Nabiac Emergency Temporary Desalination

Review of Environmental Factors

MidCoast Council

DECEMBER 2019

ABN 16 602 201 552

Executive Summary

Prolonged drought conditions have led to a high risk of depleted water supply. MidCoast Council have evaluated options and propose to implement temporary desalination of water from the Wallamba River to augment supplies. A site was selected based on a multicriteria which evaluated technical, environmental, social and economic factors. Time for completion is a critical consideration and constraint for this emergency project.

MidCoast Council have commissioned this Review of Environmental Factors to assess impacts, identify mitigations and self-determine under the State Environmental Planning Policy (Infrastructure). Consultation was undertaken with government regulators, none of whom raised an objection.

The infrastructure will generally comprise of pumps, pipelines, tanks, hire of portable desalination units and associated electrical infrastructure. Construction is expected to occur over 2-3 months from January 2020. Operation will occur for a minimum of three months, subject to drought conditions.

Environmental impacts in construction and operation were considered based on review of desktop data and physical site investigations. Ecological and water quality modelling investigations were undertaken which did not identify major environmental impacts that could not be mitigated or were not justified by the proposal.

Specific mitigation measures for construction and operation are identified.

Report Details

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Document History and Status

Revision	Report Status	Prepared by	Reviewed by	Approved by	Issue Date
A	Draft	James McMahon	Josh Plummer	[Draft only]	12 Dec 19
B	Review	James McMahon	Josh Plummer Rob Scott		13 Dec 19
C	Review	James McMahon	Josh Plummer MCC Natural Systems		14 Dec 19
D	Review	James McMahon	Josh Plummer		18 Dec 19
E	With terrestrial ecological report appended	James McMahon (Ecologist report AEP)	Josh Plummer	Graeme Watkins	20 Dec 19

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1 Introduction

1.1 General Background

Following a prolonged drought, record low inflows to the Manning River and a period of severe bushfires, supplies of water within the Manning Scheme have been substantially depleted. Level 4 water restrictions have now been introduced. Without additional rainfall in the upper catchments of the Manning River, storage in Bootawa dam will soon be depleted entirely.

MidCoast Council (MCC) (the Proponent) are therefore seeking to urgently procure a temporary augmentation to the regional water supply through the construction and commissioning of a temporary desalination plant to yield additional water of a minimum of 3ML/day and possibly up to 8ML/day.

It is proposed to harvest bulk water from the Wallamba River for desalination in the Nabiac bore field adjacent to the existing Nabiac treatment plant. Discharge from reverse osmosis process would be released back to the Wallamba river at a location just downstream of Gowack Island.

1.2 Proposal identification

MCC have commissioned this Review of Environmental Factors (REF) to self-determine (as the Proponent) planning consent under the State Environmental Planning Policy (Infrastructure) 2007.

This REF was prepared by James McMahon, Director/Principal, JME Environments on behalf of Mid Coast Council, the proponent and refers to and relies on ecological assessments undertaken by Andersons (appended to this report).

2 Proposal need and justification

2.1 Objectives of proposal

MidCoast Council has identified that there is a shortfall between the current reticulated water and water storage levels. Without additional rainfall in the upper catchments of the Manning River the storage at Bootawa Dam may be exhausted in the short term. When this happens the reticulated water system would run entirely from the Nabiac bore field groundwater system.

The Nabiac bore field groundwater system currently supplies approximately 5ML/day to the reticulated system, although this is being upgraded. The current usage rate is approximately 20ML/day. The objective of the proposal is to **temporarily** supplement the Nabiac bore fields supply with up to 8ML/day of potable water generated be a desalination plant. This would initially be procured with a plant to yield 3ML/day and then increased incrementally thereafter depending on ongoing drought conditions.

Desalination plants are a proven technology that has been used worldwide for the production of potable water from a saline water source.

2.2 Existing water/wastewater infrastructure

The project location was selected to utilise the existing Mid Coast Council's water treatment plant and reticulated water work. The project site is also located within the tidal region of the Wallamba River which a reliable source of saline water. The Wallamba River will also be used to discharge the elevated saline reverse osmosis reject (RO reject), subject to approvals for the relevant authorities and mitigation of potential environmental impacts.

2.3 Options considered

The proponent has considered the following other options to supplement the potable water supply:

- Option 1: Additional capacity from the Nabiac Borefield;
- Opition2: Further additional capacity of Nabiac Borefield;
- Option 3: Access to 1000ML of stored water at Strafford Mine and discharged into the Manning River Catchment for collection and processing at Bootawa WTP;
- Option 4: Water Cart supply from outside of catchment area via road or rail;
- Implementation of multiple options.

A do-nothing approach was not considered as the supply of potable water is not expected to meet the demand in the near future.

Council are currently in the process of investigating and/or implementing Options 1-3, but current investigations and estimates are indicating that they will not yield sufficient water in the short-term to meet total demand.

Option 4 is not considered as sustainable in the short or long term and would only be implemented under emergency conditions.

2.4 Preferred Option Justification

Desalination plants can be sourced and commissioned in a relatively short period of time. Desalination plants are a proven technology that has been used worldwide for the production of potable water from a saline water source. The project is situated in the tidal zone of the Wallamba River and therefore the saline water source will not be depleted. Further information regarding site selection and RO reject disposal options can be found in Section 7.

3 Description of the proposal

3.1 Scope of works

The scope of works broadly entail:

- the construction of intake pipes and pumps on the banks of the Wallamba River.
- Installation of Raw Water pipeline to the site of the desalination plant;
- Installation of a containerised desalination plant;
- Construction of the RO reject pipeline and discharge point;

3.2 Construction activities

The key construction activities are listed below:

3.2.1 Establish a Construction Site

Prepare management plans.

Establish a secure compound and take delivery of materials.

Construct access roads and temporarily relocate fences as required to construct the works.

Clear grub treatment plant site to situate infrastructure adjacent to Nabiac WTP

Cranage and placement of tanks and desalination equipment in positions shown on the site arrangement.

3.2.2 Intake Water

Excavate a platform in the bank, stabilise and place aggregate to prevent dust / erosion and support 2 off suction mains.

Place 2 off pumps for harvesting of raw water onto the excavated platform.

Assemble 2 off DN400 pipework inlets and intake screens to enable suction of raw water.

Connection of manifold, valves, non-return valves and fittings on downstream side of pumps

3.2.3 Raw water intake pipeline

Trench, lay, backfill and compact 750m of DN400 HDPE pipe from Wallamba river to Nabiac WTP site.

3.2.4 Raw water infrastructure at treatment plant site

Install basket strainer in raw water intake line in close proximity to the raw water tanks.

Construct upturn and connection to first raw water tank complete with valves.

Construct connections to second and third raw water tanks complete with valves.

Construct manifold downstream of second and third raw water tanks complete with valves and connect to Pre-treatment (Micro filtration).

3.2.5 Waste Streams

Connect pipework from Pre-treatment (Micro filtration) to inground backwash tank.

Install pump in Backwash tank and make pipework connections. (Electrical by others).

Connect pump to Concentrate (RO Reject) tank. Connect pipework from SWRO to Concentrate (RO Reject) tanks.

Install RO Reject pumps. Install drain / sewer line from SWRO to existing sewer collection point and pump station at Nabiac WTP.

3.2.6 Product stream

Connect pipework from MF units supplied by others to MR Filtrate Tank.

Connect pipework from MF tank to SWRO units (supplied by others).

Connect pipework from Permeate (Product Water) tank including pumps and flowmeter (supplied by others) to connection point within Nabiac WTP upstream of the chlorination point.

Ensure supply line and pump from Permeate (Product Water) tank including pump back to a termination point on SWRO (this is for backwashing).

3.2.7 RO Reject Pipeline and Discharge

Trench, lay, backfill and compact 6550m of DN400 HDPE pipe from the Nabiac WTP site to discharge location at Wallamba River

Supply and construct scour arrangements as directed by the Principal (contingent item)

Supply and construct air-valve arrangements as directed by the Principal (contingent item).

Construct crossing of stormwater drainage line near bridge abutment at corner of Elliot's road near Wallamba River.

Assemble discharge tee and lay on bank of Wallamba river just below low water mark and connect with end of RO Reject pipeline to enable discharge of RO reject to Wallamba river.

Fill and test pipeline.

3.3 Operational requirements

The intended operation of the desalination plant is temporary. Subject to the drought continuance, it is foreseeable that operation will continue for 3-6 months.

Once commissioned, the plant will operate to produce potable water via existing network supplies.

Bulk water would continue to be drawn from Wallamba River and waste streams would be discharged via a discharge pipeline to south of Gowack Island.

Desalination will be powered from fuel powered diesel generators and/or equipment or existing power supply.

3.4 Timing and staging

3.4.1 Construction timing

Construction is expected to commence from January to March 2020. Hours of work would be from 7am-9pm, seven days per week. This is required to accelerate delivery of the infrastructure required to meet drought conditions.

3.4.2 Operation

The works would be operated continuously for 24hrs per day.

3.5 Ancillary facilities and access

Site compounds would be located nearby the treatment plant site. Some ancillary compounds and storage areas may be located along the treatment plant route.

4 Statutory framework

This REF considers the requirements of Clause 228 of the Environmental Planning and Assessment Regulation, 2000 and Sections 5A and 111 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

4.1 Environmental Planning Instruments

4.1.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 allows developments for water treatment facilities to be undertaken with consent as per Clause 126A "development permitted with consent". This clause states that:

126A Development permitted with consent

1. *Development for the purpose of water reticulation systems may be carried out by any person with consent on any land.*
2. *Development for the purpose of water treatment facilities may be carried out by any person with consent on land in a prescribed zone.*
3. *Nothing in this clause requires a public authority to obtain consent for development that is permitted without consent by clause 125.*

Prescribed zone means any of the following land use zones or a land use zone that is equivalent to

any of those zones—

(a) RU2 Rural Landscape,

(b) RU4 Primary Production Small Lots,

(c) RU6 Transition,

(d) B4 Mixed Use,

(e) SP1 Special Activities,

(f) SP2 Infrastructure.

Water treatment facility is defined in Standard Instrument (Local Environmental Plans) Order 2006.

A water treatment facility means a building or place used for the treatment of water (such as a desalination plant or a recycled or reclaimed water plant) whether the water produced is potable or not, and includes residuals treatment, storage and disposal facilities, but does not include a water recycling facility.

This project involves the development of a water treatment facility (desalination plant). The Water sanitation and reticulation components have already been authorised, as well as other water storage components of the project. MidCoast Council is a public authority and the land is zoned either SP2 Infrastructure or RU2 Rural Landscape.

As such, the proposed desalination plant is permitted with consent on the land.

4.1.2 State Environmental Planning Policy (Coastal Management) 2018

The Coastal Management SEPP gives effect to the objectives of the Coastal Management Act 2016 from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

Parts of the site lie within a Coastal Environment Area as shown in Figure 1.

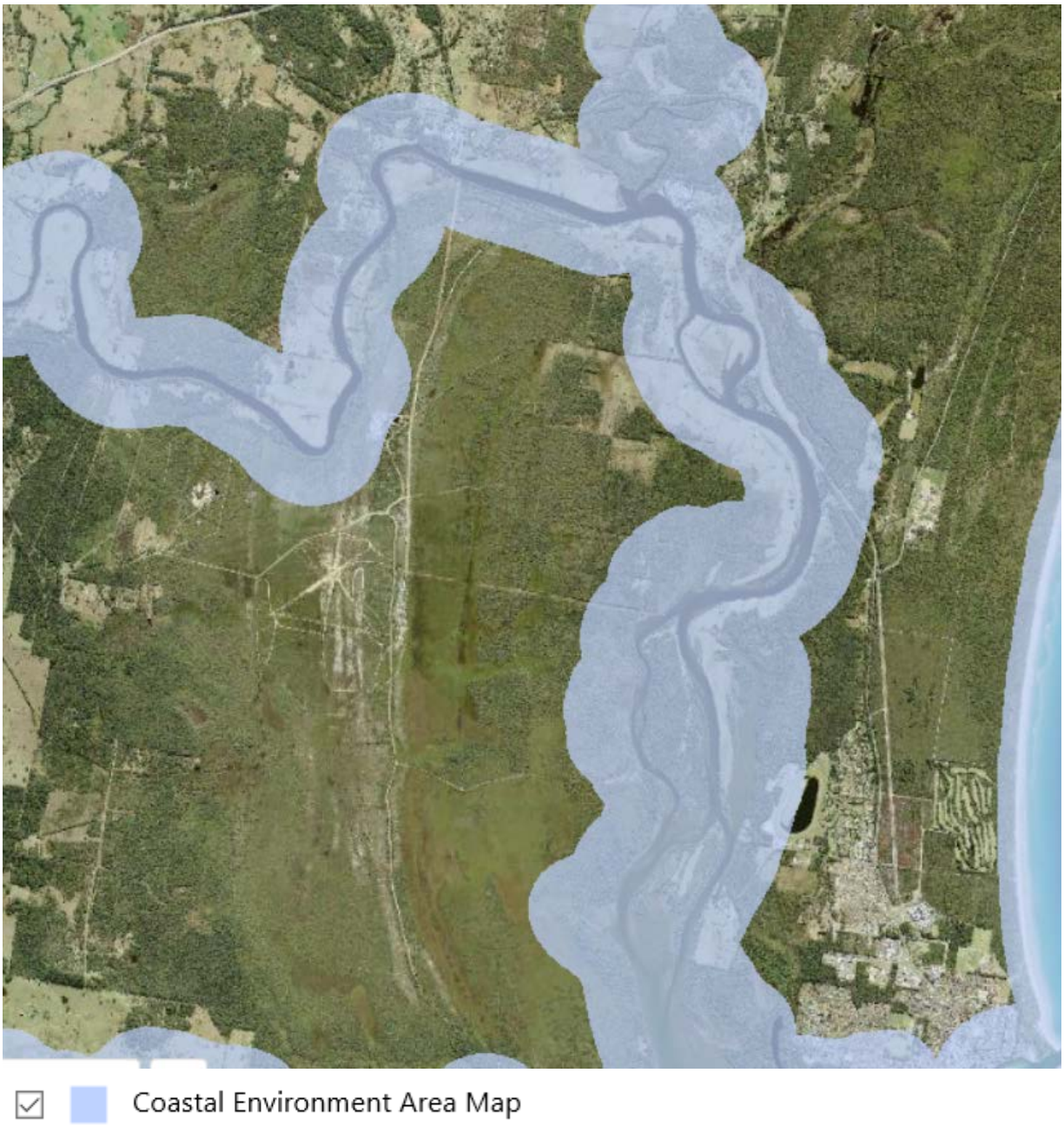


Figure 4.1.2: Coastal Environment Area

Part 2, Division 3 Coastal Environment Area, Clause 13 states

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,

b) coastal environmental values and natural coastal processes,

c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,

d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,

e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,

f) Aboriginal cultural heritage, practices and places,

g) the use of the surf zone.

(2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or

b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

The proposed desalination plant is being assessed by Council through the development application process. This REF considers the matters listed in subclause (1) and describes the management and/or mitigation measures required in subclause (2).

4.2 Commonwealth and NSW legislation

4.2.1 Environment Protection and Biodiversity Conservation Act 1999

This issue was examined by Andersons Environment and Planning Pty Ltd (AEP) who has determined that the works for the water treatment plant will not significantly impact species or ecological communities listed under the EPBC Act. The assessment determines that referral under the EPBC Act was not necessary for the proposed water treatment plant.

4.2.2 Water Act 1912/Water Management Act 2000

The proposed location of extraction of surface water from the Wallamba River is not covered by the Water Sharing Plan for the North Coast Unregulated and Alluvial Water Sources 2009. Refer to clause 4 sub-clause 4(d) of the water sharing plan at the following link.

https://www.legislation.nsw.gov.au/#/view/regulation/2009/348/part1/sec4

The Water Act 1912 does not have the provision to license the take of water downstream of the tidal limit.

Consequently, there are no licensing requirements from the Natural Resources Access Regulator for the proposed activity.

4.2.3 Protection of the Environment Operations Act 1997

The Proposal as outlined is not a Scheduled Activity for the purposes of Schedule 1 of the Protection of the Environment Operations Act 1997 (the POEO Act). As such, MCC is not required to hold an environment protection license (EPL) for the Proposal.

However, the discharge of the RO reject into the Wallamba River is potentially in breach of section 120 of the POEO Act. Hence an EPL is required for the RO reject discharge.

The proponent must comply with the requirements of the POEO Act including, but not limited to, the following sections:

- Section 115 and 116 (regarding disposal of waste and leaks, spillages and other escapes)
- Section 120 (regarding pollution of waters)
- Section 124 and 126 (regarding operations that result in air pollution)

- Section 139 (regarding noise pollution)
- Section 142A (regarding pollution of land) and
- Section 167 (regarding the appropriate maintenance and operation of plant and equipment).

4.2.4 Fisheries Management Act 1994

The Proposal requires some excavation of the riverbank. Division 3, Section 200- 'Circumstances in which a local government authority may carry out dredging or reclamation' of the Fisheries Management Act 1994, requires that local government authority must not carry out dredging work or reclamation work except under the authority of a permit issued by the Minister.

5 Stakeholder and community consultation

5.1 Government agency and other stakeholder consultation

Table 1

Clause 16 of SEPP (Infrastructure) 2007, provides for consultation with other agencies as follows.

Public authority	**Requirement for notification**
Office of Environment and Heritage	Not required – land is not adjacent to land reserved under the National Parks and wildlife Act 1974.
Marine Parks Authority	Not required – the development is not adjacent to a marine park declared under the Marine Parks Act 1997.
Department of Primary Industries	The project requires a permit under section 200 of the Fisheries Management Act 1994. A copy of correspondence with the NSW Department of Primary Industries/Fisheries can be found in Appendix A.
Transport for NSW (TfNSW)	Required - the development does comprise a fixed or floating structure in or over navigable waters. A copy of correspondence with the TfNSW can be found in Appendix A.
NSW Rural Fire Service	Not required – while the land is identified as bushfire prone land, the activity does not involve uses for which consultation with the RFS is required (health services facility, correctional centre, group home or residential purposes).

5.2 Consultation with the NSW EPA

The NSW EPA was consulted for the purpose of obtaining and environmental protection license for the discharge of RO reject into the Wallamba River. The NSW EPA informed the proponent that the EPA is the appropriate regulatory authority (ARA) for compliance with environmental legislation irrespective of licensing requirements.

The EPA requested that the following be considered when preparing the REF. The relevant sections where the EPAs concerned are addressed are in parentheses. A copy of the correspondence with the EPA can be found in Appendix A.

Water Management -

i. demonstrate that all reasonable alternatives to polluting waters have been considered (e.g. onsite storage, drying and offsite disposal to landfill, or discharge to sewer) and that there are no other alternatives but to discharge. (See Section 7.2)

ii. justify selection of the proposed desalination plant site rather than the other sites considered (e.g. alternative sites along the Manning River and near Foster STP were also identified), including consideration of the relative water quality risks to each of the potential receiving waterways. (See Section 7.1)

iii. specify the location of the proposed brine discharge point, justifying why the location was selected over other potential discharge points, including discussion of the waterway characteristics at each

point (e.g. depth, salinity, hydrodynamics, sensitive receptors) and consideration of the relative water quality risks. (See Section 7.1, Section 6.5, Appendix B and Appendix C).

iv. estimate the discharge flow rate and characterises the quality of the proposed brine discharge in terms of the concentrations of all pollutants present at non-trivial levels, including salinity and any treatment chemicals such as antiscalents and biocides. (see Appendix B)

v. characterise the background water quality at the proposed brine discharge location (where practical salinity should be determined based on measurements representative of the full tidal cycle). Existing data could potentially be used to characterise background water quality. (See Appendix B)

vi. provide details of measures to minimise and mitigate potential impacts on the receiving waterway, such as optimising the location, depth and mode (e.g. diffuser) and timing of discharge to maximise dilution, mixing and dispersion. (See Appendix B and Section 6.5)

vii. assess the residual impact of the discharge on the environmental values of the receiving waterway with reference to relevant guideline values or other relevant benchmarks. This assessment should consider a range of conditions including typical and worst-case scenarios. (See Appendix B)

viii. propose an operation stage monitoring program, specifying monitoring locations, frequency and analytes and identifying water quality management triggers and responses (See Section 6.10)

ix. provide details of procedures to prevent and respond to potential spills. (See Section 6.10)

x. confirm that operation and refuelling of generators and storage of fuels and other chemicals will occur within bunded areas. (See Section 6.10)

xi. identify potential impacts to surface and groundwater during both the construction and operational stages and (See Section 6.10 and Section 6.3)

xii. identify appropriate pollution control systems/measures to protect surface and groundwater resources, particularly erosion and sediment controls during the construction stage and the rehabilitation stage. (see Section 6.3)

Noise and Vibration - identify potential noise and vibration emissions during both the construction and operational stages and identify mitigation strategies to be incorporated for both stages to minimise noise and vibration impacts where required;

Air Quality and Odour - identify potential air and odour emissions (point source emissions from plant and equipment and/or fugitive dust emissions) during both the construction and operational stages and identify mitigation strategies to minimise point and/or fugitive and/or odour impacts;

Land Management - identify if the soils in the area of the Proposal are contaminated or are acid forming (i.e. acid sulphate soils) and if so, identify any mitigation strategies or remedial and/or disposal actions that will be required/undertaken;

Waste Management - identify options and strategies for waste avoidance, minimisation; reuse and recycling across all activities and appropriate disposal options

General Flooding Impacts - any developments should be designed and undertaken in accordance with the State Government's Flood Policy as outlined in the Floodplain Development Manual. (the desalination plant including diesel and chemical storage are above the 1 in 100 years ARI level. The intake and discharge pipeline will be buried).

This REF addresses each of these matters in section 6.

5.3 Consultation with Department of Primary Industries/Fisheries

The Department of Primary Industries/Fisheries (Fisheries) raised the following concerns

1. dredge and reclamation if the discharge point or inlet require any excavation of the river or banks.
2. assessment of entrainment of larval fish.
3. potential requirement for a permit to harm marine vegetation at discharge point
4. potential impact on Oyster industry from increased salinity downstream of discharge point.

Following a meeting with Fisheries it was agreed that Fisheries would review the relevant sections of the REF. A Permit under section 200 of the Fisheries Management Act 1994 would be issued for the works if the REF is deemed appropriate by Fisheries.

5.4 Consultation with Roads and Maritime Services

Transport for NSW (TfNSW) Maritime was consulted with respect to ensure that any disruption to navigation for vessels is minimised as much as is practical.

The project documentation provided has been assessed as having minimal impact on the safety of navigation to vessels operating in this area and TfNSW Maritime has no objections to the proposed works.

TfNSW Maritime advised the following:

1. Any works impacting on navigation during the construction phase must seek TfNSW Maritime support and a full scope of works including dates is to be provided to navigationadvicenorth@rms.nsw.gov.au. So that a Marine Notice can be prepared and published on the Maritime website.

2. All associated work boats to comply with the relevant NSW Marine Legislation for survey, registration and safety equipment, and comply with the Marine Safety (Domestic Commercial Vessels) National Law Act 2012.

3. Vessels must exhibit lights and shapes in accordance with International Regulations for Preventing Collisions at Sea.

4. TfNSW Maritime will arrange for the installation of aids to navigation to mark any hazards associated with the pickup and discharge points during and following construction if required. TfNSW Maritime recommends liaising with the local Boating Safety Officer to provide assistance with the assessment and placement of objects.

5.5 Consultation with NSW Office of Water

The NSW Office of Water advised that “The Water Act 1912 does not have the provision to license the take of water downstream of the tidal limit. Consequently, there are no licensing requirements from the Natural Resources Access Regulator for the proposed activity.”

5.6 Community consultation

5.6.1 Consultation with land owners

Part of the pipeline infrastructure will be located on land owned by the Forster Local Aboriginal Land Council (LALC). MidCoast Council have consulted with this LALC and they are agreeable to the provision of a construction lease.

5.6.2 Consultation with Wallis Lake Fisherman’s Co-Op

Wallis Lake Fisherman Co-Op advised that commercial fishing is undertaken in the Wallamba Raver up to the Nabiac Bridge.

5.6.3 Consultation with nearby residents

MidCoast Council will provide letters to landowners within 500m of construction areas (primarily along Elliot’s Road) or other stakeholders who may be affected to inform of construction impacts, durations and mitigations.

6 Environmental assessment

6.1 Introduction

This section describes the potential construction and operational impacts of the proposal and provides mitigation measures to manage identified impacts.

6.2 Assessment Methodology

For each environmental aspect the following is described:

- Existing environment: describe the nature of the aspect at the time of REF preparation. Where appropriate details from specialist reports describing the nature of the environment should be included (e.g. vegetation types and condition).
- Impact assessment: assess the environmental impacts of the proposed works during construction and operation phases.
- Mitigation measures: specify controls to be implemented during the construction and operation of the proposal. Controls should be relevant to the impacts identified. If an impact is not identified, control measures will not be included.

6.3 Soils and geology

6.3.1 Existing Environment

The landform is comprised of Quaternary barrier sands and beach ridges. The sand plains over this area have been previously disturbed through mining and the landform can generally be described as flat, with undulations caused by the movement of sands within the landscape.

The site is situated in an area of low to high probability of the occurrence of acid sulphate soils as shown in Figure 6.3.2. The risk categories shown in Figure 6.3.2 are: L4 Low probability, >3 m below ground surface; L2: Low probability, 1 - 3 m below ground surface; H1: High probability <1 m below ground surface; H2: High probability 1 - 3 m below ground surface and Hm: High probability, bottom sediments.

6.3.2 Impact Assessment

6.3.2.1 Construction impacts

The proposed works will involve ground disturbance including trenching of soils, riverbanks and some minimal river sediments, ground stripping, grading, excavation and vehicle movements around the site. This has a risk of sediment being washed away in stormwater that may leave the site. There are potential risks of soil erosion and sedimentation impacts.

The RO reject pipeline is approximately 400mm in diameter and is proposed to be placed underground with a minimum of 600mm cover. The L4, H1, H2 and Hm areas where the proposed pipeline route passes through are required to be assessed in accordance with the New South Wales Acid Sulfate Soil Management Advisory Committee's Acid Sulfate Soil Manual 1998 prior to the start of pipeline trenching works.

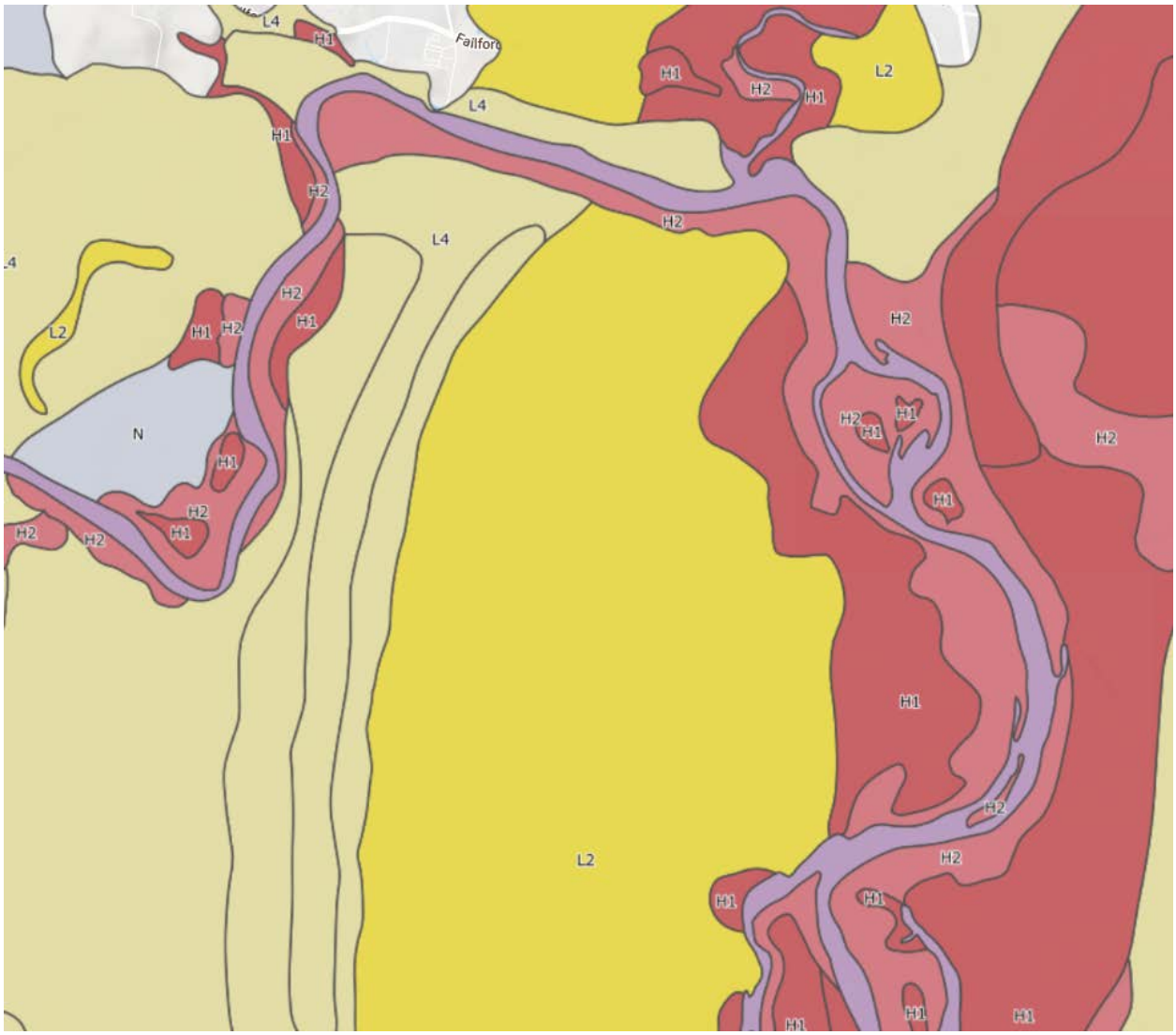


Figure 6.3.2 Acid Sulfate Soil Risk Map

6.3.2.2 Operational Impacts

There are no ongoing impacts on the site soil from the operation of the desalination plant.

