the year during spring when Redfin are known to spawn. As Redfin larvae have high levels of natural mortality during the larval and juvenile stages of development (Viljanen et al. 1982; Heibo et al. 2005), it is expected that if entrained through the screens, only a small proportion would potentially subsequently reach maturity.

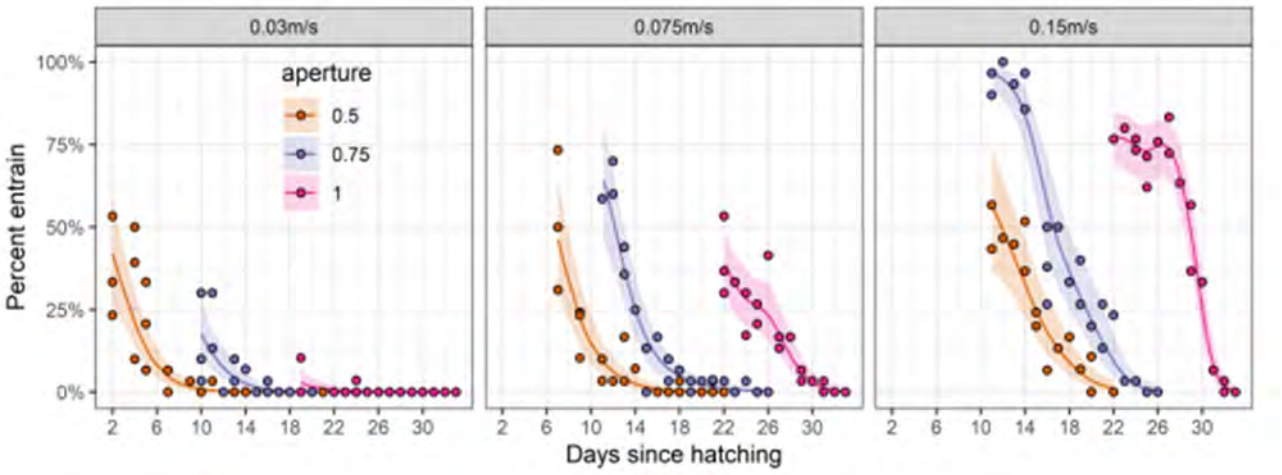


Figure 13: Relationship between entrainment percentages and age for varying velocities (0.03, 0.075 and 0.15 m/s, different panels) and aperture (0.5, 0.75 and 1 mm, different colour lines) from 3-minute trials for larvae 1–34 DPH. Round symbols show raw data estimates. Curves shows mean estimates with 95% Credible interval bands (shaded regions) (Source: Doyle et al., 2023).

8.4.3. Adults and Juveniles

As all larvae over one month old were excluded from the experimental trials (Figure 13), it is expected that the normal operation of the screens will prevent the movement of all adult and juvenile Redfin from Tantangara Reservoir to the mid-Murrumbidgee River and Lake Eucumbene.

8.5. Secondary (Behavioural) Controls

Building on the research by THA Aquatic (2019), Snowy Hydro commissioned international expert, Richard Horsfield as well as other Australian engineers to consider the potential to use secondary, behavioural controls such as sound and light to reduce the likelihood of Redfin larvae to come in contact with the planned screens in the context of the current application within Tantangara Reservoir. Based on these evaluations, no secondary control measures were considered feasible to increase the effectiveness or efficacy of the proposed screens. This result was based on an assessment of many factors including but not limited to the unreliability of many secondary control systems, the lack of species-specific deterrence measures, limited ability to modify larval behaviour (due to sensory/behavioural responses to secondary control measures), limited documented efficacy of many measures, and site specific constraints associated with factors such as the depth of the reservoir, the high volume of water being transferred, site access, remoteness and safety and maintainability of effective control measures. As such, no secondary control measures will be installed as part of the fish screen structure. The later design and operational phases of the screens will however consider how to minimise the potential for larvae to come in contact with the screens while they are in use (See Section 8.7).

8.6. Minimising Environmental Impacts

The environmental impacts associated with installing the screens will be managed throughout the civil design process with a focus placed on minimising the construction footprint (Figure 5) as well as minimising environmental impacts during the construction and operational stages of the project. All construction work will occur below the probable maximum flood level of the reservoir. All areas utilised during the construction stage and not required for long term operation will be rehabilitated.

A key limitation for the design and construction of the screens is that Tantangara is an operational reservoir and cannot be physically drained. In addition, during construction of the screens water releases out of the Tantangara ROW will need to continue to meet SWL requirements or any agreements made with the Ministerial Corporation to vary these. As such the duration that any restriction in water releases from Tantangara Reservoir will occur throughout the construction phase will be minimised and closely managed.

All construction activities will be subject to compliance with a Construction Environmental Management Plan (CEMP) which will be prepared and implemented by the contractor responsible for installing the screens. This document will address and manage environmental risks associated with construction including the requirement to minimise risks associated with the movement and/or spread of weeds, pests and pathogens during construction. Public access to the boat ramp and along Tantangara Road during construction will be managed in accordance with the Snowy 2.0 Infrastructure Approval conditions for Recreation and Traffic Management and will be set out in the CEMP.

The CEMP will include all relevant requirements from other approved Snowy 2.0 Management Plans. Aspects of the CEMP relating to construction and public access, including access to the Tantangara Boat Ramp, during works are to be developed in close consultation with NPWS.

8.7. Maintaining and Improving Effectiveness Over Time

Ensuring that the screens will function as designed and maintain efficacy over time is acknowledged as crucial for the design of the structure. Operation of the screens will be fully automated with several alarms and other protections in place to ensure that the system cannot operate if efficacy or safety is compromised. Once constructed, the Tantangara Screens will form part of the Upper Tumut Snowy Scheme region and will be maintained and operated by the Upper Tumut maintenance team based out of Cabramurra, a 60 km, approximately 1 hour trip. As with other Snowy Scheme Assets, operation of the screens will occur via the Snowy Mountains Control Centre (SMCC).

The selection of durable screen material and components is a key criterion for design and is one of the key reasons why wedge wire was selected as the screen medium. The selection of an appropriate cleaning system will prevent blockages, ensure the structure functions as designed and meets the requirement of this plan. All screens will be operated and maintained within the fabricators requirements under their operations and maintenance plans in order to keep the warranties on the structures.

During commissioning, performance testing will occur to ensure that the structure is operating as designed and intended. As the design develops a suite of performance testing will be developed with the screen suppliers to ensure appropriate verification of the design and manufacture. At this stage it is envisioned that real time differential pressures will be monitored and used to assess debris loading and condition across the screens.

Whilst the experiments by Doyle et al. (2023) show that the potential period of entrainment of Redfin larvae through the screening system at Tantangara will be short, there are additional measures associated with screen operation that could reduce the potential for larvae to encounter the screens during the short period when larvae may be present in the reservoir, should Redfin establish at some point in the future. These measures include:

- Minimising or even avoiding releases to the mid-Murrumbidgee River during the period when pest fish larvae are present. Under the SWL, Snowy Hydro is required to make releases from Tantangara Dam in accordance with volumes and a pattern of releases prescribed by NSW DEECCW Water. NSW DPI and NSW DEECCW Water may choose to work together to dictate a pattern of releases to Snowy Hydro that ceases/minimises releases to the mid-Murrumbidgee River during the highest risk period.
- Make releases from deeper sections of the reservoir. The SWL also requires that Snowy Hydro make releases from Tantangara Dam using water drawn from the near surface horizons. As larvae are more likely to be found in shallower water (THA Aquatic, 2019), the risk of transfer will be higher if releases are made from this part of the reservoir. As Redfin spawn during late winter, early spring (NSW DPI, 2019), stratification within the reservoir is unlikely to be well developed at this time. If requested by NSW DPI, NSW DEECCW Water may choose to request that Snowy Hydro make releases from deeper in the reservoir during the highest risk period.

8.8. Summary of preliminary screen design criteria

A summary of the preliminary design criteria for the Tantangara Screens is provided in Table 9. These will be confirmed in Stage 2 of the BRMP. Should any of the criteria need to be amended following Stage 2, Snowy Hydro will revise the BRMP.

Table 9: Key preliminary design criteria for the Tantangara Screens

Screen aspect	Details
Screen location	Southern end of Tantangara Reservoir between Tantangara Dam and the M-E Tunnel intake
Screen type	Cylindrical screens
Water filtration	All water delivered to the M-E Tunnel and Tantangara Dam ROW will pass through the screens
Screen configuration	Multiple cylindrical screen units arranged in a modular fashion
Screen material and aperture	Wedge wire material with an aperture of 0.75mm
Cleaning apparatus	Brushes
Approach velocity	Nominal design maximum approach velocity of 0.15 m/s.

8.9. Conclusion

Snowy Hydro have undertaken an exhaustive and objective process to identify a screen design that can exclude pest fish so far as is reasonably practicable and can meet the operational requirements that are essential for the ongoing operation of Tantangara Dam and the M-E Tunnel.

The screen design presented here has been developed based on extensive engagement with fisheries scientists, engineers and screen manufacturers. It is Snowy Hydro's view that this design represents the best possible solution to prevent so far as is reasonably practicable the movement of pest fish (in all its forms: eggs, larvae, juveniles and adults) and spread of disease from Tantangara Reservoir to the mid-Murrumbidgee River and Lake Eucumbene.

As noted above, Snowy Hydro will continue to keep NSW DPI updated on the screen design and procurement process as they progress. Stage 2 of the BRMP will be submitted prior to the commencement of construction of the screens. It will provide an update to the criteria presented in Table 9 should this be required and will provide additional details of the screens arising from the next stage of design.

9. Tantangara Creek Weir

9.1. Project Description

As part of the EIS, Snowy Hydro made a commitment to construct a fish barrier on Tantangara Creek. This commitment was subsequently imposed as Condition 21(a) of the Infrastructure Approval. The objective of the Tantangara Creek Barrier (the Barrier) is to prevent so far as is reasonably practicable, Climbing Galaxias reaching the existing population of Stocky Galaxias in the upper reaches of Tantangara Creek (Condition 21(a); Table 1).

9.1.1. Biosecurity Risk of Concern

If Climbing Galaxias are transferred from Talbingo Reservoir to Tantangara Reservoir and are subsequently able to establish in the upper Murrumbidgee River catchment, there is a risk that, in the absence of controls, the species may colonise the known habitat of the Stocky Galaxias in the upper section of Tantangara Creek above Tantangara Creek Falls. Impacts to Stocky Galaxias could include predation and/or competition resulting in impacts to the population (Cardno 2019).

9.1.2. Design Considerations

The barrier design process has included multiple iterations and input from the SMEC Dams and Hydropower team in consultation with species specialists. The structure has been designed in compliance with dam safety portfolio management requirements, the safety in design review process, operational guidelines and using the fish barrier design criteria developed by Raadik (2019). Due to the isolated nature of the site and the challenging weather conditions that can occur, the structure has been designed to be as low maintenance as practical to minimise risks to operational staff. Key elements of the design criteria by Raadik (2019) intended to prevent access over the barrier by Climbing Galaxias include:

- Barrier strength and design life
- Design flow
- Barrier height, width, profile
- Upstream and downstream zones
- Wetted pathways for movement (Raadik, 2019).

The Barrier site is in the Gooandra region within the KNP. The site is approximately 10 km Southwest of Tantangara Dam on the Tantangara Creek. Access to the site can be gained from the south via the Alpine Creek Trail or from the north via the Nungar Creek and Bullocks Hill Trail. Figure 4 shows the locality of the Barrier site. All works associated with construction and operation of the Barrier will be contained within the construction envelope equating to an area equal to or less than the indicative disturbance area identified in the main works EIS (Figure 14).

The positioning of the Barrier considered multiple factors including:

- Maximising Barrier effectiveness
- Minimising impacts to Stocky Galaxias habitat
- Minimising the footprint of the Barrier and upstream inundation area
- Site Access
- Minimising impacts to visual amenity
- Utilising the natural change in topography to maximise exclusion potential.

The site indicated in Figure 15 was selected as it provides a natural jump in topography that is beneficial for barrier design and allows for the smallest possible and least intrusive structure. This location provides the smallest permanent inundation area of alternate locations considered. Although the location is slightly further upstream than the area proposed by Raadik (2019), it is still located within the area of Tantangara Creek that is considered marginal habitat for Stocky Galaxias due to the extensive areas of bedrock present and fast flows. As such construction at this location will minimise potential construction impacts and loss of habitat to Stocky Galaxias. From a visual impact perspective, the structure will be largely obscured from most viewpoints by local topography. The barrier will not be visible from the access track below and will not detract from the Tantangara Creek Falls located downstream of the barrier.

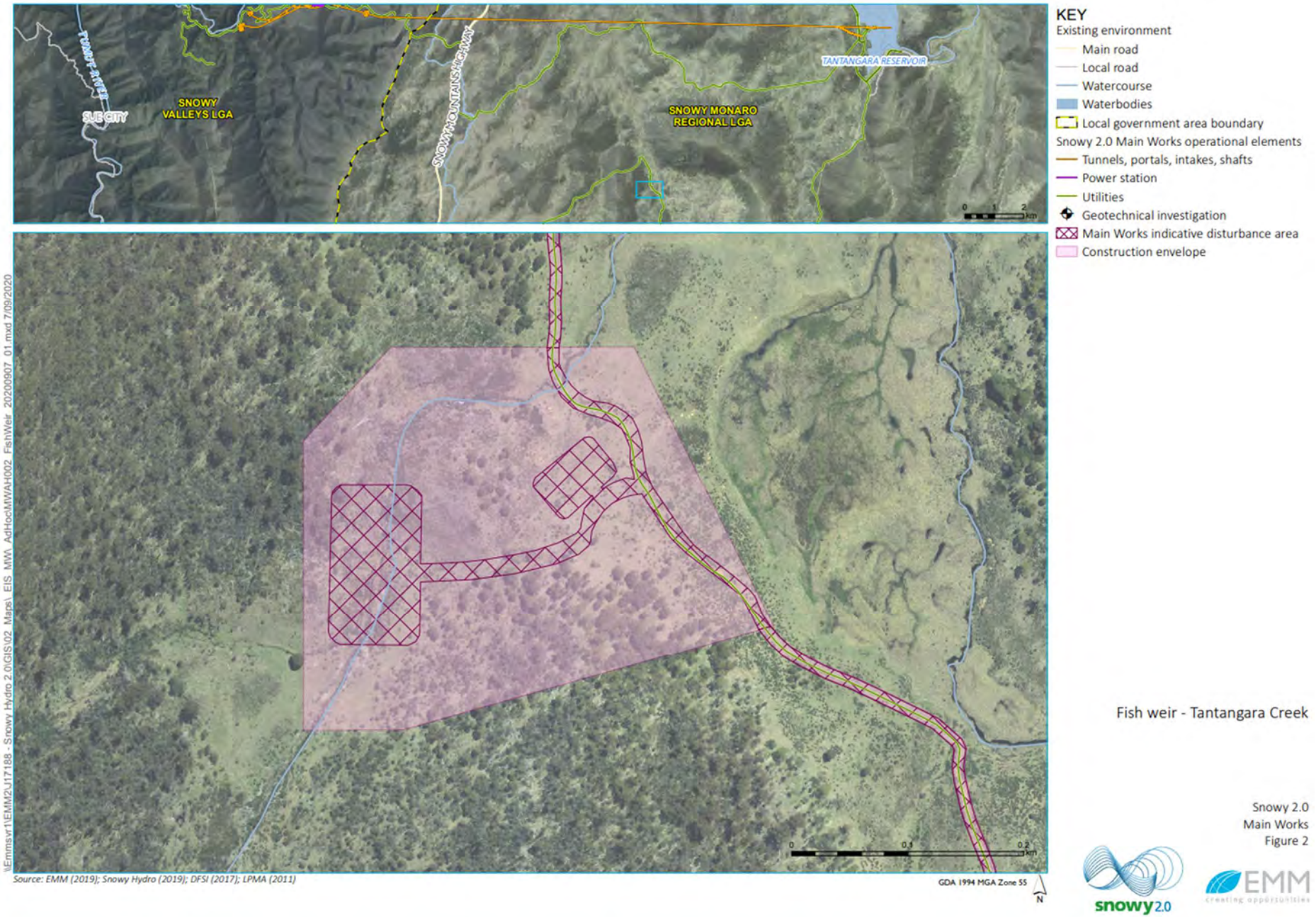


Figure 14: Tantangara Creek fish barrier disturbance Area

Note: Construction road alignment and laydown area are indicative only and may be reduced

