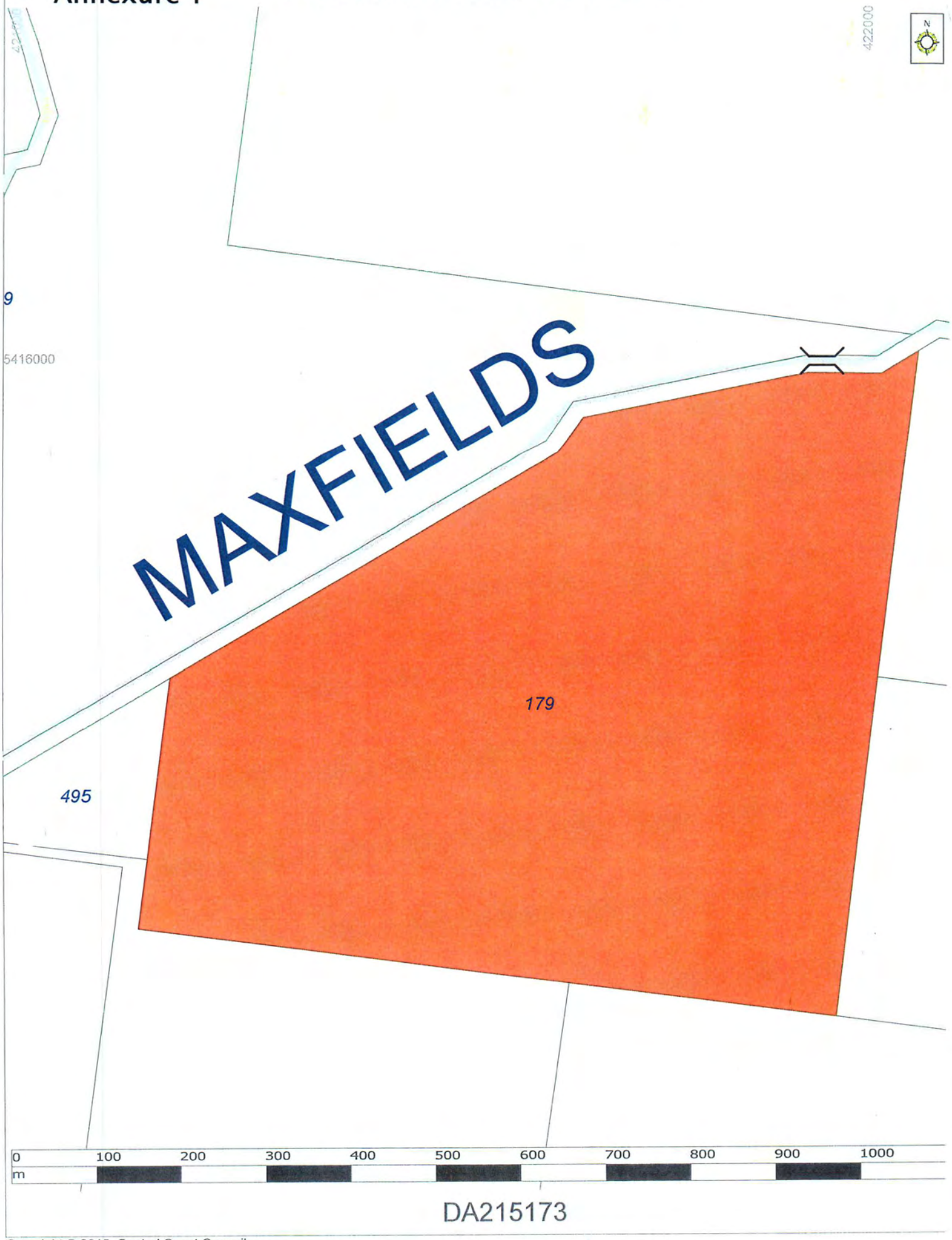
Annexure 1

179 Maxfields Road, South Nietta



DA215173

Annexure 2

CENTRAL COAST COUNCIL

PO Box 220
19 King Edward Street
Ulverstone Tasmania 7315.
Tel (03) 6429 8900
Fax (03) 6425 1224
admin@centralcoast.tas.gov.au
www.centralcoast.tas.gov.au

DEVELOPMENT APPLICATION

Sections 57 & 58

Application Number	DA215173

APPLICANT DETAILS

Applicant Name	Casey Rohan Miles			
Postal Address	40 Radnor Road GALSTON NSW 2159			
Phone(B)	Phone(H)	Mobile 0408668879	Fax	

OWNER DETAILS

Owner/Authority Name	Casey Rohan Miles, Christopher Gordon Miles
Address	40 Radnor Road GALSTON NSW 2159

DEVELOPMENT APPLICATION DETAILS

Property Address	179 Maxfields Road South Nietta 7315
Title Reference	221116/1
Zone(s)	Rural Resource [Central Coast Interim Planning Scheme 2013]

Note: Council requires a survey plan or certificate of title to clarify the property description

Present Use	Rural land, road reserve and existing Mini Hydro Power Plant.
Proposal (intended use)	Utilities (Water Transfer Infrasturcture, including Pump House, Pipeline, Dam, Penstock and Turbine House)
Developent Type	Discretionary Permit Area >250m2
Estimated Value of Development	$850,000.00

Building Application	No
Are all Documents Attached? (Refer to Application Checklist)	Yes

Existing Floor Area	Area: 0.00	m2
New or Additional Floor Area	Area: 98.00	m2

CENTRAL COAST COUNCIL
DEVELOPMENT & REGULATORY SERVICES
Received: 17 MAY 2016
Application No:
Doc. ID:

CENTRAL COAST COUNCIL

Application Number: DA215173

NON-RESIDENTIAL DEVELOPMENT/USE

Hours of Operation	Monday/Friday	12am	to	12pm
	Saturday	12am	to	12pm
	Sunday	12am	to	12pm

Number of Car Parking (Existing)	0	**Number of Employees (Existing)**	0
Number of Car Parking (Additional)	2	**Number of Employees (Additional)**	0

Type of Machinery Installed	2 x 250Kw Motors and 2 x 125kW Generators
Details of Trade Waste and Method of Disposal	There will be no trade waste during operation.

APPLICANT DECLARATION

YOUR DECLARATION - To be completed by all applicants.

I apply for consent to carry out the development described in this application. I declare that all the information given is true and correct. I also understand that:

if incomplete, the application may be delayed or rejected.

more information may be requested within 21 days of lodgement.

PUBLIC ACCESS TO DISCRETIONARY PLANNING DOCUMENTS

I, the undersigned understand that during the 14-day public display period, all documentation included with this planning application will be made available for inspection by the public and upon request and following payment of a prescribed fee, copies of submitted documentation, with the exception of plans which will be made available for display only, will be provided to members of the public.

OWNERS NOTIFICATION

I declare that I have notified the owner of the intention to make of this application.
If the land is subject to a mining lease, or is owned by the Crown or Council, the written consent of the Owner must be submitted with the application in accordance with s.52 of the Act.
In the course of inspections and investigations relating to this application, it may be necessary for Council officers to enter upon the land which is subject to this application. Accordingly, permission is hereby granted for entry for that purpose provided reasonable attempts are made on site to inform any resident or occupant on the property at that time.

	Name (Print):	*Signed:*	*Date:*
Applicant:	Casey Miles	Casey Miles	13.04.16
	Chris Miles	Chris Miles	13.04.16

Minister to Co-Sign here →

I Jesse Walker being and as Team Leader, Crow Land Services (Unit Manager, Policy + Project prescribed in Statutory Rule 116 of 2011 and pursuant to an Instrument of Delegation d

21st August 2015
consent to the making of this permit application.

RESULT OF SEARCH

RECORDER OF TITLES

Issued Pursuant to the Land Titles Act 1980

Doc ID 228605

Tasmanian Government

SEARCH OF TORRENS TITLE

VOLUME	FOLIO
221116	1
EDITION	DATE OF ISSUE
4	16-Nov-2015

SEARCH DATE : 30-Mar-2016
SEARCH TIME : 12.41 PM

DESCRIPTION OF LAND

Parish of NIETTA, Land District of DEVON
Lot 1 on Plan 221116
Derivation : Part of Lot 18799 Gtd. to T.J. Clerke
Prior CT 2734/22

SCHEDULE 1

M542325 TRANSFER to CHRISTOPHER GORDON MILES and CASEY ROHAN MILES as tenants in common in equal shares
Registered 16-Nov-2015 at 12.01 PM

SCHEDULE 2

Reservations and conditions in the Crown Grant if any
E28199 MORTGAGE to Commonwealth Bank of Australia
Registered 16-Nov-2015 at 12.02 PM

UNREGISTERED DEALINGS AND NOTATIONS

No unregistered dealings or other notations

[illegible] COUNCIL
[illegible] REGULATORY SERVICES
Received: 30 MAR 2016
Application No:
Doc ID:

R.P. 312

2734 22

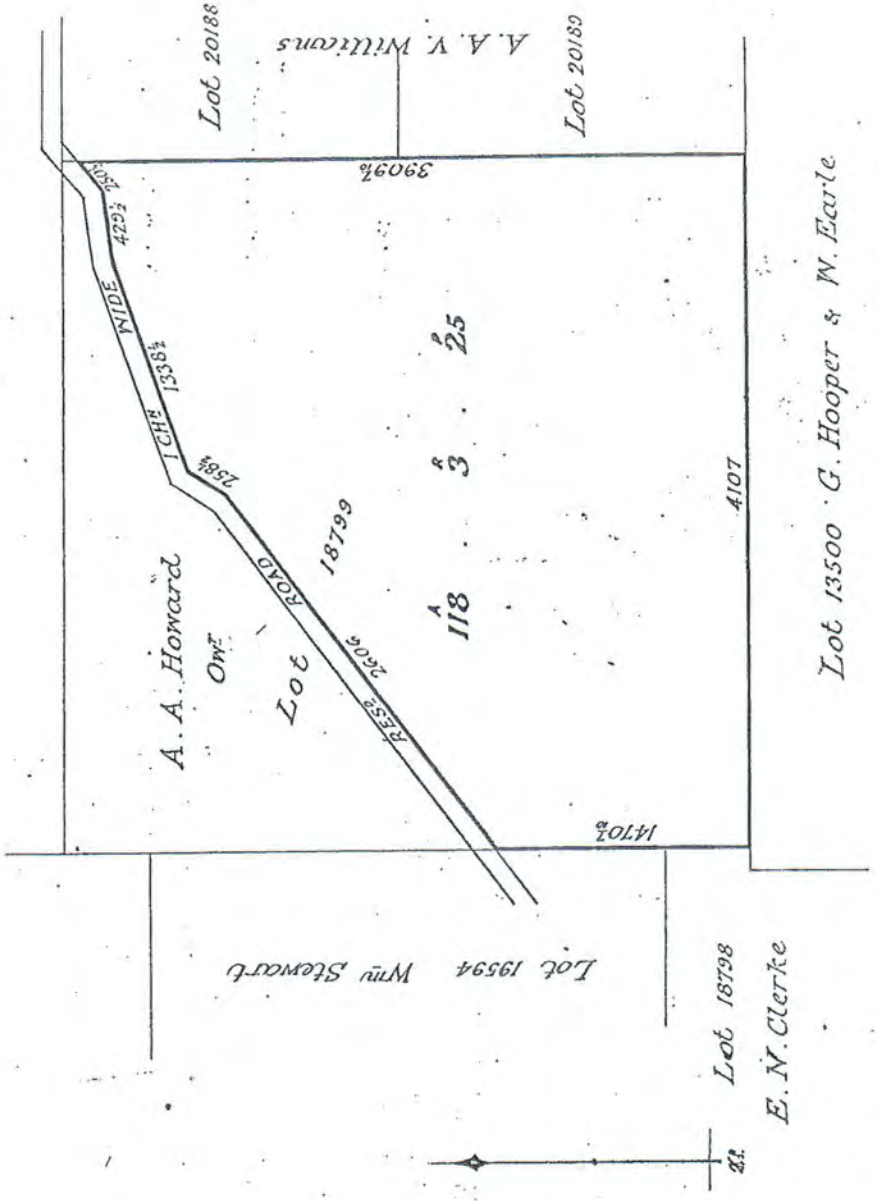
ANNEXURE TO CERTIFICATE OF TITLE VOL. FOL.

Recorder of Titles

REGISTERED NUMBER

221116

Lot 1 of this plan consists of all the land comprised in the above-mentioned cancelled folio of the Register.



Department of Primary Industries, Parks, Water and Environment
GPO Box 44, Hobart TAS 7001
Ph 1300 368 550
Web www.dpipwe.tas.gov.au
Enquiries: Anne Maginnity
Ph: 6165 4684
Email: cls.enquiries@dpipwe.tas.gov.au
Our ref: LM-LM-AU-CW-249397

Tasmanian Government

Mr Casey & Mr Christopher Miles
40 Radnor Road
GALSTON NSW 2159

Email to: milestonecivil@live.com.au

Dear Messrs Casey & Miles,

LODGEMENT OF PLANNING APPLICATION
MR CASEY & MR CHRISTOPHER MILES
INSTALLATION OF UTILITIES
179 MAXFIELDS ROAD, SOUTH NIETTA

This letter, issued pursuant to section 52(1B) of the *Land Use Planning and Approvals Act 1993*, is to confirm that the Crown consents to the making of the enclosed Planning Permit Application, insofar as the proposed development relates to Crown land managed by the Department of Primary Industries, Parks, Water and Environment.

Crown consent is only given to the lodgement of this application. Any variation will require further consent from the Crown.

This letter does not constitute, nor imply, any approval to undertake works, or that any other approvals required under the *Crown Lands Act 1976* have been granted. If planning approval is given for the proposed development, the applicant will be required to obtain separate and distinct consent from the Crown before commencing any works on Crown land.

If you need more information regarding the above, please contact the officer nominated at the head of this correspondence.

Yours sincerely,

Jesse Walker
Team Leader (Unit Manager Policy & Projects)
Crown Land Services

17 May, 2016

Department of Primary Industries, Parks, Water & Environment
WATER AND MARINE RESOURCES DIVISION

Hobart GPO Box 44, Hobart TAS 7001
Launceston PO Box 46, Kings Meadows TAS 7249
Devonport PO Box 303, Devonport TAS 7310
Web www.dpipwe.tas.gov.au

Tasmanian Government

11 May 2016

Inquiries: Paula Mannes
Phone: 6165 3020
Email: paula.mannes@dpipwe.tas.gov.au
Our Ref: H540210

Casey Miles
40 Radnor Road
GALSTON NSW 2159

Dear Mr Casey

Application of a Notice of Intention to Undertake Dam Works under Division 4

I am writing to advise that the notice of your intent to construct an off-stream dam with a wall height of 7 metres and of 40 megalitres (ML) storage capacity at 179 Maxfields Road, South Nietta, under Division 4 of the *Water Management Act 1999* (the Act) was received on 4 May 2016.

Having reviewed the details of your NoI in accordance with section 161 of the Act, I am satisfied that it meets the criteria of a Division 4 Permit as outlined under section 159 of the *Water Management Act* 1999.

Accordingly this Permit for Dam Works #2016009186, to undertake works in accordance with that specified in the NoI, takes effect on 11 May 2016 and will expire on 11 May 2018, unless the works are completed earlier.

In accordance with s.164A of the Act, conditions have been imposed on this Permit, Conditions:

1. The dam works authorised by this Permit must be carried out in accordance with the Division 4 Permit Dam Works Code 2015. A copy of the Code is attached.

This condition is designed to ensure that the authorised dam works achieve appropriate dam safety and environmental management objectives. Accordingly it is recommended that you read and understand the requirements of the Code.

It is important to note, that as landowner and dam owner that you are aware of the implications of your responsibilities to ensure that ongoing maintenance of the dam is in accordance with the Act and the *Water Management (Safety of Dams) Regulations* 2015.

Should you require further information in relation to our requirements or wish to discuss any aspect of your application, please contact Paula Mannes on the contact details above.

Yours sincerely

Bill Shackcloth
Section Head, Water Licence & Dam Administration

Enc: Division 4 Permit Dam Works Code 2015
Notice of Completion (Div 4)

DA 215173 - Water Transfer Project – South Nietta

Background

The purpose of this Water Transfer Project is to provide additional flows of water to facilitate an increase in Renewable Energy generation through the existing Mini Hydro Power Plant located on the Miles family property at Nietta.

In addition, the provision of extra flows will support development opportunities for tourism, aquaculture and agriculture by increasing surety and supply of water resources to both the Maxfields and Gaunts Road properties.

The project will also ensure that the entire Maxfields Road property can be irrigated by gravity feed, greatly improving the efficiency of irrigation costs. It will also greatly improve water security to both properties during periods of drought.

The water will be sourced from the Jean Brook and transferred over a small ridge line and into the Castra Rivulet tributary via a transfer pipeline.

The Pump House, Pipeline, Penstock and Turbine House for the purposes of this application have been interpreted as utility structures for which standards like setback and height apply. They are not sensitive uses.

The project is located within Loongana Road, Maxfields Road road reserves and private property on Maxfields Road (**PID 6989737, 179 Maxfields Road)** in South Nietta.

A desktop assessment has been undertaken by Aboriginal Heritage Tasmania and they have advised that there are no Aboriginal Heritage sites recorded within or close to the proposed works, accordingly there is no requirement for an AHT investigation. For this report refer Appendix A below.

Development Description

Key components of the project are:

- Pump House
- Pipeline & Penstock

- 40ML Dam
- Turbine House

Pump House

A 7m x 7m x 3m high pump house of 'colour bond type' would be located at the pipeline intake situated on the Jean Brook (Point A), just downstream of the Loongana Road bridge. Access to the pump house would be directly off Loongana Road.

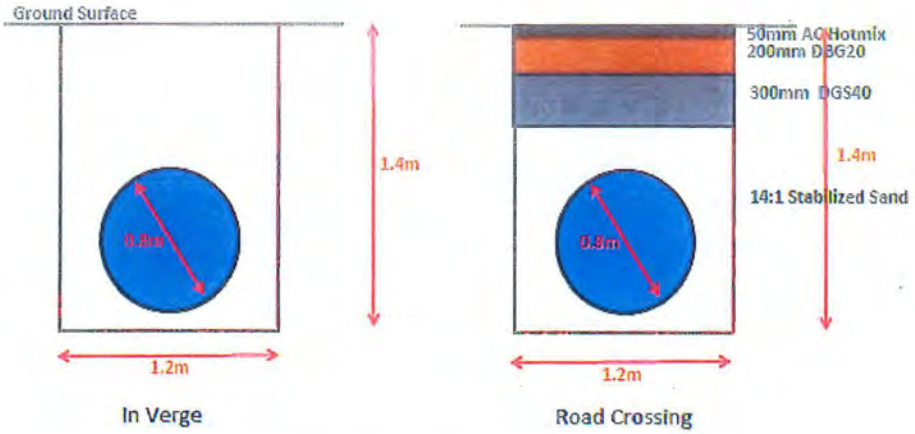
Pipeline & Penstock

From the Pump House at Point A the water would be transferred via a 1650m pipeline beside Loongana Road to a hilltop dam at Point B located on private property on Maxfields Road, South Nietta (PID 6989737). The alignment of the proposed pipeline is to be within the Western side Road Reserve for 1450m until it reaches the private property at Maxfields Road, the remaining 200m would be within the private property until it reached the hilltop dam.