6.3.3 Mitigation Measures

An Erosion and Sedimentation Control Plan would be prepared and implemented and would incorporate appropriate erosion and sediment control measures e.g. socks around inlets, silt fences etc, in accordance with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book). Where over 2,500m2 of soil is being disturbed as a result of the works, a Soil and Water Management Plan would be implemented.

Erosion and sedimentation control measures will be maintained regularly and after rainfall events in accordance with the Blue Book.

Erosion and sedimentation control measures will not be removed until disturbed areas have stabilized.

Disturbed areas will be stabilised during construction works where necessary and revegetation of previously vegetated areas will be undertaken after works are complete, in line with the Blue Book.

Any excess spoil following construction will be seeded to minimise the likelihood of it being transported offsite through wind or water action. Alternatively, it will be removed off site for disposal in accordance with the EPA Waste Classification Guidelines or a Site Specific Resource Recovery Order and Exemption.

If acid sulfate soils are detected above the limits requiring management, then an acid sulfate soil plan (ASSMP) will pe prepared. ASSMP will include:

- Construction of an acid sulfate soil treatment area (ASTA);
- Liming rates established by laboratory analysis;
- Covering of acid sulfate stockpiles;
- Measures to capture stormwater run off collected in the ASTA.

6.4 Hydrology

6.4.1 Existing Environment

The site overly a shallow unconfined aquifer at a depth of between 2 and 3 metres and a deeper semi-confined aquifer between 15 and 20 metres below the surface. The lower aquifer is the aquifer from which water is extracted for treatment and delivery to the water supply scheme.

6.4.2 Impact Assessment

6.4.2.1 Construction Impacts

The proposed works will involve the disturbance of potential acid sulfate soils. Oxidation of the acid sulfate soils may result in the acidification of the shallow aquifer which may lead to release of mineralised (bound) heavy metals (such as iron and aluminum) into the shallow aquifer causing impact of the water quality.

6.4.2.2 Operational Impacts

Incidental spills of desalination chemicals and diesel fuel have the potential to infiltrate into the shallow aquifer causing localized impacts of the shallow aquifer.

6.4.3 Mitigation Measures

Mitigation measures are included in Section 6.10

6.5 Marine Ecology

6.5.1 Existing Environment

The proposal involves the uptake of up to 20ML/day from the tidal reaches of the Wallamba River. The desalination process will result in a discharge approximately 13ML/day of elevated salinity water into the tidal reaches of the Wallamba River. The locations of the uptake and discharges are not aquatic habitat for sea grasses or endangered species. The uptake and discharge areas are commercial fishing grounds.

6.5.2 Impact Assessment

6.5.2.1 Construction Impacts

Erosion and sedimentation impacts from construction activities are discussed in Section 6.3.

6.5.2.2 Operational Impacts

The uptake of water has the potential to entrain larval fish and the discharge of elevated saline water has the potential to impact on the marine ecology, there by impacting on the local commercial fisheries including the downstream oyster farms.

Preliminary modelling of the dispersion of the RO reject water into the Wallamba river was undertaken by BMT. The preliminary model was conservative as it assumed that the river was in a nonflow state and the dispersive actions of natural flows and tidal influences were not included and as such were considered a worst-case scenario. Based on the intake and discharge ratio BMT assumed the salinity of the discharge

would be approximately 1.6 times that of the intake water. The salinity of the Wallamba River at the discharge was recently measured to range between 34.95-36.05 g/kg. The BMT dispersion model indicated that the salinity would be around 49.08g/kg-52.47g/kg at the discharge point and 1.1 g/kg higher than the background concentration within 12.7m-14.3m of the discharge point. Given the conservative nature of the model, the dispersion rate is predicted to be faster with tidal influences. Therefore, the impact of the saline discharge on the marine ecology is not considered significant and no further mitigation was considered.

Anderson Environment and Planning Pty Ltd (AEP) undertook and Aquatic Ecological Assessment Report (AEAR).

The assessment has resulted in the following key findings:

- Aquatic (and terrestrial) impacts at the WIP are not significant on any threatened flora or fauna;
- Aquatic (and terrestrial) impacts at the WDP are not significant on any threatened flora or fauna.
- Minor immature Mangrove removal will occur at the WDP, and as such a permit to harm marine vegetation will be required from NSW Fisheries. It is considered highly likely that Mangroves will recolonise the immediate area post construction.
- Water intake at the WIP will be limited to 0.1m² / second, and therefore combined with appropriate screening and intake pipe design, larvae entrainment is not expected to be a notable issue.
- With saline plume modelling showing that the notable effect zone of increased saline plume from discharge point is <14m, changes to the local saline ecological environment are unlikely to be discernible.
- Pipeline maintenance including the use of descaling agents will follow industry best practice and thus should not invoke any notable impacts.
- Sensitive downstream receivers including Coastal SEPP Wetlands and commercial Oyster production areas are well beyond any immediate area that may be affected by discharge of increased salinity water.
- Given all of the the above, impacts on other river system user groups is unlikely to be discernible.

The Department of Primary Industry/Fisheries identified that the entrainment of larval fish was a potential impact on the marine ecology.

Appendices B contains a report summarising an assessment for a discharge of 8ML/day and then a supporting statement for a subsequent sensitivity analysis for discharge of up to 13ML/day (which is beyond the maximum foreseeable discharge). This sensitivity analysis identified an expansion of the zone of noticeable influence from 14m to <16m without having any additional impact on flora or fauna.

6.5.3 Mitigation Measures

Salinity and dissolved oxygen will be monitored at times, locations and depths as agreed with the NSW EPA. An Environmental Protection Licence (EPL) will be requested to discharge the RO reject to the Wallamba River. It is anticipated the EPL will include operational limits for salinity and dissolved oxygen.

In order to mitigate the entrainment of larval fish the intake velocity will designed at 0.1m/s.

6.6 Terrestrial Ecology

6.6.1 Existing Environment

Anderson Environment & Planning (AEP) prepared a Terrestrial Ecological Assessment Report (TEAR) to accompany a Review of Environmental Factors (REF) for a proposed emergency desalination plant, located on the Wallamba River, Nabiac NSW.

The TEAR assessed the terrestrial environs covered by:

- The Water Intake Point (WIP), located approximately 20km upstream of the ocean
- entrance;
- The Water Discharge Point (WDP), located approximately 12km upstream of the
- ocean entrance.
- The proposed site of the Desalination Plant located within the existing Water
- Treatment Compound; and

- The proposed pipeline alignment connecting the above points

The assessment was informed by desktop research and field survey of the above development components. Field survey was limited to general floristics work, habitat assessment and incidental fauna observations only, due to the short timeframes available for this emergency project. Large sections of the alignment have also been recently burnt which hinders botanical survey.

The development area and surrounds were found to contain the following general vegetation communities:

- WIP: Eucalyptus racemosa ssp. racemosa / Angophora costata Woodland
- WDP: Casuarina glauca Forest
- Desal Plant: Grassland
- Pipeline alignment – traverses a number of communities including:
    - Eucalyptus racemosa ssp. racemosa / Angophora costata Woodland
    - Casuarina glauca Forest
    - Grassland
    - Eucalyptus robusta / Melaleuca quinquenervia Swamp Forest
    - Eucalyptus grandis Forest
    - Banksia spp Shrubland / Heathland

Of the above communities, two are considered aligned with listed Endangered Ecological

Communities, being:

- Casuarina glauca Forest (Swamp Oak Floodplain Forest – listed under State & Federal legislation). Impact is limited to a thin shoreline strip at the WDP.
- Eucalyptus robusta / Melaleuca quinquenervia Swamp Forest (Swamp Sclerophyll Forest – listed under State legislation). Pipeline alignment in the existing Elliots Road corridor should be able to avoid any direct impact on this community.

The alignment has been sited to follow existing tracks and cleared road easements wherever possible to minimise vegetation loss. Vegetation impacts will occur on non-EEC communities at the WIP and unavoidably along some sections of the pipeline alignment.

No threatened plants were observed along the alignment during fieldwork, though there is potential for such to occur, particularly for seasonal / cryptic species. Some threatened species including Allocasuarina simulans were noted in the general area during fieldwork but were not encountered along the alignment.

Habitat assessment revealed that the alignment and surrounds would offer suitable habitat for a variety of locally occurring threatened fauna species. The only threatened fauna species encountered during the (limited) field survey was Varied Sitella, which was observed foraging in Eucalyptus grandis trees near the bridge.

The terrestrial ecology assessment was undertaken with reference to the Environmental Planning and Assessment Act 1979 (EP&A Act) as well as the NSW Biodiversity Conservation Act 2016 (BC Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Assessment under the Biodiversity Offset Scheme determined no threshold is triggered and the '5-part test' determined that no significant impacts upon threatened entities listed under the NSW BC Act are likely to occur if mitigation measures are implemented. Loss of vegetation / habitat is very limited in spatial extent, and much of the area would be expected to regenerate post construction. Consideration of the EPBC Act revealed that impacts on Matters of National Environmental Significance are unlikely to occur.

Assessment under State Environmental Planning Policy 44 – Koala Habitat Protection revealed that parts of the site do constitute 'Potential Koala Habitat' as defined within the policy. No evidence of Koala activity was found, and any impacts on PKH should be able to be avoided by aligning the pipeline within the Elliots Road corridor through areas supporting Swamp Mahogany. As such, no further provision of the policy would apply to the site.

6.6.2 Impact Assessment

6.6.2.1 Construction Impacts

The proposed construction will result in the removal of approximately 0.4 hectares of vegetation. The impacts as a result of this work will result in the loss of habitat areas for some native species. The AEP

assessment has examined the impact of the proposed works on listed species within both the Threatened Species Conservation Act 1995 and the Environmental Protection and Biodiversity Conservation Act 1999.

The proposed clearing area is only a small proportion of the other available similar habitats in the area and will not result in a large loss of habitat resources for native species in the area. The AEP assessment confirms that, given the small area of disturbance and available habitats in surrounding areas, the impact to Threatened Species is not significant.

6.6.2.2 Operational Impacts

The proposed desalination plant operation is unlikely to generate any additional impacts to terrestrial flora and fauna in the area.

6.6.3 Mitigation Measures

The proposed construction will result in the removal of vegetation.

An ecologist will be present during vegetation clearing to provide guidance and assistance in case of incidental fauna encounters and/or injury, and to salvage potential habitat. Attempts will be made to relocate potential habitat including felled trees and hollow logs into adjacent habitats to provide further habitat resources for native fauna.

The ecologist will undertaken an inspection to confirm that no endangered vegetation will be removed. Such vegetation within close proximity of clearing works will be clearly flagged, and site personnel made aware of their existence, to prevent accidental damage or removal. Vegetation to be removed is to be clearly marked in the field using temporary fencing (flagging tape or similar exclusion tape) so that boundaries are clearly established and to minimise the potential for equipment to accidently enter areas to be retained.

Weed management procedures are to be implemented to prevent the spread of weed species. Ongoing weed monitoring will be implemented and potential weed infestations appropriately managed. A high level of hygiene will be adopted in respect to vehicle and machinery to help prevent soil-borne disease (Phytophthora) and pathogenic fungus (Exotic Rust Fungi) transmission.

Erosion and sediment control measures will be installed, monitored and maintained to prevent erosion and sedimentation impact on adjacent areas. Implement dust control measures where necessary to protect adjacent retained vegetation communities. Stockpiling of materials will occur within already disturbed areas and not within retained vegetation.

6.7 Noise and Vibration

6.7.1 Existing Environment

The subject site is located in a relatively isolated area and is remote from any sensitive areas in relation to noise (dwellings, schools, etc).

There are noise sources in the area which would elevate background noise levels, including the sporting car club and the sand quarry to the north west.

6.7.2 Impact Assessment

6.7.2.1 Construction Impacts

Construction will involve the use of vehicles and machinery and is therefore likely to create noise during the daytime. The impact of the anticipated noise level is dependent on the local traffic volumes and the nature of day-to-day construction. The impact of noise is not expected to be significant given the significant separation distance from residential properties.

6.7.2.2 Operational Impacts

The operation of the desalination plant will rely on diesel generators 24 hours/day. The diesel generators will be placed in acoustic enclosures. Given the substantial separation distances that exist between the diesel generators and the closest residences, operational noise impacts are not expected.

6.8 Air quality and energy

6.8.1 Existing Environment

The subject land is located in an isolated area with little activity. Existing impacts to air quality exist as a result of dust and exhaust generated from traffic on the dirt roads and from activities undertaken within the sporting car club. In addition, the sand quarry operating to the north west of the site may give rise to dust impacts as well as emissions from machinery. The landscape does not have full vegetation coverage to protect topsoils, and dust from exposed sand may be generated during adverse wind conditions, impacting on local air quality.

6.8.2 Impact Assessment

6.8.2.1 Construction Impacts

Construction traffic and activities may intermittently affect local air quality but is unlikely to contribute to permanent reductions in air quality. Airborne dust is also likely to be generated by excavation works and vehicle movements, although these are considered to be minor and unlikely to exceed regional ambient air quality threshold levels. Controls during construction such as Erosion and Sediment Control Plans and site fencing will assist in reducing the incidence of windblown dust from the construction site. Appropriate mitigation measures have been recommended below.

6.8.2.2 Operational Impacts

Once operating, the desalination plant may give rise to air quality impacts in terms of release of greenhouse gases and emissions from the combustion of diesel to generate power. It is anticipated the generators will use approximately 20,000 litres of diesel per week. The National Greenhouse and Energy Reporting Act (the NGER Act) was passed on 29 September 2007, establishing a mandatory reporting system for company greenhouse gas emissions and energy production and consumption. Reporting is required for a facility that emits 25 kilotonnes/year or more of greenhouse gases (CO_2) equivalents. Emissions of CO_2 and other greenhouse gases from the combustion of diesel have been estimated using emission factors contained in Table 4 of the NGA Factors August 2019. The calculated diesel combustion related emissions for operations are:

•CO2 - 590 t CO2-e/year;

•CH4 –0.8 t CO2-e/year; and

•N20 – 4.2 t CO2-e/year

Mandatory NGER is not expected for the operation the desalination plant.

6.8.3 Mitigation Measures

Dust generation during construction activities will be controlled by regular control measures such as on-site watering. Exposed areas will be progressively revegetated as soon as practical.

Diesel generators will be maintained and serviced as per the manufacturers instructions.

6.9 Cultural heritage

6.9.1 Existing Environment

The subject land does not contain any items of European heritage identified in the Local Environmental Plan or State Heritage Register. The land is not located in a heritage conservation area.

An AHIMS Search has been undertaken for the site which has not identified any Aboriginal Sites or Places on the subject land or surrounds. A copy of the search is included in Appendix D

The landscape of the site and surrounding area has been disturbed from past activities and there is little likelihood of disturbance of archaeological materials. An Aboriginal Heritage report was undertaken in 2004 which included walkovers with the Local Aboriginal Land Council. The report considered that it was unlikely

that any material would occur in the area and that trees in the area were not of sufficient age to have been scarred by traditional activities.

6.10 Contamination Impacts

6.10.1 Existing Environment

The subject land and surrounding land are predominantly vacant. A relatively new water treatment plant is located adjacent to the area for the proposed desalination plant. A car club uses a former aerodrome to south to hold race meetings and other events. It is expected that both the car club use and the former aerodrome use would involve the storage and use of fuels and machinery maintenance chemicals.

The website https://nabiac.com/a-historical-perspective/ indicated aerodrome was operated by the RAAF from 1942 until the end of World War II. The aerodrome was disused for some time and was used by commercial airway operators until 1952. Given the length of time since the aerodrome was used and the distance to the subject site, impacts (if any) from the use of hydrocarbons is unlikely to affect the subject site.

6.10.1.1 Construction Impacts

During construction, there may be some storage of fuel and chemicals at the site which are used in construction and other site operations. These are generally in small volumes and do not create significant risk to the surrounding area.

The Construction Environmental Management Plan will include procedures for the handling and storage of fuels and chemicals to ensure that risks to the surrounding area are minimised.

6.10.1.2 Operational Impacts

The operation of the desalination plant requires the use and storage of diesel and smaller volumes other chemicals. Major spills of the diesel or chemicals can significantly impact the water quality of the shallow unconfined aquifer underlying the site and the receiving water of the Wallamba River.

6.10.2 Mitigation Measures

Bulk diesel fuels will be stored in double walled tanks with interstitial leak detection. Refuelling of the diesel tanks from a tanker will be undertaken using a “Dry Break Coupling” or similar to avoid minor spills. Chemicals in 25L drums (or less) will be stored in a weather proof shed with a hardstand floor and on bunded pallets. The capacity of the bunding will be 110% of the maximum capacity of the chemicals stored on it. Spill kits and appropriate PPE will be placed near chemical storage and transfer areas and utilised in the case of minor spills.

In the case of a major spill (>100L of diesel or liquid chemicals), the spill will be contained as quickly as practicable using available spill kits. Particular efforts to stop chemicals entering drainage lines will be prioritised. Impacted soils will be excavated and placed onto hardstand or builder’s plastic as soon as practicable. Impacted soils stockpiles will be covered with builders plastic and have sediment and erosion controls put in place. A suitably qualified and experienced contaminated land will be engaged to assess the extent of soil and groundwater impact, remediation strategies and validation if required and whether notification to the EPA is required.

6.11 Waste Management

6.11.1 Existing Environment

Solid waste generated at the existing water treatment plant, such as office waste and other small quantities of general solid waste are separated into recyclables and general solid waste, and taken to Councils solid waste facility. Liquid waste from the treatment process is collected and piped to the sewerage system via a pump station. Note that the sewerage pipe and pump station is significantly undersized to accept the RO reject. Further, the volume of RO reject water is also not able to be accepted at the sewerage treatment plant under Council’s trade waste process.

6.11.1.1 Construction Impacts

It is likely that some excess building materials would be produced due to the construction work, such as miscellaneous waste associated with packaging and transport of materials and equipment and various other manufactured items forming part of the works. Excavation required for construction may result in excess spoil.

6.11.1.2 Operational Impacts

The operation of the desalination will generate to streams of liquid waste namely the RO reject and the other lesser volume reject. The potential impacts of the RO reject are discussed throughout this REF. The lesser volume reject contains neutralised membrane cleaning chemicals, including citric acid, sodium hydroxide and sodium hypochlorite, which has the potential to impact the local soils and groundwater. These are the same cleaning chemicals used in the current water treatment plant and are general stored in low volumes (20L drums).

6.11.2 Mitigation Measures

Generation of construction building waste will be mitigated by implementation of the HunterH2O procurement plan.

Handling and disposal of excess soils is discussed in Section 6.3.

The lesser volume reject will be disposed of to the existing sewerage system under a trade waste agreement.

6.12 Cumulative Impacts

The water treatment plant will be an isolated development and is not in proximity to other uses which would create any significant cumulative impacts.

7 Alternatives to the Project Proposal

7.1 Site Selection Options

A desktop investigation and multi-criteria assessment was undertaken of alternative sites for implementation of desalination. Five criteria were used, four of which indirectly affect time for delivery and commissioning. The assessment was undertaken qualitatively based on geographical information system data. *Table 2*

Option / site	Minimum infrastructure	Minimum environmental impact	Operational risk	Technical complexity	Cost
Desalination from Wallamba River at Nabiac WTP – disposal of RO Reject near Greeba island	Fair + Desal close to raw water and existing headworks. - long pipeline for discharge	Fair + Disposal close to river mouth - Disposal close to SEPP 14 wetlands	Superior + Brackish water (good source) + Low distribution complexity	Superior + Simple network infrastructure with low distribution complexity	Fair Low cost of infrastructure
Desalination from Wallamba River at Nabiac WTP –disposal of RO Reject at Gowack island **[SELECTED]**	Fair + Desal close to raw water and existing headworks. - long pipeline for discharge required	Superior + Infrastructure * ROF reject disposal clear of environmentally sensitive or populated areas	Superior + Brackish water (good source) + Low distribution complexity	Superior + Simple network infrastructure with low distribution complexity	Fair Low cost of infrastructure
Desalination near ocean or estuary at site near Forster / Tuncurry with outfall in estuary or to ocean **[Note potential for future desalination]**	Superior - need network upgrades to distribute permeate + short discharge	Fair + discharge to ocean minimises impact on waterway - site in relatively public area	Unknown - may need network upgrades to distribute permeate - may have insufficient room	Unknown + simplified discharge - water distribution more complex	Unknown - additional cost due to additional power and network infrastructure
Desalination near ocean or estuary at site near Forster / Tuncurry with RO reject disposed via dunes	Inferior - need network upgrades to distribute permeate - need transport for raw water	Fair + avoids discharge to waterways - in proximity to Darawank nature reserve	Inferior - need network upgrades to distribute permeate	Inferior - need network upgrades to distribute permeate - ocean outfall at beach	Inferior - additional cost due to additional power and network infrastructure

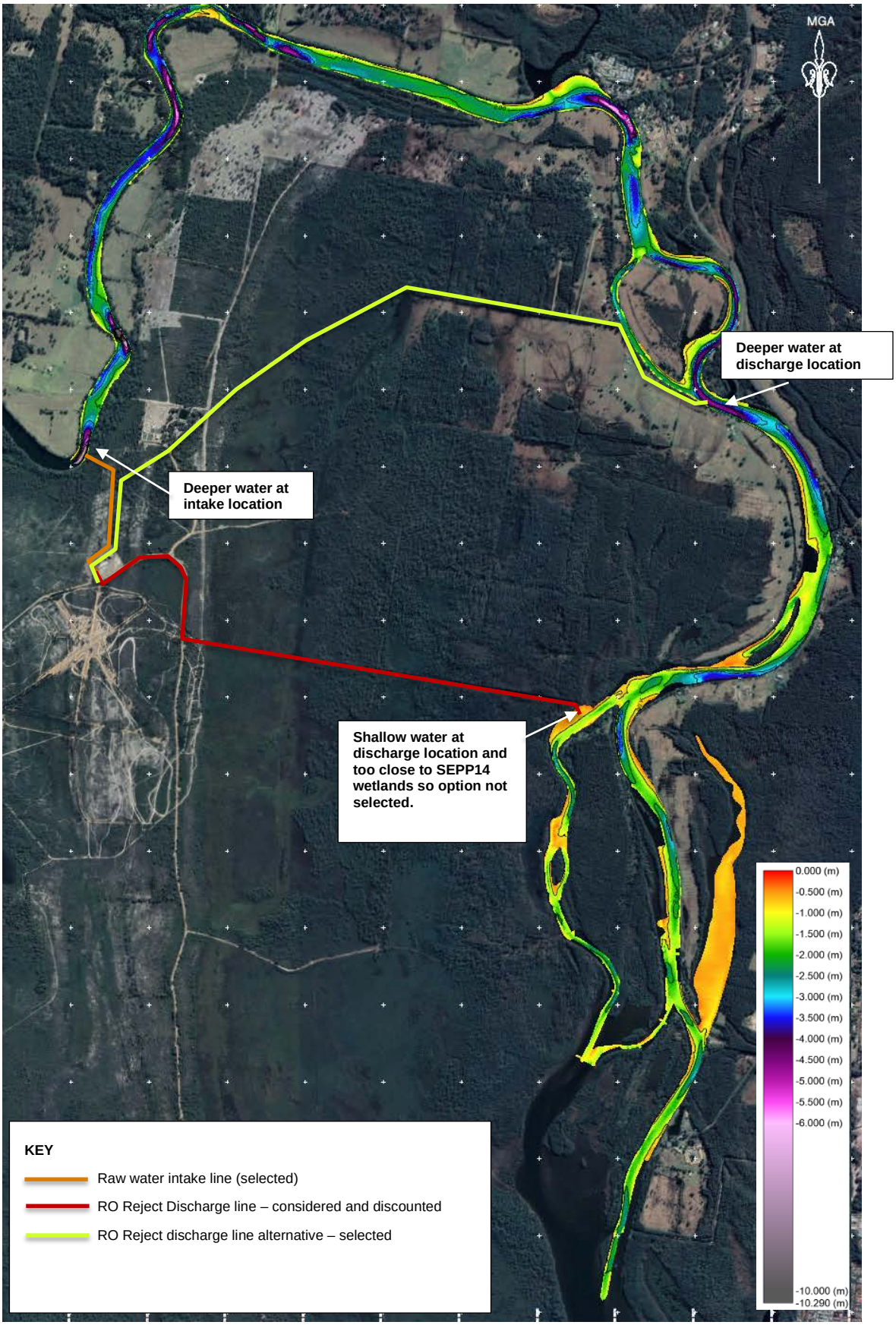
Based on the above assessment and consultation between MCC & HH2O, the option that has the best chance of being viable within the shortest timeframe is desalination from Wallamba River near Nabiac WTP and disposal of RO reject near Gowack island.

The desktop assessment identified that portable desalination units could potentially be situated at a site close to the ocean (near Forster) although this would have limited room for expansion and also has more unknowns in terms of stakeholder impacts and integration with network infrastructure which would create risks of delay to early commissioning. This is noted as a potential site for future works.

To achieve the earliest supply of emergency water, MidCoast Council selected a desalination site next to the existing Nabiac WTP with disposal of RO reject south of Gowack Island as the most pragmatic option with the least overall impact to the community and the environment.

Figure 7.1.2 Overview of desktop investigation of desalination sites

Figure 7.2.2 Bathymetric survey of Wallamba River and alternative sites considered for water harvesting and disposal of RO reject



7.2 RO Reject Disposal Options

The largest and most significant waste stream from the desalination plant is the RO reject. RO reject will comprise saline solution of around 49.08g/kg-52.47g/kg salt concentration with minor concentrations of a polyphosphate antiscalant (~5mg/L). It is anticipated that between 5ML and 13ML/day of RO reject will be produced.

7.2.1 Evaporation and Disposal of Solids to Landfill

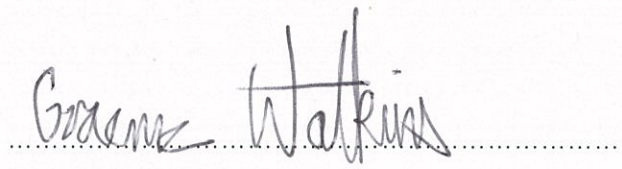
The Bureau of Meteorology website indicates that the average annual pan evaporation rate for the Nabiac region is approximately 1,200 mm/year (or 0.003m/day). The minimum generation of RO reject is 5ML/day (5,000m^3/day). Hence, an evaporation pan of approximately 152 hectares in area would be required. This option was not considered to be practically feasible.