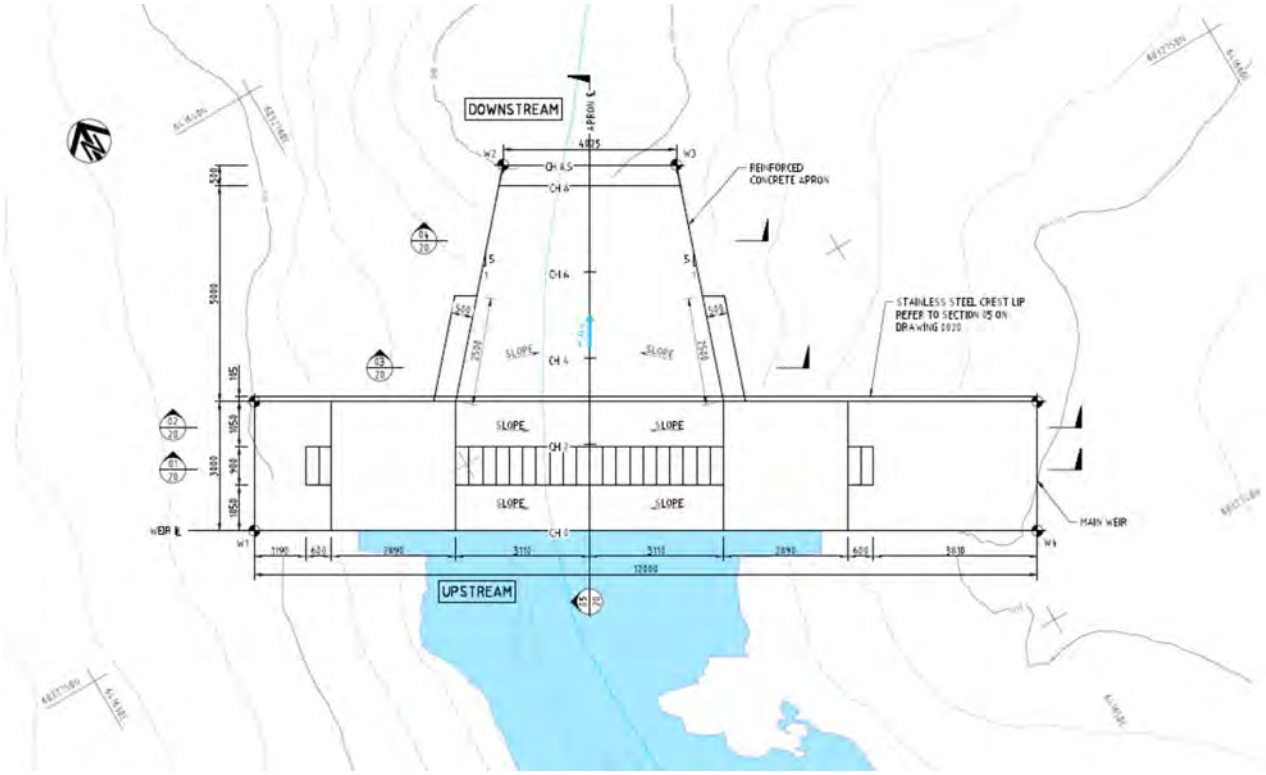
Figure 15: Concept Plan of Site Layout

9.1.3. Barrier Design

The Plan and Sections of the Tantangara Creek Barrier are shown in Figure 16. The barrier comprises a simple mass concrete gravity section across the Tantangara Creek and a downstream reinforced concrete apron. The barrier and apron are designed to accelerate the flow of water to the downstream pool resulting in a high flow velocity over the structure, thereby preventing fish from swimming up to the Barrier or jumping over the barrier during a wide range of flow conditions (Figure 17). In addition to the high velocity jet over the barrier during low flow conditions, should fish attempt to climb the apron, prevention mechanisms have been incorporated to prevent fish migration including a slight incline of five degrees on the downstream face of the barrier and multiple stainless steel lips that extends over the whole of the structure.

The strength and stability criteria used in the design are based on the relevant ANCOLD Guidelines (ANCOLD, 2000; 2012; 2013; 2019) as is industry practice with all water barrier structures in Australia. The structure has been designed with a flood capacity AEP of 1:1000. Comprehensive hydrological and hydraulic modelling was undertaken during the design. The hydrological assessment enabled the calculation of key flood volumes for the barrier design while a 2D HEC-RAS model was set up to assess the river hydraulics and expected tailwater depths.

(a)



(b)

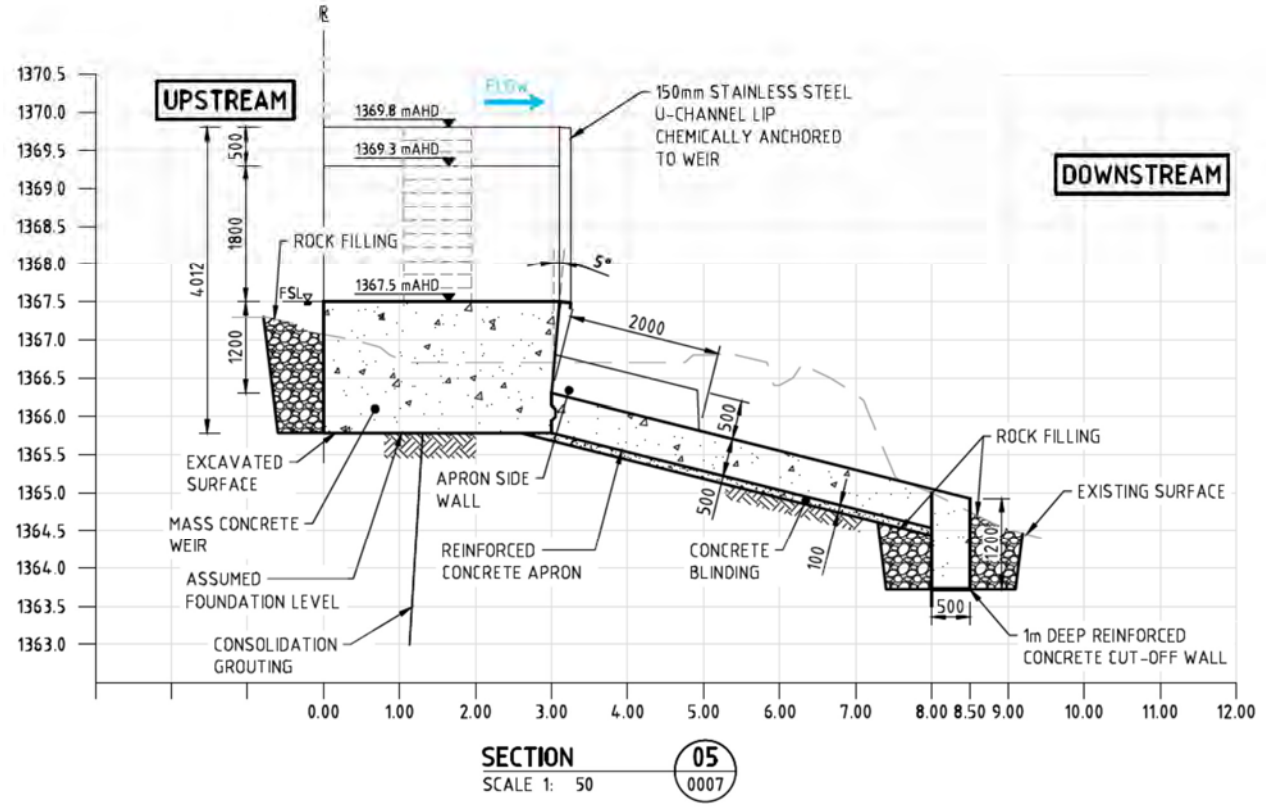


Figure 16: (a) Plan and (b) Cross-section of the fish barrier

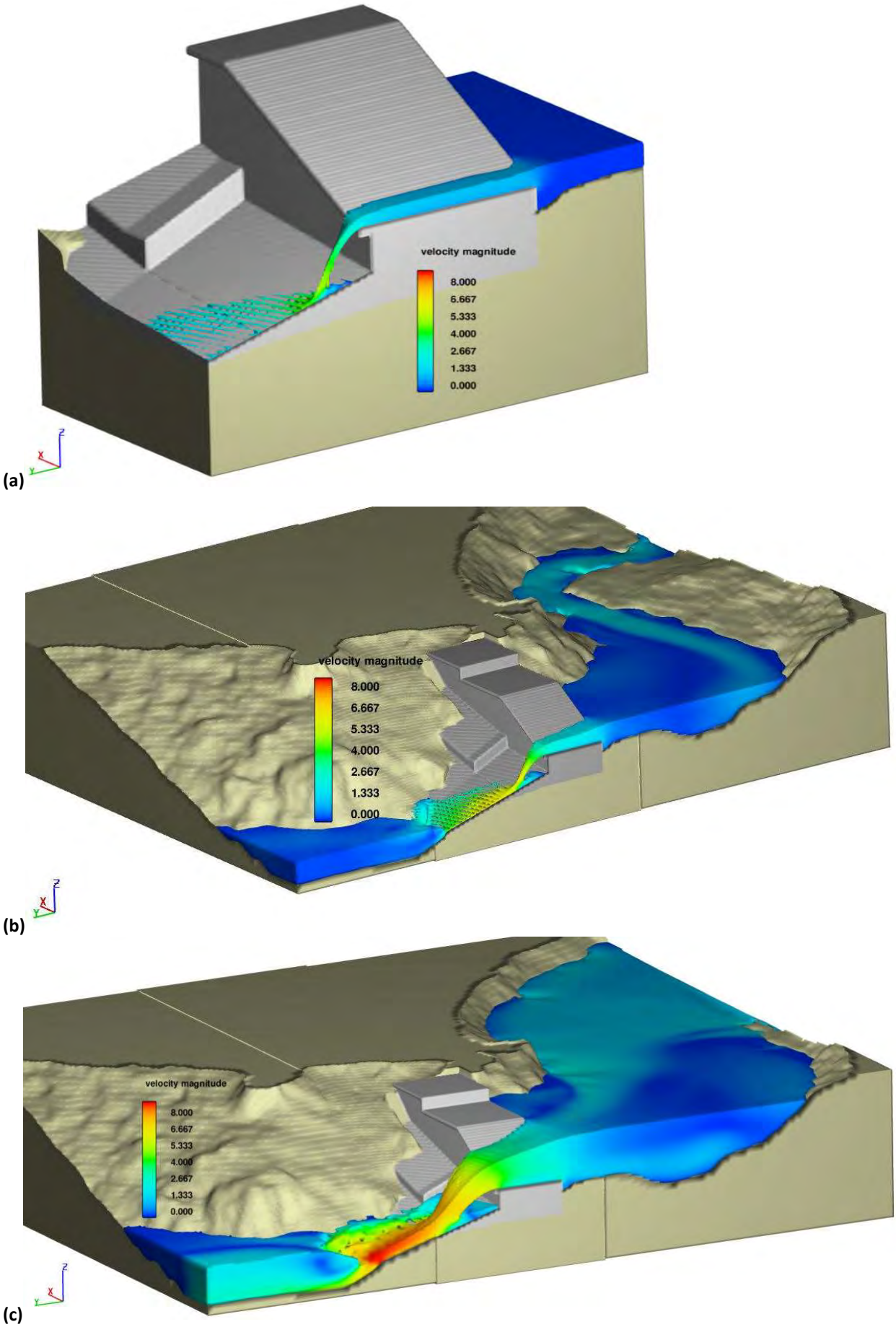


Figure 17: Hydraulic modelling outputs of concept design. Isometric slice through the barrier indicative of (a) Average Flow (b) Moderate Flow and (c) 1 in 100 AEP.

The fish barrier design criteria by Raadik (2019) have been achieved as far as it practicable by ensuring:

1. All flows up to the 1:1000 AEP can be contained within the structure.
2. The height of the barrier is such that the barrier will not become drowned across the full natural flow range.
3. All flows up to the 1:100 AEP can be accommodated within the V-shape section of the barrier which will project flow over and away from the barrier wall meaning the downstream face would only be wetted during high wind and flow events or during rain.
4. The tailwater has been minimised by removing downstream obstacles and providing a high velocity, shallow flow over a concrete apron. The apron also ensures the nape coming over the barrier is deflected downstream, thereby keeping the downstream face dry, as well channelling the flow down the middle of the creek preventing the abutments from getting wet.
5. A minimum flow velocity of 1.7m/s is achieved and significantly exceeded over the crest, in the downstream nappe and on the downstream apron for most flows (Figure 17). The only exception is for very low flows which may be blown by the wind onto the downstream face or the surface tension would make the water "stick" to the concrete surface.
6. During significant flood events the tailwater will rise however there will still be greater than 1.5m between the tailwater level and the lowest part of the weir crest. Velocities and turbulent flow in these larger flood events will be significant across the full width of the wall.
7. A minimum of three stainless-steel lips will be provided on the downstream face to prevent climbing should fish reach the barrier. It is also above the tailwater level and therefore provides protection for all flows should the fish be present downstream of the barrier.
8. The downstream face is inclined 5 degrees to make climbing harder.
9. Seepage will be minimised by providing a concrete structure and grouting beneath the structure if required due to rock quality.
10. Turbulence on the apron and the downstream tailwater will be high.
11. The upstream storage has been reduced significantly from earlier designs, both increasing upstream velocities and reducing the inundation area.

As detailed design progresses and geotechnical assessments are undertaken, there is potential that modifications to the designs shown here may be required. Where these changes will have a negative effect on the visual aesthetic of the barrier or the ability of the design to meet the design criteria by Raadik (2019), Snowy Hydro will inform NSW DPI and NPWS. Any material changes will be discussed with NSW DPI to determine if a revision of Section 9 of the BRMP is warranted.

9.2. Minimising Environmental Impacts

The environmental impacts associated with installing the fish barrier will be managed throughout the civil design process with a focus placed on minimising the construction footprint (Figure 14) as well as minimising environmental impacts during the construction and operational stages of the project. All areas utilised during the construction stage and not required for long term operation will be rehabilitated.