There would be one road crossing required at approximately 10m South of the Loongana/Maxfields Road intersection. It is envisaged that the crossing would be of trenched type with the appropriate road pavement restorations. An appropriate permit for these works would be applied for through the normal Council processes.

From the hilltop dam and located entirely on the private property, the water would then run through a 750m, 0.8m diameter underground penstock into a recovery turbine (Point C) located on a tributary to the Castra Rivulet.

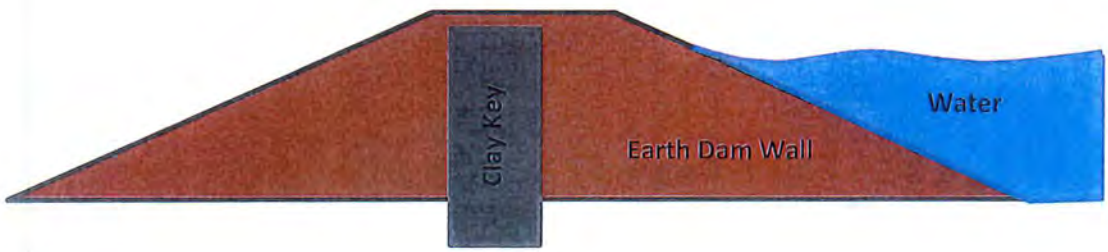
Both pipeline and penstock would be of the same material type, and size and would be buried underground as per typical cross section below.



Pipeline/Trench Typical Cross-section

Dam

The dam would be approximately 60m x 160m in size and would be of earth wall retaining type and maximum 9.4m in height. It would be located entirely on private property (at Point B). As the dam is not located on a water course and is believed to meet the other eligibility criteria, a Division 4 Dam Works Permit is currently being applied for under the Water Management Act, through DPIPWE.



Dam Typical Cross Section

Turbine House

A recovery turbine would be located within a 7m x 7m x 5.8m high Turbine House of 'colour bond type' located at Point C. It would recover the energy used to pump the water and would be grid connected.

Water Entitlement

We have been in consultation with the Water Management Branch of the DPIPWE since July 2015 regarding the proposed project and the required Environmental Studies have now been completed by Entura Consulting. This document, *'Nietta Creek and Jean Brook Offtakes – Aquatic Assessment and Environmental Flows Stages 1 & 2'*, has been made available as attached.

Please note that within this document a water licence application has also been made for Nietta Creek. Please note that this Nietta Creek component is not required to and does not form a part of this Development Application.

Subsequently an application has now been lodged with the Water Management Branch – DPIPWE and is currently under assessment.

Once complete the scheme we have been advised by DPIPWE that the Scheme will be licenced to extract water from the month of May through to November each year.

Contacts within Water Management Branch - DPIPWE in regards to this application for water entitlement are:

Bill Shackcloth

Section Head, Water Licence and Dam Administration

Ph 03 61653001

Ph 0419360559

Bill.Shackcloth@dpipwe.tas.gov.au

AND

Anna Henricks

Senior Administrative Officer (Permits and Licensing)

Water Management & Assessment Branch

Water & Marine Resources Division

Department of Primary Industries, Parks, Water & Environment

anna.henricks@dpipwe.tas.gov.au

Ph: (03) 6165 3019

Fax: (03) 6233 7781

Scheme Operation

As per above, once complete the scheme will be licenced to extract water during the months of May to November each year.

Water will be transferred predominantly overnight through the pipeline from the Jean Brook (Point A) to the 40ML hill top dam (Point B).

The water will then be discharged predominantly during daylight hours from the hill top dam through the penstock and turbine at Point C.

On exiting the turbine at Point C, the water will flow into the Castra Rivulet and through to the Gaunts Road property. At this point the water will be further used for Hydroelectricity Generation, Tourism, Agriculture, and Aquaculture.

The scheme will be required to operate in accordance with the conditions of the Water Licence which is currently being sort through DPIPWE.

Once operational no staff will be required to be onsite. Maintenance contractors may attend the site periodically, ie for 2 hours once a month.

Hours and days of operation will be 24 hours a day, 7 days a week during the months of May to November each year.

Plant and machinery to be held onsite includes water transfer equipment, turbine, generator, electrical control cabinet and a 22Kv:415V transformer.

During operation there will be no requirement for regular load and unloading of supplies or materials.

There is no requirement for provision of parking spaces.

There is no waste, refuse or bi product created by the development.

Natural and Environmental Values Search

The Tasmanian Government Service - 'The List' was consulted and a desk top search undertaken on the following layers to determine if any environmental values exist with the proposed works footprint.

- Threatened Fauna Point
- Threatened Flora Point
- Threatened Native Vegetation Communities 2014 (TNVC 2014)
- Raptor Nests
- Conservation Significant Fauna
- Conservation Significant Flora
- Proclaimed Landslip Zones
- Wetlands
- Water body and water courses
- Acid Sulphate Soils

The results are as displayed below.

In summary, only 'Wetlands' was identified as affecting the proposed project footprint at the Proposed Turbine House location (Point C). No other values were identified as being affected by the development.

We seek approval for the proposed location (Point C), as the proposed location is only on the edge of the 'Wetlands' and is within an area/paddock which has been previously worked by machinery for crops and grazed by cattle.


'The List' Data Base Search Results

Compliance with Central Coast Planning Scheme

26.3.1 P1	Compliant The proposed development is consistent with the Zone Purpose Statements as it will produce low cost, reliable and sustainable renewable energy (electricity). During peak demand periods it will be fed into the Local Area Electricity Network. Sourcing low cost, reliable and sustainable electricity on demand is a common necessity of industries such as agriculture, mining and other primary industries, particularly in the current wholesale electricity market environment of high prices and low Hydo dam levels and Bass Link outage. The scheme will directly improve sustainability of agriculture on our Maxfields and Gaunts Road properties as it will provide a more reliable source of water for irrigation during dry or drought periods and will ensure dams can be full prior to commencement of Summer months. Due to the scale, costs in pumping will be greatly reduced due to improvement in pumping efficiencies. The use and need for diesel run pumps for irrigation will be greatly reduced improving environmental sustainability. The increase in reliability, flow volumes and water levels in the Gaunts road dam will create further opportunities for tourism and aquaculture on both the Gaunts and the Maxfields

	Road properties. This scheme is consistent with Desired Future Character Statement as it does not result in loss of land for primary industry. The 7mx7m pump house is a small area and is on land within the road reserve which is not currently being utilized for any primary industry or resource purpose. The 7m x 7m turbine house is a small area and is on the edge of swampy land which has low potential for agricultural use. The dam will serve a double purpose, not only to facilitate electricity generation but will facilitate more efficient and sustainable irrigation practices for agriculture on the Maxfields Road property. As the pipeline and penstock will be buried underground (up to 500mm below the surface) hence there will be no effect on this land that will prevent ongoing agricultural use purposes. Where the pipeline is to be located within the road reserve, this road reserve is not currently being used for any agricultural purpose. The proposed scheme provides better access for agriculture to this naturally occurring water resource not just in the purpose for watering crops but converts the potential energy of the water into electricity which facilitates access by all primary industry consumers such as for mining, resource processing and pumping for agricultural irrigation. After the electricity

	generation the water is not lost and is still available for all other purposes downstream.
26.4.1 P1	Compliant The 7m x 7m pump house do not meet frontage setback requirements of the A1 Acceptable Solutions as they located within a road reserve which in itself is only 20.16m wide. However the pump house and pipeline <u>are</u> compliant with the P1 Performance Criteria because they do not constrain or interfere with; (a) erection of a building if required, (b) access to the site, (c) use or development of adjacent land, (d) a utility, (e) and easement or lawful entitlement for access to other land. All other components of the proposed scheme - dam, penstock and turbine house all meet the A1 Acceptable Solution requirements and P1 Performance Criteria.
26.4.1 A2	Compliant (a) Compliant (b) Compliant (c) Compliant (d)Compliant

26.4.1.P3	Compliant It is unnecessary to require a water supply.
26.4.1.P4	Compliant Both the pump house and turbine house are proposed as uninhabitable buildings, ie Class 10A type structures only, hence it is unnecessary to require the drainage and disposal of sewerage or liquid trade waste.
26.4.2 P1	Compliant The 7m x 7m pump house do not meet frontage setback requirements of the A1 Acceptable Solutions as they located within a road reserve which in itself is only 20.16m wide. All other components of the proposed scheme - dam, penstock and turbine house all meet the A1 Acceptable Solution requirements and P1 Performance Criteria. (a) The Pump house walls and roof will be made of concrete and colourbond type materials painted with appropriate non obtrusive colours (shades of green, brown and grey) to ensure they are consistent with the streetscape. The pipeline will be located underground and will not be visible. (b) The pump house and pipeline do not meet the A1 Acceptable Solution setback requirements because their location is constrained by the size and shape imposed by the road reserve width of only 20.16m, hence the reduced setback is required.

26.4.2 A2	Compliant The height of the pump house and turbine house will both be less than 8.5m. There are no other buildings proposed.
26.4.2 P3	Compliant None of the proposed structures will have any visual impact on the skyline. None of the proposed structures will have any height above the vegetation canopy. The pump house will inset 1.5m into the ground this reduces the visible height of the building and therefore minimises visual impact of the structure on the watercourse (Jean Brook). Both the pump house and the turbine house walls and roof will be made of concrete and colour bond type materials painted with appropriate non obtrusive colours (shades of green, brown and grey) to ensure they minimise visual impact on wetland/watercourse. Materials of Non reflective surface type will be used for all exterior walls and roof of pump and turbine house buildings.
28.1.1 28.1.2	Compliant

28.1.3	The project is classed as a Utility for purpose of generation of electricity and hence is compliant with the 28.1.1 Zone Purpose Statements, 28.1.2 Local Area Objectives and 28.1.3 Desired Future Character Statements. Although there is minimal risk imposed, for both pump house and turbine house the exterior walls and roof will be constructed with concrete and colour bond materials finished with Non reflective surface type, and pump house inset 1.5m into the ground to ensure the utilities are buffered and screened to attenuate risk to health, safety and peacefully enjoyment of people, property and the environment on adjacent land.
28.4.1.P1	Compliant The 7m x 7m pump house do not meet frontage setback requirements of the A1 Acceptable Solutions as they located within a road reserve which in itself is only 20.16m wide. However the pump house and pipeline <u>are</u> compliant with the P1 Performance Criteria because they do not constrain or interfere with; (a) erection of a building if required, (b) access to the site, (c) use or development of adjacent land, (d) a utility, (e) and easement or lawful entitlement for access to other land. All other components of the proposed scheme - dam, penstock and turbine house all meet

	the A1 Acceptable Solution requirements and P1 Performance Criteria.
28.4.1A2	Compliant (d) Compliant (e) Compliant (f) Compliant (g) Compliant
28.4.2 P1	Compliant The 7m x 7m pump house do not meet frontage setback requirements of the A1 Acceptable Solutions as they located within a road reserve which in itself is only 20.16m wide. All other components of the proposed scheme - dam, penstock and turbine house all meet the A1 Acceptable Solution requirements and P1 Performance Criteria. (a) The Pump house walls and roof will be made of concrete and colour bond type materials painted with appropriate non obtrusive colours (shades of green, brown and grey) to ensure they are consistent with the streetscape. The pipeline will be located underground and will not be visible. (b) The pump house and pipeline do not meet the A1 Acceptable Solution setback requirements because the possibilities in locating them is constrained by the size and shape imposed by the road reserve width of only 20.16m, hence the reduced setback is required.
28.4.2 A2	Compliant

.	The proposed pump and turbine building height will be not be more than 10m.
28.4.2.P3	Compliant None of the proposed structures will have any visual impact on the skyline. None of the proposed structures will have any height above the vegetation canopy. The pump house will inset 1.5m into the ground this reduces the visible height of the building and therefore minimises visual impact of the structure on the watercourse (Jean Brook). Both the pump house and the turbine house walls and roof will be made of concrete and colour bond type materials painted with appropriate non obtrusive colours (shades of green, brown and grey) to ensure they minimise visual impact on wetland/watercourse. Materials of Non reflective surface type will be used for all exterior walls and roof of pump and turbine house buildings.
E10.6.1.P1	Compliant We have been in consultation with the DPIPWE – Water Management Branch since July 2015 in regards to the requirements of the Water Management Act and environmental studies that are required for such a project. As a result we have engaged Entura Consulting to undertake the necessary environmental investigations and studies. The results of these are contained within the attached Aquatic Assessment and Environmental Flows Stage 1 and 2. These studies address biodiversity, water quality and the effects on hydraulic and ecological

	performance of both the Jean Brook and Castra Rivulet. These studies also investigate availability of water, and assess the hydrology of the two rivers, their capacity to adjust to the changes in flow and identify and assess risks and their likelihood of occurrence. An Operational Environmental Management Plan is currently being prepared by Entura and once complete will address the risks to aquatic environmental values identified within the Aquatic Assessment and Environmental Flows Stage 1 and 2 report and will provide practical and easily implemented mitigation measures and management actions to ensure that the operation of the Water Transfer Project does not have any adverse impact on the aquatic environment and associated values. The OEMP will form part of the Water Licence conditions to be implemented for the allocation of water from the Jean Brook. Significant environmental flow volumes and flushing flows will be provided as a requirement of the water licence hence there will be no detrimental effect on the economic value of the Jean Brook. It is noted that the conditions of the Water Licence will only allow extraction of water from the Jean Brook for a 7 month Winter period of the year when there is surplus water available, for the months outside this period the river will flow unimpeded in its natural state. As per the Cease to Take volumes specified by Entura within the Aquatic Assessment and Environmental Flows Stage 1 and 2 report, the Jean Brook will maintain between 90 and 110% of its original wetted perimeter during the licenced extraction period, hence there be minimal or no risk to the Jean Brooks ability to function for water based activity and public access and use, or effect to its aesthetic or scenic quality.

	From an operational perspective it should be noted that the Water Transfer Project is only required to supplement the flows in the Castra Rivulet up to a flow rate of ~900l/s, once this flow is reached with in the Castra Rivulet no water transfer from the Jean Brook is required. There will be no modifications to the natural drainage channel of the Jean Brook apart from an inlet structure for the pipeline, this will simply be a small 5m long alcove in the bank of the river and will have no impact on the current drainage course of the river. The inlets to the pipeline will be fenced and covered by a steel grate eliminating any risk to community or public safety. The require flows to be achieved by the Water Transfer Project (800l/s) do not exceed the natural capacity of the Castra Rivulet or its tributary so there is no risk of this project creating flooding or inundation or creating additional sedimentation. It is also noted that the distance of the Castra Rivulet affected has no building structures in the vicinity and is in a remote area away from population. Disturbance and change to natural ground levels is limited to a 7m x 7m footprint of the proposed pump house and turbine house. This is an area which can be appropriately managed with a construction environmental management plan which will be submitted prior to Council approval of a Construction Certificate. The scheme will be required to operate in accordance with the conditions of the Water Licence which is currently being sort through DPIPWE.