7.2.2 Discharge to Sewer

The existing site sewer main capacity is significantly below the required discharge capacity. A new sewer main to the nearest Sewage treatment plant (8.8km to the north east) was considered to be cost and time prohibitive. The environmental impact of installing a new sewer main was considered to outweigh the environmental impact of discharging to the Wallamba River.

8 Declaration

This Review of Environmental Factors provides a true and fair review of the activity in relation to its likely impact on the environment. It address to the fullest extent possible, all of the factor listed in Clause 228 of the Environmental Planning and Assessment Regulation Act (as amended) and the Commonwealth Environmental Protection and Biodiversity Conservation Act (as amended).



Graeme Watkins

Manager Water Management and Treatment

Acting Director Infrastructure and Engineering Services

Appendix A Consultation Documentation

DOC19/1054865, EF16/5705

The General Manager
Mid Coast Council
By email: council@midcoast.nsw.gov.au

Attention: Graeme Watkins

3 December 2019

Dear Mr Watkins

Proposed Nabiac Desalination Plant

I refer to your email to the Environment Protection Authority (EPA) dated 19 November 2019 regarding the proposed Nabiac Desalination Plant (the Proposal) and the request for EPA comment on the attached File Note titled *Emergency Water Supply & Treatment Options for Manning Water Scheme* (the File Note).

The File Note outlines a range of emergency water supply options that MidCoast Council (MCC) is exploring for the Manning area in response to drought and dwindling water storages within Bootawa Dam. One of the options proposed is a mobile reverse osmosis (RO) membrane desalination plant located adjacent to the Wallamba River and MCC water treatment plant and borefield at Nabiac.

The Proposal includes:

- Establishment of three (3) mobile membrane RO desalination plants on a 50m x 50m pad
- Extraction of 7-8ML/day raw water from the Wallamba River
- Discharge of 4-5ML/day of saline RO reject/brine water into the Wallamba River
- Transfer of treated water to the Nabiac water treatment plant for further treatment (disinfection, pH correction and other dosing) and distribution via the reticulated water network
- Diesel generated power supply; and
- Provision of pumping, pipework (up to 1km) and other civil works (clearing, pad construction and access road)

Planning/Licensing

The Proposal as outlined is not a Scheduled Activity for the purposes of Schedule 1 of the *Protection of the Environment Operations Act 1997* (the POEO Act) based on the information currently provided to the EPA. As such, MCC is not required to hold an environment protection licence for the Proposal. However, the EPA understands that MCC intends to apply for an EPL for the proposed desalination plant to provide a defence against any liability for an offence under s120 of the POEO Act (water pollution).

In general, the EPA will only consider issuing a licence where reasonable technology or practice is not available to avoid the pollution and/or where a discharge represents the best overall environmental outcome. If a licence is sought for the Proposal, MCC will need to demonstrate that all

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NSW 2302 Australia
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hunter.region@epa.nsw.gov.au

reasonable alternatives to polluting waters have been considered and that there are no other alternatives but to discharge.

It is understood that the Proposal will be undertaken by MCC. Where any activities are being carried out by a public authority, the EPA is the appropriate regulatory authority (ARA) for compliance with environmental legislation irrespective of licensing requirements.

MCC must comply with the requirements of the POEO Act including, but not limited to, the following sections:

- Section 115 and 116 (regarding disposal of waste and leaks, spillages and other escapes)
- Section 120 (regarding pollution of waters)
- Section 124 and 126 (regarding operations that result in air pollution)
- Section 139 (regarding noise pollution)
- Section 142A (regarding pollution of land) and
- Section 167 (regarding the appropriate maintenance and operation of plant and equipment).

MCC should also be aware of Section 257 of the POEO Act which encompasses vicarious liability.

Environmental Impacts Requiring Consideration

The EPA understands MCC have engaged a consultant to prepare a Review of Environmental Factors (REF) for the Proposal under Part 5 of the *Environmental Planning and Assessment Act 1979* and that the Proposal is to be carried out under State Environmental Planning Policy Infrastructure 2007.

The key environmental issue for the Proposal is potential impacts on receiving waters. The EPA's recommended information requirements for inclusion in the REF are detailed in **Attachment A,** including specific detail provided in relation to water.

Consideration by MCC should be given to community consultation and public exhibition of the Proposal REF, with any public submissions being provided to the EPA to inform our assessment.

If you require any further information regarding this matter, please contact Rebecca Akhurst on 4908 6807 or by email to hunter.region@epa.nsw.gov.au.

Yours sincerely

KAREN MARLER
Director Hunter
Environment Protection Authority

Contact officer: REBECCA AKHURST
(02) 4908 6807
hunter.region@epa.nsw.gov.au

Encl: Attachment A: EPA recommended considerations for Nabiac Desalination Plant REF

cc: Graeme.watkins@midcoast.nsw.gov.au; james@jmenvironments.com

Attachment A: EPA recommended considerations for Nabiac Desalination Plant REF

The EPA recommends the following matters are considered in the REF:

- **Water Management –**
  i. demonstrate that all reasonable alternatives to polluting waters have been considered (e.g. onsite storage, drying and offsite disposal to landfill, or discharge to sewer) and that there are no other alternatives but to discharge.
  ii. justify selection of the proposed desalination plant site rather than the other sites considered (e.g. alternative sites along the Manning River and near Foster STP were also identified), including consideration of the relative water quality risks to each of the potential receiving waterways
  iii. specify the location of the proposed brine discharge point, justifying why the location was selected over other potential discharge points, including discussion of the waterway characteristics at each point (e.g. depth, salinity, hydrodynamics, sensitive receptors) and consideration of the relative water quality risks
  iv. estimate the discharge flow rate and characterises the quality of the proposed brine discharge in terms of the concentrations of all pollutants present at non-trivial levels, including salinity and any treatment chemicals such as antiscalents and biocides
  v. characterise the background water quality at the proposed brine discharge location (where practical salinity should be determined based on measurements representative of the full tidal cycle. Existing data could potentially be used to characterise background water quality. For example, the File Note indicates water quality monitoring has been undertaken in the Wallamba River.)
  vi. provide details of measures to minimise and mitigate potential impacts on the receiving waterway, such as optimising the location, depth and mode (e.g. diffuser) and timing of discharge to maximise dilution, mixing and dispersion
  vii. assess the residual impact of the discharge on the environmental values of the receiving waterway with reference to relevant guideline values or other relevant benchmarks. This assessment should consider a range of conditions including typical and worst-case scenarios.
  viii. propose an operation stage monitoring program, specifying monitoring locations, frequency and analytes and identifying water quality management triggers and responses
  ix. provide details of procedures to prevent and respond to potential spills
  x. confirm that operation and refuelling of generators and storage of fuels and other chemicals will occur within bunded areas.
  xi. identify potential impacts to surface and groundwater during both the construction and operational stages and
  xii. identify appropriate pollution control systems/measures to protect surface and groundwater resources, particularly erosion and sediment controls during the construction stage and the rehabilitation stage.

- **Noise and Vibration** – identify potential noise and vibration emissions during both the construction and operational stages and identify mitigation strategies to be incorporated for both stages to minimise noise and vibration impacts where required;
- **Air Quality and Odour** – identify potential air and odour emissions (point source emissions from plant and equipment and/or fugitive dust emissions) during both the construction and operational stages and identify mitigation strategies to minimise point and/or fugitive and/or odour impacts;
- **Land Management** – identify if the soils in the area of the Proposal are contaminated or are acid forming (i.e. acid sulphate soils) and if so, identify any mitigation strategies or remedial and/or disposal actions that will be required/undertaken;
- **Waste Management** - identify options and strategies for waste avoidance, minimisation; reuse and recycling across all activities and appropriate disposal options
- **General Flooding Impacts** – any developments should be designed and undertaken in accordance with the State Government's Flood Policy as outlined in the Floodplain Development Manual.

- **Storage of Chemicals/Fuels** - ensure adequate control and clean-up measures are in place for storages to reduce the risk of spills contaminating land and waterways during the construction and operational stages; and
- **Incident Management Procedures** - adequate procedures must be established including notification requirements to the Appropriate Regulatory Authority and other relevant authorities for incidents that cause, or have the potential to cause, material harm to the environment (Part 5.7 of the POEO Act).

james@jmenvironments.com

From: Scott Carter <scott.carter@dpi.nsw.gov.au>
Sent: Wednesday, 4 December 2019 11:05 AM
To: james@jmenvironments.com
Subject: Re: Emergency desal plant Nabiac.

OK, when you finalise the REF and designs and lodge it
Send in an application and we can expedite it. (pref before 13 Dec)
that way construction can start as soon as the approval is granted

Scott Carter | Senior Fisheries Manager
Coastal Systems
NSW Department of Primary Industries | Fisheries
Port Stephens Fisheries Institute| Taylors Beach | NSW 2316
T: +61 2 4916 3931 | E: scott.carter@dpi.nsw.gov.au

ALL MAIL TO: DPI Fisheries, Attn: R. Philps,1243 Bruxner Hwy, Wollongbar NSW 2477

On Wed, 4 Dec 2019 at 10:31, <james@jmenvironments.com> wrote:

> Hi Scott
>
> Mid Coast Water no longer exists. Mid Coast Council will be the proponent. Looks like we need a permit for:
>
> - Water intake
> - Excavation of banks to place intake pumps
> - Excavation or under boring of river bed to place discharge pipe

Kind Regards

James McMahon

0427 893 668

james@jmenvironments.com
Licenced Asbestos Assessor LAA001286

Certified Environmental Practitioner CEnvP 1235

Site Contamination Specialist SC41110

From: Scott Carter <scott.carter@dpi.nsw.gov.au>
Sent: Tuesday, 3 December 2019 4:06 PM
To: james@jmenvironments.com
Subject: Re: Emergency desal plant Nabiac.

we treat Mid Coast Water as a relevant public authority so we do it as a s199.

If its purely Council then its a 200.

Scott Carter | Senior Fisheries Manager
Coastal Systems
NSW Department of Primary Industries | Fisheries
Port Stephens Fisheries Institute| Taylors Beach | NSW 2316
T: +61 2 4916 3931 | E: scott.carter@dpi.nsw.gov.au

ALL MAIL TO: DPI Fisheries, Attn: R. Philps,1243 Bruxner Hwy, Wollongbar NSW 2477

On Tue, 3 Dec 2019 at 16:04, <james@jmenvironments.com> wrote:

> Hi Scott,
>
> Thanks for your time today. You mentioned the project would carried out under section 199. I assume you were referring to Section 199 of the Fisheries Management Act 1994. I have checked this and it appears that the Section 199 explicitly excludes local authorities and Section 200 is relevant hence the project would require a permit from the Minister.
>
> **Kind Regards**
>
> **James McMahon**
>
> 0427 893 668
>
> james@jmenvironments.com
> Licenced Asbestos Assessor LAA001286
>
> Certified Environmental Practitioner CEnvP 1235
>
> Site Contamination Specialist SC41110

From: Scott Carter <scott.carter@dpi.nsw.gov.au>
Sent: Thursday, 28 November 2019 1:36 PM
To: james@jmenvironments.com
Subject: Emergency desal plant Nabiac.

James

You will need to consult with Fisheries on several issues.

1. dredge and reclamation if the discharge point or inlet require any excavation of the river or banks.

2. assessment of entrainment of larval fish.

3. potential requirement for a permit to harm marine vegetation at discharge point if

4. potential impact on Oyster industry from increased salinity downstream of discharge point.

Obviously the salinity is an issue from the discharge and as you have noted the dilution rates and plume modelling should be rigorous.

The SEPP does not turn off the Act

regards

Scott Carter | Senior Fisheries Manager

6 December 2019

James McMahon
JM Environments

email: *james@jmenvironments.com*

Dear Mr McMahon

Nabiac Emergency Desalination Plant

Thank you for your correspondence dated 4 December 2019 about the Nabiac Emergency Desalination Plant on the Wallamaba River at Nabiac.

Transport for NSW (TfNSW) Maritime is responsible for the ongoing maintenance of safe navigation throughout NSW under the Marine Safety Act 1998. As such, proposals like this are reviewed to ensure that any disruption to navigation for vessels is minimised as much as is practical.

The project documentation provided has been assessed as having minimal impact on the safety of navigation to vessels operating in this area and TfNSW Maritime has no objections to the proposed works.

TfNSW Maritime advises the following for your reference:

1. Any works impacting on navigation during the construction phase must seek TfNSW Maritime support and a full scope of works including dates is to be provided to *navigationadvicenorth@rms.nsw.gov.au*. So that a Marine Notice can be prepared and published on the Maritime website.
2. All associated work boats to comply with the relevant NSW Marine Legislation for survey, registration and safety equipment, and comply with the Marine Safety (Domestic Commercial Vessels) National Law Act 2012.
3. Vessels must exhibit lights and shapes in accordance with International Regulations for Preventing Collisions at Sea.
4. TfNSW Maritime will arrange for the installation of aids to navigation to mark any hazards associated with the pickup and discharge points during and following construction if required. TfNSW Maritime recommends liaising with the local Boating Safety Officer to provide assistance with the assessment and placement of objects.

For more information, please contact me on *navigationadvicenorth@rms.nsw.gov.au* or Boating Safety Officer, Nick Richards on 0408 245 399.

Yours sincerely

Lynda Hourigan
Project Officer North
Maritime

james@jmenvironments.com

From: Estelle Avery <estelle.avery@nrar.nsw.gov.au>
Sent: Monday, 25 November 2019 3:31 PM
To: Tracey Hamer
Cc: Mitchell Stace; nrar.servicedesk@industry.nsw.gov.au; Robert Scott; Glenn George (Glenn.George@dpi.nsw.gov.au); Geoff Snell <geoff.snell@industry.nsw.gov.au> (geoff.snell@industry.nsw.gov.au); Josh Plummer; Alison Collaros
Subject: Re: Licence application or exemption for proposed 8 new bores at Nabiac Borefield and extraction from the Wallamba River

Hi Tracey

The proposed location of extraction of surface water from the Wallamba River is not covered by the Water Sharing Plan for the North Coast Unregulated and Alluvial Water Sources 2009. Refer to clause 4 sub-clause 4(d) of the water sharing plan at the following link.

https://www.legislation.nsw.gov.au/#/view/regulation/2009/348/part1/sec4

The *Water Act 1912* does not have the provision to license the take of water downstream of the tidal limit.

Consequently there are no licensing requirements from the Natural Resources Access Regulator for the proposed activity. However, the disposal of brine is likely to require an Environment Protection Licence from the Environment Protection Authority and MidCoast Council should compile a Review of Environmental Factors for the construction of the proposed work.

If you have any questions in relation to the above, please contact me.

Estelle

Dr Estelle Avery | Senior Water Regulation Officer
Regional Water Regulation (East)
Natural Resources Access Regulator | Lands & Water
Department of Industry
Level 3 | 26 Honeysuckle Drive | Newcastle NSW 2300
PO Box 2213 | Dangar NSW 2309
T: 02 4904 2512
E: estelle.avery@nrar.nsw.gov.au
W: www.water.nsw.gov.au | www.industry.nsw.gov.au

On Fri, 22 Nov 2019 at 18:49, Tracey Hamer <Tracey.Hamer@midcoast.nsw.gov.au> wrote:

> Hi Estelle,

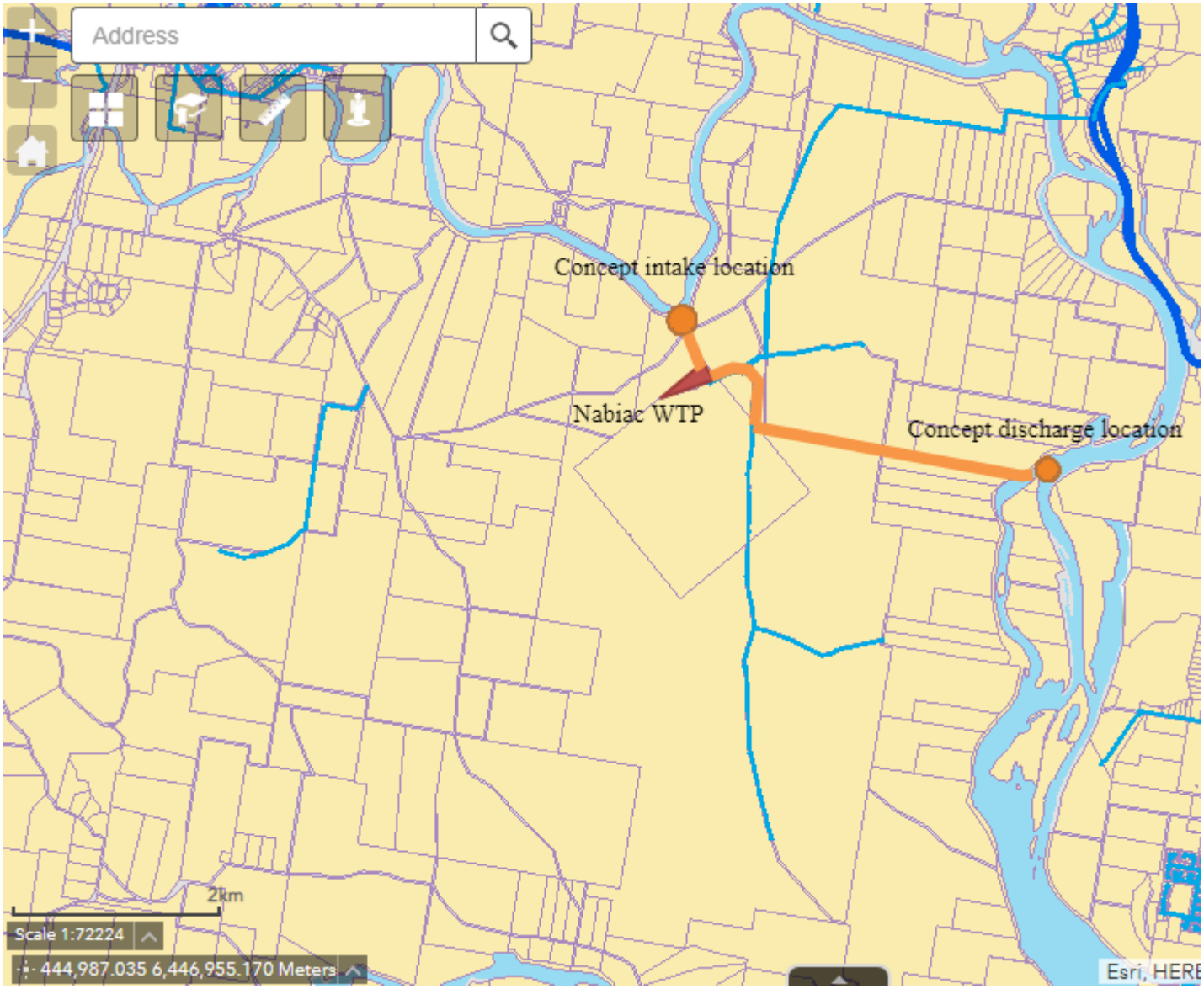
Further to our request for exemption under clause 39A of the Water Management (General) Regulation 2018 for the additional bores at Nabiac, we'd also like to request exemption for proposed extraction of surface water from the Wallamba River.

I note that since our discussion this morning, you have confirmed that the water source from which the borefield extracts water is not covered by a water sharing plan and as a consequence clause 39A of the Water Management (General) Regulation 2018 is unlikely to be applicable. Further, that the existing bores are licensed under Part 5 of the Water Act 1912 as the water source is not covered by a water sharing plan.

We are investigating and planning for temporary desalination units which would produce from 3 ML/d to 10 ML/d. This would require extraction of 6 ML/d to 20 ML/d from the river with 3 ML/d to 10 ML/d being returned to the river downstream.

The figure below shows a rough concept of the proposed extraction and discharge points. The containerised desalination units are likely to be placed at the Nabiac WTP. Hunter H2O have been engaged to investigate the emergency desalination option.

Can you please advise what further information you would require to assess this exemption request for the proposed extraction of surface water from the Wallamba River?



Regards,

Tracey

Tracey Hamer
Manager Planning and Assets

MIDCOAST council
We deliver benefits for our community in a way that adds value and builds trust

Direct 6591 7552 Mobile 0447106626
Tracey.Hamer@MidCoast.nsw.gov.au
www.midcoast.nsw.gov.au or follow us

From: Tracey Hamer
Sent: Friday, 22 November 2019 6:41 AM
To: Estelle Avery
Cc: Mitchell Stace; 'nrar.servicedesk@industry.nsw.gov.au'; Robert Scott; Glenn George (Glenn.George@dpi.nsw.gov.au); Geoff Snell <geoff.snell@industry.nsw.gov.au> (geoff.snell@industry.nsw.gov.au)
Subject: Licence application or exemption for proposed 8 new bores at Nabiac Borefield
Importance: High

Hi Estelle,

We are planning to construct 8 new bores at the Nabiac Inland Dune Aquifer as part of our drought response. Council would like to apply for an exemption under clause 39A of the Water Management (General) Regulation 2018 to allow us to go ahead with construction of these bores.

The proposed works involves the following:

- Construction of 8 x 250mm diameter new extraction bores within the existing borefield, with the below proposed timeframes
    - One in December 2019
    - Three in January 2020

- Four in February 2020

- Construction of pipe lines to connect the new bores with the existing borefield pipe network

- Use of existing power available in bore huts.

A consultant has been engaged to deliver a Review of Environmental Factors (REF) and we expect this REF to be completed within two weeks.

Please find attached the following supporting information:

1. Emergency Water Supply Briefing Note – this summarises the current situation and the options we are investigating and planning for. This briefing note was recently sent to the Minister for Water, Property and Housing to keep the Minister updated on MidCoast Council's current situation.

2. Concept locations for the 8 new bores – these locations should be firmed up by COB Tuesday 26 November.

Can you please advise the following?

1. Is the exemption under clause 39A applicable to this proposed works?

2. If so, what additional information, if any, is required to complete the application?

3. If we receive the exemption, what are the next steps in terms of bore construction applications and bore licences?

Thanks and regards,

Tracey

Tracey Hamer
Manager Planning and Assets
MIDCOAST council
We deliver benefits for our community in a way that adds value and builds trust
Direct 6591 7552 Mobile 0447106626

Tracey.Hamer@MidCoast.nsw.gov.au
www.midcoast.nsw.gov.au or follow us

james@jmenvironments.com

From: james@jmenvironments.com
Sent: Friday, 6 December 2019 10:01 AM
To: 'aragno@bigpond.net.au'
Subject: Emergency Desalination Plant/Fish Co-Op
Attachments: SITE B_AHD.PDF; MCC Desal Pipelines.kmz

Hi Anthony

Thanks for taking my call on Wednesday.
I am part of HunterH2O's team that is assisting Mid Coast Council to plan and install an Emergency Desalination Plant at Nabiac. Dam storage is predicted to runout in the next 40-50 days, hence the project has quite a sensitive timeline. Details are still being sorted out but in brief, the desalination system will take around 8-9ML per day from the Wallamba River, produce 3-4M/L per day of potable water and discharge 5-6ML of RO reject (brine). The water discharge will be in an estuarine area of the Wallamba River (see attached kml). The primary option is to lay a 400mm PVC pipe along the bottom of the Wallamba River to the discharge point. The discharge point is in about 4.5m of water. I have also attached recent bathymetry results for that section of the river.

As far as approvals go, Council will be the regulatory authority under SEPP Infrastructure. An Review of Environmental Factors will be prepared to accompany the DA.
We are undertaking assessments of the impact of the brine discharge on the aquatic ecosystem and modelling on the brine dispersion. We will happily share these with you once they are complete.

Kind Regards

James McMahon
0427 893 668
james@jmenvironments.com
Licenced Asbestos Assessor LAA001286
Certified Environmental Practitioner CEnvP 1235
Site Contamination Specialist SC41110

Appendix B BMT Saline Dispersion Modelling Report

BMT Commercial Australia Pty Ltd
Level 8, 200 Creek Street
Brisbane Qld 4000
Australia
PO Box 203, Spring Hill 4004

Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627

ABN 54 010 830 421

www.bmt.org

Our Ref: DAB: L.B24170.002.BrineDilution.docx

5 December 2019

2 Pulleney St
PO BOX 482
Taree NSW 2430

Attention: Tracey Hamer

Dear Tracey

RE: MIDCOAST EMERGENCY DESALINATION PLANT - PRELIMINARY DISCHARGE DILUTION ASSESSMENT

In the following, we present a preliminary assessment of brine dilution from the proposed emergency desalination plant discharge into the Wallamba River.

Please do not hesitate to contact me should you require any further information.

Yours Faithfully
BMT

Daniel Botelho

1 Background

The water supply for the MidCoast Council (MCC) is severely depleted to the point MCC have acquired an emergency desalination plant to augment its existing water supply. The acquired reverse osmosis (RO) plant has a production capacity ranging from 3 to 4 ML per day capacity and will produce a brine effluent of 5 to 6 ML per day to be discharged in the Wallamba River. However, before the operations can start, an assessment of the dilution and resulting salinity in the surrounds of the plant's discharge is required. This document presents the results of this preliminary assessment. It is envisaged this assessment will be part of the ongoing environmental license approval process for the plant.

2 Near field dilution

Near field, in simple terms, refers to the region near a discharge where conditions are highly influenced by the properties of the discharge itself. For a discharge from a desalination plant, the brine effluent is expected to be more saline, and therefore denser, than the receiving environment. As a result, the effluent is expected to undergo initial mixing as it exits the discharging pipe and propagate along the bed as it undergoes mixing via other environmental processes (i.e. mixing due to winds and currents). This region where the discharge is more influenced by ambient process is termed far field and will not be addressed in this section.

2.1 Scaling

The near field properties were calculated based on the scaling proposed by Roberts et al. (1997). The scaling assumes the discharge is oriented at a 60° angle with the vertical (this angle allows the best mixing performance) without any ambient flows. In this configuration the discharge initially rises through the water column up to a point where its initial momentum is overcome by the discharge buoyancy forces, at which point the plume starts descending towards the bed. The plume undergoes mixing along its interface as it shears the water column, entraining ambient fluid. The rate of entrainment into the plume is generally more vigorous in the descending phase. So improved near field mixing can be achieved without the aid of environmental mixing, the discharge is required to be placed at the deepest location possible. This will maximise the rate of near field mixing.

All parameters in Roberts et al. (1997) scale with the discharge densimetric Froude number (F_d) and allows estimates for the following variables (see diagram in Figure 2-1):

- The terminal height of the plume (y_t);
- The dilution at the point of impact with the bed (S_i);
- The distance from the point of discharge to the point of impact (x_i);
- The dilution at the end of the near field region (S_n);
- The distance from the point of discharge to the end of the near field region (x_n); and
- The thickness of the plume (or spread layer thickness) at the end of the near field region (y_l).

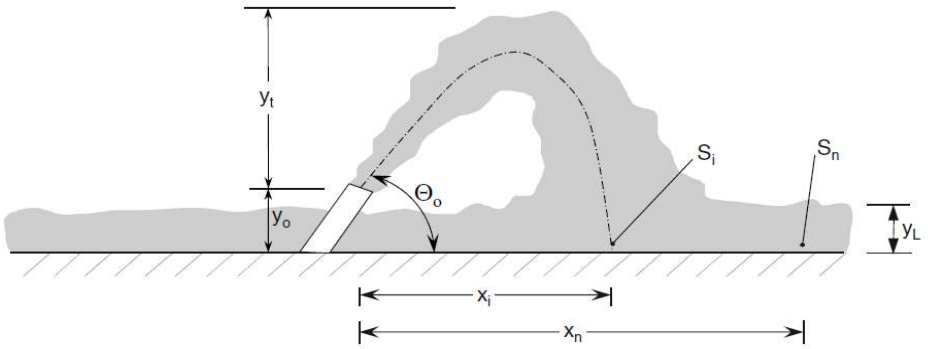


Figure 2-1 Diagram of near field parameters obtained from Roberts et al. (1997) scaling

The scaling equations proposed in Roberts et al. (1997) are as follows:

$$y_t = 2.2F_d d_o \quad (1)$$

$$S_i = 1.6F_d \quad (2)$$

$$x_i = 2.4F_d d_o \quad (3)$$

$$S_n = 2.6F_d \quad (4)$$

$$x_n = 9.0F_d d_o \quad (5)$$

$$y_l = 0.7F_d d_o \quad (6)$$

$$F_d = \frac{u_o}{\sqrt{g\frac{\rho-\rho_a}{\rho_a}}} \quad (7)$$

Where d_o is the discharge port diameter, u_o is the mean discharge velocity, g is the acceleration due to gravity, ρ is the density of the discharge effluent and ρ_a is the ambient density.