All construction activities will be subject to compliance with a CEMP which will be prepared and implemented by the contractor responsible for installing the barrier. This document will address and manage environmental risks associated with construction. The CEMP will include all relevant requirements from other approved Snowy 2.0 Management Plans including vehicle hygiene procedures. Aspects of the CEMP relating to construction and public access during works are to be developed in close consultation with NPWS.

Any roadworks associated with construction access for the barrier are to be undertaken to the satisfaction of NPWS prior to works commencing on the road in accordance with the conditions of approval.

During future design stages controls, such as fencing and/or signage, to prevent public and feral animal access to the structure and the inundation area upstream will be considered. The primary goal will be maintaining the safety, integrity and reliable operation of the structure including maximising its effectiveness to prevent potential pest fish incursion. Any such controls implemented will be selected in consultation with NPWS and NSW DPI.

9.3. Maintaining and Improving Effectiveness over time

Once constructed, the Barrier will be incorporated into Snowy Hydro's asset management system which will schedule regular inspections to ensure the structure is functioning as designed and remains stable. This will involve annual inspections and ongoing reviews and reporting in accordance with dam management guidelines and legislative requirements. Activities such as debris clearing and vegetation maintenance around the structure will occur as required to maintain the effectiveness of the structure.

During the initial period post construction, Snowy Hydro will also ensure that the structure is inspected during a range of flows to confirm that the operation of the structure conforms to the hydraulic design assumptions associated with the design criteria set by Raadik (2019).

Monitoring for Climbing Galaxias incursion into the Tantangara Reservoir and Upper Murrumbidgee catchment as well as into upper Tantangara Creek above the barrier will be carried out in accordance with the Pest Fish Monitoring Program detailed in Appendix E.

10. Additional Barriers

To minimise potential impacts of pest fish movement on Stocky Galaxias and Macquarie Perch, the EPBC Approval for the project included a requirement to investigate reasonable measures, including the installation of secondary fish barriers, to protect tributaries identified as priority receiving sites for the establishment of stocking insurance populations of the Macquarie Perch and Stocky Galaxias (Section 1.2; Table 2).

The identification of potential locations for the establishment of additional populations of Stocky Galaxias and Macquarie Perch is an activity to occur as part of the Habitat Surveys for each of these species under the TFMP. The outcomes of these investigations will be reported in the relevant BRMP Annual Report (see Section 7) with any planned measures to be set out in the relevant TFMP Annual Plan.

If any additional barriers are deemed necessary, this section of the BRMP will be revised.

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Appendix A – Details of Consultation

Table 10: Details of Consultation with agencies during BRMP preparation

NSW DPI Working Group Meetings	NSW DPI Steering Committee Meetings	Other Correspondence/Meetings
11/08/2020; 24/09/2020; 10/11/2020; 04/12/2020; 10/02/2021; 10/03/2021; 05/05/2021; 09/06/2021; 14/07/2021; 17/08/2021; 08/09/2021; 13/10/2021; 10/11/2021; 14/12/2021; 22/02/2022; 17/03/2022; 04/05/2022; 29/07/2022; 01/09/2022; 31/10/2022; 01/12/2022; 16/02/2023; 16/03/2023; 26/04/2023; 18/05/2023; 15/06/2023; 28/07/2023; 13/10/2023; 07/11/2023; 08/12/2023; 09/02/2024; 19/03/2024; 16/05/2024.	14/12/2020; 12/04/2021; 13/09/2021; 03/02/2022 (Including Fieldtrip to Snowy 2.0); 25/10/2022; 16/12/2022; 23/06/2023; 01/12/2023	30/11/2022 – Meeting with NPWS to present Tantangara Creek Weir design 31/01/2023 – Meeting with DCCEEW to provide an update on Management Plans 30/06/2023 – Presentation to NPWS on the BRMP 03/07/2023 – Presentation to DCCEEW on the BRMP 17/08/2023 – Meeting with NPWS to discuss consultation on road works 03/04/2023 and 16/05/2024 – Meetings with DPI Biosecurity to discuss Control Plan

Table 11: Steering Committee and Working Group participants

Person	Title	Organisation Represented	Steering Committee	Working Group
Kieran Cusack	Project Director – Snowy 2.0	Snowy Hydro Limited	✓	
Dave Evans	Director of Engineering – Snowy 2.0	Snowy Hydro Limited	✓	
Andrew Nolan	Manager Water and Environment	Snowy Hydro Limited	✓	✓
Charlie Litchfield	Head of Environment and Lands	Snowy Hydro Limited	✓	✓
Elizabeth Pope	Senior Environmental Scientist	Snowy Hydro Limited		✓
Lachlan Barnes	Technical Director	Snowy Hydro Limited (SLR Consulting Australia)		✓
Jonathan Carroll	Project Engineer – Snowy 2.0	Snowy Hydro Limited (SMEC)		✓
Sean Sloane	Deputy Director General Fisheries	NSW DPI	✓	
John Tracey	Deputy Director General Biosecurity & Food Safety	NSW DPI	✓	
Andrew Sanger	Director Biosecurity Projects	NSW DPI	✓	✓
Cameron Lay	Director Freshwater Environment	NSW DPI	✓	✓
Sarah Fairfull	Director Aquatic Environment	NSW DPI	✓	✓
Marcel Green	Program Leader Shark Strategy & Threatened Species	NSW DPI		✓
Peter Turnell	Director Recreational and Aboriginal Fisheries	NSW DPI		✓
Luke Pearce	Senior Fisheries Manager	NSW DPI		✓
Craig Boys	Fish Ecologist	NSW DPI		✓
Trevor Daly	Senior Fisheries Manager	NSW DPI		✓
Melissa Walker	Manager Aquatic Biosecurity	NSW DPI		✓

Person	Title	Organisation Represented	Steering Committee	Working Group
Ben Rampano	Manager Aquatic Biosecurity	NSW DPI		✓
Karina Worrell	Policy Officer (Aquatic) Animal Biosecurity	NSW DPI		✓
Rhys Powell	Acting Technical Officer Animal Biosecurity	NSW DPI		✓
Jeffrey Go	Senior Veterinary Officer	NSW DPI		✓
Cameron Westaway	Senior Fisheries Manager Inland	NSW DPI		✓
Jim Harnwell	Program Leader Fish Stocking & Enhancement Operations	NSW DPI		✓
Christina Bos	Policy and Projects Officer	NSW DPI		✓
Matthew McLellan	Senior Fisheries Manager Inland	NSW DPI		✓

NB. Listed participants did not necessarily attend each meeting

Appendix B – Peer Review

INDEPENDENT PEER REVIEW REPORT

SNOWY 2.0 BIOSECURITY RISK MANAGEMENT PLAN

MARCH 2024

wolfpeak.com.au

Authorisation

Author Name:	Steve Fermio	**Reviewer / Approver:**	Will Steggall
Position:	Principal Environmental and Earth Scientist	**Position:**	Practice Lead Biodiversity
Signature:		**Signature:**	
Date:	4/03/2024	**Date:**	4/03/2024

Document Revision History

Revision	Date	Details
1.0	27/11/2023	Draft report
2.0	4/03/2024	Final Report

Report Name: Snowy 2.0 Biosecurity Risk Management Plan Peer Review

Project No.: 981

Prepared for:

Snowy Hydro Limited

Prepared by:

WolfPeak Pty Ltd

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CONTENTS

1. INTRODUCTION

1.1 Project background

The Snowy 2.0 Project was declared designated Critical State Significant Infrastructure (CSSI 9687) and assessed under Part 5 Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project was approved by the NSW Minister for Planning and Public Spaces under Section 5.19 of the EP&A Act on the 20th of May 2020 (the NSW Approval).

A referral (EPBC 2018/8322) was also prepared and lodged with the Commonwealth, Minister for the Environment (via the former Department of Agriculture, Water and the Environment (DAWE), now Department of Climate Change, Energy, the Environment and Water (DCCEEW)) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the proposal was subsequently determined to be a controlled action under that Act. The project was approved by the Commonwealth's Minister for the Environment under section 130(1) and 133(1) of the EPBC Act on the 29th of June 2020 (the EPBC Approval).

A key requirement of the NSW Approval is the preparation of a Biosecurity Risk Management Plan (BRMP), a Threatened Fish Management Plan (TFMP), and a Recreational Fishing Management Plan (RFMP), to underpin the NSW Department of Primary Industries (DPI) consideration of necessary instruments under the *Biosecurity Act 2015*. Approvals of the BRMP, TFMP and RFMP by the Director-General of NSW DPI are required under Schedule 3 Conditions 22, 24 and 26 respectively of the NSW Approval.

Prior to approval of the BRMP and the TFMP by the Director-General of the NSW DPI, Condition 14 of the EPBC Approval, requires that the BRMP and TFMP be peer reviewed by an independent, suitably qualified expert/s approved by DCCEEW.

On 9 May 2023, the DCCEEW approved Steve Fermio, Will Steggall and Leonie Stevenson from WolfPeak to undertake the peer review of the TFMP. WolfPeak were further approved by DCCEEW on 21 September 2023 to undertake a peer review of the BRMP as required under Condition 14 of the EPBC Approval (Appendix A).

As indicated, Conditions that relate to biosecurity were included within the NSW Approval in Schedule 3, Conditions 20, 22 and 23 and in the EPBC Approval in Annexure A, Part A, Conditions 12-16.

Section 2 of this report details WolfPeak's approved experts' assessment undertaken in accordance with Condition 14 of the EPBC Approval as to whether the BRMP (Revision A dated 1 March 2024) satisfies the specific requirements of Condition 22 (a)-(d) of the NSW Approval.

Conclusions relevant to this review are provided in Section 3.

1.2 About the review team

WolfPeak is a specialist environmental and sustainability consultancy based in NSW with its main offices in Sydney and Port Macquarie. We provide specialist and high quality environmental, ecological, sustainability, compliance assurance, auditing and strategic advisory services to

government and communities, proponents and design and construction contractors in the private and public infrastructure sectors, including but not limited to:

- Inland Rail Project (Australian Rail Track Corporation)
- Central Land Council (Northern Territory)
- Sydney Metro (Transport for NSW (TfNSW))
- TfNSW (roads and maritime)
- NSW Department of Education
- NSW Department of Health
- Coffs Harbour Bypass (Gamuda Ferrovial Joint Venture)
- NSW Northern Rivers Reconstruction Corporation
- Port Authority of NSW
- Local councils in the Mid North Coast region of NSW
- NSW National Parks and Wildlife Service

We are regularly appointed as independent Environmental Representatives and Auditors by the NSW Department of Planning and Environment (DPE) on major development (SSD) and infrastructure (CSSI/SSI) projects including Sydney Metro, Inland Rail, NSW National Parks and Wildlife Service, major TfNSW's motorways, NSW Department of Education school infrastructure projects, NSW Health infrastructure projects and Port Botany operations to name a few.

In these roles we are trusted to act and advise in an independent capacity and our reports are made publicly available and relied on for assurance purposes by government agencies, proponents and the community.

Steve Fermio (Peer Review Lead Author) is an independent environmental expert appointed by the NSW DPE to the Wollongong City and Lane Cove Council's Independent Local Planning Panels. These Panels determine development applications within those two local government areas that are of a contentious nature or where significant departures from planning controls are proposed.

The Biosecurity Risk Management Plan was also reviewed by our experienced ecologists Will Steggall (Practice Lead, Biodiversity) and Leonie Stevenson (Senior Aquatic Ecologist).

WolfPeak has previously been engaged by Snowy Hydro Limited (SHL) to undertake the Peer Review of the TFMP prepared for the Project. WolfPeak has had no involvement whatsoever in the preparation of the BRMP.

2. PEER REVIEW

Our assessment as to whether the BRMP (Revision A, 1 March 2024) satisfies the requirements of Schedule 3 Condition 22 (a) – (d) of the NSW Approval is detailed in Table 1 below.

It is noted that due to the complexity of design associated with the planned fish screens at the southern end of Tantangara Reservoir, the BRMP has been staged and the version subject to this review is known as Stage 1. The BRMP will be updated into Stage 2 once the fish screens have been subject to detailed design and confirmation that they can be safely and reliably operated. At that point, and prior to the commencement of construction of the fish screens at Tantangara Dam, the BRMP Stage 2 will require further peer review under Condition 14 of the EPBC Approval and subsequent approval by the Director-General of NSW DPI under Condition 22 of the NSW Approval. The BRMP Stage 2 will involve a revision of Section 8 of the BRMP to update the screen design information provided in the BRMP Stage 1.

The BRMP Stage 1 (Rev A, 1 March 2024, referred to in the rest of the document as the BRMP) is a comprehensive document that has been prepared based on expert advice and best-practise monitoring methods. The document has been prepared by SHL and a suitably qualified expert (Dr Lachlan Barnes from SLR Consulting Australia Pty Ltd), informed by close consultation with NSW DPI fisheries and biosecurity experts and input from other nationally recognised fisheries scientists including Mark Lintermans and Tarmo Raadik. The BRMP also references ecological monitoring and surveys undertaken on site to date and a significant suite of published scientific literature in the field of aquatic ecology.

The BRMP has been prepared in consultation with the relevant government agency scientific specialists, and includes a comprehensive suite of surveillance, monitoring, management and preventative measures.

The BRMP commits to publishing an annual report detailing the monitoring data (excluding sensitive ecological data) and outcomes from surveillance and management activities undertaken as part of the BRMP.

The BRMP includes document review provisions including specific events that will trigger a review and update (if necessary). The BRMP provides scope for improvements to the BRMP's pest fish surveillance program over time, with any relevant advances in technology or increase in knowledge based on the results from implementation of the BRMP, and consideration of guidance provided by fisheries scientists and advice provided by NSW DPI.

The BRMP is to be implemented until the end date of the EPBC Approval (December 2040) unless otherwise agreed by the Australian Government Minister administering the EPBC Act.