Photo No. 1

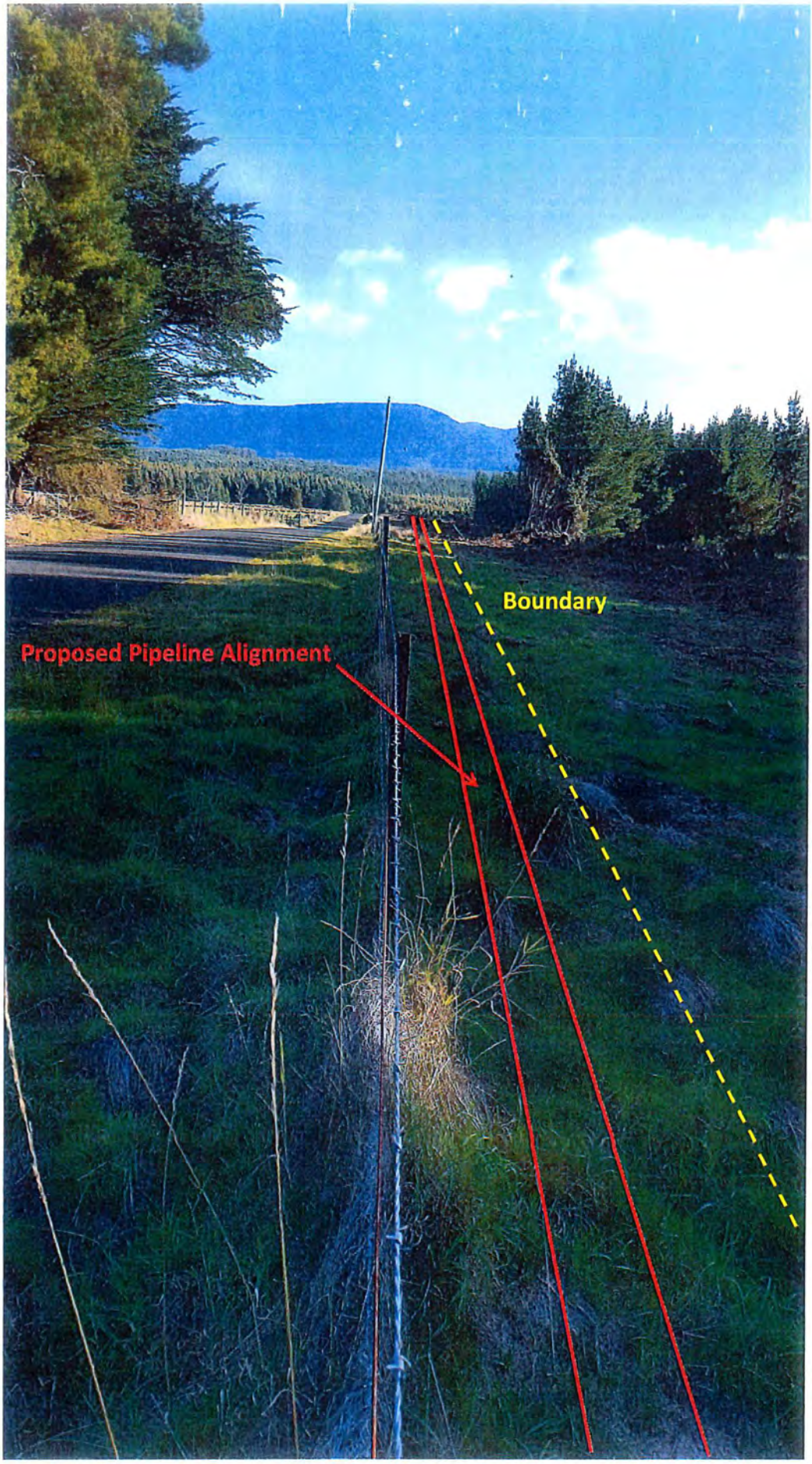


Photo No. 2

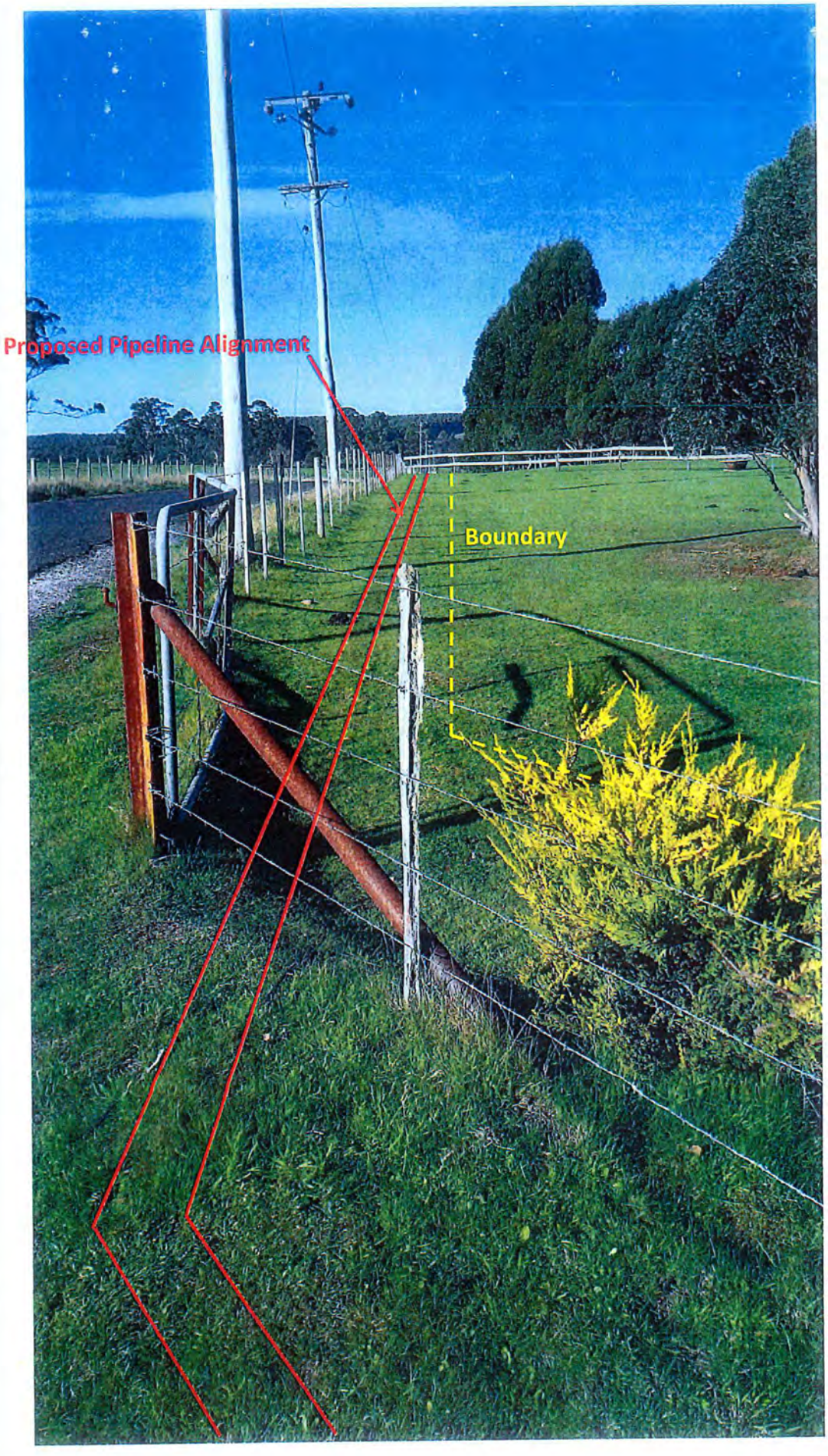


Photo No. 3

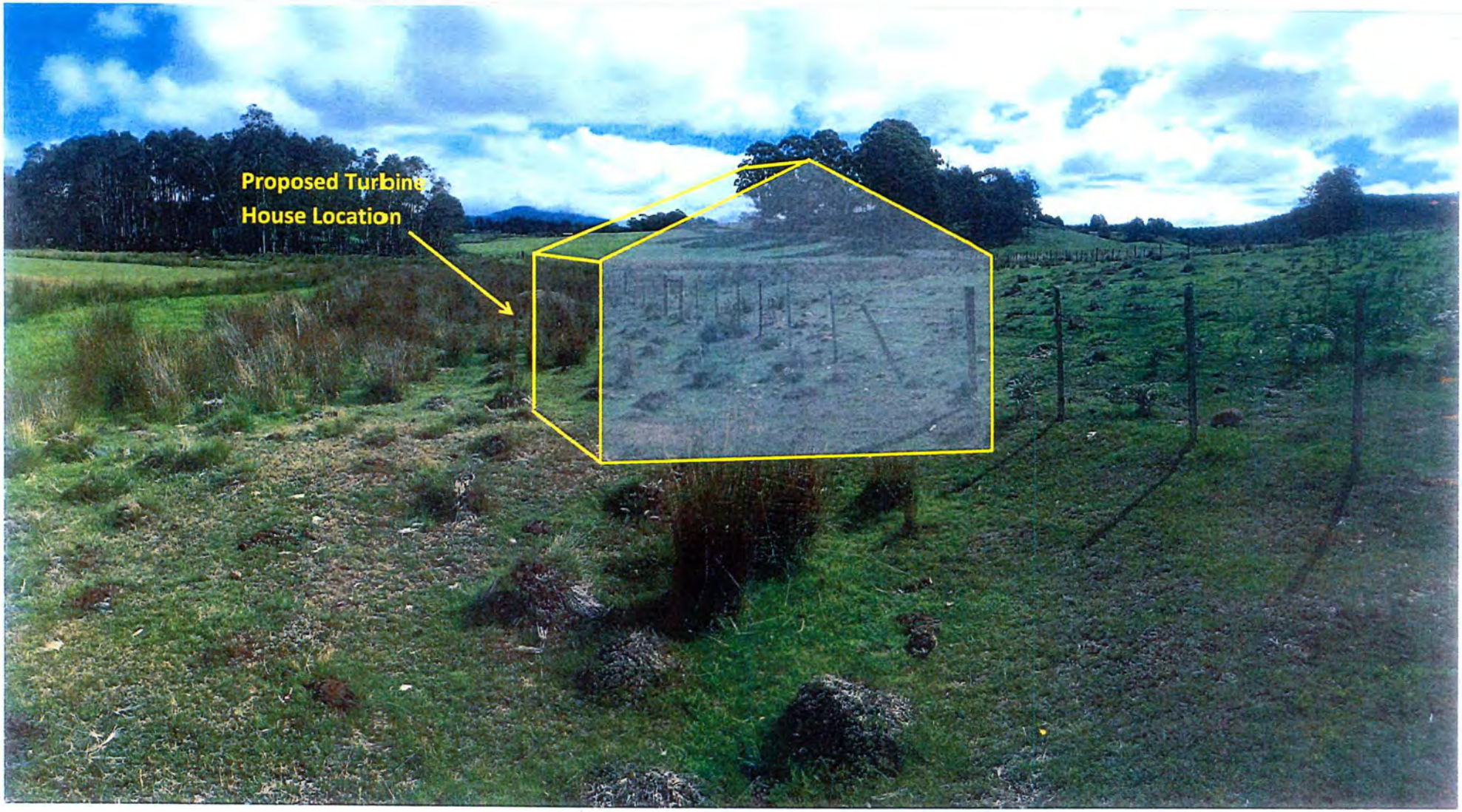


Photo No. 4

Trees Proposed for Removal at Pump House Location (Point A)

(Photo faces South)

Appendix A

From: aboriginal@heritage.tas.gov.au <aboriginal@heritage.tas.gov.au>
Sent: Thursday, 17 March 2016 2:23 PM
To: milestonecivil@live.com.au
Subject: Application for an Aboriginal Heritage Desktop Assessment

---

RE: ABORIGINAL HERITAGE DESKTOP ASSESSMENT

AHTP2789 - Water Transfer Project South Nietta

Dear Casey,

Aboriginal Heritage Tasmania (AHT) has completed a search of the Aboriginal Heritage Register (AHR) regarding the proposed Water Transfer Project South Nietta and can advise that there are no Aboriginal heritage sites recorded within or close to the proposed works.

Accordingly there is no requirement for an Aboriginal heritage investigation and AHT have no objection to the project proceeding.

Please be aware that all Aboriginal heritage is protected under the *Aboriginal Relics Act 1975*. If at any time during works you suspect Aboriginal heritage. cease works immediately and contact AHT for advice. Attached is an Unanticipated Discovery Plan, which you should have on hand during ground disturbing works, to aid you in meeting your requirements under the Act.

If you have any queries please do not hesitate to contact AHT.

Kind Regards,

Samuel Dix
Archaeologist

N

Point C: 421443E, 5415718N

Building Footprint: 7m x7m

Photo 4

Proposed Pipeline Alignment

750m

Maxfields Road

200m

Property ID: 6989737

Street Address: 179 Maxfiel ds Road, South Nietta

Photo 3

Point B

Proposed New Dam

Proposed Pipeline Alignment

1450m

Photo 2

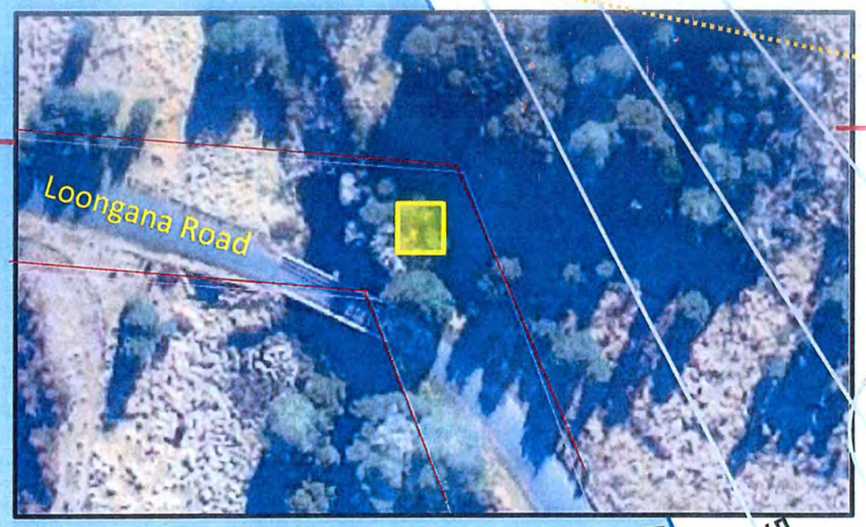
Loongana Road

Point A: 420223E, 5414681N

Building Footprint: 7m x7m

Photo 1

Pump House Plan View (Scale 1:100)



N

Jean Brook

AHD 514.82

515.00

516.00

517.00

518.00

Setback Distance
from Jean Brook
5.50m

Suction Pipe

Suction Pipe

Pump House
7m x 7m

Remove

Remove

Remove

Remove

Remove

Remove

Remove

Remain

New
Acacia dealbata
'Silver Wattle'

New
Acacia dealbata
'Silver Wattle'

New
Acacia dealbata
'Silver Wattle'

New
Acacia dealbata
'Silver Wattle'

Setback Distance
from property
boundary 6.00m

New
Acacia dealbata
'Silver Wattle'

New
Acacia dealbata
'Silver Wattle'

New
Acacia dealbata
'Silver Wattle'