2.2 Discharge and Intake Location

The potential discharge and intake locations are shown in Figure 2-2. The discharge is to be located just downstream of the Gowack Island approximately 9 km upstream of the Wallamba River confluence with the Coolongolook River at Wallis Lake. The potential intake location is located 18 km from the same confluence.

Depth at the discharge location was obtained from a bathymetric survey provided by MCC (Figure 2-3). The minimum elevation on the scale is approximately -5.0 mAHD. Assuming the lowest tidal plane elevation (i.e. I.S.W.L.) for Wallamba River at Tuncurry also applies to the discharge location (see note 5 in Figure 2-3), the maximum depths at the proposed discharge location are approximately 4.8 m.

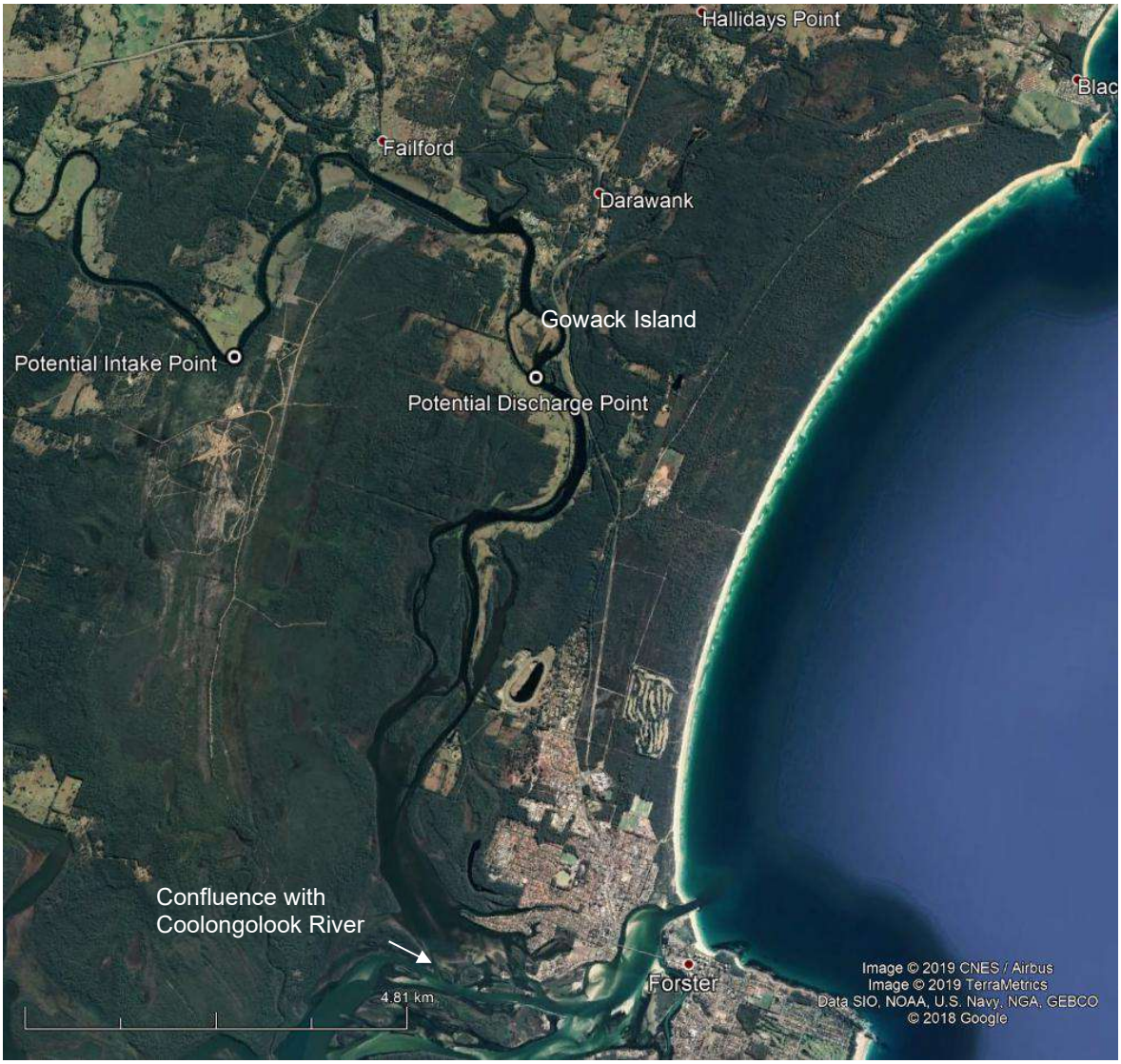


Figure 2-2 Proposed intake and discharge locations (Source: Google Earth)

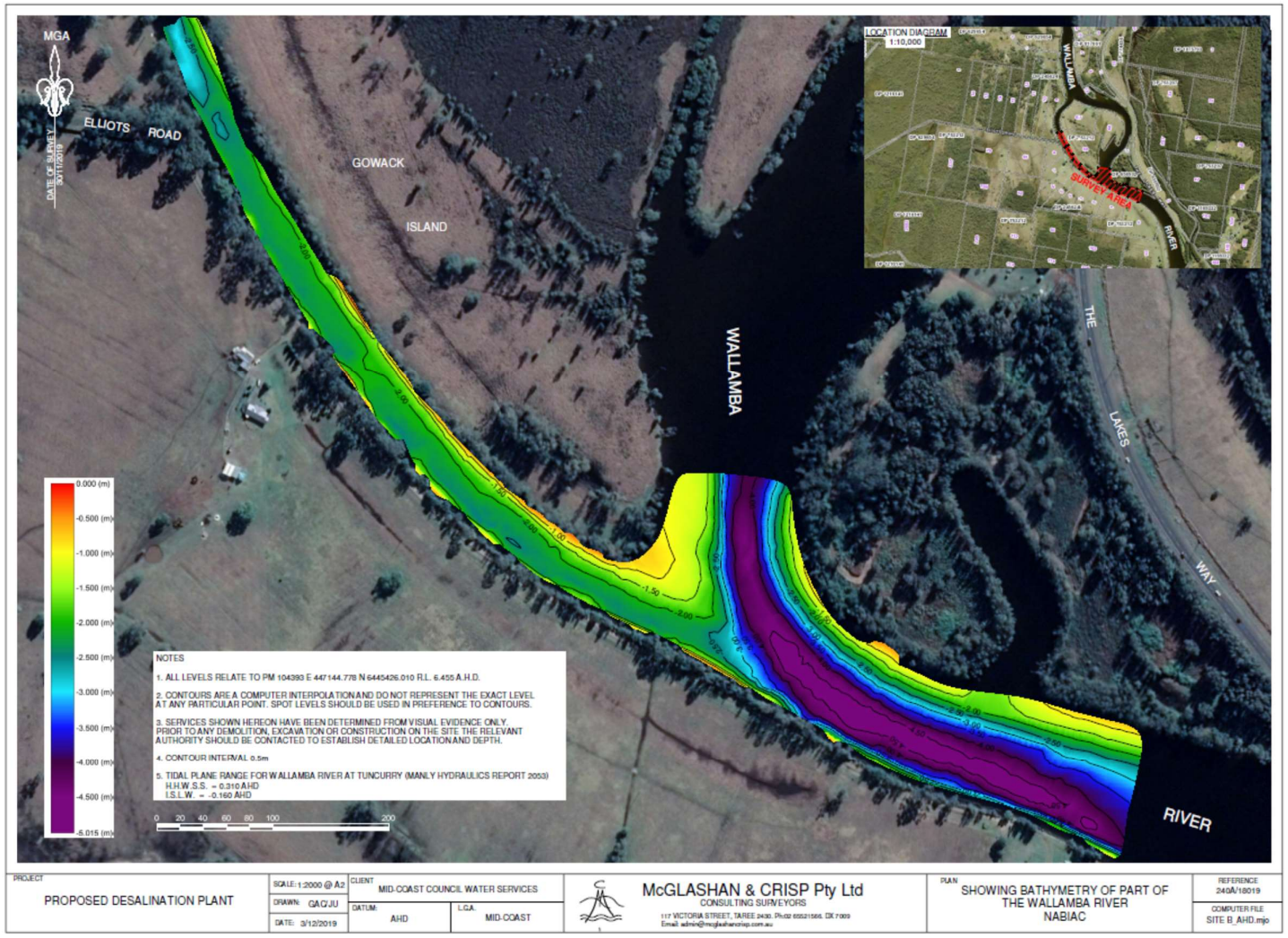


Figure 2-3 Bathymetric survey at the discharge location

2.3 Discharge and Ambient Parameters

Information at both discharge and intake locations are still scarce and based on preliminary data collection. Electrical conductivity (EC) and temperature data (also other water quality parameters not presented here) for the Wallamba River were obtained on 26 November 2019 (Table 2-1). Salinity and density data were then derived according to UNESCO (1983). Conditions are from a spring tidal cycle, so within a relatively wide range expected in the region.

Table 2-1 Electrical Conductivity, Temperature, Salinity and Density Data at Intake and Discharge Locations

Time	Location	EC (µS/cm)	Temperature (°C)	Salinity* (-)	Density (kg/m^3)
09:47	Discharge	54,900	25.4	36.05	1,024.01
11:21	Intake	50,100	26.9	31.48	1,020.10
14:08	Discharge	55,300	27.2	34.95	1,022.62
14:45	Intake	49,900	27.9	30.68	1,019.18
17:06	Discharge	54,900	26.6	35.11	1,022.93
17:42	Intake	49,600	27.3	30.86	1,019.51

*Salinity when calculated as a function of electrical conductivity has no units. For the purposes of these calculations, it will be assumed equivalent to concentrations in g/kg.

The effluent salinity and density were then calculated based on the expected plant performance. For example, a production rate of 3 ML per day and a discharge flow rate of 5 ML per day indicates that the intake flow rate is approximately 8 ML per day, so the discharge salinity is approximately 1.6 times the intake salinity. Similarly, a production rate of 4 ML per day and a discharge flow rate of 6 ML per day indicates that the intake flow rate is approximately 10 ML per day and the discharge salinity is approximately 1.67 times higher than the intake. Assuming the discharge temperature being equal to the intake, based on data from Table 2-1, the discharge salinities and densities were calculated for four cases (Table 2-2):

(1) High production rate (and discharge) and low ambient salinity

(2) High production rate (and discharge) and high ambient salinity

(3) Low production rate (and discharge) and high ambient salinity; and

(4) Low production rate (and discharge) and low ambient salinity.

Table 2-2 Assumed Discharge Salinity and Density.

Production and Discharge Rate	Intake Salinity	Parameter	Value
High (Production 4 ML/day Discharge 6 ML/day)	Low (30.68)	Salinity (-)	51.13
		Density (kg/m^3)	1,034.62
	High (31.48)	Salinity (-)	52.47
		Density (kg/m^3)	1,035.99
Low (Production 3 ML/day Discharge 5 ML/day)	Low (30.68)	Salinity (-)	49.08
		Density (kg/m^3)	1,033.07
	High (31.48)	Salinity (-)	50.37
		Density (kg/m^3)	1,034.39

2.3.1 Discharge Pipe Diameter

The diameter of the discharge port was not provided; therefore, it was used as a free parameter in the calculations. Given the location of the discharge is relatively shallow, a port diameter was selected such that the combination of terminal rise and the spread layer thickness would not break the surface during low water. This assumes the port elevation is above the spread layer thickness and maximum use of the water column is adopted for mixing.

2.4 Results

Results for the different parameters considered in the Roberts et al. (1997) scaling are presented in Table 2-3. A port exit diameter of 300 mm was adopted in these calculations. The highest combination of terminal rise and spread layer thickness for this port diameter was 4.6 m, just lower than the minimum expected depth of 4.8 m. It is recommended the port be placed at a height at least 1.1 m from the bed.

The results at the end of the nearfield are particularly relevant for impact assessment. All the conditions expected 1.1 salinity units increase at the end of the nearfield, resulting in salinities varying between 36.0 and 37.2. The associated dilutions varied between 12.3 and 13.8. Length of the nearfield range was between 12.7 m and 14.3 m.

2.4.1 Assumptions and limitations

The analysis undertaken assumes the ambient receiving environment is quiescent. In reality, it is expected that local currents (i.e. induced by winds, river flows and/or tidal flows) would improve mixing conditions. In this sense, the results presented in this assessment are likely to represent a lower bound for dilution and a higher bound for salinity increases in the nearfield. Additional analysis is required to estimate effects of ambient currents.

The adopted scaling in our analysis was developed with a discharge into the open ocean in mind. The present configuration is not consistent with this assumption, as the effluent is to be discharged in a confined environment (i.e. along the river channel). Having said that, the laboratory conditions (i.e. flume where experiments were performed) from which the scaling was derived were akin to this confined situation,

assuming the exit port is oriented in the streamwise direction (i.e. along the river channel). In real conditions, deviations from our calculations can therefore be expected. In fact, the derived coefficient for the nearfield dilutions had a standard deviation of 15%.

Further, the densimetric Froude number, from which the scaling was derived, ranged between 19 and 36. The Froude numbers in our analysis varied from 4.7 to 5.3, and therefore they are outside of the range adopted in Roberts et al. (1997) experiments. This is not to say that the scaling is not applicable to the discharge in question, rather that the conditions need confirmation through either field measurements or additional laboratory experiments. In the absence of a scaling derived for the proposed discharge conditions, caution is to be exercised when relying on our estimates of nearfield dilution. Hence, our results need to be seen as preliminary and the ambient conditions need to be monitored so the dilution performance can be verified.

It is to be noted the tidal conditions (and confined receiving environment) may induce mixing between the effluent with waters affected by the discharge (i.e. as the tide motion reverses). This is likely to counteract any other ambient mixing mechanisms. Additional analysis is required to estimate these effects.

Finally, the adopted design considerations assume a single port exit for the outfall. An alternative design considering multiple ports is likely to improve mixing conditions in the nearfield. Initial calculations indicate that the same discharge split across three different ports of 0.15 m diameter each is likely to nearly double the dilution at the end of the nearfield without breaking the water surface. In this condition an expected salinity increase at the end of the nearfield would be the order of 0.6 units.

Table 2-3 Nearfield Mixing Results

Production and Discharge Rate	Intake Salinity	Parameter	Value
High (Production 4 ML/day Discharge 6 ML/day)	Low (30.68)	Terminal Rise (y_t)	3.5 m
		Dilution at impact (S_i)	8.5
		Point of impact (x_i)	3.8 m
		Dilution at end of nearfield (S_n)	13.7
		Nearfield length (x_n)	14.3 m
		Spread layer thickness (y_l)	1.1 m
		Ambient salinity	35.0
		Salinity increase at impact point	1.7
		Salinity at impact point	36.7
		Salinity increase at end of nearfield	1.1
		Salinity at end of nearfield	36.1
	High (31.48)	Terminal Rise (y_t)	3.5 m
		Dilution at impact (S_i)	8.5
		Point of impact (x_i)	3.8 m
		Dilution at end of nearfield (S_n)	13.8
		Nearfield length (x_n)	14.3 m
		Spread layer thickness (y_l)	1.1 m
		Ambient salinity	36.1
		Salinity increase at impact point	1.7
		Salinity at impact point	37.8
		Salinity increase at end of nearfield	1.1
		Salinity at end of nearfield	37.2
Low (Production 3 ML/day Discharge 5 ML/day)	Low (30.68)	Terminal Rise (y_t)	3.1 m
		Dilution at impact (S_i)	7.6
		Point of impact (x_i)	3.4 m
		Dilution at end of nearfield (S_n)	12.3
		Nearfield length (x_n)	12.8 m
		Spread layer thickness (y_l)	1.0 m
		Ambient salinity	36.1
		Salinity increase at impact point	1.7
		Salinity at impact point	37.7
		Salinity at end of nearfield	1.1
		Salinity increase at end of nearfield	37.1
	High (31.48)	Terminal Rise (y_t)	3.1 m
		Dilution at impact (S_i)	7.5
		Point of impact (x_i)	3.4 m
		Dilution at end of nearfield (S_n)	12.3
		Nearfield length (x_n)	12.7 m
		Spread layer thickness (y_l)	1.0 m
		Ambient salinity	35.0
		Salinity increase at impact point	1.7
		Salinity at impact point	36.6
		Salinity at end of nearfield	1.1
		Salinity increase at end of nearfield	36.0

3 River Mixing

River mixing was calculated to estimate the distance from the point of release at which the discharge is likely to fully mix across the Wallamba River width, depending on river depth, mean current, and distance of the release point from the river bank. It also calculates the resulting concentrations as the discharged plume moves in the direction of the flow. The calculations were based on the transversal mixing formulation of Fischer et al. (1979) and provide an estimate for far-field mixing.

3.1 Approach

Salinity increases within the Wallamba River were estimated based on equation 5.9 of Fischer et al. (1979).

$$C = \frac{C_o}{\sqrt{4\pi x'}} \sum_{n=-\infty}^{\infty} \left\{ exp\left[-\frac{(y' - 2n - y_o')^2}{4x'} \right] + exp\left[-\frac{(y' - 2n + y_o')^2}{4x'} \right] \right\} \quad (8)$$

This equation provides an estimate of transverse mixing of a discharged constituent at constant flow rate (Q) and concentration (C_Q) at a given distance from the bank (y_o), assuming constant depth (d), width (W) and average velocity ($\overline{U}$) of the receiving environment. Concentration in the context of equation (8) can be considered proportional to the expected salinity increase above background Wallamba River salinity. In equation (8), the different variables are given by the following:

$C_o = \frac{QC_Q}{\overline{U}dW}$ is the discharge concentration (i.e. salinity increase) multiplied by the ratio between the discharge flow rate and the river flow rate.

$x' = \frac{x\varepsilon_t}{\overline{U}W^2}$ is the non-dimensional downstream distance from the discharge, where x is the downstream distance and ε_t is the transverse mixing coefficient given by $\varepsilon_t = 0.6du^* \pm 50\%$, where u^* is the shear velocity (Fischer et al. 1979).

$y' = \frac{y}{W}$ is the non-dimensional transversal distance from the bank, where y is the dimensional distance.

$y_o' = \frac{y_o}{W}$ is the non-dimensional transversal distance of the discharge from the bank.

The shear velocity was assumed to be 5% of the mean stream velocity, i.e. $u^* = 0.05\overline{U}$. This assumption effectively makes ε_t directly proportional to $\overline{U}$, such that the rate of transversal spreading balances advection resulting in maximum concentrations at a given downstream position of the discharge being the same regardless of the river flow velocity. The width of the plume is however larger for increased $\overline{U}$ (i.e. more turbulence, as characterised by u^*).

3.2 Input Parameters

We applied equation (8) to a range of assumed Wallamba River velocities and depths, assuming W = 50 m, which is approximately the width of the river between the -3.5 mAHD contours at each side of the river (Figure 2-3).

Although river velocities are not known, as discussed above, results of the distance at which full mixing across the river width occurs are independent of the current velocity. The velocity however provides the dislocation of the plume along the river over a given time. For the semidiurnal tides, the river is unlikely to move on a given direction for over 6 hours (neglecting any catchment flows, noting the dry conditions).

Mixing was computed for discharges located at the edge of the bank and at the centre of the river channel (i.e. $y_o' = 0$ and $y_o' = 0.5$).

Two flow depths were considered: 1.0 m and 3.0 m. These assumed depths take into consideration that the spread layer (i.e. after near field) is only ~1.0 m thick and will slowly mix in the vertical as the plume moves downstream. It is also noted that the tidal range of the Wallamba River is relatively small (<0.5 m at Tuncurry, MHL 2012), so we do not expect too much change in flow depth for the resulting brine flow.

The discharge flow and concentration data were considered to be the same as the results obtained at the end of the nearfield (only lowest and highest dilutions considered). In this case, the salinity increase was used as the initial concentration and the discharge flow rate was multiplied by the dilution at the end of the nearfield.

Input parameters are summarised below in Table 3-1.

Table 3-1 Input parameters for River Mixing Analysis

Parameter	Values
Flow width	50 m
Flow depths	1.0 m, 3.0 m
Flow velocities	0.1 m/s, 0.50 m/s
Discharge location	edge of bank and mid-channel
Salinity increase	1.06 and 1.11
Discharge flow rate	5 ML/day and 6 ML/day
Dilution	12.27 and 13.76

3.3 Results

The results are tabulated for the eight different input parameter combinations in Table 3-2. We extracted results at three locations: at the edge of the river bank, at mid-channel, and at the opposite edge. For cases considering discharge placed in the middle of the channel, the salinity increases are the same at both banks, noting the analysis in this case assumes the system is symmetrical. The ranges shown for the results in Table 3-2 are due to the variability of the ε_t coefficient given in Fischer et al. (1979).

The larger plant production rates (i.e. larger discharge flow and salinity) produced larger salinity increases along the river, as expected. Also, the salinity increases were higher for reduced flow depths, as a smaller river volume is used for further dilution of the plume beyond the near field. As such, highest salinities are expected around low water at the end of ebb tides and commencement of floods. The discharge in the middle of the channel produced better mixing conditions along the river, with results at both banks converging more quickly than the discharge at the bank edge (again, as expected).

All cases suggest that a maximum salinity increase of ~0.1 will be achieved within 1,000 m of the discharge in the direction of the flow. Mixing after that point was relatively sluggish, however the level of salinity increases would likely be within the natural variability of the system.

The salinity increases approximately 9 km from the discharge (i.e. location of the intake) were always <0.04 units. A salinity increase of 0.04 is likely well within natural variability of the system, and likely to be difficult to measure in reality. This is based on our experience that two similar conductivity and temperature probes measuring a same water parcel are likely to provide a variability of this order (or larger).

Such salinity increases would likely have little effect on the RO plant performance, particularly if the water intake is placed near the surface, where salinity increases would be lower (i.e. approximately -1.0 mAHD). In effect, and assuming a 6-hour advection time scale (i.e. semidiurnal tidal cycle), a velocity of 0.42 m/s is required so the effects of the discharge are felt at the intake location.

3.3.1 Assumptions and Limitations

Results in Table 3-2 require caution in their interpretation, as they are based on rather simplistic assumptions. For example, Fischer et al. (1979) shows that a factor of 4 (four) was observed between field measurements and the proposed equations. Adopting this factor in Table 3-2 shows that maximum salinity increases can be as high as 0.5 units at 1,000 m from the discharge.

In addition to the caution remark above, we would like to add some caveats to the estimates shown in Table 3-2. On one hand estimates are based on conservative assumptions. These include:

- The estimate of the shear velocity equals 5% of the mean velocity (i.e. it is a common assumption to adopt a 10% of mean velocity);
- The consideration of a uniform river cross section, noting a meandering channel (and the presence of islands) would likely increase the rates of transversal mixing (Fischer et al. 1979);
- The consideration that salinity increases would be uniform across the spread layer. In fact, the scaling adopted in Roberts et al. (1997) is for salinity increases at the bed with significant reduction of these increases over the spread layer thickness; and
- Wind-induced turbulence and associated mixing has been neglected.

On the other hand, the adopted approach does not consider the following:

- The brine plume will propagate along the river thalweg and will tend to descend (and accumulate) onto river depressions. It will also pile-up as it reaches river banks before it can continue to propagate in the main direction of flow. Both processes are likely to slow the propagation of the plume but would also change the mixing conditions as the plume moves in either direction of the tidal flow.
- The reversal of the tides is likely to slowly alter the river background salinity over several tidal cycles. For a continuous discharge, this accumulation of brine may build up the very own plume salinity, as the plume would effectively dilutes in itself. As this accumulation process is not considered in the estimates, the results may also underestimate the increases in salinity.
- The assumption that the discharge behaves as a point source is likely to overestimate the rate of transversal mixing. In reality, transversal mixing is likely to be slower as transversal salinity gradients are likely to be lower than the assumption presented. This is nevertheless counteracted by the assumption of uniform salinity increases (equal to salinity at the bed) over the spread layer thickness.

More sophisticated modelling accounting for three-dimensional hydrodynamics and associated salt transport is required to address the limitations posed above. The assessment nevertheless should provide a reasonable first order approximation of mixing of the plant discharge within the Wallamba River.

Table 3-2 Salinity Increase Along Wallamba River

Mean flow depth (m)	Location	Distance from end of nearfield (m)									
		100	500	1,000	2,000	3,000	5,000	7,000	8,000	9,000	10,000
Discharge flow rate of 5 ML/day at mid bank											
1.0	Mid bank	0.11-0.15	0.05-0.07	0.03-0.05	0.02-0.03	0.02-0.03	0.02	0.02	0.02	0.02	0.02
	Bank edges	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.01	0.01	0.01	0.01-0.02	0.01-0.02
3.0	Mid bank	0.02-0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Bank edges	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.01	0.01	0.01	0.01
Discharge flow rate of 5 ML/day at edge of bank											
1.0	Bank edge	0.21-0.30	0.10-0.13	0.07-0.10	0.05-0.07	0.04-0.05	0.03-0.04	0.03-0.04	0.02-0.03	0.02-0.03	0.02-0.03
	Mid bank	0.00	0.00	0.00	0.00	0.00-0.01	0.01	0.01	0.01	0.01-0.02	0.01-0.02
	Opposite edge	0.00	0.00	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.00-0.01	0.00-0.01
3.0	Bank edge	0.04-0.06	0.02-0.03	0.01-0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Mid bank	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.01	0.01	0.01	0.01
	Opposite edge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Discharge flow rate of 6 ML/day at mid bank											
1.0	Mid bank	0.15-0.21	0.07-0.09	0.05-0.07	0.03-0.05	0.03-0.04	0.02-0.03	0.02-0.03	0.02	0.02	0.02
	Bank edges	0.00	0.00	0.00	0.00-0.01	0.01	0.01-0.02	0.02	0.02	0.02	0.02
3.0	Mid bank	0.03-0.04	0.01-0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Bank edges	0.00	0.00	0.00-0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Discharge flow rate of 6 ML/day at edge of bank											
1.0	Bank edge	0.30-0.42	0.13-0.19	0.09-0.13	0.07-0.09	0.05-0.07	0.04-0.06	0.04-0.05	0.03-0.05	0.03-0.04	0.03-0.04
	Mid bank	0.00	0.00	0.00	0.00-0.01	0.01	0.01-0.02	0.02	0.02	0.02	0.02
	Opposite edge	0.00	0.00	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.00-0.01	0.00-0.01
3.0	Bank edge	0.06-0.08	0.03-0.04	0.02-0.03	0.01-0.02	0.01	0.01	0.01	0.01	0.01	0.01
	Mid bank	0.00	0.00	0.00-0.01	0.00-0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Opposite edge	0.00	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01	0.01	0.01	0.01

4 References

Fischer, H.B, List, E.H., Koh, R.C.Y., Imberger, J. and Brooks, N.H. (1979). *Mixing in Inland and Coastal Waters.* Academic Press.

Manly Hydraulics laboratory, MHL (2012). *OEH NSW Tidal Planes Analysis - 1990-2010 Harmonic Analysis*. Report No. MHL2053.

Roberts, P.J.W., Ferrier, A., and Daviero, G. (1997). Mixing in Inclined Dense Jets. *Journal of Hydraulic Engineering*, *ASCE*, 123(8), 693-699.

UNESCO (1983). *Algorithms for computation of fundamental properties of seawater*. Unesco Tech. Pap. in Mar. Sci., No. 44, 53 pp.

james@jmenvironments.com

Subject: FW: [External] RE: Draft B24170

From: Daniel Botelho <Daniel.Botelho@bmtglobal.com>
Sent: Tuesday, 17 December 2019 6:21 PM
To: James McMahon <james@jmenvironments.com>
Subject: RE: [External] RE: Draft B24170

Hi James,

Nearfield modelling for a 13 ML/day discharge at the bank.

Assumed the same intake, ambient and effluent salinity as per the report.
Provide here two options so plume does not break the surface.
Option 1: Increase the pipe diameter to 0.5 m.
Option 2: Split the discharge equally into two 0.35 m diameter pipes.