Table 1 – Compliance with Condition 22 - NSW Approval

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
Schedule 3, Condition 22	**Biosecurity Risk Management Plan** Within two years of the commencement of construction, the Proponent must prepare a Biosecurity Risk Management Plan for the development to the satisfaction of the Director-General of NSW DPI.	The BRMP, Certificate of Approval and Section 1.5	No	Construction of Main Works commenced in October 2020 and therefore the BRMP is outside the timing requirements of Condition 22. Note that this requirement cannot be satisfied until the BRMP is approved by the Director-General of NSW DPI. Notwithstanding, its pre-requisites have been satisfied as set out in this table and via the completion of this Peer Review Report.
	This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with DPIE, National Parks and Wildlife Service (NPWS) and DAWE;	The BRMP, Certificate of Approval and Section 1.5	Yes	The BRMP has been prepared by Elizabeth Pope, a Senior Environmental Scientist (BSC(Hons)) for SHL and Dr Lachlan Barnes, Technical Director - Aquatic Environmental Sciences (PhD) at SLR Consulting. Dr Barnes has extensive experience in this field with a Bachelor degree in Science Marine Biology and a PhD in Fish Ecology. A Working Group oversighting the development of the BRMP - comprising representatives of SHL and NSW DPI (formerly part of DPIE) - have met generally on a monthly basis since July

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
				2020. A Steering Committee has also been formed, including representatives of SHL and NSW DPI, and met on an approximately quarterly basis from December 2020. The BRMP references consultation with the NSW DPI, NPWS, DCEEW (formerly DAWE) and DPE regarding the preparation of the plan. On 30 November 2022 a meeting was held with NPWS to present the Tantangara Creek weir design. On 31 January 2023 a meeting was held with DCCEEW (formerly DAWE) to provide an update of the management plans. On the 30 June 2023 a presentation was provided to NPWS on the BRMP. On 7 March 2023 a presentation was provided to DCCEEW on the BRMP. And on the 17 August 2023 a meeting was held with NPWS to discuss consultation on road works.
	(b) include a detailed biosecurity risk management framework for minimising the ongoing biosecurity risks of	BRMP, Part 1, Sections 4, 5 and 6,	Yes	The BRMP includes a detailed biosecurity risk management framework for minimising the ongoing biosecurity risks of the

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
	the development required in condition 20(a) above, including: • Developing systems to prevent spills from the Tantangara Reservoir so far as is reasonably practicable; and • Pest fish and disease surveillance and eradication/management measures to protect the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment and the salmonid fishery in Lake Eucumbene.	Appendices D and E		development. It includes details of the following key measures, among others: • Tantangara Reservoir Spill Management (Section 6), with design measures that combine the generation diversion capacity of the Snowy 2.0 infrastructure with the M-E Tunnel and Tantangara Dam, to ensure capacity is higher than expected peak inflows. • Surveillance program (Sections 4 and 5) to determine potential pest fish and disease incursions and to confirm any presence of pest fish and diseases; along with identification of relevant information in order to determine the likely incursion pathway. • Management measures to be implemented following any pest fish/disease incursions, with scope for specific details to be determined based on the status of the incursion (Sections 4 and 5).
	(c) include detailed plans for the installation and use of the fish screens and barriers required in condition 21 above, including:	BRMP, Part 2, Sections 8 and 9	Yes	The BRMP includes details of the following: • Tantangara fish screens (Section 8), including details of the screens

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
	• Minimising the environmental impacts associated with installing the screens; • Testing the effectiveness of the screens before they are used; and • Maintaining and improving the effectiveness of the screens and barriers over time.			functional and operational requirements, preliminary screen design, testing screen effectiveness, secondary (behavioural) controls, minimising environmental impacts and maintaining and improving effectiveness over time. Potential environmental impacts will be managed via compliance with a Construction Environmental Management Plan (CEMP) that will be prepared to minimise environmental risks associated with construction. Charles Sturt University (CSU) has been commissioned to undertake testing of the efficiency of various screens in excluding Redfin eggs and larvae. An international expert, Richard Horsfield has been commissioned to evaluate secondary controls. Fully automated screen alarms and protections will be established to ensure performance testing is performed. ***Note: Due to the complexity of design associated with the planned fish screens at the southern end of Tantangara Reservoir, the BRMP***

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
				has been staged. The version subject to this peer review is known as Stage 1. The BRMP will be updated into Stage 2 once the fish screens have been subject to detailed design and confirmation that they can be safely and reliably operated. At that point, and prior to the commencement of construction of the fish screens at Tantangara Dam, the BRMP Stage 2 will require further peer review under Condition 14 of the EPBC Approval and subsequent approval by the Director-General of NSW DPI under Condition 22 of the NSW Approval. In particular, the BRMP Stage 2 will involve a revision of Section 8 of the BRMP to update the screen design information provided in the BRMP Stage 1. • Tantangara Creek Weir (Section 9) including design considerations, barrier design, minimising environmental impacts (via a CEMP), and maintaining and improving effectiveness over time. If additional barriers are deemed necessary as investigated as part of

Condition	Requirement	Where addressed in the BRMP	Requirement satisfied (Yes/No)	Comment / recommendation
				the Habitat Surveys, these will be reported in the BRMP Annual Report and the BRMP will be revised. ***Recommendation:*** ***It is recommended that Stage 2 of the BRMP, which will be subject to approval by the Director-General of NSW DPI under Condition 22 of the NSW Approval, include details of the specific requirements to be included in the CEMP(s) to be prepared for the installation of the fish screens to provide further detail on how environmental impacts associated with installation of the fish screens at southern end of Tantangara Reservoir will be minimised.***
	(d) include a program to monitor, evaluate and publicly report on these plans, including; • Carrying out monitoring using epidemiologically designed surveys; and • Conducting fish, disease and eDNA surveys.	BRMP, Part 1. Sections 4, 5 and 7	Yes	An Annual Report (prepared by SHL) on the results of the implementation of the BRMP, including monitoring and survey results, along with any planned amendments and deviations to the monitoring activities, is proposed to be published and made publicly available on SHL's website (www.snowyhydro.com.au).

3. CONCLUSIONS

We consider that the BRMP Stage 1 (Rev A, 1 March 2024), is fit for purpose and satisfies the requirements of NSW Approval Condition 22[1] (a) – (d), as detailed in Table 1 above.

We therefore endorse the BRMP (Rev A, 1 March 2024) for approval by the Director-General of the NSW DPI.

It is noted that due to the complexity of design associated with the planned fish screens at the southern end of Tantangara Reservoir, the BRMP has been staged and the version subject to this review (Stage 1 BRMP) will be updated into Stage 2 once the fish screens have been subject to detailed design and confirmation that they can be safely and reliably operated. At that point, and prior to the commencement of construction of the fish screens at Tantangara Dam, the BRMP Stage 2 will require further peer review under Condition 14 of the EPBC Approval and subsequent approval by the Director-General of NSW DPI under Condition 22 of the NSW Approval. The BRMP Stage 2 will involve a revision of Section 8 of the BRMP to update the screen design information provided in the BRMP Stage 1.

It is recommended that Stage 2 of the BRMP, which will be subject to approval by the Director-General of NSW DPI under Condition 22 of the NSW Approval, include details of the specific requirements to be included in the CEMP(s) to be prepared for the installation of the fish screens to provide further detail on how environmental impacts associated with installation of the fish screens at southern end of Tantangara Reservoir will be minimised.

[1] Noting that the approval of the BRMP by the Director-General of NSW DPI is required to fully satisfy Condition 22

LIMITATIONS

This Document has been provided by WolfPeak Pty Ltd (WolfPeak) to the Client and is subject to the following limitations:

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APPENDIX A – APPROVAL OF PEER REVIEW TEAM

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC ref: 2018/8322

Elizabeth Pope
Senior Environmental Scientist
Snowy Hydro Limited
Elizabeth.Pope@snowyhydro.com.au

Approval of qualified experts for EPBC 2018/8322 Snowy 2.0 Main Works, NSW

Dear Elizabeth

Thank you for your correspondence dated 22 June 2023 to the department, requesting approval of suitably qualified experts to undertake a peer review of the Biosecurity Risk Management Plan under condition 14 of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval 2018/8322, for the Snowy Hydro 2.0 Project.

I have noted the information provided, including the qualifications and experience of the nominated experts and the requirements specified in definitions attached to the EPBC Act approval for the above project.

I have approved Steve Fermio, Will Steggall and Leonie Stevenson from WolfPeak as independent and suitably qualified experts for the purpose of undertaking a peer review of the Biosecurity Risk Management Plan, in accordance with condition 14 of the approval for Snowy 2.0 Main Works Project, NSW (EPBC 2018/8322).

Should you require any further information please contact Jessica Feder by email to PostApproval@dcceew.gov.au.

Yours sincerely

Rachel Short
Branch Head
Environment Assessment (Vic, Tas) and Post Approvals Branch

21 September 2023

Appendix C – Snowy 2.0 Pest Fish and Disease Response and Control Plan

Purpose

This Pest Fish and Disease Response and Control Plan lays out the responsibilities of all staff of Snowy Hydro Limited where it is suspected that aquatic pests or diseases, or native fish translocated outside of their natural range, are present in the waters Tantangara Reservoir, Upper Murrumbidgee Catchment (including Tantangara Creek), Mid-Murrumbidgee Catchment or Lake Eucumbene.

Scope

This Pest Fish and Disease Response and Control Plan will apply once Snowy 2.0 is complete and water has been transferred from Talbingo Reservoir to Tantangara Reservoir through the new pipeline.

The Plan provides guidance for the on-ground actions and steps to be taken in the event of a suspected or confirmed incursion of a *target pest species* into one of the surveillance catchments where the suspected disease is not already confirmed as being present in those waters in that season or the suspected pest or translocated native species is not known to be established in that waterway.

Areas this Control Plan Applies (Surveillance Catchments)

This control plan applies to the *Surveillance catchments*, with the exception of Talbingo Reservoir, as defined in Section 2 of the Biosecurity Risk Management Plan (BRMP), being:

- Tantangara Reservoir
- Upper Murrumbidgee Catchment (including Tantangara Creek)
- Mid-Murrumbidgee catchment
- Lake Eucumbene.

Target Pest Species

This plan applies to the target pest fish species, including native fish translocated outside of their natural range, as defined in Section 5.1 of the BRMP and the target diseases defined in Section 6.1. These species are:

- Redfin Perch (*Perca fluviatilis*) (Redfin) – exotic fish, notifiable matter under Schedule 1 of the Biosecurity Regulation 2017
- Eastern Gambusia (*Gambusia holbrooki*) - exotic fish
- Climbing Galaxias (*Galaxias brevipinnis*) - native fish but considered translocated outside of its natural range into the Murray and Tumut River catchments
- Epizootic Haematopoietic Necrosis Virus (EHNV) - a disease associated with fish kill events in Redfin, notifiable matter under Schedule 1 of the Biosecurity Regulation 2017
- Lernaea (*Lernaea cyprinacea*) - a copepod crustacean that acts as a fish ectoparasite.

Management of the Biosecurity Risk

Snowy Hydro is committed to meeting its biosecurity duty under the *Biosecurity Act 2015* to ensure that so far as is reasonably practicable, the biosecurity risks associated with Snowy 2.0 are prevented, eliminated or minimised. The measures Snowy Hydro have committed to are detailed in the Snowy 2.0 BRMP. A summary of these commitments are below:

- A comprehensive program of pest fish surveillance across multiple catchments that will maximise the likelihood that any new incursion is detected and confirmed as soon as practicable.
- Installation and operation of fish screens at the southern end of the Tantangara Reservoir to prevent so far as is reasonably practicable the movement of pest fish (in all its forms: eggs, larvae, juveniles and adults) to the mid-Murrumbidgee River and Lake Eucumbene.
- Installation and operation of a fish barrier on Tantangara Creek to prevent so far as is reasonably practicable Climbing Galaxias reaching the existing population of Stocky Galaxias in the upper reaches of the creek.
- A program of eradication and/or management measures to protect the Macquarie Perch (*Macquaria australasica)* and Stocky Galaxias (*Galaxias tantangara*) in the Mid to Upper Murrumbidgee catchment and

the salmonid fishery in Lake Eucumbene should pest fish be spread to these locations from the operation of Snowy 2.0.

- The implementation of the captive breeding program within the Snowy 2.0 Threatened Fish Management Plan (TFMP) to build resilience in both Macquarie Perch and Stocky Galaxias populations within the upper to mid Murrumbidgee Catchment.
- The implementation of the Snowy 2.0 Recreational Fishing Management Plan (RFMP) to develop the capability to restock, and to restock, the Tantangara Reservoir and Lake Eucumbene with salmonid fish.
- Operational management of Tantangara Reservoir to prevent spills from the Tantangara Dam so far as is reasonably practicable.

Legislation Summary

Relevant legislation includes:

- *Biosecurity Act 2015*
- Biosecurity Regulation 2017
- *Fisheries Management Act 1994*
- Fisheries Management (General) Regulation 2019.

Under the *Biosecurity Act 2015*, any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.

The *NSW Biosecurity Act 2015* lists Redfin and EHNV as notifiable species under Schedule 1, Part 2 of the Biosecurity Regulation 2017.

Under Clause 7 of the Biosecurity Regulation 2017, a person who in the course of engaging in a dealing with biosecurity matter or a carrier becomes aware of, or suspects, the presence of any pest or disease listed in Schedule 1 of that regulation must notify the presence of the pest or disease in accordance with Part 6 of that regulation within 1 working day after the person first suspects or becomes aware of the presence.

Under Clause 18 of the Biosecurity Regulation 2017, it is illegal to possess or control, buy or sell, move or release live Redfin in NSW unless an exemption has been granted under the *Biosecurity Act 2015*.

Under Clause 216 of the *Fisheries Management Act 1994*, it is illegal to release live fish into a waterway without a permit.

Snowy Hydro Roles and Responsibilities

All Staff. Report any unusual or unexpected conditions, such as a fish kill or potential novel species in any waterway or reservoir to the Snowy Hydro Environment Team

Snowy 2.0 Project Director. Responsible for the design and construction of Snowy 2.0 as well as the Fish Screens at Tantangara Reservoir and the Fish Barrier on Tantangara Creek.

Upper Tumut Regional Manager. Operate and maintain Snowy 2.0, the Fish Screens and Fish Barrier in accordance with the relevant operations and maintenance instructions once constructed.

Environment and Lands Manager. Responsible for implementation of the Pest Fish and Disease Monitoring Plans and this Pest Fish and Disease Response and Control Plan as detailed in the Snowy 2.0 BRMP.

Verification and Management of a Potential Pest Incursion

The process to follow for a potential pest fish or disease incursion is detailed in Figure 18 and Figure 19. Figure 1 details the process to follow at the commencement of operation for Snowy 2.0. Figure 2 provides details on the process to follow should any of the target pest species become established in Tantangara reservoir at some point following the commencement of operation. Further detail on each of the steps to be undertaken are described below.

In all situations and at all times, the safety of staff and contractors will be of paramount importance and all company safety procedures and policies, including any relevant access rules and restrictions, will be adhered to at all times.

In accordance with the process below, Snowy Hydro will take responsibility for verification activities and resulting control and management measures for target pest species in the surveillance catchments until or unless such time as credible evidence is presented that concludes an alternative vector was more likely to be responsible for the incursion rather than water transfers associated with the operation of Snowy 2.0.