Road Reserve Boundary

Underground Pipeline

11.00m

Standard Car

Setback Distance
from Bridge
6.00m

Setback Distance
from Loongana Road
pavement 8.00m

New Gate

Road Table Drain

New Fence

5.00m

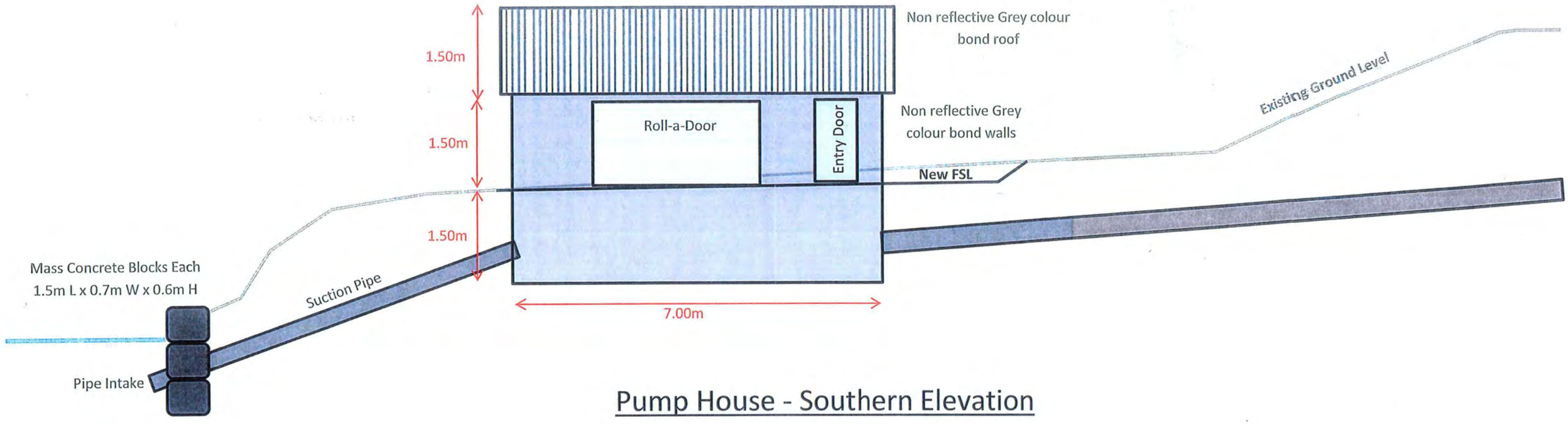
Proposed Crossover

5.50m

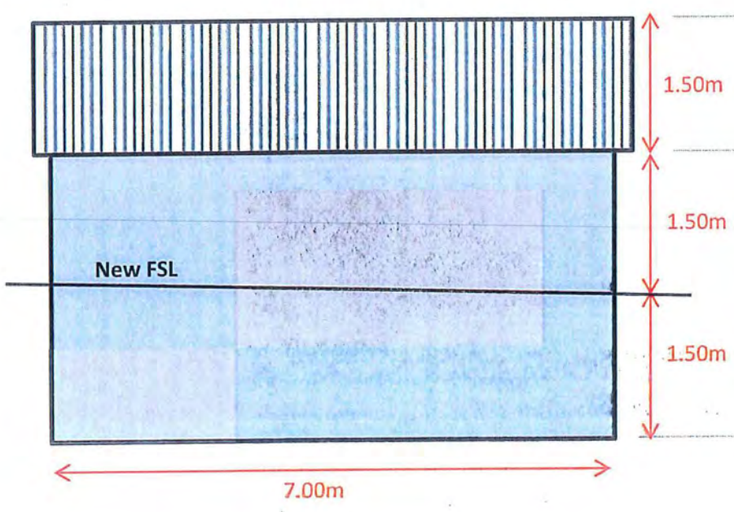
Loongana Road

Road Reserve

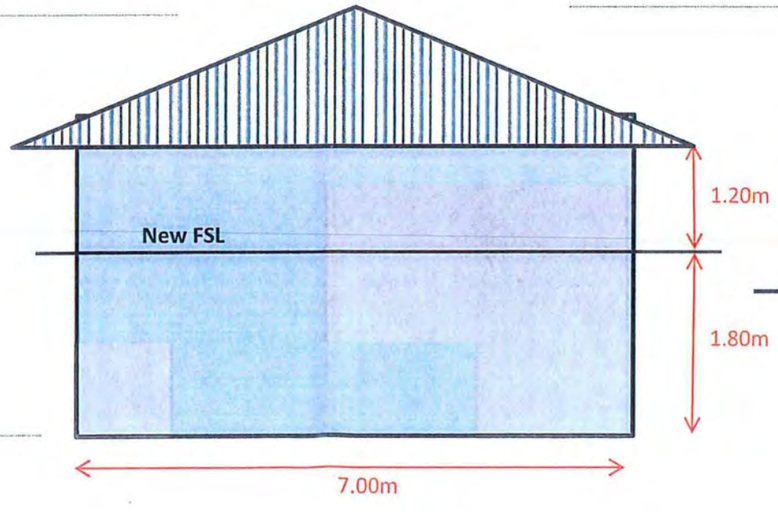
Boundary



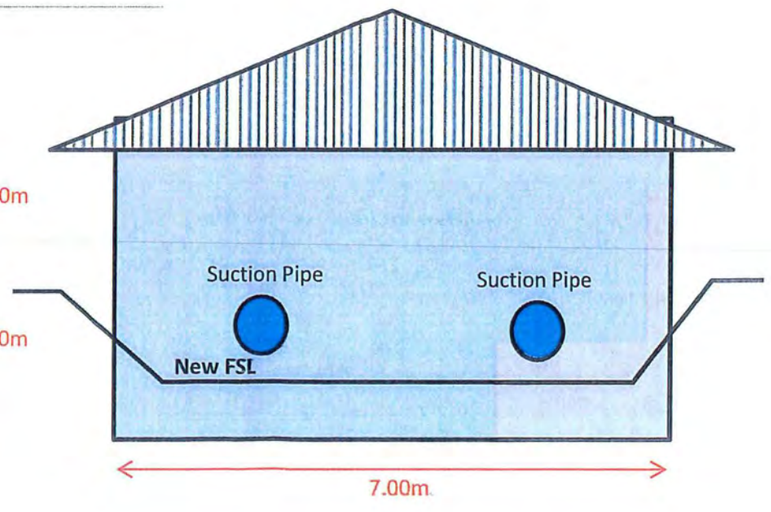
Pump House - Southern Elevation



Northern Elevation



Eastern Elevation



Western Elevation

Maxfields Road

E

E

Road Reserve Boundary

Widen existing
farm gate

AHD 516.00

AHD 515.00

AHD 514.00

AHD 513.00

N

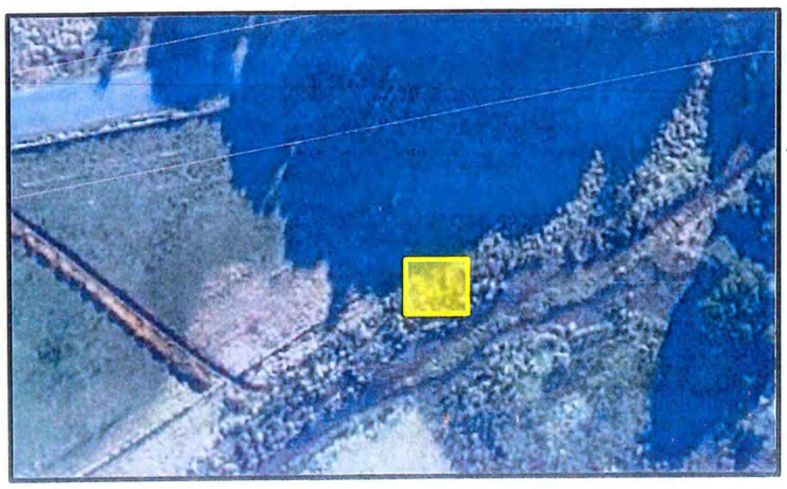
20m

Reinforced Concrete Slab

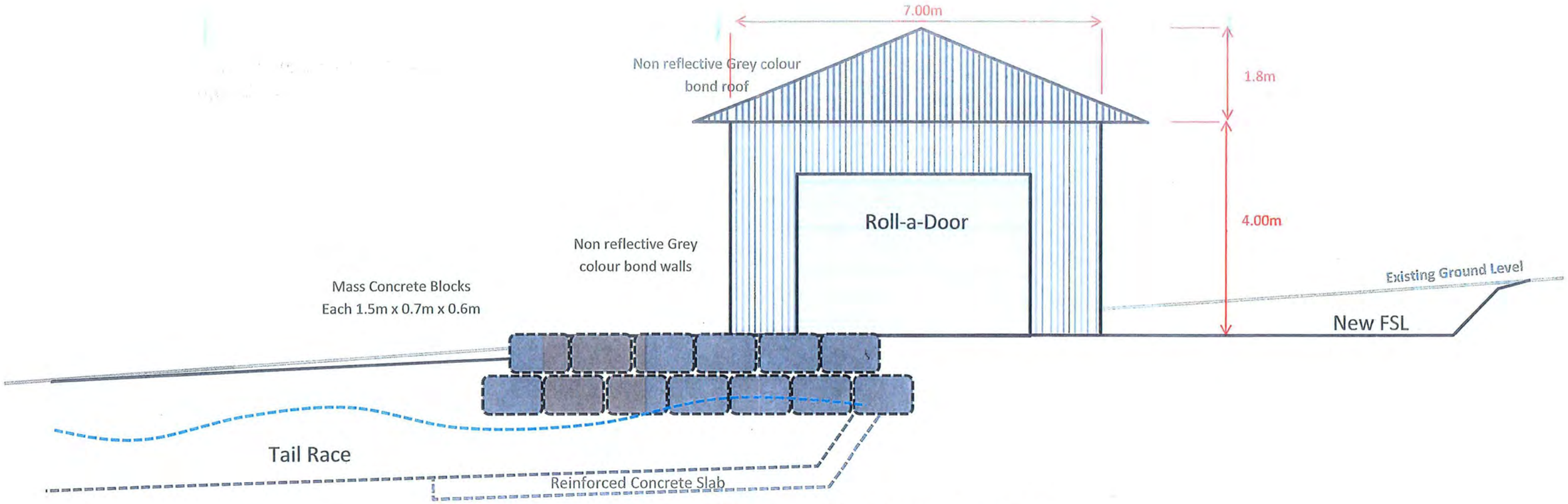
Tail Race

Underground Pipeline

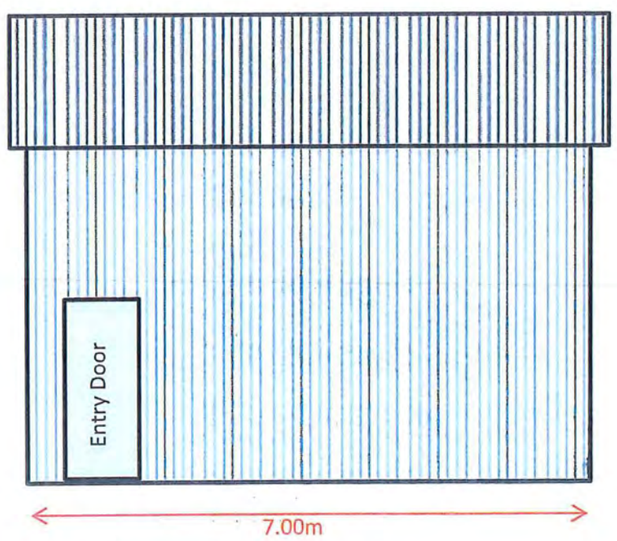
Castra Rivulet Tributary



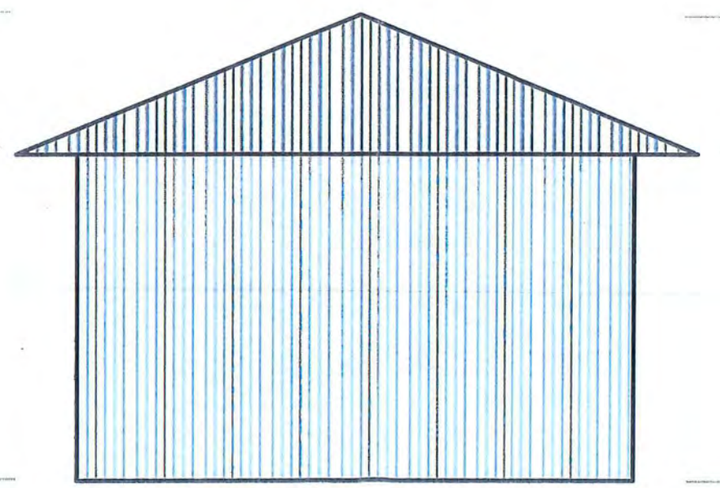
Turbine House Plan View



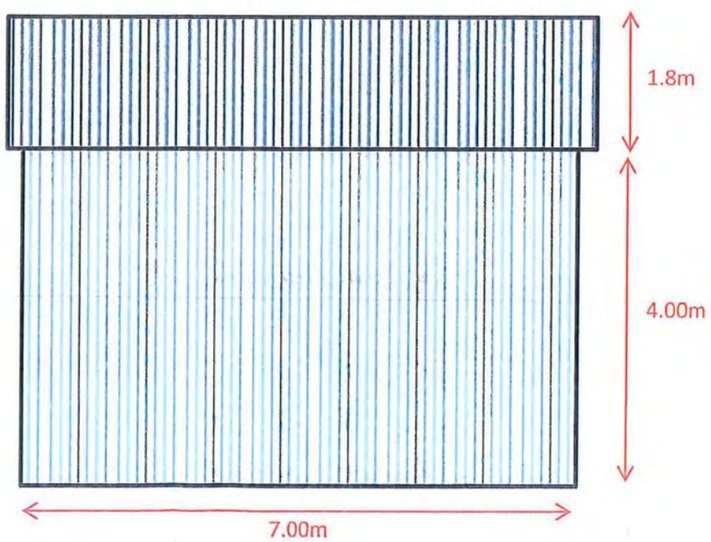
Turbine House - Northern Elevation



Western Elevation

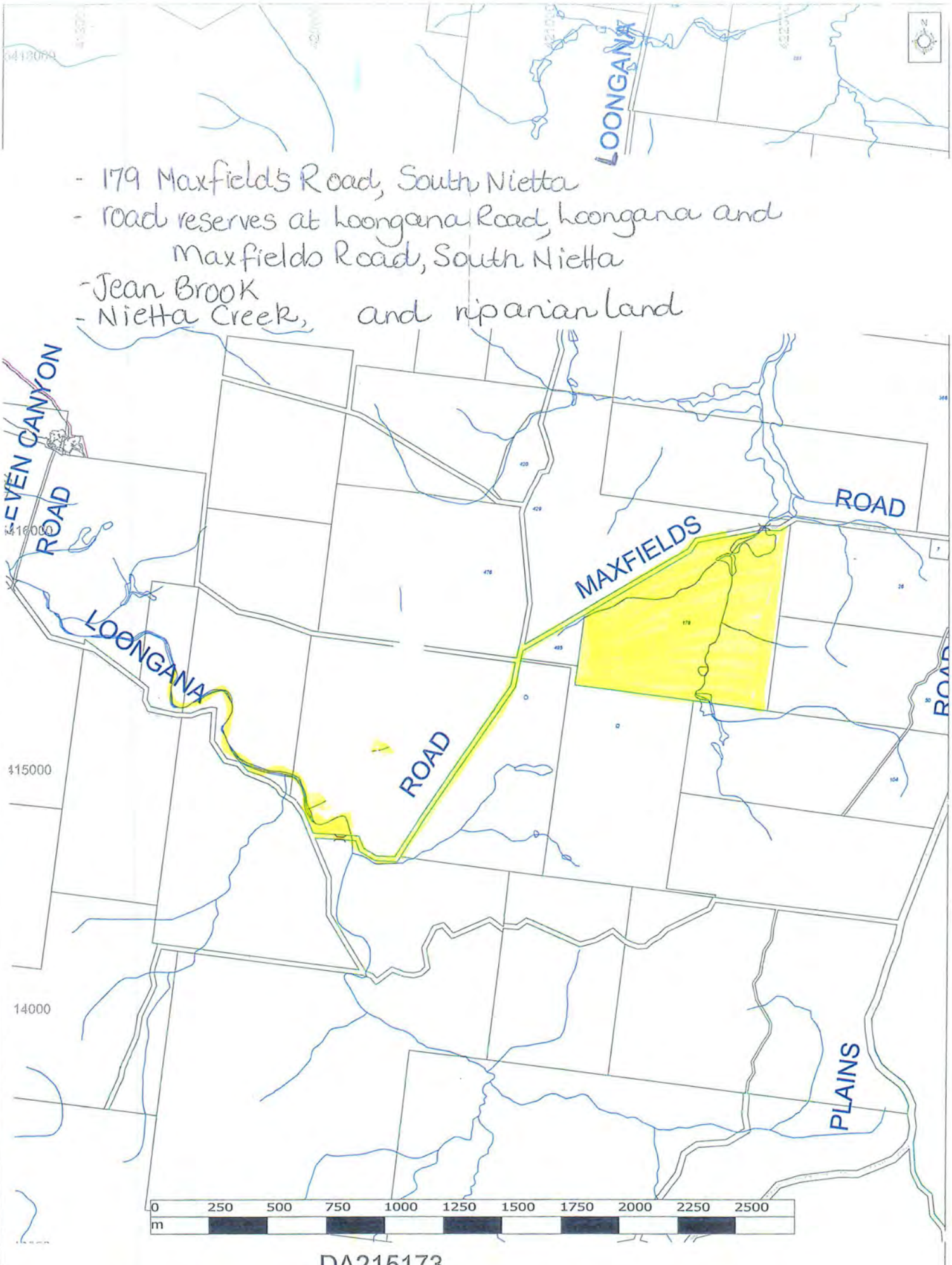


Southern Elevation



Eastern Elevation

- 179 Maxfields Road, South Nietta
- road reserves at Loongana Road, Loongana and Maxfields Road, South Nietta
- Jean Brook
- Nietta Creek, and riparian land



DA215173

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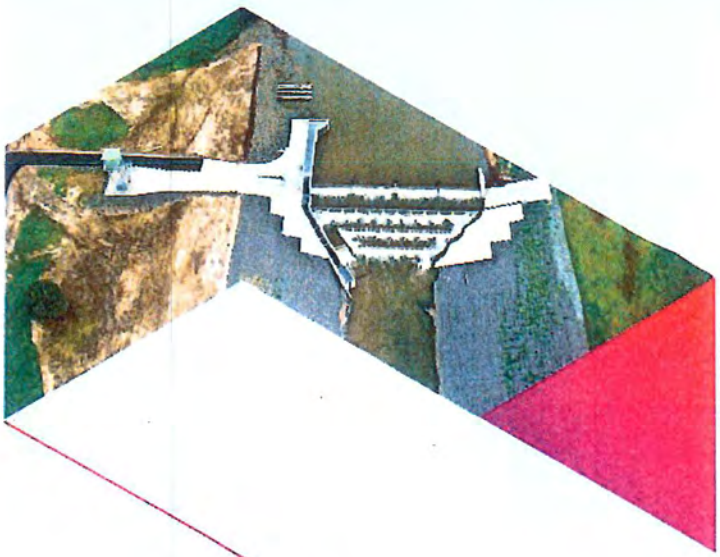
NIETTA CREEK AND JEAN BROOK OFFTAKES Aquatic Assessment and Environmental Flows Stage 1 and 2

ENTURA-A938F
15 March 2016

Prepared by Hydro-Electric Corporation
ABN48 072 377 158

t/a Entura 89 Cambridge Park Drive, Cambridge TAS 7170 Australia



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Document information

Title	Nietta Creek and Jean Brook Offtakes Aquatic Assessment and Environmental Flows Stage 1 and 2
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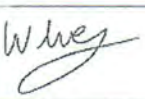
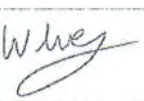
Client contact	Nietta Hydro Pty Ltd
Document number	ENTURA-A938F
Project manager	Bradley Smith
Project reference	E304870 - P510353

Revision history

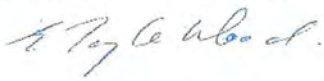
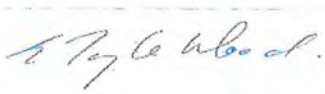
Revision 0.3

Revision description	Final Rev 0.3 – Stage 2		
Prepared by	Brad Smith and Will Elvey		15 March 2016
Reviewed by	Will Elvey and Craig Ludlow		15 March 2016
Approved by	Eleni Taylor-Wood		15 March 2016
	(name)	(signature)	(date)
Distributed to	Nietta Hydro Pty Ltd (name)	Nietta Hydro Pty Ltd (organisation)	8 March 2016 (date)

Revision 0.2

Revision description	Draft Rev 0.2 – Stage 2		
Prepared by	Brad Smith and Will Elvey		8 March 2016
Reviewed by	Will Elvey and Craig Ludlow		8 March 2016
Approved by	Eleni Taylor-Wood		8 March 2016
	(name)	(signature)	(date)
Distributed to	Nietta Hydro Pty Ltd (name)	Nietta Hydro Pty Ltd (organisation)	8 March 2016 (date)

Revision 0.1

Revision description	Draft Rev 0.1 – Stage 1		
Prepared by	Brad Smith, Kim Robinson, Fiona Ling		2 October 2015
Reviewed by	Will Elvey and Eleni Taylor-Wood		2 October 2015
Approved by	Eleni Taylor-Wood		2 October 2015
	(name)	(signature)	(date)
Distributed to	Nietta Hydro Pty Ltd (name)	Nietta Hydro Pty Ltd (organisation)	2 October 2015 (date)

Executive summary

Nietta Hydro Pty Ltd (Nietta Hydro) commissioned a 1 MW hydro-electric scheme in 2014 that sources water from Castra Rivulet for power generation. Nietta Hydro is proposing to supplement the existing water resource from Castra Rivulet with additional offtakes from Nietta Creek and Jean Brook to increase the generation capacity and efficiency of the scheme. In addition, the ability to maintain high water level more frequently in Castra Dam will provide security for potential tourist developments, which may include lake side accommodation and boating. In order to access additional water from Nietta Creek and Jean Brook, Nietta Hydro is required to apply for additional water allocations under the Tasmania *Water Management Act 1999*, which is administered by the Department of Primary Industries, Water and Environment (DPIPWE).

The aim of this project is to provide some of the required inputs to assist contribute to Nietta Hydro Pty Ltd to apply for an application for additional water allocations under the Tasmanian *Water Management Act 1999,* including undertaking a field survey for aquatic values, hydrological modelling, hydraulic modelling and undertaking an environmental flow assessment consistent with the Tasmanian Environmental Flows Framework (TEFF).

Environmental flow rules are required to protect the environmental aquatic values identified in Nietta Creek and Jean Brook downstream of the two proposed offtakes. This report presents cease-to-take (CTT) and event rules for the 'winter period' (May to November) for both watercourses.

The aim of the proposed cease-to-take and event rules is to provide a flow regime which will:

- maintain the shape of the natural hydrograph
- cause minimal overall change to the flow regime
- maintain aquatic habitats and species

The environmental flow rules are intended to protect the listed species and general aquatic and riparian habitats and their associated species. Listed and high conservation value aquatic species known to or likely to occur in Nietta Creek and/or Jean Brook include the Australian grayling (*Prototroctes maraena*); the Ouse River caddis fly (*Oxyethira mienica*), the giant freshwater crayfish (*Astacopsis gouldi*), five species of *Beddomeia* sp. (Hydrobiid snails), Tasmanian azure kingfisher (*Ceyx azureus diemenensis*), white bellied sea-eagle (*Haliaeetus leucogaster*) and platypus (*Ornithorhynchus anatinus*). The native fish community is also considered of particular value (specifically *Gadopsis marmoratus*). Native wintercress (*Barbarea australis*) are also predicted to occur in the catchments.

This assessment has been based on a maximum take of 200 l/sec in Nietta Creek and 800 l/sec in Jean Brook.

Proposed environmental flow rules for Nietta Creek

The proposed cease-to-take rules for Nietta Creek in winter are based on the monthly 20 percentile flows, which are also the DPIPWE default environmental flow cease-to-take rule:

- 1.4 ML/day in May
- 3.1 ML/day in June
- 5 ML/day in July

- 6.9 ML/day in August
- 3.6 ML/day in September
- 2 ML/day in October
- 1.1 ML/day in November.

The proposed event-based rules for Nietta Creek in winter are:

- One event in May if the inflows reach or exceed 3.2 ML/day at which point all flows are passed downstream until the flow recedes back to 3.2 ML/day naturally or for a maximum of 5.9 days, ramped down at a rate no faster than 1.8 ML/day/day.
- One event in October if the inflows reach or exceed 3.8 ML/day at which point all flows are passed downstream until the flow recedes back to 3.8 ML/day naturally or for a maximum of 4.6 days, ramped down at a rate no faster than 2.7 ML/day/day.
- One event in November if the inflows reach or exceed 2 ML/day at which point all flows are passed downstream until the flow recedes back to 2 ML/day naturally or for a maximum of 5.2 days, ramped down at a rate no faster than 1 ML/day/day.

Proposed environmental flow rules for Jean Brook

The proposed cease-to-take rules for Jean Brook in winter:

- 12.5 ML/day in May
- 23.8 ML/day in June
- 24.2 ML/day in July
- 38.2 ML/day in August
- 24.2 ML/day in September
- 14.3 ML/day in October
- 8.6 ML/day in November.

The proposed event-based rules for Jean Brook in winter are:

- One event in May if the inflows reach or exceed 46.2 ML/day at which point all flows are passed downstream until the flow recedes back to 46.2 ML/day naturally or for a maximum of 5.9 days, ramped down at a rate no faster than 14.9 ML/day/day.
- One event in June if the inflows reach or exceed 70.6 ML/day at which point all flows are passed downstream until the flow recedes back to 70.6 ML/day naturally or for a maximum of 4.9 days, ramped down at a rate no faster than 17.1 ML/day/day.
- One event in July if the inflows reach or exceed 98 ML/day at which point all flows are passed downstream until the flow recedes back to 98 ML/day naturally or for a maximum of 4.4 days, ramped down at a rate no faster than 29 ML/day/day.
- One event in August if the inflows reach or exceed 110.5 ML/day at which point all flows are passed downstream until the flow recedes back to 110.5 ML/day naturally or for a maximum of 4.5 days, ramped down at a rate no faster than 33.4 ML/day/day.
- One event in September if the inflows reach or exceed 79.3 ML/day at which point all flows are passed downstream until the flow recedes back to 79.3 ML/day naturally or for a maximum of 4.7 days, ramped down at a rate no faster than 24.6 ML/day/day.

- One event in October if the inflows reach or exceed 49.1 ML/day at which point all flows are passed downstream until the flow recedes back to 49.1 ML/day naturally or for a maximum of 5 days, ramped down at a rate no faster than 18.2 ML/day/day.
- One event in November if the inflows reach or exceed 26.3 ML/day at which point all flows are passed downstream until the flow recedes back to 26.3 ML/day naturally or for a maximum of 6.3 days, ramped down at a rate no faster than 9.5 ML/day/day.