Nearfield results Option 1 (lowest dilution conditions):

n ports	1	
Total Flow	0.150463	m3/s
flow/perport	0.150463	m3/s
port diametre	0.5	m
rho eff	1034.39	kg/m3
rho amb	1024.01	kg/m3
Terminal Rise	3.778375	m
Impact Point	4.121864	m
Nearfield Len	15.45699	m
Spread. Layer Thick.	1.20221	m
Dilution Impact	5.495818	
Dilution nearfield	8.930705	
Salinity eff	50.37	
Salinity amb	36.05	
Salinity Impact	38.25	
Salinity Nearfield	37.49	
Salinity Increase Impact	2.20	
Salinity Increase Nearfield	1.44	

Nearfield results Option 2 (lowest dilution conditions):

n ports	2	
Total Flow	0.150463	m3/s
flow/perport	0.075231	m3/s
port diametre	0.35	m
rho eff	1034.39	kg/m3
rho amb	1024.01	kg/m3
Terminal Rise	3.22573	m
Impact Point	3.518978	m
Nearfield Len	13.19617	m
Spread. Layer Thick.	1.026369	m
Dilution Impact	6.702816	
Dilution nearfield	10.89208	
Salinity eff	50.37	
Salinity amb	36.05	
Salinity Impact	37.91	
Salinity Nearfield	37.25	
Salinity Increase Impact	1.86	
Salinity Increase Nearfield	1.20	

Notes:

1- The nearfield length and dilution parameters should not change considerably between a discharge near the bank and a discharge in the middle of the channel. The highest turbulence in the flow is expected to be achieved before the discharge reaches the opposite river bank.
2- The analysis assumes that although the discharge is to be made near the bank, it is placed at ~4.5 m depth (i.e. -4.5 mAHD).
3- Froude number are low compared to experimental conditions used to derive the experiments.
4- Salinity increase in the end of the nearfield would increase in comparison to previous analysis (from 1.1 to 1.4);
5- Spread layer thickness is similar to previous analysis
6- Far field results (discharge at the edge of the bank – worst case) – Up to 1.0 salinity increase at the edge noting a factor of 4 in the results (see report for discussion)

Mean flow depth (m)	Location	Distance from end of nearfield (m)						
		100	500	1,000	2,000	3,000	5,000	7,000
Discharge flow rate of 13 ML/day at edge of bank								
1.0	Bank edge	0.55-0.77	0.24-0.35	0.17-0.24	0.12-0.17	0.10-0.14	0.08-0.11	0.07-0.09
	Mid bank	0.00	0.00	0.00	0.00-0.01	0.01-0.03	0.02-0.04	0.03-0.04
	Opposite edge	0.00	0.00	0.00	0.00	0.00	0.00-0.01	0.00-0.01
3.0	Bank edge	0.11-0.15	0.05-0.07	0.03-0.05	0.02-0.03	0.02-0.03	0.02	0.01-0.02
	Mid bank	0.00	0.00	0.00-0.01	0.01	0.01	0.01	0.01
	Opposite edge	0.00	0.00	0.00	0.00	0.00-0.01	0.01	0.01

Hope this helps. Please let me know if you require anything further.

Bets regards,

Dr Daniel A. Botelho
Principal Engineer

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Appendix C AEP Environmental Report

AEP

ECOLOGY | BIOBANKING | OFFSETS | BUSHFIRE

AQUATIC ECOLOGY ASSESSMENT

FOR

EMERGENCY DESALINATION PLANT INFRASTRUCTURE

AT

WALLAMBA RIVER, NABIAC NSW

Prepared for: Mid Coast Council

13 December 2019

AEP Ref: 2045

P 0418 681 581 E CRAIG@ANDERSONEP.COM.AU PO BOX 210 ADAMSTOWN NSW 2289 ABN 27 170 660 510

EXECUTIVE SUMMARY

Anderson Environment & Planning (AEP) has been requested by Mid Coast Council to undertake field investigations and reporting to prepare an Aquatic Ecological Assessment Report (AEAR) to accompany a Review of Environmental Factors (REF) for a proposed emergency desalination plant, located on the Wallamba River, Nabiac NSW.

Specifically, the AEAR herewith focusses on two key points:

- The Water Intake Point (WIP), located approximately 20km upstream of the ocean entrance; and
- The Water Discharge Point (WDP), located approximately 12km upstream of the ocean entrance.

The layout of the plant will include a Water Intake Point (WIP) from the river where desalination treatment will occur via reverse osmosis, and Water Discharge Point (WDP) further downstream to release saline waste water following treatment. Direct impacts associated with the construction of the WIP and WDP have been assessed on the shoreline and aquatic environment, in particular threatened/protected species and communities, and marine vegetation and habitats. In this regard, the report aims to recognise the relevant requirements of the *Fisheries Management Act 1994*, and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Operational impacts have also been assessed at the WIP and WDP, including the potential for fish larvae entrainment into the system at the WIP, and release of increased salinity waste water into the receiving environment at the WDP. Consideration of potential for impacts on other river user groups (wake boarders, professional fishermen etc) is also included.

The assessment has resulted in the following key findings:

- Aquatic (and terrestrial) impacts at the WIP are not significant on any threatened flora or fauna;
- Aquatic (and terrestrial) impacts at the WDP are not significant on any threatened flora or fauna.
- Minor immature Mangrove removal will occur at the WDP, and as such a permit to harm marine vegetation will be required from NSW Fisheries. It is considered highly likely that Mangroves will recolonise the immediate area post construction.
- Water intake at the WIP will be limited to $0.1m^2$ / second, and therefore combined with appropriate screening and intake pipe design, larvae entrainment is not expected to be a notable issue.

- With saline plume modelling showing that the notable effect zone of increased saline plume from discharge point is <14m, changes to the local saline ecological environment are unlikely to be discernible.
- Pipeline maintenance including the use of descaling agents will follow industry best practice and thus should not invoke any notable impacts.
- Sensitive downstream receivers including Coastal SEPP Wetlands and commercial Oyster production areas are well beyond any immediate area that may be affected by discharge of increased salinity water.
- Given all of the the above, impacts on other river system user groups is unlikely to be discernible.

In summary, the proposed development is unlikely to lead to any notable impacts on the local aquatic environment, nor affect any stakeholders to any degree.

Regardless, recommendations are made to minimise potential impacts further.

Contents

Tables

Figures

1.0 Introduction

Anderson Environment & Planning (AEP) has been commissioned by Mid Coast Council to undertake field investigations and reporting to prepare an Aquatic Ecology Assessment Report (AEAR) as part of a Review of Environmental Factors (REF) for a proposed emergency desalination plant, located on the Wallamba River, Nabiac NSW.

The layout of the plant will include a Water Intake Point (WIP) from the river where desalination treatment will occur via reverse osmosis, and Water Discharge Point (WDP) further downstream to release saline waste water following treatment. Direct impacts associated with the construction of the WIP and WDP have been assessed on the shoreline and aquatic environment, in particular threatened/protected species and communities, and marine vegetation and habitats. Operational impacts have also been assessed at the WIP and WDP, including the potential for fish larvae entrainment into the system at the WIP, and release of increased salinity waste water into the receiving environment at the WDP.

Other infrastructure associated with the treatment plant is located terrestrially, which will be assessed within a separate report.

In this regard, the report aims to recognise the relevant requirements of the *Fisheries Management Act 1994*, and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

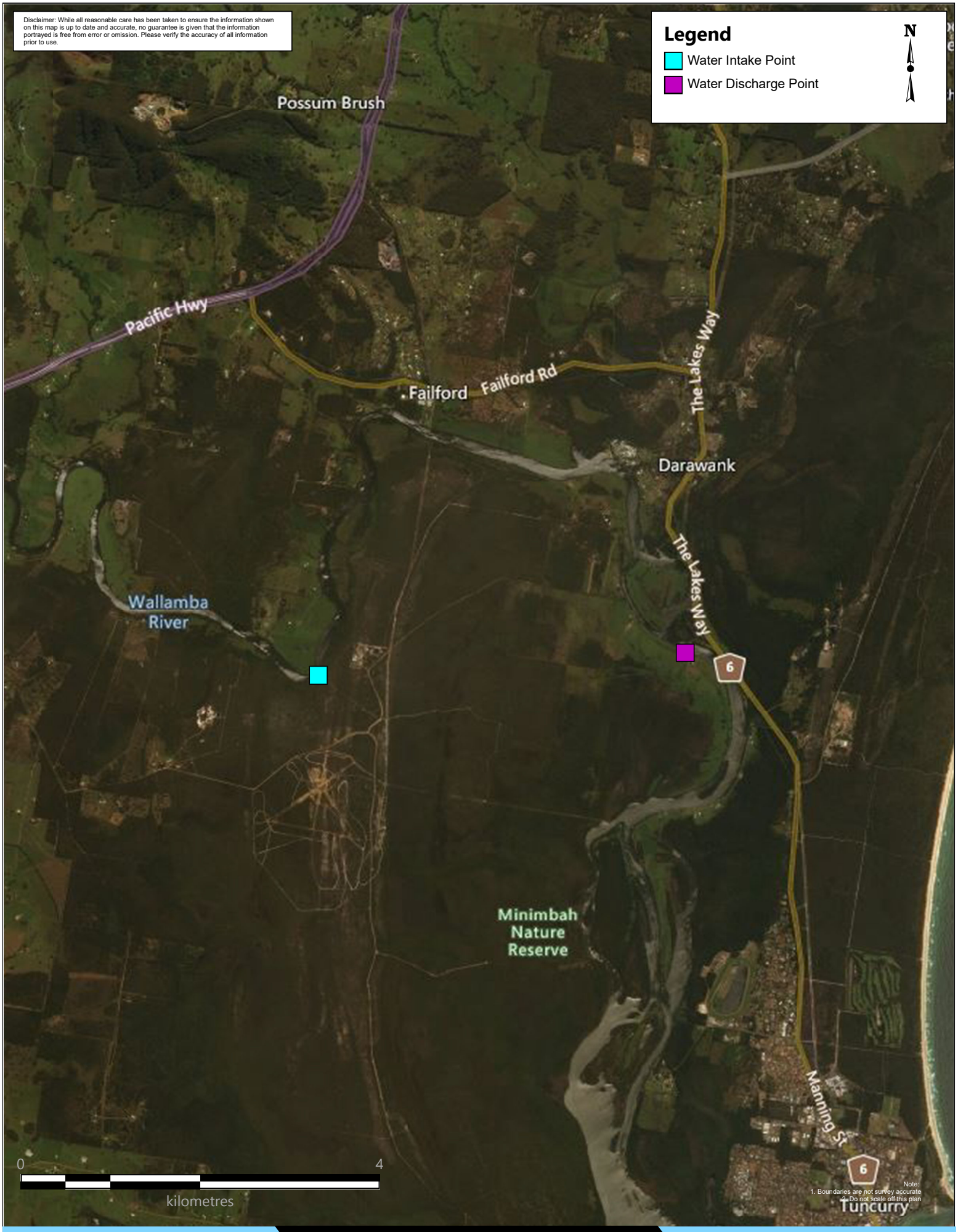
For the purposes of referencing, this document should be referred to as:

> Anderson Environment & Planning (2019) *Aquatic Ecological Assessment Report for Emergency Desalination Plant, Wallamba River, Nabiac NSW.* Unpublished report for Mid Coast Council.

2.0 Site Particulars

- **Location** – Wallamba River, NSW.
- **Local Government Area (LGA)** – Mid Coast
- **Subject Site** – The WIP and WDP points and immediate terrestrial surrounds, and the entire Wallamba River aquatic system.
- **Current Land Use** – The WIP is currently native bushland and undisturbed river environs. The WDP is a this strip of remnant vegetation along Elliots Road. Rock armouring has been emplaced along the WDP area by wakeboarders to reduce bank erosion.

Figure 1 depicts the extent of the subject site showing the location of the WIP and WDP, overlain on an aerial photograph of the study area.



AEP

Title: Figure 1 - Site Location

Date: Dec 2019

Location: Wallamba, NSW

Client: Mid Coast Council

Our Ref: 2045

3.0 Proposed Development

The proposed desalination plant would directly affect the aquatic environment at two separate locations, Water Intake Point (WIP), and Water Discharge Point (WDP). Indirect impacts are considered for the wider aquatic system, and in particular the downstream environs.

At the time of conducting this assessment, no detailed design for the proposal was available.

However, the assessment herewith has been undertaken on the basis of the following design advices:

- That intake water rate is set at $0.1m^2$ / second; and
- That the notable effect zone of increased saline plume from discharge point is <14m.
- That required maintenance of the system using descaling agents etc will be undertaken in accordance with industry best practice.

4.0 Existing Environment

The proposed desalination plant would affect the aquatic environment at two separate locations, Water Intake Point (WIP), and Water Discharge Point (WDP).

The WIP is located in the upper reaches of the Wallamba River east of the Pacific Highway, approximately 20km upstream of the ocean entrance. The river is still tidal at this point.

The river bank at this location is incised and obviously eroding with a near vertical cross section, approximately 3m from top of the bank to water level. The surrounding vegetation on the bank contains woodland dominated by *Angophora costata* (Smooth-barked Apple), *Eucalyptus signata* (Scribbly Gum), and *Banksia aemula* (Wallum Banksia). This vegetation community is mapped as MU 119 – Scribbly Gum / Wallum Banksia / Prickly-leaved Paperbark Heathy Coastal Woodland.

The WDP is located approximately 8km downstream of the WIP (i.e. approximately 12km upstream of the ocean entrance), on the river flat surrounded largely by cleared rural land, and bounded by Elliots Road to the west. Vegetation in the immediate area surrounding the WDP on the river bank contains *Casuarina glauca* (Swamp Oak), *Eucalyptus grandis* (Flooded Gum), *Acacia longifolia subsp. sophorae* (Coastal Wattle), *Parsonsia straminea* (Common Silkpod), *Avicennia marina* (Grey Mangrove), and *Aegiceras corniculatum* (River Mangrove). A number of exotics are intermixed with this vegetation including Coastal Morning Glory, Camphor Laurel, and Kikuyu. This vegetation community is indicative of MU 192 – Swamp Oak Forest on Coastal Lowlands.

5.0 Scope and Purpose

This AEAR has been informed by background research, literature review, database searches, consultation with NSW Fisheries, targeted ecological fieldwork, mapping, detailed habitat assessment, and ultimately, impact assessment consideration against the type and form of the proposal.

Survey design, impact assessment and consideration of recommendations were undertaken with due reference to the above legislation and the following relevant guidelines:

- NSW Department of Environment and Conservation. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities: Working Draft, (2004);
- NSW Department of Environment and Climate Change - Threatened Species Assessment Guidelines – The assessment of significance (2007);
- NSW Office of Environment and Heritage - *NSW Guide to Surveying Threatened Plants* (2016); and
- Various documents relating to assessment of marine vegetation.

Specifically, the scope of this study is to:

- Identify vascular plant species occurring within the subject site, including any threatened species listed under the FM Act or EPBC Act;
- Identify and map the extent of vegetation communities within the subject site, including listed EECs;
- Identify any fauna species, including threatened and migratory species, and populations or their habitats, which occur within the site and/or are known to occur in the wider locality;
- Assess the potential for the proposal to have a significant impact on any threatened species, populations or EEC (or their habitats) identified within the subject site;
- Assess the potential for the proposal to impact on marine vegetation;
- Consider the impacts on other user groups / stakeholders / sensitive downstream features within the aquatic system; and
- Recommend measures to be implemented to identify, minimise, mitigate and ameliorate potential environmental impacts of the proposal.

6.0 Study Certification and Licencing

This report was drafted by Tim Mouton (BEnv Sc, MEnv Sc) and reviewed / finalised by Craig Anderson BAppsc (EAM) of Anderson Environment & Planning.

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL101313;
- Animal Research Authority (Trim File No: 14/600(2)) issued by NSW Agriculture; and
- Animal Research Establishment Accreditation Number 53724.

Certification:

As the principal author, I, Craig Anderson, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the subject site;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, unless specified departures from industry standard guidelines are justified for scientific and/or animal ethics reasons; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the Animal Research Act 1995, BC Act and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Principal Author and Certifier:

CRAIG ANDERSON

Director

Anderson Environment & Planning

13 December 2019

7.0 Methods

The assessment approach was tailored to undertake sufficient works relating to threatened species, and native species in general, to ensure that legislative requirements were met for the proposal.

To ensure a robust impact assessment approach, where any potential doubt remained over species impact, presence within the study area was assumed to ensure an overly conservative approach was employed.

Consideration of other matters such as downstream effect on commercial Oyster Farms and Coastal SEPP Wetlands is included, as is consideration of any impacts on recreational users of the river system (wake boarders etc).

7.1 Literature Review

Primary information sources reviewed included:

- Aerial Photograph Interpretation (API) of the site and surrounding locality;
- Review of regional vegetation mapping relevant to the site, sourced from Vegetation Map for the Mid North Coast of NSW dataset (Eco Logical 2006);
- Review of Department of Primary Industries Threatened Species Lists and distribution maps;
- Search and review of threatened species records from the NSW Bionet Atlas within a 5km radius of the site;
- Search and review of records within a 5km radius of the site held by the Commonwealth Department of Energy and Environment, summarising *Matters of National Environmental Significance* that may occur in, or may relate to, the study area;
- Note that any records considered erroneous, historic (records before 1999), or obviously of no relevance to the site in regards to habitat have been omitted.

Collective knowledge gained from previous ecological survey and assessment in the Great Lakes area over more than 25 years has also been relied upon.

7.2 Field Survey

Vegetation and habitat were surveyed utilising a variety of methods, as outlined below:

- Visual survey of the water line for presence of aquatic flora / fauna, in particular for the presence of seagrass;
- Assess bank / shoreline vegetation, in particular for the presence of mangroves;
- Record the presence of habitat features including overhanging vegetation and timber snags.

Terrestrial environs for the WIP and WDP were collectively surveyed for both the AEAR herewith a separate Terrestrial Ecology Assessment Report currently in production.

7.2.1 Survey Dates, Times & Activity

Table 1 – Field Survey Effort

Date	Time	Activity
09/12/2019	11:00 – 13:30	Aquatic flora and fauna surveys – WIP & WDP
10/12/2019	8:50 – 12:40	Aquatic WIP & WDP terrestrial assessment
11/12/2019	8:25 – 12:00	WIP & WDP re-checks (as part of overall terrestrial surveys)

8.0 Results

8.1 Threatened Species Database Searches

Searches were undertaken of the Department of Primary Industries Threatened Species Lists and distribution maps, to determine the potential for threatened species to occur within the vicinity of the WIP and WDP.

The BC Act NSW Bionet Atlas and EPBC Protected Matters Search tool were also used to search for listed threatened species records within a 5km radius of the site. Note that any records considered erroneous, or obviously of no relevance to the site in regards to aquatic habitat have been omitted such as terrestrial or strictly oceanic species.

The potential for listed threatened species to occur within the site is considered in **Table 2** below.

Table 2 – Threatened Species Appraisal

Scientific Name	Common Name	FM Act	BC Act	EPBC Act	Likelihood of Occurrence
Flora					
Avicennia marina	Grey Mangrove	P*			Grey Mangroves are actively recolonising along the base of emplaced rock armouring along the river bank at the WDP. As a result it is unlikely that total avoidance of mangroves will be achievable at the WDP. However, the mangroves in this area are juvenile/seedlings, and it is likely that only a small amount would be disturbed resulting in minimal impact to this species. Recolonisation post development is considered likely. Notwithstanding, a permit would be required from NSW DPI to harm marine vegetation.
Aegiceras corniculatum	River Mangrove	P*			Scattered River Mangrove are present within patches of recolonising Grey Mangrove. As above, it is likely that a small number would be disturbed, requiring a permit from NSW DPI to harm marine vegetation. Recolonisation post development is considered likely.
Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - EEC	Swamp Oak Floodplain Forest		E	E	This community is present within the proposed WDP site. It occurs as a very narrow and disturbed strip (max. 5m wide) of vegetation between the bank of the river and Elliots Road immediately to the west. **Assessment of Significance required**
Fish					
Hippocampus whitei	White Seahorse			E	This species favours shallow water estuarine habitat on the east coast of NSW. The subject site is located a significant distance (approx. 12-20km) upstream from the ocean outlet of the Wallamba River. Preferred habitat (sponge gardens, seagrass and soft corals) is not present at either the WIP or WDP locations. Therefore, it is highly unlikely that this species would occur in the vicinity of the subject site.

Scientific Name	Common Name	FM Act	BC Act	EPBC Act	Likelihood of Occurrence
Mogurnda adspersa	Southern Purple Spotted Gudgeon			E	This species occurs as two separate populations, eastern and western. The eastern population generally occurs north of the Clarence River, and the species has not been recorded in this area since 1983. However, DPI distribution mapping shows this species as potentially occurring within the catchment of the Wallamba River. The mapped distribution occurs outside of the study site, west of the Pacific Highway within parts of the river less influenced by tidal activity. Given the estuarine/tidal nature of the subject site, and the subject site is outside the mapped distribution, it is unlikely that this species would occur.
Herpetofauna					
Caretta caretta	Loggerhead Turtle			E	This species is predominantly ocean dwelling, however may utilise nearshore coastal habitat including corals, rocky reefs, seagrass beds, and muddy bays. These features are not present at either the WIP or WDP locations. In addition, the subject site is located a significant distance (approx. 12-20km) upstream from the ocean outlet of the Wallamba River. Therefore, it is highly unlikely that this species would occur in the vicinity of the subject site.
Chelonia mydas	Green Turtle			V	This species is predominantly ocean dwelling and may utilise nearshore coastal areas including beaches and seagrass beds. The subject site is located a significant distance (approx. 12-20km) upstream from the ocean outlet of the Wallamba River, and does not contain preferred habitat. Therefore, it is highly unlikely that this species would occur in the vicinity of the subject site.
Dermochelys coriacea	Leatherback Turtle			E	This species is predominantly ocean dwelling and may utilise nearshore coastal areas for foraging. The subject site is located a significant distance (approx. 12-20km) upstream from the ocean outlet of the Wallamba River, and does not contain preferred foraging habitat. Therefore, it is highly unlikely that this species would occur in the vicinity of the subject site.

Table Key - Status (BC Act & EPBC Act):

CE: Critically Endangered E: Endangered V: Vulnerable P: Protected

*Note that Marine Vegetation (Mangroves, Seagrasses, Macroalgae) are not listed as Threatened under the FM Act (with the exception of location specific listed populations), however they are protected from 'harm' under Part 7 Division 4 of the Act

8.2 Vegetation Communities

Shoreline and aquatic vegetation communities were identified using a combination of desktop assessment using the Vegetation Map for the Mid North Coast of NSW dataset (Eco Logical 2006) and ground-truthing.

8.2.1 Shoreline Vegetation

Water Intake Point

The river bank at this location is incised and obviously eroding. Some vegetation was present on the steep bank including *Baloskion pallens*, *Pteridium esculentum*, *Angophora costata*, and *Casuarina glauca*. Vegetation on the bank is indicative of the surrounding vegetation community, which is mapped as MU 119 – Scribbly Gum / Wallum Banksia / Prickly-leaved Paperbark Heathy Coastal Woodland.

Riverbank at WIP

Woodland Community at WIP

Water Discharge Point

The WDP is located on the river flat surrounded by cleared rural land. Vegetation in the immediate area surrounding the WDP on the river bank contains *Casuarina glauca* (Swamp Oak), *Eucalyptus grandis* (Flooded Gum), *Acacia longifolia subsp. sophorae* (Coastal Wattle), and *Parsonsia straminea* (Common Silkpod), A number of exotics are intermixed with this vegetation including Coastal Morning Glory, Camphor Laurel, and Kikuyu.

This vegetation is mapped as MU 181 – Broad-leaved Paperbark / Swamp Mahogany / Swamp Oak / Saw Sedge Forest, however is more indicative of MU 192 – Swamp Oak Forest on Coastal Lowlands, and is equivalent to a disturbed version of the EEC *Swamp Oak Floodplain Forest* (BC Act) or *Coastal Swamp Oak Forest* (EPBC Act).

Assessment of significance for Swamp Oak is included in the terrestrial ecology report.

Riverbank at WDP

Swamp Oak Forest strip along WDP area

8.2.2 Aquatic Vegetation

Water Intake Point

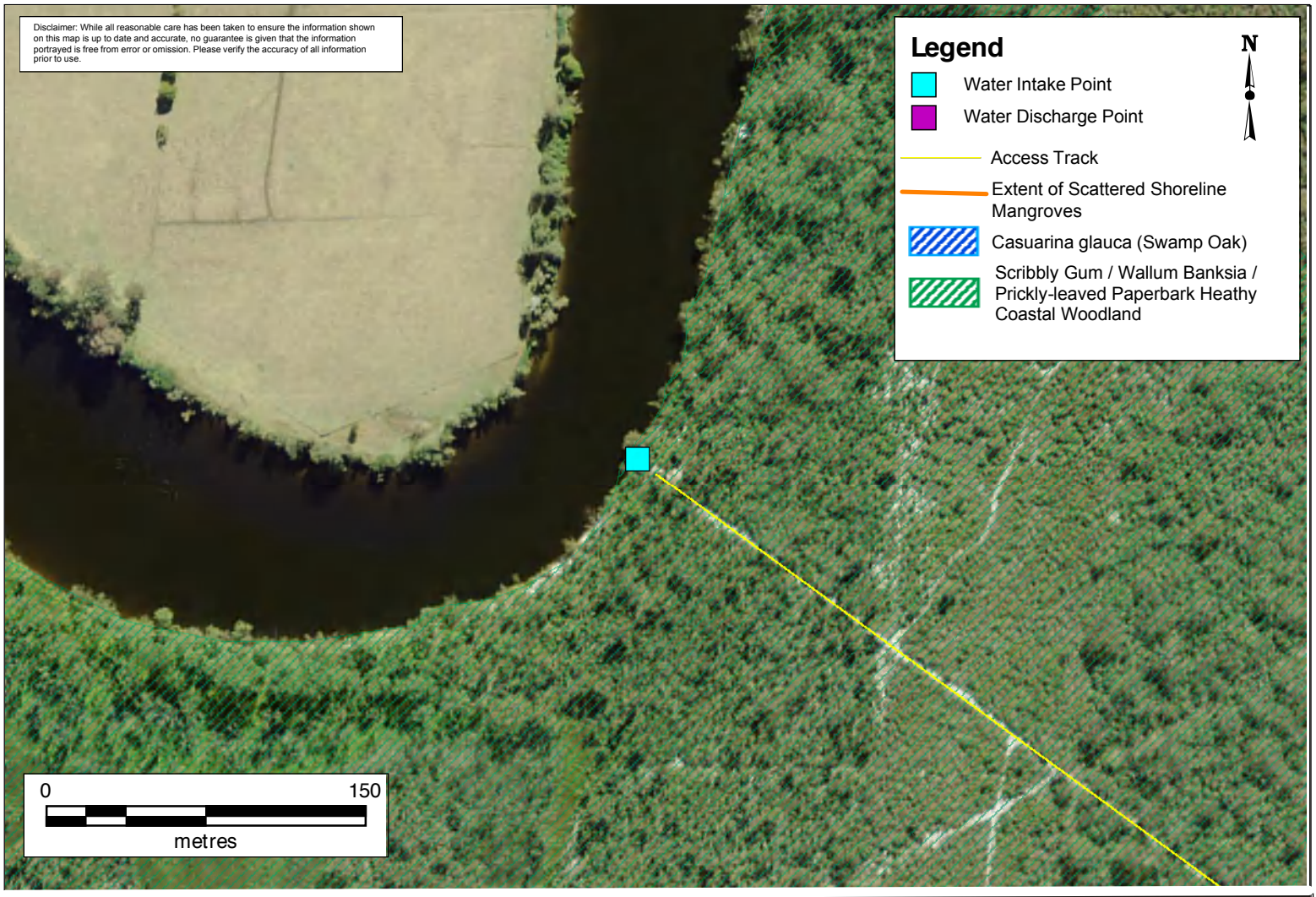
The substrate present on the shoreline and river bed at the WIP is sand and scattered sandstone cobble. Microalgae was present on the sandstone cobble. No aquatic vegetation, including seagrass or macroalgae, were observed within the substrate or water column. No saltmarsh or mangroves were present on the water line or river bank.

Water Discharge Point

The substrate present on the shoreline and river bed at the WDP was fine sediment and emplaced small to medium rock armouring (this was placed by local Wakeboarding community to stop shoreline erosion). Microalgae was present on the rock armour. No seagrass or macroalgae were observed within the substrate or water column. Mangroves were present on the water line or river bank including recolonising / regrowth *Avicennia marina* (Grey Mangrove) and *Aegiceras corniculatum* (River Mangrove). No saltmarsh species were present.