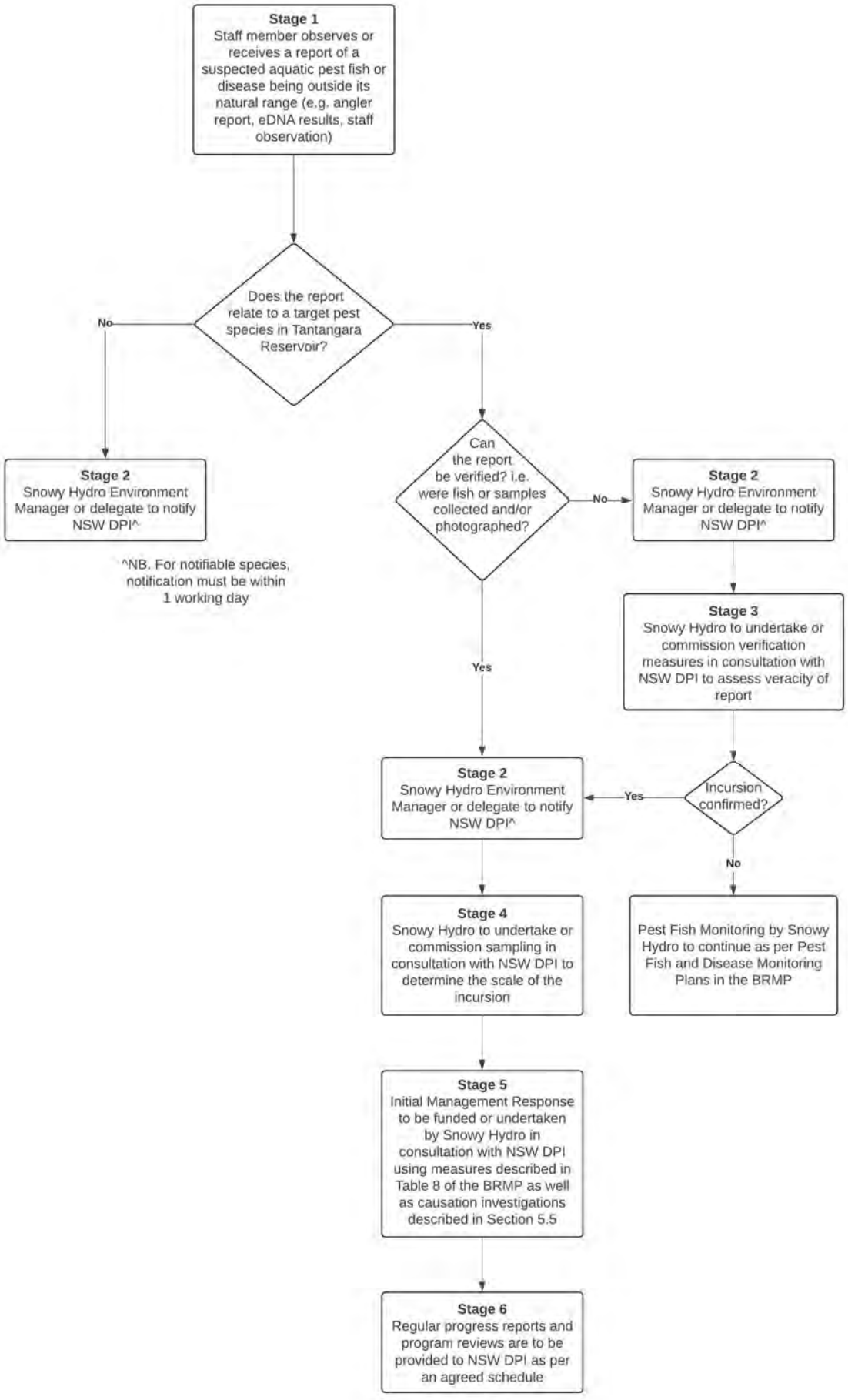


Figure 18: Flow chart detailing the process to notify NSW DPI and verify and manage a potential pest species incursion into Tantangara Reservoir following the commencement of operation of Snowy 2.0.

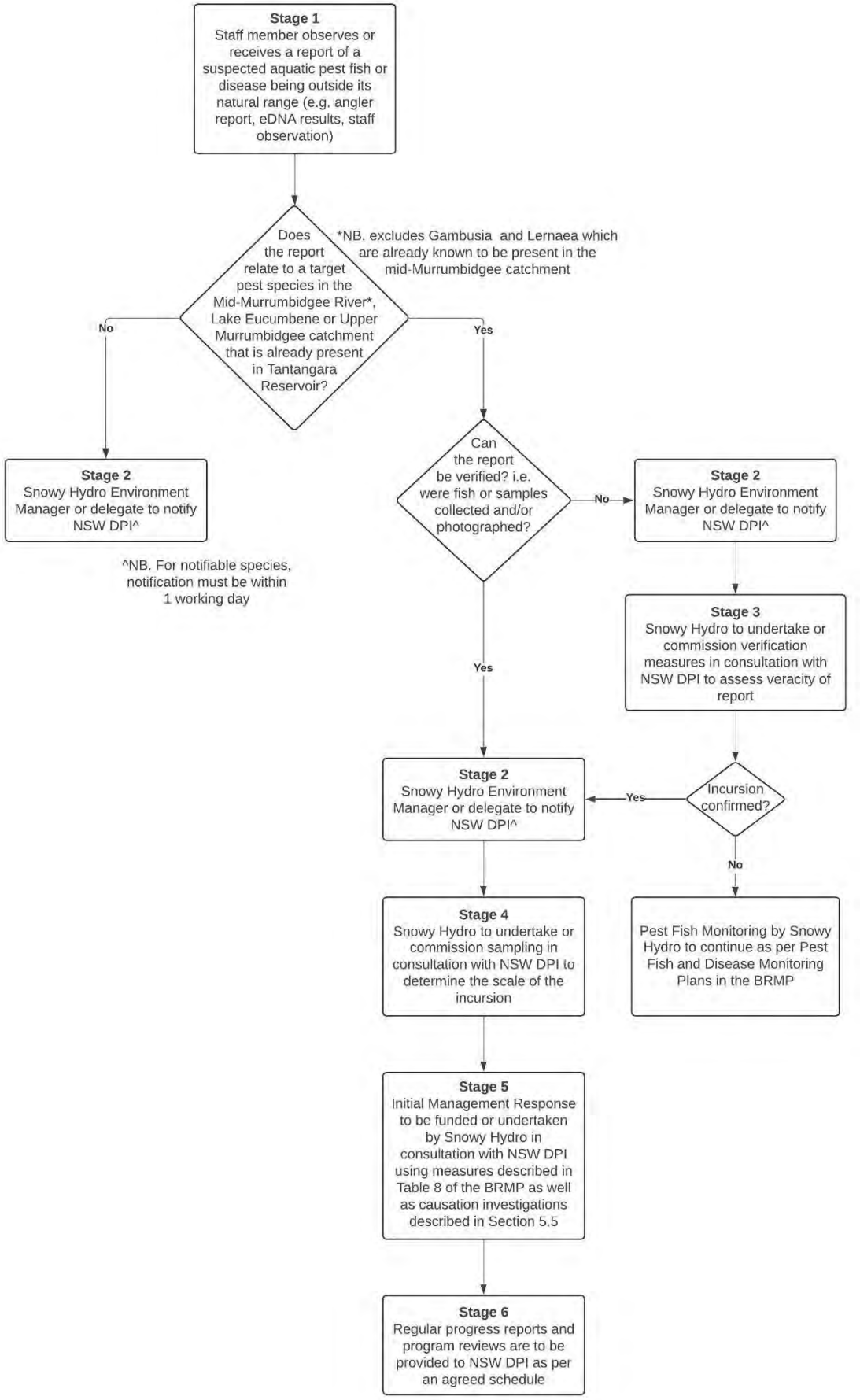


Figure 19: Flow chart detailing the process to notify NSW DPI and verify and manage a potential pest species incursion if the relevant species has already been detected in Tantangara Reservoir following the commencement of operation of Snowy 2.0.

Stage 1 – Unverified Aquatic Pest or Disease Report received

Information to be collected:

Reporter – Details of the person making the report i.e. member of public, contractor or staff member?

Location – The location of the observation or fish catch is to be recorded as accurately as possible.

Time – Date and time of the observation or catch.

Details of the observation – Pest fish? Fish kill? Suspected disease or parasite? Nature of the observation or evidence? i.e. fish sighted or caught? eDNA? How many individuals? If a fish, was it alive, moribund or dead?

Photographic Evidence - If possible, good quality digital photos of the fish or suspected pest are to be taken at multiple angles in good light.

Sample - If dead, moribund or suspected exotic and if safe to do so, the fish or organism is to be collected, placed in a labelled plastic bag including time and date of collection and put on ice while seeking further instruction from NSW DPI regarding sample preservation and process for positive identification. If the observation includes dead or moribund fish, best efforts are to be made to collect moribund fish as these are the most suitable for disease identification.

Stage 2 – Notification to NSW DPI

For notifiable species (Redfin and EHNV), within one business day of Snowy Hydro becoming aware of an incursion or suspected incursion in one of the surveillance catchments, the Snowy Hydro Environment Lands Manager, or an appropriate delegate, will notify DPI Aquatic Biosecurity via one of the following methods providing all information collected as described above:

- Calling the 24-hour EAD Hotline: 1800 675 888
- Completing the online form: https://forms.bfs.dpi.nsw.gov.au/forms/9247
- Emailing: aquatic.biosecurity@dpi.nsw.gov.au

For all other species, the report will be made as soon as practicable.

If the report relates to a fish kill, it is to be reported to the Fishers Watch Phoneline 1800 043 536.

Stage 3 – Incursion Verification

If a reported potential incursion cannot be appropriately verified via photographic or physical evidence, Snowy Hydro, in consultation with NSW DPI, will commission or undertake seasonally appropriate targeted sampling as soon as safe and practicable.

Depending on the target species, location, and the time of year, this would include collection of fish via boat or backpack electrofishing, netting and/or larval light traps. If appropriate, the use of baited remote underwater video (BRUV) may also be considered.

If within a reservoir, sampling will be targeted towards the location where the observation was reported but will also include adjacent locations. Similarly, if the location is a river, the location in question plus accessible areas immediately upstream and downstream will be targeted.

Snowy Hydro will request available technical expertise from within NSW DPI Biosecurity and Fisheries. Support from external stakeholders such as the Australian Museum or fisheries experts may also be sought.

Should the potential incursion not be verified, sampling will continue as per the Pest Fish and Disease Monitoring Plans within the BRMP (Appendix D and E).

Stage 4 – Assessment of Incursion Scale

If a positive verification is obtained, at the same time or as soon as practicable, further sampling will be undertaken to understand the scale of the incursion to enable decisions around appropriate management and control measures.

In the case of a pest fish species, sampling will use the methods above to ascertain an estimate of geographic spread, abundance and what life history stages are present. Where appropriate, investigations will also be undertaken, such as DNA analysis, to determine the provenance of the incursion in accordance with Section 5.5 of the BRMP.

Stage 5 – Incursion Management

Following verification and assessment of the incursion, Snowy Hydro will commission or implement appropriate management and control measures in consultation with NSW DPI and in accordance with Table 8 of the BRMP.

If expert advice based on the investigations in Step 2 and 3 conclude that eradication is possible, this will be pursued. Alternatively, if evidence suggests that the species is well established or that regular transfer is occurring such that eradication is unlikely, the priority will be population management to limit further spread and minimise potential impacts to native or recreationally important species. If the incursion relates to an area within the known range of Macquarie Perch or Stocky Galaxias, Snowy Hydro will liaise with NSW DPI to determine if any further conservation measures and funding are justified under the Trigger, Action, Response Plan detailed in the Snowy 2.0 TFMP.

Stage 6 – Management Reporting and Review

Progress reports and regular reviews of the appropriateness of the eradication or control program undertaken in Stage 5 will be provided to NSW DPI in accordance with a mutually agreed schedule to be decided at the commencement of the control program.

Appendix D – Known Fish Distribution

Based on a synthesis of literature and database reviews, results of eDNA surveys and field surveys undertaken for the Snowy 2.0 EIS, the likelihood of fish and crayfish species inhabiting the Snowy 2.0 catchments and surrounding areas was based on criteria described in Table 12. The likely distribution of fish and crayfish species throughout these catchments as of 2019 is summarised in Table 13 (Cardno, 2019).

Table 12 Likelihood of Occurrence Criteria (from Cardno, 2019, p.323)

Likelihood of occurrence	Code	Criteria for Assessment of Occurrence
Low	Low (X):	Area within historical distribution with sporadic recent records (stocking or catch records), expert opinion and/or negative DNA detection or field survey results suggest species is not currently present.
	Low (P):	Within predicted distribution, however, strong evidence to suggest it is not currently present (based on expert opinion and/or negative DNA detection or field survey results; or
	Low (DNA):	DNA detected*, but unlikely to represent live fish (due to low relative abundance of DNA and / or low detection rate combined with the absence of previous records (for known recreationally targeted species) and none caught during current field surveys). DNA may be from inert source of material from outside the reservoir/catchment. Includes potential landlocked populations of catadromous fish (e.g. *Anguilla* sp.)
Moderate	Mod (Adj):	No recent records in the reservoir/catchment but suitable habitat is present (NSW DPI, 2016) with no barriers to movement from adjacent areas of known occurrences; or
	Mod (P):	Within predicted distribution range (NSW DPI, 2016), but no confirmed catch records. (A precautionary approach has been applied and a medium likelihood of occurrence used where the species cannot be categorised as absent or of low occurrence (see above).
ccursOccurs Combination	Oc (X):	Species recently recorded or stocked in the catchment and the catchment provides suitable habitat.
	Oc (DNA)	DNA detected and the area is within the currently expected species distribution. Recent records may not be available for non-recreationally important species.
	Oc (C)	Caught during current study.
	Oc (X +DNA)	Combination of Oc (X) and Oc (DNA) .
	Oc (X+C+DNA)	Combination of Oc (X), Oc (DNA) and Oc (C)

*DNA detections at low relative abundance (≤ 1 % relative abundance) reported by EnviroDNA (2019a) represent a low likelihood of occurrence of live individuals in the absence of historical catch records or catches during project field surveys.

Table 13 Likelihood of occurrence of fish and crayfish species in the study area based on catch data and eDNA data, findings of the literature review and field surveys (Cardno, 2019, p.324).

Scientific Name		Common Name	Tumut River Catchment						Murrumbidgee River Catchment					Snowy River Catchment			Murray River Catchment		
			Tabingo Reservoir	T2 Reservoir Catchment	Upper Tumut River Catchment	Yarrangobilly River Catchment	Blowering Reservoir Catchment	Lower Tumut River Catchment	Tantangara Reservoir	Upper Murrumbidgee River Catchment	Upper Tantangara Creek Catchment	Mid-Murrumbidgee River Catchment	Lower-Murrumbidgee River Catchment	Lake Eucumbene Catchment	Lake Jindabyne Catchment	Lower Snowy River Catchment	Murray River to Hume Reservoir Catchment	Swampy Plain River Catchment	Geehi Reservoir and M2 Reservoir Catchments
Threatened Species																			
Percichthyidae	*Macquaria australasica*	Macquarie perch (FM & EPBC Acts: End.)	Low (X)		Low (P)	Low (P)	Low (X)	Oc (X)	Low (P)	Low (P)		Oc (X+DNA)	Oc (X)				Oc (X)		
Percichthyidae	*Maccullochella macquariensis*	Trout cod FM & EPBC Acts: End.)	Oc (X)		Mod (Adj)	Mod (Adj)						Oc (X)	Oc (X)				Oc (X)		
Percichthyidae	*Maccullochella peelii*	Murray cod (EPBC Act: Vul.)					Oc (X+DNA)	Mod (Adj)				Oc (X)	Oc (X)				Oc (X)	Oc (X)	
Percichthyidae	*Gadopsis marmoratus*	River blackfish – Snowy River Catchment Population (FM Act: End.)													Mod (P)	Oc (X)			
Percichthyidae	*Nannoperca australis*	Southern pygmy perch (FM Act: End.)										Mod (P)				Oc (X)	Oc (X)		
Percichthyidae	*Bidyanus bidyanus*	Silver perch (FM Act: Vul.)					Oc (X)	Mod (Adj)					Oc (X)						
Galaxiidae	*Galaxias tantangara*	Stocky galaxias (FM Act: Crit. End.)									Oc (X)								
Plotosidae	*Tandanus tandanus*	Eel-tailed catfish - Murray-Darling Basin Population (FM Act: End.)											Oc (X)						
Parastacidae	*Euastacus armatus*	Murray crayfish (FM Act: Vul.)	Oc (X+C+DNA)	Oc (X)	Mod (Adj)	Oc (X+C+DNA)	Oc (X)	Oc (X)				Oc (X)	Oc (X)				Oc (X)	Oc (X)	
Odonata	*Austropetalia tonyana*	Alpine redspot dragonfly (FM Act: Vul.)													Mod (P)			Oc (X)	Mod (P)
Non-threatened Native Species																			
Percichthyidae	*Macquaria ambigua*	Golden perch	Low (DNA)				Oc (X+DNA)	Oc (X)				Oc (X)	Oc (X)				Oc (X)		