Operation under the proposed environmental flow rules is predicted to have **negligible** to **low adverse** on the flow regimes of the affected watercourses and on associated aquatic habitat, species and geomorphology.

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Contents

Appendices

List of figures

List of tables

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1. Introduction

Nietta Hydro Pty Ltd (Nietta Hydro) commissioned a 1 MW hydro-electric scheme in 2014 that sources water from Castra Rivulet for power generation. Nietta Hydro is proposing to supplement the existing water resource from Castra Rivulet with additional offtakes from Nietta Creek and Jean Brook to increase the generation capacity and efficiency of the scheme (Figure 1.1). In addition, the ability to maintain high water level more frequently in Castra Dam will provide security for potential tourist developments, which may include lake side accommodation and boating. The current hydro-electric scheme captures flows from Castra Rivulet in a headwater dam, which supplies the power station via a headrace before discharging back into Castra Rivulet.

The proposed additional diversion from Nietta Creek will divert up to 200 L/sec from Nietta Creek directly into the headwater dam (Nietta Creek is a tributary of Castra Rivulet). The proposed diversion from Jean Brook will divert up to 800 L/sec into Castra Rivulet approximately 3 km upstream of the headwater dam.

Nietta Hydro currently holds a water licence for 13,900 ML from the existing Castra Rivulet off-take, which is conditional on implementation of an operational environmental management plan (OEMP). The OEMP prescribes an environmental flow and associated monitoring for identified aquatic values in Castra Rivulet. In order to access additional water from Nietta Creek and Jean Brook, Nietta Hydro is required to apply for additional water allocations under the Tasmania *Water Management Act 1999*, which is administered by the Department of Primary Industries, Water and Environment (DPIPWE).

In order to determine the necessary information required by DPIPWE for a water allocation application, representatives from DPIPWE, Nietta Hydro and Entura met on 24 July, 2015 and then again on 19 October, 2015. The outcome of these meetings was advice provided by DPIPWE that formed the scope for Entura's proposal to Nietta Hydro.

The project has been undertaken in the following stages:

- Stage 1: undertake a baseline aquatic values survey and preliminary hydrological assessment;
- Hold point: meet with DPIPWE to discuss the outcomes from stage 1 and specific requirements for stage 2;
- Stage 2 (the current study): undertake any additional work as required by DPIPWE including an environmental flow study;
- Hold point: meet with DPIPWE to discuss the outcomes from stage 2 and the proposed amendments to the OEMP;
- Stage 3: update the existing OEMP to include the outcome of stage 1 and 2 in late January 2016.

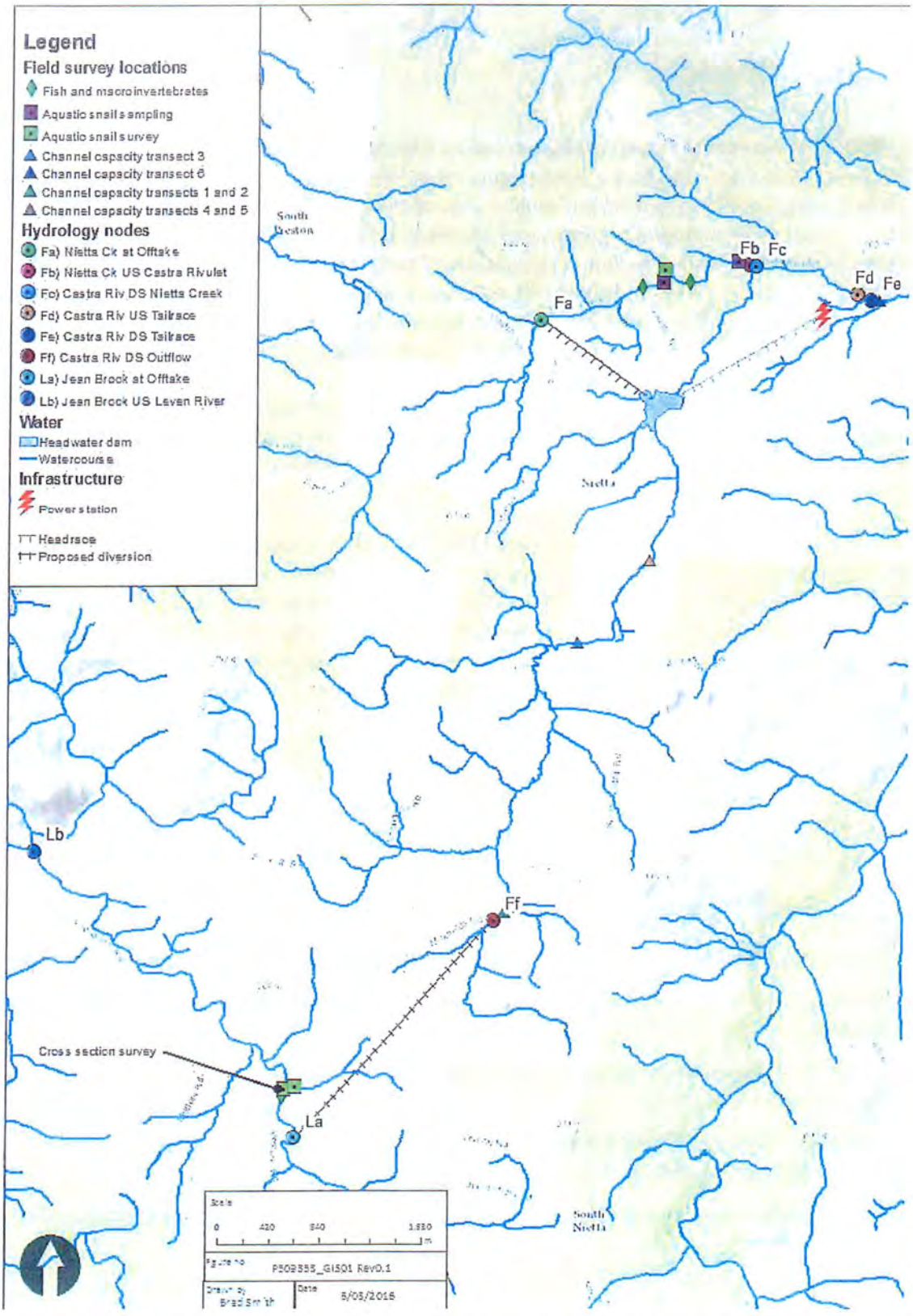

Figure 1.1: Location of mini hydro scheme, proposed diversions, field survey sites and hydrology assessment nodes

The aim of the project is to provide inputs to assist Nietta Hydro Pty Ltd application for additional water allocations under the Tasmanian *Water Management Act 1999.*

More specifically, the current study forms Stage 1 and Stage 2 of the project. The aims of Stage 1 were to:

- Undertake an initial hydrological assessment of the available yield within Nietta Creek and Jean Brook using DPIPWE's Water Assessment Tool (WAT).
- Undertake an initial hydrological analyses of the current and proposed flows in Nietta Creek, Jean Brook and Castra Rivulet under normal and dry climate change (Cdry) scenarios for seasonal and monthly periods.
- Undertake a baseline survey of aquatic values within Nietta Creek and Jean Brook.

The aims of Stage 2 were to provide Nietta Hydro Pty Ltd and DPIPWE with:

- Provide advice as to whether the 20th percentile monthly flow will protect identified aquatic values in Nietta Creek.
- Provide environmental flow recommendations for Jean Brook using the Tasmanian Environmental Flows Framework (TEFF) method.

1.1 Limitations

Whilst this report identifies aquatic values relevant to various state and federal legislative Acts, this assessment of operation of the Nietta mini hydro scheme on identified values is limited to the objectives of the Tasmanian Water *Management Act 1999* for the purpose of applying for additional water licence allocations and does not specifically address the requirements of other Acts.

The Tasmanian Government is currently maintaining a moratorium on the allocation of summer water (November to April inclusive) pending a review of the summer allocation policy, which is yet to be finalised (Bryce Graham, Manager Water Assessment Branch DPIPWE, 2015 pers comms 11 September; DPIPWE surface water allocation policy). Due to the moratorium on summer allocations, the current study is limited to the winter water licence allocation period (May to November inclusively).

2. Catchment overview

2.1 Jean Brook

Jean Brook rises at 832 mASL from the north-west slopes of Tiger Plains and flows into the Leven River at 310 mASL in the Leven River gorge. Land use in the catchment consists primarily of plantation forestry and agriculture to a lesser extent. Native forests are present close to the confluence with the Leven River where Jean Brook falls into the Leven Gorge. The watercourse downstream from the proposed offtake is a steep headwater with occasional, small discontinuous floodplains and flows over predominantly basalt geology with some small pockets of alluvial sediments. The catchment area of Jean Brook at the confluence with Leven River is 57.23 km^2 and 19.6 km^2 at the proposed offtake.

2.1.1 Hydrological regime

The modelled average annual rainfall in the Jean Brook catchment at the proposed offtake is 1575.6 mm/year with an annual discharge of 14,807 ML/year; however, discharge is variable with a minimum of 6,261 ML/year in 1982 and a maximum of 29,738 ML/year in 1975 (Figure 2.1). Jean Brook is a perennial river with average annual median and a mean daily base flow (RAP software) approximately 21 ML/day and 15.7 ML/day (Figure 2.2).

Average daily flows for each month shows a distinct pattern from very low flows in summer and autumn (for example, the average daily flow in March is 7.4 ML/day), with flows increasing considerably through winter (for example, the average daily flow in August average is 93.9 ML/day, Figure 2.3). However, daily flows can be highly variable, especially during the winter months (Figure 2.4).

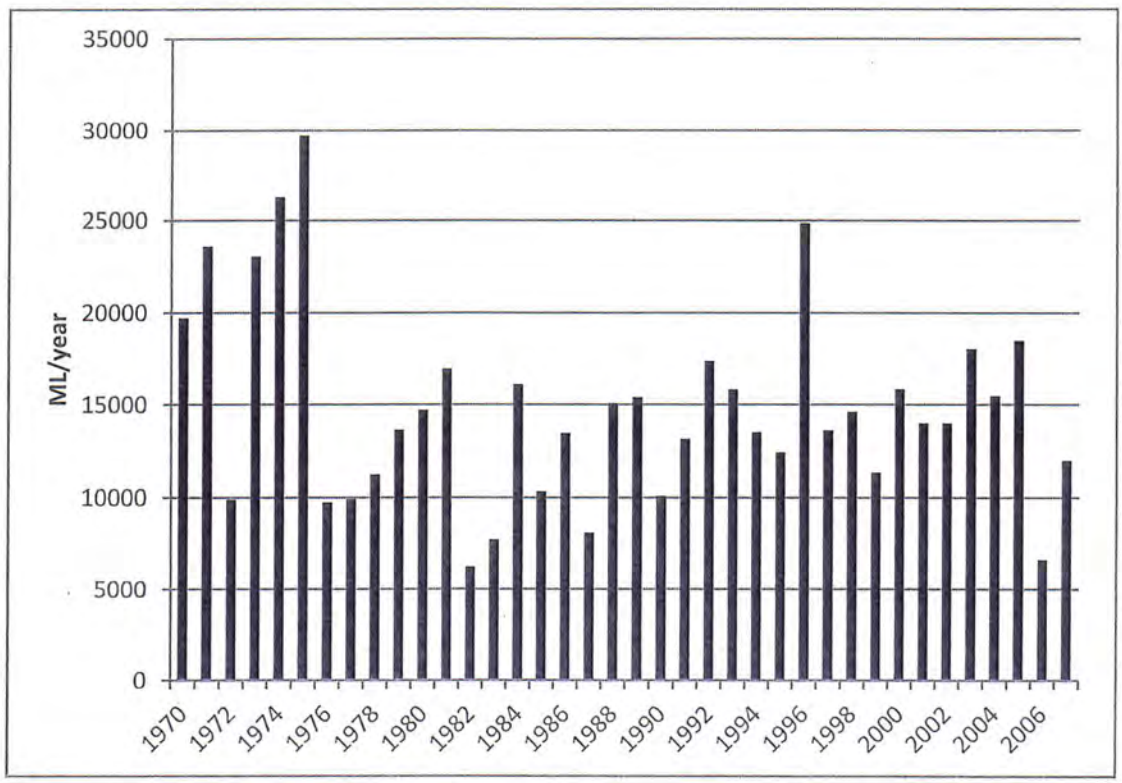

Figure 2.1: Modelled annual discharge for Jean Brook at the proposed offtake (1970 to 2007)

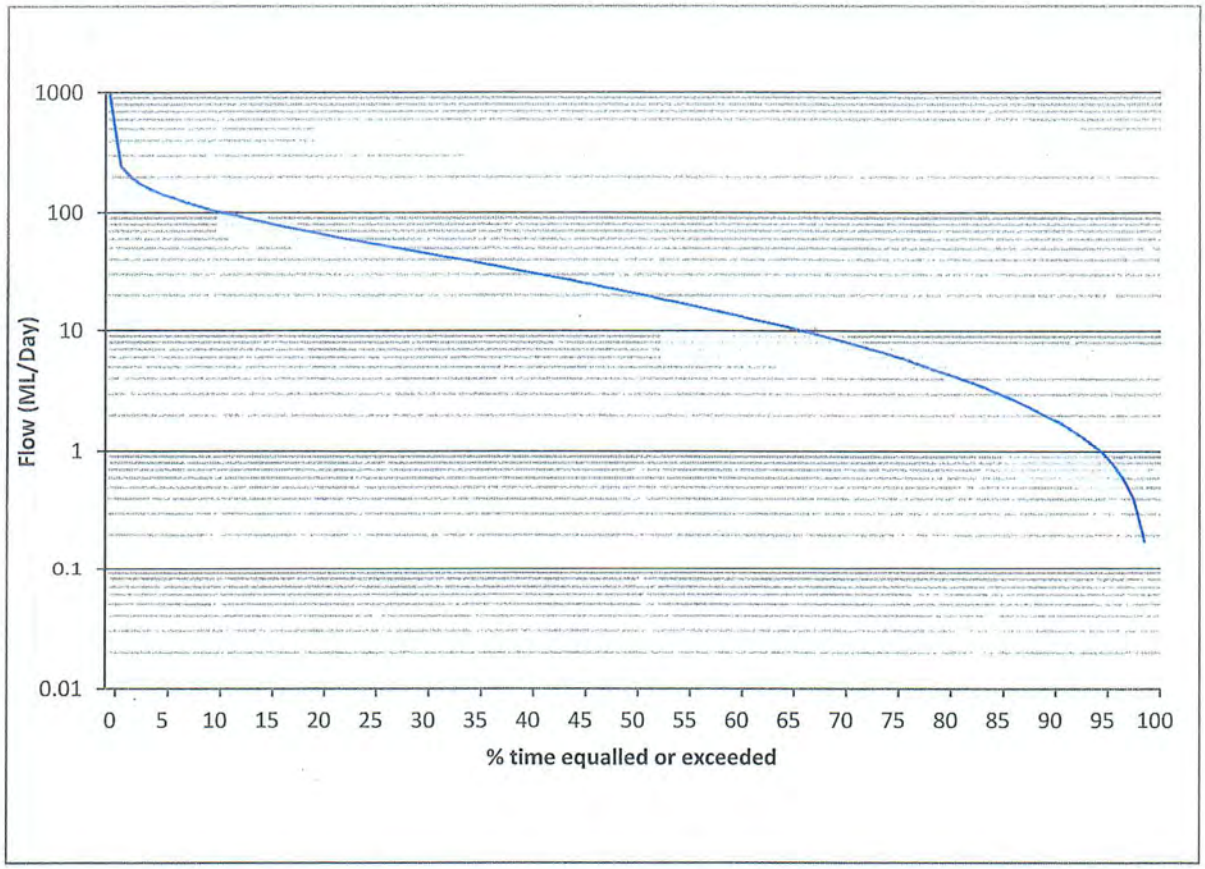

Figure 2.2: Modelled annual duration curve for the proposed Jean Brook offtake (1970 to 2007)

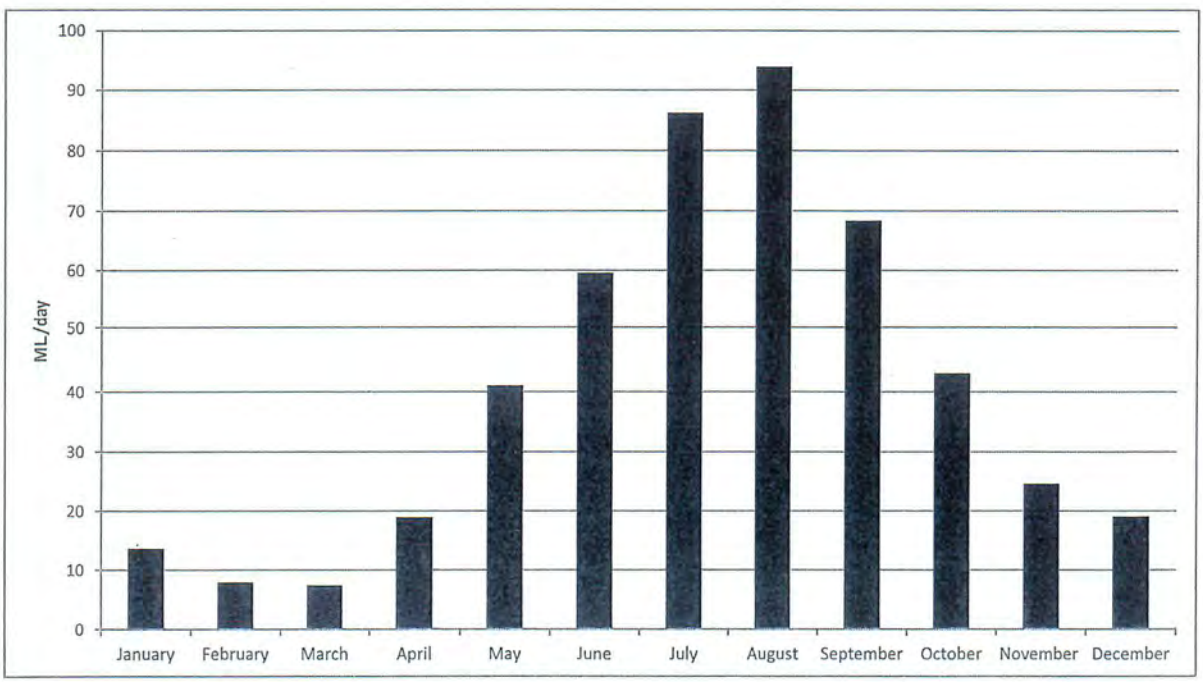

Figure 2.3: Modelled daily average flow for each month at the proposed Jean Brook offtake (1970 to 2007)