The proposal is likely to result in disturbance to Mangroves at the WDP, and therefore will require a permit to 'harm' from NSW DPI – Fisheries.

Mangroves at WDP



AEP

Title: Figure 2 - WIP & WDP Vegetation Map

Date: Dec 2019

Location: Wallamba, NSW

Client: Mid Coast Council

Our Ref: 2045

8.3 Habitat Assessment

No submerged snags were present at either WIP or WDP sites. Some overhanging vegetation is present at the WIP, such as destabilised trees as a result of bank erosion and ferns/sedges on the lower bank. This vegetation has the potential to form future submerged habitat at the WIP, given the bank is likely to continue to erode further undermining vegetation anchoring in the bank.

At the WDP rock armouring offset from the bank edge has created areas with reduced tidal/wave activity where mangrove propagules are collecting and recolonising.

Overall both sites represent limited aquatic habitat for threatened flora or fauna identified in Table 2.

8.4 Fauna

No aquatic fauna was observed in the vicinity of the WIP or WDP. As discussed in **Table 2**, it is considered unlikely any threatened fauna would utilise the site as potential foraging or breeding habitat.

9.0 Threatened Species Impact Assessment

No threatened aquatic flora or fauna were observed within the vicinity of the WIP or WDP. The study site is unlikely to contain suitable habitat for threatened species listed under the FM Act, BC Act, or EPBC Act as detailed in **Table 2**. Therefore, no further assessment is deemed necessary.

10.0 Fisheries Management Act

Under the *Fisheries Management Act 1994 (*FM Act*)*:

- A permit is required for dredging or reclamations works on water lands; and
- Approval from the relevant consent authority is required for the harm of seagrass and mangroves.

In accordance with the FM Act, the proposed WDP will likely impact on a small area of mangrove regrowth, and therefore constitute harm of mangroves. Therefore, consultation and applications to the Department of Primary Industries (Fisheries) will be required.

11.0 EPBC Act Assessment

A Protected Matters search of an area of 5km radius of the subject site was conducted in December 2019 for Matters of National Environmental Significance (MNES) as relevant to the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

The following MNES are considered in this assessment.

World Heritage Properties:

The site is not a World Heritage area and is not in close proximity to any such area.

National Heritage Places:

The site is not a National Heritage place, and it is not in close proximity to and such places.

Wetlands of International Significance (declared Ramsar Wetlands):

There are no Ramsar Wetlands located nearby.

Great Barrier Reef Marine Park:

The site is not part of, or within close proximity to, the Great Barrier Reef Marine Park.

Commonwealth Marine Areas:

The site is not part of, or within close proximity to, any Commonwealth Marine Area.

Threatened Ecological Communities:

An EPBC Protected Matters Search revealed CEECs that may occur within the 5km radius search area surrounding the subject site:

- Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland;
- Lowland Rainforest of Subtropical Australia; and
- Subtropical and Temperate Coastal Saltmarsh.

Disturbed *Coastal Swamp Oak Forest* has been identified as present in the study area. This is being assessed in the Terrestrial Ecology Report, but given the small linear strip and area present, impact is unlikely to be significant.

Threatened Species:

No threatened species listed under the EPBC Act were observed or recorded on site.

Migratory Species:

A number of EPBC listed migratory species have potential to utilise the site on an irregular basis.

It is not considered that the development of this land as proposed is likely to significantly affect the availability of potential habitat for such mobile species or disrupt migratory patterns.

EPBC Act Assessment Conclusion:

As there would be little impact on listed species recorded within the subject site, it is considered that no further assessment would be required under the EPBC Act, and therefore referral of the proposal to the Commonwealth is not required.

12.0 Recommendations

The following general recommendations are made for consideration to minimise localised impacts on biodiversity in general, and to ensure overall improved environmental outcomes for aquatic flora and fauna habitat in the locality, as a result of the proposal:

- Bank stabilisation measures should be implemented at the WIP during construction and operation of the desalination plant to minimise erosion risk. This could include localised reshaping of the incised bank, installation of ground stabilising matting and/or terracing, and revegetation using suitably dense planting of groundcovers, trees, and shrubs.
- Aquatic floating screening should be utilised around the extent of the works area to ensure that mobilised sediment and debris is not distributed into the wider system;
- Detailed design is not currently available for the proposal and therefore locations for the WIP and WDP identified in this report are indicative. No constraints were identified within the vicinity of the WIP. Mangroves are present along the tidal shoreline of the majority of the proposed WDP, and therefore avoidance and/or minimising disturbance should be considered (noting that impacts are considered minor, and mangrove recolonization following construction is considered highly likely.

13.0 References

DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities: Working Draft.* NSW Department of Environment and Conservation, Sydney.

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EXECUTIVE SUMMARY

Anderson Environment & Planning (AEP) has been requested by Mid Coast Council to undertake field investigations and reporting to prepare a Terrestrial Ecological Assessment Report (TEAR) to accompany a Review of Environmental Factors (REF) for a proposed emergency desalination plant, located on the Wallamba River, Nabiac NSW.

The TEAR herewith documents and assesses the terrestrial environs covered by:

- The Water Intake Point (WIP), located approximately 20km upstream of the ocean entrance;
- The Water Discharge Point (WDP), located approximately 12km upstream of the ocean entrance.
- The proposed site of the Desalination Plant located within the existing Water Treatment Compound; and
- The proposed pipeline alignment connecting the above points (approx. XX km).

The assessment herewith has been informed by desktop research and field survey of the above development components. Field survey was limited to general floristics work, habitat assessment and incidental fauna observations only, due to the short timeframes available for this emergency project. Large sections of the alignment have also been recently burnt which hinders botanical survey.

The development area and surrounds were found to contain the following general vegetation communities:

- WIP: *Eucalyptus racemosa ssp. racemosa / Angophora costata* Woodland
- WDP: *Casuarina glauca* Forest
- Desal Plant: Grassland
- Pipeline alignment – traverses a number of communities including:
    - *Eucalyptus racemosa ssp. racemosa / Angophora costata* Woodland
    - *Casuarina glauca* Forest
    - Grassland
    - *Eucalyptus robusta / Melaleuca quinquenervia* Swamp Forest
    - *Eucalyptus grandis* Forest
    - *Banksia spp* Shrubland / Heathland

Of the above communities, two are considered aligned with listed Endangered Ecological Communities, being:

- *Casuarina glauca* Forest (Swamp Oak Floodplain Forest – listed under State & Federal legislation). Impact is limited to a thin shoreline strip at the WDP.

- *Eucalyptus robusta / Melaleuca quinquenervia* Swamp Forest (Swamp Sclerophyll Forest – listed under State legislation). Pipeline alignment in the existing Elliots Road corridor should be able to avoid any direct impact on this community.

The alignment has been sited to follow existing tracks and cleared road easements wherever possible to minimise vegetation loss. Vegetation impacts will occur on non-EEC communities at the WIP and unavoidably along some sections of the pipeline alignment.

No threatened plants were observed along the alignment during fieldwork, though there is potential for such to occur, particularly for seasonal / cryptic species. Some threatened species including *Allocasuarina simulans* were noted in the general area during fieldwork, but were not encountered along the alignment.

Habitat assessment revealed that the alignment and surrounds would offer suitable habitat for a variety of locally occurring threatened fauna species. The only threatened fauna species encountered during the (limited) field survey was Varied Sitella, which was observed foraging in *Eucalyptus grandis* trees near the bridge.

The terrestrial ecology assessment herewith has been undertaken with reference to the *Environmental Planning and Assessment Act 1979* (EP&A Act) as well as the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Assessment under the Biodiversity Offset Scheme determined no threshold is triggered and the '5-part test' determined that no significant impacts upon threatened entities listed under the NSW BC Act are likely to occur if mitigation measures are implemented. Loss of vegetation / habitat is very limited in spatial extent, and much of the area would be expected to regenerate post construction. Consideration of the EPBC Act revealed that impacts on Matters of National Environmental Significance are unlikely to occur.

Assessment under *State Environmental Planning Policy 44 – Koala Habitat Protection* revealed that parts of the site do constitute 'Potential Koala Habitat' as defined within the policy. No evidence of Koala activity was found, and any impacts on PKH should be able to be avoided by aligning the pipeline within the Elliots Road corridor through areas supporting Swamp Mahogany. As such, no further provision of the policy would apply to the site.

General recommendations covering construction and post construction are included for consideration to minimise localised impacts on biodiversity in general as a result of the proposed activity.

ECOLOGY | BIOBANKING | OFFSETS | BUSHFIRE

TERRESTRIAL ECOLOGICAL ASSESSMENT REPORT

FOR

EMERGENCY DESALINATION PLANT INFRASTRUCTURE

AT

WALLAMBA RIVER, NABIAC NSW

Prepared for: Mid Coast Council

20 December 2019

AEP Ref: 2045

P 0418 681 581 E CRAIG@ANDERSONEP.COM.AU PO BOX 210 ADAMSTOWN NSW 2289 ABN 27 170 660 510

EXECUTIVE SUMMARY

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The development area and surrounds were found to contain the following general vegetation communities:

- WIP: Dry Sclerophyll Woodland - *Eucalyptus racemosa ssp. racemosa / Angophora costata / Banksia aemula*
- WDP: Swamp Oak Forest - *Casuarina glauca*
- Desal Plant: Exotic Grassland
- Pipeline alignment – traverses a number of communities including:
    - Dry Sclerophyll Woodland - *Eucalyptus racemosa ssp. racemosa / Angophora costata / Banksia aemula*
    - Swamp Oak Forest - *Casuarina glauca*
    - Exotic Grassland
    - Swamp Sclerophyll Forest - *Eucalyptus robusta / Melaleuca quinquenervia*
    - Wet Sclerophyll Forest - *Eucalyptus grandis / Angophora floribunda / Casuarina glauca*
    - Wallum Sand Heath – *Banksia aemula*

Of the above communities, two are considered aligned with listed Endangered Ecological Communities, being:

- *Casuarina glauca* Forest (Swamp Oak Floodplain Forest – listed under State & Federal legislation). Impact is limited to a thin shoreline strip at the WDP.
- *Eucalyptus robusta / Melaleuca quinquenervia* Swamp Forest (Swamp Sclerophyll Forest – listed under State legislation). Pipeline alignment in the existing Elliots Road corridor should be able to avoid any direct impact on this community.

The alignment has been sited to follow existing tracks and cleared road easements wherever possible to minimise vegetation loss. Vegetation impacts will occur on non-EEC communities at the WIP and unavoidably along some sections of the pipeline alignment.

No threatened plants were observed along the alignment during fieldwork, though there is potential for such to occur, particularly for seasonal / cryptic species. Some threatened species including *Allocasuarina simulans* were noted in the general area during fieldwork, but were not encountered along the alignment.

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1.0 Introduction

Anderson Environment & Planning (AEP) has been requested by Mid Coast Council to undertake field investigations and reporting to prepare a Terrestrial Ecological Assessment Report (TEAR) to accompany a Review of Environmental Factors (REF) for a proposed emergency desalination plant, located on the Wallamba River, Nabiac NSW.

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- The Water Discharge Point (WDP), located approximately 12km upstream of the ocean entrance.
- The proposed site of the Desalination Plant located within the existing Water Treatment Compound; and
- The proposed pipeline alignment connecting the above points (approx. 6 km).

The assessment herewith has been informed by desktop research and field survey of the above development components. Field survey was limited to general floristics work, habitat assessment and incidental fauna observations only, due to the short timeframes available for this emergency project. Large sections of the alignment have also been recently burnt which hinders botanical survey.

This TEAR is specifically intended to indicate the likelihood of the proposed works having a significant effect on threatened species, populations or flora assemblages considered to constitute an Endangered Ecological Community (EEC). In this regard, the report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EPA Act), the *Biodiversity Conservation Act 2016* (the BC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The purpose of this TEAR is to:

- Describe ecological values of the site;
- Explore the potential for threatened species to utilise the site;
- Assess ecological impacts associated with the proposal against relevant legislation; and
- Recommend actions to mitigate deleterious environmental effects of the project.

For the purposes of referencing, this document should be referred to as:

> Anderson Environment & Planning (2019) *Terrestrial Ecological Assessment Report for Emergency Desalination Plant, Wallamba River, Nabiac NSW. Unpublished report for Mid Coast Council.*

2.0 Site Particulars

- **Location** – Wallamba River NSW
- **Local Government Area (LGA)** – Mid Coast
- **Subject Site** – The subject site comprises four components associated with the proposal:
    - The Water Intake Point (WIP), located approximately 20km upstream of the ocean entrance;
    - The Water Discharge Point (WDP), located approximately 12km upstream of the ocean entrance.
    - Desalination Plant located within the existing Water Treatment Compound;
    - Pipeline alignment located within existing tracks and cleared road easements (approx. 6 km)
- **Zoning** – As per *Great Lakes Environmental Plan 2014*, the site is zoned RU2 – Rural Lanscape and SP2 – Infrastructure.
- **Current Land Use** – The WIP is currently located within native bushland and undisturbed river environs. The WDP location contains a narrow strip of remnant vegetation between Elliots Road and the river bank. The Desalination plant is located within an existing cleared area containing exotic grassland. The remaining surrounds contain remnant heathland and swamp forest vegetation, and cleared rural land.

Figure 1 depicts the extent of the subject site, overlain on an aerial photograph of the study area.


Legend
Water Intake Point
Water Discharge Point
Proposed Alignment
N
W
E
S
Failford Rd
Failford Rd
The Lakes Way
Ton-O-Fun Park
Darawank
Wallamba River
Wallamba River
The Lakes Way
Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.
Note:
1. Boundaries are not survey accurate
2. Do not scale off this plan
0
1.6
kilometres
AEP
Title: Figure 1 - Site Location
Date: Dec 2019
Location: Wallamba, NSW
Client: Mid Coast Council
Our Ref: 2045
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3.0 Proposed Development

The proposed development comprises four components associated with the proposal:

- The Water Intake Point (WIP), located approximately 20km upstream of the ocean entrance;
- The Water Discharge Point (WDP), located approximately 12km upstream of the ocean entrance.
- Desalination Plant located within the existing Water Treatment Compound;
- Pipeline alignment located within existing tracks and cleared road easements (approx. 6 km)

4.0 Scope and Purpose

This TEAR has been informed by background research, literature review, database searches, consultation, targeted ecological fieldwork, mapping, detailed habitat assessment, historical site knowledge and ultimately, impact assessment consideration against the type and form of the proposal.

Survey design, impact assessment and consideration of recommendations were undertaken with due reference to the above legislation and the following relevant guidelines:

- NSW Department of Environment and Conservation. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities: Working Draft, (2004);
- NSW Department of Environment and Climate Change - Threatened Species Assessment Guidelines – The assessment of significance (2007);
- NSW Office of Environment and Heritage - *NSW Guide to Surveying Threatened Plants* (2016); and

Specifically, the scope of this study is to:

- Identify vascular plant species occurring within the subject site, including any threatened species listed under the BC Act or EPBC Act;
- Identify and map the extent of vegetation communities within the subject site, including listed EECs;
- Identify any fauna species, including threatened and migratory species, and populations or their habitats, which occur within the site and/or are known to occur in the wider locality;
- Assess the potential for the proposal to have a significant impact on any threatened species, populations or EEC (or their habitats) identified within the subject site; and
- Recommend measures to be implemented to identify, minimise, mitigate and ameliorate potential environmental impacts of the proposal.

In addition to the survey works conducted within the subject site, consideration has been afforded to the wider locality utilising database searches within 10km of the site and assessment of habitat that may be ecologically linked to the subject site.

5.0 Study Certification and Licencing

This report was drafted by Tim Mouton (BEnv Sc, MEnv Sc) and reviewed / finalised by Craig Anderson BAppsc (EAM) of Anderson Environment & Planning.

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL101313;
- Animal Research Authority (Trim File No: 14/600(2)) issued by NSW Agriculture; and
- Animal Research Establishment Accreditation Number 53724.

Certification:

As the principal author, I, Craig Anderson, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the subject site;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, unless specified departures from industry standard guidelines are justified for scientific and/or animal ethics reasons; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the Animal Research Act 1995, BC Act and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Principal Author and Certifier:

CRAIG ANDERSON

Director

Anderson Environment & Planning

20 December 2019

6.0 Methods

The field surveys for the subject area have been prepared and performed with due recognition of the instruments previously discussed.

The size of the subject site, the type and status of native vegetation and habitats remaining, the status of existing and proposed surrounding land use, and the level and type of habitat linkages to other proximate bushland areas were all considered in formulating the methodology employed and described below.

The assessment approach was tailored to undertake sufficient works relating to threatened species, and native species in general, to ensure that legislative requirements were met for the proposal.

To ensure a robust impact assessment approach, where any potential doubt remained over species impact, presence within the study area was assumed to ensure an overly conservative approach was employed.

6.1 Literature Review

Primary information sources reviewed included:

- Aerial Photograph Interpretation (API) of the site and surrounding locality;
- Review of regional vegetation mapping relevant to the site, sourced from Vegetation Map for the Mid North Coast of NSW dataset (Eco Logical 2006);
- Reference to Griffith & Wilson (2007), Wallum on the Nabiac Pleistocene barriers, NSW. *Cunninghamia 10(1): 2007*;
- NSW Office of Environment & Heritage (OEH) Threatened Species, Populations and Ecological Communities website;
- Collective knowledge gained from previous ecological survey and assessment in the Great Lakes area over more than 25 years; and
- Anecdotal records.

In addition, database searches were carried out, namely:

- Search and review of flora and fauna sighting records in the OEH *Atlas of NSW Wildlife* within 10km of the subject site; and
- Search and review of records within a 5km radius of the site held by the Commonwealth Department of Energy and Environment, summarising *Matters of National Environmental Significance* that may occur in, or may relate to, the study area.
- Note that any records considered erroneous, historic (records before 1999), or obviously of no relevance to the site in regards to habitat have been omitted.

6.2 Field Survey

6.2.1 Vegetation Communities

Vegetation was surveyed utilising a variety of methods, as outlined below:

- Review of API and vegetation mapping to identify any obvious notable variations within the site;
- Consultation of 1:25,000 topographic map series for the area;
- Subject site inspection to ground truth the unit(s) identified by API and vegetation mapping; and
- Fieldwork, including incidental fauna of observations and compilation of floristic inventory of the subject site (see below).

Consideration was given to the potential for derived vegetation community(s) to constitute EEC, as listed under the BC Act and/or EPBC Act. Study area floristic composition, geomorphological characteristics and geographical extent were considered in this process.

6.2.2 Flora

A general flora survey was undertaken to produce a flora species list for the subject site, to search specifically for threatened flora species known from the wider area, and to gather data necessary to both derive vegetation community type and to meet the survey guidelines of relevant authorities. Survey works included:

- Vegetation was assessed 5m either side of the pipeline alignment. Identification of all vascular plant species encountered during fieldwork. Coverage by standard plot or transect was deemed unnecessary due to the small subject site area and high level of disturbance and management associated with roads and easements. Adequate survey coverage was achieved by recording all species found in a walkover of the subject site and incidental observations during fieldwork; and
- Targeted searches in areas of potentially suitable habitat were undertaken for threatened flora species identified by literature searches.

It should be noted that limitations apply to the timing of flora surveys conducted. The timeframe to conduct surveys was limited due to the nature of the proposal being emergency works to maintain adequate water supply. In addition, large sections of the alignment have been recently burnt which hinders botanical survey, and detailed design was not available for the WIP, WDP, pipeline alignment, and desalination plant. Targeted surveys were not undertaken for cryptic species with known flowering periods outside of the current survey effort, specifically ground orchids.

A full inventory of flora species recorded during fieldwork is included as **Appendix A**.

6.2.3 Habitat

An assessment of the relative habitat values present within the subject site was carried out. This focused primarily on the identification of specific habitat types and resources available within the subject site favoured by identified threatened species from the locality. The assessment also considered the potential value of the subject site and locality for major guilds of native flora and fauna.

The assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, ranging patterns and corridor requirements. Consideration was given to contributing factors including topography, soils, aspect, foliage cover, frequency of hollows and ground habitat, and hydrology for threatened flora and /or ecological community assemblages.

6.2.4 Fauna

Fauna survey effort for the site was covered by incidental and opportunistic records of fauna species during fieldwork including:

- Avifauna surveys. Birds were identified by direct observation, by recognition of calls, any sightings of secondary distinctive features such as nests, feathers etc. during fieldwork; and
- Incidental records of fauna species observed during fieldwork were noted. This included searches for secondary indications (scratches, scats, diggings, tracks etc.) that may indicate subject site usage by resident or migratory species. Observation was conducted for whitewash, regurgitation pellets and prey remains from forest owls, chewed *Casuarina* species cones from cockatoos, chewed fruit remains from frugivorous birds, koala scats etc.

6.2.5 Survey Dates, Times & Activity

Table 1 – Field Survey Effort

Date	Time	Activity
09/12/2019	11:00 – 13:30	Aquatic flora and fauna surveys – WIP & WDP
10/12/2019	8:50 – 12:40	WIP & WDP terrestrial assessment
11/12/2019	8:25 – 12:00	Terrestrial assessment of pipeline alignment and desal site

In addition, by applying rigorous habitat assessment to more mobile species recorded within the locality, it is ensured that all possible use of the study area and wider site by notable species is considered, and hence accommodated within subsequent biodiversity management recommendations.

7.0 Results

7.1 Database Searches

Searches were undertaken of databases within a 10km radius of the subject site for BC Act listings and 5km radius for EPBC Act listings. Note that any records considered erroneous, or obviously of no relevance to the site in regards to habitat (e.g. seabirds, aquatic and marine species etc.) have been omitted, as have records prior to 1999.

The potential for listed threatened species to occur within the site is considered in **Table 2** below.

Detailed ecological profiles of threatened species can be found at:

https://www.environment.nsw.gov.au/threatenedSpeciesApp/

Table 2 – Threatened Species Appraisal

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Flora				
Allocasuarina defungens (58)	**Dwarf Heath Casuarina**	**E**	**E**	The species is found in tall heath on sand, but can also occur on clay soils and sandstone. Suitable habitat is found within the subject site although the species was not observed during recent surveys. **SUBJECT SPECIES**
Allocasuarina simulans (97)	**Nabiac Casuarina**	**V**	**V**	The species grows in heathland on coastal sands. A number of specimens were observed during recent field work although these individuals all occurred outside the development footprint. **SUBJECT SPECIES**
Maundia triglochinoides (2)		V		Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater. Suitable habitat absent from site, considered unlikely to occur.
Lindernia alsinoides (4)	Noah's False Chickweed	E		Grows in swampy sites in sclerophyll forest and coastal heath. Although suitable habitat may be present onsite the species was not observed during recent surveys and is unlikely to go undetected due to small size of the subject site. Considered unlikely to occur or be impacted by the proposed development.
Genoplesium littorale (195)	**Tuncurry Midge Orchid**	**E**	**CE**	Species not observed during recent surveys although the survey was conducted outside of known flowering period. Found in coastal heath close to the ocean in deep, well-drained sandy soils, suitable habitat is found onsite. **SUBJECT SPECIES**
Asperula asthenes (12)	Trailing Woodruff	V	V	Occurs in damp sites, often along river banks. Suitable habitat may be present onsite. The species was not observed during recent surveys and is unlikely to go undetected due to small size of the subject site. Considered unlikely to occur or be impacted by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Birds				
Lophoictinia isura (2)	Square-tailed Kite	V		Species not observed during recent surveys. Given the small area of vegetation proposed to be impacted by the proposed development, the mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Haematopus fuliginosus (1)	Sooty Oystercatcher	V		Species not observed during recent surveys. Given the small area of vegetation impacted by the proposed development, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Glossopsitta pusilla (4)	Little Lorikeet	V		Species not observed during recent surveys. Given the small area of vegetation impacted by the proposed development, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Ninox connivens (2)	Barking Owl	V		Species not observed during recent surveys. Absence of suitable nesting trees mean the site may offer foraging habitat only. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Calyptorhynchus lathami (3)	Glossy Black-Cockatoo	V		Species not observed during recent surveys. Preferred habitat (coastal open forest and woodland with she-oak stands) is present onsite. Despite this, given the small area of vegetation impacted by the proposed development, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted in any notable way by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Tyto longimembris (2)	Eastern Grass Owl	V		Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. The site at best would offer a very small area of suboptimal habitat for the species. Considering this, the small area proposed to be impacted and large areas of more suitable habitat to remain offsite it is unlikely that the proposed development will impact the species to any notable degree.
Daphoenositta chrysoptera (4)	Varied Sittella	V		Recorded onsite foraging in *Eucalyptus grandis* trees near the bridge. The area where it was observed will be retained. Preferred habitat (eucalypt forest and woodland, especially with rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland) present on site. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development. **SUBJECT SPECIES**
Artamus cyanopterus cyanopterus (3)	Dusky Woodswallow	V		Species not observed during recent surveys. Species widely but sparsely spread throughout most of New South Wales. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Ephippiorhynchus asiaticus (16)	Black-necked Stork	**E**		Species not observed during recent surveys. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Suitable habitat present onsite. **SUBJECT SPECIES**

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Haliaeetus leucogaster (6)	White-bellied Sea-Eagle	V		Species not observed during recent surveys. Preferred foraging habitat (large areas of open water either near the ocean or in a variety of terrestrial habitats) present on site. Preferred breeding habitat (mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat, with large emergent eucalypts) not present on site. As development will not impact areas of preferred habitat, it is unlikely that this species would be impacted by the proposal.
Ixobrychus flavicollis (2)	Black Bittern	V		Species not observed during recent surveys. Preferred habitat (terrestrial or estuarine wetlands, or flooded grassland, forest, woodland, rainforest or mangroves near permanent water with dense reeds) not present on site. Unlikely to utilise site.
Lathamus discolor (7)	Swift Parrot	E	CE	Species not observed during recent surveys. Does not breed in mainland Australia. Preferred nectar feed trees (*Eucalyptus robusta*) present on site. **SUBJECT SPECIES**
Ninox strenua (3)	Powerful Owl	V		Species not observed during recent surveys. Absence of suitable nesting trees mean the site may offer foraging habitat only. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Pandion cristatus (4)	Eastern Osprey	V		Species not observed during recent surveys. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Tyto novaehollandiae (4)	Masked Owl	V		Species not observed during recent surveys. Absence of suitable nesting trees mean the site may offer foraging habitat only. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Pezoporus wallicus wallicus (1)	Eastern Ground Parrot	V		The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). The site offers a very small area of habitat for the species, which is known to occur in the area. Considering the small area proposed to be impacted and large areas of more suitable habitat to remain offsite it is unlikely that the proposed development will impact the species to any notable degree. **SUBJECT SPECIES**
Mammals				
Micronomus norfolkensis (6)	Eastern Freetail-bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Miniopterus australis (11)	Little Bentwing-bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Miniopterus schreibersii oceanensis (7)	Eastern Bentwing-bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Dasyurus maculatus (3)	Spotted-tailed Quoll	V	E	Species or evidence of presence was not observed during recent surveys. Species recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Suitable den sites absent from the site. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Petaurus norfolcensis (39)	Squirrel Glider	V		Species not observed during recent surveys. Suitable breeding habitat in the form of hollows absent, foraging habitat only may be present onsite. **SUBJECT SPECIES**
Phascolarctos cinereus (15)	Koala	V	V	Species not observed during recent surveys. A small number of *Eucalyptus robusta* a feed tree is present onsite, but makes up less than 15% of the canopy. Feed trees will not be impacted by proposed development. **SUBJECT SPECIES**
Phascogale tapoatafa (17)	Brush-tailed Phascogale	V		Known to inhabit heath, swamps, rainforest and wet sclerophyll forest. Suitable habitat present onsite. **SUBJECT SPECIES**
Cercartetus nanus (2)	Eastern Pygmy-possum	V	V	Species nor evidence of presence observed during recent surveys. The species is found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Suitable habitat present onsite. Despite this, given the lack of records and small amount of vegetation proposed to be impacted it is considered unlikely that the species will be impacted by the proposed development in any notable way.
Saccolaimus flaviventris (1)	Yellow-bellied Sheathtail-bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Scoteanax rueppellii (3)	Greater Broad-nosed Bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Pteropus poliocephalus (23)	Grey-headed Flying-fox	V	V	Species not observed during recent surveys. Eucalypt species suitable for foraging present on site. Preferred habitat (subtropical and temperate rainforest, tall sclerophyll forest and woodland, heath and swamps, and urban gardens) present on site. Site could provide food during migrations, but unlikely to be a significant part of range. **SUBJECT SPECIES**
Falsistrellus tasmaniensis (2)	Eastern False Pipistrelle	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Myotis macropus (1)	Southern Myotis	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.
Vespadelus troughtoni (1)	Eastern Cave Bat	V		Species not observed during recent surveys. No hollows or other suitable breeding habitat onsite or proposed to be impacted by the proposed development. Given the small area of vegetation impacted, mobile nature of the species and large areas of high-quality habitat to remain offsite, it is considered unlikely that the species will be impacted by the proposed development.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Pseudomys gracilicaudatus (2)	Eastern Chestnut Mouse	V		Species not observed during recent surveys. In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. Suitable habitat found onsite. **SUBJECT SPECIES**
Pseudomys novaehollandiae (17)	New Holland Mouse		V	Species not observed during recent surveys. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. Suitable habitat for the species found onsite. **SUBJECT SPECIES**
Herpetofauna				
Crinia tinnula (13)	Wallum Froglet	E	E	Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Suitable habitat for the species may be found within drainage ditches within the subject site. **SUBJECT SPECIES**

Table Key - Status (BC Act & EPBC Act):

CE: Critically Endangered, E: Endangered and V: Vulnerable

7.2 Vegetation Communities

Vegetation communities were identified using a combination of desktop assessment using the Mid North Coast of NSW dataset (Eco Logical 2006), reference to Griffith & Wilson (2007), and ground-truthing.