Scientific Name		Common Name	Tumut River Catchment						Murrumbidgee River Catchment					Snowy River Catchment			Murray River Catchment		
			Talbingo Reservoir	T2 Reservoir Catchment	Upper Tumut River Catchment	Yarrangobilly River Catchment	Blowering Reservoir Catchment	Lower Tumut River Catchment	Tantangara Reservoir	Upper Murrumbidgee River Catchment	Upper Tantangara Creek Catchment	Mid-Murrumbidgee River Catchment	Lower-Murrumbidgee River Catchment	Lake Eucumbene Catchment	Lake Jindabyne Catchment	Lower Snowy River Catchment	Murray River to Hume Reservoir Catchment	Swampy Plain River Catchment	Geehi Reservoir and M2 Reservoir Catchments
Percichthyidae	*Gadopsis marmoratus*	(Northern) River blackfish						Oc (X)									Oc (X)		
Percichthyidae	*Gadopsis bispinosus*	Two-spined blackfish	Oc (X+DNA)		Mod (Adj)	Oc (X+DNA)	Oc (X+DNA)	Oc (X)				Oc (X)	Oc (X)				Oc (X)	Oc (X)	
Galaxiidae	*Galaxias olidus*	Mountain galaxias*	Oc (DNA)	Oc (X)	Mod (Adj)	Oc (X)	Oc (X)		Oc (DNA)	Oc (C+DNA)		Oc (X+C+DNA)	Oc (X)		Oc (X)	Oc (X)	Oc (X)	Oc (X)	
Galaxiidae	*Galaxias brevipinnis*	Climbing galaxias	Mod (Adj)			Oc (X+C+DNA)	Oc (X)							Oc (DNA)	Oc (DNA)	Oc (X)	Oc (X)	O	Oc (X+DNA)
Galaxiidae	*Galaxias terenasus*	Roundsnout galaxias														Oc (X)			
Galaxiidae	*Galaxias maculatus*	Common galaxias														Oc (X)			
Galaxiidae	*Galaxias arcanus*	Riffle galaxias															Oc (X)		
Retropinnidae	*Retropinna semoni*	Australian smelt	Low (DNA)					Oc (X)				Oc (X)	Oc (X)		Oc (X)	Oc (X)	Oc (X)	Oc (X)	
Eleotridae	*Philypnodon grandiceps*	Flathead gudgeon	Oc (DNA)		Mod (Adj)	Mod (Adj)	Oc (X+DNA)	Oc (X)				Oc (X)	Oc (X)	Oc (DNA)	Mod (Adj)	Oc (X)	Oc (X)	Mod (Adj)	
Eleotridae	*Philypnodon macrostomus*	Dwarf flathead gudgeon											Oc (X)				Oc (X)		
Eleotridae	*Hypseleotris* spp.	Carp gudgeon						Oc (X)				Oc (X)	Oc (X)				Oc (X)		
Anguillidae	*Anguilla australis*	Shortfinned eel	Low (DNA)						Low (DNA)							Oc (X)			
Anguillidae	*Anguilla reinhardtii*	Longfinned eel												Low (X)		Oc (X)			
Parastacidae	*Cherax* spp.	Common yabbie	Oc (C+DNA)	Oc (X)	Mod (Adj)	Mod (Adj)	Oc (DNA)	Mod (Adj)	Oc (C+DNA)	Oc (DNA)		Oc (X+C+DNA)	Mod (Adj)	Oc (X+DNA)	Oc (X)	Oc (X)	Oc (X)	Oc (X)	
Parastacidae	*Euastacus reiki*	Reik's crayfish							Oc (DNA)	Oc (X+C+DNA)	Mod (Adj)	Oc (X)		Oc (C+DNA)	Oc (X)				
Parastacidae	*Euastacus crassus*	Alpine spiny crayfish						Oc (X)								Oc (X)	Mod (Adj)	Oc (X)	Mod (Adj)
Parastacidae	*Euastacus* sp.	Unidentified spiny crayfish***				Oc (DNA)													

Scientific Name		Common Name	Tumut River Catchment						Murrumbidgee River Catchment					Snowy River Catchment			Murray River Catchment		
			Tabingo Reservoir	T2 Reservoir Catchment	Upper Tumut River Catchment	Yarrangobilly River Catchment	Blowering Reservoir Catchment	Lower Tumut River Catchment	Tantangara Reservoir	Upper Murrumbidgee River Catchment	Upper Tantangara Creek Catchment	Mid-Murrumbidgee River Catchment	Lower-Murrumbidgee River Catchment	Lake Eucumbene Catchment	Lake Jindabyne Catchment	Lower Snowy River Catchment	Murray River to Hume Reservoir Catchment	Swampy Plain River Catchment	Geehi Reservoir and M2 Reservoir Catchments
Parastacidae	*Engaeus cymus*	Burrowing crayfish					Oc (X)	Oc (X)										Oc (X)	
Palaemonidae		Freshwater prawn										Oc (DNA)							
Atyidae		Freshwater glass shrimp	Oc (DNA)				Low (DNA)					Oc (DNA)							
Non-Native Species																			
Percidae	*Perca fluviatilis*	Redfin perch	Oc (X+C+ DNA)		Oc (X+DN A)	Oc (X+C+ DNA)	Oc (X+DN A)	Oc (X)					Oc (X+DN A)			Oc (X)	Oc (X)	Oc (X+DN A)	
Poeciliidae	*Gambusia holbrooki*	Eastern gambusia	Oc (X+C+ DNA)				Oc (DNA)	Oc (X)				Oc (X+DN A)	Oc (X+DN A)	Low (DNA)	Low (DNA)	Oc (X)	Oc (X)		
Cypriniforme	Cypriniforme OTU1	Cypriniforme OTU1	Low (DNA)																
Cypriniforme	Cypriniforme OTU2	Cypriniforme OTU2	Low (DNA)				Low (DNA)			Low (DNA)									
Cypriniforme	Cypriniforme OTU3	Cypriniforme OTU3	Low (DNA)																
Cyprinidae	*Carassius auratus*	Wild goldfish	Oc (X+C+ DNA)				Oc (DNA)	Oc (X)				Oc (X+DN A)	Oc (X)	Oc (X)	Oc (X)	Oc (X)	Oc (X)		
Cyprinidae	*Cyprinus carpio*	Carp	Low (DNA)					Oc (X)				Oc (X+DN A)	Oc (X)			Oc (X)	Oc (X)	Oc (X)	
Cobitidae	*Misgurnus anguillicaudatus*	Oriental weatherloach						Oc (X)				Oc (X)	Oc (X)	Oc (X)	Oc (X)				
Salmonidae	*Oncorhynchus mykiss*	Rainbow trout	Oc (X+C+ DNA)	Oc (X)	Oc (X)	Oc (X+C+ DNA)	Oc (X+DN A)	Oc (X)	Oc (X+C+ DNA)	Oc (X+C+ DNA)		Oc (X+C+ DNA)	Oc (X)	Oc (X+DN A)	Oc (X)	Oc (X)	Oc (X)	Oc (X)	Oc (X)
Salmonidae	*Salmo trutta*	Brown trout	Oc (X+C+ DNA)	Oc (X)	Oc (X)	Oc (X+C+ DNA)	Oc (X+DN A)	Oc (X)	Oc (X+C+ DNA)	Oc (X+C+ DNA)		Oc (X+C+ DNA)	Oc (X)	Oc (X+DN A)	Oc (X)	Oc (X)	Oc (X)	Oc (X)	Oc (X)
Salmonidae	*Salmo salar*	Atlantic salmon													Oc (X)			Oc (X)	
Salmonidae	*Salvelinus fontinalis*	Brook trout		Oc (X)										Oc (X+DN A)	Oc (X)				

Key: Vul. = Vulnerable, End. = Endangered, Crit. End. = Critically Endangered

Appendix E – Pest Fish Surveillance Program

This pest fish surveillance program is based on advice provided by Raadik and Lintermans (2022) and consultation with NPWS, NSW DPI and DCCEEW. These surveillance activities will occur until the program is revised in accordance with Section 4.4.3.

Monitoring sites and frequency

To detect the presence of pest fish species as early as possible (i.e. at low abundance) following an incursion, and given multiple incursion pathways, a wide network of monitoring sites have been selected in each of the surveillance catchments. Table 14 provides a summary of pest fish surveillance activities to be undertaken as part of the BRMP.

Specific monitoring details in each of the surveillance catchments are provided in the Figures and Tables below:

1. Tantangara Reservoir (Table 15; Figure 20; Figure 21)
2. Upper Murrumbidgee River upstream of Tantangara Reservoir (Table 16; Figure 20; Figure 21)
3. Lake Eucumbene (Table 17; Figure 20; Figure 21)
4. Mid Murrumbidgee (Table 18; Table 20; Figure 22; Figure 23).
5. Talbingo Reservoir (Table 19; Figure 20; Figure 21).

The sites shown on the figures below are indicative only and will require ground-truthing and adaptive sampling with respect to the adequacy of vehicle or boat access (water level, tracks, boat ramps, etc.) during pre and/or post connection periods, including weather and safety constraints. Sampling locations in reservoirs have been selected based on geographic spread and areas of potential incursion via tunnel outlets (greater density around outlets), and popular fishing locations, but will require localised refinement towards areas containing favourable habitat for the target species which is best determined in the field during sampling. For these reasons, the precise location of sampling may vary between sampling events. All access to monitoring and boat launching locations within KNP will occur along existing access tracks or on foot.

If sampling by others within the surveillance catchments occurs at or in the vicinity of a site at an equal or higher standard than the tables below, this will be considered the sampling for that period. For example, if physical surveys for Macquarie Perch and/or Stocky Galaxias occur as part of the TFMP in the vicinity of any surveillance sites, the data from those surveys will be used for reporting under the BRMP.

To improve baseline knowledge of the distribution of Redfin more broadly in the mid Murrumbidgee catchment, as other potential sources of incursion into Macquarie Perch habitat other than via downstream or upstream colonisation in the Murrumbidgee River, a one-off detailed pre-connection eDNA survey will occur incorporating the sites listed in Table 18 and Table 20. This will involve eDNA sampling, with positive detections confirmed by physical sampling.

During pest fish surveillance activities, opportunistic visual examination of captured fish for the presence of Lernaea will occur to provide information on the potential presence and prevalence of this parasite in the relevant waterbodies (Appendix E).

Timing of Surveillance Activities

Where practicable, sampling will avoid periods when detection probability may be very low such as during elevated water levels and coincident very fast flows during winter to early spring or following large storm events. In general, sampling will occur annually in late Summer/Autumn. Additional sampling for larvae and/or juveniles will occur in late spring/early summer in Tantangara Reservoir. Given the high altitude and low temperature of Tantangara Reservoir compared to other Australian locations where Redfin are present, the potential timing of Redfin breeding is uncertain and if it occurs, could be later in the year than other locations. As such, sampling will be timed to target juveniles but also utilise methods capable of detecting larvae.

Spring/summer sampling may be expanded to other catchments if the species of concern becomes established in Tantangara Reservoir. eDNA sampling, if not upstream of Tantangara Reservoir or connected waterways, may be targeted towards periods when no pumping or water transfers have occurred to minimise the possibility of false positives arising from DNA transferred from Talbingo Reservoir. Alternatively, sampling locations will be shifted into upstream tributaries.

The timing of all activities will be adaptive. The safety of Snowy Hydro staff, contractors and the general public is of paramount importance to Snowy Hydro. Reasonable efforts will be made to access sites at the times and frequency specified here, however, sampling will only occur when deemed safe to do so and sites may be skipped if safe access is not possible or weather conditions are not suitable.

Table 14: Summary of pest surveillance activities in each catchment including target species, connection stage, method, frequency and timing
CGal – Climbing Galaxias; EGam – Eastern Gambusia; RedF – Redfin; Sal - Salmonids. Pre – pre-Snowy 2.0 connection, Post – post-Snowy 2.0 connection. eDNA – environmental DNA sampling, Physical – physical sampling methods (EF/BP – backpack electrofishing, EF/B – boat electrofishing, LLT – larval light trap).

Catchment	Target Species	Connection Stage	Method	Frequency	Timing	Justification
Tantangara Reservoir	CGal EGam RedF	Pre	eDNA Physical (EF/B)	Once	Summer-autumn (adults)	Establish a baseline of presence/absence
		Post	eDNA Physical (EF/B, LLT)	Biannual	Summer-autumn (adults) Spring-summer (larvae/juveniles)	Monitor for incursion, establishment and expansion - eDNA sites shift to above supply level at the mouth of inflowing tributaries where possible or occur within the reservoir if no pumping has occurred for > 1 month. - physical sampling to verify and complement eDNA
Upper Murrumbidgee	CGal Sal[10]	Pre	eDNA Physical (EF/BP)	Once	Summer-autumn (adults)	Establish a baseline of presence/absence
		Post	eDNA Physical (EF/BP)	Annual	Summer-autumn (adults) [11]	Monitor for incursion, establishment and expansion
Lake Eucumbene	RedF EGam	Pre	eDNA Physical (EF/B)	Once	Summer-autumn (adults)	Establish a baseline of presence/absence
		Post	eDNA Physical (EF/B)	Annual	Summer-autumn (adults) [11]	Monitor for incursion, establishment and expansion
Mid Murrumbidgee	RedF	Pre	eDNA Physical (EF/BP)	Once	Summer-autumn (adults)	Establish a baseline of presence/absence
		Post	eDNA Physical (EF/BP)	Annual	Summer-autumn (adults) [11]	Monitor for incursion, establishment and expansion
Talbingo Reservoir	CGal EGam RedF	Pre	eDNA (Physical if no positive detection)[12]	Once	Summer-autumn (adults)	Positive eDNA control site where target species are present
		Post	eDNA (Physical if no positive detection)[12]	Annual	Summer-autumn (adults)	Positive eDNA control site where target species are present

[10] Salmonids will only be targeted for eDNA sampling above the waterfall on Tantangara Creek however their presence will also be recorded and reported in other locations where they are detected during physical sampling.

[11] Physical sampling for larvae (LLT) post-connection will also occur in spring/summer, in locations other than Tantangara Reservoir, if relevant species presence is confirmed in Tantangara Reservoir.

[12] As Climbing Galaxias have not, to date, been detected in Talbingo Reservoir near the Snowy 2.0 intake, it is possible that they never will be. If a species is not detected via eDNA sampling, reasonable efforts using physical sampling will be made on up to 2 occasions after which time, only eDNA sampling will occur, regardless of whether a positive detection was made.