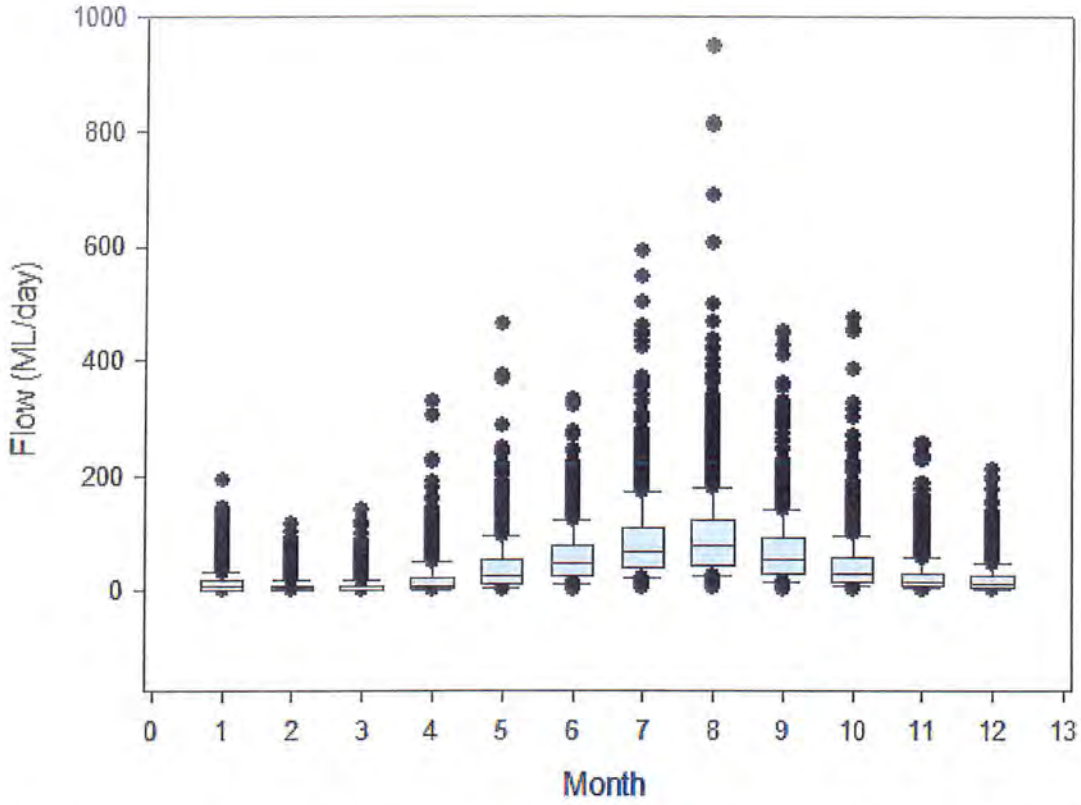

Figure 2.4: Box-and-whisker plot of modelled daily flows at the proposed Jean Brook offtake for each month (1970 to 2007)

2.1.2 Yield assessment

DPIPWE determines the available yield at any given location, based on current allocation policy, from catchments within Tasmania using the online Water Assessment Tool (WAT) (https://wrt.tas.gov.au/wat/). The online tool accounts for other allocations in the local and greater catchments and provides a default environmental flow based on the 20th percentile flow in winter and 30th percentile flow in summer. The available yield in winter was calculated using WAT which for the Project catchments uses the Forth and Leven sustainable yields models (DPIPWE 2012). Due to a moratorium on summer allocations, the available summer yield was provided by DPIPWE (Bryce Graham pers comms 2015, 2 October).

The outputs from WAT were used to gain an understanding of:

- the current water allocations within the Forth and Leven River catchments
- the quantity of water available within Nietta Creek and Jean Brook based on DPIPWE's default water allocation policy
- whether the quantity of water available is viable for Nietta Hydro plans to increase the schemes generation capacity.

2.1.2.1 *Jean Brook (May- Nov)*

The yield assessment for Jean Brook identified that 2,365 ML is available at Surety 5 (high reliability) for the period May-November once upstream user's allocations and the 20th percentile environmental flow rule is accounted for (Figure 2.5).

Yield Assessment	
Selected reference catchment number Justification for selection of reference catchment : (if other than recommended reference catchment)	1008a, Leven-Gawler,13, Total Yield
N/A	

Upstream catchment size (km²):	19.6
Upstream catchment rainfall (mm/a):	1575.62

Water Availability Assessment: Winter (May to November)			
Local Level - Water take location Please ensure any relevant secondary allocations are included in the assessment, add to existing upstream allocations if required.			
Reliability	**Availability limit**	**Current allocated**	**Potentially available**
High Availability	2365.04	0	2365.04
Mid Availability	695.02	11.43	683.59

Sub catchment Level			
Sub catchment Outlet Point[GDA94]		E 423245.05	N 5443037.2
Reliability	**Availability limit**	**Current allocated**	**Potentially available**
High Availability	49832.96	1206.77	48626.19
Mid Availability	19702.57	184.91	19517.65

Catchment Level			
Catchment Name: N/A			
Catchment Outlet Point [GDA94]		E 430188.54	N 5444632.72
Reliability	**Availability limit**	**Current allocated**	**Potentially available**
High Availability	59168.49	4805.46	54363.03
Mid Availability	23393.58	599.31	22794.27

Figure 2.5: Yield assessment from the DPIPWE FDAT online tool for the proposed Jean Brook offtake for the winter irrigation period (provided by DPIPWE 14 September 2015)

2.2 Nietta Creek

Nietta Creek rises at 520 mASL and flows approximately north-east into Castra Rivulet at 386 mASL, then into the Wilmot River and ultimately into the Forth River. The watercourse downstream from the proposed offtake is initially partly confined and then meanders through a continuous flood plain down to Gaunts Road, at which point the watercourse falls over Castra Falls into a steep headwater setting. The underlying geology of Nietta Creek is sedimentary with a small pocket of basalt in the headwaters upstream of the proposed offtake. The catchment area of Nietta Creek at the confluence with Castra Rivulet is 10.7 km^2 and 2.5 km^2 at the proposed offtake.

2.2.1 Hydrological regime

The modelled average annual rainfall in the Nietta Creek catchment at the proposed offtake is 1425 mm/year and the annual discharge of 1319 ML/year; however, discharge is variable with a minimum of 354 ML/year in 2006 and a maximum of 2,349 ML/year in 1975 (Figure 2.6). Average daily flows for each month shows a distinct pattern from very low flows in summer and autumn (for example, the average daily flow in March is 0.7 ML/day), with flows increasing considerably through winter (for example, the average daily flow in August is 10.34 ML/day, Figure 2.7). However, daily flows can be highly variable during the winter months (Figure 2.8). Nietta Creek is likely to be relatively flashy watercourse experiencing near cease-to-flow events and high magnitude floods in proportion to base flow and median flows (Figure 2.2).

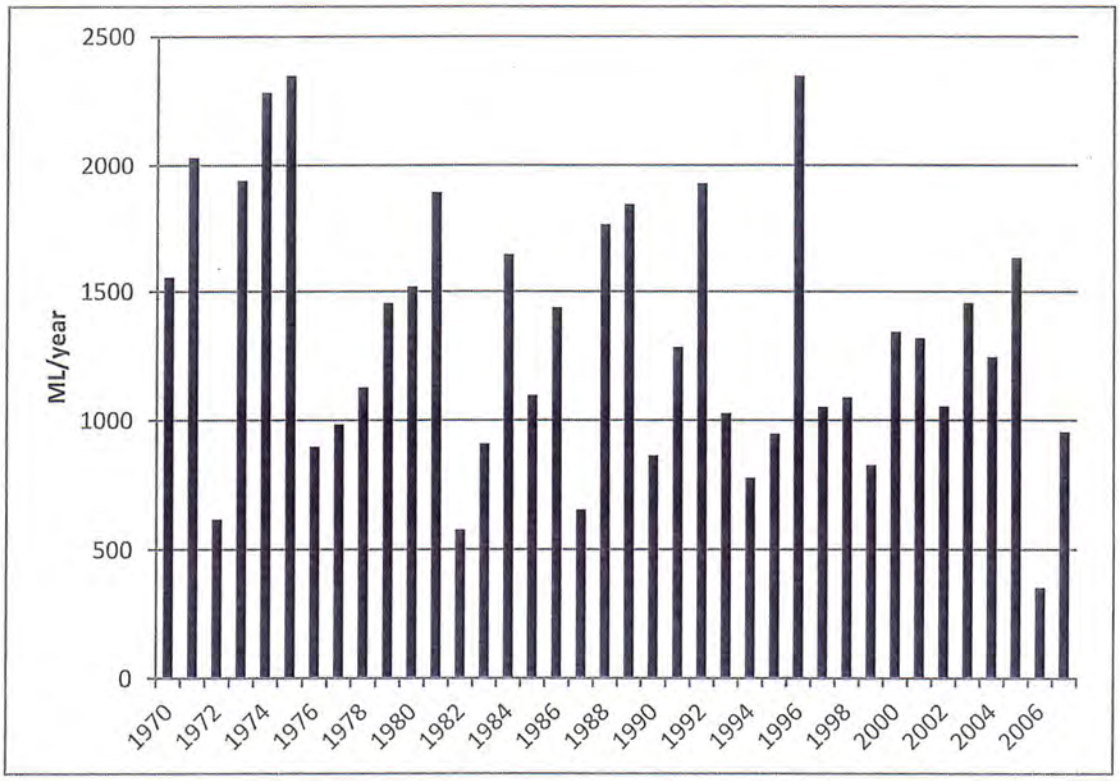

Figure 2.6: Modelled annual discharge for Jean Brook at the proposed offtake from 1970 to 2007

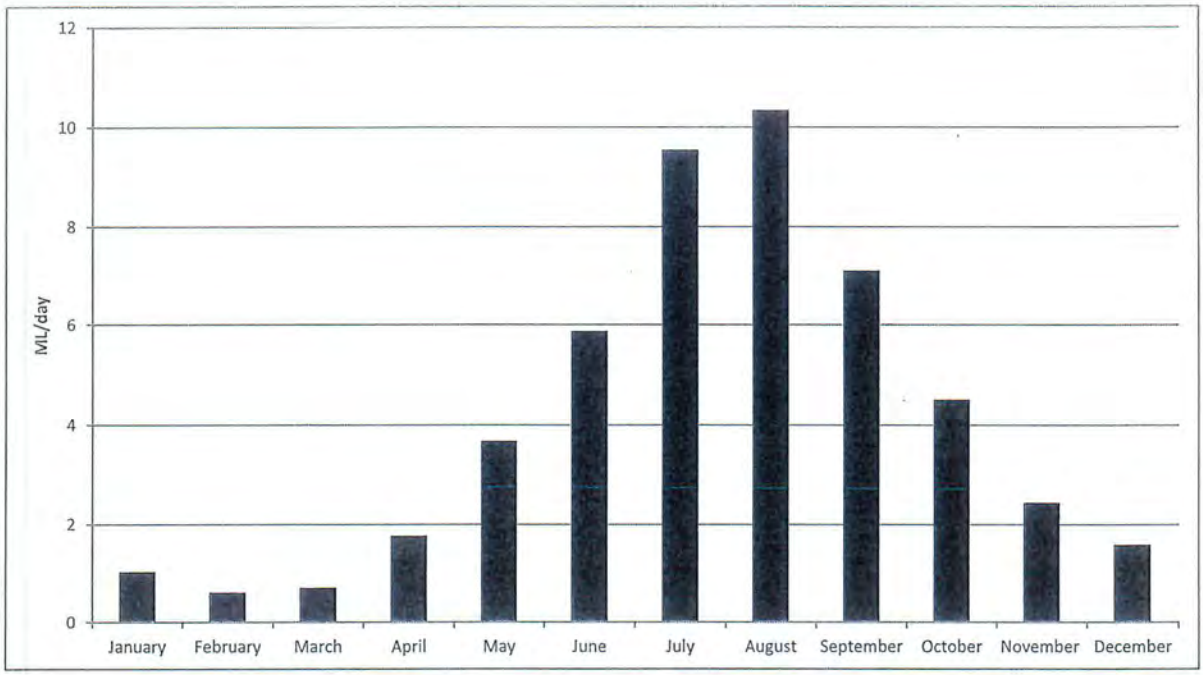

Figure 2.7: Modelled daily average flow for each month at the proposed Nietta Creek offtake (1970 to 2007)

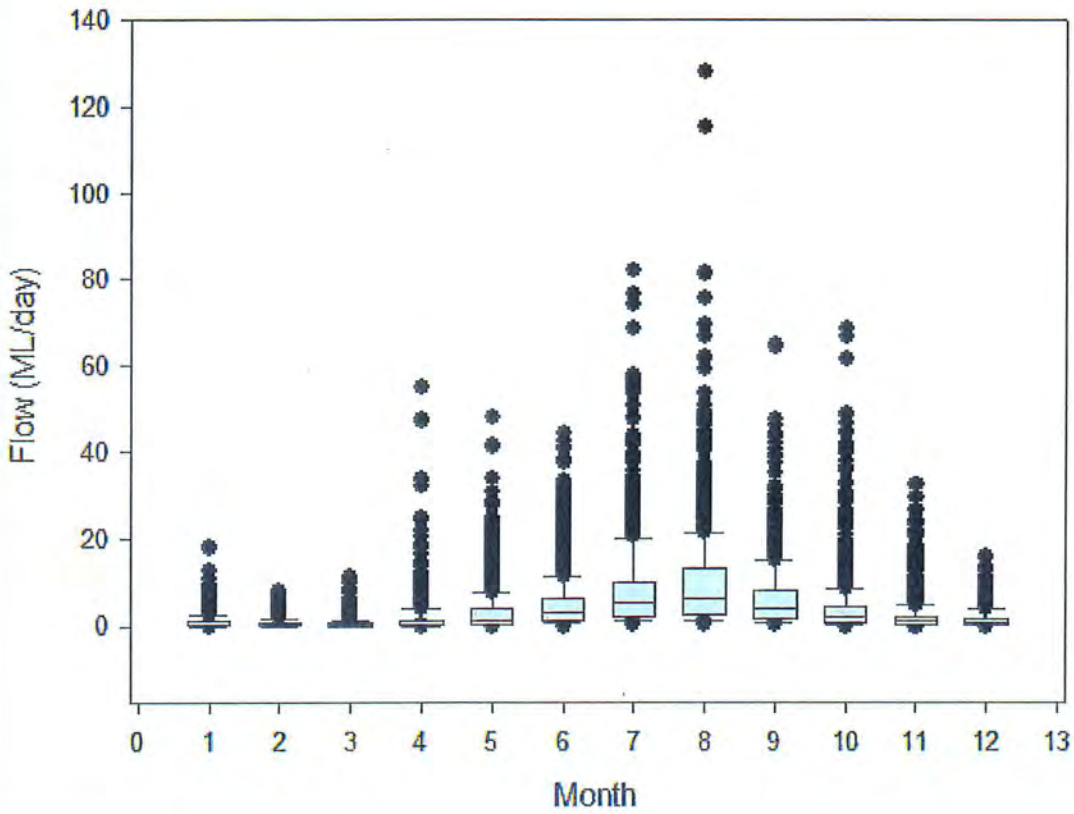

Figure 2.8: Box-and-whisker plot of modelled daily flows at the proposed Nietta Creek offtake for each month from 1970 to 2007

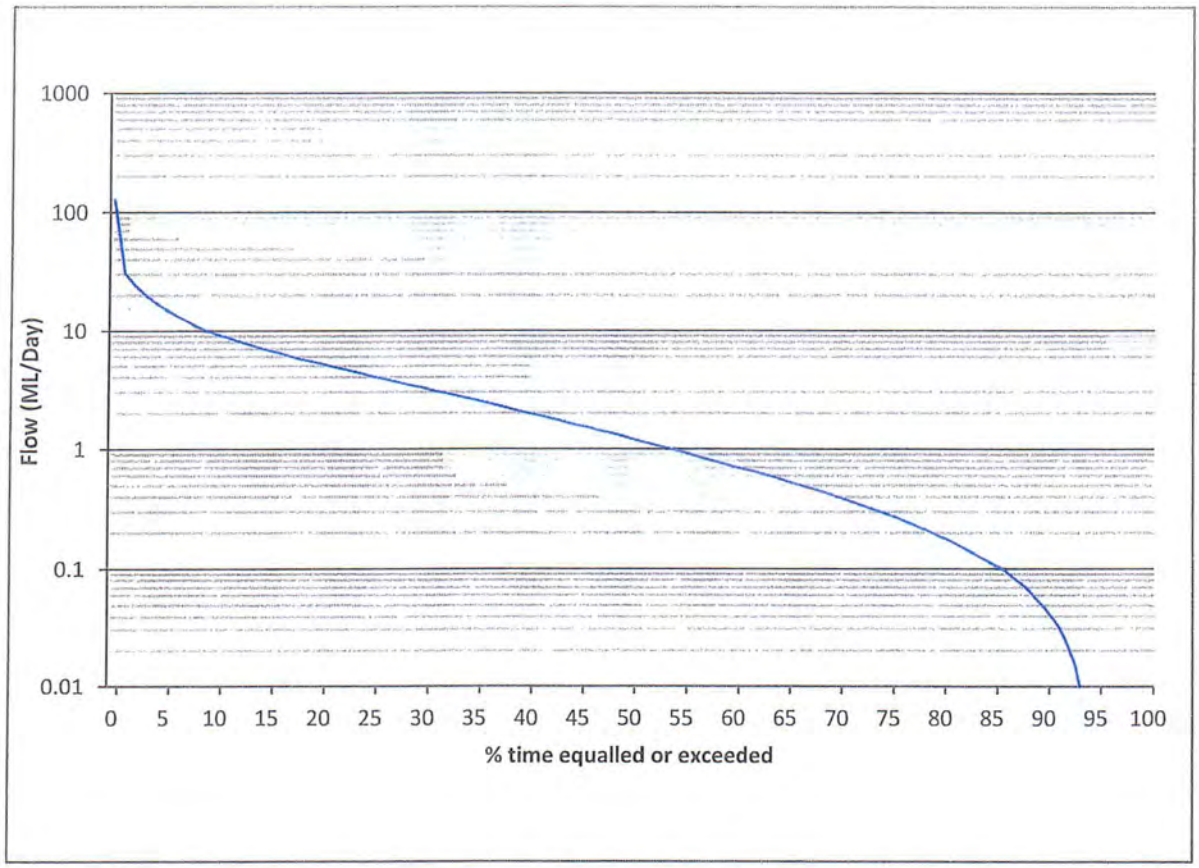

Figure 2.9: Modelled annual duration curve for the proposed Nietta Creek offtake from 1970 to 2007

2.2.2 Yield assessment

2.2.2.1 Nietta Creek (May-Oct)

The yield assessment for Nietta Creek identified that 322 ML is available at Surety 5 (high reliability) for the period May-Nov once upstream user's allocations and the 20th percentile environmental flow rule is accounted for (Figure 2.10).

Yield Assessment	
Selected reference catchment number Justification for selection of reference catchment : (if other than recommended reference catchment)	675,Forth,7,SubcatYield
Better site	

Upstream catchment size (km²):	2.4
Upstream catchment rainfall (mm/a):	1425.05

Water Availability Assessment: Winter (May to November)

Local Level - Water take location

Please ensure any relevant secondary allocations are included in the assessment, add to existing upstream allocations if required.