Vegetation communities have been assessed and mapped within the pipeline corridor, within 5m either side of the centre line. While the majority of works will occur within existing track and road easements, it is expected that some minor clearing of isolated trees and shrubs will be removed to accommodate machinery movements and temporary spoil placement from pipeline trenching works. Vegetation communities are shown in **Figure 2.**

7.2.1 Dry Sclerophyll Woodland – *Eucalyptus racemosa ssp. racemosa / Angophora costata / Banksia aemula*

This community is predominantly located along at the western extent of the project alignment, predominantly between the river and Elliots road. Some areas are present as regrowth which display a heath dominated structure with scattered Eucalypt saplings. Dominant species within the canopy are *Eucalyptus racemosa ssp. racemosa, Angophora floribunda,* and *Banksia aemula*. The shrub layer is characteristic of wallum heath including *Leptospermum trinervium*, *Leptospermum polygalifolium*, *Leucopogon leptospermoides*, *Dillwynia glaberrima*, *Bossiaea heterophylla*, and *Aotus ericoides.* The ground layer is relatively sparse containing *Actinotus helianthi*, *Baloskion pallens*, and *Pteridium esculentum*.

Dry Sclerophyll Woodland

7.2.2 Wallum Sand Heath – *Banksia aemula*

This community is located on sand flats through the central portion of the alignment, where Eucalypt canopy species are absent. Low canopy is present, predominantly consisting of *Banksia aemula*. The shrub layer is dense containing *Leptospermum trinervium*, *Leptospermum polygalifolium*, *Acacia longifolia*, *Acacia ulicifolia*, *Acacia suaveolens*, *Isopogon anemonifolius*, *Leucopogon leptospermoides*, *Dillwynia glaberrima*, *Bossiaea heterophylla*, and *Aotus ericoides*. The ground layer is relatively sparse containing *Actinotus helianthi*, *Baloskion pallens*, and *Pteridium esculentum*.

Wallum Sand Heath

7.2.3 Swamp Sclerophyll Forest – *Eucalyptus robusta / Melaleuca quinquenervia / Casuarina glauca*

This community is located on floodplain areas through the central and eastern portion of the alignment, present as a narrow strip either side of the road verge. This community is considerably disturbed due to the location adjacent to Elliots Road, and much of this vegetation community has recently been burnt during wildfires. Dominant species within the canopy are *Eucalyptus robusta*, *Melaleuca quinquenervia*, and *Casuarina glauca*. The shrub and ground layers contain a mix of exotic (*Cinnamomum camphora*, *Lantana camara*, exotic pasture) and native regrowth (*Acacia sp.*, *Hakea teretifolia*, *Phragmites australis*, Gahnia sp., and *Parsonsia straminea*).

This community is representative of Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community.

Swamp Sclerophyll Forest

7.2.4 Swamp Oak Forest – *Casuarina glauca*

This community is located adjacent to the Wallamba River at the eastern extent (WDP) of the alignment, and is present as a narrow strip between the road verge and river bank. Dominant species within the canopy are *Casuarina glauca*. The shrub and ground layers contain a mix of exotic (*Cinnamomum camphora*, *Senecio madagascariensis*, *Pennisetum clandestinum*) and native regrowth (*Acacia longifolia*, *Polyscias sambucifolia*, *Glochideon ferdinandi*, *Parsonsia straminea*).

This community is representative of Swamp Oak Floodplain Forest Endangered Ecological Community.

Swamp Oak Forest

7.2.5 Wet Sclerophyll Forest – *Eucalyptus grandis / Angophora floribunda / Casuarina Glauca*

This community is located on floodplain areas through the eastern portion of the alignment, present as a narrow strip either side of the road verge, predominantly surrounding the wooden bridge on Elliots Road. Dominant species within the canopy are *Eucalyptus grandis*, *Angophora floribunda*, and *Casuarina glauca*. The shrub and ground layers contain a mix of exotic (*Cinnamomum camphora*, *Sida rhombifolia*) and native regrowth (*Acacia longifolia*, *Melaleuca quinquenervia*, *Lomandra longifolia*, *Phragmites australis*).

Wet Sclerophyll Forest

7.2.6 Exotic Grassland

This community is located at the desalination plant site and road verge adjacent to the WDP. Species present include *Paspalum dilatum*, *Stenotaphrum secundatum*, *Briza sp.*, *Pennisetum clandestinum*, *Seneccio madagascariensis*, and *Plantago lanceolata*.

7.3 Flora

Flora survey identified 54 species within the study area, of which 13 (24%) were exotic species. No threatened flora species were identified. The threatened *Allocasuarina simulans* (Nabiac Casuarina) was observed in heath adjacent to the alignment. The heath vegetation within the subject site also represents potential habitat for the Critically Endangered *Genoplesium littorale* (Tuncurry Midge Orchid).

A full list of flora species identified by surveys conducted within the subject site is included in **Appendix A**.

Impact assessment upon threatened flora by the proposal is considered in **Section 10**.


Legend
Water Intake Point
Pipeline
Cadastre
Vegetation
Heath
Swamp Sclerophyll Forest
Scribbly Gum/ Angophora Woodland
N
W
E
S
Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate , no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.
Notes:
1. Boundaries are not survey accurate
2. Do not scale off this plan
Elliots Rd
Elliots Rd
Elliots Rd
Elliots Rd
0
300
metres
AEP
Title: Figure 2a - Vegetation Map
Date: Dec 2019
Location: Wallamba, NSW
Client: Mid Coast Council
Our Ref: 2045
© 2019 Microsoft Corporation © 2019 DigitalGlobe © CNES (2019) Distribution Airbus DS © 2019 HERE


Legend
Water Discharge Point
Pipeline
Cadastre
Vegetation
Wallum Sand Heath
Swamp Sclerophyll Forest
Wet Sclerophyll Forest
Swamp Oak Forest
Exotic Grassland
N
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Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.
Note:
1. Boundaries are not survey accurate
2. Do not scale off this plan
Riverview R
The Lakes Way
Wallamba River
Wallamba River
Elliots Rd
Elliots Rd
Elliots Rd
Elliots Rd
0
400
metres
AEP
Title: Figure 2b - Vegetation Map
Date: Dec 2019
Location: Wallamba, NSW
Client: Mid Coast Council
Our Ref: 2045
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7.4 Habitat Assessment

No habitat trees were identified within the project alignment / subject site that would be impacted by the proposal. Therefore, the subject site does not contain significant habitat resources for arboreal fauna.

Dense shrub layer and regrowth associated with woodland and heath vegetation communities within the subject site could offer foraging and shelter habitat for ground fauna and avifauna.

Given the narrow linear nature of the development, and extent of available high quality habitat available in the locality, the subject site is not likely to constitute important habitat for threatened fauna species.

7.5 Fauna

Fauna surveys identified 30 species including 28 bird, and 2 reptile, species within the study area. Species recorded were typical of those associated with coastal heath and swamp forest vegetation within the subject site and study area.

The only threatened fauna species encountered during the (limited) field survey was Varied Sittella, which was observed foraging in *Eucalyptus grandis* trees near the bridge.

An Expected Fauna Species List was generated for the site and is included as **Appendix B**, and fauna species recorded during fieldwork are noted therein.

Impact assessment upon threatened fauna by the proposal is considered in **Section 10**.

8.0 Key Species Considerations

Following works outlined in previous sections, species identified for further consideration have been categorised into guilds for simplicity of assessment.

By considering these species and their lifecycle needs, many other species are also inadvertently considered as well in identifying key features. The analysis below considers key lifecycle features for each guild of species in more detail and assists in informing the 5-part test assessment in **Section 10.**

Table 3 - Key Species Considerations

Species	Key Habitat Feature	Comment
Allocasuarina simulans **Allocasuarina defungens**	Habitat	Records of both species in the vicinity of subject site, A.defungens (58), A.simulans (97). A.simulans was observed in heath vegetation adjacent to the subject site.
Genoplesium littorale	Habitat	This species has been recorded within similar heath vegetation to the south-east of the subject site, north of Tuncurry east of the Wallamba River.
Swift Parrot	Foraging	Preferred feed trees Swamp Mahogany present within the Subject Site.
Varied Sittella	Habitat	Recorded onsite foraging in *Eucalyptus grandis* trees.
Ground Parrot	Habitat	This species is known to inhabit heath areas within the Minimbah sandplains.
Black-necked Stork	Roosting and Nesting Habitat	Tall trees absent from the subject site.
	Foraging	The Wallamba River contains suitable for foraging for this species.
Squirrel Glider	Nesting Habitat	Hollow bearing trees absent from the subject site.
	Foraging	Heath understory within the subject site would provide potential foraging habitat.
Koala	Foraging	Preferred feed trees Swamp Mahogany present within the Subject Site.
Grey-headed Flying-fox	Foraging	Preferred feed trees Swamp Mahogany and flowering shrubs present within the Subject Site.
Brush-tailed Phascogale **New Holland Mouse** **Eastern Chestnut Mouse**	Nesting Habitat Foraging	Heath vegetation community within the subject site would provide potential nesting and foraging habitat on site.
Wallum Froglet	Habitat	Low lying areas within heath and swamp forest vegetation would provide potential habitat, in particular roadside table drains containing heath regrowth.

9.0 Biodiversity Offsets Scheme Thresholds

This TEAR has been undertaken as part of an REF under Part 5 of the *Environmental Planning and Assessment Act*. As such the Biodiversity Offset Scheme Thresholds do not apply, such as the area clearing thresholds and reference to the Biodiversity Values Map. It is up to the discretion of the determining authority to determine if entry into the BOS is required.

Potential impacts associated with this proposal are covered in the 5-part test is in **Section 10** of this report.

10.0 5-part Test Assessment

Section 7.3 of the BC Act lists five factors that must be taken into account in determining the significance of potential impacts of proposed activities on threatened species, populations, ecological communities and/or their habitats as listed within the BC Act.

The 5-part test is used to determine whether there is likely to be a significant impact, and thus whether a Biodiversity Development Assessment Report (BDAR) is then required.

For the purposes of the 5-part test assessment, the **subject site** is the area directly affected by the proposal. The **study area** covers the subject site and its immediate surrounds.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Allocasuarina defungens

Allocasuarina simulans

Habitat for both these species is present within the Study Area. *Allocasuarina simulans* was observed outside of the project alignment / Subject Site. The proposed works involve excavation of a narrow trench to install a water pipeline, however this would not result in any impact on *Allocasuarina simulans* as they do not occur within the subject site in the direct vicinity of the proposed works. Therefore the proposal would not have an adverse effect on the lifecycle of this species.

Genoplesium littorale

Areas of the subject site represent potential suitable habitat, containing coastal heath on well drained sandy soils, and presence of Leptospermum / Banksia species. The location of this habitat is mapped as Dry Sclerophyll Woodland and Wallum Sand Heath in Figure 2a and 2b. However presence of this species within the Subject Site could not be determined as part of this assessment, as surveys were undertaken outside of the known flowering period (March-May) due to the expedited timeframe of the proposal.

Given the disturbed nature of the subject site being previously cleared regrowth within existing tracks and road verges, it is unlikely that the subject site represents significant habitat for this species. However, as mentioned above this assessment cannot determine presence or absence of this species as a result of the limited survey period available.

Swift Parrot

No Swift Parrot were observed within the Study Area. The proposed works would occur within existing tracks and road reserve, however minor vegetation clearing may be required of isolated trees and shrubs in areas of previously cleared regrowth on existing tracks and the road verge. No preferred feed trees (Swamp Mahogany) trees were identified as requiring removal. Therefore the proposal would not have an adverse effect on the lifecycle of this species.

Varied Sittella

One individual was observed foraging within the subject site, in a Flooded Gum adjacent to Elliots Road near the bridge crossing. None of these trees are proposed to be removed as the works will occur within the roadway. Any indirect impacts to this species would be temporary and minor in nature, during construction of the pipeline through this section of the alignment. In addition, this species is highly mobile and the immediate and wider locality contains large areas of high quality habitat. As a result the proposal would not have an adverse effect on the lifecycle of this species.

Ground Parrot

No Ground Parrots were observed during fieldwork, but the species is known to inhabit heath areas within the Minimbah sandplains system. A small amount of such habitat would be (temporarily) affected by the proposal. Given that large areas of habitat occur throughout the wider sandplain area, it is considered unlikely that the proposal would have an adverse effect on the lifecycle of this species.

Black-necked Stork

No Black-necked Stork were observed within the Study Area. The proposal predominantly involves the installation of a pipeline through terrestrial habitat, with small areas of aquatic habitat affected at the pipeline WIP and WDP. Given the extent of riverine and estuarine habitat available in the immediate and wider locality, it is highly unlikely that the proposal would have an adverse effect on the lifecycle of this species.

Squirrel Glider

No hollow-bearing trees are present within the study area, therefore the subject site does not contain are suitable refuge / nesting habitat for this species. Heath vegetation within the subject site may represent marginal foraging habitat, however the majority of this has been previously disturbed by clearing and/or fire. The wider locality contains high quality interconnected heath and woodland habitat (well in excess of 1000ha). Therefore removal of small areas of regrowth along a linear easement to install the water pipeline would not have an adverse effect on the lifecycle of this species.

Koala

No Koala were observed within the Study Area. The proposed works would occur within existing tracks and road reserve, however minor vegetation clearing may be required of isolated trees and shrubs in areas of previously cleared regrowth on existing tracks and the road verge. No preferred feed trees (Swamp Mahogany) trees were identified as requiring removal. Therefore the proposal would not have an adverse effect on the lifecycle of this species.

Grey-headed Flying-fox

No Grey-headed Flying-fox were observed within the Study Area. The proposed works would occur within existing tracks and road reserve, however minor vegetation clearing may be required of isolated trees and shrubs in areas of previously cleared regrowth on

existing tracks and the road verge. No preferred feed trees (Swamp Mahogany) trees were identified as requiring removal. Therefore the proposal would not have an adverse effect on the lifecycle of this species.

Brush-tailed Phascogale

New Holland Mouse

Eastern Chestnut Mouse

These species were not observed within the Study Area. Suitable habitat is present on site within heathland vegetation, mapped as Dry Sclerophyll Woodland and Wallum Sand Heath as shown in Figure 2a and 2b. However the majority of this has been previously disturbed by clearing and/or fire. The wider locality contains high quality interconnected heath and woodland habitat (well in excess of 1000ha). Any impacts to vegetation will be temporary in nature. Following trenching works and pipeline installation, the disturbed area will be immediately backfilled with stabilised with in-situ topsoil containing the existing seed bank, which will help facilitate quick regeneration. Therefore removal of small areas of regrowth to install the water pipeline would not have an adverse effect on the lifecycle of these species.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Swamp Oak Floodplain Forest

Swamp Sclerophyll Forest

Swamp Oak and Swamp Sclerophyll forest vegetation is present within the subject site, with Swamp Oak located along the river bank at the WDP, and both communities adjacent to the roadside table drain along Elliots Road. The majority of this these vegetation communities within the subject site will be avoided by the proposal, however minor clearing of isolated *Casuarina glauca* individuals and regrowth at these locations may be required. Given the large extent of both these communities occurring in the immediate and wider locality, and implementation of mitigation measures recommended in **Section 14,** minor clearing of this vegetation within the subject site would not adversely effect the life cycle or composition of these communities to place them at risk of extinction.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will result in minor temporary impacts to vegetation along a narrow linear corridor within existing tracks and road corridor. The immediate and wider locality contains large areas of similar or higher quality interconnected vegetation (well in excess of 1000ha). Mitigation measures recommended in **Section 14** would ensure that removal and/or modification would not result in loss of long-term habitat connectivity in the locality**.** Therefore the proposal would not significantly affect the extent of EEC vegetation or habitat.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,

The immediate and wider locality contains large areas of similar or higher quality interconnected vegetation (well in excess of 1000ha). Mitigation measures recommended in **Section 14** would ensure that removal and/or modification would not result in loss of long-term habitat connectivity in the locality**.**

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

As outlined above, the habitat present is not considered of significance for long term survival of any threatened species or EEC in this locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No area of outstanding biodiversity value would be affected by the proposal.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

The development has potential to contribute to the following KTPs:

- Clearing of native vegetation

The development as proposed will remove a very small area of disturbed native regrowth vegetation within existing tracks and road reserve. In addition, the narrow strip to be disturbed will be rehabilitated immediately following pipeline installation. Therefore, the contribution to this KTP in this instance is not of a notable magnitude.

- Anthropogenic climate change

The development as proposed will contribute in a small way to the processes causing Anthropogenic Climate Change via the removal of vegetation which acts as a carbon sink. It is not considered the contribution to this KTP in this instance is of a notable magnitude.

- Invasion of native plant communities by exotic species

Multiple exotic species are already present on the subject site. Development has some potential to preference growth of these exotic species over native species. Mitigation

measures recommended in **Section 14,** in particular post trenching rehabilitation, will limit the impact of this KTP.

11.0 Koala Assessment

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) applies to land in the Mid Coast LGA. Schedule 2 of SEPP 44 lists tree species which are considered indicators of potential Koala habitat as they are known to be utilised as feed trees by Koalas. The presence of any of these tree species on a site proposed for development triggers the requirement for an assessment of the study site for 'Potential Koala Habitat' (PKH).

PKH is defined in the SEPP as:

"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component."

Site inspection reveals that one feed tree species (Eucalyptus robusta) listed within Schedule 2 of SEPP 44 is present onsite. As this species does not constitute greater than 15% of the canopy the site is not considered PKH.

Core koala habitat is defined in the SEPP as:

"an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population."

No sightings or evidence of Koalas was found onsite during recent surveys nor do any Atlas records exist within the subject site. This indicates that no resident population of Koalas resides or utilises the site in any meaningful way and it is therefore not considered Core Koala habitat.

As such, no further provision of the policy would apply to the site.

12.0 Coastal Management SEPP

The Subject Site is not mapped as Coastal Wetland Use under the *State Environmental Planning Policy (Coastal Management) 2018* (CM SEPP).

13.0 EPBC Act Assessment

A Protected Matters search of an area of 5km radius of the subject site was conducted in December 2019 for Matters of National Environmental Significance (MNES) as relevant to the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

The following MNES are considered in this assessment.

World Heritage Properties:

The site is not a World Heritage area and is not in close proximity to any such area.

National Heritage Places:

The site is not a National Heritage place, and it is not in close proximity to and such places.

Wetlands of International Significance (declared Ramsar Wetlands):

There are no Ramsar Wetlands located nearby.

Great Barrier Reef Marine Park:

The site is not part of, or within close proximity to, the Great Barrier Reef Marine Park.

Commonwealth Marine Areas:

The site is not part of, or within close proximity to, any Commonwealth Marine Area.

Threatened Ecological Communities:

An EPBC Protected Matters Search revealed CEECs that may occur within the 5km radius search area surrounding the subject site:

- Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland;
- Lowland Rainforest of Subtropical Australia; and
- Subtropical and Temperate Coastal Saltmarsh.

Small areas of disturbed *Coastal Swamp Oak Forest* will be impacted by the proposed development. This impact will involve the removal of a very small number of isolated individuals. It is considered that impacts to the community will be negligible given the small area to be removed, the fact that it will likely regenerate once works are finalised and the large areas of the community that exist offsite.

Threatened Species:

No threatened species listed under the EPBC Act were observed or recorded on site. Although 195 records of *Genoplesium littorale* (Tuncurry Midge Orchid) exist with a 10km radius of the site. As surveys were not undertaken during the known flowering period, presence and therefore significant impact cannot be ruled out for this species.

14.0 Recommendations

The following general recommendations are made for consideration to minimise localised impacts on biodiversity in general, and to ensure overall improved environmental outcomes in the locality, as a result of the proposal:

- Dedicated stripping of topsoil, leaf litter etc. should be undertaken and stockpiled adjacent to the trench. This is to be progressively placed back over the disturbed area last after backfilling;
- Backfilling and topsoil placement should occur immediately following pipeline installation, with the aim of reinstating the existing soil profile. The majority of the trench is to be filled by the end of each work day, and any remaining open sections covered if possible;
- Daily checks of any sections of open trench should be undertaken at the start of each work day by an ecologist prior to works commencing to ensure any trapped fauna are identified and relocated;
- Tree retention (particularly within EEC) is highly encouraged wherever feasible within the scope of the development. A tree retention zone should be clearly marked on site to ensure protection of retained trees within the surrounding vegetation;
- Best practice erosion and sedimentation controls should be put in place to limit offsite movement of materials into the surrounding areas. Particular care should be taken to minimise impacts to drainage ditches adjacent to roads;
- Effective weed control should be used on site, ensuring that appropriate methods are used to eliminate and dispose of highly competitive weeds.

15.0 References

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Appendix A – Flora Species List

FLORA SPECIES LIST

The following list includes all species of vascular plants observed on site during fieldwork. It should be noted that such a list cannot be considered comprehensive, but rather indicative of the flora present on the site. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Such species are identified as accurately as possible, and are indicated in the list as thus:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation "sp.", indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark ("?") placed in front of the generic, which is followed by the abbreviation "sp." and;
- specimens that could be accurately identified to genus level but could be identified to species level with only a degree of certainty are indicated by a ("?") placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

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Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated in the first part of the table.

Threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font.**

Family Name	Scientific Name	Common Name
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax
Asteraceae	*Actinotus helianthi*	Flannel Flower
Asteraceae	*Senecio madagascariensis**	Fireweed
Asteraceae	*Actinotus minor*	Lesser Flannel Flower
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza parva**	Fleabane
Asteraceae	*Taraxacum sp.*	Dandelion
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Cyperaceae	*Gahnia sp.*	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Ericaceae	*Leucopogon leptospermoides*	
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree
Fabaceae	*Acacia longifolia*	
Fabaceae	*Bossiaea heterophylla*	Variable Bossiaea
Fabaceae	*Dillwynia glaberrima*	Parrot Pea
Fabaceae	*Aotus ericoides*	-
Fabaceae	*Acacia suaveolens*	Sweet Scented Wattle
Fabaceae	*Acacia ulicifolia*	Prickly Moses
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine tabacina*	Twining Glycine
Juncaceae	*Juncus sp.*	-
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Lauraceae	*Cassytha glabella f. glabella*	Slender Devil's Twine
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Myrtaceae	*Eucalyptus grandis*	Flooded gum
Myrtaceae	*Eucalyptus racemosa*	Narrow-leaved Scribbly Gum
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany
Myrtaceae	*Leptospermum polygalifolium*	Tantoon
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Phormiaceae	*Dianella sp.*	
Plantaginaceae	*Plantago lanceolata**	Ribwort
Poaceae	*Briza maxima**	Quaking Grass
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Pennisetum clandestinum**	Kikuyu, Kikuyu Grass
Poaceae	*Phragmites australis*	Common Reed
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass
Poaceae	*Briza minor**	Shivery Grass

Family Name	Scientific Name	Common Name
Poaceae	*Sporobolus sp.**	Rat's Tail Couch
Proteaceae	*Banksia aemula*	Wallum Banksia
Proteaceae	*Hakea teretifolia*	Dagger Hakea
Proteaceae	*Isopogon anemonifolius*	Flat-leaved Drumsticks
Proteaceae	*Persoonia lanceolata*	Lance-leaved Geebung
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Restionaceae	*Baloskion pallens*	-
Restionaceae	*Baloskion tetraphyllum*	
Sapindaceae	*Dodonaea triquetra*	Hop-bush
Verbenaceae	*Lantana camara**	Lantana

Appendix B – Expected Fauna Species List

EXPECTED FAUNA SPECIES LIST

The following list includes fauna species that could be reasonably expected to occur within the study area at some point, given site attributes and location. Records prior to 1999 were excluded.

"●"- species observed or indicated by scats, tracks, etc. on, over or near the site during field investigations undertaken by AEP.

* - Introduced species

? - Unconfirmed record, anecdotal records, etc.

A - NSW Atlas of Wildlife record of threatened species for the study area.

Threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font**.