Table 15: Pest fish surveillance sites in Tantangara Reservoir, including target species, connection stage, method and frequency

Site	Specific location	Species	Stage	Methods	Frequency	Justification
TR1 to 13	Around edge of reservoir in areas of potential habitat	CGal EGam RedF	Pre	- eDNA, Physical	Once;	Establish a baseline of presence/absence - eDNA sites along edge in reservoir. - physical sampling (EF/B, LLT, consider other less rigorous methods), to verify and complement eDNA results
TR1, 3 to 5, 7 to 10, 12 to 13	Sites into lower reaches of nearby stream (sites 2, 6, 11 excluded)		Post	- eDNA - Physical – at pre connection locations	Annual;	Monitor for incursion, establishment and expansion - eDNA sites shift to above supply level at the mouth of inflowing tributaries where possible or occur within the reservoir if no pumping has occurred for a period of 1 month. - physical sampling (gear as above) to verify and complement eDNA results

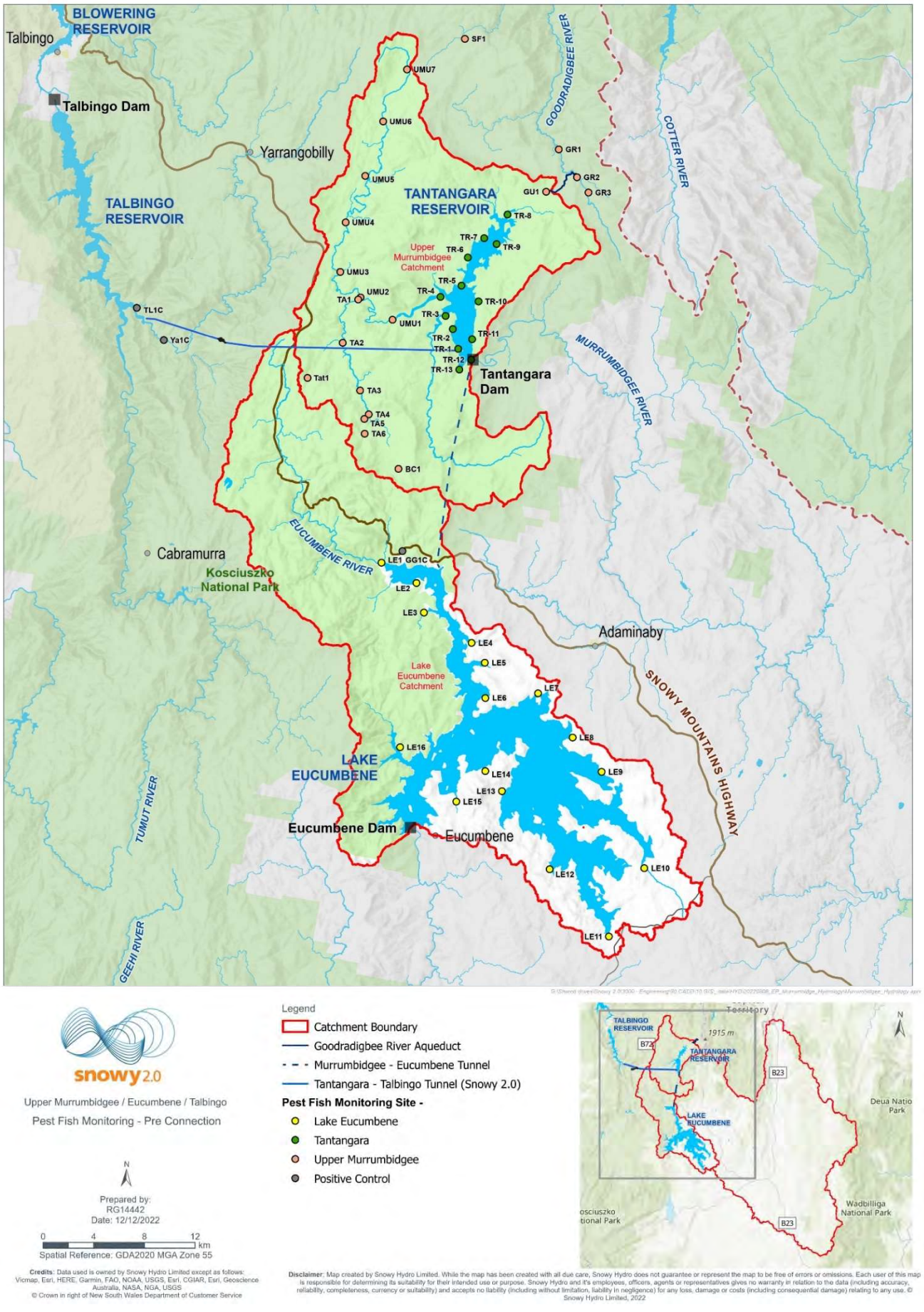
Table 16: Pest fish surveillance sites in Upper Murrumbidgee and surrounding catchments, including target species, connection stage, method and frequency

Site	Specific location	Species	Stage	Methods	Frequency	Justification
UMU1 to 7	Murrumbidgee River upstream of Tantangara Reservoir, to headwaters	CGal EGam RedF	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence - single eDNA run to set baseline - physical sampling (EF/BP) to verify and complement eDNA results.
			Post	- eDNA, Physical	Annual	Monitor for incursion, establishment and expansion - monitoring at UMU1 to 3 only, expanded to all sites for CGal if target taxa detected at these sites or in Tantangara Reservoir - ongoing eDNA surveillance of pest fish - physical sampling (EF/BP) to verify and complement eDNA results
TA1 to 6, Tat1, BC1	Tantangara Creek system (includes one site on Boggy Plain Creek)	CGal Sal	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence upstream towards, and into, the Stocky Galaxias population - single eDNA run to set baseline - physical sampling (EF/BP) to verify and complement eDNA results
			Post	- eDNA, Physical	Annual	Monitor for incursion, establishment and expansion upstream towards, and into, the Stocky Galaxias population - eDNA monitoring at TA1, expanded to all sites if CGal detected in Tantangara Reservoir or at TA1 - physical sampling (EF/BP) to verify and complement eDNA results

Site	Specific location	Species	Stage	Methods	Frequency	Justification
SF1	Sally's Flat Creek, below trout barrier (Goodradigbee system)	CGal	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence below Stocky Galaxias population - single eDNA run to set baseline for target taxa - physical sampling (EF/BP) to verify and complement eDNA results
			Post	- eDNA, Physical	Annual	Monitor for incursion, establishment and expansion upstream towards, and into, the Stocky Galaxias population - eDNA monitoring if CGal detected at UMU3, 4 or 5 - physical sampling (EF/BP) to verify and complement eDNA results
GR1 to 3	Goodradigbee River headwaters, around diversion inlet	CGal	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence - single eDNA run to set baseline for target taxa - physical sampling (EF/BP) to verify and complement eDNA results
			Post	- eDNA, Physical	Annual	Monitor for incursion and establishment - eDNA monitoring if CGal detected in Tantangara Reservoir - physical sampling (EF/BP) to verify and complement eDNA results
GU1	Gurrangorambla Creek tributary, at outlet of Goodradigbee River aqueduct	CGal EGam RedF	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence - single eDNA run to set baseline for target taxa - physical sampling (EF/BP) to verify and complement eDNA results
			Post	- eDNA, Physical	Annual	Monitor for incursion and establishment - eDNA monitoring if CGal detected in Tantangara Reservoir - physical sampling (EF/BP) to verify and complement eDNA results

Table 17: Pest fish surveillance sites in Lake Eucumbene, including target species, connection stage, method and frequency

Site	Specific location	Species	Stage	Methods	Frequency	Justification
GG1	Gang Gang Creek, at Snowy Mountain Highway	CGal	Pre Post	- eDNA	Once Annual	Positive control site where target species is present - eDNA monitoring for target taxa, until established in Tantangara Reservoir a minimum of three months
LE1 to 16	Eucumbene Inlet; Providence Flats; Hughes Creek Inlet; Long Plain Inlet; Wattledale Inlet; Wangrabelle Bay; Adaminaby Bay; Springwood Bay; White Rocks Inlet; Frying pan Arm; Buckenderra Arm; Wainui Bay; Cobrabald Bay; Coppermine Bay; Braemer; Big Tolbar Inlet	RedF	Pre	- eDNA, Physical	Once	Establish a baseline of presence/absence - eDNA sites along edge of reservoir - single eDNA run to set baseline for target taxa - physical sampling (EF/B) to verify and complement eDNA results
LE1a to 5a, 11A to 2a, 15a to 16a	Eucumbene River; Swamp Creek; Hughes Creek Long Plain Creek; Little Plain Creek; Fryingpan Creek; Buckenderra Creek; Andys Creek (Braemer); Big Tolbar Creek		Post	- eDNA, Physical	Annual	Monitor for incursion, establishment and expansion - eDNA sites shift to above full supply level at the mouth of inflowing tributaries - Annual eDNA monitoring of sites between Eucumbene River Inlet and Wangrabelle Bay (sites LE1–5), expand to all other sites if target taxa detected in Tantangara Reservoir - physical sampling (EF/B) to verify and complement eDNA results



snowy 2.0

Upper Murrumbidgee / Eucumbene / Talbingo

Pest Fish Monitoring - Pre Connection

Prepared by:
RG14442
Date: 12/12/2022

0 4 8 12 km

Spatial Reference: GDA2020 MGA Zone 55

Legend

- Catchment Boundary
- Goodradigbee River Aqueduct
- Murrumbidgee - Eucumbene Tunnel
- Tantangara - Talbingo Tunnel (Snowy 2.0)

Pest Fish Monitoring Site -

- Lake Eucumbene
- Tantangara
- Upper Murrumbidgee
- Positive Control

Figure 20: Map showing the indicative location of pre-connection pest fish surveillance sites in Tantangara Reservoir, Lake Eucumbene and the Upper Murrumbidgee catchment

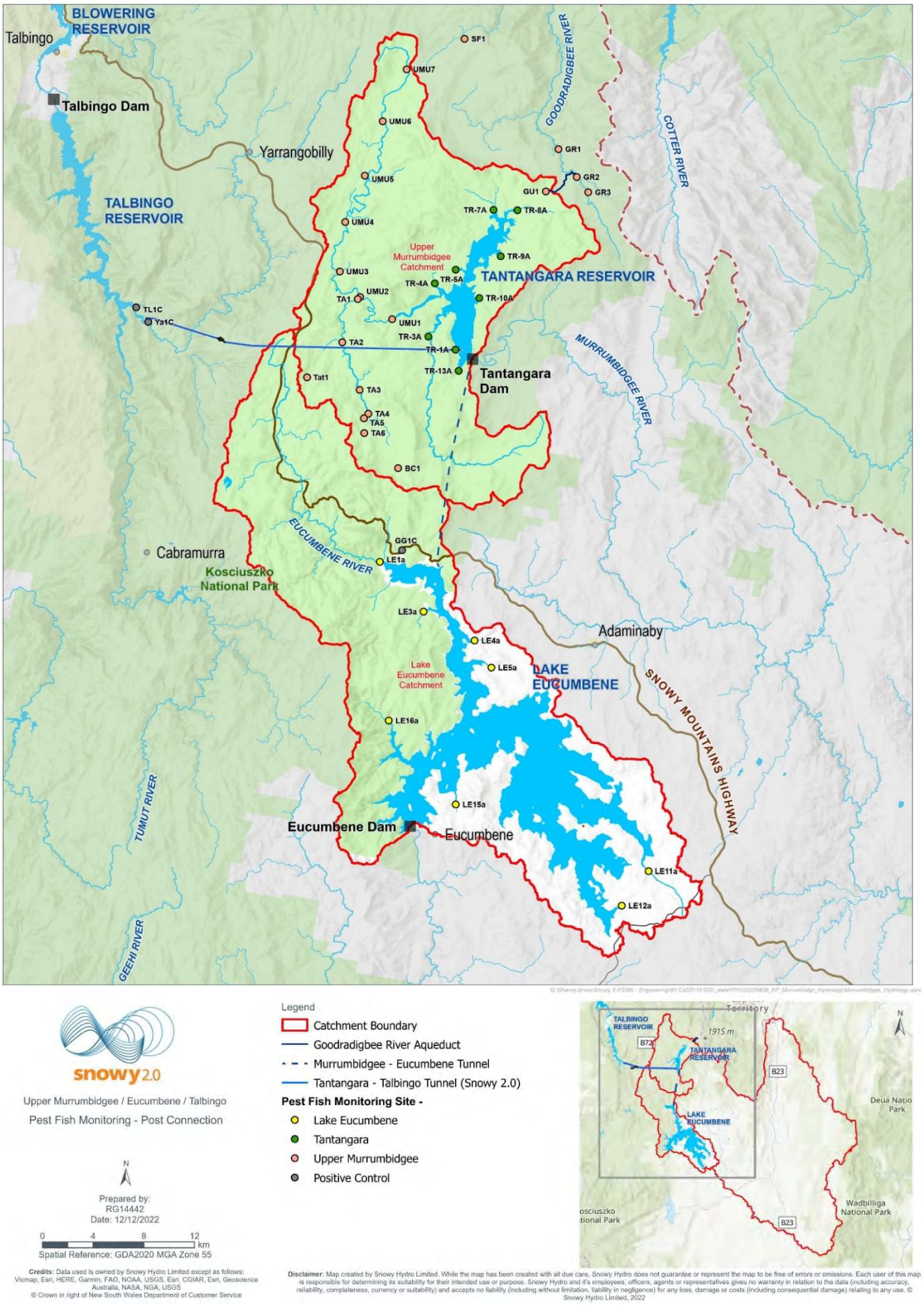


Figure 21: Map showing the indicative location of post-connection pest fish surveillance sites in Tantangara Reservoir, Lake Eucumbene and the Upper Murrumbidgee catchment.

Table 18: Pest fish surveillance sites in the mid Murrumbidgee catchment, including target species, connection stage, method and frequency

Site	Specific location	Species	Stage	Methods	Frequency	Justification
Angle Crossing	Murrumbidgee R, off Angle Crossing Rd	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual	Monitor for incursion, establishment, expansion. Continue post-connection physical sampling
Lawler Rd	Murrumbidgee R, off Lawler Rd	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling
D/s Bredbo	Murrumbidgee R, off Bumbalong Rd	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling
Bredbo R 1	Monaro Highway	RedF	Post	- eDNA	Annual	D/s Bredbo and Billilingra Rd replacement sites for eDNA
Billilingra Rd	Murrumbidgee R, Billilingra Rd	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion
Numeralla R (on Murrumbidgee)	Murrumbidgee R, off Monaro Highway	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling only
Numeralla R	Monaro Highway	RedF	Post	- eDNA	Annual	Numeralla R (on Murrumbidgee) site replacement for eDNA
Mittagang Crossing	Murrumbidgee R, Mittagang Rd	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling only
Kissops Flat	Murrumbidgee R, private road off Dry Plains Road	RedF	Pre	- eDNA	Annual	Establish a baseline of presence/absence
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion
Bridle Crk	Dry Plains Rd	RedF	Post	- eDNA	Annual	Kissops Flat site replacement for eDNA
Alum Creek (on Murrumbidgee)	Murrumbidgee R off Jones Plain Rd	RedF, EGam	Pre	- eDNA	Annual	Establish a baseline of presence/absence. *Positive control for Eastern Gambusia.*
			Post	- Physical	Annual[13]	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling.
Alum Crk	Jones Plain Rd	RedF, EGam	Post	- eDNA	Annual	Alum Creek site replacement for eDNA. *Positive control for Eastern Gambusia*

[13] Annual physical sampling in these locations is only to occur if the relevant species presence in Tantangara Reservoir or other mid-Murrumbidgee catchment locations is confirmed.