Reliability	Availability limit	Current allocated	Potentially available
High Availability	323.29	1	322.29
Mid Availability	69.8	0	69.8

Sub catchment Level			
Sub catchment Outlet Point[GDA94]		E 427873.6	N 5420654.69
Reliability	**Availability limit**	**Current allocated**	**Potentially available**
High Availability	4551.79	243.07	4308.72
Mid Availability	1173.46	12.5	1160.96

Catchment Level			
Catchment Name: N/A			
Catchment Outlet Point [GDA94]		E 437091.13	N 5443560.64
Reliability	**Availability limit**	**Current allocated**	**Potentially available**
High Availability	117102.7	6725.3	110377.39
Mid Availability	57950.85	226.75	57724.1

Figure 2.10: Yield assessment from the DPIPWE FDAT online tool for the proposed Nietta Creek offtake for the winter irrigation period (provided by DPIPWE 1 October 2015)

2.3 Relevant legislation

The following legislation guided the assessment of aquatic values in this report:

- Tasmanian *Threatened Species Protection Act 1995* (TSP Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); the purpose of the TSP Act is to protect listed fauna classified as threatened, vulnerable or rare, as well as critical habitat for listed species. The purpose of the EPBC Act is to protect and manage nationally and internationally important species, ecological communities and heritage places. The requirements of these Acts will determine the need for a referral to the commonwealth and/or permits under the TSP Act for the proposed mini-hydro power station;
- Tasmanian *Water Management Act 1999* (WM Act); the purpose of the Act is to provide for the use and management of freshwater resources in Tasmania, including the promotion of sustainable use, facilitation of economic development of water resources and maintaining ecological processes and genetic diversity of aquatic and riparian ecosystems; and,
- Tasmanian *Nature Conservation Act 2002* (NC Act); in the context of this assessment, the purpose of the NC Act is to protect listed vegetation communities and assess the need for permits to affect wildlife.

3. Methods

3.1 Hydrology

3.1.1 Analysis of current and proposed flows

Entura developed a hydrological model for Nietta Hydro in 2012 to assess the impact of the original power station project on flows in Castra Rivulet. The model was developed using the TasCatch model for the Forth River catchment using the KISTERS (Hydstra) modelling software (Entura 2012a). The original model was extended to include the additional offtakes and updated to use modelled flows from the current Sustainable Yields Models for the Forth and Leven River catchments. Details of model development and associated assumptions are provided in Appendix A.

To compare current (which includes natural inflows, current allocations and the current operation of the mini hydro scheme) and proposed (current flows plus operation of the two proposed diversions) flows in the affected water courses, a flow duration analyses was conducted at the following locations (Figure 1.1) using modelled daily time-step:

- Forth River catchment
  - Nietta Creek immediately downstream of the proposed offtake in Nietta Creek (to assess changes in flow in Nietta Creek).
  - Nietta Creek immediately upstream of the confluence with Castra Rivulet (to assess the mitigating impact of catchment runoff on flows downstream of the proposed Nietta off-take).
  - Castra Rivulet immediately downstream of the confluence with Nietta Creek (to assess the cumulative impact of changes in flow within Castra Rivulet).
  - Castra Rivulet immediately upstream of the mini hydro tailrace outflow (to assess the mitigating impact of catchment runoff on the cumulative impact on flows downstream of the confluence of Nietta Creek and Castra Rivulet).
  - Castra Rivulet immediately downstream of the mini hydro tailrace (to assess the impact of increased flows from Jean Brook on channel capacity).
  - Castra Rivulet immediately downstream of the Jean Brook offtake outflow at Maxfields Road (to assess the impact of increased flows from Jean Brook).
- Leven River catchment
  - Jean Brook downstream of the proposed off-take in Jean Brook (to assess changes in flow in Jean Brook).
  - Jean Brook immediately upstream of the confluence with the Leven River (to assess the mitigating impact of catchment runoff on flow in Jean Brook).

3.2 Desktop assessment

Aquatic and riparian values include characteristics of the aquatic ecosystems that are worthy of protection. Information on the catchment, surrounding land use, biological, physical and chemical properties of the waterways was obtained from a literature review and search of relevant databases (within 5 km radius of each proposed offtake) including:

- The Conservation of Freshwater Ecosystem Values (CFEV) database rivers and wetlands layers for catchment-wide conservation values and associated special values (including high conservation values nominated by expert opinion (https://cfev.dpiw.tas.gov.au, accessed 29 July 2011).
- The Commonwealth Protected Matters Tool (PMT) for communities, species and other values listed under the *Environment Protection and Biodiversity Conservation Act 1999* (http://www.environment.gov.au/epbc/pmst/index.html, accessed 29 July 2011).
- The Tasmanian Natural Values Atlas (NVA) for listed aquatic, wetland and riparian species under the *Threatened Species Protection Act 1995* (www.naturalvaluesatlas.tas.gov.au, accessed 28 July 2011).
- The TASVEG v2 database for vegetation communities listed under the Tasmanian *Nature Conservation Act 2002* (Harris and Kitchener 2005).
- The aquatic environmental assessment undertaken by Entura for the original mini hydro power station water licence (Entura 2012a) and the current operational environmental management plan (2012b).

3.3 Field survey – Stage 1

Freshwater habitat, macroinvertebrate community, freshwater snail and fish surveys were conducted from 15 – 17 September 2015 in two reaches of Nietta Creek and one reach of Jean Brook (Figure 1.1). The study reaches were chosen to be representative of the stream habitat that would be affected by the proposed offtakes and the data collected provides a baseline assessment of the freshwater ecological values of these waterways (Figure 1.1).

3.3.1 Channel capacity

An estimation of channel capacity was undertaken in the Castra Rivulet at five transects downstream from the proposed discharge location of the Jean Brook diversion to determine whether an additional 800 L/sec would cause the flow to exceed the capacity of the channel more often and to provide supporting evidence as to whether erosion may increase (Figure 1.1).

A single transect was also surveyed in Castra Rivulet downstream from the power station outflow whilst the power station was running at full capacity (i.e. approx. 800 - 900 L/sec) to assess the capacity of the channel under operation (Figure 1.1).

The channel capacity survey did not include determination of actual flow capacity through hydraulic surveys, flow gauging or hydraulic modelling. However, a preliminary estimate of channel capacity was obtained by measuring the width across the section and bank full height (i.e. height where water would spill into the surrounding vegetation during high flows). An estimation of water depth and flow velocity at different flows was then calculated by using an online formula which uses channel width, side slope, longitudinal channel slope and Manning's n to provide an estimate of flow depth and flow velocity for a cross-section of a prismatic channel (http://ponce.sdsu.edu/onlinechannel01.php, last accessed 2 October 2015). Slope was derived from the CFEV database.

The channel capacity assessments provide an approximation of water depth and velocities at different locations under varying flows. Flow scenarios assessed include the median flow (Q50) up to

peak flows (i.e., Q1 flow or flow that is only exceeded one percent of the time). Flow scenarios were calculated using the winter period (May-Nov) percentiles.

3.3.2 Macroinvertebrates and fish

Macroinvertebrate community samples were collected and a qualitative fish survey was conducted at three locations (Figure 1.1):

- Nietta Creek downstream of the proposed offtake (upstream from Gaunts Road which is low gradient, depositional headwater).
- Nietta Creek downstream of the proposed offtake (downstream from Gaunts Road and Castra Falls) which is a relatively high gradient reach immediately below the falls).
- Jean Brook downstream of the proposed offtake.

Macroinvertebrates were collected using the AusRivAS methodology. Macroinvertebrate samples were identified to family level in the laboratory.

The fish survey was undertaken using a Smith-Root LR24 backpack electro-fisher and the catch recorded based on a 20-min CPUE method. Fish were identified to species, counted, measured and released.

Whilst outside the scope of this study, the presence/absence of giant freshwater crayfish was also noted.

3.3.3 Aquatic snail and snail habitat survey

A number of threatened aquatic snail species from the genus Beddomeia are known to occur in the Castra Rivulet catchment. In particular, *Beddomeia fallax* is known to occur in the reach of Nietta Creek downstream from the proposed Nietta Creek offtake and *B. lodderae* is known to occur in the Castra Rivulet downstream from the Jean Brook diversion outflow (Natural Values Atlas Database; Karen Richards, Senior Zoologist, DPIPWE, 2012, pers comms).

An aquatic snail survey was undertaken at number locations in Nietta Creek and Jean Brook using two methods:

- Sampling using the method provided on permit no. DA15194 (Appendix B) whereby two boulders, twenty-five cobbles and twenty-five pebbles are washed and sieved through a 300 µm sieve, stored in menthol crystals initially and then transferred to 70% ethanol. The samples were examined under a dissecting microscope and any individuals were picked out and placed in 70% ethanol. Habitat parameters were also noted based on the sampling method described in the permit. Sampling using this method was undertaken at Nietta Creek in the following locations:
  - Immediately downstream from Castra Falls and upstream from the tributary inflow where *B. fallax* has been observed previously (Karen Richards, Senior Zoologist, DPIPWE, 2012 pers comms).
  - Approximately 25 m upstream from the confluence with Castra Rivulet where *B. fallax* has been observed previously (Natural Values Atlas database, last accessed 2/10/2015).
- Surveying using a modified version of the method provided on permit no. DA15194, whereby substrate was searched by sight at each location. This method allowed for rapid surveys of additional locations and extension surveys beyond the impacted river reaches within the budget and time constraints. Surveying using this method was undertaken in:

- In a tributary of Nietta Creek where *B. fallax* has been observed previously.
- In Jean Brook (no previous observations of threatened snail species).
- In a tributary of Jean Brook (no previous observations of threatened snail species).

An aquatic snail survey was not conducted in Castra Rivulet downstream of the Jean Brook diversion outflow as the proposed Jean Brook diversion will add flow to Castra Rivulet and the magnitude of change was not known at the time of the surveys.

3.4 Field survey – Stage 2

A hydraulic field survey was undertaken on 9 December 2015 along a 230 m reach of Jean Brook downstream of the Leven Canyon Road to develop a hydraulic model for the environmental flow determination (Figure 1.1).

3.4.1 Survey aim

The aim of the Stage 2 field survey was to collect field measurements and observations for input into the hydraulic model to determine the environmental flow requirement for Jean Brook. The field data consisted of:

- cross-section surveys for input to hydraulic and habitat modelling
- flow gauging to calibrate flows for the hydraulic models
- additional field notes on reach characteristics to support the development of the hydraulic model and general understanding of aquatic habitat.

3.4.2 Reach selection and description

The reach within Jean Brook was chosen on the basis of being representative of the aquatic habitat and hydraulic conditions within the impacted reach of Jean Brook downstream from the proposed offtake. The representative reaches consisted of a combination of riffle, run and pool habitat. Two riffles were included in the survey, with one riffle being steeper and consisting mainly of larger sediment classes (cobbles and boulders, Figure 3.1), whilst the second riffle was of a shallower slope and contained more homogeneous sediment class sizes of mainly small cobble. The two pools were approximately 58 cm at the deepest point with some boulder and large cobble over bedrock with some woody debris at the margins (Figure 3.2).

The surrounding riparian vegetation was generally thick, with tall native shrubs (dominated by *Leptospermum* sp., *Acacia* spp. and *Nothofagus cunninghamii*), ferns and the occasional wet forest tree species. There was a high degree of canopy cover in most areas.

Figure 3.1: The cobble/boulder dominated, steeper riffle section within the representative reach looking upstream from cross-section twenty

Figure 3.2: The pool looking downstream from cross-section seven

3.4.3 Cross-section survey

Thirty-two river cross-sections were surveyed over a 230 m reach (Figure 3.3) using a combination of a Trimble R8 GPS unit and a Total Station. Cross-sections were located at and immediately downstream of hydraulic controls with emphasis on characterising the riffles/high gradient habitats which are the most sensitive habitats in terms of changing flow levels. The location of individual GPS points along each cross-section were based on minute changes in elevation but also included metadata including water level on the day and top of bank flows. A detailed photo catalogue was also collected for each cross-section that represented the left bank, right bank and looking up and downstream. Photos and field notes provided guidance with calculating the Manning's n values and verifying the model.

3.4.4 Flow gauging

Flow gauging's were undertaken on the day of the field survey using a SonTek Flow Tracker handheld ADV, with a measuring tape to define the gauging cross-section. Six flow gauging's were undertaken at Cross-section 4 as there were no other suitable hydraulic controls for gauging within the reach. The SonTek Flow Tracker allowed for an instantaneous calculation of flow.

Figure 3.3: location of field survey cross-sections

3.5 Hydraulic modelling

A one dimensional hydraulic model was built for the representative reach using the field cross-section surveys, the photo catalogue and HEC-RAS software (Hydraulic Engineering Centre 2008). Input variables relating to reach lengths and bank station heights were calculated using ArcGIS software and the cross-section survey data. Manning's n roughness coefficients were initially calculated using the photo catalogue and known roughness relationships with various surface types including sediment size and vegetation. Slope was calculated using the difference in the channel level invert between cross-sections as an input into the upstream and downstream boundary conditions. A mixed flow regime steady flow model was used to run the hydraulic model due the assessment of super-critical and sub-critical flows present within the representative reach.

A global Manning's n value of 0.13 was applied to each cross-section based on a formula where the flow is between 0.3 and 1.5 times the D50 rock size (Department of Transportation Federal Highway Administration 2015).

A number of profile flow stages were modelled including flow/habitat statistics derived from observed and modelled hydrological data.

3.5.1 Model calibration

Model calibration was achieved using the observed water levels and a combination of cross-section interpolations and adjusting Manning's n values within natural and reasonable bounds, until the observed water level were in close agreement with those measured on the day. Ideally, the model would be calibrated to a number of observed flows and associated water levels; however, a single flow measurement (Figure 3.2) was used to calibrate the model due to project time constraints. The blue line represents the modelled water surface for the average flow that was observed on the day of the survey, whilst the open diamonds represent the surveyed water surface on the day of the survey. The general agreement indicates that the model has been reasonably calibrated. Figure 3.5 is a perspective plot of the reach with the modelled water surface for the average flow on the day and provides a general overview of the model.

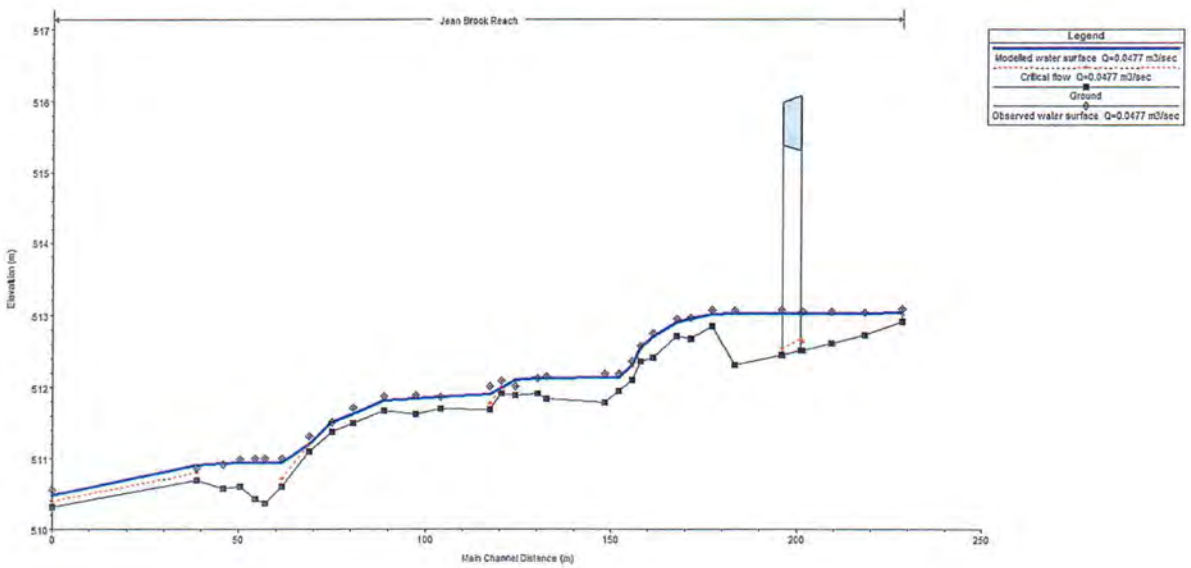

Figure 3.4: HEC-RAS profile plot of modelled and observed average flow of 0.0477 m^3/sec (4.1 ML/day)

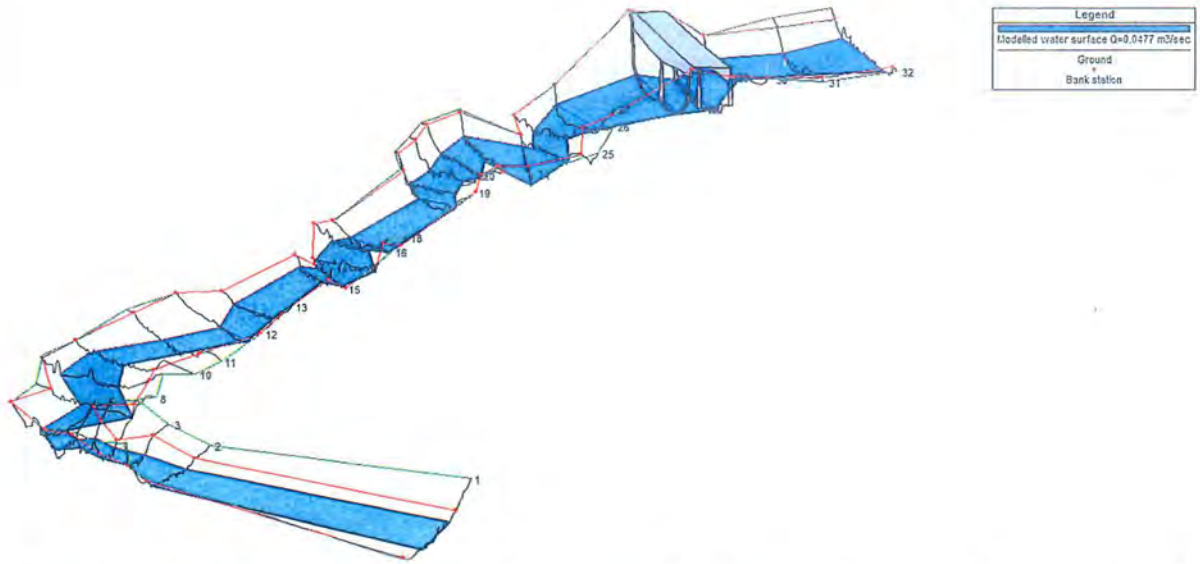

Figure 3.5: HEC-RAS perspective plot of the representative reach and the observed average flow of 0.0477 m3/sec (4.1 ML/day)

3.6 Environmental flow determination

The method used to determine an appropriate environmental flow was guided by the Tasmanian Environmental Flows Framework (TEFF) method developed by the Department of Primary Industry, Parks, Water and Environment (DPIPWE) in Tasmania (Bobbi et al 2014, DPIW 2007). The principles of the TEFF also reflect the guiding principles of environmental flow methods used worldwide.

The TEFF method links the biological components and physical heterogeneity within watercourses to specific flow events and to specific environmental flow objectives. The process involves the following main steps:

- Identify freshwater ecosystem values to identify the objectives of the environmental flows. Values were determined through desktop assessment of existing information and assessment of habitat during field surveys.
- Conduct hydrological analyses of flow data to define the pattern of occurrence of important flow events and the availability of important habitats for biota.
- Identify representative stream reaches, conduct stream cross-section surveys to obtain stream geometry data and conduct flow gauging to calibrate flows for input to hydraulic and habitat modelling.
- Develop hydraulic and hydrological models to characterise physical habitat and biological diversity of the system, and identify specific flow events that relate to these attributes.
- Recommend a flow regime that meets the objectives of the environmental flow assessment.

3.7 Assessment criteria

For this report, the impact assessment considers the likely significant impacts of the scheme on the aquatic fauna and flora, riverine habitat, geomorphology and hydrology in the study area. The assessment is based on the predicted magnitude of the impact and the sensitivity of receptors derived from the desktop assessment and field surveys. The criteria used to determine the

magnitude of the impact are described below. Table 3-1 (aquatic ecology), Table 3-2 (fluvial geomorphology) and Table 3-3 (hydrology) provide a definition of the levels of impact magnitude and a general description of the meaning of each 'level' of magnitude. The impact table for aquatic ecology also provides a description of its definition in terms of the ecological vulnerability of the receptor.

Impact magnitude is the degree of change that the impact causes or is considered to cause compared to baseline conditions. This is a qualitative judgment based on expert opinion and interpretation of the desktop and field assessments. Wherever possible, quantitative information is used to support the impact assessments.

Table 3-1 Description of magnitude of impacts for aquatic ecological values

Impact Magnitude	Description	Ecological Vulnerability
High Adverse	A large change.	In ecological terms, the species / local population is likely to be killed / destroyed by the effect under consideration.
Medium Adverse	Change that is noticeable.	In ecological terms, some individuals of a species / population may be killed / destroyed by the effect under consideration and the viability of a species population may be affected.
Low Adverse	Change which may only just be noticeable.	In ecological terms, some individuals of a species / population may be killed / displaced by the effect under consideration but the viability of a species population will not be affected.
No Impact/ negligible	No effect	No detectible effect on the species / population is likely.
Beneficial	Change that is noticeable	The change is likely to benefit the species / population.
High beneficial	A large change	The change is likely to restore the integrity of a species / population to a favourable condition.

Table 3-2 Description of magnitude of effects for fluvial geomorphology

Magnitude of likely effects	Description
High adverse	Fundamental change to the baseline condition of the watercourse. Intervention will result in a major alteration to the geomorphology, conservation value of the watercourse and morphological processes. Low potential to recover from a "threshold" shift
Medium adverse	Intervention shows some signs of partial alteration to the geomorphology, conservation value of the watercourse and morphological processes. "threshold" may not have yet been exceeded with potential to recover
Low adverse	Negligible change to receptors, resulting in a minor impact to the baseline condition (e.g. geomorphology, conservation value of the watercourse, morphological processes) that may or may not be detectable – i.e. small scale localised erosion.

Magnitude of likely effects	Description
No impact or beneficial impact	No change to receptors. A stable equilibrium balancing geomorphic inputs with outputs. Alternately, there may be a slight improvement in receptors with for example: areas that are presently degraded being improved through a range of alterations such as water quality, physical habitat or erosion rates.

Table 3-3 Description of magnitude of effects for hydrology and water quality

Impact Magnitude	Description
High adverse	*Flow Regime:* Impact affects widespread area and large section of watercourse. Fundamental change to connectivity between floodplain and channel. In-channel hydraulic processes altered such that there is likely to be a change to the morphological character of the system. *Water Quality:* Prolonged / widespread disturbance or pollution of the water course.
Medium adverse	*Flow Regime:* Impact affects are localised, not affecting widespread area or large section of watercourse. Some changes to connectivity between floodplain and channel. In-channel hydraulic processes altered such that there may be localised changes in morphological character. *Water Quality:* Short-term disturbance or pollution of water course or section of water course.
Low adverse/ negligible	*Flow Regime:* Very localised impacts. No change to connectivity between floodplain and channel. No change to morphological character of the system. *Water Quality:* Duration of impact / pollution of section of water course very short and minor.
Beneficial	*Flow Regime* Improved hydrological conditions (increased base flow in denuded systems; increased connectivity between floodplain and channel, beneficial change to the morphological character of the system *Water Quality:* Change to regime has potential to improve water quality

4. Existing environment

4.1.1 Catchment ecosystem values

The Conservation of Freshwater Ecosystems Values (CFEV) is a spatial database tool that provides an audit and evaluation of Tasmania's freshwater ecosystems for their conservation value and management priority. The output of the CFEV assessment provides information about the biophysical character and condition of all freshwater-dependent ecosystems. The framework for this database is based around the CAR (comprehensive, adequate and representative) reserve design strategy. The CFEV project developed a number of conservation criteria that supported the CAR principle, these being 'naturalness' (N) when compared to pre-European condition, 'representativeness' (R) of the biophysical character of a spatial unit (i.e. lake or river segment) when compared with other spatial units, and the 'distinctiveness' (D) of a rare biophysical character and other special values such as listed threatened species and species/communities with high conservation value (DPIW 2008).

4.1.1.1 CFEV rivers layer

Within CFEV, rivers are sub-divided into river sections, which are defined by DPIW (2008) as 'being the section of river, in the 1:25,000 river spatial data layer, between confluences'. Based on this definition, Nietta Creek from the proposed offtake point down to the confluence with Castra Rivulet and Jean Brook from the proposed offtake down to the confluence with the Leven River consists of five and seven river segments respectively.

The conservation representativeness (R) and naturalness (N) of the Nietta Creek study reach show that the entire study reach is classified as having a medium (B) representative conservation value (R), which means that the biophysical values within the reach are moderately well-represented regionally and is driven by the presence of an important vegetation class (presumably linked to the river riparian zone). The Nietta Creek study reach is characterised as being in good (high) condition (N) (Table 4.1).

Table 4.1: CFEV Representative Conservation Value (R) and Naturalness Score (N) for the Nietta Creek study reach including the database attribute identifiers, river length and important biophysical class (D)

River Section (RS_ID)	Section Length (m, RS_LENGTH)	Representative Conservation Value (*R*, RS_RCV)	Naturalness (*N*, RS_NSCOR_C)	Important Biophysical Class (*D*, RS_CLASSN)	Important Biophysical Class Description
172277	467	B	High	T11	North-western ash forests mosaics with rainforest and wet sclerophyll understoreys*
172278	282	B	High		
172285	476	B	High		
172749	495	B	High		
172751	378	B	High		

* Species Composition: *Acacia dealbata, Acacia melanoxylon, Anodopetalum biglandulosum, Atherosperma moschatum, Cenarrhenes nitida, Eucalyptus delegatensis, Eucalyptus nitida, Eucalyptus obliqua, Eucalyptus regnans, Eucryphia lucida, Monotoca glauca, Notelaea ligustrina, Nothofagus cunninghamii, Olearia argophylla, Phebalium squameum, Phyllocladus aspleniifolius, Pittosporum bicolor, Pomaderris apetala, Tasmannia lanceolata, Zieria arborescens*

The conservation representativeness (R) and naturalness (N) of the Jean Brook study reach show that the majority of the study reach is classified as having a low (C) representative conservation value (R), which means that the biophysical values within the reach are well-represented regionally and is driven by the presence of an important vegetation class (presumably linked to the river riparian zone). However, there is one river segment, which is characterised as having a medium representative conservation value (R) and is only moderately well-represented regionally. This classification is due to the predicted presence eels and climbing galaxias, steeper slope and riparian vegetation in good condition (Table 4.2).

The Jean Brook study reach is characterised as being in variable condition (N). This variability is mainly attributed to variables relating to land use. For example, the condition of river segment 156872 is low as the proportion of native and introduced riparian vegetation is low, which in turn lowers the modelled condition of the macroinvertebrate community (Table 4.2).

Table 4.2: CFEV Representative Conservation Value (R) and Naturalness Score (N) for the Jean Brook study reach including the database attribute identifiers, river length and important biophysical class (D)

River Section (RS_ID)	Section Length (m, RS_LENGTH)	Representative Conservation Value (*R*, RS_RCV)	Naturalness (*N*, RS_NSCOR_C)	Important Biophysical Class (*D*, RS_CLASSN)	Important Biophysical Class Description
156872	325	C	Low	T11	North-western ash forests mosaics with rainforest and wet sclerophyll understoreys*
156874	1566	C	Medium		
156876	192	C	Medium		
156877	482	C	Medium		
157106	856	B	High		
157352	364	C	Medium		
157353	892	C	High		

* Species Composition: *Acacia dealbata, Acacia melanoxylon, Anodopetalum biglandulosum, Atherosperma moschatum, Cenarrhenes nitida, Eucalyptus delegatensis, Eucalyptus nitida, Eucalyptus obliqua, Eucalyptus regnans, Eucryphia lucida, Monotoca glauca, Notelaea ligustrina, Nothofagus cunninghamii, Olearia argophylla, Phebalium squameum, Phyllocladus aspleniifolius, Pittosporum bicolor, Pomaderris apetala, Tasmannia lanceolata, Zieria arborescens*

In addition to the important biophysical class, the analysis of the special values for the five river sections in Nietta Creek and the seven river sections in Jean Brook that also represent the distinctiveness (D) of the study reach is represented by the predicted presence of platypus (*Ornithorhynchus anatinus*) as a phylogenetically distinct species in all river sections. Lowland poa grasslands are also represented as a distinctive special value in the uppermost river segment of the study reach in Nietta Creek.

4.1.1.2 CFEV karst layer

The Loongana karst system is located downstream of the Jean Brook catchment, within the riverine environment of River Leven and is classified as having a medium representative conservation value (R) and within the medium condition band (N) (Table 4.3). The surface hydrology of Jean Brook is on Basalt and is disconnected from the karst down to the confluence with the River Leven; however, the sub-surface connectivity is unknown.

Table 4.3: CFEV Representative Conservation Value (R) and Naturalness Score (N) for the Loongana karst system including the database attribute identifiers, area and important biophysical class (D)

Karst ID/Name (KT_ID, KT_Name)	Area (m2, KT_Area)	Representative Conservation Value (*R*, KT_RCV)	Naturalness (*N*, KT_NSCOR_C)	Important Biophysical Class (*D*, KT_CLASSN)	Important Biophysical Class Description
143 (Loongana)	13,013,906	B	Medium	K50	Ordovician limestones (Gordon Group) undifferentiated on riverine plains (precipitation system 4)

4.1.2 Listed, high conservation significance and flow dependent communities

The Protected Matters Tool (PMT) predicts that two EPBC Act listed floodplain communities (Lowland Native Grasslands of Tasmania; Alpine Sphagnum Bogs and Associated Fens) are likely to occur within a 5 km radius of Nietta Creek and Jean Brook study reaches (Table 4-4). Entura (2011) identified the closest known observation of a lowland native grassland as Lowland *Poa labillardierei* grassland on Nietta Creek in TASVEG2. The updated TASVEG3 database no longer shows this community as present on Nietta Creek, with the closest known observation approximately 2.5 km NW of the proposed Nietta Creek offtake in an adjacent catchment. The closest known observation of a sphagnum bog is approximately 6 km SW of the proposed Jean Brook offtake on Tiger Plain near Black Bluff in the upper catchment (TASVEG v3).

Table 4-4 Threatened communities predicted within 5km of the study reach

Common Name or Group	EPBC Act	NC Act	Habitat	Source
Lowland Native Grasslands of Tasmania	Critically Endangered	Not Listed	Terrestrial and riverine floodplains	PMT (modelled)
Alpine Sphagnum Bogs and Associated Fens	Endangered	Not Listed	Terrestrial and riverine floodplains	PMT (modelled)

4.1.3 Listed, high conservation significance and flow dependant species

The Tasmanian Natural Values Atlas (NVA) and the Commonwealth Protected Matters Tool (PMT) identified observations of a number of threatened aquatic, riparian and wetland species (the PMT database also predicted habitat for these species) within a 5 km radius of the Nietta Creek and Jean Brook study reaches (Table 4.5). All species are all listed under the Tasmanian *Threatened Species Protection Act 1995* (TSP Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In addition, the Tasmanian *Nature Conservation Act 2002* (NC Act) lists the platypus (*Ornithorhynchus anatinus*) as protected wildlife. The CFEV database also identified platypus (*Ornithorhynchus anatinus*) within the study area.

4.1.3.1 Mammals

The CFEV database predicts that platypus (*Ornithorhynchus anatinus*) occurs within the Nietta Creek and Jean Brook study reach. A platypus was observed during the hydraulic survey in Jean Brook in the pool associated with the bridge at Leven Canyon Road. Anecdotal observations of platypus in Castra Rivulet (Nietta Creek catchment) were confirmed in Entura (2012a). This species is semi-aquatic and is commonly observed in freshwater lakes and rivers, where it burrows in the banks and under tree roots (Watts 1987).

4.1.3.2 Birds

The PMT predicts suitable habitat for the azure kingfisher (*Ceyx azureus diemenensis*) within the study reach. This species builds its nest in burrows dug into river banks and feeds on aquatic fauna including fish (Watts 1999). One of the reasons for the listing of this species in the EPBC Act is the ambiguity of its distribution (DSEWPC 2010); therefore, it is difficult to know if this species is present without a targeted survey; however, it is assumed that suitable habitat is present.

The PMT also predicts suitable habitat for the white-bellied sea eagle (*Haliaeetus leucogaster*) within the study reach. This species occurs in a broad variety of habitats that include inland lakes and large rivers. It is frequently observed hunting fish from high tree perches in riparian vegetation (Bryant and Jackson 1999, Watts 1999). Given the predominantly closed riparian canopy over the watercourse within the study reach, it is unlikely that the white-bellied sea eagle uses the study reach for foraging.

Table 4.5: Threatened and high conservation significance fauna and flora known or habitat predicted to occur from aquatic habitats previously recorded within a 5 km radius of the study reach

Species	Common Name or Group	TSP Act	EPBC Act	NC Act	CFEV Non-Legislated Value	Habitat	Source	Offtake
Ornithorhynchus anatinus	Platypus	Not Listed	Not Listed	Protected Wildlife	Phylogenetically distinct fauna species based on expert nomination	Aquatic, Wetlands	CFEV	Nietta Creek Jean Brook
Ceyx azureus diemenensis	Tasmanian azure kingfisher	Endangered	Endangered	Not Listed	-	Riparian	PMT (modelled)	Nietta Creek Jean Brook
Haliaeetus leucogaster	White-bellied sea-eagle	Vulnerable	Migratory	-	-	Riparian/ riverine	NVA, PMT (modelled)	Nietta Creek Jean Brook
Prototroctes maraena	Australian grayling	Vulnerable	Vulnerable	Not Listed	-	Riverine (Diadromous)	PMT (modelled)	Nietta Creek Jean Brook
Galaxiella pusilla	Eastern dwarf galaxias	Vulnerable	Vulnerable	Not Listed	-	Aquatic	PMT (modelled)	Nietta Creek Jean Brook
Astacopsis gouldi	Giant freshwater crayfish	Vulnerable	Vulnerable	-	-	Aquatic	NVA, PMT, Davies *et al.* 2007	Nietta Creek Jean Brook
Beddomeia fallax	Hydrobiid snail (Heathcote Creek)	Rare	-	-	-	Aquatic	NVA, Dr. Karen Richards (DPIPWE)	Nietta Creek
Beddomeia hallae	Hydrobiid snail (Buttons Rivulet)	Endangered	-	-	-	Aquatic	NVA	Nietta Creek
Beddomeia inflata	Hydrobiid snail (Heathcote Creek)	Rare	-	-	-	Aquatic	NVA	Nietta Creek

Species	Common Name or Group	TSP Act	EPBC Act	NC Act	CFEV Non-Legislated Value	Habitat	Source	Offtake
Beddomeia lodderae	Hydrobiid snail (Upper Castra Rivulet)	Vulnerable	-	-	-	Aquatic	NVA	Nietta Creek Jean Brook
Beddomeia wilmotensis	Hydrobiid snail (Wilmot River)	Rare	-	-	-	Aquatic	NVA	Nietta Creek
Oxyethira mienica	Invertebrate - caddis fly (Ouse River)	Rare	Not Listed	Not Listed	-	Aquatic	Dr. Karen Richards (DPIPWE)	Nietta Creek
Barbarea australis	Riverbed Wintercress	Endangered	Critically Endangered	Not Listed	-	Riparian/riverine	PMT (modelled)	Nietta Creek Jean Brook

4.1.3.3 Fish

The PMT predicts that suitable habitat for the Australian grayling (*Prototroctes maraena*) occurs within a 5 km radius of the proposed Nietta Creek and Jean Brook offtakes. This species is diadromous as it migrates from coastal seas and estuaries into freshwater environments as adults (Backhouse et al. 2008). The closest observation of this species to the Nietta Creek catchment from the NVA database is approximately 11 km downstream at Spellman's Bridge over the Wilmot River (approximately 1 km outside the 5 km search radius). Given the absence of large dams on the Forth River, Wilmot River and Castra Rivulet (i.e. from the estuary to the study reach), it is possible that this species may migrate up to the study reach given that flows are perennial. However, it is unknown whether there are any natural fish barriers upstream of the Spellman's Bridge observation. The closest observation of this species to the Jean Brook catchment from the NVA database is approximately 30 km downstream in the Leven River near the township of Leven (south of Gunn's Plains). Similarly, the absence of large dams on the Leven River may allow this species to migrate up to Jean Brook; however, it is unknown whether there are any natural fish barriers upstream from the Leven River observation.

The CFEV database suggests that the fish community in the Nietta Creek study reach is depauperate and only predicts the short-finned eel (*Anguilla australis*) and climbing galaxias (*Galaxias brevipinnis*) to occur in the lower sections from Castra Falls down to the confluence with Castra Rivulet, whilst exotic fish are likely to be absent. The electrofishing survey demonstrated that exotic brown trout (*Salmo trutta*) were present in Nietta Creek upstream (n=3) and downstream (n=2) of Gaunts Road in low numbers and within a single cohort (size ranging from 90-100 mm in the upstream location and 130-140 mm in the downstream location). Nine river blackfish (*Gadopsis marmoratus)* were caught in Nietta Creek in the reach downstream of Gaunts Road and ranged in length from 70 – 230 mm.

Similarly, Jean Brook is predicted to be depauperate by the CFEV database with only short-finned eel and climbing galaxias predicted in the most downstream reach at the confluence with Leven River. The electro-fishing survey demonstrated that brown trout were present in high number and from a number of cohorts including twenty-three adults ranging from 160-220 mm and sixteen juveniles. No suitable habitat was observed during the Stage 1 survey for the eastern dwarf galaxias (*Galaxiella pusilla*).

4.1.3.4 Freshwater crayfish

Habitat suitability mapping conducted by Davies et al. (2007) for the giant freshwater Crayfish (*Astacopsis gouldi*) shows that suitable habitat is likely to occur Nietta Creek and Jean Brook; however, habitat suitability is highest in the lower reaches and lower in the upper reaches due to a rise in elevation. Despite this, the NVA database shows a record of this species within the Castra Rivulet catchment above the confluence with Nietta Creek. Karen Richards (DPIPWE, Senior Zoologist, 2012, pers comms) confirmed the observation as occurring in a farm dam.

Two giant freshwater crayfish were caught (carapace length ~ 56 mm) and another two smaller individuals were observed during the electro-fishing survey in Jean Brook at the proposed offtake location (Figure 4.1). Another individual was also detected when lifting rocks for the aquatic snail survey. No *A. gouldi* were observed or caught in Nietta Creek.