Family	Scientific Name	Recorded	Common Name
Reptiles			
Chelidae	*Chelodina longicollis*		Eastern Snake-necked Turtle
Scincidae	*Bellatorias major*		Land Mullet
Scincidae	*Cryptoblepharus virgatus*		Cream-striped Shinning-skink
Scincidae	*Ctenotus robustus*		Robust Ctenotus
Scincidae	*Ctenotus taeniolatus*		Copper-tailed Skink
Scincidae	*Lampropholis delicata*		Dark-flecked Garden Sunskink
Scincidae	*Lampropholis guichenoti*		Pale-flecked Garden Sunskink
Scincidae	*Saproscincus mustelinus*		Weasel Skink
Scincidae	*Tiliqua scincoides*		Eastern Blue-tongue
Agamidae	*Amphibolurus muricatus*		Jacky Lizard
Varanidae	*Varanus varius*	●	Lace Monitor
Pythonidae	*Morelia spilota spilota*		Diamond Python
Colubridae	*Dendrelaphis punctulatus*		Common Tree Snake
Elapidae	*Acanthophis antarcticus*		Common Death Adder
Elapidae	*Cryptophis nigrescens*		Eastern Small-eyed Snake
Elapidae	*Demansia psammophis*	●	Yellow-faced Whip Snake
Elapidae	*Hemiaspis signata*		Black-bellied Swamp Snake
Elapidae	*Pseudechis porphyriacus*		Red-bellied Black Snake
Elapidae	*Pseudonaja textilis*		Eastern Brown Snake
Amphibians			
Myobatrachidae	*Crinia signifera*		Common Eastern Froglet
Myobatrachidae	*Crinia tinnula*		**Wallum Froglet**
Myobatrachidae	*Limnodynastes dumerilii*		Eastern Banjo Frog
Myobatrachidae	*Limnodynastes peronii*		Brown-striped Frog
Myobatrachidae	*Limnodynastes tasmaniensis*		Spotted Grass Frog
Myobatrachidae	*Paracrinia haswelli*		Haswell's Froglet
Myobatrachidae	*Pseudophryne bibronii*		Bibron's Toadlet
Myobatrachidae	*Pseudophryne coriacea*		Red-backed Toadlet
Myobatrachidae	*Uperoleia fusca*		Dusky Toadlet
Myobatrachidae	*Uperoleia laevigata*		Smooth Toadlet
Hylidae	*Litoria caerulea*		Green Tree Frog
Hylidae	*Litoria chloris*		Red-eyed Tree Frog
Hylidae	*Litoria dentata*		Bleating Tree Frog
Hylidae	*Litoria fallax*		Eastern Dwarf Tree Frog
Hylidae	*Litoria freycineti*		Freycinet's Frog
Hylidae	*Litoria gracilenta*		Dainty Green Tree Frog
Hylidae	*Litoria latopalmata*		Broad-palmed Frog
Hylidae	*Litoria nasuta*		Rocket Frog
Hylidae	*Litoria peronii*		Peron's Tree Frog
Hylidae	*Litoria revelata*		Revealed Frog
Hylidae	*Litoria tyleri*		Tyler's Tree Frog
Hylidae	*Litoria verreauxii*		Verreaux's Frog
Bufonidae	*Rhinella marina**		Cane Toad
Birds			
Phasianidae	*Coturnix pectoralis*		Stubble Quail
Phasianidae	*Coturnix ypsilophora*	●	Brown Quail

Family	Scientific Name	Recorded	Common Name
Phasianidae	*Coturnix chinensis*	B	King Quail
Anatidae	*Anas castanea*	B	Chestnut Teal
Anatidae	*Anas superciliosa*	B	Pacific Black Duck
Anatidae	*Aythya australis*		Hardhead
Anatidae	*Chenonetta jubata*	●	Australian Wood Duck
Anatidae	*Cygnus atratus*		Black Swan
Columbidae	*Chalcophaps indica*		Emerald Dove
Columbidae	*Columba leucomela*	B	White-headed Pigeon
Columbidae	*Columba livia*		Rock Dove
Columbidae	*Geopelia humeralis*	●	Bar-shouldered Dove
Columbidae	*Geopelia striata*	B	Peaceful Dove
Columbidae	*Lopholaimus antarcticus*	B	Topknot Pigeon
Columbidae	*Macropygia amboinensis*	B	Brown Cuckoo-Dove
Columbidae	*Ocyphaps lophotes*	●	Crested Pigeon
Columbidae	*Phaps chalcoptera*		Common Bronzewing
Columbidae	*Phaps elegans*	B	Brush Bronzewing
Columbidae	*Streptopelia chinensis*		Spotted Turtle-Dove
Podargidae	*Podargus strigoides*	B	Tawny Frogmouth
Caprimulgidae	*Eurostopodus mystacalis*	B	White-throated Nightjar
Aegothelidae	*Aegotheles cristatus*		Australian Owlet-nightjar
Apodidae	*Hirundapus caudacutus*	B	White-throated Needletail
Phalacrocoracidae	*Phalacrocorax sulcirostris*	●	Little Black Cormorant
Phalacrocoracidae	*Phalacrocorax varius*		Pied Cormorant
Pelecanidae	*Pelecanus conspicillatus*		Australian Pelican
Ardeidae	*Ardea ibis*	●	Cattle Egret
Ardeidae	*Ardea intermedia*		Intermediate Egret
Ardeidae	*Ardea modesta*		Eastern Great Egret
Ardeidae	*Ardea pacifica*	B	White-necked Heron
Ardeidae	*Egretta novaehollandiae*	B	White-faced Heron
Threskiornithidae	*Plegadis falcinellus*		Glossy Ibis
Threskiornithidae	*Threskiornis molucca*		Australian White Ibis
Threskiornithidae	*Threskiornis spinicollis*		Straw-necked Ibis
Accipitridae	*Accipiter fasciatus*	B	Brown Goshawk
Accipitridae	*Aquila audax*	B	Wedge-tailed Eagle
Accipitridae	*Aviceda subcristata*		Pacific Baza
Accipitridae	*Circus approximans*	B	Swamp Harrier
Accipitridae	*Elanus axillaris*	B	Black-shouldered Kite
Accipitridae	*Haliaeetus leucogaster*		**White-bellied Sea-Eagle**
Accipitridae	*Haliastur sphenurus*	B	Whistling Kite
Accipitridae	*Lophoictinia isura*		**Square-tailed Kite**
Accipitridae	*Pandion cristatus*	**B**	**Eastern Osprey**
Falconidae	*Falco berigora*	●	Brown Falcon
Falconidae	*Falco peregrinus*	B	Peregrine Falcon
Rallidae	*Gallinula tenebrosa*		Dusky Moorhen
Rallidae	*Gallirallus philippensis*		Buff-banded Rail
Rallidae	*Porphyrio porphyrio*		Purple Swamphen
Haematopodidae	*Haematopus fuliginosus*		Sooty Oystercatcher
Charadriidae	*Pluvialis fulva*	●	Pacific Golden Plover
Charadriidae	*Vanellus miles*	●	Masked Lapwing
Scolopacidae	*Gallinago hardwickii*		Latham's Snipe

Family	Scientific Name	Recorded	Common Name
Turnicidae	*Turnix varius*	B	Painted Button-quail
Laridae	*Thalasseus bergii*		Crested Tern
Cacatuidae	*Cacatua galerita*	B	Sulphur-crested Cockatoo
Cacatuidae	*Calyptorhynchus funereus*	●	Yellow-tailed Black-Cockatoo
Cacatuidae	*Calyptorhynchus lathami*		**Glossy Black-Cockatoo**
Cacatuidae	*Eolophus roseicapillus*	B	Galah
Psittacidae	*Alisterus scapularis*	B	Australian King-Parrot
Psittacidae	*Glossopsitta pusilla*	**B**	**Little Lorikeet**
Psittacidae	*Lathamus discolor*		**Swift Parrot**
Psittacidae	***Pezoporus wallicus wallicus***	**B**	**Eastern Ground Parrot**
Psittacidae	*Platycercus eximius*		Eastern Rosella
Psittacidae	*Trichoglossus chlorolepidotus*	B	Scaly-breasted Lorikeet
Psittacidae	*Trichoglossus haematodus*		Rainbow Lorikeet
Centropodidae	*Centropus phasianinus*	B	Pheasant Coucal
Cuculidae	*Cacomantis flabelliformis*		Fan-tailed Cuckoo
Cuculidae	*Cacomantis variolosus*	●	Brush Cuckoo
Cuculidae	*Chalcites basalis*		Horsfield's Bronze-Cuckoo
Cuculidae	*Chalcites lucidus*	B	Shining Bronze-Cuckoo
Cuculidae	*Eudynamys orientalis*	B	Eastern Koel
Cuculidae	*Scythrops novaehollandiae*	B	Channel-billed Cuckoo
Strigidae	*Ninox connivens*		**Barking Owl**
Strigidae	*Ninox strenua*		**Powerful Owl**
Tytonidae	*Tyto javanica*		Eastern Barn Owl
Tytonidae	*Tyto longimembris*	**B**	**Eastern Grass Owl**
Tytonidae	*Tyto novaehollandiae*		**Masked Owl**
Alcedinidae	*Ceyx azureus*	B	Azure Kingfisher
Alcedinidae	*Dacelo novaeguineae*	●	Laughing Kookaburra
Alcedinidae	*Todiramphus sanctus*	●	Sacred Kingfisher
Meropidae	*Merops ornatus*	●	Rainbow Bee-eater
Coraciidae	*Eurystomus orientalis*	B	Dollarbird
Climacteridae	*Cormobates leucophaea*		White-throated Treecreeper
Ptilonorhynchidae	*Ailuroedus crassirostris*		Green Catbird
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	B	Satin Bowerbird
Maluridae	*Malurus cyaneus*	●	Superb Fairy-wren
Maluridae	*Malurus lamberti*	B	Variegated Fairy-wren
Maluridae	*Stipiturus malachurus*	B	Southern Emu-wren
Acanthizidae	*Acanthiza chrysorrhoa*		Yellow-rumped Thornbill
Acanthizidae	*Acanthiza lineata*		Striated Thornbill
Acanthizidae	*Acanthiza nana*		Yellow Thornbill
Acanthizidae	*Acanthiza pusilla*	●	Brown Thornbill
Acanthizidae	*Gerygone mouki*		Brown Gerygone
Acanthizidae	*Gerygone olivacea*		White-throated Gerygone
Acanthizidae	*Hylacola pyrrhopygia*		Chestnut-rumped Heathwren
Acanthizidae	*Sericornis frontalis*		White-browed Scrubwren
Acanthizidae	*Smicrornis brevirostris*		Weebill
Pardalotidae	*Pardalotus punctatus*		Spotted Pardalote
Pardalotidae	*Pardalotus striatus*		Striated Pardalote
Meliphagidae	*Acanthorhynchus tenuirostris*	●	Eastern Spinebill

Family	Scientific Name	Recorded	Common Name
Meliphagidae	*Anthochaera carunculata*	●	Red Wattlebird
Meliphagidae	*Anthochaera chrysoptera*	●	Little Wattlebird
Meliphagidae	*Caligavis chrysops*		Yellow-faced Honeyeater
Meliphagidae	*Gliciphila melanops*		Tawny-crowned Honeyeater
Meliphagidae	*Lichmera indistincta*	●	Brown Honeyeater
Meliphagidae	*Manorina melanocephala*		Noisy Miner
Meliphagidae	*Meliphaga lewinii*		Lewin's Honeyeater
Meliphagidae	*Melithreptus lunatus*	B	White-naped Honeyeater
Meliphagidae	*Myzomela sanguinolenta*	B	Scarlet Honeyeater
Meliphagidae	*Philemon corniculatus*	●	Noisy Friarbird
Meliphagidae	*Phylidonyris niger*	B	White-cheeked Honeyeater
Meliphagidae	*Phylidonyris novaehollandiae*	B	New Holland Honeyeater
Meliphagidae	*Plectorhyncha lanceolata*	B	Striped Honeyeater
Meliphagidae	*Ptilotula penicillatus*		White-plumed Honeyeater
Psophodidae	*Psophodes olivaceus*	B	Eastern Whipbird
Neosittidae	*Daphoenositta chrysoptera*		**Varied Sittella**
Campephagidae	*Coracina novaehollandiae*	●	Black-faced Cuckoo-shrike
Campephagidae	*Coracina tenuirostris*		Cicadabird
Pachycephalidae	*Colluricincla harmonica*	●	Grey Shrike-thrush
Pachycephalidae	*Pachycephala pectoralis*	**B**	Golden Whistler
Pachycephalidae	*Pachycephala rufiventris*	●	Rufous Whistler
Oriolidae	*Oriolus sagittatus*	●	Olive-backed Oriole
Oriolidae	*Sphecotheres vieilloti*	●	Australasian Figbird
Artamidae	*Artamus cyanopterus cyanopterus*	**B**	**Dusky Woodswallow**
Artamidae	*Cracticus nigrogularis*	●	Pied Butcherbird
Artamidae	*Cracticus tibicen*	●	Australian Magpie
Artamidae	*Cracticus torquatus*	B	Grey Butcherbird
Artamidae	*Strepera graculina*	●	Pied Currawong
Dicruridae	*Dicrurus bracteatus*	B	Spangled Drongo
Rhipiduridae	*Rhipidura albiscapa*	●	Grey Fantail
Rhipiduridae	*Rhipidura leucophrys*	●	Willie Wagtail
Rhipiduridae	*Rhipidura rufifrons*		Rufous Fantail
Corvidae	*Corvus coronoides*		Australian Raven
Corvidae	*Corvus orru*	●	Torresian Crow
Corvidae	*Corvus tasmanicus*	●	Forest Raven
Monarchidae	*Grallina cyanoleuca*	●	Magpie-lark
Monarchidae	*Monarcha melanopsis*		Black-faced Monarch
Monarchidae	*Myiagra inquieta*	●	Restless Flycatcher
Monarchidae	*Myiagra rubecula*		Leaden Flycatcher
Corcoracidae	*Corcorax melanorhamphos*		White-winged Chough
Petroicidae	*Eopsaltria australis*	●	Eastern Yellow Robin
Petroicidae	*Microeca fascinans*		Jacky Winter
Petroicidae	*Petroica rosea*	B	Rose Robin
Cisticolidae	*Cisticola exilis*	B	Golden-headed Cisticola
Acrocephalidae	*Acrocephalus australis*		Australian Reed-Warbler
Megaluridae	*Megalurus timoriensis*	B	Tawny Grassbird
Timaliidae	*Zosterops lateralis*	B	Silvereye
Hirundinidae	*Hirundo neoxena*	●	Welcome Swallow
Hirundinidae	*Petrochelidon ariel*	●	Fairy Martin

Family	Scientific Name	Recorded	Common Name
Hirundinidae	*Petrochelidon nigricans*	●	Tree Martin
Sturnidae	*Sturnus tristis*	●	Common Myna
Sturnidae	*Sturnus vulgaris*		Common Starling
Nectariniidae	*Dicaeum hirundinaceum*	●	Mistletoebird
Estrildidae	*Lonchura castaneothorax*	B	Chestnut-breasted Mannikin
Estrildidae	*Neochmia temporalis*	B	Red-browed Finch
Estrildidae	*Taeniopygia bichenovii*	●	Double-barred Finch
Motacillidae	*Anthus novaeseelandiae*	B	Australian Pipit
Mammals			
Ornithorhynchidae	*Ornithorhynchus anatinus*		Platypus
Tachyglossidae	*Tachyglossus aculeatus*		Short-beaked Echidna
Dasyuridae	*Antechinus flavipes*		Yellow-footed Antechinus
Dasyuridae	*Antechinus stuartii*		Brown Antechinus
Dasyuridae	*Antechinus swainsonii*		Dusky Antechinus
Dasyuridae	*Dasyurus maculatus*		**Spotted-tailed Quoll**
Dasyuridae	*Phascogale tapoatafa*		**Brush-tailed Phascogale**
Dasyuridae	*Sminthopsis murina*		Common Dunnart
Peramelidae	*Isoodon macrourus*		Northern Brown Bandicoot
Peramelidae	*Perameles nasuta*		Long-nosed Bandicoot
Phascolarctidae	*Phascolarctos cinereus*		**Koala**
Vombatidae	*Vombatus ursinus*		Common Wombat
Burramyidae	*Cercartetus nanus*		**Eastern Pygmy-possum**
Petauridae	*Petaurus breviceps*		Sugar Glider
Petauridae	*Petaurus norfolcensis*		**Squirrel Glider**
Pseudocheiridae	*Pseudocheirus peregrinus*		Common Ringtail Possum
Acrobatidae	*Acrobates pygmaeus*		Feathertail Glider
Phalangeridae	*Trichosurus vulpecula*		Common Brushtail Possum
Macropodidae	*Macropus rufogriseus*		Red-necked Wallaby
Macropodidae	*Wallabia bicolor*		Swamp Wallaby
Pteropodidae	*Pteropus poliocephalus*		**Grey-headed Flying-fox**
Emballonuridae	*Saccolaimus flaviventris*		**Yellow-bellied Sheathtail-bat**
Miniopteridae	*Miniopterus australis*		**Little Bent-winged Bat**
Miniopteridae	*Miniopterus orianae oceanensis*		**Large Bent-winged Bat**
Molossidae	*Austronomus australis*		White-striped Freetail-bat
Molossidae	*Micronomus norfolkensis*		**Eastern Coastal Free-tailed Bat**
Molossidae	*Mormopterus planiceps*		Little Mastiff-bat
Molossidae	*Mormopterus ridei*		Eastern Free-tailed Bat
Vespertilionidae	*Chalinolobus gouldii*		Gould's Wattled Bat

Family	Scientific Name	Recorded	Common Name
Vespertilionidae	*Chalinolobus morio*		Chocolate Wattled Bat
Vespertilionidae	*Falsistrellus tasmaniensis*		**Eastern False Pipistrelle**
Vespertilionidae	*Myotis macropus*		**Southern Myotis**
Vespertilionidae	*Nyctophilus geoffroyi*		Lesser Long-eared Bat
Vespertilionidae	*Nyctophilus gouldi*		Gould's Long-eared Bat
Vespertilionidae	*Scoteanax rueppellii*		Greater Broad-nosed Bat
Vespertilionidae	*Scotorepens orion*		Eastern Broad-nosed Bat
Vespertilionidae	*Vespadelus darlingtoni*		Large Forest Bat
Vespertilionidae	*Vespadelus pumilus*		Eastern Forest Bat
Vespertilionidae	*Vespadelus vulturnus*		Little Forest Bat
Muridae	*Mus musculus**		House Mouse
Muridae	*Pseudomys gracilicaudatus*		**Eastern Chestnut Mouse**
Muridae	*Pseudomys novaehollandiae*		**New Holland Mouse**
Muridae	*Rattus fuscipes*		Bush Rat
Muridae	*Rattus lutreolus*		Swamp Rat
Muridae	*Rattus norvegicus**		Brown Rat
Muridae	*Rattus rattus**		Black Rat
Canidae	*Canis lupus*		Dingo, domestic dog
Canidae	*Canis lupus familiaris*		Dog
Canidae	*Vulpes Vulpes**		Fox
Felidae	*Felis catus*		Cat
Leporidae	*Lepus capensis**		Brown Hare
Leporidae	*Oryctolagus cuniculus**		Rabbit
Equidae	*Equus caballus*		Horse
Bovidae	*Bos taurus*	•	European cattle

Appendix C - Author CVs

CRAIG ANDERSON
Curriculum Vitae

An environmental professional with over 20 years experience providing high level ecological services, advice, strategic direction and management for sectors such as land development, infrastructure, conservation, government, legal, mining & quarrying.

Personal Details

Full Name:	Craig John Anderson
Date of Birth:	5 November 1971
Postal Address:	PO Box 210, ADAMSTOWN NSW 2289
Email:	craig@andersonep.com.au
Phone Mobile:	0418 681 581

Qualifications

- Bachelor of Applied Science (Environmental Assessment & Management) University of Newcastle, New South Wales (1994).
- Completing a Graduate Diploma in Archaeological Heritage through University of New England (one subject to complete).

Licencing

- NSW Scientific Investigation Licence SL101313
- NSW Animal Research Authority
- NSW Accredited Biobanking Assessor No. 150
- NSW Biodiversity Accredited Assessor BAAS: 17002

Further Education & Training (select summary)

- Biobank and Biocertification Assessors Training Course / BAAS Fast-track Accreditation Course
- Animal Ethics Training (University of Newcastle / NSW DPI)
- RFS / PIA NSW Consulting Planners Bushfire Training
- Bush Regeneration Training
- OH&S Induction Training / Green Card
- NSW Driver's Licence: Car (Class "C"). Experienced 4WD operator.
- Occupational Health & Safety Training, including legal compliance requirements of Officers (Standard 11 & S1,S2,S3).
- + various other vocational environmental and computer based training sessions.

Fields of Special Competence

- Production and peer review of detailed environmental impact assessment documentation. Author and / or Manager of hundreds of ecological / environmental / bushfire / historical heritage / archaeological heritage / strategic & statutory planning documents over nearly 25 years of environmental work
- Biobanking & Biodiversity Offset Commissions – initial scoping and feasibility, BAM impact assessments and BDAR reporting, biobank calculations, Stewardship site creation
- Detailed ecological field survey, covering all aspects of terrestrial and aquatic flora and fauna
- Expert witness legal representation
- Ecological Management Planning, ranging from individual species to full ecosystem management
- Project Management and delivery of complex projects, including projects worth more than $100M
- Project Management (including areas outside environmental sphere)
- Environmental Due Diligence processes for both asset procurement and divestment
- Management and co-ordination of teams producing EIA documentation
- Identification of strategic approval pathways and key project risk evaluation and management
- Extensive experience in conflict resolution, impact mediation and outcome negotiation on large scale and contentious projects
- Environmental peer review and ecological compliance auditing
- Project advocacy and representation with all levels of stakeholders
- Detailed knowledge of land and infrastructure development processes

Professional Affiliations / Memberships (past / present)

- Hunter Bird Observers Club (HBOC). Current member of Records Appraisal Committee, previous elected Committee Member.
- Ecological Consultants Association of NSW (ECA). Current member. Involved in the initial formulation of the Association. Served two terms as an elected Councillor.
- Society for Growing Australian Plants (SGAP).
- Hunter Coal Environment Group (HCEG).
- NSW Minerals Council (NSWMC), including Executive Committee Meetings representation.
- Queensland Resources Council (QRC).
- Bird Observers Club of Australia (BOCA).
- Urban Development Institute of Australia (UDIA).
- Planning Institute of Australia (PIA).
- Australasian Bat Society (ABS).
- Frog and Tadpole Study Group (FATS).

- Society of Frogs and Reptiles (SOFAR).
- Hunter Heritage Network (HHN).

Employment History

2013-present	**Director / Principal Consultant** Anderson Environment & Planning, Environment & Planning Consultants, Newcastle
2012-present	**Director** Habitat Indoor / Outdoor Living, Furniture, Homewares & Design, Newcastle
2010-2012	**General Manager Sustainable Development** Cockatoo Coal Ltd, Coal Mining Company, Newcastle / Sydney / Brisbane
2009 – 2010	**Independent Environmental Expert** Donaldson Conservation Trust
2010	**Principal - Environment** RPS, Development Consultants, Newcastle
2006 – 2009	**Manager Environment Group** RPS HSO, Development Consultants, Newcastle (Company sold to UK listed Company RPS in Nov 2006)
2001 – 2006	**Manager Environment Group / Director** Harper Somers O'Sullivan, Development Consultants, Newcastle. (Company Director & shareholder as of July 2003)
2000 – 2001	**Senior Ecologist & NSW Projects Manager** Wildthing Environmental Consultants, Salt Ash.
1996 – 1999	**Ecologist** Wildthing Environmental Consultants, Salt Ash.
1995 – 1996	**Ecologist / Environmental Officer** Pulver Cooper & Blackley, Engineers & Surveyors, Newcastle.
1995	**Environmental Officer / Cadastral Survey Assistant** Kel Nagle Cooper & Associates, Golf Course Design & Construction Newcastle.

Tim Mouton
Curriculum Vitae

Tim works with AEP in the role of Ecologist. Tim has over 10 years of professional experience managing projects in the fields of ecology, natural area restoration, biodiversity conservation, community education, and construction environmental management. Tim also has 5 years experience working in the field as a bush regenerator.

Qualifications

- Bachelor of Environmental Science University of Newcastle (2001)
- Conservation Land Management Certificate II Tafe (2003)
- Master of Environmental Science Southern Cross University (2008)

Further Education & Training (select summary)

- NSW Class C Driver's Licence. Experienced 4WD operator.
- OH&S NSW White Card
- Erosion & Sediment Control Training (4 day Blue Book course / CPESC)
- Biodiversity Assessment Methodology (BAM) Assessor Course (accreditation in process)
- Feral Animal Control training (1080 & Pindone baiting)
- Certificate 3 in Chemical Application (AQF3)

Fields of Special Competence

- Ecological field survey, covering terrestrial and aquatic flora and fauna
- Highly proficient at botanical surveys and establishing monitoring programs
- Project Management and auditing
- Restoration Science

Professional Affiliations / Memberships (past / present)

- Board of Management member for Worimi Conservation Lands (NPWS & Worimi LALC)
- Certified Practitioner in Erosion & Sediment Control (CPESC) (not currently active)

Relevant Employment History

2019-present **Ecologist**
Anderson Environment & Planning, Newcastle

Currently employed by Anderson Environment & Planning to assist in the provision of consulting services to land, property, mining industry, legal and government sectors. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2015-2018 **Senior Project Officer / Ecologist**
Conservation Volunteers Australia / WetlandCare Australia

- Project managing on-ground restoration works including revegetation, site stabilisation, weed control and bush regeneration.
- Facilitating community engagement events, and supervision of volunteers.
- Undertaking site assessments, ecological surveys, and preparing plans of management.
- Scoping and preparing grant applications, managing all aspects of grant delivery, budgets, and reporting.

2009-2015 **Senior Ecologist / Environmental Scientist**
Onsite Environmental Management

- Undertaking and project managing detailed environmental assessments including flora and fauna surveys, threatened species assessments, management plans and monitoring reports.
- Environmental site management, monitoring and compliance auditing on large scale infrastructure projects and extractive industries.

2008-2009 **Bush Regenerator / Leading Hand**
Lane Cove Council
Australian Wetlands

- Undertaking bush regeneration activities including removal of environmental/noxious weeds, track construction and maintenance, native seed collection and propagation, fire assisted regeneration, feral animal control and supervision and training of volunteers.
- Supervising bush regeneration and weed management teams.
- Undertaking large scale revegetation works on infrastructure projects involving mass tubestock planting, site stabilisation and maintenance weeding.

2006-2007 **Ecologist / Environmental Scientist**
GeoLINK Consulting

- Undertaking and project managing detailed environmental assessments including flora and fauna surveys, threatened species assessments, management plans and monitoring reports.
- Monitoring and analysis of wetland, groundwater, and domestic wastewater systems.

2002-2006 **Bush Regenerator / Leading Hand**
Gondwana Bush Restoration
Willoughby City Council

- Undertaking bush regeneration activities including removal of environmental/noxious weeds, track construction and maintenance, native seed collection and propagation, fire assisted regeneration, feral animal control and translocation of vegetation.
- Supervision and training of bush regeneration teams and volunteers.

2001-2002 **John Holland Construction**
Environmental Officer

- Environmental site management and monitoring and reporting on large scale infrastructure projects.

Relevant Volunteer Experience

2014 - Current **Burwood Beach Coastcare - Facilitator (Volunteer)**

Supporting and managing volunteers, on-ground works, promotion and funding opportunities on a monthly basis, to undertake conservation and restoration activities within Glenrock State Conservation Area (NPWS estate).

2013 - 2016 **Humane Society International – EPBC Act Nomination Support**

Preparation of Threatened Ecological Community (TEC) nominations under the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act).

Appendix D AHIMS Search

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : JME19107

Client Service ID : 470824

JM Environments

37 Tooke Street
COOKS HILL New South Wales 2300

Attention: James Mcmahon

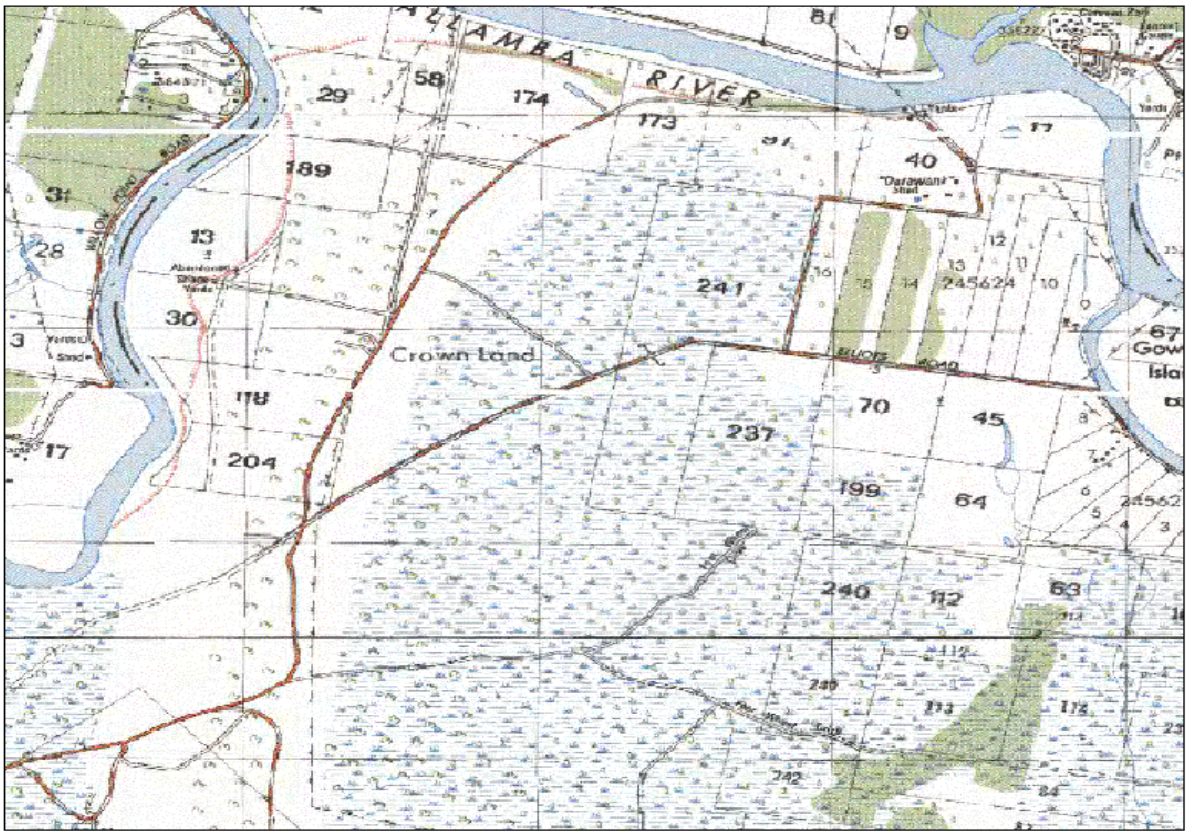
Email: james@jmenvironments.com

Date: 07 December 2019

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -32.1256, 152.4311 - Lat, Long To : -32.1026, 152.4726 with a Buffer of 50 meters, conducted by James Mcmahon on 07 December 2019.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
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