Site	Specific location	Species	Stage	Methods	Frequency	Justification
Bolaro	Murrumbidgee R, Bolaro Rd	RedF, EGam	Pre	- eDNA	Annual	Establish a baseline of presence/absence. *Positive control for Eastern Gambusia*
			Post	- Physical	Annual[14]	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling only.
Yaouk	Murrumbidgee R, Yaouk Rd	RedF, EGam	Pre	- eDNA	Annual	Establish a baseline of presence/absence.
			Post	- Physical	Annual	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling
Yaouk Creek	Yaouk Rd	RedF, EGam	Post	- eDNA	Annual	Yaouk site replacement for eDNA
Murrumbidgee R Firetrail	At Murrumbidgee R	RedF, EGam	Pre	- eDNA	Annual	Establish a baseline of presence/absence.
			Post	- Physical	Annual	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling
Paytens Crk	Off Murrumbidgee River Firetrail	RedF, EGam	Post	- eDNA	Annual	Murrumbidgee Firetrail site replacement for eDNA
Tantangara Road	At Murrumbidgee R	RedF, EGam	Pre	- eDNA	Annual	Establish a baseline of presence/absence.
			Post	- Physical	Annual	Monitor for incursion, establishment and expansion. Continue post-connection physical sampling
Gulf Plain Creek	Pedens Hut Firetrail	RedF, EGam	Post	- eDNA	Annual	Tantangara Rd site replacement for eDNA

Table 19: Pest fish surveillance sites in Talbingo Reservoir, including target species, connection stage, method and frequency

Site	Specific location	Target Species	Stage	Methods	Frequency	Justification
TL1 Ya1	Talbingo Reservoir around water intake infrastructure and in lower Yarrangobilly River	CGal EGam RedF	Pre	- eDNA, Physical	Once;	Positive eDNA control site where target species are present
			Post		Annual;	Monitoring for each target taxa, until each established in Tantangara Reservoir a minimum of three months Undertake physical sampling (EF/B, LLT, consider GN, FN and other methods) if no positive eDNA detection Note: A single detection of each species per year using any method is considered sufficient

[14] Annual sampling in these locations is only to occur if the relevant species presence in Tantangara Reservoir or other mid-Murrumbidgee catchment locations is confirmed.

Table 20: Additional sites for pre-connection, one-off wider catchment scan for Redfin using eDNA in the mid Murrumbidgee catchment

Site designation	Specific location
Strike-A-Light R	Jeralang Road
Bredbo R 2	Dowling Firetrail
Bredbo R 3	Peak View Road
Cowra Crk 1	Dowling Firetrail
Cowra Crk 2	Peak View Road
Murrumbucca Crk	Nightingale Road
Numeralla R 2	Numeralla Road, Numeralla
Numeralla R 3	Off Carlaminda Road
Big Badja R	Badja Road
Kybeyan R 1	Corner Road
Kybeyan R 2	Tuross Road
Cooma Crk 1	Monaro Highway (downstream of Cooma)
Cooma Crk 2	Monaro Highway (upstream of Cooma)
Cooma Crk 3	Myall Road
Rock Flat Crk 1	Numeralla Road
Rock Flat Crk 2	Monaro Highway
Cooma Back Crk 1	Snowy Mountains Highway
Cooma Back Crk 2	Maffra Road
Slacks Crk	Dry Plains Road
Wambrook Crk	Snowy Mountains Highway
Bulga Crk	Track off Shannons Flat Road
Caddigat Crk 1	Unnamed track
Caddigat Crk 2	Snowy Mountains Highway
Wild Mares Crk	Bobeyan Road
Goorudee R	Yaouk Road

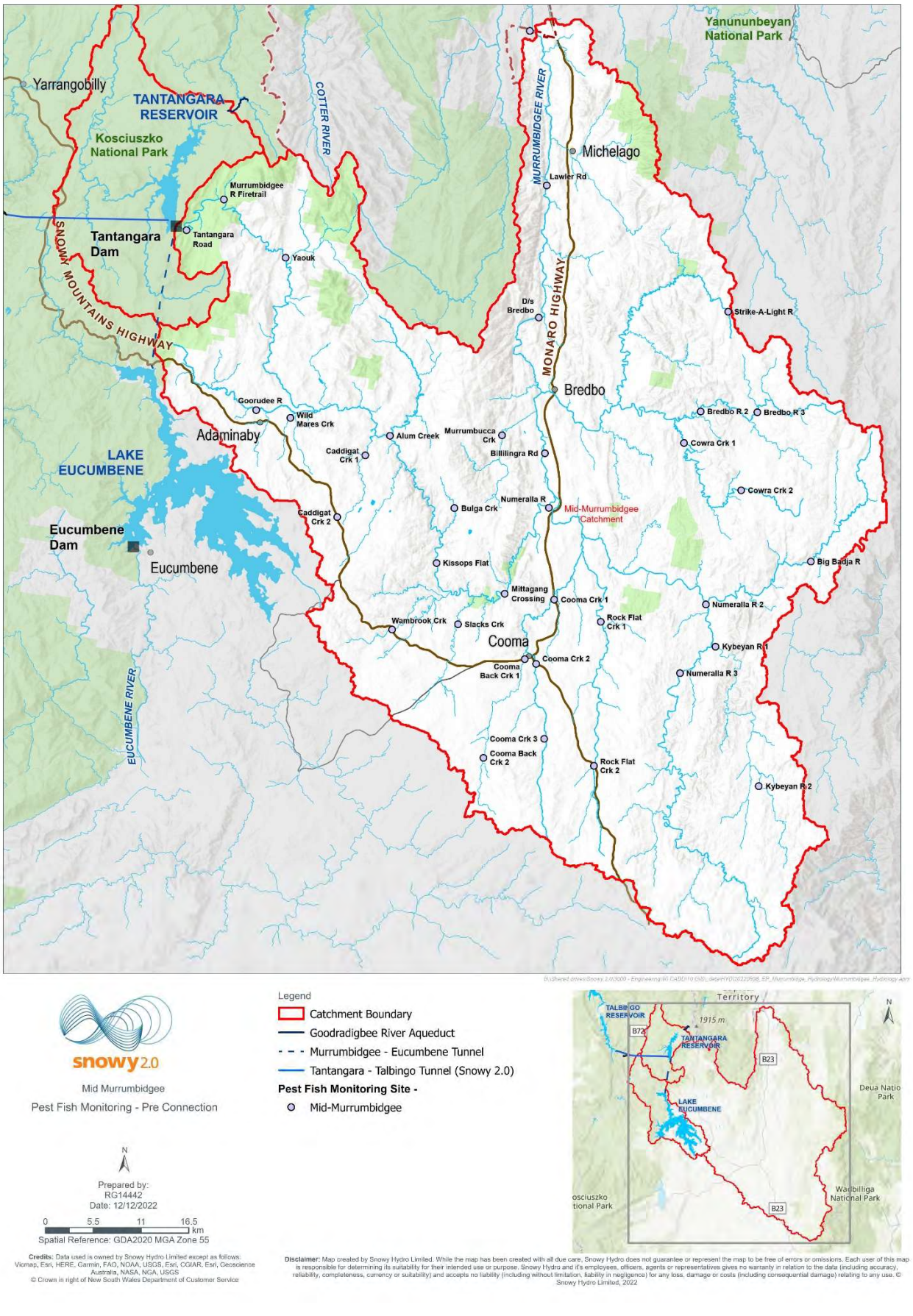


Figure 22: Map showing the indicative location of pre-connection pest fish surveillance sites in mid Murrumbidgee and surrounding catchments

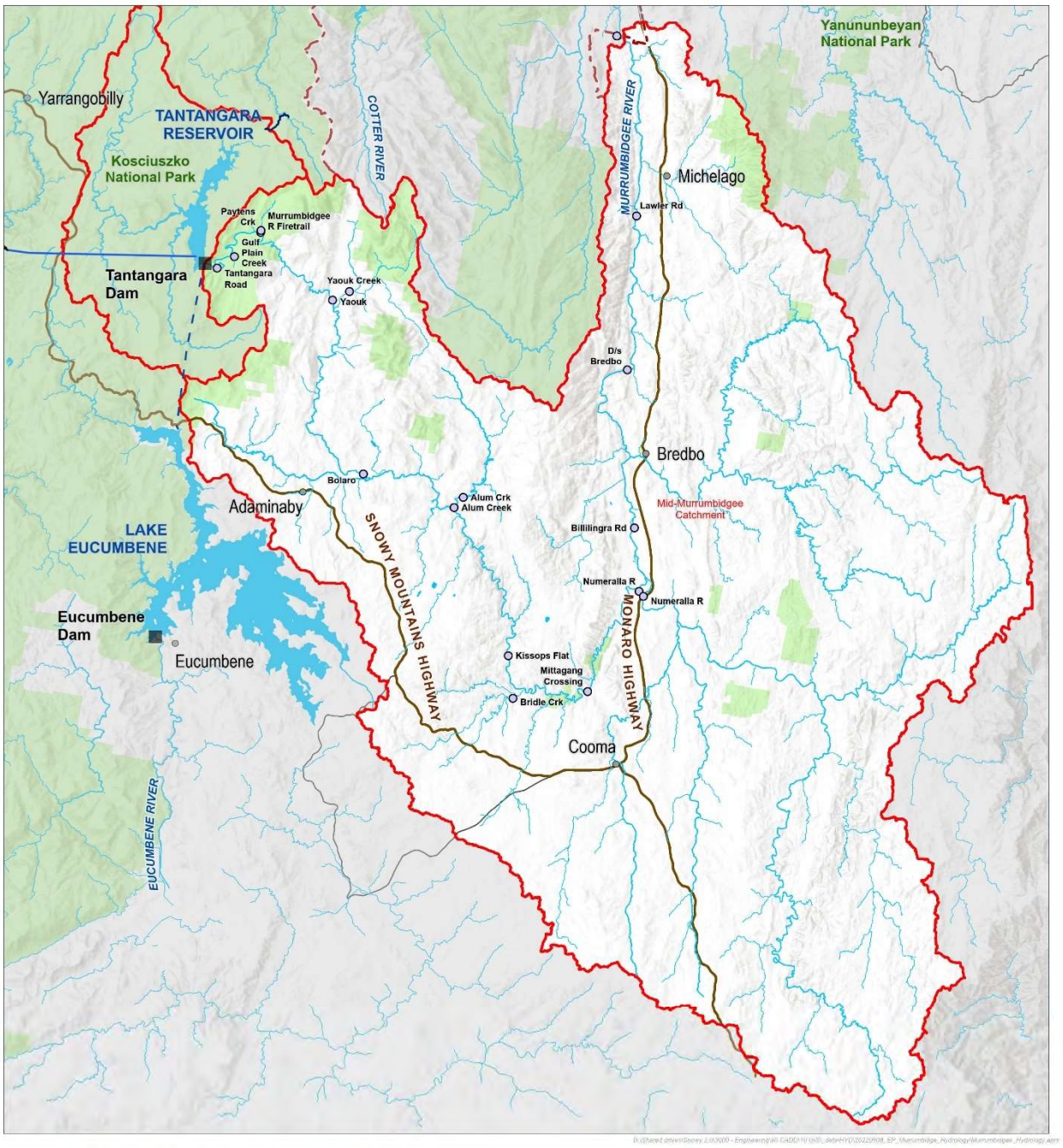


Figure 23: Map showing the indicative location of post-connection pest fish surveillance sites in mid Murrumbidgee and surrounding catchments

Appendix F – Disease Surveillance Program

This disease surveillance program is based on advice provided by Diggles (2022b) and Dr Paul Hick from the Elizabeth Macarthur Agricultural Institute (EMAI). Surveillance will include both active and passive components.

Active Surveillance

Targeted active sampling for EHNV will be undertaken in Talbingo targeting the summer months between December and February once water temperatures exceed 19°C. Annual surveillance surveys will occur for 2 consecutive years, to meet the usual international requirements for declaration of freedom from disease (OIE, 2015).

The target fish species is Redfin. Sampling will be biased towards young of year (YOY) and juvenile fish. Each sampling season, best efforts will be made to lethally sample the numbers of fish presented in Table 21 for EHNV analysis using qPCR testing and if available, serology. Fish collection will be undertaken using electrofishing, netting or other methods of capturing fish that aim to collect fish that may be elusive and/or are not necessarily feeding.

Table 21: Surveillance design for detecting EHNV in Talbingo reservoir.

Location	Water Temperature	Time of Year	No. of samples and species targeted for lethal testing by qPCR and serology
Talbingo Reservoir	>19°C	Dec-Feb	Redfin YOY (n => 156) (qPCR testing only) Redfin juveniles or adults (n = > 156)

The reservoir will be partitioned into at least 10 units with fish in each unit to be collected and bagged separately. Fish from each unit will be analysed to account for disease clustering. The collection of unwell or injured fish or fish showing unusual external signs (including signs of disease) will be prioritised. If more than the required number of Redfin are collected, additional fish will be analysed for qPCR using pooled sampling. If insufficient Redfin of each age classes can be collected, other age classes will be substituted. In the event that insufficient numbers of Redfin can be collected, Snowy Hydro will consult with NSW DPI on the appropriate course of action to ensure confidence in results.

Chilled samples of whole fish (<5 cm long) or dissected internal organs of larger (>5 cm) fish will be maintained at 2-4°C and sent to the laboratory within three days. Alternatively, the samples will be frozen at -20°C prior to transport to the laboratory within six months of collection. The preferred laboratory to conduct the testing is the OIE Reference Laboratory for infection with EHNV, namely, EMAI. Any non-normal results from qPCR analysis will be tested by conventional PCR and sequence analysis to increase sensitivity and specificity.

If analysis capability is available at the EMAI, blood samples will also be collected from the caudal vein of up to 156 adult Redfin and placed in labelled tubes and placed on ice or in a portable fridge. The same fish can be tested using qPCR and serology.

Notification of suspected emergency disease and positive test results for EHNV will be undertaken according to legislative requirements.

During pest fish and EHNV surveillance activities, opportunistic visual examination of captured fish for the presence of Lernaea will occur. This will be done by visually examining all relevant fish species, including juvenile and adult Redfin, native species such as Trout Cod, Golden Perch, Mountain Galaxias, as well as exotic Rainbow and Brown Trout and Goldfish that are collected during sampling for EHNV or pest fish. Non-lethal sampling of desirable species will involve brief, gentle handling of freshly captured fish including close visual observation of the entire body surface (including fins and under opercula) prior to their release at the site of capture.

Specific diagnostic tests are not required for Lernaea, however in order to confirm a positive detection in an area where the parasite is not already confirmed to occur, where appropriate, voucher specimens will be dissected from the infected fish, and fixed in 70% ethanol before being sent to an appropriate person/facility for official identification.

If EHNV is not detected in the Talbingo Redfin population at the conclusion of this program, active sampling will cease. If EHNV is detected in the Talbingo Redfin population, the program will be reviewed and updated.

Passive Surveillance

Passive surveillance for EHNV will occur across all surveillance catchments for the duration of the BRMP.

Reports of fish kill[15] events or fish disease in any of the surveillance catchments will trigger a notification to NSW DPI in accordance with legislative requirements and the deployment of a sample collection team as soon as reasonably practicable who will seek to collect dead or moribund fish from the relevant location and submit them for EHNV testing. Any affected fish species will be collected and will include a minimum of 5 and up to 30 moribund or freshly dead fish per location where possible. Visual examination of any affected fish species for Lernaea will also occur.

[15] See: https://www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills