Review of Environmental Factors

Concept and Detailed Design of South Nowra Surcharge Main – Major Upgrades

WI21102IP

Prepared for

Shoalhaven Water

22 October 2021

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Document Information

Prepared for	Shoalhaven Water
Project Name	Concept and Detailed Design of South Nowra Surcharge Main – Major Upgrades
File Reference	WI21102IP_R001_REF_Rev B
Job Reference	WI21102IP
Date	21October 2021
Version Number	V1

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Effective Date 22/10/2021

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Date Approved 22/10/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
RevA	21/06/2021	First draft for review	KJ	CNB / ZW / SP
RevB	22/10/2021	Final	KJ	ZW

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Executive Summary

Shoalhaven Water proposes to upgrade the existing South Nowra Surcharge Main in South Nowra (the proposal). The South Nowra Surcharge Main (SNSM) has become increasing problematic for Shoalhaven Water, as local growth in the south has placed the system under increased hydraulic pressure. This increase in growth has created two key issues for system operators: surcharge and flooding upstream of each pumping station (which is a public and environmental health risk) and odour generation which has been a public nuisance.

By implementing this proposal, the SNSM will be able to meet its operational needs. The upgrades will provide increased wet weather storage, improved pumping efficiencies and a reduction in sewerage retention times which will reduce the amount of odour being produced by the current system.

The proposal will include:

- Installation of 635 m of diameter nominal (DN) DN300 Rising Main along Old Southern Road
- Installation of 1,300 m of DN225 or DN300 Rising Main, to improve the performance of sewer pump station (SPS) 024
- Decommission SPS028, connecting it to SPS024 gravity sewer network via 80 m of DN150 gravity sewer
- Installation of a new SPS in the reserve to the south of Greenpoint Road
- Replacement of the existing DN300 asbestos cement (AC) surcharge main with:
  - 685 m of DN375 gravity sewer to be installed from the rear of 44 Warrigal St, to the injection of SPS024
  - 325 m of DN525 gravity sewer from the injection/discharge of SPS024 to flow to the new SPS
  - 1,200 m of DN500 rising main connecting the new SPS to the DN500 main installed as part of the construction of the new Nowra Sewage Treatment Plant (STP)
  - Upgrading all pump stations to meet peak wet weather flow (PWWF) requirements, and maximise operational efficiencies.

None of the existing sewer mains that are being replaced will be removed during the works. They will all remain in ground and be grout filled. The only demolition activities will be the removal on the top 1m of SPS28. The remaining pits and wet well at SPS28 will either be sand or grout filled and the top 1m of ground will be filled and the surface will be turfed.

This Review of Environmental Factors (REF) has been prepared to assess the proposed development in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979.* This REF has found that with the implementation of the appropriate mitigation measures, included below, the proposed development is unlikely to result in significant impacts to the environment and therefore an Environmental Impact Statement (EIS) is not required.

Approval of this REF by Shoalhaven Water, the determining authority, is recommended so that works can proceed in a timely manner.

The proposed mitigation measures are as follows.

A Construction Environmental Management Plan (CEMP) should be prepared for the project documenting all of the impact avoidance and mitigation measures outlined in this REF. All project staff should be inducted to the site prior to commencement of construction activities. The induction should include an explanation of the requirements under the CEMP to ensure all environmental impacts are avoided (where possible) or otherwise appropriately managed.

Ecology

The following avoidance measures shall be implemented to manage and mitigate potential impacts on biodiversity:

- Use of previously cleared and non-native vegetated areas for construction of the project where possible, including laydown areas
- Use of non-invasive techniques for decommissioning of underground mains (e.g. grout-filling) within the project footprint to avoid earthworks and associated soil and vegetation disturbance, as well as

preventing sedimentation and erosion impacts into adjacent lands, including Browns Creek and its riparian corridor

- Install project boundary fencing on laydown areas and/or site compounds to ensure activities and ancillary facilities are restricted to the project footprint.

The following mitigation measures shall be implemented to manage and mitigate potential impacts on biodiversity.

General

- Creek lines and riparian corridors to be fenced off and labelled as No-Go areas to prevent accidental impacts and introduction of pathogens, such as *Batrachonchtrium dendrobatidis*, a pathogen that caused chytridiomycosis, an infection disease on amphibians
- All machinery should be cleaned of foreign soil and vegetative matter to avoid the spread of *Phytophthora cinnamomi*, Exotic Rust Fungi of the order *Pucciniales pathogenic* (Myrtle Rust) and dispersal of seeds of non-native plants
- Strict weed management, monitoring and control practices should be implemented as part of the CEMP to minimise the spread of exotic species into natural areas within and outside of the study area. In particular, priority weed and high threat exotic species should be targeted in accordance with the NSW DPI WeedWise recommended control measures (DPI 2021)
- Strict erosion and sediment control measures should be implemented as part of the CEMP, with the site to be monitored and maintained to prevent impacts on adjacent areas, particularly to avoid erosion and sediment mobilisation from rain events
- Implement dust control measures where necessary to protect adjacent retained vegetation and water quality in Browns Creek
- Stockpiling of materials should occur within previously disturbed areas and not within driplines or retained vegetation.

Vegetation clearing

While all attempts to avoid vegetation clearing would be put in place, should some limited tree removal be required the following mitigation measures would apply:

- Tree removal to be supervised as detailed in 'Wildlife protection during construction' section below
- Compensatory planting at rate of 1:1 to occur for any large trees (i.e. diameter at breast height (DBH) ≥50 cm)
- No native vegetation clearing is permitted in the areas marked as a TEC on Figure 6-2.

Wildlife protection during construction

- Stop-work procedure on the chance encounter of any dispersing wildlife during works should be implemented to avoid death or injury
- If tree clearing is unavoidable, ensure that a suitably qualified ecologist is present during the removal of any trees to act as a spotter-catcher that can relocate any captured wildlife
- Ensure that all captured animals are relocated into the nearest suitable native vegetation
- Ensure that any injured animals are taken to a local wildlife carer for treatment.

Aquatic habitat

- Strict erosion and sedimentation control measures should be implemented where required to ensure that the water quality and hydrological regime of Browns Creek adjacent to the study area is not impacted.

Non-Aboriginal Heritage

- Construction activities, including site access and ancillary activities are to remain within the study area only
- The CEMP should include an unexpected finds protocol to manage the risk of unexpected archaeological finds. If any non-Aboriginal items are discovered during the works, or suspected items of non-Aboriginal heritage significance, then works in the immediate area should stop immediately and Shoalhaven Water should be contacted to advise of management measures prior to recommencing works in the vicinity

- All construction workers should be informed of their responsibilities in relation to Aboriginal and non-Aboriginal cultural heritage under the relevant legislation.

Aboriginal Heritage

- Construction activities, including site access and ancillary activities are to remain within the study area only
- Areas of moderate and high archaeological potential as shown on Figure 6-3 and in Appendix C are to be delineated as no-go areas and communicated to all site personnel. The no-go zone is to delineate areas where laydown, parking, traffic of light vehicle/plant or any other works with a risk of ground disturbance are prohibited
- All construction workers should be informed of their responsibilities in relation to Aboriginal and non-Aboriginal cultural heritage under the relevant legislation
- The CEMP should include an unexpected finds protocol to manage the risk of unexpected archaeological finds. If any Aboriginal items are discovered during the works, or suspected items of Aboriginal heritage significance, then works in the immediate area should stop immediately and Shoalhaven Water and NSW Department of Planning, Industry and Environment (DPIE) should be contacted to advise of management measures prior to recommencing works in the vicinity. Where the find comprises human remains, NSW Police must be contacted in the first instance.

Soils and Contamination

- Prepare a CEMP containing an Unexpected Finds Protocol (UFP) outlining appropriate management of contamination items which may be encountered or disturbed by construction
  - In the event of an unexpected contamination find a suitably qualified environmental consultant will be required to attend site to assess contamination and provide advice on appropriate management or treatment
- For the areas within the proposal where acid sulfate soil (ASS) is deemed to be present, it is recommended that further investigation be undertaken to inform any future mitigation measures required
- Where asbestos materials (i.e. former pipes) are to remain buried onsite these are to be noted in Council property records with an Asbestos Management Plan (AMP) in place to ensure appropriate long term management.

Water Quality and Hydrology

- Locate site amenities away from waterbodies or drainage lines
- Include emergency procedures for chemical/fuel spills in the CEMP and keep a functioning 'spill kit' on site at all times for clean-up of accidental spills
- Chemicals and fuels are required to be stored in bunded storage containers, and the Material Safety Data Sheets (MSDSs) for any chemicals must be available onsite. Spill and incident management procedures must be in place and communicated to crews prior to works commencing.
- Record all stored chemicals on a register with their MSDS's
- Do not use equipment with fuel, oil or hydraulic leaks. Repair or remove equipment immediately
- The site will be managed to minimise the extent of exposed soils. Erosion and sediment control measures will be implemented in accordance with the "Blue Book" (*Managing Urban Stormwater: Soils and construction – Volume 1, fourth edition*, dated March 2004)
- If the intersection of groundwater occurs, testing of excavation water to ensure suitable quality for ground/stormwater disposal would be implemented
- Prior to commencement of construction, the contractor would need to determine the anticipated volume of groundwater likely to require collection and disposal off-site and put in place measures to monitor the actual volumes if encountered during construction
- It is considered likely that the groundwater system will be intercepted during excavation. The contractor must obtain a Water Access Licence (WAL) from DPI Water/ NRAR if groundwater extraction volume will be greater than 3ML / year, although it is considered unlikely that this will occur.

Odour

No specific mitigation measures are required for the control of normal operating odours. However, regular inspection of the pump stations and sewer pipelines must be undertaken including the detection of odours. Furthermore, complaints received related to odours must be fully investigated and corrective action undertaken where required if practicable and reasonable.

Air Quality and Energy

- Exposed areas of soil will be kept to the smallest areas practicable to minimise the potential for dust generation
- The work areas and stockpiles will be monitored for dust generation and will be sprayed with appropriate non-potable water as required
- No matter of any kind will be burnt on site
- Equipment will be maintained to ensure no exhaust particulates are visible for more than 10 continuous seconds
- Vehicles will not be left idling
- Works will be scheduled to minimise journeys
- Fuel and energy usage will be recorded
- Odour or air pollutant emission complaints will be dealt with promptly and the source will be eliminated wherever practicable
- Details of the complaint will be recorded
- In addition to the above, Shoalhaven Water may wish to consider opportunities for reducing the overarching energy requirements associated with the water and sewage supply network and/or options for supplying the system from renewable sources.

Waste and Hazardous Materials

- Recommendation's as detailed in the Preliminary Site Investigation (PSI) (included in Appendix D) and Section 6.4 be carried out to ensure contaminated waste and soils are managed appropriately
- CEMP to include waste management strategy prepared in accordance with the waste management hierarchy including details such as:
  - List of waste likely to be generated
  - Procedure for sorting and storing waste
  - Waste register to record: quantity, type, transportation method; time of and location of waste disposal
  - Strategy devised and implemented to recycle, reuse or avoid waste generation.
- All waste disposal locations to be suitably licenced
- All waste leaving the site must be appropriately characterised
- No waste is to be left on-site post construction
- Working site is to be kept free of rubbish and cleaned at the end of each working day; and
- EPA is to be notified of any incidents of pollution or environmental harm (as per part 5.7 of the POEO Act).

Traffic and Site Access

- Contractor to secure a section 138 permit prior to work on any local road reserves;
- Greenwell Point Road is classified by Transports for NSW (TfNSW) as a Regional Road (pursuant to the Road Act 1993 - i.e. Those Regional Roads that are not classified as Highway, Main Road, Secondary Road or Tourist Road under the Roads Act) and is managed by TfNSW. The contractor will secure a Road Occupancy License as required from TfNSW for any works likely to impact on traffic flow, such as trenching or underboring for pipeline installation.
- A traffic management plan will be prepared as part of securing the ROL and Council requirements regarding traffic control, access and road restoration will be complied with

- Open trenches would be fenced off during construction where required to ensure pedestrian safety
- Erect signs regarding proposed works, temporary road / pavement closures, diversions etc.
- Provide alternate access (e.g. ramps and bike ramps) if access is impeded for an extended period
- Avoid blocking access to vehicular or pedestrian roads, private driveways, public facilities or businesses wherever possible
- Adequately notify affected people and businesses
- Restore access quickly.

Noise and Vibration

- Work and deliveries will preferably occur during the following times: Monday to Friday 7am to 6pm, Saturday 8am to 1pm. No construction work or deliveries will occur on Sundays or public holidays
- Limited works will be permitted outside of the standard construction hours outlined above (e.g. to minimise impacts of road closures)
- Surrounding residences and/or businesses will be given reasonable notice of the proposed works (including proposed start date, work methods and duration)
- Equipment will have noise mufflers and be well maintained.

Social, Visual and Land uses

- All work will be contained within the boundaries of the study area shown on Figure 1-1
- It is proposed to powder coat the visible pump station infrastructure in a colour that blends into the surrounding environment in order to reduce the visual impact
- The site must be kept clean of general litter and tidy for the duration of the works
- The spread of stockpiles, waste, and parking will be minimised
- Accurate public information signs will be provided until site restoration is complete
- Work sites will be restored as close to their original condition as possible
- Community and stakeholder liaison will be carried out before and during the site works
- A Dial Before You Dig search will be completed prior to the commencement of site works to located underground services, and these services will be pegged out as no-go areas to avoid service disruptions
- All personnel will exercise courtesy in dealing with the community.

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Glossary and Abbreviations

AHIMS	Aboriginal Heritage Information Management System
ASS	Acid sulfate soils
BC Act	*NSW Biodiversity Conservation Act 2016*
CEMP	Construction Environmental Management Plan
DECC	Former Department of Environment and Climate Change
DECCW	Former Department of Environment, Climate Change and Water
DEE	Department of the Environment and Energy
DPIE	NSW Department of Planning, Industry and Environment
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPA	NSW Environment Protection Authority
EP&A Act	NSW *Environmental Planning and Assessment Act 2000*
ESD	Ecologically Sustainable Development
ISEPP	NSW *State Environmental Planning Policy (Infrastructure) 2007*
LEP	Local Environment Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPW Act	NSW *National Parks and Wildlife Act 1974*
NPI	*National Pollution inventory*
NSW	New South Wales
OEH	Former NSW Office of Environment and Heritage
POEO Act	NSW *Protection of the Environment Operations Act 1997*
REF	Review of Environmental Factors
SEPP 55	NSW State Environmental Planning Policy 55 – Remediation of Land

1 Introduction

This Review of Environmental Factors (REF) has been prepared by Cardno (NSW/ACT) Pty Ltd (Cardno) on behalf of Shoalhaven Water to assess the potential environmental impacts associated with the proposed South Nowra Surcharge Main (SNSM) replacement.

This REF has been prepared in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal involves the upgrade of a sewerage reticulation system. Clause 106(1)(a) and 106(3)(B) of the Infrastructure SEPP together permit development for these purposes by or on behalf of a public authority without consent on any land.

1.1 Background

Shoalhaven Water is seeking approval for the upgrade of the SNSM (the proposal) under Part 5 of the EP&A Act. The SNSM is operated by Shoalhaven Water and transfers sewage from six different sewage pumping stations (SPSs 17, 19, 20, 22, 24 and 28) to the Nowra Wastewater Treatment Plant (refer to Figure 1-1).

The SPSs 17 and 19 share a common rising main for around 600 m before flowing into a discharge maintenance hole near the corner of Old Southern Rd and Killara Rd. After this point, the remainder of the main flows under gravity with surcharge. The four (4) additional SPSs (SPS 20, 22, 24 and 28) pump into the gravity section below static water levels.

This proposal follows on from the recent Options Assessment for the South Nowra Surcharge Main Air Relief and Odour Control project. Whilst that project began as an odour assessment, hydraulic modelling of the existing system found significant hydraulic impacts due to excessive surcharging in the main. The surcharging was causing significant odour issues in the network. The reduced hydraulic capacity also contributed to more frequent overflows at the pump stations as there is insufficient capacity in the network and at the pump stations to store wet weather flows.

Shoalhaven Water have decided to undertake a larger series of upgrades to the network to remove the hydraulic constraints. This will remove the hydraulic bottlenecks in the system that have caused the issues mentioned above and allow each pump station to pump to its full capacity during wet weather events, when it is most needed. The overall proposal will deliver increased hydraulic capacity which is important to future growth of the area.

A full description of the proposal is provided in Section 3.

1.2 Site Analysis

The proposal site is located within Shoalhaven City Local Government Area (LGA) approximately 1.3 kilometres south-east of Nowra's town centre. The site is zoned primarily within:

- RE1 – Public Recreation
- RU1 – Primary Production
- SP2 – Infrastructure
- R1 – General Residential
- R2 – Low Density Residential
- R3 – Medium Density Residential.

The existing landscape within the proposal site was characteristic of predominately disturbed areas including, road reserves, drainage reserves and adjacent to existing sewer mains.

The proposal site is located primarily on council reserves and local council road reserves with some small areas of the proposal crossing crown land and private property (refer to Figure 1-2). Impact on this land are discussed in Section 5.2. The land titles of the land within the proposal area are listed in Table 1-1.

Table 1-1 Impacted properties

Detail	Comments	
Land Titles	The proposal intersects or passes through the following lots:	
	Lot 1 Deposited Plan (DP) 725965	Lot 352 DP 1068794
	Lot 2 DP 725975	Lot 241 DP 755952
	Lot 112 DP 1061374	Lot 206 DP 1060103
	Lot 1 DP 880854	Lot 254 DP 1060103
	Lot 2 DP 880854	Lot 9 DP 1048562
	Lot 133 DP 703670	Lot 8 DP 1048562
	Lot 2 DP 1245988	Lot 1 DP 1119599
	Lot 1 DP 1245988	Lot 58 DP 1048562
	Lot 1 DP 1119599	Lot 59 DP 1048562
	Lot 918 DP1240172	Lot 7318 DP 1177129
	Lot 379 DP 1077197	Lot 300 DP 1086791
	Lot 3512 DP 1217801	Lot 350 DP 1068794
	Lot 3511 DP 1217801	

1.3 Purpose of this Report

The purpose of the REF is to describe the proposal, document the likely impacts of the proposal on the environment and detail protective measures to be implemented.

The description of the proposed works and associated environmental impacts have been undertaken in context of Clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act) and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act, namely that Shoalhaven Water examine and consider to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF will be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in Section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement; and
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

1.4 Structure of this Report

The structure of this report is as follow:

- Section 1 - Introduces the proposed development and the site
- Section 2 - Discusses the needs and justification for the proposed development
- Section 3 - Describes the proposed development in greater detail
- Section 4 - Assesses the proposed development in relation to relevant planning legislation and policies
- Section 5 - Summarises any consultation undertaken to date
- Section 6 - Assesses the potential environmental impacts from the proposed development and provides recommended mitigation measures based on the potential impacts
- Section 7 - Summarises the assessment undertaken herein and provides conclusions recommendations.

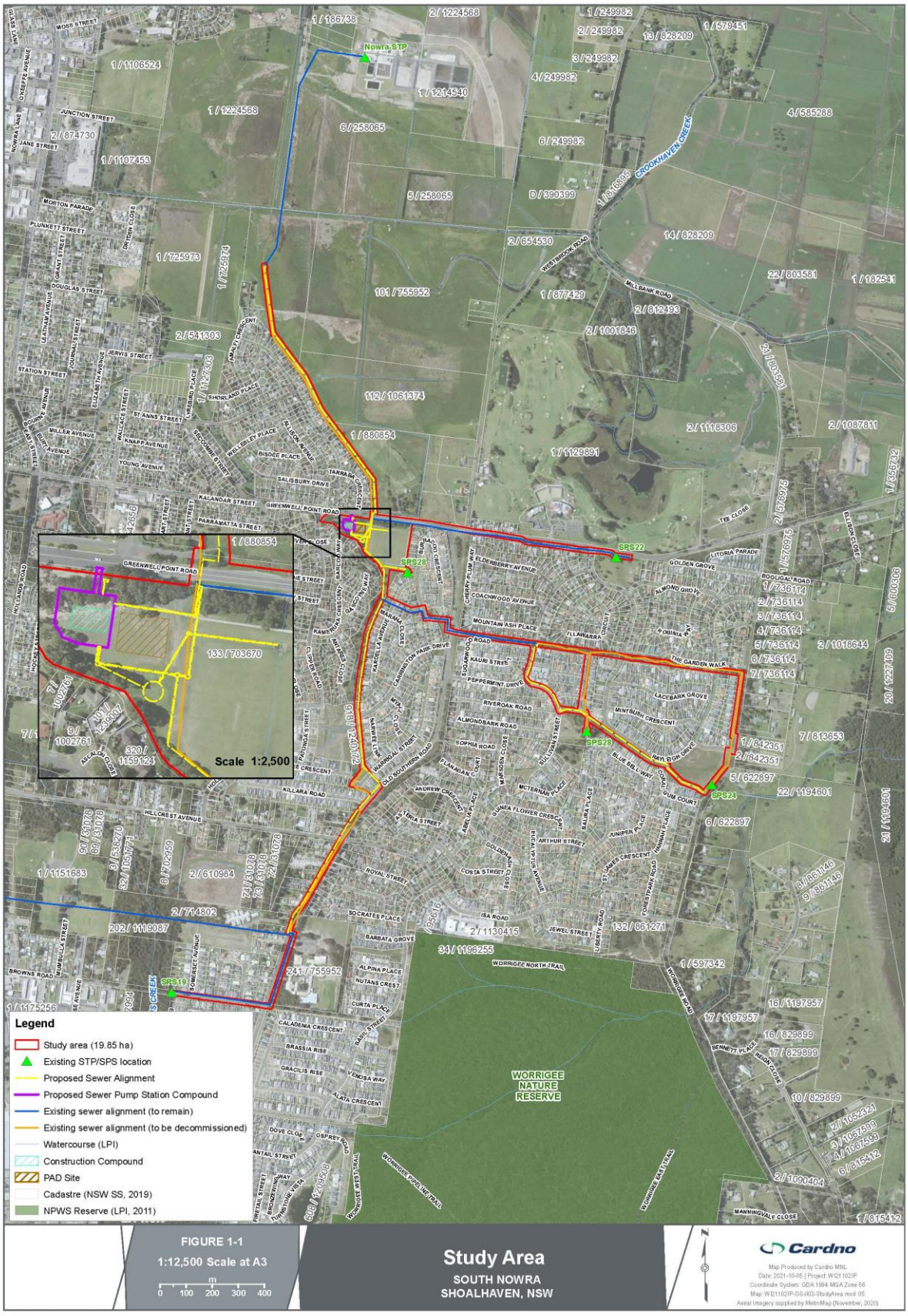


Figure 1-1 Concept design study area

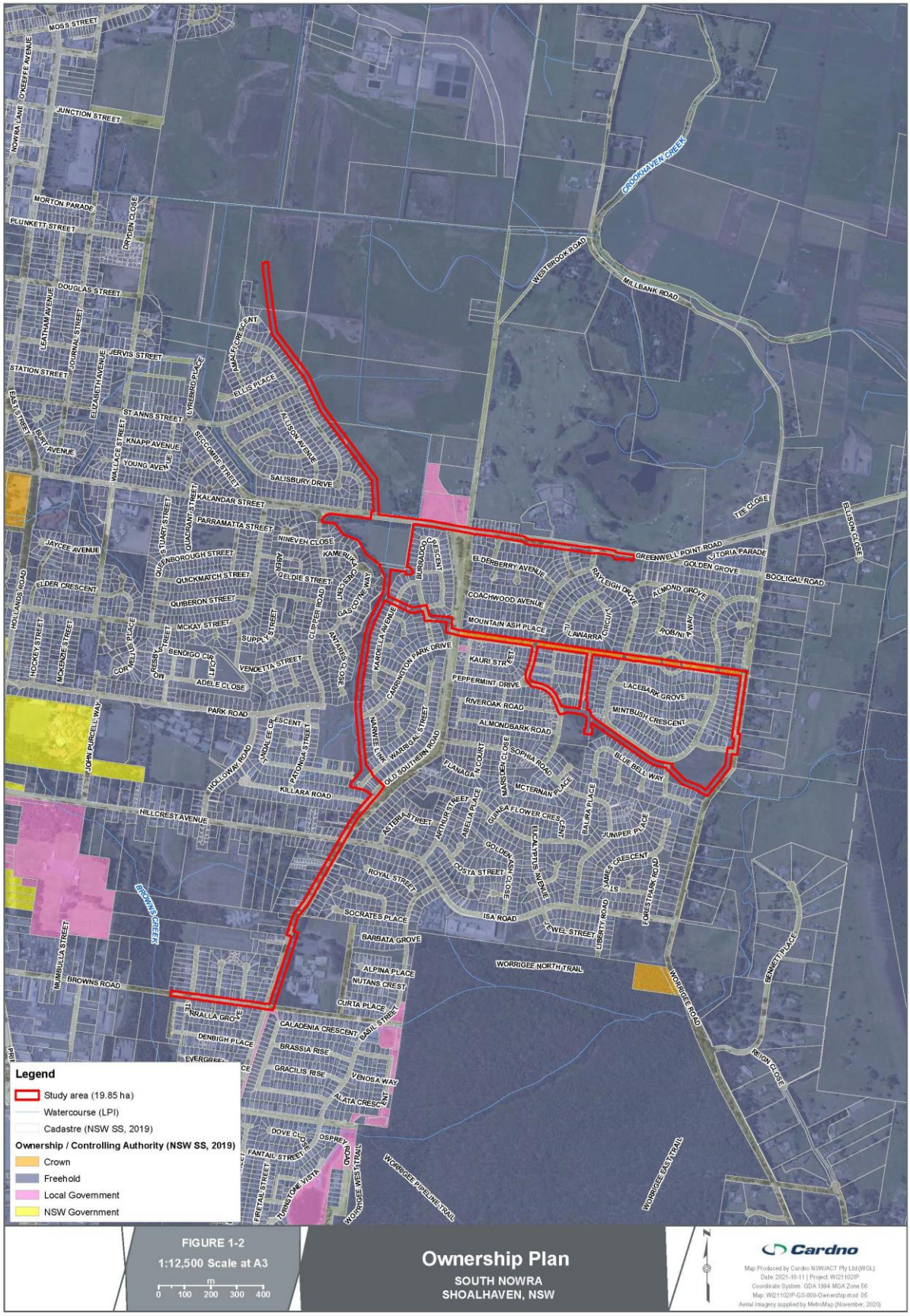


Figure 1-2 Ownership plan

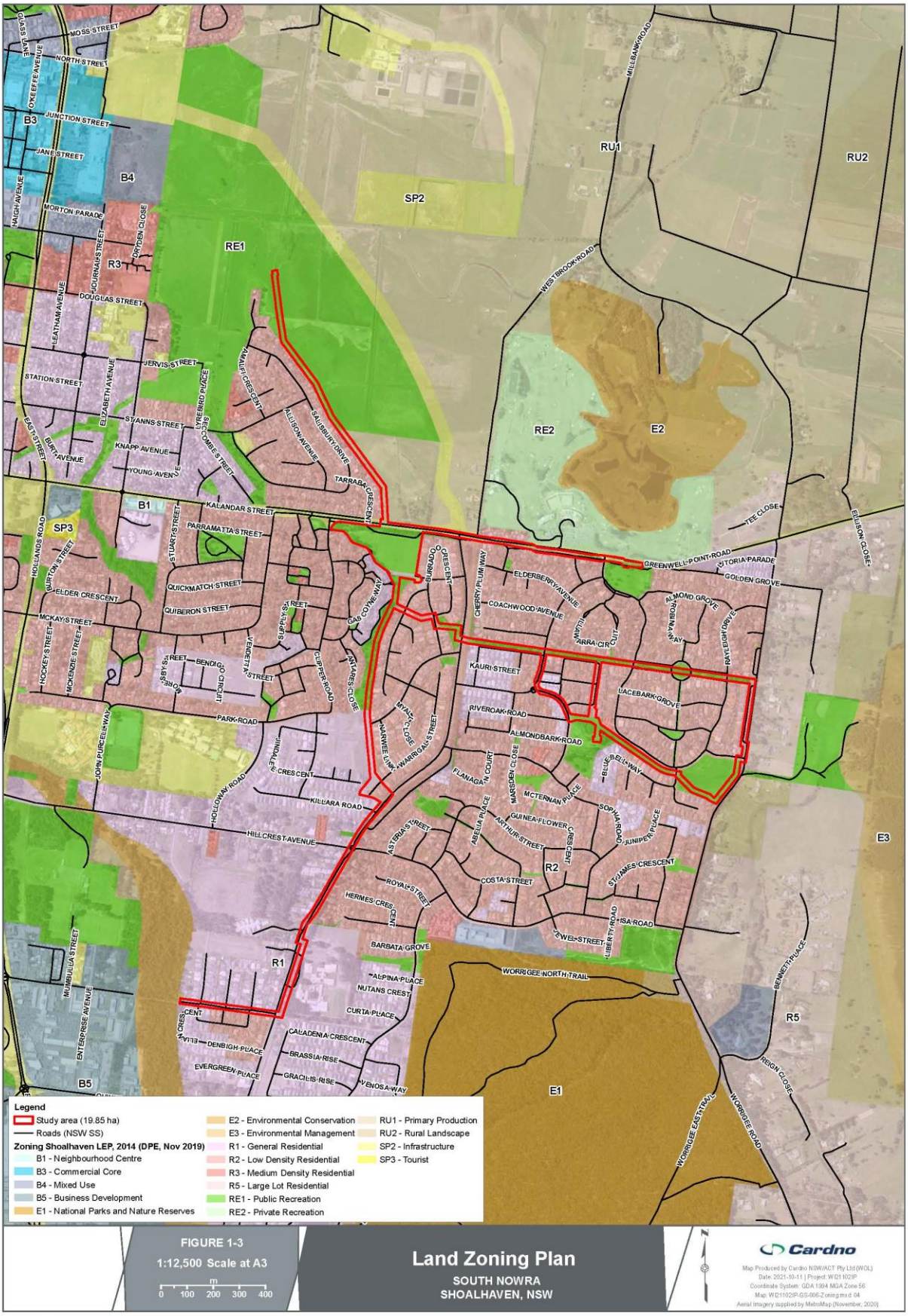


Figure 1-3 Land zoning plan

Figure 1-4 Site locality

2 Proposal Justification

2.1 Need for and objectives of the proposal

The South Nowra Surcharge Main has become increasing problematic for Shoalhaven Water, as local growth in the south has placed the system under increased hydraulic pressure. This increase in growth has created two key issues for system operators:

1. Pumps are not able to discharge wet weather flows, when some or all of the pumps are injecting into the combined system. This generates surcharge and flooding upstream of each pumping station, which is a public and environmental health risk.
2. Air generation within the main is expelled through the existing odour control unit at Killara Rd. Increased surcharge levels in the SNSM are exceeding the ground levels at the odour unit. This causes air and sewage to flow through the odour unit when all pumps are operating. Odour generated at this location has been a public nuisance and a cause for a long-list of historical complaints.

The existing system is not meeting the peak wet weather flow (PWWF) design requirements at all SPSs, with the exception of SPS017. The hydraulic incapacities in the system are associated with the DN300 AC mains, the DN225 combined SPS017 and SPS019 rising main, and the DN225 servicing SPS024. A number of options were reviewed as part of the hydraulic improvement investigation. The preferred strategy was identified in the *"Preliminary Options Assessment Technical Memorandum, South Nowra Surcharge Main Air Relief and Odour Control"*, dated 11 November 2020 (Cardno (2020)) and forms the basis of this proposal as outlined in further detail below.

By implementing this proposal, the SNSM will be able to meet its operational needs. The upgrades will provide increased wet weather storage, improved pumping efficiencies and a reduction is sewerage retention times which will reduce amount of odour being produced by the current system.

3 Proposed Development

3.1 The proposal

The proposed upgrade of the SNSM is located within road reserves, drainage reserves and adjacent existing mains and in close proximity to properties located along Salisbury Drive, Kardella Avenue, Killara Road, Old Southern Road, Greenwell Point Road, Buradoo Crescent, The Garden Walk, Peppermint Drive, Sullivan Street, Rayleigh Drive and Worigee Road.

3.1.1 Design details

The concept design for the proposal is shown in Figure 1-1.

The proposal will include:

- Installation of 635 m of diameter nominal (DN) DN300 Rising Main along Old Southern Road
- Installation of 1,300 m of DN225 or DN300 Rising Main, to improve the performance of SPS024
- Decommission SPS028, connecting it to SPS024 gravity sewer network via 80 m of DN150 gravity sewer
- Installation of a new SPS in the reserve to the south of Greenpoint Road
- Replacement of the existing DN300 asbestos cement (AC) surcharge main with:
  - 685 m of DN375 gravity sewer to be installed from the rear of 44 Warrigal St, to the injection of SPS024
  - 325 m of DN525 gravity sewer from the injection/discharge of SPS024 to flow to the new SPS
  - 1,200 m of DN500 rising main connecting the new SPS to the DN500 main installed as part of the construction of the new Nowra Sewage Treatment Plant (STP)
  - Upgrading all pump stations to meet peak wet weather flow (PWWF) requirements, and maximise operational efficiencies.

The proposal has been split into 5 delivery packages and the plans for construction of each package is described in Section 3.3.

None of the existing sewer mains that are being replaced will be removed during the works. They will all remain in ground and be grout filled. The only demolition activities will be the removal on the top 1m of SPS28. The remaining pits and wet well at SPS28 will either be sand or grout filled as well and the top 1m of ground will be filled and the surface will be turfed.

3.2 Options Considered

A preliminary options assessment for the SNSM was undertaken by Cardno in 2020. The assessment considered the performance of the sewer network under a 2020 and 2050 scenario and identified a number of constraints that would need to be addressed to ensure the adequate ongoing performance of the network.

To understand the drivers of the system underperformance, a hydraulic model was used to run a number of simulations. These simulations included:

- Scenario 1 - Retain existing piped network, with all pumps updated to 2020 required capacities.
- Scenario 2 - Retain existing piped network, with all pumps updated to 2050 required capacities.

The 2020 simulation (existing sewer contributions) showed that the 2020 configuration of the SNSM does not have the capacity to convey design flows. Thus, upgrading/augmentation to the SNSM is needed to meet Shoalhaven Water's design requirements.

The 2050 simulation identified three key hydraulic constraints within the rising/surcharge main network. These key constraints were:

1. The DN225 combined SPS017 and SPS019 rising main.
2. The DN225 rising main from SPS024.
3. The DN300 AC sections of the SNSM.

The options considered for each of these constraints is discussed in the sections below. The preferred options identified below form the proposal that is the basis of this REF.

3.2.1 SPS017 and SPS019 Combined Main

There were two potential options considered for augmenting the combined section of rising main, which were:

1. Retain combined configuration; and
2. Split SPS017 and SPS019 rising mains.

The modelling showed that with either option the operational window of SPS017 and SPS019 is significantly improved. To provide Shoalhaven Water with improved operational flexibility, it was recommended that a new DN300 main be installed along old Southern Road. This main could be retained as a combined system, or a split network, as the impact on the pumps are minimal.

3.2.2 SPS024 DN225 Rising Main

In order to address the hydraulic constraints of the DN225 rising main from SPS024, it was recommended that the existing rising main be upgraded to have an equivalent diameter of a DN300. This would be achieved through either:

1. Installing a duplicate DN225; or
2. Replacing the main with a new DN300.

Each option would provide positive outcomes for Shoalhaven Water, with:

- A duplicate main providing greater operational redundancy and flexibility of operation maintenance.
- A new main could have a different alignment that is easier to access and maintain

The above options were investigated further in *Package 4 – Concept Design Report (2021)* prepared by Cardno, which identified option '2' as being the preferred option as this alternate route offers, easier construction and maintenance and also offers a reduced pumping head.

3.2.3 South Nowra Surcharge Main

In order to address the hydraulic constraints of the DN300 AC sections of the SNSM, two options were considered:

1. Upsize the existing mains and retain the existing surcharge operational configuration; or
2. Alter the system, and remove the surcharge main.

Of the two options considered, option '2' was selected as the preferred option as the long-term operational benefits associated with the alternate alignment are considered worth the additional capital investment.

3.3 Construction Methodology

It is anticipated that the sewer pipeline would be constructed using an open trench excavation technique. This is based on site inspections, the existing condition of pavements and the anticipated low traffic volumes along the proposed routes.

3.3.1 Pre-construction Activities

Pre-construction activities associated with the proposal include:

- Preparation of a site-specific Construction Environmental Management Plan (CEMP) by the engaged contractor to the satisfaction of the Project Manager and/or Shoalhaven Water;
- Establishment of construction compound area;
- Preconstruction utility services site meeting & establishment of service locations;
- Survey and site preparation

3.3.2 Construction Activities

Construction activities associated with the proposal include:

- Trench excavation for the proposed pipeline depth of variable depths;

- Under boring to occur where the proposed main traverses under Greenwell Point Road;
- Installation of the new sewer infrastructure to Shoalhaven Water's standards;
- Backfilling of the trench;
- Testing of sewer alignment;

3.3.2.1 Sewer Mains and Man holes

The installation of the majority of the pipes and man holes is to be undertaken by traditional open-cut trench excavation. Trench walls for the pipes would be expected to stand unsupported for the short duration of the construction, however, all deep excavations would require trench support or benching. If water were encountered in the excavation trenches they would be required to be dewatered. Water would be disposed to a temporary soakage pit/area constructed adjacent to the construction site and within the study area investigated as part of this REF.

3.3.2.2 Sewer Pump Station

Construction of the pumping station would be by open excavation. Shoring would be required due to the depth of the wet well and inlet manhole. Concrete valve chamber will also be provided as part in the bulk excavation works. Ancillary works at the pump station will include:

- Construction of an all-weather access track
- Hardstand area for generator
- New switchboard building
- Electrical lead-in works
- Construction of overflow pipework to existing stormwater channel

3.3.2.3 Emergency Storage Tanks

New emergency storage tanks are proposed at the new SPS site, SPS 019, 022 and 024. The new storage tanks will be large diameter concrete chambers either cast in-situ or pre-cast and delivered to site. Excavation of the pits for the storage tanks would be by open excavation.

3.3.2.4 Restoration and Rehabilitation

All services, vegetation, fences, kerbing and guttering, pavements, lawns, and roads impacted by construction will be restored as soon as practicable to a condition that was the same or better than the original state. Seeding and/or replanting of exposed areas would occur. Restoration and rehabilitation of the site would also include;

- Work as executed survey of buried ends; and
- Site rehabilitation to pre-existing condition or as agreed with the landowners.

3.3.3 Machinery, Vehicles and Equipment

The following equipment, vehicles and machinery will be used to undertake the proposal. This list is indicative only and is subject to change based on site conditions and construction requirements:

Plant:

- Excavator;
- Backhoe;
- Tip truck;
- Water trucks;
- Light vehicles.

Equipment:

- Generators;
- Hand tools;

- Concrete Saw;
- Compactors;
- Vibrators;
- Jackhammer;
- Road plates.

3.3.4 Access and Ancillary works

A storage/compound area has been nominated adjacent within the SPS compound. A number of other suitable locations are available within the defined proposal footprint that would cause minimum disturbance if Shoalhaven Water choose to stage the works and have multiple compound areas.

The facilities at the compound site could include toilet facilities, secure bunded areas for the storage of fuels and chemicals and designated parking and waste management areas. A site office will be established if required.

Any construction compounds and stockpiles required will allow for the following conditions:

- Located in areas not prone to flash flooding and more than 40m from a watercourse;
- Located more than 100m from occupied residences;
- Located in areas previously disturbed that do not require the clearing of native vegetation;
- Located in plain view of the public to deter theft and illegal dumping;
- Stockpiles would be located outside the drip line of trees and would be on level ground wherever possible; and
- The stockpile site would be temporary for the period of construction and would be rehabilitated before the completion of construction.

3.3.5 Duration and Working Hours

It is expected that the construction works will take 9 -12 months to complete pending approval and if all packages were completed at once. Construction will occur during the standard construction hours of:

- Monday to Friday 7 am to 6 pm;
- Saturday 8am to 1 pm; and
- No work on Sundays or public holidays.

At the time of preparing this REF it is not yet known the order the 5 packages will be delivered. The delivery of the packages are subject to funding approval through Shoalhaven City Council. Depending on the delivery strategy the construction timeframe may be spread over 2 or 3 financial years.

3.3.6 Construction Environmental Management Plan

The proposed works would be undertaken in accordance with a CEMP prepared by the construction contractor and approved by Shoalhaven Water prior to the commencement of works.

The CEMP would incorporate site-specific management plans and would reflect all the mitigation measures identified in this REF, additional mitigation measures identified as a result of the contractor's risk assessment and construction methodology and any conditions of the proposal determination and other licences/approvals.

4 Statutory and Planning Framework

4.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act is the principal planning legislation for NSW. Part 5 of the EP&A Act applies to infrastructure and environmental impact assessment of activities undertaken by Government departments or agencies. *Division 5.1 – Environmental impact assessment*, refers to the assessment of impacts of an "activity". An activity is defined in Section 5.1 as:

"(a) the use of land, and

(b) the subdivision of land, and

(c) the erection of a building, and

(d) the carrying out of a work, and

(e) the demolition of a building or work, and

(f) any other act, matter or thing referred to in section 3.14 that is prescribed by the regulations for the purposes of this definition,

but does not include—

(g) any act, matter or thing for which development consent under Part 4 is required or has been obtained, or

(h) any act matter or thing that is prohibited under an environmental planning instrument, or

(i) exempt development, or

(j) development carried out in compliance with a development control order, or

(k) any development of a class or description that is prescribed by the regulations for the purposes of this definition."

In this case, the 'activity' proposed is the *carrying out of work* (Section 5.1(d)).

Section 1.5 to the EP&A Act lists the categories of development under this Act. The proposed work fits the category of:

> *"development that is an activity requiring environmental assessment under Division 5.1 before it is carried out by a public authority or before a public authority gives approval for the carrying out of the activity,*

Section 4.1 of the EP&A Act applies to development that does not need consent and states as follows:

> ***"4.1 Development that does not need consent***
>
> *(1)* ***General***

If an environmental planning instrument provides that specified development may be carried out without the need for development consent, a person may carry the development out, in accordance with the instrument, on land to which the provision applies".

The work is permissible without consent in accordance with *State Environmental Planning Policy (Infrastructure) 2007* as outlined under **Section 4.2** of this REF.

In accordance with the definitions in Section 5.1 of the EP&A Act:

- the proponent for the activity is Shoalhaven Water and
- the determining authority is also Shoalhaven Water being the "*public authority by or on whose behalf the activity is or is to be carried out*" as well as the "*public authority whose approval is required in order to enable the activity to be carried out*".

Section 5.5 to the EP&A Act sets out the duty of the determining authority for assessing the impacts for work under Part 5 and states as follows:

> *"(1) For the purpose of attaining the objects of this Act relating to the protection and enhancement of the environment, a determining authority in its consideration of an activity shall, notwithstanding any other provisions of this Act or the provisions of any other Act or of any instrument made under this or any other Act, examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity."*

This REF examines all matters related to the potential environmental impacts of the activity including methods for avoidance, mitigation and management of impacts as appropriate to the case.

4.2 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The aim of ISEPP is to facilitate the effective delivery of infrastructure across NSW by identifying whether certain types of infrastructure require consent, can be carried out without consent or are exempt development.

Division 18 (Sewerage Systems) Clause 105 applies to ***biosolids treatment facility***, ***sewage reticulation system***, ***sewage treatment plant***, ***sewerage system*** and ***water recycling facility*** as defined in the Standard Instrument.

The proposed works fit the following definitions in the Standard Instrument:

> **"sewerage system** means any of the following—
>
> (*a) biosolids treatment facility,*
>
> ***(b) sewage reticulation system,***
>
> *(c) sewage treatment plant,*
>
> *(d) water recycling facility,*
>
> *(e) a building or place that is a combination of any of the things referred to in paragraphs (a)–(d)."*

The works are characterised as a 'sewage reticulation system' from the above, which means:

> ***"****a building or place used for the collection and transfer of sewage to a sewage treatment plant or water recycling facility for treatment, or transfer of the treated waste for use or disposal, including associated—*
>
> *(a) pipelines and tunnels, and*
>
> *(b) pumping stations, and*
>
> *(c) dosing facilities, and*
>
> *(d) odour control works, and*
>
> *(e) sewage overflow structures, and*
>
> *(f) vent stacks."*

In accordance with Clause 106(3B) of the ISEPP, Shoalhaven Water (being a public authority) can undertake the proposed works without consent subject to the prescribed circumstances. Clause 106(3B) states:

- *"Development for the purpose of **sewage reticulation systems** may be carried out without consent on any land in the prescribed circumstances"*,

Clause 106(1)(a) of the ISEPP states that:

> *"Development is carried out in the prescribed circumstances if the development (a) is carried out **by or on behalf of a public authority** […]".*

Therefore in summary, the proposal can be carried out by Shoalhaven Water provided they examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment. This REF documents those matters and provides the basis on which Shoalhaven Water can determine whether to proceed with this proposal.

Part 2 (Division 1) of the ISEPP contains provisions for public authorities to consult with local councils and other authorities prior to the commencement of certain types of development. Consultation, including that required by ISEPP, is discussed in **Section 5** of this REF.

4.3 Remediation of Land – SEPP 55

State Environmental Planning Policy (SEPP) No. 55 – Remediation of Land and relates to the remediation of contaminated land, consent requirements for this, and considerations for the rezoning and development of land. The contamination status of the land has been assessed via a desktop review of potential contaminant sources. The site is partially an existing road reserve that is highly disturbed due to previous installation of utility infrastructure. The EPA Contaminated Lands Register did not yield any results of contaminated land in proximity to the site. Consequently, the proposal site is not expected to be contaminated. Therefore, this SEPP is not relevant to the project.

An unexpected finds protocol is proposed to be implemented during any earthworks and ground disturbance.

Should contamination be uncovered during the construction, the relevant provisions within the SEPP for remediation work may be applicable. These will be identified in the contractor's CEMP to ensure that contaminated material is identified and removed in accordance with NSW WorkCover and EPA guidelines.

4.4 Local Government Act 1993

The purpose of the *Local Government Act 1993* is to provide a legal framework for the local government system of New South Wales, and sets out the responsibilities and functions of local government in order to provide an accountable, sustainable, flexible and effective system.

Under Section 60 of the *Local Government Act 1993*, local water utilities are required to obtain ministerial approval for the provision of *"sewage from its area to be discharged, treated or supplied to any person*."

Section 60 is not considered to be applicable to the proposal as the sewage system is already approved and is in operation. This proposal is for upgrade and extension works to the existing sewage system.

4.5 Heritage Act 1977

The *Heritage Act 1977* relates to the registration, conservation, interim protection and adaptive reuse of items of State heritage significance. The subject site does not contain any known State Heritage objects. A number of LEP listed heritage sites are located to the west and east of the study area.

The proposed works are located outside the property boundaries of all LEP listed heritage sites and consequently, it is considered unlikely that the proposed works will disturb any items of heritage significance and a permit is not required from the Department of Premier and Cabinet – Heritage NSW. Mitigation measures will be incorporated into the works to ensure there will be no adverse effects to any heritage items in the event of an unexpected find (Refer to Section 6.2.2).

4.6 National Parks and Wildlife Act 1974 (NPW Act)

The *National Parks and Wildlife Act 1974* aims to conserve nature, places, objects and features of cultural value (including those of significance to Aboriginal people), fostering public appreciation and providing for the management of these places.

Section 86 lists offences relating to harming or desecrating Aboriginal objects. Under Section 90(1) of the Act, where harm to an Aboriginal object or Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) is required.

An Aboriginal Cultural Heritage Due Diligence Assessment (ACHDDA) was undertaken by Austral Archaeology. The full report is provided in Appendix C.

The ACHDDA identified areas within the study area that have the potential to contain archaeological deposits, however the proposed works are unlikely to cause disturbance or destruction of any Aboriginal objects or places as they are located outside of the potential archaeological deposit areas.

These areas require further investigation (including test excavations) to be documented in an Aboriginal Cultural Heritage Assessment Report (ACHAR). Depending on the findings of the ACHAR, an Aboriginal Heritage Impact Permit (AHIP) may be required before construction of the proposal could proceed.

4.7 Water Management Act 2000

The *Water Management Act 2000* provides that certain types of development and activities carried out within 40 m of a river, lake or estuary are controlled activities and require a controlled activity approval (CAA). A controlled activity includes *"The erection of a building or the carrying out of a work"*. The proposal constitutes 'carrying out a work' and is proposed to be installed within 40 m of a drainage channel. Clause 41 of the related *Water Management (General) Regulation 2018* allows public authorities to be exempt from having to obtain a CAA in order to carry out controlled activities on prescribed land.

Clause 41 states as follows:

> *"A public authority is exempt from section 91E(1) of the Act in relation to all controlled activities that it carries out in, on or under waterfront land."*

The WM Act 2000 includes the following definition of a public authority:

> ***"public authority** means—*
>
> *(a) a Minister of the Crown, or*

(b) a Public Service agency, or

(c) a statutory body representing the Crown, or

(d) a statutory State owned corporation (or any of its subsidiaries) within the meaning of the State Owned Corporations Act 1989, or

(e) a council or county council within the meaning of the Local Government Act 1993,

but does not include any person or body declared by the regulations not to be a public authority."

Shoalhaven Water is a Category 1 business operated by Shoalhaven Council as a Local Water Utility Provider. Shoalhaven Water is operated under Shoalhaven Council's governance framework under the Local Government Act, 1993. Therefore, Shoalhaven Water is exempt from a CAA.

The NSW Aquifer Interference Policy outlines the requirement for an aquifer interference licence under the WM Act. The proposed works involve trenching and under boring to install the water main, which is defined as a minimal impact aquifer interference activity under Section 3.3 of the NSW Aquifer Interference Policy.

If groundwater is intersected during excavation, the incidental discharge volume is likely to be less than 3 Mega Litres (ML) per year, and all extracted groundwater will be returned to the groundwater system as outlined in the mitigation measures in Section 6.4.

Therefore, no aquifer interference licence will be required.

4.8 Protection of Environmental Operations Act 1997 (POEO Act)

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates land, air, noise and water pollution in NSW. It also aims to provide opportunity for increased public involvement and access to information regarding environmental protection.

The POEO Act focuses on environmental protection and provisions for the reduction of water, noise and air pollution as well as the storage, treatment and disposal of waste. Shoalhaven Water and/or contractors working on behalf of Shoalhaven Water are required to notify the EPA when a 'pollution incident' occurs that is likely to impact upon the environment as per Section 148 of the Act. An incident management plan would be included within the Construction Environmental Management Plan (CEMP).

Shoalhaven Water holds an Environmental Protection Licence (EPL) for the operation of the Nowra Sewage Treatment Plant (STP). The proposal includes the upgrade of sewer pipes that connect to the Nowra STP, which has an existing EPL (licence number '1734') and therefore no other licence is required for the proposal works.

4.9 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) commenced on 25 August 2017 and replaced the *Threatened Species Conservation Act 1997* and the *Native Vegetation Act 2003*.

The BC Act outlines protection of threatened species, populations or ecological communities, or their habitats, and delivers a strategic approach to biodiversity conservation in NSW whilst supporting improved farm productivity and sustainable development.

The proposal would only involve minor clearing of non-significant vegetation which will be reinstated following construction.

Provided the recommendations within this REF are undertaken, the proposal is unlikely to have a significant impact on threatened flora or fauna species or ecological communities.

4.10 Local Government Provisions

Shoalhaven City Council's Local Environment Plan 2014 (LEP) is the principal legal document for controlling development at the council level. The zoning provisions establish permissibility of uses and standards to regulate the extent of development. The LEP zones the land on which the sewer works are proposed as:

- RE1 – Public Recreation
- RU1 – Primary Production
- SP2 – Infrastructure

- R1 – General Residential
- R2 – Low Density Residential
- R3 – Medium Density Residential
- E2 – Environmental Conservation.

Subject to *Clause 106* of ISEPP development consent under the LEP is not required. The provisions of the ISEPP prevail over the LEP in terms of permissibility.

4.11 Other Relevant Legislation

4.11.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation, focusing on Matters of National Environmental Significance (MNES), with States and Territories having responsibility for matters of State and local significance.

Approval is required from the Commonwealth Minister for the Environment for any controlled action that may result in a significant impact on MNES.

A search of the EPBC Act database (Protected Matters Search Tool (PMST)) was undertaken to identify the potential for occurrence of MNES within 10km of the proposal (full search results within Ecological Impact Assessment in **Appendix B**). The MNES protected under the EPBC Act are shown in **Table 4-1** which also identifies the potential for occurrence within 10km of the proposal.

Potential impacts to the MNES identified within the proposal site are addressed in **Section 6.1** of this report.

Table 4-1 Potential Impacts on MNES

Matters of National Environmental Significance	Potentially Occurring
World heritage properties	None
National heritage places	None
Wetlands of international importance (listed under the Ramsar Convention)	None
Great Barrier Reef Marine Park	None
Commonwealth marine areas	None
Threatened ecological communities	6
Threatened species	82 (10 critically endangered species)
Migratory species	57 (only 6 of these species were considered relevant given the others were marine or wetland species)

Other Commonwealth matters identified through the PMST are identified in Table 4-2. Commonwealth Land is addressed in Section 6.2, Commonwealth Heritage Places are addressed in Section 6.2 and listed marine species are addressed in Section 6.1.

Table 4-2 Other Commonwealth matters

Other Commonwealth matters	Number
Commonwealth Land	11
Commonwealth Heritage Places	1
Listed Marine Species	67

5 Consultation

5.1 ISEPP Consultation

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Clauses 13 to 16 of the ISEPP outline the requirements for consultation with public authorities and local council where the development has impacts on council related infrastructure or services, impacts on local heritage or impacts on flood liable land. As Shoalhaven Water (Council) is the proponent for the proposed works, Clauses 13 to 15A are to be addressed via internal consultation with respect to the development.

This is detailed below in Table **5-1.** Based on the inputs below; no additional consultation is required.

Table 5-1 Infrastructure SEPP Consultation Requirements

Relevant SEPP Clause	Is consultation with Council or others required under clauses 13-16 of the Infrastructure SEPP?	
13(1)(a)	Are the works likely to have a substantial impact on the stormwater management services which are provided by council?	No. The works relate to the sewer network. The proposal may have minor impacts on stormwater management while the proposal is under construction (e.g. potential for sediment entering stormwater) however any such impacts are manageable with the mitigation measures outlined in Section 6.
13(1)(b)	Are the works likely to generate traffic to an extent that will strain the existing road system in a Local Government Area?	No. The works will result in temporary and minimal levels of traffic generated during construction.
13(1)(c)	Will the works involve connection to a council owned sewerage system? If so, will this connection have a substantial impact on the capacity of the system?	Yes. The works involve the upgrade of a Council owned sewerage system and will improve the operational capacity of the system into the future. As Shoalhaven Water is the proponent for the works, consultation with the relevant departments within Council has been and will be ongoing throughout the proposal.
13(1)(d)	Will the works involve connection to a council owned water supply system? If so, will this require the use of a substantial volume of water?	No/NA
13(1)(3)	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a minor or inconsequential disruption to pedestrian or vehicular flow?	Yes. A site compound area is proposed within the north western corner of Ratcliff Park, which will be enclosed. No, the site compound will not cause more than a minor or inconsequential disruption to pedestrian or vehicular flow. Open trenches would be fenced off during construction where required to ensure pedestrian safety. Such fences would not disrupt pedestrian or vehicle flow.
13(1)(f)	Will the works involve more than a minor or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes. The works will involve excavation of roads where the alignment crosses roads for installation of pipes. As Shoalhaven Water is the proponent for the works, consultation with the relevant departments within Council has been undertaken internally and will be ongoing throughout the proposal.
14	Is there a local heritage item (that is not also a state heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the item/area are more than minor or inconsequential?	No. The study area for the works does not contain local heritage items or a heritage conservation area. An unexpected finds protocol would be implemented should the proposal unearth any unexpected heritage items during trench excavation.

Relevant SEPP Clause	Is consultation with Council or others required under clauses 13-16 of the Infrastructure SEPP?	
15 & 15AA	Are the works located on flood liable land? If so, will the works change flooding patterns to more than a minor extent?	Yes, the works are located on flood liable land, however will not change flooding patterns to more than a minor extent.
15A	Are the works likely to impact land within the coastal zone?	No, the proposal is not in the coastal zone.
16	Is consultation with other agencies required under clause 16 of the Infrastructure SEPP?	
16(2)(a)&(b)	Are the works adjacent to a national park, nature reserve or other area reserved under the *National Parks and Wildlife Act 1974*?	No. Worrigee Nature Reserve is located approximately 400 m east of the study area and would not be impacted by the proposal.
16(2)(c)	Are the works adjacent to a declared aquatic reserve under the *Fisheries Management Act 1994*?	No
16(2)(d)	Are the works in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	No
16(2)(e)	Do the works involve the installation of a fixed or floating structure in or over navigable waters?	No
16(2)(f)	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional facility or group home in bush fire prone land?	No
16(2)(g)	Will the works increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map	No
16(2)(h)	Are the works located on defence communications facility buffer land within the meaning of clause 5.15 of the Standard Instrument	No
16(2)(i)	Are the works located on land in a mine subsidence district within the meaning of the Mine Subsidence Compensation Act 1961	No

5.2 Stakeholder and Community Consultation

The REF for this project was placed on public exhibition from 24 November 2021 to 24 December 2021, during which time submissions were invited. Notification via mail to properties along the proposed alignments were issued informing the community of the REF being placed on Public Exhibition and inviting Community feedback; zero (0) responses were received during the exhibition period.

Prior to the commencement of construction, the construction contractor will further notify:

- Shoalhaven City Council
- Land owners
- Utility owners
- Residents that will potentially be impacted by the proposed works.

These parties would be contacted by letter 28 days prior to the work starting. Responses received within 21 days will be considered prior to works commencing. Potentially affected land owners and residents who will be directly impacted by the works (access or noise) will be notified by letter 28 days before work starts and by telephone or door knocking 7 days before works start. Signs will be posted around construction site fences with contact details for the Construction Project Manager.

6 Environmental Impacts

This section of the report provides an assessment of the potential environmental impacts of the proposed works.

6.1 Ecology

6.1.1 Existing environment

To assess the ecological impacts associated with the project, an Ecological Impact Assessment (EIA) has been undertaken by Cardno. The full report is contained at Appendix B. The findings of this assessment are summarised below.

The assessment describes the ecological values and constraints in the study area and provides a list of threatened species that are found in the broader area and identifies those that may use the study area. A site survey collected data to identify the native vegetation communities in the study area and their conservation status.

The EIA has been undertaken in accordance with the BC Act and EPBC Act. Management requirements for priority weeds listed under the NSW Biosecurity Act 2015 were also considered.

Summary of findings during the EIA

A summary of findings during the EIA is provided in Table 6-1 below.

Table 6-1 Ecological assessment

Subject area	Results
Vegetation	▪ A total of 88 flora species were recorded across the study area, including 33 native species and 55 exotics across 45 families. The most represented families were the Myrtaceae (12 species), Poaceae (12 species) and the Asteraceae (9 species). ▪ No threatened flora species were detected during field surveys.
Threatened species	▪ Records of threatened biodiversity listed under the *BC Act* and with known records within 10 km of the study area were determined using the BioNet Atlas ▪ No threatened species, populations and/or communities were detected within the study area during field surveys ▪ Subsequent to field surveys, an assessment of likelihood of occurrence was undertaken for all threatened biodiversity identified with potential to occur within 10 km of the study area. It was found that none of the predicted threatened species have moderate, high or known likely occurrence within the study area
TECs	▪ Based on desktop review, six threatened ecological communities (TEC) listed under the EPBC Act and one TEC listed under the BC Act were predicted to occur within 10 km of the project footprint; o Coastal Swamp Oak (*Cassuarina glauca*) Forest of New South Wales and South East Queensland ecological community (listed as EEC under the EPBC Act); o Illawarra and south coast lowland forest and woodland ecological community (listed as CEEC under the EPBC Act); o Illawarra-Shoalhaven subtropical Rainforest of the Sydney Basin Bioregion (listed as CEEC under the EPBC Act and as EEC under the BC Act); o River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as CEEC under the EPBC Act); o Subtropical and Temperate Coastal Saltmarsh (listed as VEC under the EPBC act); and o Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion (listed as EEC under the EPBC Act) ▪ Subsequently, an assessment of likelihood of occurrence was undertaken and it was found that only one of the TECs has the probability to occur within the study area, being the Illawarra and south coast lowland forest and woodland ecological community listed as CEEC under the EPBC Act and EEC under the BC Act. ▪ Assessment of the Illawarra Lowland Forest community indicated that the vegetation within the study area does not correspond to the EPBC Act listed TEC, however, a small area of vegetation was found commensurate with the BC Act listed TEC.

	▪ The Illawarra Lowland Forest (BC Act compliant) will be delineated as a No-Go-Zone and avoided by the project. ▪ Therefore, it is considered that works and activities reasonably anticipated from the sewage upgrade works are unlikely to result in impacts on EPBC Act and BC Act listed TECs.
Migratory Species	▪ The PMST identified 57 listed migratory species as known to, likely to or may occur within 10 km of the study area. o Subsequently, an assessment of likelihood of occurrence was undertaken and it was found that none of the migratory terrestrial species have moderate, high or known likely occurrence within the study area

Vegetation communities and flora species

The study area consisted predominantly of cleared land with exotics, remnant native trees and an area of regrowth native vegetation. Cleared land without vegetation included culverts, bridges area, concreted areas, driveways and roads. Most vegetation areas within the study area do not correspond to any known vegetation community, except for woodland areas which are commensurate with Plant Community Type PCT 1326 (see Table 6-2).

Ground-truthed vegetation mapping is shown in Figure 6-1.

Table 6-2 Vegetation communities and cleared areas

PCT ID	PCT Name	Condition	Area (ha)
Native Vegetation			
1326	Wollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Low	0.07
-	Native Tree Patch	NA	5.42
-	Paddock Trees	NA	0.03
-	Planted Natives	NA	0.04
Miscellaneous areas			
-	Creek Line Vegetation	NA	0.16
-	Exotics with Native Regrowth	NA	1.15
-	Exotic Grassland / Cleared	NA	10.07
-	Cleared Land	NA	0.02

Notes: NA = Not Applicable

Figure 6-1 Ground-truthed vegetation

A large portion of the study area consists of land historically cleared and disturbed currently occupied by exotic vegetation, mainly exotic grassland and herbfields located in open space (maintained lawns, grazing areas), front yards, road reserves and landscaped gardens. Exotic species present include common Couch (*Cynodon dactylon*), Parramatta Grass (*Sporobolus fertilis*), Paspalum (*Paspalum dilatatum*), Ribwort (*Plantago lanceolata*), Dandelion (*Taraxacum officinale*), Cobbler's Pegs (*Bidens pilosa*), Cudweed (*Gamochaeta coarctata*), Japanese Cudweed (*Euchiton sphaericus*), Fleabane (*Conyza bonnariensis*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*), Blackberry (*Rubus fruticosus* aggregate), Asparagus Fern (*Asparagus aethiopicus*), Lantana (*Lantana camara*), Spear Thistle (*Cirsium vulgare*), Mother of Millions (*Bryophyllum delagoense*), Pennywort (Centella asiatica). Kiluyu (*Pennisetum clandestinum*), White Clover (*Trifolium repens*). Sparse incidences of the native grasses Three-awn Speargrass (*Aristida vagans*) and Wiry Panic (*Entolasia stricta*) occur in this vegetation zone.The weed categorisation and legislative context of each species is outlined in Appendix B.

Regrowth of native trees and shrubs in found in disturbed land with exotic groundcover and shrubs, but lacking native groundcover. These areas are dominated by exotic groundcover and have garden escapees as result of garden waste dumping. Evidence of ongoing impacts on this area included waste dumping, household drain/runoff and waste burning. Due to the exotic dominated ground cover and the low variety of native species, these areas cannot be allocated to any known Plant Community Types (PCT).

Planted native trees were recorded in otherwise cleared landscape, including *Ficus* sp., paperbarks (*Melaleuca* spp.), bottlebrushes (*Callistemon* spp.). These plantings do not conform any known vegetation community. Planted natives at Ratcliff Park included Spotted Gum (*Corymbia maculata*), Sydney Blue Gum (*Eucalyptus saligna*), Large-fruited Red Mahogany (*Eucalyptus scias*), Swamp She-oak (*Casuarina glauca*), Weeping Bottlebrush (*Callistemon viminalis*), Sweet Pittosporum (*Pittosporum undulatum*), Kidney Weed (*Dichondra repens*) and Wiry Panic (*Entolasia stricta*). The exotic tree *Pinus* sp. was also observed. The groundcover at Ratcliff Park include the exotic species Asparagus Fern (*Asparagus aethiopicus*) and Cobbler's Pegs (*Bidens pilosa*).

Patches of native trees were recorded present in historically disturbed areas. The alignment of some of these trees along roads suggest they might have been planted. These areas lack native groundcover and in most cases are maintained (e.g. lawn maintained, exotic plants used for landscaping) with evidence of revegetation (e.g. planting) present. These areas do not conform to any known PCT. This includes patches of trees at Ratcliffe Park, The Garden Walk, Old Southern Road, Greenwell Point Road and Worrigee Road.

Native trees were also recorded as isolated trees in otherwise cleared landscape, including Spotted Gum (*Corymbia maculata*), White Stringybark (*E. globoidea*) and Forest Red Gum (*E. tereticornis*).

Aquatic vegetation was observed in creek lines, most of which are associated with existing culverts and are in very degraded condition. Other areas have been preserved as fenced off areas surrounded by build-up environment (e.g. roads, road reserves, residential properties). Species present in these areas include Broadleaf Cumbungi (*Typha orientalis*), *Persicaria* sp., Bracken (*Pteridium esculentum*) and exotic herbs.

A total of 88 flora species across 45 families were recorded within the study area. The flora species included 33 native (37%) and 55 exotics (63%). The most represented families were the Myrtaceae (12 species), Poaceae (12 species) and the Asteraceae (9 species).

There were no threatened flora species recorded within the study area.

A small patch of PCT 1326 was found to be commensurate with the BC Act listed Endangered Ecological Community (EEC) Illawarra Lowlands Woodland in the Sydney Basin Bioregion as shown in Figure 6-2. No other TEC was recorded within the study area.

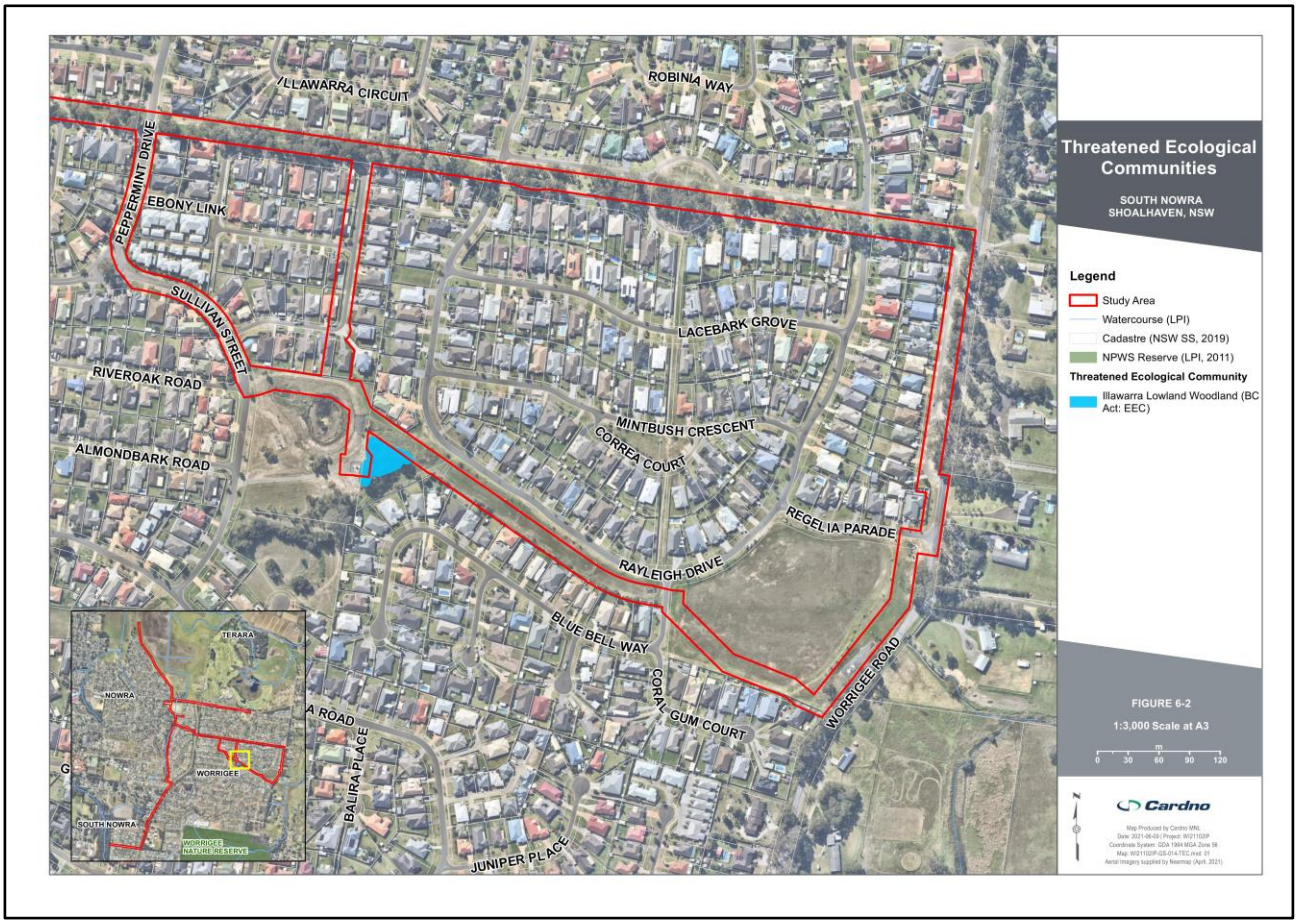


Figure 6-2 Threatened ecological communities to be marked as a no-go-zone during construction

Fauna species and habitat features

A total of four threatened species listed under the BC Act were identified as having a moderate or known likelihood of occurrence within the study area using the BioNet Atlas, the species included:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) listed as Vulnerable under the BC Act;
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as Vulnerable under the BC Act;
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) listed as Vulnerable under the BC Act;
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) listed as Vulnerable under the BC Act.

Assessment of significance on those species concluded that the proposed sewage upgrade works would not result in significant impacts on those threatened species

A total of 17 fauna species were observed during the surveys including 13 native and four introduced species. Table 6-3 shows the full list of fauna.

Table 6-3 List of Fauna Species

Family	Scientific Name	Common Name	Origin	Type of Observation
Aves				
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	N	Seen
Artamidae	*Cracticus tibicen*	Australian Magpie	N	Seen
Artamidae	*Cracticus torquatus*	Grey Butcherbird	N	Seen
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	N	Seen
Cacatuidae	*Eolophus roseicapillus*	Galah	N	Seen
Corvidae	*Corvus coronoides*	Australian Raven	N	Seen
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	N	Seen

Family	Scientific Name	Common Name	Origin	Type of Observation
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	N	Seen
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	N	Seen
Sturnidae	*Acridotheres tristis*	Indian Myna	E	Seen
Psittacidae	*Platycercus elegans*	Crimson Rosella	N	Seen
Psittacidae	*Platycercus eximius*	Eastern Rosella	N	Seen
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	N	Seen
Mammalia				
Canidae	*Canis lupus familiaris*	Dog	E	Seen
Equidae	*Equus caballus*	Horse	E	Seen
Reptilia				
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	N	seen
Gastropoda				
Helicidae	*Helix aspersa*	Common Garden Snail	E	Seen
Notes: Origin: N = Native; E = exotic/pest/introduced;				

No threatened fauna species listed under the BC Act and/or EPBC Act were observed during the field survey.

Fauna habitat observed within the study area during the field survey is included in Table 6-4 below.

Table 6-4 Fauna habitat values

Habitat Value	Description
Hollow Bearing Tree	Few hollow-bearing trees were observed on living trees. Hollows of small size (<15 cm diameter) were observed and would be suitable as habitat for small fauna (birds, reptiles, mammals).
Stags	Stags were present within the study area, mainly as part of larger trees. Stags would be suitable habitat for birds, small reptiles and microbats.
Logs	No naturally occurring logs were observed within the study area. Logs were present as a 'soft fence' at the boundary of a vegetated area at Sullivan Street Playground and Park.
Rocky Outcrops	None observed.
Caves	None observed.
Leaf Litter	Leaf litter is present in small amounts at the base of trees in vegetated areas and in treed areas. Overall, leaf litter is removed as part of maintenance of areas within the study area. Leaf litter provide foraging opportunities for a range of fauna including birds, reptiles, gastropods and small ground mammals.
Decorticating bark	Decorticating bark was observed in some gum trees. Decorticating bark provides habitat for insects, small reptiles and microbats.
Burrows, nests and other fauna made habitat	A bird nest observed on a tree within the Garden Walk part of the study area. No other fauna made habitat was observed.
Koala Feed Trees	Three koala feed tree species part of the South Coast Koala Management Area were recorded within the study area, Spotted Gum (*Corymbia maculata*), Grey Ironbark (*E. paniculata*) and Grey Gum (*E. punctata subsp. punctata*). No records of koala exist withn the study area and within the last decade. Given the location of the study area in highly disturbed landscape, it is considered that core koala habitat is not present therein.
Connectivity	Most of the study area is located in cleared or residential area and mostly with low to no connectivity value. The presence of trees in patches of trees and vegetated areas provides limited connectivity value to mobile species (e.g. birds, microbats), but little to no connectivity to less mobile fauna or fauna for which the presence of roads, fences and exotic species (e.g. cats, dogs) would limit their movement.

Habitat Value	Description
	The presence of the bridge and culverts across waterways would allow connectivity for aquatic fauna (e.g. frogs) where aquatic habitat quality occurs.
Aquatic Habitat	Aquatic habitat is limited and in poor condition. These areas provide aquatic habitat of low to moderate value. There is limited amount of aquatic emergent vegetation in the creek channel at Browns Creek. The riparian corridor is highly modified with banks eroded and/or occupied by weeds.

6.1.2 Potential impacts

Vegetation

The proposed project will be located in highly disturbed land consisting of cleared land with miscellaneous vegetation non-consistent with endemic native vegetation communities. The Study Area includes the presence of one plant community type, PCT 1326. A portion of the PCT 1326 is commensurate with the BC Act listed EEC Illawarra Lowlands Woodland in the Sydney Basin Bioregion.

It is expected that earth works would impact native vegetation as follows:

- Native trees: the upgrade route would potentially result in impact to root system of native trees where they occur close to the new sewer pipe alignment. Spotted Gum (*Corymbia maculata*) and Grey Ironbark (*Eucalyptus paniculata*) are the tree species present close to the sewer pipe.
- Native trees will be removed at Ratcliff Park to create an access from the road. The possibility exists that additional native trees being affected to install a fence. The impact on native trees not part of a known PCT is a minimal impact with no significant effects on fauna. In order to compensate for loss of native trees, compensatory planting is proposed at a rate of 1:1 (i.e. one new tree planted for each native tree removed).
- PCT 1326: This vegetation community is located on the western roadside of Worrigee Road and in a small patch at Rayleigh Drive (east to SPS28), the proposed alignment is located within 10m of trees of the Worrigee Road patch. The vegetation patch at Rayleigh Drive will not be impacted as the existing sewer at SPS28 will be decommissioned in-situ.

Overall, exotic grasslands/Cleared and exotics with native regrowth are located where the proposed sewer alignment will occur. Therefore, no remnant native vegetation will be affected.

Key Threatening Processes

Key Threatening Processes (KTP) are listed under the BC Act, the FM Act and the EPBC Act. Of these, there are five KTPs that have the potential to occur as result of the proposal:

- Clearing of Native Vegetation;
- Human-caused Climate Change;
- Infection of native plants by *Phytophthora cinnamomi*;
- Alteration of the natural flow regimes of rivers, streams, floodplains & wetlands; and
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis.

Clearing of Native Vegetation

The study area includes vegetation communities (PCT 1326) as well as native trees, planted natives and native tree regrowth. All native vegetation is protected under the BC Act and all threatened biodiversity (i.e. threatened species, threatened populations and threatened ecological communities) are protected under both the BC Act and EPBC Act. Impacts on threatened biodiversity will be avoided by defining No-Go-Zones, whereas impacts on non-threatened native vegetation would be avoided as far as possible by routing the pipeline to avoid the vegetation. Should some limited tree removal be required mitigation planting would be required as described in the mitigation section below (**Section 6.1.3**).

. Clearing of exotic grasslands will be required. It is noted that although the Proposal will not require clearing of native vegetation, it is possible that trenching could impact the root system of some native trees located close to the new sewer alignment and this could cause decay/ mortality of these resulting in loss of canopy and loss of native cover. Loss of native canopy would constitute the Clearing of Native Vegetation KTP.

Human-caused Climate Change

The study area includes cleared land and vegetated areas. Vegetated areas are mainly located as disturbed patches in an otherwise disturbed (rural/urban) landscape. The Proposal would require removal of exotic grasslands, native and planted vegetation (if native trees are impacted) and potentially clearing of poor-quality herb field in riparian areas for construction of new sewer pipeline.

The project would contribute to clearing of native vegetation and native trees which is associated with loss of cooling effects provided by vegetation, particularly canopy cover. Although most of the project area will be located in disturbed landscapes, removal of canopy trees would trigger this KTP. It is considered that this KTP would not result in permanent effect where compensatory planting occurs. Planted trees would provide localized cooling effects within the proposed project area.

Infection of native plants by Phytophthora cinnamomic

Phytophthora cinnamomi Rands is a soil borne pathogen that spreads in plant roots in warm, moist conditions. The pathogen appears to be widespread in coastal forests, but may also occur at higher elevations. The pathogen affects native species which display a range of symptoms, come are killed, some are damaged but endure, and some show no apparent symptoms.

The project has the potential of triggering this KTP by cross contamination of soils in vegetated areas and areas with native species, particularly near creek lines, by accessing areas with soil contaminated equipment and PPE. Soil cross contamination can be avoided by establishing and implementing a cleaning protocol for machinery and PPE. Provided, decontamination protocols are put in place, it is expected the proposal would not result in triggering this KTP.

Alteration of the natural flow regimes of rivers, streams, floodplains & wetlands

The study area includes a channelized section of Browns Creek and other disturbed creek line areas. The location of the proposed new sewage alignment would not be located in creek lines. Indirect impacts on creek lines would be minimized through sediment and erosion measures being installed prior to commencement of works and implemented during the project lifetime. Therefore, it is expected the proposal would not result in triggering this KTP.

Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

As noted above, the project will avoid creek lines and will not result in disturbance to creek lines or its vegetation. No direct use of these aquatic environments is proposed as part of the proposed project. However, the possibility exists of use of the project site to indirectly impact on these aquatic environments, and their aquatic fauna (where present), such as frogs, by cross-contamination and importation of pathogens. Given the proximity of the project to aquatic environments, effective control measures would be considered to restrict access to creek lines during establishment, construction and operational phased of the project. Inclusion of control measures to prevent run off, access to creek lines and educational information during construction and operation of the project works would significantly minimize the possibility of triggering of this KTP.

Provided that the impact avoidance and mitigation measures are implemented, no threatened species, population or ecological community is likely to be significantly impacted by the proposed project.

6.1.3 Avoidance and mitigation measures

A Construction Environmental Management Plan (CEMP) should be prepared for the project documenting all of the impact avoidance and mitigation measures outlined in this REF. All project staff should be inducted to the site prior to commencement of construction activities. The induction should include an explanation of the requirements under the CEMP to ensure all environmental impacts are avoided (where possible) or otherwise appropriately managed.

The following avoidance measures shall be implemented to manage and mitigate potential impacts on biodiversity:

- Use of previously cleared and non-native (e.g. miscellaneous) vegetated area for the footprint of the project layout where possible, including laydown areas during the construction phase;
- Use of non-invasive techniques for decommissioning of underground mains (e.g. grout-filling) within the project footprint to avoid earthworks and associated soil and vegetation disturbance, as well as preventing sedimentation and erosion impacts into adjacent lands, including Browns Creek and its riparian corridor;

- Install project boundary fencing on laydown areas and/or site compounds to ensure activities and ancillary facilities are restricted to the project footprint.

The following mitigation measures shall be implemented to manage and mitigate potential impacts on biodiversity.

General

- Creek lines and riparian corridors to be fenced off and labelled as No-Go areas to prevent accidental impacts and introduction of pathogens, such as *Batrachonchtrium dendrobatidis*, a pathogen that caused chytridiomycosis, an infection disease on amphibians;
- All machinery should be cleaned of foreign soil and vegetative matter to avoid the spread of *Phytophthora cinnamomi*, Exotic Rust Fungi of the order Pucciniales pathogenic (Myrtle Rust) and dispersal of seeds of non-native plants;
- Strict weed management, monitoring and control practices should be implemented as part of the CEMP to minimise the spread of exotic species into natural areas within and outside of the study area. In particular, priority weed and high threat exotic species should be targeted in accordance with the NSW DPI WeedWise recommended control measures (DPI 2021);
- Strict erosion and sediment control measures should be implemented as part of the CEMP, with the site to be monitored and maintained to prevent impacts on adjacent areas, particularly to avoid erosion and sediment mobilisation from rain events;
- Implement dust control measures where necessary to protect adjacent retained vegetation and water quality in Browns Creek; and
- Stockpiling of materials should occur within previously disturbed areas and not within driplines or retained vegetation.

Vegetation clearing

While all attempts to avoid vegetation clearing would be put in place, should some limited tree removal be required the following mitigation measures would apply:

- If required, tree removal to be supervised as detailed in 'Wildlife protection during construction' section below
- Compensatory planting at rate of 1:1 to occur for any large trees (i.e. Diameter at Breast Height (DBH) ≥50 cm).
- No native vegetation clearing is permitted in the areas marked as a TEC on Figure 6-2.

In addition, weed removal shall follow weed management mitigation measures listed above.

Wildlife protection during construction

- Stop-work procedure on the chance encounter of any dispersing wildlife during works should be implemented to avoid death or injury;
- If tree clearing is unavoidable, ensure that a suitably qualified ecologist is present during the removal of any trees to act as a spotter-catcher that can relocate any captured wildlife;
- Ensure that a suitable qualified ecologist is present during the removal of all trees to act as a spotter-catcher that can relocate any captured wildlife
- Ensure that all captured animals are relocated into the nearest suitable native vegetation; and
- Ensure that any injured animals are taken to a local wildlife carer for treatment.

Aquatic habitat

- Strict erosion and sedimentation control measures should be implemented where required to ensure that the water quality and hydrological regime of Browns Creek adjacent to the study area is not impacted

6.2 Non-Aboriginal Heritage

6.2.1 Existing Environment

The database searches identified the following heritage items and places in general proximity to the proposal area, of which one place is listed under the Commonwealth Heritage List and the remaining items listed under the Shoalhaven LEP 2014 as heritage items of local significance:

Commonwealth Heritage List site and Shoalhaven LEP 2014 locally listed site:

- "Bundanon Trust Property; address Illaroo Road, approximately 9km from the proposal extents;
  - An area comprising the whole of Land Parcels Lot 5 DP 622583 (including the road reserves within the land parcel), Lot 17 DP 751273 (including the road reserve within the land parcel), Lot 16 DP751273 (including the road reserve within the land parcel), Lot 14 DP 751273 (including the road reserve within the land parcel), Lot 224 DP 751273, Lot 227 DP 751273, Lot 101 DP 751273 and Lot 118 DP 751273;.

Shoalhaven LEP 2014 locally listed items:

- "Nowra Park", early Victorian masonry residence and garden; address 124 Wallace Street; Lot 4, DP 542656; Local Significance; LEP item no 403; approximately 750m from proposal extents.
- "Myambah", Federation weatherboard bungalow and garden; address 134 Plunkett Street; Lot 1, DP 124486; Local Significance; LEP item no 401; approximately 650m from the proposal extents.
- "The Pines", late Victorian weatherboard residence and trees; address 76 East Street; Lot 1, DP 115881 and adjacent road reserve; Local Significance; LEP item no 340; approximately 800m from proposal extents.
- "Roseville", Federation weatherboard residence and fig tree; address 49–51 Journal Street and Station Street; Lots 1 and 2, DP 2607 and adjacent road reserve; Local Significance; LEP item no 346; approximately 850m from proposal extents.
- "Trelawney", Victorian Georgian weatherboard residence; address 69 Jervis Street; Lot 1, DP 998589; Local Significance; LEP item no 345; approximately 850m from proposal extents.
- "Cudgerie", Federation weatherboard residence; address 108 East Street; Lot 11, DP 2607; Local Significance; LEP item no 341; approximately 950m from proposal extents.
- Rubblestone school (former Worrigee schoolhouse); address 20 Booligal Road; Lot 15, DP 755953; Local Significance; LEP item no 521; approximately 380m from proposal extents.
- Worrigee Cemetery; address Greenwell Point Road; Lot 8, DP 791226; Local Significance; LEP item no 524; approximately 650m from proposal extents.
- Cement rendered colonial (dome) wells (2); address 315 Greenwell Point Road; Lot 2, DP 1087811; Local Significance; LEP item no 523; approximately 670m from the proposal extents.

All Commonwealth Heritage listed places and heritage items of local significance were located a reasonable distance from the proposal area.

6.2.2 Potential Impacts

The proposal area as shown in Figure 1-1 does not contain any known non-Aboriginal heritage items or encroach on conservation area boundaries, and the proposal does not interface with any heritage items or lot boundaries containing known items of significance. Therefore a significant impact on non-Aboriginal heritage is unlikely.

It is noted that there remains the potential to encounter previously unidentified sites or artefacts of non-Aboriginal heritage significance. Should previously unidentified sites or items be uncovered during the works, the mitigation measures in Section 6.2.3 should be followed.

Operation of the site would not change significantly from the existing operation of the site, however there would be an increase of light vehicle and plant traffic which could present a potential risk to heritage sites. This risk would be mitigated by the measures provided in Section 6.2.3.

6.2.3 Mitigation Measures

- Construction activities, including site access and ancillary activities are to remain within the study area only

- The CEMP should include an unexpected finds protocol to manage the risk of unexpected archaeological finds. If any non-Aboriginal items are discovered during the works, or suspected items of non-Aboriginal heritage significance, then works in the immediate area should stop immediately and Shoalhaven Water should be contacted to advise of management measures prior to recommencing works in the vicinity
- All construction workers should be informed of their responsibilities in relation to Aboriginal and non-Aboriginal cultural heritage under the relevant legislation

6.3 Aboriginal Heritage

6.3.1 Existing Environment

Austral Archaeology Pty Ltd (Austral) were engaged to provide Aboriginal Cultural Heritage Due Diligence Advice (ACHDDA) for the proposed works at the site. A copy of the report is provided is provided in Appendix C. This report consisted of a desktop assessment and visual site inspection undertaken on 13 May 2021.

An extensive search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted on 10 May 2021 (Client service ID: 589839). The search identified 86 Aboriginal archaeological sites within an 8-kilometre search area centred on the proposed study area. None of these registered sites are located within the study area.

6.3.2 Potential Impacts

A visual inspection was undertaken in five areas (SA 1-5) within the study area as shown in Figure 6-3. The visual inspection identified three areas of moderate archaeological potential within SA1 and SA3 and one potential archaeological deposit (PAD) in the western portion of Ratcliff Park within SA3 as shown in Figure 6-4. All remaining areas inspected within the study area were considered to have a low archaeological potential.

The proposal works would be carried out in areas with low archaeological potential, however the proposed SPS is within close proximity (approximately 5m away) to the PAD site. Other parts of the proposal works are also in close proximity to areas of moderate archaeological potential identified during the visual inspection (Figure 6-4). Provided the mitigation measures outlined Section 6.3.3 below are followed it is considered unlikely that the proposal will have a significant impact on Aboriginal Heritage.

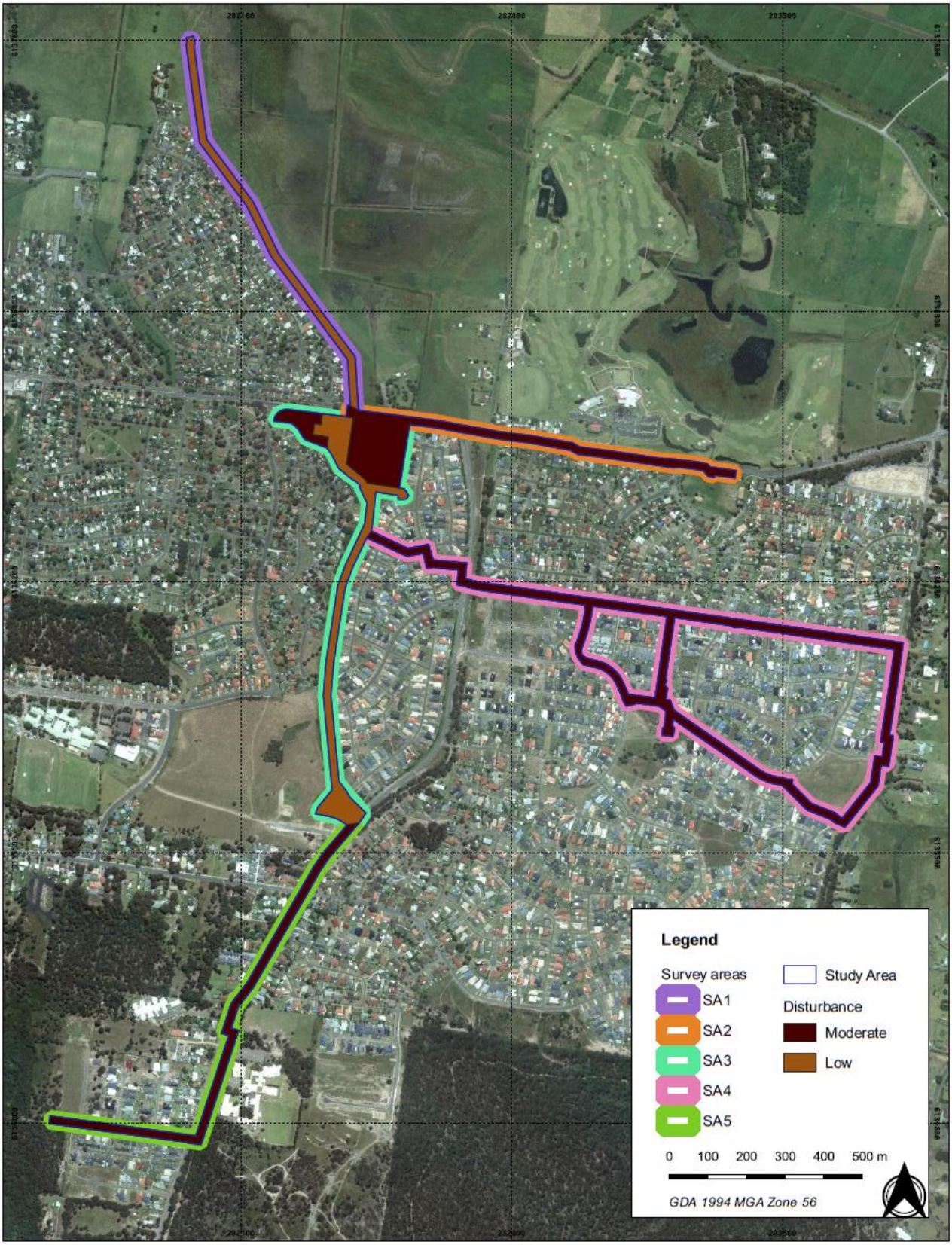


Figure 6-3 Proposal survey areas

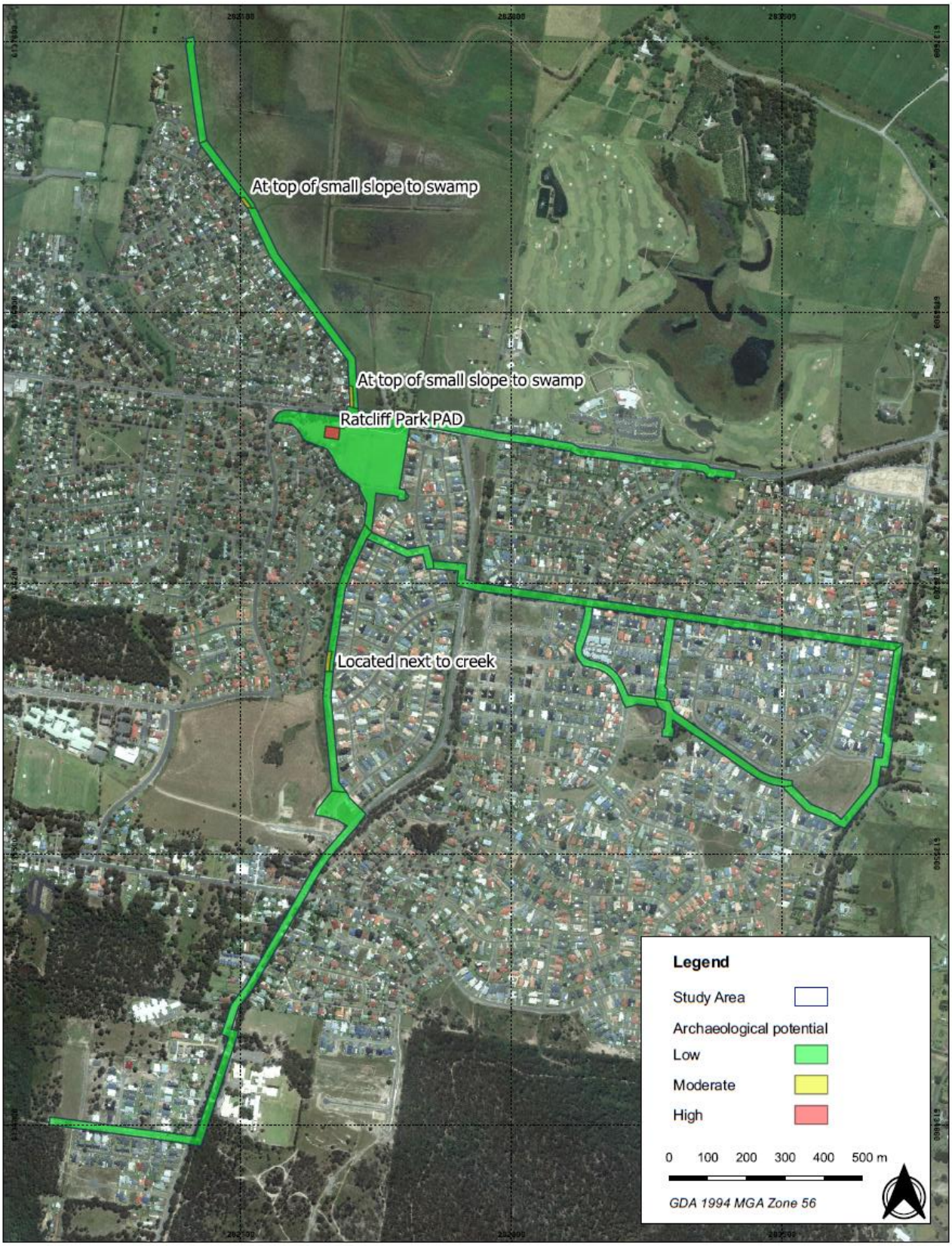


Figure 10 - Archaeological potential of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-19

AUSTRAL ARCHAEOLOGY

Figure 6-4 Archaeological potential with the study area

6.3.3 Mitigation Measures

- Construction activities, including site access and ancillary activities are to remain within the study area only
- Areas of moderate and high (PAD site) archaeological potential as shown on Figure 6-4 and in Appendix C are to be delineated as no-go areas and communicated to all site personnel. The no-go zone is to delineate areas where laydown, parking, traffic of light vehicle/plant or any other works with a risk of ground disturbance are prohibited
- All construction workers should be informed of their responsibilities in relation to Aboriginal and non-Aboriginal cultural heritage under the relevant legislation
- The CEMP should include an unexpected finds protocol to manage the risk of unexpected archaeological finds. If any Aboriginal items are discovered during the works, or suspected items of Aboriginal heritage significance, then works in the immediate area should stop immediately and Shoalhaven Water and DPIE should be contacted to advise of management measures prior to recommencing works in the vicinity. Where the find comprises human remains, NSW Police must be contacted in the first instance.

6.4 Soils and Contamination

A preliminary site investigation (PSI) has been prepared for the proposal. The PSI is provided in Appendix D. The purpose of this investigation was to undertake a preliminary assessment to identify potential contamination issues and constraints on the proposed upgrades of the SNSM in order to inform the REF.

The objective of the PSI was to assess whether contamination has the potential to exist on the site and whether further investigation is needed.

The PSI included:

- A site walkover by an Environmental Engineer to identify potential sources of contamination
- A desktop site history review including the following sources:
  - NSW Environment Protection Authority (EPA) contaminated land public register and the Public Register under Section 308 of the Protection of the Environment Operations Act 1997
  - Local and regional geology, hydrogeology, topography and hydrology
  - Groundwater data available for the area
  - Historic aerial photographs
  - Current and historic land title information
- Preparation of a PSI report in accordance with the Consultants reporting on contaminated land, Contaminated land guidelines (NSW EPA, 2020) and National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999).

6.4.1 Existing Environment

6.4.1.1 Contaminated materials

The study area has a maximum elevation of approximately 40 m Australian Height Datum (AHD) in the southern portion of the study area. The study area falls to approximately 4 m AHD in the northern and eastern portions of the study area.

Potential areas of cut to fill and earthworks were noted associated with surface water management. This includes the drainage easements and stormwater retention basin identified on the study area and potential built up embankments for residential properties located adjacent to the study area. More extensive filling was identified along some road and sewer alignments throughout the study area and potential built up embankments for residential properties within the centre of the study area.

Study area infrastructure such as SPS were located in various locations throughout the site. Timber structures used for horse agistment, a fenced off garden with associated timber storage structures were also located within the northern portion of the site. No evidence of historical structures within the study area exists.

A fragment of potential asbestos containing materials (PACM) was observed in the northern portion of the study area immediately adjacent to residential properties located along Salisbury Drive and SPS012.

Various fly tipped items such as shopping trolleys, timber furniture, cardboard boxes and car tyres were observed on the surface within the drainage easement in the central portion of the study area.

Three stockpiles containing construction and demolition waste including brick, concrete, tile and soil were observed within a vacant block in the central portion of the study area. Stockpile volumes were approximately between 2 to 10 m^3.

6.4.1.2 Geology and Soils

The proposal is mapped as underlain by two soil landscapes with the Nowra landscape found in the western portion of the site and the Shoalhaven landscape in the eastern portion of the site. The locations of the landscapes within the site is shown in Figure 6-5.

- Nowra soil landscape (shown as green with code “9028sf” on the Figure 6-4 below): This landscape is described as moderately to gently undulating rises to low hills on Nowra Sandstone. Broad ridges and crests. Benched sandstone outcrops adjacent to drainage lines. The topography has a relief of >40 m with slope gradients of >5%. Vegetation is extensively to moderately cleared with stands of tall open-forest. Soils are moderately deep (50–100 cm). Brown Podzolic Soils occur on crests and upper slopes. Soloths and/ or Yellow Earths occur midslope. Yellow Podzolic Soils occur on lower slopes and drainage lines.
- Shoalhaven soil landscape (shown as brown with code “9028no” on the Figure 6-4 below): This landscape is described as having level to gently undulating present river bed and banks, active floodplain with levees and backwater swamps on alluvium. Flat to gently undulating terrace surfaces of the Shoalhaven River. The topography has a relief of <5 m and slope gradients of <3%. Vegetation is completely cleared except for scattered decorative paperbark, swamp oak, Illawarra flame tree on terraces and various reeds in swamps Soils are moderately deep (50–100 cm) Prairie Soils occur on levees. Red Earths and Yellow and Red Podzolic Soils occur on terraces. Alluvial Soils and Gleyed Podzolic (potential acid sulfate) Soils occur on the floodplain.

The proposal is mapped as being underlain by two geological units with an undifferentiated formation found in the western, northern, eastern and southern portions of the site and the Berry Siltstone formation found in the central and southern portions of the site. The locations of the landscapes within the site is shown in Figure 6-6.

- Undifferentiated Formation (shown as orange with code “Qal” on the figure below) – Is of the Cainozoic age. The material is described as alluvium, gravel, sand silt and clay
- Berry Siltstone Formation (shown as blue with code “Psb” on the figure below) –Is of the Palaesoic age Shoalhaven Group. The material is described as bluish grey to light grey siltstone, shaly in part with bands of silty sandstone.

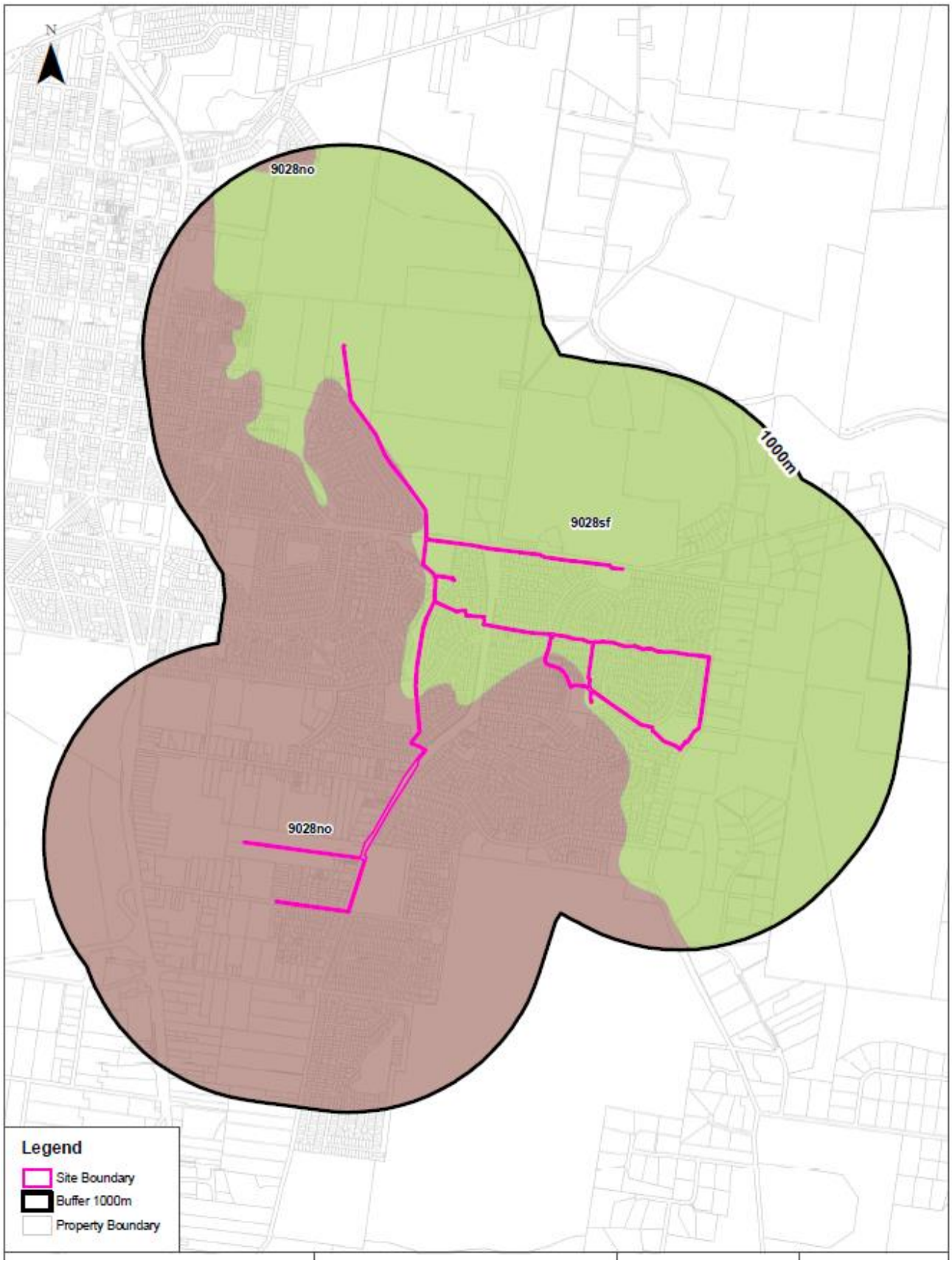


Figure 6-5 Proposal soil landscapes

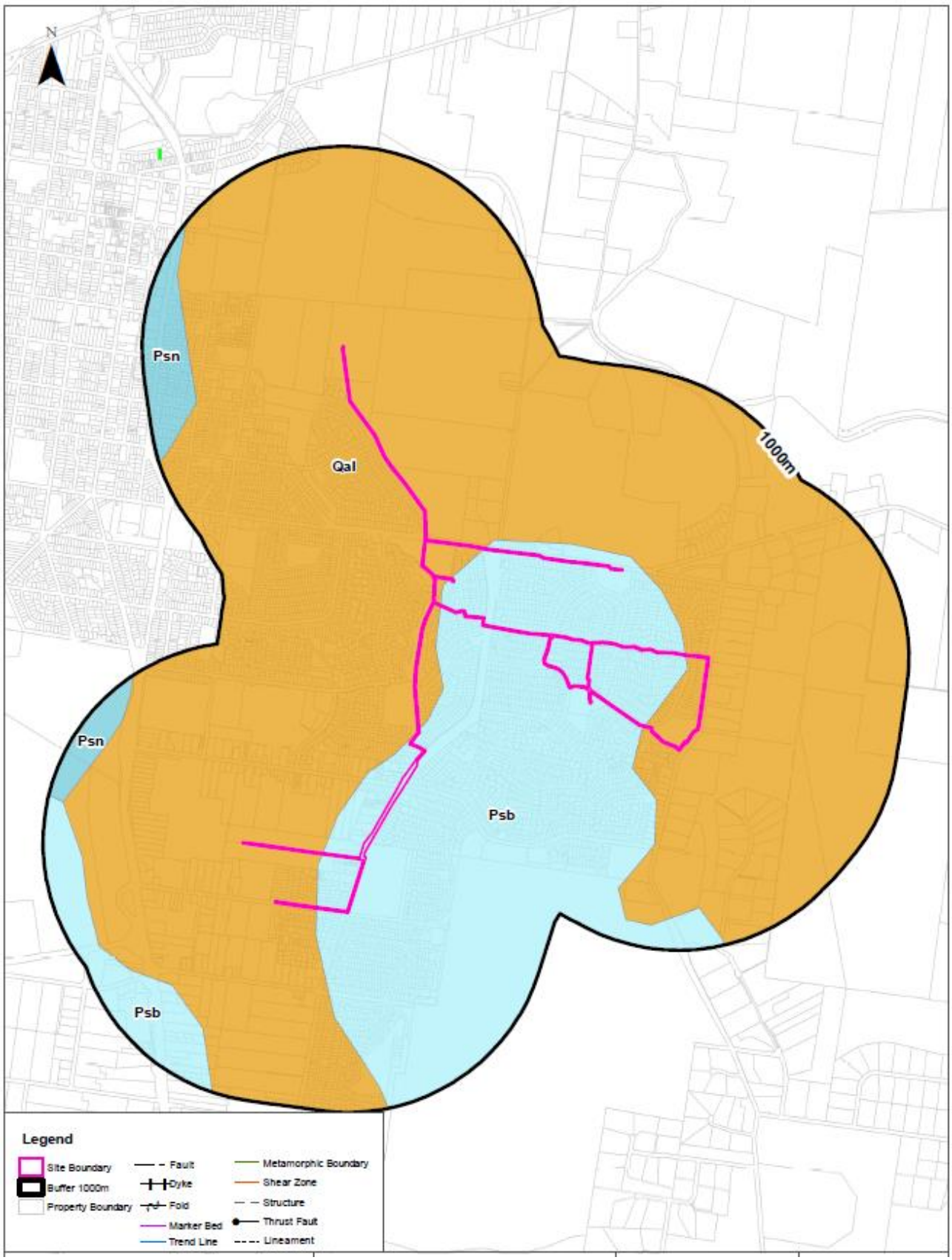


Figure 6-6 Proposal geology landscapes

6.4.1.3 Acid Sulfate Soils

The NSW Department of Planning Industry and Environments' on-line eSPADE v2.1 indicated that parts of the northern portion of the site are within a L1 area, which is described as having a low probability of acid sulfate soils (ASS) <1 m below ground level (bgl) and within a L4 area which is described as having a low probability of ASS >3 m bgl.

It is noted that ASS testing has been undertaken for the proposal by Cardno as part of a geotechnical investigation as reported in Geotechnical Investigation Report, South Nowra Surcharge Main – Major Upgrades, WI211021IP, prepared for Shoalhaven Water, dated May 2021 (Cardno, 2021). The results of this testing indicate that ASS and potential ASS is in fact present in various locations within the proposal area.

6.4.2 Potential Impacts

The PSI identified the following potential sources of contamination within the proposal area which could be uncovered/disturbed during the construction of the proposal and cause harm:

- Potential fill materials of an unknown environmental quality during development and installation of the existing utility infrastructure, roads and drainage systems.
- Potential fill materials of an unknown environmental quality during the development of embankments and mounds observed along the proposal area.
- Soil stockpiles observed to contain construction and demolition waste within the central portion of the proposal area.
- The potential for sewerage leakage from the existing use of the proposal as a sewerage system.
- Potential fly tipped waste, including PACM within the proposal area.

Identified receptors for the potential proposal contamination include:

- Ecological receptors dependent on soils in fill impacted areas
- Current proposal area users and workers disturbing identified fill materials
- Future proposal area users and workers disturbing identified fill materials.

6.4.3 Mitigation Measures

The following mitigation measures shall be implemented to manage and mitigate potential impacts on soil and contamination:

- Prepare a CEMP containing an Unexpected Finds Protocol (UFP) outlining appropriate management of contamination items which may be encountered or disturbed by constructions
  - In the event of an unexpected contamination find a suitably qualified environmental consultant will be required to attend site to assess contamination and provide advice on appropriate management or treatment
- For the areas within the proposal where ASS is deemed to be present, it is recommended that further investigation be undertaken. This further investigation will inform any future mitigation measures required
- Where asbestos materials (i.e. former pipes) are to remain buried onsite these are to be noted in Council property records with an Asbestos Management Plan (AMP) in place to ensure appropriate long term management

6.5 Water Quality and Hydrology

6.5.1 Existing Environment

The proposal is located partially within and in close proximity to drainage easements and unnamed creeks (particularly within the central and northern portions of the study area) which are considered to be flood prone. The proposal is not located within a drinking water catchment. The nearest waterways are Browns Creek, unnamed creeks, drainage easements and drainage ponds (within the northern, southern, central and eastern portions of the study area) which the proposal will be within and adjacent to.

A groundwater bore search was undertaken as part of the PSI and identified one registered bore within 500 m of the study area. The registered bore (Bore ID GW104352) is located 251 m northeast of the study area and is used for domestic purposes. The standing water level recorded for the bore was 2.5 m below ground level (bgl).

The unnamed drainage easements and stormwater retention basin located in the centre and eastern portions of the study area are displayed in Figure 6-7, Figure 6-8 and Figure 6-9.

Figure 6-7 Drainage easement located within the central portion of the study area

Figure 6-8 Drainage easement located within the eastern portion of the study area

Figure 6-9 Stormwater retention basin located within the eastern portion of the study area

6.5.2 Potential impacts

The potential impacts to water quality and hydrology during construction of the proposal would include:

- Pollution of water from construction activities, construction materials and spills of liquids such as diesel machinery oils and unleaded petrol
- Increased levels of turbidity, nutrients, metals and other pollutants, transported via sediment reducing overall water quality at receiving environments
- Trenching will be required as part of this proposal however no creek crossings are proposed
- There may be minimal storage of fuels/chemicals onsite
- While works are within 40m of the drainage easements (which are considered waterfront land under the *Water Management Act 2000*) a controlled activity approval is not required as the works are being undertaken by or on behalf of Shoalhaven Water, a relevant public authority
- Localised minor disruption of flow paths during excavation works
- Excavation is required to be between approximately 1.5 m to 10 m below the ground surface, and it is considered likely that the groundwater system will be intercepted during excavation. If groundwater is intersected during excavation, the incidental discharge volume is likely to be less than 3 Mega Litres (ML) per year.

With the implementation of the mitigation measures below, the potential impacts to water quality and hydrology would be minor in nature.

As the proposed works consist of the installation of a new sewer alignment operation of the proposal will result in positive impacts to the surrounding area by reducing potential future sewer overflows and associated environmental impacts such as reduction of odour.

6.5.3 Mitigation Measures

The following mitigation measures shall be implemented to manage and mitigate potential impacts on water quality and hydrology:

- Locate site amenities away from waterbodies or drainage lines

- Include emergency procedures for chemical/fuel spills in the CEMP and keep a functioning 'spill kit' on site at all times for clean-up of accidental spills
- Chemicals and fuels are required to be stored in bunded storage containers, and the Material Safety Data Sheets (MSDSs) for any chemicals must be available onsite. Spill and incident management procedures must be in place and communicated to crews prior to works commencing.
- Record all stored chemicals on a register with their MSDS's
- Do not use equipment with fuel, oil or hydraulic leaks. Repair or remove equipment immediately
- The site will be managed to minimise the extent of exposed soils. Erosion and sediment control measures will be implemented in accordance with the "Blue Book" (*Managing Urban Stormwater: Soils and construction – Volume 1, fourth edition*, dated March 2004)
- If the intersection of groundwater occurs, testing of excavation water to ensure suitable quality for ground/stormwater disposal would be implemented
- Prior to commencement of construction, the contractor would need to determine the anticipated volume of groundwater likely to require collection and disposal off-site and put in place measures to monitor the actual volumes if encountered during construction
- It is considered likely that the groundwater system will be intercepted during excavation. The contractor must obtain a Water Access Licence (WAL) from DPI Water/ NRAR if groundwater extraction volume will be greater than 3ML / year, although it is considered unlikely that this will occur.

6.6 Odour

An initial odour risk assessment of the proposal was conducted by Cardno's design team which identified the proposed SPS as having the potential to cause odour impacts. As such, RWDI Australia Pty Ltd (RWDI) were engaged to prepare an Odour Assessment for the proposed SPS. A copy of the report is provided is provided in Appendix E.

6.6.1 Existing Environment

The nearest potentially affected sensitive receptors to the proposed SPS are identified in Table 6-2 and shown in Figure 6-4.

Table 6-5 Sensitive Receptors

Receptor ID	Address
R1	8 Clipper Road, Nowra, NSW
R2	10 Clipper Road, Nowra, NSW
R3	6 Kameruka Crescent, Nowra, NSW
R4	12 Kameruka Crescent, Nowra, NSW
R5	14 Kameruka Crescent, Nowra, NSW
R6	18 Kameruka Crescent, Nowra, NSW

Figure 6-10 Sensitive Receptors

6.6.2 Potential Impacts

The operation of proposal has the potential to result in the generation of odours with the most likely source being the vent of the proposed SPS.

The proposal is located in an urban area and given the impact assessment criteria listed in Table 6-3, an impact assessment criterion of 2.0 OU was adopted for the Odour Assessment.

Table 6-6 Impact Assessment Criteria – Complex Mixtures of Odorous Pollutants (NSW EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (the Approved Methods)

Population of affected community	Impact assessment criteria (OU) [a]
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

a. 99th percentile noise response time

Five scenarios were modelled as part of the Odour Assessment to inform the SPS design. and included:

- Scenario 1 – 5.5 metre high vent without an odour control unit
- Scenario 2 – 5.5 metre high vent with an odour control unit
- Scenario 3 – 3 metre high vent with an odour control unit
- Scenario 4 – 2 metre high vent with an odour control unit
- Scenario 5 – 1 metre high vent with an odour control unit.

The predicted odour concentrations at sensitive receivers for all scenarios modelled are presented in Table 6-4.

Table 6-7 Predicted Odour Concentration

Receptor ID	Odour Concentration (Criteria = 2.0 OU)	Complies? (Yes/No)
Scenario 1 – (5.5 metre high vent without an odour control unit)		
R1	5.9	No
R2	7.2	No
R3	8.2	No
R4	11.0	No
R5	11.3	No
R6	7.3	No
Scenario 2 – (5.5 metre high vent with an odour control unit)		
R1	0.59	Yes
R2	0.72	Yes
R3	0.82	Yes
R4	1.10	Yes
R5	1.13	Yes
R6	0.73	Yes
Scenario 3 – (3 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.76	Yes
R3	0.87	Yes
R4	1.20	Yes
R5	1.25	Yes
R6	0.78	Yes
Scenario 4 – (2 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.76	Yes
R3	0.88	Yes
R4	1.22	Yes
R5	1.27	Yes
R6	0.79	Yes
Scenario 5 – (1 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.77	Yes
R3	0.88	Yes
R4	1.23	Yes
R5	1.28	Yes
R6	0.79	Yes

As can be seen from the predicted odour concentrations in Table 6-4, all scenarios with the exception of 'Scenario 1' (scenario modelled without odour control unit) would be adequate to minimise odour impacts at the closest receptors.

The proposed SPS design currently includes a 6m high vent with an odour control unit installed which, based on the above predicted odour concentrations, would be adequate to minimise odour impacts at the closest receptors.

6.6.3 Mitigation measures

No specific mitigation measures are required for the control of normal operating odours. However, regular inspection of the pump stations and sewer pipelines must be undertaken including the detection of odours. Furthermore, complaints received related to odours must be fully investigated and corrective action undertaken where required if practicable and reasonable.

6.7 Air Quality and Energy

6.7.1 Existing Environment

A search of the *National Pollution Inventory* (NPI) was conducted on 25 May 2021. The results highlighted a number of sources of pollution within the Shoalhaven LGA which are listed in **Table 6-3** below.

Table 6-8 Sources of pollution within the Shoalhaven LGA

Facility Name	Facility Address	Approximate Distance and Direction from Study Area
Bomaderry Main Line Valve and Meter Station	Pestells Lane, Bomaderry	6.7 km north west
Nowra Main Line Valve and Meter Station	Yalwal Road, South Nowra	12 km west
Nowra Chemical Manufacturers Pty Ltd	112A Albatross Road, Nowra	2.5 km west
Orica Nowra Plant	102 Albatross Road, Nowra	2.5 km west
Sydney Trains Bomaderry Refuelling Facility	Meroo Street, Bomaderry	3 km north west
SUPAGAS Nowra	Sextant St, South Nowra	2 km west
Bamarang Water Treatment Plant	Yalwal Road, Bamarang	8 km west
Bomaderry Wastewater Treatment Plant	Railway Street, Bomaderry	3 km north west
Nowra Sewage Treatment Plant	Terara Road, Terara	800 m north
Sussex Inlet Sewage Treatment Works	Medlyn Avenue, Sussex Inlet	29 km south west
Ulladulla Sewage Treatment Plant	Kings Point Drive, Ulladulla	53 km south west
West Nowra Recycling Facility & Landfill	120 Flatrock Road, Mondamia	6 km west
Shoalhaven Starches Bomaderry	160 Bolong Road, Bomaderry	3 km north

These potential odour sources are all located a reasonable distance away from the proposal site and are unlikely to influence the air quality at the proposal site. As such, and given the largely residential nature of the area the local air quality is expected to be good.

6.7.2 Potential Impacts

Minor dust emissions are predicted during construction as part of the disturbance of soil that may have a minor impact to nearby residents. While sensitive receivers are located in close proximity to the proposal (in some cases as close as 10m away), the potential air quality impacts during construction are expected to be minor given the short-term duration of the construction period. Mitigation measures have been recommended to reduce this impact further.

The proposed works will be located within an open environment. The small scale of construction works, combined with the implementation of the mitigation measures outlined below, will ensure that construction air quality is not significantly affected by the proposal.

During operation, the existing SPSs which currently utilise energy from the grid and would continue to do so following upgrades as part of this proposal. One new SPS would be added as part of the proposal and

therefore energy use would increase as part of the proposal. The SPSs have been designed to cater for the realistic future needs of the community and are sized appropriately thereby minimising energy use to the greatest extent possible while remaining functioning.

6.7.3 Mitigation Measures

The following mitigation measures shall be implemented to manage and mitigate potential impacts on air quality and energy:

- Exposed areas of soil will be kept to the smallest areas practicable to minimise the potential for dust generation
- The work areas and stockpiles will be monitored for dust generation and will be sprayed with appropriate non-potable water as required
- No matter of any kind will be burnt on site
- Equipment will be maintained to ensure no exhaust particulates are visible for more than 10 continuous seconds
- Vehicles will not be left idling
- Works will be scheduled to minimise journeys
- Fuel and energy usage will be recorded
- Odour or air pollutant emission complaints will be dealt with promptly and the source will be eliminated wherever practicable
- Details of the complaint will be recorded
- In addition to the above, Shoalhaven Water may wish to consider opportunities for reducing the overarching energy requirements associated with the water and sewage supply network and/or options for supplying the system from renewable sources.

6.8 Waste Management

6.8.1 Existing Environment

As identified in Section 6.4, potential areas of cut to fill and earthworks were noted associated with surface water management as well as more extensive filling along some road and sewer alignments throughout the site and potential built up embankments for residential properties within the centre of the site.

A fragment of PACM was observed in the northern portion of the site immediately adjacent to residential properties located along Salisbury Drive and SPS012.

Should the proposed works at the site proceed, these areas of fill, as well as any other locations of excavation or demolition, would produce waste streams at the site.

6.8.2 Potential Impacts

The proposed works may generate the following waste streams:

- Timber and green waste from vegetation removal
- Demolition waste including:
  - fencing
  - Utility infrastructure including water pipelines, utility poles and conduits
  - Pavement from existing track and field features.
- General construction waste including:
  - Packaging waste likely to include plastic, cardboard, paper, and glass
  - Chemical and fuel spills
  - Sediment build-up
  - Wastewater from washdowns of equipment and plant
  - Temporary structures that cannot be reused

- General waste from construction site use including plastic, paper, cardboard, cans and food waste

> Excess spoil from excavations unsuitable for backfill, and drilling waste

> Asbestos waste generated by excavation of fill onsite.

The operation of the proposed SNSM upgrade will generate the following waste streams:

> Transportation of sewerage to the Nowra STP

> Waste from routine maintenance activities

> Green waste from landscape maintenance.

6.8.3 Mitigation Measures

The following actions are to be implemented to manage and mitigate impacts of waste during construction and operational phases of the project:

> Recommendation's as detailed in the PSI (included in Appendix D) and Section 6.4 be carried out to ensure contaminated waste and soils are managed appropriately

> CEMP to include waste management strategy prepared in accordance with the waste management hierarchy including details such as:

- List of waste likely to be generated
- Procedure for sorting and storing waste
- Waste register to record: quantity, type, transportation method; time of and location of waste disposal
- Strategy devised and implemented to recycle, reuse or avoid waste generation.

> All waste disposal locations to be suitably licenced

> All waste leaving the site must be appropriately characterised

> No waste is to be left on-site post construction

> Working site is to be kept free of rubbish and cleaned at the end of each working day; and

> EPA is to be notified of any incidents of pollution or environmental harm (as per part 5.7 of the POEO Act).

6.9 Traffic and Site Access

6.9.1 Existing Environment

The proposal falls predominately within grazing paddocks and park grass lands, the verge of road reserves, drainage reserves and adjacent to existing mains, with road crossings within Blue Bell Way, Carrington Park Road, Warrigal Street, Killara Road, Hillcrest Avenue, Kaross Close, Browns Road, Denbigh Place, Evergreen Place and Old Southern Road. Greenwell Point Road will be underbored. The roads listed are marked at between 50 km/hr and 70 km/hr within the study area. The roads are asphalt at the locations of the proposed crossings. The proposal site also contains footpaths (within the verge along parts of Greenwell Point Road and Old Southern Road) which will be crossed by the proposal.

6.9.2 Potential Impacts

The proposed works would have limited impacts on residents, businesses or communities in terms of their ability to access the area during both construction and operation of the proposal. During construction, the proposal would result in temporary disruption of traffic flows during construction, with stop-go traffic control measures in place where work is in close vicinity to the transit lane. However, alternative access to surrounding areas is available in the broader road network, and therefore the proposal is unlikely to have any significant impacts on the local traffic flow.

Access to all private properties and businesses would be maintained at all times.

During operation, there would be a limited number of operational vehicles visiting the SPSs from time to time and this is not expected to have any meaningful impact on the traffic network which will be able to easily cater for this traffic.

6.9.3 Mitigation Measures

The following mitigation measures shall be implemented during construction to manage and mitigate potential impacts on traffic and site access:

- Contractor to secure a section 138 permit prior to work on any local road reserves;
- Greenwell Point Road is classified by Transports for NSW (TfNSW) as a Regional Road (pursuant to the Road Act 1993 - i.e. Those Regional Roads that are not classified as Highway, Main Road, Secondary Road or Tourist Road under the Roads Act) and is managed by TfNSW. The contractor will secure a Road Occupancy License as required from TfNSW for any works likely to impact on traffic flow, such as trenching or underboring for pipeline installation.
- A traffic management plan will be prepared as part of securing the ROL and Council requirements regarding traffic control, access and road restoration will be complied with
- Open trenches would be fenced off during construction where required to ensure pedestrian safety
- Erect signs regarding proposed works, temporary road / pavement closures, diversions etc.
- Provide alternate access (e.g. ramps and bike ramps) if access is impeded for an extended period
- Avoid blocking access to vehicular or pedestrian roads, private driveways, public facilities or businesses wherever possible
- Adequately notify affected people and businesses
- Restore access quickly.

6.10 Noise and Vibration

6.10.1 Existing Environment

The township of Nowra is located in a mix of residential, commercial, industrial and rural settings and therefore background noise levels vary. Background noise within the study area is typical of a rural-residential environment with minimal traffic noise.

A number of residential noise receptors are located within close proximity (approximately 10 m) to the proposal as the works are located within the verge of road reserves, drainage reserves and existing mains adjacent to residential properties.

There is an operational sewerage treatment plant approximately 800 m north from the study area. This could be a source of existing low level noise within the northern portion of the study area, however overall the study area is typical of a rural-residential environment with low noise levels.

6.10.2 Potential Impacts

Construction works will create temporary noise and vibration through operation of site machinery for the duration of works. The zone of works will move progressively along the proposed alignment; therefore, no individual sensitive receiver will be affected for an extended period of time. With the implementation of the safeguards below, it is unlikely that construction of the proposal will exceed the noise criteria in the *Industrial Noise Policy* (EPA 2000) or *Interim Construction Noise Guideline* (DECC 2009).

Significant noise impacts are not expected from the operation of the sewer main pipelines and upgrades to the existing SPS sites. The noise generation of the proposal is limited to the proposed new SPS pumps. The proposed SPS pumps are to be installed approximately 8 m below the ground surface and will only start a maximum of 8 times per hour, which is only expected to occur during extreme wet weather events. It is therefore considered that noise impacts from the proposed SPS pumps will be negligible.

6.10.3 Mitigation Measures

The following mitigation measures shall be implemented to manage and mitigate potential impacts for noise and vibration:

- Work and deliveries will preferably occur during the following times: Monday to Friday 7am to 6pm, Saturday 8am to 1pm. No construction work or deliveries will occur on Sundays or public holidays;
- Limited works will be permitted outside of the standard construction hours outlined above (e.g. to minimise impacts of road closures)

- Surrounding residences and/or businesses will be given reasonable notice of the proposed works (including proposed start date, work methods and duration); and
- Equipment will have noise mufflers and be well maintained.

6.11 Social, Visual and Land Uses

6.11.1 Existing Environment

The current visual amenity of the proposal site is typical of residential/rural townships of Australia. The area is characterised by low to medium residential dwellings surrounded by hinterland consisting of broad acre and intensive farming operations. The proposal will mainly run through green open space areas between residential properties/areas within South Nowra.

Land use within the proposal site is predominantly green open space or road/drainage reserves surrounded by residential properties. There are no known businesses that operate within the proposal site.

6.11.2 Potential Impacts

Construction of the proposal will result in short term visual impacts during the trenching of reticulation and rising main pipelines as well as the construction of the new pumping station. Due to the nature of the construction works, visual impacts will be limited to the study area and are not considered to be wide spread or significant.

The works will impact several private properties during the installation of the pipeline however this will be within an existing easement and the construction period will be limited therefore the proposal is unlikely to have a significant impact on private property. Shoalhaven Water has and would continue to consult with landholders as part of the proposal.

The construction of the proposal would be conducted in a manner that would avoid any impacts or disruption to the existing sewer network.

There would be limited to no negative visual impacts from the operation of the proposal as all disturbed areas would be rehabilitated at the completion of works.

The pumping station building will have a permanent visual impact, however it will be located within Ratcliff Park and would be visible only to a small number of nearby residences and to vehicles and pedestrians passing by.

6.11.3 Mitigation Measures

A number of safeguards have been put in place to ensure the proposal does not negatively impact land use or visual character of the area, produce disruptions to the water or waste water services of residents or cause significant disruption to nearby residents. These safeguards include:

- All work will be contained within the boundaries of the study area shown on Figure 1-1
- It is proposed to powder coat the visible pump station infrastructure in a colour that blends into the surrounding environment to reduce the visual impact
- The site must be kept clean of general litter and tidy for the duration of the works
- The spread of stockpiles, waste, and parking will be minimised
- Accurate public information signs will be provided until site restoration is complete
- Work sites will be restored as close to their original condition as possible
- Community and stakeholder liaison will be carried out before and during the site works
- A Dial Before You Dig search will be completed prior to the commencement of site works to located underground services, and these services will be pegged out as no-go areas to avoid service disruptions
- All personnel will exercise courtesy in dealing with the community.

7 Conclusions and Recommendations

The proposal must be considered in accordance with the four principles of Ecologically Sustainable Development (ESD) as outlined in section 6(2) of the *Protection of the Environment Administration Act 1991*. ESD consideration is detailed below:

Table 7-1 ESD Considerations

The precautionary principle If there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The proposal will not result in serious or irreversible environmental damage. The identification of environmental risks and mitigation measures as outlined in this REF has addressed the precautionary principle by providing a thorough analysis of potential environmental impacts. No significant impacts on the environment as a result of this proposal are expected.
Inter-generational equity The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.	The proposal is important to ensure the area is capable of meeting the current and future wastewater requirements of adjacent developments. The new infrastructure will contribute to the protection of the surrounding environment from potential impacts such as wastewater overflow from the existing sewage systems. The proposal will not compromise the local environment or surrounding environment for current or future generations.
Conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The proposal is unlikely to have a significant impact on biodiversity or ecological integrity. The proposal has been designed to minimise disturbance on mature vegetation. Mitigation measures (outlined in **Section 6.1**) will ensure that potential indirect impacts to flora and fauna are minimised.
Improved valuation, pricing and incentive mechanisms Users pay for their products or services including their full life-cycle impacts and cost-effective market mechanisms should be implemented to attribute externalities.	Shoalhaven Water propose to run a competitive tender process to ensure the work is delivered in a cost-effective manner. Sewerage services provided by Shoalhaven Water are funded, at least in part, by the rate payers they service. By requiring compliance with the safeguards outlined in this REF, the externalities associated with the proposal have been considered.

Clause 228 of the *Environmental Planning and Assessment Regulation 2000* lists the factors to be taken into account when considering likely environmental impacts. This is summarised below for the proposal.

Table 7-2 Clause 228 Factors

Clause 228 Factor	REF Findings
a) any environmental impact on a community	It is unlikely that the proposal will generate unacceptable impacts on communities once in operation. There may be some temporary impacts during the construction phase, however these impacts will be minimised through the mitigation measures listed in this REF.
b) any transformation of a locality	With the implementation of the mitigation measures outlined herein, it is unlikely that the proposal will transform a locality.
c) any environmental impact on the ecosystems of the locality	With the implementation of the mitigation measures outlined herein, it is unlikely that the proposal will impact ecosystems within the locality.
d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	It is likely that there will be some minor short-term impacts during the construction phase however it is unlikely that the proposal will permanently reduce aesthetic, scientific, recreational or any other environmental quality or value of the locality once operational.
e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations	It is unlikely that the proposal will have an impact on the locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations. There would be no impact to the identified PAD site and areas of moderate archaeological potential provided the mitigation measures listed in Section 6.3.3 are implemented.
f) any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)	There is no protected fauna habitat identified in the study area. Therefore, the potential impact to fauna species and their habitat is considered to be negligible. Mitigation measures would be implemented to ensure potential impacts are minimised.
g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	It is unlikely that the proposal will be endangering any species of animal, plant or other life forms whether living on land, in water or in the air.
h) any long-term effects on the environment	It is unlikely that the proposal will have any long-term effects on the environment. The proposal would result in environmental benefits by increasing the capacity of the sewage network to appropriately cater for the community it serves.
i) any degradation of the quality of the environment	Some minor short-term impacts may occur during the construction phase, however in the medium to long term, degradation of the quality of the environment is unlikely. The proposal would result in environmental benefits by increasing the capacity of the sewage network to appropriately cater for the community it serves.
j) any risk to the safety of the environment	Mitigation measures proposed in this REF will effectively minimise any risk to the safety of the environment. The proposal would result in environmental benefits by increasing the capacity of

	the sewage network to appropriately cater for the community it serves.
k) any reduction in the range of beneficial uses of the environment	It is unlikely that any reduction in the range of beneficial uses of the environment will occur as a result of the proposal.
l) any pollution of the environment	There is potential for pollution from fuels or chemical spills used during the works and from erosion, sedimentation, dust and noise. The mitigation measures proposed in this REF will minimise the potential for pollution. The proposal would result in environmental benefits by increasing the capacity of the sewage network to appropriately cater for the community it serves and thereby reducing potential sewage overflows.
m) any environmental problems associated with the disposal of waste	With adherence to the mitigation measures presented in this REF, there should not be any significant environmental problems associated with the disposal of waste.
n) any increased demand on resources (natural or otherwise), that are, or are likely to become, in short supply	It is unlikely that the proposal will result in an increased demand on resources or in a shortage of supplies.
o) any cumulative environmental effect with other existing or likely future activities	The proposed SNSM upgrade will benefit future development in Nowra in accordance with the objectives of the Land Use Zones within the area. Cumulative environmental impacts are not anticipated; however, mitigation measures will be in place to ensure potential impacts are minimised.
p) any impact on coastal processes and coastal hazards, including those under projected climate change conditions	There are no impacts on coastal processes and coastal hazards including those under the current climate change conditions likely to occur as a result of the proposal.

The proposal is unlikely to significantly affect the environment and an environmental impact statement is not required.

7.1.1.2 Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required.

7.1.1.3 Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

The main potential environmental impacts of the proposal relate to minor vegetation clearance, noise, erosion, sedimentation and heritage impacts. Environmental risks will be managed by implementing the mitigation measures identified in this REF and through the preparation of a CEMP. The engaged contractor is responsible for the preparation of the CEMP and managing construction risks. The engaged contractor will comply with the REF and CEMP.

If the scope of work or methodology changes significantly at any time during the project, the engaged contractor is responsible for identifying the need for any additional Environmental Impact Assessment (EIA) and for communicating this to Shoalhaven Water.

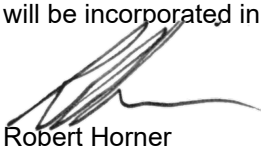
Council Determination

This Review of Environmental Factors has assessed the likely environmental impacts, in the context of Part 5 of the Environmental Planning and Assessment Act 1979, of a proposal by Shoalhaven City Council for the South Nowra Surcharge Main Major Upgrades project.

Shoalhaven City Council has considered the potential environmental effects of the proposal and the effectiveness and feasibility of measures for reducing or preventing detrimental effects. It is determined that:

1. The proposed safeguards and mitigation measures identified in the report (Section 6) shall be adopted and implemented.
2. The proposal is unlikely to significantly affect the environment and an environmental impact statement is not required.
3. The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required.
4. No additional statutory approvals, licences, permits and external Government consultations are required.

The proposed activity is recommended to proceed subject to the implementation of the measures to avoid, minimise or manage environmental impacts listed in this REF. The mitigation measures outlined in the REF will be incorporated in the construction contract documents.



Robert Horner
Executive Manager, Shoalhaven Water

Date: 15 February 2022

8 References

- Department of Environment, Climate Change and Water, 2010, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*.
- *Industrial Noise Policy* (EPA 2000)
- *National Pollution Inventory* (NPI)
- The *EPA Contaminated Lands Register*
- *Protection of Environmental Operations (POEO) Public Register*
- DECCW (2009), *Interim Construction Noise Guideline,* published by the Department of Environment, Climate Change and Water NSW.
- NSW EPA (2014), Waste Classification Guidelines - Parts 1 to 4.

8.1 Websites

- Department of Agriculture, Water and the Environment – Australian Heritage Database, accessed 31 May 2021.

http://www.environment.gov.au/heritage/publications/australian-heritage-database

- NSW DPIE – eSPADE NSW Soil and Land Information Online Mapping Tool, accessed 24 May 2021.

http://www.environment.nsw.gov.au/eSpade2WebApp

- Department of Agriculture, Water and the Environment – National Pollution Inventory, accessed 25 May 2021.

http://www.npi.gov.au/npidata/action/load/map-search

- Heritage NSW – State Heritage Inventory – Accessed 24 May 2021.

https://www.heritage.nsw.gov.au/search-for-heritage/search-for-nsw-heritage/

- NSW Environment Protection Agency – Contaminated Site Register, accessed May 2021.

http://www.epa.nsw.gov.au/prclmapp/aboutregister.aspx

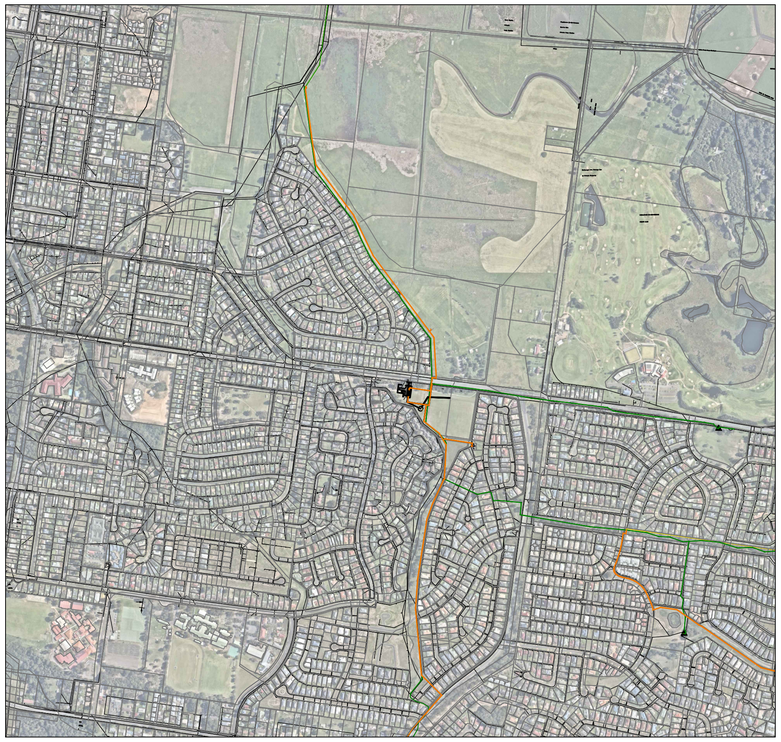
- NSW Environment Protection Agency – POEO Public Register, accessed May 2021.

http://www.epa.nsw.gov.au/prpoeoapp/

APPENDIX A

DESIGN DRAWINGS

SHOALHAVEN CITY COUNCIL
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM



LOCALITY PLAN
SCALE 1:10000

LIST OF STANDARD DRAWINGS

DRAWING NUMBER	DESCRIPTION
S-25350-048-1	TYPICAL AIR VALVE PIT FOR POLY MAIN (NON TRAFFICABLE)
S-25350-052-1	MARKER POST AND PLATES ARRANGEMENT
S-25350-053-0	TYPICAL SCOUR VALVE ARRANGEMENT WITH DN80 CAMLOCK FITTING TO SUIT MAINS 600 DIA. OR LESS
S-25350-054-0	TYPICAL BOLLARD PROTECTION ARRANGMENT
S-25350-055-A	TYPICAL AIR VALVE PIT FOR POLY MAIN WITH OFFSET ODOUR SCRUBBER PIT (NON TRAFFICABLE)

DRAWING INDEX

DRAWING NUMBER	DESCRIPTION
25267-110	COVER PAGE, LOCALITY PLAN AND DRAWING INDEX
25267-111	GENERAL NOTES - SHEET 1
25267-112	GENERAL NOTES - SHEET 2
25267-113	TRENCH DETAILS
25267-114	TRENCHLESS CONSTRUCTION DETAILS
	GRAVITY SEWER: 44 WARRINGAL ST. TO THE INJECTION OF SPS024
25267-115	GRAVITY MAIN - OVERALL PLAN
25267-116	GRAVITY MAIN - DETAIL PLAN LAYOUT - SHEET 1 OF 3
25267-117	GRAVITY MAIN - DETAIL PLAN LAYOUT - SHEET 2 OF 3
25267-118	GRAVITY MAIN - DETAIL PLAN LAYOUT - SHEET 3 OF 3
25267-121	GRAVITY MAIN - LONG SECTION - SHEET 1 OF 5
25267-122	GRAVITY MAIN - LONG SECTION - SHEET 2 OF 5
25267-123	GRAVITY MAIN - LONG SECTION - SHEET 3 OF 5
25267-124	GRAVITY MAIN - LONG SECTION - SHEET 4 OF 5
25267-125	GRAVITY MAIN - LONG SECTION - SHEET 5 OF 5
25267-126	CONNECTION - PLAN AND SECTION - RM24 OUTLET - DN1500 MH-25
25267-127	CONNECTION - PLAN AND SECTION - RM22 OUTLET - DN1500 DISCHARGE MH
	1200m OF DN560 RISING MAIN CONNECTING THE NEW SPS TO THE DN560 MAIN INSTALLED
25267-130	KEY PLAN
25267-131	PLAN AND SECTION - SHEET 1 OF 4
25267-132	PLAN AND SECTION - SHEET 2 OF 4
25267-133	PLAN AND SECTION - SHEET 3 OF 4
25267-134	PLAN AND SECTION - SHEET 4 OF 4
25267-135	CONNECTION DETAILS - PLAN AND SECTION
25267-140	DN1050 CAST IN-SITU CIRCULAR - MAINTENANCE HOLE DETAILS PLAN
25267-141	DN1200 CAST IN-SITU CIRCULAR - MAINTENANCE HOLE DETAILS PLAN
25267-142	DN1050 CAST IN-SITU SQUARE - MAINTENANCE HOLE DETAILS PLAN
25267-143	DN1200 CAST IN-SITU SQUARE - MAINTENANCE HOLE DETAILS PLAN
25267-144	STANDARD DETAILS PLAN
25267-145	CONNECTION DETAILS PLAN
25267-146	TYPICAL CHANNEL ARRANGEMENTS DETAILS PLAN
25267-147	DN1200 CAST IN-SITU - FLOW GAUGING CHANNEL DETAILS

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	MC	
A	ISSUED FOR CONCEPT DESIGN	HH	26/02/2021

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
COVER PAGE, LOCALITY PLAN AND DRAWING INDEX

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	110	1	B

100 mm on original

Plotted: 07/10/21 - 17:11 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-110.dwg

GENERAL

1. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE WORK HEALTH AND SAFETY ACT 2011, WHICH REQUIRES EMPLOYERS TO ENSURE THE HEALTH, SAFETY AND WELFARE OF EMPLOYEES AND PERSONS IN THE VICINITY OF THE WORK SITE.
2. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH THE DRAWINGS, WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWAGE PUMPING STATION CODE OF AUSTRALIA - WSA 04-2005-2.1, WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE CODE OF AUSTRALIA - WSA 02-2014 VERSION 2.3, AND SHOALHAVEN WATER SUPPLEMENTS, AND THESE NOTES.
3. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION WORK COMMENCING AND MAINTAINED DURING THE CONSTRUCTION PHASE.
4. NO VEGETATION SHALL BE REMOVED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.
5. THE CONTRACTOR IS TO GAIN APPROVAL UNDER SECTION 138 OF THE ROADS ACT 1993 PRIOR TO COMMENCING CONSTRUCTION WITHIN ALL ROAD RESERVES. TRAFFIC CONTROL PLAN IS TO BE SUBMITTED WITH SECTION 138 APPLICATION PRIOR TO CONSTRUCTION WORK COMMENCING.
6. THE CONSTRUCTOR SHALL OBTAIN AN APPROVED ROAD OCCUPANCY LICENCE FROM TRANSPORT FOR NSW (ROADS AND MARITIME) FOR ANY WORKS IMPACTING THE PRINCES HIGHWAY.
7. TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH AS 1742.3 ARE TO BE IN PLACE AND MAINTAINED AT ALL TIME.
8. THE CONTRACTOR IS RESPONSIBLE FOR ARRANGING FOR INSPECTIONS BY COUNCIL'S AUTHORISED REPRESENTATIVE AT THE TIMING AND FOLLOWING THE PROCEDURE OUTLINED IN COUNCIL'S LETTER OF APPROVAL.
9. THE CONTRACTOR SHALL ENSURE THAT THE RESIDENTS ADJACENT TO THE CONSTRUCTION ZONE ARE NOT AFFECTED BY DUST OR UNDUE NOISE DURING CONSTRUCTION AND ARE NOT DEPRIVED OF ALL WEATHER ACCESS NOR ARE SUBJECTED TO ADDITIONAL STORM WATER RUNOFF AT ALL TIMES DURING CONSTRUCTION.
10. TO LIMIT T IMPACT OF THE CONSTRUCTION ON ADJOINING OWNERS, ALL WORKS SHALL BE RESTRICTED TO THE HOURS OF 7AM-6PM MONDAY TO FRIDAY AND 8AM-3PM SATURDAY. NO WORK SHALL TAKE PLACE ON SUNDAYS OR PUBLIC HOLIDAYS.
11. ALL WORK SHALL BE SET OUT BY THE SURVEYOR PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, UPON REQUEST. TWO (2) DAYS NOTICE REQUIRED.
12. THE CONTRACTOR SHALL NOT DISTURB ANY SURVEY CONTROL MARKS. SHOULD ANY SURVEY CONTROL MARK BE DISTURBED OR OBLITERATED, THE CONTRACTOR SHALL NOTIFY THE SUPERINTENDENT IMMEDIATELY. THE CONTRACTOR SHALL HAVE THE MARKS REPLACED AT HIS EXPENSE.
13. PRIOR TO COMMENCEMENT OF EXCAVATION THE CONTRACTOR SHALL DETERMINE THE LOCATION OF ALL SERVICES AND WILL BE RESPONSIBLE FOR ADJUSTMENT OF SERVICES AND REPAIR OF ANY DAMAGE TO COUNCIL'S INFRASTRUCTURE. SUCH REPAIR OR REINSTATEMENT TO BE CARRIED OUT IMMEDIATELY TO THE SATISFACTION OF THE COUNCIL'S DEVELOPMENT MANAGER OR DELEGATE.

SURVEY, SET OUT AND ASSET RECORDING

14. ALL LEVELS ARE IN METRES TO AHD.
15. ALL CO-ORDINATES ARE IN METRES TO THE MAP GRID OF AUSTRALIA (MGA Zone 56).
16. THE CONSTRUCTOR IS DIRECTLY RESPONSIBLE FOR ENSURING THE PROJECT SET OUT IS CONSISTENT WITH THE DESIGN. THE CONSTRUCTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ACCURATE SETTING OUT OF THE ENTIRE WORKS. THE CONSTRUCTOR SHALL ENSURE THE PIPES ARE LAID TO CORRECT INVERT LEVELS. SHOULD ACTUAL SITE CONDITIONS CONFLICT IN ANY WAY WITH THAT DOCUMENTED, THE CONSTRUCTOR SHALL CONTRACT THE SUPERINTENDENT' REPRESENTATIVE FOR CLARIFICATION PRIOR TO PROCEEDING.
17. THE CONSTRUCTOR SHALL BE RESPONSIBLE FOR CONFIRMING THE LOCATION OF ALL SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
18. THE CONSTRUCTOR IS TO ENGAGE A SUITABLY QUALIFIED AND EXPERIENCE SURVEYOR TO UNDERTAKE ASSET RECORDING OF THE WORK. ALL SURVEYOR WORKS AND DATA RECORDING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE SHOALHAVEN WATER TECHNICAL SPECIFICATION FOR WORK AS EXECUTED INFORMATION DOCUMENT NO. D13/14490.
19. ALL CHAINAGES ARE IN METRES.
20. OFFSET FROM EXISTING SERVICES ARE FOR INFORMATION ONLY, AND TO BE CONFIRMED BY THE CONSTRUCTOR.

PRODUCTS AND MATERIALS

21. ALL PRODUCTS AND MATERIAL SHALL COMPLY WITH THE DRAWINGS.
22. FOR POLYETHYLENE PIPE CONSTRUCTION, REFER TO WSA 01 (POLYETHYLENE PIPELINE CODE). WELDERS SHALL BE ACCREDITED TO PMBWELD301A (BUTT WELD POLYETHYLENE PLASTIC PIPELINES) AND PMBWELD3028 (ELECTROFUSION WELD POLYETHYLENE PIPELINES).
23. ALL PRODUCTS AND MATERIALS TO COMPLY WITH THE WATER SERVICES ASSOCIATION OF AUSTRALIA PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS.
24. ALL STOP VALVES SHALL BE FLANGES CLASS PN16.
25. ALL AIR VALVES SHALL BE FLANGED CLASS PN16.
26. ALL DICL PIPES AND BENDS SHALL BE PN35.
27. DICL PIPE TO BE WRAPPED IN POLYETHYLENE SLEEVE TO AS 3680.
28. ALL POLYETHYLENE PIPES AND BENDS SHALL BE MINIMUM PE100 PN16. ALL POLYETHYLENE BENDS SHALL BE SWEEP BENDS, UNLESS NOTED OTHERWISE.
29. ALL FLANGES SHALL BE PN16 TO AS4087.
30. ALL BOLTS ON PE FLANGE CONNECTIONS SHALL BE RE-TIGHTENED AFTER A MINIMUM OF 4 HOURS AFTER INITIAL TIGHTENING.
31. ALL BOLTS, NUTS AND WASHERS TO BE STAINLESS STEEL BOLT GRADE 3116 IN ACCORDANCE WITH WAT-1313.
32. ALL PVC PIPES AND BENDS SHALL BE PVC-M PN12.
33. ALTERNATE PIPE MATERIALS SHALL NOT BE USED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.

SEWER RISING MAIN CONSTRUCTION

34. PRIOR TO COMMENCING WORK ON SITE THE CONTRACTOR SHALL PROVIDE THE SUPERINTENDENT EVIDENCE THAT THEY HAVE CURRENT PUBLIC RISK AND COMPENSATION INSURANCE POLICIES.
35. ANY MODIFICATIONS/DEVIATIONS OR AMENDMENTS TO THE APPROVED DESIGN PLANS ARE TO BE SUBMITTED IN WRITING TO THE SUPERINTENDENT FOR SUBMISSION TO SHOALHAVEN WATER FOR THEIR APPROVAL. APPROVAL FROM SHOALHAVEN WATER IS TO BE GRANTED BEFORE ANY SUCH ALTERATIONS ARE IMPLEMENTED BY THE CONTRACTOR.
36. ALL SEWERAGE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE CODE OF AUSTRALIA - WSA 02-2014 AND SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE CODE OF AUSTRALIA (WSA 02) AND WITH ANY OTHER SPECIAL REQUIREMENTS AND STANDARDS OF SHOALHAVEN CITY COUNCIL.
37. TRENCH STOPS AND/OR CONCRETE BULKHEADS SHALL BE PROVIDED IN ACCORDANCE WITH NOTE 35 ABOVE.
38. TRENCH, PIPE PLACEMENT, EMBEDMENT AND BACKFILL SHALL BE IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE CODE OF AUSTRALIA - WSA 02-2014 AND SHOALHAVEN WATER'S SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE CODE OF AUSTRALIA (WSA 02-2014).
39. THE CONTRACTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ENTIRE WORKS. THE CONTRACTOR SHALL ARRANGE FOR ALL PIPES AND FITTINGS TO BE INSPECTED BY THE SUPERINTENDENT AND THE SHOALHAVEN WATER INSPECTOR PRIOR TO THE OPENING OF ANY TRENCHES ON SITE. THE CONTRACTOR SHALL GIVE NOT LESS THAN 48 HOURS' NOTICE WHEN REQUESTING AN INSPECTION UNDER THIS CLAUSE.
40. IF ROCK IS ENCOUNTERED THE SUPERINTENDENT IS TO BE ADVISED IMMEDIATELY SO A RECORD OF AMOUNT CAN BE MADE.
41. WHERE SHOWN ON THE PLAN AND/OR LONGITUDINAL SECTIONS, SEWER LINES ARE TO BE CONCRETE ENCASED WITH 20MPA CONCRETE 150MM THICK ALL ROUND.
42. CONCRETE ENCASEMENT IS TO COMMENCE AND FINISH AT A FLEXIBLE JOINT. BACKFILLING OVER THE CONCRETE ENCASED PIPELINE IS NOT TO BE UNDERTAKEN WITHIN 24 HOURS OF PLACING CONCRETE AND UNTIL "WORKS AS EXECUTED" (WAE) DETAILS OF THE ENCASEMENT HAVE BEEN OBTAINED BY THE SURVEYOR.
43. INTERCONNECTION WORKS WILL NOT TAKE PLACE UNTIL SUCH TIME AS ALL PROPOSED CONSTRUCTION IS COMPLETED, BACKFILLED AND SATISFACTORILY TESTED.
44. ALL DISTURBED AREAS AFFECTED BY THE WORKS ARE TO BE GRASS SEEDED AND FERTILISED AT THE COMPLETION OF WORKS.

THRUST RESTRAINTS

45. THRUST RESTRAINTS SHALL BE IN ACCORDANCE WITH THESE DRAWINGS AND THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE PUMPING STATION CODE OF AUSTRALIA - WSA 04 - 2004-2.1.
46. USE MINIMUM GRADE N25 CONCRETE FOR THRUST RESTRAINT. JOINTS, BOLTS AND NUTS TO BE CLEAR OF CONCRETE. CONCRETE BLOCKS MUST BE KEPT CLEAR OF OTHER SERVICES.
47. ALL VALVES WITH UNRESTRAINED PIPES ON ONE OR BOTH SIDE(S) REQUIRE AN IN-LINE CONCRETE THRUST BLOCK.
48. CONCRETE THRUST BLOCKS SHALL BE CURED FOR A MINIMUM OF 7 DAYS PRIOR TO BEING SUBJECTED TO ANY THRUST LOAD.
49. CONSTRUCT CONCRETE THRUST RESTRAINTS IN ACCORDANCE WITH WSA STANDARD DRAWING NUMBERS WAT-1205 AND WAT-1207.
50. THE CONSTRUCTOR SHALL VERIFY THE HORIZONTAL BEARING CAPACITY PRIOR TO INSTALLATION OF THRUST BLOCKS IN ACCORDANCE WITH WSA STANDARD DRAWING WAT-1200. REFER TO THE SUPERINTENDENT'S REPRESENTATIVE FOR FURTHER INSTRUCTIONS SHOULD THE ESTIMATED ALLOWABLE HORIZONTAL BEARING CAPACITY BE LESS THAN THAT NOMINATED IN THESE DRAWINGS.
51. WHEN POURING CONCRETE AGAINST FITTINGS, PLACE A MEMBRANE OF POLYETHYLENE BETWEEN THE FITTING AND CONCRETE TO PREVENT DAMAGE TO THE FITTING. JOINTS SHALL BE CLEAR OF CONCRETE.

EXISTING SERVICES

52. THE CONSTRUCTOR SHALL UNDERTAKE A "DIAL BEFORE YOU DIG" ENQUIRY PRIOR TO COMMENCEMENT OF CONSTRUCTION, TO ENSURE THE LATEST SERVICE INFORMATION IS OBTAINED.
53. THE CONSTRUCTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES, AND ADVISE THE SUPERINTENDENT'S REPRESENTATIVE IF THERE ARE ANY CLASHES.
54. MINIMUM SERVICE CLEARANCES SHALL BE IN ACCORDANCE WITH SHOALHAVEN WATER'S SUPPLEMENT TO WSA02-2014.
55. THE CONSTRUCTOR SHALL NOTIFY THE RELEVANT SERVICE AUTHORITIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, IN THE VICINITY OF THE SERVICES.

CONSTRUCTION STAGING

56. THE WORKS ARE TO BE CONSTRUCTED UNDER THREE SEPARATE STAGES, BY POTENTIALLY THREE SEPARATE CONSTRUCTORS.

TESTING, ASSET ACCEPTANCE AND COMMISSIONING

57. PRESSURE TESTING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA - SEWERAGE PUMPING STATION CODE OF AUSTRALIA - WSA 04 - 2004-2.1, AND SHOALHAVEN WATER REQUIREMENTS.
58. THE MAXIMUM TEST PRESSURE SHALL BE TBC KPA.
59. THE CONTRACTOR SHALL PROVIDE AT LEAST 7 DAYS' NOTICE TO THE SUPERINTENDENT'S REPRESENTATIVE PRIOR TO CONNECTION OF NEW WORKS TO THE EXISTING NETWORK.
60. THE CONTRACTOR SHALL COORDINATE ALL CUT OVER AND SEWER ISOLATION WORKS WITH SHOALHAVEN WATER.

STANDARD SEWER CONSTRUCTION NOTES

61. ALL SEWERAGE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WSAA SEWER CODE OF AUSTRALIA AND SHOALHAVEN WATER'S SUPPLEMENT, AND WITH ANY OTHER SPECIAL REQUIREMENTS AND STANDARDS OF SHOALHAVEN CITY COUNCIL.
62. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH & SAFETY ACT 2000, WHICH REQUIRES EMPLOYERS TO ENSURE THE HEALTH, SAFETY & WELFARE OF EMPLOYEES.
63. THE CONTRACTOR SHALL AT ALL TIMES EXERCISE ALL NECESSARY PRECAUTIONS APPROPRIATE TO ENSURE THE SAFETY OF ALL PERSON'S ON THE WORK SITE OR IN THE VICINITY OF THE WORK SITE.
64. PRIOR TO COMMENCING WORK ON SITE THE CONTRACTOR SHALL PROVIDE TO THE SUPERINTENDENT EVIDENCE THAT HE HAS CURRENT PUBLIC RISK AND COMPENSATION INSURANCE POLICIES.
65. THE CONTRACTOR SHALL PROVIDE ALL LABOUR, MATERIALS, AND EQUIPMENT NECESSARY FOR THE ACCURATE SETTING OUT OF THE ENTIRE WORKS. THE CONTRACTOR SHALL ARRANGE FOR ALL PIPES AND FITTINGS TO BE INSPECTED BY THE SUPERINTENDENT AND THE SHOALHAVEN WATER INSPECTOR PRIOR TO THE OPENING OF ANY TRENCHES ON SITE. THE CONTRACTOR SHALL GIVE NOT LESS THAN 24 HOURS NOTICE WHEN REQUESTING AN INSPECTION UNDER THIS CLAUSE.
66. UPVC PIPES AND FITTINGS ARE TO BE RUBBER RING JOINTED (RRJ), CLASS (SN4 AND/OR SN8) AND MANUFACTURED IN ACCORDANCE WITH AS/NZ 1260. PIPE LENGTHS ARE NOT TO EXCEED 3M IN LENGTH.
67. WRITTEN PERMISSION IS TO BE OBTAINED FROM THE LANDOWNERS THROUGH WHICH THE SEWER MAIN WILL TRAVERSE, PRIOR TO ENTERING OR COMMENCING ANY SEWER CONSTRUCTION WORKS WITHIN THOSE PROPERTIES AND FOR THE DURATION OF CONSTRUCTION WORKS. A COPY OF THE WRITTEN CONSENT SHALL BE FORWARDED TO SHOALHAVEN WATER.
68. APPROVAL UNDER SECTION 138 OF THE ROADS ACT 1993 MUST BE OBTAINED FROM COUNCIL OR THE RTA PRIOR TO COMMENCEMENT OF ANY WORK WITHIN COUNCIL'S OR RTA'S ROAD/ROAD RESERVE.
69. TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH AS1742.3 ARE TO BE IN PLACE AND MAINTAINED AT ALL TIMES. TRAFFIC CONTROL PLAN IS TO BE SUBMITTED TO COUNCIL AND APPROVED PRIOR TO CONSTRUCTION WORK COMMENCING.
70. THE CONTRACTOR SHALL GIVE NOT LESS THAN FOUR (4) DAYS NOTICE PRIOR TO COMMENCING WORK ON SITE.
71. POSITION OF MANHOLES/LAMPHOLES SHALL BE LOCATED BY A SURVEYOR PRIOR TO A PRE-COMMENCEMENT MEETING.
72. ALL JUNCTIONS/JUNCTION SIDELINES ARE TO BE LAID AT A MINIMUM GRADE OF 1 IN 60.
73. WHERE SHOWN ON THE PLAN, CROSS HATCHING DENOTES THE SERVICE LIMIT OF THE LOT (BEING CALCULATED AT 1:60).
74. HEIGHT OF VERTICAL RISERS AS SHOWN ON THE LONG SECTION IS MEASURED FROM THE INVERT OF THE SEWER MAIN TO THE INVERT OF THE SIDELINE OFF THE RISER.
75. RISERS TO BE PLACED ONLY WHERE SHOWN ON THE LONGITUDINAL SECTIONS.
76. SEWER MANHOLES TO BE OF THE TYPE SHOWN ON THE SEW-1300SW OR AS AMENDED.
77. SEWER MANHOLE COVERS AND SURROUNDS TO BE OF THE TYPE SHOWN ON THE SEW-1300SW OR AS AMENDED - HEAVY TYPE COVER 'H'.
78. THE CONTRACTOR IS TO TAKE EXTRA CARE WITH MANHOLE CONSTRUCTION TO ENSURE THAT SUFFICIENT FALL IS PROVIDED THROUGH EACH MANHOLE. THE CONTRACTOR IS TO CONSULT WITH THE SUPERVISING ENGINEER/SURVEYOR TO VERIFY THE REQUIRED CONSTRUCTED FALL ACROSS EACH MANHOLE. CONSTRUCTED FALL ACROSS EACH MANHOLE SHOULD ALLOW FOR THE CONTINUATION OF GRADE PLUS THE DESIGN DROP AT THE CENTRE OF THE MANHOLE. (REFER TO TABLE FOR DEP TAILS ON THE REQUIRED FALLS TO BE CONSTRUCTED THROUGH EACH MANHOLE).
79. THE CONTRACTOR SHALL ENSURE THAT PIPES ARE LAID TO CORRECT INVERT LEVELS, WHERE LASER PIPE LAYING AIDS ARE USED THE CONTRACTOR SHALL VERIFY THAT THE CORRECT MANHOLE INVERT LEVEL HAS BEEN ACHIEVED (REFER TO TABLE SHOWING FALLS THROUGH MANHOLES).
80. INTERCONNECTION/CONSTRUCTION OF MANHOLE A/1 IS TO BE JOINTLY CONSTRUCTED BY SHOALHAVEN WATER STAFF AND THE CONTRACTOR. ALL MATERIALS (INCLUDING MAINLINE PIPEWORK) ARE TO BE PROVIDED BY THE CONTRACTOR. THE CONTRACTOR IS TO CARRY OUT THE REQUIRED EXCAVATION FOR MANHOLE AND, ONCE COMPLETED, SHOALHAVEN WATER SHALL PERFORM THE "CUT-IN", INSERTING THE REQUIRED MANHOLE (MAINLINE) PIPEWORK INTO THE MAIN. THE CONTRACTOR IS TO THEN CONSTRUCT THE MANHOLE, BACKFILL AND REINSTATE THE AREA. TESTING OF THE MANHOLE IS TO BE PERFORMED BY THE CONTRACTOR. THE CONTRACTOR IS TO LIAISE WITH SHOALHAVEN WATER'S WASTEWATER DISTRIBUTION CO-ORDINATOR IN THIS REGARD. SHOALHAVEN WATER'S WORKFORCE SHALL THEN CARRY OUT THE INTERNAL BENCHING AND RENDERING WORKS WITHIN THE MANHOLE.
81. UNLESS PRIOR WRITTEN APPROVAL IS GRANTED, ALL WORK ON EXISTING COUNCIL MAINS OR WITHIN EXISTING SEWER MANHOLES IS TO BE UNDERTAKEN BY COUNCIL STAFF AT THE DEVELOPERS EXPENSE.THE CONTRACTOR OR PERSON REQUESTING THE WORK SHALL SIGN A WORKS ORDER (PRIVATE INSTALLATION-PI) FORM PRIOR TO THE WORKS BEING CARRIED OUT. THIS PERSON/FIRM SHALL BE INVOICED FOR WORK CARRIED OUT.
82. THE CONTRACTOR WILL BE RESPONSIBLE FOR REPAIR OF ANY DAMAGE TO COUNCIL'S EXISTING INFRASTRUCTURE. SUCH REPAIR OR REINSTATEMENT IS TO BE CARRIED OUT IMMEDIATELY TO THE SATISFACTION OF SUBDIVISION MANAGER AND/OR DEVELOPMENT MANAGER AND/OR SHOALHAVEN WATER.
83. JUNCTION "CUT-INS" FOR PROPOSED LOTS NA AND NA IS TO BE PERFORMED BY SHOALHAVEN WATER AT THE DEVELOPER'S COST. SUPPLY OF MATERIALS (INCLUDING BEDDING MATERIAL), EXCAVATION, BACKFILL AND REINSTATEMENT WORK IS TO BE CARRIED OUT BY THE CONTRACTOR. WAE DETAILS FOR JUNCTIONS ARE TO BE OBTAINED BY THE SUPERVISING SURVEYOR PRIOR TO BACKFILLING THE TRENCHES.
84. WHERE SHOWN ON THE PLAN AND LONGITUDINAL SECTIONS, SEWER LINES ARE TO BE CONCRETE ENCASED WITH 20MPA CONCRETE 150MM THICK ALL ROUND (OVER, UNDER & EACH SIDE) AND THE MAXIMUM WIDTH OF THE CONCRETE ENCASEMENT SHALL NOT EXCEED 600MM. IF EXCESS EXCAVATION OCCURS IT WILL BE NECESSARY FOR THE ENCASEMENT TO BE FORMED TO ACHIEVE THE 600MM MAXIMUM WIDTH REQUIREMENTS. CONTRACTION JOINTS SHALL BE PROVIDED ALONG THE CONCRETE ENCASEMENT AT THE FACE OF EACH PIPE SOCKET. CONCRETE ENCASEMENT IS TO COMMENCE & FINISH AT A FLEXIBLE JOINT.
85. SHOALHAVEN WATER REQUIRES THAT ALL PROPOSED CONCRETE ENCASEMENT BE INSPECTED BY SHOALHAVEN WATER'S INSPECTOR, AT THE DEVELOPER'S COST. WORKS TO BE INSPECTED AT PRIOR TO ANY CONCRETE BEING POURED AND AT THE COMPLETION OF CONCRETE POUR, PRIOR TO BACKFILLING. INSPECTION AND TRAVELLING COSTS ARE SET OUT IN COUNCIL'S FEES, CHARGES AND RENTALS DOCUMENT.
86. BACKFILLING OVER THE CONCRETE ENCASED PIPELINE IS NOT TO BE UNDERTAKEN WITHIN 48 HOURS OF PLACING CONCRETE AND UNTIL "WORK-AS-EXECUTED" (W.A.E.) DETAILS OF THE ENCASED PIPELINE HAVE BEEN OBTAINED BY THE SURVEYOR.
87. WHERE LAMPHOLE/S ARE SPECIFIED, THE CONTRACTOR IS TO PROVIDE A MANHOLE COVER AND SURROUND OVER THE CONSTRUCTED LAMPHOLE TO INDICATE THE POSITION OF, AND PROVIDE FUTURE ACCESS TO, THE CONSTRUCTED LAMPHOLE.
88. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION WORK COMMENCING AND MAINTAINED DURING THE CONSTRUCTION PHASE. SEDIMENT CONTROL MEASURES ARE TO INCORPORATE THOSE AS DETAILED ON THE SEDIMENT AND EROSION CONTROL PLAN. SEDIMENT CONTROL MEASURES SHOULD ALSO INCORPORATE THE MEASURES AS SET OUT IN COUNCIL'S STANDARD ANNEXURE FOR "EROSION CONTROL MEASURES FOR WORK UNDERTAKEN BY PRIVATE CONTRACTORS DURING THE INSTALLATION OF UTILITY SERVICES". ALL MEASURES AS DETAILED ON THE PLAN PERTAINING TO THE SEDIMENT CONTROL AROUND THE SEWER CONSTRUCTION SITE ARE TO BE IMPLEMENTED PRIOR TO WORKS COMMENCING.
89. ALL FILLING THAT TAKES PLACE OVER THE SITE IS TO BE IN ACCORDANCE WITH COUNCIL'S WRITTEN APPROVAL'. THE COMPACTION TEST RESULTS SHALL BE FORWARDED TO SHOALHAVEN WATER UPON COMPLETION.

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
GENERAL NOTES - SHEET 1

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	111	1	A

100 mm on original

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GENERAL

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING:

   A. SEWERAGE CODE OF AUSTRALIA WSA 02-2002-2.2 SYDNEY WATER EDITION 1 -VERSION 3 - PART 3
   B. SYDNEY WATER STANDARD SPECIFICATION SS210 CORROSION PROTECTION AND REHABILITATION OF MAINTENANCE HOLES REV.3.
   C. SYDNEY WATER PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS.
   D. WSA 114-2002 INDUSTRY STANDARD FOR CONCRETE SPECIAL CLASS.
   E. 140 DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN.
   F. 141 DN1200 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN.
   G. 142 DN1050 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN.
   H. 143 DN1200 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN.
   I. 144 STANDARD DETAILS
   J. 145 CONNECTION DETAILS PLAN
   K. 146 TYPICAL CHANNEL ARRANGEMENTS PLAN
   L. 147 DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS
   M. AS 3600-2009-CONCRETE STRUCTURES.
   N. AS 3735-2001-SONCRETE STRUCTURE RETAINING LIQUIDS.

2. ALL DIMENSION IN MILLIMETRES UNLESS NOTED OTHERWISE.

3. SETTING OUT DIMENSIONS AND SIZES OF STRUCTURAL MEMBERS NOT TO BE OBTAINED BY SCALING THE DRAWINGS.

4. ALL PENETRATIONS TO BE CAST IN. BLOCKOUTS ARE NOT PERMITTED.

FOUNDATIONS

1. MINIMUM ALLOWABLE BEARING PRESSURES FOR MAINTENANCE HOLES SHALL BE:

DEPTH TO SEWER INVERT	MNIMUM ALLOWABLE BEARING PRESSURE
0-6m	100 kPa

   FOUNDATION MATERIAL TO BE INSPECTED AND APPROVED BY A SUITABLY EXPERIENCED GEOTECHNICAL ENGINEER PRIOR TO PLACING BLINDING CONCRETE
2. ANY OVER-EXCAVATION OR VOIDS OF FOUNDATION MATERIALS TO BE FILLED WITH NORMAL CLASS N15 MASS CONCRETE TO PS-357

LOCATIONS WHERE MAINTENANCE HOLES CAN BE USED:

1. WITHIN RESIDENTIAL AREAS(INCLUDES LOTS AND ROAD VERGE).
2. OUTSIDE OF ROAD PAVEMENTS.
3. UP TO 6m DEEP.
4. DN1050 MAINTENANCE HOLES UP TO DN300 PIPE.
5. DN1200 MAINTENANCE HOLES UP TO DN450 PIPE.

STRUCTURAL CRITERIA

1. SOIL PROPERTIES:
   ϕ'=30°
   DENSITY (γ) = 20kN/m^3
   COEFFICIENT OF EARTH PRESSURE AT REST Ko=0.5
2. LOADS:
   LIVE LOAD = SM1600 LOAD TO AS5100.2
   SURCHARGE AROUND STRUCTURES = 20kPa
   GROUND WATER AT SURFACE
3. CONCRETE EXPOSURE CLASSIFICATION:
   140 (AS 3735)
   141 (AS 3735)
   142 (AS 3735)
   143 (AS 3735)

FORMWORK

1. FORMWORK AND CONCRETE FINISHED SHALL BE IN ACCORDANCE WITH AS 3610. SURFACE EXPOSED TO VIEW - CLASS 2. SURFACE TO EXPOSED VIEW - CLASS 4.
2. CONCRETE SHALL ACHIEVE A MINIMUM COMPRESSIVE STRENGTH OF 25MPa PRIOR TO STRIPPING OF FORMWORK.

CONCRETE

1. CONCRETE DIMENSIONS SHOWN DO NOT INCLUDE THICKNESS OF APPLIED FINISHES.
2. MINIMUM CLEAR COVER TO REINFORCEMENT SHALL BE 50MM UNO.
3. CONCRETE SHALL BE SPECIAL CLASS SCC40 TO WSA 114-2002 EXCEPT AS VARIED BELOW.

   SECTION 4 - MIX DESIGN

MINIMUM F'C AT 28 DAYS	40mPa
MINIMUM BINDER CONTENT	450kg/m^3
MAXIMUM 56 DAY DRYING SHRINKAGE STRAIN	600x10
MAXIMUM WATER:CEMENT RATIO	0.45
SLUMP	80-120mm

   SECTION 6 - SUPPLEMENTARY CEMENTITIOUS MATERIALS

   THE TOTAL AMOUNT OF SUPPLEMENTARY CEMENTITIOUS MATERIALS SHALL NOT BE MORE THEN 60% BY WEIGHT OF THE TOTAL CEMENT MATERIAL.

   SECTION 6.2 - FLYASH

   THE MAXIMUM AMOUNT OF SLAG FLYASH SHALL BE 25% BY WEIGHT OF THE TOTAL CEMENT MATERIAL.

   SECTION 6.3 - SLAG

   THE MAXIMUM AMOUNT OF SLAG SHALL BE 50% BY WEIGHT OF THE TOTAL CEMENT MATERIAL.

   SECTION 6.5 - AGGREGATES.

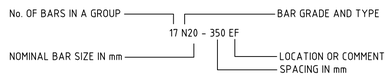
   THE MAXIMUM NOMINAL SIZE OF AGGREGATE SHALL BE 20MM. RECYCLED MATERIAL OR SLAG PRODUCTS SHALL NOT BE USED AS AGGREGATES.

   SECTION 6.7 - CHEMICAL ADMIXTURES.

   WHERE TWO OR MORE ADMIXTURES ARE PROPOSED FOR INCORPORATION INTO A CONCRETE MIX THE MANUFACTURES SHALL CERTIFY THE COMPATIBILITY OF THE ADMIXTURES.
4. CURING OF ALL CONCRETE TO BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF 7 DAYS. POLYETHYLENE SHEETING OR WET HESSIAN MAY BE USED. POLYETHYLENE AND HESSIAN TO BE ADEQUATELY SECURED TO RESIST WIND AND TRAFFIC FORCES. ALTERNATIVE CURING MAY BE ACHIEVED BY APPLYING SIKA ANTISOL WB CURING COMPOUND OR APPROVED EQUIVALENT TO ALL SURFACES IN ACCORDANCE WITH THE MANUFACTURES REQUIREMENTS FOR A PERIOD OF 14 DAYS.
5. CONCRETE SHALL ACHIEVE A MINIMUM COMPRESSIVE STRENGTH OF 32MPA PRIOR TO BACKFILLING AND TESTING OF STRUCTURES. BACKFILL SHALL BE PLACED AND COMPACTED EVENLY AROUND MAINTENANCE HOLES IN LAYERS NOT EXCEEDING 300MM LOOSE THICKNESS.

REINFORCEMENT

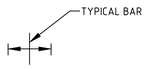
1. STEEL REINFORCING MATERIALS SHALL BE TO AS/NZS4671.
   SHAPE - D
   STRENGTH GRADE = 500MPA
   DUCTILITY CLASS - N
2. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY: IT IS NOT NECESSARILY SHOWN IN TRUE PROJECTION.
3. DESIGNATION OF REINFORCEMENT BARS AS IN EXAMPLE:



4. THE FOLLOWING ABBREVIATIONS APPLY TO THE LOCATION OF REINFORCEMENT:

EW	EACH WAY	FF	FAR FACE	CP	CENTRALLY PLACED
EF	EACH FACE	B	BOTTOM	BB	BOTTOM BOTTOM (LAID FIRST)
NF	NEAR FACE	T	TOP	TT	TOP TOP (LAID LAST)

5. EXTENT OF BARS SHOWN THUS:



6. SPLICE REINFORCEMENT ONLY AT LOCATIONS SHOWN ON DRAWINGS. LAP LENGTHS TO COMPLY WITH THE FOLLOWING UNLESS NOTED OTHERWISE.
   N12 - 400LAP
   N16 - 500 LAP
   N20 - 650 LAP
7. WELDING OF REINFORCEMENT IS NOT PERMITTED.
8. ALL REINFORCEMENT EXPOSURE CLASS D
9. MINIMUM COVER TO BE 75MM AS PER AS3735.

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CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
GENERAL NOTES - SHEET 2

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	112	1	A

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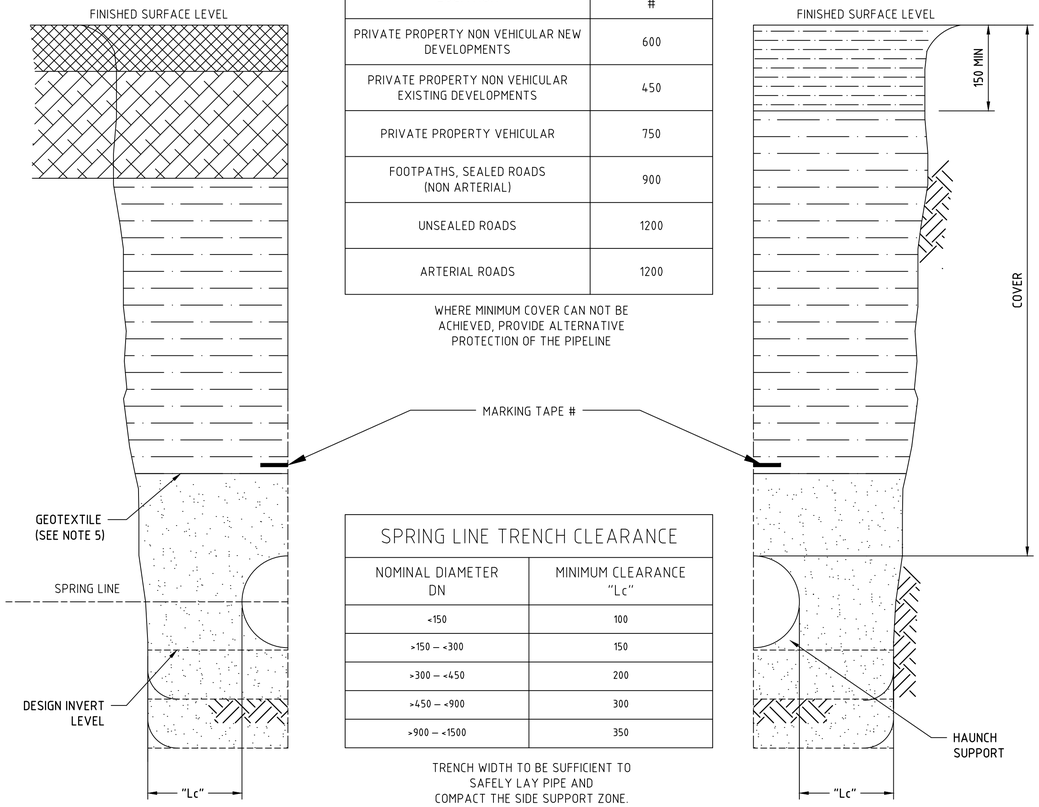
MATERIAL		ZONE
ROAD SURFACE	VERGE & TRACK	
ROAD SURFACE LAYER	TO MATCH EXISTING	SURFACE COURSE
TO MATCH EXISTING ROAD BASE OR TO ROAD OWNER'S REQUIREMENTS		ROAD BASE
TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4) BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING		OVERLAY (EMBEDMENT)
		SIDE SUPPORT (EMBEDMENT)
		BEDDING (EMBEDMENT)
		OVER-EXCAVATION

VEHICULAR LOADING



MINIMUM PIPE COVER	
LOCATION	MINIMUM COVER #
PRIVATE PROPERTY NON VEHICULAR NEW DEVELOPMENTS	600
PRIVATE PROPERTY NON VEHICULAR EXISTING DEVELOPMENTS	450
PRIVATE PROPERTY VEHICULAR	750
FOOTPATHS, SEALED ROADS (NON ARTERIAL)	900
UNSEALED ROADS	1200
ARTERIAL ROADS	1200

WHERE MINIMUM COVER CAN NOT BE ACHIEVED, PROVIDE ALTERNATIVE PROTECTION OF THE PIPELINE

SPRING LINE TRENCH CLEARANCE	
NOMINAL DIAMETER DN	MINIMUM CLEARANCE "Lc"
<150	100
>150 – <300	150
>300 – <450	200
>450 – <900	300
>900 – <1500	350

TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE.

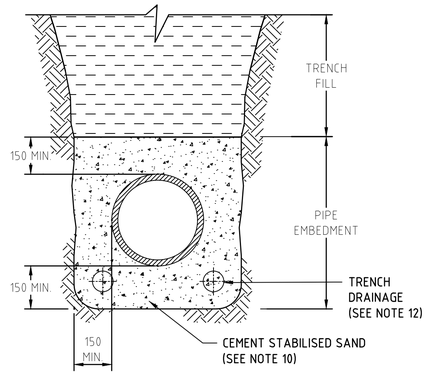
ZONE	MATERIAL
TOPSOIL OR PAVEMENT	ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL	INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
EMBEDMENT: OVERLAY, SIDE SUPPORT, BEDDING	EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4) BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER-EXCAVATION	

NO VEHICULAR LOADING

INCLUDES LOCATIONS WHERE OCCASIONAL VEHICLE LOADING OCCURS
EG RESERVES AND FOOTWAYS

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
   - IRREGULAR OUTCROPS OF ROCK.
   - AHBP OF <50 kPa (SEE SEW-1200), OR
   - BEEN DISTURBED BY UNCONTROLLED GROUND WATER .
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR.
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS AND WSA 02 PART 3.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.
7. USE THESE SUPPORT SYSTEMS WHERE SPECIFIED BY DESIGNER DETAILS TO BE PROVIDED IN DESIGN DRAWINGS.
8. USE REINFORCED CONCRETE CLASS N20 MIN., AND REINFORCED CONCRETE N25 MIN. FOR AGGRESSIVE CONDITIONS USE SPECIAL CLASS CONCRETE.
9. WHERE SPECIFIED MINIMUM STEEL REINFORCEMENT OF 0.4% CONCRETE CROSS SECTION PLACED CENTRALLY AND WITH 65 MINIMUM COVER TO EXTERNAL FACE. SPECIFY REINFORCEMENT FOR THE APPLICABLE LOADING IN DESIGN DRAWINGS.
10. CEMENT STABILISED SAND OR WELL GRADED CRUSHED ROCK TO BE 25:1 SAND: CEMENT (PLACED DRY).
11. DURING THE ENCASEMENT PROCESS, PIPES WILL REQUIRE A RESTRAINT SYSTEM TO PREVENT PIPE MOVEMENT AND/OR FLOTATION.
12. SEE SEW-1207SW IF CONTINUOUS TRENCH DRAINAGE REQUIRED.



TYPE 1 SUPPORT
UTILISING CEMENT STABILISED EMBEDMENT
(RIGID & FLEXIBLE PIPES)

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TRENCH DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
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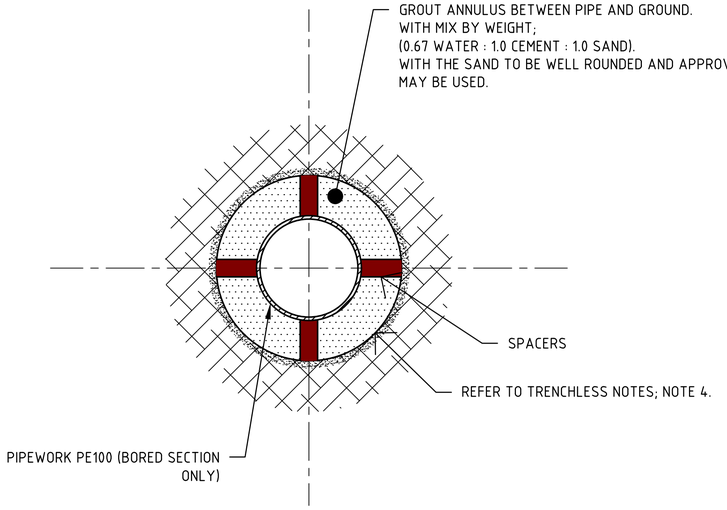

DETAIL 1

"TRENCHLESS" PIPEWORK TYPICAL SECTION
NOT TO SCALE

TRENCHLESS NOTES:

1. FOR ENVELOPER PIPE EXTENTS / DEPTHS REFER TO PLAN AND LONGITUDINAL SECTION DRAWINGS.
2. STEEL ENCASING PIPE JOINTS TO BE EITHER PLAIN ENDS WITH WELDED COLLAR, BUTT WELDED OR SLIP-IN TYPE WELDED JOINTS.
3. FILL ANNULAR SPACE BETWEEN BORED ENCASING PIPE AND CARRIER PIPES WITH GROUT UNLESS OTHERWISE SPECIFIED BY (PMHC).
4. ALTERNATE MICRO-TUNNELLING PIPE MATERIAL OPTIONS AVAILABLE WITH APPROVAL OF SHOALHAVEN WATER.
5. FREE BORE SIZE TO BE DETERMINED BY A TRENCHLESS CONTRACTOR.

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TRENCHLESS CONSTRUCTION DETAILS

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WI21102IP	25267	114	1	A

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COORDINATE SETOUT TABLE - GRAVITY SEWER - PACKAGE 1

SEWER LINE (MC02)			
NAME	TYPE	EASTING	NORTHING
MH-18	MH 1200	282338.339	6135524.623
MH-17	MH 1200	282359.256	6135548.831
MH-16	MH 1200	282413.768	6135611.211
MH-15	MH 1200	282347.902	6135677.099
MH-14	MH 1200	282338.653	6135778.899
MH-13	MH 1200	282328.110	6135894.925
MH-12	MH 1200	282335.885	6135995.199
MH-11	MH 1200	282350.643	6136090.520
MH-10	MH 1200	282365.401	6136185.841
MH-9	MH 1200	282384.132	6136237.473
MH-8	MH 1200	282422.021	6136318.840
MH-7	MH 1200	282424.947	6136360.002
MH-6	MH 1200	282428.555	6136427.794
MH-5	MH 1200	282418.569	6136444.746
MH-4	MH 1200	282406.029	6136466.033
MH-3	MH 1200	282355.722	6136505.617
MH-2	MH 1200	282363.545	6136559.135
MH-1	MH 1200	282302.156	6136568.277
SPS	PUMPSTATION	282305.911	6136593.490
SEWER LINE (MC03)			
NAME	TYPE	EASTING	NORTHING
MH-20	MH 1200	282382.137	6136628.226
MH-19	MH 1200	282371.753	6136557.921
MH-2	MH 1200	282363.545	6136559.135
SEWER LINE (MC04)			
NAME	TYPE	EASTING	NORTHING
EX-MH	MH 1200	282510.000	6136424.867
MH-23	MH 1200	282512.200	6136424.833
MH-22	MH 1200	282513.558	6136433.943
MH-21	MH 1200	282424.307	6136448.126
MH-5	MH 1200	282418.569	6136444.746
SEWER LINE (MC05)			
NAME	TYPE	EASTING	NORTHING
MH-25	MH 1500	282424.706	6136316.268
MH-8	MH 1200	282422.021	6136318.840
NOTE: XY SETOUT TO PIT CENTRE			

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

GREENWELL POINT ROAD
NEW RISING MAIN - PACKAGE 1- SRM (MC01) REFER TO DRAWING 25267-130 ONWARDS
REFER TO SHEET 25267-137 FOR DETAILS OF DISCHARGE MH AND CONNECTION FROM SPS22
0.000
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1224.084
25267-118
25267-117
25267-116
SPS20
GASCOYNE WAY
KARDELLA AVENUE
ANTARES CLOSE
CARRINGTON PARK DRIVE
MILDURA ST
WARRIGAL STREET
NARWEE LINK
OLD SOUTHERN ROAD
SUGARWOOD ROAD
PEPPERMINT DRIVE
JINDALEE CRESCENT
EXISTING DN300 AC SNSM TO BE ABANDONED
NEW SEWER GRAVITY MAIN
NEW DN300 SRM (SPS19) DISCHARGE CHAMBER FOR DETAILS REFER TO DRAWING 25267- 315 FOR DETAILS
N

PLAN
SCALE 1:2500
1:2500 0 125 250m

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	MC	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

CONSULTANT DETAILS:
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	JP	12/07/2021	CARDNO
	DESIGNED:	DATE:	COMPANY:
	PS	08/10/2021	CARDNO
	DRAWN:	DATE:	COMPANY:
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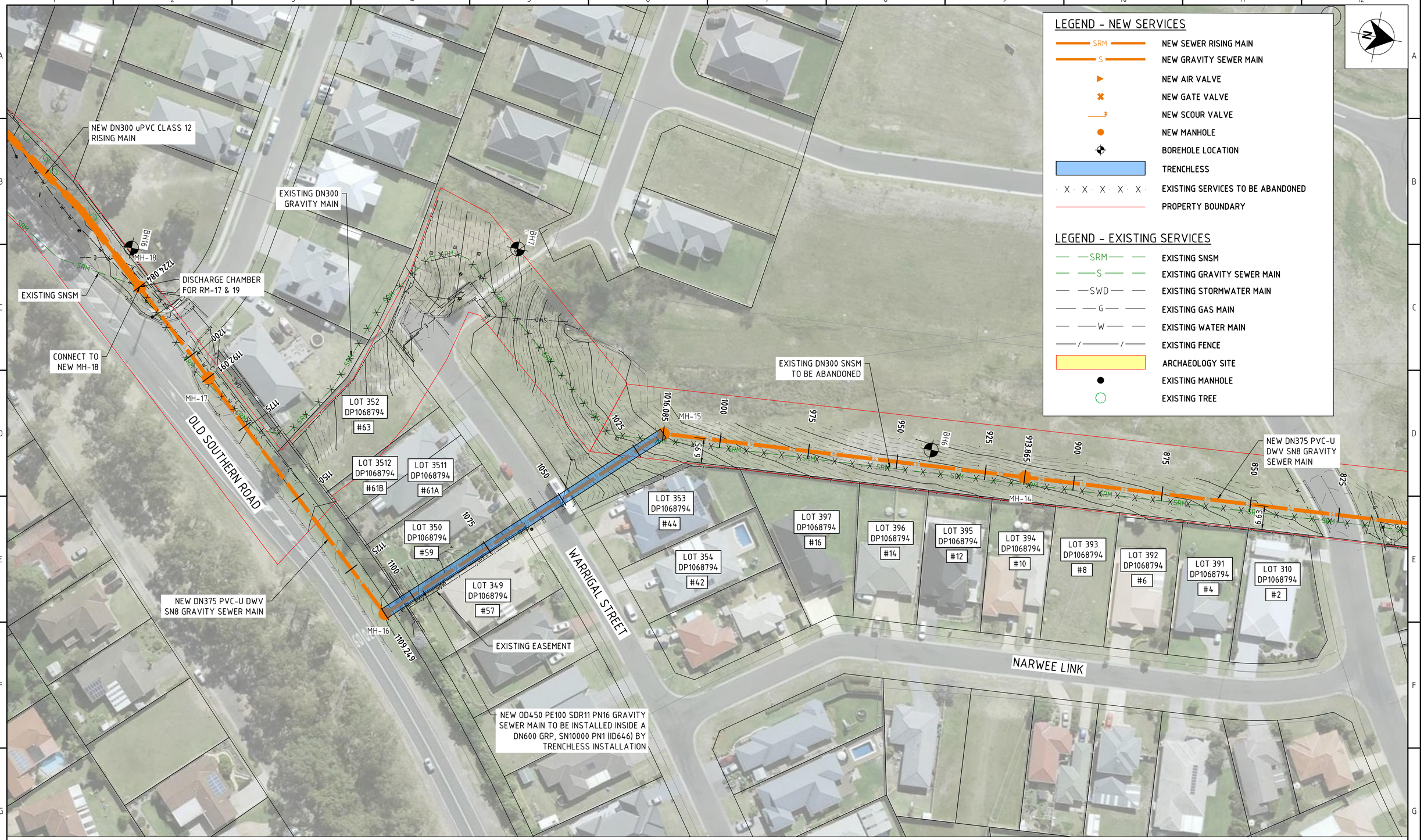
	APPROVED:	DATE:	COMPANY:
	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT REPLACEMENT OF THE EXISTING DN300 AC SNSM GRAVITY MAIN - OVERALL PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	115	1	B

Plotted: 08/10/21 - 09:12 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-115.dwg

100 mm on original



PLAN
SCALE 1:500

1:500 0 25 50m

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	MC	

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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DRAWN:	SMV	08/10/2021	CARDNO
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APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM GRAVITY MAIN - DETAIL PLAN LAYOUT
SHEET 1 OF 3

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	116	1	A

100 mm on original

Plotted: 07/10/21 - 17:12 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-116-118.dwg

ANTARES CLOSE

KARDELLA AVENUE

MILDURA STREET

CARRINGTON PARK RIDE

EXISTING DN300 SNSM TO BE ABANDONED

NEW DN375 PVC-U DWV SN8 GRAVITY SEWER MAIN

ARCHAEOLOGY SITE

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

MH-13 MH-12 MH-11 MH-10 MH-9

BH5 BH4 BH3

LOT 1 DP1170261 #40

LOT 2 DP1170261 #40A

LOT 226 DP1060103 #56

LOT 225 DP1060103 #54

LOT 224 DP1060103 #52

LOT 223 DP1060103 #50

LOT 222 DP1060103 #48

LOT 221 DP1060103 #46

LOT 220 DP1060103 #44

LOT 219 DP1060103 #42

LOT 218 DP1060103 #40

LOT 217 DP1060103 #38

LOT 216 DP1060103 #36

LOT 215 DP1060103 #34

LOT 214 DP1060103 #32

LOT 213 DP1060103 #30

LOT 212 DP1060103 #28

LOT 211 DP1060103 #26

LOT 210 DP1060103 #24

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

PLAN
SCALE 1:500

0 25 50m

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	MC	

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APPROVED:	NM	08/10/2021	CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
GRAVITY MAIN - DETAIL PLAN LAYOUT
SHEET 2 OF 3

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	117	2	A

100 mm on original

Plotted: 07/10/21 - 17:13 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-116-118.dwg

GASCOYNE WAY

KARDELLA AVENUE

GREENWELL POINT RD

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

CONNECT TO NEW SEWER PUMP STATION

NEW SPS

NEW PUMP STATION PACKAGE 2

ARCHAEOLOGY SITE

NEW DN560 PE100 PN16 RISING MAIN PACKAGE 1 (SRM MC01)

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW SNSM GRAVITY SEWER PACKAGE 1 (GRV MC03)

NEW SNSM GRAVITY SEWER PACKAGE 1 (GRV MC05)

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW DN675 GRP, SN10000 PN1 (ID723) GRAVITY SEWER MAIN

NEW SNSM GRAVITY SEWER PACKAGE 1 (GRV MC04)

EXISTING DN300 SNSM TO BE ABANDONED

EXISTING SPS20

LOT 101 DP1239007 #18

LOT 320 DP1159124

LOT 319 DP1159124 #6

LOT 316 DP1159124 #2

LOT 317 DP1159124 #3

LOT 318 DP1159124 #4

LOT 208 DP1060103 #20

LOT 207 DP1060103 #18

LOT 206 DP1060103 #16

LOT 205 DP1060103 #14

LOT 204 DP1060103 #12

LOT 203 DP1060103 #10

LOT 202 DP1060103 #8

MH-1 MH-2 MH-3 MH-4 MH-5 MH-6 MH-7 MH-8 MH-19 MH-20 MH-21 MH-22 MH-23 MH-25

BH1 BH2 BH5 BH14 BH27 BH28

EX-MH

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
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- NEW GATE VALVE
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- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

PLAN
SCALE 1:500

0 25 50m
1:500

No.	REVISION DETAILS	DWN	DATE
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CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM GRAVITY MAIN - DETAIL PLAN LAYOUT
SHEET 3 OF 3

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	118	3	A

100 mm on original

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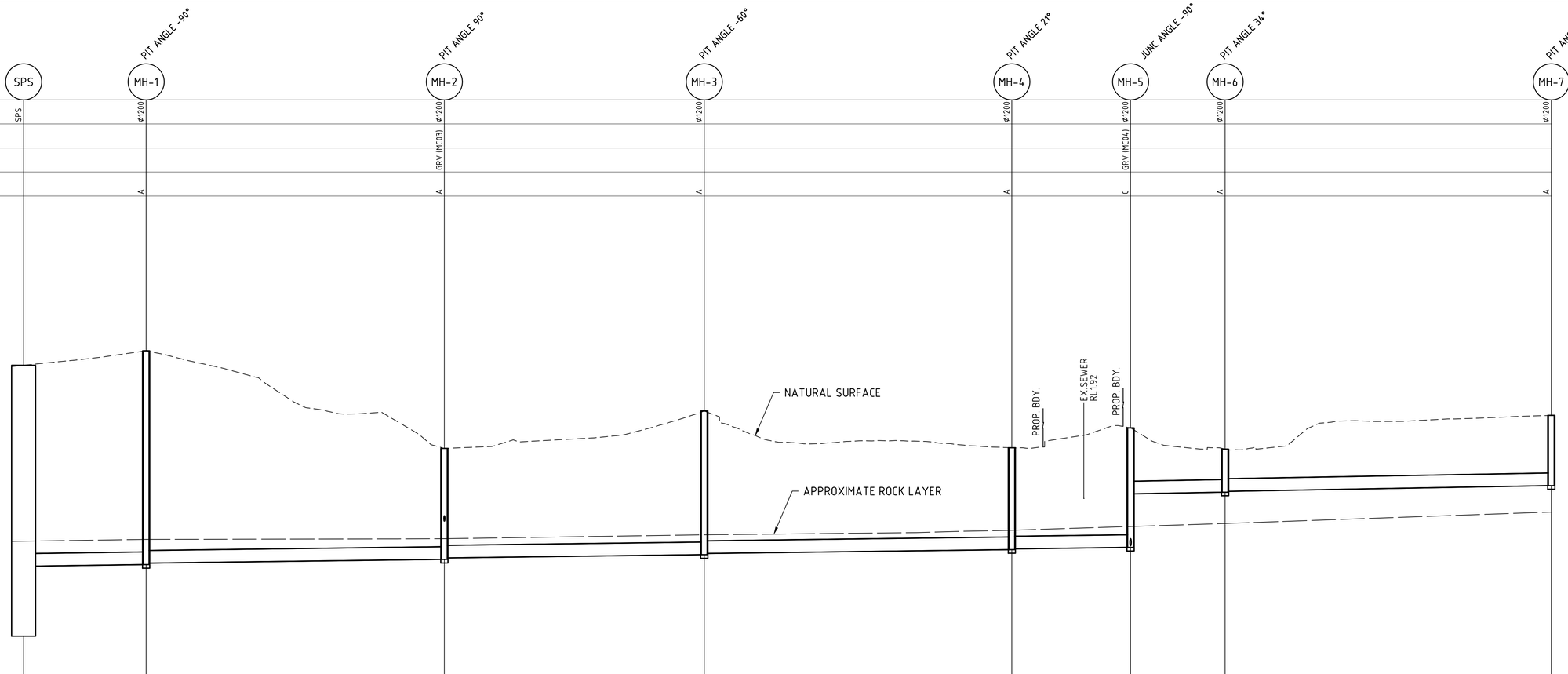
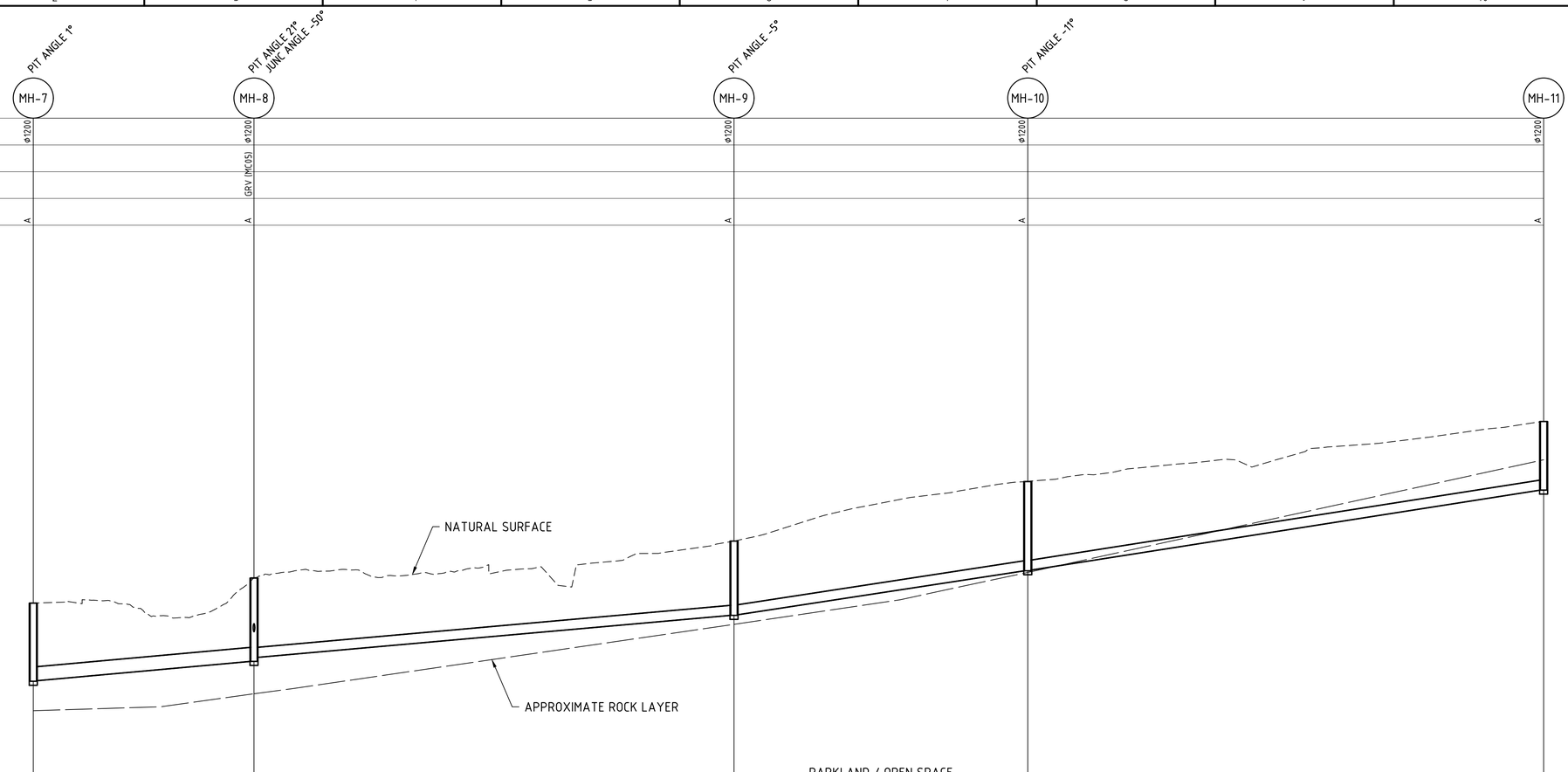
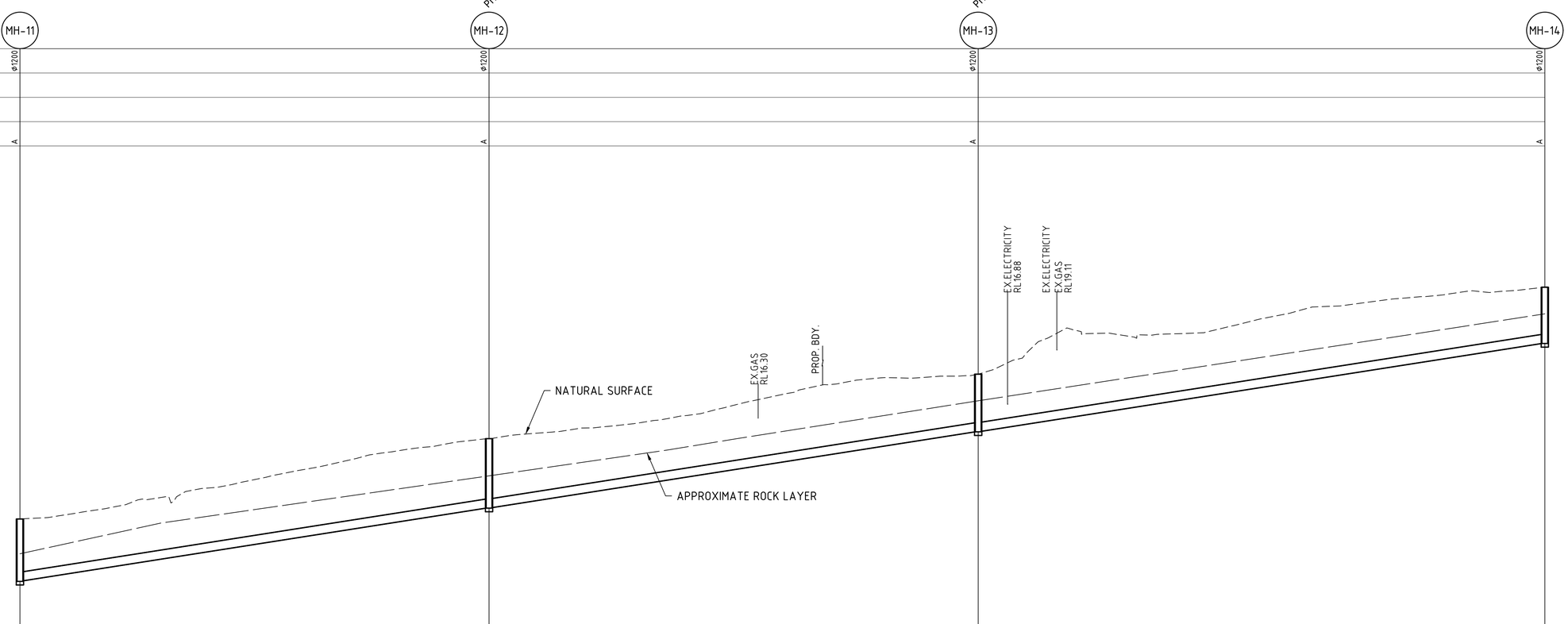

SPS
MH-1
MH-2
MH-3
MH-4
MH-5
MH-6
MH-7
PIT ANGLE -90°
PIT ANGLE 90°
PIT ANGLE -60°
PIT ANGLE 21°
JUNC. ANGLE -90°
PIT ANGLE 34°
PIT ANGLE 1°
NATURAL SURFACE
APPROXIMATE ROCK LAYER
PROP. BDY.
EX.SEWER RL1.92
PROP. BDY.

| | | |


PIT ANGLE 1°
PIT ANGLE 21°
JUNC. ANGLE -50°
PIT ANGLE -5°
PIT ANGLE -11°
MH-7
MH-8
MH-9
MH-10
MH-11
NATURAL SURFACE
APPROXIMATE ROCK LAYER
PARKLAND / OPEN SPACE

| | | |



MANHOLE TYPE:	ø1200 A	ø1200 A	ø1200 A	ø1200 A
COVER TYPE:				
JUNCT. LINE No.				
DROP TYPE:				
LOCATION		PARKLAND / OPEN SPACE		
PIPE DIAMETER/TYPE		DN375 PVC-U DWV SN8	DN375 PVC-U DWV SN8	DN375 PVC-U DWV SN8
TRENCH TYPE		TRENCH TYPE 1	TRENCH TYPE 1	TRENCH TYPE 1
PIPE GRADE (%)		3.10	3.10	3.10
DATUM R.L.	3.000			
DEPTH TO INVERT	2.564 / 2.544	2.857	2.837 / 2.371	2.351 / 2.315
JUNCTION INVERT LEVEL				
INVERT LEVEL	9.599 / 9.619	12.609	12.629 / 15.747	15.767 / 19.379
FINISHED SURFACE LEVEL	12.163	15.466	18.118	21.694
EXISTING SURFACE LEVEL	12.163	15.466	18.118	21.694
CHAINAGE/ LENGTH	600.330	96.456	696.786 / 100.575	797.361 / 116.504 913.865

SEWER LINE GRV (MC02)

LONGITUDINAL SECTION

SCALE 1:500 (H) ; 1:100 (V)

1:500 0 25 50m

1:100 0 5 10m

NOTES:

1. FOR TRENCH TYPE 1 DETAILS REFER TO DRAWING 25267-113.
2. FOR TRENCH TYPE 2 (TRENCHLESS CONSTRUCTION) REFER TO DRAWING 25267-114.
3. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-111 AND 112.
4. FOR STANDARD MAINTENANCE HOLE DETAILS REFER TO DRAWING 25267-140 TO 147.

No.	REVISION DETAILS	DWN	DATE
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A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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APPROVED: NM	DATE: 01/10/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM GRAVITY MAIN - LONGITUDINAL SECTION
SHEET 3 OF 5

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	123	3	B

100 mm on original

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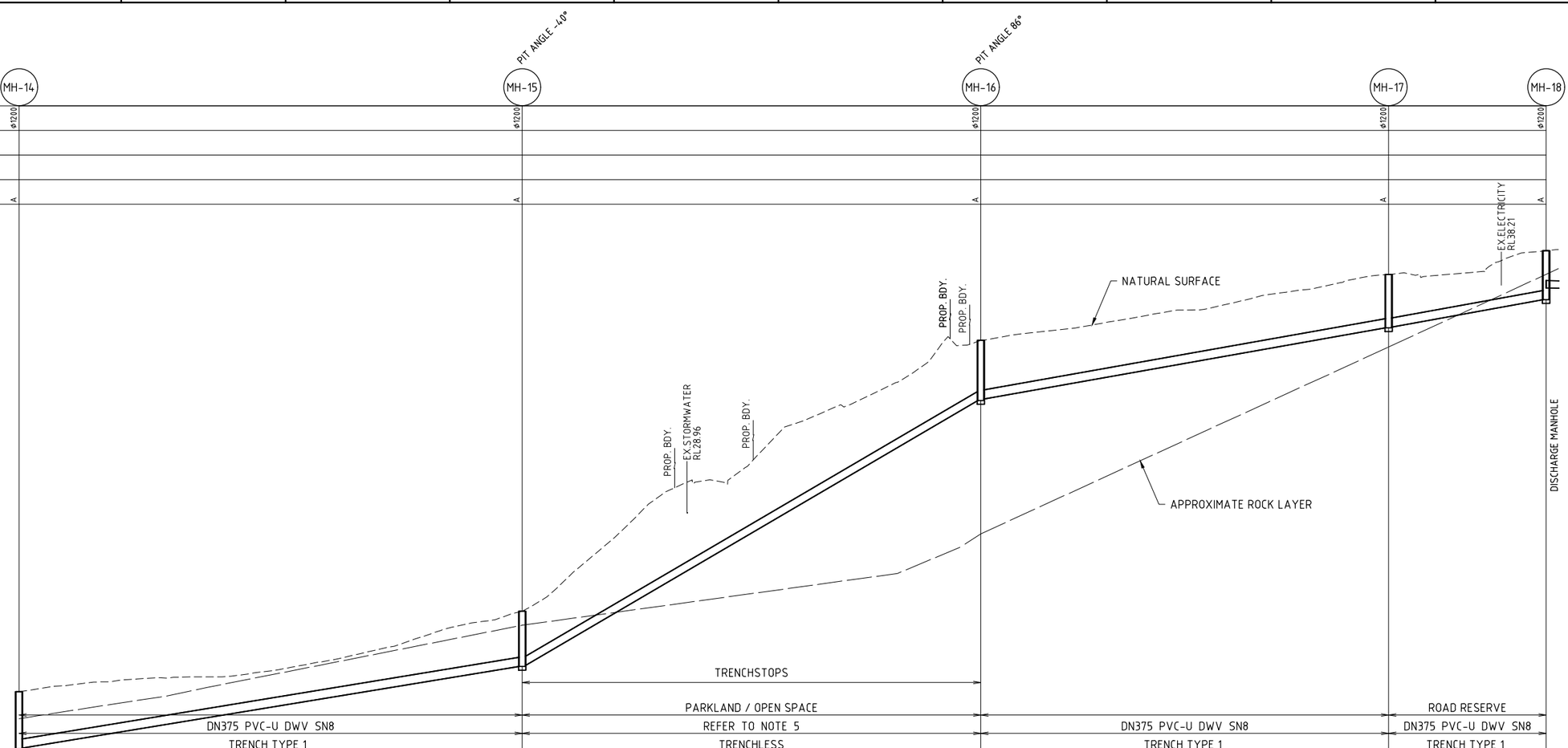
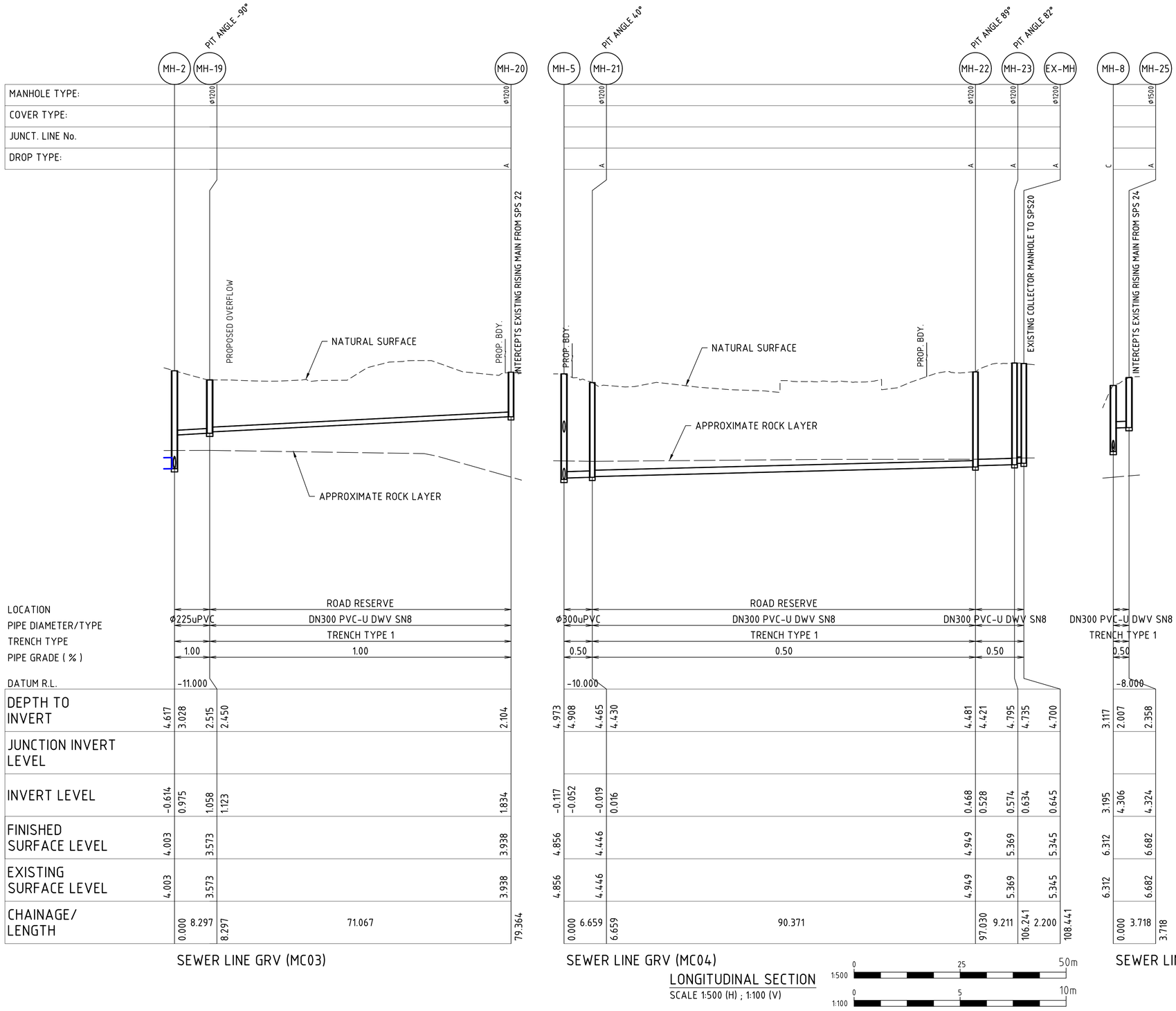

MH-14
MH-15
MH-16
MH-17
MH-18
PIT ANGLE -40°
PIT ANGLE 86°
Ø1200
A
EX. ELECTRICITY RL38.21
NATURAL SURFACE
PROP. BDY.
PROP. BDY.
PROP. BDY.
EX. STORMWATER RL28.96
PROP. BDY.
APPROXIMATE ROCK LAYER
DISCHARGE MANHOLE
TRENCHSTOPS

| | | |



SEWER LINE GRV (MC03)

SEWER LINE GRV (MC04)

SEWER LINE GRV (MC05)

LONGITUDINAL SECTION

SCALE 1:500 (H) ; 1:100 (V)

1:500 0 25 50m

1:100 0 5 10m

NOTES:

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No.	REVISION DETAILS	DWN	DATE
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT REPLACEMENT OF THE EXISTING DN300 AC SNSM GRAVITY MAIN - LONGITUDINAL SECTION SHEET 5 OF 5

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	125	5	B

100 mm on original

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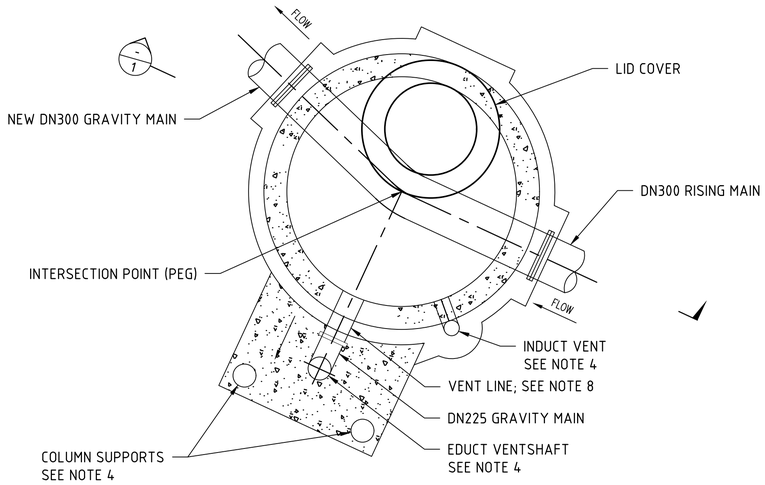
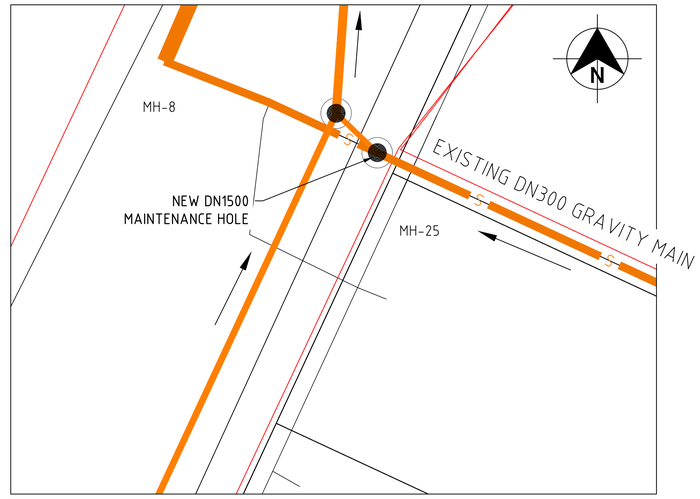
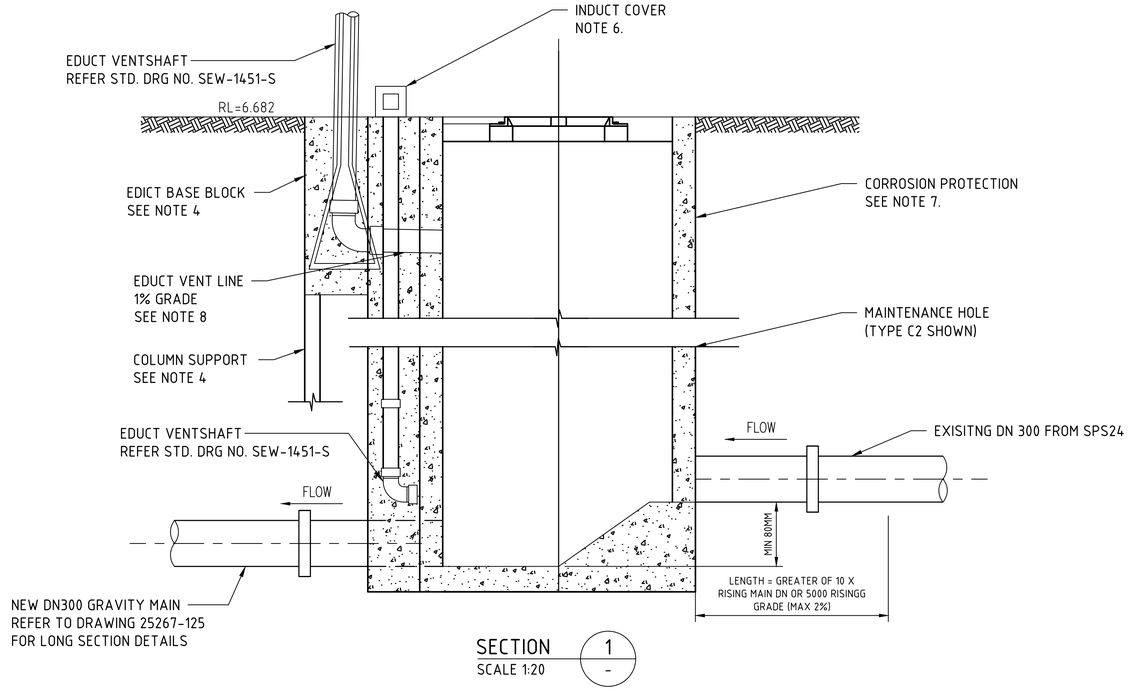


DN1200 MAINTENANCE HOLE MH-25
PLAN
SCALE 1:20



DN1500 MAINTENANCE HOLE MH-8
PLAN VIEW
SCALE 1:200



SECTION 1-1
SCALE 1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMMETRES UNLESS OTHERWISE NOTED
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH STD. DRG NO. SEW-1451-S
3. THIS DRAWING SHOWS TYPICAL ARRANGEMENT OF A RISING MAIN DISCHARGE MAINTENANCE HOLE. DESIGN PLANS SHALL BE DEVELOPED ONCE SERVICE PROVING HAS BEEN CONDUCTED
4. EDUCT VENTSHAFT
   LOCATION, HEIGHT, DIMENSIONS AND STRUCTURAL SUPPORT OF BASE BLOCK SHALL BE AS SPECIFIED ON THE DETAILED DESIGN PLANS AND IN ACCORDANCE WITH STD. DRG NO SEW-1451-S ONCE SERVICE PROVIDING HAS OCCURRED
5. MAINTENANCE HOLD BASE SHALL BE CONSTRUCTED TO MINIMISE TURBULENCE CREATED BY A RAPID FLOW OF SEWAGE. SLOPING FLOW CHANNEL IS A MINIMUM REQUIREMENT
6. INDUCT VENT:
   INDUCT VENT LINE TO BE FITTED WITH A DN100 MICA FLAP VENT COMPLETE WITH A S.S INDUCT COVER. THE INDUCT COVER TO BE A LOUVRED BOX APPROX 300 HIGH AND 300 SQUARE FABRICATED FROM 2MM (MIN) THICK STAINLESS STEEL SHEET. THE INDUCT COVER TO BE FIXED TO CONCRETE WITH DYNABOLTS & PAINTED IF REQUIRED. DETAILS OF THE CONCRETE SURROUND SHALL BE SPECIFIED IN THE DETAILED DESIGN DRAWINGS . INDUCT VENT SHALL BE FIXED TO REDUCING BUSH WITH ADHESIVE SEALANT
7. CORROSION PROTECTION
   THE INTERNAL SURFACES AND UNDERSIDE OF ROOF OF THE TWO IMMEDIATELY DOWNSTREAM MAINTENANCE HOLES SHALL BE PROTECTED IN ACCORDANCE WITH SYDNEY WATER PROTECTIVE COATING STANDARD PCS-100 FOR EXPOSURE CLASS EXTREME (OR EQUIVALENT CLASS D AS PER AS3735)
8. VENT LINES TO BE PVC OR DICL SIZE TO SUIT AIRFLOW REQUIREMENTS, MIN PIPE SIZE TO BE DN150
9. DESIGN, MATERIALS AND WORKMANSHIP TO BE IN ACCORDANCE WITH AS3600 AND AS3735
   STRUCTURAL CONCRETE TO BE MIN GRADE 40MPa MEETING REQUIREMENTS OF WATER SERVICES ASSOCIATION WSA 114, EXCEPT AS MODIFIED BELOW:
   - MINIMUM CEMENT CONTENT OF 450KG/m^3
   - TOTAL AMOUNT OF SUPPLEMENTARY CEMENTITIOUS MATERIAL SHALL NOT BE MORE THAN 60% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL SLAG CONTENT SHALL NOT BE MORE THAN 50% B WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL FLY ASH CONTENT SHALL NOT BE MORE THAN 25% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - MAXIMUM WATER/CEMENT RATIO SHALL NOT BE MORE THAN 0.45
   - DRYING SHRINKAGE STRAIN AT 56 DAYS SHALL NOT BE MORE THAN 600X10^{-6}

   INTERNAL CONCRETE SURFACES TO BE TREATED AS EXPOSURE CLASSIFICATION 'D' IN ACCORDANCE WITH AS3735. ISOLATION FROM THE ATTACKING ENVIRONMENT TO BE IN ACCORDANCE WITH SYDNEY WATER'S 'PCS 100 - PROTECTIVE COATING STANDARD.

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

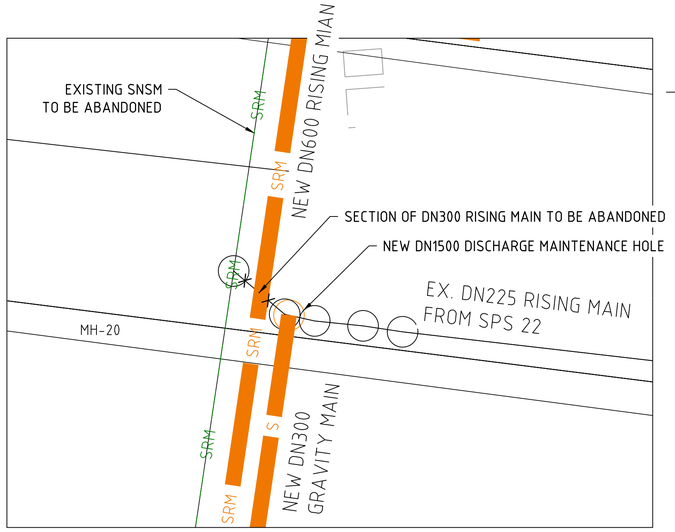
		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	SMV	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM CONNECTION - PLAN AND SECTION
RM24 OUTLET - DN1500 MH-25

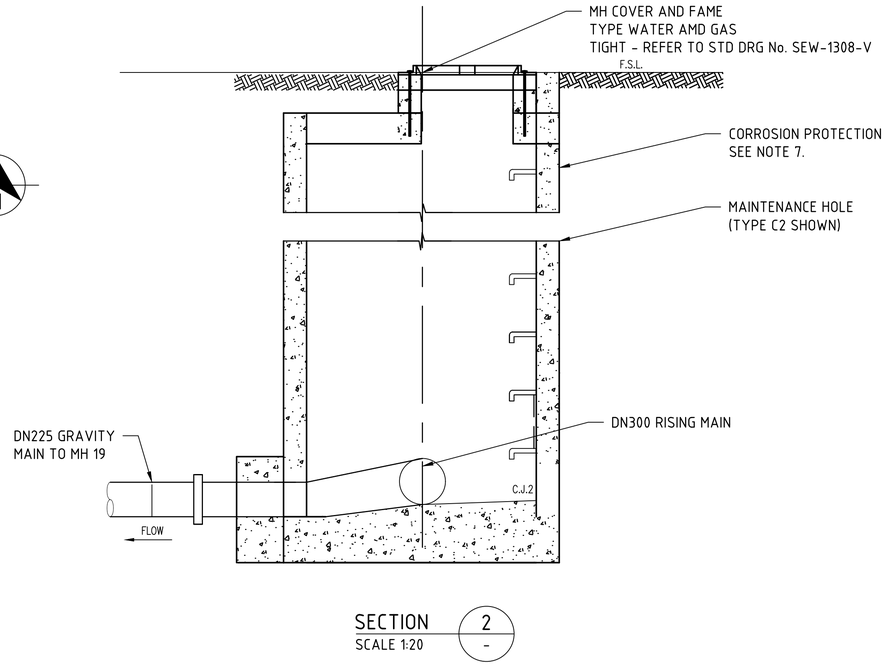
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	126	1	B

100 mm on original

Plotted: 07/10/21 - 17:14 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-126.dwg



DN1500 DISCHARGE MAINTENANCE HOLE MH-20
PLAN VIEW
SCALE 1:200



SECTION 2
SCALE 1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMMETRES UNLESS OTHERWISE NOTED
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH STD. DRG NO. SEW-1451-S
3. THIS DRAWING SHOWS TYPICAL ARRANGEMENT OF A RISING MAIN DISCHARGE MAINTENANCE HOLE. DESIGN PLANS SHALL BE DEVELOPED ONCE SERVICE PROVING HAS BEEN CONDUCTED
4. EDUCT VENTSHAFT
   LOCATION, HEIGHT, DIMENSIONS AND STRUCTURAL SUPPORT OF BASE BLOCK SHALL BE AS SPECIFIED ON THE DETAILED DESIGN PLANS AND IN ACCORDANCE WITH STD. DRG NO SEW-1451-S ONCE SERVICE PROVIDING HAS OCCURRED
5. MAINTENANCE HOLD BASE SHALL BE CONSTRUCTED TO MINIMISE TURBULENCE CREATED BY A RAPID FLOW OF SEWAGE. SLOPING FLOW CHANNEL IS A MINIMUM REQUIREMENT
6. INDUCT VENT:
   INDUCT VENT LINE TO BE FITTED WITH A DN100 MICA FLAP VENT COMPLETE WITH A S.S INDUCT COVER. THE INDUCT COVER TO BE A LOUVRED BOX APPROX 300 HIGH AND 300 SQUARE FABRICATED FROM 2MM (MIN) THICK STAINLESS STEEL SHEET. THE INDUCT COVER TO BE FIXED TO CONCRETE WITH DYNABOLTS & PAINTED IF REQUIRED. DETAILS OF THE CONCRETE SURROUND SHALL BE SPECIFIED IN THE DETAILED DESIGN DRAWINGS . INDUCT VENT SHALL BE FIXED TO REDUCING BUSH WITH ADHESIVE SEALANT
7. CORROSION PROTECTION
   THE INTERNAL SURFACES AND UNDERSIDE OF ROOF OF THE TWO IMMEDIATELY DOWNSTREAM MAINTENANCE HOLES SHALL BE PROTECTED IN ACCORDANCE WITH SYDNEY WATER PROTECTIVE COATING STANDARD PCS-100 FOR EXPOSURE CLASS EXTREME (OR EQUIVALENT CLASS D AS PER AS3735)
8. VENT LINES TO BE PVC OR DICL SIZE TO SUIT AIRFLOW REQUIREMENTS, MIN PIPE SIZE TO BE DN150
9. DESIGN, MATERIALS AND WORKMANSHIP TO BE IN ACCORDANCE WITH AS3600 AND AS3735
   STRUCTURAL CONCRETE TO BE MIN GRADE 40MPa MEETING REQUIREMENTS OF WATER SERVICES ASSOCIATION WSA 114, EXCEPT AS MODIFIED BELOW:
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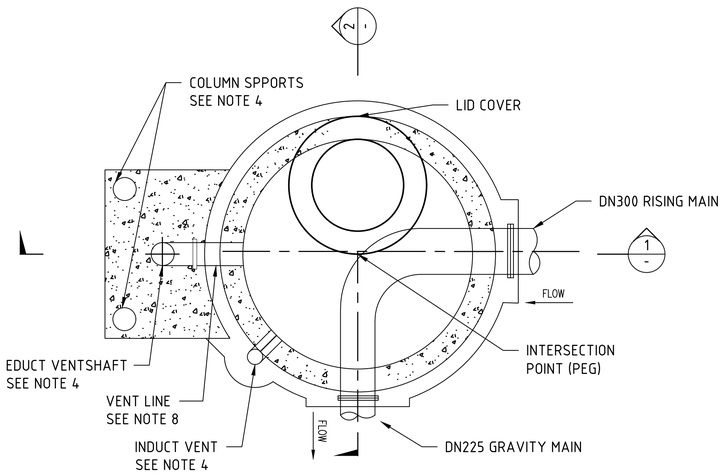
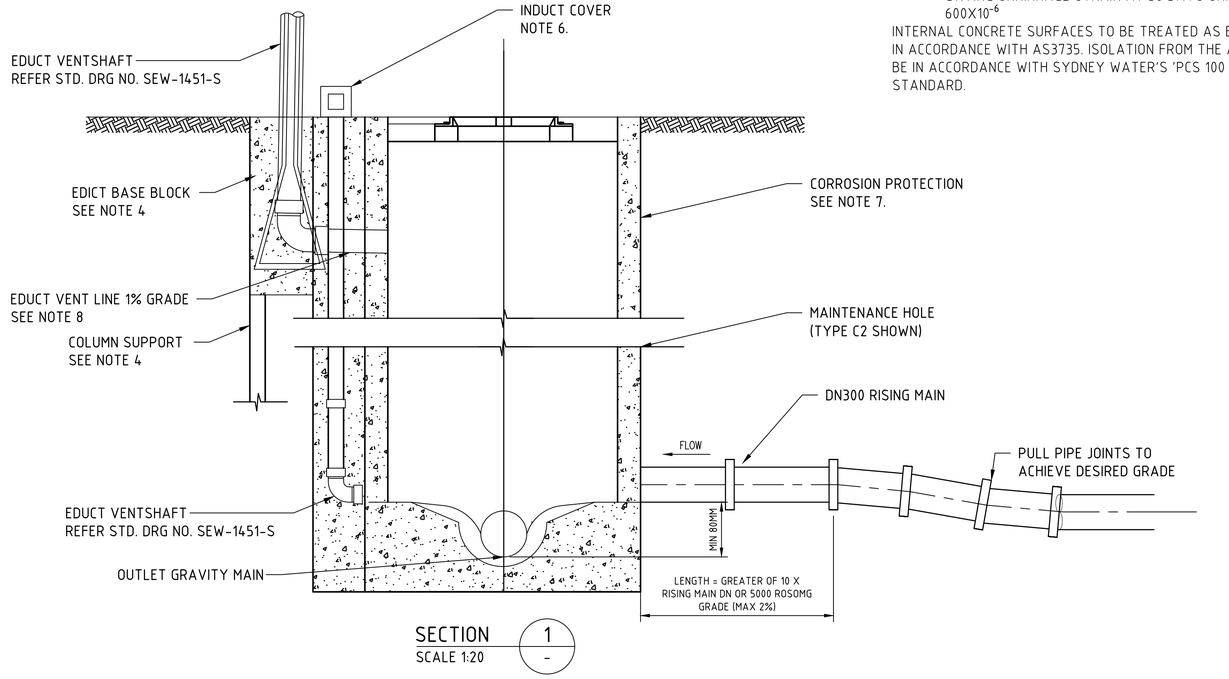
   - TOTAL SLAG CONTENT SHALL NOT BE MORE THAN 50% B WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL FLY ASH CONTENT SHALL NOT BE MORE THAN 25% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - MAXIMUM WATER/CEMENT RATIO SHALL NOT BE MORE THAN 0.45
   - DRYING SHRINKAGE STRAIN AT 56 DAYS SHALL NOT BE MORE THAN $600X10^{-6}$

   INTERNAL CONCRETE SURFACES TO BE TREATED AS EXPOSURE CLASSIFICATION 'D' IN ACCORDANCE WITH AS3735. ISOLATION FROM THE ATTACKING ENVIRONMENT TO BE IN ACCORDANCE WITH SYDNEY WATER'S 'PCS 100 - PROTECTIVE COATING STANDARD.



DN1500 DISCHARGE MAINTENANCE HOLE MH-20
PLAN
SCALE 1:20



SECTION 1
SCALE 1:20

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	MC	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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Ph 02 4429 3111
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

	SURVEYED:	DATE:	COMPANY:
	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	SMV	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM CONNECTION - PLAN AND SECTION
RM22 OUTLET - DN1500 DISCHARGE MH

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	127	1	B

100 mm on original

Plotted: 07/10/21 - 17:14 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-127.dwg

FOR CONNECTION DETAIL REFER TO DRAWING 25267-134

SNSM REPLACEMENT REFER TO DRAWING 24658-122 FOR DETAILS

EXISTING OD560 PE100 SDR11 PN16 SNSM

EXISTING DN300 AC SNSM TO BE ABANDONED

NEW OD560 PE100 SDR11 PN16 RISING MAIN

FOR NEW PUMP STATION DETAILS REFER TO DRAWING 25267-210

CONNECT TO THE NEW SEWER PUMP STATION VALVE PIT

25267-134

25267-133

25267-132

25267-131

SALISBURY DRIVE

TARRABA CRESCENT

GREENWELL POINT RD

WEST BROOK ROAD

OLD SOUTH RD

COORDINATE SETOUT TABLE - RISING MAIN - PACKAGE 1- SRM (MC01)			
PT	CHAINAGE	EASTING	NORTHING
IP 1	0.000	282307.075	6136607.744
IP 2	4.565	282307.747	6136612.259
IP 3	8.720	282311.086	6136614.732
IP 4	75.011	282376.655	6136604.978
IP 5	118.578	282383.074	6136648.071
IP 6	130.223	282394.627	6136646.615
IP 7	138.148	282395.495	6136654.492
IP 8	262.719	282388.486	6136778.865
IP 9	596.564	282189.604	6137047.004
IP 10	741.245	282126.773	6137177.330
IP 11	948.885	282002.664	6137343.797
IP 12	1039.978	281988.827	6137433.833
IP 13	1196.976	281968.814	6137589.551
IP 14	1202.228	281971.639	6137593.978
IP 15	1207.885	281970.419	6137599.502

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

1:2500 0 125 250m

PLAN
SCALE 1:2500

No.	REVISION DETAILS	DWN	DATE
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A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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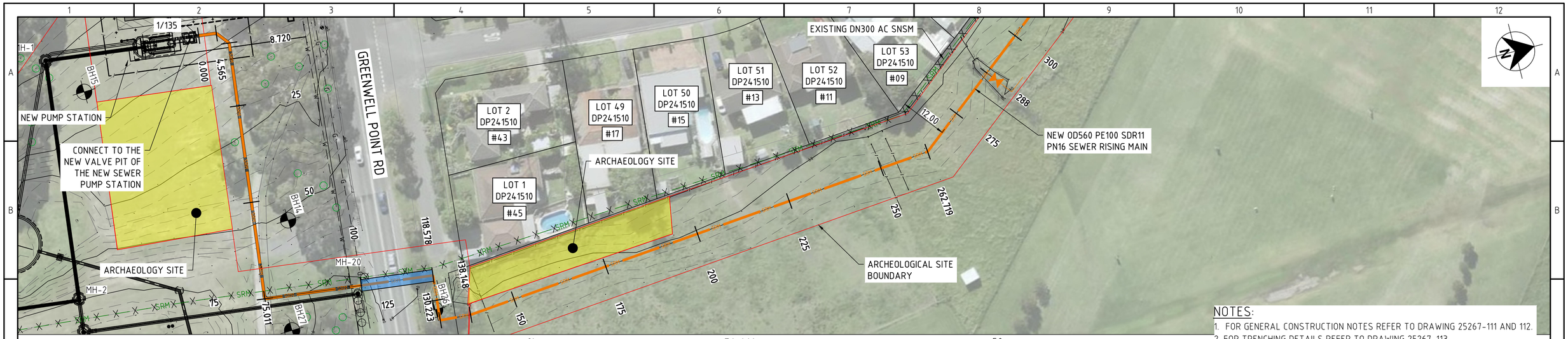
SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: SMV	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
KEY PLAN

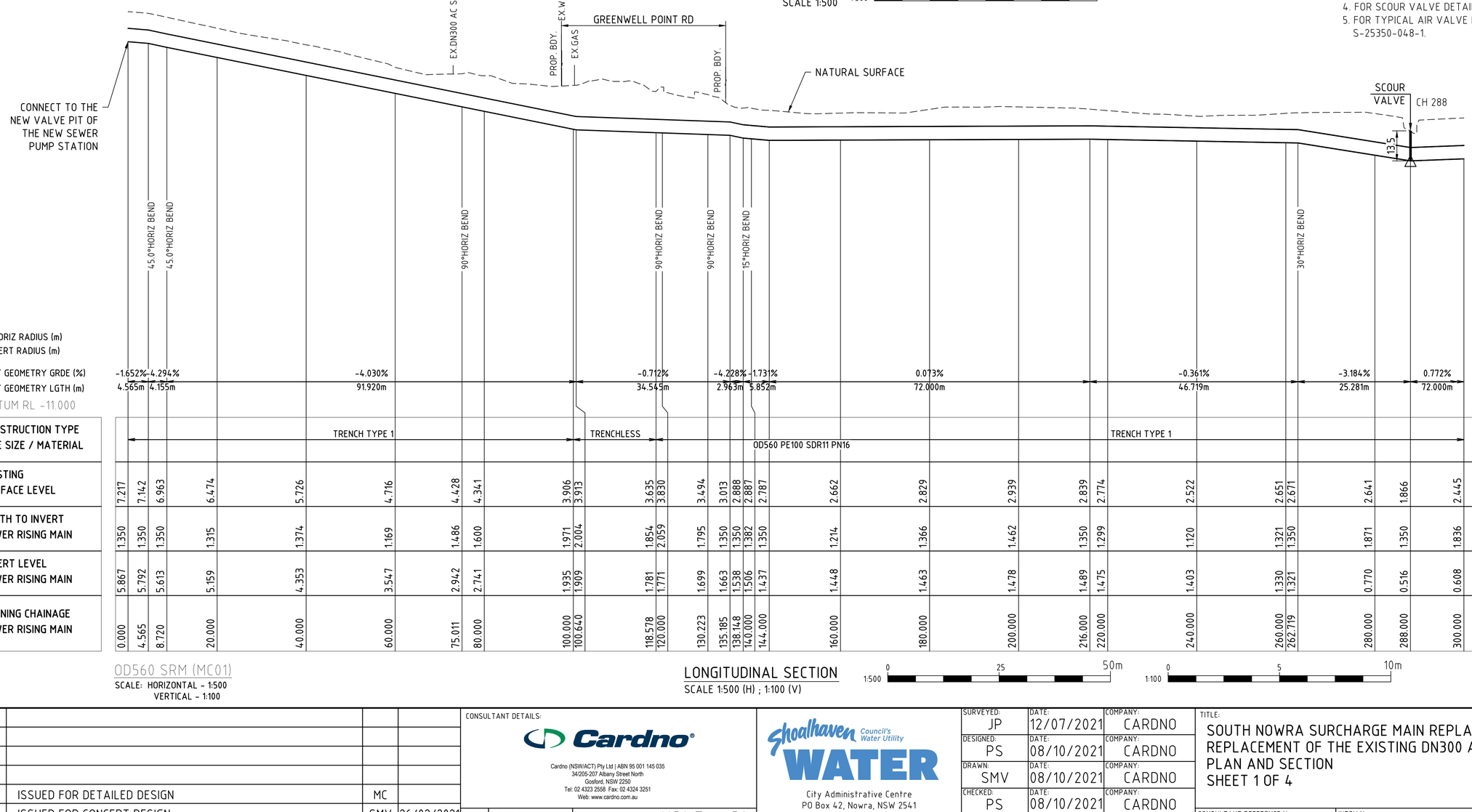
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	130	1	B

Plotted: 07/10/21 - 17:15 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-130.dwg



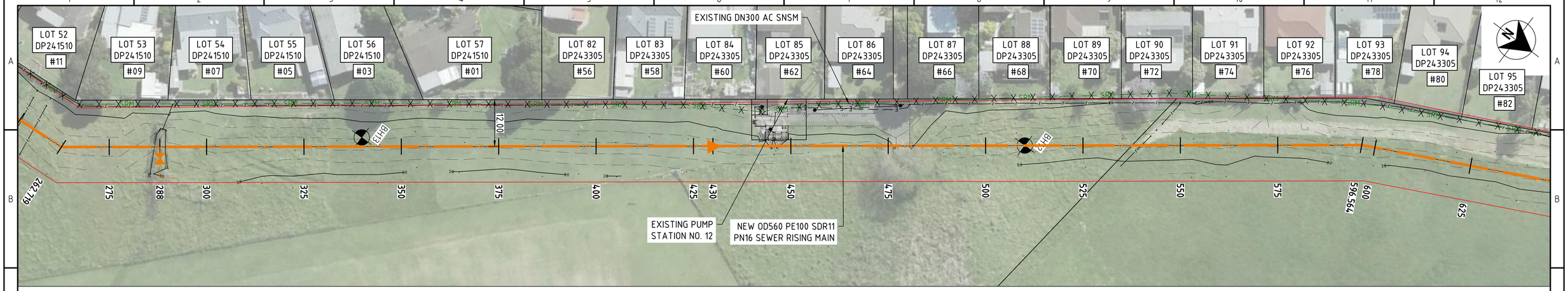
PLAN
SCALE 1:500 (1:500; 0, 25, 50m)

NOTES:
1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-111 AND 112.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-113.
3. FOR TRENCHLESS DETAILS REFER TO DRAWING 25267-114.
4. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
5. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDARD DRAWING S-25350-048-1.



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

| | | |



PLAN
SCALE 1:500

0 25 50m

NOTES:

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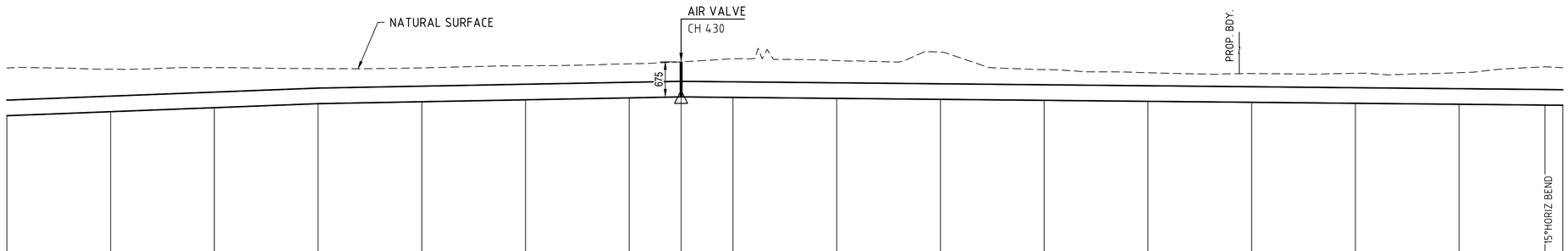
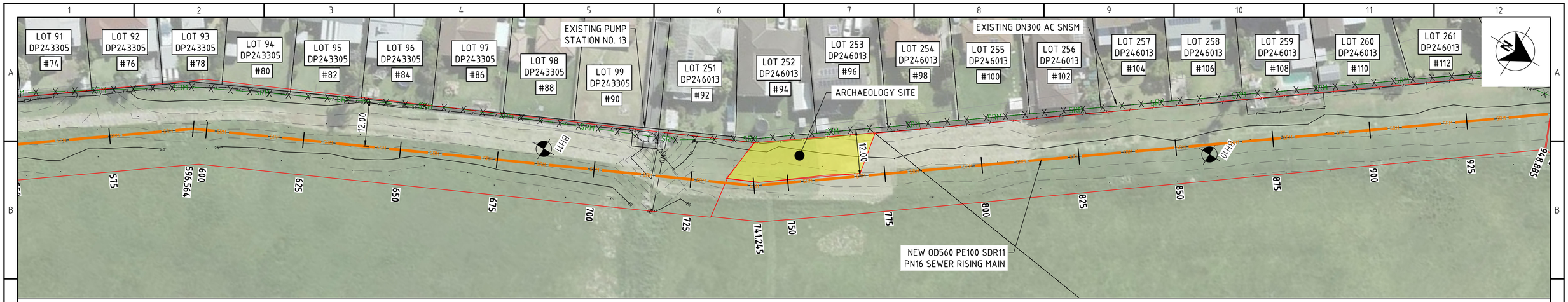
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-113.
3. FOR TRENCHLESS DETAILS REFER TO DRAWING 25267-114.
4. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
5. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDARD DRAWING S-25350-048-1.



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

| | | |



PLAN
SCALE 1:500

1:500 0 25 50m

NOTES:
1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-111 AND 112.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-113.
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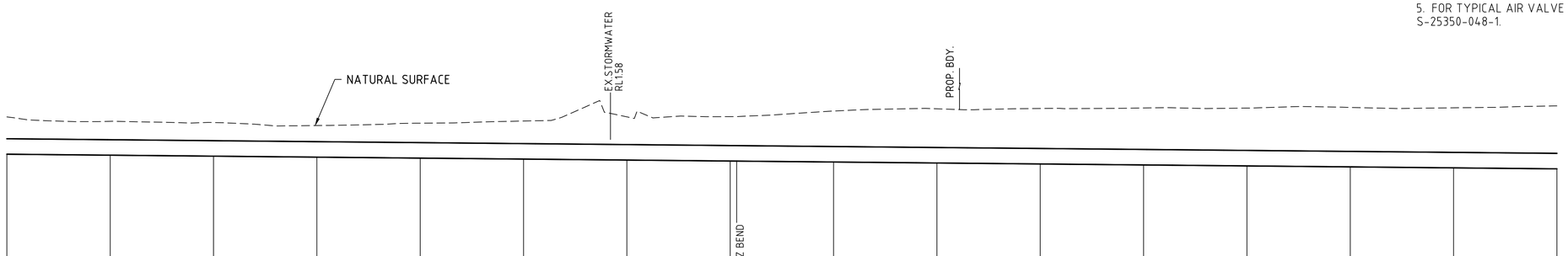
5. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDARD DRAWING S-25350-048-1.



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)
VERT GEOMETRY GRDE (%)
VERT GEOMETRY LGTH (m)
DATUM RL -11.000

TRENCH TYPE 1
OD560 PE100 SDR11 PN16

CONSTRUCTION TYPE PIPE SIZE / MATERIAL																				
EXISTING SURFACE LEVEL	2.456	2.287	2.239	2.122	2.214	2.297	2.458	2.467	2.467	2.684	2.771	2.783	2.803	2.799	2.821	2.809	2.884			
DEPTH TO INVERT SEWER RISING MAIN	1.445	1.314	1.304	1.225	1.354	1.475	1.674	1.721	1.724	1.975	2.101	2.150	2.208	2.242	2.302	2.327	2.440			
INVERT LEVEL SEWER RISING MAIN	1.011	0.973	0.935	0.897	0.860	0.822	0.784	0.746	0.744	0.708	0.671	0.633	0.595	0.557	0.519	0.482	0.444			
RUNNING CHAINAGE SEWER RISING MAIN	600.000	620.000	640.000	660.000	680.000	700.000	720.000	740.000	741.245	760.000	780.000	800.000	820.000	840.000	860.000	880.000	900.000			

OD560 SRM (MC01)
SCALE: HORIZONTAL - 1:500
VERTICAL - 1:100

LONGITUDINAL SECTION
SCALE 1:500 (H) ; 1:100 (V)

1:500 0 25 50m

1:100 0 5 10m

LEGEND - NEW SERVICES
- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES
- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

No.	REVISION DETAILS	DWN	DATE
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
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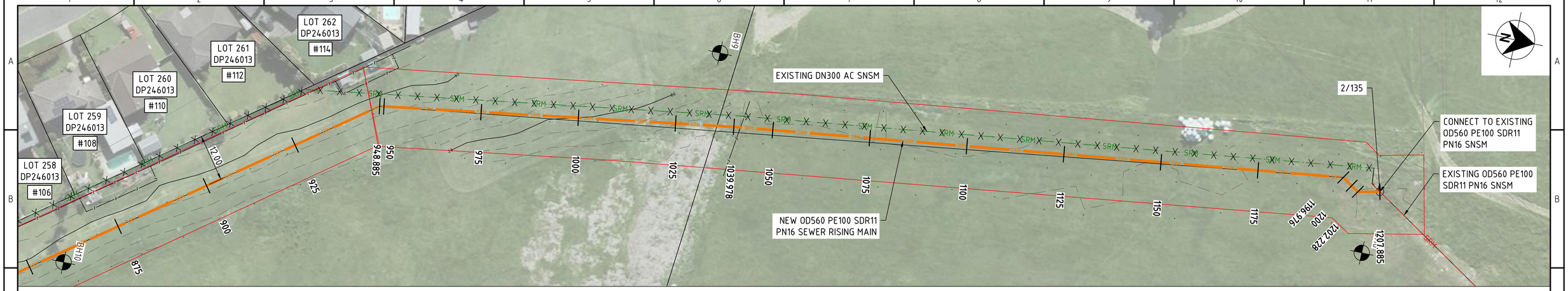
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
PLAN AND SECTION
SHEET 3 OF 4

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	133	3	B

100 mm on original

Plotted: 07/10/21 - 17:16 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-131-134.dwg

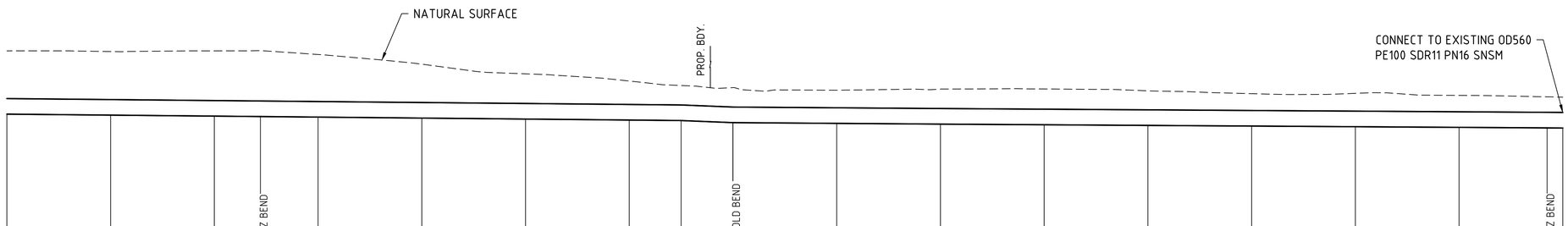


PLAN
SCALE 1:500

0 25 50m
1:500

NOTES:

1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-111 AND 112.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-113.
3. FOR TRENCHLESS DETAILS REFER TO DRAWING 25267-114.
4. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
5. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDARD DRAWING S-25350-048-1.



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

VERT GEOMETRY GRDE (%)					-0.189%					-0.814%		-0.143%				-0.125%							
VERT GEOMETRY LGTH (m)					600.000m					9.978m		40.022m				127.885m							
DATUM RL -12.000																							
CONSTRUCTION TYPE PIPE SIZE / MATERIAL	TRENCH TYPE 1 OD560 PE100 SDR11 PN16																						
EXISTING SURFACE LEVEL	2.884	2.858	2.884	2.896	2.744	2.372	1.999	1.721	1.548	1.467	1.467	1.368	1.410	1.415	1.343	1.234	1.246	1.167	1.113	1.099			
DEPTH TO INVERT SEWER RISING MAIN	2.440	2.452	2.516	2.544	2.414	2.079	1.744	1.504	1.350	1.350	1.350	1.280	1.350	1.380	1.334	1.249	1.286	1.232	1.199	1.189			
INVERT LEVEL SEWER RISING MAIN	0.444	0.406	0.368	0.351	0.330	0.293	0.255	0.217	0.198	0.117	0.117	0.088	0.060	0.035	0.010	-0.015	-0.040	-0.065	-0.086	-0.090			
RUNNING CHAINAGE SEWER RISING MAIN	900.000	920.000	940.000	948.885	960.000	980.000	1000.000	1020.000	1030.000	1039.978	1040.000	1060.000	1080.000	1100.000	1120.000	1140.000	1160.000	1180.000	1196.976	1200.000			

OD560 SRM (MC01)
SCALE: HORIZONTAL - 1:500
VERTICAL - 1:100

LONGITUDINAL SECTION
SCALE 1:500 (H) ; 1:100 (V)

0 25 50m
1:500

0 5 10m
1:100

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

No.	REVISION DETAILS	DWN	DATE
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Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: SMV	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

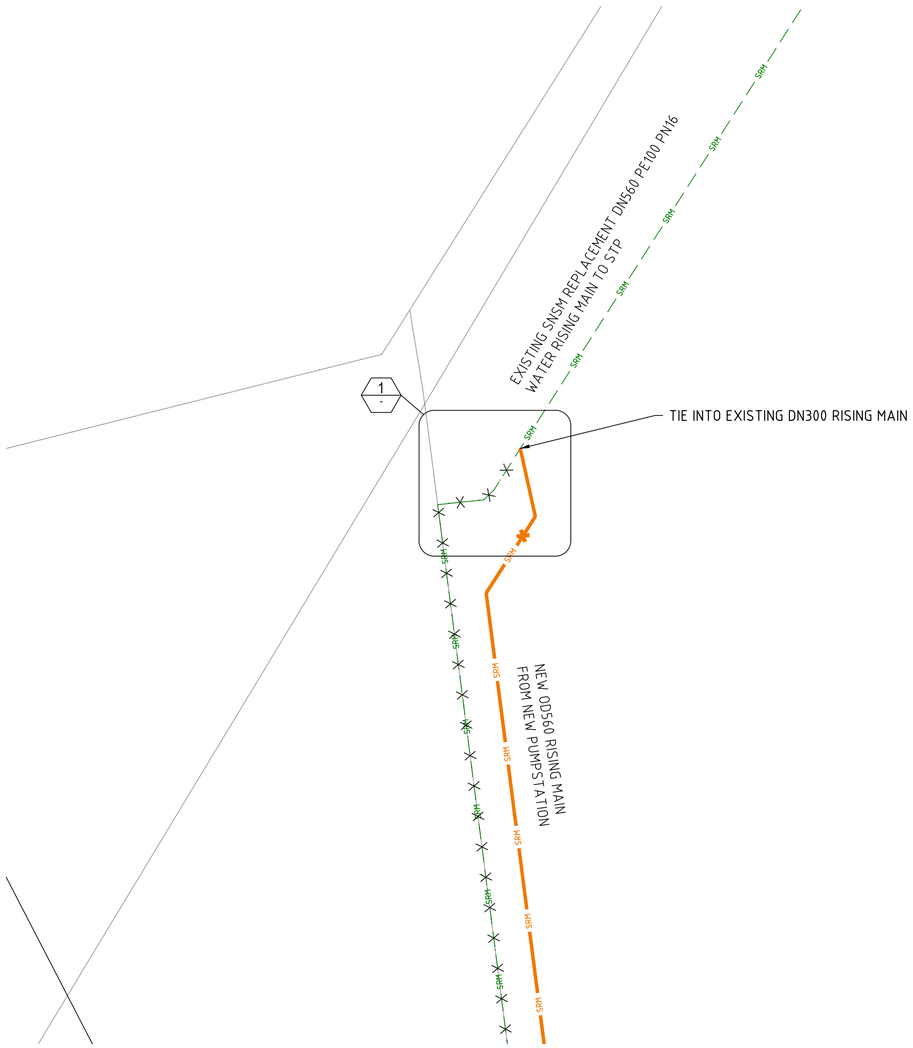
SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
PLAN AND SECTION
SHEET 4 OF 4

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	134	4	B

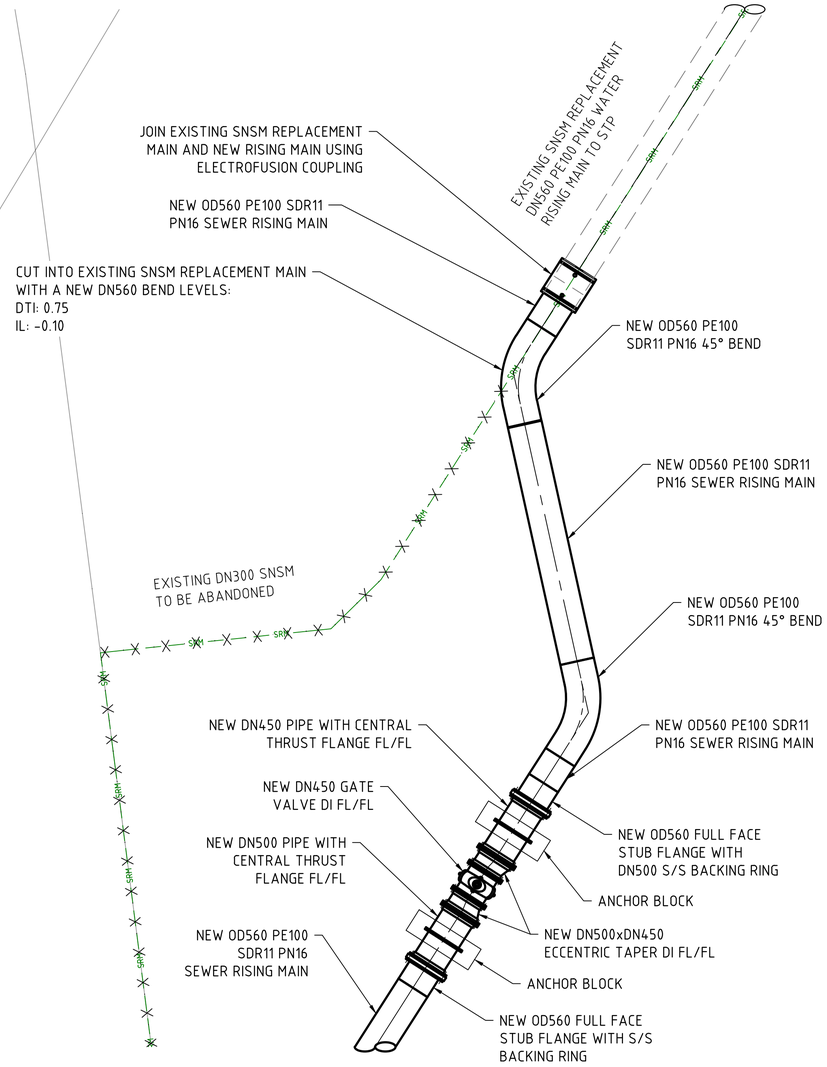
100 mm on original

Plotted: 07/10/21 - 17:16 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-131-134.dwg



PLAN
SCALE 1:500

0 25 50m
1:500



CONNECTION DETAIL 1
SCALE 1:50

0 2.5 5m
1:50

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED
- PROPERTY BOUNDARY

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- EXISTING FENCE
- ARCHAEOLOGY SITE
- EXISTING MANHOLE
- EXISTING TREE

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	MC	
A	ISSUED FOR CONCEPT NEW	SMV	26/02/2021

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

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SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
NEWED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: SMV	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

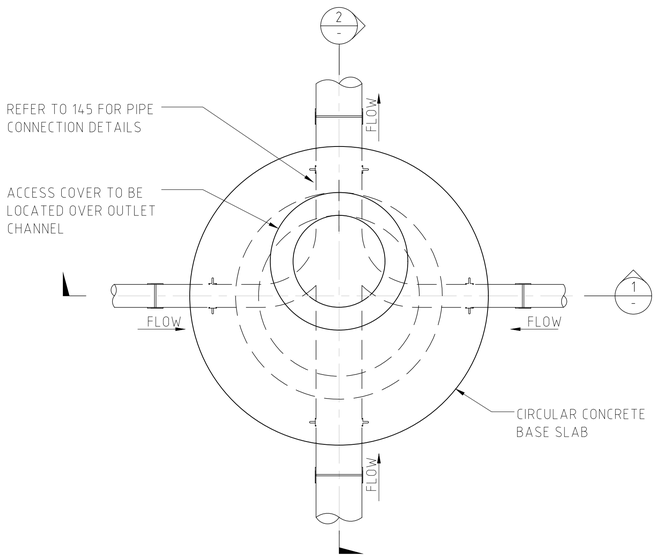
SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
CONNECTION DETAILS - PLAN AND SECTION
DN560 UPSTREAM CONNECTION

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	135	1	B

100 mm on original

Plotted: 08/10/21 - 09:18 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-135.dwg



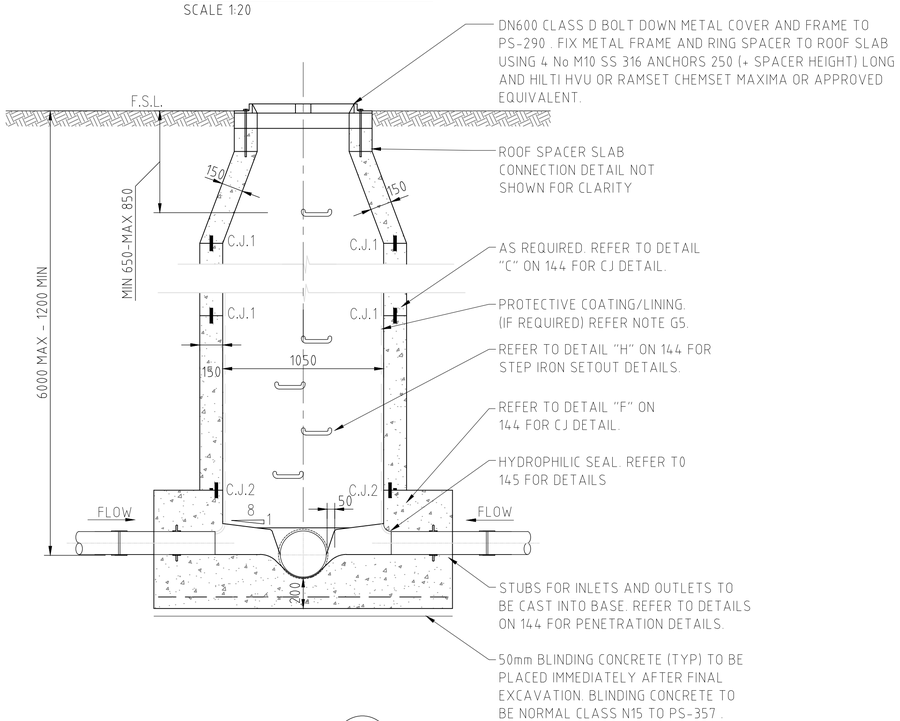
MAINTENANCE HOLE - PLAN

SCALE 1:20

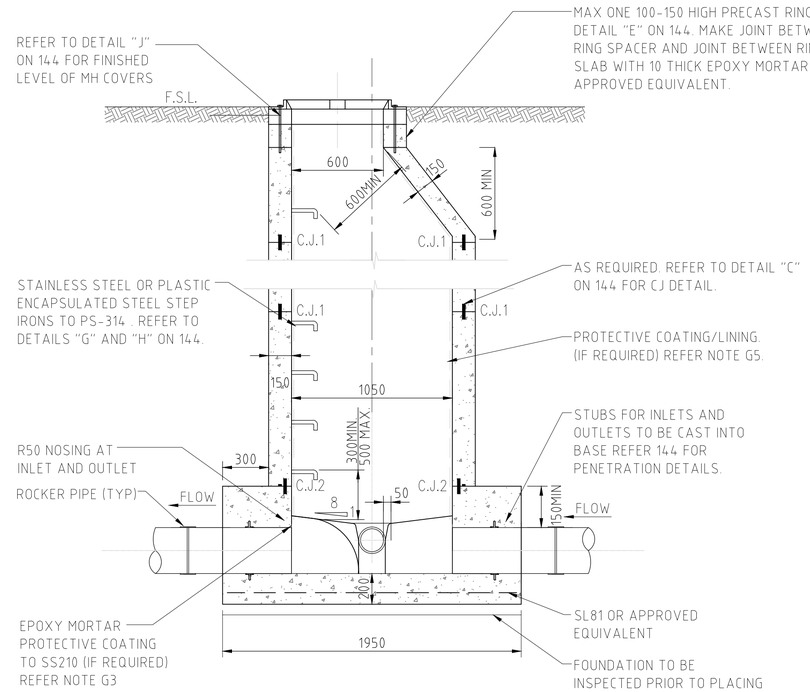
NOTES:

1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - A. 112 MAINTENANCE HOLES CONSTRUCTION NOTES.
   - B. 144 STANDARD DETAILS PLAN
   - C. 145 CONNECTION DETAILS PLAN
   - D. 146 TYPICAL CHANNEL ARRANGEMENTS PLAN
2. NUMBER, SIZE, LOCATION AND LEVEL OF INLETS AND OUTLETS ARE INDICATIVE ONLY.
3. THE DESIGN MAY ONLY BE USED IN AREAS OUTSIDE THE ROAD CARRIAGEWAY.
4. THE DESIGN IS NOT SUITABLE FOR AREAS WHERE THE GROUND SLOPE IS GREATER THAN 1V:8H OR AREAS WHERE UNBALANCED LOADS ARE EXPECTED. THE MAINTENANCE HOLE SHALL BE LOCATED OUTSIDE ZONE OF INFLUENCE OF OTHER STRUCTURES.
5. ALL INTERNAL SURFACES (EXCLUDING BENCHING) OF MAINTENANCE HOLES AT THE DISCHARGE OF PUMPED FLOWS AND THE NEXT TWO MAINTENANCE HOLES DOWNSTREAM OF A PUMPED DISCHARGE SHALL BE PROVIDED WITH A PROTECTIVE COATING/LINING IN ACCORDANCE WITH STANDARD SPECIFICATION SS210 AS INDICATED.

ROCKER PIPE DIMENSIONS		
SIZE (DN)	"L" MIN	"L" MAX
150	300	450
225	450	650
300	600	900



SECTION 1 - SCALE 1:20



SECTION 2 - SCALE 1:20

1050 CIRCULAR MAINTENANCE HOLE

1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:

Cardno

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
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Shoalhaven Council's Water Utility WATER

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		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	HH	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

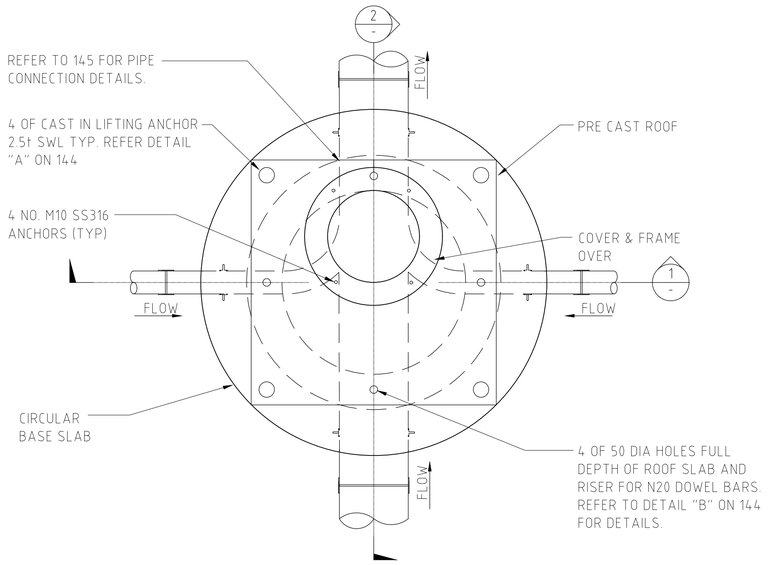
TITLE:

SOUTH NOWRA SURCHARGE MAIN REPLACEMENT REPLACEMENT OF THE EXISTING DN300 AC SNSM DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN

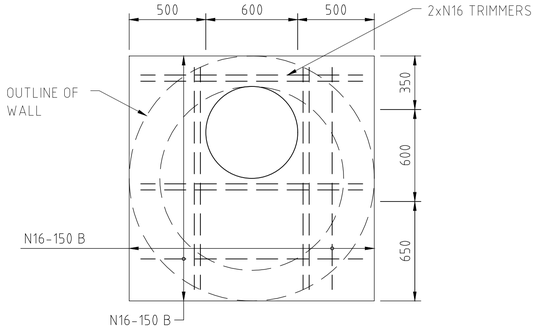
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	140	1	A

100 mm on original

Plotted: 08/10/21 - 09:29 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-140.dwg



MAINTENANCE HOLE - PLAN
SCALE 1:20



ALL REINFORCEMENT N16-150 TYP. U.N.O

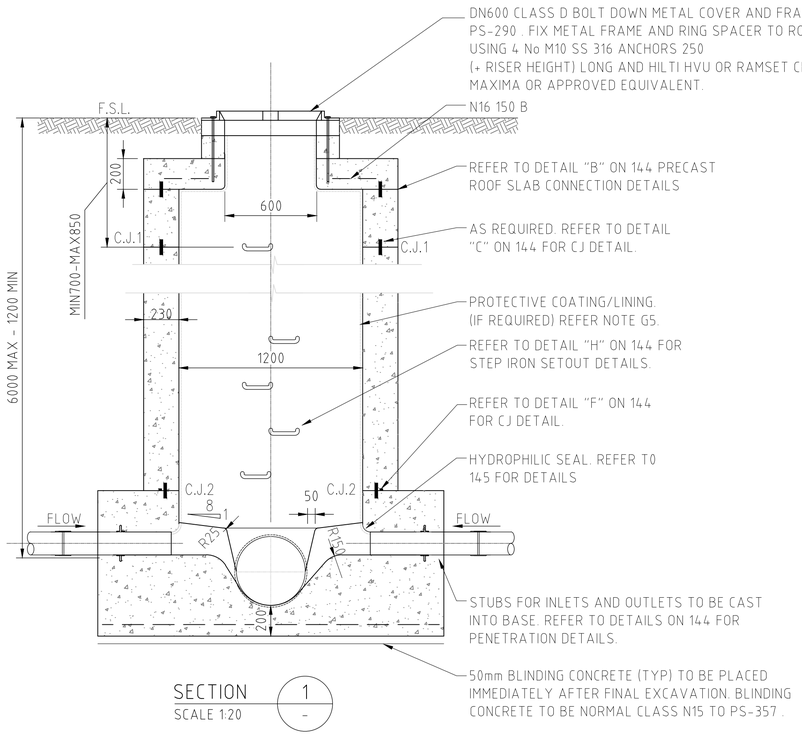
PRECAST ROOF - REINFORCEMENT
SCALE 1:20

NOTES:

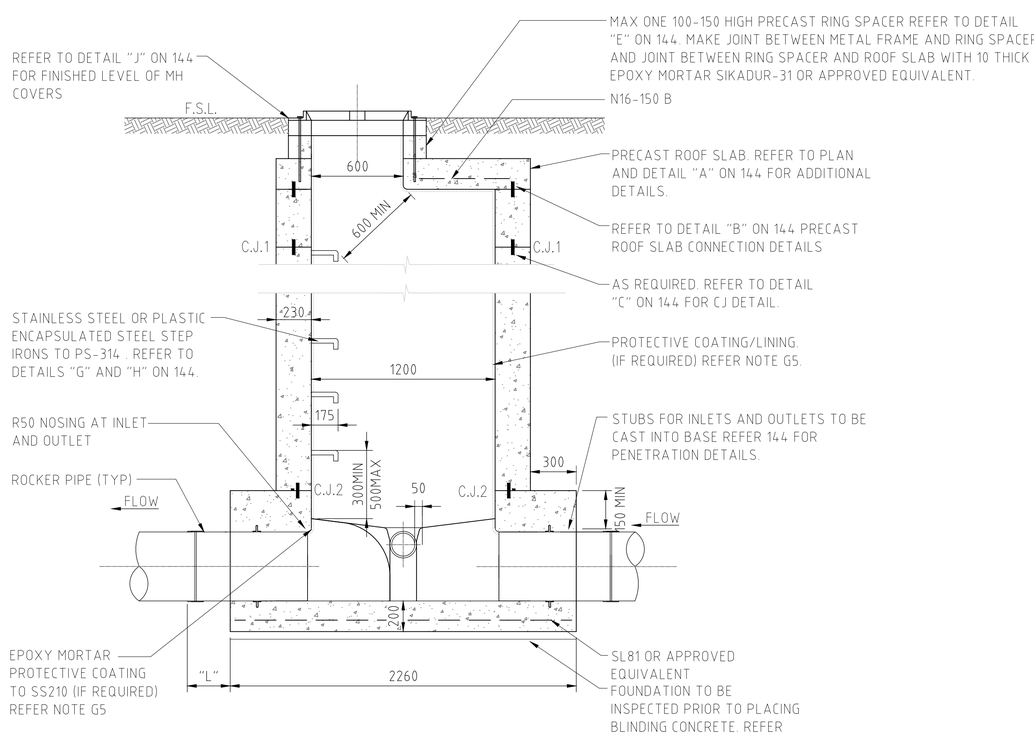
1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:
   A. 112 MAINTENANCE HOLES CONSTRUCTION NOTES.
   B. 144 STANDARD DETAILS PLAN
   C. 145 CONNECTION DETAILS PLAN
   D. 146 TYPICAL CHANNEL ARRANGEMENTS PLAN
   E. 147 DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS
2. NUMBER, SIZE, LOCATION AND LEVEL OF INLETS AND OUTLETS ARE INDICATIVE ONLY.
3. THE DESIGN MAY ONLY BE USED IN AREAS OUTSIDE THE ROAD CARRIAGEWAY.
4. THE DESIGN IS NOT SUITABLE FOR AREAS WHERE THE GROUND SLOPE IS GREATER THAN 1V:8H OR AREAS WHERE UNBALANCED LOADS ARE EXPECTED. THE MAINTENANCE HOLE SHALL BE LOCATED OUTSIDE ZONE OF INFLUENCE OF OTHER STRUCTURES.
5. ALL INTERNAL SURFACES (EXCLUDING BENCHING) OF MAINTENANCE HOLES AT THE DISCHARGE OF PUMPED FLOWS AND THE NEXT TWO MAINTENANCE HOLES DOWNSTREAM OF A PUMPED DISCHARGE SHALL BE PROVIDED WITH A PROTECTIVE COATING/LINING IN ACCORDANCE WITH STANDARD SPECIFICATION SS210 AS INDICATED.
6. ALL MAINTENANCE HOLES ON SEWERS OF SIZE DN375 AND DN450 SHALL BE PROTECTED IN ACCORDANCE WITH SS210

ROCKER PIPE DIMENSIONS

SIZE (DN)	"L" MIN	"L" MAX
150	300	450
225	450	650
300	600	900
375	750	1125
450	900	1350



SECTION 1
SCALE 1:20



SECTION 2
SCALE 1:20

1200 CIRCULAR MAINTENANCE HOLE

1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

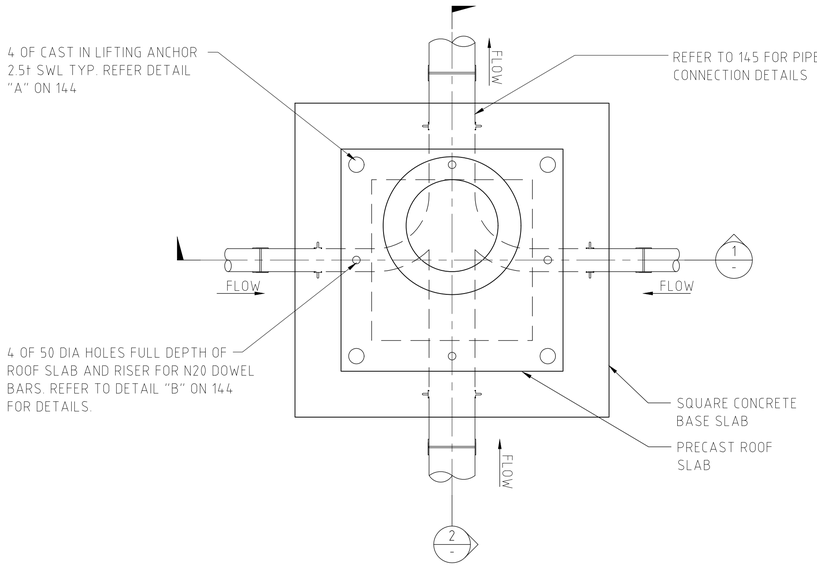
		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	HH	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
DN1200 CAST IN-SITU CIRCULAR
MAINTENANCE HOLE DETAILS PLAN

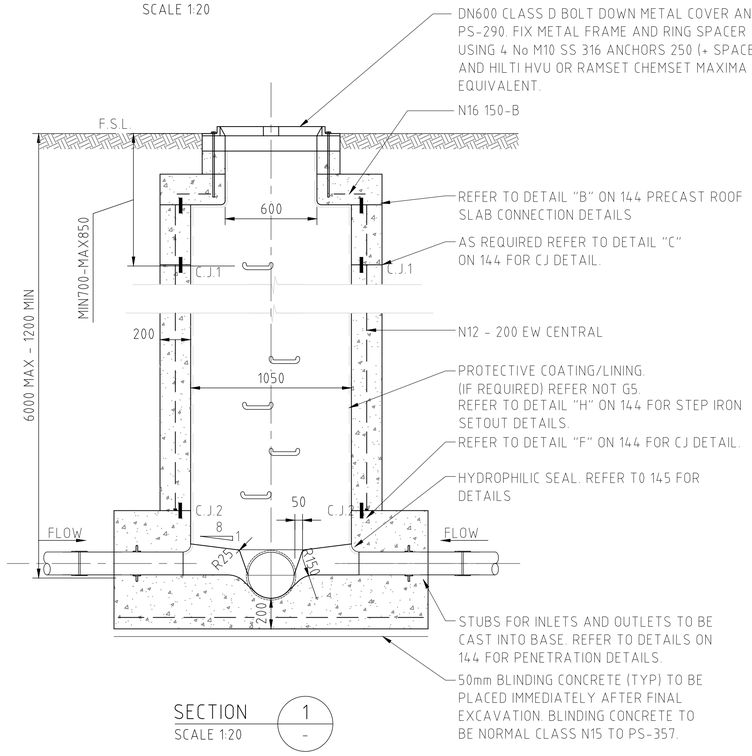
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	141	1	A

Plotted: 08/10/21 - 09:28 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-141.dwg

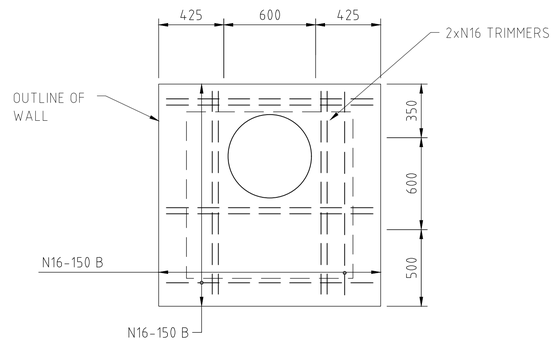
100 mm on original



MAINTENANCE HOLE - PLAN
SCALE 1:20



SECTION 1 / -
SCALE 1:20



ALL REINFORCEMENT N16-150 TYP. U.N.O

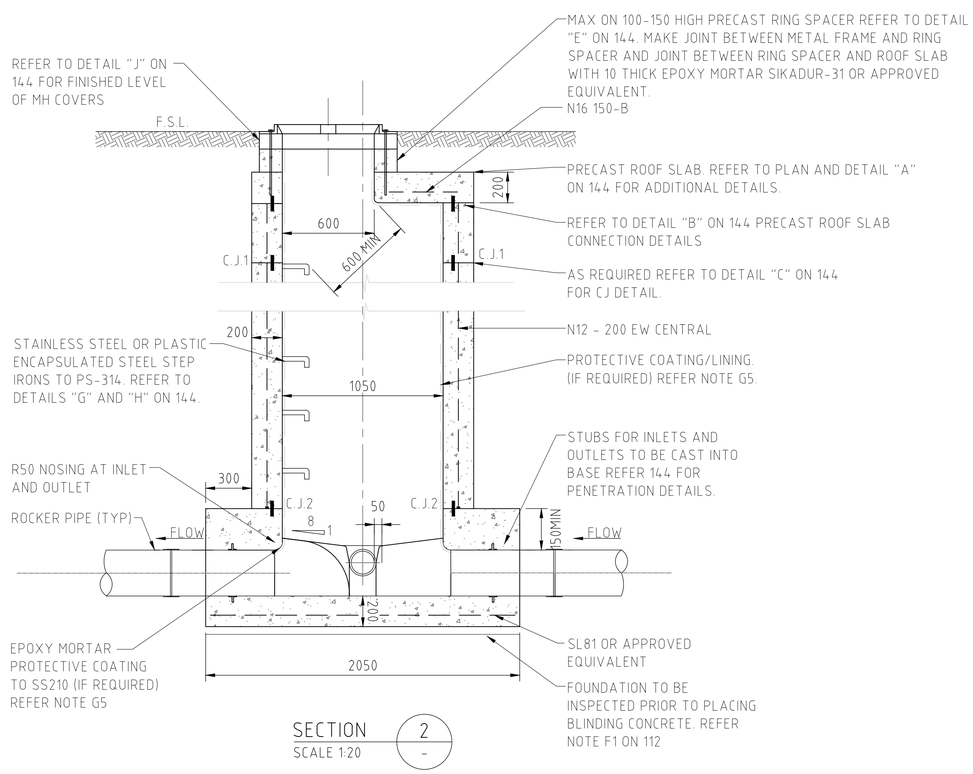
PRECAST ROOF - REINFORCEMENT
SCALE 1:20

NOTES:

1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - A. 112 MAINTENANCE HOLES CONSTRUCTION NOTES.
   - B. 144 STANDARD DETAILS PLAN
   - C. 145 CONNECTION DETAILS PLAN
   - D. 146 TYPICAL CHANNEL ARRANGEMENTS PLAN
   - E. 147 DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS
2. NUMBER, SIZE, LOCATION AND LEVEL OF INLETS AND OUTLETS ARE INDICATIVE ONLY.
3. THE DESIGN MAY ONLY BE USED IN AREAS OUTSIDE THE ROAD CARRIAGEWAY.
4. THE DESIGN IS NOT SUITABLE FOR AREAS WHERE THE GROUND SLOPE IS GREATER THAN 1V:8H OR AREAS WHERE UNBALANCED LOADS ARE EXPECTED. THE MAINTENANCE HOLE SHALL BE LOCATED OUTSIDE ZONE OF INFLUENCE OF OTHER STRUCTURES.
5. ALL INTERNAL SURFACES (EXCLUDING BENCHING) OF MAINTENANCE HOLES AT THE DISCHARGE OF PUMPED FLOWS AND THE NEXT TWO MAINTENANCE HOLES DOWNSTREAM OF A PUMPED DISCHARGE SHALL BE PROVIDED WITH A PROTECTIVE COATING/LINING IN ACCORDANCE WITH STANDARD SPECIFICATION SS210 AS INDICATED.

ROCKER PIPE DIMENSIONS

SIZE (DN)	"L" MIN	"L" MAX
150	300	450
225	450	650
300	600	900



SECTION 2 / -
SCALE 1:20

1050 SQUARE MAINTENANCE HOLE

1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
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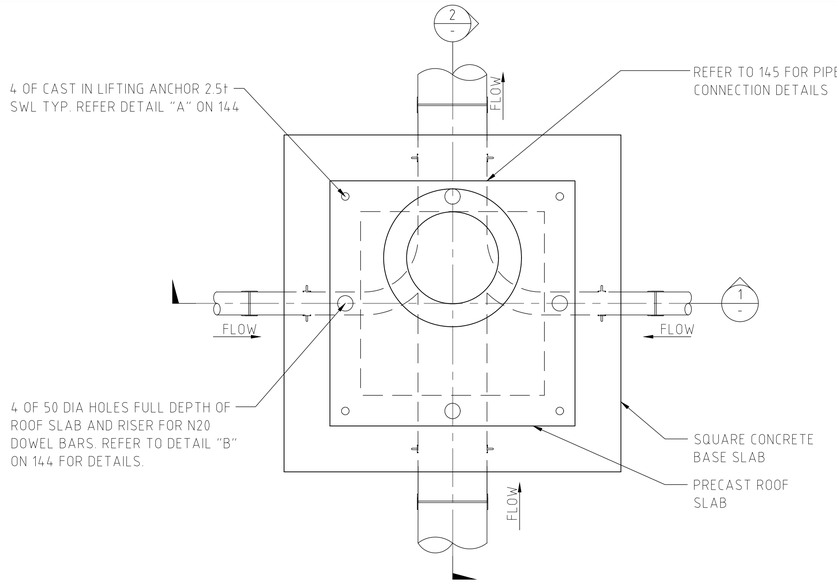
		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	HH	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

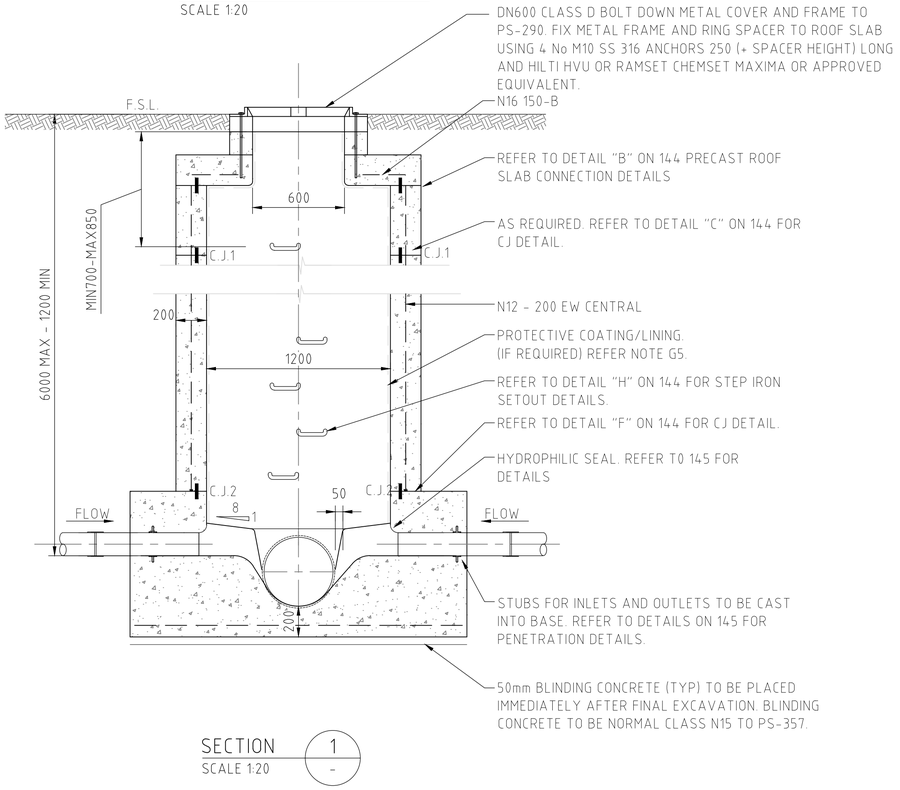
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
DN1050 CAST IN-SITU SQUARE
MAINTENANCE HOLE DETAILS PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	142	1	A

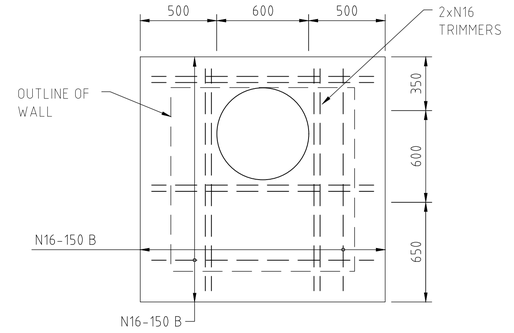


MAINTENANCE HOLE - PLAN

SCALE 1:20



SECTION 1 / SCALE 1:20



ALL REINFORCEMENT N16-150 TYP. U.N.O

PRECAST ROOF - REINFORCEMENT

SCALE 1:20

NOTES:

1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:
   - A. 112 MAINTENANCE HOLES CONSTRUCTION NOTES.
   - B. 144 STANDARD DETAILS PLAN
   - C. 145 CONNECTION DETAILS PLAN
   - D. 146 TYPICAL CHANNEL ARRANGEMENTS PLAN
   - E. 147 DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS
2. NUMBER, SIZE, LOCATION AND LEVEL OF INLETS AND OUTLETS ARE INDICATIVE ONLY.
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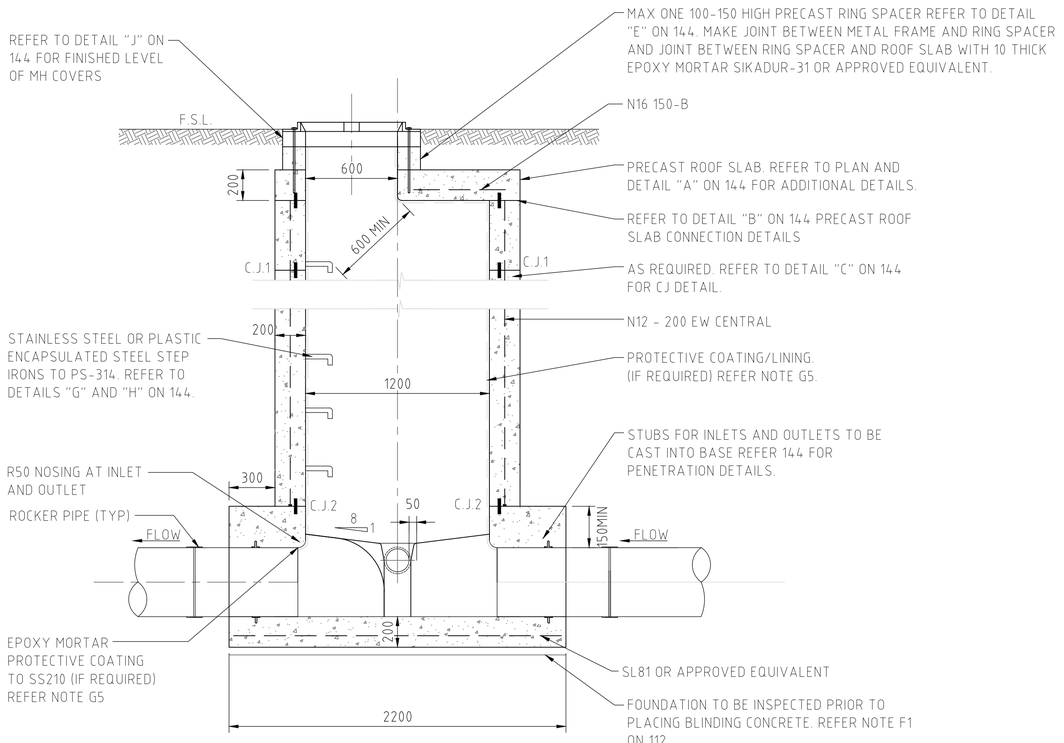
5. ALL INTERNAL SURFACES (EXCLUDING BENCHING) OF MAINTENANCE HOLES AT THE DISCHARGE OF PUMPED FLOWS AND THE NEXT TWO MAINTENANCE HOLES DOWNSTREAM OF A PUMPED DISCHARGE SHALL BE PROVIDED WITH A PROTECTIVE COATING/LINING IN ACCORDANCE WITH STANDARD SPECIFICATION SS210 AS INDICATED.
6. ALL MAINTENANCE HOLES ON SEWERS OF SIZE DN375 AND DN450 SHALL BE PROTECTED IN ACCORDANCE WITH SS210

ROCKER PIPE DIMENSIONS		
SIZE (DN)	"L" MIN	"L" MAX
150	300	450
225	450	650
300	600	900
375	750	1125
450	900	1350



SECTION 2 / SCALE 1:20

1200 SQUARE MAINTENANCE HOLE

1:20 — 0 — 1000 — 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
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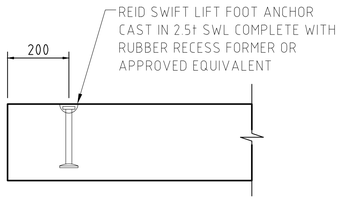
	SURVEYED:	DATE:	COMPANY:
	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	BC	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
DN1200 CAST IN-SITU SQUARE
MAINTENANCE HOLE DETAILS PLAN

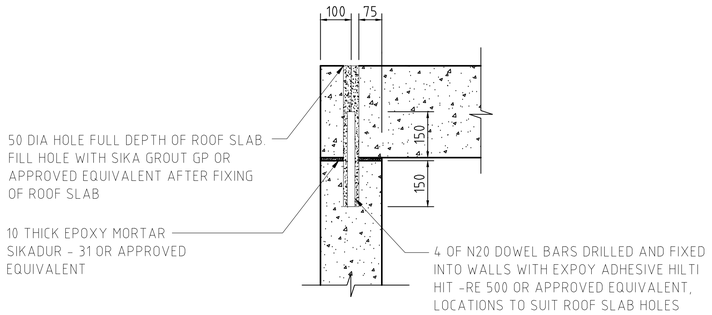
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	143	1	A

Plotted: 08/10/21 - 09:31 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-143.dwg

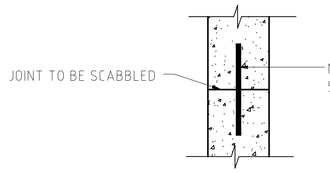


NOTES:
- PRECAST CONCRETE ROOF PANEL TO HAVE A MINIMUM STRENGTH OF 25MPa AT LIFTING.
- SPREADER BARS MUST BE USED DURING LIFTING TO ENSURE LIFT FORCE IS VERTICAL

DETAIL "A"
PRECAST ROOF CASTING DETAIL
SCALE 1:10



DETAIL "B"
PRECAST ROOF CONNECTION DETAIL
SCALE 1:10



NOTES:
- DOWELS TO START 100mm FROM CORNERS

DETAIL "C"
CONSTRUCTION JOINT DETAIL (C.J.1)
SCALE 1:10

NOTES:

1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:

A.112	MAINTENANCE HOLES CONSTRUCTION NOTES
B.140	DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
C.141	DN1200 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
D.142	DN1050 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
E.143	DN1200 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
F.144	STANDARD DETAILS PLAN
G.145	CONNECTION DETAILS PLAN
H.147	DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS

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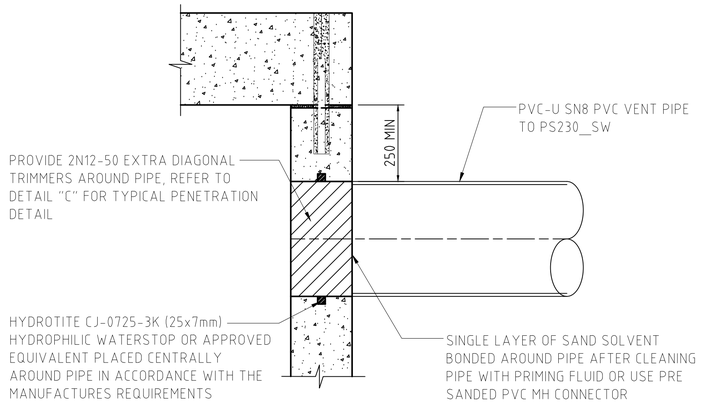
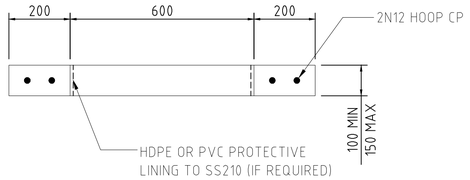
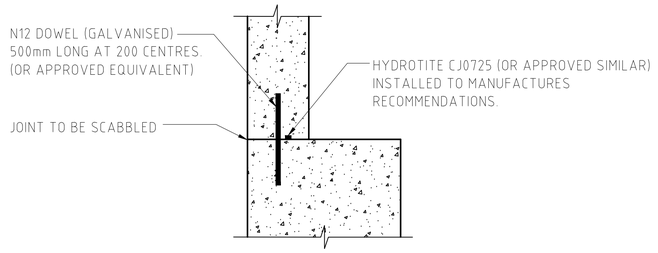


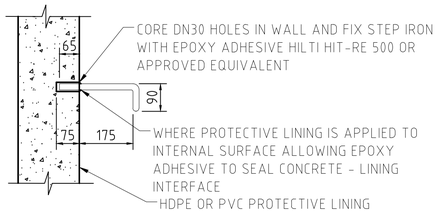
DETAIL "D"
VENT PIPE PENETRATION DETAIL
SCALE 1:10



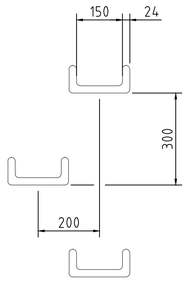
DETAIL "E"
PRECAST RING SPACER DETAIL
SCALE 1:10



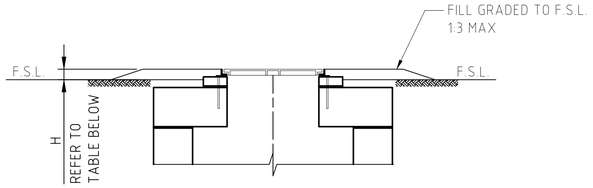
DETAIL "F"
CONSTRUCTION JOINT DETAIL (C.J.2)
SCALE 1:10



DETAIL "G"
STEP IRON FIXING DETAIL
SCALE 1:10

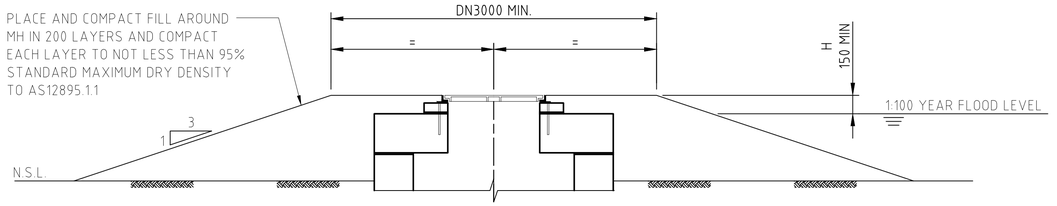


DETAIL "H"
STEP IRON SET OUT DETAIL
SCALE 1:10

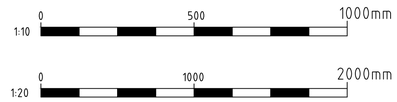


FINISHED LEVELS OF MH COVERS	
LOCATION DESCRIPTION	H
UNDEVELOPED AREAS	100
ROADS, LANEWAYS, FOOTWAYS, AND DRIVEWAYS	FLUSH
FLOOD PRONE AREAS (REFER TO DETAIL "K")	150

DETAIL "J"
FINISHED LEVELS ON M.H. COVERS
SCALE 1:20



DETAIL "K"
M.H. IN FLOOD PRONE AREAS
SCALE 1:20



No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

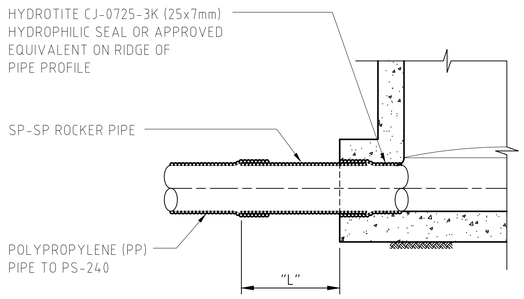
Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	BC	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

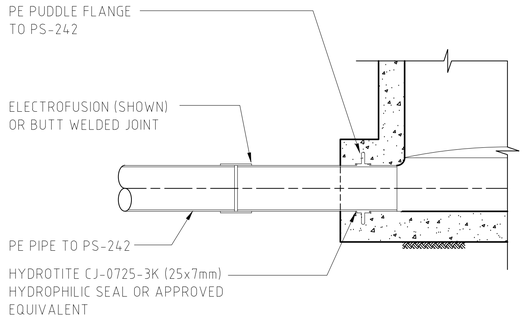
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT REPLACEMENT OF THE EXISTING DN300 AC SNSM STANDARD DETAILS PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	144	1	A

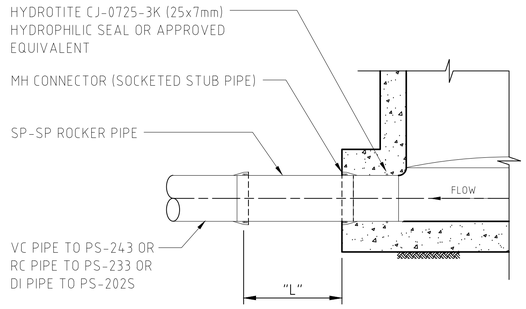
Plotted: 08/10/21 - 09:33 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-144.dwg



CONNECTION PROFILE WALL PP
SCALE 1:20



CONNECTION PE-PE
SCALE 1:20



TYPICAL MH BASE FOR VC, RC & DI SOCKETED PIPE
SCALE 1:20

NOTES:

1. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:

A.112	MAINTENANCE HOLES CONSTRUCTION NOTES
B.140	DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
C.141	DN1200 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
D.142	DN1050 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
E.143	DN1200 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
F.144	STANDARD DETAILS PLAN
G.145	CONNECTION DETAILS PLAN
H.147	DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS

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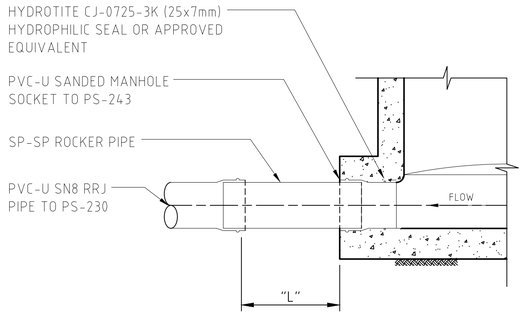
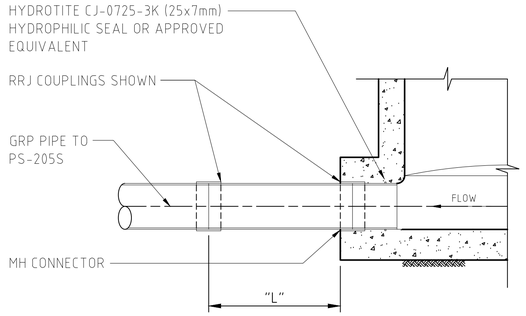
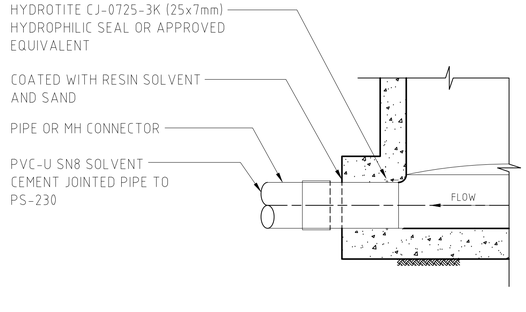
ROCKER PIPE DIMENSION		
SIZE (DN)	"L" MIN	"L" MAX
150	300	450
225	450	675
300	600	900
375	750	1125
450	900	1350
525	1050	1575
600	1200	1800
750	1500	2250



TYPICAL MH BASE FOR RUBBER RING JOINED PVC
SCALE 1:20



TYPICAL MH BASE FOR GRP SLEEVE COUPLED PIPE
SCALE 1:20



TYPICAL MH BASE FOR SOLVENT CEMENT JOINTED PIPE
SCALE 1:20

1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

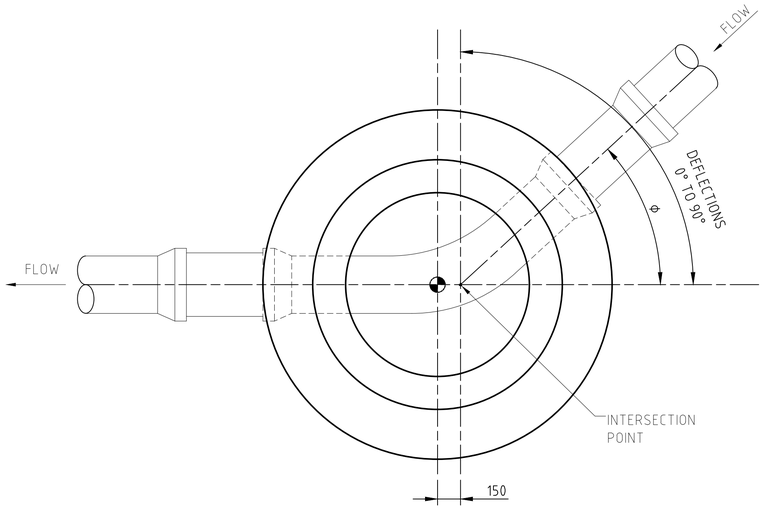
Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

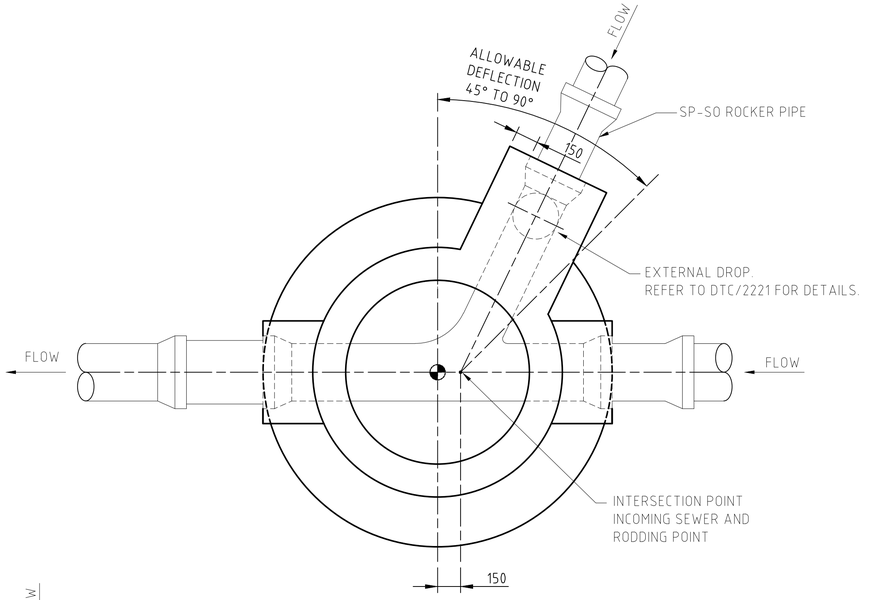
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
CONNECTION DETAILS PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	145	1	A

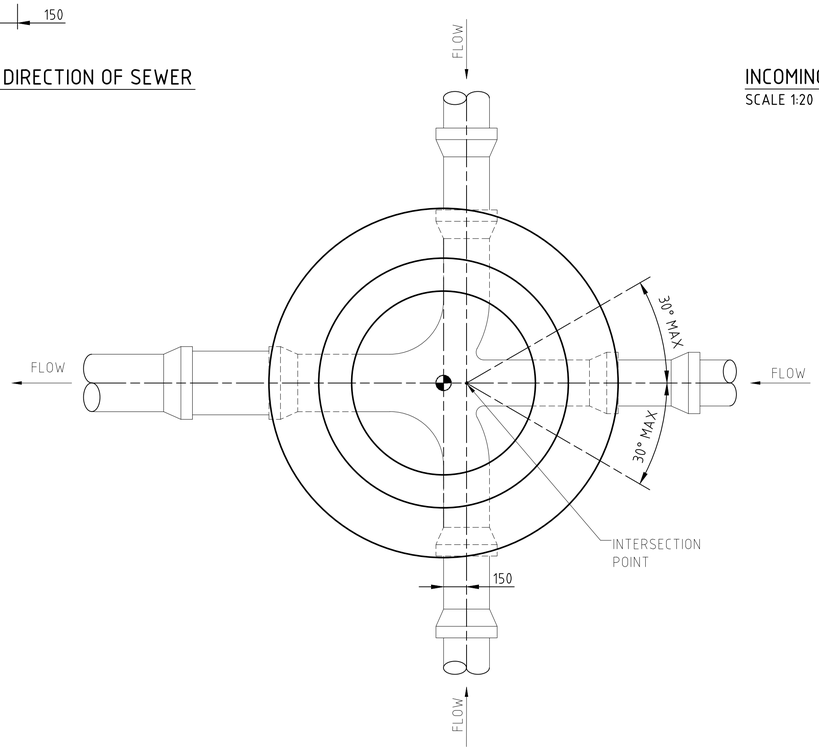
Plotted: 08/10/21 - 09:34 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-145.dwg



CHANGE IN DIRECTION OF SEWER
SCALE 1:20



INCOMING SEWERS HAVING EXTERNAL DROP
SCALE 1:20



MULTIPLE INCOMING SEWERS
SCALE 1:20

NOTES:

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A.112	MAINTENANCE HOLES CONSTRUCTION NOTES
B.140	DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
C.141	DN1200 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
D.142	DN1050 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
E.143	DN1200 CAST IN-SITU SQUARE MAINTENANCE HOLE DETAILS PLAN
F.144	STANDARD DETAILS PLAN
G.145	CONNECTION DETAILS PLAN
H.147	DN1200 CAST IN-SITU FLOW GAUGING CHANNEL DETAILS

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VERTICAL DROP	
DEFLECTION Ø°	FALL ACROSS MH (mm)
0≤ Ø≤30	30
0<Ø ≤60	50
60<Ø≤90	80

LEGEND

INTERSECTION POINT OF SEWERS

CENTER LINE OF M.H.

1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:

Cardno

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34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility WATER

City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

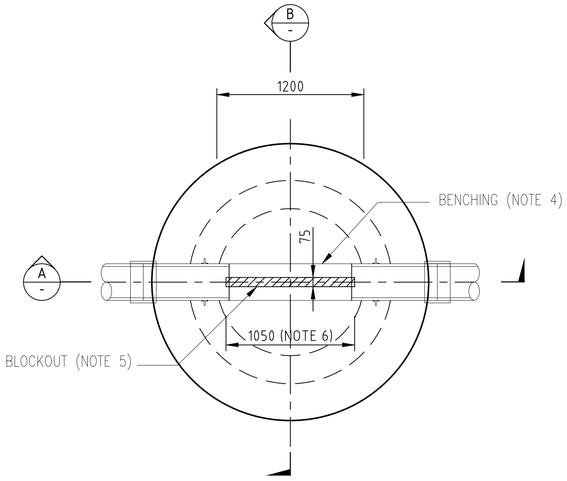
		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	08/10/2021	CARDNO
DRAWN:	HH	08/10/2021	CARDNO
CHECKED:	PS	08/10/2021	CARDNO
APPROVED:	NM	08/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
TYPICAL CHANNEL ARRANGEMENTS DETAILS PLAN

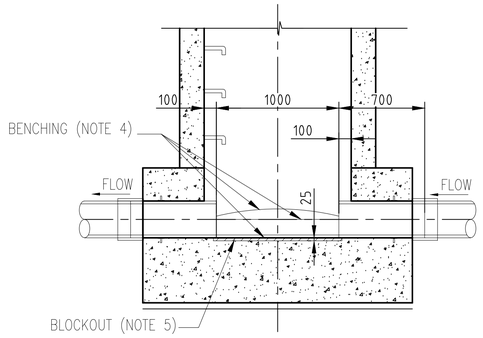
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	146	1	A

100 mm on original

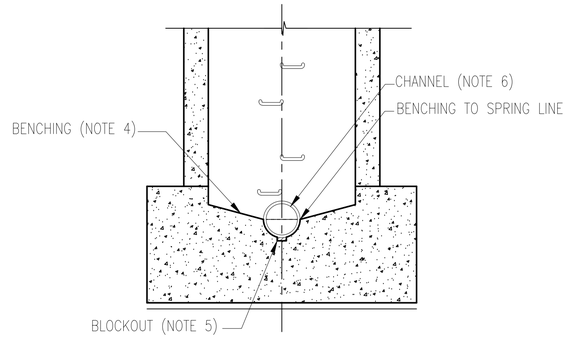
Plotted: 08/10/21 - 09:35 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-146.dwg



FLOW GAUGING MAINTENANCE HOLE - PLAN
SCALE 1:25



SECTION A
SCALE 1:25



1200 CIRCULAR MAINTENANCE HOLE

SECTION B
SCALE 1:25

NOTES:

1. REFER FIGURE 145 FOR TYPICAL PIPE CONNECTION DETAIL.
2. INTERNAL DIMENSION 1200.
3. SEWER GRADE TO BE MAINTAINED ACROSS FLOW GAUGING M.H. NO ADDITIONAL FALL ACROSS M.H.
4. BENCHING SHALL BE TO SPRING LINE OF INLET/OUTLET SEWER PIPES WITH 8:1 (H:v) BENCH SLOPE AWAY FROM CHANNEL.
5. BLOCKOUT SHALL BE PROVIDED AT BASE OF CHANNEL WITH DIMENSIONS 1050 x 75 x 25 AS SHOWN.
6. CHANNEL SHALL BE SMOOTH AND FLUSH WITH OUTSIDE OF INLET/OUTLET SEWER PIPES.
7. THIS DRAWING WILL BE READ IN CONJUNCTION WITH THE FOLLOWING:

A.112	MAINTENANCE HOLES CONSTRUCTION NOTES
B.140	DN1050 CAST IN-SITU CIRCULAR MAINTENANCE HOLE DETAILS PLAN
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F.144	STANDARD DETAILS PLAN
G.146	TYPICAL CHANNEL ARRANGEMENTS PLAN

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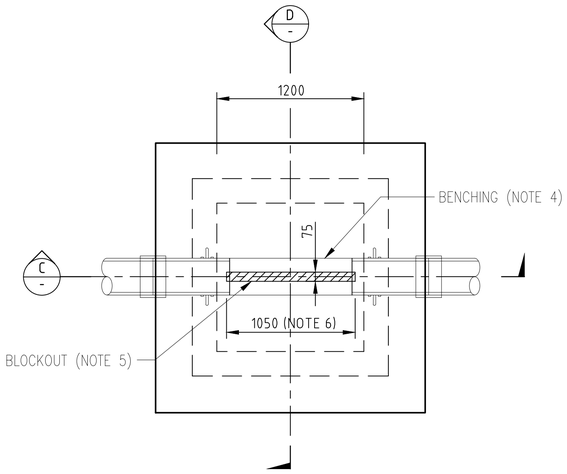
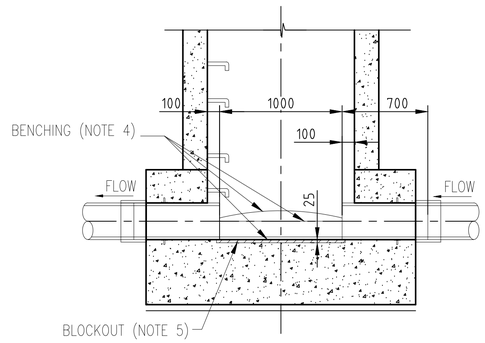
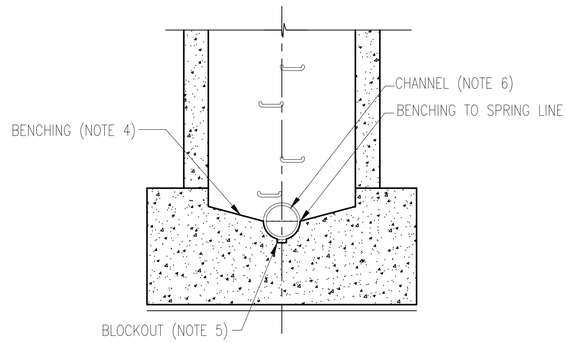


FLOW GAUGING MAINTENANCE HOLE - PLAN
SCALE 1:25



SECTION C
SCALE 1:25



1200 SQUARE MAINTENANCE HOLE

SECTION D
SCALE 1:25

1:25 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
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Shoalhaven Council's Water Utility WATER
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SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 08/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 08/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 08/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 08/10/2021	COMPANY: CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
REPLACEMENT OF THE EXISTING DN300 AC SNSM
DN1200 CAST IN-SITU
FLOW GAUGING CHANNEL DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	147	1	A

Plotted: 08/10/21 - 09:36 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 1 - Replacement of the existing DN300 AC South Nowra Surcharge Main\25267-147.dwg

SHOALHAVEN CITY COUNCIL
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW PUMPING STATION

LOCALITY PLAN
SCALE 1:1000

LIST OF STANDARD DRAWINGS

DRAWING NUMBER	DESCRIPTION
(SC) 263723	STANDARD KERB RAMPS
5104_07	STANDARD VEHICULAR GUTTER CROSSINGS WITH K&G
G202605	STANDARD VEHICULAR FOOTPATH CROSSINGS
G263710	STANDARD KERB AND GUTTER SHAPES SHEET 2
S-25350-54	TYPICAL BOLLARDS

DRAWING INDEX

DRAWING NUMBER	DESCRIPTION
25267-200	COVER PAGE, LOCALITY PLAN AND DRAWING INDEX
25267-201	GENERAL NOTES
25267-205	LEVEL INTERACTION DIAGRAM
25267-206	PUMP SYSTEM CURVES
25267-210	SPS SITE PLAN AND SETOUT
25267-211	SPS PLAN AT GROUND LEVEL
25267-213	SPS WET WELL AND VALVE PIT PLAN
25267-214	SPS WET WELL AND VALVE PIT SECTION
25267-215	SPS FLOW METER PIT SECTIONAL PLAN AND SECTION
25267-216	SPS INLET MANHOLE PLAN AND SECTION
25267-217	FOUNDATION DETAILS
25267-218	METALWORK
25267-219	FRAMES AND COVERS
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NOTE: GRAY ITEMS TO BE ISSUED AT FINAL DESIGN

No.	REVISION DETAILS	DWN	DATE
C	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
B	ISSUED FOR DRAFT DETAILED DESIGN	SMV	16/08/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

CONSULTANT DETAILS:
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Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
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Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
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		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	30/09/2021	CARDNO
DRAWN:	SMV	30/09/2021	CARDNO
CHECKED:	PS	30/09/2021	CARDNO
APPROVED:	NM	30/09/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
COVER PAGE, LOCALITY PLAN AND DRAWING INDEX

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	200	1	C

Plotted: 16/09/21 - 14:09 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-200.dwg

GENERAL NOTES:

G1 SPECIFICATIONS AND CODES
CONSTRUCTION MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE SPECIFICATION FOR THE WORKS TOGETHER WITH THE REQUIREMENTS OF ALL CODES OF PRACTICE REFERRED TO THEREIN AND THE REQUIREMENTS OF ALL STATUTORY AUTHORITIES.

G2 DIMENSIONS
ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE COMMENCING ANY WORK. STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO MECHANICAL OR ELECTRICAL EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

G3 PROVISION FOR EQUIPMENT
MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS BUT REQUIRED BY OTHER CONTRACT DRAWINGS, SHALL BE VERIFIED BY CONTRACTOR PRIOR TO PLACING CONCRETE.

G4 CONSTRUCTION LOADS
STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL LOADS ON THE COMPLETE STRUCTURES. DURING CONSTRUCTION, THE STRUCTURES SHALL BE PROTECTED BY BRACING AND PROPPING WHEREVER CONSTRUCTION LOADS MAY OCCUR.

G5 CO-ORDINATION
ALL STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH CIVIL, MECHANICAL, ELECTRICAL, HYDRAULIC AND FABRICATION DRAWINGS TOGETHER WITH SPECIFICATIONS AND SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED BY THE PRINCIPAL FROM TIME TO TIME.

G6 ELECTRICAL WORK IS NOT INCLUDED IN THIS CONTRACT.

G7 ODOUR CONTROL UNIT IS NOT INCLUDED IN THIS CONTRACT (BY SHOALHAVEN WATER)

CONCRETE:

(REFER TO CONCRETE SECTION OF SPECIFICATION)

C1 DESIGN CODES
DESIGN IS IN ACCORDANCE WITH THE FOLLOWING SAA CODES:-
AS 1170 SAA LOADING CODES PART 1 & 2.
AS 3600 SAA CONCRETE STRUCTURES CODE.
AS 3735-2001 CONCRETE STRUCTURES FOR RETAINING LIQUIDS.

C2 MATERIALS
CONSTRUCTION MATERIALS AND WORKMANSHIP FOR CONCRETE WORKS SHALL BE IN ACCORDANCE WITH THE SPECIFICATION AND THE SAA CODE AS 3600.

C3 CONCRETE PROPERTIES
FOR CONCRETE PROPERTIES REFER TO SPECIFICATION.

C4 CURING
CURING SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.

C5 JOINTING IN CONCRETE STRUCTURES
LOCATION OF ALL EXPANSION AND CONTRACTION JOINTS SHALL BE AS SHOWN ON THE DRAWINGS. LOCATION OF SUCH JOINTS SHALL NOT BE CHANGED WITHOUT APPROVAL OF THE SUPERINTENDENT. IF ADEQUATE CONSTRUCTION JOINTS ARE NOT SHOWN IN THE DRAWINGS THE CONTRACTOR SHALL SUBMIT PROPOSED LOCATION OF REQUIRED CONSTRUCTION JOINTS FOR APPROVAL BEFORE CONSTRUCTION.

C6 CHAMFERS
EXCEPT AS OTHERWISE REQUIRED, EXPOSED CONCRETE CORNERS AND EDGES SHALL HAVE 20mm CHAMFERS. ALL CHAMFERS TO PROVIDE SMOOTH AND CLEAN EDGES.

C7 NO HOLES OR CHASES OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE WITHOUT PRIOR APPROVAL OF THE PRINCIPAL.

REINFORCEMENT:

(REFER TO SECTION 20 OF SPECIFICATION)

R1 REINFORCEMENT DESIGNATION
SYMBOLS INDICATED ON DRAWINGS FOR GRADE AND TYPE OF REINFOCEMENT ARE AS FOLLOWS:-
SL - COLD ROLLED, HIGH STRENGTH FABRIC OF GRADE R500N TO AS/NZS 4671.
N - HOT ROLLED, HIGH STRENGTH DEFORMED BARS OF GRADE D500N TO AS/NZS 4671.

R2 BAR NOTATION
BAR NOTATION AS FOLLOWS:- GRADE(TYPE),BAR(DIA.),BAR SPACING LOCATION SYMBOLS
eg N12-200

E.W. - EACH WAY	E.F. - EACH FACE
B - BOTTOM	N.F. - NEAR FACE
T - TOP	F.F. - FAR FACE
CP - CENTRALLY PLACED	B.F. - BOTH FACE

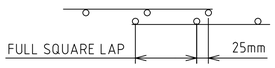
R3 COVER
CLEAR CONCRETE COVER TO REINFORCEMENT UNLESS NOTED OTHERWISE SHALL BE:-

SURFACES IN CONTACT WITH SEWAGE OR GROUNDWATER	65MM
SURFACES CAST AGAINST GROUND WITHOUT BLINDING SLAB	65MM
SURFACES CAST AGAINST GROUND WITH BLINDING SLAB	50MM
REMAINDER	40MM

R4 SPLICES AND LAPS
WHERE NOT DETAILED ON DRAWING,LOCATION OF REINFORCEMENT SPLICES SHALL BE APPROVED BY THE PRINCIPAL. LENGTH OF SPLICES ARE SUBJECT TO CODE AS 3600 REQUIREMENTS. MIN. LAP LENGTH SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:-

BAR SIZE	LAP LENGTH		
	HORIZONTAL		VERTICAL
	SLAB LESS THAN 350mm THICK	OTHER	
N12	300	400	300
N16	400	500	400
N20	500	650	500
N24	600	750	600

FABRIC SHALL BE LAPPED WITH AT LEAST ONE FULL SQUARE OR RECTANGULAR LAP WITH BARS ON FOUR SIDES PLUS 25mm AS SHOWN BELOW



R5 TRIMMER BARS ALL TRIMMER BARS AROUND OPENINGS,BLOCKOUTS,PIPE PENETRATIONS AND CORNERS,WHERE REQUIRED BUT NOT DIMENSIONED,SHALL EXTEND A MIN. ANCHORAGE DISTANCE OF 25 BAR DIAMETERS PAST THE POINT OF INTERSECTION WITH THE CROSSING TRIMMER BARS UNLESS NOTED OTHERWISE.

R6 MINIMUM COG AND HOOK LENGTHS SHALL BE IN ACCORDANCE WITH SECTION 13 OF AS 3600.

R7 LAPS AND SPLICES TO BE POSITIONED TO MAINTAIN THE SAME COVER.

R8 LAP LENGTHS FOR DIFFERENT BAR SIZES SHALL BE BASED ON THE LARGER SIZE BAR. LAPS ARE TO BE STAGGERED.

EARTHWORKS:

(REFER TO SECTION 28 OF SPECIFICATION)

E1 DETAILS OF IN-SITU MATERIAL ARE CONTAINED IN THE SPS 4 ALBANY ST SEWAGE PUMPING STATION, GEOTECHNICAL INVESTIGATION REPORT PREPARED BY COFFEY.

E2 EXCAVATION, STOCKPILE, EMBANKMENTS, COMPACTIONS ETC. SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.

DATUM:

D1 SURVEY LEVELS ARE TO AHD (AUSTRALIAN HEIGHT DATUM)

METALWORK:

(REFER TO SECTION 25 OF THE SPECIFICATION)

M1 DESIGN IS IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS: - STEEL STRUCTURES AS 4100 FIXED PLATFORMS, WALKWAYS,STAIRWAYS AND LADDERS

M2 SPECIFICATION AND CODES
ALL STEEL CONSTRUCTION MATERIALS AND WORKMANSHIP SHALL CONFORM TO AS 4100.

M3 MATERIALS
ALL STRUCTURAL SHAPES,BARS AND PLATES UNLESS NOTED OTHERWISE,SHALL BE 10MM THICK OF GRADE 250 STEEL IN ACCORDANCE WITH AS 3678 & 3679.

M4 SURFACE PREPARATION

ELEMENT	SURFACE PREPARATION	TREATMENT
ALL MILD STEEL WORK INCLUDING STEPIRONS	ABRASIVE BLAST CLEANING (AS 1627.4) or CHEMICALLY DESCALE (AS 1627.5)	HOT DIP GALVANISED AFTER FABRICATION

M5 FABRICATION DRAWINGS
CONTRACTOR SHALL PREPARE AND SUBMIT TWO COPIES OF ALL STRUCTURAL STEELWORK FABRICATION DRAWINGS TO THE PRINCIPAL PRIOR TO COMMENCING FABRICATION.

M6 WELDING
ALL WELDING SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STEEL WELDING CODE AS 1554. ALL WELDS SHALL BE 6MM CONTINUOUS FILLET WELD CATEGORY SP UNLESS NOTED OTHERWISE.

M7 ALUMINIUM
ALUMINIUM PRODUCTS SHALL BE OF ALUMINIUM ALLOY AS FOLLOWS:

PRODUCT	ALLOY
PLATES,SHEETS EXTRUSIONS, GRATINGS	5251 6061 6063

AND SHALL BE IN ACCORDANCE WITH AS/NZS 1664, AS/NZS 1734, AS/NZS1866, UNLESS NOTED OTHERWISE.

M8 REFER TO SPECIFICATION FOR TREATMENT OF ALUMINIUM SURFACES IN CONTACT WITH OTHER MATERIALS.

PIPEWORK:

(REFER TO SECTION 30 OF THE SPECIFICATION)

P1 ALL DUCTILE IRON PIPES SHALL BE LIGHT CEMENT LINED WITH TYPE SR CEMENT, CLASS PN35 TO AS 2280. ALL FLANGES SHALL BE TABLE C TO AS 2129 AND CLASS 16 TO AS 4087. ALL BURIED DI PIPES TO BE WRAPPED (REFER TO THE SPECIFICATION).

P2 ALL HDPE PRESSURE PIPES REFER TO THE SPECIFICATIONS, WSA PS-207 AND PS-208

P3 ALL NON-PRESSURE PVC-U PIPES SHALL BE WITH RUBBER RING JOINTS TO AS 1260 AS FOLLOW:
80 MM ND OR SMALLER PIPES - CLASS SH
100 MM ND PIPES - CLASS SN10
150 MM ND OR LARGER PIPES - CLASS SN8.
ALL ODOUR/VENT DDUCTING SHAL BE CLASS 9 TO AS 1477

P4 FOR MINIMUM COVER TO PIPES, REFER TO THE SPECIFICATIONS

P5 PIPES WITH LESS COVER THAN INDICATED IN NOTE P5 SHALL BE MASS CONCRETE ENCASED 150 ALL AROUND UNLESS OTHERWISE STATED.

P6 LAY PIPES BETWEEN PITS/STRUCTURES ON A CONTINUOUS RISING OR FALLING GRADE.

P7 PROVIDE THRUST BLOCKS AT ALL LOCATIONS (EG BENDS AND VALVES) WHERE UNBALANCED THRUST CAN DEVELOP. DRAWINGS MAY NOT SHOW REQUIRED THRUST BLOCKS.

P8 CONSTRUCT ALL PIPEWORK UNDER SEALED ROAD WAYS BY UNDERBORING.

P9 ALL PIPEWORK IS TO BE IN ACCORDANCE WITH WSAA 02 AND THE SHOALHAVEN WATER SUPPLEMENT.

P10 ALL PIPEWORK TO BE TRENCHED AND BEDDED AS PER DRG WSA-SEW-1201SW.

MAINTENANCE HOLES:

MH1 MAINTENANCE HOLES IN ACCORDANCE WITH WSA-02

STANDARD SEWER CONSTRUCTION NOTES

1. ALL SEWERAGE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WSAA SEWER CODE OF AUSTRALIA AND SHOALHAVEN WATER'S SUPPLEMENT, AND WITH ANY OTHER SPECIAL REQUIREMENTS AND STANDARDS OF SHOALHAVEN CITY COUNCIL.
2. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH & SAFETY ACT 2000, WHICH REQUIRES EMPLOYERS TO ENSURE THE HEALTH, SAFETY & WELFARE OF EMPLOYEES.
3. THE CONTRACTOR SHALL AT ALL TIMES EXERCISE ALL NECESSARY PRECAUTIONS APPROPRIATE TO ENSURE THE SAFETY OF ALL PERSON'S ON THE WORK SITE OR IN THE VICINITY OF THE WORK SITE.
4. PRIOR TO COMMENCING WORK ON SITE THE CONTRACTOR SHALL PROVIDE TO THE SUPERINTENDENT EVIDENCE THAT HE HAS CURRENT PUBLIC RISK AND COMPENSATION INSURANCE POLICIES.
5. THE CONTRACTOR SHALL PROVIDE ALL LABOUR, MATERIALS, AND EQUIPMENT NECESSARY FOR THE ACCURATE SETTING OUT OF THE ENTIRE WORKS. THE CONTRACTOR SHALL ARRANGE FOR ALL PIPES AND FITTINGS TO BE INSPECTED BY THE SUPERINTENDENT AND THE SHOALHAVEN WATER INSPECTOR PRIOR TO THE OPENING OF ANY TRENCHES ON SITE. THE CONTRACTOR SHALL GIVE NOT LESS THAN 24 HOURS NOTICE WHEN REQUESTING AN INSPECTION UNDER THIS CLAUSE.
6. UPVC PIPES AND FITTINGS ARE TO BE RUBBER RING JOINTED (RRJ), CLASS (SN4 AND/OR SN8) AND MANUFACTURED IN ACCORDANCE WITH AS/NZ 1260. PIPE LENGTHS ARE NOT TO EXCEED 3M IN LENGTH.
7. WRITTEN PERMISSION IS TO BE OBTAINED FROM THE LANDOWNERS THROUGH WHICH THE SEWER MAIN WILL TRAVERSE, PRIOR TO ENTERING OR COMMENCING ANY SEWER CONSTRUCTION WORKS WITHIN THOSE PROPERTIES AND FOR THE DURATION OF CONSTRUCTION WORKS. A COPY OF THE WRITTEN CONSENT SHALL BE FORWARDED TO SHOALHAVEN WATER.
8. APPROVAL UNDER SECTION 138 OF THE ROADS ACT 1993 MUST BE OBTAINED FROM COUNCIL OR THE RTA PRIOR TO COMMENCEMENT OF ANY WORK WITHIN COUNCIL'S OR RTA'S ROAD/ROAD RESERVE.
9. TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH AS1742.3 ARE TO BE IN PLACE AND MAINTAINED AT ALL TIMES. TRAFFIC CONTROL PLAN IS TO BE SUBMITTED TO COUNCIL AND APPROVED PRIOR TO CONSTRUCTION WORK COMMENCING.
10. THE CONTRACTOR SHALL GIVE NOT LESS THAN FOUR (4) DAYS NOTICE PRIOR TO COMMENCING WORK ON SITE.
11. POSITION OF MANHOLES/LAMPHOLES SHALL BE LOCATED BY A SURVEYOR PRIOR TO A PRE-COMMENCEMENT MEETING.
12. ALL JUNCTIONS/ JUNCTION SIDELINES ARE TO BE LAID AT A MINIMUM GRADE OF 1 IN 60.
13. WHERE SHOWN ON THE PLAN, CROSS HATCHING DENOTES THE SERVICE LIMIT OF THE LOT (BEING CALCULATED AT 1:60).
14. HEIGHT OF VERTICAL RISERS AS SHOWN ON THE LONG SECTION IS MEASURED FROM THE INVERT OF THE SEWER MAIN TO THE INVERT OF THE SIDELINE OFF THE RISER.
15. RISERS TO BE PLACED ONLY WHERE SHOWN ON THE LONGITUDINAL SECTIONS.
16. SEWER MANHOLES TO BE OF THE TYPE SHOWN ON THE SEW-1300SW OR AS AMENDED.
17. SEWER MANHOLE COVERS AND SURROUNDS TO BE OF THE TYPE SHOWN ON THE SEW-1300SW OR AS AMENDED - HEAVY TYPE COVER 'H'.
18. THE CONTRACTOR IS TO TAKE EXTRA CARE WITH MANHOLE CONSTRUCTION TO ENSURE THAT SUFFICIENT FALL IS PROVIDED THROUGH EACH MANHOLE. THE CONTRACTOR IS TO CONSULT WITH THE SUPERVISING ENGINEER/SURVEYOR TO VERIFY THE REQUIRED CONSTRUCTED FALL ACROSS EACH MANHOLE. CONSTRUCTED FALL ACROSS EACH MANHOLE SHOULD ALLOW FOR THE CONTINUATION OF GRADE PLUS THE DESIGN DROP AT THE CENTRE OF THE MANHOLE. (REFER TO TABLE FOR DEP TAILS ON THE REQUIRED FALLS TO BE CONSTRUCTED THROUGH EACH MANHOLE).
19. THE CONTRACTOR SHALL ENSURE THAT PIPES ARE LAID TO CORRECT INVERT LEVELS, WHERE LASER PIPE LAYING AIDS ARE USED THE CONTRACTOR SHALL VERIFY THAT THE CORRECT MANHOLE INVERT LEVEL HAS BEEN ACHIEVED (REFER TO TABLE SHOWING FALLS THROUGH MANHOLES).
20. INTERCONNECTION/CONSTRUCTION OF MANHOLE A/1 IS TO BE JOINTLY CONSTRUCTED BY SHOALHAVEN WATER STAFF AND THE CONTRACTOR. ALL MATERIALS (INCLUDING MAINLINE PIPEWORK) ARE TO BE PROVIDED BY THE CONTRACTOR. THE CONTRACTOR IS TO CARRY OUT THE REQUIRED EXCAVATION FOR MANHOLE AND, ONCE COMPLETED, SHOALHAVEN WATER SHALL PERFORM THE "CUT-IN", INSERTING THE REQUIRED MANHOLE (MAINLINE) PIPEWORK INTO THE MAIN. THE CONTRACTOR IS TO THEN CONSTRUCT THE MANHOLE, BACKFILL AND REINSTATE THE AREA. TESTING OF THE MANHOLE IS TO BE PERFORMED BY THE CONTRACTOR. THE CONTRACTOR IS TO LIAISE WITH SHOALHAVEN WATER'S WASTEWATER DISTRIBUTION CO-ORDINATOR IN THIS REGARD. SHOALHAVEN WATER'S WORKFORCE SHALL THEN CARRY OUT THE INTERNAL BENCHING AND RENDERING WORKS WITHIN THE MANHOLE.
21. UNLESS PRIOR WRITTEN APPROVAL IS GRANTED, ALL WORK ON EXISTING COUNCIL MAINS OR WITHIN EXISTING SEWER MANHOLES IS TO BE UNDERTAKEN BY COUNCIL STAFF AT THE DEVELOPERS EXPENSE.THE CONTRACTOR OR PERSON REQUESTING THE WORK SHALL SIGN A WORKS ORDER (PRIVATE INSTALLATION-PI) FORM PRIOR TO THE WORKS BEING CARRIED OUT. THIS PERSON/FIRM SHALL BE INVOICED FOR WORK CARRIED OUT.
22. THE CONTRACTOR WILL BE RESPONSIBLE FOR REPAIR OF ANY DAMAGE TO COUNCIL'S EXISTING INFRASTRUCTURE. SUCH REPAIR OR REINSTATEMENT IS TO BE CARRIED OUT IMMEDIATELY TO THE SATISFACTION OF SUBDIVISION MANAGER AND/OR DEVELOPMENT MANAGER AND/OR SHOALHAVEN WATER.
23. JUNCTION "CUT-INS" FOR PROPOSED LOTS NA AND NA IS TO BE PERFORMED BY SHOALHAVEN WATER AT THE DEVELOPER'S COST. SUPPLY OF MATERIALS (INCLUDING BEDDING MATERIAL), EXCAVATION, BACKFILL AND REINSTATEMENT WORK IS TO BE CARRIED OUT BY THE CONTRACTOR. WAE DETAILS FOR JUNCTIONS ARE TO BE OBTAINED BY THE SUPERVISING SURVEYOR PRIOR TO BACKFILLING THE TRENCHES.
24. WHERE SHOWN ON THE PLAN AND LONGITUDINAL SECTIONS, SEWER LINES ARE TO BE CONCRETE ENCASED WITH 20MPA CONCRETE 150MM THICK ALL ROUND (OVER, UNDER & EACH SIDE) AND THE MAXIMUM WIDTH OF THE CONCRETE ENCASEMENT SHALL NOT EXCEED 600MM. IF EXCESS EXCAVATION OCCURS IT WILL BE NECESSARY FOR THE ENCASEMENT TO BE FORMED TO ACHIEVE THE 600MM MAXIMUM WIDTH REQUIREMENTS. CONTRACTION JOINTS SHALL BE PROVIDED ALONG THE CONCRETE ENCASEMENT AT THE FACE OF EACH PIPE SOCKET. CONCRETE ENCASEMENT IS TO COMMENCE & FINISH AT A FLEXIBLE JOINT.
25. SHOALHAVEN WATER REQUIRES THAT ALL PROPOSED CONCRETE ENCASEMENT BE INSPECTED BY SHOALHAVEN WATER'S INSPECTOR, AT THE DEVELOPER'S COST. WORKS TO BE INSPECTED AT PRIOR TO ANY CONCRETE BEING POURED AND AT THE COMPLETION OF CONCRETE POUR, PRIOR TO BACKFILLING. INSPECTION AND TRAVELLING COSTS ARE SET OUT IN COUNCIL'S FEES, CHARGES AND RENTALS DOCUMENT.
26. BACKFILLING OVER THE CONCRETE ENCASED PIPELINE IS NOT TO BE UNDERTAKEN WITHIN 48 HOURS OF PLACING CONCRETE AND UNTIL "WORK-AS-EXECUTED" (W.A.E.) DETAILS OF THE ENCASED PIPELINE HAVE BEEN OBTAINED BY THE SURVEYOR.
27. WHERE LAMPHOLE/S ARE SPECIFIED, THE CONTRACTOR IS TO PROVIDE A MANHOLE COVER AND SURROUND OVER THE CONSTRUCTED LAMPHOLE TO INDICATE THE POSITION OF, AND PROVIDE FUTURE ACCESS TO, THE CONSTRUCTED LAMPHOLE.
28. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION WORK COMMENCING AND MAINTAINED DURING THE CONSTRUCTION PHASE. SEDIMENT CONTROL MEASURES ARE TO INCORPORATE THOSE AS DETAILED ON THE SEDIMENT AND EROSION CONTROL PLAN. SEDIMENT CONTROL MEASURES SHOULD ALSO INCORPORATE THE MEASURES AS SET OUT IN COUNCIL'S STANDARD ANNEXURE FOR "EROSION CONTROL MEASURES FOR WORK UNDERTAKEN BY PRIVATE CONTRACTORS DURING THE INSTALLATION OF UTILITY SERVICES". ALL MEASURES AS DETAILED ON THE PLAN PERTAINING TO THE SEDIMENT CONTROL AROUND THE SEWER CONSTRUCTION SITE ARE TO BE IMPLEMENTED PRIOR TO WORKS COMMENCING.
29. ALL FILLING THAT TAKES PLACE OVER THE SITE IS TO BE IN ACCORDANCE WITH COUNCIL'S WRITTEN APPROVAL'. THE COMPACTION TEST RESULTS SHALL BE FORWARDED TO SHOALHAVEN WATER UPON COMPLETION.

No.	REVISION DETAILS	DWN	DATE
C	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
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A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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SIZE: A1 | SCALE FACTOR: NTS | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility WATER
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		DATE:	COMPANY:
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DRAWN:	SMV	30/09/2021	CARDNO
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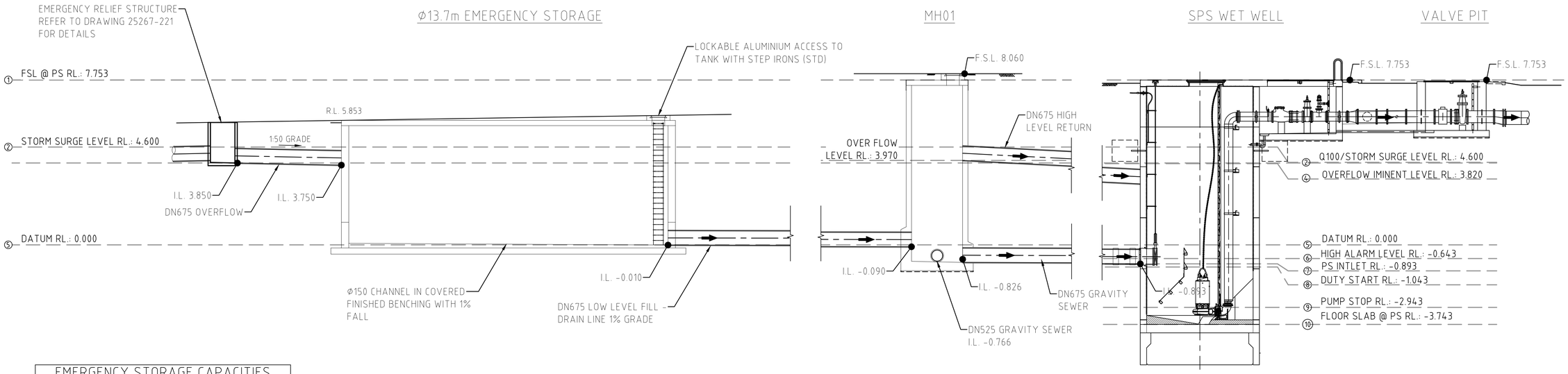
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
GENERAL NOTES

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	201	1	C

Plotted: 16/09/21 - 10:03 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-201.dwg

100 mm on original



EMERGENCY STORAGE CAPACITIES REQUIRED VOLUME = 863 m^2	
CHAMBER	VOLUME (m^3)
WET WELL	90
GRAVITY NETWORK	197
STORAGE TANK	585

EMERGENCY STORAGE SECTION
SCALE 1:100

0 1 2 4m
SCALE 1:100 @A1

NOTES:
1. DRAWING NOT TO BE SCALED.
2. THE TOTAL EMERGENCY STORAGE CAPACITY IS BASED ON 8 HR AT ADWF 2049 EMERGENCY STORAGE.
3. A SURVEY MARK TO BE PLACED ON THE TOP SURFACE OF THE PUMP STATION. THE LEVEL IN AHD TO 3 DECIMAL PLACES IS TO BE ENGRAVED ON A BRASS PLAQUE AND FIXED TO THE TOP SLAB. THE LEVEL IS TO BE RECORDED IN THE AS CONSTRUCTION DRAWINGS.

No.	REVISION DETAILS	DWN	DATE
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A	ISSUED FOR DRAFT DETAILED DESIGN	SMV	16/08/2021

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TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
LEVEL INTERACTION DIAGRAM

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	205	1	B

100 mm on original

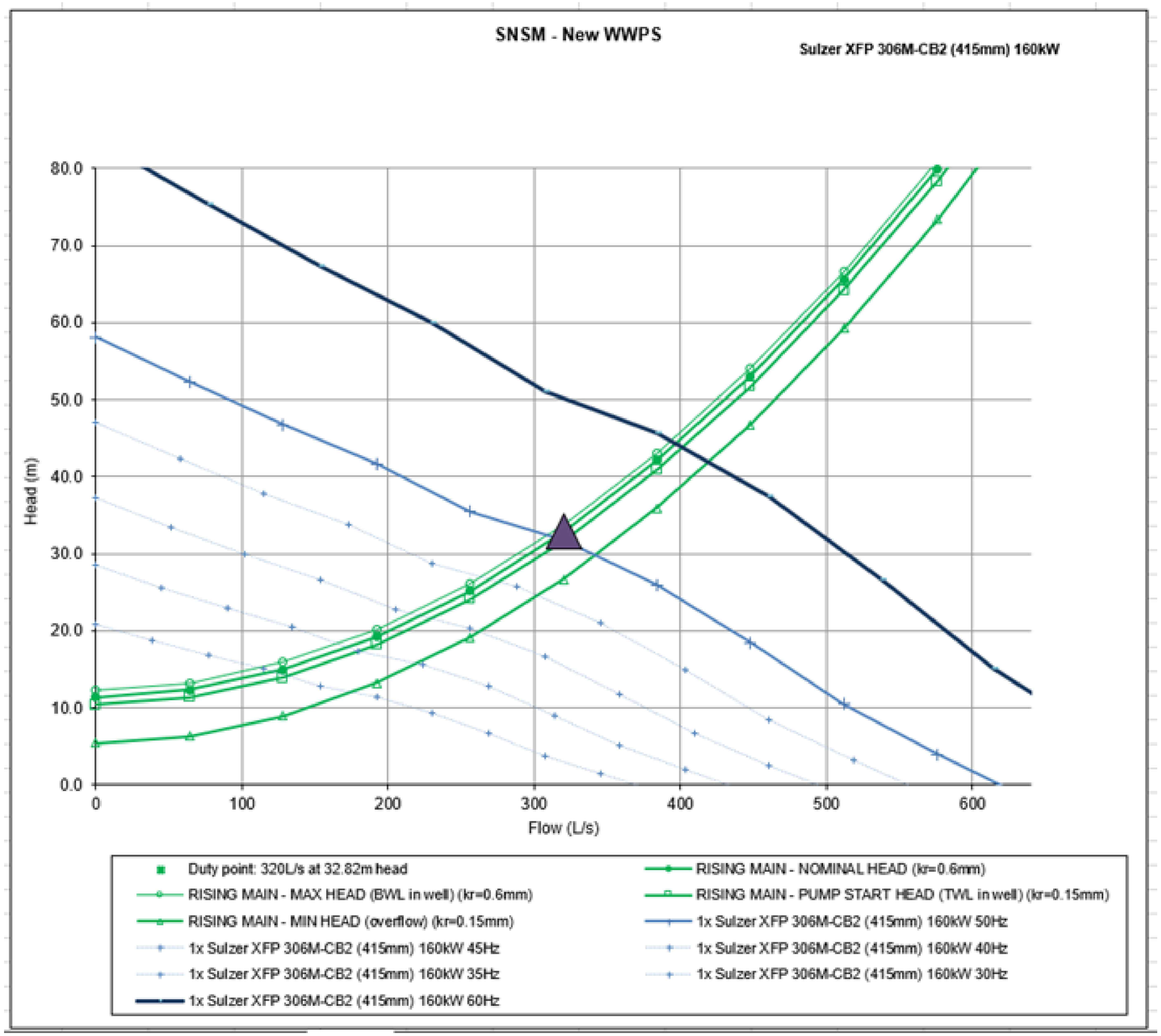
Plotted: 16/09/21 - 15:08 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-205.dwg

PUMP DETAILS

NUMBER OF DUTY PUMPS	1
NUMBER OF STANDBY PUMPS	1
PUMP MANUFACTURER	SULZER
PUMP MODEL	XFP 306M-CB2
PUMP IMPELLER DIAMETER	415
MOTOR RATING	160 kW
MOTOR START TYPE	VFD
MOTOR VOLTAGE	415V
MOTOR SPEED AT 50 Hz	1455 rpm
CABLE LENGTH	20 m
TOTAL EFFICIENCY @ DUTY POINT	74.70%

RISING MAIN DETAILS

PIPE NOMINAL DIAMETER	560 mm
PIPE MATERIAL	PE100
PIPE MANUFACTURER	TBC
PIPE INTERNAL DIAMETER	560 mm
PIPE OUTSIDE DIAMETER	455.8 mm
PIPE PN RATING	PN16
VELOCITY AT 50 Hz FROM TWL	1.96 m/s
VELOCITY AT 35 Hz FROM TWL	1.15 m/s
MEAN STATIC HEAD AT ZERO FLOW	12.33 m
RISING MAIN VOLUME	270 m^3



No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR DRAFT DETAILED DESIGN	SMV	16/08/2021

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
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CHECKED: PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
PUMP SYSTEM CURVES

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	206	1	B

Plotted: 16/09/21 - 10:03 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-206.dwg

STANDARD VEHICULAR FOOT PATH CROSSING TO CITY OF SHOALHAVEN STANDARD DRAWING G202505

EXISTING LIGHT POLE

EXISTING BUS STOP

EXISTING PATH

GREENWELL POINT RD

SECURITY FENCING AND ACCESS GATE IN ACCORDANCE WITH SHOALHAVEN CITY COUNCIL FENCING SPECIFICATION REFER TO DRAWING 25267-222 FOR DETAILS

STANDARD VEHICLE BARRIER

PAD MOUNT TRANSFORMER SITE TO BE CONFIRMED BY OTHERS

POWER CONNECTION

WATER SERVICE CONNECTION

4.0m DRIVEWAY

BH26

BH14

BH27

EXISTING DN225 SPS22 RM

NEW DISCHARGE CHAMBER. REFER TO PACKAGE 1 FOR DETAILS

4.0m WIDE CONCRETE DRIVEWAY

FLOW METER PIT

NEW PUMPSTATION

NEW DN150 GRAVITY CONNECTION. REFER TO PACKAGE 1 FOR DETAILS.

NEW SNSM - REPLACEMENT GRAVITY SEWER DN560 REFER TO PACKAGE 1 FOR DETAILS

SWITCHBOARD ROOM

HARDSTAND, 150mm DGB20 BASE, 300mm DGB40 - SUB-BASE

DIA 90mm BOLLARDS AT 5m CTR's. REFER TO STANDARD DRAWING 25350-054

SWITCHBOARD ROOM

BH15

OVERFLOW TO ENVIRONMENT REFER TO DRAWING 25267-221

NEW SNSM - REPLACEMENT GRAVITY SEWER DN525 REFER TO PACKAGE 1 FOR DETAILS

HERITAGE SITE

EMERGENCY OVERFLOW SCREEN

EMERGENCY STORAGE
1x 6m DEEP x 13.7m DIA STORAGE TANK

PLAN
SCALE 1:50

0 5 10m
SCALE 1:250 @A1

N

SETOUT SCHEDULE		
NO.	NORTHING	EASTING
P01	6136607.266	282305.74
P02	6136606.824	282308.707
P03	6136603.755	282305.217
P04	6136603.357	282308.117
P05	6136601.42	282304.261
P06	6136600.595	282309.8
P07	6136592.667	282302.957
P08	6136590.905	282304.262
P09	6136590.308	282308.268
P10	6136593.49	282305.911
P11	6136605.404	282282.903
P12	6136604.363	282289.898
P13	6136600.547	282282.180
P14	6136599.506	282289.175
P15	6136568.277	282302.156
P16	6136546.764	282344.827
P17	6136559.2	282363.164
P18	6136558.127	282371.392

SETOUT SCHEDULE		
NO.	NORTHING	EASTING
C01	6136641.727	282301.116
C02	6136641.067	282306.275
C03	6136640.76	282301.579
C04	6136640.253	282305.547
C05	6136616.432	282297.959
C06	6136611.38	282291.141
C07	6136613.441	282277.294
C08	6136609.484	282276.705
C09	6136607.424	282290.553
C10	6136600.606	282295.604
C11	6136591.213	282294.207
C12	6136590.625	282298.163

No.	REVISION DETAILS	DWN	DATE
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B	ISSUED FOR DRAFT DETAILED DESIGN	SMV	16/08/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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CHECKED: PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SPS SITE PLAN AND SET OUT

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	210	1	C

100 mm on original

Plotted: 16/09/21 - 15:15 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-210.dwg

GREENWELL POINT ROAD

GREENWELL POINT RD

BH26

BH14

BH27

BH15

SECURITY FENCING AND ACCESS GATE IN ACCORANCE WITH SHOALHAVEN CITY COUNCIL FENCING SPECIFICATION REFER TO DRAWING 25267-222 FOR DETAILS

WATER SERVICE CONNECTION

POWER CONNECTION

5.3m ACCESS ROAD

FLOW METER PIT

NEW PUMPSTATION

SWITCHBOARD ROOM

EXISTING DN225 SPS22 RM

NEW DISCHARGE CHAMBER. REFER TO PACKAGE 1 FOR DETAILS

NEW DN150 GRAVITY CONNECTION. REFER TO PACKAGE 1 FOR DETAILS.

NEW SNSM - REPLACEMENT GRAVITY SEWER DN560 REFER TO PACKAGE 1 FOR DETAILS

OVERFLOW TO ENVIRONMENT REFER TO DRAWING 25267-221

HERITAGE SITE

1
216

REFER TO DRAWING 25267-221 FOR EMERGENCY OVERLOW LONG SECTION

EMERGENCY STORAGE
1x 6m DEEP x 13.7m DIA
STORAGE TANK

NEW SNSM - REPLACEMENT GRAVITY SEWER DN525 REFER TO PACKAGE 1 FOR DETAILS

EMERGENCY OVERFLOW SCREEN

PLAN
SCALE 1:50

0 5 10m
SCALE 1:250 @A1

No.	REVISION DETAILS	DWN	DATE
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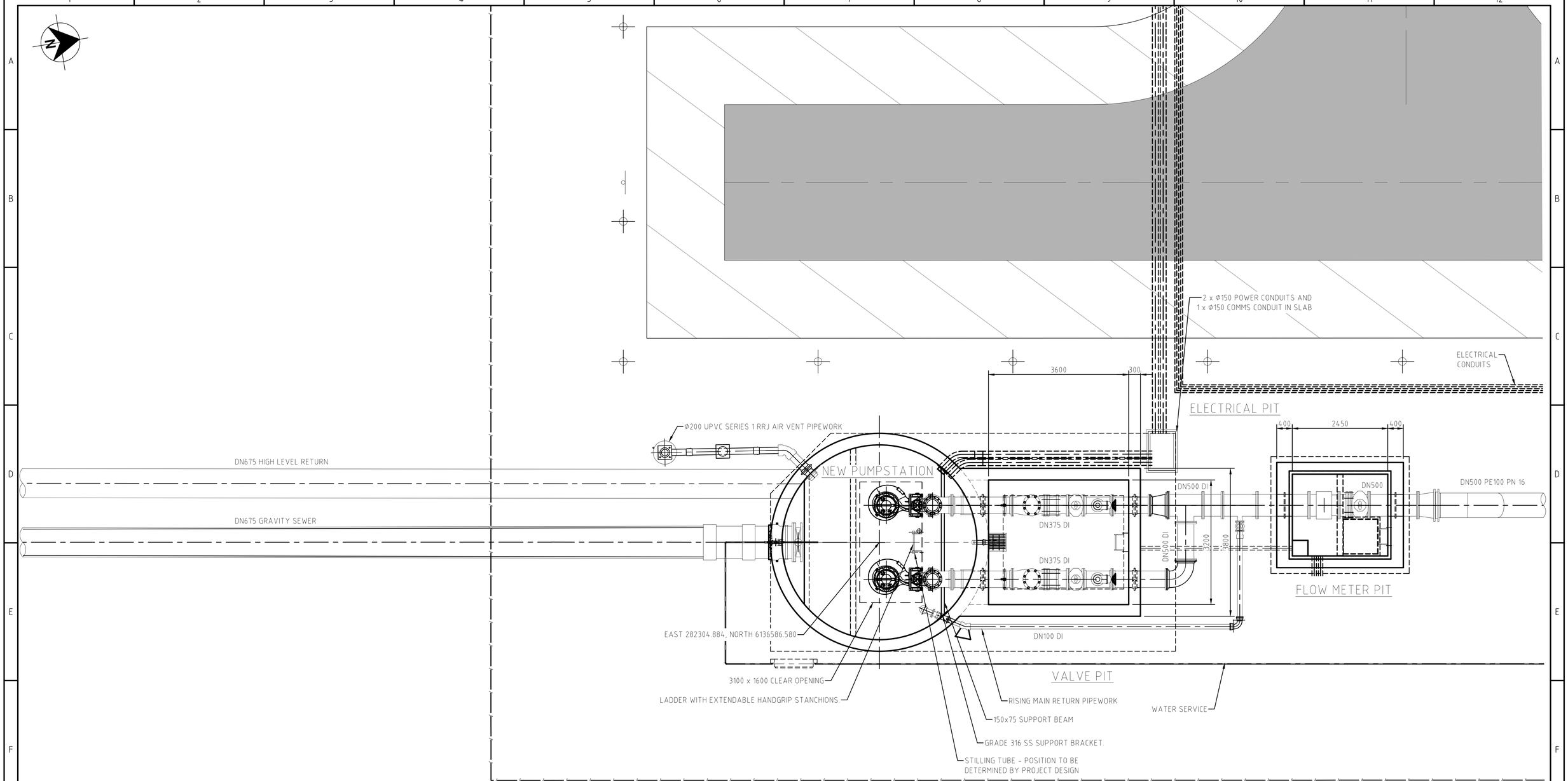
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SPS PLAN AT GROUND LEVEL
SITE PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	211	1	C

100 mm on original

Plotted: 16/09/21 - 13:49 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-211-213-214 & 220.dwg



PLAN
SCALE 1:50

0 1 2m
SCALE 1:50 @A1

No.	REVISION DETAILS	DWN	DATE
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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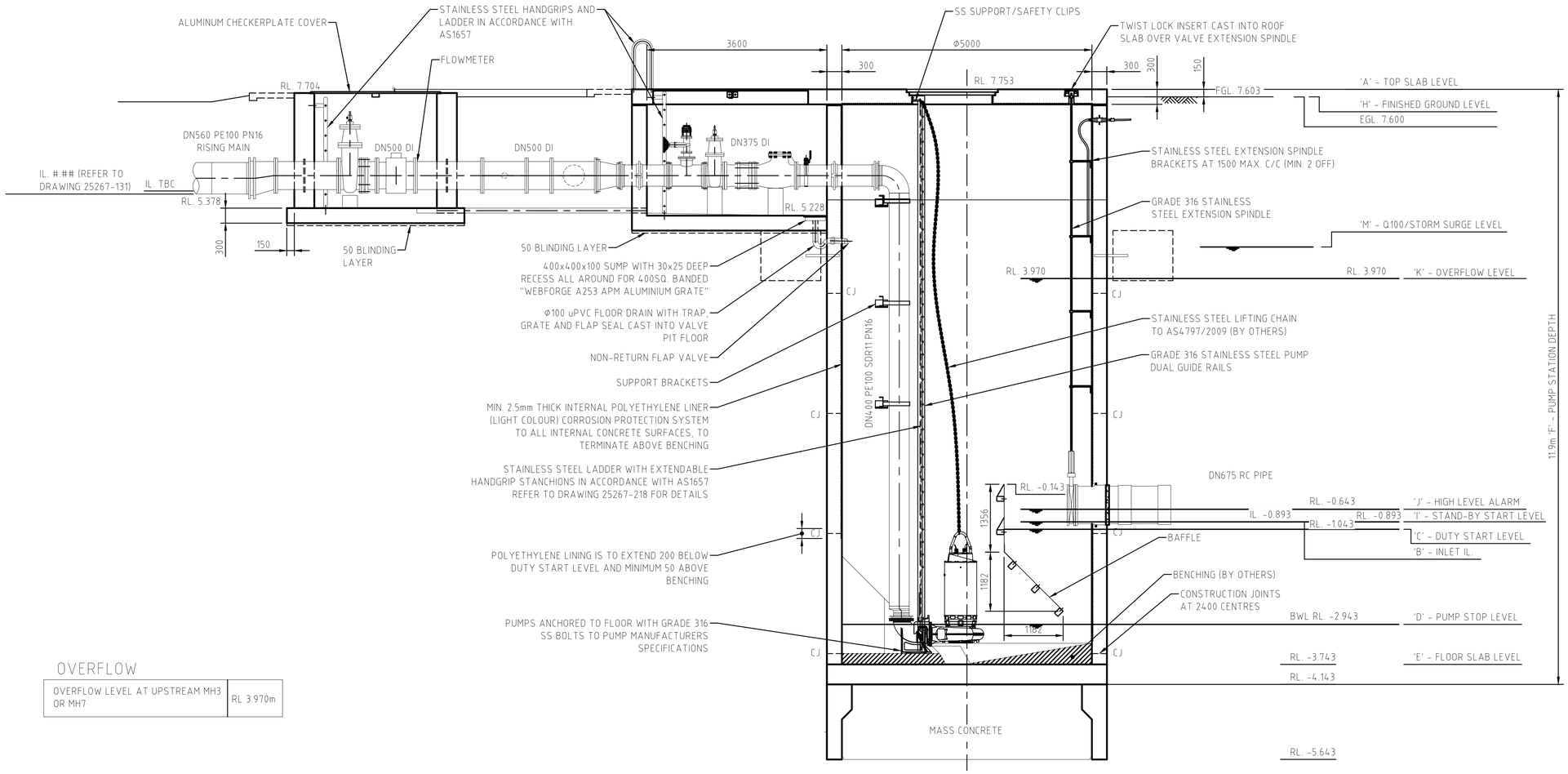
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SPS WET WELL AND VALVE PIT PLAN
GENERAL ARRANGEMENT

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	213	1	C

100 mm on original

Plotted: 16/09/21 - 09:53 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-211-213-214 & 220.dwg



PUMP STATION CONTROL LEVELS

	ITEM	RL LEVEL
A	TOP OF SLAB	7.753
B	INLET	-0.893
C	DUTY START	-1.043
D	PUMP STOP	-2.943
E	FLOOR SLAB	-3.743
F	PUMP STATION DEPTH	11.346
G	-	-
H	FINISHED GROUND LEVEL	7.753
I	STAND-BY START	-0.893
J	HIGH LEVEL ALARM	-0.643
K	OVERFLOW LEVEL	3.970
L	OVERFLOW IMINENT LEVEL	3.820
M	Q100/STORM SURGE LEVEL	4.600

OVERFLOW

OVERFLOW LEVEL AT UPSTREAM MH3 OR MH7	RL 3.970m

0 1000 2000mm
SCALE 1:50 @A1

SECTION 1
SCALE 1:50 -

No.	REVISION DETAILS	DWN	DATE
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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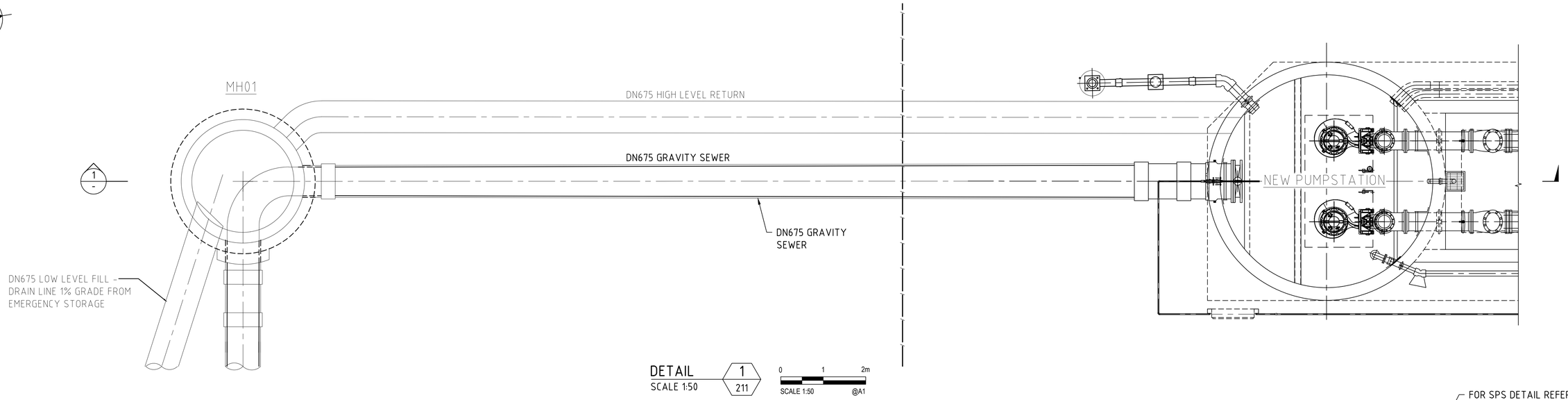
	CHECKED: PS	30/09/2021	CARDNO
	APPROVED: NM	30/09/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SPS WET WELL AND VALVE PIT SECTION

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	214	1	C

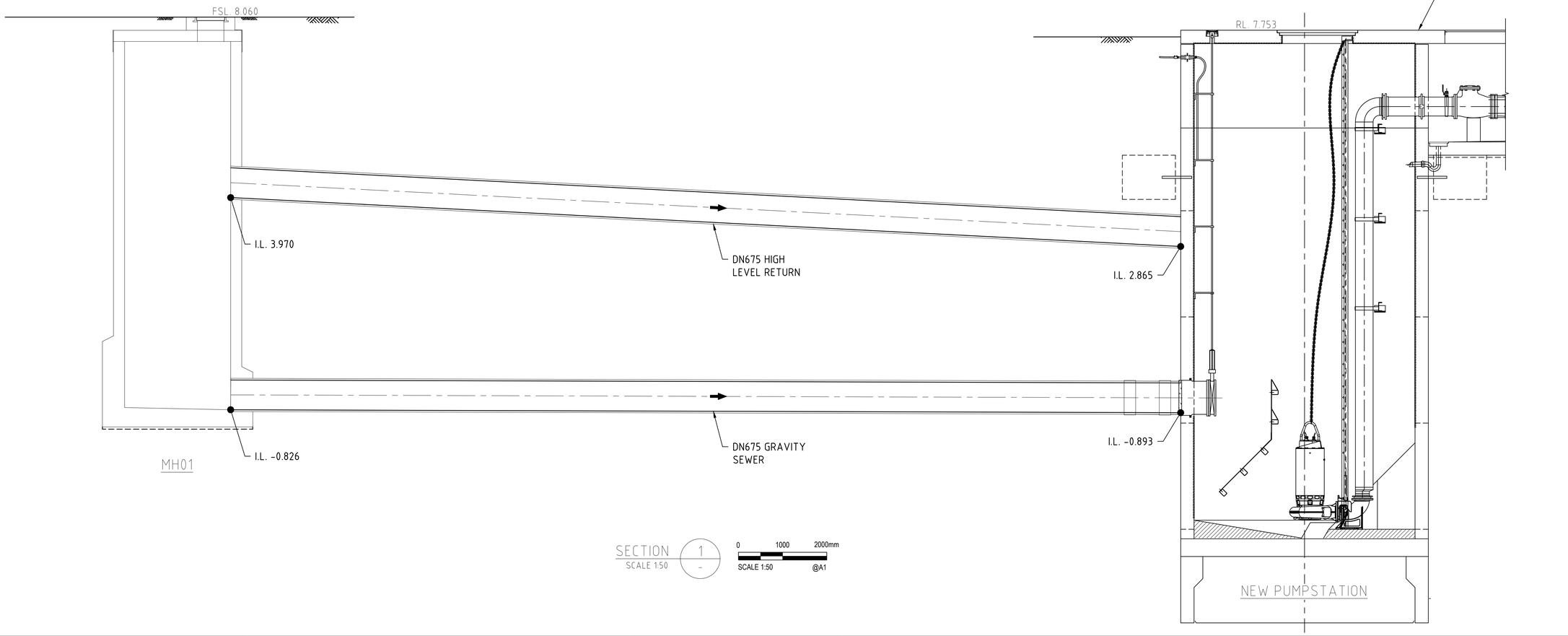
100 mm on original

Plotted: 16/09/21 - 13:20 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-211-213-214 & 220.dwg



DETAIL 1/211
SCALE 1:50

0 1 2m
SCALE 1:50 @A1



SECTION 1/-
SCALE 1:50

0 1000 2000mm
SCALE 1:50 @A1

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	JQ	30/09/2021

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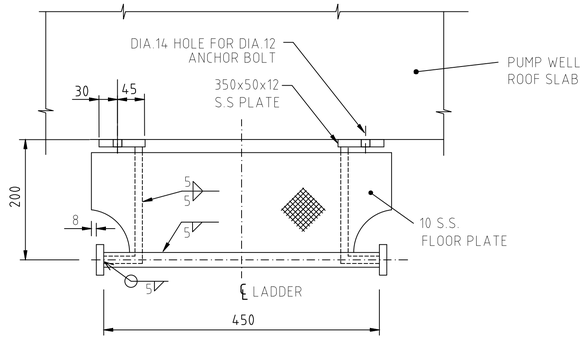
SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SPS INLET MANHOLE PLAN AND SECTION

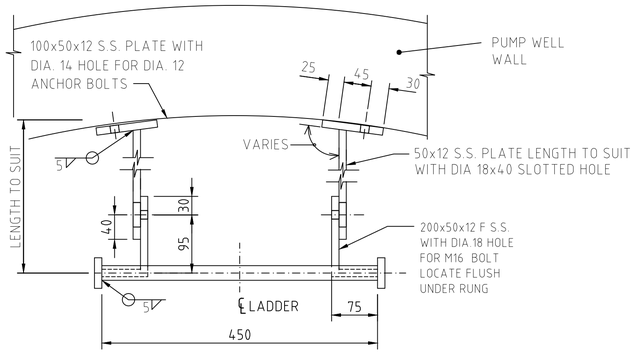
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	216	1	A

100 mm on original

Plotted: 16/09/21 - 10:19 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-216.dwg



DETAIL 1
NTS



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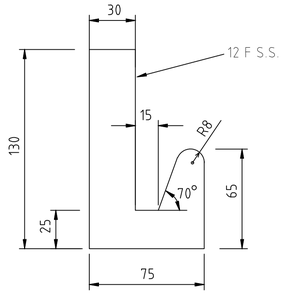
NTS



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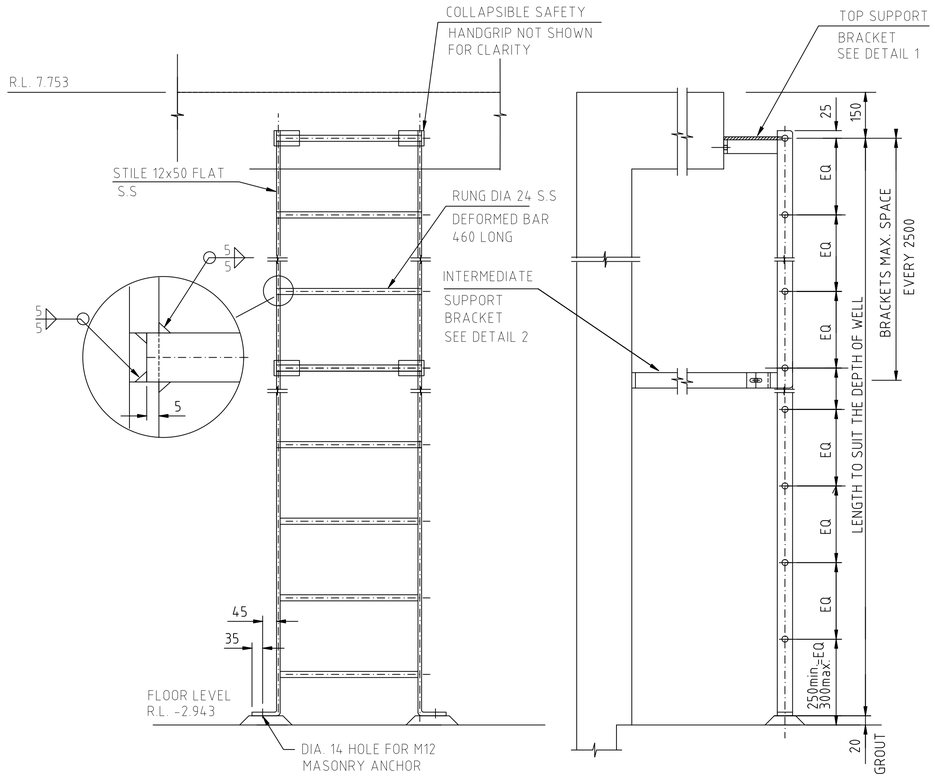
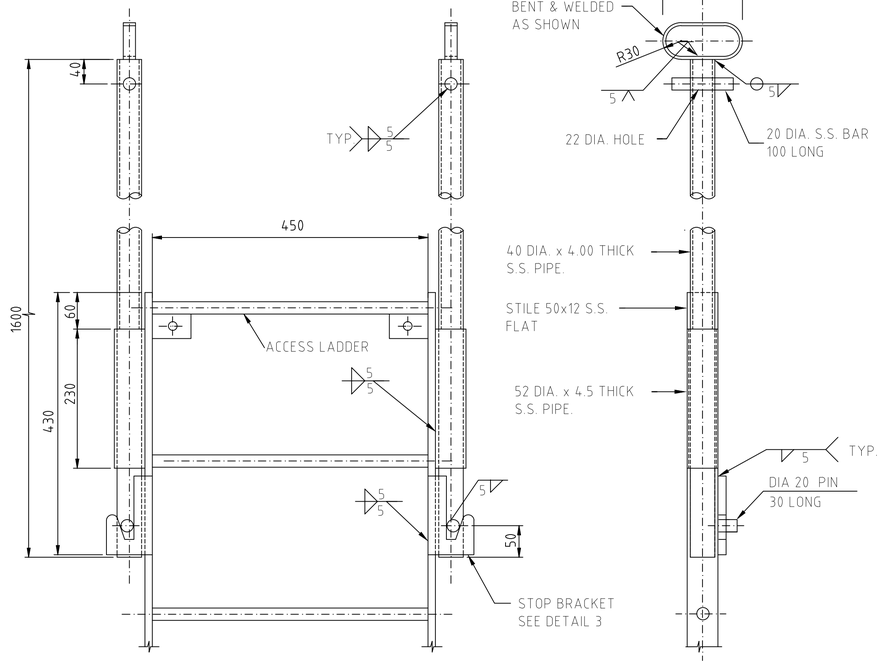


FRONT ELEVATION

SIDE ELEVATION



FRONT ELEVATION

SIDE ELEVATION

NOTE:

1. CONFIRM ALL DIMENSIONS BEFORE FABRICATION.

STAINLESS STEEL ACCESS LADDER
NTS

COLLAPSIBLE SAFETY HANDGRIP
NTS

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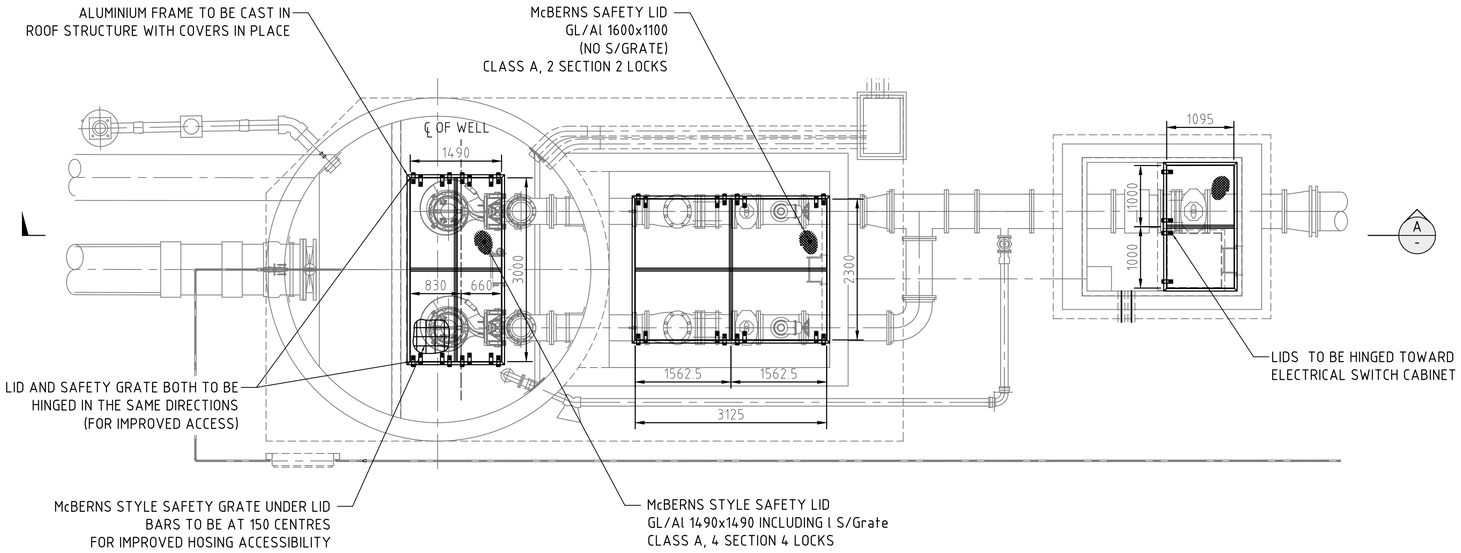
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
METALWORK

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	218	1	A

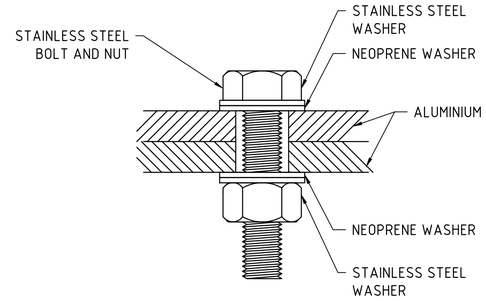
100 mm on original

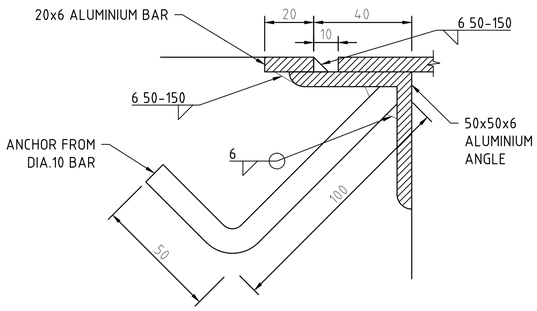
Plotted: 16/09/21 - 10:36 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-218.dwg

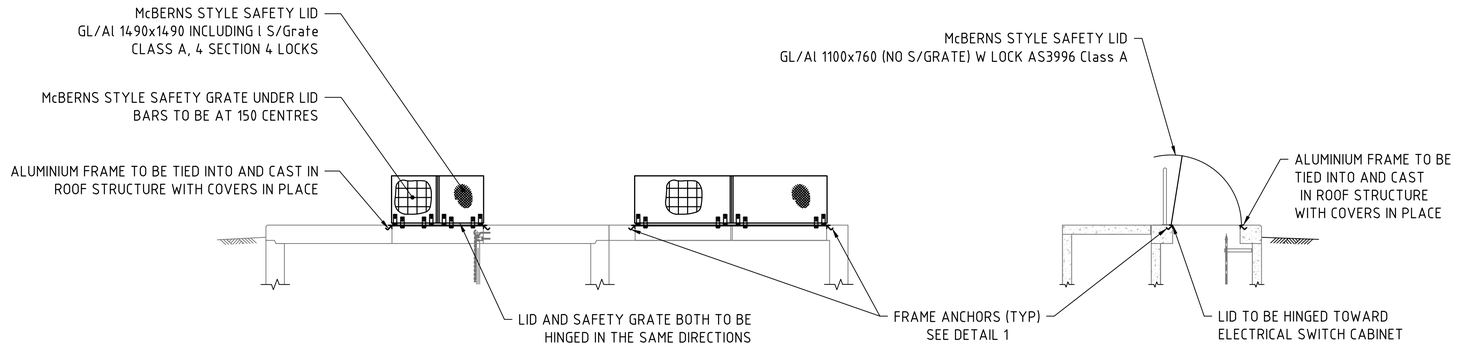


PUMP WELL FRAME AND COVER VALVE PIT FRAME AND COVER FLOW METER CHAMBER FRAME AND COVER

PLAN
SCALE 1:50







PUMP WELL FRAME AND COVER VALVE PIT FRAME AND COVER FLOW METER CHAMBER FRAME AND COVER

SECTION A
SCALE 1:50

NOTES:

1. FRAME TO BE PRE-ASSEMBLED AND TRANSPORTED TO SITE WHOLE.
2. FRAME TO BE CAST IN ROOF STRUCTURE WITH COVERS IN PLACE.
3. ALL FRAMES AND COVERS TO BE ALUMINIUM.
4. FRAME TO BE USED AS JIG TO FORM CONCRETE ROOF STRUCTURE.
5. CHAIN OR RATCHET SYSTEM FITTED SO THAT COVER CANNOT BE OPENED MORE THAN 120° SO AS TO PROTECT THE HINGES AND TO BE PROVIDED WITH FRAME.
6. ALL BOLTS TO BE GRADE 316 STAINLESS STEEL AND NUTS AND WASHERS TO BE GRADE 304 STAINLESS STEAL U.N.O. AND TO HAVE 2mm CLEARANCE IN HOLES. FIBRE OR NEOPRENE WASHERS TO BE FITTED BETWEEN ALL STAINLESS STEEL BOLTS AND ALUMINIUM METALWORK - SEE DETAIL 2.
7. COVERS TO OVERLAP FRAMES BY A MINIMUM OF 30mm.
8. HINGE AND HASP TO BE CAST AS PART OF THE ROOF STRUCTURE
9. ALL WELDS ARE TO BE 6mm CONTINUOUS FILLET U.N.O. IN ACCORDANCE WITH A.S.1665.
10. McBERNS STYLE SAFETY GRATE UNDER LID, BARS TO BE AT 150 CENTRES.

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APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO	

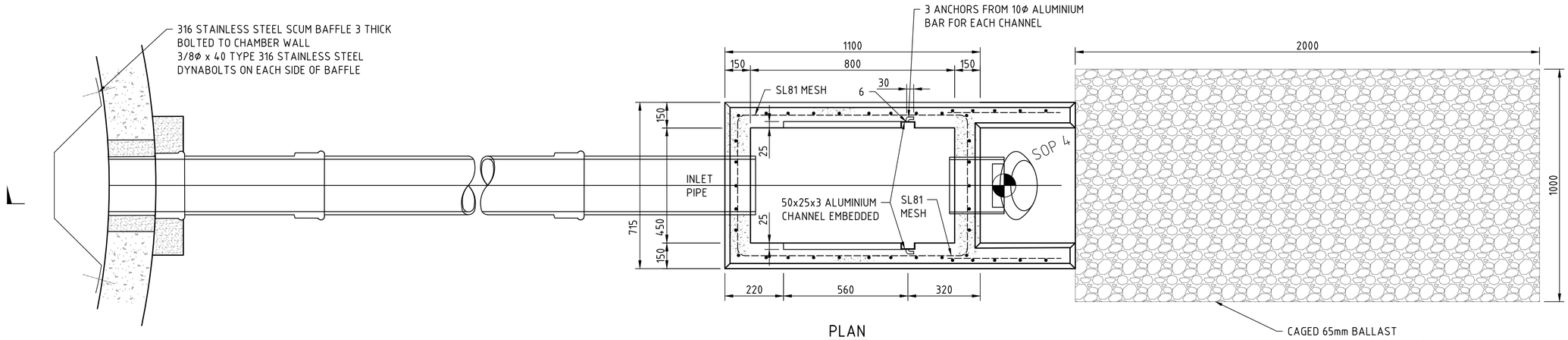
SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
FRAMES AND COVERS

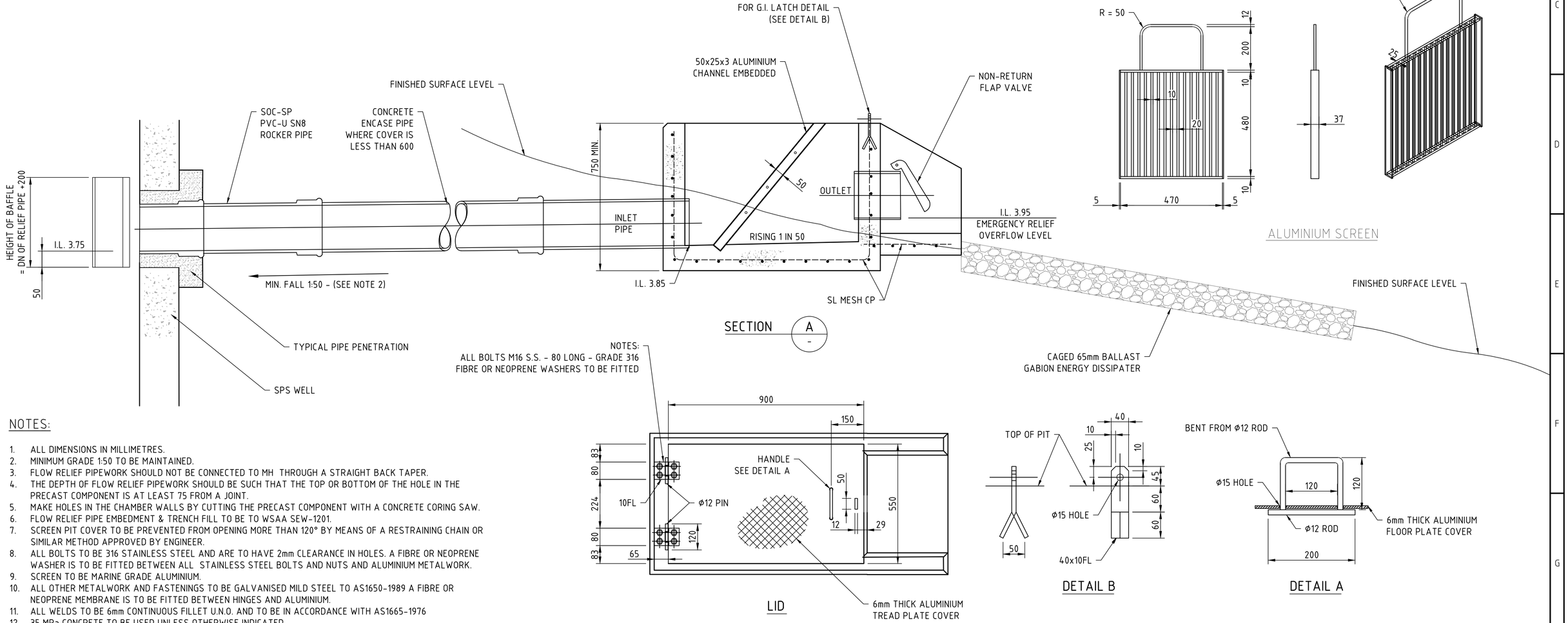
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	219	1	A

Plotted: 16/09/21 - 10:15 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-219.dwg

100 mm on original

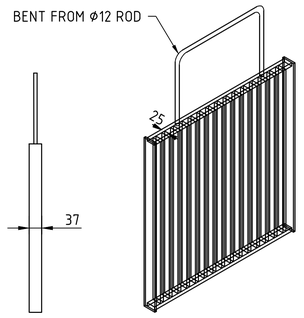


PLAN



SECTION A -

ALUMINIUM SCREEN



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. MINIMUM GRADE 1:50 TO BE MAINTAINED.
3. FLOW RELIEF PIPEWORK SHOULD NOT BE CONNECTED TO MH THROUGH A STRAIGHT BACK TAPER.
4. THE DEPTH OF FLOW RELIEF PIPEWORK SHOULD BE SUCH THAT THE TOP OR BOTTOM OF THE HOLE IN THE PRECAST COMPONENT IS AT LEAST 75 FROM A JOINT.
5. MAKE HOLES IN THE CHAMBER WALLS BY CUTTING THE PRECAST COMPONENT WITH A CONCRETE CORING SAW.
6. FLOW RELIEF PIPE EMBEDMENT & TRENCH FILL TO BE TO WSAA SEW-1201.
7. SCREEN PIT COVER TO BE PREVENTED FROM OPENING MORE THAN 120° BY MEANS OF A RESTRAINING CHAIN OR SIMILAR METHOD APPROVED BY ENGINEER.
8. ALL BOLTS TO BE 316 STAINLESS STEEL AND ARE TO HAVE 2mm CLEARANCE IN HOLES. A FIBRE OR NEOPRENE WASHER IS TO BE FITTED BETWEEN ALL STAINLESS STEEL BOLTS AND NUTS AND ALUMINIUM METALWORK.
9. SCREEN TO BE MARINE GRADE ALUMINIUM.
10. ALL OTHER METALWORK AND FASTENINGS TO BE GALVANISED MILD STEEL TO AS1650-1989 A FIBRE OR NEOPRENE MEMBRANE IS TO BE FITTED BETWEEN HINGES AND ALUMINIUM.
11. ALL WELDS TO BE 6mm CONTINUOUS FILLET U.N.O. AND TO BE IN ACCORDANCE WITH AS1665-1976
12. 35 MPa CONCRETE TO BE USED UNLESS OTHERWISE INDICATED.

NOTES:
ALL BOLTS M16 S.S. - 80 LONG - GRADE 316
FIBRE OR NEOPRENE WASHERS TO BE FITTED

LID

DETAIL B

DETAIL A

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	JA	30/09/2021

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
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Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
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City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

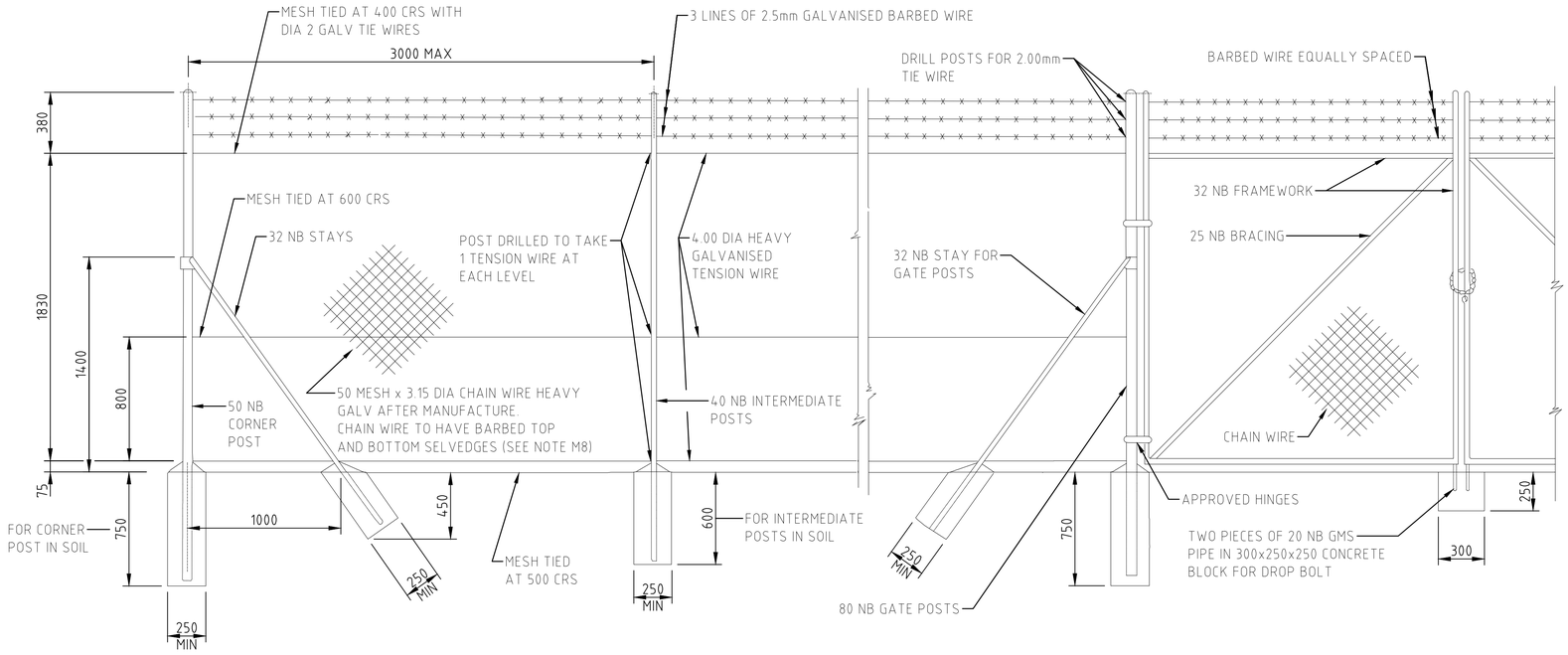
		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	30/09/2021	CARDNO
DRAWN:	SMV	30/09/2021	CARDNO
CHECKED:	PS	30/09/2021	CARDNO
APPROVED:	NM	30/09/2021	CARDNO

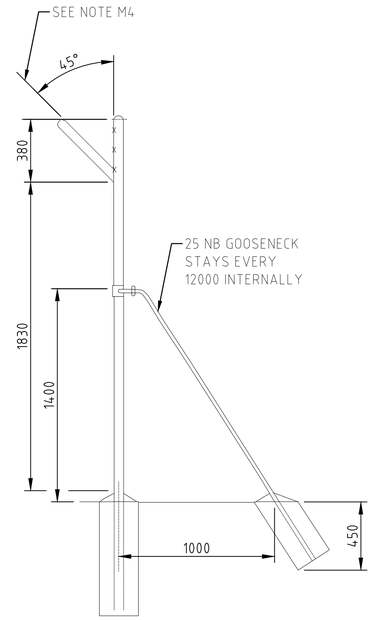
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
EMERGENCY RELIEF STRUCTURE DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	221	1	A

100 mm on original

Plotted: 16/09/21 - 14:20 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-221.dwg





MANPROOF WIRE MESH FENCE

	POST SIZE		DEPTH OF FOOTINGS	
	NOM BORE	THICKNESS	IN EARTH	IN ROCK
CORNER POSTS	50	3.6	750	450
GATE POSTS	80	4.0	750	450
INTERMEDIATE POSTS	40	3.2	600	300
DIAGONAL STAYS	32	3.2	450	300
GOOSENECK STAYS	25	3.2	450	300

NOTES

MANPROOF WIRE MESH FENCE

M1 GATES WIDER THAN 2000 TO HAVE 2 LEAVES EACH WITH 200 GALV. DROP BOLT, 10 GALV. CHAIN TO BE WELDED TO ONE LEAF FOR PADLOCK.

M2 ONLY APPROVED G.M.S. FITTINGS AND BOLTS TO BE USED. BOLTS TO BE BURRED AFTER NUTS ARE TIGHTENED.

M3 POSTS, STAYS ETC, TO BE G.M.S. PIPES.

M4 TOPS OF POSTS TO BE CRANKED AWAY FROM PROPERTY.

M5 ALL VERTICAL POSTS SHALL BE WEATHER CAPPED.

M6 POSTHOLES IN ROCK SHALL BE 50 LARGER THAN THE OUTSIDE OF THE PIPE; PIPE SHALL BE GROUTED IN WITH 3:1 SAND/CEMENT MORTAR.

M7 POSTHOLES IN OTR TO BE MIN DIA 300 BACKFILLED WITH GRADE 15 CONCRETE.

M8 MESH MAY BE GREEN OR BLACK P.V.C. COATED IF SPECIFIED.

GENERAL

G1 ALL METALWORK TO BE HOT DIP GALVANISED AFTER FABRICATION, TO AS/NZS 4680.

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

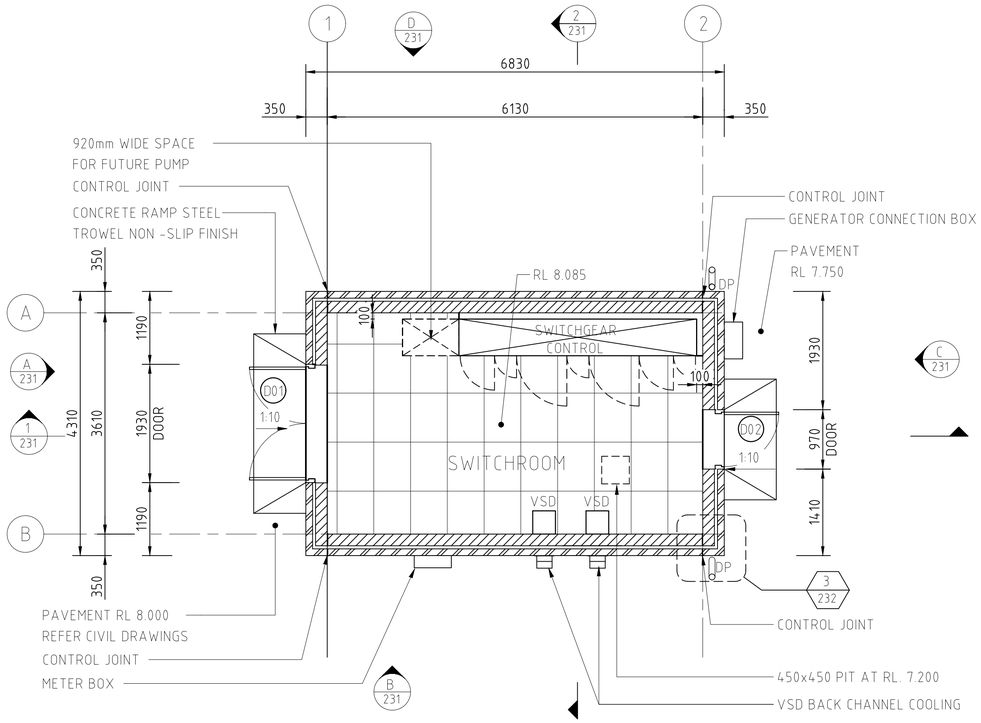
		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	30/09/2021	CARDNO
DRAWN:	SMV	30/09/2021	CARDNO
CHECKED:	PS	30/09/2021	CARDNO
APPROVED:	NM	30/09/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
TYPICAL MANPROOF FENCE

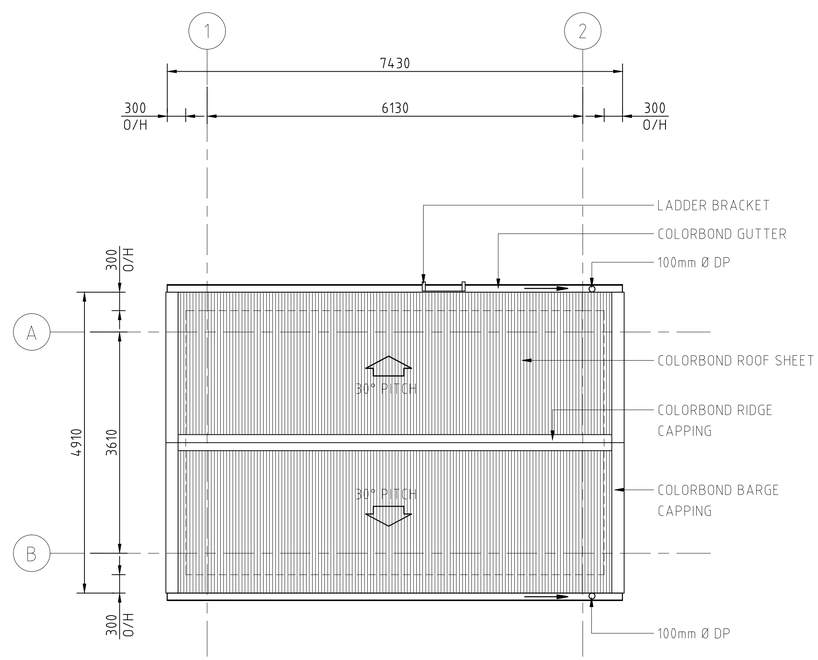
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	222	1	A

100 mm on original

Plotted: 16/09/21 - 15:01 CAD File: C:\Users\jaypee.quintao\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-222.dwg



GROUND FLOOR PLAN
SCALE 1:50



ROOF PLAN
SCALE 1:50

0 1 2 3 4 5m
SCALE 1:50 @A1

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

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DRAWN:	SMV	DATE: 30/09/2021	COMPANY: CARDNO
CHECKED:	PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED:	NM	DATE: 30/09/2021	COMPANY: CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
FLOOR PLAN AND ROOF PLAN

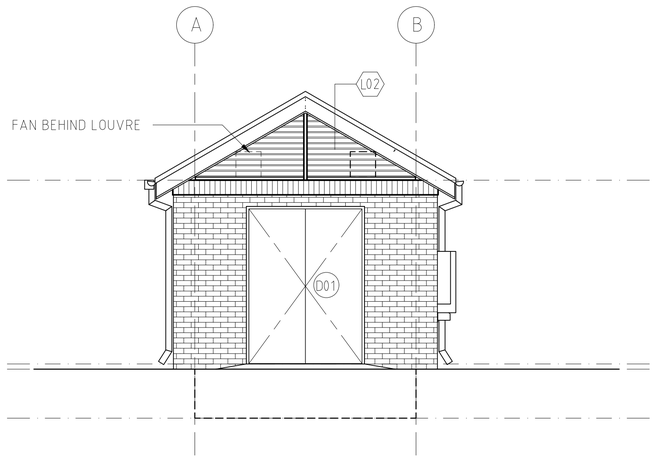
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	230	1	B

100 mm on original

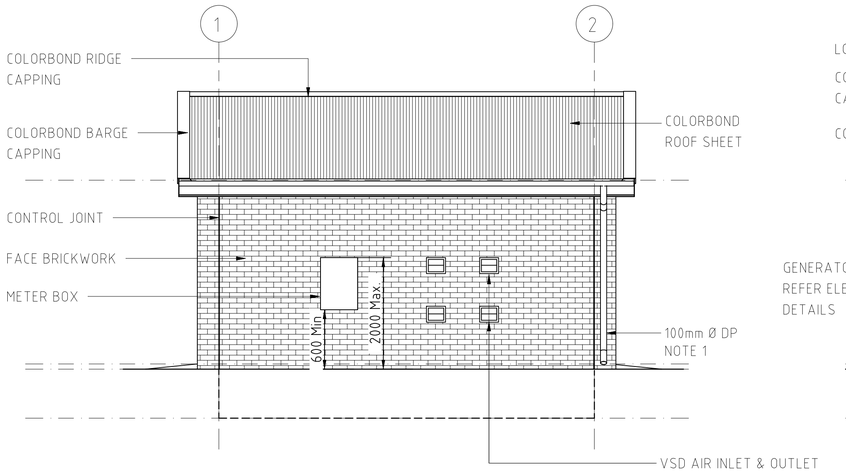
Plotted: 16/09/21 - 11:08 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-230.dwg

NOTE:

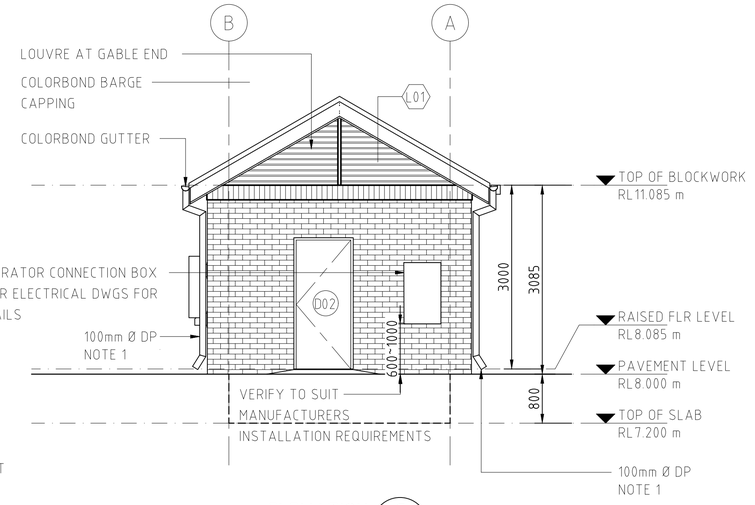
1. DUE TO HIGH REACTIVITY OF THE SOIL, THE DP IS RECOMMENDED TO DISCHARGE INTO A GULLY AND EVENTUALLY TO STORM WATER.



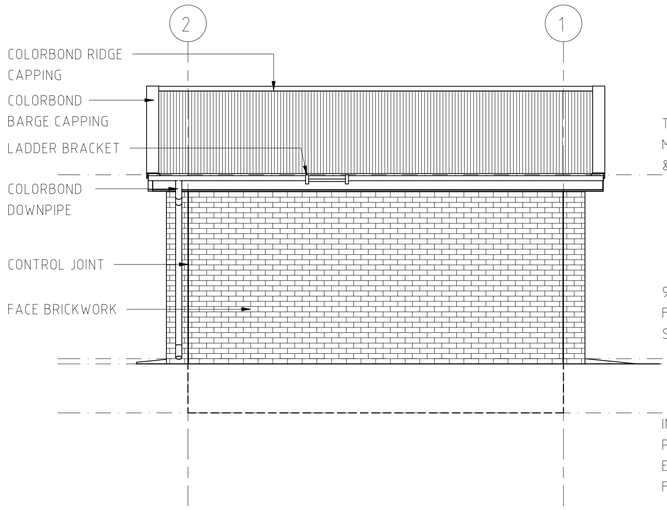
ELEVATION A
SCALE 1:50 230



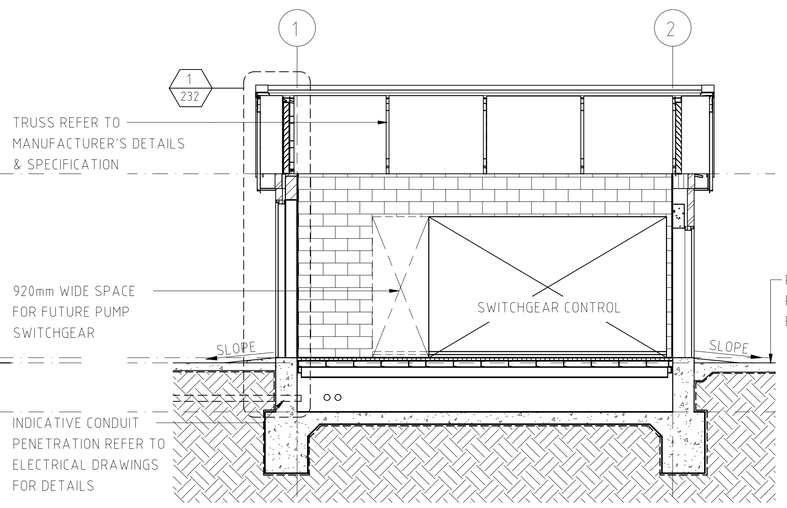
ELEVATION B
SCALE 1:50 230



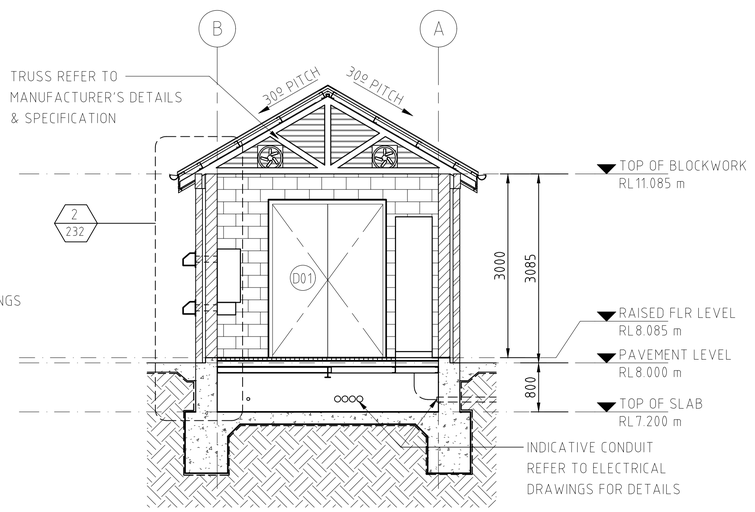
ELEVATION C
SCALE 1:50 230



ELEVATION D
SCALE 1:50 230



SECTION 1
SCALE 1:50 230



SECTION 2
SCALE 1:50 230

0 1 2 3 4 5m
SCALE 1:50 @A1

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

CONSULTANT DETAILS:
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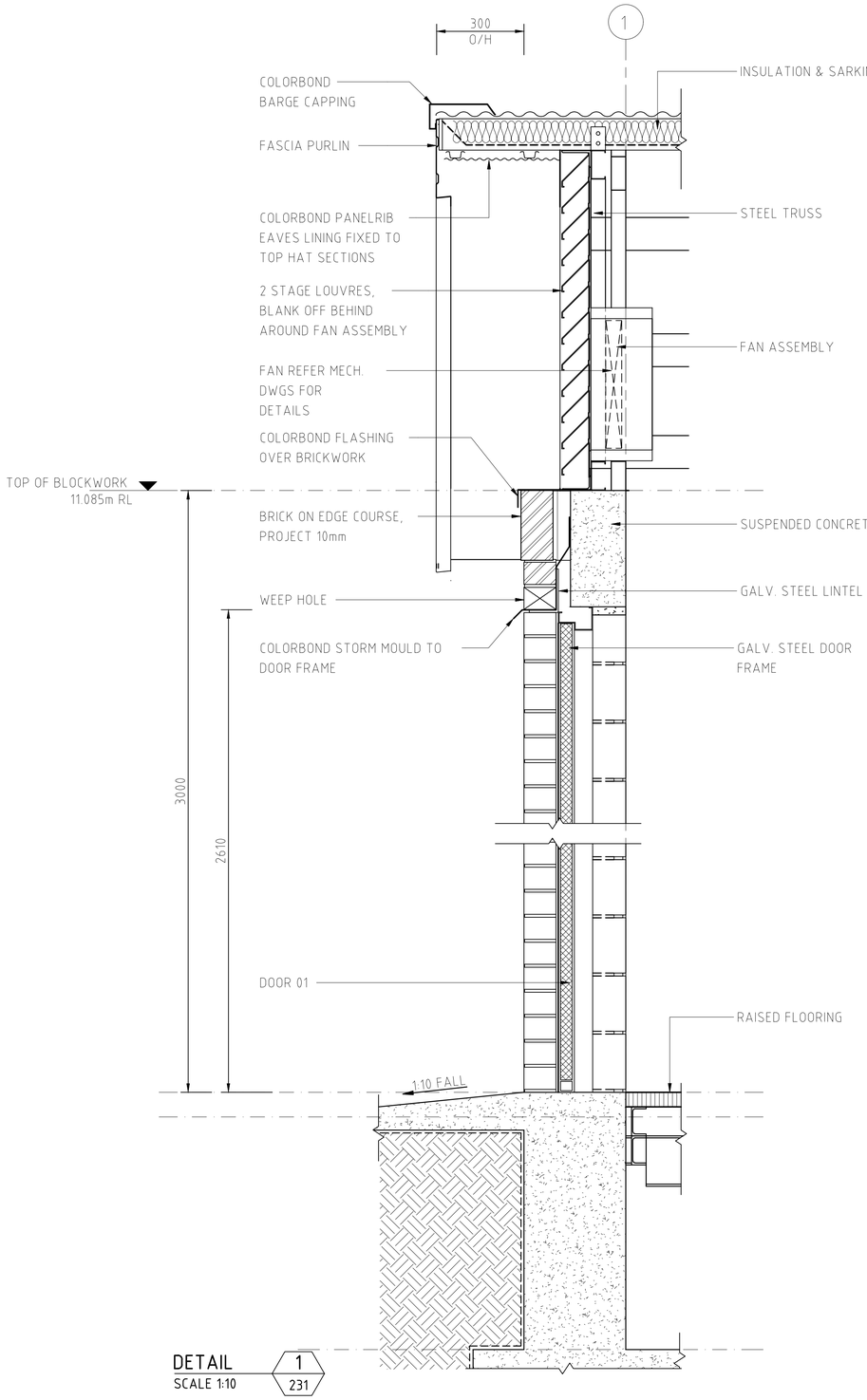
APPROVED:	NM	30/09/2021	CARDNO

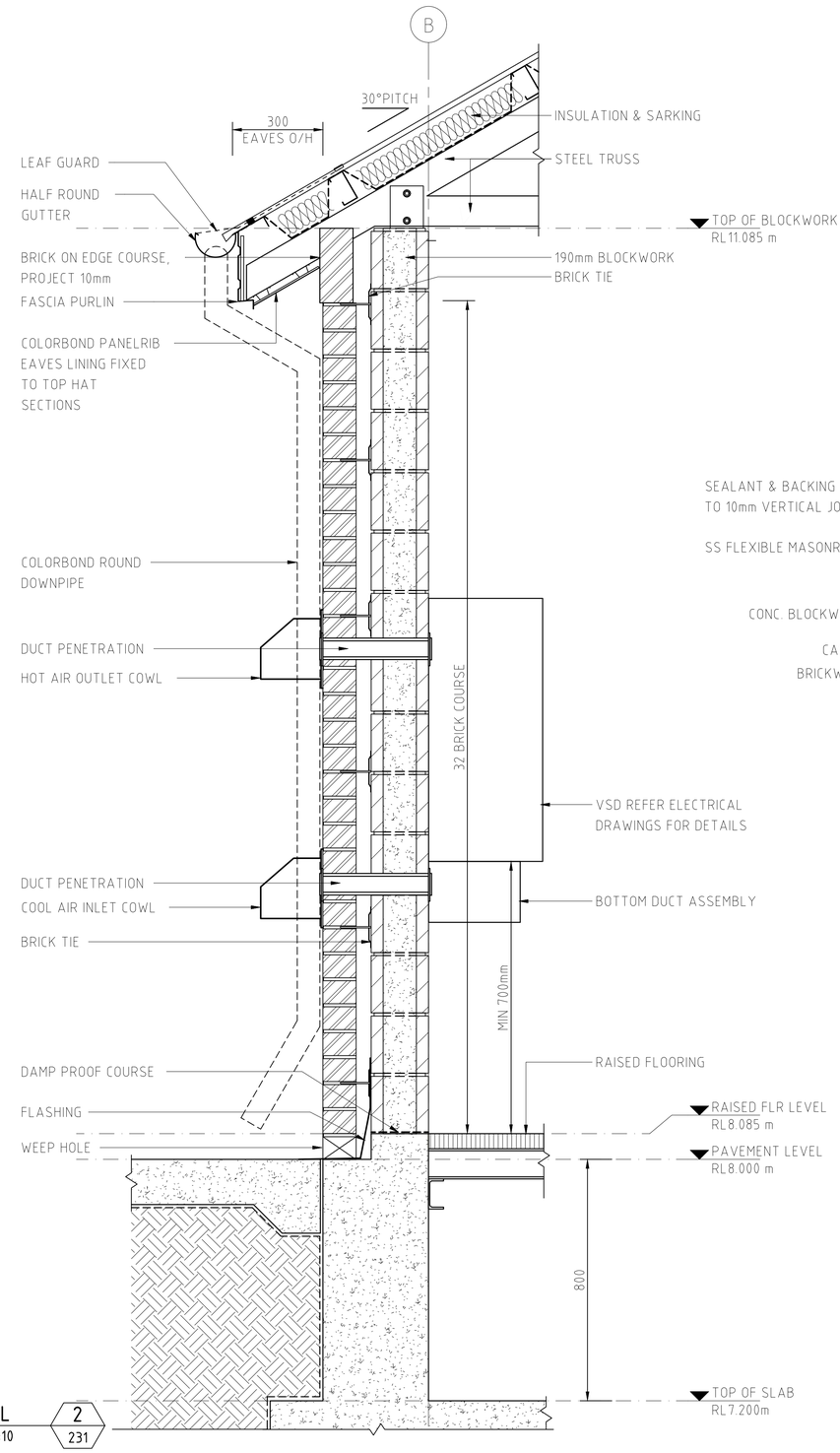
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
ELEVATIONS AND SECTIONS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	231	1	B

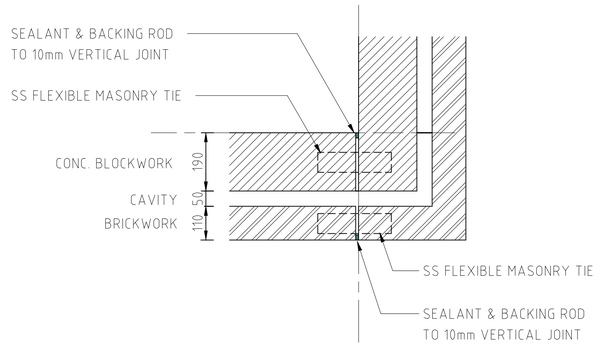
Plotted: 16/09/21 - 11:09 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-231.dwg



DETAIL 1 / 231
SCALE 1:10



DETAIL 2 / 231
SCALE 1:10



CONTROL JOINT TYPICAL DETAIL

DETAIL 3 / 231
SCALE 1:10

0 0.2 0.4 0.6 0.8 1m
SCALE 1:10 @A1

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

	DATE	COMPANY
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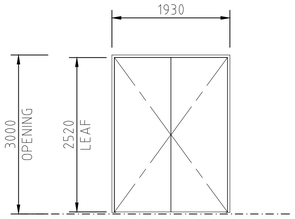
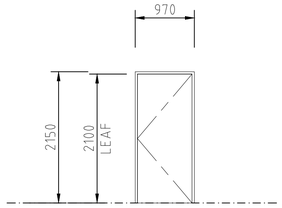
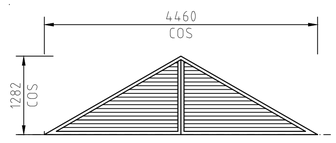
APPROVED: NM	30/09/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
SECTION DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	232	1	B

Plotted: 16/09/21 - 11:15 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-232.dwg

DOOR AND LOUVRE SCHEDULE

DIMENSION			
MARK	D01	D02	L01 & L02
TYPE	EXTERNAL DOUBLE LEAF PERSONNEL & EQUIPMENT DOOR	EXTERNAL SINGLE LEAF PERSONNEL DOOR	LOUVRE
FRAME	STEEL FRAME TO BE CONTINUOUSLY WELDED FROM METALLIC COATED STEEL SHEET SECTION, INCLUDING NECESSARY ACCESSORIES SUCH AS BUFFERS, STRIKE PLATES, SPREADERS, FIXING TIES OR BRACKETS, AND SUITABLE PROVISION FOR FIXING HARDWARE, AND PRE-FINISHED WITH PROTECTIVE COATING. FRAME FINISH BEFORE PAINT: GRIND WELDS SMOOTH, COLD GALVANIZE JOINTS AND SHOP PRIME FULL FRAME. BASE METAL THICKNESS: GREATER OR EQUAL TO 1.4mm. METALLIC COATED STEEL SHEET: TO AS1397. PAINT FINISH AS PER CLIENT STANDARD	STEEL FRAME TO BE CONTINUOUSLY WELDED FROM METALLIC COATED STEEL SHEET SECTION, INCLUDING NECESSARY ACCESSORIES SUCH AS BUFFERS, STRIKE PLATES, SPREADERS, FIXING TIES OR BRACKETS, AND SUITABLE PROVISION FOR FIXING HARDWARE, AND PRE-FINISHED WITH PROTECTIVE COATING. FRAME FINISH BEFORE PAINT: GRIND WELDS SMOOTH, COLD GALVANIZE JOINTS AND SHOP PRIME FULL FRAME. BASE METAL THICKNESS: GREATER OR EQUAL TO 1.4mm. METALLIC COATED STEEL SHEET: TO AS1397. PAINT FINISH AS PER CLIENT STANDARD.	STEEL FRAMED STORM PROOF TWO STAGE LOUVRES WITH POWDER COATED ALUMINIUM BLADES, ALL AS SPECIFIED. FIT WITH 25mm GALVANISED BIRD MESH TO REAR FACE AND G4 PLEATED FILTER.
DESCRIPTION	METAL LINED SOLID CORE, 40mm WITH WP PLY FACING AND COLORBOND STEEL CLADDING TO ALL FACES, INCL. STILES, TOP AND BOTTOM. EXIT MUST BE READILY OPENABLE WITHOUT A KEY FROM THE INSIDE (DIRECTION OF EGRESS OUT), LEVEL ACTION BY SINGLE HAND DOWNWARD ACTION OR PUSHING ON A SINGLE DEVICE, HEIGHT OF HANDLE LOCATED BETWEEN 900 TO 1200mm FROM FLOOR LEVEL. THE DOOR IS ABLE TO BE OPENED MANUALLY UNDER A FORCE OF NOT MORE THAN 110N.	METAL LINED SOLID CORE, 40mm WITH WP PLY FACING AND COLORBOND STEEL CLADDING TO ALL FACES, INCL. STILES, TOP AND BOTTOM. EXIT MUST BE READILY OPENABLE WITHOUT A KEY FROM THE INSIDE (DIRECTION OF EGRESS OUT), LEVEL ACTION BY SINGLE HAND DOWNWARD ACTION OR PUSHING ON A SINGLE DEVICE, HEIGHT OF HANDLE LOCATED BETWEEN 900 TO 1200mm FROM FLOOR LEVEL. THE DOOR IS ABLE TO BE OPENED MANUALLY UNDER A FORCE OF NOT MORE THAN 110N.	N/A
LOCKS, LATCHES, KEYING	REFER TO MANUFACTURERS SPECIFICATION.	REFER TO MANUFACTURERS SPECIFICATION.	N/A
FURNITURE	STAINLESS STEEL, SATIN FINISH, D LEVER HANDLES ON PLATE, COMPLIANT WITH AS1428.1_2009, INTEGRATED KEY CYLINDER. DELAYED ACTION HEAVY DUTY DOOR CLOSER WITH BACK CHECK OPERATION EQ. TO KABA 9026 SERIES.	STAINLESS STEEL, SATIN FINISH, D LEVER HANDLES ON PLATE, COMPLIANT WITH AS1428.1_2009, INTEGRATED KEY CYLINDER. DELAYED ACTION HEAVY DUTY DOOR CLOSER WITH BACK CHECK OPERATION EQ. TO KABA 9026 SERIES.	N/A
HINGES	3 OFF SS HEAVY DUTY BUTT HINGES 304 GRADE, 100x75.	3 OFF SS HEAVY DUTY BUTT HINGES 304 GRADE, 100x75.	N/A
SEAL	RAVEN PRODUCTS P/L ACOUSTIC DOOR SEALS -RP47 SI FRAME SEALS (JAMB & HEAD) RP99 SI BOTTOM SEAL FIXED TO INSIDE FACE OF DOORS TO FIT TIGHT TO FLOOR -ADD RP16 SI TO ACTIVE LEAF OF PAIR (EXTERNAL)	RAVEN PRODUCTS P/L ACOUSTIC DOOR SEALS -RP47 SI FRAME SEALS (JAMB & HEAD) RP99 SI BOTTOM SEAL FIXED TO INSIDE FACE OF DOORS TO FIT TIGHT TO FLOOR.	N/A
WEATHERPROOFING	INSTALL FLASHING, WEATHER BARS, DRIPS, STORM MOULDS, CAULKING AND POINTING TO PREVENT WATER FROM PENETRATING THE BUILDING STRUCTURE UNDER THE PREVAILING SERVICE CONDITIONS, INCLUDING NORMAL STRUCTURAL MOVEMENT OF THE BUILDING.	INSTALL FLASHING, WEATHER BARS, DRIPS, STORM MOULDS, CAULKING AND POINTING TO PREVENT WATER FROM PENETRATING THE BUILDING STRUCTURE UNDER THE PREVAILING SERVICE CONDITIONS, INCLUDING NORMAL STRUCTURAL MOVEMENT OF THE BUILDING.	INSTALL CAULKING AND POINTING TO PREVENT WATER FROM PENETRATING THE BUILDING STRUCTURE UNDER THE PREVAILING SERVICE CONDITIONS, INCLUDING NORMAL STRUCTURAL MOVEMENT OF THE BUILDING.

DRAFT CONCEPT DESIGN

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

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SURVEYED:	JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED:	PS	DATE: 30/09/2021	COMPANY: CARDNO
DRAWN:	SMV	DATE: 30/09/2021	COMPANY: CARDNO
CHECKED:	PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED:	NM	DATE: 30/09/2021	COMPANY: CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
OPENING SCHEDULE

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	233	1	B

Plotted: 16/09/21 - 11:11 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-233.dwg
5/28/2021 10:43:20 AM 23142664104_ST ANNS SWITCHROOM_detached.rvt

100 mm on original

GENERAL

1. READ THESE NOTES IN CONJUNCTION WITH OTHER ENGINEERING DRAWINGS AND PROJECT SPECIFICATIONS, AND WITH SUCH OTHER WRITTEN INSTRUCTIONS ISSUED. IN CASE OF DISCREPANCY, PRECEDENCE IS GIVEN TO DRAWINGS, THEN NOTES, THEN SPECIFICATION.
2. CARRY OUT WORK IN A SAFE MANNER IN ACCORDANCE WITH APPLICABLE LEGISLATION, STATUTORY REGULATIONS, BY-LAWS OR RULES. CONTRACTOR IS RESPONSIBLE FOR OCCUPATIONAL HEALTH AND SAFETY OF SITE PERSONNEL AND GENERAL PUBLIC IN ACCORDANCE WITH WORK HEALTH AND SAFETY ACT 2011, LEGISLATIVE REQUIREMENTS, ASSOCIATED REGULATIONS AND CODES OF PRACTICE, INDUSTRIAL AGREEMENTS AND ACCEPTED INDUSTRY PRACTICE.
3. REFER DISCREPANCIES TO SUPERINTENDENT BEFORE PROCEEDING WITH WORK.

DESIGN ASSUMPTIONS

4. ALL STRUCTURES TO HAVE A DESIGN WORKING LIFE OF 50 YEARS UNO. EXCEPTION INCLUDES JOINT SEALANTS, STRUCTURAL STEELWORK ETC. WHERE PERIODIC MAINTENANCE WILL BE REQUIRED.
5. STRUCTURAL WORK HAS BEEN DESIGNED FOR FOLLOWING LOADS:
   - LOADS AS DEFINED IN DRAWINGS.
   - BUILDING IMPORTANCE LEVEL : 2
   - WIND LOADS TO AS/NZS1170.0:2002: AS/NZS 1170.2:2011 AND BCA
   - REGION : A2
   - AVERAGE RECURRENCE INTERVAL : 500 years
   - ULTIMATE REGIONAL WIND SPEED V_R (3 sec GUST): 45 m/s
   - SERVICEABILITY REGIONAL WIND SPEED V_{25} (3 sec) 37 m/s
   - DIRECTIONAL MULTIPLIER : 1.0
   - TERRAIN CATEGORY : 2.0
   - SHIELDING MULTIPLIER (M) : 1.0
   - TOPOGRAPHIC MULTIPLIER (Mr) : 1.0
   - LIVE LOADS TO AS 1170.1:2002, AND AS FOLLOWS:
     - ROOFS: GREATER OF 0.25 kPa OR (1.8/A) + 0.12 kPa.
     - BUILDING FLOOR 5.0 kPa.

FOUNDATIONS AND FOOTINGS

1. SITE IS CLASSIFIED AS CLASS H1 TO AS2870.
2. REFER TO GEOTECHNICAL INVESTIGATION REPORT No. WI21102IP PREPARED BY CARDNO DATED MAY 2021. NOTIFY SUPERINTENDENT IF CONDITIONS ENCOUNTERED DIFFER FROM THOSE DESCRIBED IN THE REPORT AND SEEK DIRECTIONS.
3. REMOVE TOP SOIL CONTAINING GRASS ROOTS OR OTHER ORGANIC MATTER, RUBBLE AND / OR DEBRIS AND OTHER UNSUITABLE MATERIAL BELOW FOUNDATIONS.
4. BACKFILL OVER EXCAVATION WITH GRADE N15 BLINDING CONCRETE.
5. ENSURE EXCAVATIONS ARE STABLE AND PROTECT SURROUNDING PROPERTY AND SERVICES FROM ADVERSE EFFECTS OF GROUND WORKS. PROVIDE TEMPORARY WORKS AS REQUIRED. PROVIDE SHORING CERTIFIED BY SUITABLY QUALIFIED STRUCTURAL ENGINEER TO ALL DEEP EXCAVATIONS WHERE REQUIRED.
6. USE SUITABLE CONSTRUCTION TECHNIQUES AND EQUIPMENT FOR BACKFILLING ADJACENT TO STRUCTURES TO PREVENT OVERSTRESS AND DAMAGE. BACKFILL EVENLY TO AVOID DIFFERENTIAL SOIL PRESSURES ON STRUCTURES. BACKFILL AGAINST STRUCTURES ONLY AFTER SPECIFIED CONCRETE STRENGTH IS ACHIEVED, AND PERMANENT SUPPORT INSTALLED WHERE APPLICABLE.
7. KEEP EXCAVATIONS FREE OF WATER. PROVIDE ADEQUATE DRAINAGE TO ENSURE FORMATION IS NOT AFFECTED BY MOISTURE. PREVENT FOUNDATION DRYING OUT DUE TO EXPOSURE. PLACE BLINDING, FOOTINGS, PILES AND BACKFILL AS SOON AS PRACTICABLE AFTER EXCAVATION.
8. PROVIDE SAFETY MESH AND OTHER PROTECTION TO PREVENT EXPOSURE OF PERSONNEL TO EXCAVATION DURING FOUNDATION CONSTRUCTION.
9. SERVICES PASS THROUGH MIDDLE THIRD OF FOOTING, SLEEVE SERVICES OR PROVIDE40mm THICK CLOSED-CELL POLYETHYLENE LAGGING.
10. WHERE SERVICES PASS UNDER FOOTINGS BACKFILL TRENCHES WITH BLINDING CONCRETE FOR 150mm EACH SIDE OF FOOTING AGAINST CLEAN, DRY, UNDISTURBED NATURAL MATERIAL. PROVIDE FLEXIBLE JOINTS IN STORMWATER AND WASTEWATER SERVICES AT EXTERIOR OF BUILDING.
11. ENSURE EXCAVATION ARE STABLE AND PROTECT SURROUNDING PROPERTY AND SERVICES FROM ADVERSE EFFECTS OF GROUND WORKS. PROVIDE TEMPORARY WORKS AS REQUIRED. PROVIDE SHORING CERTIFIED BY SUITABLY QUALIFIED STRUCTURAL ENGINEER TO ALL DEEP EXCAVATIONS WHERE REQUIRED.
12. DO NOT EXCAVATE WITHIN 45 DEGREE INFLUENCE LINE UNDER ADJACENT FOOTINGS.
13. ALL FOOTINGS TO BE FOUNDED 200 MIN. INTO A SOIL WITH A MINIMUM ALLOWABLE BEARING CAPACITY OF 100kPa.
14. TOP OF CONCRETE SLAB TO BE LOCATED ABOVE ADJACENT GROUND LEVELS AS SHOWN ON ARCHITECTURAL DRAWINGS. GROUND SURROUNDING BUILDING TO BE SLOPED SO THAT WATER WILL DRAIN AWAY FROM BUILDING TO SUITABLE DISCHARGE POINTS. WHERE ACHIEVED BY FILLING, FILL TO BE LESS PERMEABLE THAN UNDERLYING MATERIAL.

STEEL

1. ALL STEELWORK IS TO BE HOT DIPPED GALVANISED TO AS/NZS4680 AND AS1214 FOR FASTENERS. THICKNESS OF GALVANISED COATINGS TO AS/NZS4680. ZINC OF GALVANISING BATH TO BE NOT LESS THAN 98% PURE. BATH TEMPERATURE, TIME OF IMMERSION AND WITHDRAWAL SPEED TO BE AS REQUIRED TO ACHIEVE SPECIFIED COATING THICKNESS AND FINISH. ZINC COATING TO BE CONTINUOUS, ADHERENT, FREE FROM LUMPS, SPIKES, DAGS, RUNS, BLISTERS, ROUGHNESS, GRITTY AREAS, UNCOATED SPOTS, ACID AND BLOCK SPOTS, DROSS, FLUX AND OTHER IMPERFECTIONS.
2. PROVIDE STEEL IN ACCORDANCE WITH:
   - AS1163 GRADE C350 FOR RECTANGULAR AND SQUARE HOLLOW SECTIONS,
   - AS/NZS3678 FOR PLATES AND FLOOR PLATE,
   - AS/NZS3679 PART 2, GRADE 300 FOR WELDED BEAMS AND WELDED COLUMNS,
   - AS/NZS3679 PART 1 GRADE 300 OR BHP GRADE 300 PLUS FOR UNIVERSAL BEAMS, UNIVERSAL COLUMNS, PARALLEL FLANGE CHANNELS, AND ANGLES,
   - AS1397 GRADE G450 FOR PURLINS AND GIRTS, OTHERWISE TO COMPLY WITH AS/NZS3678 OR AS/NZS3679 GRADE 250 UNO.
3. STAIR, WALKWAY, PLATFORMS AND HANDRAILS SHALL COMPLY WITH AS1657.
4. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO THE SUPERINTENDENT FOR APPROVAL PRIOR TO FABRICATION.

WELDING

5. WELDING TO BE UNDERTAKEN BY SUITABLY QUALIFIED EXPERIENCED WELDER UNDER SUPERVISION OF QUALIFIED WELDING SUPERVISOR.
6. CARRY OUT WELDING TO AS/NZS1554: ALL INTERFACES BETWEEN STEEL SECTIONS TO BE CONNECTED WITH 6 mm CONTINUOUS FILLET WELDS ALL ROUND, BOTH SIDES UNO.
   - WELDS TO BE SHOP WELDED UNO.
   - WELDS TO BE CATEGORY SP.
   - ELECTRODES TO BE LOW CARBON WITH TENSILE STRENGTH OF fuw=490MPa, PRE-APPROVED TO AS/NZS1554, eg CLASSIFICATION B-E48XX.

REINFORCEMENT

1. SYMBOLS ON DRAWINGS FOR GRADE AND TYPE OF REINFORCEMENT ARE AS FOLLOWS:
   - N: HOT ROLLED GRADE 500 DEFORMED (RIBBED) BAR DUCTILITY CLASS N TO AS/NZS4671
   - SL: HARD DRAWN WIRE GRADE 500 SQUARE MESH DUCTILITY CLASS L TO AS/NZS4671
2. PROVIDE ACRS (AUSTRALIAN CERTIFICATION AUTHORITY FOR REINFORCING STEEL LTD) CERTIFICATION OF COMPLIANCE WITH AS/NZS4671 FOR ALL REINFORCEMENT.
3. REINFORCEMENT TO BE CLEAN, FREE OF LOOSE MILL SCALE, RUST, OIL, GREASE, MUD OR OTHER MATERIAL THAT MIGHT REDUCE BOND BETWEEN REINFORCEMENT AND CONCRETE.
4. PROVIDE ONE CONTINUOUS BAR PARALLEL TO (WITHIN 75 mm OF) CONCRETE EDGES UNO.
5. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND IS NOT NECESSARILY IN TRUE PROJECTION. SET REINFORCEMENT OUT AT EQUAL CENTRES IF SPACING IS NOT NOMINATED.
6. DO NOT PLACE OR MOVE REINFORCEMENT DURING OR AFTER CONCRETE PLACEMENT.
7. LAPPED SPLICE LENGTHS FOR VERTICAL BARS (AND HORIZONTAL BARS WITH LESS THAN 300 mm CONCRETE CAST BELOW THE BAR) SPACED AT 150 mm CENTRES TO COMPLY WITH THE FOLLOWING UNO:

COVER	f'c	N12	N16	N20	N24	N28	N32
≥25	≥20	590	890	1210	-	-	-
≥30	≥25	490	750	1040	1340	-	-
≥40	≥32	390	600	840	1110	1400	1710
≥50	≥40	350	480	690	920	1180	1450

DO NOT INTERPOLATE INTERMEDIATE VALUES OF SPLICE LENGTHS. EPOXY COATED BARS, BARS IN LIGHTWEIGHT CONCRETE AND SLIP FORMED CONCRETE WILL REQUIRE LONGER SPLICE LENGTHS. REFER TO AS3600 OR SUPERINTENDENT.

8. PROVIDE MINIMUM MESH LAPS TO CROSS WIRES OF REINFORCING MESH, SO THAT TWO OUTERMOST WIRES OF ONE SHEET OVERLAP TWO OUTERMOST WIRES OF ADJACENT SHEET BY AT LEAST 25 mm. FOR MESH TYPE SL81, USE 125 mm LAP LENGTH FOR THE END AND SIDE LAP. USE LAP LENGTHS BASED ON LARGEST WIRE SPACING.
9. DO NOT BEND OR STRAIN REINFORCEMENT IN A WAY THAT MAY CAUSE DAMAGE. BEND DIAMETERS TO BE TO AS3600. BARS TO BE BENT COLD UNO. GRADE 250 BARS MAY BE BENT AT TEMPERATURES UP TO 850°C. DO NOT COOL HEATED BARS BY QUENCHING.

MASONRY

GENERAL

1. MASONRY WORK TO BE TO AS3700 AND AS/NZS4455.
2. CONSTRUCT MASONRY COMPLETE WITH BED JOINT REINFORCEMENT, FLEXIBLE MASONRY ANCHORS, WALL TIES, FIXING STRAPS etc TO AS/NZS2699. USE ONLY R4 GRADE 316 OR 316L STAINLESS STEEL.
3. ENSURE WALLS WHICH RELY ON FLOORS FOR STABILITY ATTAIN SUFFICIENT STRENGTH BEFORE NEXT LEVEL IS COMMENCED.
4. USE GRADE 15 CONCRETE BLOCKS ie MINIMUM CHARACTERISTIC UNCONFINED COMPRESSIVE STRENGTH (Cu), 15 MPa TO AS/NZS4455 UNO AND OF DIMENSIONAL CATEGORY DW4 TO AS/NZS4455. USE BRICKS WITH MINIMUM CHARACTERISTIC COMPRESSIVE STRENGTH OF 20 MPa AND DIMENSIONAL CATEGORY DW1 TO AS/NZS4455 AND AS/NZS4456. DO NOT LAY CLAY BRICKS UNTIL THEY HAVE BEEN OUT OF KILN FOR AT LEAST 14 DAYS. COLOUR AND TEXTURE OF MASONRY UNITS TO BE WITHIN AN AGREED RANGE. MASONRY UNITS TO BE RESISTANT TO SALT ATTACK. MAXIMUM PERMEABILITY OF MASONRY UNITS TO BE 2 mm/minute. EFFLORESCENCE POTENTIAL OF MASONRY UNITS TO BE NIL OR SLIGHT. CHARACTERISTIC LATERAL MODULUS OF RUPTURE OF MASONRY UNITS TO BE 0.8 MPa.
5. FOR CONCRETE BLOCKWORK USE CLASS M3 MORTAR MADE WITH 1 PART CEMENT: 5 PARTS SAND AND A METHYL CELLULOSE WATER THICKENER (eg: 'DYNEX' AS PRODUCED BY A.V. SYNTEC) TO AS3700. WHERE REQUIRED IN TABLE 5 OF AS3700-2001, USE CLASS M4 MORTAR MADE WITH 1 PART CEMENT, 0 TO 0.25 PARTS LIME AND 3 PARTS SAND, OR 1 PART CEMENT AND 4 PARTS SAND PLUS A METHYL CELLULOSE WATER THICKENER (eg: 'DYNEX' AS PRODUCED BY A.V. SYNTEC) TO AS3700. SUBMIT DETAILS OF PROPOSED ADDITIVES FOR SUPERINTENDENT'S APPROVAL. USE WHITE CEMENT TO AS3972 TYPE GP OR GB, WITH IRON SALTS NOT EXCEEDING 1%. USE WELL GRADED CLEAN SAND WITH LOW CLAY CONTENT (MAXIMUM 10% PASSING THE 75 MICRON SIEVE) AND FREE FROM EFFLORESCING SALTS, ORGANIC MATTER AND OTHER IMPURITIES. USE HYDRATED BUILDING LIME TO AS1672.1 COLOUR AND TEXTURE OF FACE OR POINTING MORTAR TO MATCH APPROVED SAMPLE. USE APPROVED REFRACTORY MORTAR FOR REFRACTORY BRICKWORK, AS RECOMMENDED BY MANUFACTURER.
6. ENSURE THAT PERPENDS AND BEDS ARE COMPLETELY FILLED WITH MORTAR.
7. MORTAR BED JOINTS AND PERPENDS TO BE FULLY BEDDED, AND 10 mm MAXIMUM AS PER SECTION 4.9 OF AS3700-2001.
8. CONTROL JOINTS TO BE 20 mm WIDE WITH 25 mm DIAMETER CLOSED CELL POLYETHYLENE FOAM BACKING ROD AND APPROVED POLYSULPHIDE SEALANT AT EXTERNAL FACE UNO. FINISH SEALANT IN LINE WITH MORTAR JOINTS. TOLERANCE ON WIDTH +5, -0 mm. PROVIDE JOINTS IN WALL FINISHES AT CONTROL JOINTS IN MASONRY. PLACE POLYSTYRENE IN VERTICAL JOINTS DURING CONSTRUCTION TO ENSURE THAT MORTAR DROPPINGS AND OTHER HARD MATERIALS DO NOT FALL INTO OR REMAIN IN CONTROL JOINTS. REMOVE POLYSTYRENE AT COMPLETION.
9. INSTALL CONTROL JOINTS IN MASONRY AT 6 METRES MAXIMUM CENTRES (3 METRES MAXIMUM FROM CORNERS, AND AS SHOWN ON DRAWINGS.
10. PROVIDE WEEP HOLES IN THE FORM OF OPEN PERPENDS TO EXTERNAL LEAVES OF CAVITY WALLS IN COURSE ABOVE DAMP-PROOF COURSES, FLASHINGS AND CAVITY FILL, AND AT BOTTOMS OF UNFILLED CAVITIES. SPACING 750 mm MAXIMUM CENTRES.
11. USE "HEAVY DUTY" RIGID WALL TIES TO AS/NZS 2699 eg. MFA POSI-TIES" AND FIX TO MANUFACTURER'S RECOMMENDATIONS. TIES TO BE EMBEDDED 50 mm MINIMUM INTO MORTAR JOINTS. ENSURE 15 mm MINIMUM MORTAR COVER TO EXPOSED FACES.

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
STRUCTURAL DRAWING NOTES SHEET 1

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	234	1	B

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100 mm on original

LINTELS

12. LINTEL DURABILITY REQUIREMENTS TO BE IN ACCORDANCE WITH TABLE 12.2 OF AS3700. PROVIDE ONE LINTEL TO EACH WALL LEAF IN CONFORMANCE WITH THE LINTEL SCHEDULE. KEEP LINTELS 10 mm CLEAR OF HEADS OF FRAMES. PACK MORTAR BETWEEN ANY VERTICAL COMPONENT AND SUPPORTED MASONRY UNITS. FOR ANGLES INSTALL THE LONG LEG VERTICAL. PROVIDE MINIMUM BEARING EACH END AS FOLLOWS:
    - SPAN 5 1000 mm: 150x90x10 UA WITH 200 mm END BEARING.
    - SPAN > 1000 mm 5 3000 mm: 150x90x10 UA (LONG LEG VERTICAL) 200 mm END BEARING.

    TEMPORARILY PROP LINTELS UNTIL THE MASONRY REACHES REQUIRED STRENGTH TO PREVENT DEFLECTION OR EXCESSIVE ROTATION.
13. PROP COMPOSITE STEEL AND MASONRY LINTELS UNTIL MORTAR IN COURSES OF MASONRY BEING ENGAGED ABOVE LINTEL HAS CURED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

REINFORCED MASONRY

14. USE CONCRETE GROUT FOR FILLING CORES WITH:
    - MINIMUM f'c = 20 MPa TO AS3600.
    - MINIMUM CEMENT CONTENT = 300 kg/m3.
    - MAXIMUM AGGREGATE SIZE = 10 mm.
    - SLUMP = 230 ± 30 mm TO AS1012.3.
15. FOR BOND BEAMS USE CONCRETE WITH f'c = 20 MPa TO AS3600, SLUMP = 80 ±15 mm TO AS1012.3.
16. REMOVE MORTAR DROPPINGS FROM BOTTOM OF CORES BY USE OF CLEANOUT BLOCKS BEFORE PLACING CONCRETE AND AT HORIZONTAL BREAKS IN CONSTRUCTION. REMOVE MORTAR FINS PROTRUDING FROM JOINTS BEFORE PLACING CONCRETE.
17. DO NOT PROCEED WITH BLOCKWORK CONSTRUCTION MORE THAN SIX COURSES OR 1500 mm AHEAD OF CONCRETE PLACEMENT.
18. STOP CONCRETE 50 mm BELOW TOP OF BLOCKS TO PROVIDE KEY FOR FOLLOWING CONCRETE. ENSURE PROPER COMPACTION OF CONCRETE BY "RODDING" OR OTHER APPROVED MEANS.

LIGHT STEEL FRAMING

1. ROOF FRAMING INCLUDING ROOF BRACING, BLOCKING AND TIE DOWNS TO RESIST UPLIFT, ETC TO BE DESIGNED TO AS4600 AND NASH STANDARD FOR RESIDENTIAL AND LOWRISE STEEL FRAMING AND CERTIFIED BY AN INDEPENDENT CHARTERED ENGINEER PROVIDE WORKSHOP DRAWINGS AND DESIGN CALCULATIONS. SUBMIT THREE COPIES OF EACH TO PRINCIPAL'S REPRESENTATIVE FOR REVIEW OF GENERAL COMPLIANCE WITH DESIGN CONCEPTS. DO NOT COMMENCE FABRICATION UNTIL SHOP DRAWINGS HAVE BEEN REVIEWED. PRINCIPAL'S REPRESENTATIVE REVIEW DOES NOT INCLUDE CHECKING OF DIMENSIONS, AND DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR COMPLIANCE WITH DRAWINGS AND SPECIFICATIONS.
2. DESIGN CALCULATIONS/SHOP DRAWINGS TO SHOW:
    ARRANGEMENT OF MEMBERS, LOCATION OF MEMBERS IN BUILDING, LOADING PARAMETERS AND BRACING LENGTHS ASSUMED IN DESIGN, SIZE OF EACH MEMBER, TOLERANCES ON MEMBER SIZES, JOINT DETAILS INCLUDING LIFTING POINTS, METHOD OF FIXING AND BRACING, CORROSION PROTECTION, LONG TERM DEFLECTION, METHOD OF FABRICATION, SIZE AND SPECIFICATION OF GUSSETS, GUSSET FASTENINGS, BASE PLATE DETAILS, FIXINGS FOR PURLINS, GIRTS AND BRACING, METHOD OF HANDLING ERECTION INCLUDING TEMPORARY BRACING REQUIRED, IF ANY) PRECAMBER, ETC.
3. ROOF FRAMING SHALL BE DESIGNED FOR THE FOLLOWING LOADS:
    - DEAD LOADS ROOF CLADDING, FRAMING AND CEILINGS
    - PLANT AND DUCTS AS SHOWN ON MECHANICAL SHOP DRAWINGS.
    - ADDITIONAL TRUSS LOADS OF 0.15 kPa AS NOTED ON THIS DRAWING
4. MAX LONG TERM DEFLECTION OF ROOF FRAMING UNDER PERMANENT LOAD = SPAN/600.
5. MAX DEFLECTION UNDER OTHER LOADS: SPAN/400 OR 20mm WHICHEVER IS SMALLER.
6. DESIGN ROOF BRACING IS THE RESPONSIBILITY OF ROOF FRAMING DESIGNER. BRACING SHOWN IN THE DRAWING IS INDICATIVE ONLY.

ADDITIONAL TRUSS LOADS:

0.13 KpA (15kg/m^2) SERVICES LOAD (MECHANICAL AND ELECTRICAL) ACTING ON BOTTOM CHORDS OF TRUSSES.

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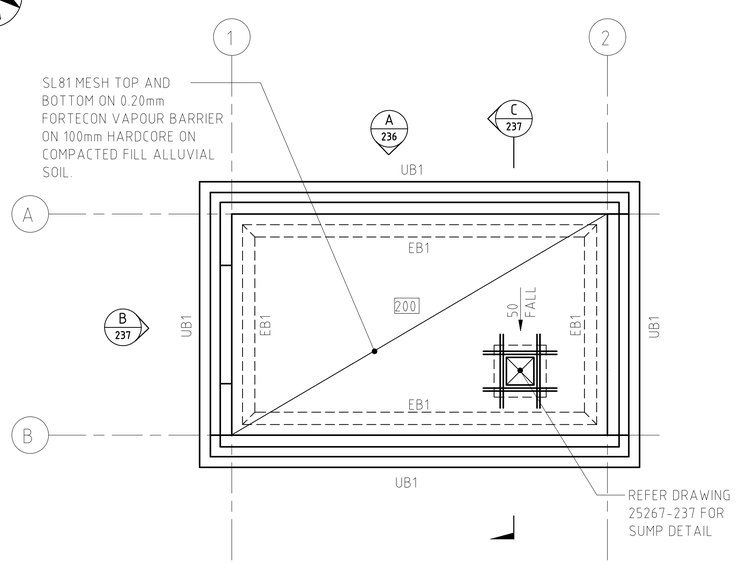
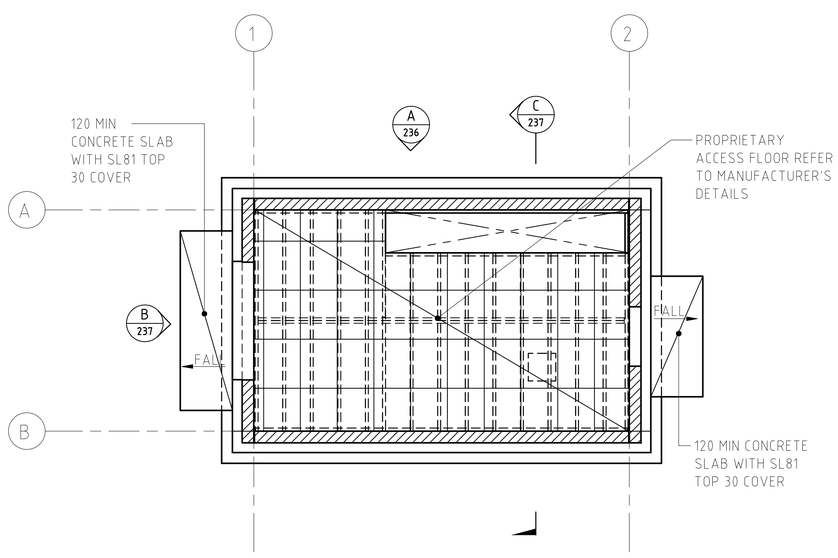
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
STRUCTURAL DRAWING NOTES SHEET 2

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	235	1	B

Plotted: 16/09/21 - 11:14 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-235.dwg



FOUNDATION PLAN
SCALE 1:50



GROUND FLOOR FRAMING PLAN
SCALE 1:50

NOTES:

1. REFER TO ARCHITECTURAL DRAWINGS FOR ALL LEVELS, SETOUT, DIMENSIONS, SLAB, SETDOWNS, CONTROL JOINT DETAILS, HOBS AND FALLS.
2. REFER TO DRAWINGS 25267-234 AND 235 FOR STRUCTURAL NOTES.
3. FALSE FLOOR SHALL BE DESIGNED FOR THE FOLLOWING LOADS:
   - EQUIPMENT WEIGHT
   - LIVE LOAD = 5kPa

LEGEND:

- 200 — DENOTES 200 SLAB THICKNESS
- DENOTES BEAM REBATE/ EXTERNAL SLAB LOCATIONS
- DENOTES BLOCKWORK WALL
- DENOTES BRICKWORK WALL

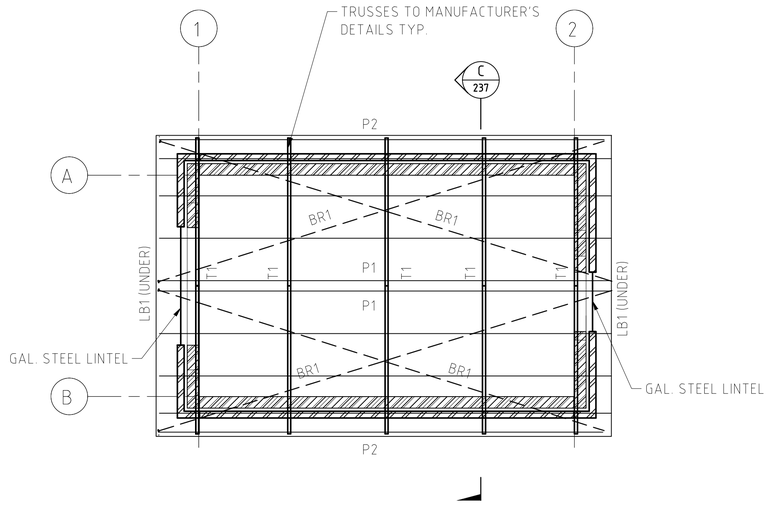
CONCRETE ELEMENTS:

STRUCTURAL ELEMENT	BLINDING	SLAB / FOOTINGS
EXPOSURE CLASSIFICATION	B1	B1
STRENGTH GRADE (MPa)	N15	N25
MIN. DENSITY (kg/m^3)	-	2350
MAX. AGGREGATE SIZE (mm)	20	20
CEMENT TYPE	GP	GP

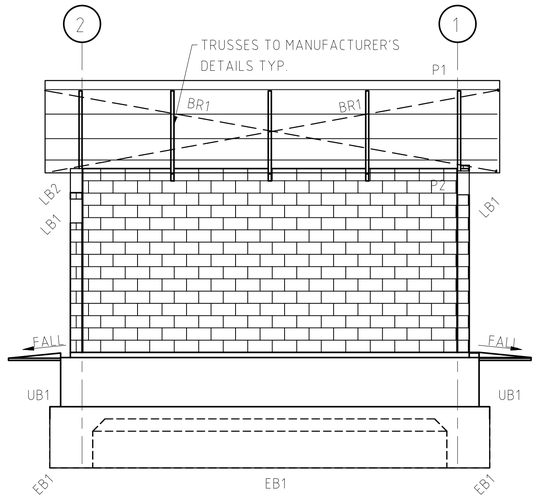
FOOTING SCHEDULE		
MARK	SIZE	REMARKS
EB1	700Wx1000D	4N20 TOP&BOTTOM BARS W/ N12 LIGS @ 400

BEAM SCHEDULE		
MARK	SIZE	REMARKS
LB1	190W x 390D	400 MIN END BEARING REFER TO DETAIL
UB1	350W x 885D	REFER DETAIL

ROOF FRAMING SCHEDULE		
MARK	SIZE	REMARKS
BR1	STEEL BRACING	PRYDA SPREEDBRACE SCREW FIXED TO EVERY PURLIN
P1	C 100x12	CONTINUOUS SPAN ROOF PURLIN @ 800 MAX CTS
P2	230FP19	FASCIA PURLIN
T1	TRUSS	STEEL FRAME ROOF TRUSSES @ 1300 MAX CTS. TO MANUFACTURER'S DETAILS



ROOF FRAMING PLAN
SCALE 1:50



ELEVATION A 236
SCALE 1:50

SCALE 1:50 @A1

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	27/08/2021

CONSULTANT DETAILS:
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
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Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

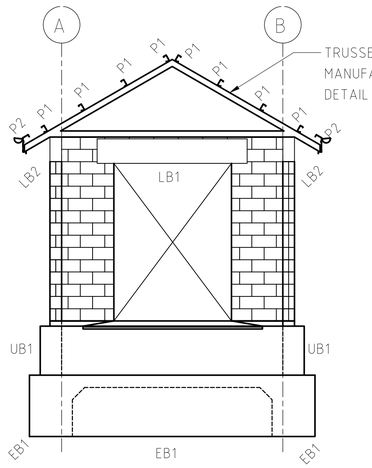
SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 30/09/2021	COMPANY: CARDNO
DRAWN: SMV	DATE: 30/09/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
FOUNDATION, FRAMING PLANS, ELEVATION AND NOTES

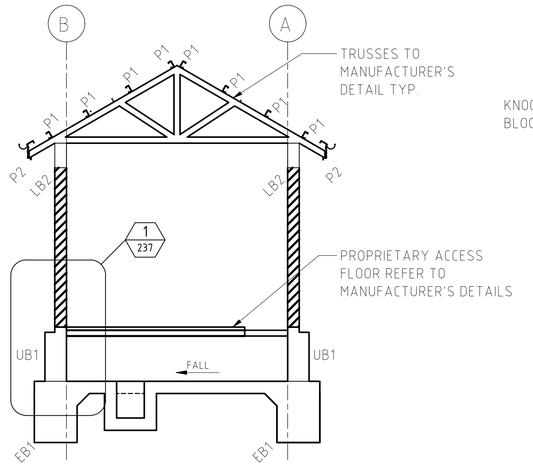
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	236	1	B

Plotted: 16/09/21 - 11:13 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-236.dwg

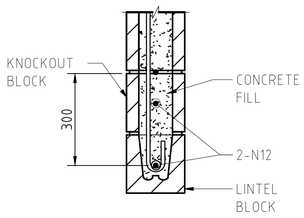
100 mm on original



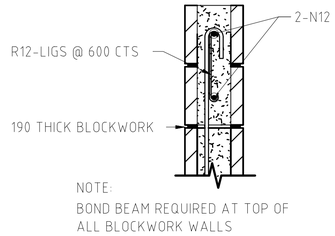
ELEVATION B
SCALE 1:50 236



SECTION C
SCALE 1:50 236



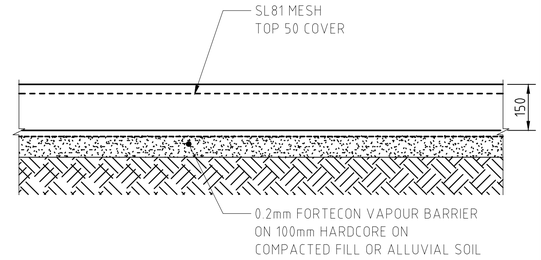
LINTEL BEAM DETAIL (LB1)
SCALE 1:10



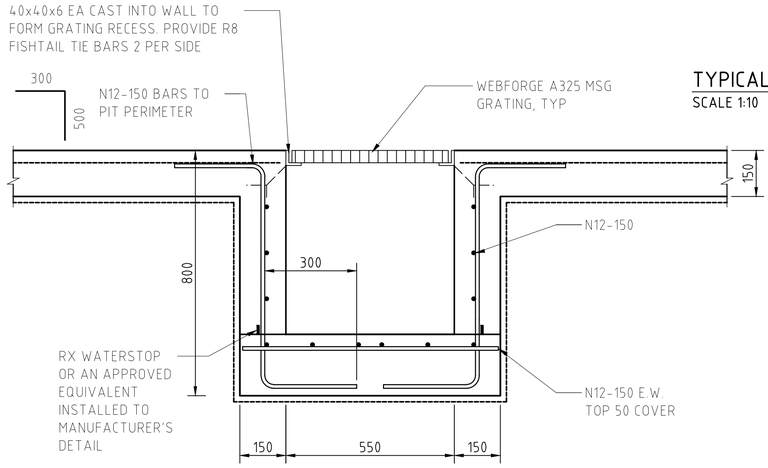
2 COURSE BOND BEAM (LB2)
SCALE 1:10

NOTES:

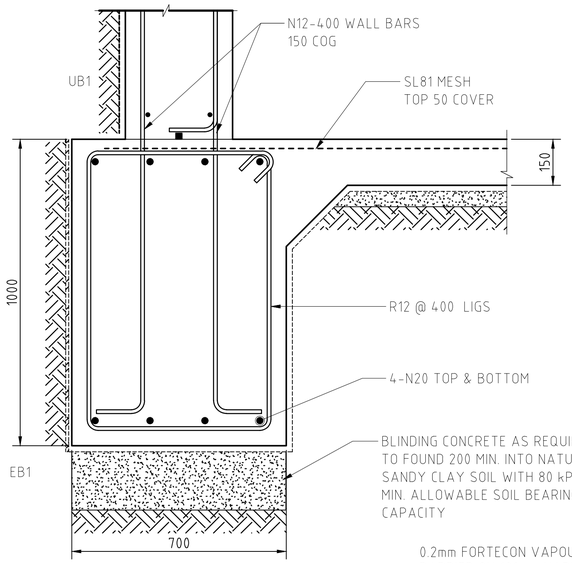
1. REFER TO ARCHITECTURAL DRAWINGS FOR ALL LEVELS, SETOUT, DIMENSIONS, SLAB, SETDOWNS, CONTROL JOINT DETAILS, HOBS AND FALLS.
2. REFER TO DRAWINGS 25267-234 AND 235 FOR STRUCTURAL NOTES.
3. FALSE FLOOR SHALL BE DESIGNED FOR THE FOLLOWING LOADS:
   - EQUIPMENT WEIGHT
   - LIVE LOAD = 5kPa



TYPICAL SLAB DETAIL
SCALE 1:10

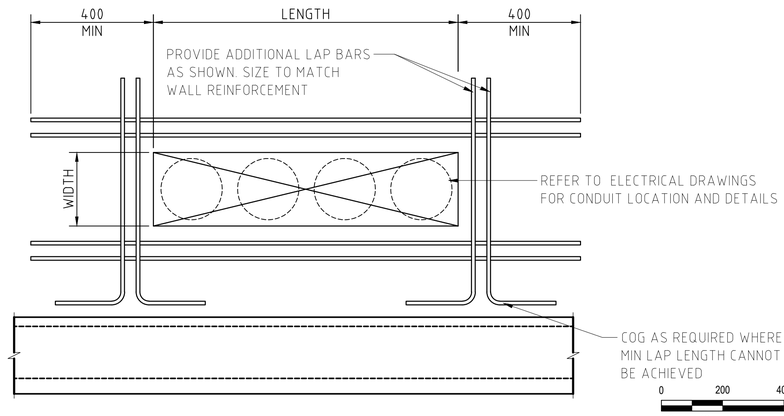


SUMP DETAIL
SCALE 1:10



TYPICAL EDGE BEAM (EB1)
SCALE 1:10

DETAIL 1
SCALE 1:10 237



TYPICAL WALL PENETRATION DETAIL
SCALE 1:10

0 200 400 600 800 1000mm
SCALE 1:10 @A1

0 1000 2000 3000 4000 5000mm
SCALE 1:50 @A1

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CHECKED: PS	DATE: 30/09/2021	COMPANY: CARDNO	
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO	

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW SEWER PUMP STATION
SWITCHROOM BUILDING
SECTIONS AND DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	237	1	B

100 mm on original

Plotted: 16/09/21 - 11:13 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 2 - New Sewerage Pumping Station\25267-237.dwg

SHOALHAVEN CITY COUNCIL
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 MAIN INSTALLED ALONG SOUTHERN ROAD

LOCALITY PLAN
SCALE 1:5000

DRAWING INDEX	
DRAWING NUMBER	DESCRIPTION
25267-300	COVER PAGE, LOCALITY PLAN AND DRAWING INDEX
25267-301	GENERAL NOTES
25267-303	TRENCH DETAILS
25267-310	KEY PLAN
25267-311	RISING MAIN PLAN AND SECTION - SHEET 1
25267-312	RISING MAIN PLAN AND SECTION - SHEET 2
25267-313	GRAVITY MAIN DISCHARGE MANHOLE PLAN AND SECTION
25267-314	RM17 AND 19 - DN1500 DISCHARGE MANHOLE

LIST OF STANDARD DRAWINGS	
DRAWING NUMBER	DESCRIPTION
S-25350-048-1	TYPICAL AIR VALVE PIT FOR POLY MAIN (NON TRAFFICABLE)
S-25350-052-1	MARKER POST AND PLATES ARRANGEMENT
S-25350-053-0	TYPICAL SCOUR VALVE ARRANGEMENT WITH DN80 CAMLOCK FITTING TO SUIT MAINS 600 DIA. OR LESS
S-25350-054-0	TYPICAL BOLLARD PROTECTION ARRANGMENT
S-25350-055-A	TYPICAL AIR VALVE PIT FOR POLY MAIN WITH OFFSET ODOUR SCRUBBER PIT (NON TRAFFICABLE)

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	HH	26/02/2021

CONSULTANT DETAILS:
Cardno
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DESIGNED: PS	DATE:	COMPANY: CARDNO	
DRAWN: HH	DATE:	COMPANY: CARDNO	
CHECKED: PS	DATE:	COMPANY: CARDNO	
APPROVED: NM	DATE:	COMPANY: CARDNO	

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
COVER PAGE, LOCALITY PLAN AND DRAWING INDEX

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	300	1	B

100 mm on original

Plotted: 03/10/21 - 18:19 CAD File: C:\Users\jay-ar.armamento\OneDrive - Cardno\WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-300.dwg

GENERAL

1. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE WORK HEALTH AND SAFETY ACT 2011, WHICH REQUIRES EMPLOYERS TO ENSURE THE HEALTH, SAFETY AND WELFARE OF EMPLOYEES AND PERSONS IN THE VICINITY OF THE WORK SITE.
2. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH THE DRAWINGS, WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04-2005-2.1, WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 VERSION 2.3, AND SHOALHAVEN WATER SUPPLEMENTS, AND THESE NOTES.
3. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION WORK COMMENCING AND MAINTAINED DURING THE CONSTRUCTION PHASE.
4. NO VEGETATION SHALL BE REMOVED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.
5. THE CONTRACTOR IS TO GAIN APPROVAL UNDER SECTION 138 OF THE ROADS ACT 1993 PRIOR TO COMMENCING CONSTRUCTION WITHIN ALL ROAD RESERVES. TRAFFIC CONTROL PLAN IS TO BE SUBMITTED WITH SECTION 138 APPLICATION PRIOR TO CONSTRUCTION WORK COMMENCING.
6. THE CONSTRUCTOR SHALL OBTAIN AN APPROVED ROAD OCCUPANCY LICENCE FROM TRANSPORT FOR NSW (ROADS AND MARITIME) FOR ANY WORKS IMPACTING THE PRINCES HIGHWAY.
7. TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH AS 1742.3 ARE TO BE IN PLACE AND MAINTAINED AT ALL TIME.
8. THE CONTRACTOR IS RESPONSIBLE FOR ARRANGING FOR INSPECTIONS BY COUNCIL'S AUTHORISED REPRESENTATIVE AT THE TIMING AND FOLLOWING THE PROCEDURE OUTLINED IN COUNCIL'S LETTER OF APPROVAL.
9. THE CONTRACTOR SHALL ENSURE THAT THE RESIDENTS ADJACENT TO THE CONSTRUCTION ZONE ARE NOT AFFECTED BY DUST OR UNDUE NOISE DURING CONSTRUCTION AND ARE NOT DEPRIVED OF ALL WEATHER ACCESS NOR ARE SUBJECTED TO ADDITIONAL STORM WATER RUNOFF AT ALL TIMES DURING CONSTRUCTION.
10. TO LIMIT THE IMPACT OF THE CONSTRUCTION ON ADJOINING OWNERS, ALL WORKS SHALL BE RESTRICTED TO THE HOURS OF 7AM-6PM MONDAY TO FRIDAY AND 8AM-3PM SATURDAY. NO WORK SHALL TAKE PLACE ON SUNDAYS OR PUBLIC HOLIDAYS.
11. ALL WORK SHALL BE SET OUT BY THE SURVEYOR PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, UPON REQUEST. TWO (2) DAYS NOTICE REQUIRED.
12. THE CONTRACTOR SHALL NOT DISTURB ANY SURVEY CONTROL MARKS. SHOULD ANY SURVEY CONTROL MARK BE DISTURBED OR OBLITERATED, THE CONTRACTOR SHALL NOTIFY THE SUPERINTENDENT IMMEDIATELY. THE CONTRACTOR SHALL HAVE THE MARKS REPLACED AT HIS EXPENSE.
13. PRIOR TO COMMENCEMENT OF EXCAVATION THE CONTRACTOR SHALL DETERMINE THE LOCATION OF ALL SERVICES AND WILL BE RESPONSIBLE FOR ADJUSTMENT OF SERVICES AND REPAIR OF ANY DAMAGE TO COUNCIL'S INFRASTRUCTURE. SUCH REPAIR OR REINSTATEMENT TO BE CARRIED OUT IMMEDIATELY TO THE SATISFACTION OF THE COUNCIL'S DEVELOPMENT MANAGER OR DELEGATE.

SURVEY, SET OUT AND ASSET RECORDING

14. ALL LEVELS ARE IN METRES TO AHD.
15. ALL CO-ORDINATES ARE IN METRES TO THE MAP GRID OF AUSTRALIA (MGA 56 – 94).
16. THE CONSTRUCTOR IS DIRECTLY RESPONSIBLE FOR ENSURING THE PROJECT SET OUT IS CONSISTENT WITH THE DESIGN. THE CONSTRUCTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ACCURATE SETTING OUT OF THE ENTIRE WORKS. THE CONSTRUCTOR SHALL ENSURE THE PIPES ARE LAID TO CORRECT INVERT LEVELS. SHOULD ACTUAL SITE CONDITIONS CONFLICT IN ANY WAY WITH THAT DOCUMENTED, THE CONSTRUCTOR SHALL CONTRACT THE SUPERINTENDENT' REPRESENTATIVE FOR CLARIFICATION PRIOR TO PROCEEDING.
17. THE CONSTRUCTOR SHALL BE RESPONSIBLE FOR CONFIRMING THE LOCATION OF ALL SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
18. THE CONSTRUCTOR IS TO ENGAGE A SUITABLY QUALIFIED AND EXPERIENCE SURVEYOR TO UNDERTAKE ASSET RECORDING OF THE WORK. ALL SURVEYOR WORKS AND DATA RECORDING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE SHOALHAVEN WATER TECHNICAL SPECIFICATION FOR WORK AS EXECUTED INFORMATION DOCUMENT NO. D13/14490.
19. ALL CHAINAGES ARE IN METRES.
20. OFFSET FROM EXISTING SERVICES ARE FOR INFORMATION ONLY, AND TO BE CONFIRMED BY THE CONSTRUCTOR.

PRODUCTS AND MATERIALS

21. ALL PRODUCTS AND MATERIAL SHALL COMPLY WITH THE DRAWINGS.
22. FOR POLYETHYLENE PIPE CONSTRUCTION, REFER TO WSA 01 (POLYETHYLENE PIPELINE CODE). WELDERS SHALL BE ACCREDITED TO PMBWELD301A (BUTT WELD POLYETHYLENE PLASTIC PIPELINES) AND PMBWELD3028 (ELECTROFUSION WELD POLYETHYLENE PIPELINES).
23. ALL PRODUCTS AND MATERIALS TO COMPLY WITH THE WATER SERVICES ASSOCIATION OF AUSTRALIA PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS.
24. ALL STOP VALVES SHALL BE FLANGES CLASS PN16.
25. ALL AIR VALVES SHALL BE FLANGED CLASS PN16.
26. ALL DICL PIPES AND BENDS SHALL BE PN35.
27. DICL PIPE TO BE WRAPPED IN POLYETHYLENE SLEEVE TO AS 3680.
28. ALL POLYETHYLENE PIPES AND BENDS SHALL BE MINIMUM PE100 PN16. ALL POLYETHYLENE BENDS SHALL BE SWEEP BENDS, UNLESS NOTED OTHERWISE.
29. ALL FLANGES SHALL BE PN16 TO AS4087.
30. ALL BOLTS ON PE FLANGE CONNECTIONS SHALL BE RE-TIGHTENED AFTER A MINIMUM OF 4 HOURS AFTER INITIAL TIGHTENING.
31. ALL BOLTS, NUTS AND WASHERS TO BE STAINLESS STEEL BOLT GRADE 3116 IN ACCORDANCE WITH WAT-1313.
32. ALL PVC PIPES AND BENDS SHALL BE PVC-M PN12.
33. ALTERNATE PIPE MATERIALS SHALL NOT BE USED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.

SEWER RISING MAIN CONSTRUCTION

34. PRIOR TO COMMENCING WORK ON SITE THE CONTRACTOR SHALL PROVIDE THE SUPERINTENDENT EVIDENCE THAT THEY HAVE CURRENT PUBLIC RISK AND COMPENSATION INSURANCE POLICIES.
35. ANY MODIFICATIONS/DEVIATIONS OR AMENDMENTS TO THE APPROVED DESIGN PLANS ARE TO BE SUBMITTED IN WRITING TO THE SUPERINTENDENT FOR SUBMISSION TO SHOALHAVEN WATER FOR THEIR APPROVAL. APPROVAL FROM SHOALHAVEN WATER IS TO BE GRANTED BEFORE ANY SUCH ALTERATIONS ARE IMPLEMENTED BY THE CONTRACTOR.
36. ALL SEWERAGE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 AND SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA (WSA 02) AND WITH ANY OTHER SPECIAL REQUIREMENTS AND STANDARDS OF SHOALHAVEN CITY COUNCIL.
37. TRENCH STOPS AND/OR CONCRETE BULKHEADS SHALL BE PROVIDED IN ACCORDANCE WITH NOTE 35 ABOVE.
38. TRENCH, PIPE PLACEMENT, EMBEDMENT AND BACKFILL SHALL BE IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 AND SHOALHAVEN WATER'S SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA (WSA 02-2014).
39. THE CONTRACTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ENTIRE WORKS. THE CONTRACTOR SHALL ARRANGE FOR ALL PIPES AND FITTINGS TO BE INSPECTED BY THE SUPERINTENDENT AND THE SHOALHAVEN WATER INSPECTOR PRIOR TO THE OPENING OF ANY TRENCHES ON SITE. THE CONTRACTOR SHALL GIVE NOT LESS THAN 48 HOURS' NOTICE WHEN REQUESTING AN INSPECTION UNDER THIS CLAUSE.
40. IF ROCK IS ENCOUNTERED THE SUPERINTENDENT IS TO BE ADVISED IMMEDIATELY SO A RECORD OF AMOUNT CAN BE MADE.
41. WHERE SHOWN ON THE PLAN AND/OR LONGITUDINAL SECTIONS, SEWER LINES ARE TO BE CONCRETE ENCASED WITH 20MPA CONCRETE 150MM THICK ALL ROUND.
42. CONCRETE ENCASEMENT IS TO COMMENCE AND FINISH AT A FLEXIBLE JOINT. BACKFILLING OVER THE CONCRETE ENCASED PIPELINE IS NOT TO BE UNDERTAKEN WITHIN 24 HOURS OF PLACING CONCRETE AND UNTIL "WORKS AS EXECUTED" (WAE) DETAILS OF THE ENCASEMENT HAVE BEEN OBTAINED BY THE SURVEYOR.
43. INTERCONNECTION WORKS WILL NOT TAKE PLACE UNTIL SUCH TIME AS ALL PROPOSED CONSTRUCTION IS COMPLETED, BACKFILLED AND SATISFACTORILY TESTED.
44. ALL DISTURBED AREAS AFFECTED BY THE WORKS ARE TO BE GRASS SEEDED AND FERTILISED AT THE COMPLETION OF WORKS.

THRUST RESTRAINTS

45. THRUST RESTRAINTS SHALL BE IN ACCORDANCE WITH THESE DRAWINGS AND THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04 – 2004-2.1.
46. USE MINIMUM GRADE N25 CONCRETE FOR THRUST RESTRAINT. JOINTS, BOLTS AND NUTS TO BE CLEAR OF CONCRETE. CONCRETE BLOCKS MUST BE KEPT CLEAR OF OTHER SERVICES.
47. ALL VALVES WITH UNRESTRAINED PIPES ON ONE OR BOTH SIDE(S) REQUIRE AN IN-LINE CONCRETE THRUST BLOCK.
48. CONCRETE THRUST BLOCKS SHALL BE CURED FOR A MINIMUM OF 7 DAYS PRIOR TO BEING SUBJECTED TO ANY THRUST LOAD.
49. CONSTRUCT CONCRETE THRUST RESTRAINTS IN ACCORDANCE WITH WSA STANDARD DRAWING NUMBERS WAT-1205 AND WAT-1207.
50. THE CONSTRUCTOR SHALL VERIFY THE HORIZONTAL BEARING CAPACITY PRIOR TO INSTALLATION OF THRUST BLOCKS IN ACCORDANCE WITH WSA STANDARD DRAWING WAT-1200. REFER TO THE SUPERINTENDENT'S REPRESENTATIVE FOR FURTHER INSTRUCTIONS SHOULD THE ESTIMATED ALLOWABLE HORIZONTAL BEARING CAPACITY BE LESS THAN THAT NOMINATED IN THESE DRAWINGS.
51. WHEN POURING CONCRETE AGAINST FITTINGS, PLACE A MEMBRANE OF POLYETHYLENE BETWEEN THE FITTING AND CONCRETE TO PREVENT DAMAGE TO THE FITTING. JOINTS SHALL BE CLEAR OF CONCRETE.

EXISTING SERVICES

52. THE CONSTRUCTOR SHALL UNDERTAKE A "DIAL BEFORE YOU DIG" ENQUIRY PRIOR TO COMMENCEMENT OF CONSTRUCTION, TO ENSURE THE LATEST SERVICE INFORMATION IS OBTAINED.
53. THE CONSTRUCTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES, AND ADVISE THE SUPERINTENDENT'S REPRESENTATIVE IF THERE ARE ANY CLASHES.
54. MINIMUM SERVICE CLEARANCES SHALL BE IN ACCORDANCE WITH SHOALHAVEN WATER'S SUPPLEMENT TO WSA02-2014.
55. THE CONSTRUCTOR SHALL NOTIFY THE RELEVANT SERVICE AUTHORITIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, IN THE VICINITY OF THE SERVICES.

CONSTRUCTION STAGING

56. THE WORKS ARE TO BE CONSTRUCTED UNDER THREE SEPARATE STAGES, BY POTENTIALLY THREE SEPARATE CONSTRUCTORS.

TESTING, ASSET ACCEPTANCE AND COMMISSIONING

57. PRESSURE TESTING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04 – 2004-2.1, AND SHOALHAVEN WATER REQUIREMENTS.
58. THE MAXIMUM TEST PRESSURE SHALL BE TBC KPA.
59. THE CONTRACTOR SHALL PROVIDE AT LEAST 7 DAYS' NOTICE TO THE SUPERINTENDENT'S REPRESENTATIVE PRIOR TO CONNECTION OF NEW WORKS TO THE EXISTING NETWORK.
60. THE CONTRACTOR SHALL COORDINATE ALL CUT OVER AND SEWER ISOLATION WORKS WITH SHOALHAVEN WATER.

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

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TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
GENERAL NOTES

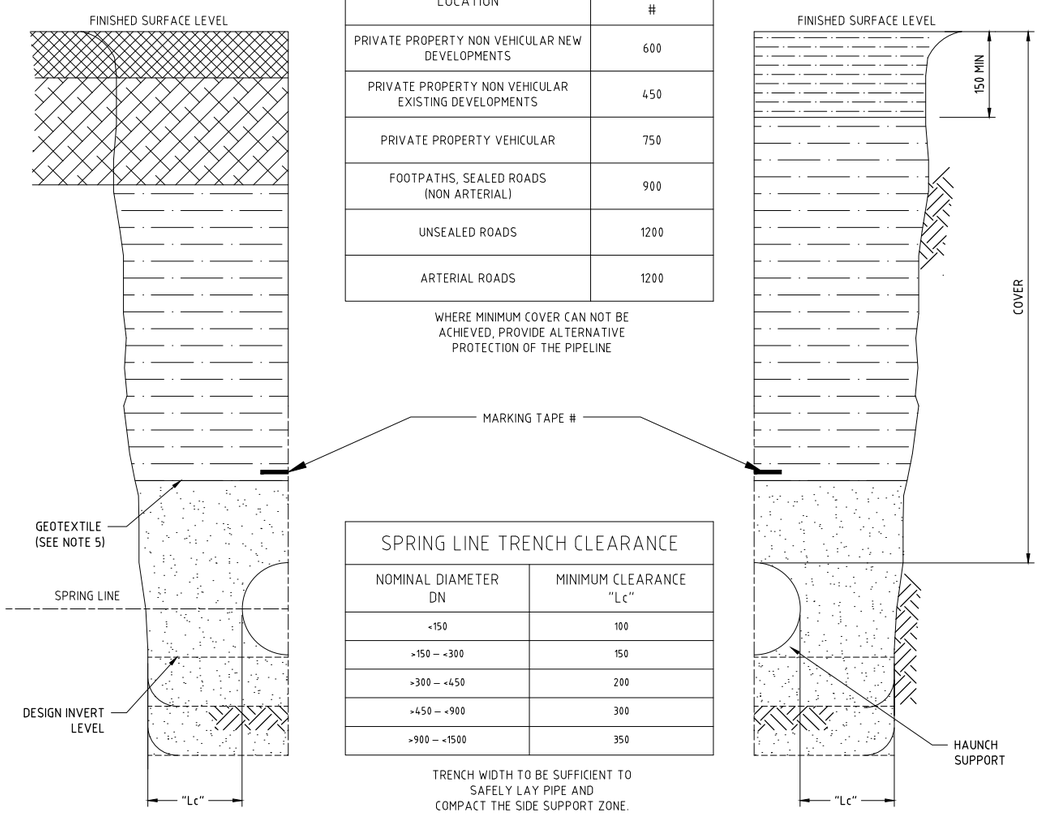
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	301	1	A

100 mm on original

Plotted: 01/10/21 – 16:54 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento – WI21102IP – SW (South Nowra)\CAD\Design Package 3 – 635m of new DN300 main be installed along Old Southern Road\25267-301.dwg

MATERIAL		ZONE
ROAD SURFACE	VERGE & TRACK	
ROAD SURFACE LAYER	TO MATCH EXISTING	SURFACE COURSE
TO MATCH EXISTING ROAD BASE OR TO ROAD OWNER'S REQUIREMENTS		ROAD BASE
TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4)		EMBEDMENT: OVERLAY / SIDE SUPPORT
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING		EMBEDMENT: BEDDING
		OVER-EXCAVATION

VEHICULAR LOADING



MINIMUM PIPE COVER	
LOCATION	MINIMUM COVER #
PRIVATE PROPERTY NON VEHICULAR NEW DEVELOPMENTS	600
PRIVATE PROPERTY NON VEHICULAR EXISTING DEVELOPMENTS	450
PRIVATE PROPERTY VEHICULAR	750
FOOTPATHS, SEALED ROADS (NON ARTERIAL)	900
UNSEALED ROADS	1200
ARTERIAL ROADS	1200

WHERE MINIMUM COVER CAN NOT BE ACHIEVED, PROVIDE ALTERNATIVE PROTECTION OF THE PIPELINE

SPRING LINE TRENCH CLEARANCE	
NOMINAL DIAMETER DN	MINIMUM CLEARANCE "Lc"
<150	100
>150 – <300	150
>300 – <450	200
>450 – <900	300
>900 – <1500	350

TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE.

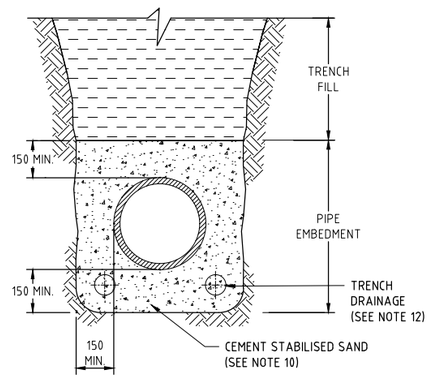
ZONE	MATERIAL
TOPSOIL OR PAVEMENT	ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL	INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
EMBEDMENT: OVERLAY / SIDE SUPPORT	EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4)
EMBEDMENT: BEDDING	BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER-EXCAVATION	

NO VEHICULAR LOADING

INCLUDES LOCATIONS WHERE OCCASIONAL VEHICLE LOADING OCCURS EG RESERVES AND FOOTWAYS

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
   - IRREGULAR OUTCROPS OF ROCK.
   - AHBP OF <50 kPa (SEE SEW-1200), OR
   - BEEN DISTURBED BY UNCONTROLLED GROUND WATER .
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR.
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS AND WSA 02 PART 3.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.
7. USE THESE SUPPORT SYSTEMS WHERE SPECIFIED BY DESIGNER DETAILS TO BE PROVIDED IN DESIGN DRAWINGS.
8. USE REINFORCED CONCRETE CLASS N20 MIN., AND REINFORCED CONCRETE N25 MIN. FOR AGGRESSIVE CONDITIONS USE SPECIAL CLASS CONCRETE.
9. WHERE SPECIFIED MINIMUM STEEL REINFORCEMENT OF 0.4% CONCRETE CROSS SECTION PLACED CENTRALLY AND WITH 65 MINIMUM COVER TO EXTERNAL FACE. SPECIFY REINFORCEMENT FOR THE APPLICABLE LOADING IN DESIGN DRAWINGS.
10. CEMENT STABILISED SAND OR WELL GRADED CRUSHED ROCK TO BE 25:1 SAND: CEMENT (PLACED DRY).
11. DURING THE ENCASEMENT PROCESS, PIPES WILL REQUIRE A RESTRAINT SYSTEM TO PREVENT PIPE MOVEMENT AND/OR FLOTATION.
12. SEE SEW-1207SW IF CONTINUOUS TRENCH DRAINAGE REQUIRED.



TYPE 1 SUPPORT
UTILISING CEMENT STABILISED EMBEDMENT
(RIGID & FLEXIBLE PIPES)

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

Shoalhaven Council's Water Utility WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	01/10/2021	CARDNO
DRAWN:	HH	01/10/2021	CARDNO
CHECKED:	PS	01/10/2021	CARDNO
APPROVED:	NM	01/10/2021	CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
TRENCH DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	303	1	A

Plotted: 01/10/21 - 17:28 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-303.dwg

100 mm on original

COORDINATE SETOUT TABLE - RISING MAIN - PACKAGE 3 - SRM (MC08)			
PT	CHAINAGE	EASTING	NORTHING
IP 1	0.000	282065.162	6135039.067
IP 2	1.040	282065.494	6135040.052
IP 3	8.909	282058.013	6135042.493
IP 4	78.219	282079.513	6135108.384
IP 5	143.760	282119.475	6135160.332
IP 6	224.392	282159.843	6135230.132
IP 7	285.351	282190.284	6135282.946
IP 8	295.884	282194.916	6135292.406
IP 9	316.646	282205.276	6135310.398
IP 10	402.457	282248.234	6135384.682
IP 11	431.019	282261.240	6135410.111
IP 12	469.581	282280.383	6135443.587
IP 13	542.255	282320.615	6135504.108
IP 14	569.366	282338.339	6135524.623

CARRINGTON PARK DRIVE
MARWEE LINK
WARRIGAL STREET
JINDALEE CRESCENT
REFER TO PACKAGE 1 DRAWING 25267-120
FOR CONNECTION DETAIL REFER TO DRAWING 25267-314
25267-312
OLD SOUTHERN RD
HILLCREST AVENUE
ISA ROAD
SRM
NEW OD315 PE100 SDR11 PN16 SEWER RISING MAIN
EXISTING OD225 PE100 SDR11 PN16 SEWER RISING MAIN
25267-311
FOR CONNECTION DETAIL REFER TO DRAWING 25267-313
SOMERSET AVENUE
CORNWALL CLOSE
HANOVER CLOSE
SPS19
BROWNS ROAD

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- ARCHEOLOGICAL SITE
- EXISTING MANHOLE

PLAN
SCALE 1:2500
1:2500 0 100 250m

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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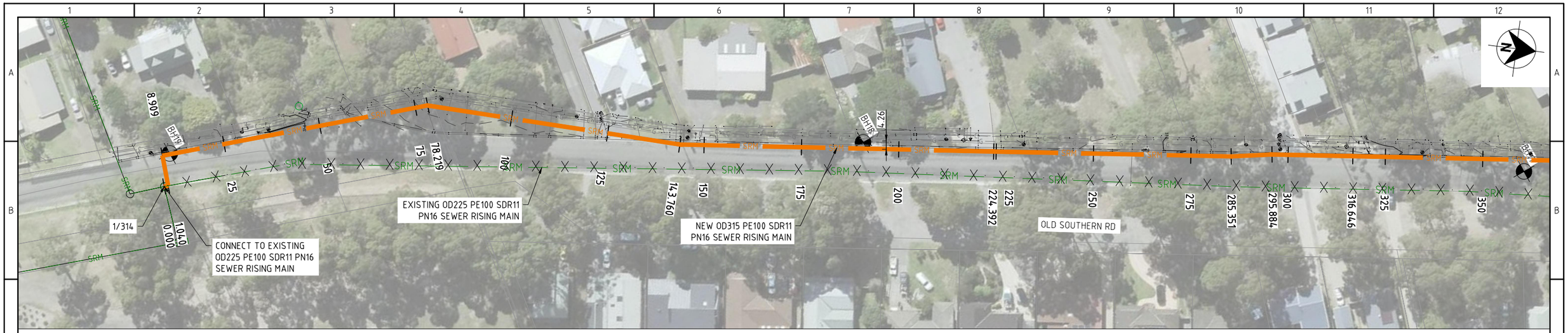
SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 01/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 01/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 01/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 01/10/2021	COMPANY: CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
KEY PLAN

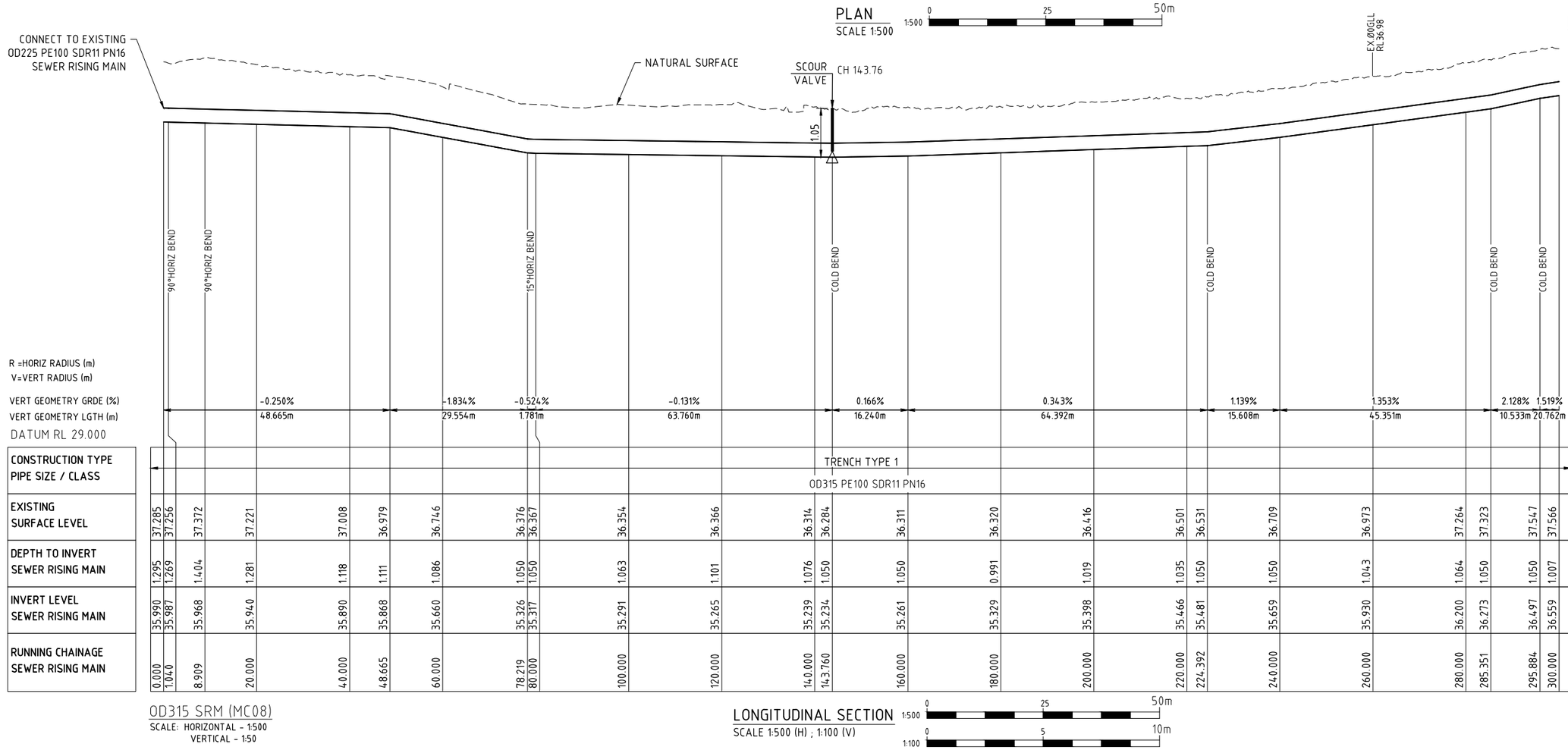
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	310	1	A

Plotted: 01/10/21 - 17:26 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-310.dwg



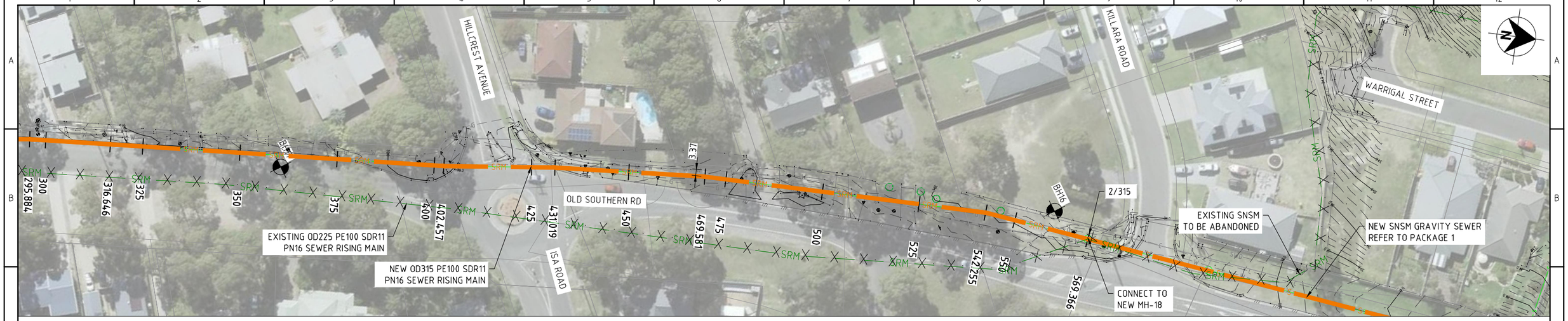
PLAN
SCALE 1:500

1:500 0 25 50m

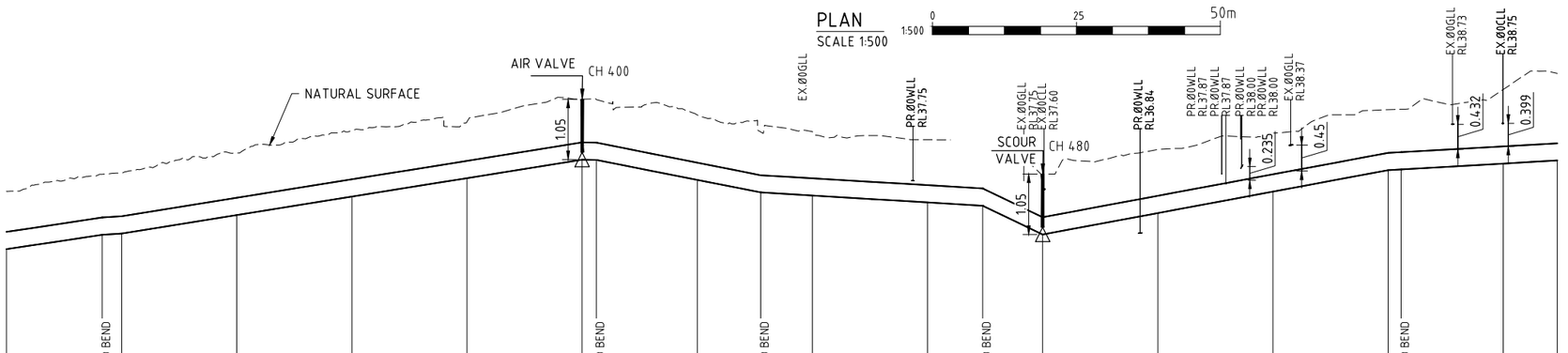


R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

| | | |



PLAN
SCALE 1:500



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

VERT GEOMETRY GRDE (%)		1.519%	0.605%		1.604%			-0.227%	-1.977%		-0.594%		-4.803%		1.862%			0.569%					
VERT GEOMETRY LGTH (m)		20.762m	3.354m		80.000m			2.457m	28.562m		38.562m		10.419m		60.000m			29.366m					
DATUM RL 31.000																							
CONSTRUCTION TYPE PIPE SIZE / CLASS	TRENCH TYPE 1 OD315 PE100 SDR11 PN16																						
EXISTING SURFACE LEVEL	37.566		37.862	37.883		38.227		38.621		38.775	39.165	39.160		38.892	38.595	38.602		38.461	38.366		37.866		38.293		38.572		38.983	38.992		39.335		39.613
DEPTH TO INVERT SEWER RISING MAIN	1.007		1.050	1.050		1.074		1.147		0.981	1.050	1.050		1.129	1.050	1.110		1.088	1.050		1.050		1.105		1.011		1.050	1.046		1.288		1.513
INVERT LEVEL SEWER RISING MAIN	36.559		36.812	36.833		37.153		37.474		37.795	38.115	38.110		37.763	37.545	37.492		37.373	37.316		36.816		37.188		37.561		37.933	37.946		38.047		38.100
RUNNING CHAINAGE SEWER RISING MAIN	300.000		316.646	320.000		340.000		360.000		380.000	400.000	402.457		420.000	431.019	440.000		460.000	469.581		480.000		500.000		520.000		540.000	542.255		560.000		569.366

OD315 SRM (MC08)
SCALE: HORIZONTAL - 1:500
VERTICAL - 1:50

LONGITUDINAL SECTION
SCALE 1:500 (H) ; 1:100 (V)

NOTES:

1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-301.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-303.
3. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A
4. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDARD DRAWING S-25350-048.

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- ARCHEOLOGICAL SITE
- EXISTING MANHOLE

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

CONSULTANT DETAILS:
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

	SURVEYED:	DATE:	COMPANY:
	JP	12/07/2021	CARDNO
DESIGNED:	PS	01/10/2021	CARDNO
DRAWN:	HH	01/10/2021	CARDNO
CHECKED:	PS	01/10/2021	CARDNO
APPROVED:	NM	01/10/2021	CARDNO

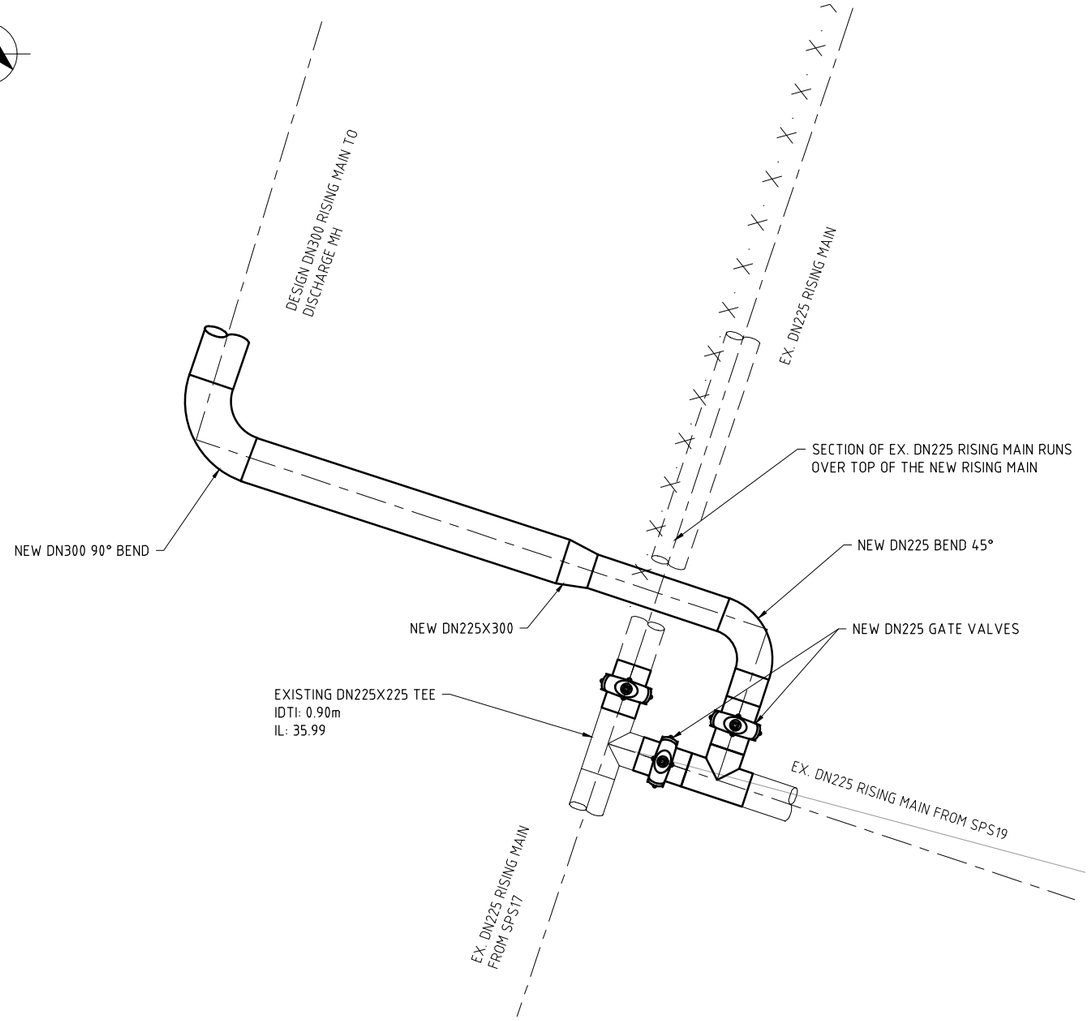
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
RISING MAIN PLAN AND SECTION
SHEET 2 OF 2

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	312	2	B

100 mm on original

Plotted: 01/10/21 - 18:15 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-311-312.dwg

PLAN
SCALE 1:500 1:500 0 25 50m



CONNECTION DETAIL
SCALE 1:20 1:20 0 1000 2000mm

LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN (SRM)
- NEW GRAVITY SEWER MAIN (S)
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

- EXISTING SNSM (SRM)
- EXISTING GRAVITY SEWER MAIN (S)
- EXISTING STORMWATER MAIN (SWD)
- EXISTING GAS MAIN (G)
- EXISTING WATER MAIN (W)
- ARCHEOLOGICAL SITE
- EXISTING MANHOLE

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

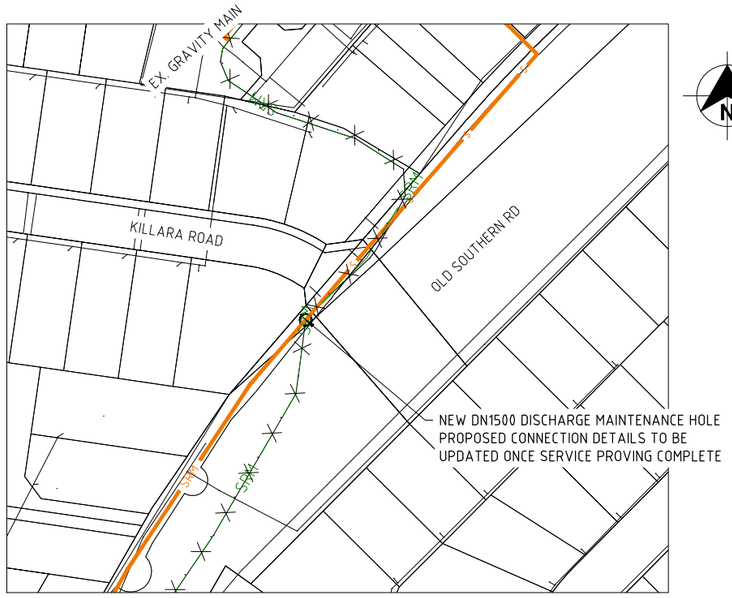
SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 01/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 01/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 01/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 01/10/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
GRAVITY MAIN DISCHARGE MANHOLE PLAN AND SECTION
RM17 - DN1500 DISCHARGE MAIN

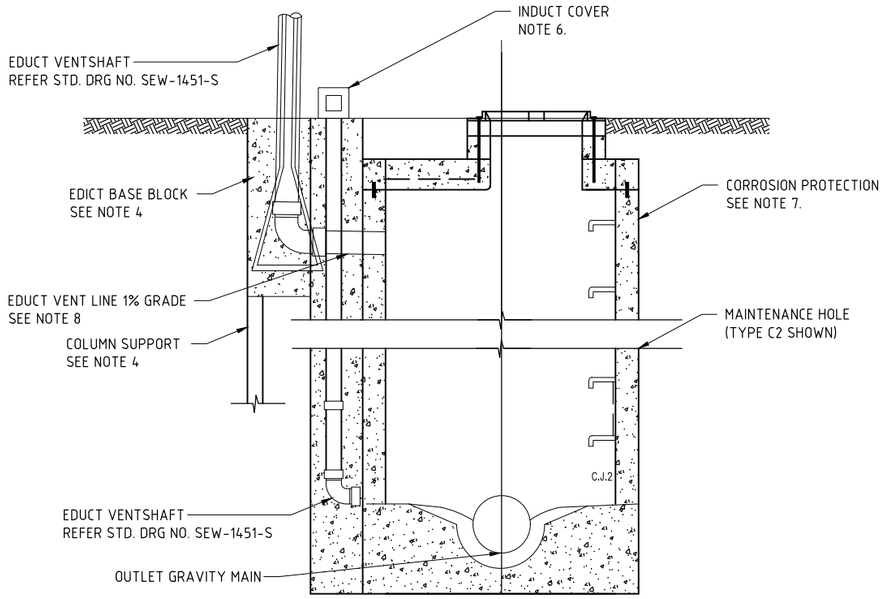
CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	313	1	B

100 mm on original

Plotted: 01/10/21 - 18:16 CAD File: C:\Users\haroldkenneth.herrer\Cardno\Jay-ar Armamento - WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-313-314.dwg



DN1500 DISCHARGE MAINTENANCE HOLE - PLAN VIEW
SCALE 1:200

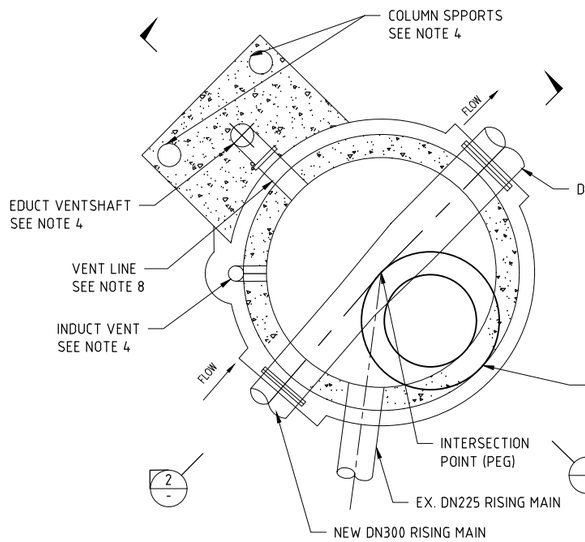


SECTION 1
SCALE 1:20

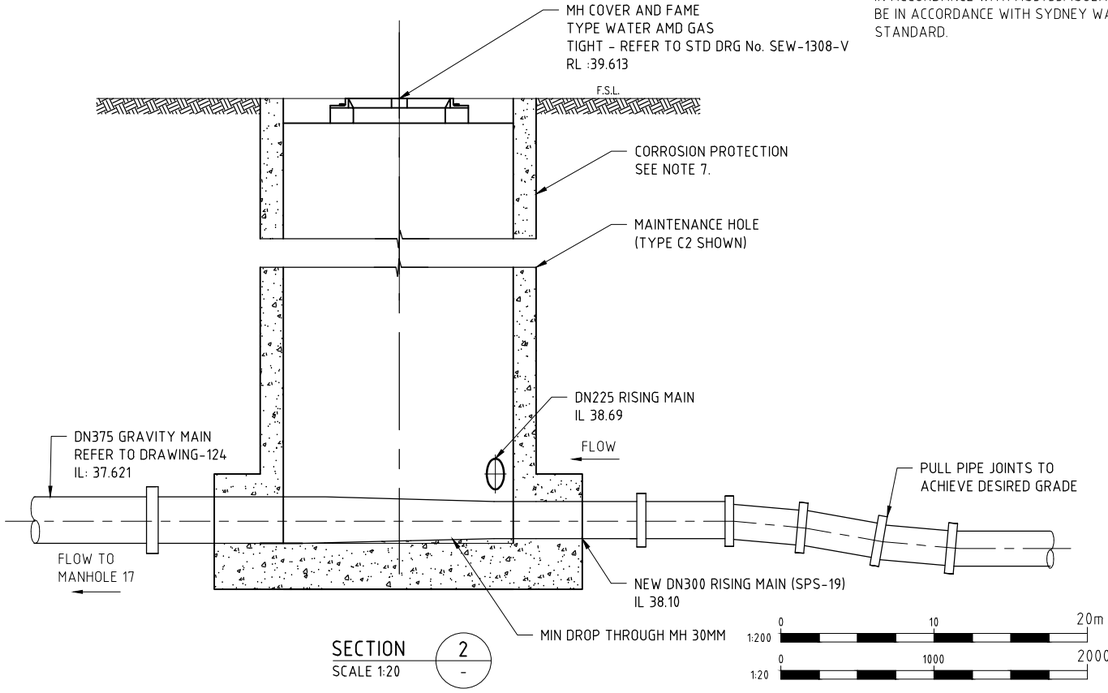
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMMETRES UNLESS OTHERWISE NOTED
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH STD. DRG NO. SEW-1451-S
3. THIS DRAWING SHOWS TYPICAL ARRANGEMENT OF A RISING MAIN DISCHARGE MAINTENANCE HOLE. DESIGN PLANS SHALL BE DEVELOPED ONCE SERVICE PROVING HAS BEEN CONDUCTED
4. EDUCT VENTSHAFT
   LOCATION, HEIGHT, DIMENSIONS AND STRUCTURAL SUPPORT OF BASE BLOCK SHALL BE AS SPECIFIED ON THE DETAILED DESIGN PLANS AND IN ACCORDANCE WITH STD. DRG NO SEW-1451-S ONCE SERVICE PROVIDING HAS OCCURRED
5. MAINTENANCE HOLD BASE SHALL BE CONSTRUCTED TO MINIMISE TURBULENCE CREATED BY A RAPID FLOW OF SEWAGE. SLOPING FLOW CHANNEL IS A MINIMUM REQUIREMENT
6. INDUCT VENT:
   INDUCT VENT LINE TO BE FITTED WITH A DN100 MICA FLAP VENT COMPLETE WITH A S.S INDUCT COVER. THE INDUCT COVER TO BE A LOUVRED BOX APPROX 300 HIGH AND 300 SQUARE FABRICATED FROM 2MM (MIN) THICK STAINLESS STEEL SHEET. THE INDUCT COVER TO BE FIXED TO CONCRETE WITH DYNABOLTS & PAINTED IF REQUIRED. DETAILS OF THE CONCRETE SURROUND SHALL BE SPECIFIED IN THE DETAILED DESIGN DRAWINGS . INDUCT VENT SHALL BE FIXED TO REDUCING BUSH WITH ADHESIVE SEALANT
7. CORROSION PROTECTION
   THE INTERNAL SURFACES AND UNDERSIDE OF ROOF OF THE TWO IMMEDIATELY DOWNSTREAM MAINTENANCE HOLES SHALL BE PROTECTED IN ACCORDANCE WITH SYDNEY WATER PROTECTIVE COATING STANDARD PCS-100 FOR EXPOSURE CLASS EXTREME (OR EQUIVALENT CLASS D AS PER AS3735)
8. VENT LINES TO BE PVC OR DICL SIZE TO SUIT AIRFLOW REQUIREMENTS, MIN PIPE SIZE TO BE DN150
9. DESIGN, MATERIALS AND WORKMANSHIP TO BE IN ACCORDANCE WITH AS3600 AND AS3735
   STRUCTURAL CONCRETE TO BE MIN GRADE 40MPa MEETING REQUIREMENTS OF WATER SERVICES ASSOCIATION WSA 114, EXCEPT AS MODIFIED BELOW:
   - MINIMUM CEMENT CONTENT OF 450KG/m^3
   - TOTAL AMOUNT OF SUPPLEMENTARY CEMENTITIOUS MATERIAL SHALL NOT BE MORE THAN 60% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL SLAG CONTENT SHALL NOT BE MORE THAN 50% B WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL FLY ASH CONTENT SHALL NOT BE MORE THAN 25% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - MAXIMUM WATER/CEMENT RATIO SHALL NOT BE MORE THAN 0.45
   - DRYING SHRINKAGE STRAIN AT 56 DAYS SHALL NOT BE MORE THAN 600X10^{-6}

   INTERNAL CONCRETE SURFACES TO BE TREATED AS EXPOSURE CLASSIFICATION 'D' IN ACCORDANCE WITH AS3735. ISOLATION FROM THE ATTACKING ENVIRONMENT TO BE IN ACCORDANCE WITH SYDNEY WATER'S 'PCS 100 - PROTECTIVE COATING STANDARD.



DN1500 DISCHARGE MAINTENANCE HOLE MH-18
PLAN
SCALE 1:20



SECTION 2
SCALE 1:20

LEGEND - NEW SERVICES

- SRM — NEW SEWER RISING MAIN
- S — NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

- SRM — EXISTING SNSM
- S — EXISTING GRAVITY SEWER MAIN
- SWD — EXISTING STORMWATER MAIN
- G — EXISTING GAS MAIN
- W — EXISTING WATER MAIN
- ARCHEOLOGICAL SITE
- EXISTING MANHOLE

1:200 0 10 20m
1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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		DATE	COMPANY
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APPROVED:	NM	01/10/2021	CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

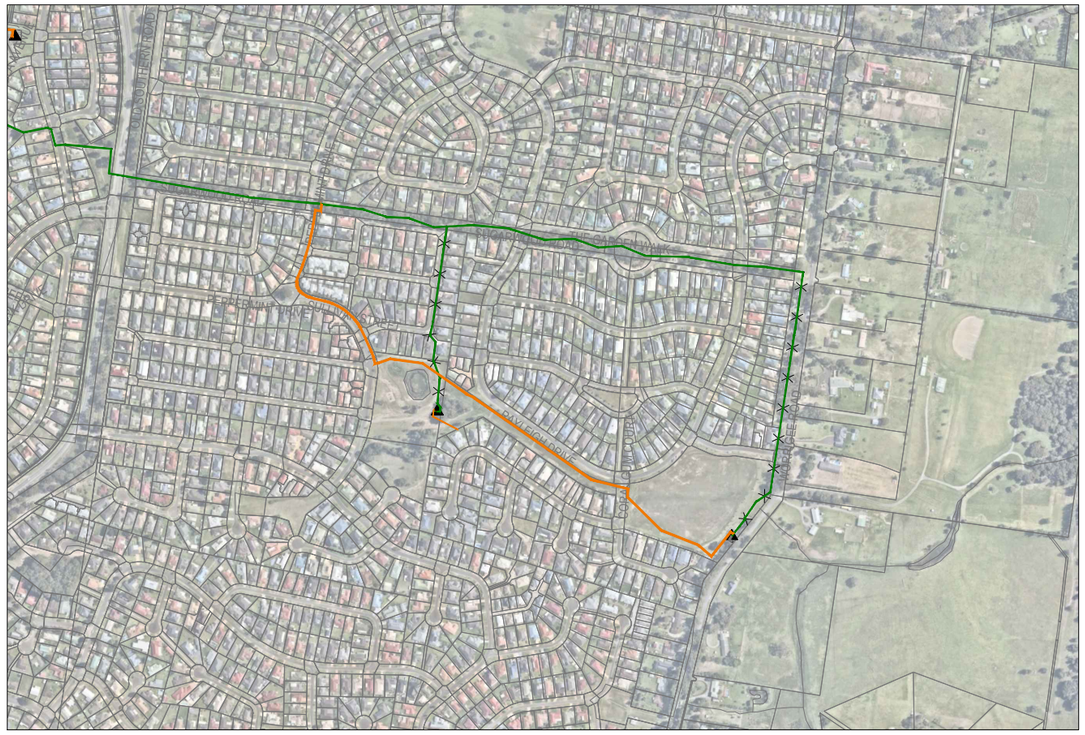
TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MIAN FOR SPS019
RM17 AND 19 - DN1500 DISCHARGE MANHOLE

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	314	1	B

100 mm on original

Plotted: 03/10/21 - 18:19 CAD File: C:\Users\jay-ar.armamento\OneDrive - Cardno\WI21102IP - SW (South Nowra)\CAD\Design Package 3 - 635m of new DN300 main be installed along Old Southern Road\25267-313-314.dwg

SHOALHAVEN CITY COUNCIL
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 PM FOR SPS024 AND DECOMMISSIONING OF SPS028


N
ILLAROO ROAD
RIVERSIDE DRIVE
RIVERSIDE DRIVE
RIVERSIDE DRIVE

GENERAL

1. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE WORK HEALTH AND SAFETY ACT 2011, WHICH REQUIRES EMPLOYERS TO ENSURE THE HEALTH, SAFETY AND WELFARE OF EMPLOYEES AND PERSONS IN THE VICINITY OF THE WORK SITE.
2. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH THE DRAWINGS, WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04-2005-2.1, WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 VERSION 2.3, AND SHOALHAVEN WATER SUPPLEMENTS, AND THESE NOTES.
3. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED PRIOR TO CONSTRUCTION WORK COMMENCING AND MAINTAINED DURING THE CONSTRUCTION PHASE.
4. NO VEGETATION SHALL BE REMOVED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.
5. THE CONTRACTOR IS TO GAIN APPROVAL UNDER SECTION 138 OF THE ROADS ACT 1993 PRIOR TO COMMENCING CONSTRUCTION WITHIN ALL ROAD RESERVES. TRAFFIC CONTROL PLAN IS TO BE SUBMITTED WITH SECTION 138 APPLICATION PRIOR TO CONSTRUCTION WORK COMMENCING.
6. THE CONSTRUCTOR SHALL OBTAIN AN APPROVED ROAD OCCUPANCY LICENCE FROM TRANSPORT FOR NSW (ROADS AND MARITIME) FOR ANY WORKS IMPACTING THE PRINCES HIGHWAY.
7. TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH AS 1742.3 ARE TO BE IN PLACE AND MAINTAINED AT ALL TIME.
8. THE CONTRACTOR IS RESPONSIBLE FOR ARRANGING FOR INSPECTIONS BY COUNCIL'S AUTHORISED REPRESENTATIVE AT THE TIMING AND FOLLOWING THE PROCEDURE OUTLINED IN COUNCIL'S LETTER OF APPROVAL.
9. THE CONTRACTOR SHALL ENSURE THAT THE RESIDENTS ADJACENT TO THE CONSTRUCTION ZONE ARE NOT AFFECTED BY DUST OR UNDUE NOISE DURING CONSTRUCTION AND ARE NOT DEPRIVED OF ALL WEATHER ACCESS NOR ARE SUBJECTED TO ADDITIONAL STORM WATER RUNOFF AT ALL TIMES DURING CONSTRUCTION.
10. TO LIMIT THE IMPACT OF THE CONSTRUCTION ON ADJOINING OWNERS, ALL WORKS SHALL BE RESTRICTED TO THE HOURS OF 7AM-6PM MONDAY TO FRIDAY AND 8AM-3PM SATURDAY. NO WORK SHALL TAKE PLACE ON SUNDAYS OR PUBLIC HOLIDAYS.
11. ALL WORK SHALL BE SET OUT BY THE SURVEYOR PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, UPON REQUEST. TWO (2) DAYS NOTICE REQUIRED.
12. THE CONTRACTOR SHALL NOT DISTURB ANY SURVEY CONTROL MARKS. SHOULD ANY SURVEY CONTROL MARK BE DISTURBED OR OBLITERATED, THE CONTRACTOR SHALL NOTIFY THE SUPERINTENDENT IMMEDIATELY. THE CONTRACTOR SHALL HAVE THE MARKS REPLACED AT HIS EXPENSE.
13. PRIOR TO COMMENCEMENT OF EXCAVATION THE CONTRACTOR SHALL DETERMINE THE LOCATION OF ALL SERVICES AND WILL BE RESPONSIBLE FOR ADJUSTMENT OF SERVICES AND REPAIR OF ANY DAMAGE TO COUNCIL'S INFRASTRUCTURE. SUCH REPAIR OR REINSTATEMENT TO BE CARRIED OUT IMMEDIATELY TO THE SATISFACTION OF THE COUNCIL'S DEVELOPMENT MANAGER OR DELEGATE.

SURVEY, SET OUT AND ASSET RECORDING

14. ALL LEVELS ARE IN METRES TO AHD.
15. ALL CO-ORDINATES ARE IN METRES TO THE MAP GRID OF AUSTRALIA (MGA 56 - 94).
16. THE CONSTRUCTOR IS DIRECTLY RESPONSIBLE FOR ENSURING THE PROJECT SET OUT IS CONSISTENT WITH THE DESIGN. THE CONSTRUCTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ACCURATE SETTING OUT OF THE ENTIRE WORKS. THE CONSTRUCTOR SHALL ENSURE THE PIPES ARE LAID TO CORRECT INVERT LEVELS. SHOULD ACTUAL SITE CONDITIONS CONFLICT IN ANY WAY WITH THAT DOCUMENTED, THE CONSTRUCTOR SHALL CONTRACT THE SUPERINTENDENT' REPRESENTATIVE FOR CLARIFICATION PRIOR TO PROCEEDING.
17. THE CONSTRUCTOR SHALL BE RESPONSIBLE FOR CONFIRMING THE LOCATION OF ALL SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
18. THE CONSTRUCTOR IS TO ENGAGE A SUITABLY QUALIFIED AND EXPERIENCE SURVEYOR TO UNDERTAKE ASSET RECORDING OF THE WORK. ALL SURVEYOR WORKS AND DATA RECORDING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE SHOALHAVEN WATER TECHNICAL SPECIFICATION FOR WORK AS EXECUTED INFORMATION DOCUMENT NO. D13/14490.
19. ALL CHAINAGES ARE IN METRES.
20. OFFSET FROM EXISTING SERVICES ARE FOR INFORMATION ONLY, AND TO BE CONFIRMED BY THE CONSTRUCTOR.

PRODUCTS AND MATERIALS

21. ALL PRODUCTS AND MATERIAL SHALL COMPLY WITH THE DRAWINGS.
22. FOR POLYETHYLENE PIPE CONSTRUCTION, REFER TO WSA 01 (POLYETHYLENE PIPELINE CODE). WELDERS SHALL BE ACCREDITED TO PMBWELD301A (BUTT WELD POLYETHYLENE PLASTIC PIPELINES) AND PMBWELD3028 (ELECTROFUSION WELD POLYETHYLENE PIPELINES).
23. ALL PRODUCTS AND MATERIALS TO COMPLY WITH THE WATER SERVICES ASSOCIATION OF AUSTRALIA PRODUCT SPECIFICATIONS FOR PRODUCTS AND MATERIALS.
24. ALL STOP VALVES SHALL BE FLANGES CLASS PN16.
25. ALL AIR VALVES SHALL BE FLANGED CLASS PN16.
26. ALL DICL PIPES AND BENDS SHALL BE PN35.
27. DICL PIPE TO BE WRAPPED IN POLYETHYLENE SLEEVE TO AS 3680.
28. ALL POLYETHYLENE PIPES AND BENDS SHALL BE MINIMUM PE100 PN16. ALL POLYETHYLENE BENDS SHALL BE SWEEP BENDS, UNLESS NOTED OTHERWISE.
29. ALL FLANGES SHALL BE PN16 TO AS4087.
30. ALL BOLTS ON PE FLANGE CONNECTIONS SHALL BE RE-TIGHTENED AFTER A MINIMUM OF 4 HOURS AFTER INITIAL TIGHTENING.
31. ALL BOLTS, NUTS AND WASHERS TO BE STAINLESS STEEL BOLT GRADE 3116 IN ACCORDANCE WITH WAT-1313.
32. ALL PVC PIPES AND BENDS SHALL BE PVC-M PN12.
33. ALTERNATE PIPE MATERIALS SHALL NOT BE USED WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT'S REPRESENTATIVE.

SEWER RISING MAIN CONSTRUCTION

34. PRIOR TO COMMENCING WORK ON SITE THE CONTRACTOR SHALL PROVIDE THE SUPERINTENDENT EVIDENCE THAT THEY HAVE CURRENT PUBLIC RISK AND COMPENSATION INSURANCE POLICIES.
35. ANY MODIFICATIONS/DEVIATIONS OR AMENDMENTS TO THE APPROVED DESIGN PLANS ARE TO BE SUBMITTED IN WRITING TO THE SUPERINTENDENT FOR SUBMISSION TO SHOALHAVEN WATER FOR THEIR APPROVAL. APPROVAL FROM SHOALHAVEN WATER IS TO BE GRANTED BEFORE ANY SUCH ALTERATIONS ARE IMPLEMENTED BY THE CONTRACTOR.
36. ALL SEWERAGE CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 AND SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA (WSA 02) AND WITH ANY OTHER SPECIAL REQUIREMENTS AND STANDARDS OF SHOALHAVEN CITY COUNCIL.
37. TRENCH STOPS AND/OR CONCRETE BULKHEADS SHALL BE PROVIDED IN ACCORDANCE WITH NOTE 35 ABOVE.
38. TRENCH, PIPE PLACEMENT, EMBEDMENT AND BACKFILL SHALL BE IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA – WSA 02-2014 AND SHOALHAVEN WATER'S SUPPLEMENT TO THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE CODE OF AUSTRALIA (WSA 02-2014).
39. THE CONTRACTOR SHALL PROVIDE ALL LABOUR, MATERIALS AND EQUIPMENT NECESSARY FOR THE ENTIRE WORKS. THE CONTRACTOR SHALL ARRANGE FOR ALL PIPES AND FITTINGS TO BE INSPECTED BY THE SUPERINTENDENT AND THE SHOALHAVEN WATER INSPECTOR PRIOR TO THE OPENING OF ANY TRENCHES ON SITE. THE CONTRACTOR SHALL GIVE NOT LESS THAN 48 HOURS' NOTICE WHEN REQUESTING AN INSPECTION UNDER THIS CLAUSE.
40. IF ROCK IS ENCOUNTERED THE SUPERINTENDENT IS TO BE ADVISED IMMEDIATELY SO A RECORD OF AMOUNT CAN BE MADE.
41. WHERE SHOWN ON THE PLAN AND/OR LONGITUDINAL SECTIONS, SEWER LINES ARE TO BE CONCRETE ENCASED WITH 20MPA CONCRETE 150MM THICK ALL ROUND.
42. CONCRETE ENCASEMENT IS TO COMMENCE AND FINISH AT A FLEXIBLE JOINT. BACKFILLING OVER THE CONCRETE ENCASED PIPELINE IS NOT TO BE UNDERTAKEN WITHIN 24 HOURS OF PLACING CONCRETE AND UNTIL "WORKS AS EXECUTED" (WAE) DETAILS OF THE ENCASEMENT HAVE BEEN OBTAINED BY THE SURVEYOR.
43. INTERCONNECTION WORKS WILL NOT TAKE PLACE UNTIL SUCH TIME AS ALL PROPOSED CONSTRUCTION IS COMPLETED, BACKFILLED AND SATISFACTORILY TESTED.
44. ALL DISTURBED AREAS AFFECTED BY THE WORKS ARE TO BE GRASS SEEDED AND FERTILISED AT THE COMPLETION OF WORKS.

THRUST RESTRAINTS

45. THRUST RESTRAINTS SHALL BE IN ACCORDANCE WITH THESE DRAWINGS AND THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04 – 2004-2.1.
46. USE MINIMUM GRADE N25 CONCRETE FOR THRUST RESTRAINT. JOINTS, BOLTS AND NUTS TO BE CLEAR OF CONCRETE. CONCRETE BLOCKS MUST BE KEPT CLEAR OF OTHER SERVICES.
47. ALL VALVES WITH UNRESTRAINED PIPES ON ONE OR BOTH SIDE(S) REQUIRE AN IN-LINE CONCRETE THRUST BLOCK.
48. CONCRETE THRUST BLOCKS SHALL BE CURED FOR A MINIMUM OF 7 DAYS PRIOR TO BEING SUBJECTED TO ANY THRUST LOAD.
49. CONSTRUCT CONCRETE THRUST RESTRAINTS IN ACCORDANCE WITH WSA STANDARD DRAWING NUMBERS WAT-1205 AND WAT-1207.
50. THE CONSTRUCTOR SHALL VERIFY THE HORIZONTAL BEARING CAPACITY PRIOR TO INSTALLATION OF THRUST BLOCKS IN ACCORDANCE WITH WSA STANDARD DRAWING WAT-1200. REFER TO THE SUPERINTENDENT'S REPRESENTATIVE FOR FURTHER INSTRUCTIONS SHOULD THE ESTIMATED ALLOWABLE HORIZONTAL BEARING CAPACITY BE LESS THAN THAT NOMINATED IN THESE DRAWINGS.
51. WHEN POURING CONCRETE AGAINST FITTINGS, PLACE A MEMBRANE OF POLYETHYLENE BETWEEN THE FITTING AND CONCRETE TO PREVENT DAMAGE TO THE FITTING. JOINTS SHALL BE CLEAR OF CONCRETE.

EXISTING SERVICES

52. THE CONSTRUCTOR SHALL UNDERTAKE A "DIAL BEFORE YOU DIG" ENQUIRY PRIOR TO COMMENCEMENT OF CONSTRUCTION, TO ENSURE THE LATEST SERVICE INFORMATION IS OBTAINED.
53. THE CONSTRUCTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES, AND ADVISE THE SUPERINTENDENT'S REPRESENTATIVE IF THERE ARE ANY CLASHES.
54. MINIMUM SERVICE CLEARANCES SHALL BE IN ACCORDANCE WITH SHOALHAVEN WATER'S SUPPLEMENT TO WSA02-2014.
55. THE CONSTRUCTOR SHALL NOTIFY THE RELEVANT SERVICE AUTHORITIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, IN THE VICINITY OF THE SERVICES.

CONSTRUCTION STAGING

56. THE WORKS ARE TO BE CONSTRUCTED UNDER THREE SEPARATE STAGES, BY POTENTIALLY THREE SEPARATE CONSTRUCTORS.

TESTING, ASSET ACCEPTANCE AND COMMISSIONING

57. PRESSURE TESTING SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT VERSION OF THE WATER SERVICES ASSOCIATION OF AUSTRALIA – SEWERAGE PUMPING STATION CODE OF AUSTRALIA – WSA 04 – 2004-2.1, AND SHOALHAVEN WATER REQUIREMENTS.
58. THE MAXIMUM TEST PRESSURE SHALL BE 625 KPA.
59. THE CONTRACTOR SHALL PROVIDE AT LEAST 7 DAYS' NOTICE TO THE SUPERINTENDENT'S REPRESENTATIVE PRIOR TO CONNECTION OF NEW WORKS TO THE EXISTING NETWORK.
60. THE CONTRACTOR SHALL COORDINATE ALL CUT OVER AND SEWER ISOLATION WORKS WITH SHOALHAVEN WATER.

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

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SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 01/10/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 01/10/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 01/10/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 01/10/2021	COMPANY: CARDNO

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
GENERAL NOTES

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	401	1	A

100 mm on original

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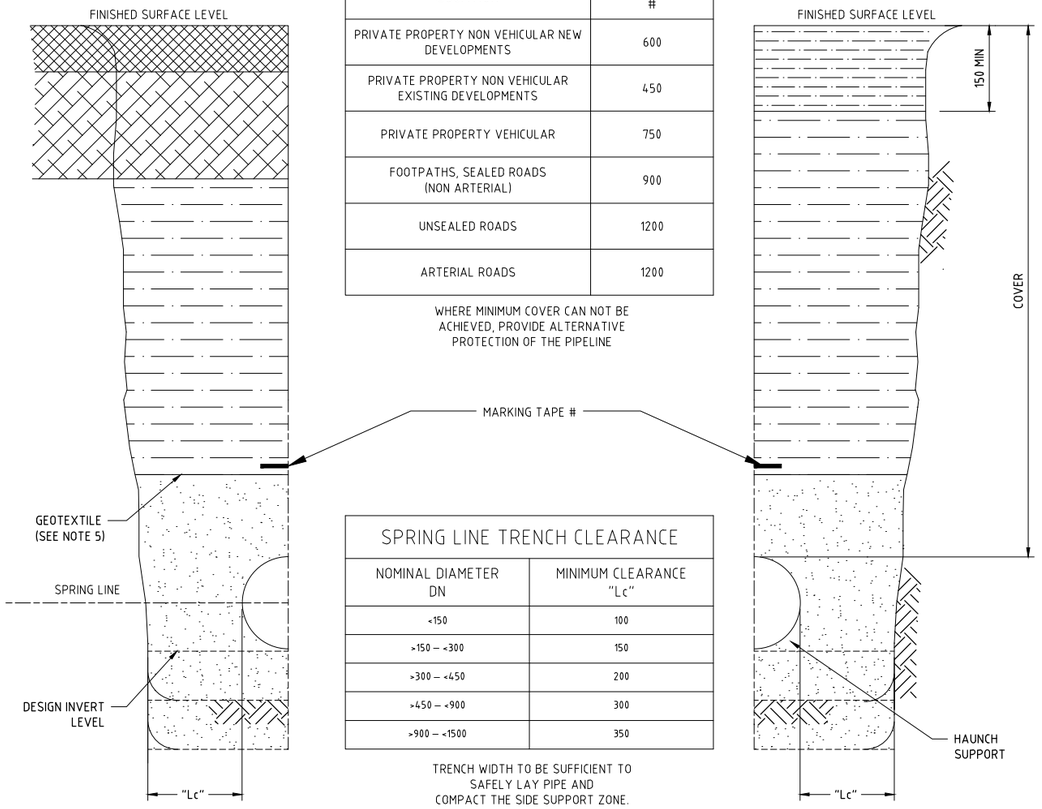
MATERIAL		ZONE
ROAD SURFACE	VERGE & TRACK	
ROAD SURFACE LAYER	TO MATCH EXISTING	SURFACE COURSE
TO MATCH EXISTING ROAD BASE OR TO ROAD OWNER'S REQUIREMENTS		ROAD BASE
TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL TO ROAD OWNER'S REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4)		EMBEDMENT: OVERLAY / SIDE SUPPORT
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING		EMBEDMENT: BEDDING
		OVER-EXCAVATION

VEHICULAR LOADING



MINIMUM PIPE COVER	
LOCATION	MINIMUM COVER #
PRIVATE PROPERTY NON VEHICULAR NEW DEVELOPMENTS	600
PRIVATE PROPERTY NON VEHICULAR EXISTING DEVELOPMENTS	450
PRIVATE PROPERTY VEHICULAR	750
FOOTPATHS, SEALED ROADS (NON ARTERIAL)	900
UNSEALED ROADS	1200
ARTERIAL ROADS	1200

WHERE MINIMUM COVER CAN NOT BE ACHIEVED, PROVIDE ALTERNATIVE PROTECTION OF THE PIPELINE

SPRING LINE TRENCH CLEARANCE	
NOMINAL DIAMETER DN	MINIMUM CLEARANCE "Lc"
<150	100
>150 – <300	150
>300 – <450	200
>450 – <900	300
>900 – <1500	350

TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE.

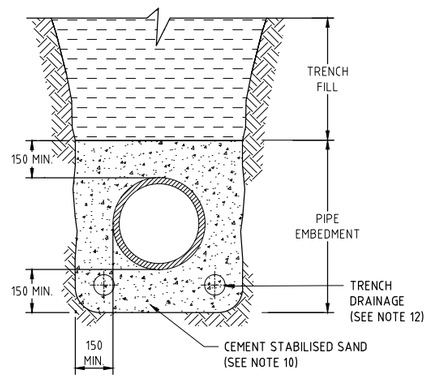
ZONE	MATERIAL
TOPSOIL OR PAVEMENT	ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL	INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
EMBEDMENT: OVERLAY / SIDE SUPPORT	EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND WATER AGENCY REQUIREMENTS. (SEE NOTE 4)
EMBEDMENT: BEDDING	BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER-EXCAVATION	

NO VEHICULAR LOADING

INCLUDES LOCATIONS WHERE OCCASIONAL VEHICLE LOADING OCCURS EG RESERVES AND FOOTWAYS

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
   - IRREGULAR OUTCROPS OF ROCK.
   - AHBP OF <50 kPa (SEE SEW-1200), OR
   - BEEN DISTURBED BY UNCONTROLLED GROUND WATER .
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR.
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS AND WSA 02 PART 3.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.
7. USE THESE SUPPORT SYSTEMS WHERE SPECIFIED BY DESIGNER DETAILS TO BE PROVIDED IN DESIGN DRAWINGS.
8. USE REINFORCED CONCRETE CLASS N20 MIN., AND REINFORCED CONCRETE N25 MIN. FOR AGGRESSIVE CONDITIONS USE SPECIAL CLASS CONCRETE.
9. WHERE SPECIFIED MINIMUM STEEL REINFORCEMENT OF 0.4% CONCRETE CROSS SECTION PLACED CENTRALLY AND WITH 65 MINIMUM COVER TO EXTERNAL FACE. SPECIFY REINFORCEMENT FOR THE APPLICABLE LOADING IN DESIGN DRAWINGS.
10. CEMENT STABILISED SAND OR WELL GRADED CRUSHED ROCK TO BE 25:1 SAND: CEMENT (PLACED DRY).
11. DURING THE ENCASEMENT PROCESS, PIPES WILL REQUIRE A RESTRAINT SYSTEM TO PREVENT PIPE MOVEMENT AND/OR FLOTATION.
12. SEE SEW-1207SW IF CONTINUOUS TRENCH DRAINAGE REQUIRED.



TYPE 1 SUPPORT UTILISING CEMENT STABILISED EMBEDMENT

(RIGID & FLEXIBLE PIPES)

No.	REVISION DETAILS	DWN	DATE
A	ISSUED FOR DETAILED DESIGN	HH	

CONSULTANT DETAILS:

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
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		DATE	COMPANY
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	01/10/2021	CARDNO
DRAWN:	HH	01/10/2021	CARDNO
CHECKED:	PS	01/10/2021	CARDNO
APPROVED:	NM	01/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
TRENCH DETAILS

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	403	1	A

100 mm on original

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LEGEND - NEW SERVICES

- NEW SEWER RISING MAIN
- NEW GRAVITY SEWER MAIN
- NEW AIR VALVE
- NEW GATE VALVE
- NEW SCOUR VALVE
- NEW MANHOLE
- BOREHOLE LOCATION
- TRENCHLESS
- EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

- EXISTING SNSM
- EXISTING GRAVITY SEWER MAIN
- EXISTING STORMWATER MAIN
- EXISTING GAS MAIN
- EXISTING WATER MAIN
- ARCHEOLOGICAL SITE
- EXISTING MANHOLE

COORDINATE SETOUT TABLE - RISING MAIN - PACKAGE 4 - SRM (MC09)

PT	CHAINAGE	EASTING	NORTHING
IP 1	0.000	283688.111	6135612.955
IP 2	5.407	283683.883	6135616.325
IP 3	56.434	283652.074	6135576.426
IP 4	84.225	283631.114	6135594.676
IP 5	150.096	283569.931	6135619.080
IP 6	226.970	283515.452	6135673.318
IP 7	240.037	283516.414	6135686.349
IP 8	302.055	283456.295	6135701.583
IP 9	536.803	283263.809	6135835.953
IP 10	547.001	283254.465	6135840.037
IP 11	635.765	283181.680	6135890.846
IP 12	689.225	283128.740	6135898.282
IP 13	711.640	283107.537	6135891.011
IP 14	715.565	283103.655	6135890.431
IP 15	721.864	283102.389	6135896.602
IP 16	724.838	283101.648	6135899.481
IP 17	727.515	283100.874	6135902.044
IP 18	734.551	283098.384	6135908.625
IP 19	738.511	283096.862	6135912.280
IP 20	758.837	283088.621	6135930.861
IP 21	778.596	283080.150	6135948.713
IP 22	780.130	283079.377	6135950.037
IP 23	781.780	283078.520	6135951.447
IP 24	785.144	283076.693	6135954.272
IP 25	787.628	283075.279	6135956.315
IP 26	790.984	283073.282	6135959.011
IP 27	793.477	283071.735	6135960.967
IP 28	795.953	283070.148	6135962.867
IP 29	800.980	283066.769	6135966.589
IP 30	809.438	283060.643	6135972.420
IP 31	815.020	283056.318	6135975.950
IP 32	820.042	283052.251	6135978.896
IP 33	824.180	283048.783	6135981.153

COORDINATE SETOUT TABLE - RISING MAIN - PACKAGE 4 - SRM (MC09)

PT	CHAINAGE	EASTING	NORTHING
IP 34	831.730	283042.206	6135984.860
IP 35	841.185	283033.584	6135988.742
IP 36	846.795	283028.288	6135990.592
IP 37	852.706	283022.602	6135992.207
IP 38	874.743	283001.176	6135997.360
IP 39	878.768	282997.313	6135998.491
IP 40	881.207	282995.033	6135999.356
IP 41	884.169	282992.335	6136000.579
IP 42	887.176	282989.691	6136002.011
IP 43	891.300	282986.243	6136004.274
IP 44	894.845	282983.469	6136006.481
IP 45	896.721	282982.078	6136007.741
IP 46	898.416	282980.899	6136008.958
IP 47	900.211	282979.775	6136010.357
IP 48	902.717	282978.439	6136012.478
IP 49	904.122	282977.818	6136013.738
IP 50	905.824	282977.191	6136015.320
IP 51	907.158	282976.800	6136016.596
IP 52	908.470	282976.504	6136017.874
IP 53	909.828	282976.289	6136019.214
IP 54	911.943	282976.148	6136021.325
IP 55	913.692	282976.213	6136023.072
IP 56	914.956	282976.361	6136024.328
IP 57	920.452	282977.191	6136029.761
IP 58	935.352	282982.773	6136043.576
IP 59	943.774	282985.748	6136051.455
IP 60	957.722	282990.283	6136064.645
IP 61	977.654	282995.865	6136083.780
IP 62	993.570	282999.550	6136099.264
IP 63	1013.419	283003.164	6136118.781
IP 64	1035.329	283006.232	6136140.474
IP 65	1044.411	283015.226	6136139.206
IP 66	1055.902	283016.825	6136150.585

DETAIL 1 / - SCALE 1:1000

PLAN SCALE 1:2500 (1:2500; 0, 100, 250m)

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

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		DATE:	COMPANY:
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TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
KEY PLAN

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	410	1	B

100 mm on original

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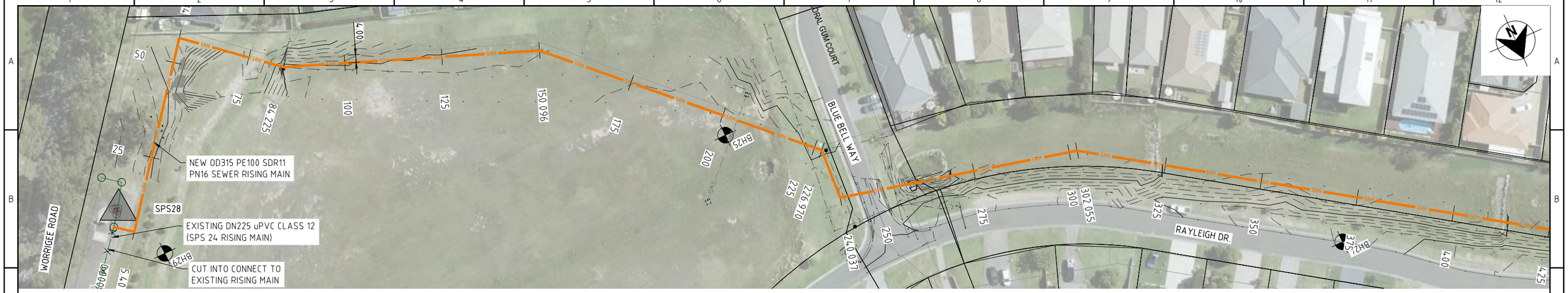
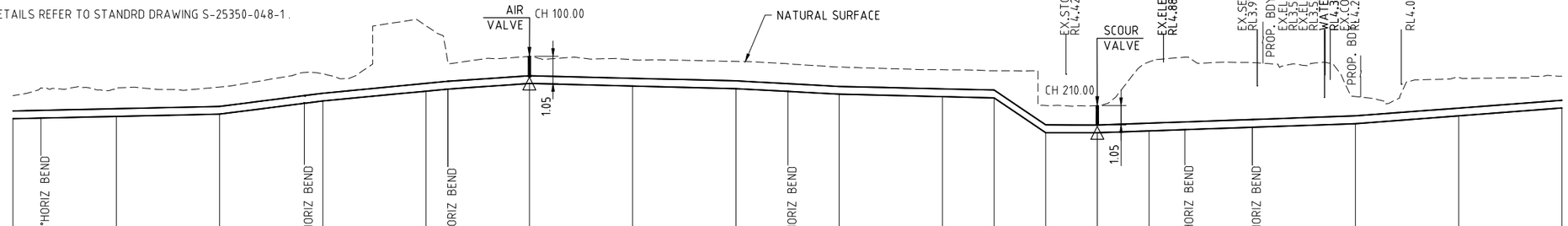


PLAN
SCALE 1:500

1:500 0 25 50m

NOTES:

1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-401.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-403.
3. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
4. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDRD DRAWING S-25350-048-1.



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

VERT GEOMETRY GRDE (%)		0.437%		2.558%		1.892%		1.364%		-0.493%		-1.073%		-0.476%		-13.454%	-0.034%		0.705%			1.506%	
VERT GEOMETRY LGTH (m)		40.000m		20.000m		24.235m		15.765m		40.000m		20.000m		30.000m		10.000m	10.000m		50.000m			60.000m	
DATUM RL -9.000																							
CONSTRUCTION TYPE	TRENCH TYPE 1																						
PIPE SIZE / CLASS	OD315 PE100 SDR11 PN16																						
EXISTING SURFACE LEVEL	3.598	3.890	3.890	3.925	4.489	4.437	6.293	4.895	4.885	5.110	4.980	4.913	4.822	4.699	4.593	4.556	3.210	3.207	4.894	5.077	4.873	4.873	3.559	4.295	4.344
DEPTH TO INVERT SEWER RISING MAIN	0.898	1.167	1.103	1.050	1.194	1.050	2.528	1.050	1.040	1.050	1.019	1.050	1.067	1.050	1.039	1.050	1.050	1.050	2.667	2.801	2.504	2.504	1.050	1.485	1.232
INVERT LEVEL SEWER RISING MAIN	2.700	2.724	2.787	2.875	3.295	3.387	3.765	3.845	3.845	4.060	3.962	3.863	3.755	3.648	3.553	3.506	2.160	2.157	2.227	2.276	2.368	2.368	2.509	2.810	3.112
RUNNING CHAINAGE SEWER RISING MAIN	0.000	5.407	20.000	40.000	56.434	60.000	80.000	84.225	84.235	100.000	120.000	140.000	150.096	160.000	180.000	190.000	200.000	210.000	220.000	226.970	240.000	240.037	260.000	280.000	300.000

OD315 SRM (MC09)
SCALE: HORIZONTAL - 1:500
VERTICAL - 1:100

LONGITUDINAL SECTION
SCALE 1:500 (H) ; 1:100 (V)

1:500 0 25 50m
1:100 0 5 10m

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	01/10/2021
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

CONSULTANT DETAILS:
Cardno
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
34/205-207 Albany Street North
Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

		DATE:	COMPANY:
SURVEYED:	JP	12/07/2021	CARDNO
DESIGNED:	PS	01/10/2021	CARDNO
DRAWN:	HH	01/10/2021	CARDNO
CHECKED:	PS	01/10/2021	CARDNO
APPROVED:	NM	01/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
RISING MAIN PLAN AND SECTION
SHEET 1 OF 4

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	411	1	B

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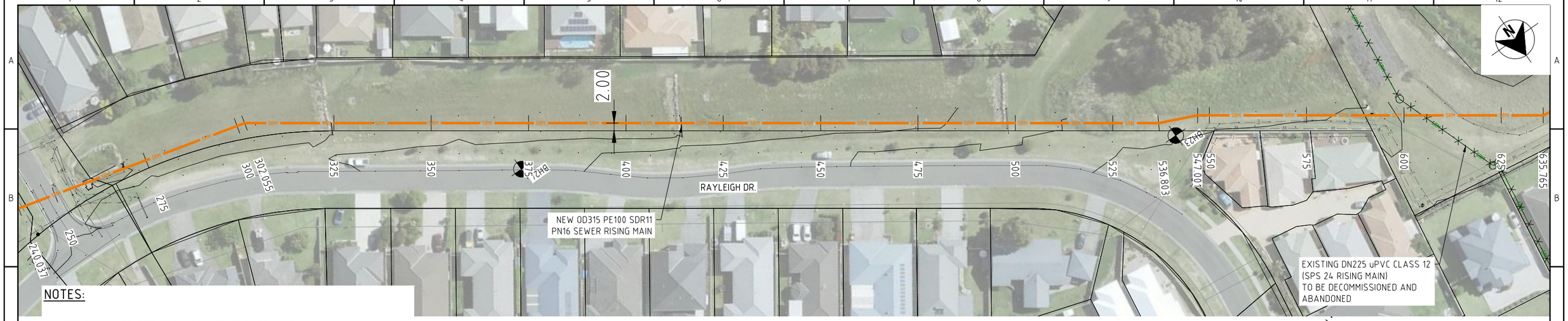
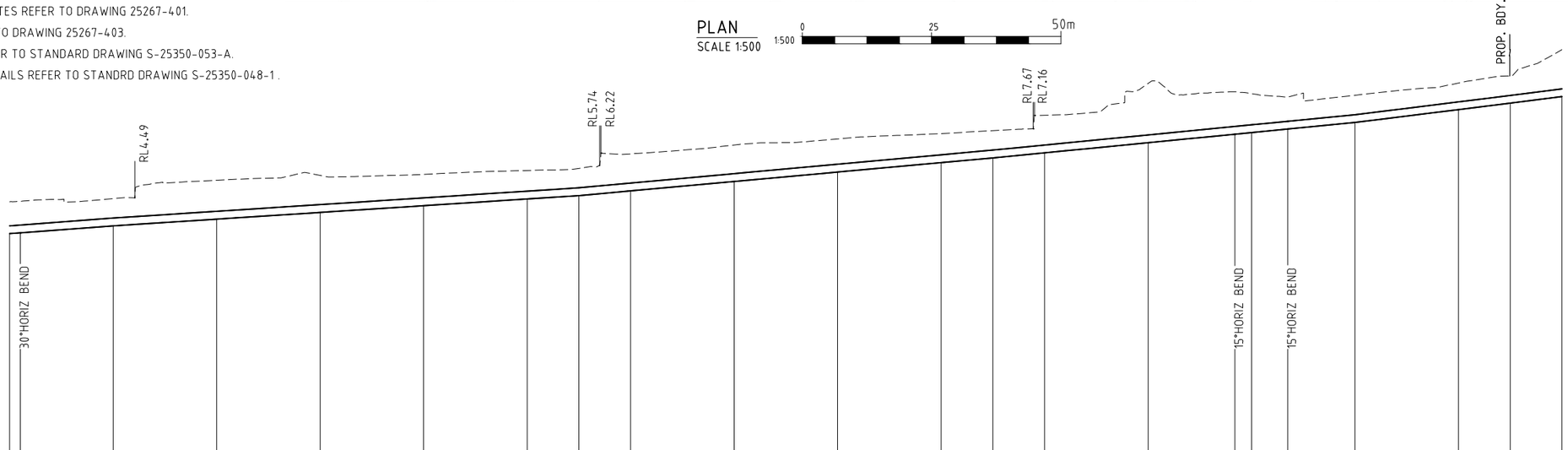


NOTES:

1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-401.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-403.
3. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
4. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDRD DRAWING S-25350-048-1.

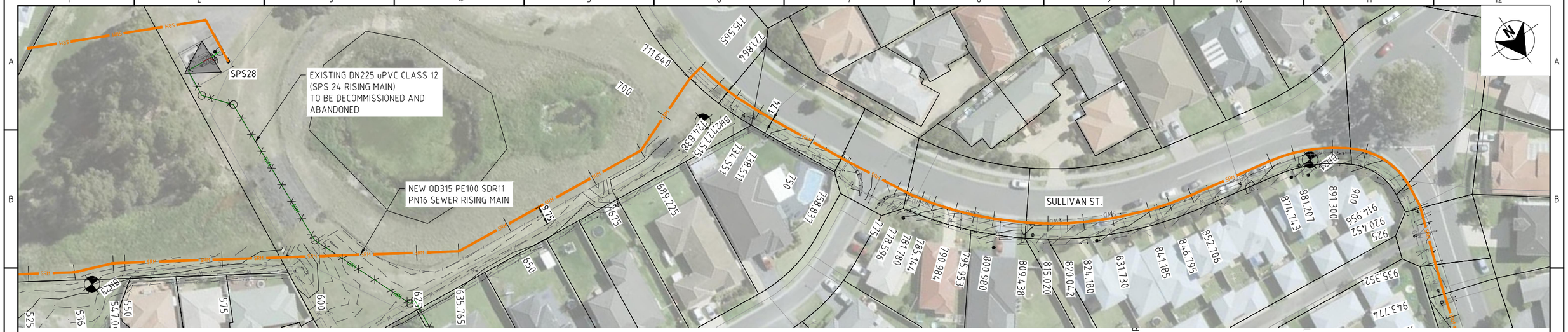
PLAN
SCALE 1:500

1:500 0 25 50m



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

| | | |



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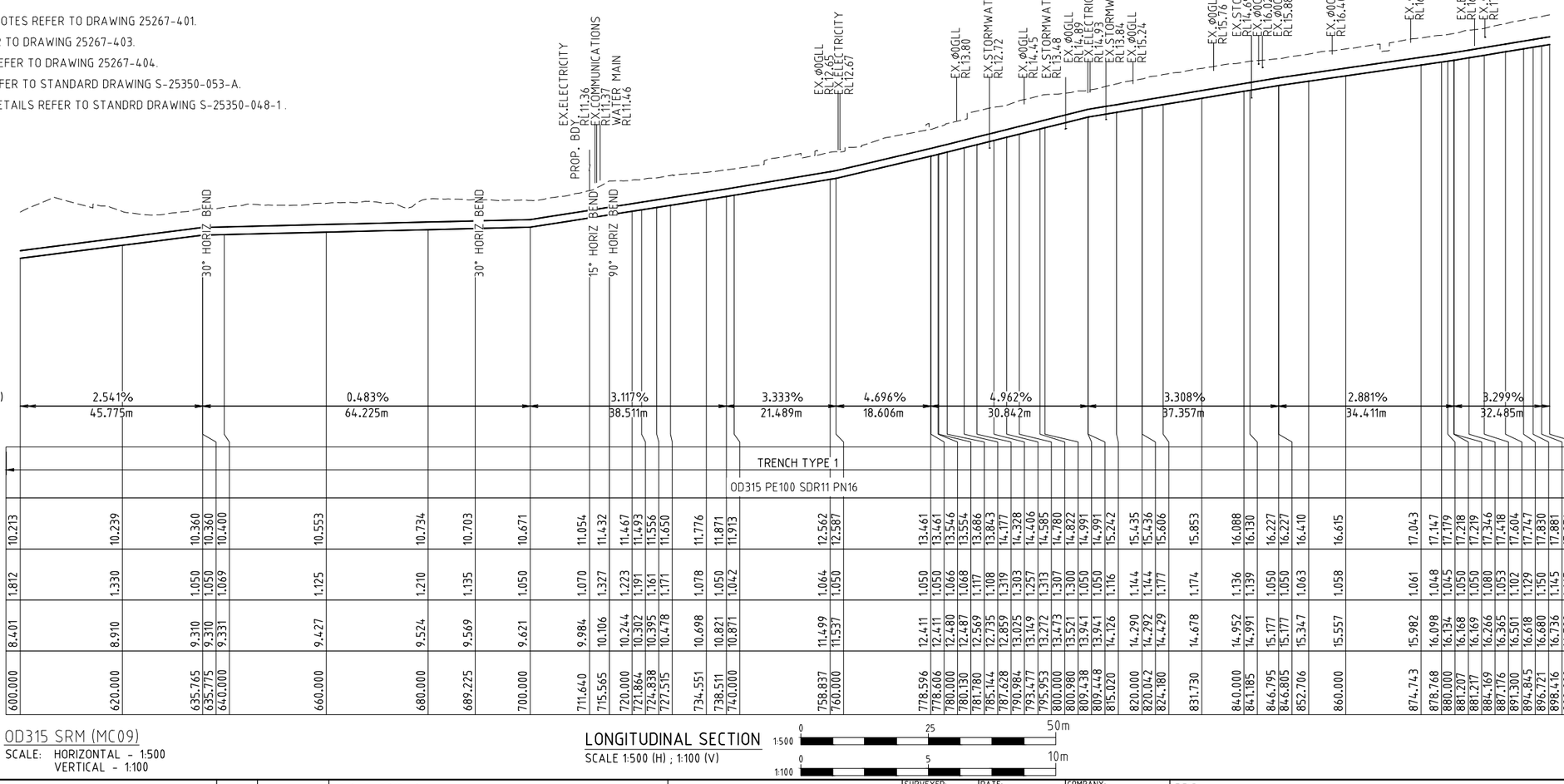
1. FOR GENERAL CONSTRUCTION NOTES REFER TO DRAWING 25267-401.
2. FOR TRENCHING DETAILS REFER TO DRAWING 25267-403.
3. FOR THRUST BLOCK DETAILS REFER TO DRAWING 25267-404.
3. FOR SCOUR VALVE DETAILS REFER TO STANDARD DRAWING S-25350-053-A.
4. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDRD DRAWING S-25350-048-1 .

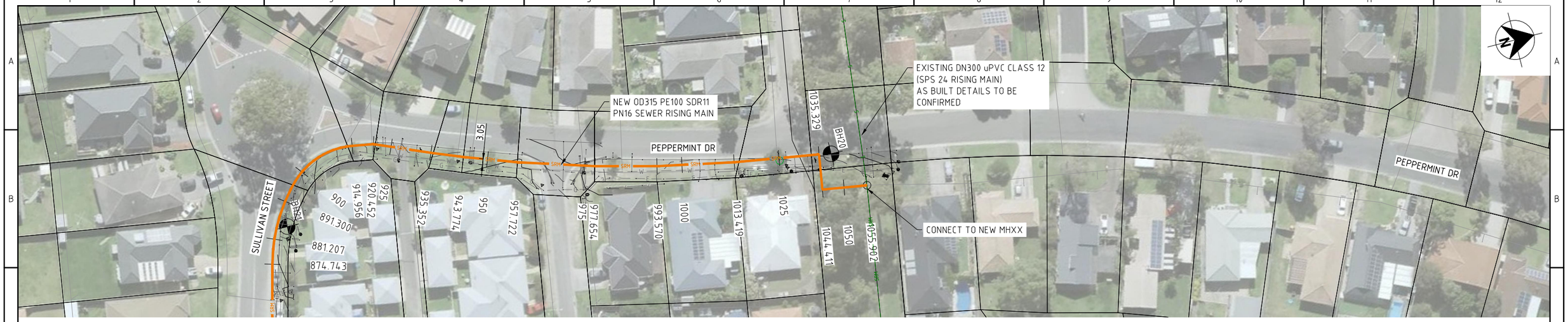
PLAN
SCALE 1:500

1:500 0 25 50m



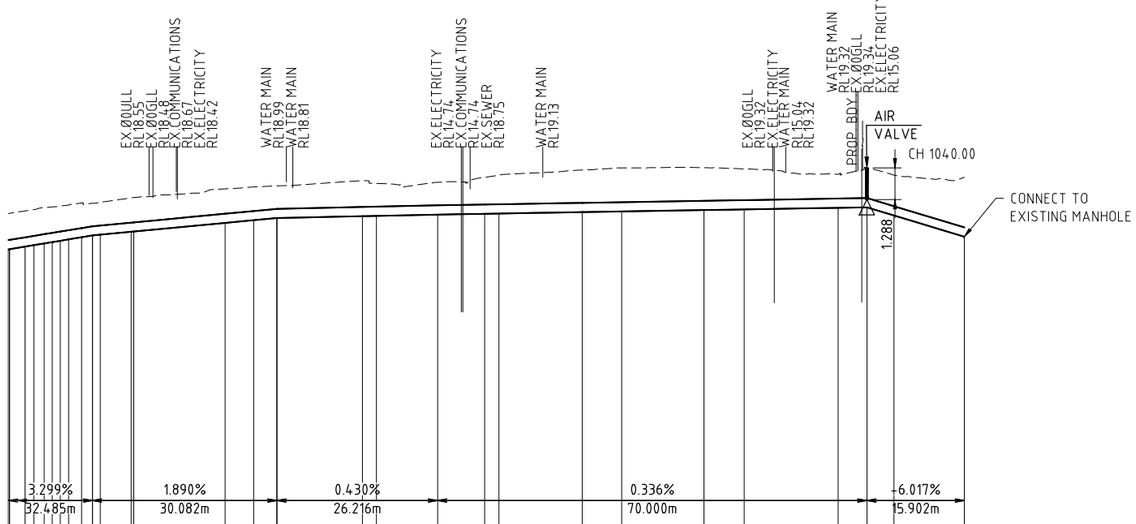
R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

| | | |



PLAN
SCALE 1:500

1:500 0 25 50m



R =HORIZ RADIUS (m)
V=VERT RADIUS (m)

VERT GEOMETRY GRDE (%)	3.299%	1.890%	0.430%	0.336%	-6.017%
VERT GEOMETRY LGTH (m)	32.485m	30.082m	26.216m	70.000m	15.902m

DATUM RL 7.000

CONSTRUCTION TYPE	TRENCH TYPE 1
PIPE SIZE / CLASS	OD315 PE100 SDR11 PN16
EXISTING SURFACE LEVEL	17.954, 17.962, 18.041, 18.083, 18.153, 18.169, 18.204, 18.235, 18.303, 18.290, 18.290, 18.317, 18.461, 18.474, 18.759, 18.821, 18.859, 18.859, 19.027, 18.937, 18.972, 19.135, 19.208, 19.373, 19.443, 19.452, 19.411, 19.233, 19.445, 19.205, 19.137
DEPTH TO INVERT SEWER RISING MAIN	1.165, 1.166, 1.163, 1.158, 1.173, 1.144, 1.137, 1.122, 1.120, 1.050, 1.049, 1.053, 1.102, 1.106, 1.110, 1.083, 1.050, 1.058, 1.158, 1.050, 1.188, 1.252, 1.372, 1.421, 1.385, 1.321, 1.092, 1.288, 1.314, 1.937
INVERT LEVEL SEWER RISING MAIN	16.788, 16.795, 16.878, 16.924, 16.981, 17.025, 17.068, 17.113, 17.182, 17.240, 17.241, 17.264, 17.360, 17.368, 17.650, 17.737, 17.809, 17.809, 17.869, 17.879, 17.922, 17.947, 17.955, 18.001, 18.022, 18.067, 18.090, 18.141, 18.157, 17.891, 17.200
RUNNING CHAINAGE SEWER RISING MAIN	900.000, 900.211, 902.717, 904.122, 905.824, 907.158, 908.470, 909.828, 911.943, 913.692, 913.702, 914.956, 920.000, 920.452, 935.352, 940.000, 943.774, 943.784, 957.722, 960.000, 970.000, 977.654, 980.000, 993.570, 1000.000, 1013.419, 1020.000, 1035.329, 1040.000, 1044.411, 1055.902

OD315 SRM (MC09)
SCALE: HORIZONTAL - 1:500
VERTICAL - 1:100

LONGITUDINAL SECTION
SCALE 1:500 (H) ; 1:100 (V)

1:500 0 25 50m
1:100 0 5 10m

NOTES:

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4. FOR TYPICAL AIR VALVE PIT DETAILS REFER TO STANDRD DRAWING S-25350-048-1 .

No.	REVISION DETAILS	DWN	DATE
B	ISSUED FOR DETAILED DESIGN	HH	
A	ISSUED FOR CONCEPT DESIGN	SMV	26/02/2021

CONSULTANT DETAILS:
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Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
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Gosford, NSW 2250
Tel: 02 4323 2558 Fax: 02 4324 3251
Web: www.cardno.com.au

SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
WATER
City Administrative Centre
PO Box 42, Nowra, NSW 2541
Ph 02 4429 3111
www.shoalwater.nsw.gov.au

	SURVEYED:	DATE:	COMPANY:
	JP	12/07/2021	CARDNO
DESIGNED:	PS	01/10/2021	CARDNO
DRAWN:	HH	01/10/2021	CARDNO
CHECKED:	PS	01/10/2021	CARDNO
APPROVED:	NM	01/10/2021	CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
RISING MAIN PLAN AND SECTION
SHEET 4 OF 4

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	414	4	B

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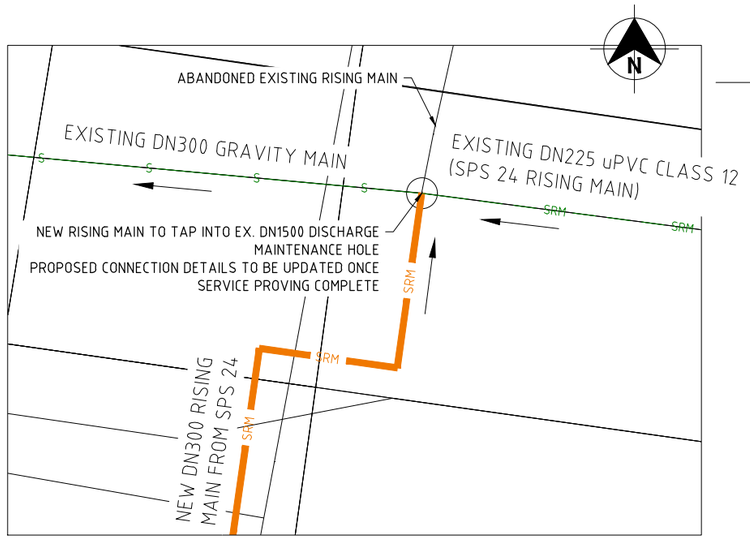
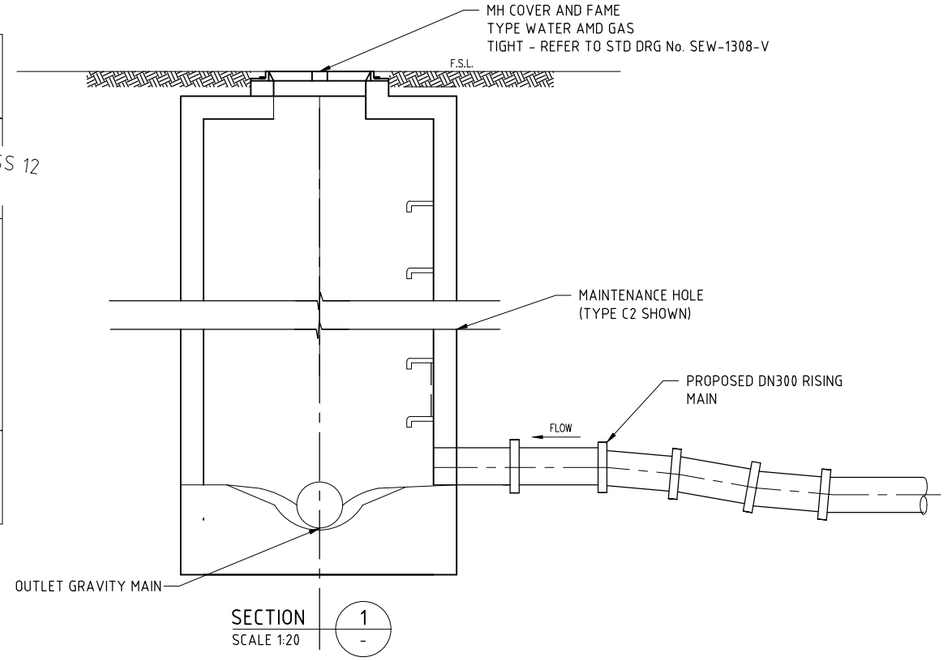


DN1500 DISCHARGE MAINTENANCE HOLE - PLAN VIEW
SCALE 1:200



SECTION 1
SCALE 1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMMETRES UNLESS OTHERWISE NOTED
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH STD. DRG NO. SEW-1451-S
3. THIS DRAWING SHOWS TYPICAL ARRANGEMENT OF A RISING MAIN DISCHARGE MAINTENANCE HOLE. DESIGN PLANS SHALL BE DEVELOPED ONCE SERVICE PROVING HAS BEEN CONDUCTED
4. EDUCT VENTSHAFT
   LOCATION, HEIGHT, DIMENSIONS AND STRUCTURAL SUPPORT OF BASE BLOCK SHALL BE AS SPECIFIED ON THE DETAILED DESIGN PLANS AND IN ACCORDANCE WITH STD. DRG NO SEW-1451-S ONCE SERVICE PROVIDING HAS OCCURRED
5. DESIGN, MATERIALS AND WORKMANSHIP TO BE IN ACCORDANCE WITH AS3600 AND AS3735
   STRUCTURAL CONCRETE TO BE MIN GRADE 40MPa MEETING REQUIREMENTS OF WATER SERVICES ASSOCIATION WSA 114, EXCEPT AS MODIFIED BELOW:
   - MINIMUM CEMENT CONTENT OF 450KG/m^3
   - TOTAL AMOUNT OF SUPPLEMENTARY CEMENTITIOUS MATERIAL SHALL NOT BE MORE THAN 60% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL SLAG CONTENT SHALL NOT BE MORE THAN 50% B WEIGHT OF THE TOTAL CEMENT MATERIAL
   - TOTAL FLY ASH CONTENT SHALL NOT BE MORE THAN 25% BY WEIGHT OF THE TOTAL CEMENT MATERIAL
   - MAXIMUM WATER/CEMENT RATIO SHALL NOT BE MORE THAN 0.45
   - DRYING SHRINKAGE STRAIN AT 56 DAYS SHALL NOT BE MORE THAN 600X10^{-6}

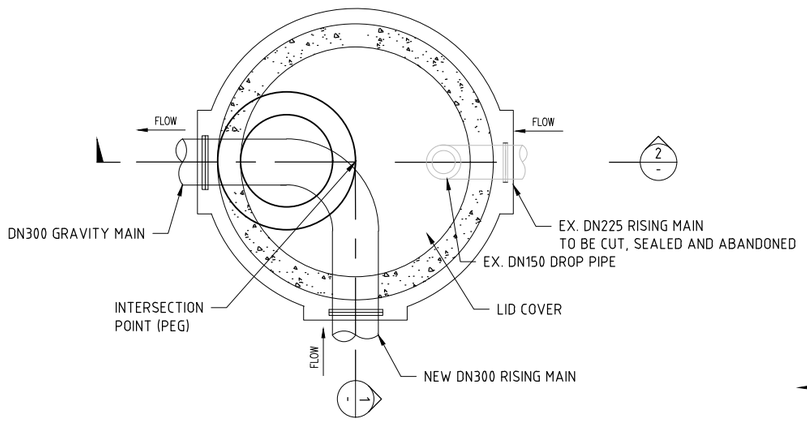
   INTERNAL CONCRETE SURFACES TO BE TREATED AS EXPOSURE CLASSIFICATION 'D' IN ACCORDANCE WITH AS3735. ISOLATION FROM THE ATTACKING ENVIRONMENT TO BE IN ACCORDANCE WITH SYDNEY WATER'S 'PCS 100 - PROTECTIVE COATING STANDARD.

LEGEND - NEW SERVICES

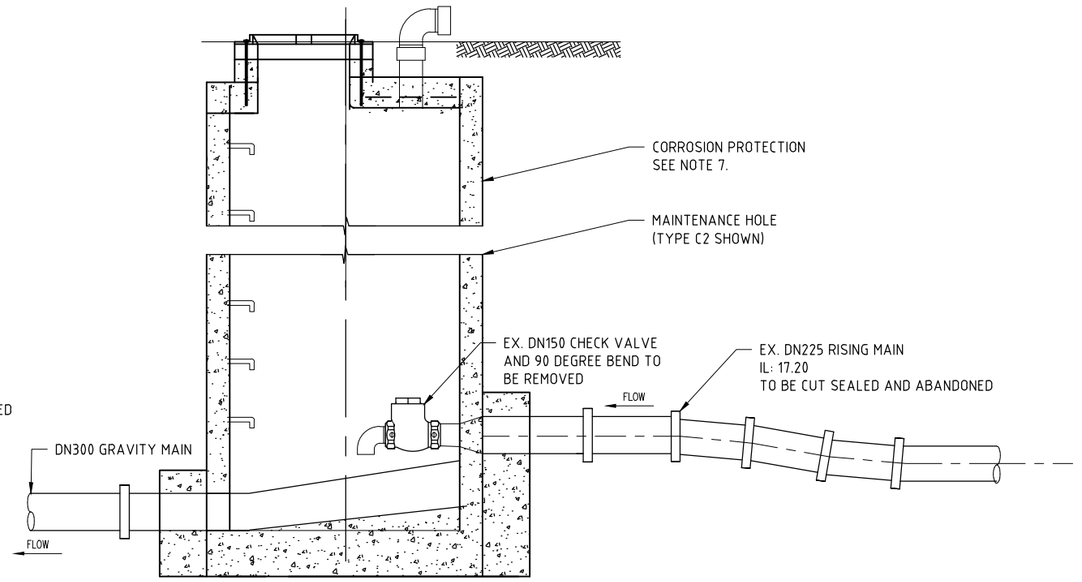
SRM	NEW SEWER RISING MAIN
S	NEW GRAVITY SEWER MAIN
▶	NEW AIR VALVE
✖	NEW GATE VALVE
	NEW SCOUR VALVE
●	NEW MANHOLE
	BOREHOLE LOCATION
	TRENCHLESS
X X X X X	EXISTING SERVICES TO BE ABANDONED

LEGEND - EXISTING SERVICES

SRM	EXISTING SNSM
S	EXISTING GRAVITY SEWER MAIN
SWD	EXISTING STORMWATER MAIN
G	EXISTING GAS MAIN
W	EXISTING WATER MAIN
	ARCHEOLOGICAL SITE
●	EXISTING MANHOLE



EX. DISCHARGE MAINTENANCE HOLE - PLAN
SCALE 1:20



SECTION 2
SCALE 1:20

1:200 0 10 20m
1:20 0 1000 2000mm

No.	REVISION DETAILS	DWN	DATE
C	ISSUED FOR DETAILED DESIGN	SMV	30/09/2021
B	ISSUED FOR DRAFT DETAILED DESIGN	SMV	16/08/2021
A	ISSUED FOR CONCEPT DESIGN	HH	26/02/2021

CONSULTANT DETAILS:
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Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
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SIZE: A1 | SCALE FACTOR: | CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: AHD

Shoalhaven Council's Water Utility
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PO Box 42, Nowra, NSW 2541
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www.shoalwater.nsw.gov.au

SURVEYED: JP	DATE: 12/07/2021	COMPANY: CARDNO
DESIGNED: PS	DATE: 30/09/2021	COMPANY: CARDNO
DRAWN: HH	DATE: 30/09/2021	COMPANY: CARDNO
CHECKED: PS	DATE: 30/09/2021	COMPANY: CARDNO
APPROVED: NM	DATE: 30/09/2021	COMPANY: CARDNO

TITLE:
SOUTH NOWRA SURCHARGE MAIN REPLACEMENT
NEW DN300 RISING MAIN FOR SPS024
RISING MAIN CONNECTION DETAILS
RM24 - DN1500 DISCHARGE MH

CONSULTANT REFERENCE No.	INDEX No.	DRAWING No.	SHEET	REV No.
WI21102IP	25267	417	1	C

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APPENDIX

B

ECOLOGICAL IMPACT ASSESSMENT

Biodiversity Impact Assessment

South Nowra - Surcharge Main Replacement

WP21102IP

Prepared for

Shoalhaven Water

22 October 2021

Cardno

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Document Information

Prepared for	Shoalhaven Water
Project Name	South Nowra - Surcharge Main Replacement
File Reference	WP21102IP_R001_BIA_Rev D.docx
Job Reference	WP21102IP
Date	22 October 2021
Version Number	RevD

Author(s):

Dr Adriana Corona Mothe
Ecologist

Effective Date: 20/10/2021

Approved By:

Kevin Roberts
Regional Senior Principal – Environment Services

Date Approved: 12/05/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
V01	12/05/2021	First draft for internal review	Adriana Corona Mothe	Kevin Roberts
Rev0	12/05/2021	First draft for release	Adriana Corona Mothe	Kevin Roberts
RevA	19/05/2021	Amend as per Environment PMs	Adriana Corona Mothe	Kyle Johannes | Zoe Wood

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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

RevC	15/06/2021	An edit by Environment PMs	Adriana Corona Mothe	Kyle Johannes | Zoe Wood
RevD	20/10/2021	Minor addition due to footprint extent, major changes due corrected GIS estimates	Adriana Corona Mothe	Kyle Johannes

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Executive Summary

Shoalhaven Water is proposing to upgrade sewer alignment and associated structures as part of the sewer located in the suburbs of Nowra and Worrigee, NSW (the proposed project). Cardno NSW/ACT Pty Ltd (Cardno) was engaged by Shoalhaven Water to prepare a Biodiversity Impact Assessment (BIA) to inform a Review of Environmental Factors (REF) for the proposed project.

Cardno undertook desktop searches and field survey to identify biodiversity values across the proposed project area and its immediate surroundings (Study Area). The following was found with regards to biodiversity values:

- The proposed sewer upgrade footprint will be located on highly disturbed and cleared land
- Native vegetation and suitable fauna and flora habitat are restricted to small patches due to historical clearing
- A total of 76 plant species were recorded across the Study Area, including 28 native species (37 %) and 48 exotic species (63 %)
- PCT 1326 was recorded within the Study Area and was commensurate with a threatened ecological community, Illawarra Lowland Woodlands listed as an Endangered Ecological Community (EEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act). No threatened species were recorded within the Study Area during surveys
- Threatened biodiversity predicted to occur within the 10km locality from the proposed project site included six threatened ecological communities (TECs), 27 threatened flora species, 55 threatened fauna species (including frogs, reptiles, mammals, birds and fish) and six migratory terrestrial bird species. These species were identified in databases with potential to occur within 10 km locality surrounding the project site.

A likelihood of occurrence and risk (LoOR) assessment was undertaken to assess whether threatened biodiversity was likely to be impacted by the proposed project. The LoOR assessment identified four threatened species with moderate likelihood of occurrence. Assessment of significance on those four threatened species and the Illawarra Lowland Woodlands concluded that the proposal is unlikely to result in significant impacts on threatened species or TECs.

Avoidance and mitigation measures have been proposed to minimize potential of indirect impacts to native vegetation and aquatic habitat. Based on the avoid and minimise impact approach, it is concluded that the proposed sewer upgrade is unlikely to have significant effects on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

Terms and Abbreviations

Abbreviation	Description
AOBV	Areas of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BIA	Biodiversity Impact Assessment
Bio Act	NSW *Biosecurity Act 2015*
BoM	Bureau of Meteorology
Cardno	Cardno (NSW/ACT) Pty Ltd
CEMP	Construction Environmental Management Plan
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPI	NSW Department of Primary Industries
DoEE	Commonwealth Department of Environment and Energy
DPIE	NSW Department of Planning, Industry and Environment
EP&A Act	NSW *Environmental Planning & Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
KFH	Key Fish Habitat
KTP	Key Threatening Processes
LGA	Local Government Area
LoOR	Likelihood of Occurrence and potential for risk
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service
OEH	NSW Office of Environment and Heritage (now DPIE)
PCT	Plant Community Types
PMST	Protected Matters Search Tool
RCE	Riparian, channel and environment inventory for small streams
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act 1995* (replaced by the BC Act)
WoNS	Weed of National Significance

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1 Introduction

Cardno was engaged by Shoalhaven Water (SW) to prepare a Biodiversity Impact Assessment to inform the Review of Environmental Factors (REF) for replacement of surcharge mains and associated infrastructure at South Nowra, NSW.

1.1 Background

The proposal will involve the construction of new storage tanks, pump upgrades, a new pump station, new rising mains and sewer mains and decommissioning of existing rising mains. The proposed works will be undertaken at South Nowra, including along Greenwell Point Road, Old Southern Road, Sugarwood Road and in the vicinity of Sullivan Street Park (**Figure 1-1**).

The biodiversity assessment covered a 20 m wide construction corridor (generally 10 m either side of the sewer alignment). Where the sewer main was closer to property boundaries on one side, the 20 m corridor was shifted to be larger on one side of the main and narrower on the other side. The Study Area comprised the 20 m wide construction corridor.

A Review of Environmental Factors (REF) is required to assess the environmental impacts associated with the proposed upgrade works. This Biodiversity Impact Assessment (BIA) has been prepared to inform the REF.

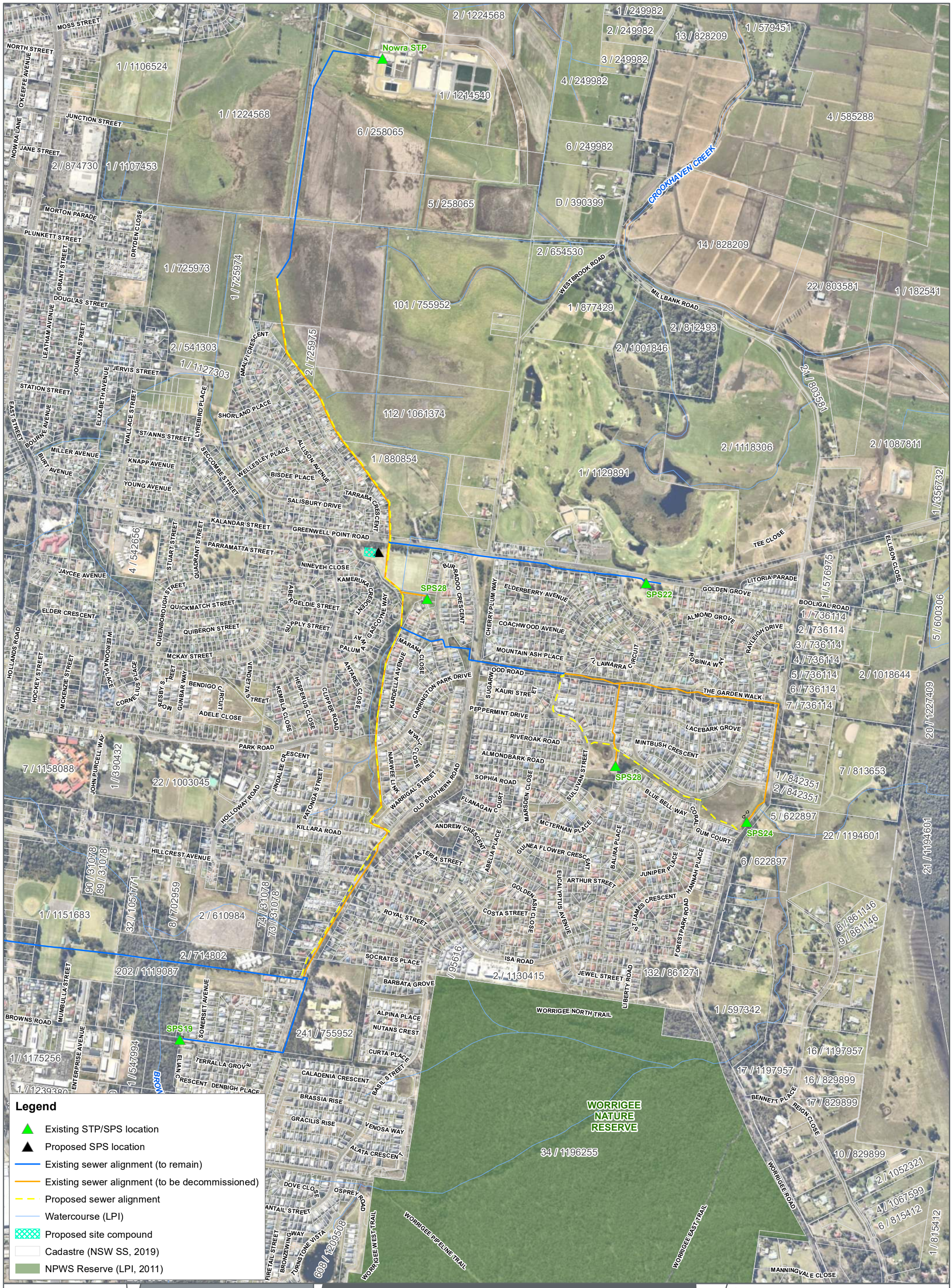


FIGURE 3-1

1:12,500 Scale at A3

m

0 100 200 300 400

Site Plan

SOUTH NOWRA
SHOALHAVEN, NSW

Cardno

Map Produced by Cardno MNL
Date: 2021-05-18 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-002-SitePlan.mxd 03
Aerial Imagery supplied by Nearmap (April, 2021)

1.2 Description of the Proposed Project

The proposal will include:

- Installation of 635 m of diameter nominal (DN) DN300 Rising Main along Old Southern Road
- Installation of 1,300 m of DN225 or DN300 Rising Main, to improve the performance of SPS024
- Decommission sewer pump station (SPS) SPS028, connecting it to SPS024 gravity sewer network via 80 m of DN150 gravity sewer
- Installation of a new SPS in the reserve to the south of Greenpoint Road
- Replacement of the existing DN300 asbestos cement (AC) surcharge main with:
  - 685 m of DN375 gravity sewer to be installed from the rear of 44 Warrigal St, to the injection of SPS024
  - 325 m of DN525 gravity sewer from the injection/discharge of SPS024 to flow to the new SPS
  - 1,200 m of DN500 rising main connecting the new SPS to the DN500 main installed as part of the new Nowra Sewer Treatment Plan (STP) construction
  - Upgrading all pump stations to meet peak wet weather flow (PWWF) requirements, and maximise operational efficiencies.
  - Temporary use of an approximately 120 m^2 area as a site compound.

It is noted that none of the existing sewer mains that are being replaced will be removed during the works. They will all remain in ground and be grout filled. The only demolition will be the removal on the top 1 m of SPS28. The remaining pits and wet well at SPS28 will either be sand or grout filled as well and the top 1 m of ground will be filled with environmentally suitable fill and the surface will be turfed. Location of project areas is shown in **Figure 1-1**.

1.3 Objective of the Biodiversity Impact Assessment Report

The overall aim of the BIA was to assess the potential impacts of the proposed project on the flora and fauna of the local area. Specifically, it would:

> Determine if the proposed project was likely to result in any significant impacts to flora and fauna, in particular threatened and / or migratory species, populations or ecological communities listed under State and / or Commonwealth legislation, or their associated habitats;

> Recommend measures to avoid, minimise and/or mitigate any potential impacts to flora and fauna; and

> Determine whether the residual impacts (if any) to flora and fauna were ecologically acceptable following implementation of mitigation measures.

For the purposes of this BIA, the Site includes the existing sewer alignment to be decommissioned, the proposed new sewer alignment, sewer pump station, underground storage tanks and the site compound; whereas the wider area surveyed, including a 20 m wide construction corridor, as part of this BIA is referred to as the Study Area (**Figure 1-1** and **Figure 1-2**).

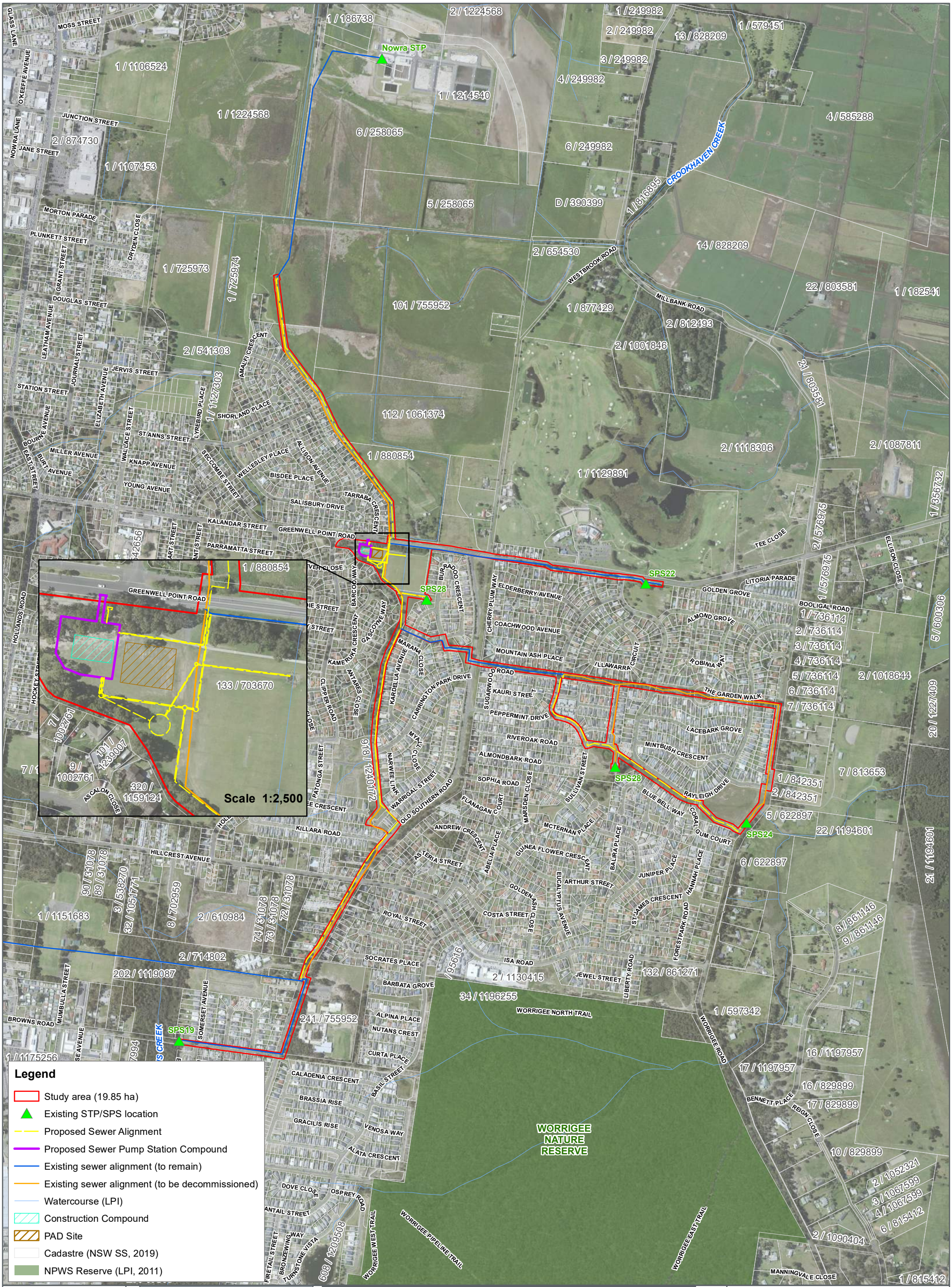


FIGURE 1-1

1:12,500 Scale at A3

m 0 100 200 300 400

Study Area

SOUTH NOWRA
SHOALHAVEN, NSW

Cardno

Map Produced by Cardno MNL
Date: 2021-10-05 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-003-StudyArea.mxd 05
Aerial Imagery supplied by MetroMap (November, 2020)

1.4 Study Area and Site Particulars

The Site is approximately 10,680m long and the Study Area is an approximately 19.45ha with the proposed surcharge mains and associated infrastructure running along and/or across roads and some council owned lots. From south to south-east, the proposed works would be located from the western boundary of Nowra Driving range and Putt Putt, Greenwell Point Road, Old Southern Road, Sugarwood Road and in the vicinity of Sullivan Street Park. The Site is shown in **Figure 1-1**. **Table 1-1** provides other particulars of the Study Area.

Table 1-1 Study Area and Site Particulars

Properties	Site Particulars
Lot/DP	The proposed works runs along several Lot/DP.
Address	From Greenwell Point Road, Nowra NSW 2541 to Worrigee Road, Worrigee, NSW 2540
Location	Several locations in the suburbs of Nowra and Worrigee
Study Area	Approximately 16.2ha
Site	The proposed surcharge mains and associated infrastructure including approximately 2680m of rising main and approximately 1233m of gravity sewer main (see **Figure 1-1**).
LGA	Shoalhaven City Council
Zoning	In accordance with Shoalhaven LEP 2014, the Study Area includes: ▪ RE1 (Public Recreation): along western boundary of Nowra Driving range and Putt Putt, Ratcliff Park, open space between Burradoo Crescent and Old southern Road, The Garden Walk along Sugarwood Road, open space off Sullivan Street – Rayleigh Drive – Regelia Parade and Rayleigh Garden Reserve; ▪ RU1 (Primary Production): the southern portion of boundary of Nowra Driving range and Putt Putt; ▪ SP2 (infrastructure): Greenwell Point Road; ▪ R1 (General Residential): lot off Holloway Road; ▪ R2 (Low Density Residential): lots off Old Southern Road;. ▪ E2 (Environmental Conservation): western portion of 189 Old Southern Road (off Kaross Close) and western portion of Browns Road.
IBRA Bioregion	Sydney Basin (SYB)
IBRA Sub-region	Illawarra (SYB12)
Mitchell Landscape	The Study Area is located within the following Mitchell Landscapes: ▪ Bomaderry Plains (Bpp) of the SB Illawarra ecosystem meso grouping. The landscape has an over cleared status (estimated 81% cleared). ▪ Nowra – Durras Coastal Slopes (Nds) of the SB Jervis ecosystem meso grouping. The landscape has an over cleared status(estimated 32% cleared).
Geology	The Shoalhaven 1:100,000 Coastal Quaternary Geological Map indicates that the Study Area includes Permian sedimentary rocks including sandstone, shale and conglomerate (Sydney Basin) (Ps); Holocene backswamp with organic mud, peat, silt and clay (Qhas) and quaternary alluvial and colluvial fan with fluvial sand, silt, gravel and clay (Qavf), the latter two geological units part of the alluvial plain system.
Koala Habitat Protection SEPP	On 17 March 2021, the State Environmental Planning Policy (Koala Habitat Protection) 2021 commenced (hereafter referred to as Koala SEPP 2021). In accordance with the Koala SEPP 2021: ▪ Koala SEPP 2020 applies to land within the Shoalhaven City Council which is zoned as RU1, RU2 and RU3. The Koala SEPP 2020 replicates the objectives and provisions of the Koala SEPP 44. The Koala SEPP 2020 applies to the proposed proposal as: – The Site is located within the Shoalhaven City Council listed in Schedule 1 of the Koala SEPP 2020. – The SEPP applies to development applications on land over 1 hectare (alone, or together with adjoining land in the same ownership). It is noted that application of the Koala SEPP 2020 to zones RU1, RU2 and RU3 is an interim measure while new land management and private native forestry codes are developed in accordance with the Koala SEPP 2021. Koala SEPP 2021 applies to all other land zones within the Shoalhaven City Council LGA.

Properties	Site Particulars
NSW WeedWise Local Area	The Shoalhaven City Council LGA is part of the South East Local Land Services Region.
Locality	The Study Areas is located within urban and rural landscape, it is surrounded by: ▪ Most of the route is located on road verges along sealed roads, including Greenwell Point Road, Old Southern Road, Browns Road and Sullivan Street; ▪ Parts of the route is located in lots with historical clearing and use for recreation such as Nowra driving range and Putt Putt, Rayleigh Garden Reserve and The Garden Walk; ▪ The south-western portion of the study area will decommission mains located within the Browns Creek's riparian corridor which appear to contain native vegetation.

**as shown in SixMaps (https://maps.six.nsw.gov.au/)*

1.5 Legislative Requirements

The BIA addresses the following specific legislative planning requirements relating to flora and fauna:

> Potential impacts on threatened species, populations and ecological communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act);

> Potential impacts to nationally listed Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);

> Potential impacts to threatened and protected species listed under the NSW *Fisheries Management Act 1994* (FM Act); and

> Potential requirements listed under the NSW *Biosecurity Act 2015* (Bio Act) for Priority Weeds for the South East LLS Region.

As the proposed project will be assessed under Part 5 of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act), the preparation of a Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Assessment Method (BAM) is optional and has not been included in this report.

2 Methodology

2.1 Data Searches and Literature Review

Prior to attending the Study Area, Cardno ecologists undertook a desktop study that included a review of:

- Existing vegetation mapping as available in NSW BioNet Vegetation Information System;
- Local threatened species records within the NSW BioNet Atlas;
- Relevant Threatened Ecological Community description and assessment guidelines (DEC 2004; DPIE 2020);
- Predicted Matters of National Environmental Significance (MNES), including threatened species and ecological communities as per the Commonwealth Department of Agriculture, Water and the Environment (DAWE)'s Protected Matters Search Tool (PMST);
- NSW DPIE Biodiversity Values Map and Threshold Report;
- NSW Department of Primary Industries (DPI) threatened freshwater fish indicative distribution mapping and key fish habitat; and
- The NSW DPI threatened species database.

2.2 Field Surveys

Field surveys in terrestrial and aquatic habitats were undertaken as per methods described in **Table 2-1**.

Table 2-1 Surveys Conducted

Group	Survey Type	Survey Method and Objective
Terrestrial Ecology		
Vegetation	Random Meander Transect (RMT); and Rapid Biodiversity Assessment (RBA)	A random meander transect was undertaken across the Site to ground-truth vegetation mapping (if available). Vegetation ground-truthing consisted of: ▪ Preparation of a field map showing existing vegetation mapping. Field map was prepared as a hard copy; ▪ An RMT was walked and rapid biodiversity assessment points (RBA) collected. An RBA point consisted of collecting a geographic reference point (e.g. waypoint with a Geographic Positioning System (GPS) or a point using the ArcGIS app Collector in a tablet), followed by collection of biodiversity values notes to: – Identify biodiversity values at the point, including the presence of native vegetation (including Threatened Ecological Communities (TEC)), threatened flora and fauna species and habitat for fauna; – Allocate native vegetation to a Plant Community Type (PCT). In NSW, and in accordance with the Vegetation Information System (VIS), native vegetation communities are allocated to a given PCT. A PCT identification number (e.g. PCT 1081) refers to a specific vegetation community within a given vegetation formation and class; and – Assess the general condition of the point in terms of disturbance and/or condition. The field data was used to generate an updated map of the Study Area.
Fauna habitat	RMT	General fauna habitat assessment was undertaken along RMT. The availability and quality of habitat within the Study Area was assessed with respect to the following factors: ▪ Structural and floral diversity; ▪ Diversity and extent of habitat types; ▪ Habitat connectivity, including continuity with similar habitats within the Study Area, and adjacent areas via habitat corridors;

Group	Survey Type	Survey Method and Objective
		▪ Location and description of key habitat features including tree hollows, water bodies, caves and crevices and rocky areas; ▪ Degree of disturbance and degradation evident from visual inspections; and ▪ Topographic features such as aspect and slope. Fauna occupation was assessed by collecting: ▪ Direct fauna habitat evidence: opportunistic records of fauna sightings and fauna habitat features such as creeks, hollow-bearing trees, caves, bird nests, etc.; and ▪ Indirect fauna habitat evidence: recording scats, bird nests, burrows, and other incidental evidence of fauna occupation.
Bird Survey	Point survey	A 20minutes point survey was undertaken at selected point(s) within the Study Area.
Threatened Species	Opportunistic sightings in RMT	Threatened species predicted to occur within the Study Area as per the BioNet Atlas and PMST report were considered for opportunistic survey by: ▪ Adding threatened species sightings to the field map; ▪ Preparing a threatened species profile summary (e.g. description from PlantNet, description as per the species' profile in the Threatened Biodiversity Data Collection (TBDC)) and based on ecologists' experience; and ▪ Undertaking a search in areas where threatened species were predicted to occur.
All	Opportunistic sightings	Opportunistic sightings of flora and fauna were recorded.
Aquatic Ecology		
Aquatic Habitat Assessment	RMT	Aquatic habitat assessment along RMT consisted of descriptions of physical habitat including visual assessment of streambed composition, aquatic and riparian vegetation and evidence of disturbance (e.g. dumping) within creeks and other water bodies.
Aquatic Fauna	Opportunistic sightings	Opportunistic sightings of aquatic fauna in creeks found along RMT.

2.3 Survey Limitations

Snapshot surveys as undertaken during this biodiversity study do not account for temporal variation. Given the short period of time spent on the study area, the detection of certain species and ecological values may be affected by:

> Seasonal migration (particularly migratory birds);

> Seasonal flowering periods (some species are cryptic and are unlikely to be detected outside of the known flowering period);

> Seasonal availability of food, such as blossoms for some fauna;

> Weather conditions during the survey period (some species may go through cycles of activity related to specific weather conditions, for example some microchiropteran bats (microbats), reptiles and frogs can be inactive during cold weather); and

> Species life-cycle (cycles of activity related to breeding).

These potential limitations have been addressed by applying the precautionary principle in cases where the survey methodology may have given a false negative result (e.g. a species that could reasonably be expected to occur, based on previous records and available habitat, was not observed). All species have been assessed on the basis of the presence of suitable habitat and the likely significance of that habitat to support a viable local population.

3 Results

3.1 Database Searches and Literature Review

3.1.1 BioNet Atlas

The results from the BioNet Atlas database searches indicated that 65 threatened species have been recorded within 10km of the Study Area, including two amphibian, one reptile, 36 birds, 14 mammals and 12 flora species (**Appendix A**: **Table A-1**). **Figure 3-1** shows the distribution of BioNet Atlas records within the 10km locality.

In addition, six threatened ecological communities (TECs) are known, or are predicted to occur, within 10km of the Study Area (**Appendix D**: **Table D-2**).

3.1.2 Protected Matters Search Tool

The results of Commonwealth EPBC Protected Matters Search Tool (PMST) indicated that a total of three MNES are predicted to occur within the Study Area as listed in **Table 3-1**.

See **Appendix B** for the full PMST report.

Table 3-1 MNES predicted by the PMST Report

<table>
<tr><th>MNES</th><th>PMST predicted</th><th>Applicability to Study Area</th></tr>
<tr><td>World Heritage Places</td><td>None</td><td>NA</td></tr>
<tr><td>National Heritage Places</td><td>None</td><td>NA</td></tr>
<tr><td>Wetlands of International Importance</td><td>None</td><td>NA</td></tr>
<tr><td>Great Barrier Reef Marine Park</td><td>None</td><td>NA</td></tr>
<tr><td>Commonwealth Marine Area</td><td>None</td><td>NA</td></tr>
<tr><td>Threatened Ecological Communities (TECs)</td><td>Six TECs are predicted as likely to occur within the 10km locality:
Coastal Swamp Oak (Cassuarina glauca) Forest of New South Wales and South East Queensland ecological community (EEC);
Illawarra and south coast lowland forest and woodland ecological community (CEEC);
Illawarra-Shoalhaven subtropical Rainforest of the Sydney Basin Bioregion (CEEC);
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC);
Subtropical and Temperate Coastal Saltmarsh (VEC); and
Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion (EEC).</td><td>Further assessment is presented in Section 4.3.</td></tr>
<tr><td>Threatened Species</td><td>A total of 82 threatened species were predicted to occur within the 10km locality as per Table below.
<table>
<tr><th>Group</th><th colspan="3">Number of species predicted</th></tr>
<tr><th></th><th>Vulnerable</th><th>Endangered</th><th>Critically Endangered</th></tr>
<tr><td>Birds</td><td>19</td><td>9</td><td>6</td></tr>
<tr><td>Fish</td><td>2</td><td>1</td><td>-</td></tr>
<tr><td>Frogs</td><td>3</td><td>-</td><td>-</td></tr>
</table></td><td>Further assessment of threatened species was undertaken as shown in Section 4.3.</td></tr>
</table>

Mammals	7	2	-
Plants	13	10	4
Reptiles	4	2	-

Migratory Species	A total of 57 migratory species were predicted to occur within the 10km locality. However, only six of these species were considered relevant given the others were marine or wetland species.	Further assessment of migratory species was undertaken as shown in **Section 4.3**.

FIGURE 3-1

1:12,500 Scale at A3

m
0 100 200 300 400

Bionet Atlas Records

SOUTH NOWRA
SHOALHAVEN, NSW

N

Cardno

Map Produced by Cardno (NSW/ACT) Pty Ltd (NWE)
Date: 2021-10-21 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-004-BionetAtlas.mxd 04
Aerial Imagery supplied by MetroMap (November 2020)

3.1.3 Aquatic Threatened Species Indicative Map

Naturally occurring aquatic habitats, such as rivers and creeks are not present within the Study Area. The Study Area is, however, close to creeks, including:

- A first order stream mapped at approximately 400 m west of Nowra driving range, west of Salisbury Drive
- Crookhaven Creek located at approximately 1.3 km east from the Nowra driving range
- Browns Creek located at approximately 130 m west of end of Browns Road
- The northernmost end of the Study Area is approximately 1.8 km south of the Shoalhaven River.

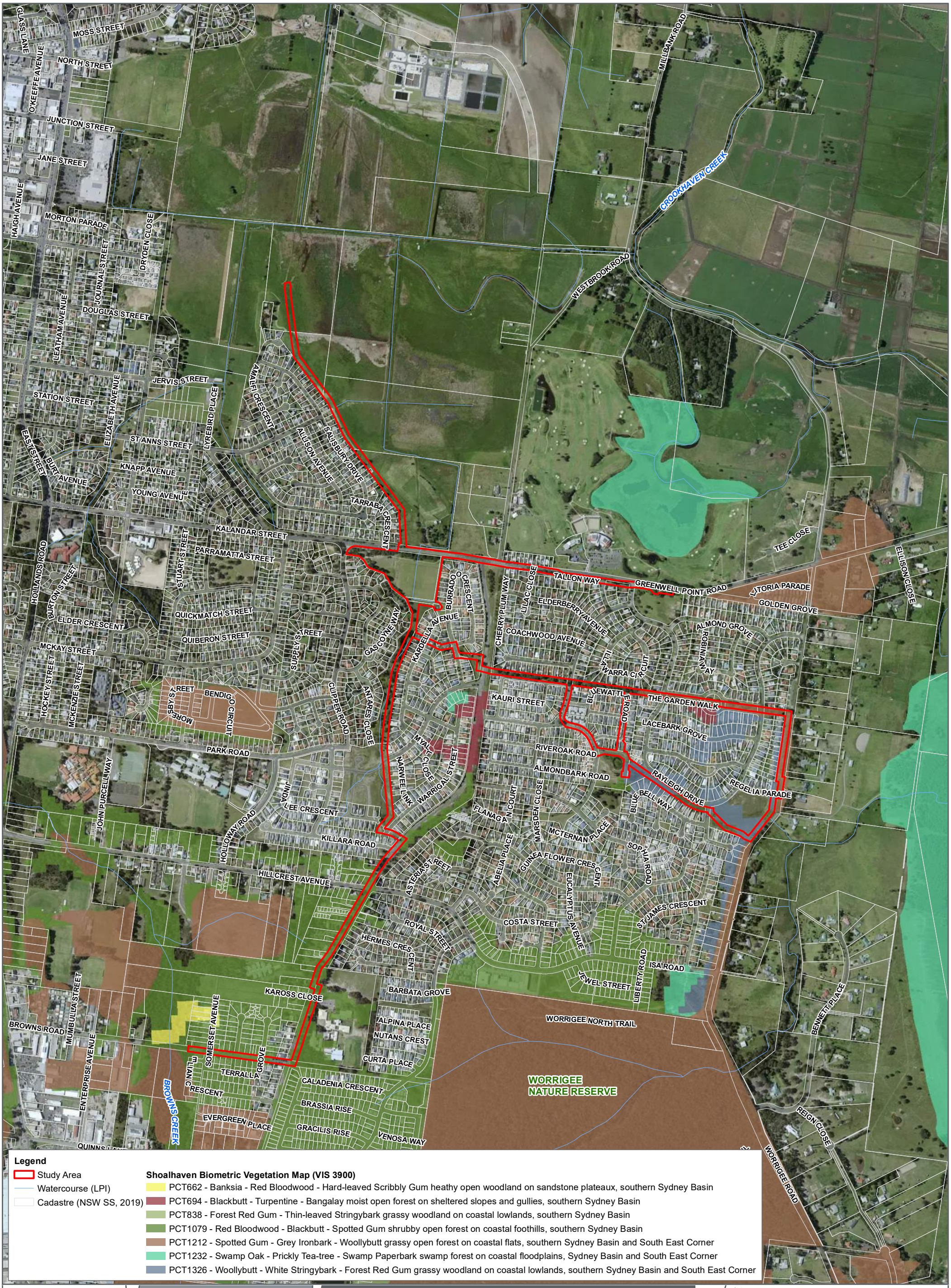
Only the Shoalhaven River is mapped as Key Fish Habitat (DPI 2021a), however none of the water bodies near the Study Area are identified as habitat for threatened freshwater fish (DPI 2021b).

3.1.4 Local Vegetation Mapping

The Study Area is located within the Shoalhaven City Council LGA to which the Shoalhaven Biometric Vegetation Map (VIS 3900) mapping applies. In accordance with the Shoalhaven Vegetation Map, the study area includes two vegetation communities as summarised in **Table 3-2** and shown in **Figure 3-2**.

Table 3-2 Vegetation Communities within the Study Area as per Shoalhaven Vegetation Map (VIS 3900)

PCT ID	PCT Name	Area (ha)	TEC Associated
1079	Red Bloodwood – Blackbutt – Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion	2.18	No
1212	Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin Bioregion and South East Corner Bioregion	1.75	Yes



Legend

- Study Area
- Watercourse (LPI)
- Cadastre (NSW SS, 2019)

Shoalhaven Biometric Vegetation Map (VIS 3900)

- PCT662 - Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin
- PCT694 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin
- PCT838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin
- PCT1079 - Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin
- PCT1212 - Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin and South East Corner
- PCT1232 - Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest on coastal floodplains, Sydney Basin and South East Corner
- PCT1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin and South East Corner

FIGURE 3-2

1:12,500 Scale at A3

m
0 100 200 300 400

Shoalhaven Biometric Vegetation Map (VIS 3900)

SOUTH NOWRA
SHOALHAVEN, NSW

N

Cardno

Map Produced by Cardno (NSW/ACT) Pty Ltd (NWE)
Date: 2021-10-21 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-005-VegMapVIS3900.mxd 04
Aerial Imagery supplied by MetroMap (November 2020)

3.1.5 Biodiversity Values Map

Review of DPIE's Biodiversity Values Map showed that no biodiversity values are mapped within the Site as per 28th April 2021.

Therefore, no land mapped as having high biodiversity values in the BVM will be affected by the proposed project.

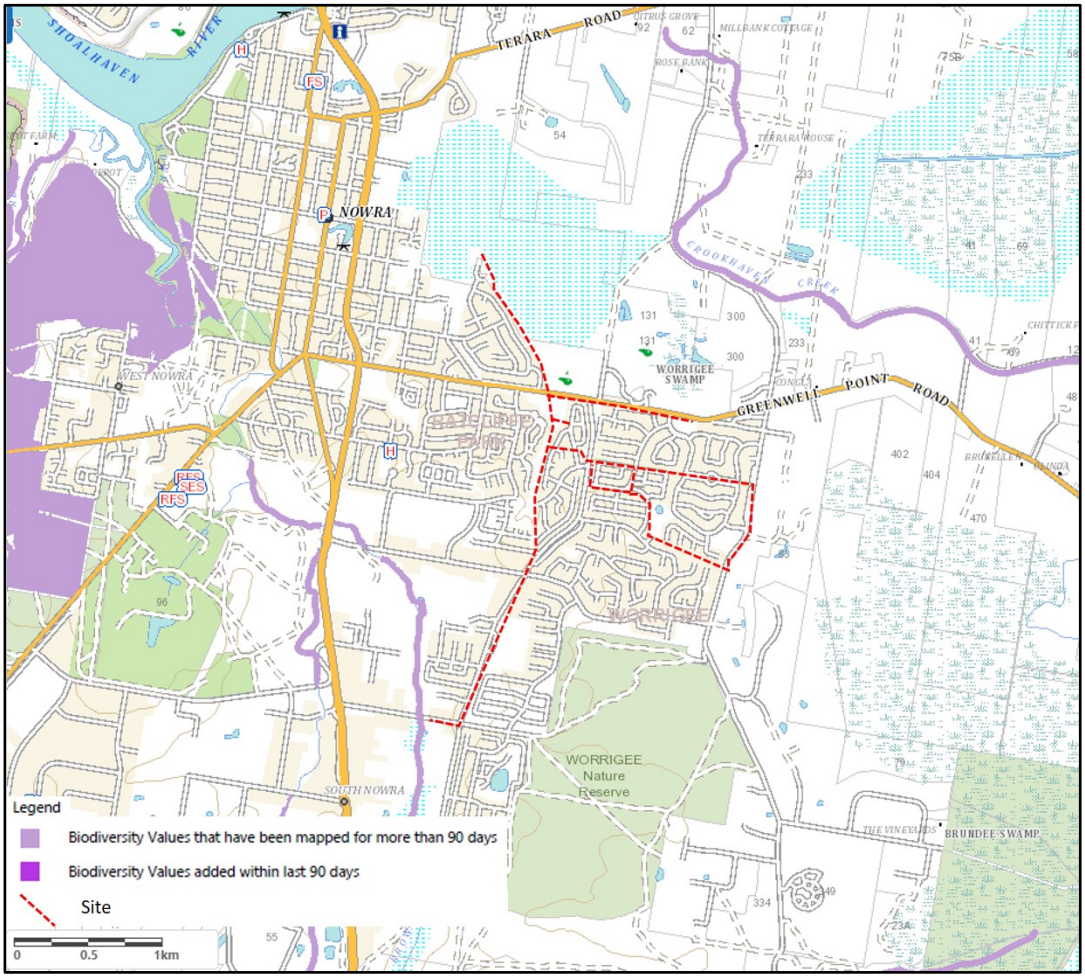


Figure 3-3 Biodiversity Values Map

3.1.6 Areas of Outstanding Biodiversity Value

Areas of Outstanding Biodiversity Value (AOBV) are declared by the NSW Minister for the Environment and under the BC Act. The register of AOBV indicates that at the time of assessment (28 April 2021) There are four declared AOBV:

- Gould's Petrel – Critical Habitat Declaration;
- Little penguin population in Sydney's North Harbour – Critical Habitat Declaration;
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve – Critical Habitat Declaration; and
- Wollemi Pine – Critical Habitat Declaration.

The proposed project is not located near or at any of the AOBV. Therefore, it is considered that the proposed project will not result on any direct or indirect impacts on AOBV.

3.2 Field Survey and Effort

Field surveys were undertaken between Monday 3 and Tuesday 4 May 2021 by Dr Adriana Corona Mothe and on 17 September by Dane Fogliada. RMT, RBP, a bird survey, general fauna habitat and opportunistic observations were undertaken during surveys. .

Environmental conditions at time of survey are provided in **Table 3-3**.

Table 3-3 Environmental Conditions at the Time of Survey

Date	Temperature (°C) *		Rainfall*	Other observations on-site
	Minimum	Maximum	(mm)	
3/05/2021	11.9	26.7	0.2	Sunny
4/05/2021	13.4	16.7	0	Raining
17/09/2021	4.8	22.6	0.2	-

**Data as per Bureau of Meteorology (BoM) nearest meteorological station (Station 068072 Nowra RAM Air Station AWS) at http://www.bom.gov.au/climate/dwo/IDCJDW2101.latest.shtml*

3.3 Terrestrial Ecology

3.3.1 Existing Vegetation

The Study Area consisted predominantly of cleared land with exotics, remnant native trees and an area of regrowth native vegetation. Cleared land without vegetation included culverts, bridges area, concreted areas, driveways and roads. Most vegetation areas within the Study Area do not correspond to any known vegetation community, except for woodland areas which are commensurate with PCT 1326 (see **Table 3-4**).

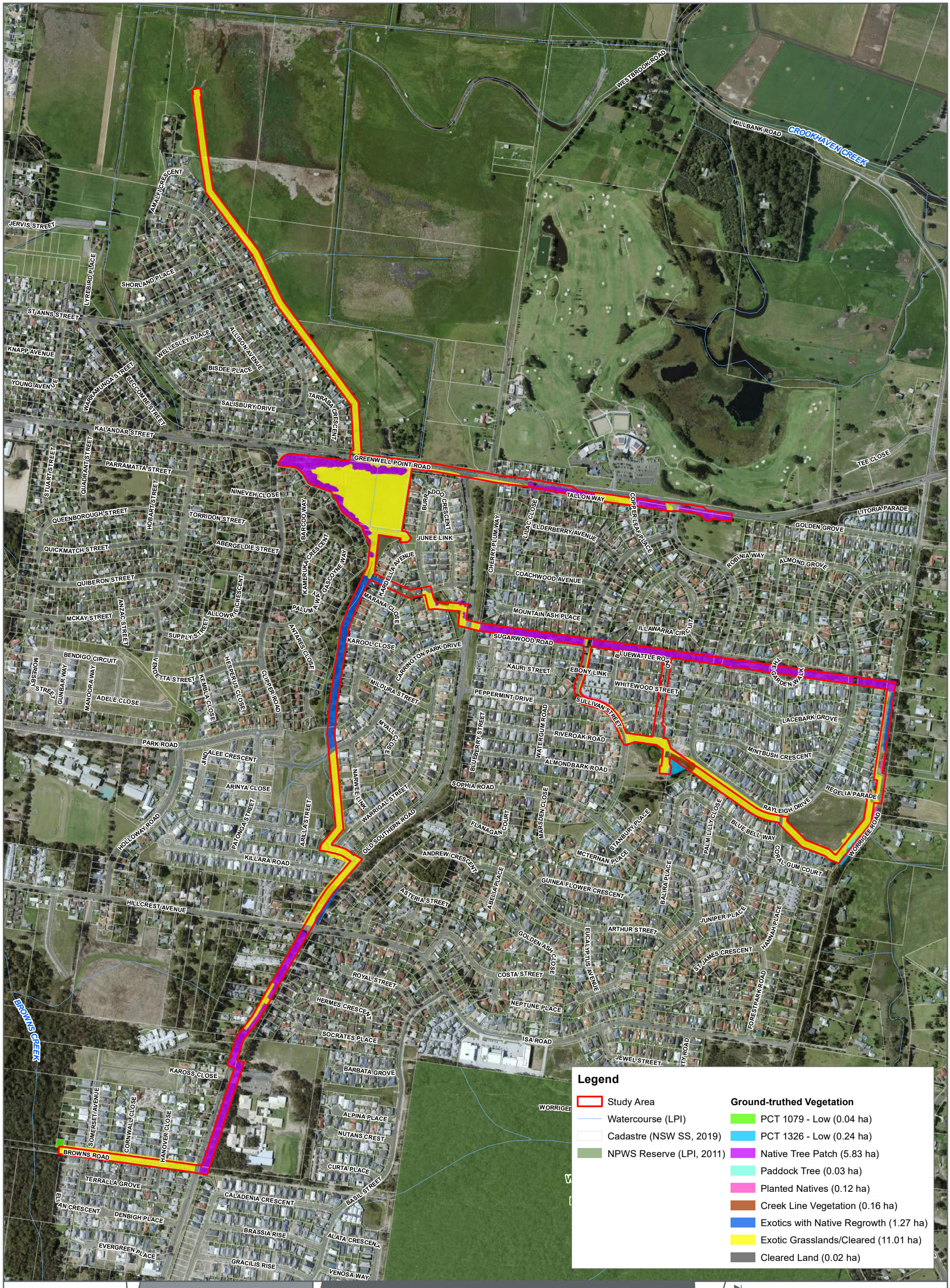
Ground-truthed vegetation mapping is shown in **Figure 3-3**.

Description of vegetated areas within the Study Area is provided in sub-sections below.

Table 3-4 Vegetation Communities and Cleared Areas

PCT ID	PCT Name	Condition	Area (ha)
Native Vegetation			
1326	Wollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Low	0.07
-	Native Tree Patch	NA	5.42
-	Paddock Trees	NA	0.03
-	Planted Natives	NA	0.04
Miscellaneous areas			
-	Creek Line Vegetation	NA	0.16
-	Exotics with Native Regrowth	NA	1.15
-	Exotic Grassland / Cleared	NA	10.07
-	Cleared Land	NA	0.02

Notes: NA = Not Applicable


WESTBROOK ROAD
MILLBANK ROAD
CROOKHAVEN CREEK
AMALFI CRESCENT
JERVIS STREET
LYREBIRD PLACE
SHORLAND PLACE
ST ANNS STREET
KNAPP AVENUE
WELLESLEY PLACE
ALLISON AVENUE
BISDEE PLACE
YOUNG AVENUE
WARRAMUNGA STREET
SECCOMBE STREET
SALISBURY DRIVE
TARRABA CRESCENT
KALANDAR STREET
GREENWELL POINT ROAD
TEE CLOSE
STUART STREET
QUADRANT STREET
PARRAMATTA STREET
NINEVEH CLOSE
BURRADOO CRESCENT
TALLON WAY
COPPERLEAF PLACE
LITORIA PARADE
GOLDEN GROVE
QUEENBOROUGH STREET
HOBART STREET
TORRIDON STREET
BARCOO WAY
JUNEE LINK
CHERRY PLUM WAY
LILAC CLOSE
ELDERBERRY AVENUE
QUICKMATCH STREET
ABERGELDIE STREET
KAMERUKA CRESCENT
GASCOYNE WAY
KARDELLA AVENUE
ROBINIA WAY
ALMOND GROVE
QUIBERON STREET
COACHWOOD AVENUE
MCKAY STREET
ANZAC STREET
ALLOWRIE CRESCENT
PALUMA WAY
MARANA CLOSE
MOUNTAIN ASH PLACE
ILLAWARRA CIRCUIT
SUPPLY STREET
ANTARES CLOSE
KAROOL CLOSE
SUGARWOOD ROAD
CARRINGTON PARK DRIVE
LUEWATTLE ROAD
THE GARDEN WALK
BENDIGO CIRCUIT
MORESBY STREET
GUNBAR WAY
MANOORA WAY
ADELE CLOSE
BENDOTTA STREET
KEMBLA CLOSE
HESPERUS CLOSE
CLIPPER ROAD
KAURI STREET
EBONY LINK
WHITEWOOD STREET
MILDURA STREET
PEPPERMINT DRIVE
SULLIVAN STREET
LACEBARK GROVE
MYALL CLOSE
WATERGUM ROAD
RIVEROAK ROAD
BLUEBERRY STREET
MINTBUSH CRESCENT
PARK ROAD
ALMONDBARK ROAD
JALEE CRESCENT
ARINYA CLOSE
NARWEE LINK
SOPHIA ROAD
REGELIA PARADE
WARRIGAL STREET
RAYLEIGH DRIVE
HOLLOWAY ROAD
PATONGA STREET
ARILLA STREET
FLANAGAN COURT
MARSDEN CLOSE
STANBURY PLACE
PALM LILLY CLOSE
BLUE BELL WAY
OLD SOUTHERN ROAD
WORRIGEE ROAD
KILLARA ROAD
ANDREW CRESCENT
MCTERNAN PLACE
COAL GUM COURT
ABELIA PLACE
GUINEA FLOWER CRESCENT
BALIRA PLACE
ASTERIA STREET
HILLCREST AVENUE
JUNIPER PLACE
ARTHUR STREET
GOLDEN ASH CLOSE
EUCALYPTUS AVENUE
ST JAMES CRESCENT
HANNAH PLACE
FORESTPARK ROAD
ROYAL STREET
COSTA STREET
HERMES CRESCENT
NEPTUNE PLACE
SOCRATES PLACE
ISA ROAD
JEWEL STREET
BROWNS CREEK
KAROSS CLOSE
BARBATA GROVE
SOMERSET AVENUE
CORNWALL CLOSE
HANOVER CLOSE
ALPINA PLACE
NUTANS CREST
BROWNS ROAD
CURTA PLACE
TERRALLA GROVE
BASIL STREET
CALADENIA CRESCENT
ELIZAN CRESCENT
DENBIGH PLACE
BRASSIA RISE
ALATA CRESCENT
EVERGREEN PLACE
GRACILIS RISE
VENOSA WAY
Legend
Study Area
Watercourse (LPI)
Cadastre (NSW SS, 2019)
NPWS Reserve (LPI, 2011)
Ground-truthed Vegetation
PCT 1079 - Low (0.04 ha)
PCT 1326 - Low (0.24 ha)
Native Tree Patch (5.83 ha)
Paddock Tree (0.03 ha)
Planted Natives (0.12 ha)
Creek Line Vegetation (0.16 ha)
Exotics with Native Regrowth (1.27 ha)
Exotic Grasslands/Cleared (11.01 ha)
Cleared Land (0.02 ha)
FIGURE 3-4
1:9,000 Scale at A3
m
0
100
200
300
Ground-truthed Vegetation
SOUTH NOWRA
SHOALHAVEN, NSW
N
Cardno
Map Produced by Cardno MNL
Date: 2021-10-21 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-010-GroundTruthVeg.mxd 04
Aerial Imagery supplied by Metromap (November 2020)

3.3.1.2 Exotic Grassland / Cleared Land

A large portion of the Study Area consists of land historically cleared and disturbed currently occupied by exotic vegetation, mainly exotic grassland and herbfields located in open space (maintained lawns, grazing areas), front yards, road reserves and landscaped gardens (see **Plate 1** to **Plate 4**). Cleared land includes hard stand (driveways), roads, infrastructure (e.g. underground services, electricity structures, culverts). Flora species present include common Couch (*Cynodon dactylon*), Parramatta Grass (*Sporobolus fertilis*), Paspalum (*Paspalum dilatatum*), Ribwort (*Plantago lanceolata*), Dandelion (*Taraxacum officinale*), Cobbler's Pegs (*Bidens pilosa*), Cudweed (*Gamochaeta coarctata*), Japanese Cudweed (*Euchiton sphaericus*), Fleabane (*Conyza bonnariensis*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*), Blackberry (*Rubus fruticosus* aggregate), Asparagus Fern (*Asparagus aethiopicus*), Lantana (*Lantana camara*), Spear Thistle (*Cirsium vulgare*), Mother of Millions (*Bryophyllum delagoense*), Pennywort (*Centella asiatica*), Kiluyu (*Pennisetum clandestinum*), White Clover (*Trifolium repens*). Sparse incidences of the native grasses Three-awn Speargrass (*Aristida vagans*) and Wiry Panic (*Entolasia stricta*) occur in this vegetation zone.

Plate 1: View of exotic grassland north of Greenwell Point Road

Plate 2: View of maintained lawns in open space in Ratcliffe Park, south of Greenwell Point Road

Plate 3: View of maintained lawns on front yards of residential properties

Plate 4: View of exotic lawn and herbfield north of Carrington Park Drive towards Warrigal Street

3.3.1.3 Exotics with Native Regrowth

Regrowth of native trees and shrubs in found in disturbed land with exotic groundcover and shrubs, but lacking native groundcover. These areas are dominated by exotic groundcover and have garden escapees as result of garden waste dumping. Evidence of ongoing impacts on this area observed included waste dumping, household drain/runoff and waste burning. Due to the exotic dominated ground cover and the low variety of native species, these areas cannot be allocated to any known PCT.

Native species present include Spotted Gum (*Corymbia maculata*), Sweet Pittosporum (*Pittosporum undulatum*), Wattle (*Acacia* spp.), Paperbark (*Melaleuca* spp.). Exotic species included Parramatta Grass (*Sporobolus fertilis*), Paspalum (*Paspalum dilatatum*), Ribwort (*Plantago lanceolata*), Dandelion (*Taraxacum officinale*), Cobbler's Pegs (*Bidens pilosa*), Fleabane (*Conyza bonnariensis*), Curled Dock (*Rumex crispus*), Fireweed (*Senecio madagascariensis*), Blackberry (*Rubus fruticosus* aggregate), Asparagus Fern (*Asparagus aethiopicus*), Lantana (*Lantana camara*), Spear Thistle (*Cirsium vulgare*) and *Persicaria* sp..

Plate 5: View of vegetation with native trees

Plate 6: View of vegetation with native trees and tree recruitment

3.3.1.4 Planted Natives

Planted native trees were recorded in otherwise cleared landscape, including *Ficus* sp., paperbarks (*Melaleuca* spp.), bottlebrushes (*Callistemon* spp.). These plantings do not conform any known vegetation community. Planted natives at Ratcliff Park included Spotted Gum (*Corymbia maculata*), Sydney Blue Gum (*Eucalyptus saligna*), Large-fruited Red Mahogany (*Eucalyptus scias*), Swamp She-oak (*Casuarina glauca*), Weeping Bottlebrush (*Callistemon viminalis*), Sweet Pittosporum (*Pittosporum undulatum*), Kidney Weed (*Dichondra repens*) and Wiry Panic (*Entolasia stricta*). The exotic tree *Pinus* sp. was also observed. The groundcover at Ratcliff Park include the exotic species Asparagus Fern (*Asparagus aethiopicus*) and Cobbler's Pegs (*Bidens pilosa*).

Plate 7: View of a planted bottlebrushes within the Study Area

Plate 8: View of planted native within the Study Area

3.3.1.5 Native Tree Patch

Patches of native trees were recorded present in historically disturbed areas. The alignment of some of these trees along roads suggest they might have been planted. These areas lack native groundcover and in most cases are maintained (e.g. lawn maintained, exotic plants used for landscaping) with evidence of revegetation (e.g. planting) present. These areas do not conform to any known PCT. This includes patches of trees at:

- Ratcliffe Park – Greenwell Point Road: A patch of trees is present adjacent to Greenwell Point Road and is dominated by Swamp Oak (*Casuarina glauca*) with presence of Spotted Gum (*Corymbia maculata*). The groundcover of this patch consists of exotic species including Paddy's Lucerne (*Sida rhombifolia*), Mothvine (*Araujia sericifera*), oxalis (*Oxalis* sp.), Parramatta Grass (*Sporobolus fertilis*), Ribwort (*Plantago lanceolata*), Fleabane (*Conyza bonariensis*). These trees appear to be planted and would not correspond to a known PCT.
- Ratclife Park – southern boundary: a patch of native trees is present on the southern portion of the park, including Spotted Gum, Bottlebrush (*Callistemon* sp., *C. citrinus*) and non-endemic gums (*C. ficifolia*). The groundover is mainly exotic with grasses and herbs, including Paddy's Lucerne (*Sida rhombifolia*), Mothvine (*Araujia sericifera*), Panic Veldtgrass (*Ehrharta erecta*), Small-leaved Privet (*Ligustrum sinense*), Mallow (*Malva* sp.), Paspalum (*Paspalum dilatatum*), Cobbler's Pegs (*Bidens pilosa*), Black Nightshade (*Solanum nigrum*) and English Ivy (Hedera helix). Native species include Berry Saltbush (*Einadia hastata*), Scurvy Weed (*Commelina cyanea*) and Blue Bells (*Wahlenbergia gracilis*). These trees appear to be planted and would not correspond to a known PCT.
- The Garden Walk: remnant and potentially planted native trees occur along the Garden Walk, overall, the shrub and ground layer are absent, with occasional occurrence of native shrubs. Exotic species had been planted at base of trees or in small landscaped areas across this walk. In many sections, the lawn is maintained. Trees in this area include: Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*). Native species include: Sweet Pittosporum (*Pittosporum undulatum*), False sarsaparilla (*Hardenbergia violacea*), Berry Saltbush (*Einadia hastata*), paperbark (*Melaleuca* sp.), Wattles (*Acacia cf. mearnsii*) and Kydney Weed (*Dichondra repens*). Exotic species include: Asparagus Fern (Asparagus aethiopicus), Paddy's Lucerne (*Sida rhombifolia*), *Chloris* sp., Black Nightshade (*Solanum nigrum*), Panic Veldtgrass (*Ehrharta erecta*), Mothvine (*Araujia sericifera*), Lantana (*Lantana camara*), Ribwort (*Plantago lanceolata*), White clover (*Trifolium repens*), Parramatta Grass (*Sporobolus fertilis*), Dandelion (*Taraxacum officinale*), several palms and succulents. Some trees appear to be remnant trees, whereas other trees appear to be planted. This vegetation forms an open to close woodland in some sections but do not corresponds to any known PCT.

Similar treed areas were observed along Old Southern Road, Greenwell Point Road and Worrigee Road.

Plate 9: View of patch of trees at Ratcliffe Park, adjacent to Greenwell Point Road

Plate 10: View of patch of trees on the southern part of Ratcliffe Park.

Plate 11: View native trees and exotics on the Garden Walk

Plate 12: view of trees on Rayleigh Garden Reserve, south of Greenwell Point Road

3.3.1.6 Paddock Trees

Native trees were also recorded as isolated trees in otherwise cleared landscape, including Spotted Gum (*Corymbia maculata*), White Stringybark (*E. globoidea*) and Forest Red Gum (*E. tereticornis*).

Plate 13: View of a Spotted Gum at Ratcliffe Park

Plate 14: View of Spotted Gum off Old Southern Road

3.3.1.7 Creek Line Vegetation

Aquatic vegetation was observed in creek lines, most of which are associated with existing culverts and are in very degraded condition. Other areas have been preserved as fenced off areas surrounded by build-up environment (e.g. roads, road reserves, residential properties). Species present in these areas include Broadleaf Cumbungi (*Typha orientalis*), *Persicaria* sp., Bracken (*Pteridium esculentum*) and exotic herbs.

Plate 15: View of aquatic vegetation south of Ratcliffe Park

Plate 16: View of aquatic vegetation on the eastern side of Buradoo Crescent

Plate 17: View of channelized Browns Creek on Browns Road

3.3.1.8 PCT 1326 – Wollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

Disjunct patches of treed woodland vegetation occur along Worrigee Road and on Rayleigh Drive (east to SPS28), these vegetated areas contain native trees and shrubs with a mix of natives and exotics on the ground stratum. These remnant patches are highly disturbed, they occur adjacent to road, infrastructure and subject to road runoff as well as garden waste (e.g. potted plants and garden cuttings) dumping. These vegetated areas are considered to be in low condition. Species present therein include Spotted Gum (*Corymbia maculata*), White Feather Honey-myrtle (*Melaleuca decora*), a tea tree (*Leptospermum* sp.), Slender Rice Flower (*Pimelea linifolia*), Wiry Panic (*Entolasia stricta*), Swamp Pennywort (*Centella asicatica*), Scurvy Weed (*Commelina cyanea*), Sweet Pittosporum (*Pittosporum undulatum*), Caustic Weed (*Euphorbia drummondii*) and Spiky-headed Mat-rush (*Lomandra longifolia*). Exotic species present include Fireweed (*Senecio madagascariensis*), Paddy's Lucerne (*Sida rhombifolia*), Parramatta Grass (*Sporobolus fertilis*), Umbrella Sedge (*Cyperus eragrostis*), Forked Rush (*Juncus cognatus*), Paspalum (*Paspalum dilatatum*), Dill (*Anethum graveolens*), Asparagus Fern (*Asparagus aethiopicus*), Prairie Grass (*Bromus catharticus*), Mother of Millions (*Bryophyllum delagoense*) and Blackberry (*Rubus fruticosus* aggregate).

PCT 1326 was the most likely PCT for these vegetated areas. PCT 1326 is associated with TECs as follows:

- BC Act listed Endangered Ecological Community (EEC) known as Illawarra Lowlands Woodland in the Sydney Basin Bioregion (Equivalent).

- BC Act listed EEC known as River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales Coast, Sydney Basin and South East Corner Bioregion (part).
- EPBC Act listed Critically Endangered Ecological Community (CEEC) known as Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (Equivalent).
- EPBC Act listed CEEC known as River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregion (Part).

The two patches of PCT 1326 within the Study Area had some elements of the Illawarra Lowlands Woodland, assessment of their consistency with a TEC indicated that:

- Patch of PCT 1326 at Worrigee Road: due to its condition the vegetation along Worrigee Road was not considered commensurate with the EPBC Act or BC Act listed TECs.
- Patch of PCT 1326 at Rayleigh Drive: The vegetation at Rayleigh Drive appeared to have been improved by assisted revegetation and is considered to be commensurate with the BC Act listed TEC. The vegetation community therein is not considered commensurate with the EPBC Act listed CEEC due to the absence of key characteristic species (e.g. *E. tereticornis*).

Plate 18: View of native vegetation on Worrigee Road

Plate 19: View of patch of woodland vegetation at corner of Worrigee Road and Regelia Parade

3.3.2 Flora Species

A total of 88 flora species across 45 families were recorded within the study area. The flora species included 33 native (37%) and 55 exotics (63%). The most represented families were the Myrtaceae (12 species), Poaceae (12 species) and the Asteraceae (nine species).

Table 3-5 includes the list of flora species recorded.

3.3.2.1 Threatened Flora Species

No threatened flora species were recorded within the Study Area.

3.3.2.2 Weeds

Thirteen of the 48 exotic species recorded within the Study Area have listing at national, state and local level as:

- Weed of National Significance (WoNS): the national weed strategy (IPAC 2016) recognises WoNS as species that are a current or future threat to Australia, which require coordinated and strategic management to prevent, eradicate contain and/or minimise their economic, environmental and/or social impacts.

- High Threat Weeds (HTW): are exotic species listed under the Biodiversity Assessment Method (BAM) under the BC Act. HTW are plants not native to Australia that if not controlled will invade and outcompete native species (DPIE 2020). These exotic plants are required to be managed and controlled.
- Priority Weeds (PW): PW are exotic species recognised as part of the NSW *Biosecurity Act 2015* as requiring specific management. The management of PW is identified in the weed strategy for each Local Land Service (LLS) region. The Shoalhaven City Council is part of the South East LLS region.

Table 3-6 provides summary of listed weeds.

Table 3-5 List of Flora Species

Family	Scientific Name	Common Name	Plant Type	Growth Form	BC Act Status	EPBC Act Status
Agavaceae	*Agave spp.*	-	E		-	-
Apiaceae	*Anethum graveolens*	Dill	E		-	-
Apiaceae	*Centella asiatica*	Swamp Pennywort	N	Forb (FG)	-	-
Araliaceae	*Hedera helix*	English Ivy	E		-	-
Arecaceae	*Archontophoenix alexandrae*	Alexandra Palm	E		-	-
Asclepiadaceae	*Araujia sericifera*	Mothvine	HTW		-	-
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	WoNS, PW, HTW		-	-
Asteraceae	*Arctotheca calendula*	Capeweed	E		-	-
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	HTW		-	-
Asteraceae	*Cirsium vulgare*	Spear Thistle	E		-	-
Asteraceae	*Conyza bonariensis*	Flax-leaf Fleabane	E		-	-
Asteraceae	*Euchiton sphaericus*	Japanese Cudweed	N	Forb (FG)	-	-
Asteraceae	*Gamochaeta coarctata*	Cudweed	E		-	-
Asteraceae	*Hypochaeris radicata*	Flatweed	E			
Asteraceae	*Senecio madagascariensis*	Fireweed	WoNS, PW		-	-
Asteraceae	*Taraxacum officinale*	Dandelion	E		-	-
Brassicaceae	*Capsella bursa-pastoris*	Shepherds purse	E		-	-
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell	N	Forb (FG)	-	-
Casuarinaceae	*Casuarina glauca*	Swamp Oak	N	Tree (T)	-	-
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	N	Forb (FG)	-	-
Commelinaceae	*Commelina cyanea*	Scurvy Weed, Native Wandering Jew	N	Forb (FG)	-	-
Convolvulaceae	*Dichondra repens*	Kidney Weed	N	Forb (FG)	-	-
Crassulaceae	*Bryophyllum delagoense*	Mother of Millions	HTW		-	-
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	HTW		-	-
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	Fern (EG)	-	-
Euphorbiaceae	*Euphorbia drummondii*	Caustic Weed	N	Forb (FG)	-	-
Euphorbiaceae	*Euphorbia hirta*	Asthma Plant	E		-	-

Family	Scientific Name	Common Name	Plant Type	Growth Form	BC Act Status	EPBC Act Status
Fabaceae (Caesalpinioideae)	*Senna pendula*	-	E		-	-
Fabaceae (Faboideae)	*Erythrina sp.*	Coral tree	E		-	-
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsparilla	N	Other (OG)	-	-
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	E		-	-
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory	N	Tree (TG)	-	-
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally	N	Shrub (SG)	-	-
Juncaceae	*Juncus cognatus*	Forked Rush	E		-	-
Lauraceae	*Cassytha glabella*	-	N	Other (OG)	-	-
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush	N	Grass & grasslike (GG)	-	-
Loranthaceae	*Amyema sp.*	Mistletoe	N	Other (OG)	-	-
Malvaceae	*Hibiscus sp.*	Hibiscus	E (C)		-	-
Malvaceae	*Malva sp.*	Mallow	E		-	-
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	E		-	-
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	E		-	-
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	N	Shrub (SG)	-	-
Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush	N	Shrub (SG)	-	-
Myrtaceae	*Callistemon sp.*	-	E (C)		-	-
Myrtaceae	*Corymbia ficifolia*	Pink W.A. Gum	E (P)		-	-
Myrtaceae	*Corymbia maculata*	Spotted Gum	N	Tree (TG)	-	-
Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark	N	Tree (TG)	-	-
Myrtaceae	*Eucalyptus punctata subsp. Punctata*		N	Tree (TG)	-	-
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum	N (P)	Tree (TG)	-	-
Myrtaceae	*Eucalyptus scias*	Large-fruited Red Mahogany	N (P)	Tree (TG)	-	-
Myrtaceae	*Kunzea ambigua*	Tick Bush	N	Shrub (SG)	-	-
Myrtaceae	*Melaleuca decora*	White Feather Honey-myrtle	N	Shrub (SG)	-	-
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	N	Shrub (SG)	-	-
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	HTW		-	-
Oxalidaceae	*Oxalis sp.*	-	E		-	-

Family	Scientific Name	Common Name	Plant Type	Growth Form	BC Act Status	EPBC Act Status
Phytolaccaceae	*Phytolacca octandra*	Inkweed	E		-	-
Pinaceae	*Pinus radiata*	Radiata or Monterey Pine	HTW		-	-
Pinaceae	*Pinus sp.*	A Pine tree	E (C)		-	-
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	N	Shrub (SG)	-	-
Plantaginaceae	*Plantago lanceolata*	Ribwort	E		-	-
Poaceae	*Aristida vagans*	Three-awn Speargrass	N	Grass & grasslike (GG)	-	-
Poaceae	*Briza minor*	Shivery Grass	E		-	-
Poaceae	*Bromus cartharticus*	Prairie Grass	E		-	-
Poaceae	*Chloris gayana*	Rhodes Grass	E		-	-
Poaceae	*Chloris virgata*	Feathertop Rhodes Grass	E		-	-
Poaceae	*Cynodon dactylon*	Common Couch	N	Grass & grasslike (GG)	-	-
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HTW		-	-
Poaceae	*Entolasia stricta*	Wiry Panic	N	Grass & grasslike (GG)	-	-
Poaceae	*Lolium perrenne*	Perennial Ryegrass	E		-	-
Poaceae	*Paspalum dilatatum*	Paspalum	HTW		-	-
Poaceae	*Pennisetum clandestinum*	Kikuyu, Kikuyu Grass	E		-	-
Poaceae	*Sporobolus fertilis*	Giant Parramatta Grass	PW, HTW		-	-
Polygonaceae	*Persicaria sp.*	Knotweed	E		-	-
Polygonaceae	*Rumex crispus*	Curled Dock	E		-	-
Proteaceae	*Grevillea sp. (cultivar)*	-	E (C)		-	-
Proteaceae	*Persoonia sp.*	-	N	Shrub (SG)	-	-
Rosaceae	*Rosa sp.*	Rose	E (C)		-	-
Rosaceae	*Rubus fruticosus spp. agg.*	Blackberry complex	WoNS, PW, HTW		-	-
Rubiaceae	*Gardenia jasminoides*	Gardenia	E (C)		-	-
Rutaceae	*Citrus limon*	Lemon Tree	E (C)		-	-
Santalaceae	*Exocarpos cupressiformis*	Native Cherry	N	Shrub (SG)	-	-
Solanaceae	*Solanum nigrum*	Black Nightshade, Black-berry Nightshade	E		-	-
Strelitzeaceae	*Strelitzia juncea*	Bird of Paradise	E (C)		-	-
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	N	Shrub (SG)	-	-

Family	Scientific Name	Common Name	Plant Type	Growth Form	BC Act Status	EPBC Act Status
Tropaeolaceae	*Tropaeolum majus*	Nasturtium	E		-	-
Typhaceae	*Typha orientalis*	Cumbungi	N	Grass & grasslike (GG)	-	-
Verbenaceae	*Lantana camara*	Lantana	WoNS, PW, HTW		-	-
Verbenaceae	*Verbena bonariensis*	Purpletop	E		-	-

Notes:
Plant Type: E= exotic; N = Native; WoNS = Weeds of National Significance; PW = Priority Weed; HTW = High Threat Weed
BC Act = NSW Biodiversity Conservation Act 2016; EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999
Status: all native species are protected under the BC Act; threatened status: V = Vulnerable; E = Endangered; CE = Critically Endangered

Table 3-6 Listed Weed Species

Scientific Name	Common Name	WoNS	HTW	PW	Management Requirements
All exotic species	-	-			**Biosecurity Duty** Under the NSW *Biosecurity Act 2015*, all landowners have the obligation to manage weeds as per the General Biosecurity Duty which states "*All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable*".
Arauja sericifera	Mothvine	-	Yes	-	HTW-M The species can be effectively managed with specific management practices. In the event that land containing the species is to become a Stewardship Site under the BAM, the risk weight for the species can be removed where actions are included in the management plan.
Asparagus aethiopicus	Asparagus Fern	Yes	Yes	Yes	**Prohibition on dealings** Must not be imported into the State or sold. HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Bidens pilosa	Cobbler's Pegs	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Bryophyllum delagoense	Mother of Millions	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Cyperus eragrostis	Umbrella Sedge	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Ehrharta erecta	Panic Veldtgrass	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Lantana camara	Lantana	Yes	Yes	Yes	**Prohibition on dealings** Must not be imported into the State or sold

Scientific Name	Common Name	WoNS	HTW	PW	Management Requirements
					Regional Recommended Measure *Exclusion zone:* whole region excluding the core infestation area of Eurobodalla, Kiama, Shellharbour, Wollongong and the Shoalhaven local government area north of the Lantana Containment Line at 35'11"42 S *Whole region:* Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core area: Land managers reduce impacts from the plant on priority assets.
					HTW-M The species can be effectively managed with specific management practices. In the event that land containing the species is to become a Stewardship Site under the BAM, the risk weight for the species can be removed where actions are included in the management plan.
Ligustrum sinense	Small-leaved Privet	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are sought to be created, a risk weighting will apply to this species.
Paspalum dilatatum	Paspalum	-	Yes	-	HTW-RW Under the BAM, where stewardship sites are to be created, a risk weighting will apply to this species.
Pinus radiata	Pine	-	Yes	-	HTW-M The species can be effectively managed with specific management practices. In the event that land containing the species is to become a Stewardship Site under the BAM, the risk weight for the species can be removed where actions are included in the management plan.
Rubus fruticosus spp. agg.	Blackberry complex	Yes	Yes	Yes	**Prohibition on dealings** Must not be imported into the State or sold *All species in the Rubus fruticosus species aggregate have this requirement, except for the varietals Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree.*
					HTW-RW Under the BAM, where stewardship sites are to be created, a risk weighting will apply to this species.
Senecio madagascariensis	Fireweed	Yes	-	Yes	**Prohibition on dealings** Must not be imported into the State or sold

Scientific Name	Common Name	WoNS	HTW	PW	Management Requirements
					Regional Recommended Measure *Exclusion zone:* whole of region except the core infestation area of Wollongong, Kiama, Shellharbour, Eurobodalla, Shoalhaven, Bega Valley and Wingecaribee councils. *Whole region:* Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core area: Land managers reduce impacts from the plant on priority assets.
Sporobolus fertilis	Giant Parramatta Grass	-	Yes	Yes	**Regional Recommended Measure** *Exclusion zone:* whole of region except core infestation area of Wollongong, Kiama, Shellharbour, Eurobodalla, and Shoalhaven councils *Whole region:* Land managers should mitigate the risk of new weeds being introduced to their land. Plant should not be bought, sold, grown, carried or released into the environment. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core area: Land managers reduce impacts from the plant on priority assets.
					HTW-RW Under the BAM, where stewardship sites are to be created, a risk weighting will apply to this species.

Notes: WoNS = Weed of National Significance; HTW = High Threat Weed; PW = Priority Weed; HTW-M = Manageable HTW; HTW-RW = Risk Weighting applies to the HTW;

3.3.3 Fauna Species

A total of 17 fauna species were observed during surveys, including 13 native and four introduced species. **Table 3-7** shows the full list of fauna.

Table 3-7 List of Fauna Species

Family	Scientific Name	Common Name	Origin	Type of Observation
Aves				
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	N	Seen
Artamidae	*Cracticus tibicen*	Australian Magpie	N	Seen
Artamidae	*Cracticus torquatus*	Grey Butcherbird	N	Seen
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	N	Seen
Cacatuidae	*Eolophus roseicapillus*	Galah	N	Seen
Corvidae	*Corvus coronoides*	Australian Raven	N	Seen
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	N	Seen
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	N	Seen
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	N	Seen
Sturnidae	*Acridotheres tristis*	Indian Myna	E	Seen
Psittacidae	*Platycercus elegans*	Crimson Rosella	N	Seen
Psittacidae	*Platycercus eximius*	Eastern Rosella	N	Seen
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	N	Seen
Mammalia				
Canidae	*Canis lupus familiaris*	Dog	E	Seen
Equidae	*Equus caballus*	Horse	E	Seen
Reptilia				
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	N	seen
Gastropoda				
Helicidae	*Helix aspersa*	Common Garden Snail	E	Seen
Notes: Origin: N = Native; E = exotic/pest/introduced;				

3.3.3.2 Threatened Fauna Species

No threatened fauna species were recorded during surveys.

3.3.3.3 Introduced Fauna Species

Four introduced species were present within the Study Area as listed in **Table 3-7**.

3.3.4 Fauna Habitat

Table 3-8 provides a summary of fauna habitat observed in the Study Area. Example of fauna habitat values observed within the Study Area are shown in **Plate 20** to **Plate 21**.

Table 3-8 Fauna Habitat Values

Habitat Value	Description
Hollow Bearing Tree	Few hollow-bearing trees were observed on living trees. Hollows of small size (<15 cm diameter) were observed and would be suitable as habitat for small fauna (birds, reptiles, mammals).
Stags	Stags were present within the Study Area, mainly as part of larger trees. Stags would be suitable habitat for birds, small reptiles and microbats.
Logs	No naturally occurring logs were observed within the Study Area. Logs were present as a 'soft fence' at the boundary of a vegetated area at Sullivan Street Playground and Park.

Habitat Value	Description
Rocky Outcrops	None observed.
Caves	None observed.
Leaf Litter	Leaf litter is present in small amounts at the base of trees in vegetated areas and in treed areas. Overall, leaf litter is removed as part of maintenance of areas within the Study Area. Leaf litter provide foraging opportunities for a range of fauna including birds, reptiles, gastropods and small ground mammals.
Decorticating bark	Decorticating bark was observed in some gum trees. Decorticating bark provides habitat for insects, small reptiles and microbats.
Burrows, nests and other fauna made habitat	A bird nest observed on a tree within the Garden Walk part of the Study Area. No other fauna made habitat was observed.
Koala Feed Trees	Three koala feed tree species part of the South Coast Koala Management Area were recorded within the Study Area, Spotted Gum (*Corymbia maculata*), Grey Ironbark (*E. paniculata*) and Grey Gum (*E. punctata subsp. punctata*). No records of koala exist withn the Study Area and within the last decade. Given the location of the Study Area in highly disturbed landscape, it is considered that core koala habitat is not present therein.
Connectivity	Most of the Study Area is located in cleared or residential area and mostly with low to no connectivity value. The presence of trees in patches of trees and vegetated areas provides limited connectivity value to mobile species (e.g. birds, microbats), but little to no connectivity to less mobile fauna or fauna for which the presence of roads, fences and exotic species (e.g. cats, dogs) would limit their movement. The presence of the bridge and culverts across waterways would allow connectivity for aquatic fauna (e.g. frogs) where aquatic habitat quality occurs.
Aquatic Habitat	Aquatic habitat is limited and in poor condition. These areas provide aquatic habitat of low to moderate value. There is limited amount of aquatic emergent vegetation in the creek channel at Browns Creek. The riparian corridor is highly modified with banks eroded and/or occupied by weeds.

Plate 20: View of tree hollow within the Study Area

Plate 21: View of bird nest within the Study Area

3.4 Aquatic Ecology

No naturally occurring aquatic habitats, such as rivers, lakes or wetlands, are present within the Study Area. A couple of creek lines are present with limited extent and isolated from larger surface aquatic habitat. The section of Browns Creek within the Study Area is a channelized body in poor condition (see **Section 3.3.1.7**).

4 Likelihood of Occurrence and Potential for Impact

4.1 Terrestrial Threatened Species, Populations and Ecological Communities

Threatened biodiversity (e.g. TECs, threatened species and their habitats) listed under the BC Act and with known records within the 10 km locality surrounding the Study Area were determined using the BioNet Atlas (**Appendix A**).

Although the database identified threatened biodiversity for consideration during field surveys, targeted surveys were not part of the scope of works for the present assessment. The following is noted regarding threatened biodiversity in the Study Area:

- One BC Act listed threatened ecological community Illawarra Lowlands Woodland in the Sydney Basin Bioregion (EEC) was observed within the Study Area;
- No threatened species were recorded during surveys;
- Habitat suitable for threatened biodiversity was observed as tree hollows and decorticating bark (e.g. microbats) within the Study Area;

Subsequent to field surveys, an assessment of likelihood of occurrence and potential risk of impact (LoOR) was undertaken for all threatened biodiversity identified with potential to occur within the 10 km locality surrounding the Study Area (**Appendix C**). Generally, threatened biodiversity identified in the LoOR assessment as having moderate, high or known ranking are subject to further survey and analysis of significance.

A total of four threatened biodiversity was identified as having moderate, high or known likelihood of occurrence. Any threatened species likely to be impacted by the proposed works or activities must be subject to an analysis of significance (i.e. Test of Significance (BC Act) and/or Assessment of Significance (EPBC Act)) which would determine if the proposal would result in significant impacts on a threatened species. A test of significance was undertaken (see **Appendix C**). It was concluded that the proposed works are unlikely to result in significant impacts on threatened species listed under the BC Act provided mitigation measures are implemented.

4.2 Aquatic Threatened Species, Populations and Ecological Communities

Substandard aquatic habitat is present within the Study Area and it is not considered suitable for threatened species; therefore, the proposed works will not result on impacts on threatened aquatic biodiversity.

It is noted that the riparian corridor and Browns Creek are at proximity of a section of sewer main to be decommissioned. The proposed method of decommissioning would include filling of the existing main with concrete, which would not require earthworks (e.g. excavation for removal of the existing underground main). Therefore, it is considered that indirect impacts on Browns Creek and its habitat would not occur as result of the proposed sewer main decommissioning.

4.3 Matters of National Environmental Significance

As detailed in **Section 3.1.2**, the PMST indicated that only three out of the eight MNES listed under the EPBC Act are known or predicted to occur within a 10 km locality surrounding the Study Area (**Appendix B**). The three MNES include threatened ecological communities (TECs), threatened species and migratory species.

Information gathered from the Study Area during desktop review and surveys was used to assess the likelihood of occurrence and risk of impact on the three MNES (**Appendix C**).

The result of the assessment is provided in the following subsections.

4.3.1 EPBC Act Listed Threatened Ecological Communities

The PMST report indicated that six Threatened Ecological Communities (TECs) are known or predicted to occur within the 10 km locality from the Study Area. These TECs are:

- Coastal Swamp Oak (*Cassuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EEC);
- Illawarra and south coast lowland forest and woodland ecological community (CEEC);

- Illawarra-Shoalhaven subtropical Rainforest of the Sydney Basin Bioregion (CEEC);
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC);
- Subtropical and Temperate Coastal Saltmarsh (VEC); and
- Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion (EEC)

Based on the LoOR assessment (**Appendix C**), it was found that only one of this TECs has the probability to occur within the Study Area, the Illawarra and south coast lowland forest and woodland ecological community listed as CEEC. Assessment of the CEEC indicates that the vegetation within the Study Area does not correspond to the EPBC Act listed TEC. Therefore, it is considered that that works and activities reasonably anticipated from the sewage upgrade works are unlikely to result in impacts on EPBC Act listed TECs.

4.3.2 EPBC Act Listed Threatened Species

The PMST report indicated that 82 threatened species are known or predicted to occur within the 10 km radius from the Study Area. The threatened species include 34 birds, three frogs, nine mammals, three fish, six reptiles and 27 flora species.

No threatened species listed were observed within the Study Area during surveys.

An assessment of likelihood of occurrence and risk (LoOR) assessment was undertaken for all threatened species (see **Appendix C**). Based on the LoOR assessment, it was found that none of the predicted threatened species have moderate, high or known likely occurrence within the Study Area. It is considered unlikely the proposal will result in significant impacts on this threatened species.

4.3.3 EPBC Act Listened Migratory Species

The PMST report indicated that 57 migratory species are known or predicted to occur within the 10 km radius from the Study Area, including 18 migratory marine birds, eight migratory marine species, 25 migratory wetland species and six migratory terrestrial species. Habitat for marine and wetland species does not occur within the Study Area and were excluded from analysis.

Based on the LoOR assessment, it was found that none of the migratory terrestrial species have moderate, high or known likely occurrence within the Study Area (see **Appendix D**).

5 Impact Assessment

5.1 Terrestrial Environment

5.1.1 Vegetation

The proposed project will be located in highly disturbed land consisting of cleared land with miscellaneous vegetation non-consistent with endemic native vegetation communities. The Study Area includes the presence of two plant community types, PCT 1079 and PCT 1326. A portion of the PCT 1326 is commensurate with the BC Act listed EEC Illawarra Lowlands Woodland in the Sydney Basin Bioregion.

It is expected that earth works would impact native vegetation as follows:

- Native trees: the upgrade route would potentially result in impact to root system of native trees where they occur close to the new sewer pipe alignment. Spotted Gum (*Corymbia maculata*) and Grey Ironbark (*Eucalyptus paniculata*) are the tree species present close to the sewer pipe.

  Native trees will be removed at Ratcliff Park to create an access from the road. The possibility exists that additional native trees being affected to install a fence. The impact on native trees not part of a known PCT is a minimal impact with no significant effects on fauna. In order to compensate for loss of native trees, compensatory planting is proposed at a rate of 1:1 (i.e. one new tree planted for each native tree removed).

- PCT 1326: This vegetation community is located on the western roadside of Worrigee Road and in a small patch at Rayleigh Drive (east to SPS28), the proposed alignment is located within 10m of trees of the Worrigee Road patch. The vegetation patch at Rayleigh Drive will not be impacted as the existing sewer at SPS28 will be decommissioned in-situ.

Overall, exotic grasslands/Cleared and exotics with native regrowth are located where the proposed sewer alignment will occur. Therefore, no remnant native vegetation will be affected.

5.1.2 Threatened Species

No threatened species were recorded within the Study Area during surveys.

A total of four threatened species were identified as having a moderate or known likelihood of occurrence within the Study Area (see **Appendix C**), the species included:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) listed as Vulnerable under the BC Act;
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as Vulnerable under the BC Act;
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) listed as Vulnerable under the BC Act;
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) listed as Vulnerable under the BC Act;

Assessment of significance on those species concluded that the proposed sewage upgrade works would not result in significant impacts on those threatened species (see **Appendix E**).

5.1.3 Habitat and Wildlife Corridor

The proposed replacement of surcharge mains and associated infrastructure works are located within a mostly cleared and highly disturbed landscape within the Study Area. Endemic native vegetation in low condition occurs near Browns Creek riparian corridor, also part of the Study Area, but no works are proposed to occur therein as part the existing sewage main will be decommissioned in-situ without disturbance due to earthworks on ground condition or onto vegetation. Vegetation within Browns Creek riparian corridor is connected with the creek's riparian corridor further away from the Study Area.

A certain level of connectivity is maintained among patches of trees along Old Southern Road and the Garden Walk with nearby vegetation on Browns Creek corridor and Worrigee Nature Reserve. However, the value of these treed areas is diminished by the highly urbanised landscape and road network.

Based on the above, it is predicted that the proposed project works will not result on impacts on habitat and corridors in the terrestrial or riparian zones at and adjacent to the project's footprint.

5.1.4 AOBV

As discussed in Section 3.1.5, AOBV do not occur within or nearby the Study Area. Therefore, the proposed project would not result on impacts on AOBV.

5.1.5 Koala Habitat Protection

As detailed in Section 3.3.4 koala feed trees were recorded within the study Area but no koala or potential core koala habitat is present within the proposed Study Area. Therefore, it is considered that the proposed project is unlikely to result on any direct or indirect impacts on koalas or their habitat.

5.2 Aquatic Environment

Aquatic habitat is absent within the Study Area. The riparian corridor and Browns Creek are adjacent to the Study Area. However, no disturbance on vegetation and aquatic habitat will occur as result of main decommissioning in the vicinity of Browns Creek. Therefore, it is considered that the proposed project is unlikely to result on any direct or indirect impacts on aquatic environment.

5.3 Key Threatening Processes

Key Threatening Processes (KTP) are listed under the BC Act, the FM Act and the EPBC Act. Of these, there are five KTPs that have the potential to occur as result of the proposal:

- Clearing of Native Vegetation;
- Human-caused Climate Change;
- Infection of native plants by *Phytophthora cinnamomi*;
- Alteration of the natural flow regimes of rivers, streams, floodplains & wetlands; and
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis.

5.3.1 Clearing of Native Vegetation

The Study Area includes vegetation communities (PCT 1326) as well as native trees, planted natives and native tree regrowth. All native vegetation is protected under the BC Act and all threatened biodiversity (i.e. threatened species, threatened populations and threatened ecological communities) are protected under both the BC Act and EPBC Act. Impacts on threatened biodiversity will be avoided by defining No-Go-Zones, whereas impacts on non-threatened native vegetation would be avoided as far as possible by routing the pipeline to avoid the vegetation. Clearing of exotic grasslands will be required. It is noted that although the construction of the new sewer alignment is not predicted to require clearing of vegetation, the possibility exists that the root system of some native trees located close to the new sewer alignment might be affected and/or require removal. Decay and/or mortality and clearing of established trees will result in loss of canopy and loss of native cover. Loss of native canopy would contribute to the Clearing of Native Vegetation KTP.

5.3.2 Human-caused Climate Change

The Study Area includes cleared land and vegetated areas. Vegetated areas are mainly located as disturbed patches in an otherwise disturbed (rural/urban) landscape. The proposed project would require removal of exotic grasslands, native and planted vegetation (if native trees are impacted) and potentially clearing of poor-quality herb field in riparian areas for construction of new sewer pipeline.

The project would contribute to clearing of native vegetation and native trees which is associated with loss of cooling effects provided by vegetation, particularly canopy cover. Although most of the project area will be located in disturbed landscapes, removal of canopy trees would trigger this KTP. It is considered that this KTP would not result in permanent effect where compensatory planting occurs. Planted trees would provide localized cooling effects within the proposed project area.

5.3.3 Infection of native plants by *Phytophthora cinnamomi*

Phytophthora cinnamomi Rands is a soil borne pathogen that spreads in plant roots in warm, moist conditions. The pathogen appears to be widespread in coastal forests, but may also occur at higher elevations. The pathogen affects native species which display a range of symptoms, come are killed, some are damaged but endure, and some show no apparent symptoms.

The project has the potential of triggering this KTP by cross contamination of soils in vegetated areas and areas with native species, particularly near creek lines, by accessing areas with soil contaminated equipment and PPE. Soil cross contamination can be avoided by establishing and implementing a cleaning protocol for machinery and PPE. Provided, decontamination protocols are put in place, it is expected the proposal would not result in triggering this KTP.

5.3.4 Alteration of the natural flow regimes of rivers, streams, floodplains & wetlands

The Study Area includes a channelized section of Browns Creek and other disturbed creek line areas. The location of the proposed new sewage alignment would not be located in creek lines. Indirect impacts on creek lines would be minimized through sediment and erosion measures being installed prior to commencement of works and implemented during the project lifetime. Therefore, it is expected the proposal would not result in triggering this KTP.

5.3.5 Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

As noted in Section 5.3.3, the project will avoid creek lines and will not result in disturbance to creek lines or its vegetation. No direct use of these aquatic environments is proposed as part of the proposed project. However, the possibility exists of use of the project site to indirectly impact on these aquatic environments, and their aquatic fauna (where present), such as frogs, by cross-contamination and importation of pathogens. Given the proximity of the project to aquatic environments, effective control measures would be considered to restrict access to creek lines during establishment, construction and operational phased of the project. Inclusion of control measures to prevent run off, access to creek lines and educational information during construction and operation of the project works would significantly minimize the possibility of triggering of this KTP.

6 Mitigation Measures and Recommendations

Recommended impact avoidance and mitigation measures that should be incorporated into the proposal design are described in **Sections 6.1** and **Section 6.2**. These recommendations would avoid and mitigate impacts to flora, fauna and their habitat in the Study Area and in adjacent areas.

6.1 Avoidance

- Use of previously cleared and non-native (e.g. miscellaneous) vegetated area for the footprint of the project layout where possible, including laydown areas during construction phase;
- Use of non-invasive techniques for decommissioning of underground mains (e.g. grout-filling) within the project footprint to avoid earthworks and associated soil and vegetation disturbance, as well as preventing sedimentation and erosion impacts into adjacent lands, including Browns Creek and its riparian corridor;
- Install project boundary fencing on laydown areas and/or site compounds to ensure activities and ancillary facilities are restricted to the project footprint.

6.2 Mitigation

6.2.1 General

- Creek lines and riparian corridors to be fenced off and labelled as No-Go areas to prevent accidental impacts and introduction of pathogens, such as *Batrachonchtrium dendrobatidis*, a pathogen that caused chytridiomycosis, an infection disease on amphibians;
- All machinery should be cleaned of foreign soil and vegetative matter to avoid the spread of *Phytophthora cinnamomi*, Exotic Rust Fungi of the order Pucciniales pathogenic (Myrtle Rust) and dispersal of seeds of non-native plants;
- Strict weed management, monitoring and control practices should be implemented as part of the Construction Environmental Management Plan (CEMP) to minimise the spread of exotic species into natural areas within and outside of the Study Area. In particular, priority weed and high threat exotic species should be targeted in accordance with the NSW DPI WeedWise recommended control measures (DPI 2021);
- Strict erosion and sediment control measures should be implemented as part of the CEMP, monitored and maintained to prevent impacts on adjacent areas, particularly following erosion and sediment mobilisation from rain events;
- Implement dust control measures where necessary to protect adjacent retained vegetation and water quality in Browns Creek; and
- Stockpiling of materials should occur within previously disturbed areas and not within driplines or retained vegetation.

6.2.2 Vegetation Clearing

- Weed removal shall follow weed management mitigation measures as listed in **Section 6.2.1**.
- If required, tree removal to be supervises as detailed in **Section 6.2.3**.
- Compensatory planting at rate of 1:1 to occur for any large trees (i.e. Diameter at Breast Height (DBH) ≥50 cm).

6.2.3 Wildlife Protection during construction

- Stop-work procedure on the chance encounter of any dispersing wildlife during works should be implemented to avoid death or injury;
- Ensure that a suitable qualified ecologist is present during the removal of all trees to act as a spotter-catcher that can relocate any captured wildlife;
- Ensure that all captured animals are relocated into the nearest suitable native vegetation; and
- Ensure that all injured animals are taken to a local wildlife carer for treatment.

6.2.4 Aquatic Habitat

> Strict erosion and sedimentation control measures should be implemented where required to ensure that the water quality and hydrological regime of Browns Creek adjacent to the Study Area is not impacted.

7 Conclusions

The proposed surcharge mains and associated infrastructure is located in highly disturbed land with mostly cleared land and miscellaneous vegetation not conforming to any known native vegetation community. Only one vegetation community (PCT 1326) was recorded within the Study Area, however this PCT will not require clearing as part of the project. The proposal has the potential to impact the root system of native trees located at proximity of the proposed new sewer alignment. Therefore, it would only result in localised impacts on native trees.

A small patch of PCT 1326 within the Study Area was considered to be commensurate with a TEC listed under the BC Act, Illawarra Lowlands Woodland (EEC). This PCT would be avoided by the proposed project works. No other vegetation commensurate with listed TECs under the BC Act, FM Act and/or EPBC Act were recorded. Also, threatened species listed under the BC Act, FM Act and/or EPBC Act and predicted to occur within 10km locality were not detected during the field survey and within the Study Area.

A likelihood of occurrence and risk (LoOR) assessment was undertaken for all threatened species and vegetation communities identified in databases with potential to occur within the 10 km locality surrounding the Study Area. Different levels of potential impact on a threatened species or community are identified as part of the LoOR and generally further assessment in the form of a significance test is undertaken for all threatened species and/or vegetation communities for which moderate or higher potential of impact is identified. Only four microbat species listed as vulnerable under the BC Act were assessed as having moderate likelihood of occurrence within the Study Area, and the test of significance concluded that it is unlikely the proposal would result in significant impacts on these species. Similarly, a test of significance concluded that significant impacts on the Illawarra Lowlands Woodland is unlikely to occur as result of the proposal. This was the case as the project footprint will be located within 10m from the location of a patch of this vegetation and potential impacts would not be significant for the vegetation community. Overall, the project site is highly impacted with no relevant ecological value for species or vegetation communities. Many of the threatened species with potential to occur are highly mobile (e.g. migratory birds and bats) that are known to move throughout the landscape as they forage and move between areas of higher quality habitat.

8 References

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APPENDIX A

BIONET ATLAS

Table A-1 shows the list of threatened species with known records in the BioNet Atlas within a 10 km locality surrounding the Study Area.

Table A-1. BioNet Atlas records within 10 km locality surrounding the Study Area

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Records
Amphibia					
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	570
Limnodynastidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	2
Reptilia					
Cheloniidae	*Chelonia mydas*	Green Turtle	V	V	1
Aves					
Anatidae	*Stictonetta naevosa*	Freckled Duck	V		2
Apodidae	*Apus pacificus*	Fork-tailed Swift		C,J,K	1
Apodidae	*Hirundapus caudacutus*	White-throated Needletail		V,C,J,K	3
Procellariidae	*Ardenna pacifica*	Wedge-tailed Shearwater		J	6
Procellariidae	*Ardenna tenuirostris*	Short-tailed Shearwater		C,J,K	2
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	7
Ardeidae	*Ixobrychus flavicollis*	Black Bittern	V		2
Accipitridae	*Circus assimilis*	Spotted Harrier	V		1
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V		11
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		2
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		19
Accipitridae	*Pandion cristatus*	Eastern Osprey	V		2
Falconidae	*Falco subniger*	Black Falcon	V		1
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E		2
Charadriidae	*Thinornis cucullatus cucullatus*	Eastern Hooded Dotterel	CE	V	1
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	E	1
Scolopacidae	*Calidris melanotos*	Pectoral Sandpiper		J,K	1
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe		J,K	1
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit		C,J,K	3
Scolopacidae	*Limosa limosa*	Black-tailed Godwit	V	C,J,K	1
Scolopacidae	*Numenius madagascariensis*	Eastern Curlew		CE,C,J,K	2
Scolopacidae	*Numenius phaeopus*	Whimbrel		C,J,K	1
Laridae	*Gelochelidon nilotica*	Gull-billed Tern		C	1
Laridae	*Hydroprogne caspia*	Caspian Tern		J	3
Laridae	*Thalasseus bergii*	Crested Tern		J	4
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		7
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		68
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		1
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		1
Strigidae	*Ninox strenua*	Powerful Owl	V		13
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V		3
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		2
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	3
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V		3
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		2

Family	Scientific Name	Common Name	BC Act Status	EPBC Act Status	Records
Petroicidae	*Petroica boodang*	Scarlet Robin	V		4
Mammalia					
Peramelidae	*Isoodon obesulus obesulus*	Southern Brown Bandicoot (eastern)	E	E	1
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	2
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		1
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		75
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	1770
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		3
Molossidae	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V		2
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	5
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		6
Vespertilionidae	*Myotis macropus*	Southern Myotis	V		3
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		8
Miniopteridae	*Miniopterus australis*	Little Bent-winged Bat	V		1
Miniopteridae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V		16
Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur-seal	V		1
Flora					
Dilleniaceae	*Hibbertia stricta subsp. furcatula*	-	E		4
Fabaceae (Mimosoideae)	*Acacia pubescens*	Downy Wattle	V	V	3
Myrtaceae	*Eucalyptus langleyi*	Albatross Mallee	V	V	1
Myrtaceae	*Eucalyptus langleyi*	Eucalyptus langleyi population north of the Shoalhaven River in the Shoalhaven local government area	E	V	1
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	CE		1
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	2
Myrtaceae	*Triplarina nowraensis*	Nowra Heath Myrtle	E	E	4
Orchidaceae	*Genoplesium baueri*	Bauer's Midge Orchid	E	E	5
Orchidaceae	*Pterostylis gibbosa*	Illawarra Greenhood	E	E	109
Orchidaceae	*Pterostylis vernalis*	-	CE	CE	6
Rutaceae	*Zieria baeuerlenii*	Bomaderry Zieria	E	E	15
Solanaceae	*Solanum celatum*	-	E		1

Notes: BC Act = NSW Biodiversity Conservation Act 2016; EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
Status: V = Vulnerable; E = Endangered; CE = Critically Endangered;
Migratory agreements: J – JAMBA (Japan-Australia Migratory Bird Agreement); C = CAMBA (China-Australia Migratory Bird Agreement), K = ROKAMBA (Republic of Korea-Australia Migratory Bird Agreement);

APPENDIX

B

PMST REPORT

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

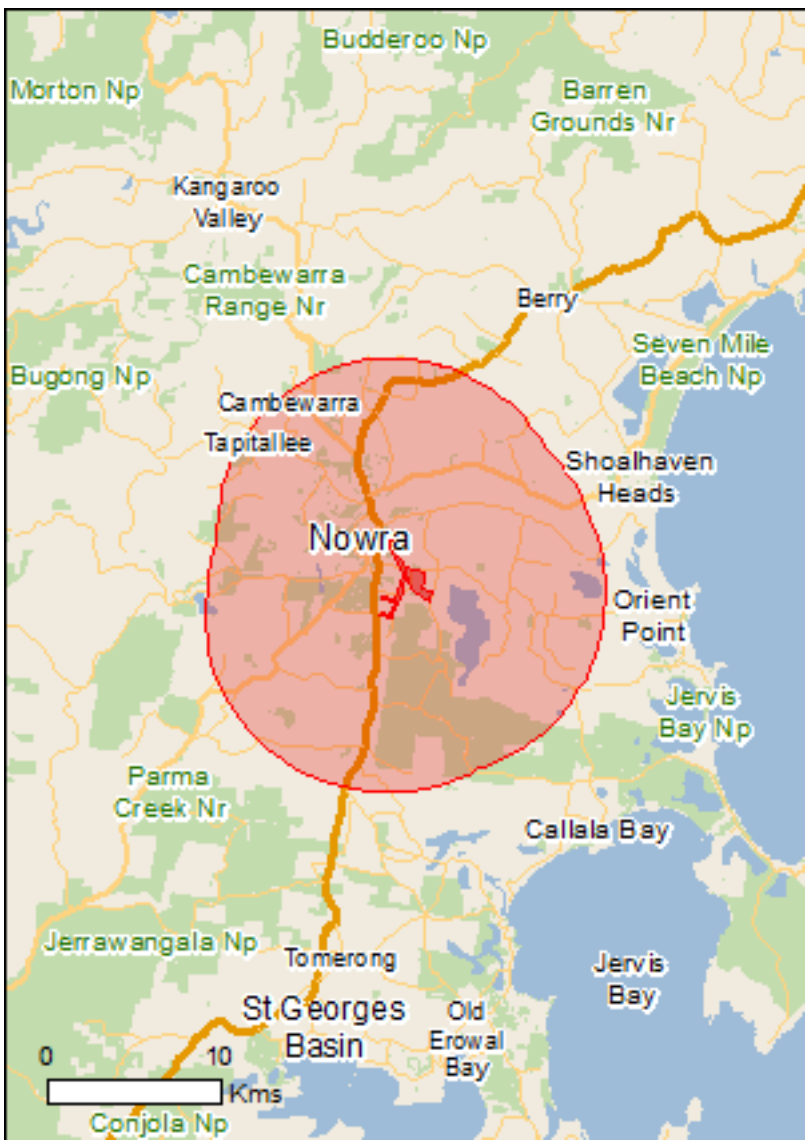
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 27/04/21 17:15:03

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

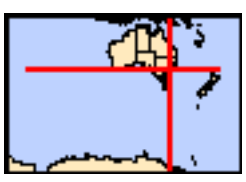
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	82
Listed Migratory Species:	57

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	11
Commonwealth Heritage Places:	1
Listed Marine Species:	67
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	15
Regional Forest Agreements:	1
Invasive Species:	45
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Illawarra and south coast lowland forest and woodland ecological community	Critically Endangered	Community likely to occur within area
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat known to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat known to occur within area
Cynanchum elegans		
White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Eucalyptus langleyi		
Albatross Mallee [56224]	Vulnerable	Species or species habitat known to occur within area
Genoplesium baueri		
Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata		
Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat likely to occur within area
Irenepharsus trypherus		
Delicate Cress, Illawarra Irene [14664]	Endangered	Species or species habitat may occur within area
Melaleuca biconvexa		
Biconvex Paperbark [5583]	Vulnerable	Species or species habitat likely to occur within area
Persicaria elatior		
Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Pimelea spicata		
Spiked Rice-flower [20834]	Endangered	Species or species habitat may occur within area
Pomaderris brunnea		
Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
[Pomaderris cotoneaster](#) Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat known to occur within area
[Prasophyllum affine](#) Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210]	Endangered	Species or species habitat likely to occur within area
[Pterostylis gibbosa](#) Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat known to occur within area
[Pterostylis pulchella](#) Pretty Greenhood [6448]	Vulnerable	Species or species habitat may occur within area
[Pterostylis vernalis](#) Halbury Rustyhood [84711]	Critically Endangered	Species or species habitat known to occur within area
[Rhizanthella slateri](#) Eastern Underground Orchid [11768]	Endangered	Species or species habitat known to occur within area
[Rhodamnia rubescens](#) Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area
[Rhodomyrtus psidioides](#) Native Guava [19162]	Critically Endangered	Species or species habitat may occur within area
[Syzygium paniculatum](#) Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
[Thelymitra kangaloonica](#) Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat may occur within area
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
[Triplarina nowraensis](#) Nowra Heath-myrtle [64544]	Endangered	Species or species habitat known to occur within area
[Xerochrysum palustre](#) Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat may occur within area
[Zieria baeuerlenii](#) Bomaderry Zieria, Bomaderry Creek Zieria [56781]	Endangered	Species or species habitat known to occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon		
Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta birostris		
Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Defence - DCO NOWRA
Defence - HMAS ALBATROSS
Defence - PARACHUTE DROPPING ZONE (PARACHUTE TRAINING SCHOOL) ; NOWRA - PTS
Defence - Shop 3
Defence - Suite 18, Holt Centre

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Bundanon Trust Property	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bamarang	NSW
Bomaderry Creek	NSW
Brundee Swamp	NSW
Cambewarra Range	NSW
Comerong Island	NSW
Forestry Management Areas in Nowra (FMZ2)	NSW
Jervis Bay	NSW
Parma Creek	NSW
Saltwater Swamp	NSW
South Coast Subregion of Southern Region	NSW
Tapitallee	NSW
Triplarina	NSW
Wogamia	NSW
Woollamia	NSW
Worrigee	NSW

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Southern RFA	New South Wales

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Shoalhaven/Crookhaven Estuary	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.87475 150.613261,-34.879398 150.61309,-34.889395 150.619613,-34.8901 150.624763,-34.891085 150.629054,-34.898266 150.628368,-34.89897 150.632659,-34.903193 150.631629,-34.901645 150.627166,-34.897703 150.622016,-34.891648 150.619956,-34.900096 150.617381,-34.906431 150.613948,-34.910232 150.61206,-34.909247 150.606223,-34.908543 150.606567,-34.909388 150.611201,-34.903897 150.613605,-34.902912 150.607082,-34.901504 150.607253,-34.902912 150.61412,-34.891789 150.618411,-34.880102 150.611373,-34.874469 150.61206,-34.87475 150.613261

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C

LOOR TABLE

C.1 Likelihood of Occurrence

Threatened species, populations and ecological communities, and migratory species (listed under the BC Act, FM Act and/or EPBC Act) that are known, or have potential, to occur within a 10 km radius of the Study Area have been considered in this section. The likelihood of occurrence within the Study Area of each species or TEC was assessed using the criteria described in **Table C-1** and the findings presented in **Table C-2**. This assessment was undertaken based on previous records, the results of the field survey and known species habitat requirements. **Table C-2** also provides an assessment of the potential impact of the proposed project on each species and TEC.

Table C-1. Likelihood of Occurrence Criteria

Likelihood Rating	Criteria
Known	The species was recorded within the Study Area during the field surveys.
High	It is likely that a species would inhabit or utilise habitat within the Study Area. Criteria for this category may include: > Species recently and/or regularly recorded in contiguous or nearby habitat; > High quality habitat or resources present within the Study Area; > Species is known or likely to maintain a resident population surrounding the Study Area; and > Species is known or likely to visit during migration or in response to seasonal availability of resources present on site.
Moderate	Potential habitat for a species occurs within the Study Area. Criteria for this category may include: > Species previously recorded in contiguous habitat albeit not recently (>10 years); > Habitat present, but poor quality, depauperate or modified types and/or resources; > Species has potential to utilise habitat during migration or seasonal availability of resources; and > Cryptic flora species with potential habitat within the Study Area that have not been targeted by surveys (for example, surveys were not undertaken with the flowering season.
Low	It is unlikely that the species inhabits the area, if it did, it would likely be a transient visitor. Criteria for this category may include: > The Study Area does not support the specific habitat types or resources required by the species; > The Study Area is beyond the current distribution of the species or is isolated from known populations; and > Non-cryptic flora species not observed during targeted surveys.
None/Absent	The habitat within the Study Area is unsuitable for the species.

Table C-2. Likelihood of Occurrence and Risk Impact Assessment of threatened species, populations and communities

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
Fish						
Black Rockcod, Black Cod, Saddled Rockcod (*Epinephelus daemelii*)	FM Act: V	V	PMST	The Black Rockcod is found in warm temperate and subtropical parts of the south-western Pacific.	**Absent:** the species inhabits marine waters which are not present within the Study Area. No known records of the species occur within the Site.	**Unlikely:** The project will not impact marine habitat or the species.
Macquarie Perch (*Macquaria australasica*)	E	E	PMST	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning sites.	**Absent:** Riparian habitat suitable for the species is not present within the Study Area. No known records of the species occur within the Site.	**Unlikely:** The project will not impact riparian habitat; therefore, it is unlikely impacts would occur of habitat for the species
Australian Grayling (*Prototroctes maraena*)		V	PMST	The Australian Grayling is a small to medium-sized, slender, silvery fish with soft-rayed fins lacking any spines. It is endemic to south-eastern Australia, including Victoria, Tasmania and New South Wales, and is a migratory species that inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults.	**Absent:** Riparian habitat suitable for the species is not present within the Study Area. No known records of the species occur within the Site.	**Unlikely:** The project will not impact riparian habitat; therefore, it is unlikely impacts would occur of habitat for the species
Frogs						
Giant Burrowing Frog (*Heleioporus australiacus*)	V	V	BioNet – 4 PMST	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	**Absent:** substandard aquatic habitat is present within the Study Area which is not suitable habitat for the species. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is not present within the Site, therefore, it is unlikely impacts would occur on habitat of this species.
Green and Golden Bell Frog (*Litoria aurea*)	E	V	BioNet: 570 PMST	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	**Absent:** substandard aquatic habitat is present within the Study Area which is not suitable habitat for the species. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is not present within the Site, therefore, it is unlikely impacts would occur on habitat of this species.
Stuttering Frog, Southern Barred Frog (*Mixophyes balbus*)	E	V	PMST	Stuttering Frog is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understory vegetation on the forest floor.	**Absent:** substandard aquatic habitat is present within the Study Area which is not suitable habitat for the species. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is not present within the Site, therefore, it is unlikely impacts would occur on habitat of this species.
Birds						
Regent Honeyeater (*Anthochaera phrygia*)	CE	CE	BioNet – 3 PMST	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	**Low:** limited suitable habitat for the species is present at the site. No known records of the species occur within the Site.	**Unlikely:** although limited suitable habitat for the species occurs at the site, the proposed project is unlikely to result in impacts on suitable resources for the species.
Fork-tailed Swift (*Apus pacificus*)	C, J, K		BioNet: 1	The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea; over settled areas, including towns, urban areas and cities. They forage aerially, up to hundreds of metres above ground, but also less than 1 m above open areas or over water.	**Low:** limited suitable foraging habitat for the species occurs within the study area. Given that the species is migratory, its occasional occurrence at the site cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** the species is highly mobile, limited resources are likely to occur in treed areas within the Study Area. Given that the species is migratory and highly mobile and that there would be resources for it elsewhere in the locality, it is unlikely that the project would result in a significant effect on the species.
Wedge-tailed Shearwater (*Ardenna pacifica*)	J		BioNet: 6	Wedge tailed shearwaters are pelagic, migratory seabirds that typically occur in tropical and sub-tropical oceans across the Pacific and Indian Oceans, but are also found in temperate waters. Regardless of colony location, wedge-tailed shearwaters lay a single egg which is incubated for an average of 53 days. Both parents share incubation duties. These birds use several methods for obtaining prey: contact-dipping (where only the head, bill or breast make contact with the water), surface-seizing (a bird grasps prey in its bill when settled on the surface), and plunge diving (a bird plunges from the air and descends the water column.	**Absent:** suitable habitat for the species do not occur within the site. The species is migratory, therefore it occasional occurrence flying over or at the site cannot be precluded. The species would not depend solely on resources within the site for its long-term survival.	**Unlikely:** the species is highly mobile, limited resources are likely to occur within the Study Area. Given that the species is migratory and highly mobile and that there would be resources for it elsewhere in the locality, it is unlikely that the project would result in a significant effect on the species.

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
					No known records of the species occur within the Site.	
Short-tailed Shearwater (*Ardenna tenuirostris*)		C, J, K, Ma	BioNet: 2	Short-tailed Shearwater is a migratory seabird that breeds mainly on small islands in Bass Strait and Tasmania and migrates to the Northern Hemisphere for the boreal summer. The Short-tailed Shearwater is Australia's most numerous seabird. The Short-tailed Shearwater feeds on krill, small fish and other small marine creatures. Food is caught mostly on the surface of the water but sometimes birds are seen diving for food.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Australasian Bittern (*Botaurus poiciloptilus*)	E	E	BioNet: 7 PMST	In NSW, they may be found over most of the state except for the far north-west. Favors permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Bush Stone-curlew (*Burhinus grallarius*)	E	-	BioNet – 2	The Bush Stone-curlew is found throughout Australia except the central southern coast and inland. The species inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. It is largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.	**Absent:** no suitable habitat for the species occurs across the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the site. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Red Knot, Knot (*Calidris canutus*)	-	E, Mi	PMST	The Red Knot is a medium-sized shorebird which breeds in tundra and the Arctic Cordillera in the far north of Canada, Europe, and Russia. The Red Knot occurs in Australian's coasts during its non-breeding migrating phase. Red Knots gather in large flocks with other waders. They walk fast, probing rapidly in soft sand and mud for worms, bivalves and crustaceans and also eat spiders, insects, seeds and shoots. They feed by day and night, regulated by the tide.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Curlew Sandpiper (*Calidris ferruginea*)	-	CE, Bonn, C, J, K	PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.	**Absent:** no suitable habitat for the species occurs across the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the site. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Pectoral Sandpiper (*Calidris melanotos*)	-	J, K, Bonn, Ma	BioNet: 1	is a small, migratory wader that breeds in North America and Asia, wintering in South America and Oceania. It eats small invertebrates. Its nest, a hole scraped in the ground and with a thick lining, is deep enough to protect its four eggs from the cool breezes of its breeding grounds. In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands. In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Great Knot (*Calidris tenuirostris*)	V	CE	PMST	The Great Knot is a migratory medium-sized wader. The species breeds in tundra in northeast Siberia and visits Australia during its non-breeding phase. It occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November. Most birds return north in March and April, however some individuals may stay over winter in Australia. Forages for food by methodically thrusting its bill deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	V	-	BioNet – 7	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	**Low:** no suitable habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or roosting within the Study Area cannot be precluded.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
					No known records of the species occur within the Site.	
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	-	BioNet – 68	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, *Allocasuaraina diminuta*, and *A. gymnathera*. Belah is also utilised and may be a critical food source for some populations.	**Low:** limited suitable foraging and roosting habitat for the species occurs in within the Study Area. Given the low abundance of foraging resources for the species within the Study Area, its occasional occurrence cannot be precluded. However, it is not expected the species would depend on resources within the Study Area for its survival. No known records of the species occur within the Site.	**Unlikely:** limited suitable foraging resources for the species occurs within the site. However, given the substandard and low amount of forging resources within the Study Area, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Spotted Harrier (*Circus assimilis*)	V		BioNet: 1	The Spotted Harrier occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (eg bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	**Low:** no suitable breeding habitat for the species occurs within the Study Area, limited foraging habitat for the species occurs in within the study area. No known records of the species occur within the Site.	**Unlikely:** limited suitable foraging habitat for the species occurs within the Study Area. However, given the substandard and low amount of forging resources within the Study Area, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Greater Sand Plover, Large Sand Plover (*Charadrius leschenaultii*)	V	V, C, J, K	PMST	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Lesser Sand Plover, Mongolian Plover (*Charadrius mongolus*)	V	E, C, J, K	PMST	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	BioNet – 2	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or roosting within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the site. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species
Eastern Bristlebird (*Dasyornis brachypterus*)	E	E	PMST	Eatern Bristlebird are shay, cryptic birds that mostly occur in coastal habitats. Habitat for the central and southern populations of the Eastern Bristlebird is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Antipodean Albatross (*Diomedea antipodensis*)	V	V, Ma	PMST	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. The majority of birds breed on Antipodes Island, with a small number of pairs breeding on Campbell Island.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Gibson'ts Albatross	V	V	PMST	Essentially endemic to the Auckland Islands of New Zealand. The non-breeding range is poorly known however the species	**Absent:** No suitable aquatic habitat for it	**Unlikely:** No suitable habitat occurs within the

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
(*Diomedea antipodensis gibsoni*)				probably disperses across the southern Pacific. The species is regularly encountered on trans-Tasman shipping routes and at seas off Sydney, and regularly occurs off the NSW coast usually between Green Cape and Newcastle. This species is known only to breed on the Adams, Disappointment and Auckland Islands in the subantarctic Auckland Island group.	occurs within the Study Area. No known records of the species occur within the Site.	Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Southern Royal Albatross (*Diomedea epomorpha*)	-	V	PMST	Endemic to New Zealand, the majority of the southern royal breeding population is found on subantarctic Campbell Island, with smaller numbers on the Auckland Islands.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Wandering Albatross (*Diomedea exulans*)	E	V	PMST	Visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September. Has been recorded along the length of the NSW coast. At other times birds roam the southern oceans and commonly follow fishing vessels for several days. Breeds on a number of islands just north of the Antarctic Circle: South Georgia Island (belonging to the UK), Prince Edward and Marion Islands (South Africa), Crozet and Kerguelen Islands (French Southern Territories) and Macquarie Island (Australia).	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Northern Royal Albatross (*Diomedea sanfordi*)	-	E	PMST	The Northern Royal Albatross primarily forages in inshore and offshore waters over the continental shelf to the shelf edge. It feeds mainly on cephalopods and fish, but also salps, crustacea and carrion. The Northern Royal Albatross breeds in New Zealand waters. The main population (estimated at 6,500 to 7,000 pairs) nests on islands off the Chatham Islands, and up to 50 pairs nest at Taiaroa Head on the South Island. Away from its nesting sites this Albatross is circumpolar between 30 and 45 degrees south. Most the population spends the non-breeding period off both coasts of southern South America, especially off Chile and Argentina. It is a rare visitor to NSW waters, predominantly visiting southern waters in the winter and early spring period.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
White-fronted Chat (*Epthianura albifrons*)	V	-	BioNet: 3	The White-fronted Chat is an endemic Australian passerine bird. It is a gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground). Two to three eggs are laid in each clutch, and the complete nesting cycle from nest-building to independent young is approximately 50 days. Birds can breed at one year of age and are estimated to live for five years. It occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	**Absent:** No suitable aquatic habitat for it occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Grey Falcon (*Falco hypoleucos*)	E	V	PMST	The Grey Falcon is a medium-size bird of prey Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring; two or three eggs are laid. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands and the coast, the possibility of the species occasionally flying over or roosting within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland or native grassland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Black Falcon (*Falco subniger*)	V	-	BioNet: 1	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. It is found along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas. It roosts in trees at night and often on power poles by day.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands and the coast, the possibility of the species occasionally flying over or roosting within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland or native grassland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Latham's Snipe (*Gallinago hardwickii*)	-	Bonn, J, K	BioNet: 1	Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded	**Absent:** No suitable aquatic habitat for it occurs within the Study	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore,

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				grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity.	Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	the proposal is unlikely to result in impacts to the species or its habitat.
Gull-billed Tern (*Gelochelidon nilotica*)	-	C	BioNet: 1	Gull-billed Tern is migratory bird. This large tern inhabits shallow wetlands, including coastal or inland lakes, swamps and lagoons, as well as sheltered bays and estuaries, where they hawk for flying insects, dip into the water to take insects or small fish from the surface of the water or mud, or plunge into the water for fish. The diet of the Gull-billed Tern is extremely varied, consisting mainly of small fish, reptiles, amphibians, crustaceans, small mammals, insects and their larvae. When fishing, the Gull-billed Tern fans out its tail and with wings outstretched and flapping occasionally, glides swiftly down to the surface of the water. It tilts its head downwards so that its bill is nearly vertical and only the tip touches the water. After seizing its prey the bird gains height rapidly and continues its slow hawk-like flight. It does not dive or settle on the water.	**Absent:** The species is dependent on aquatic habitat for its feeding and reproduction. No suitable habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** No suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Little Lorikeet (*Glossopsitta pusilla*)	V	-	BioNet: 1	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or roosting within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Painted Honeyeater (*Grantiella picta*)		V	PMST	The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema.*	**Low:** limited suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	V	C	BioNet – 11	Habitats are characterized by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	**Low:** no suitable roosting or breeding habitat for the species occurs within the study area. Given that the species is migratory and highly mobile, its occasional occurrence at the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** the species is highly mobile, limited resources are likely to occur within the Study Area. Given that the species is migratory and highly mobile and that there would be resources for it elsewhere in the locality, it is unlikely that the project would result in a significant effect on the species.
Little Eagle (*Hieraaetus morphnoides*)	V	-	BioNet – 2	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	**Low:** limited suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
White-throated Needletail (*Hirundapus caudacutus*)		V, Mi	BioNet: 3 PMST	Found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial. Large tracts of native vegetation, particularly forest, may be a key habitat requirement for the species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites.	**Low:** limited suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.

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Caspian Tern (*Hydroprogne caspia*)		J	BioNet: 3	Australia's largest tern, the Caspian Tern is easily identified by its large, bright-red, dagger-like bill. They forage by plunge-diving into the water from heights of up to 15 metres, grabbing a fish with that massive beak. Caspian Terns are able to take larger fish than any other Australian tern. They are widespread around virtually the entire Australian coastline, and also occur inland along major rivers, especially in the Murray–Darling and Lake Eyre drainage basins, preferring wetlands with clear water so they can detect their prey.	**Absent:** The species is mainly coastal. No suitable habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is coastal and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Black Bittern (*Ixobrychus flavicollis*)	V		BioNet: 2	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night.	**Low:** limited suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Swift Parrot (*Lathamus discolor*)	E	CE	PMST	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Inland Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*.	**Low:** suitable seasonal foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Bar-tailed Godwit (*Limosa lapponica*)		C, J, K, Bonn, Ma	BioNet: 3	The Bar-tailed Godwit is a large wader and member of the Tringinae family. The Bar-tailed Godwit is a migratory marine wader that visits Australia during its non-breeding phase. It has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh.	**Absent:** The species is mainly coastal. No suitable habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is coastal and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri*)	-	V, Ma	PMST	Nunivak Bar-tailed Godwit is a large long-necked wader found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. It often occurs around beds of seagrass, and sometimes in nearby saltmarsh or the outer margins of mangrove areas. It forages at low to mid tide in shallow water or along the water's edge on sandy substrates on intertidal flats, banks and beaches or on soft mud substrates. Its diet consists of worms, molluscs, crustaceans, insects and some plant material. In NSW its high tide roost areas on sandy beaches, sandbars, spits and near-coastal saltmarsh are frequently shared with other shorebirds. It is rarely found on inland wetlands or in areas of short grass such as farmland, paddocks and airstrips. In large part, the observed decline in Bar-tailed Godwit (Western Alaskan) numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea.	**Low:** The species is mainly coastal. Although no suitable habitat for it occurs within the Study Area, the species had been found in some terrestrial habitats including paddocks. The latter along with the fact that the species is highly mobile suggest that its occasional presence within the Study Area cannot be precluded. However, the species would not depend on resources within terrestrial habitat for its survival. No known records of the species occur within the Site.	**Unlikely:** The species is coastal and no suitable feeding habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Black-tailed Godwit (*Limosa limosa*)	-	C, J, K	BioNet: 1	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars	**Absent:** The species is mainly coastal. No suitable habitat for it occurs within the Study Area. This migratory bird does not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is coastal and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Square-tailed Kite (*Lophoictinia isura*)	V	-	BioNet: 19	The Square-tailed Kite is a long-winged raptor with scattered known records across most of NSW. It is found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy,	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands and the coast, the possibility of the species occasionally flying over	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland or native grassland areas, it is considered the proposal would not

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				picking most prey items from the outer foliage. The species appears to occupy large hunting ranges of more than 100km^2.	or roosting within the Study Area cannot be precluded. No known records of the species occur within the Site.	result in significant impacts on foraging habitat for the species.
Southern Giant-Petrel, Southern Giant Petrel (*Macronectes giganteus*)	E	E, Ma, Bonn	PMST	The Southern Giant Petrel is a marine seabird and the largest petrel. It breeds on six subantarctic and Antarctic islands in Australian territory; Macquarie Island, Heard Island and McDonald Island in the Southern Ocean, and Giganteus Island, Hawker Island, and Frazier Island in the Australian Antarctic Territories.	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Northern Giant Petrel (*Macroneces halli*)	V	V	PMST	Northern Giant Petrel is a large seabird with circumpolar pelagic distribution. Its breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds. Northern Giant-Petrels seldom breed in colonies but rather as dispersed pairs, often amidst tussocks in dense vegetation and areas of broken terrain. A single chick is raised and although breeding occurs annually, approximately 30% of the potential breeding population do not nest. There are marked differences in diet between the sexes. Females obtain most of their prey live from the sea, while males also scavenge from the carcases of penguins and seals on land. At sea, both sexes are aggressive opportunists, feeding on fish, cephalopods, birds and crustaceans, including euphausiids or krill, and regularly scavenge on fishing vessels. During the vulnerable early chick phase adult birds utilise land-based carrion resources (e.g. seals) extensively.	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Orange-bellied Parrot (*Neophema chrysogaster*)		CE	PMST	On the mainland, the Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland. Diet mainly comprises seeds and fruits of sedges and salt-tolerant coastal and saltmarsh plants. Occasionally, flowers and stems are eaten. Orange-bellied Parrots are known to forage among flocks of Blue-winged Parrots. Recent records from unexpected places, including Shellharbour and Maroubra suggest that the species may be expanding their selection of habitats and foraging plant species. Birds seen in NSW in 2003 were foraging on weed species several hundred metres from the coast.	**Absent:** The species is mainly coastal and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is coastal and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Turquoise Parrot (*Neophema pulchella*)	V	-	BioNet – 1	The Turquoise Parrot lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. It prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. It nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	**Low:** suitable seasonal foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Powerful Owl (*Ninox strenua*)	V	-	BioNet – 13	Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of eucalypt species. Forages on arboreal marsupials, flying foxes and birds. Nest in large tree hollows (at least 0.5m deep) in large eucalypts (DBH 80-240 cm) that are at least 150 years old.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Large tree hollows and hollowed stags suitable for breeding were not observed across the Study Area during surveys. Therefore, the Study Area does not provide suitable breeding habitat. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the Study Area. Given that no suitable breeding habitat for the species occur, it is considered unlikely that the proposal would result in significant impacts to the species or its habitat.
Eastern Curlew, Far Eastern Curlew (*Numenius madagascariensis*)		CE, J, K, C	BioNet: 2 PMST	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				saltworks and sewage farms. The numbers of Eastern Curlew recorded during one study were correlated with wetland areas.		
Whimbrel (*Numenius phaeopus*)		C, J, K, Ma	BioNet: 1	Whimbrels are common across northern Australia and uncommon to rare further south. They breed in central Siberia to Iceland. The subspecies variegatus is the one mainly found in Australia and also the Bay of Bengal through to Melanesia, Micronesia and to New Zealand in small numbers. Whimbrels are found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores. Whimbrels feed on intertidal mudflats by day and night, on worms, crustaceans and occasionally fish and nestling birds	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Fairy Prion (*Pachyptila turtur subanatrctica*)	-	V, Ma	PMST	The fairy prion is found throughout oceans and coastal areas in the Southern Hemisphere. Fairy prions are numerous and circumpolar in their distribution, ranging north to subtropical waters during non-breeding periods. Fairy prions occur through most of their range, with subantarctica restricted to Antipodes, Big South Cape, Snares Is. and Macquarie Islands. Prions are normally zooplankton eaters.	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding or reproduction. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Eastern Osprey (*Pandion cristatus*)	V		BioNet: 2	Eastern Osprey favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometres of the sea.	**Absent:** No suitable aquatic habitat for the species occur within the Study Area. No known records of the species occur within the Site.	**Unlikely:** Aquatic habitat for the species do not occur within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Scarlet Robin (*Petroica boodang*)	V	-	BioNet: 4	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	**Low:** suitable seasonal foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Flame Robin (*Petroica phoenicea*)	V	-	BioNet – 1	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. In winter, occasionally seen in heathland or other shrublands in coastal areas.	**Low:** suitable seasonal foraging habitat for the species occurs within the Study Area. Given the proximity of the Study Area to woodlands, the possibility of the species occasionally flying over or foraging within the Study Area cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the study area. Given the proposal would not result in removal of woodland areas, it is considered the proposal would not result in significant impacts on foraging habitat for the species.
Australian Painted Snipe (*Rostratula australis*)	E	E	BioNet: 1 PMST	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	**Absent:** The species is a coastal shorebird and do not depend on terrestrial habitat for feeding. No known records of the species occur within the Site.	**Unlikely:** The species is a coastal bird for which no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Australian Fairy Tern (Sternula nereis nereis)		V	PMST	The Fairy Tern is found on coastal beaches, inshore and offshore islands, sheltered inlets, sewage farms, harbours, estuaries and lagoons. It favours both fresh and saline wetlands and near-coastal terrestrial wetlands, including lakes and salt-ponds.	**Absent:** The species is a coastal shorebird and do not depend on terrestrial habitat for feeding. No known records of the species occur within the Site.	**Unlikely:** The species is a coastal bird for which no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Freckled Duck (*Stictonetta naevosa*)	V	-	BioNet: 2	he Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally, rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** The species depend on aquatic wetland habitat which does not occur within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				times when conditions are favourable. Nests are usually located in dense vegetation at or near water level		
Buller's Albatross, Pacific Albatross (*Thalassarche bulleri*)	-	V	PMST	Buller's Albatross is one of the smallest albatross. Occurs in both inshore and offshore waters, including the continental shelf break and pelagic waters. Feeds mainly on squid, fish, tunicates, octopus and crustacea. This albatross only nests on islands off New Zealand. The northern subspecies (platei) nests on islands off Chatham Island with an estimated population of around 18,200 breeding pairs. The southern subspecies (bulleri) breeds on the Snares and Solander islands with a total population of around 13,600 breeding pairs. After breeding both subspecies migrate to the seas off Peru and Chile. In NSW waters it is a relatively common visitor between March and October, with few sightings outside this period.	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Northern Buller's Albatross, Pacific Albatross (*Thalassarche bulleri platei*)	-	V	PMST	Northern Buller's Albatross is a migratory bird an done of the smallest species of albatross. It nests on islands off Chatham Island with an estimated population of around 18,200 breeding pairs	**Absent:** The species is mainly marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Shy Albatross (*Thalassarche cauta*)	V	E	PMST	This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Chatham Albatross (*Thalassarche eremita*)	-	E	PMST	The Chatham Albatross is a true pelagic species only returning to land to breed. The only breeding location is the isolated windswept 1.7 hectare rock stack, The Pyramid, located at the southern end of the Chatham Islands. One pair has attempted to breed on Western Chain, Snares Island. During the breeding season, Chatham Albatross are commonly seen at sea around The Pyramid and the southern Chatham Islands and occasionally at sea around the eastern New Zealand coastline. They migrate to coastal waters off Chile and Peru outside their breeding season. There are records of vagrant Chatham Island mollymawks from eastern Australia, Tasmania and southern Africa. Chatham Albatross breed in a single colony on The Pyramid, Chatham Islands. They are monogamous, annual breeders, with shared incubation and chick rearing. Chatham Albatross are generally surface feeders, but will shallow dive for food. They are known to feed on fish, squid and krill.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Campbell Albatross, Campbell Black-browed Albatross (*Thalassarche impavida*)	-	V	PMST	This species nests only at Campbell Island and the adjacent Isle de Jeanette Marie south of New Zealand, with a total population estimated at 24,600 pairs. It ranges widely in Australasian seas. In NSW waters it is probably frequently overlooked due to the difficulties of separating it from the Black-browed Albatross	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
Black-browed Albatross (*Thalassarche melnophris*) (formerly *Diomedea meanophris*)	V	V	PMST	Black-browed Albatross is a large seabird of the albatross family Diomedeidae; it is the most widespread and common member of its family. Spends most of its time at sea, breeding on small isolated islands. It is circumpolar in the southern oceans, and it breeds on 12 islands throughout that range. In the Atlantic Ocean, it breeds on the Falkland Islands, South Georgia and the South Sandwich Islands, and the Cape Horn Islands In the Pacific Ocean it breeds on Islas Ildefonso, Diego de Almagro, Islas Evangelistas, Campbell Island, Antipodes Islands, Snares Islands, and Macquarie Island. In the Indian Ocean it breeds on the Crozet Islands, Kerguelen Islands, Heard Island, and McDonald Island. This species migrates to waters off the continental shelf from approximately May to November and is regularly recorded off the NSW coast during this period. The species has also been recorded in Botany Bay National Park.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Salvin's Albatross (*Thalassarche salvini*)		V	PMST	During the breeding season (August-April) Salvin's Albatross occur throughout coastal New Zealand, especially from Cook Strait south, and also across to south-east Australian waters. After breeding it migrates to seas off Peru and Chile and occurs as a vagrant in the South Atlantic. A small population of a few pairs was reported breeding on the Crozet Islands in the Indian Ocean.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
White-capped Albatross (*Thalassarche steadi*)	V	PMST		This species breeds on a number of islands in New Zealand waters. Virtually the entire population nests in the Auckland Islands, comprising between 75,000 and 117,000 breeding pairs. A small number of pairs nest on Bollons Island in the Antipodes Islands and occasionally on The Forty-Fours in the Chatham Islands. After breeding most birds remain in Australasian waters with some adults migrating across the Indian Ocean to seas off South Africa and Namibia. In NSW waters it is probably frequently overlooked due to the difficulties of separating it from the Shy Albatross. However, it appears to be a regular visitor principally occurring between March and December.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Crested Tern (*Thalasseus bergii*)	J, Ma	BioNet: 4		Crested Terns form small to large flocks, often with other species, along coastal areas throughout Australia and Tasmania. They are seldom seen on inland waterways, preferring islands, beaches, lakes and inlets. They are widespread from the south coast of Africa north to Asia and east to Polynesia. The Crested Tern feeds mainly on small surface fish that are between 5 to 8 cm long. Crested Terns form large, noisy colonies on offshore islands, often with other terns or gulls. Breeding takes place between October and December each year. The eggs, placed in a shallow scrape in the ground, are incubated by both sexes, and both care for the young.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Eastern Hooded Dotterel, Eastern Hooded Plover (Thinornis cucullatus cucullatus)	CE	V	BioNet: 1 PMST	The Hooded Plover (Eastern) is a small beach-dwelling bird. Widely dispersed along coastal south-east Australia, they are easily disturbed while nesting on sandy beaches and numbers have fallen over time in areas where human activity has increased.	**Absent:** The species is marine and do not depend on terrestrial habitat for feeding. Given the proximity of the Study Area to the see, the possibility of this migratory species being observed on flight could occur. However, given the lack of suitable habitat on the Study Area, it is unlikely the species would land or roost therein. No known records of the species occur within the Site.	**Unlikely:** The species is marine and no suitable habitat occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Masked Owl (*Tyto novaehollandiae*)	V	-	BioNet: 3	Masked Owl distribution extends from the coast to the western plains. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges	**Low:** suitable foraging habitat for the species occurs within the Study	**Unlikely:** suitable foraging habitat for the species occurs within the

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Area. Large tree hollows and hollowed stags suitable for breeding were not observed across the Study Area during surveys. Therefore, the Study Area does not provide suitable breeding habitat. No known records of the species occur within the Site.	Study Area. Given that no suitable breeding habitat for the species occur, it is considered unlikely that the proposal would result in significant impacts to the species or its habitat.
Sooty Owl (*Tyto tenebricosa*)	V	-	BioNet: 2	Sooty Owl occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Nests in very large tree-hollows	**Low:** suitable foraging habitat for the species occurs within the Study Area. Large tree hollows and hollowed stags suitable for breeding were not observed across the Study Area during surveys. Therefore, the Study Area does not provide suitable breeding habitat. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species occurs within the Study Area. Given that no suitable breeding habitat for the species occur, it is considered unlikely that the proposal would result in significant impacts to the species or its habitat.
Migratory Terrestrial Birds						
Oriental Cuckoo (*Cuculus optatus*)	-	C, J, R	PMST	Oriental Cuckoo is a winter visitor in Australia during its non-breeding phase. It inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae.	**Low:** suitable habitat for the species occurs within the site. Given that the species is migratory, its occasional occurrence at the site cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species occurs within the site. Given its migratory nature, the species would not depend on resources within the site for its long-term survival. It is unlikely that the proposal would result in significant impact on the species.
Black-faced Monarch (*Monarcha melanopsis*)	-	K	PMST	Wet forest specialist, found mainly in rainforest and wet sclerophyll forest, especially in sheltered gullies and slopes with a dense understorey of ferns and/or shrubs.	**Low:** suitable habitat for the species occurs within the site. Given that the species is migratory, its occasional occurrence at the site cannot be precluded. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species occurs within the site. Given its migratory nature, the species would not depend on resources within the site for its long-term survival. It is unlikely that the proposal would result in significant impact on the species.
Spectacled Monarch (*Monarcha trivirgatus*)			PMST	Usually considered a denizen of the dense rainforests and moist eucalypt forests of eastern and north-eastern Australia, the Spectacled Monarch sometimes also inhabits mangroves and other densely vegetated habitats. The species occurs at all strata of the forest, but stays mostly in the middle to lower levels, where it gleans, sallies and flutter-chases insect prey among the inner foliage of the trees and shrubs.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Satin Flycatcher (*Myagra cyanoleuca*)		K, Ma	PMST	Eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along watercourses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests. Wintering birds in northern Qld will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Rufous Fantail (*Rhipidura rufifrons*)		Bonn, Ma	PMST	Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Mammals						
Eastern Pygmy-possum (*Cercartetus nanus*)	V	-	BioNet – 1	Eastern Pygmy-possum 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, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	**Low:** limited suitable habitat for the species occurs in native vegetated areas within the Study Area. Given the proximity of the Study Area to residential properties, the liklihood of the species surviving predatory impacts (e.g.	**Unlikely:** limited suitable habitat for the species is present in some vegetated areas within the Study Area. Targeted surveys would be required to confirm presence of the species and to assess likely impacts on suitable

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
					cats and dogs) is very low. No known records of the species occur within the Site.	habitat likely to be impacted and subsequently to design completion.
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	BioNet – 5 PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	**Low:** suitable foraging habitat for the species occurs within the Study Area. No suitable breeding habitat occurs therein. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species is present. Given than no breeding habitat is present, and that the proposal would not remove treed areas, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V	-	BioNet – 6	Prefers moist habitats, with trees taller than 20 m. Generally, roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	**Moderate:** suitable habitat for the species occurs within the Study Area, including hollow-bearing trees and trees with decorticating bark. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is present. Given the low frequency of hollow-bearing trees and trees with decorticating bark, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Southern Brown Bandicoot (eastern) (*Isoodon obesulus obesulus*)	E	E	BioNet: 1 PMST	Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil.	**Low:** limited suitable habitat for the species occurs in remnant native vegetation within the Study Area. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is present. Given the non-intrusive activities to be undertaken on native vegetation, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	V	-	BioNet – 2	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous	**Moderate:** suitable habitat for the species occurs within the Study Area, including hollow-bearing trees and trees with decorticating bark. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is present. Given the low frequency of hollow-bearing trees and trees with decorticating bark, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Little Bent-winged Bat (*Miniopterus australis*)	V	-	BioNet – 1	The Little Bent-winged Bat occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. The species roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters.	**Low:** suitable foraging habitat for the species occurs within the Study Area. No suitable breeding habitat occurs therein. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species is present. Given than no breeding habitat is present, and that the proposal would not remove treed areas, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Large Bent-winged Bat (*Miniopterus orianae oceanensis*)	V	-	BioNet – 16	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves.	**Low:** suitable foraging habitat for the species occurs within the Study Area. No suitable breeding habitat occurs therein. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species is present. Given than no breeding habitat is present, and that the proposal would not remove treed areas, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Southern Myotis (*Myotis Macropus*)	V	-	BioNet – 3	Generally, the Southern Myotis roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	**Low:** suitable foraging habitat for the species occurs within the Study Area. No suitable breeding habitat occurs therein. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species is present. Given than no breeding habitat is present, and that the proposal would not remove treed areas, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Yellow-bellied Glider (*Petaurus australis*)	V	-	BioNet – 75	The Yellow-bellied Grlider is a nocturnal arboreal (hollow-dependent) mammal that occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the	**Low:** limited substandard suitable habitat for the species occurs within the Study Area. Limited hollows	**Unlikely:** substandard suitable habitat for the species is present. Given that large trees and HBT are unlikely to be removed as part of

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				south. The species feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	occur within the Study Area. No known records of the species occur within the Site.	the proposal, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Greater Glider (*Petauroides volans*)	-	V	PMST	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The distribution may be patchy even in suitable habitat. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	**Low:** limited substandard suitable habitat for the species occurs within the Study Area. Limited hollows occur within the Study Area. No known records of the species occur within the Site.	**Unlikely:** substandard suitable habitat for the species is present. Given that large trees and HBT are unlikely to be removed as part of the proposal, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Brush-tailed Rock Wallaby (*Petrogale penicillata*)		V	PMST	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure, Brush-tailed Rock-wallaby also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest. They also require suitable caves and rocky overhangs for shelter and also for 'lookout' posts.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Koala (*Phascolarctos cinereus*) Koala (combined populations of Queensland, NSW and ACT) (*Phascolarctos cinereus*)	V 	V V	BioNet – 2 PMST	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	**Low:** suitable foraging habitat for the species occurs within the Study Area. Given the highly disturbed landscape and minimal connectivity to native bushland, it is considered unlikely the species would occur within the Study Area. No known records of the species occur within the Site.	**Likely:** limited suitable habitat for the species is present. it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Long-nosed Potoroo (*Potoros tridactylus tridactylus*)		V	PMST	Long-nosed Potoroo inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. Often digs small holes in the ground in a similar way to bandicoots. The species is mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
New Holland Mouse, Pookila (*Pseudomys novaehollandiae*)	-	V	PMST	New Holland Mouse are known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals. Its distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	BioNet – 1770 PMST	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	**Low:** suitable foraging habitat for the species occurs within the Study Area. The species roosts in 'roost camps' where hundreds to thousands of individuals co-exist and breed. At dusk, the colony fly out in search for food, individuals can travel over 20km each night in search for food. The site do not contain a 'roost camp'. No known records of the species occur within the Site.	**Unlikely:** suitable foraging habitat for the species is present. It is considered unlikely the proposal would result in significant impacts to the species or its habitat.
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V	-	BioNet – 3	Yellow-bellied Sheathtail-bat is an insectivorous microbat that roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	**Moderate:** suitable habitat for the species occurs within the Study Area, including hollow-bearing trees and trees with decorticating bark. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is present. Given the low frequency of hollow-bearing trees and trees with decorticating bark, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.

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Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	BioNet – 8	Greater Broad-nosed Bat is found mainly in the gullies and river systems, it utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.	**Moderate:** suitable habitat for the species occurs within the Study Area, including hollow-bearing trees and trees with decorticating bark. No known records of the species occur within the Site.	**Unlikely:** suitable habitat for the species is present. Given the low frequency of hollow-bearing trees and trees with decorticating bark, it is considered unlikely the proposed works would result in significant impacts on the species or its habitat.
Reptiles						
Broad-headed Snake (*Hoplocephalus bungaroides*)	E	V	PMST	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. The Broad-headed Snake is nocturnal. It shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. It moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer. Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Females produce four to 12 live young from January to March, which is a relatively low level of fecundity.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Flora						
Bynoe's Wattle (*Acacia bynoeana*)	E	V	PMST	Bynoe's Wattle is a semi-prostrate shrub found in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Downy Wattle (*Acacia pubescens*)	V	V	BioNet: 3	Downy Wattle is spreading shrub, 1 - 5 m high with brilliant yellow flowers, it occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. It occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Longevity is unknown, but clonal species have been known to survive for many decades. Flowers from August to October. Pollination of Acacia flowers is usually by insects and birds. The pods mature in October to December. Recruitment is more commonly from vegetative reproduction than from seedlings. The percentage of pod production and seed fall for this species appears to be low. Acacia species generally have high seed dormancy and long-lived persistent soil seedbanks. It is thought that the species needs a minimum fire free period of 5 - 7 years to allow an adequate seedbank to develop. The species distribution is concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Thick-lipped Spider-orchid, Daddy Long-legs (*Caladenia tessellata*)		V	PMST	The Thick Lip Spider Orchid is from a ground orchid generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations). The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Leafless Tongue-orchid (*Cryptostylis hunteriana*)		V	PMST	The Leafless Tongue-orchid does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations of the species typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
White-flowered Wax Plant (*Cynachum elegans*)	E	E	PMST	White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia subsp. Integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to

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				(*Corymbia maculata*) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub	No known records of the species occur within the Site.	result in impacts to the species or its habitat.
Albatross Mallee (*Eucalyptus langleyi*) Eucalyptus langleyi population north of the Shoalhaven River in the Shoalhaven local government area (*Eucalyptus langleyi*)	V E	V V	BioNet: 1 PMST	Albatross Mallee is a mallee to 5m high that occurs on skeletal soils on rocky sloping Nowra Sandstone outcrops along Bomaderry Creek. The endangered population occurs at an altitude of 30-40 m above sea level whilst the general *E. langleyi* population occurs at an altitude of between 130 and 255 m. It occurs as a midstorey species in woodland dominated by Grey Gum (*E. punctata*), but sometimes with Spotted Gum (*Corymbia maculata*) present. The woodland habitat has a shrubby midstorey comprising species such as Sweet Pittosporum, Tick Bush, Bracelett Honey-myrtle, Black Sheoak, Tea-tree and Sandpaper Fig. The woodland habitat has a mostly shrubby ground layer, but in some places there are significant patches of Blady Grass. Vigorous regrowth has been observed from plants that have been burnt only occasionally, however regrowth becomes weak on frequently burnt plants. No seedling regrowth has been observed within the endangered population, but whether this is due to lack of seedling vigour or other environmental factors has not yet been established. Insects are presumed to be the primary pollinators of *Eucalyptus langleyi*, limiting the distance over which pollen will be exchanged between plants and populations. Current estimates of pollen movement for eucalypts are <1 km with rare events >5 km. This endangered population of the Albatross Mallee occurs north of the Shoalhaven River in the Shoalhaven local government area. The population occurs as a series of fragmented stands across approximately 1.3 km^2 and occurs on both sides of the boundary between Bomaderry Creek Regional Park and land owned by Shoalhaven City Council. In 1998 the population was estimated at 32 plants but a survey in 2008 found only 20 of these still alive. The endangered population is approximately 5 km from the closest population of the main Albatross Mallee (a listed Vulnerable species) occurrences which is located to the southwest across the Shoalhaven River.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Bauer's Midge Orchid, Yellow Gnat-orchid (*Genoplesium baueri*)	E	E	BioNet – 5 PMST	Bauer's Midge Orchid is a terrestrial orchid which grows in dry sclerophyll forest and moss gardens over sandstone. It flowers February to March.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Small-flower Grevillea (*Grevillea parviflora subsp. parviflora*)	V	V	PMST	Small-flower Grevillea is a low spreading to erect shrub that grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. The species occurs in a range of vegetation types from heath and shrubby woodland to open forest. In Sydney it has been recorded from Shale Sandstone Transition Forest and in the Hunter in Kurri Sand Swamp Woodland. however, other communities occupied include *Corymbia maculata - Angophora costata* open forest in the Dooralong area, in Sydney Sandstone Ridgetop Woodland at Wedderburn and in Cooks River / Castlereagh Ironbark Forest at Kemps Creek. It is found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Hunter occurrences are usually 30-70m ASL, while the southern Sydney occurrences are typically at 100-300m ASL. Often occurs in open, slightly disturbed sites such as along tracks.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Wingless Raspwort, Square Raspwort (*Haloragis exalata subsp. exalata*)	V	V	PMST	Square Raspwort appears to require protected and shaded damp situations in riparian habitats. Flowering specimens in NSW are recorded from November to January.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Hibbertia stricta subsp. furcatula	E		BioNet: 4	Hibbertia stricta subsp. furcatula is a small shrub growing to 1.3 m in height and up to 70 cm wide. *Hibbertia stricta subsp. furcatula* (*Hibbertia sp*. nov. 'Menai') is known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. The Southern Sydney population occurs on both sides of the Woronora River gorge, near Loftus and in Royal National Park. The southern population is mainly in the vicinity of Nowra. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. It has been noted that the species usually grows in 'gravelly loam or clay soil in heath under open woodland'.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone. Hibbertia sp. nov. 'Menai' flowers in spring and summer ('September to January (February)' yet also noted as July to about December (in NSW Flora online) and 'winter to summer' (Flora of the Sydney Region). Its longevity, seed biology, and most aspects of its ecology are unknown, although in common with most species of Hibbertia it is probably pollinated primarily by bees. It appears to propagate by seed, with no evidence to date of vegetative reproduction or regeneration.		
Delicate Cress, Illawarra Irene (*Irenepharsus trypherus*)	E	E	PMST	*Irenepharsus typherus* is a herb to 2.5m height which is restricted to the Illawarra district. The plant is short lived like most herbs in the Mustard family, and it is not known whether it is a perennial or an annual. It grows on moist rock walls, steep rocky slopes or disturbed rocky areas, often near cliff tops, and seems to prefer the fertile volcanic rocks like latite. Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River. Associated vegetation includes moist sclerophyll forest, Ironwood *Backhousia myrtifolia* thicket, and rainforest. The species has been recorded from 18 sites within the local government areas of Kiama, Shellharbour, Shoalhaven, Tallaganda, Wingecarribee, and Wollongong. Found at such places as Minnamurra Falls, the Jamberoo area, and Morton and Macquarie Pass National Parks. The species has rarely been collected, perhaps because it looks like a weed.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Biconvex Paperbark (*Melaleuca biconvexa*)	V	V	PMST	Biconvex Paperbark is a shrub or small tree, usually up to 10 m tall, though occasionally as high as 20 m. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. Resprouts following fire. Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Knotweed, Tall Knotweed (*Persicaria elatior*)	V	V	PMST	Tall Knowtweed normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Spiked Rice-flower (*Pimelea spicata*)	E	E	PMST	Spiked Rice-flower occurs in both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark. The co-occurring species in the Cumberland Plain sites are grey box (*Eucalyptus moluccana*), forest red gum (*E. tereticornis*) and narrow-leaved ironbark (*E. crebra*). Blackthorn (*Bursaria spinosa*) is often present at sites (and may be important in protection from grazing) and kangaroo grass (*Themeda australis*) is usually present in the groundcover (also indicative of a less intense grazing history). In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey. Coastal headlands and hilltops are the favoured sites. The IIllawarra populations usually occur in one of two communities - a woodland or a coastal grassland. Woodland sites are dominated by forest red gum (*E. tereticornis*) and stringybark (*E. eugenioides*), with a groundcover dominated by kangaroo grass (*Themeda australis*) and matrush (*Lomandra longifolia*). The grassland sites are dominated by kangaroo grass (*Themeda australis*) and matrush (*Lomandra longifolia*), with blady grass (*Imperata cylindrica*). A shrubby layer, where present, is dominated by coastal wattle (*Acacia sophorae*) and coast rosemary (*Westringia fruticosa*) with coast banksia (*Banksia integrifolia*).	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Brown Pomaderris, Rufous Pomaderris (*Pomaderris brunnea*)	E	V	PMST	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Flowers appear in September and October. The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. The species has been found in association with *Eucalyptus amplifolia*, *Angophora floribunda*, *Acacia parramattensis*, *Bursaria spinosa* and *Kunzea ambigua*.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Cotoneaster Pomaderris (*Pomaderris cotoneaster*)	E	E	PMST	Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a	**Absent:** No suitable aquatic and/or wetland habitat for the species	**Unlikely:** no suitable habitat for the species occurs within the Study

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				creek, on rocky forested slopes and in steep gullies between sandstone cliffs. Little is known about the ecology of the species. It is probably killed by fire but plants have been observed to re-sprout from the stem following death of the crown from apparent drought. Populations tend to be isolated and range in size from a few individuals to many hundreds. Populations are not apparently influenced by local variations in habitat - it is not obvious why they are only growing where they are.	occurs within the Study Area. No known records of the species occur within the Site.	Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid (*Prasophyllum affine*)	E	E	PMST	The Jervis Bay Leek Orchid is a ground orchid which produces a single onion-like leaf that can grow to 40 cm long. Grows on poorly drained grey clay soils that support low heathland and sedgeland communities. The underground dormant tubers commence shooting in mid winter and leaves are known to have emerged above ground by June. The flowering period reliably commences in the first week of November and extends for about 3 weeks. The fruit (small green ovoid capsules) develop rapidly following flowering and eventually split to release fine dust-like seeds. Each capsule contains thousands of seeds that are primarily wind dispersed. By January the leaves and fruiting stems have withered and the plants then persist as underground tubers until they resprout the following winter. Jervis Bay Leek Orchid is currently known from three areas south-east of Nowra on South Coast. These are Kinghorne Point, Wowly Gully near the town of Callala Bay, and near the township of Vincentia.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Illawarra Greenhood (*Pterostylis gibbosa*)	E	E	BioNet: 109 PMST	Illawarra Greenhood is a ground orchid whose known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum (*Eucalyptus tereticornis*), Woollybutt (*E. longifolia*) and White Feather Honey-myrtle (*Melaleuca decora*). Near Nowra, the species grows in an open forest of Spotted Gum (*Corymbia maculata*), Forest Red Gum and Grey Ironbark (*E. paniculata*). In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (*E. crebra*), Forest Red Gum and Black Cypress Pine (*Callitris endlicheri*). The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. After a spring flowering, the plant begins to die back and seed capsules form (if pollination has taken place). As with many other greenhoods, male fungus gnats are believed to be the pollinator. The Illawarra Greenhood can survive occasional burning and grazing because of its capacity to reshoot from an underground tuber. Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803).	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Preety Greenhood (*Pterystylis pulchella*)	V	V	PMST	The Waterfall Greenhood is found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water. Flowers appear from February to May. The Waterfall Greenhood is found only at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek (Meryla) and Minnamurra Falls.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Halbury Rustyhood (*Pterostylis vernalis*)	CE	CE	BioNet: 6 PMST	Halbury Rustyhood is a perennial ground orchid with flowering stems 10-20 cm tall. *Pterostylis vernalis* grows in open sites around moss gardens in shallow soil over sandstone sheets or moss gardens on heavy laterite associated soils, in heath and dry heathy forest/woodland. The distribution of the plants throughout its range is naturally patchy as the species is often restricted to sections of rock shelf where there is only a thin layer of soil over the rock shelf and where these sites are subject to particular hydrological conditions. Habitat generally contains moss gardens on various substrates. *Pterostylis vernalis* is a seasonal perennial which is present above ground in the cooler months between late autumn until it sets seed in late spring. The above ground parts then wither and the plants persist as a dormant tuber underground over summer. *Pterostylis vernalis* is the only Pterostylis species in the vicinity of Nowra that flowers in spring.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Smooth Bush-pea, Swamp Bush-pea (*Pultenaea glabra*)	V	V	PMST	Smooth Bush-pea is primarily associated with riparian or swamp habitat areas in the mid to upper altitudes of the central Blue Mountains on sandstone derived soils. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Flowers September to November, fruit matures October to December.	**Low:** suitable habitat for the species occurs within the Study Area. However, the Study Area is located outside the known distribution range of the species. No known records of the species are known within the 10km locality.	**Unlikely:** although limited suitable habitat for the species occurs within the Study Area, the Study Area is outside of the known distribution range for the species. Therefore, it is unlikely for the species to occur within the Study Area.
Eastern Underground Orchid	V	E	PMST	Eastern Underground Orchid is an orchid with a whitish, fleshy underground stem to 15 cm long and 15 mm diameter. The flowering heads mature below the soil surface or may extend to	**Low:** limited suitable habitat for the species occurs within the Study	**Unlikely:** limited suitable habitat for the species is present in vegetated

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(*Rhizanthella slateri*)				2 cm above the ground. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore, usually located only when the soil is disturbed. Flowers September to November. Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Scrub Turpentine, Brown Malletwood (*Rhodamnia rubescens*)	CE		BioNet: 1 PMST	Scrub Turpentine is a shrub or small tree to 25 m high with reddish/brown, fissured bark. It is found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts. Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of *R. rubescens* typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Native Guava (*Rhodomyrtus psidioides*)	CE	-	PMST	Native Guava is a shrub or small tree to 12 m high. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts. Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Solanum celatum	E	-	BioNet: 1	*Solanum celatum* is a shrub 1 - 2.5 m high. It grows in rainforest clearings, or in wet sclerophyll forests. Flowers August to October and produces fruit December to January. Fire sensitive obligate seeder, with adult plants killed by fire and recruitment occurring from a soil stored seed bank. Normally recorded in disturbed margins and clearings. Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Magenta Lilly Pilly (*Syzygium paniculatum*)	E	V	BioNet – 2 PMST	Magenta Lilly Pilly occurs on the south coast, where it is found on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Kangaloon Sun Orchid (*Thelymitra kangaloonica*)	CE	CE	PMST	Kangaloon Sun Orchid is found in swamps in sedgelands over grey silty grey loam soils. It is thought to be a short-lived perennial, flowering in late October and early November. The species is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Coastal Upland Swamp" a TEC.	**Absent:** No suitable aquatic and/or wetland habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Austral Toadflax, Toadflax (*Thesium australe*)	V	V	PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Nowra Heath Myrtle (*Triplarina nowraensis*)	E	E	BioNet: 4 PMST	Nowra Heath Myrtle is a small, erect shrub to 5 m tall that occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. The sites are often either treeless or have a very open tree canopy due to the impeded drainage. Individuals have been observed to resprout from lignotubers and they are also expected to reproduce from seed though this needs to be confirmed. There are five known populations of Nowra Heath Myrtle. Three of these forms a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon.	**Low:** limited suitable habitat for the species occurs within the Study Area. The species was not recorded along RMT during surveys. No known records of the species occur within the Site.	**Unlikely:** limited suitable habitat for the species is present in vegetated areas. It is considered unlikely the proposed works would result in significant impacts on the species or its habitat
Swamp Everlasting, Swamp Paper Daisy (*Xerochrysum palustre*)		V	PMST	Swamp Everlasting is a perennial, erect herb growing to 30-100 cm tall. rows in swamps and bogs which are often dominated by heaths. Also grows at the edges of bog margins	**Absent:** No suitable habitat for the species occurs within the Study Area.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to

Species / Community Name	BC Act / FM Act	EPBC Act	Records Source	Habitat / Community Description	Likelihood of Occurrence	Potential for Impact
				on peaty soils with a cover of shrubs or grasses. Re-sprouts after fires. Sometimes grows in bogs with Sphagnum. Swamp Everlasting is endemic to south-eastern Australia, where it is widely distributed from south-eastern New South Wales through Victoria to north-eastern Tasmania. In New South Wales it occurs as far north as the Southern Tablelands and ranges up to about 1300 m altitude. In Victoria, the species is widely but patchily distributed from the South Australian border to near Bairnesdale, generally below 500 m altitude.	No known records of the species occur within the Site.	result in impacts to the species or its habitat.
Bomaderry Zieria (*Zieria baeuerlenii*)	E	E	BioNet: 15	Bomaderry Zieria is an 80 cm tall shrub, it occurs on skeletal sandy loam overlaying sandstone, on a rocky plateau amongst sandstone boulders in either shrubby open forest, shrubby woodland or closed scrub. Seed production has never been observed in the Bomaderry Zieria and all evidence collected to date suggests that the species has lost its capacity to reproduce sexually. Plants resprout following fire. The species occurs in only one location north-west of Nowra. The population occurs in a total of 43 colonies in six discrete clusters. These clusters are confined within a 0.5 km x 1.0 km area of the bushland, and are found on both sides of Bomaderry Creek.	**Absent:** No suitable habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Vegetation Communities						
Coastal Swamp Oak (*Cassuarina glauca*) Forest of New South Wales and South East Queensland ecological community	EEC	EEC	PMST	Coastal Swamp Oak Forest is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Coastal Swamp Oak Forest has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea*, *Geitonoplesium cymosum* and *Stephania japonica var. discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica*, *Commelina cyanea*, *Persicaria decipiens* and *Viola banksii*; graminoids such as *Carex appressa*, *Gahnia clarkei*, *Lomandra longifolia*, *Oplismenus imbecillis*; and the fern *Hypolepis muelleri*. On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea*, *Juncus kraussii*, *Phragmites australis*, *Selliera radicans* and other saltmarsh species.	**Absent:** No suitable habitat for the species occurs within the Study Area. No known records of the species occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Illawarra and south coast lowland forest and woodland ecological community	CEEC	CEEC	PMST	The Lowlands Grassy Forest occurs in near coastal areas below about 200 metres on gently undulating terrain. It occurs on Berry Siltstone, Budgong Sandstone and Quaternary Alluvium. Much of this community has been cleared and it now occurs chiefly as scattered fragments. Provides habitat for the endangered orchid Pterostylis gibbosa. Some remnants consist of regrowth after clearing or other disturbances. This community comprises vegetation types that occupy the Illawarra coastal plain and escarpment foothills. Characteristic tree species include Forest Red Gum (*Eucalyptus tereticornis*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Woollybutt (*Eucalyptus longifolia*), Coast Grey Box (*Eucalyptus bosistoana*) and White Feather Honey-myrtle (*Melaleuca decora*). The understorey is not necessarily grassy as moist forest vegetation types are also included within this broad community. Common shrub species include *Acacia mearnsii* and *Dodonaea viscosa subsp. angustifolia*. Floodplain vegetation dominated by *Casuarina* species or rainforests on latite soils are not part of this community.	**Moderate:** Suitable habitat and associated species occur within vegetated areas in the Study Area. PCTs associated with this TEC have been mapped near the Study Area.	**Unlikely:** suitable habitat for this TEC occurs within the Study Area, however the vegetation community was not recorded therein. Therefore, the proposal is unlikely to result in impacts to this TEC.
Illawarra-Shoalhaven subtropical Rainforest of the Sydney Basin Bioregion	EEC	CEEC	PMST	The Illawarra Subtropical Rainforest Occupies the Illawarra coastal plain and escarpment foothills, rarely extending onto the upper escarpment slopes. Usually found on Permian volcanic rocks, but can occur on a range of rock types. Illawarra Subtropical Rainforest (ISR) is a rainforest community that occupies high nutrient soils in the Illawarra region, south of Sydney. Characteristic tree species include *Baloghia inophylla* (Brush Bloodwood), *Brachychiton acerifolius* (Flame Tree), *Dendrocnide excelsa* (Giant Stinging Tree), *Diploglottis australis* (Native Tamarind), *Ficus* spp., *Pennantia cunninghamii* (Brown Beech), and *Toona ciliata* (Red Cedar). Species of *Eucalyptus*, *Syncarpia* and *Acacia* may also be present as emergents or incorporated into the dense canopy. While rainforest canopies are generally closed, in highly disturbed stands the canopy of ISR may be irregular and open.	**Absent:** No suitable habitat for the vegetation community occurs within the Study Area. No known records of the vegetation community occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

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				The height of the canopy varies considerably, and structurally some stands of ISR are scrub.		
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	EEC	CEEC	PMST	River-flat Eucalypt Forest has an important role in maintaining river ecosystems and riverbank stability due to its habitat. It is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally, it occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. River-Flat Eucalypt Forest on Coastal Floodplains provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting. These include cormorants and egrets, the Osprey (*Pandion haliaetus*), Whistling Kite (*Haliastur sphenurus*), White-bellied Sea-eagle (*Haliaeetus leucogaster*), as well as the Brush-tailed Phascogale (*Phascogale tapoatafa*), Yellow-bellied Glider (*Petaurus australis*), Squirrel Glider (*Petaurus norfolcensis*), Sugar Glider (*Petaurus breviceps*) and Grey-headed Flying Fox (*Pteropus poliocephalus*).	**Low:** Limited suitable habitat for the vegetation community occurs within the Study Area and the broader locality. No known records of the vegetation community occur within the Site	**Unlikely:** limited suitable habitat for the vegetation community occurs within the Study Area, but it was not recorded during surveys. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
Subtropical and Temperate Coastal Saltmarsh	EEC	VEC	PMST	Species composition varies with elevation and latitude, with Saltmarsh in southern NSW being generally more species-rich than further north. The sediment surface may support a diversity of seaweed species. Species restricted to coastal saltmarshes include *Distichlis distichophylla* (Endangered), *Halosarcia pergranulata subsp. pergranulata*, *Wilsonia backhousei* (Vulnerable) and *Wilsonia rotundifolia* (Endangered). Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include *Baumea juncea*, Sea Rush (*Juncus krausii subsp. australiensis*), Samphire (*Sarcocornia quinqueflora subsp. quinqueflora*), Marine Couch (*Sporobolus virginicus*), Streaked Arrowgrass (*Triglochin striata*), Knobby Club-rush (*Ficinia nodosa*), Creeping Brookweed (*Samolus repens*), Swamp Weed (*Selliera radicans*), Seablite (*Suaeda australis*) and Prickly Couch (*Zoysia macrantha*). Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans.	**Absent:** No suitable habitat for the vegetation community occurs within the Study Area. No known records of the vegetation community occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.
BC Act: Blue Mountains Basalt Forest in the Sydney Basin Bioregion EPBC Act: Upland Basalt Eucalypt Forest of the Sydney Basin Bioregion	EEC	EEC	PMST	The Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion are generally tall open eucalypt forests found on igneous rock (predominately Tertiary basalt and microsyenite) in, or adjacent to, the Sydney Basin Bioregion. The ecological community occurs in areas of high rainfall, generally ranging from 950 to 1600 mm/year. The ecological community typically occurs as an open to tall open forest with a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns. the structure of the ecological community may vary from tall open forest with trees up to and above 30 m tall with a projected foliage cover of 30–70% (e.g. Eucalyptus fastigata forest on basalt near Sassafras in and around Morton National Park) to woodland with trees 10–30 m tall, with a projected foliage cover of 10–30% (e.g. exposed woodland on rocky microsyenite at Mt Jellore) depending on aspect, slope, soil conditions, soil depth, and previous clearing and disturbance. The Blue Mountains Basalt Forest is usually a tall eucalypt forest (over 30 m in mature stands) with a dense shrub or small tree layer, often including tree ferns (*Cyathea* spp.) and moist herbaceous ground cover. The canopy composition is variable but usually dominated by one or more of the species *Eucalyptus fastigata*, *E. blaxlandii*, *E. cypellocarpa* or *E. radiata subsp. radiata*. Other canopy species which may be locally common or dominant include *E. oreades* (which is often dominant on south-facing slopes at the transition to a sandstone substrate) and *E. viminalis*. A eucalypt canopy may be absent from previously cleared or otherwise highly disturbed stands.	**Absent:** No suitable habitat for the vegetation community occurs within the Study Area. No known records of the vegetation community occur within the Site.	**Unlikely:** no suitable habitat for the species occurs within the Study Area. Therefore, the proposal is unlikely to result in impacts to the species or its habitat.

APPENDIX

D

TEST OF SIGNIFICANCE

D.1 Test of Significance

Where threatened species and vegetation communities are identified as likely to be impacted by a given proposal, an assessment of those impacts is undertaken to identify whether or not significant impacts are likely to occur. Requirements for assessment of significance involve several steps to identify extent of impacts on population and/or community structure and long-term survival and consist of addressing several questions. Assessments of significance as per different legislative instruments in the state of NSW include:

- Test of Significance as detailed in Section 7.3 of the NSW *Biodiversity Conservation Act 2016*. Where significant impacts are identified, preparation of a Species Impact Statement (SIS) is triggered;
- Assessment of Significance under the NSW *Fisheries Management Act 1994*; and
- Significant Impact Assessment under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

Selection of threatened species and vegetation communities for assessment of significance is based on the LoOR assessment. Where the LoOR assessment identifies a threatened species or ecological community as having a moderate, high or known likely of occurrence and is likely to be impacted, an assessment of significance is undertaken.

All threatened species and vegetation communities with potential to occur within the 10km locality surrounding the Study Area were identified during database searches (see **Appendix A** and **B**) and LoOR assessment undertaken (see **Appendix C**). A total of four threatened species were assessed as having a moderate likelihood of occurrence. These species are:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) listed as Vulnerable under the BC Act;
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) listed as Vulnerable under the BC Act;
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) listed as Vulnerable under the BC Act; and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) listed as Vulnerable under the BC Act.

Also, PCT 1326 was considered commensurate with the BC Act listed threatened ecological community Illawarra Lowlands Woodland in the Sydney Basin Bioregion (EEC). A test of significance was also undertaken for this TEC.

TableD-1 to **Table D-2** provide five-part tests assessing likelihood of significant impact on the above listed threatened species and TEC.

There are three KTPs that have the potential to be triggered as a result of the project (See Section 5.3).

Table D-1. Test of Significance: Threatened Microbats

Threatened Species Assessed: Mammals	
	This five-part test assesses the following mammal species: ▪ Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) ▪ Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) ▪ Greater Broad-nosed Bat (*Scoteanax rueppellii*) ▪ Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) The four microbat species were assessed as having a Moderate likelihood of occurrence within the Study Area due to foraging habitat for the species being present therein (see **Appendix D**). Roosting habitat for microbat species occurs in tree hollows, whereas forging resources for these insectivorous species occurs in vegetated areas across the Study Area.
Five-part Test	
a)	*in the case of a threatened species, whether the proposed development or activity 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*
	The threatened bat species assessed have moderate likelihood of occurrence in vegetation within the Study Area, they are likely to occur in hollow-bearing trees and trees with decorticating bark therein. Removal of trees is not predicted to occur as part of the proposal, however, the proximity of the proposed new sewer alignment

Threatened Species Assessed: Mammals	
	has the potential to affect root system of trees and indirectly affect the life expectancy of trees. Tree root system impacts can be avoided by ensuring the sewer alignment is located beyond the tree protection zone. This would in turn avoid impacts on trees which provide foraging resources and roosting habitat (where hollows occur) to microbats. Therefore, provided the tree protection zone is avoided, it is unlikely the proposed works for new sewer alignment would result in adverse effect on the life cycle of these bat species, nor would a local population of these species be placed at risk of extinction.
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
	Not applicable
	(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.
	Not applicable
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
	UP to 28 native trees, including planted, remnant and regrowth trees, are proposed to be removed, these trees represent limited foraging resources for bat species (e.g. insects over canopy for microbats), compared to larger potential foraging resources likely to occur within remnant vegetation, riparian corridor and other vegetated areas within the locality. Trees proposed for removal and containing tree hollows are potential roosting habitat for microbat species. These trees are only a minimal amount of potential roosting habitat for microbats within the Study Area and wider locality. Therefore, the number of trees likely to require removal represent a very small amount of potential habitat for bat species compared to available habitat present elsewhere within the Study Area and wider locality.
	(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, and
	The trees likely to be removed are located in a historically cleared and disturbed areas. Their removal will not result in habitat for the threatened bat species being fragmented or isolated. Furthermore, new planted trees and landscaped areas within Council lands would compensate for impact on trees.
	(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,
	The trees located along the proposed new sewer alignment do not represent relevant feeding or roosting habitat resources for the threatened bat species assessed herein. These trees whereas suitable foraging and/or roosting habitat for the species, do not represent key important habitat for the long-term survival of the threatened bat species.
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)*
	The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.
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 proposed development has the potential to trigger five key threatening processes (KTPs): ▪ Clearing of native vegetation; ▪ Human-caused Climate Change ▪ Infection of native plants by *Phytophthora cinnamomi*; ▪ Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands ▪ Infection of frogs by amphibian chytrid causing the disease chytridiomycosis As detailed in **Section 5.3**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.
Conclusion	
	UP to 28 trees are likely to be affected by the proposed new sewer alignment part of the project. These trees, if removed would reduce availability of foraging resources and habitat (hollows and decorticating bark) for microbat

Threatened Species Assessed: Mammals
species. However, they do not represent key habitat. Furthermore, compensatory planting of any tree removed would result on temporary impacts on potential resources for microbats. Therefore, the proposed new sewer alignment would not result in significant impacts on habitat of these threatened bat species.

Table D-2. Test of Significance: Illawarra Lowlands Woodland

Threatened Species Assessed: Mammals	
This five-part test assesses the Illawarra Lowlands Woodland an Endangered Ecological Community (EEC) listed under the BC Act. PCT 1326 was considered commensurate with the BC Act listed threatened ecological community Illawarra Lowlands Woodland in the Sydney Basin Bioregion (EEC). This vegetation community is located on the western roadside of Worrigee Road and in a small patch at Rayleigh Drive (east to SPS28). The proposed new sewer alignment is located within 10m of trees of the Worrigee Road patch, and potential impacts might occur on trees part of this vegetation patch if the sewer is located within the tree protection zone. The vegetation patch at Rayleigh Drive will not be impacted as the existing sewer at SPS28 will be decommissioned *in-situ*.	
Five-part Test	
a)	*in the case of a threatened species, whether the proposed development or activity 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*
Not applicable	
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
The proposed new sewer alignment is within 10m of trees part of PCT 1326. The possibility exists that up to two trees part of the vegetation community might be affected if the sewer encroaches into their tree protection zone. Loss of few trees part of this EEC would not result in impacts to the vegetation community that would place it to be at risk of extinction	
	(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.
Loss of up to two trees part of a patch of native vegetation in low condition would not result in the vegetation community to be placed 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
Up to two trees might be affected due to the proximity of the proposed new sewer alignment.	
	(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, and
The two trees are located at the edge of the patch and would result in reduction in the extent of the patch. The patch is present as an isolated patch in an otherwise cleared landscape.	
	(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,
The trees do not contain hollows or bird nest. They would provide foraging resources for fauna species, but they wold not represent key foraging resources for fauna species as more resources occur within the wider locality. Removal of two trees from this patch would not result in the vegetation community's long-term survival being at risk.	
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)*
The Study Area do not contain Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act. Therefore, the proposed development will not have an adverse effect on declared AOBV.	

Threatened Species Assessed: Mammals
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 proposed development has the potential to trigger five key threatening processes (KTPs):

- Clearing of native vegetation;
- Human-caused Climate Change
- Infection of native plants by *Phytophthora cinnamomi*;
- Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

As detailed in **Section 5.3**, a range of project design, proposed plantings and mitigation measures would avoid triggering the above listed KTPs.

Conclusion

UP to two trees part of a patch of the vegetation community are likely to be affected due to their proximity to the sewer alignment. Loss of two trees from this patch would not result in significant impacts on the threatened ecological community the PCT is associated with.

APPENDIX

C

ABORIGINAL DUE DILIGENCE REPORT

Reference: 21049

17 October 2021

Kyle Johannes
Environmental Engineer
Cardno
16 Burelli Street, Wollongong
New South Wales, 2500

Dear Kyle,

RE: ABORIGINAL CULTURAL HERITAGE DUE DILIGENCE ADVICE FOR SOUTH NOWRA SURCHARGE MAIN

Austral Archaeology Pty Ltd (Austral) has been engaged by Cardno to provide Aboriginal Cultural Heritage Due Diligence Advice for the proposed South Nowra Surcharge Main in South Nowra, New South Wales (NSW) [the study area]. This advice is intended to assist Cardno in determining their obligations with regard to the *National Parks and Wildlife Act 1974* (NPW Act) and to determine whether the project will involve activities that may harm Aboriginal objects or places.

Section 87 of the NPW Act makes it a strict liability offence to harm Aboriginal objects or declared Aboriginal places without an AHIP. Harm is defined under the NPW Act as "*any act or omission that destroys, defaces or damages the object or place or in relation to an object, moves the object from the land on which it had been situated*". The NPW Act allows for a person or organisation to exercise due diligence in determining whether their actions will or are likely to impact upon Aboriginal objects or places. Any person or organisation who can demonstrate that they have exercised due diligence has a defence against prosecution under the strict liability provisions of the NPW Act. Where an activity is likely to harm Aboriginal objects or places, consent in the form of an Aboriginal Heritage Impact Permit (AHIP) is required.

The *National Parks and Wildlife Regulation 2009* (NPW Regulation) adopted the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010a) (the code). The code sets out the reasonable and practicable steps which individuals and organisations need to take in order to:

- Identify whether Aboriginal objects are, or are likely to be, present within the study area.
- If Aboriginal objects are, or are likely to be present, determine whether their activities are likely to cause harm.
- Determine whether further assessment or an AHIP application is required for the activity to proceed.

This advice has been formulated to provide a robust assessment that will identify whether Aboriginal objects or places are present or are likely to be present within the study area. This has been achieved through the completion of a desktop review and archaeological survey of the study area. The code provides a series of questions that clarify whether it is applicable to a proposed project. These questions are addressed in Table 1.

Table 1 Applicability of the code to the proposed activity

Question	Response
Is the activity a declared project under Part 3A of the EP&A Act?	No
Is the activity an exempt activity listed in the NPW Act or other legislation?	No
Will the activity involve harm that is trivial or negligible?	No

Question	Response
Is the activity in an Aboriginal place or are you already aware of Aboriginal objects on the land?	No
Is the activity a low impact activity for which there is a defence in the NPW Regulation?	No
Do you want to use an industry specific code of practice?	No
Do you wish to follow your own procedure?	No

As none of the questions outlined in Table 1 apply to the project, having undertaken due diligence must be shown through using The Code. The Code consists of a series of five steps outlined below.

STEP 1: WILL THE ACTIVITY DISTURB THE GROUND SURFACE OR ANY CULTURALLY MODIFIED TREES?

The proposed work is part of the South Nowra Surcharge Main located in South Nowra. The proposed works will include the replacement of the existing sewer pipeline and the installation of some new areas of the sewer (Figure 5). Trench excavation will be required for the installation and replacement of the pipe which will be around 1.2 metres in with and vary in depth between one and 10 metres. The 10-metre depth will be for the new sewer pump station. The specific proposed works are as follows:

- Installation of 635 m of diameter nominal (DN) DN300 Rising Main along Old Southern Road
- Installation of 1,300 m of DN225 or DN300 Rising Main, to improve the performance of SPS024
- Decommission sewer pump station (SPS) SPS028, connecting it to SPS024 gravity sewer network via 80 m of DN150 gravity sewer
- Installation of a new SPS in the reserve to the south of Greenpoint Road
- Replacement of the existing DN300 asbestos cement (AC) surcharge main with:
- 685 m of DN375 gravity sewer to be installed from the rear of 44 Warrigal St to the injection of SPS024
- 325 m of DN525 gravity sewer from the injection/discharge of SPS024 to flow to the new SPS
- 1,200 m of DN500 rising main connecting the new SPS to the DN500 main installed as part of the new Nowra Sewer Treatment Plan (STP) construction
- Upgrading all pump stations to meet PWWF requirements, and maximise operational efficiencies.

It is noted that none of the existing sewer mains that are being replaced will be removed during the works. They will all remain in the ground and be grout filled. The only demolition will be the removal on the top 1m of SPS28. The remaining pits and wet well at SPS28 will either be sand or grout filled as well and the top 1m of ground will be filled with fill and the surface will be turfed.

The streets which are included within the works area have been heavily modified. Please note that for the proposes of this investigation the study area was broken up into five survey areas (recorded as SA 1-5, Figure 3). Three landscapes located within SA 1 and 3 have not been heavily modified;

- The northern portion of the study area (in SA 1) which has an existing sewer pipeline but is located out of the study area at some points,
- Ratcliff Park where a new sewer pipeline is to be installed (in SA 3),
- Along the creek running south from Ratcliff Park (in SA 3); there is an existing sewer pipeline located which is to be decommissioned

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The activity will disturb the ground surface and therefore consideration of steps 2a and 2b of the code is required.

STEP 2A. SEARCH THE ABORIGINAL HERITAGE INFORMATION MANAGEMENT SYSTEM (AHIMS) DATABASE AND USE ANY OTHER SOURCES OF INFORMATION OF WHICH YOU ARE ALREADY AWARE

An extensive search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted on 10 May 2021 (Client service ID: 589839). The search identified 86 Aboriginal archaeological sites within an 8-kilometre search area centred on the proposed study area. None of these registered sites are located within the study area (Figure 4). Our mapping uses EPSG:4326 datum and AHIMS coordinates aligned to a different datum were converted. The nearest artefact scatters were AHIMS # 52-5-0605 which was located 200 metres to the south-west of the southern boundary of the study area. While rock shelters of one sort or another occur within the search area by virtue of their extent, they have no potential to occur in the study area as geological conditions necessary for their occurrence are absent in the study area. Furthermore, the area of disturbance with the built-up area of Nowra reduces the chances of many site types occurring due to the levelling, excavation and construction works that have been undertaken.

Table 2 AHIMS sites identified within 8 kilometres of the study area.

Site type	Occurrence
Artefact	36
Potential Archaeological Deposit (PAD)	9
Shelter with Deposit	7
Modified Tree	4
Artefact, PAD	4
Isolated Find	3
Open Camp Site	3
Shelter with Art	3
Art	3
Habitation Structure	3
Axe Grinding Groove	2
Shelter with Art, Shelter with Deposit	2
Art, Artefact, PAD	2
Midden	1
Axe Grinding Groove, Shelter with Art, Shelter with Deposit	1
Artefact, Habitation Structure, Grinding Groove	1
Grinding Groove, Habitation Structure	1
Artefact, Habitation Structure	1
Grand Total	86

The AHIMS site types of Artefact (36), PADs (9), Artefact, PAD (4) and isolated find (3) all refer to subdivisions of what is essentially the same form of archaeological remains – stone artefacts in open contexts, and collectively these form 55 of 86 sites (64%) in total.

A review of the reports held on the AHIMS database identified several archaeological studies which have been undertaken within the locality of the study area. These are summarised in Table 3.

Table 3 Archaeological studies undertaken in the vicinity of the study area.

Author	Details
Paton 1990	Study was undertaken on a 500-metre-wide strip of land located approximately 1 kilometre south-east of the study area on the edge of Brundee Swamp. Two artefact sites had previously been recorded; AHIMS # 52-2-204 which contained one stone artefact, and AHIMS # 52-5-502 which contained four stone artefacts. Both of these sites were located on a level ground area that was adjacent to the swamp.
Navin 1992	Study was undertaken on a 900 metre by 700-metre area located approximately 4 kilometres north-east of the study area on the northern side of the Shoalhaven River. Two isolated finds were recorded. APPM Isolated Find 1 was a stone hatchet found in a drainage ditch. APPM Isolated Find 2 was a broken water-worn pebble with some flake scars. Several trees displaying scarring were noted, however, it was determined that the likelihood of these being Aboriginal in origin was minimal, instead, they appeared to be natural scars. Much of this study area was likely disturbed by flood scouring and subsequent erosion.
Kuskie 1995	Study approximately 100 metres north of the study area, measuring 350 metres by 550 metres. No Aboriginal objects were identified. The lack of archaeology in this area was attributed to a low intensity of use by Aboriginal people and/or due to the impacts of recent land practices.
Clarke & Kuskie 2006	Study undertaken across the lower Shoalhaven River Basin encompassed the study area. This study was a predictive modelling project that identified that artefact scatters were the most likely site type to occur within virtual any landscape across the region. It was noted that these artefact sites would likely occur in low densities which were consistent with background discard but some areas of high density would occur which was characteristic at campsites. No archaeological sites were identified during this project.
Kayandel Archaeological Services 2011	Study was approximately 5.5 kilometres in length with the southernmost point located 2 kilometres north of the study area. This was located along the edges of modern road reserves, with a combination of open grassland and modern housing development located alongside the road. No Aboriginal objects were identified as being within the impact area during the site survey.
Kelleher Nightingale Consulting Pty Ltd 2010	Study approximately 6 kilometres from the study area. The study area consisted of a forested sloped area that varied from gentle to moderately steep. Exposed sandstone escarpment was visible. 28 sites were located; these included 20 rock shelters and an axe-grinding site that were located within the escarpment. There were four open sites which included artefact scatters, two isolated finds and one open midden site recorded. One recent scar tree was also recorded. The artefact scatters included BCRP 014 – West Cambewarra Open Site 02 (AHIMS # 52-5-0546) which was located near a terrace, two meters above Bomaderry Creek. More than twenty artefacts were noted, including some main from fine-grained material, grey silcrete and a pale white fine-grained material.
Artefact Heritage 2018	Study was undertaken at the north and south ends of Nowra Bridge, covering a total of 61 hectares and located 2 kilometres north-west of the study area. This area is located at the Shoalhaven River Margins and extends north and south where the landscape comprises open parkland and developed urban areas. There were 10 sites included within the study area, recorded by Artefact during their survey and testing works. along the edge of the north side of the Shoalhaven River were one recorded scar tree (AHIMS ## 52-5-0857) and one PAD (AHIMS # 52-5-0860). Located slightly higher on the terrace were three artefact scatters (AHIMS #52-2-0853, 52-5-0855 and 52-5-085). One further artefact scatter was recorded on the south side of the bridge on a flat area next to the road reserve (AHIMS # 52-5-0852). There were two additional PADs recorded on the north of the river, located to the north and south of the Bomaderry Creek on either side of Princes Highway (AHIMS #52-5-0858 and 52-5-0854). Two small PADS were located on the south side of the river, located on small grassed flat areas next to road reserves (AHIMS # 52-5-0852 and 52-5-0859)

Table 4 Assessment of landscape features

Information	Details
Ethnographic	Tindale identified the Dharawal-speaking Wodi Wodi group as the Aboriginal custodians of the Nowra area (Tindale 1974, p.156). The Shoalhaven region was a very densely populated area with between 2 to 4 people present per kilometre2 (Organ & Speechley 1997, p.1). It has been estimated that in 1825 there were 1,800 Aboriginal people in the Shoalhaven area, spread as far south as Batemans Bay (Organ & Speechley 1997). Ethnohistorical sources indicate the diverse economy of the local area. In terms of food sources or subsistence activities recorded, fish and fishing are commonly noted, in addition to the gathering of shellfish and also the exploitation of sea mammals where possible (Boot 1994, Sullivan 1982, pp.25–27). In hinterland areas, macropods and possums are the most frequently mentioned animal foods. Other animal food items mentioned include birds, honey, reptiles, dogs, grubs and bandicoots (Sullivan 1982, p.44). The most commonly mentioned plant foods are fruits, berries, cabbage palms and macrozamia (burrawangs), and there are references to roots and yams (Sullivan 1982, p.43). Low (1992) lists a possible 72 edible plant species the known distributions of which take in the study area and surrounds. The Aboriginal people of the area also had a diverse material culture, and ethnographically recorded items include; spears, both barbed and unbarbed and possibly made from two pieces of wood and pointed, clubs made of “heavy wood”, bark canoes which ranged from about 7’6” to 12’ in length, fishing lines and nets, stone axes, vine traps, ropes, weirs (as mentioned above for catching fish), bark huts, bark containers and shields, containers made from knots on trees, possum and kangaroo skin cloaks, possum fur string, items of personal adornment such as kangaroo tooth necklaces, body paint, belts and ‘kilts’ for ceremonial occasions, and ceremonial items such as bull roarers (Sullivan 1982, pp.25–77).
Soils	There are two soil landscapes within the study area; the Shoalhaven sandstone landscape and the Nowra soil landscape (Figure 5). The Shoalhaven sandstone landscape takes up the eastern portion of the study area and is moderately deep: between 500 millimetres to 1 metre. It consists of six dominant soil formations: Prairie, Red Earths and Yellow and Red Podzolic, Alluvial and Gleyed Podzolic Prairie soils found on levees, Red Earths and Yellow and Red Podzolic soils found on the terraces, and alluvial Soils and Gleyed Podzolic (potential Acid Sulphate) soils located on the floodplains (Hazelton et al. 1992, p.63). The Shoalhaven soil landscape is characterised by four different forms within the soil profile. This profile includes sf1, a brownish-black to brown colour that is a fine sandy loam that exhibits hard setting behaviour; sf2, a brown to yellowish-brown colour that this a weakly pedal light sandy clay loam; sf3, a yellowish-brown sandy clay; and sf4, reddish-brown colour with a moderately pedal medium clay (Hazelton et al. 1992, p.69). The Nowra soil-landscape located across the western portion of the study area is a coarse-grained, quartz, horizontally bedded sandstone that often contains quartz pebbles (McElroy et al. 1969). The Nowra soil landscape is characterised by seven forms within the soil profile. This includes no1, a yellowish-brown loose single-grained sand; no2, yellowish-brown clayey sand that is gravelly and exhibiting hard setting behaviour; no3, a dark reddish-brown loam that is fine sand; no4, a light clay that is mottled; no5, a dark olive-green sandy clay; no 6, a bright brown to dark olive-green, moderately pedal medium clay; and n07, a brown sandy clay loam (Hazelton et al. 1992, pp.82–83).

Information	Details
Hydrology	The study area is located within the Shoalhaven River catchment area. The Shoalhaven River has a catchment area of approximately 7,250 kilometres^2. The Shoalhaven River has two mouths – one permanently open at Crookhaven Heads; the other intermittently open at Shoalhaven Heads, approximately 5 kilometres further north. Within the study area is a second-order creek that runs from south to north through the study area before connecting with Crookhaven Creek (Figure 7). This has been modified in the northern part of the study area where it runs through Terra Swamp and is crossed by a small first order creek which has also been realigned. To the south, running appears nature running through Ratcliff Park before it splits into two first-order creeks. The areas that are susceptible to flooding are less likely to contain Aboriginal sites when compared to the elevated hill crests north of the creek lines that are unaffected by flooding.
Landform	The study area is located in the southern section of the Sydney Basin (Figure 8). It is characterised by level to gently undulating riverbeds and banks as well as active floodplains (Hazelton et al. 1992, p.68). The Terra Swamp borders the north end of the study area. Behind this, the ground rises into gentle slopes, with two hill crests included in the study area. Along one hillcrest is The Garden Walk and the second is lined by Worrigee Road. To the south is the Worrigee Swamp which has been transformed into housing developments, heavily modifying the study area and surrounds it into modern subdivisions.
Disturbance	The study area consists of roadways that have been heavily disturbed, and areas of natural ground that show limited signs of disturbance (Figure 3). The northern portion of the study area through Terra Swamp shows signs of some modification and disturbance through the existing sewer pipeline which is located partially on the western boundary. However, the excavation for this is unlikely to have been more than 2 metres wide, based on the proposed plans for the currently proposed works. A housing development has been built up along the western side of the study area since the 1960s leaving a small strip of higher land at the edge of the swamp that comprises part of the study area (Figure 9). The location of the study area in Ratcliff Park showed some signs oof modification to the eastern side of the prk which had been excavated out. A small portion lcoatied oto the north end of the park showed no signs of disturbance. No pipeline being recorded in this low potential area. The area of the creek located to the south of Ratcliff Park also has an existing pipeline running through it, however, this is also likely to have had excavations that were no more than 2 metres in width for the installation of the pipe. It is important to note that the creek has been fenced off close to the east and west sides, removing terraces that may have held potential above the creeks high water level. The southern and eastern portions of the site have been heavily disturbed as they are located within the road reserve or a recently developed area of the town.

Information	Details
Resources	Before the removal of the natural vegetation, the ecological diversity of the area would have provided a wide range of resources for Aboriginal people. The Shoalhaven landscape is almost completely cleared except for small concentrations of *Melaleuca quinquenervia* (decorative paperbark), *Quercus bicolor* (swamp oak), *Brachychiton acerifolius* (Illawarra flame trees) and various reeds. Similarly, the Nowra landscape has also been nearly completely cleared, however, it still retains several tree species, including *Syncarpia glomulifera* (turpentine), *Eucalyptus punctata* (grey gum), *Corymbia maulata* (spotted gum), *E. piperita* (Sydney peppermint), *E. obliqua* (thin-leaved stringybark), *C. gummifera* (red bloodwood), *Allocasuarina toruloa* (forest oak) and *E. piluaris* (blackbutt) (Department of Environment and Conservation 2005, Stewart & Percival 1997). The soft, spongy bark of the Illawarra flame tree was used to make nets and fishing lines, sap from the red bloodwood trees were utilised to tan fishing nets and stain artefacts. Swamp oak bark provided material for canoe making and bark from the paperbark tree was used for bedding and blankets (Department of Environment and Conservation 2005). The study area and its surroundings would have provided habitats for mammals including kangaroos, brush-tail possums, sugar gliders and common wombats, and the rivers and creeks nearby would provide access to additional faunal resources such as fish species, a range of water birds and a variety of lizards. These resources would have provided food for Aboriginal people travelling between the coastline and further inland along the Shoalhaven River and its tributaries (Attenbrow 2003). As well as being important food sources, animal products were also utilised for tool making. Examples include 'bone points', which would have functioned as awls or piercers, as well as tail sinews, which were used to make fastening cords. Animals such as brush-tailed possums were highly prized for their fur, with possum-skin cloaks (Attenbrow 2003). Many of the flora and fauna species found within the vicinity of the study area were crucial for Aboriginal people and were used for numerous purposes as well as providing habitat for faunal resources (Attenbrow 2003).

Based upon the results of research a model of site location has been able to be developed, expressed as a series of predictive statements. These indicate the type and character of Aboriginal cultural heritage sites that are likely to exist within the study area and where they are more likely to be located. These predictive statements are:

- Artefact scatters are most likely to occur on raised, level ground, near sources of freshwater or wetlands, or along spur crest or ridgelines.
- Subsurface archaeological material can be found in areas where no visible surface archaeological remains are evident.
- While surface artefact scatters may indicate the presence of archaeological deposits, surface artefact distribution and density may not accurately reflect those of subsurface archaeological deposits.
- Aboriginal scarred trees may be present in areas where remnant old-growth vegetation exists.
- PADs are most likely to occur along valley floors and low slopes in well-drained areas.
- Sites are most likely to occur at or close to ecotones, i.e., where different environments meet.
- Low lying wetland areas subject to constant inundation will be unlikely to contain Aboriginal occupation.
- A low density "background" of artefacts in the form of isolated finds, subsurface or surface scatters will exist in areas not considered primary occupation sites.

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STEP 2B. ACTIVITIES IN AREAS WHERE LANDSCAPE FEATURES INDICATE THE PRESENCE OF ABORIGINAL OBJECTS

Based on the assessment of previous archaeological studies undertaken within the vicinity of the area and the assessment of landscape features three features may hold archaeological potential located across SA 1 and 3 (Figure 3).

- Northern portion of the study area (SA 1) contains an existing sewer pipeline but a new sewer will be laid 3- meters from the original. Additionally, the original sewer wanders out of the study area at locations.
- Central portion of Ratcliff Park (SA 3) – currently no sewer pipeline running through the area, is a higher area of ground located near to the second-order creek located in the study area.
- Along the creek running south from Ratcliff Park (SA 3); there is an existing sewer pipeline located within the study area, however, this is located 4 meters away from the existing location of the study area

STEP 3. CAN YOU AVOID HARM TO THE OBJECT OR DISTURBANCE OF THE LANDSCAPE FEATURE?

Due to the nature of the proposed works for this study area, it is not possible to avoid harm to the landscape features it crosses, as described in Table 4.

STEP 4: DESKTOP ASSESSMENT AND VISUAL INSPECTION

In order to ground-truth the desktop assessment, a visual inspection of the study area was undertaken on 13/05/2021 by Jasmine Weston (Austral, Archaeologist) and Dean Scott (Nowra LALC, Traditional Owner). The visual inspection consisted of a systematic survey of the study area to identify and record any Aboriginal archaeological sites visible on the surface or areas of Aboriginal archaeological potential and cultural sensitivity. The archaeological survey was conducted on foot. The methods used during the visual inspection conformed to Requirements 5 to 8 of the *Code of practice for archaeological investigation of Aboriginal objects in NSW* (DECCW 2010b). The site survey was undertaken in 5 areas (SA 1-5) ().

SA 1 was the northern most part of the study area, located to the rear of a 1970s subdivision (Figure 11). The western portion of this study area was flat and sloped down to the east to the large marshy Terra Swamp (Figure 12). A second-order creek was located within this flood plain but has been highly modified by being realigned. An existing sewer pipeline exists within this area, located near the western boundary of the study area; sometimes within and sometimes external to it. A PAD was identified near the south end of SA 1, as this is a higher point nearer to the original creek line. This was also where the sewer pipeline was located external to the study area at a distance of 3 metres away from the identified area of potential. A small first-order creek passes through the study area in the central part of SA 1 which could not be seen from the surface (Figure 7). This appears to have been realigned into a pipeline based on the hydrology showing the area (Figure 7). An area around this has been identified as having moderate potential due to it being a high point near to a creek confluence of a first and second order creek (Figure 13). The sewer pipeline was also external to the study area at this point at a distance of 4 metres from this identified PAD. Works for the adjacent sewer pipeline were being undertaken in Terra Swamp while the survey was going on that showed the water level in the creek (Figure 14).

SA 2 was recorded as Greenwell Point Road. This extended for 2.3 kilometres adjacent to some farmland to the north western end of the study area and then through a modern subdivision that has been constructed in the 1980s (Figure 15). A park area was included at the east end of the study area which has been modified into gentle hills (Figure 16). Due to the recent developments in the area, it has been highly disturbed. No areas of archaeological potential were identified.

SA 3 was a pedestrian area that covered the entirety of Ratcliff Park, and along the second-order creek to the south side of a new subdivision. Within Ratcliff Park, there was one flat area in the north-west corner (Figure 17). This appeared to be undisturbed; aerial photos showed earlier road tracks going around this area (Figure 9). There is an existing sewer pipeline in this area that will

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be decommissioned. This is located to the east of the creek. The rest of Ratcliff Park was identified as having been disturbed during the 20th century, with the ground level dropping of to the west indicating that it had been exacvted out during the 20th century. A small area of potential was identified to the west of the creek as having moderate potential due to its location on a small flat area near the creek. This was approximately 4 meters away from the sewer pipeline suggesting that this area is unlikely to be too disturbed. To the east of this was a slope leading down to another marshy area that was in line with the creek. The creek continued to the south and seemed largely natural (Figure 18). Housing developments had been built up on either side of the creek; encompassing many areas of potential. One small terrace was noted approximately halfway down SA 3 and was recorded as a moderate PAD (Figure 19). To the south end of SA 3, a new subdivision was in construction. The land surrounding the creek in this area was very sloped indicating it would be unlikely to find archaeological material in this area.

The fourth area, SA 4, extended east from the south end of Ratcliff Park. This went east along The Garden Walk hill crest. It continued south along Worrigee Road which had some areas of exposure along the western side where the ground visibility was between 20-100%, no archaeological material was seen (Figure 21, Figure 22). Additionally, there were many new houses built up along the sides of the road. The study area then cut through a new subdivision that has had groundworks completed for additional constructions. SA 4 continued west to the south of Rayleigh Road along an original creek line, that can be seen on historical aerials. This had been modified into a straight line with a water pump station at the west end (Figure 23). The study area then separated into two parts, one continuing north on Rayleigh Drive and the other continuing west before going north along Sullivan Street and Peppermint Drive. The whole of SA 4 had undergone major modifications in the last few decades that had caused a large amount of disturbance. As a result, the area was noted as having low potential.

SA 5 followed down Old Southern Road before tuning west onto Brown Street (Figure 24). This area had been heavily modified due to developments along each side of the roads. New developments that required substantial excavation works were underway to the south of Nowra Christian School which has not yet been recorded on any maps. Due to this the area was marked as having low potential.

The results of the visual inspection are outlined in Figure 10.

Step 5: Further investigations and impact assessment

Based upon the outcome of Steps 1 to 4 of the code, further assessment is warranted as similar landforms near this portion of the study area are known to contain Aboriginal artefacts, and large parts of the study area are undisturbed. It is therefore recommended that:

1. Where possible the plans should be altered in the first instance to avoid disturbing areas of potential. This will mitigate the need for further investigation or assessment.
2. If the areas of high or moderate potential cannot be avoided by changing the plans or works, an Aboriginal Cultural Heritage Assessment (ACHA) will be required. This will be completed in accordance with the Code of Practice and the Consultation Guidelines. This will support an AHIP application if sites are located within the sensitive landform.
3. The ACHA should include a program of archaeological test excavation that should be undertaken, in accordance Requirement 16 of the Code of practice, to determine the nature, extent and significance of Aboriginal heritage within areas of moderate and high potential in the study area. The recommended testing areas will be:
    i) Any area noted as having either high or moderate archaeological potential within an area where works will be undertaken.
    ii) Areas within the study area where existing sewer is to be decommissioned, or areas where high levels of disturbance have been recorded will not need further assessment.

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If you have any questions regarding the advice within this letter, please do not hesitate to contact me on the details below.

Yours sincerely,

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Figure 1 - Location of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI basemap, OSM

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

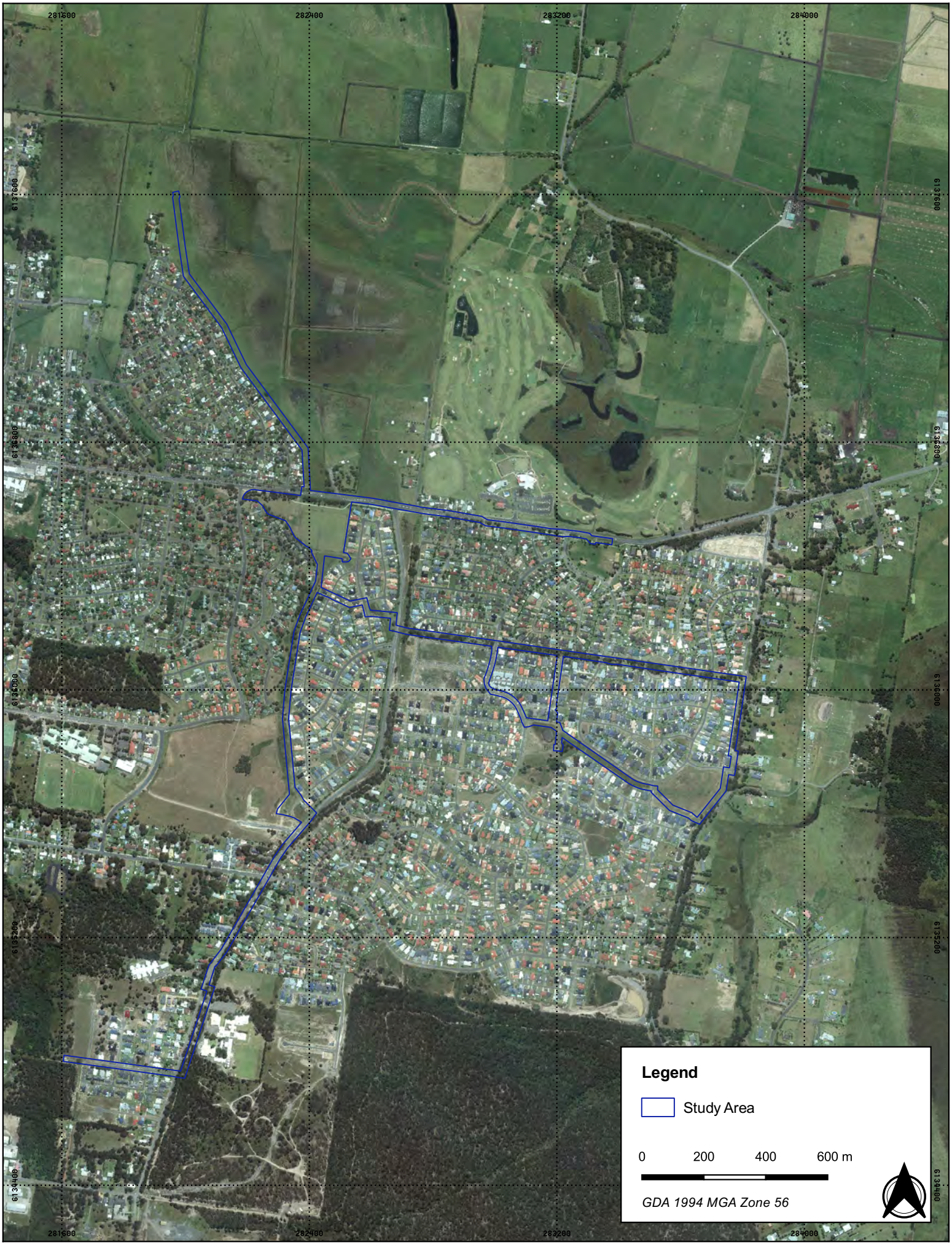

Figure 2 - Detailed aerial of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

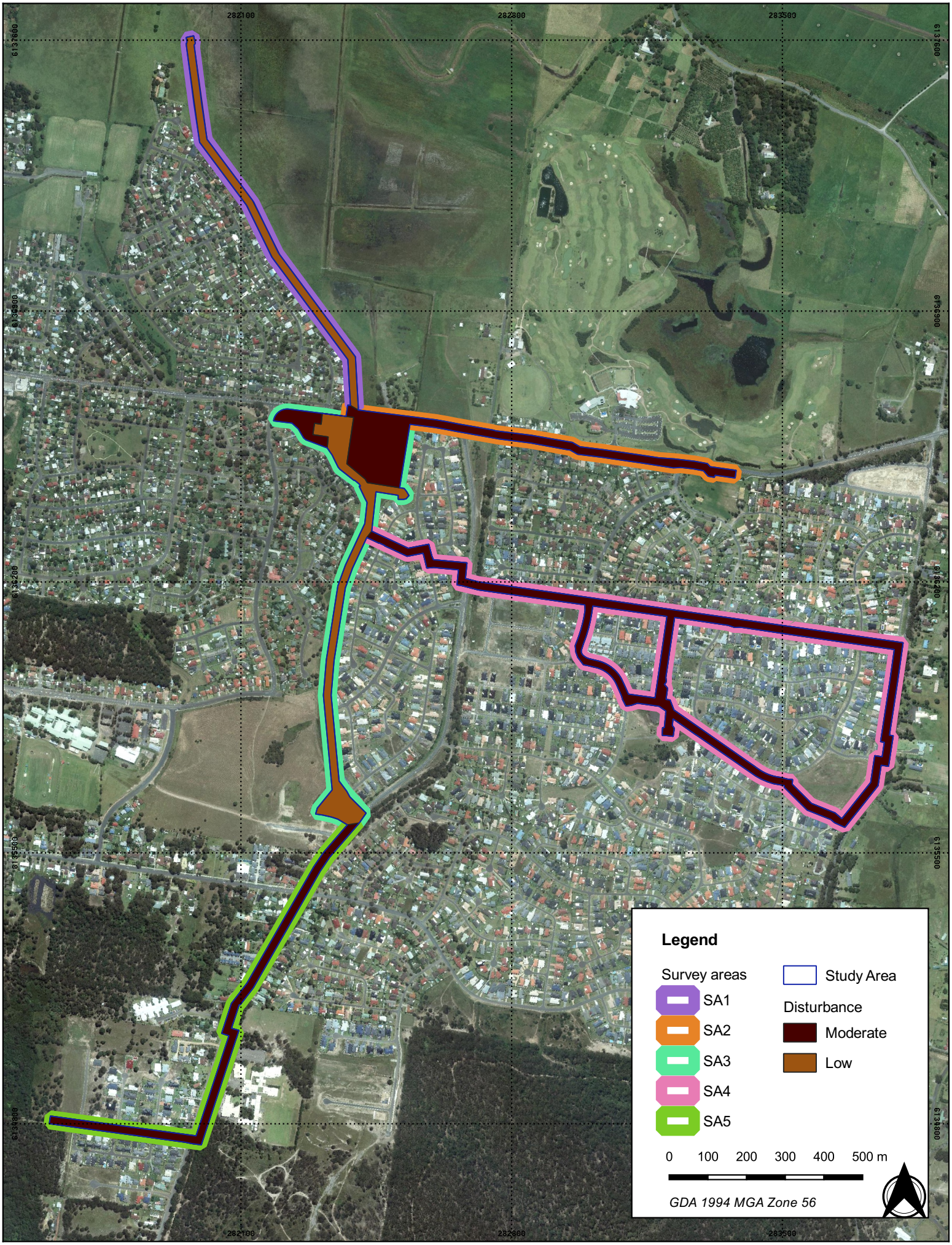

Figure 3 - Identified disturbance within the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-22

AUSTRAL ARCHAEOLOGY

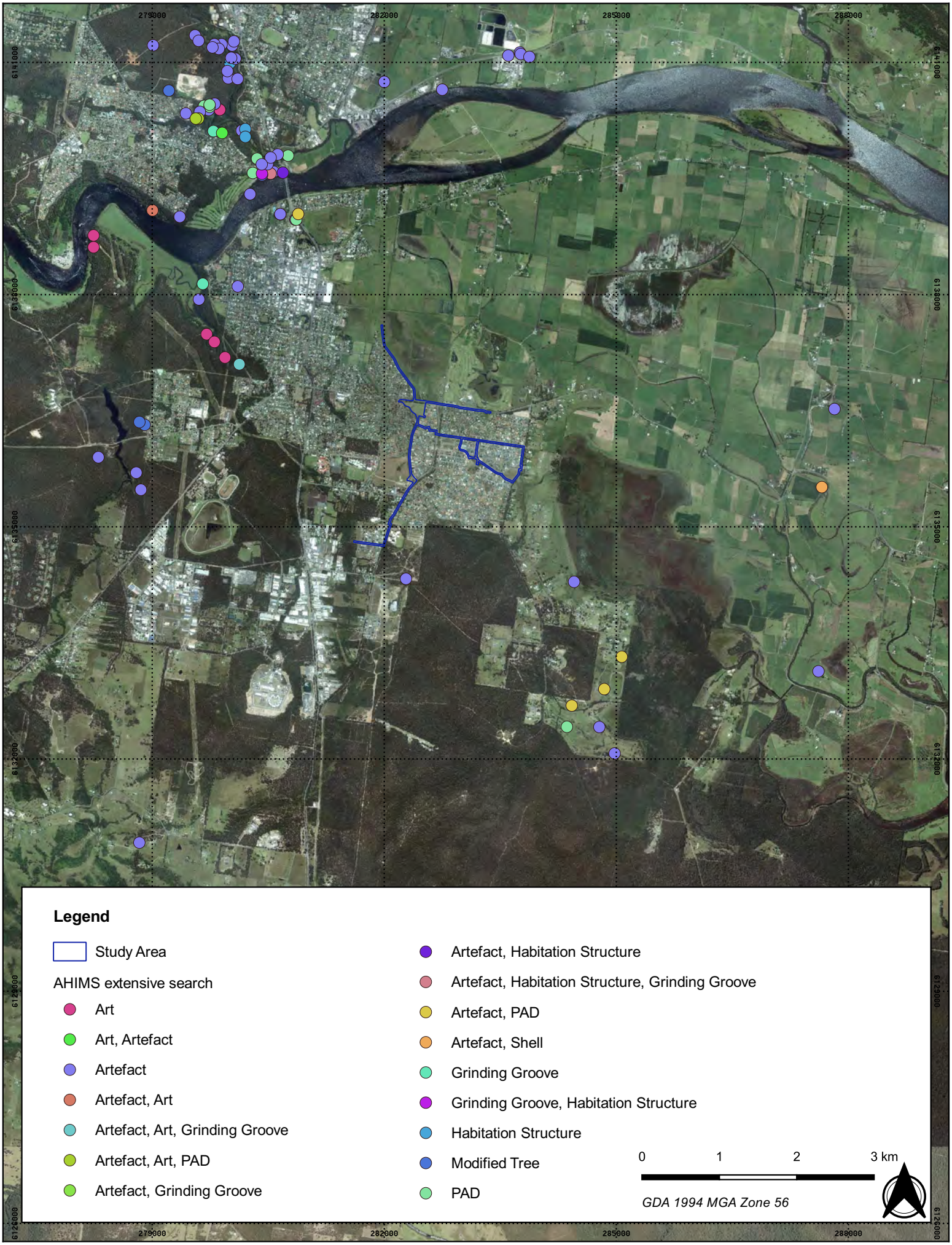

Figure 4 - AHIMS within 8km of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial, AHIMS

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

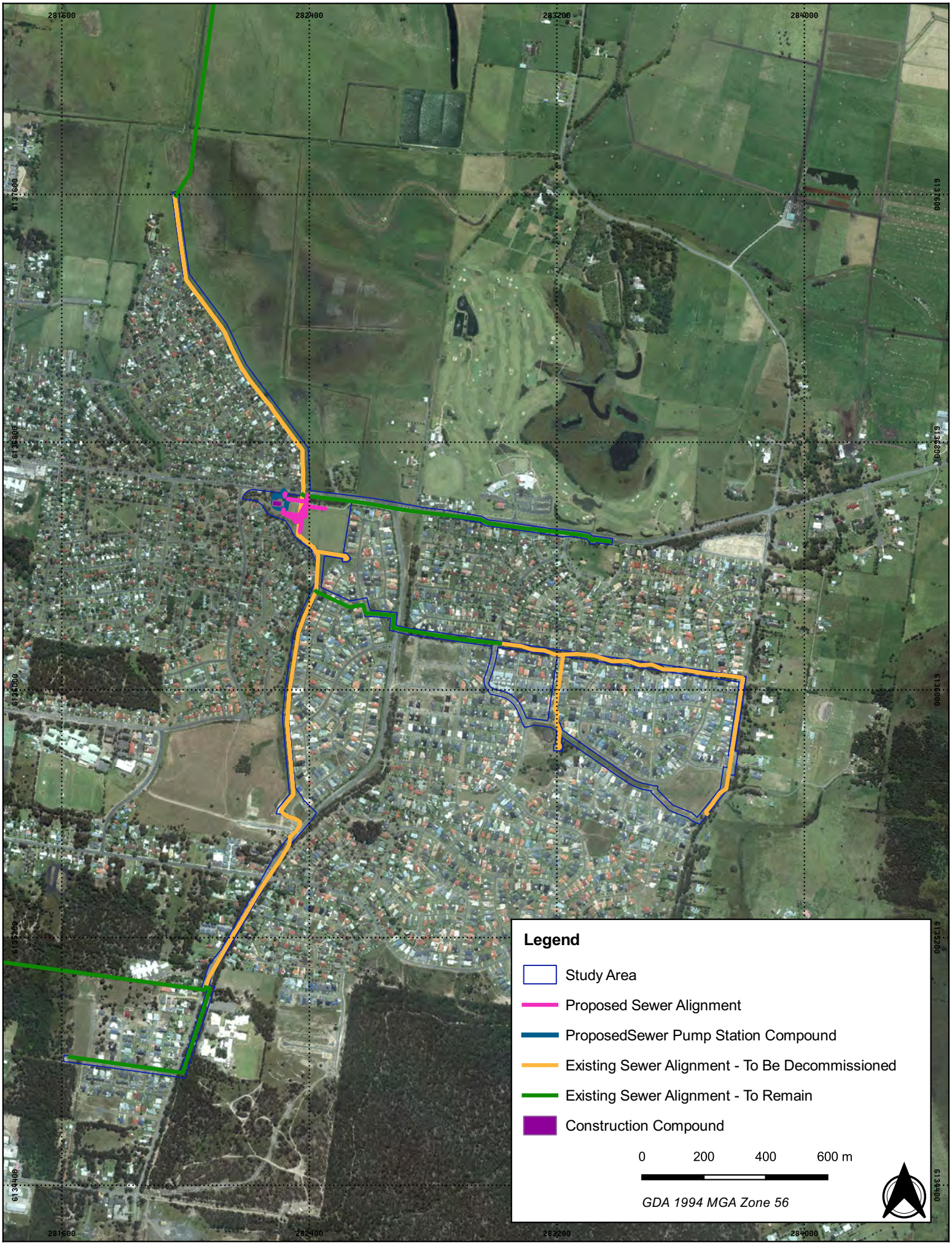

Figure 5 - Propsoed Works in the Study Area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

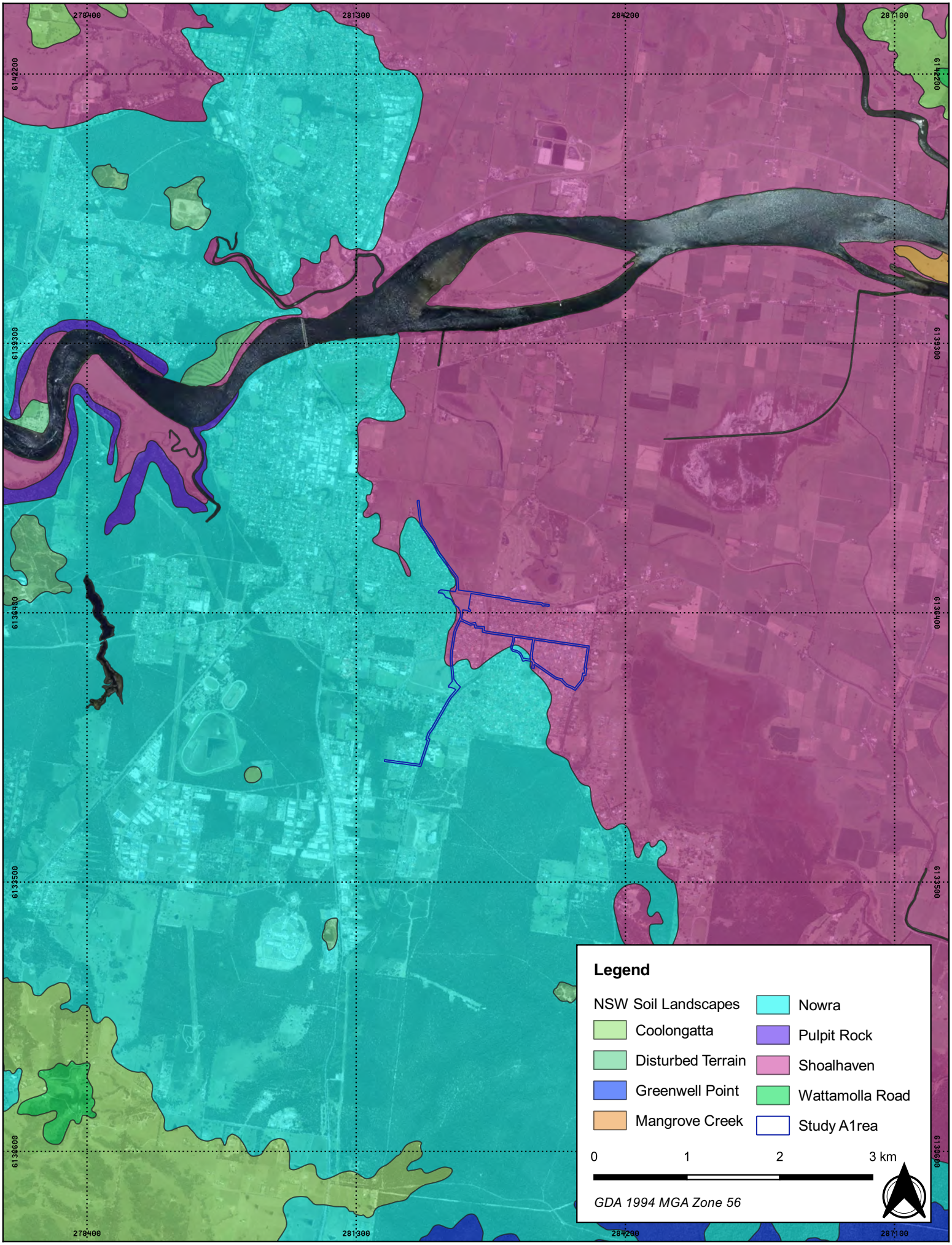

Figure 6 - Soils associated with the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial, NSW Spatial Services

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

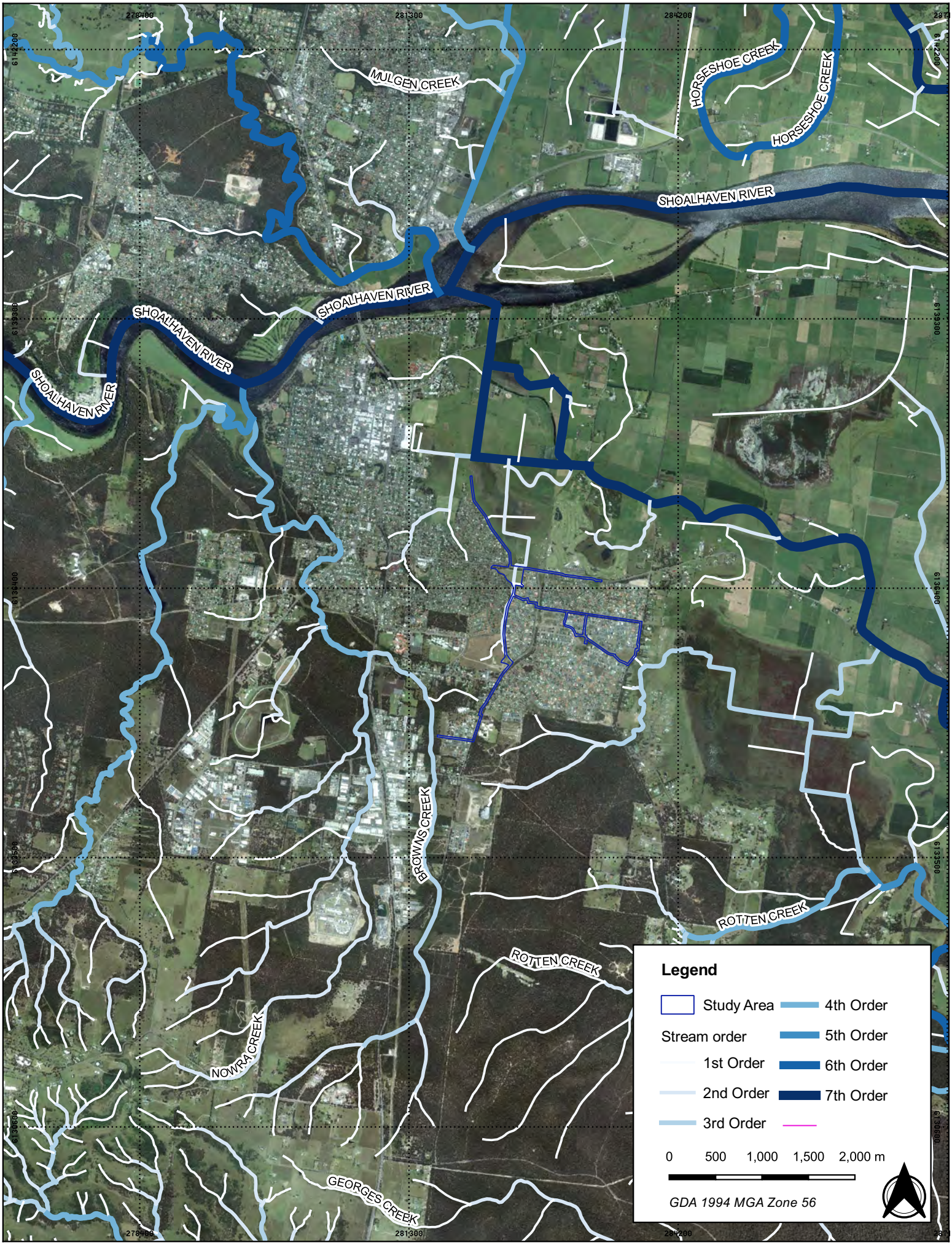

Figure 7 - Hydrology associated with the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial, NSW Spatial Services

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

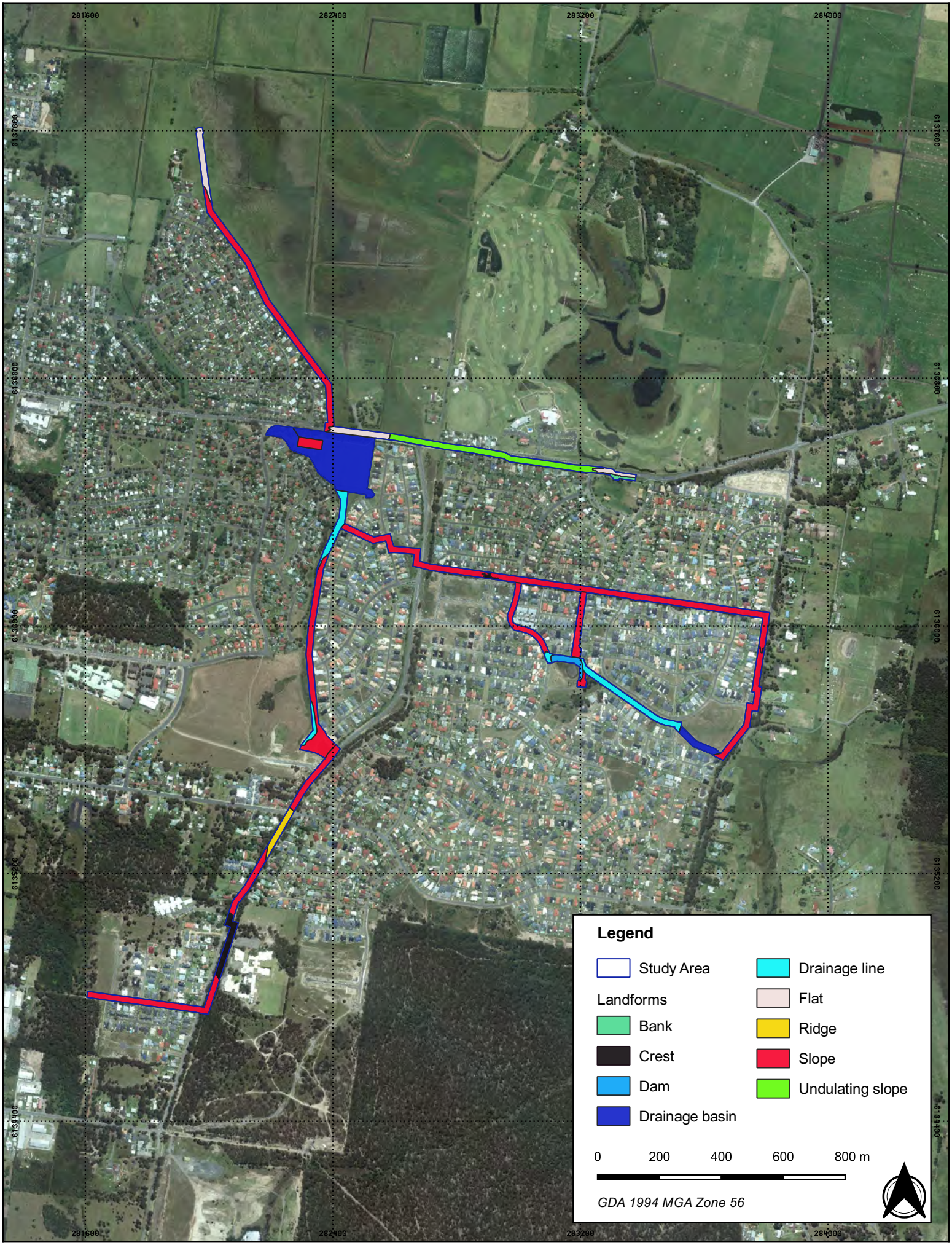

Figure 8 - Landform units of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

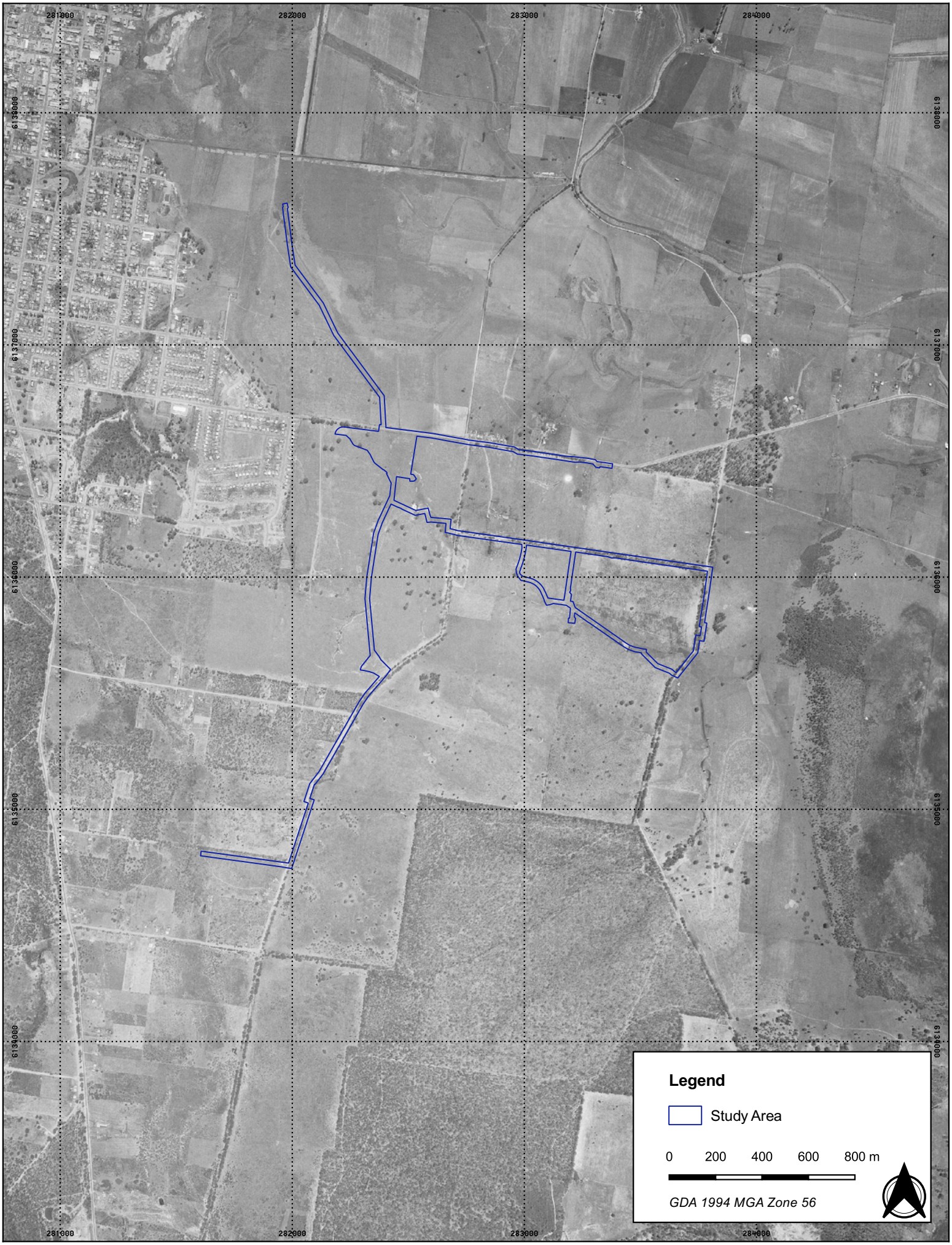

Figure 9 - 1969 Historical aerial of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial, NSW Spatial Services

Drawn by: SS Date: 2021-10-17

AUSTRAL ARCHAEOLOGY

Figure 10 - Archaeological potential of the study area

21049 - South Nowra surcharge main replacement - ACHDDA

Source: NSW LPI Aerial

Drawn by: SS Date: 2021-10-19

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Figure 11 **South-east facing view of SA 1, looking back towards subdivision.**

Figure 12 **East facing view of SA 1, looking across Terra Swamp.**

Figure 13 North-west facing view showing PAD in SA 1, looking along the edge of the subdivision.

Figure 14 North-east facing view of Terra Swamp, located north-east of SA 1.

Figure 15 East facing view of SA 2, along the south side of Greenwell Point Road.

Figure 16 West facing view of SA 2, in Rayleigh Garden Reserve.

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Figure 17 North-west facing view of SA 3 in Ratcliff Park.

Figure 18 South-east facing view of SA 3, west of the second-order creek.

Figure 19 **South facing view of PAD within SA 3, to the east of the second-order creek.**

Figure 20 **West facing view of SA 4 looking along The Garden Walk.**

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Figure 21 West facing view of SA 4 showing exposed ground along the west of Worrgie Road

Figure 22 East facing view of SA 4 with the exposed ground along the west of Worrgie Road.

Figure 23 **South-west facing view looking across the water pump station in SA 4.**

Figure 24 **West facing view looking down Browns Road in SA 5.**

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APPENDIX

D

PRELIMINARY SITE INVESTIGATION

Preliminary Site Investigation

Concept and Detailed Design of South Nowra Surcharge Main – Major Upgrades

WI21102IP

Prepared for

Shoalhaven Water

22 October 2021

Cardno®

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Document Information

Prepared for	Shoalhaven Water
Project Name	Concept and Detailed Design of South Nowra Surcharge Main – Major Upgrades
File Reference	WI21102IP_R02_PSI_RevC.docx
Job Reference	WI21102IP
Date	22 October 2021
Version Number	1

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Effective Date 22/10/2021

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Christopher Cook
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Date Approved 22/10/2021

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
A	15 June 2021	Draft for internal review	Kyle Johannes	CC & ZW
B	17 June 2021	Draft for client review	Kyle Johannes	ZW
C	22 October 2021	Final	Kyle Johannes	CC

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Our report is based on information made available by the client. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Cardno is both complete and accurate. Whilst, to the best of our knowledge, the information contained in this report is accurate at the date of issue, changes may occur to the site conditions, the site context or the applicable planning framework. This report should not be used after any such changes without consulting the provider of the report or a suitably qualified person.

Executive Summary

Cardno (NSW/ACT) Pty Ltd was engaged by Shoalhaven Water to undertake a Preliminary Site Investigation (PSI) of the proposed upgrade of the South Nowra Surcharge Main (SNSM). The PSI is being prepared as part of a broader suite of works by Cardno to inform a review of environmental factors (REF).

The investigatory area (the "site") is the proposed and existing alignments of the SNSM and is shown in **Figure 1 and 2, Appendix A** and the site location is shown in **Figure 1, Appendix A**. The proposed upgrade of SNSM is located within road reserves, drainage reserves, adjacent existing mains and in close proximity to properties located along Salisbury Drive, Kardella Avenue, Killara Road, Old Southern Road, Greenwell Point Road, Buradoo Crescent, The Garden Walk, Peppermint Drive, Sullivan Street, Rayleigh Drive and Worigee Road.

The purpose of this investigation was to undertake a PSI to identify potential contamination issues and constraints on the proposed upgrades of the SNSM in order to inform an REF. The objective of the PSI is to assess whether contamination has the potential to exist on the site and whether further investigation is needed.

The investigation of the site included:

- A desktop site history review
- A site walkover by an Environmental Engineer
- Preparation of this PSI report.

The key findings of the PSI included:

- Acid sulfate soil testing undertaken at the site as part of the geotechnical investigation (Cardno, 2021) found that acid sulfate soils (ASS) and potential acid sulfate soils (PASS) are present in various locations within the Site Boundary. It is noted that the density of acid sulfate soil testing has not been conducted in accordance with Acid Sulfate Soils Management Advisory Committee (ASSMAC) guidelines and further investigation of ASS and PASS is recommended
- There is the potential for fill material of unknown environmental quality to be present within the site (associated with the development of existing utility infrastructure, roads, drainage systems, and within embankments and mounds observed along the proposed sewer alignment routes)
- Soil stockpiles containing construction and demolition waste were observed within the central portion of the site
- Surface debris including potential asbestos containing material (PACM) were observed sporadically throughout the site
- There is the potential for sewerage leakage from the existing use of the site as a sewerage system.

For the purposes of the proposed upgrade the above noted contaminant sources present an increased risk to human and ecological health in the event of disturbance during construction however they do not impact site suitability for the proposed use.

Based on the findings of this investigation the following recommendations are made:

- Prepare a Construction Environmental Management Plan (CEMP) containing an Unexpected Finds Protocol (UFP) outlining appropriate management of contamination items which may be encountered or disturbed by constructions
  - In the event of an unexpected contamination find a suitably qualified environmental consultant will be required to attend site to assess contamination and provide advice on appropriate management or treatmen
- For the areas within the site where ASS is deemed to be present, it is recommended that further investigation be undertaken. This further investigation will inform any future mitigation measures required
- All materials do be disposed of offsite are to be assessed as per the NSW EPA (2014) *Waste Classification Guidelines* or the relevant NSW EPA Resource Recovery Orders prior to removal from site
- Where asbestos materials (i.e. former pipes) are to remain buried onsite these are to be noted in Council property records with an Asbestos Management Plan (AMP) in place to ensure appropriate long term management.

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1 Introduction

Cardno (NSW/ACT) Pty Ltd was engaged by Shoalhaven Water to undertake a Preliminary Site Investigation (PSI) of the proposed upgrade of the South Nowra Surcharge Main (SNSM). The PSI is being prepared as part of a broader suite of works by Cardno to inform a review of environmental factors (REF).

The investigatory area (the "site") is the proposed and existing alignments of the SNSM and is shown in **Figure 1 and 2, Appendix A** and the site location is shown in **Figure 1, Appendix A**. The proposed upgrade of SNSM is located within road reserves, drainage reserves, adjacent existing mains and in close proximity to properties located along Salisbury Drive, Kardella Avenue, Killara Road, Old Southern Road, Greenwell Point Road, Buradoo Crescent, The Garden Walk, Peppermint Drive, Sullivan Street, Rayleigh Drive and Worigee Road.

1.1 Purpose and objectives

The purpose of this investigation was to undertake a PSI to identify potential contamination issues and constraints on the proposed upgrades of the SNSM in order to inform an REF. The objective of the PSI is to assess whether contamination has the potential to exist on the site and whether further investigation is needed.

1.2 Proposed Development

The proposed development will involve the upgrade of the SNSM which would include:

- Installation of 635 m of diameter nominal (DN) DN300 Rising Main along Old Southern Road
- Installation of 1,300 m of DN225 or DN300 Rising Main, to improve the performance of SPS24
- Decommission sewer pump station (SPS) SPS28, connecting it to SPS24 gravity sewer network via 80 m of DN150 gravity sewer
- Installation of a new SPS in the reserve to the south of Greenpoint Road
- Replacement of the existing DN300 asbestos cement (AC) surcharge main with:
  - 685 m of DN375 gravity sewer to be installed from the rear of 44 Warrigal St, to the injection of SPS24
  - 325 m of DN525 gravity sewer from the injection / discharge of SPS24 to flow to the new SPS
  - 1,200 m of DN500 rising main connecting the new SPS to the DN500 main installed as part of the new Nowra Sewer Treatment Plan (STP) construction
- Upgrading all pump stations to meet peak wet weather flow (PWWF) requirements, and maximise operational efficiencies.

It is understood that none of the existing sewer mains that are being replaced will be removed during the works. They will all remain in ground and be grout filled. The only demolition will be the removal of the top 1 m of SPS28. The remaining pits and wet well at SPS28 will either be sand or grout filled and the top 1 m of ground will be filled with environmentally suitable fill with a final cover of turf.

The alignment of the proposed upgrades is shown in **Figure 2, Appendix A**.

1.3 Scope of work

The following scope of work was undertaken in order to achieve the above noted objectives:

- A site walkover by an Environmental Engineer to identify potential sources of contamination
- A desktop site history review including the following sources:
  - NSW Environment Protection Authority (EPA) contaminated land public register and the Public Register under Section 308 of the Protection of the Environment Operations Act 1997
  - Local and regional geology, hydrogeology, topography and hydrology
  - Groundwater data available for the area
  - Historic aerial photographs

- Current and historic land title information

> Preparation of a PSI report in accordance with the Consultants reporting on contaminated land, Contaminated land guidelines (NSW EPA, 2020) and National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999).

1.4 Applicable guidelines and legislation

The scope of this PSI has been developed in accordance with the following guidelines and legislation:

> National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPM 1999)

> NSW Department of Urban Affairs and Planning (1998) Managing Land Contamination: Planning Guidelines: SEPP 55 Remediation of Land, 1998

> NSW EPA (2017) Guidelines for the NSW Auditor Scheme (3rd edition). New South Wales Environment Protection Authority, September 2017

> NSW EPA (2020) Consultants reporting on contaminated land; Contaminated land guidelines. New South Wales Environment Protection Authority

> Western Australia Department of Health (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, May 2009.

2 Site identification

2.1 Site information

Details related to the Site are included in **Table 2-1**, below whilst **Figure 1 and 2, Appendix A** shows the site locality in the context of the local area.

Table 2-1 Site information

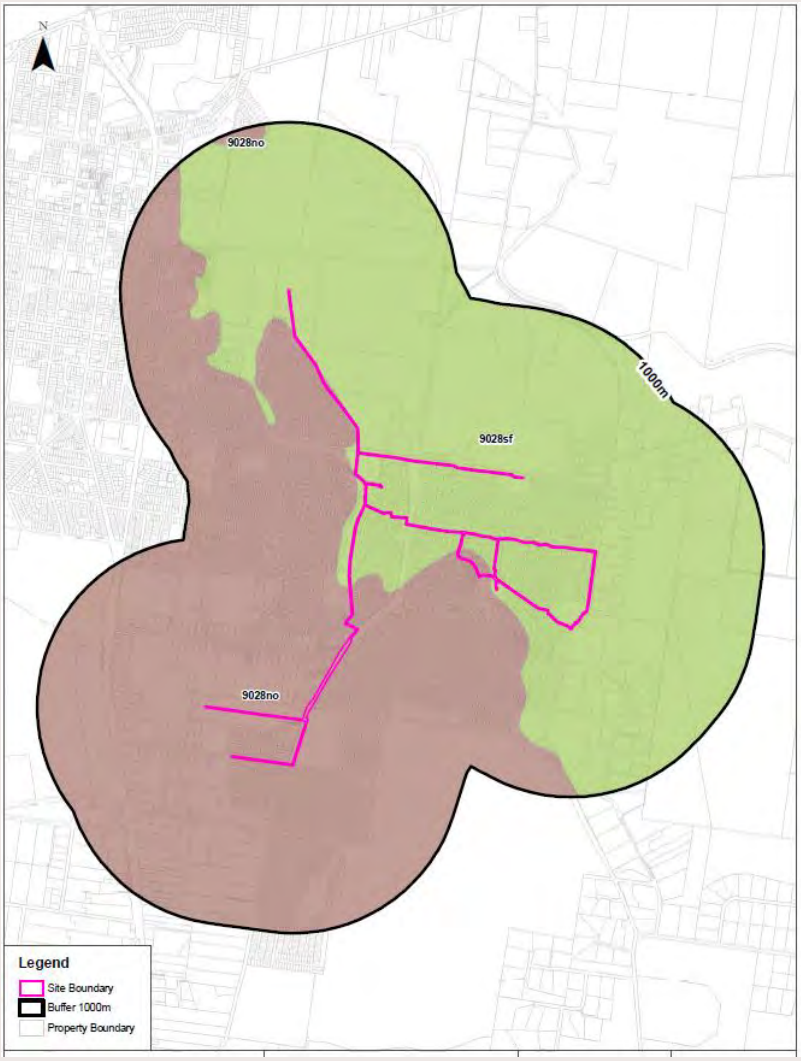
Details	Comments
Site address	South Nowra Surcharge Main, South Nowra, NSW 2540
Land Titles	The site intersects or passes through the following lots: Lot 1 Deposited Plan (DP) 725965 Lot 2 DP 725975 Lot 112 DP 1061374 Lot 1 DP 880854 Lot 2 DP 880854 Lot 133 DP 703670 Lot 2 DP 1245988 Lot 1 DP 1245988 Lot 1 DP 1119599 Lot 918 DP1240172 Lot 379 DP 1077197 Lot 3512 DP 1217801 Lot 3511 DP 1217801 Lot 352 DP 1068794 Lot 241 DP 755952 Lot 206 DP 1060103 Lot 254 DP 1060103 Lot 9 DP 1048562 Lot 8 DP 1048562 Lot 1 DP 1119599 Lot 58 DP 1048562 Lot 59 DP 1048562 Lot 7318 DP 1177129 Lot 300 DP 1086791 Lot 350 DP 1068794
Current Land use	Road reserves, drainage reserves, sewer easements, open park land and light agricultural land
Proposed Land use	Road reserves, drainage reserves, sewer easements, open park land and light agricultural land
Local Government Authority (LGA)	Shoalhaven City Council
Current Zoning - Shoalhaven Local Environment Plan (2014)	RE1 – Public Recreation RU1 – Primary Production SP2 – Infrastructure R1 – General Residential R2 – Low Density Residential R3 – Medium Density Residential.
Site Area	Lineal extent: Approximately 3 km Average width: 20 m wide
Site Coordinates (GDA94 MGA 56)	Northern most point of the site. E: 281970 N: 6137609 Southern most point of the site. E:281970 N: 6134765 Western most point of the site. E: 281609 N: 6134809 Eastern most point of the site. E: 283768 N: 6135680
Current Site Owner	Shoalhaven City Council, Crown Land, Private property

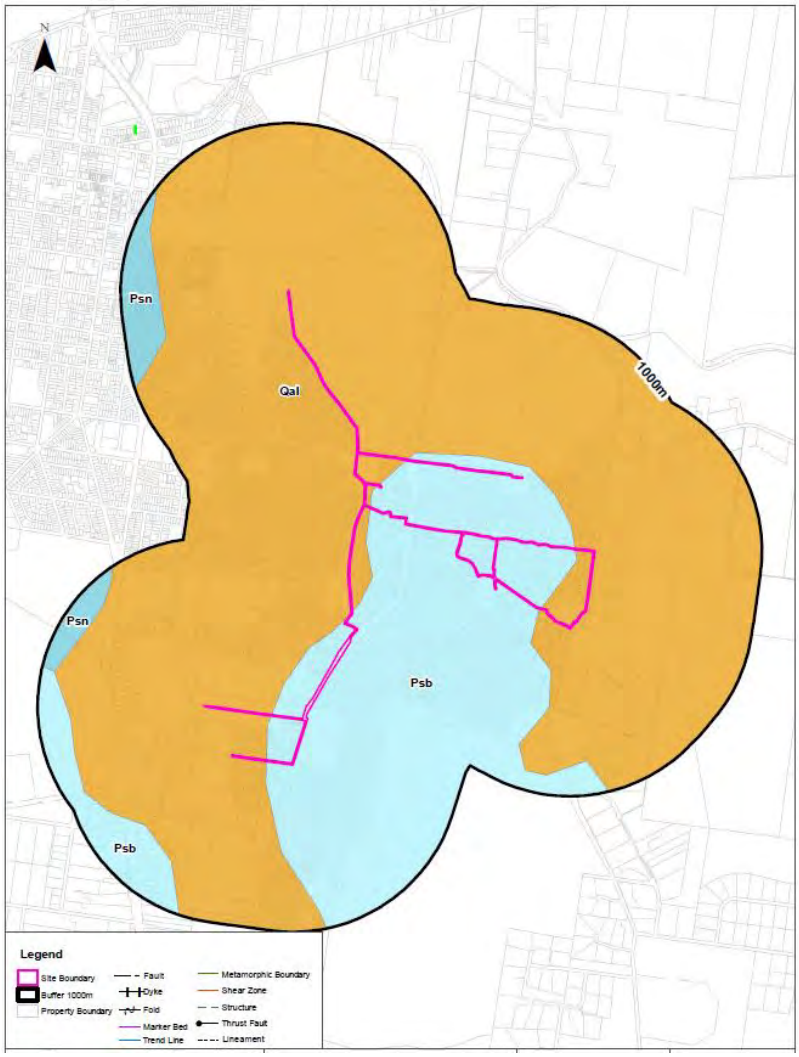
2.2 Site description

The Site details provided below in **Table 2-2** is based upon public data sets.

Table 2-2 Site information summary

Item	Site information
Site slope and elevation	The site has a maximum elevation of approximately 40 m Australian Height Datum (AHD) in the southern portion of the site. The site falls to approximately 4 m AHD in the northern and eastern portions of the site.
Nearby water bodies (NSW DFSI, Spatial Services)	In order to assess the nearby water bodies, the site has been split into four site areas (SA1 to SA4) as shown in **Figure 3**, **Appendix A**. SA1: A modified unnamed drainage channel is located to the east and adjacent to the site (within 10 m) which appears to flow to the north east and into the Crookhaven Creek approximately 1.2 km east of the site and then subsequently into the Crookhaven River approximately 4 km east of the site. Terra Swamp is located approximately 10 m east of the site, with Worrigee Swamp located approximately 750 m east of the site within the Worrigee Links Golf Course. SA2: This portion of the site encompasses Ratcliff Park and is located within and adjacent to a drainage easement and unnamed drainage channel and connects to the previously identified modified drainage channel to the north. SA3: This portion of the site is located within road reserves however; Browns Creek is located approximately 50 m west of the site, as well as an unnamed creek which is located approximately 100 m west of the site. The unnamed creek is a tributary of Browns Creek. Another unnamed creek is located approximately 110 m east of the site which subsequently flows into the Crookhaven River. SA4: This portion of the site is located within and adjacent to drainage easement and unnamed drainage channel. A stormwater retention basin is located south and adjacent to the site and Sullivan Street Playground and Park. The unnamed drainage channel flows into an unnamed creek east of the site and Worrigee Road and subsequently flows into the Crookhaven River.
Site surface coverings	Levelled areas in the north, centre and west of the site have been cleared of vegetation and are covered in grass. In the centre and east of the site within the drainage easement and “The Garden Walk” comprised large trees and with ground cover a mixture of tree detritus and grass. The SPS within the site were fenced off, with exception of SPS012, SPS022 and SPS024 which were either partially fenced or had no fencing. All were surrounded by gravel and associated infrastructure. Remaining areas of the site comprise hardstand asphalt roads and service easements.
Site soil landscapes (Lotsearch source: Soil Landscapes of Central and Eastern NSW: NSW Department of Planning, Industry and Environment)	The site is underlain by two soil landscapes with the Nowra landscape found in the western portion of the site and the Shoalhaven landscape in the eastern portion of the site. The locations of the landscapes within the site is shown in **Figure 2-1**. Nowra soil landscape (shown as green with code “9028sf” on the figure below): This landscape is described as moderately to gently undulating rises to low hills on Nowra Sandstone. Broad ridges and crests. Benched sandstone outcrops adjacent to drainage lines. The topography has a relief of >40 m with slope gradients of >5%. Vegetation is extensively to moderately cleared with stands of tall open-forest. Soils are moderately deep (50–100 cm). Brown Podzolic Soils occur on crests and upper slopes. Soloths and/ or Yellow Earths occur midslope. Yellow Podzolic Soils occur on lower slopes and drainage lines. Shoalhaven (shown as brown with code “9028no” on the figure below): This landscape is described as having level to gently undulating present river bed and banks, active floodplain with levees and backwater swamps on alluvium. Flat to gently undulating terrace surfaces of the Shoalhaven River. The topography has a relief of <5 m and slope gradients of <3%. Vegetation is completely cleared except for scattered decorative paperbark, swamp oak, Illawarra flame tree on terraces and various reeds in swamps Soils are moderately deep (50–100 cm) Prairie Soils occur on levees. Red Earths and Yellow and Red Podzolic Soils occur on terraces. Alluvial Soils and Gleyed Podzolic (potential Acid Sulphate) Soils occur on the floodplain.

Item	Site information
	Figure 2-1 Site soil landscapes 
Site surface geology (Lotsearch source: NSW Statewide Seamless Geology. NSW Department of Industry, Resources & Energy)	The site is mapped as being underlain by two geological units with an undifferentiated formation found in the western, northern, eastern and southern portions of the site and the Berry Siltstone formation found in the central and southern portions of the site. The locations of the landscapes within the site is shown in **Figure 2-2**. Undifferentiated Formation (shown as orange with code "Qal" on the figure below) – Is of the Cainozoic age. The material is described as alluvium, gravel, sand silt and clay Berry Siltstone Formation (shown as blue with code "Psb" on the figure below) –Is of the Palaesoic age Shoalhaven Group. The material is described as bluish grey to light grey siltstone, shaly in part with bands of silty sandstone.

Item	Site information
	Figure 2-2 Site surface geology 
Acid Sulfate Soils	The Atlas of Australian Acid Sulfate Soils, managed by the CSIRO, described the site as being predominantly in a Class C Area, which is considered to have extremely low probability of occurrence and parts of the northern portion of the site within a Class B area, which is considered to have a low probability of occurrence. The Shoalhaven Local Environment Plan (LEP 2014) indicated the site is predominantly mapped within a Soil Class 5 area. Class 5 soils are considered to require an acid sulfate soils preliminary assessment if the work is carried out within 500 m of an adjacent Class 2,3 or 4 area where this adjacent area is below 5 m AHD and where the works are likely to lower the water table below 1 m. , Parts of the northern and central portions of the site are mapped within Soil Classes 2 and 4 respectively. Class 2 soils are considered to require an acid sulfate soils preliminary assessment if the depth of works is below the natural ground surface and/or likely to lower the watertable below the natural ground surface. Class 4 are considered to require an acid sulfate soils preliminary assessment if the depth of works is 2 m below the natural ground surface and/or likely to lower the watertable by more the 2 m below the natural ground surface. The NSW Department of Planning Industry and Environments' on-line eSPADE v2.1 indicated that parts of the northern portion of the site are within a L1 area, which is described as having a low probability of acid sulfate soils <1 m below ground level (bgl) and within a L4 area which is described as having a low probability of acid sulfate soils >3 m bgl. It is noted that acid sulfate soil testing has been undertaken at the site by Cardno as part of a geotechnical investigation as reported in *Geotechnical Investigation Report, South Nowra Surcharge Main – Major Upgrades, WI211021IP, prepared for Shoalhaven Water*, dated May 2021 (Cardno, 2021). The results of this testing indicate that acid sulfate soil and potential acid sulfate soil is in fact present in various locations within the Site Boundary and further investigation is recommended to determine their extent and any mitigation measures required.

Item	Site information
Groundwater	A registered bore was identified within 500 m of the site boundary, in a search of the NSW Department of Primary Industry – Office of Water and Bureau of Meteorology databases by Lotsearch on behalf of Cardno (see **Appendix C**). Bore ID GW104352 is located 251 m northeast of the site and is used for domestic purposes. The standing water level recorded was 2.5 m bgl and final drill depth of 210 m. Drillers logs from the bore recorded the geology as being: ▪ 0.00 to 2.00 m – soil and clay ▪ 2.00 to 150.00 m – siltstone ▪ 150.00 to 195.00 m – grey sandstone ▪ 195.00 to 210.00 m – siltstone.

2.3 Adjacent land uses

In order to assess the surrounding land uses, the site has been split into four site areas (SA1 to SA4) as shown in **Figure 3**, **Appendix A**. The surrounding land uses are summarised in **Table 2-3** below.

Table 2-3 Surrounding land use

Site Area	Direction	Land use or activity
SA1	North	A mixture of industrial, commercial and agricultural land use, approximately 800 m north east of the site and downgradient is the Nowra Sewerage treatment site operated by Shoalhaven Water. Worrigee Links Golf Course is located adjacent to the site.
	West	Residential land use
	East	A mixture of agricultural and commercial land use
	South	A mixture of residential land use and open park land (Ratcliff Park and Rayleigh Garden Reserve).
SA2	North	A mixture of residential and agricultural land use.
	West	Residential land use. Medium-density residential development, mixture of completed and under construction homes at the time of the site visit.
	East	Open park land (Ratcliff Park) and residential land use. Medium-density residential development, mixture of completed and under construction homes at the time of the site visit.
	South	Residential land use
SA3	North	Residential land use
	West	Residential land use. Anglicare Jean Ross House was located approximately 120 m west of the site. Bushland area containing Browns Creek was located west of the site.
	East	Residential land use. Nowra Christian School was located east and adjacent to the site. Worrigee Nature Reserve is located approximately 450 m east of the site.
	South	Residential land use
SA4	North	Residential land use
	West	Residential land use
	East	Rural residential land use
	South	Residential land use and open park land

3 Site walkover

A site walkover was conducted on 21 April 2021 by a Cardno Environmental Engineer to identify potential sources or indicators of contamination on the site. Key site features are identified on **Figure 4, Appendix A** and site photos are shown in **Appendix B**.

- The area of the site between Greenwell Road and the northern most point of the site is fenced off as small paddocks with mowed sections and contain existing SNSM infrastructure (sewer and SPS012), timber structures used for horse agistment and a fenced off garden with associated timber storage structures and hay bales associated with grazing areas. (Photographs 1 to 3)
- The central portion of the site between Greenwell Point Road in the north and Old Southern Road in the south contained Rafcliff Park, a footpath, drainage and sewer reserve adjacent to residential properties located along Kardella Avenue and Narwee Link in the east and Kemeruka Crescent, Ascalon Close, Gascoyne Way, Pulma Way and Antares Close in the west and road reserves (Carrington Park Drive and Warrigal Street) and SNSM infrastructure (sewer and SPS020). (Photographs 4 to 6)
- The southern and south western areas of the site contain road reserves (Old Southern Road, Kaross Close and Browns Road), existing services easements adjacent to residential properties and SNSM infrastructure (sewer and SPS019). (Photographs 7 to 9)
- Eastern areas of the site contained road reserves (Greenwell Point Road, Kardella Avenue, Buradoo Crescent, Old Southern Road, Peppermint Drive, Sullivan Street, Bluewattle Road and Blue Bell Way), SNSM infrastructure (sewer, SPS022, SPS024 and SPS028), a drainage pond and drainage and sewer easement adjacent to Sullivan Street Park and Rayleigh Drive and The Garden Walk. (Photographs 10 to 12)
- A fragment of PACM was observed on the surface in the northern portion of the site immediately adjacent to residential properties located along Salisbury Drive and SPS012, location shown on **Figure 4, Appendix A**. (Photograph 13)
- Embankments and mounds were observed along the northern end of Ratcliff Park, adjacent to residential properties within drainage easement in the central portion of the site and adjacent to residential properties along Coral Gum crescent in the eastern portion of the site, location shown on **Figure 4, Appendix A**. (Photographs 14 and 15)
- Various fly tipped items such as shopping trolleys, timber furniture, cardboard boxes and car tyres were observed on the surface within the drainage easement in the central portion of the site. (Photograph 16)
- Scorched timber items and earth were observed within the drainage easement in the vicinity of the central portion of the site, adjacent to residential properties along Gascoyne Way, location is shown on **Figure 4, Appendix A**. (Photograph 17)
- Three stockpiles containing construction and demolition waste including brick, concrete, tile and soil were observed within a vacant block in the central portion of the site. Stockpile volumes were approximately between 2 to 10 m^3 and their location is shown on **Figure 4, Appendix A**. (Photograph 18)
- A concrete slab (potential cricket pitch) was observed within Ratcliff Park to the east of the site, the location is shown on **Figure 4, Appendix A**. (Photograph 19).

Table 3-1 Key observations summary

Item	Observation
Site cut and fill	Potential areas of cut to fill and earthworks were noted associated with surface water management. This includes the drainage easements and stormwater retention basin identified on the site and potential built up embankments for residential properties located adjacent to the site. More extensive filling was identified along some road and sewer alignments throughout the site and potential built up embankments for residential properties within the centre of the site. Observed areas impacted by fill are indicated in **Figure 4, Appendix A**.
Buildings	SNSM infrastructure such as SPS were located in various locations throughout the site. Timber structures used for horse agistment, a fenced off garden with associated timber storage structures were also located within the northern portion of the site. No evidence of historical structures on the site exists.

Item	Observation
Potential hazardous building materials	A fragment of potential asbestos containing materials (PACM) was observed in the northern portion of the site immediately adjacent to residential properties located along Salisbury Drive and SPS012. Observed PACM are indicated in **Figure 4, Appendix A**
Manufacturing, industrial or chemical processes and infrastructure	Not observed.
Fuel storage tanks (USTs/ASTs)	Not observed.
Dangerous goods	Not observed.
Solid waste deposition	No solid waste is generated on site. Construction and demolition waste was observed within stockpiles in the southern portion of the site. Stockpile locations are shown in **Figure 4, Appendix A**
Liquid waste disposal features	The site contains the existing sewer system (including SPS) for the SNSM which services the area within South Nowra.
Evidence of previous site contamination investigations	Not observed.
Evidence of land contamination (staining or odours)	Not observed.
Evidence of groundwater contamination	Not observed.
Groundwater use	Not observed.
Vegetation	Vegetation is a mixture of grassland and partially cleared woods in level and low-lying areas. No die back or other phytotoxic impacts were noted.
Site fencing	Boundary and internal fencing were generally agricultural in style though various residential type fencing was noted where the site abuts against residential lots. SPS locations were fully fenced with the exception of SPS012, SPS022 and SPS024, which were either partially fenced or had no fencing.

4 Site history sources

- A desktop site history review was undertaken of the following sources:
  - NSW Environment Protection Authority (EPA) registers and records
  - Historical business directories
  - Local and regional geology, hydrogeology, topography and hydrology
  - Historic aerial photographs.

4.1 NSW EPA records and registers

A search of the following NSW EPA databases was undertaken in May 2021 to identify properties appearing on them that are within 1000 m for the investigation Site:

- List of NSW contaminated sites notified to EPA
- Contaminated Land Records of Notice
- EPA Location of former gasworks sites
- EPA PFAS Investigation program
- EPA Other Sites with Contamination Issues
- Licensed Activities under the *Protection of Environment Operations Act 1997* (PoEO Act)
- Delicensed PoEO Activities still regulated by the EPA
- Former PoEO Licensed Activities now revoked or surrendered.

Results were returned for all searches of the NSW EPA databases, with the exception of 'EPA Location of former gasworks sites' and 'EPA Other Site with Contamination Issues', and are summarised in the subsections below.

4.1.1 List of NSW contaminated site notified to EPA

A search of the List of NSW Contaminated Sites Notified to the EPA identified three sites within 1000 m of the site, and is summarised in **Table 4.1** below. Due to the significant distance from the site, the identified sites are not expected to be a potential contaminant source at the site, noting that the identified sites were either not regulated or formerly regulated under the CLM Act.

Table 4-1 List of NSW Contaminated Sites notified to the EPA search results

Site	Activity	Management Class	Distance	Direction
Caltex South Nowra	Service Station	Regulation under CLM Act not required	495 m	South West
Mobil Service Station	Service Station	Contamination formerly regulated under the CLM Act	697 m	North West
Former Hollingworth Scrap Yard	Other Industry	Regulation under CLM Act not required	987 m	North West

4.1.2 Contaminated Land Records Notice

The search results of the Record of Notices identified a Mobil Service Station at Lot 3 Kalandar Street, approximately 700 m north west from the site. Due to the significant distance from the site, the service station is not expected to be a potential contaminant source at the site.

4.1.3 EPA PFAS Investigation Program

A search of the EPA PFAS Investigation Program did not identify any sites within 1000 m of the site, however identified two sites within 2000 m of the site, which are summarised in **Table 4-2** below. Due to the significant distance from the site, the below identified sites are not expected to be a potential contaminant source at the site

Table 4-2 EPA PFAS Investigation Program search results

Site	Distance	Direction
South Nowra NSW Rural Fire Service	1582 m	West
Shoalhaven River	1808 m	North

4.1.4 PoEO Public Register

The PoEO Public Register under Section 308 of the PoEO Act contains Environment Protection Licences (EPLs), applications and notices issued by the EPA. The Public Register was searched during May 2021 within the suburb of South Nowra, Nowra and Worrigee to identify any issues of relevance to the site. The PoEO public register search identified the following:

- One current licensed activity under the PoEO Act 1997 was recorded within a 1000 m radius of the site as described below
  - Licence No. 1734, Nowra Sewerage Treatment Plant operated by Shoalhaven City Council, licence for sewage treatment processing by small plants, approximately 356 m north of the site
- One former licensed activity still regulated by the EPA was recorded within a 1000 m radius of the site as described below
  - Licence No. 11725, Nowra Private Hospital operated by HCOA Operations (Australia) Pty Limited, licence for Hazardous, Industrial or Group A Waste Generation or Storage, approximately 919 m west of the site
- Five former licensed activities under the PoEO Act 1997, now revoked or surrendered, were identified within 1000 m of the site and are summarised in **Table 4-3** below.

Table 4-3 Search results for licensed activities under the PoEO Act 1997, now revoked or surrendered

Licence No	Organisation	Location	Status	Activity	Distance	Direction
4653	LUHRMANN ENVIRONMENT MANAGEMENT PTY LTD	Waterways throughout NSW	Surrendered	Other Activities / Non Scheduled Activity - Application of Herbicides	0 m	On-site
4838	Robert Orchard	Waterways throughout NSW	Surrendered	Other Activities / Non Scheduled Activity - Application of Herbicides	0 m	On-site
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	Waterways throughout NSW	Surrendered	Other Activities / Non Scheduled Activity - Application of Herbicides	0 m	On-site
697	RANDAMUSA PTY LTD	27-29 Quinns Lane, Nowra, NSW 2541	Surrendered	Concrete works	320 m	South West
20035	NACE CIVIL ENGINEERING PTY. LIMITED	Hwy 1 Princes Highway South Nowra Duplication, Princes Highway between Kinghorne Street and Forest Road, South Nowra	Surrendered	Road Construction	532 m	South West

Three surrendered EPLs were identified as being located within the buffer for application of herbicides however these have been mapped to all waterways throughout NSW, as such it is unlikely that the activities described have taken place within the site boundaries in an intensive or significant way. The remaining licensed and former licensed activities are not expected to be a potential contaminant source at the site, due to their significant distance from the site.

4.2 Historical business directories

Included within Lotsearch Reports LS020056 is a search of UBD Business to Business directories from 1991, 1982, 1970, 1961 and 1950. A search buffer of 150 m of the site was used for general business activities whilst a buffer of 500 m was used for dry cleaner and motor garages / service stations.

Twelve records for general business activities were identified within the search buffer. Of the 12 records identified 11 were based on road match with no address given, as a result the locations of these business activities may be greater than 150 m from site. Three records for motor garages / service stations were identified within the search buffer, all of the records were based on road match with no address given, as a result the locations of these business activities may be greater than 500 m from site

A summary of identified business that could present a potential contaminant risk are provided in **Table 4-4**.

Table 4-4 Historical business search for general activities

Business activity	Premises	Year	Location confidence	Distance from Site	Direction	Potential Contaminant Source
Not listed	A & D Tree Lopping, 4 Robine Way, East Nowra	1991	Premise Match	113 m	East	Fuels, oils and greases. Herbicides
Concrete Contractors	Casey & Sperring., Lot 1 Browns Road, South Nowra	1991	Road Match	0 m	-	Bulk fuel storage Vehicle servicing
Paint &/or Accessories - Retail	Dulux Trade Centre., Worrigee Rd. Nowra	1991	Road Match	0 m	-	Storage of paints and solvents
Paint enamel varnish and/or stain MFRS. and/or IMPS., and/or DISTS.	Dulux Trade Centre., Worrigee Rd. Nowra	1991	Road Match	0 m	-	
Bus services charter and tours	Stuarts Coaches Pty Ltd., Greenwell Point Road	1991	Road Match	0 m	-	Bulk fuel storage Vehicle servicing
Bus operators	Stuarts Coaches Pty Ltd., Greenwell Point Road	1991	Road Match	0 m	-	
Motor bus services	Stuarts Bus Service, Greenwell PL Road., Nowra-Bomaderry	1982	Road Match	0 m	-	
Motor garages and service stations	Mobil Service Station, Kalander Street, Nowra	1991	Road Match	372 m	West	
Motor garages and/or engineers and for service stations	South Nowra Auto Repairs. Lot 10 Quinn's La., South Nowra	1982	Road Match	396 m	South	
Motor garages and/or engineers and for service stations	Wray, & L Automotive Repairs, Lot 4 Quinn's La., South Nowra	1982	Road Match	396 m	South	

4.3 Controlled Chemicals

The NSW EPA uses chemical control orders (CCO) as a primary legislative tool under the Environmentally Hazardous Chemicals Act 1985 to manage chemicals of concern and limit their potential impact on the environment. Cardno provide a preliminary screening of the site history for the likelihood of chemicals of concern within the CCO framework in **Table 4-9** below.

Table 4-5 Preliminary Controlled Chemicals Screening

Chemical of Concern	Likelihood of Occurrence
Were aluminium smelter wastes used or stored on the site (CCO, 1986)?	Low
Do dioxin contaminated wastes (CCO, 1986) have the potential to impact the site?	Low
Were organotin products (CCO 1989) used or stored on site?	Low
Were polychlorinated biphenyls (PCBs) used or PCB waste (CCO 1997) stored on site?	Low
If Yes to any of the above, has site sampling suite been optimised to include specific sampling for other chemicals of concern in soil, air, water?	NA

4.4 Per and Poly Fluoroalkyl Substances (PFAS)

A PFAS probability of occurrence desktop survey is provided in **Table 4-10** and has been undertaken on the basis of information provided in the PFAS National Environmental Management Plan (NEMP 2020). PFAS are known to be present in Aqueous Film Forming Firefighting Foams (AFFF) and Alcohol-Type Concentrate (ATC). The historic use of AFFF is reported as being used by Fire & Rescue NSW between 1976 and 2007, while other agencies used AFFF during training exercises as late as 2010 (Source: Fire & Rescue NSW, Information Sheet, Firefighting Foam and PFAS, reference D16/82523).

Table 4-6 PFAS Desktop Survey

Preliminary Screening Questions	Likelihood of Occurrence [1,2,3]
Is the past or present site activity listed in the NEMP 2020 as being an activity with risk of fire. If so, list activity:	Low
Is the past or present off-site activity up-gradient or adjacent to the site listed in the NEMP 2020 as being an activity with risk of fire. If so list activity:	Low General chemical storage Commercial laundries Manufacturing of building products
Did fire training involving the use of suppressants occur on-site between 1970 and 2010?	Low
Did fire training occur up-gradient of or adjacent to the site between 1970 and 2010?	Low
Have “fuel” fires ever occurred on site between 1970 and 2010? (i.e. ignition of fuel storage tanks - solvent, petrol diesel, kerosene, other)?	Low
Have PFAS been used in manufacturing or stored on-site?	Low Wastewater treatment
Could PFAS have been imported to the site in fill materials from a site with activity listed in NEMP 2020 and subject to exposure to PFAS from 1970 to 2010?	Low
Could PFAS-contaminated groundwater or run-off have migrated beneath or on to the site?	Low
Is the site or adjacent sites listed in the NSW EPA PFAS Investigation program [4]?	Low
If the likelihood is medium or high in any of the above factors, does the site analytical suite need to be optimised to include preliminary sampling and testing for PFAS in soil and waters (incl. ASLP or TCLP)? Provide rationale.	NA

Notes:
1 Likelihood: Low – All necessary documentation has been reviewed and there is no recorded instance of potential PFAS use or exposure
2 Medium - All necessary documentation has been reviewed and there is potential evidence of a recorded instance of potential PFAS use or exposure
3 High - All necessary documentation has been reviewed and there is evidence of a recorded instance of potential PFAS use or exposure
4 https://www.epa.nsw.gov.au/your-environment/contaminated-land/pfas-investigation-program

4.5 Historical Aerials

Eight historical aerial photographs dating back to 1949 were sourced and reviewed by Cardno, a review of these photographs is included in **Table 4-7** whilst the photographs are included within the Lotsearch report in **Appendix C.**

Table 4-7 Aerial photos summary

Year	Observations
1949 (B&W)	The majority of the site appeared to be cleared and used for agricultural/grazing purposes with the exception of the southern portion of the site which still had some dense vegetation. Greenwell Point Road, Old Southern Road and Worrigee Road were already visible as well as some paddock fences within the northern, central and eastern portions of the site. A possible creek line and dam was observed within the central portion of the site and immediately to the west. The alignment of the Garden Walk was already visible in the eastern portion of the site. Some rural residential properties and associated structures were observed to the north and south of the site along Greenwell Point Road and Old Southern Road.
1961 (B&W)	The imagery is now clearer. Site land use appears generally unchanged. More paddock fences were visible in the northern portion of the site. The surrounding land use remains relatively unchanged however, some development had taken place with medium density residential properties observed west of the site.
1974 (B&W)	The site has undergone some development with medium density residential properties observed west and adjacent to the northern portion of the site and low-density residential properties observed west and adjacent to the southern portion of the site along Old Southern Road. The surrounding land use remains relatively unchanged with more residential properties observed west of the site. Stripped surfaces associated with a potential subdivision development were observed west of the central portion of the site. Several completed roads were also observed adjacent to the site.
1984 (B&W)	The site land use appears to be relatively unchanged. Ratcliff Park (which the site passes through) as well a rectangular structure and potential drainage infrastructure east of the site and within Ratcliff Park were observed. Further low and medium-density residential structures as well as a potential commercial property with several structures have been constructed west of the site. The surrounding areas appear otherwise unchanged.
1993 (Colour)	The imagery is now in colour. The site land use appears to have changed slightly with some smaller structures observed within the site and possibly associated with sewer infrastructure. Rayleigh Garden Reserve was observed. Two circular structures were observed west and east of the site and within Ratcliff Park. Further medium density residential structures and associated roads were observed to the west and east of the site. More commercial structures were observed west and south west of the site. Nowra Christian School was also observed east of the site. The surrounding land use appeared to be predominantly residential and agricultural, with some commercial use evident.
2002 (Colour)	The site land use appears relatively unchanged. The surrounding land appears to have undergone significant development with a number of residential subdivisions completed to the west and east of the site and some surface scaring and road alignments associated to subdivision development observed to the east of the site. The surrounding land use appears to be predominantly residential with some commercial and agricultural use evident.
2009 (Colour)	The site land use appears relatively unchanged. The surrounding land use appears to be relatively unchanged, however some residential development has occurred surrounding the central and eastern portions of the site on land previously observed to be vacant.
2020 (Colour)	The site and surrounding land use appear to be relatively unchanged and in its current configuration. Some residential development has occurred adjacent to the central portion of the site.

4.6 Site history data gaps

The site history information collected is considered of a high quality and suitable for the assessment undertaken.

The following searches were not undertaken as part of this investigation:

- No search of the SafeWork NSW records pertaining to the storage of Dangerous Goods was undertaken
- No search of historic land title records held by NSW Department of Land and Property Information was undertaken
- No Section 10.7 planning certificates were reviewed.

In the context of the currently available site history and given that the site resides within areas that have historically been within vacant land or utility, drainage and road easements, it is considered unlikely that these searches would identify any records of significantly contaminating activities not identified in currently reviewed records.

Information on the site prior to 1950 is limited; however, it is considered unlikely that any activities with the potential to significantly contaminate the site were undertaken prior to this. Aerial imagery suggests that prior to this time the site was not significantly developed beyond land clearing and fence installation for paddocks and grazing.

5 Preliminary conceptual site model

A conceptual site model (CSM) provides an assessment of the fate and transport of contaminants of potential concern (COPC) within the context of site-specific subsurface conditions with regard to their potential risk to human health and the environment. Risk to human health and the environment is identified through complete Source – Pathway – Receptor (SPR) linkages. In order to identify SPR linkages the CSM considers site specific factors, including:

- Source(s) of contamination
- Identification of COPC associated with past (and present) source(s)
- Site specific information including soil type(s), depth to groundwater, inferred effective porosity, inferred groundwater flow direction, surface water bodies and interactions
- Location of any identified sources relative to the proposed site development
- Actual or potential receptors considering both current and future land use both for the site, adjacent properties and any sensitive ecological receptors.

Based on the information collected as part of this PSI, including site history information, site observations, the following preliminary CSM has been developed showing potential SPR linkages considered to be potentially complete or incomplete under our understanding of the current and future land use.

Based on the findings of the site history review and site walkover the identified potential sources of contamination include:

- The potential use of filling materials of an unknown environmental quality during development and installation of the existing utility infrastructure, roads and drainage systems. Potential COPC are metals, polycyclic aromatic hydrocarbons (PAH), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX), phenols, organochlorine pesticides (OCP), organophosphorous pesticides (OPP), polychlorinated biphenyls (PCB) and asbestos
- The potential use of filling materials of an unknown environmental quality during the development of embankments and mounds observed along the proposed sewer alignments. Potential COPC are metals, PAH, TRH, BTEX, Phenols, OCP, OPP, PCB and asbestos
- Soil stockpiles observed to contain construction and demolition waste within the central portion of the site. Potential COPC are PAH, TRH, BTEX, phenols, OCP, OPP, PCB and asbestos
- The potential for sewerage leakage from the existing use of the site as a sewerage system. Potential COPC are metals, TRH, BTEX, PAH, PFAS and effluents
- Potential fly tipped waste, including PACM on the site. Potential COPC are asbestos.

Identified receptors for the potential site contamination include:

- Ecological receptors dependent on site soils in fill impacted areas
- Current site users and workers disturbing identified fill materials
- Future site users and workers disturbing identified fill materials.

The CSM for the site is summarised in **Table 5-1**.

Table 5-1 Preliminary conceptual site model

Potential contaminant source	Impacted media	Potential contaminants	Potential exposure pathway	Receptors	Completeness
Filling of unknown environmental quality associated with the development of existing utility infrastructure, roads and drainage systems	Soils, groundwater	Metals, PAH, TRH, BTEX, Phenols, OCP, OPP, PCB and Asbestos	Direct contact with media including ingestion and dust inhalation Migration of groundwater discharge to water bodies; interaction with flora, fauna and biota Extraction of groundwater for human ingestion	Ecological receptors dependent on site soils and waters Current and future site workers and users.	Potentially complete in the event of disturbance
Filling of unknown environmental quality associated with embankments and mounds along the proposed sewer alignment					
Soil stockpiles observed to contain construction and demolition waste, within vacant block in the central portion of the site.					
Potential for sewerage leakage from the existing use of the site as a sewerage system		Metals, TRH, BTEX, PAH, PFAS and effluents			
Potential fly tipped waste, including PACM	Soils	Asbestos	Inhalation of asbestos fibres	Current and future site workers and users.	

6 Discussion

Based on our understanding of the proposed development being an upgrade to the SNSM and that no change of land use is proposed to the areas impacted by potential contamination, the risk to current and future site users and ecological receptors is considered to be low and generally unchanged by the development.

In parts of the site where filling associated with development of the existing utility infrastructure, roads, drainage easements, embankments and mounds will be encountered there is the potential for unidentified contamination to be present within the fill profile.

Given the site's existing use as a sewerage system, there is a potential for unidentified contamination to be present within the surrounding soils from potential sewerage pipe leaks.

Additionally, stockpiles observed within a vacant block in the central portion of the site containing construction and demolition waste, as well as any fly tipped wastes and the PACM observed within the northern portion of the site, present a potential contamination risk if disturbed by the works.

For the purposes of the site development the above noted contaminant sources present an increased risk to human and ecological health in the event of disturbance during construction however they do not impact site suitability for the proposed use.

7 Conclusions

Cardno completed a Preliminary Site Investigation for the site located at the SNSM NSW on behalf of Shoalhaven Water. The purpose of the PSI was to identify potential contamination issues and constraints on the above noted site in order to inform the REF.

Based on the findings of this PSI, the following conclusions are made:

- Acid sulfate soil testing undertaken at the site undertaken as part of the geotechnical investigation in (Cardno, 2021) found that acid sulfate soils (ASS) and potential acid sulfate soils (PASS) are present in various locations within the Site Boundary. (Cardno, 2021) noted that the density of acid sulfate soil testing has not been conducted in accordance with Acid Sulfate Soils Management Advisory Committee (ASSMAC) guidelines
- There is the potential for fill material of unknown environmental quality to be present within the site (associated with the development of existing utility infrastructure, roads, drainage systems, and within embankments and mounds observed along the proposed sewer alignment routes)
- Soil stockpiles containing construction and demolition waste were observed within the central portion of the site
- Surface debris including potential asbestos containing material (PACM) were observed sporadically throughout the site
- There is the potential for sewerage leakage from the existing use of the site as a sewerage system.

For the purposes of the site development the above noted contaminant sources present an increased risk to human and ecological health in the event of disturbance during construction however they do not impact site suitability for the proposed use.

7.1 Recommendations

Based on the findings of this investigation the following recommendations are made:

- Prepare a Construction Environmental Management Plan (CEMP) containing an Unexpected Finds Protocol (UFP) outlining appropriate management of contamination items which may be encountered or disturbed by constructions
  - In the event of an unexpected contamination find a suitably qualified environmental consultant will be required to attend site to assess contamination and provide advice on appropriate management or treatment
- For the areas within the site where ASS is deemed to be present, it is recommended that further investigation be undertaken. This further investigation will inform any future mitigation measures required
- All materials do be disposed of offsite are to be assessed as per the NSW EPA (2014) *Waste Classification Guidelines* or the relevant NSW EPA Resource Recovery Orders prior to removal from site
- Where asbestos materials (i.e. former pipes) are to remain buried onsite these are to be noted in Council property records with an Asbestos Management Plan (AMP) in place to ensure appropriate long term management.

8 Limitations

This assessment report is not any of the following:

- A Site Audit Report or Site Audit Statement as defined under the *Contaminated Land Management Act 1997* (CLM Act)
- A Detailed or Environmental Site Investigation sufficient for an Environmental Auditor to be able to conclude a Site Audit Report and Site Audit Statement
- A geotechnical report
- A detailed hydrogeological assessment in conformance with NSW DEC (2007) *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*
- An assessment of groundwater contaminants potentially arising from other sites or sources nearby
- A total assessment of the site to determine suitability of the entire parcel of land at the site for one or more beneficial uses of land
- A hazardous building material survey that will identify any specific building materials on site, which may pose a risk to human health or the environment
- The agreed scope of this assessment has been limited for the current purposes of the Client. The assessment may not identify contamination occurring in all areas of the site.

This Document has been provided by Cardno subject to the following limitations:

- This Document has been prepared for the particular purpose outlined in Cardno's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose
- The scope and the period of Cardno's services are as described in Cardno's proposal, and are subject to restrictions and limitations. Cardno did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Cardno in regards to it
- Conditions may exist which were undetectable given the limited nature of the enquiry Cardno was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required
- In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Cardno's opinions are based upon information that existed at the time of the production of the Document. It is understood that the services provided allowed Cardno to form no more than an opinion of the actual conditions of the site at the time this Document was prepared and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations
- Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document
- Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Cardno for incomplete or inaccurate data supplied by others.

9 References

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APPENDIX A

FIGURES

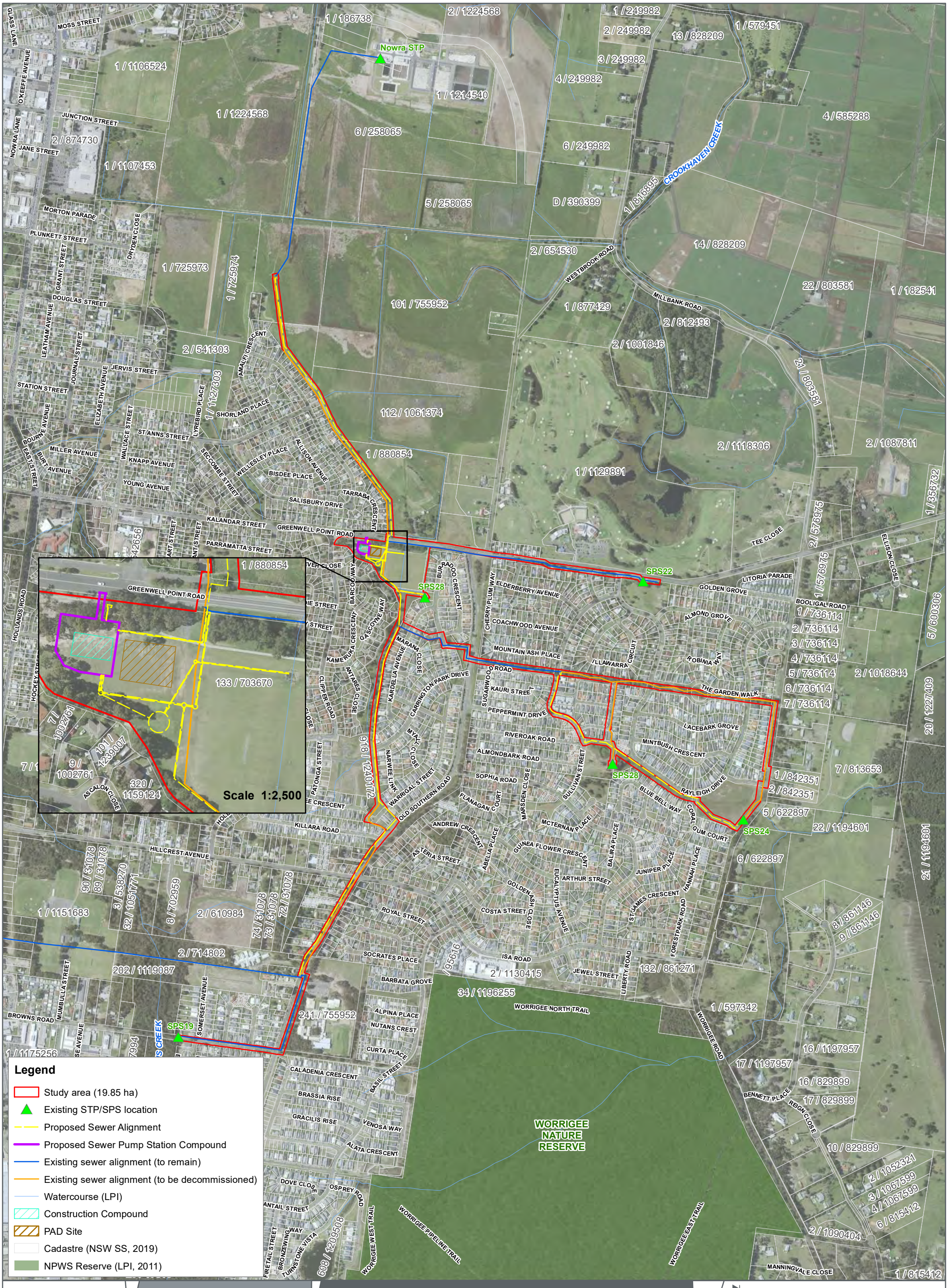


FIGURE 1

1:12,500 Scale at A3

m

0 100 200 300 400

Study Area

SOUTH NOWRA
SHOALHAVEN, NSW

Cardno

Map Produced by Cardno MNL
Date: 2021-10-05 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-003-StudyArea.mxd 05
Aerial Imagery supplied by MetroMap (November, 2020)

Site Locality Plan

SOUTH NOWRA
SHOALHAVEN, NSW

Legend

- Site Boundary
- Distance Buffer
- Railway (NSW SS)
- Major Watercourses (LPI)
- Major Waterbodies (LPI)

Roads (NSW SS)

- Major Road
- Arterial Road
- Local Road

Land Use (ABS 2016)

- Other
- Commercial
- Education
- Hospital/Medical
- Industrial
- Parkland
- Primary Production
- Residential
- Water

FIGURE 2

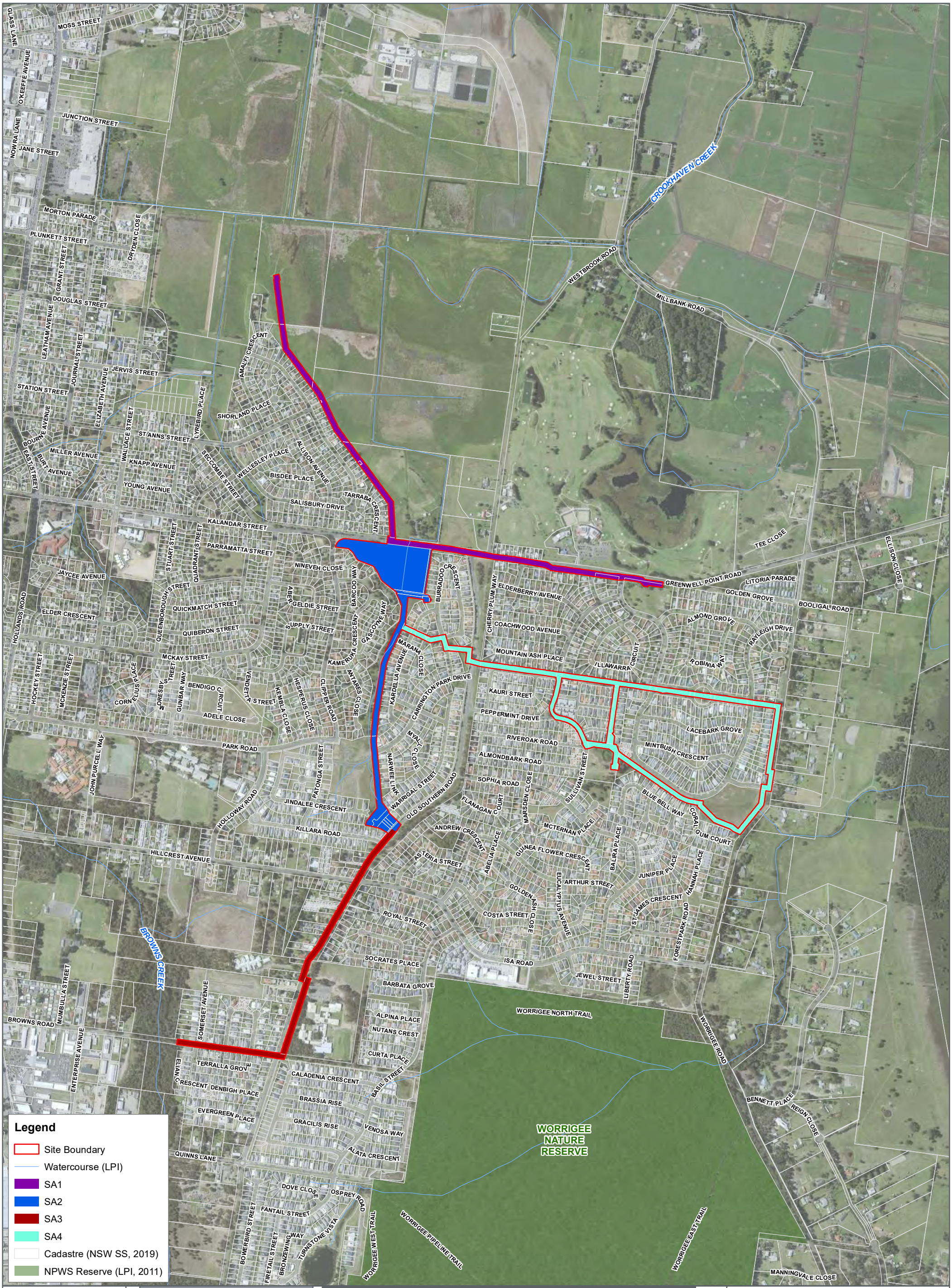
1:75,000 Scale at A3

m
0 1,000 2,000 3,000 4,000

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2021-10-11 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-008-LocalityPlan.mxd 05
Terrain hillshade supplied by ESRI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GLASS LANE
O'KEEFFE AVENUE
JUNCTION STREET
NOWRA LANE
JANE STREET
MORTON PARADE
PLUNKETT STREET
DRYDEN CLOSE
GRANT STREET
DOUGLAS STREET
LEATHAM AVENUE
JOURNAL STREET
JERVIS STREET
STATION STREET
ELIZABETH AVENUE
LYREBIRD PLACE
SHORLAND PLACE
AMALFI CRESCENT
CROOKHAVEN CREEK
WESTBROOK ROAD
MILLBANK ROAD
BOURNE AVENUE
EAST STREET
BURT AVENUE
MILLER AVENUE
WALLACE STREET
ST ANNS STREET
KNAPP AVENUE
YOUNG AVENUE
SECCOMBE STREET
WELLESLEY PLACE
ALLISON AVENUE
BISDEE PLACE
SALISBURY DRIVE
TARRABA CRESCENT
KALANDAR STREET
STUART STREET
QUADRANT STREET
PARRAMATTA STREET
NINEVEH CLOSE
BARCOO WAY
BURRADOO CRESCENT
TEE CLOSE
ELLISON CLOSE
GREENWELL POINT ROAD
LITORIA PARADE
GOLDEN GROVE
BOOLIGAL ROAD
JAYCEE AVENUE
QUEENBOROUGH STREET
GELDIE STREET
CHERRY PLUM WAY
ELDERBERRY AVENUE
ALMOND GROVE
RAYLEIGH DRIVE
HOLLANDS ROAD
ELDER CRESCENT
QUICKMATCH STREET
QUIBERON STREET
SUPPLY STREET
COACHWOOD AVENUE
MOUNTAIN ASH PLACE
ILLAWARRA CIRCUIT
ROBINIA WAY
MARANA CLOSE
KAMERUKA CRESCENT
GASCOYNE WAY
MCKAY STREET
HOCKEY STREET
MCKENZIE STREET
CORNELIUS PLACE
ORESBY STREET
GUNBAR WAY
BENDIGO CIRCUIT
ADELE CLOSE
VENDETTA STREET
KEMBLA CLOSE
HESPERUS CLOSE
CLIPPER ROAD
ANTARES CLOSE
KARDELLA AVENUE
CARRINGTON PARK DRIVE
KAURI STREET
PEPPERMINT DRIVE
RIVEROAK ROAD
LACEBARK GROVE
MINTBUSH CRESCENT
ALMONDBARK ROAD
SOPHIA ROAD
SULLIVAN STREET
BLUE BELL WAY
COOLAMON GUM COURT
MARSDEN CLOSE
FLANAGAN COURT
MCTERNAN PLACE
ANDREW CRESCENT
ABELIA PLACE
GUINEA FLOWER CRESCENT
BALIRA PLACE
JUNIPER PLACE
HANNAH PLACE
ASTERIA STREET
ARTHUR STREET
EUCALYPTUS AVENUE
GOLDEN ASH CLOSE
ST JAMES CRESCENT
FOREST PARK ROAD
ROYAL STREET
COSTA STREET
JOHN PURCELL WAY
PARK ROAD
PATONGA STREET
NARWEE LINK
MYALL CLOSE
WARRIGAL STREET
OLD SOUTHERN ROAD
HOLLOWAY ROAD
JINDALEE CRESCENT
KILLARA ROAD
HILLCREST AVENUE
BROWNS CREEK
MUMBULLA STREET
SOMERSET AVENUE
BROWNS ROAD
ENTERPRISE AVENUE
SOCRATES PLACE
ISA ROAD
JEWEL STREET
LIBERTY ROAD
BARBATA GROVE
ALPINA PLACE
NUTANS CREST
CURTA PLACE
WORRIGEE NORTH TRAIL
WORRIGEE ROAD
BENNETT PLACE
REIGN CLOSE
TERRALLA GROVE
CRESCENT
DENBIGH PLACE
CALADENIA CRESCENT
BASIL STREET
BRASSIA RISE
EVERGREEN PLACE
GRACILIS RISE
VENOSA WAY
ALATA CRESCENT
QUINNS LANE
WORRIGEE NATURE RESERVE
DOVE CLOSE
OSPREY ROAD
FANTAIL STREET
BOWERBIRD STREET
FIRETAIL STREET
BRONZEWING WAY
TURNSTONE VISTA
WORRIGEE WEST TRAIL
WORRIGEE PIPELINE TRAIL
WORRIGEE EAST TRAIL
MANNINGVALE CLOSE
Legend
Site Boundary
Watercourse (LPI)
SA1
SA2
SA3
SA4
Cadastre (NSW SS, 2019)
NPWS Reserve (LPI, 2011)
FIGURE 3
1:12,500 Scale at A3
m
0 100 200 300 400
Areas Investigated
SOUTH NOWRA
SHOALHAVEN, NSW
N
Cardno
Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2021-10-19 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-013-AreasInvestigated.mxd 02
Aerial Imagery supplied by MetroMap (November, 2020)

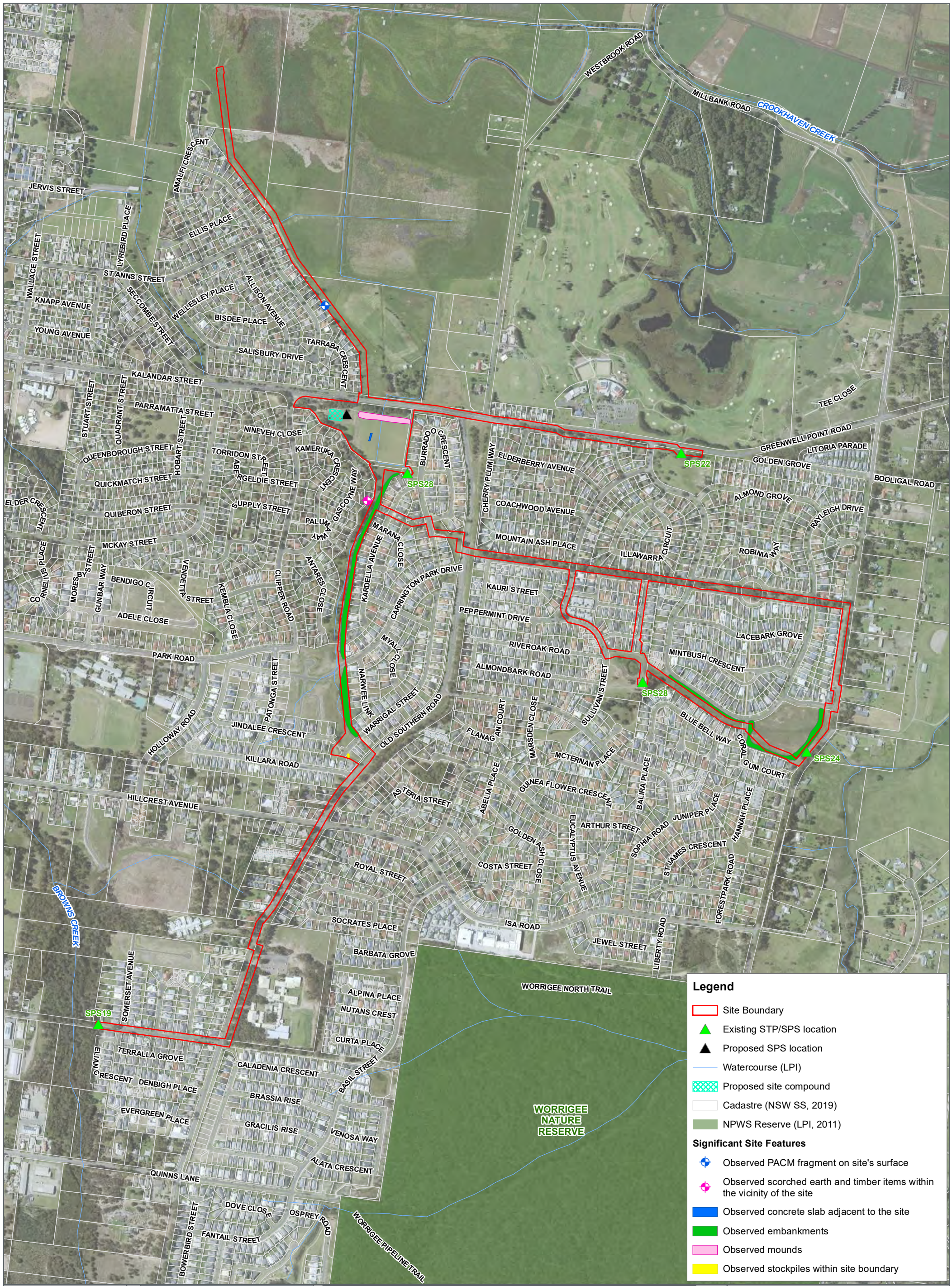


FIGURE 4

1:10,000 Scale at A3

m

0 100 200 300 400

Significant Site Features

SOUTH NOWRA
SHOALHAVEN, NSW

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2021-10-11 | Project: WI21102IP
Coordinate System: GDA 1994 MGA Zone 56
Map: WI21102IP-GS-011-SiteFeatures.mxd 04
Aerial Imagery supplied by MetroMap (November, 2020)

APPENDIX

B

SITE PHOTOS

Photograph 1: View from northern portion of the site looking south. Note fenced off garden observed.

Photograph 2: View of existing sewer pump station (SPS12) observed in the northern portion of the site.

Photograph 3: View of fenced off horse agistment area in the northern portion of the site with Greenwell Point Road beyond.

Photograph 4: View of Ratcliff Park within the central portion of the site looking north west.

Photograph 5: View of drainage and sewer reserve within the central portion of the site looking north.

Photograph 6: View of drainage and sewer reserve within the central portion of the site looking north.

Photograph 7: View of Old Southern Road and verge within the southern portion of site looking north.

Photograph 8: View of Old Southern Road and verge within the southern portion of site looking south.

Photograph 9: View of SNSM infrastructure (SPS019) within the southern portion of the site.

Photograph 10: View of eastern portion of the site looking east. Note observed fenced off stormwater retention basin located adjacent to Sullivan Street Park.

Photograph 11: View from eastern portion of site looking east within drainage easement adjacent to Rayleigh Drive.

Photograph 12: View of SPS24 within the eastern portion of the site.

Photograph 13: View of fragment of PACM observed in the northern portion of the site on the surface immediately adjacent to residential properties located along Salisbury Drive and SPS012.

Photograph 14: View of mound observed within Ratcliff Park adjacent to Greenwell Point Road.

Photograph 15: View of embankment observed within the eastern portion of the site adjacent to residential properties along Coral Gum.

Photograph 16: View of various fly tipped items within drainage easement in the central portion of the site.

Photograph 17: View of scorched timber items and earth observed within the drainage easement in the vicinity of the central portion of the site.

Photograph 18: View of stockpiles containing construction and demolition waste observed within a vacant block in the central portion of the site.

Photograph 19: View of concrete slab observed immediately east of the site within Ratcliff Park.

APPENDIX

C

LOTSEARCH REPORT

LOTSEARCH

LOTSEARCH ENVIRO LITE

Date: 03 May 2021 16:40:41

Reference: LS020056 EL

Address: Proposed Sewer Upgrade, South Nowra, NSW 2540

Disclaimer:
The purpose of this report is to provide an overview of some of the site history, environmental risk and planning information available, affecting an individual address or geographical area in which the property is located. It is not a substitute for an on-site inspection or review of other available reports and records. It is not intended to be, and should not be taken to be, a rating or assessment of the desirability or market value of the property or its features.
You should obtain independent advice before you make any decision based on the information within the report.
The detailed terms applicable to use of this report are set out at the end of this report.

Dataset Listing

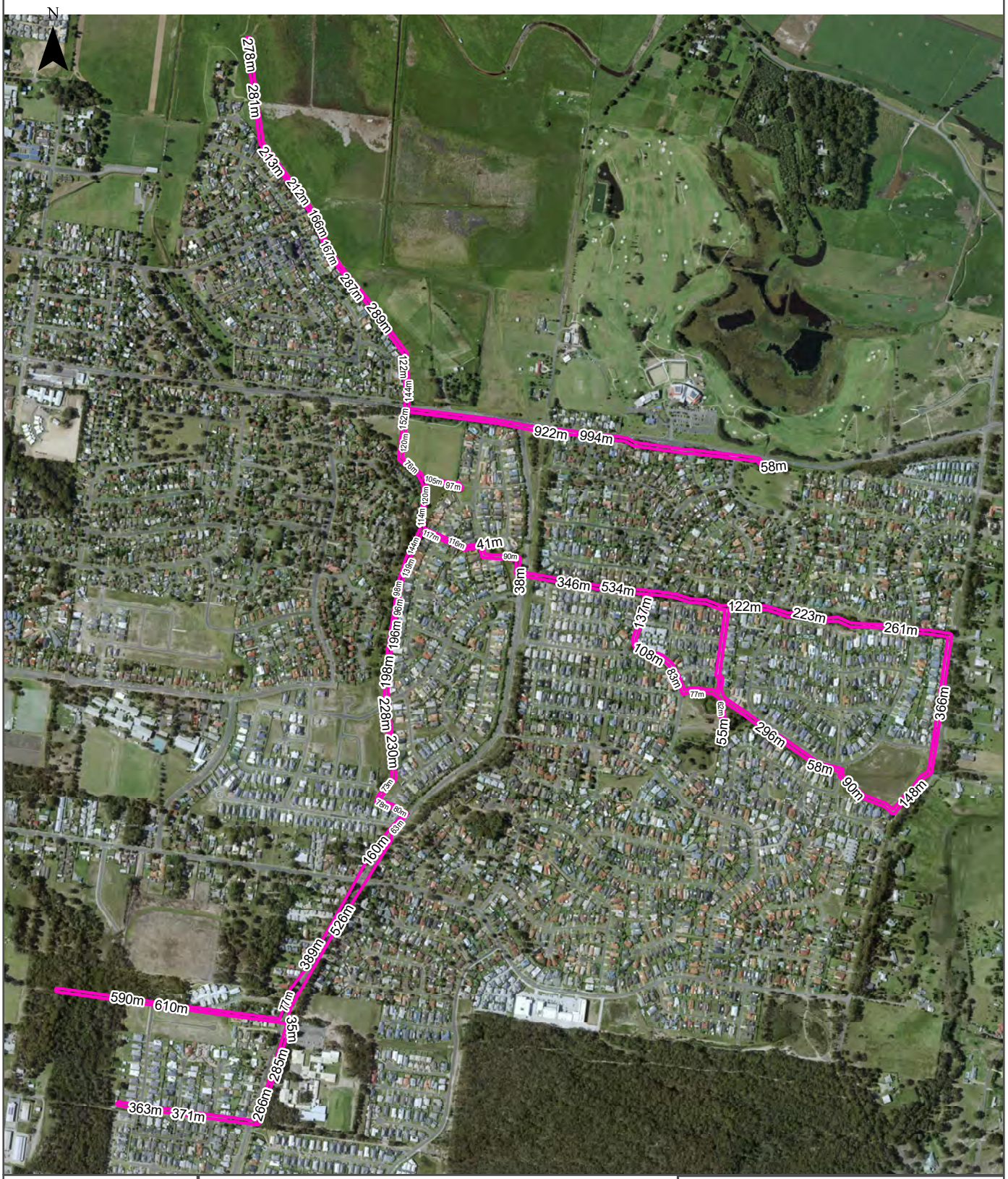
Datasets contained within this report, detailing their source and data currency:

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Cadastre Boundaries	NSW Department of Finance, Services & Innovation	16/04/2021	16/04/2021	Quarterly	-	-	-	-
Topographic Data	NSW Department of Finance, Services & Innovation	25/06/2019	25/06/2019	As required	-	-	-	-
List of NSW contaminated sites notified to EPA	Environment Protection Authority	14/04/2021	12/04/2021	Monthly	1000m	0	0	3
Contaminated Land Records of Notice	Environment Protection Authority	03/05/2021	03/05/2021	Monthly	1000m	0	0	1
Former Gasworks	Environment Protection Authority	13/04/2021	11/10/2017	Monthly	1000m	0	0	0
National Waste Management Facilities Database	Geoscience Australia	11/02/2021	07/03/2017	Quarterly	1000m	0	0	0
National Liquid Fuel Facilities	Geoscience Australia	15/02/2021	13/07/2012	Annually	1000m	0	0	3
EPA PFAS Investigation Program	Environment Protection Authority	14/04/2021	15/03/2021	Monthly	2000m	0	0	2
Defence PFAS Investigation & Management Program - Investigation Sites	Department of Defence	29/04/2021	29/04/2021	Monthly	2000m	0	0	0
Defence PFAS Investigation & Management Program - Management Sites	Department of Defence	29/04/2021	29/04/2021	Monthly	2000m	0	0	0
Airservices Australia National PFAS Management Program	Airservices Australia	26/04/2021	26/04/2021	Monthly	2000m	0	0	0
Defence 3 Year Regional Contamination Investigation Program	Department of Defence	13/04/2021	13/04/2021	Monthly	2000m	0	0	0
EPA Other Sites with Contamination Issues	Environment Protection Authority	02/02/2021	13/12/2018	Annually	1000m	0	0	0
Licensed Activities under the POEO Act 1997	Environment Protection Authority	13/04/2021	13/04/2021	Monthly	1000m	0	0	1
Delicensed POEO Activities still regulated by the EPA	Environment Protection Authority	13/04/2021	13/04/2021	Monthly	1000m	0	0	1
Former POEO Licensed Activities now revoked or surrendered	Environment Protection Authority	13/04/2021	13/04/2021	Monthly	1000m	3	3	5
UBD Business Directories (Premise & Intersection Matches)	Hardie Grant			Not required	150m	0	0	1
UBD Business Directories (Road & Area Matches)	Hardie Grant			Not required	150m	-	11	11
UBD Business Directory Dry Cleaners & Motor Garages/Service Stations (Premise & Intersection Matches)	Hardie Grant			Not required	500m	0	0	0
UBD Business Directory Dry Cleaners & Motor Garages/Service Stations (Road & Area Matches)	Hardie Grant			Not required	500m	-	0	3
Points of Interest	NSW Department of Finance, Services & Innovation	18/02/2021	18/02/2021	Quarterly	1000m	0	5	51
Tanks (Areas)	NSW Department of Customer Service - Spatial Services	16/02/2021	16/02/2021	Quarterly	1000m	0	0	0
Tanks (Points)	NSW Department of Customer Service - Spatial Services	16/02/2021	16/02/2021	Quarterly	1000m	0	0	0
Major Easements	NSW Department of Finance, Services & Innovation	17/02/2021	17/02/2021	Quarterly	1000m	0	1	9
State Forest	Forestry Corporation of NSW	25/02/2021	14/02/2021	Annually	1000m	0	0	0
NSW National Parks and Wildlife Service Reserves	NSW Office of Environment & Heritage	22/01/2021	11/12/2020	Annually	1000m	0	0	1
Hydrogeology Map of Australia	Commonwealth of Australia (Geoscience Australia)	08/10/2014	17/03/2000	As required	1000m	1	1	1
Temporary Water Restriction (Botany Sands Groundwater Source) Order 2018	NSW Department of Planning, Industry and Environment	26/10/2020	21/02/2018	Annually	1000m	0	0	0
Groundwater Boreholes	NSW Dept. of Primary Industries - Water NSW; Commonwealth of Australia (Bureau of Meteorology)	24/07/2018	23/07/2018	Annually	2000m	0	0	72

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Geological Units 1:250,000	NSW Department of Planning, Industry and Environment	20/08/2014		Annually	1000m	2	2	3
Geological Structures 1:250,000	NSW Department of Planning, Industry and Environment	20/08/2014		Annually	1000m	0	0	0
Naturally Occurring Asbestos Potential	NSW Dept. of Industry, Resources & Energy	04/12/2015	24/09/2015	Unknown	1000m	0	0	0
Atlas of Australian Soils	Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES)	19/05/2017	17/02/2011	As required	1000m	1	1	2
Soil Landscapes of Central and Eastern NSW	NSW Department of Planning, Industry and Environment	14/10/2020	27/07/2020	Annually	1000m	2	2	2
Environmental Planning Instrument Acid Sulfate Soils	NSW Department of Planning, Industry and Environment	21/04/2021	26/02/2021	Monthly	500m	3	-	-
Atlas of Australian Acid Sulfate Soils	CSIRO	19/01/2017	21/02/2013	As required	1000m	2	2	3
Dryland Salinity - National Assessment	National Land and Water Resources Audit	18/07/2014	12/05/2013	None planned	1000m	0	0	0
Mining Subsidence Districts	NSW Department of Customer Service - Subsidence Advisory NSW	16/02/2021	16/02/2021	Quarterly	1000m	0	0	0
Current Mining Titles	NSW Department of Industry	14/04/2021	14/04/2021	Monthly	1000m	0	0	0
Mining Title Applications	NSW Department of Industry	14/04/2021	14/04/2021	Monthly	1000m	0	0	0
Historic Mining Titles	NSW Department of Industry	14/04/2021	14/04/2021	Monthly	1000m	8	8	8
Environmental Planning Instrument SEPP State Significant Precincts	NSW Department of Planning, Industry and Environment	21/04/2021	07/12/2018	Monthly	1000m	0	0	0
Environmental Planning Instrument Land Zoning	NSW Department of Planning, Industry and Environment	21/04/2021	16/04/2021	Monthly	1000m	8	33	143
Commonwealth Heritage List	Australian Government Department of the Agriculture, Water and the Environment	23/02/2021	20/11/2019	Quarterly	1000m	0	0	0
National Heritage List	Australian Government Department of the Agriculture, Water and the Environment	23/02/2021	20/11/2019	Quarterly	1000m	0	0	0
State Heritage Register - Curtilages	NSW Department of Planning, Industry and Environment	15/02/2021	30/11/2020	Quarterly	1000m	0	0	0
Environmental Planning Instrument Local Heritage	NSW Department of Planning, Industry and Environment	21/04/2021	31/03/2021	Monthly	1000m	0	0	9
Bush Fire Prone Land	NSW Rural Fire Service	30/04/2021	29/04/2021	Weekly	1000m	3	3	3
Vegetation of Southern Forests	NSW Office of Environment & Heritage	09/12/2014	10/10/2011	Unknown	1000m	2	2	4
Ramsar Wetlands of Australia	Australian Government Department of Agriculture, Water and the Environment	24/02/2021	19/03/2020	Annually	1000m	0	0	0
Groundwater Dependent Ecosystems	Bureau of Meteorology	14/08/2017	15/05/2017	Annually	1000m	6	6	6
Inflow Dependent Ecosystems Likelihood	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000m	11	13	17
NSW BioNet Species Sightings	NSW Office of Environment & Heritage	27/04/2021	27/04/2021	Weekly	10000m	-	-	-

Site Diagram

Proposed Sewer Upgrade, South Nowra, NSW 2540



Legend

- Site Boundary
- Internal Parcel Boundaries

Total Area: 91084m²

Total Perimeter: 16.94km

Disclaimers:

Measurements are approximate only and may have been simplified or smaller lengths removed for readability.

Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.

Scale: 0 75 150 300 450 600 750 Meters

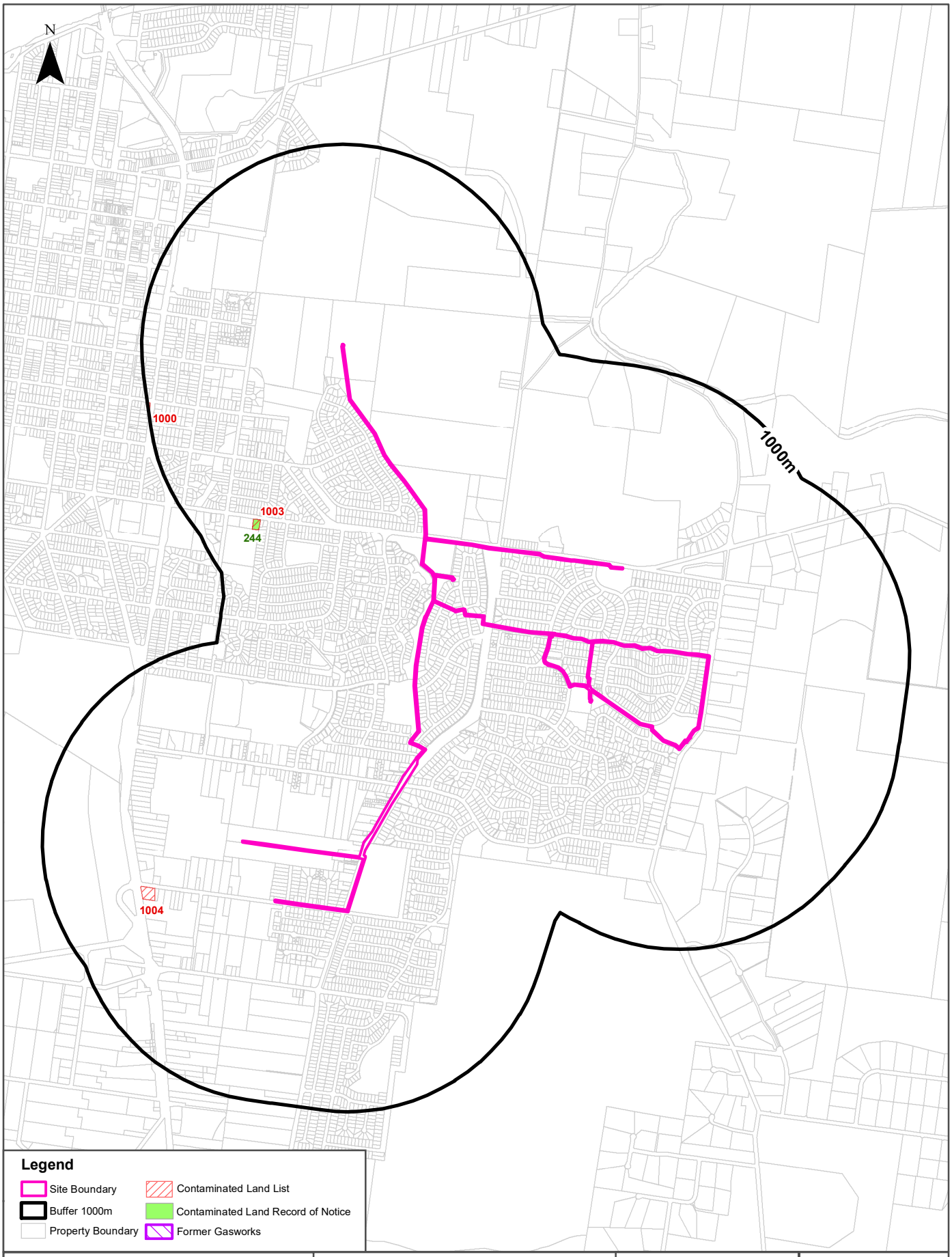
Data Sources: Data Sources: Aerial Imagery: © Aerometrex Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

Date: 03 May 2021

Contaminated Land

Proposed Sewer Upgrade, South Nowra, NSW 2540



Contaminated Land

Proposed Sewer Upgrade, South Nowra, NSW 2540

List of NSW contaminated sites notified to EPA

Records from the NSW EPA Contaminated Land list within the dataset buffer:

Map Id	Site	Address	Suburb	Activity	Management Class	Status	Location Confidence	Dist	Direction
1004	Caltex South Nowra	100 Princes Highway	South Nowra	Service Station	Regulation under CLM Act not required	Current EPA List	Premise Match	495m	South West
1003	Mobil Service Station	Lot 3 Kalandar STREET	Nowra East	Service Station	Contamination formerly regulated under the CLM Act	Current EPA List	Premise Match	697m	North West
1000	Former Hollingworth Scrap Yard	72-74 Jervis and 117 East Street	Nowra	Other Industry	Regulation under CLM Act not required	Current EPA List	Premise Match	987m	North West

The values within the EPA site management class in the table above, are given more detailed explanations in the table below:

EPA site management class	Explanation
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the Environmental Planning and Assessment Act 1979 (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record of Notices.
Contamination currently regulated under POEO Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. Management of the contamination is regulated under the Protection of the Environment Operations Act 1997 (POEO Act). The EPA's regulatory actions under the POEO Act are available on the POEO public register.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the Protection of the Environment Operations Act 1997 (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the Environmental Planning and Assessment Act 1979 (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the Contaminated Land Management Act 1997 (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record of Notices.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997. A regulatory approach is being finalised.
Regulation under the CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the Contaminated Land Management Act 1997 is not required.
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or Protection of the Environment Operations Act 1997. Alternatively, the EPA may require information via a notice issued under s77 of the Contaminated Land Management Act 1997 or issue a Preliminary Investigation Order.

NSW EPA Contaminated Land List Data Source: Environment Protection Authority

© State of New South Wales through the Environment Protection Authority

Contaminated Land

Proposed Sewer Upgrade, South Nowra, NSW 2540

Contaminated Land: Records of Notice

Record of Notices within the dataset buffer:

Map Id	Name	Address	Suburb	Notices	Area No	Location Confidence	Distance	Direction
244	Mobil Service Station	Lot 3 Kalandar Street	Nowra East	6 former	3240	Premise Match	697m	North West

Contaminated Land Records of Notice Data Source: Environment Protection Authority
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Terms of use and disclaimer for Contaminated Land: Record of Notices, please visit http://www.epa.nsw.gov.au/clm/clmdisclaimer.htm

Former Gasworks

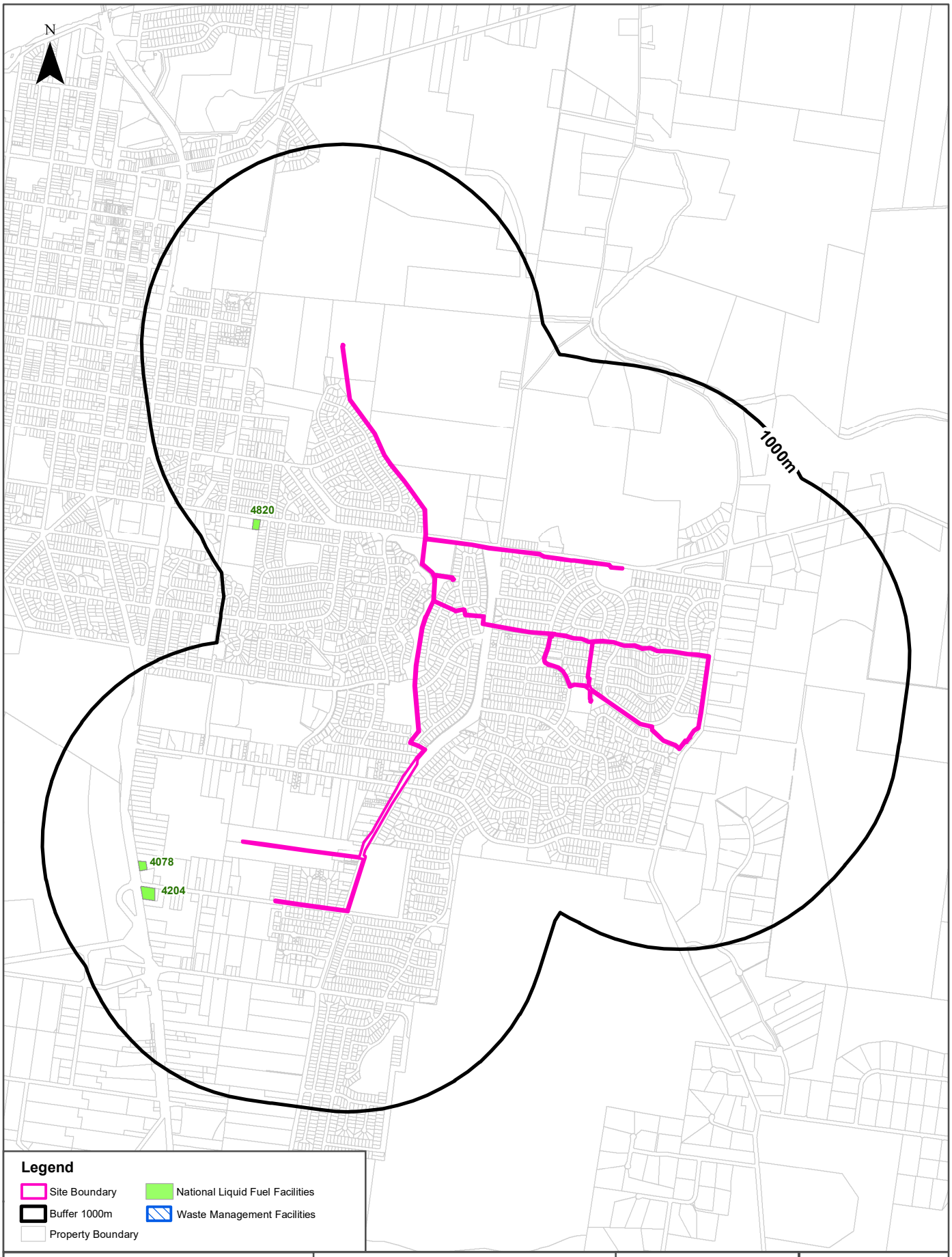
Former Gasworks within the dataset buffer:

Map Id	Location	Council	Further Info	Location Confidence	Distance	Direction
N/A	No records in buffer					

Former Gasworks Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Waste Management & Liquid Fuel Facilities

Proposed Sewer Upgrade, South Nowra, NSW 2540



Waste Management & Liquid Fuel Facilities

Proposed Sewer Upgrade, South Nowra, NSW 2540

National Waste Management Site Database

Sites on the National Waste Management Site Database within the dataset buffer:

Site Id	Owner	Name	Address	Suburb	Class	Landfill	Reprocess	Transfer	Comments	Loc Conf	Dist	Direction
N/A	No records in buffer											

Waste Management Facilities Data Source: Geoscience Australia
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National Liquid Fuel Facilities

National Liquid Fuel Facilties within the dataset buffer:

Map Id	Owner	Name	Address	Suburb	Class	Operational Status	Operator	Revision Date	Loc Conf	Dist	Direction
4078	United	United South Nowra	86 Princes Highway	South Nowra	Petrol Station	Operational		25/07/2011	Premise Match	493m	South West
4204	Caltex	Caltex Nowra South	100 Princes Highway	South Nowra	Petrol Station	Operational		25/07/2011	Premise Match	495m	South West
4820	7-Eleven Pty Ltd	Mobil Nowra East	128 Kalandar Street	Nowra	Petrol Station	Operational		13/07/2012	Premise Match	697m	North West

National Liquid Fuel Facilities Data Source: Geoscience Australia
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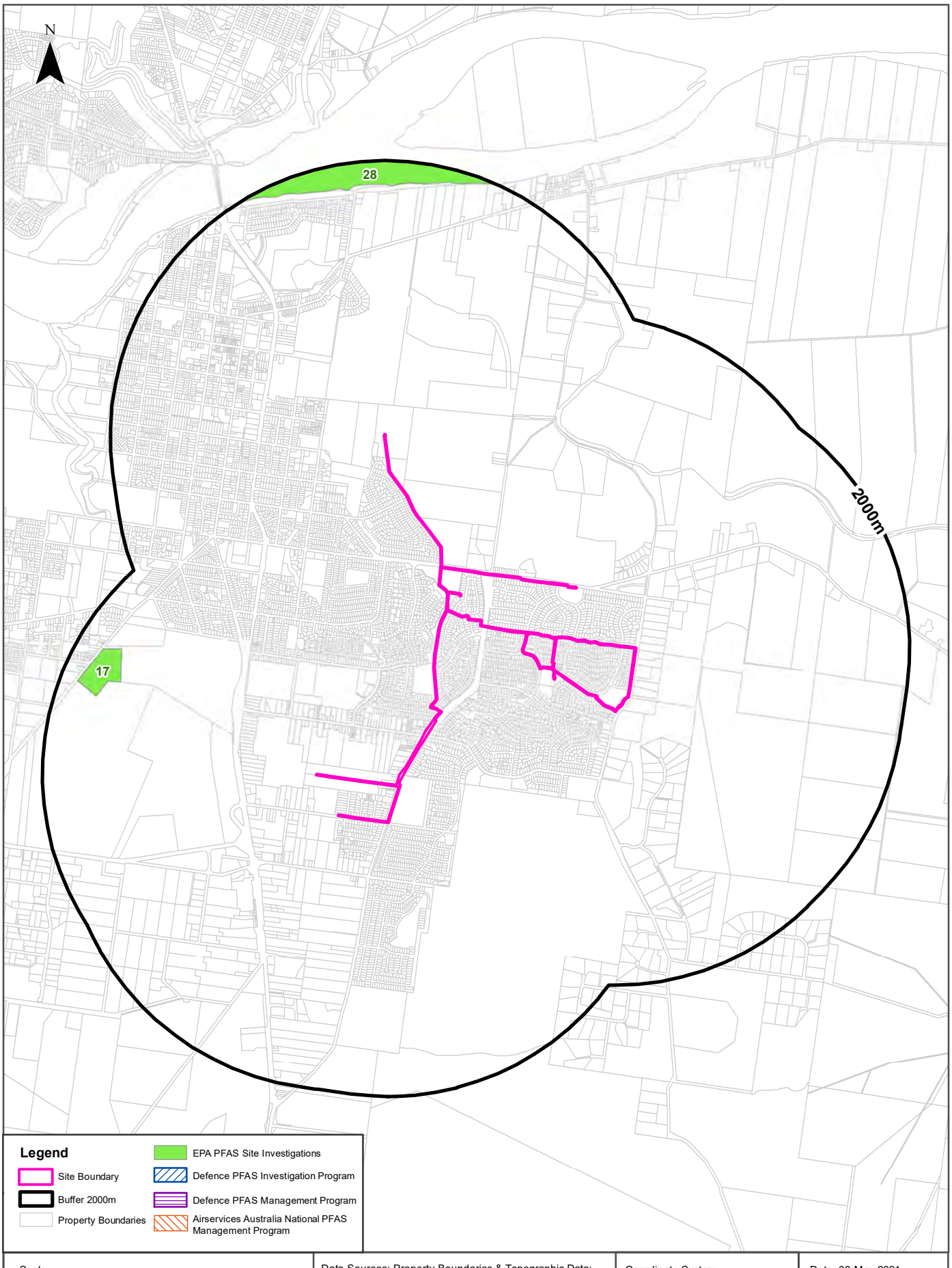
PFAS Investigation & Management Programs

Proposed Sewer Upgrade, South Nowra, NSW 2540



PFAS Investigation & Management Programs

Proposed Sewer Upgrade, South Nowra, NSW 2540

EPA PFAS Investigation Program

Sites that are part of the EPA PFAS investigation program, within the dataset buffer:

Map ID	Site	Address	Loc Conf	Dist	Dir
17	South Nowra NSW Rural Fire Service	92 Albatross Road, South Nowra	Premise Match	1582m	West
28	Shoalhaven River	Shoalhaven River, 2541	Premise Match	1808m	North

EPA PFAS Investigation Program: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Defence PFAS Investigation Program

Sites being investigated by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Loc Conf	Dist	Dir
N/A	No records in buffer				

Defence PFAS Investigation Program Data Custodian: Department of Defence, Australian Government

Defence PFAS Management Program

Sites being managed by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Loc Conf	Dist	Dir
N/A	No records in buffer				

Defence PFAS Management Program Data Custodian: Department of Defence, Australian Government

Airservices Australia National PFAS Management Program

Sites being investigated or managed by Airservices Australia for PFAS contamination within the dataset buffer:

Map ID	Site Name	Impacts	Loc Conf	Dist	Dir
N/A	No records in buffer				

Airservices Australia National PFAS Management Program Data Custodian: Airservices Australia

Defence Sites

Proposed Sewer Upgrade, South Nowra, NSW 2540

Defence 3 Year Regional Contamination Investigation Program

Sites which have been assessed as part of the Defence 3 Year Regional Contamination Investigation Program within the dataset buffer:

Property ID	Base Name	Address	Known Contamination	Loc Conf	Dist	Dir
N/A	No records in buffer					

Defence 3 Year Regional Contamination Investigation Program, Data Custodian: Department of Defence, Australian Government

EPA Other Sites with Contamination Issues

Proposed Sewer Upgrade, South Nowra, NSW 2540

EPA Other Sites with Contamination Issues

This dataset contains other sites identified on the EPA website as having contamination issues. This dataset currently includes:

- James Hardie asbestos manufacturing and waste disposal sites
- Radiological investigation sites in Hunter's Hill
- Pasminco Lead Abatement Strategy Area

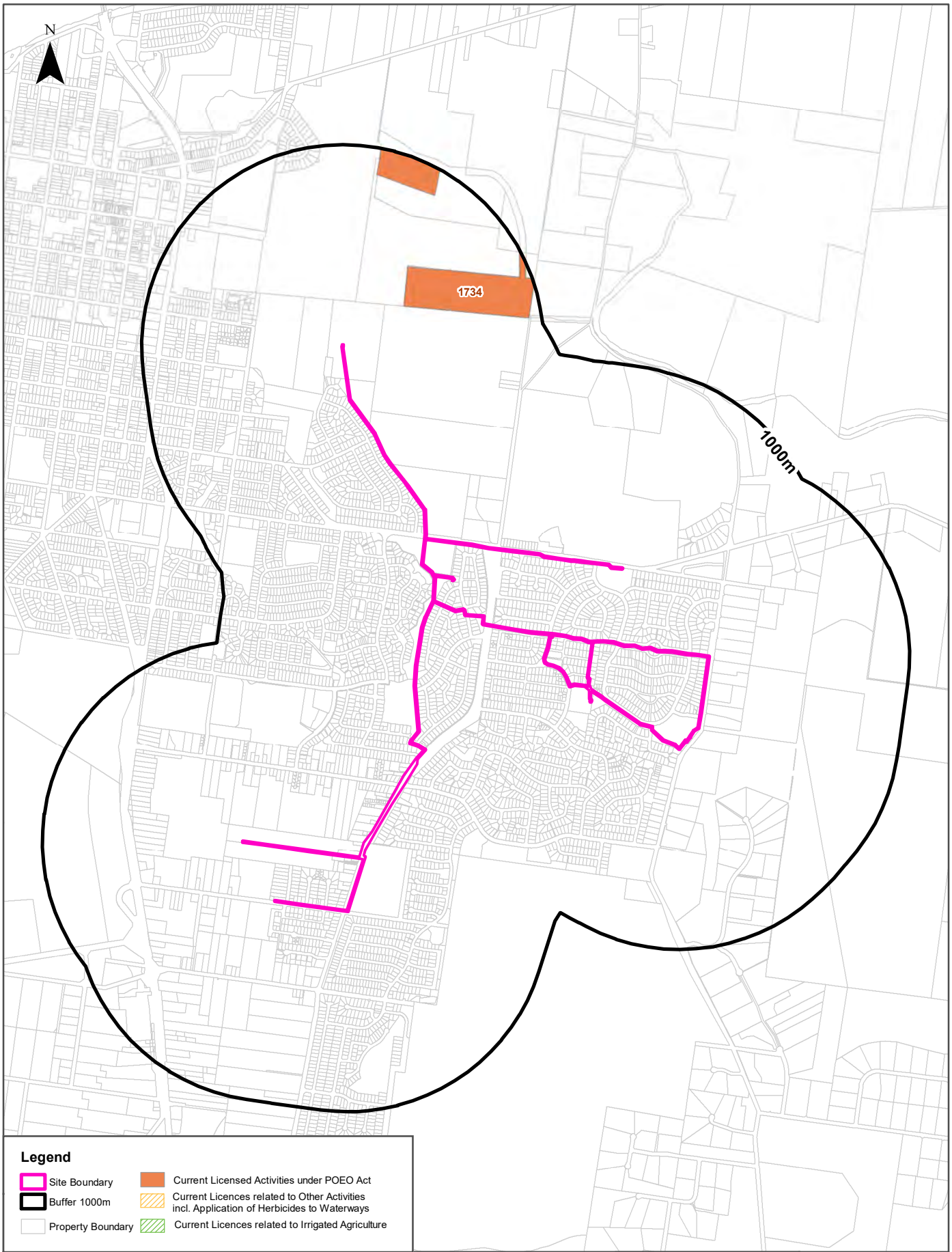
Sites within the dataset buffer:

Site Id	Site Name	Site Address	Dataset	Comments	Location Confidence	Distance	Direction
N/A	No records in buffer						

EPA Other Sites with Contamination Issues: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Current EPA Licensed Activities

Proposed Sewer Upgrade, South Nowra, NSW 2540



EPA Activities

Proposed Sewer Upgrade, South Nowra, NSW 2540

Licensed Activities under the POEO Act 1997

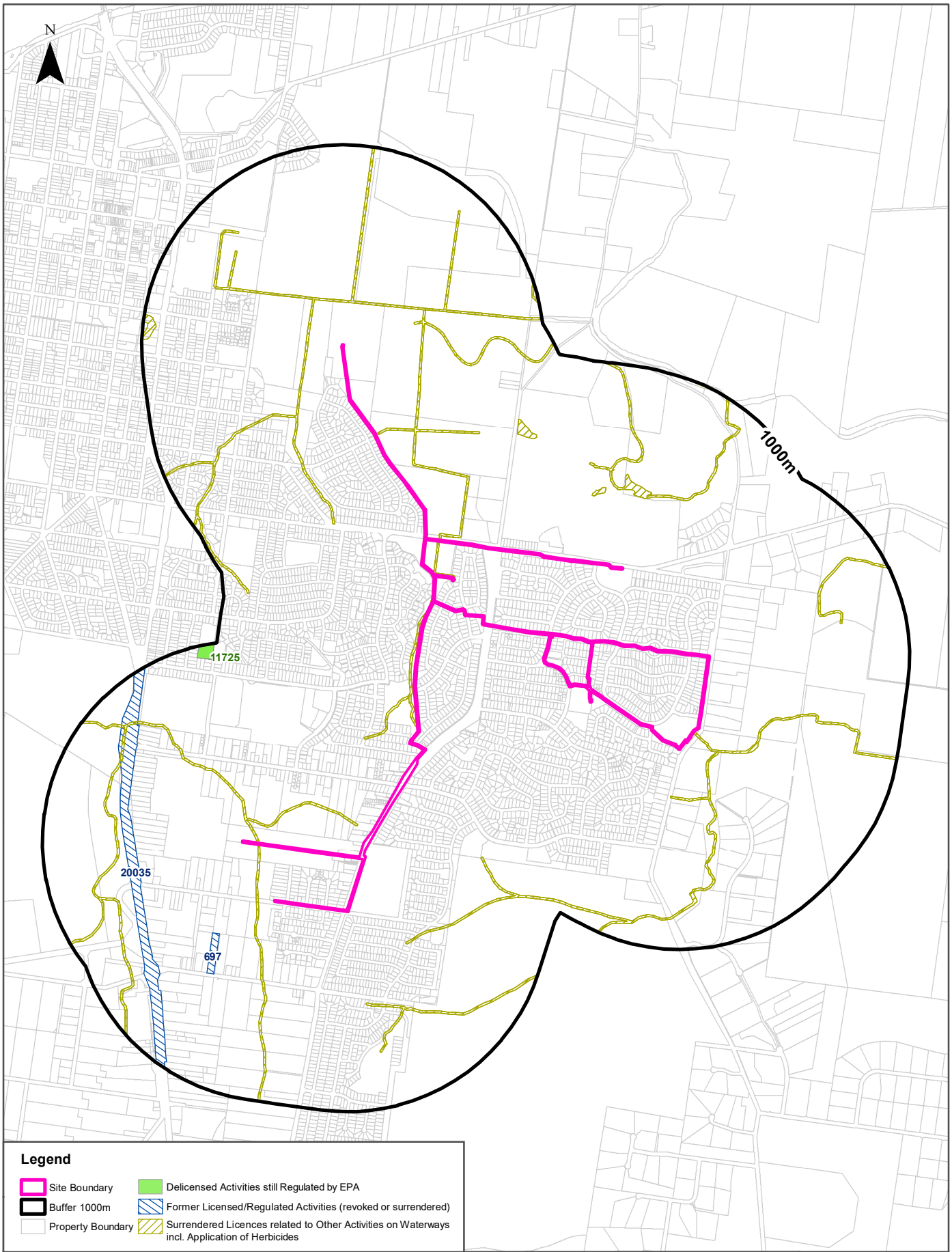
Licensed activities under the Protection of the Environment Operations Act 1997, within the dataset buffer:

EPL	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
1734	SHOALHAVEN CITY COUNCIL	NOWRA SEWAGE TREATMENT PLANT	TERARA ROAD	NOWRA	Sewage treatment processing by small plants	Premise Match	356m	North

POEO Licence Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Delicensed & Former Licensed EPA Activities

Proposed Sewer Upgrade, South Nowra, NSW 2540



EPA Activities

Proposed Sewer Upgrade, South Nowra, NSW 2540

Delicensed Activities still regulated by the EPA

Delicensed activities still regulated by the EPA, within the dataset buffer:

Licence No	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
11725	HCOA OPERATIONS (AUSTRALIA) PTY LIMITED	NOWRA PRIVATE HOSPITAL	WEEROONA PLACE	NOWRA	Hazardous, Industrial or Group A Waste Generation or Storage	Premise Match	919m	West

Delicensed Activities Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Former Licensed Activities under the POEO Act 1997, now revoked or surrendered

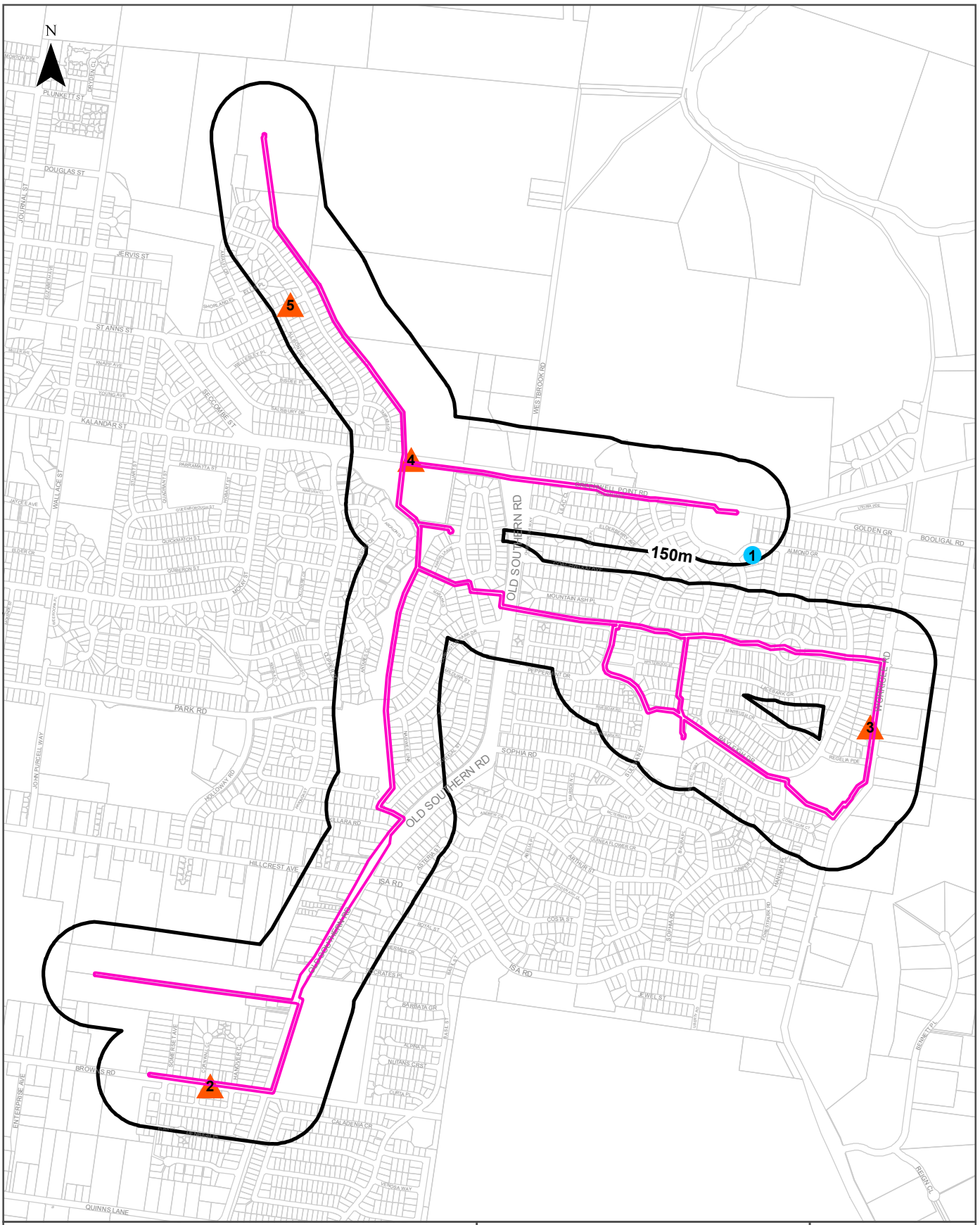
Former Licensed activities under the Protection of the Environment Operations Act 1997, now revoked or surrendered, within the dataset buffer:

Licence No	Organisation	Location	Status	Issued Date	Activity	Loc Conf	Distance	Direction
4653	LUHRMANN ENVIRONMENT MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW	Surrendered	06/09/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	On-site
4838	Robert Orchard	Various Waterways throughout New South Wales - SYDNEY NSW 2000	Surrendered	07/09/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	On-site
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW - PROSPECT, NSW, 2148	Surrendered	09/11/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	On-site
697	RANDAMUSA PTY LTD	27-29 QUINNS LANE, NOWRA, NSW 2541	Surrendered	08/03/2000	Concrete works	Premise Match	320m	South West
20035	NACE CIVIL ENGINEERING PTY. LIMITED	HW1 Princes Highway South Nowra Duplication, Princes Highway between Kinghorne Street and Forest Road, SOUTH NOWRA	Surrendered	03/11/2011	Road construction	Road Match	532m	South West

Former Licensed Activities Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Historical Business Directories

Proposed Sewer Upgrade, South Nowra, NSW 2540



Legend

- Site Boundary
- Buffer 150m
- Property Boundary
- Business directory records mapped to a specific premise
- Business directory records mapped to a road intersection
- Business directory records mapped to a road corridor
- Business directory records mapped to a general area

Scale: 0 220 440 660 880 Meters

Coordinate System: GDA 1994 MGA Zone 56

Date: 03 May 2021

Data Sources: Reproduced with permission of UBD and Hardie Grant Media Pty Ltd DD 01/08/2018

Historical Business Directories

Proposed Sewer Upgrade, South Nowra, NSW 2540

Business Directory Records 1950-1991
Premise or Road Intersection Matches

Universal Business Directory records from years 1991, 1982, 1970, 1961 & 1950, mapped to a premise or road intersection within the dataset buffer:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
1	NOT LISTED	A & D Tree Lopping., 4 Robine Way East Nowra	103399	1991	Premise Match	113m	East

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Business Directory Records 1950-1991
Road or Area Matches

Universal Business Directory records from years 1991, 1982, 1970, 1961 & 1950, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
2	CONCRETING CONTRACTORS	Casey & Sperring., Lot 1 Browns Rd South Nowra	98607	1991	Road Match	0m
	CAMPING GROUNDS &/OR CARAVAN PARKS.	Rest Point Caravan Park., Browns Rd South Nowra	100049	1991	Road Match	0m
3	PAINT &/OR ACCESSORIES - RETAIL	Dulux Trade Centre., Worrigee Rd Nowra	104127	1991	Road Match	0m
	PAINT ENAMEL VARNISH &/OR STAIN MFRS. &/OR IMPS. &/OR DISTS.	Dulux Trade Centre., Worrigee Rd Nowra	104209	1991	Road Match	0m
	LAUNDRIES SELF SERVICE &/OR LAUNDRETTES.	Uptown Laundrette., Worrigee Rd Nowra	103039	1991	Road Match	0m
	FUNCTION VENUES.	Worrigee House., Worrigee Rd Nowra	99914	1991	Road Match	0m
4	BUS SERVICES CHARTER & TOURS.	Starts Coaches Pty Ud., Greenwell Point Rd Nowra	99495	1991	Road Match	0m
	BUS OPERATORS.	Stuarts Coaches Pty Ltd., Greenwell Point Rd Nowra	99452	1991	Road Match	0m
	MOTOR BUS SERVICES	Stuarts Bus Service, Greenwell PL Rd., Nowra-Bomaderry	137857	1982	Road Match	0m
5	APIARISTS	Gould, F. A. St. Anne St. Nowra	141916	1950	Road Match	52m
	APIARISTS	Gould, F. A., St. Anne St. Nowra	141918	1950	Road Match	52m

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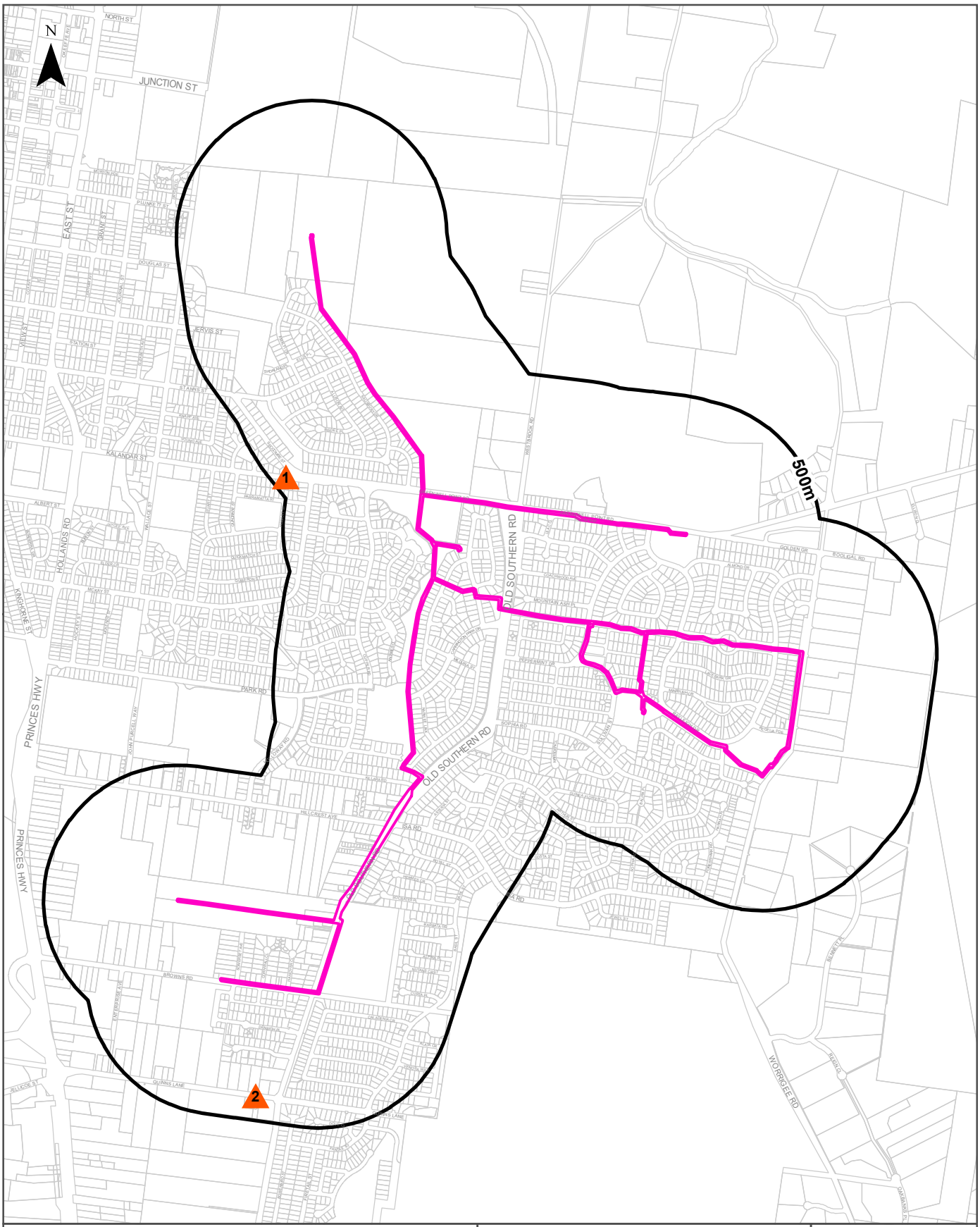
Dry Cleaners, Motor Garages & Service Stations

Proposed Sewer Upgrade, South Nowra, NSW 2540



Legend

- Site Boundary
- Buffer 500m
- Property Boundary
- Business directory records mapped to a specific premise
- Business directory records mapped to a road intersection
- Business directory records mapped to a road corridor
- Business directory records mapped to a general area

Scale: 0 275 550 825 1,100 Meters

Coordinate System: GDA 1994 MGA Zone 56

Date: 03 May 2021

Data Sources: Reproduced with permission of UBD and Hardie Grant Media Pty Ltd DD 01/08/2018

Historical Business Directories

Proposed Sewer Upgrade, South Nowra, NSW 2540

Dry Cleaners, Motor Garages & Service Stations Premise or Road Intersection Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a premise or road intersection, within the dataset buffer.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
N/A	No records in buffer						

Reproduced with permission of UBD and Hardie Grant Media Pty Ltd DD 01/08/2018

Dry Cleaners, Motor Garages & Service Stations Road or Area Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
1	MOTOR GARAGES & SERVICE STATIONS.	Mobil Service Station., Kalander St Nowra	102484	1991	Road Match	372m
2	MOTOR GARAGES &/ OR ENGINEERS &FOR SERVICE STATIONS	South Nowra Auto Repairs. Lot 10 Quinns La., South Nowra	137922	1982	Road Match	396m
	MOTOR GARAGES &/ OR ENGINEERS &FOR SERVICE STATIONS	Wray, & L Automotive Repairs, Lot 4 Quinn's La., South Nowra	137924	1982	Road Match	396m

Reproduced with permission of UBD and Hardie Grant Media Pty Ltd DD 01/08/2018

Topographic Map 2015

Proposed Sewer Upgrade, South Nowra, NSW 2540

Scale: 0 300 600 900 1,200 Meters

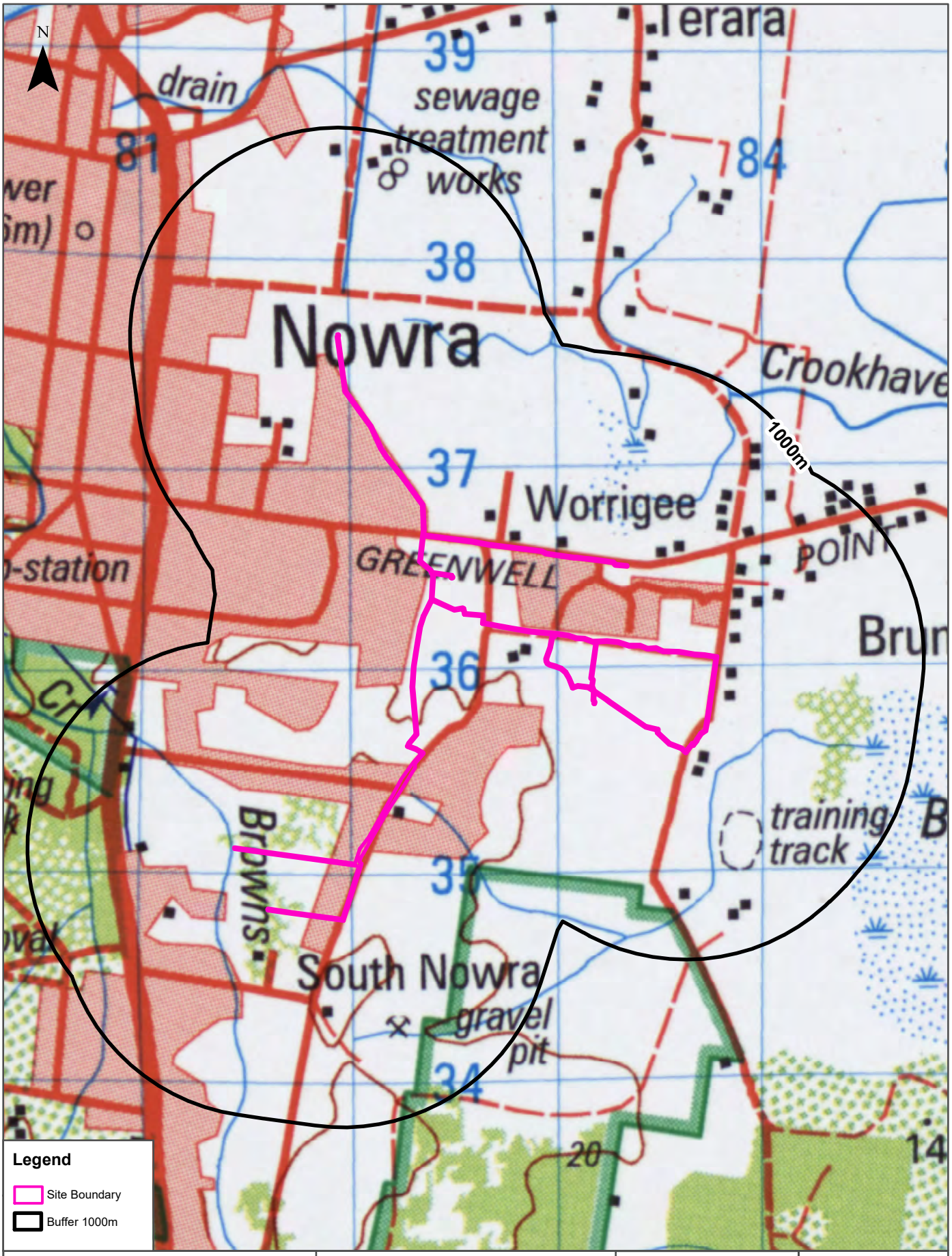
Data Sources: Topographic Map Data © NSW Land and Property Information

Coordinate System: GDA 1994 MGA Zone 56

Date: 03 May 2021

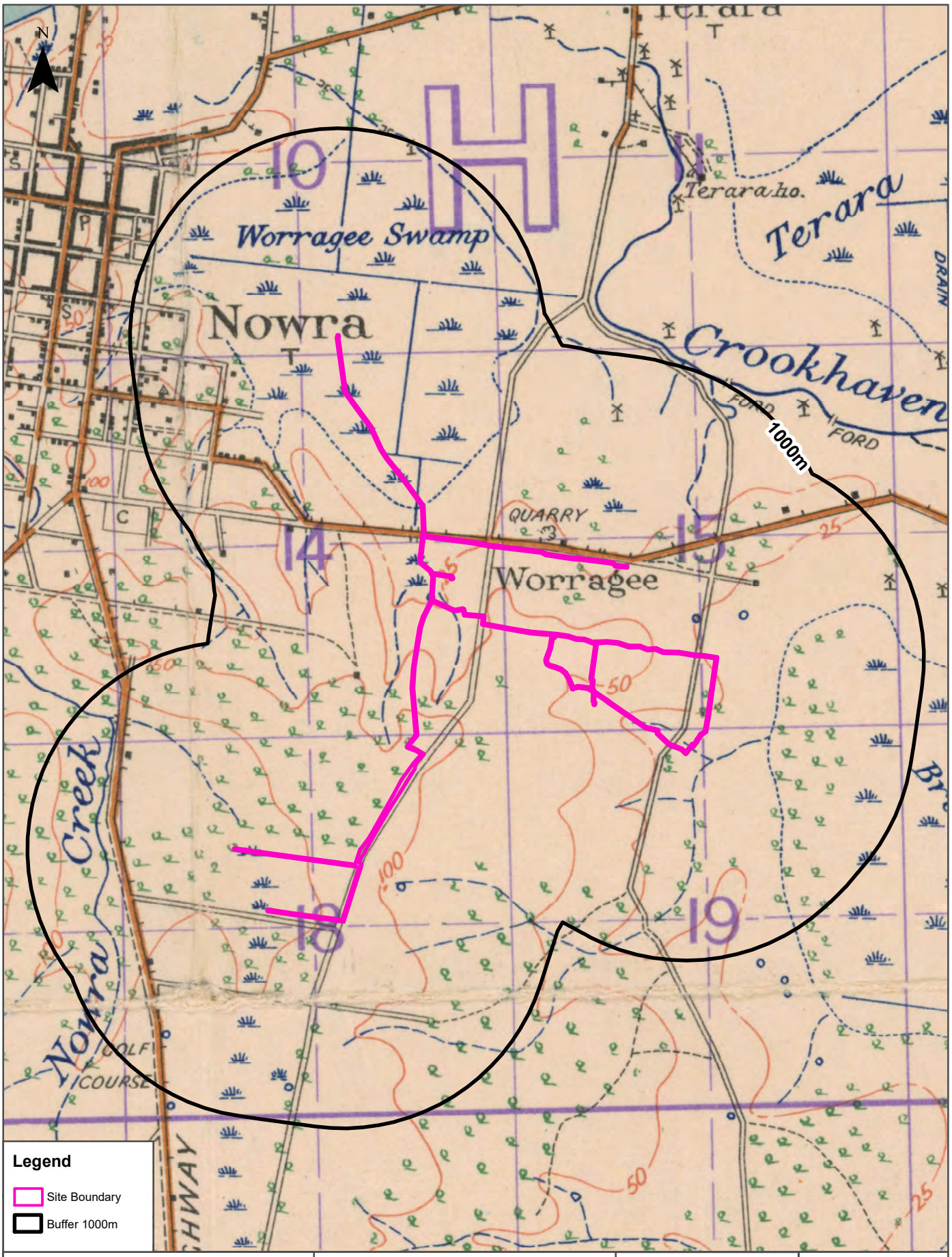
Historical Map 1998

Proposed Sewer Upgrade, South Nowra, NSW 2540



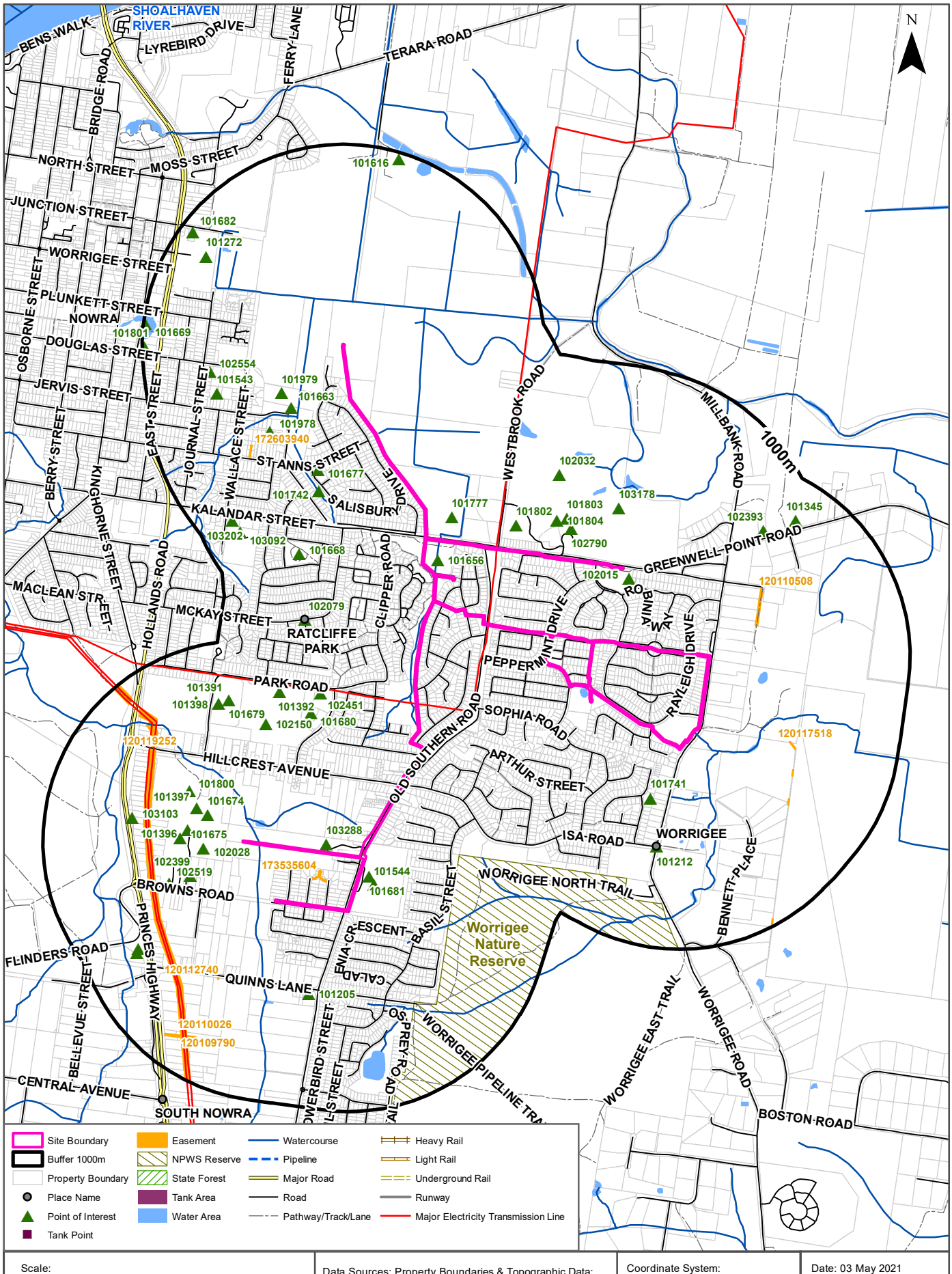
Historical Map c.1929

Proposed Sewer Upgrade, South Nowra, NSW 2540



Topographic Features

Proposed Sewer Upgrade, South Nowra, NSW 2540



Topographic Features

Proposed Sewer Upgrade, South Nowra, NSW 2540

Points of Interest

What Points of Interest exist within the dataset buffer?

Map Id	Feature Type	Label	Distance	Direction
103288	Nursing Home	JEAN ROSS HOUSE	38m	South West
101681	Place Of Worship	BAPTIST CHURCH	43m	South West
102015	Sports Court	TENNIS COURT	55m	East
101656	Park	RATCLIFFE PARK	59m	North West
101544	Combined Primary-Secondary School	NOWRA CHRISTIAN SCHOOL	78m	South West
101777	Golf Course	GOLF RANGE	118m	North
101802	Sports Field	HAYDEN DREXEL OVAL	124m	North
102790	Club	SHOALHAVEN EX SERVICEMENS SPORTS CLUB	151m	North East
101804	Sports Field	BOWLING GREEN	182m	North East
102028	Sports Field	Sports Field	199m	South West
101803	Sports Field	BOWLING GREEN	200m	North East
101674	Sports Field	SHOALHAVEN CITY SOCCER OVAL	218m	South West
103178	Swamp	WORRIGEE SWAMP	282m	North East
101397	Community Facility	SHOALHAVEN CITY SOCCER CLUB	282m	South West
101396	Community Facility	SHOALHAVEN DISTRICT AMATEUR SOCCER ASSOCIATION	283m	South West
101741	Park	FORESTPARK RESERVE	283m	South East
101663	Park	LYREBIRD SPORTS PARK	293m	North West
102399	Park	AMBROSE GOLDEN-BROWN PARK	312m	South West
101675	Sports Field	SOUTH NOWRA SOCCER FIELDS	312m	South West
101979	Sports Field	Sports Field	331m	North West
101677	Place Of Worship	SALVATION ARMY CHURCH	331m	North West
101800	Park	ISON PARK	366m	South West
101742	Park	SALISBURY RESERVE	372m	North West
102032	Golf Course	WORRIGEE LINKS GOLF COURSE	404m	North East
102519	Tourist Park / Home Village	REST POINT VILLAGE	422m	South West
101978	Sports Field	Sports Field	429m	North West
101205	Place Of Worship	JEHOVAHS WITNESSES CHURCH	434m	South West
102451	Community Medical Centre	NOWRA DAY CARE CENTRE	471m	South West
101212	Suburb	WORRIGEE	499m	South East
101680	Community Facility	SHOALHAVEN PCYC	517m	South West
103103	Roadside Rest Area	SOUTH NOWRA REST AREA	567m	South West

Map Id	Feature Type	Label	Distance	Direction
102079	Urban Place	RATCLIFFE PARK	585m	West
102150	Sports Field	RON BROWN OVAL	594m	South West
101668	Park	JAYCEE PARK	615m	West
101543	Primary School	NOWRA EAST PUBLIC SCHOOL	651m	North West
102554	Preschool	NOWRA EAST PUBLIC SCHOOL PRESCHOOL WAYEELA COOINDA	671m	North West
101392	High School	SHOALHAVEN HIGH SCHOOL	675m	West
102393	Cemetery	Cemetery	678m	East
101398	Community Facility	SHOALHAVEN NETBALL ASSOCIATION	695m	West
101679	Sports Court	PARK ROAD NETBALL COURTS	709m	West
103104	Roadside Rest Area	SOUTH NOWRA ROTARY REST AREA	724m	South West
101391	High School	ST JOHN THE EVANGELIST CATHOLIC HIGH SCHOOL	735m	West
102016	Park	SOUTH NOWRA ROTARY ROADSIDE PARK	738m	South West
101345	Homestead	CONGLA	800m	East
101272	Shopping Centre	NOWRA FAIR	813m	North West
103092	Nursing Home	JONATHAN ROGERS GC HOUSE	816m	West
103202	Post Office	NOWRA EAST POST OFFICE	827m	North West
101682	Community Facility	ABORIGINAL CULTURAL CENTRE	937m	North West
101616	Sewage Works	NOWRA WASTE TREATMENT PLANT	965m	North
101801	Picnic Area	Picnic Area	989m	North West
101669	Park	MARRIOTT PARK	991m	North West

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Topographic Features

Proposed Sewer Upgrade, South Nowra, NSW 2540

Tanks (Areas)

What are the Tank Areas located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
N/A	No records in buffer					

Tanks (Points)

What are the Tank Points located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
N/A	No records in buffer					

Tanks Data Source: © Land and Property Information (2015)
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Major Easements

What Major Easements exist within the dataset buffer?
Note. Easements provided by LPI are not at the detail of local governments. They are limited to major easements such as Right of Carriageway, Electrical Lines (66kVa etc.), Easement to drain water & Significant subterranean pipelines (gas, water etc.).

Map Id	Easement Class	Easement Type	Easement Width	Distance	Direction
173535604	Primary	Right of way	Variable	88m	South West
120110508	Primary	Undefined		273m	East
120117518	Primary	Undefined		453m	South East
120119252	Primary	Undefined		455m	South West
120112740	Primary	Undefined		476m	South West
172603940	Primary	Right of way	2m	539m	North West
172775773	Primary	Right of way	2m	541m	North West
120110026	Primary	Undefined		786m	South West
120109790	Primary	Undefined		829m	South West

Easements Data Source: © Land and Property Information (2015)
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Topographic Features

Proposed Sewer Upgrade, South Nowra, NSW 2540

State Forest

What State Forest exist within the dataset buffer?

State Forest Number	State Forest Name	Distance	Direction
N/A	No records in buffer		

State Forest Data Source: © NSW Department of Finance, Services & Innovation (2018)
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National Parks and Wildlife Service Reserves

What NPWS Reserves exist within the dataset buffer?

Reserve Number	Reserve Type	Reserve Name	Gazetted Date	Distance	Direction
N0877	NATURE RESERVE	Worrigee Nature Reserve	01/01/2001	417m	South

NPWS Data Source: © NSW Department of Finance, Services & Innovation (2018)
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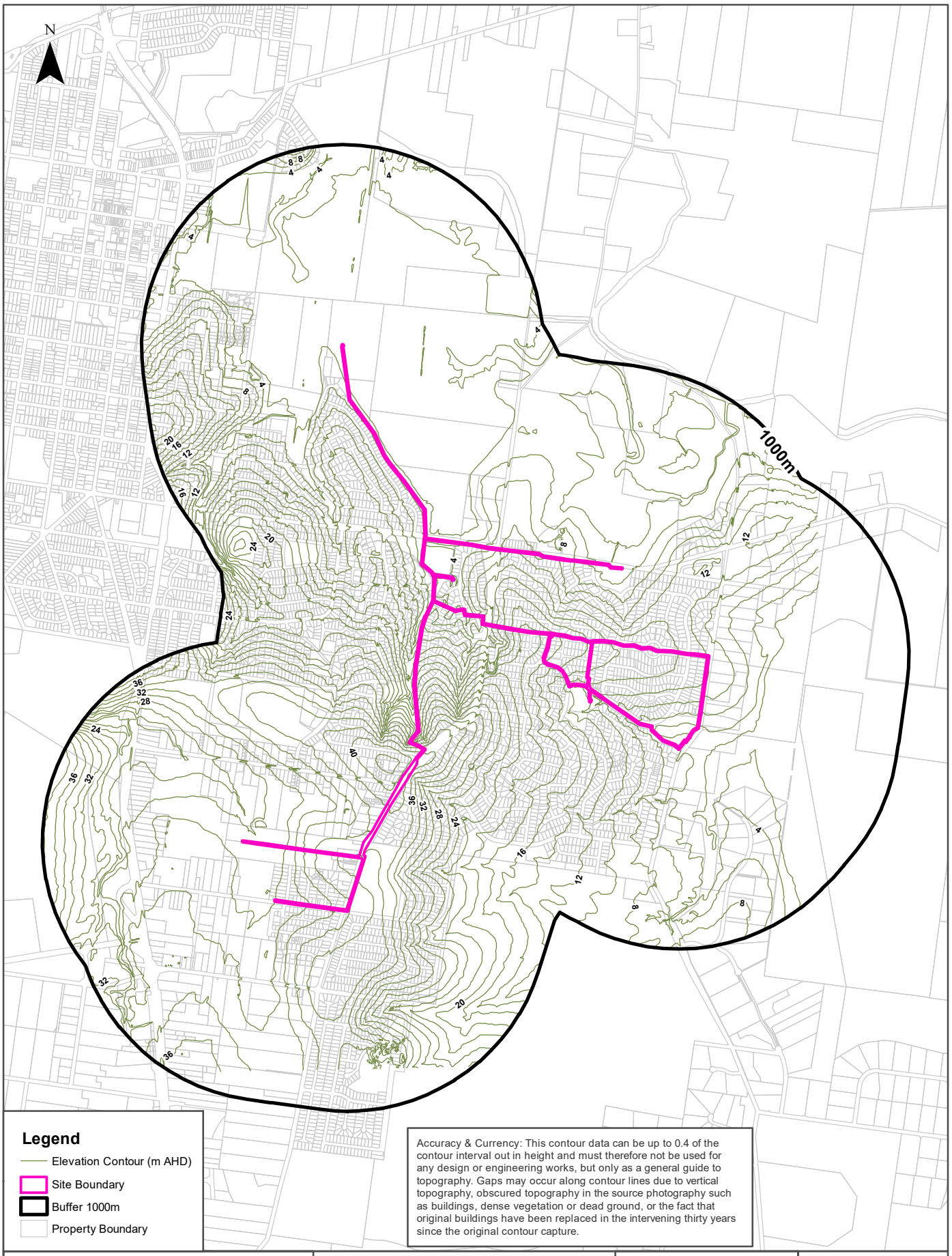
Elevation Contours (m AHD)

Proposed Sewer Upgrade, South Nowra, NSW 2540



Hydrogeology & Groundwater

Proposed Sewer Upgrade, South Nowra, NSW 2540

Hydrogeology

Description of aquifers within the dataset buffer:

Description	Distance	Direction
Fractured or fissured, extensive aquifers of low to moderate productivity	0m	On-site

Hydrogeology Map of Australia : Commonwealth of Australia (Geoscience Australia)
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Temporary Water Restriction (Botany Sands Groundwater Source) Order 2018

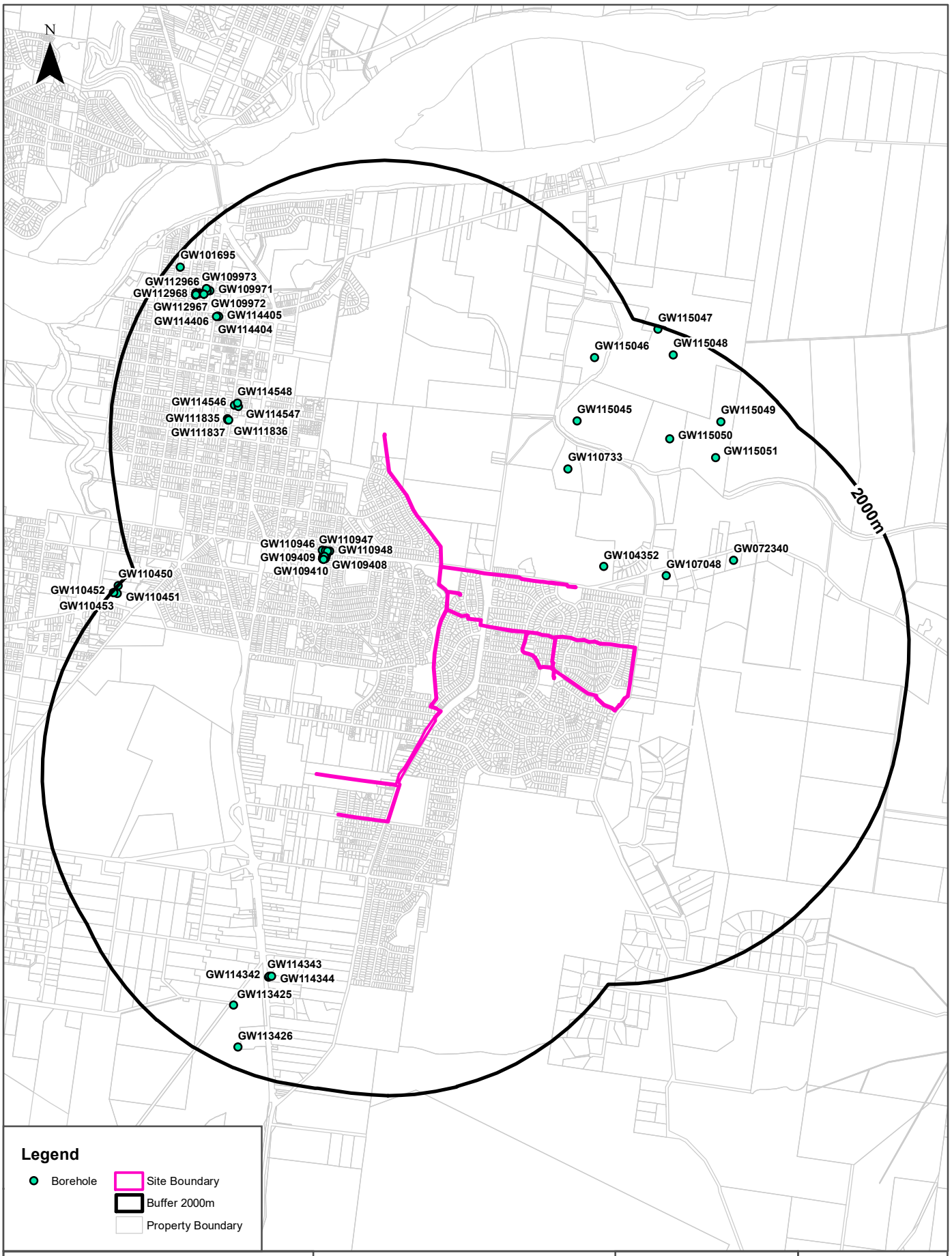
Temporary water restrictions relating to the Botany Sands aquifer within the dataset buffer:

Prohibition Area No.	Prohibition	Distance	Direction
N/A	No records in buffer		

Temporary Water Restriction (Botany Sands Groundwater Source) Order 2018 Data Source : NSW Department of Primary Industries

Groundwater Boreholes

Proposed Sewer Upgrade, South Nowra, NSW 2540



Hydrogeology & Groundwater

Proposed Sewer Upgrade, South Nowra, NSW 2540

Groundwater Boreholes

Boreholes within the dataset buffer:

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m bgl)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW104352	10BL160695, 10WA106330	Bore	Private	Domestic	Domestic		25/06/2002	210.00	210.00	7.2	2.50	0.170		251m	North East
GW107048	10BL164189, 10WA106428	Bore	Private	Domestic	Domestic		17/03/2004	76.00	76.00					566m	East
GW110948	10BL600159	Bore	Private	Monitoring Bore	Monitoring Bore		16/02/2006	13.00	13.00					676m	North West
GW110949	10BL600159	Bore	Private	Monitoring Bore	Monitoring Bore		15/02/2006	14.00	14.00					691m	North West
GW110947	10BL600159	Bore	Private	Monitoring Bore	Monitoring Bore		15/02/2006	14.30	14.30					703m	North West
GW109426	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		15/02/2006	14.00						707m	North West
GW109430	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		07/11/2007	9.50						711m	North West
GW109428	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		14/10/2008	12.00						713m	North West
GW109424	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		02/05/2006	14.30						715m	North West
GW109433	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		07/10/2007	6.50						717m	North West
GW109421	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		12/05/2005	14.00						717m	North West
GW109412	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		25/08/2004	14.00						719m	North West
GW109429	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		07/11/2007	7.00						721m	North West
GW109417	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		29/11/2005	14.00						722m	North West
GW110946	10BL600159	Bore	Private	Monitoring Bore	Monitoring Bore		14/02/2006	14.50	14.50					722m	North West
GW109416	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		29/11/2005	14.00						723m	North West
GW109420	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		25/08/2004	14.00						725m	North West
GW109422	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		09/03/2006	14.00						727m	North West
GW109409	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		07/10/2007	9.50						727m	North West
GW109408	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		18/05/2004	14.00						727m	North West
GW114749	10BL604824	Bore	Private	Monitoring Bore	Monitoring Bore		19/07/2011	7.00	7.00					728m	North West
GW109418	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		12/05/2005	15.00						729m	North West
GW109431	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		07/11/2007	9.50						729m	North West
GW109411	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		17/05/2004	15.00						729m	North West
GW109414	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		11/05/2005	12.00						731m	North West
GW109425	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		14/10/2008	13.00						735m	North West
GW109410	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		19/05/2004	10.00						736m	North West

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m bgl)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW109423	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		14/02/2006	14.50						739m	North West
GW109415	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		12/05/2005	14.00						741m	North West
GW114750	10BL604824	Bore	Private	Monitoring Bore	Monitoring Bore		20/07/2011	10.00	10.00					744m	North West
GW109413	10BL602459	Bore	Private	Monitoring Bore	Monitoring Bore		11/05/2005	14.00						744m	North West
GW109432	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		07/11/2007	9.50						747m	North West
GW109427	10BL602462	Bore	Private	Monitoring Bore	Monitoring Bore		08/09/2007	14.00						747m	North West
GW110733	10BL603372	Bore	Private	Test Bore	Test Bore		18/11/2009	7.20	7.20	930	2.30	0.900		835m	North East
GW072340	10BL155448	Bore	Private	Domestic, Stock	Domestic, Stock		25/10/1994	24.00	24.00					958m	East
GW114547	10BL605220	Bore	Private	Monitoring Bore	Monitoring Bore		11/08/2012	8.00	8.00		3.00	0.050		1082m	North West
GW114548	10BL605220	Bore	Private	Monitoring Bore	Monitoring Bore		11/08/2012	5.00	5.00		3.00	0.010		1093m	North West
GW114546	10BL605220	Bore	Private	Monitoring Bore	Monitoring Bore		10/08/2012	12.00	12.00		3.00	0.020		1112m	North West
GW111837	10BL604660	Bore	Private	Monitoring Bore	Monitoring Bore		14/04/2011	5.90	5.90		1.76			1139m	North West
GW111836	10BL604660	Bore	Private	Monitoring Bore	Monitoring Bore		14/04/2011	5.10	5.10		1.70			1144m	North West
GW111835	10BL604660	Bore	Private	Monitoring Bore	Monitoring Bore		14/04/2011	5.00	5.00		2.33			1147m	North West
GW115045	10BL157718			Monitoring Bore	Monitoring Bore		01/07/1996	10.00	10.00		3.30			1194m	North East
GW114344	10BL604977	Bore	Private	Monitoring Bore	Monitoring Bore		28/09/2011	7.20	7.20		6.00			1275m	South West
GW115050	10BL157718			Monitoring Bore	Monitoring Bore		30/06/1996	10.00	10.00					1280m	North East
GW114343	10BL604977	Bore	Private	Monitoring Bore	Monitoring Bore		28/09/2011	7.50	7.50		6.00			1282m	South West
GW114342	10BL604977	Bore	Private	Monitoring Bore	Monitoring Bore		28/09/2011	7.10	7.10		6.00			1290m	South West
GW115051	10BL157718			Monitoring Bore	Monitoring Bore		29/06/1996	10.00	10.00					1391m	North East
GW114405	10BL604560	Bore	Private	Monitoring Bore	Monitoring Bore		17/05/2011	3.00	3.00		1.50			1483m	North West
GW114404	10BL604560	Bore	Private	Monitoring Bore	Monitoring Bore		17/07/2011	2.00	2.00		1.30			1490m	North West
GW114406	10BL604560	Bore	Private	Monitoring Bore	Monitoring Bore		17/05/2011	4.00	4.00		3.00			1494m	North West
GW113425	10BL602172	Bore	Private	Monitoring Bore	Monitoring Bore	Brickworks Quarry	01/01/2007	29.00	29.00					1587m	South West
GW115049	10BL157718			Monitoring Bore	Monitoring Bore		29/06/1996	10.00	10.00					1607m	North East
GW115046	10BL157718			Monitoring Bore	Monitoring Bore		30/06/1996	10.00	10.00					1633m	North East
GW109971	10BL602597	Bore	Other Govt	Monitoring Bore	Monitoring Bore		19/05/1998	3.30	3.30					1646m	North West
GW109972	10BL602597	Bore	Other Govt	Monitoring Bore	Monitoring Bore		19/05/2008	3.00	3.00					1661m	North West
GW112970	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	29/10/2006	9.20	9.20					1667m	North West
GW112971	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	29/10/2009	5.40	5.40					1668m	North West
GW109973	10BL602597	Bore	Other Govt	Monitoring Bore	Monitoring Bore		19/05/2008	3.70	3.70					1678m	North West
GW112966	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	03/11/2009	8.50	8.50					1699m	North West

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m bgl)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW112967	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	03/11/2009	5.20	5.20					1700m	North West
GW112968	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	03/11/2009	7.70	7.70					1710m	North West
GW112973	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	28/10/2009	4.00	4.00					1712m	North West
GW112972	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	28/10/2009	3.90	3.90					1719m	North West
GW112969	10BL603409	Bore	Local Govt	Monitoring Bore	Monitoring Bore	Shoalhaven CC - Bridge Rd	03/11/2009	7.70	7.70					1720m	North West
GW115048	10BL157718			Monitoring Bore	Monitoring Bore		29/06/1996	17.00	17.00					1839m	North East
GW113426	10BL602172	Bore	Private	Monitoring Bore	Monitoring Bore	Brickworks Quarry	01/01/2007	23.00	23.00					1850m	South West
GW101695	10BL158526, 10WA107476	Bore		Domestic	Domestic		21/04/1998	48.00	48.00					1927m	North West
GW110451	10BL603155	Bore	Other Govt	Monitoring Bore	Monitoring Bore		02/04/2009	9.00	9.00		3.20			1960m	West
GW115047	10BL157718			Monitoring Bore	Monitoring Bore		27/06/1996	17.00	20.00					1974m	North East
GW110453	10BL603155	Bore	Other Govt	Monitoring Bore	Monitoring Bore		02/04/2009	9.00	9.00		2.30			1984m	West
GW110452	10BL603155	Bore	Other Govt	Monitoring Bore	Monitoring Bore		02/04/2009	10.00	10.00		2.70			1985m	West
GW110450	10BL603155	Bore	Other Govt	Monitoring Bore	Monitoring Bore		02/04/2009	9.00	9.00		3.50			1996m	West

Borehole Data Source : NSW Department of Primary Industries - Office of Water / Water Administration Ministerial Corporation for all bores prefixed with GW. All other bores © Commonwealth of Australia (Bureau of Meteorology) 2015. Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Hydrogeology & Groundwater

Proposed Sewer Upgrade, South Nowra, NSW 2540

Driller's Logs

Drill log data relevant to the boreholes within the dataset buffer:

Groundwater No	Drillers Log	Distance	Direction
GW104352	0.00m-2.00m SOIL AND CLAY 2.00m-150.00m SILTSTONE 150.00m-195.00m GREY SANDSTONE 195.00m-210.00m SILTSTONE	251m	North East
GW107048	0.00m-7.00m shale, brown 7.00m-76.00m shale, black	566m	East
GW110948	0.00m-0.50m FILL.TOPSOIL,SAND,BROWN,LITTLE GRAVEL 0.50m-2.00m CLAY RED BROWN,SOME SAND,GRAVEL 2.00m-4.00m TUFF,LIGHT GREY 4.00m-13.00m TUFF,SANDY GREY,FIRM TO STIFF	676m	North West
GW110949	0.00m-1.00m FILL,SAND AND LITTLE GRAVEL 1.00m-2.50m CLAY,RED BROWN,DRY,FIRM,DENSE,SOME SND 2.50m-14.00m TUFF SANDY,SILTY,DARK GREY TO GREY	691m	North West
GW110947	0.00m-1.00m FILL,TOPSOIL BROWN,SAND,DRY 1.00m-2.00m CLAY LITTLE SAND,BROWN 2.00m-14.30m TUFF,Water level not apparent as drilling with water.	703m	North West
GW110946	0.00m-0.50m FILL.DRY SAND 0.50m-2.00m CLAY BROWN,DRY STIFF,L/PLASTICITY 2.00m-3.10m CLAY SOME SAND 3.10m-10.00m TUFF 10.00m-11.00m SANDSTONE 11.00m-12.60m TUFF CONSOLIDATED 12.60m-14.50m TUFF HETEROGENEOUS FROM SOFT,FIRM,HARD	722m	North West
GW114749	0.00m-0.15m PAVEMENT - CONCRETE 0.15m-1.50m FILL SILTY CLAY 1.50m-3.00m CLAYS YELLOW BROWN 3.00m-7.00m SANDSTONE WEATHERED, FINE GRAINED	728m	North West
GW114750	0.00m-0.15m PAVEMENT- CONCRETE 0.15m-1.50m FILL, SILTY CLAY 1.50m-3.00m CLAYS-YELLOW BROWN 3.00m-10.00m SANDSTONE WEATHERED,FINE GRAINE4D YELLOW BROWN	744m	North West
GW110733	0.00m-0.50m TOPSOIL 0.50m-1.00m SOIL DARK 1.00m-2.50m CLAY WHITE 2.50m-4.60m CLAY RED 4.60m-7.20m SAND DARK, CLAY	835m	North East
GW072340	0.00m-3.00m SHALE & CLAY 3.00m-24.00m BLUE SHALE	958m	East
GW114547	0.00m-0.50m GRAVEL / FILL 0.50m-1.50m SANDY CLAY, YELLOW,BROWN.RED 1.50m-8.00m SANDSTONE,YELLOW,BROWN,RED	1082m	North West
GW114548	0.00m-0.50m FILL MATERIAL,CLAY,BRICK,WASTE 0.50m-5.00m SANDY CLAY, YELLOW, GREY	1093m	North West
GW114546	0.00m-0.20m CONCRETE 0.20m-0.40m FILL SAND 0.40m-12.00m SANDY CLAY, YELLOW RED BROWN	1112m	North West
GW111837	0.00m-0.80m FILL,GRAVELLY SILTY CLAY,BROWN,IRONSTONE,GRAVEL 0.80m-1.20m FILL,SILT L/BROWN,CREAM,DRY 1.20m-2.30m SILTY CLAY,ORANGE,RED,BROWN,L/PLAST. 2.30m-3.30m CLAY,RED,ORANGE,GREY,MOTTLED,VERY STIFF 3.30m-3.90m SANDY CLAY,L/GREY,MOIST 3.90m-5.90m CLAY,RED ORANGE,GREY,QUARTZ GRAVELS	1139m	North West
GW111836	0.00m-1.20m FILL GRAVELLY SILTY CLAY,BROWN,ORANGE,IRONSTONE,GRAVEL 1.20m-3.20m CLAY SILTY,ORANGE,RED,BROWN,GREY 3.20m-5.10m CLAY SILTY,GREY,VERY STIFF,DRY.L/PLASTICITY	1144m	North West
GW111835	0.00m-1.80m SILT,DADDRK BROWN,DRY,ROOTLETS 1.80m-5.00m CLAY SILTY YELLOW ORANGE BROWN	1147m	North West
GW115045	0.00m-3.00m SILTY CLAY ORANGE BROWN 3.00m-7.00m SANDY CLAY DARK BROWN FINE GRAINED 7.00m-10.00m CLAYEY SAND ORANGE BROWN	1194m	North East

Groundwater No	Drillers Log	Distance	Direction
GW114344	0.00m-0.30m GRAVELLY SAND,DARK BROWN,MG 0.30m-1.00m SANDY CLAY, BROWN SOFT 1.00m-1.30m CLAY RED/BROWN,VERY HARD 1.30m-4.00m CLAYEY SHALE FRAGMENTS,BROWN 4.00m-5.50m CLAYEY SHALE BROWN 5.50m-7.20m SILTY CLAY, RED/ GREY	1275m	South West
GW115050	0.00m-3.00m SANDY LOAM LIGHT BROWN 3.00m-6.00m SAND GREY WITH SHELLS 6.00m-8.00m SAND BROWN COARSE WITH GRAVELS 8.00m-9.00m SAND LIGHT GREY CLAYEY /GRAVELS 9.00m-10.00m CLAY VERY LIGHT GREY	1280m	North East
GW114343	0.00m-0.50m GRAVELLY SAND 0.50m-1.70m FILL, CLAY,RED BROWN 1.70m-5.50m CLAYEY SHALE FRAGMENTS 5.50m-7.50m SILTY CLAY,GREY , BROWN	1282m	South West
GW114342	0.00m-0.30m GRAVELLY SAND FILL,DARK BROWN MG 0.30m-0.50m SILTY CLAY,BROWN SOFT 0.50m-1.30m CLAY RED,BROWN, VERY HARD 1.30m-4.00m CLAYEY SHALE FRAGMENTS BROWN 4.00m-5.50m SILTY CLAY AND ROCKS ORANGE 5.50m-7.10m SILTY CLAY AND ROCKS SOFTER	1290m	South West
GW115051	0.00m-2.00m CLAYEY LOAM DARK BROWN 2.00m-3.00m SANDY CLAY BROWN 3.00m-7.00m SAND GREY MEDIUM GRAINED 7.00m-10.00m CLAY DARK GREY WITH 5% SHELLS	1391m	North East
GW114405	0.00m-0.70m FILL MIXED 0.70m-1.50m SILTY CLAY.MOIST ORANGE BROWN 1.50m-3.00m SILTY CLAY MOIST GREY RED BROWN	1483m	North West
GW114404	0.00m-1.00m FILL MIXED 1.00m-2.00m SILTY CLAY,YELLOW BROWN	1490m	North West
GW114406	0.00m-1.00m SILTY CLAY FINE GRAVEL 1.00m-3.00m SILTY CLAY WHITE GREY 3.00m-4.00m SAND SILTY CLAY WET ORANGE BROWN	1494m	North West
GW115049	0.00m-2.00m CLAY LOAMY DARK BROWN 2.00m-10.00m CLAY BROWNISH GREY AND SHELLS	1607m	North East
GW115046	0.00m-2.00m SANDY LOAM LIGHT BROWN 2.00m-3.00m CLAYEY AND SANDY LOAM 3.00m-4.00m SAND GREY AND COARSE 4.00m-8.00m GREY COARSE SAND 8.00m-9.00m GREY CLAYEY COARSE SAND 9.00m-10.00m GREY SANDY CLAY WITH5% SHELLS	1633m	North East
GW115048	0.00m-2.00m CLAY GRADING INTO SAND DARK BROWN 2.00m-17.00m SILTY CLAY DARK GREY WITH15-20 % SHELLS	1839m	North East
GW101695	0.00m-0.50m Soil 0.50m-3.00m Clay 3.00m-48.00m Grey Sandstone	1927m	North West
GW110451	0.00m-0.10m FILL,GRAVEL,TOP DRESSING 0.10m-1.20m SILTY CLAY,ORANGE BROWN AND GREY 1.20m-4.50m CLAYEY SILT,BROWN ORGANIC ODOUR 4.50m-6.00m SILTY CLAY,ORANGE,MOIST,SOME GRAVELS 6.00m-9.00m CLAYEY SILT,GREY,BROWN	1960m	West
GW115047	0.00m-3.00m CLAY LOAMY DARK BROWN 3.00m-4.00m CLAY DARK GREY 4.00m-13.00m SILTY CLAY DARK GREY WITH SHELLS 13.00m-20.00m SILTY CLAY DARK GREY	1974m	North East
GW110453	0.00m-0.30m CONCRETE,PAVEMENT SLAB 0.30m-0.40m ROADBASE,GREY CRUSHED ROCK 0.40m-3.00m SILTY CLAY,ORANGE,BROWN AND RED 3.00m-9.00m CLAYEY SILT.RED BRPWM.SOME SAND	1984m	West
GW110452	0.00m-0.30m CONCRETE,PAVEMENT SLAB 0.30m-0.40m ROADBASE,GREY CRUSHED ROCK 0.40m-3.50m SILTY CLAY,ORANGE,GREY AND RED,MOIST 3.50m-7.50m CLAYEY SILT,ORANGE B ROWN,OCCASIONAL GRAVELL CLAYEY SILT 7.50m-10.00m GRAVELL CLAYEY SILT,DARK BROWN	1985m	West
GW110450	0.00m-0.10m FILL,GRAVEL AND TOP DRESSING 0.10m-1.50m SILTY CLAY,ORANGE BROWN AND GREY,DRY 1.50m-6.00m CLAYEY SANDY SILT,ORANGE BROWN FINE GRAINED 6.00m-9.00m CLAYEY SILT,DARK GREY BRWON VERY MOIST	1996m	West

Drill Log Data Source: NSW Department of Primary Industries - Office of Water / Water Administration Ministerial Corp
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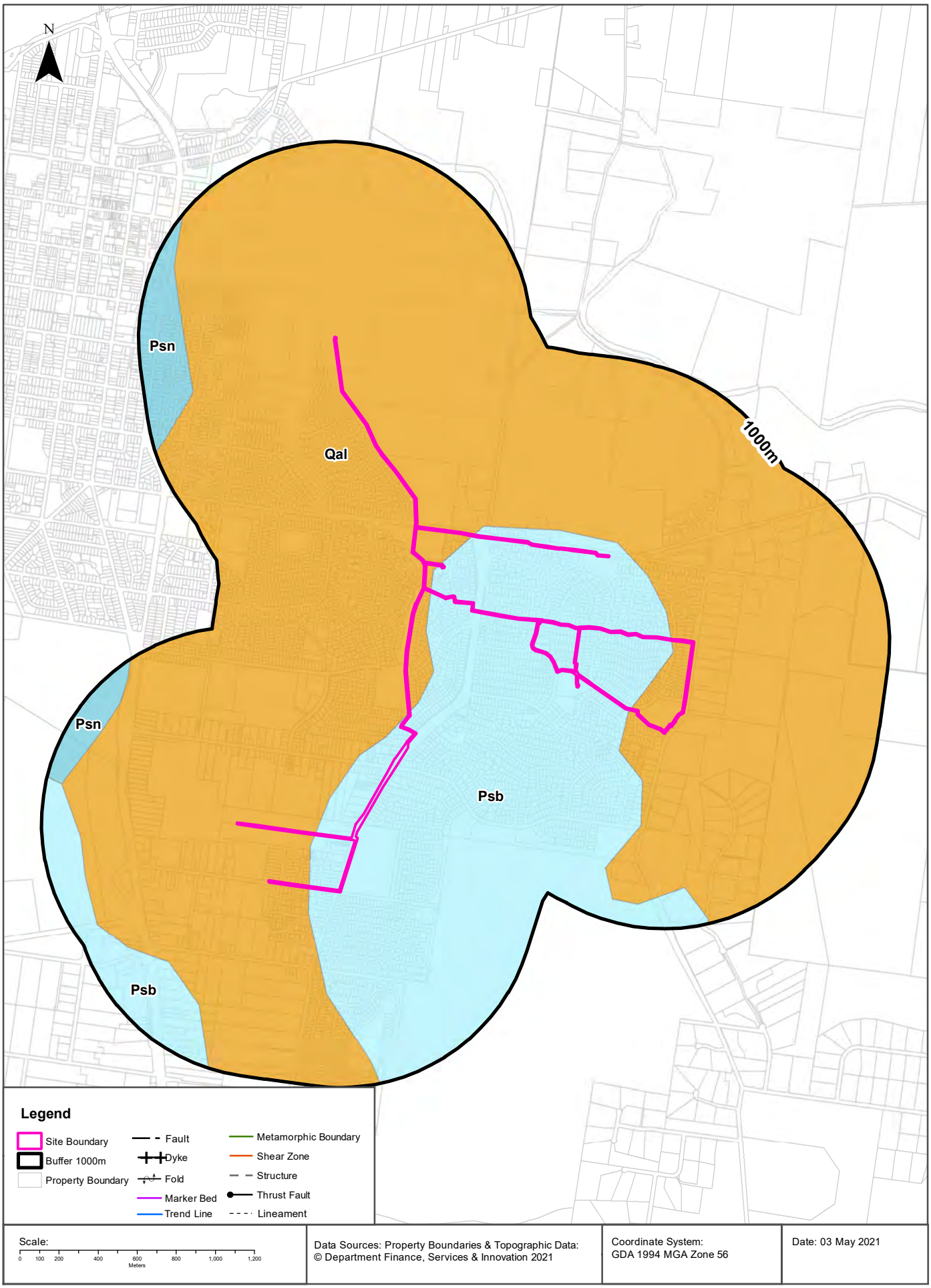
Geology

Proposed Sewer Upgrade, South Nowra, NSW 2540



Geology

Proposed Sewer Upgrade, South Nowra, NSW 2540

Geological Units 1:250,000

What are the Geological Units within the dataset buffer?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dist	Dir
Psb	Bluish grey to light grey siltstone, shaly in part with bands of silty sandstone	Berry Siltstone	Shoalhaven Group		Palaeozoic	0m	On-site
Qal	Alluvium, gravel, sand silt and clay	undifferentiated			Cainozoic	0m	On-site
Psn	Quartzose sandstone, minor siltstone plus conglomerate beds	Nowra Sandstone	Shoalhaven Group		Palaeozoic	753m	North West

Geological Structures 1:250,000

What are the Geological Structures within the dataset buffer?

Feature	Name	Description	Map Sheet	Distance	Direction
N/A	No records in buffer				

Geological Data Source : NSW Department of Industry, Resources & Energy

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Naturally Occurring Asbestos Potential

Proposed Sewer Upgrade, South Nowra, NSW 2540

Naturally Occurring Asbestos Potential

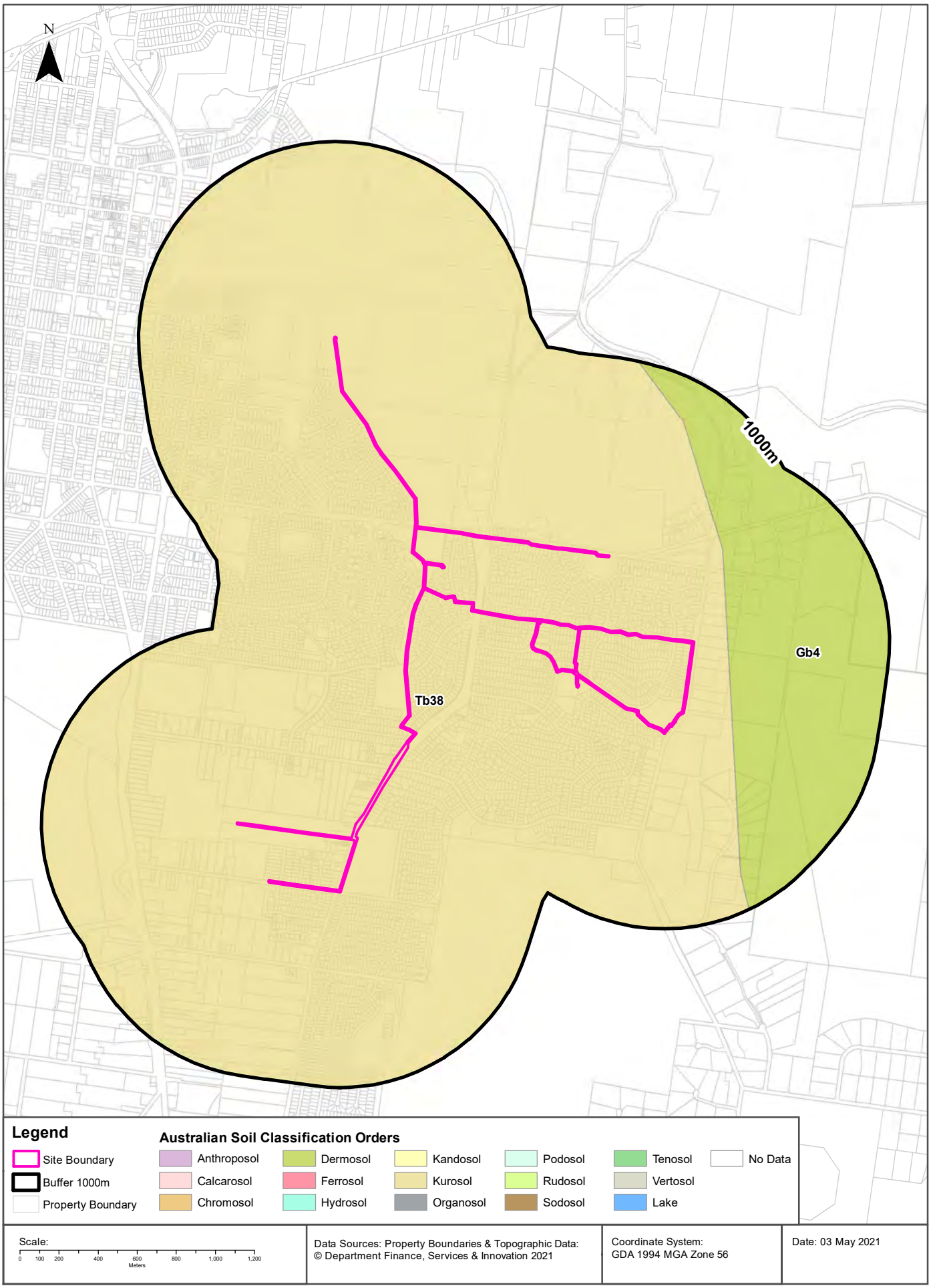
Naturally Occurring Asbestos Potential within the dataset buffer:

Potential	Sym	Strat Name	Group	Formation	Scale	Min Age	Max Age	Rock Type	Dom Lith	Description	Dist	Dir
No records in buffer												

Naturally Occurring Asbestos Potential Data Source: © State of New South Wales through NSW Department of Industry, Resources & Energy

Atlas of Australian Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540



Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540

Atlas of Australian Soils

Soil mapping units and Australian Soil Classification orders within the dataset buffer:

Map Unit Code	Soil Order	Map Unit Description	Distance	Direction
Tb38	Kurosol	Flat to undulating: chief soils are hard acidic yellow and yellow mottled soils (Dy2.41) and (Dy3.41) sometimes containing ironstone gravel. Associated are hard acidic red soils (Dr2.21, Dr2.41), and small areas of other soils, including (Gn2) and (Gn3.54).	0m	On-site
Gb4	Dermosol	River terraces: (1) lower of dark, porous, loamy soils (Um6.11), (2) middle of (Gn2.2 and Gn2.4),(3) upper of (Dy2.41 or Dy3.41 or Dy5.41), and (4) present floodplains of various (Uc1 and Um1) soils..	169m	East

Atlas of Australian Soils Data Source: CSIRO
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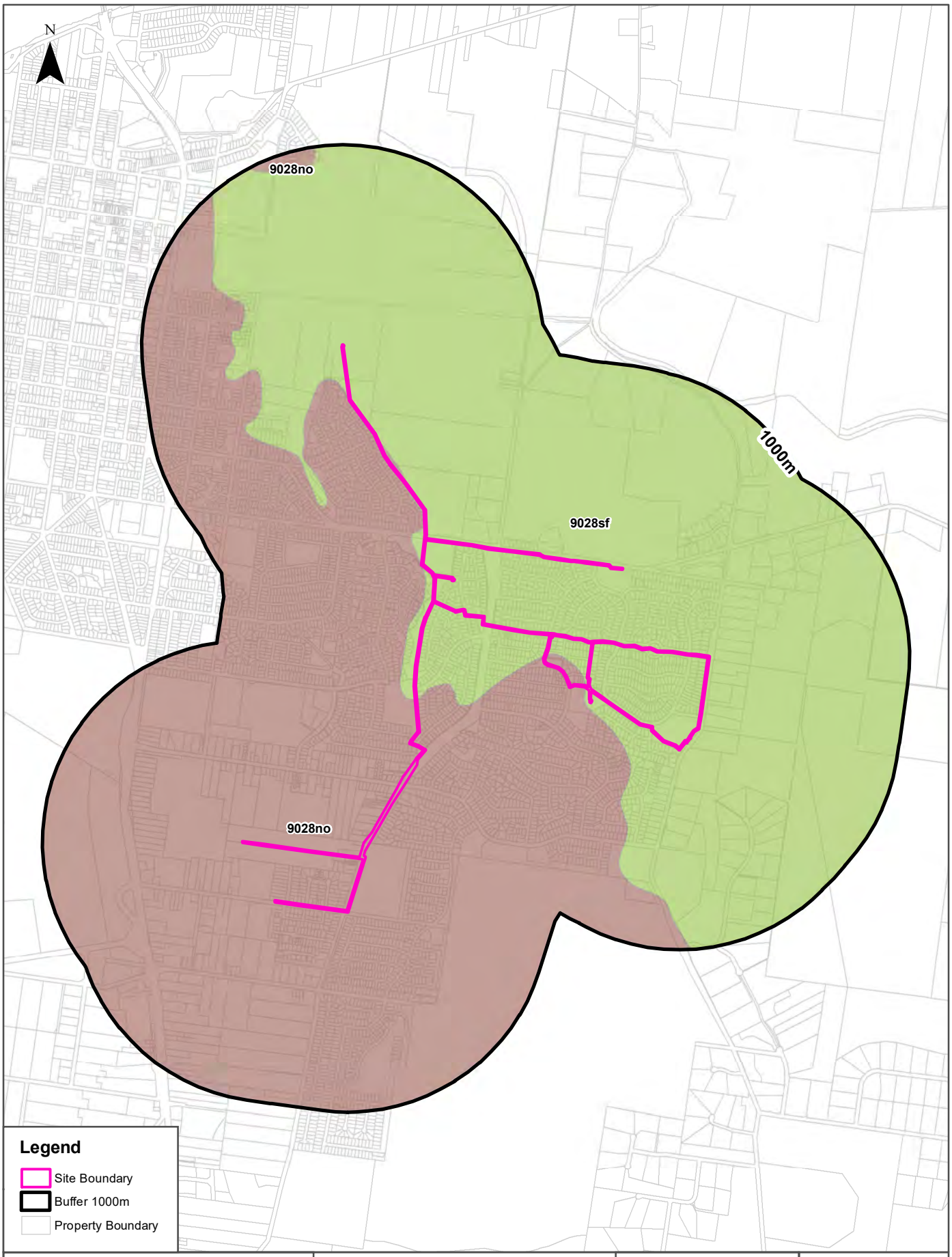
Soil Landscapes of Central and Eastern NSW

Proposed Sewer Upgrade, South Nowra, NSW 2540



Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540

Soil Landscapes of Central and Eastern NSW

Soil Landscapes of Central and Eastern NSW within the dataset buffer:

Soil Code	Name	Distance	Direction
9028sf	Shoalhaven	0m	On-site
9028no	Nowra	0m	On-site

Soil Landscapes of Central and Eastern NSW: NSW Department of Planning, Industry and Environment
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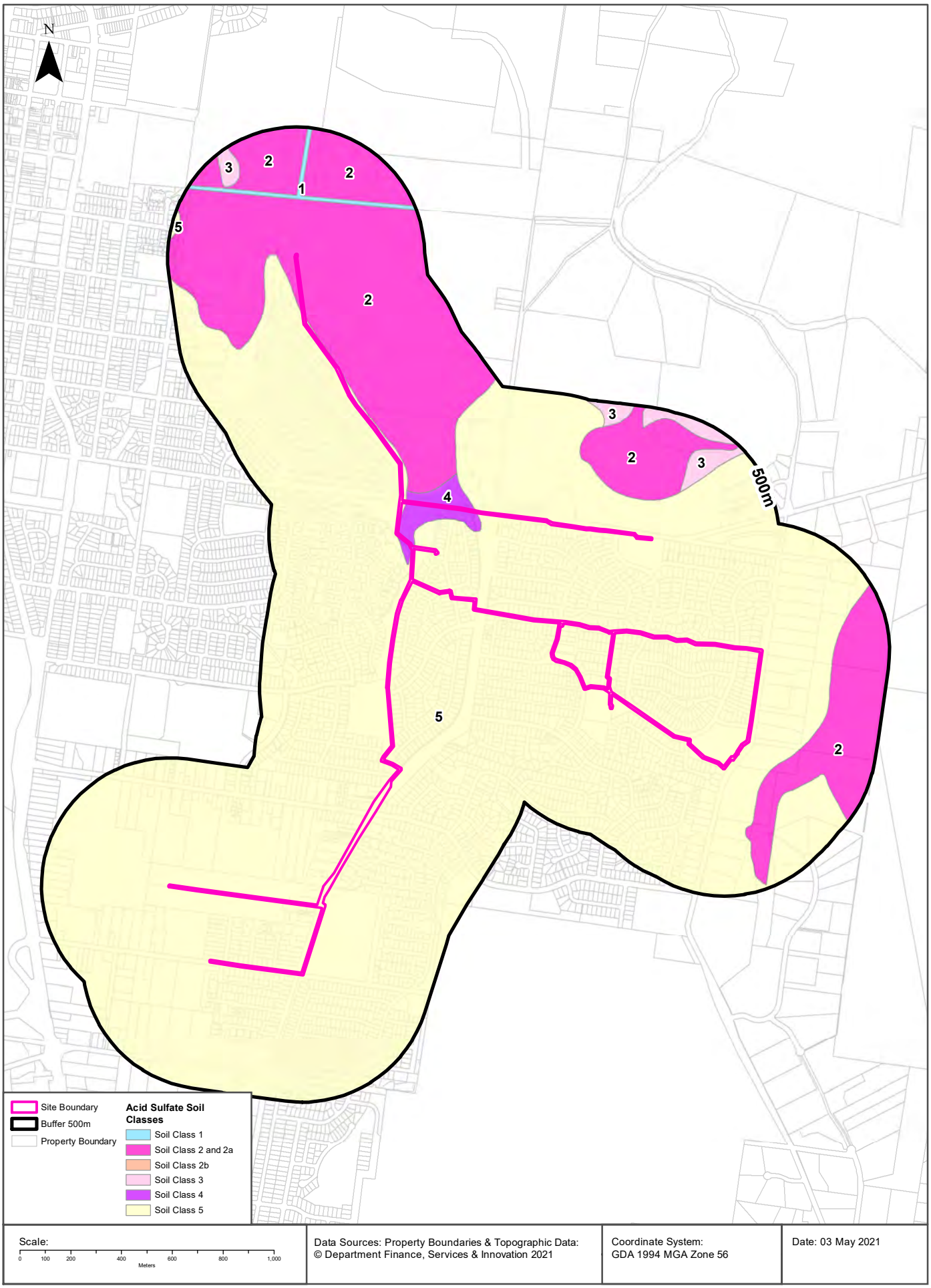
Acid Sulfate Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540



Acid Sulfate Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540

Environmental Planning Instrument - Acid Sulfate Soils

What is the on-site Acid Sulfate Soil Plan Class that presents the largest environmental risk?

Soil Class	Description	EPI Name
2	Works below natural ground surface present an environmental risk; Works by which the watertable is likely to be lowered present an environmental risk	Shoalhaven Local Environmental Plan 2014

If the on-site Soil Class is 5, what other soil classes exist within 500m?

Soil Class	Description	EPI Name	Distance	Direction
N/A				

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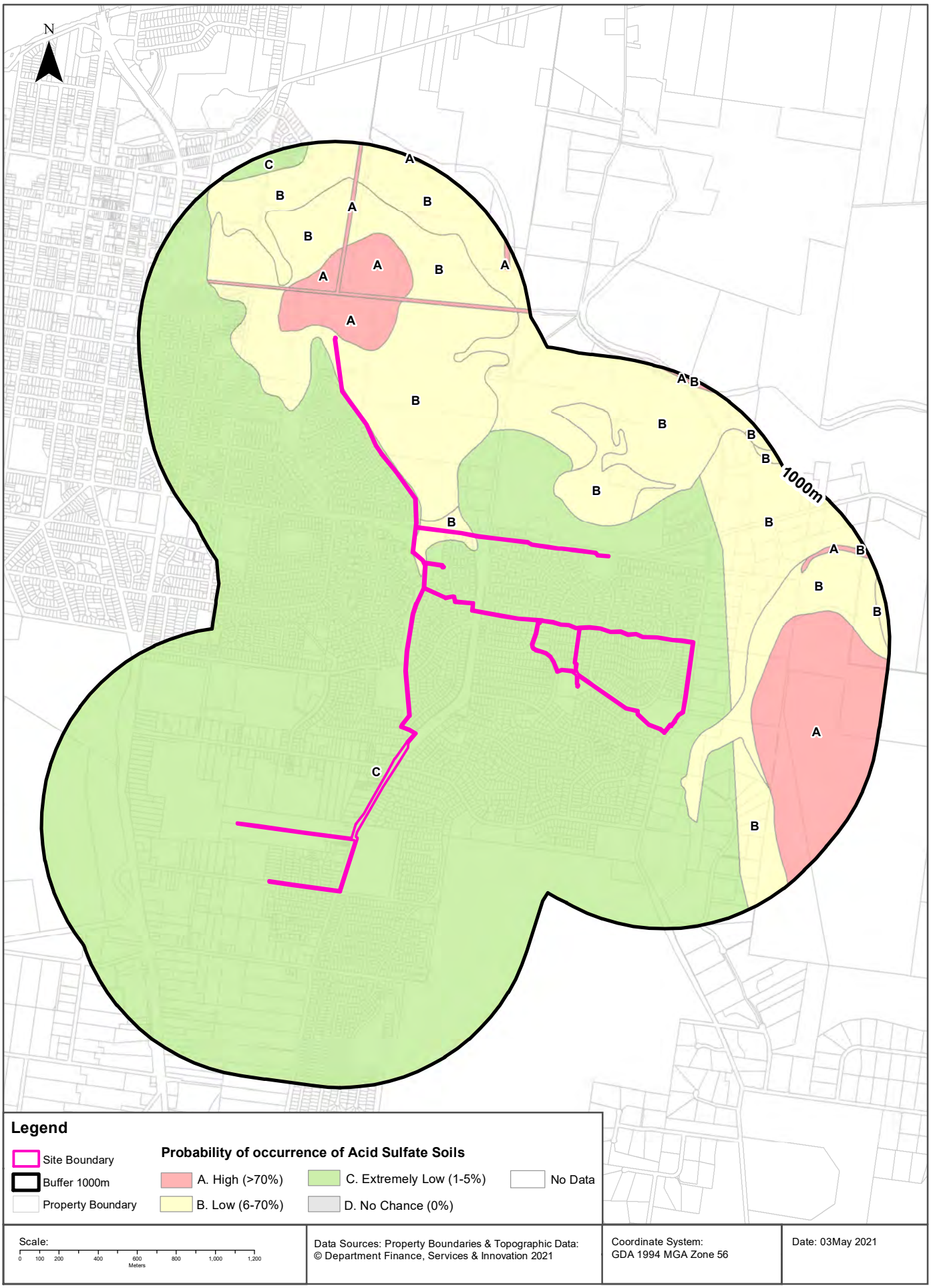
Atlas of Australian Acid Sulfate Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540



Acid Sulfate Soils

Proposed Sewer Upgrade, South Nowra, NSW 2540

Atlas of Australian Acid Sulfate Soils

Atlas of Australian Acid Sulfate Soil categories within the dataset buffer:

Class	Description	Distance	Direction
C	Extremely low probability of occurrence. 1-5% chance of occurrence with occurrences in small localised areas.	0m	On-site
B	Low Probability of occurrence. 6-70% chance of occurrence.	0m	On-site
A	High Probability of occurrence. >70% chance of occurrence.	232m	North

Atlas of Australian Acid Sulfate Soils Data Source: CSIRO
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Dryland Salinity

Proposed Sewer Upgrade, South Nowra, NSW 2540

Dryland Salinity - National Assessment

Is there Dryland Salinity - National Assessment data onsite?

No

Is there Dryland Salinity - National Assessment data within the dataset buffer?

No

What Dryland Salinity assessments are given?

Assessment 2000	Assessment 2020	Assessment 2050	Distance	Direction
N/A	N/A	N/A		

Dryland Salinity Data Source : National Land and Water Resources Audit
The Commonwealth and all suppliers of source data used to derive the maps of "Australia, Forecast Areas Containing Land of High Hazard or Risk of Dryland Salinity from 2000 to 2050" do not warrant the accuracy or completeness of information in this product. Any person using or relying upon such information does so on the basis that the Commonwealth and data suppliers shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information. Any persons using this information do so at their own risk.
In many cases where a high risk is indicated, less than 100% of the area will have a high hazard or risk.

Mining

Proposed Sewer Upgrade, South Nowra, NSW 2540

Mining Subsidence Districts

Mining Subsidence Districts within the dataset buffer:

District	Distance	Direction
There are no Mining Subsidence Districts within the report buffer		

Mining Subsidence District Data Source: © Land and Property Information (2016)
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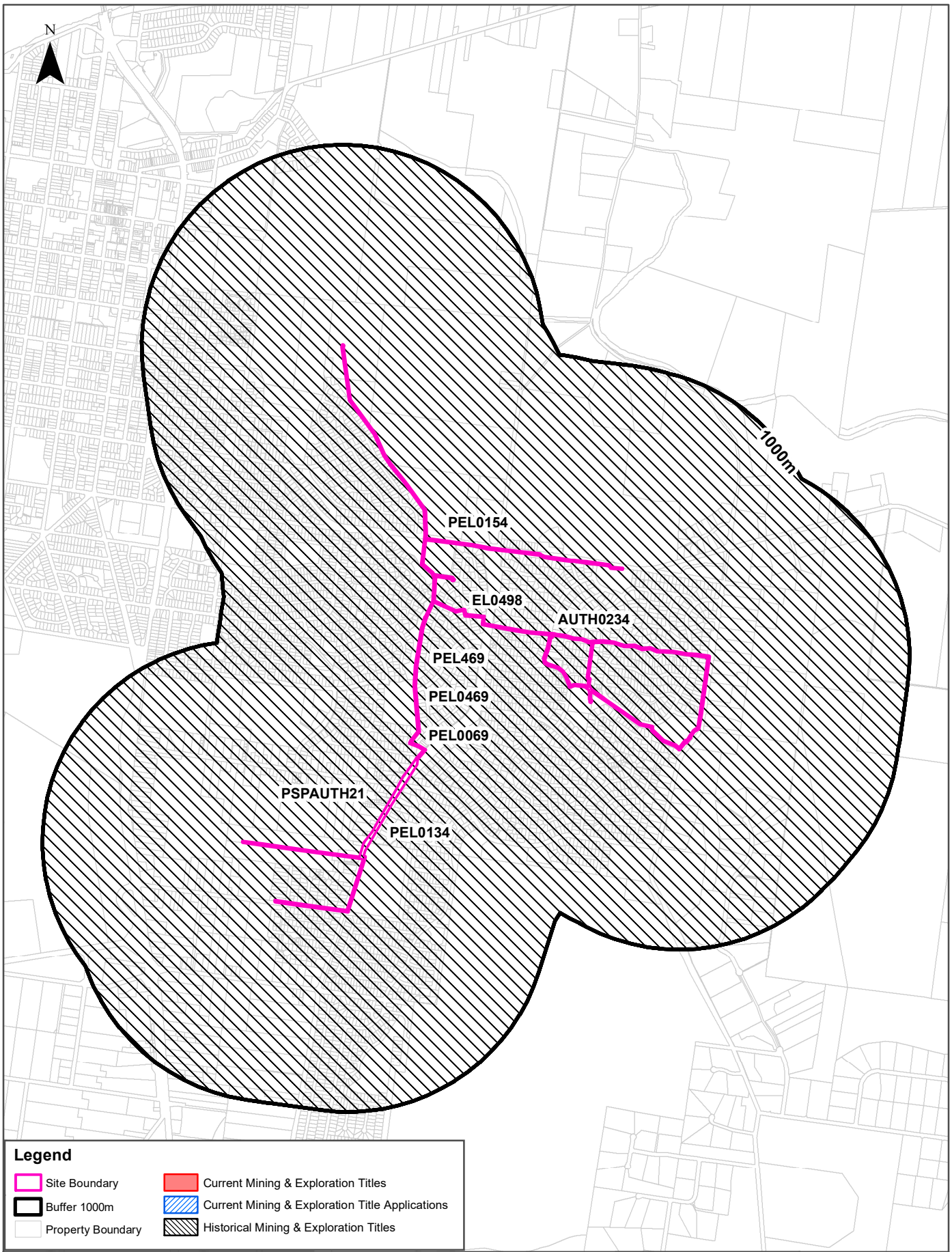
Mining & Exploration Titles

Proposed Sewer Upgrade, South Nowra, NSW 2540



Mining

Proposed Sewer Upgrade, South Nowra, NSW 2540

Current Mining & Exploration Titles

Current Mining & Exploration Titles within the dataset buffer:

Title Ref	Holder	Grant Date	Expiry Date	Last Renewed	Operation	Resource	Minerals	Dist	Dir
N/A	No records in buffer								

Current Mining & Exploration Titles Data Source: © State of New South Wales through NSW Department of Industry

Current Mining & Exploration Title Applications

Current Mining & Exploration Title Applications within the dataset buffer:

Application Ref	Applicant	Application Date	Operation	Resource	Minerals	Dist	Dir
N/A	No records in buffer						

Current Mining & Exploration Title Applications Data Source: © State of New South Wales through NSW Department of Industry

Mining

Proposed Sewer Upgrade, South Nowra, NSW 2540

Historical Mining & Exploration Titles

Historical Mining & Exploration Titles within the dataset buffer:

Title Ref	Holder	Start Date	End Date	Resource	Minerals	Dist	Dir
PEL0134	CANADIAN AUSTRALIAN PETROLEUM NL			PETROLEUM	Petroleum	0m	On-site
AUTH0234	ELECTRICITY COMMISSION OF NSW	07 May 1981	07 May 1983	COAL	Coal	0m	On-site
PEL0469	LEICHHARDT RESOURCES PTY LTD	30/04/2009	13/10/2014	PETROLEUM	Petroleum	0m	On-site
PEL0069	ALLIANCE OIL DEVELOPMENT AUSTRALIA NL, OIL DEVELOPMENT NL			PETROLEUM	Petroleum	0m	On-site
PEL469	LEICHHARDT RESOURCES PTY LTD			MINERALS		0m	On-site
PEL0154	GENOA OIL NL, HARTOG OIL NL			PETROLEUM	Petroleum	0m	On-site
EL0498	DOWNES, C	01 Feb 1972	01 Oct 1976	MINERALS	Brick clay	0m	On-site
PSPAUTH21	LEICHHARDT RESOURCES PTY LTD	18/02/2008	18/02/2009	PETROLEUM	Petroleum	0m	On-site

Historical Mining & Exploration Titles Data Source: © State of New South Wales through NSW Department of Industry

State Environmental Planning Policy

Proposed Sewer Upgrade, South Nowra, NSW 2540

State Significant Precincts

What SEPP State Significant Precincts exist within the dataset buffer?

Map Id	Precinct	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
N/A	No records in buffer							

State Environment Planning Policy Data Source: NSW Crown Copyright - Planning & Environment
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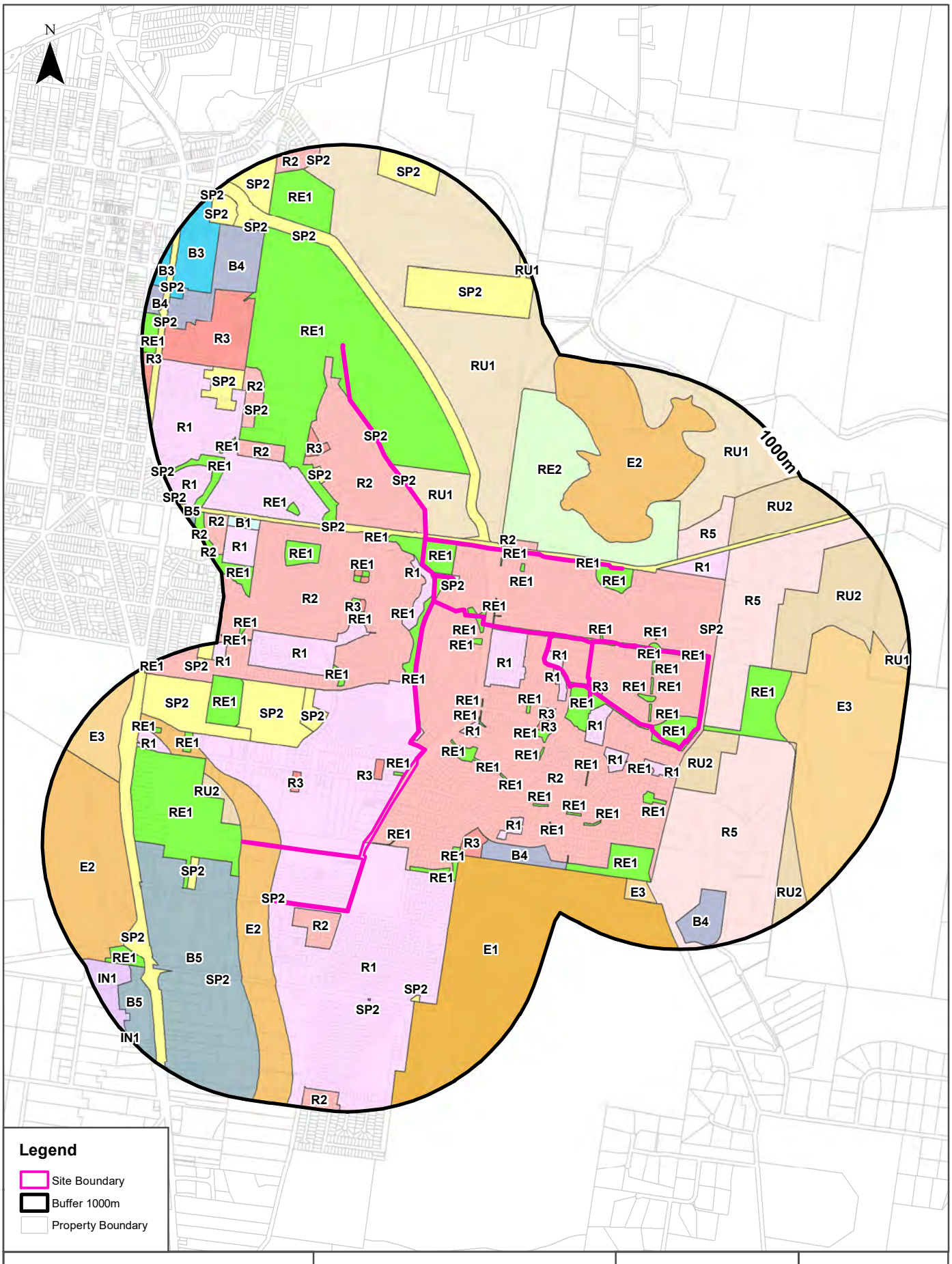
EPI Planning Zones

Proposed Sewer Upgrade, South Nowra, NSW 2540



Environmental Planning Instrument

Proposed Sewer Upgrade, South Nowra, NSW 2540

Land Zoning

What EPI Land Zones exist within the dataset buffer?

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
E2	Environmental Conservation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
RU1	Primary Production		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		0m	On-site
SP2	Infrastructure	Road	Shoalhaven Local Environmental Plan 2014	27/09/2019	27/09/2019	09/04/2021	Amendment No 23	0m	On-site
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		3m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		5m	South West
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		7m	South West
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		8m	South East
RE2	Private Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		10m	North East
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		10m	North East
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		11m	South East
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		12m	South West
RU1	Primary Production		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		14m	North
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		14m	South West
R5	Large Lot Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		17m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		17m	East
RU2	Rural Landscape		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		18m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		18m	South East
SP2	Infrastructure	Road	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		19m	North
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		27m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		35m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		38m	North
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		41m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		54m	North East

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		70m	South
RU2	Rural Landscape		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		80m	South West
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		89m	South West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		95m	West
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		96m	South East
E2	Environmental Conservation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		106m	North East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		107m	South East
B5	Business Development		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		113m	South West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		116m	South
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		126m	East
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		129m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		131m	East
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		157m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		157m	South East
R5	Large Lot Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		160m	South East
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		165m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		187m	South East
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		188m	South
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		193m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		206m	North West
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		214m	North West
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		219m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		221m	South East
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		222m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		225m	South
SP2	Infrastructure	Residential Accommodation	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		231m	South West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		254m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		264m	West
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		270m	West
R5	Large Lot Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		271m	North East
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		277m	South West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		295m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		295m	South
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		296m	North West

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		296m	South
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		297m	West
SP2	Infrastructure	Place of Public Worship	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		303m	North West
RU2	Rural Landscape		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		308m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		316m	South
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		324m	South East
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		335m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		339m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		346m	West
SP2	Infrastructure	Sewage Treatment Plant	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		357m	North
E3	Environmental Management		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		362m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		369m	South
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		379m	North West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		388m	South
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		390m	South
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		395m	North West
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		409m	North West
E1	National Parks and Nature Reserves		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		417m	South
SP2	Infrastructure	Community Facility	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		432m	South West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		434m	North West
RU2	Rural Landscape		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		446m	South East
SP2	Infrastructure	Water Supply System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		448m	South
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		463m	North West
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		479m	South West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		485m	South West
B4	Mixed Use		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		486m	South
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		497m	North West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		501m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		501m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		503m	North West
B4	Mixed Use		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		508m	North West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		511m	South East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		511m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		514m	West

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		526m	South
RU2	Rural Landscape		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		533m	East
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		534m	South East
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		540m	South
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		554m	South
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		556m	North West
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		561m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		573m	West
E2	Environmental Conservation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		582m	South West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		598m	North West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		631m	South
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		679m	West
E3	Environmental Management		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		680m	South East
E3	Environmental Management		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		683m	West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		683m	North West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		688m	North West
B1	Neighbourhood Centre		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		697m	North West
B4	Mixed Use		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		705m	South East
B3	Commercial Core		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		707m	North West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		717m	South West
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		727m	West
B5	Business Development		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		730m	South West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		751m	North West
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		760m	North West
IN1	General Industrial		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		798m	South West
SP2	Infrastructure	Educational Establishment	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		806m	North West
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		825m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		830m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		840m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		871m	West
SP2	Infrastructure	Childcare Centre	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		880m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		889m	West
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		892m	North West
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		897m	South

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
R2	Low Density Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		902m	North
R1	General Residential		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		902m	West
SP2	Infrastructure	Health Services Facilities	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		919m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	03/08/2018	03/08/2018	09/04/2021	Amendment No 19	920m	North West
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		921m	North
B4	Mixed Use		Shoalhaven Local Environmental Plan 2014	03/08/2018	03/08/2018	09/04/2021	Amendment No 19	923m	North West
R3	Medium Density Residential		Shoalhaven Local Environmental Plan 2014	20/03/2020	20/03/2020	09/04/2021	Amendment No 30	929m	North West
RU1	Primary Production		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		931m	East
B3	Commercial Core		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		933m	North West
B5	Business Development		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		942m	West
RE1	Public Recreation		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		983m	West
SP2	Infrastructure	Sewerage System	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		988m	North West
SP3	Tourist		Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	09/04/2021		995m	West

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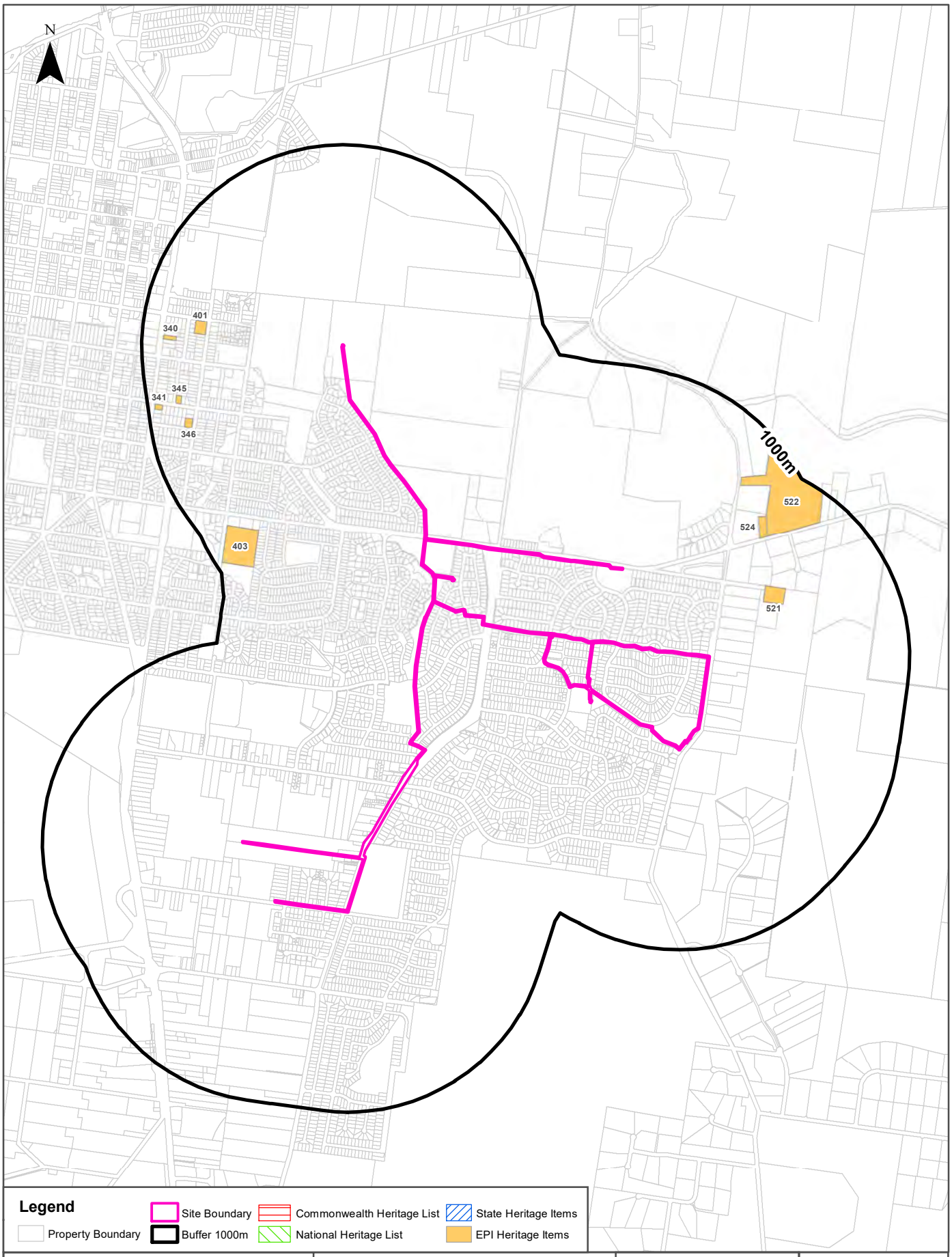
Heritage Items

Proposed Sewer Upgrade, South Nowra, NSW 2540



Heritage

Proposed Sewer Upgrade, South Nowra, NSW 2540

Commonwealth Heritage List

What are the Commonwealth Heritage List Items located within the dataset buffer?

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
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National Heritage List

What are the National Heritage List Items located within the dataset buffer?
Note. Please click on Place Id to activate a hyperlink to online website.

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
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State Heritage Register - Curtilages

What are the State Heritage Register Items located within the dataset buffer?

Map Id	Name	Address	LGA	Listing Date	Listing No	Plan No	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: NSW Crown Copyright - Office of Environment & Heritage
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Environmental Planning Instrument - Heritage

What are the EPI Heritage Items located within the dataset buffer?

Map Id	Name	Classification	Significance	EPI Name	Published Date	Commenced Date	Currency Date	Distance	Direction
521	Rubblestone School (former Worrigee Schoolhouse)	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	382m	East
524	Worrigee Cemetery	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	640m	East
522	"Congla" - (former Mackenzie Estate Manager's Residence)	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	664m	North East

Map Id	Name	Classification	Significance	EPI Name	Published Date	Commenced Date	Currency Date	Distance	Direction
401	"Myambah" - Federation Weatherboard Bungalow and garden	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	685m	North West
403	"Nowra Park" - Early Victorian Masonry Residence and garden	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	727m	West
346	"Roseville" - Federation Weatherboard Residence and figtree	Item - General	Local	Shoalhaven Local Environmental Plan 2014	05/03/2021	05/03/2021	05/03/2021	785m	North West
345	"Trelawney" - Victorian Georgian Weatherboard Residence	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	826m	North West
340	"The Pines" - late Victorian Weatherboard Residence and trees	Item - General	Local	Shoalhaven Local Environmental Plan 2014	05/03/2021	05/03/2021	05/03/2021	829m	North West
341	"Cudgerie" - Federation Weatherboard Residence	Item - General	Local	Shoalhaven Local Environmental Plan 2014	08/04/2014	22/04/2014	05/03/2021	926m	North West

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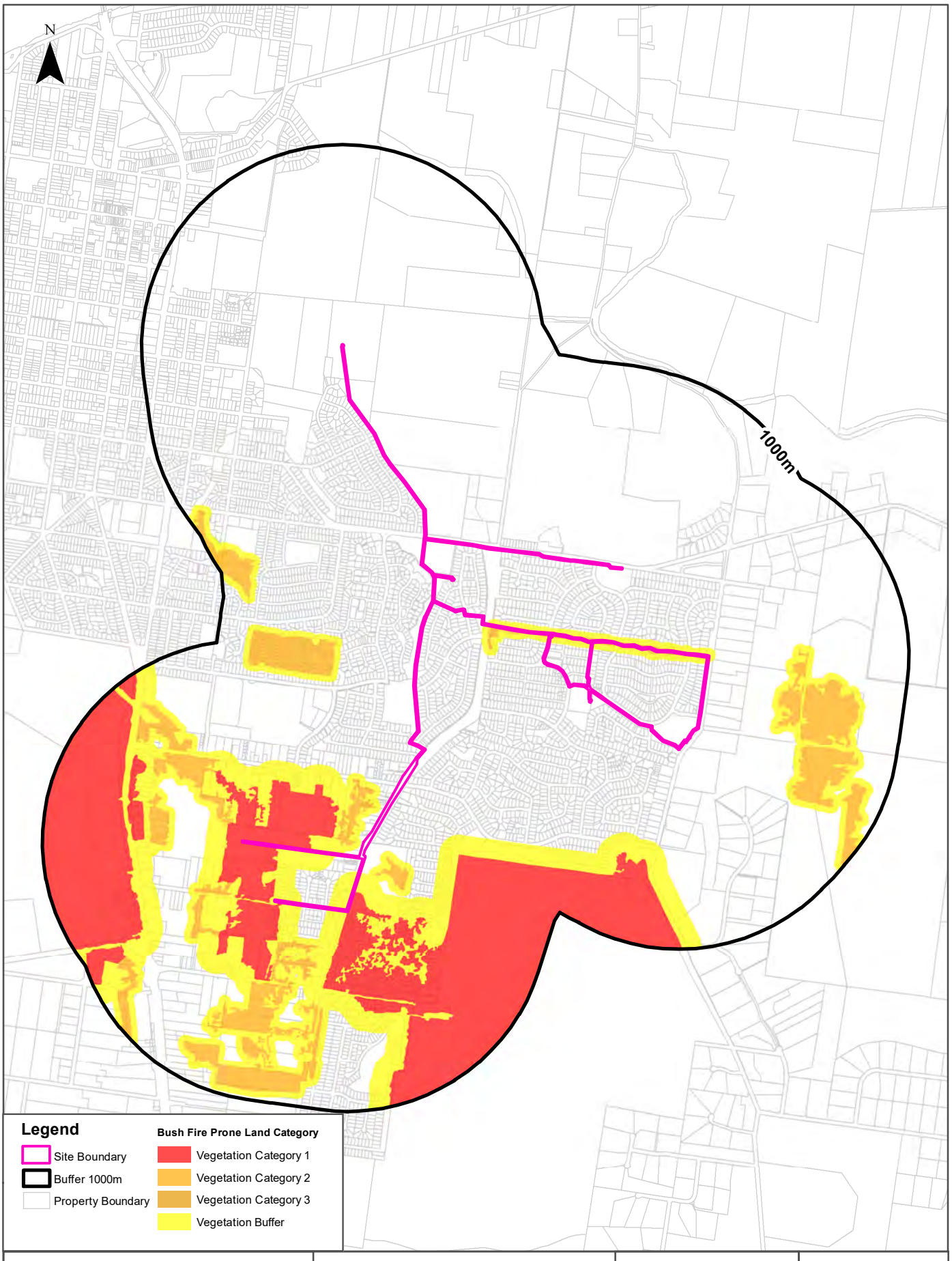
Natural Hazards - Bush Fire Prone Land

Proposed Sewer Upgrade, South Nowra, NSW 2540



Natural Hazards

Proposed Sewer Upgrade, South Nowra, NSW 2540

Bush Fire Prone Land

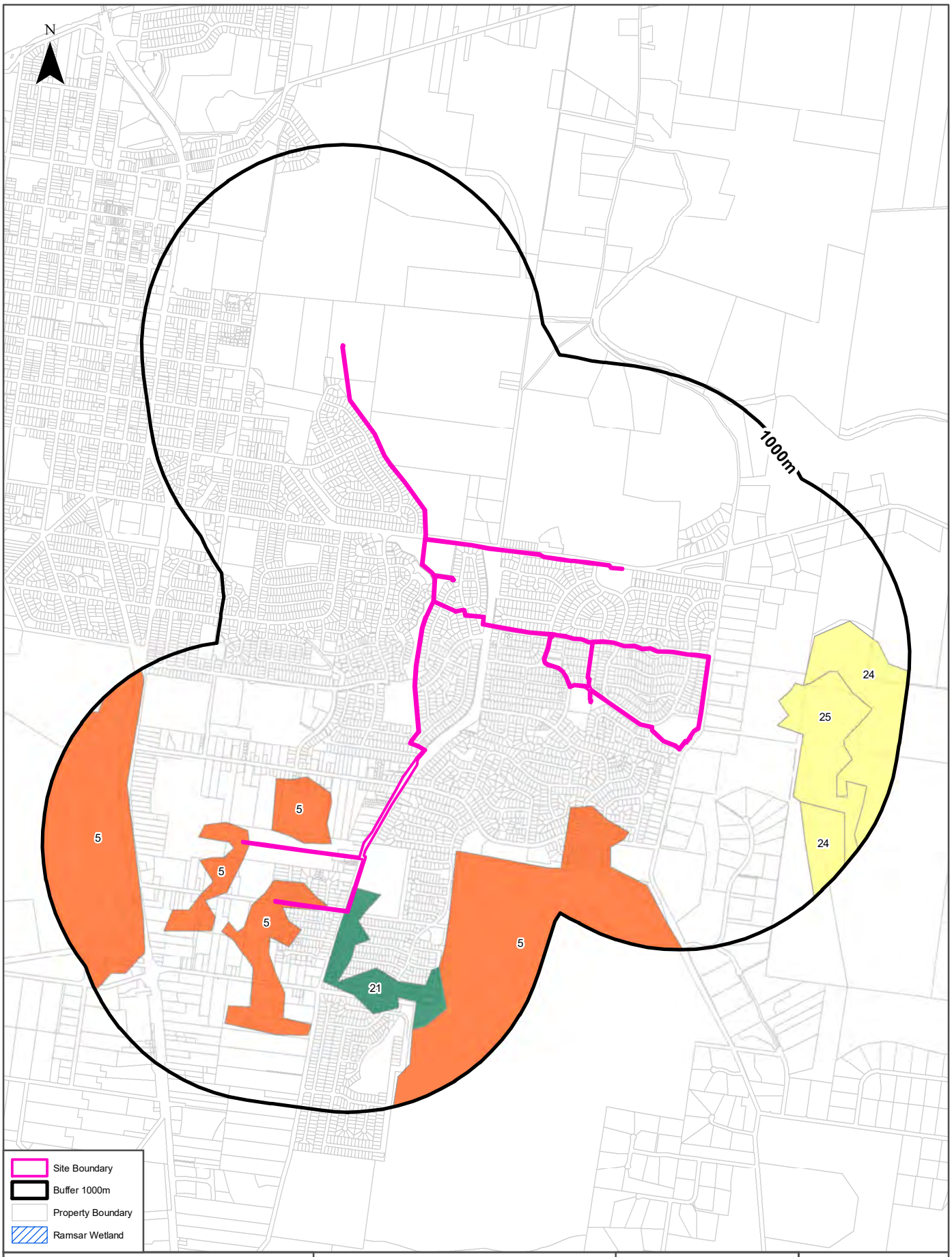
What are the nearest Bush Fire Prone Land Categories that exist within the dataset buffer?

Bush Fire Prone Land Category	Distance	Direction
Vegetation Category 1	0m	On-site
Vegetation Category 2	0m	On-site
Vegetation Buffer	0m	On-site

NSW Bush Fire Prone Land - © NSW Rural Fire Service under Creative Commons 4.0 International Licence

Ecological Constraints - Vegetation & Ramsar Wetlands

Proposed Sewer Upgrade, South Nowra, NSW 2540



Ecological Constraints

Proposed Sewer Upgrade, South Nowra, NSW 2540

Vegetation of the Southern Forests

What vegetation of the Southern Forests exists within the dataset buffer?

Veg Code	Formation	Class	Group	Distance	Direction
5	07 Dry Shrubby Forests	07c Coastal mixed species Dry Shrub forests	Jervis Bay Lowlands Dry Shrub-Grass Forest	0m	On-site
21	02 Wet Sclerophyll Forests	02c South Coast/Hinterland Layered Shrub Forests	South Coast Foothills Moist Shrub Forest	0m	On-site
25	14 Coastal Complex	14b Coastal Swamp Heath/Forest Complex	South Coast Swamp Forest Complex	369m	East
24	14 Coastal Complex	14b Coastal Swamp Heath/Forest Complex	Coastal Wet Heath Swamp Forest	480m	East

Vegetation of the Southern Forests: NSW Office of Environment and Heritage
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Ramsar Wetlands

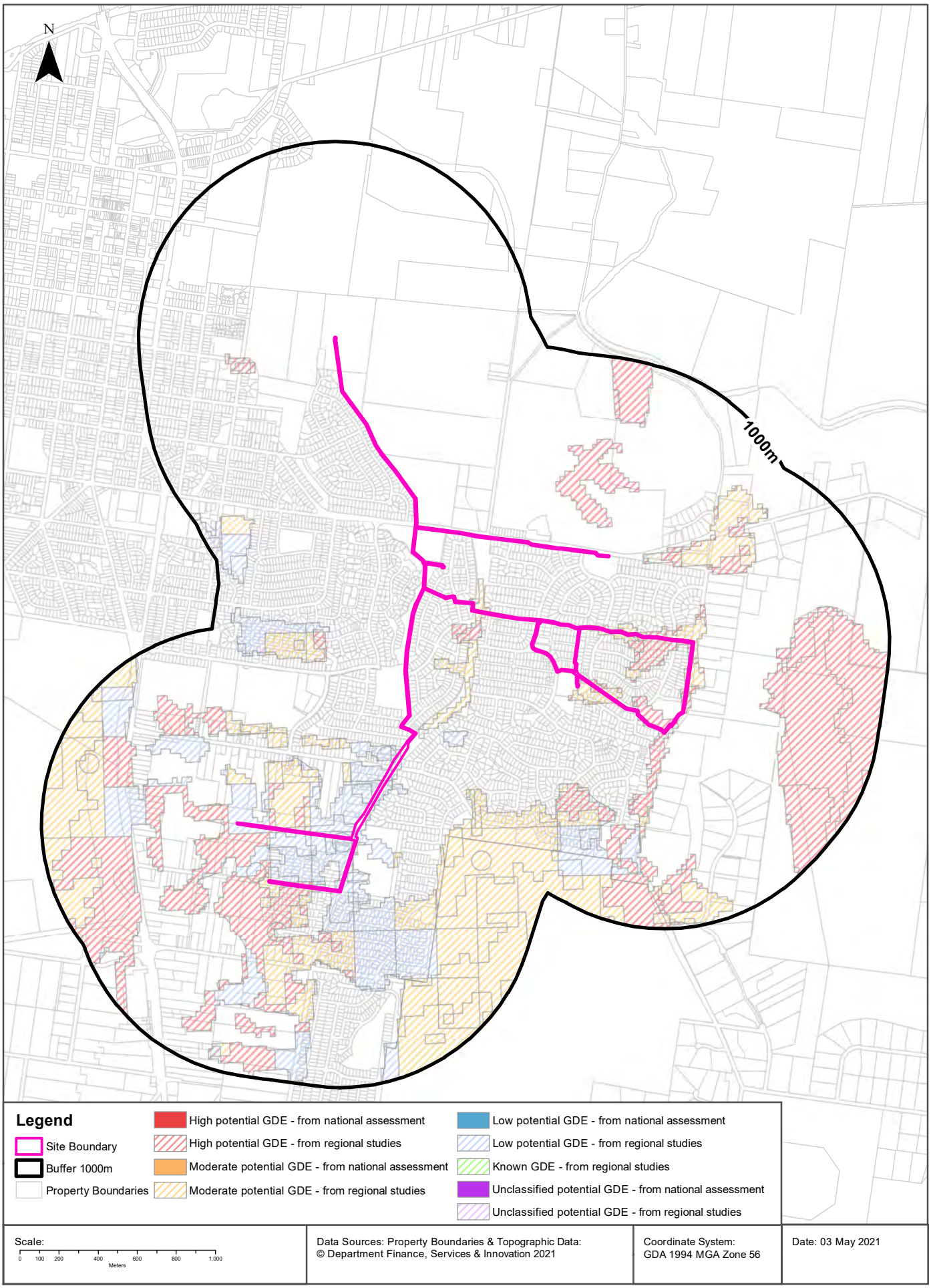
What Ramsar Wetland areas exist within the dataset buffer?

Map Id	Ramsar Name	Wetland Name	Designation Date	Source	Distance	Direction
N/A	No records in buffer					

Ramsar Wetlands Data Source: © Commonwealth of Australia - Department of Agriculture, Water and the Environment

Ecological Constraints - Groundwater Dependent Ecosystems Atlas

Proposed Sewer Upgrade, South Nowra, NSW 2540



Ecological Constraints

Proposed Sewer Upgrade, South Nowra, NSW 2540

Groundwater Dependent Ecosystems Atlas

Type	GDE Potential	Geomorphology	Ecosystem Type	Aquifer Geology	Distance	Direction
Terrestrial	High potential GDE - from regional studies	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	Moderate potential GDE - from regional studies	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	Moderate potential GDE - from regional studies	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	High potential GDE - from regional studies	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	Low potential GDE - from regional studies	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	Low potential GDE - from regional studies	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site

Groundwater Dependent Ecosystems Atlas Data Source: The Bureau of Meteorology
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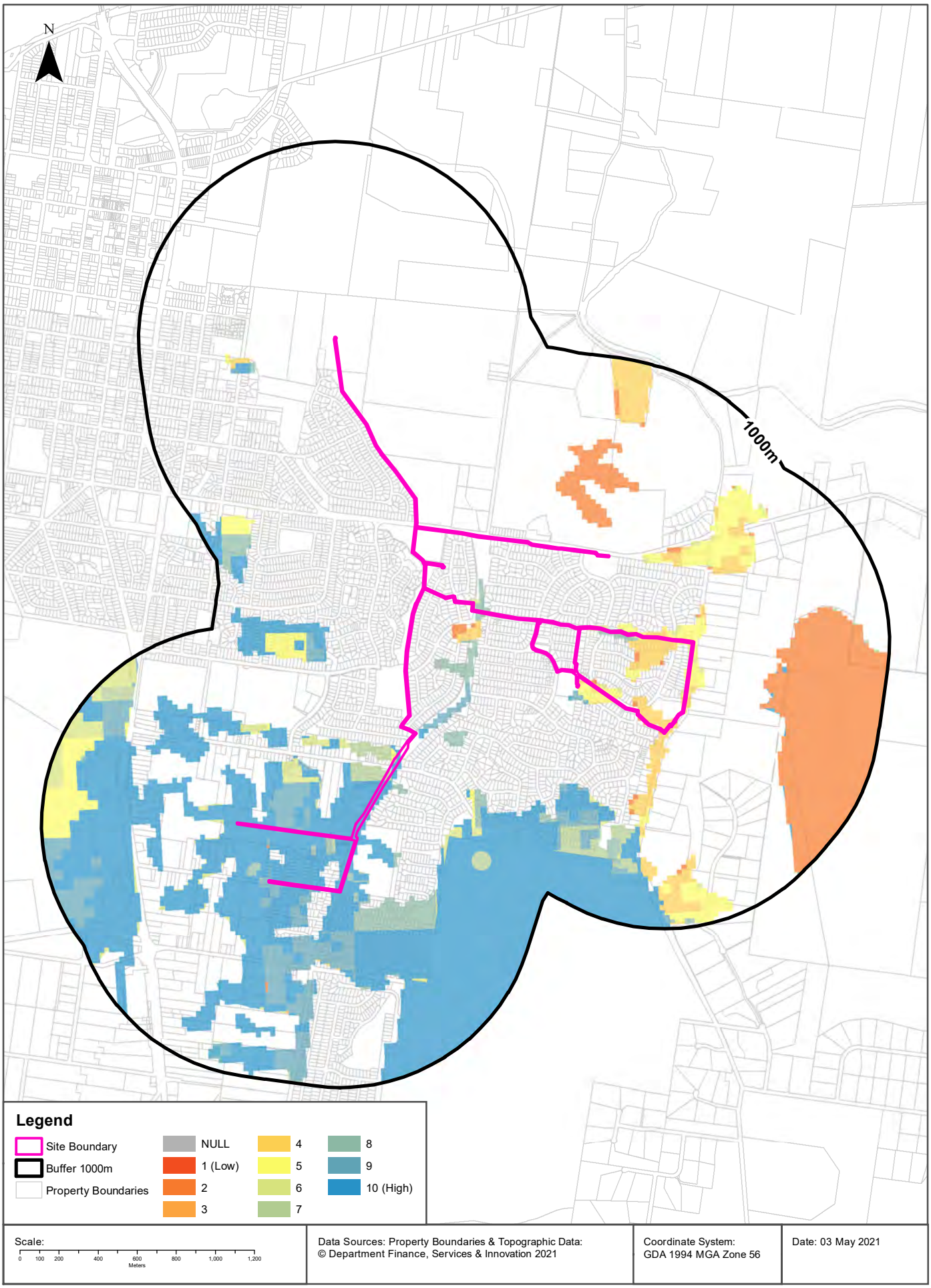
Ecological Constraints - Inflow Dependent Ecosystems Likelihood

Proposed Sewer Upgrade, South Nowra, NSW 2540



Ecological Constraints

Proposed Sewer Upgrade, South Nowra, NSW 2540

Inflow Dependent Ecosystems Likelihood

Type	IDE Likelihood	Geomorphology	Ecosystem Type	Aquifer Geology	Distance	Direction
Terrestrial	10	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	5	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	4	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	9	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	8	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	6	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	2	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	8	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	5	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	7	Deeply dissected sandstone plateaus.	Vegetation		0m	On-site
Terrestrial	7	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		0m	On-site
Terrestrial	6	Deeply dissected sandstone plateaus.	Vegetation		68m	South West
Terrestrial	10	Deeply dissected sandstone plateaus.	Vegetation		88m	South West
Terrestrial	9	Deeply dissected sandstone plateaus.	Vegetation		287m	South West
Terrestrial	4	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		357m	South
Terrestrial	3	Deeply dissected steeply sloping plateau margin in metamorphics and granite. Bounded in the west by the Great Escarpment.	Vegetation		458m	South West
Terrestrial	3	Deeply dissected sandstone plateaus.	Vegetation		697m	South East

Inflow Dependent Ecosystems Likelihood Data Source: The Bureau of Meteorology

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Ecological Constraints

Proposed Sewer Upgrade, South Nowra, NSW 2540

NSW BioNet Atlas

Species on the NSW BioNet Atlas that have a NSW or federal conservation status, a NSW sensitivity status, or are listed under a migratory species agreement, and are within 10km of the site?

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Amphibia	Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Amphibia	Litoria aurea	Green and Golden Bell Frog	Endangered	Not Sensitive	Vulnerable	
Animalia	Aves	Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Not Sensitive	Critically Endangered	
Animalia	Aves	Apus pacificus	Fork-tailed Swift	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Ardenna pacifica	Wedge-tailed Shearwater	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Ardenna tenuirostris	Short-tailed Shearwater	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Botaurus poiciloptilus	Australasian Bittern	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Burhinus grallarius	Bush Stone-curlew	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Calidris acuminata	Sharp-tailed Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Calidris melanotos	Pectoral Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Charadrius mongolus	Lesser Sand-plover	Vulnerable	Not Sensitive	Endangered	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Circus assimilis	Spotted Harrier	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Epthianura albifrons	White-fronted Chat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Esacus magnirostris	Beach Stone-curlew	Critically Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Falco subniger	Black Falcon	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Gallinago hardwickii	Latham's Snipe	Not Listed	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Gelochelidon nilotica	Gull-billed Tern	Not Listed	Not Sensitive	Not Listed	CAMBA
Animalia	Aves	Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	Critically Endangered	Not Sensitive	Vulnerable	
Animalia	Aves	Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Haematopus longirostris	Pied Oystercatcher	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	Not Sensitive	Not Listed	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Aves	Hieraaetus morphnoides	Little Eagle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Hirundapus caudacutus	White-throated Needletail	Not Listed	Not Sensitive	Vulnerable	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Hydroprogne caspia	Caspian Tern	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Ixobrychus flavicollis	Black Bittern	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Lathamus discolor	Swift Parrot	Endangered	Category 3	Critically Endangered	
Animalia	Aves	Limnodromus semipalmatus	Asian Dowitcher	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Limosa lapponica	Bar-tailed Godwit	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Limosa limosa	Black-tailed Godwit	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Lophoictinia isura	Square-tailed Kite	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Neophema pulchella	Turquoise Parrot	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox connivens	Barking Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox strenua	Powerful Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Numenius madagascariensis	Eastern Curlew	Not Listed	Not Sensitive	Critically Endangered	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Numenius minutus	Little Curlew	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Numenius phaeopus	Whimbrel	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Onychoprion fuscata	Sooty Tern	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Pandion cristatus	Eastern Osprey	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Petroica boodang	Scarlet Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Petroica rodinogaster	Pink Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Ptilinopus superbus	Superb Fruit-Dove	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Rostratula australis	Australian Painted Snipe	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Sterna hirundo	Common Tern	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Sternula albifrons	Little Tern	Endangered	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Stictonetta naevosa	Freckled Duck	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Thalasseus bergii	Crested Tern	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Thinornis cucullatus cucullatus	Eastern Hooded Dotterel	Critically Endangered	Not Sensitive	Vulnerable	
Animalia	Aves	Tringa brevipes	Grey-tailed Tattler	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Tringa nebularia	Common Greenshank	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Tringa stagnatilis	Marsh Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Tyto novaehollandiae	Masked Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Tyto tenebricosa	Sooty Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Xenus cinereus	Terek Sandpiper	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Mammalia	Arctocephalus pusillus doriferus	Australian Fur-seal	Vulnerable	Not Sensitive	Not Listed	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Mammalia	Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Not Sensitive	Endangered	
Animalia	Mammalia	Dugong dugon	Dugong	Endangered	Not Sensitive	Not Listed	
Animalia	Mammalia	Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered	Not Sensitive	Endangered	
Animalia	Mammalia	Macropus parma	Parma Wallaby	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus australis	Little Bent-winged Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus orianae oceanensis	Large Bent-winged Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Myotis macropus	Southern Myotis	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petauroides volans	Greater Glider	Not Listed	Not Sensitive	Vulnerable	
Animalia	Mammalia	Petaurus australis	Yellow-bellied Glider	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Not Sensitive	Vulnerable	
Animalia	Mammalia	Phascolarctos cinereus	Koala	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Pseudomys novaehollandiae	New Holland Mouse	Not Listed	Not Sensitive	Vulnerable	
Animalia	Mammalia	Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Sminthopsis leucopus	White-footed Dunnart	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Vespadelus baverstocki	Inland Forest Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Caretta caretta	Loggerhead Turtle	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Chelonia mydas	Green Turtle	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Reptilia	Hoplocephalus bungaroides	Broad-headed Snake	Endangered	Category 2	Vulnerable	
Plantae	Flora	Acacia constablei	Narrabarba Wattle	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Acacia pubescens	Downy Wattle	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Callistemon linearifolius	Netted Bottle Brush	Vulnerable	Category 3	Not Listed	
Plantae	Flora	Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Category 2	Vulnerable	
Plantae	Flora	Eucalyptus langleyi	Albatross Mallee	Endangered Population, Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Not Sensitive	Vulnerable	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Plantae	Flora	Eucalyptus scoparia	Wallangarra White Gum	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Genoplesium baueri	Bauer's Midge Orchid	Endangered	Category 2	Endangered	
Plantae	Flora	Hibbertia puberula		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Hibbertia stricta subsp. furcatula		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Melaleuca deanei	Deane's Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Pomaderris cotoneaster	Cotoneaster Pomaderris	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Pterostylis gibbosa	Illawarra Greenhood	Endangered	Category 2	Endangered	
Plantae	Flora	Pterostylis ventricosa		Critically Endangered	Category 2	Not Listed	
Plantae	Flora	Pterostylis vernalis		Critically Endangered	Category 2	Critically Endangered	
Plantae	Flora	Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Solanum celatum		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Triplarina nowraensis	Nowra Heath Myrtle	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Zieria baeuerlenii	Bomaderry Zieria	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Zieria tuberculata	Warty Zieria	Vulnerable	Not Sensitive	Vulnerable	

Data does not include NSW category 1 sensitive species.

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Location Confidences

Where Lotsearch has had to georeference features from supplied addresses, a location confidence has been assigned to the data record. This indicates a confidence to the positional accuracy of the feature. Where applicable, a code is given under the field heading “LC” or “LocConf”. These codes lookup to the following location confidences:

LC Code	Location Confidence
Premise Match	Georeferenced to the site location / premise or part of site
Area Match	Georeferenced to an approximate or general area
Road Match	Georeferenced to a road or rail corridor
Road Intersection	Georeferenced to a road intersection
Buffered Point	A point feature buffered to x metres
Adjacent Match	Land adjacent to a georeferenced feature
Network of Features	Georeferenced to a network of features
Suburb Match	Georeferenced to a suburb boundary
As Supplied	Spatial data supplied by provider

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Date: 14 May 2021

Reference: LS020057 AL

Address: Proposed Sewer Upgrade, South Nowra, NSW 2540

Aerial Imagery 2020

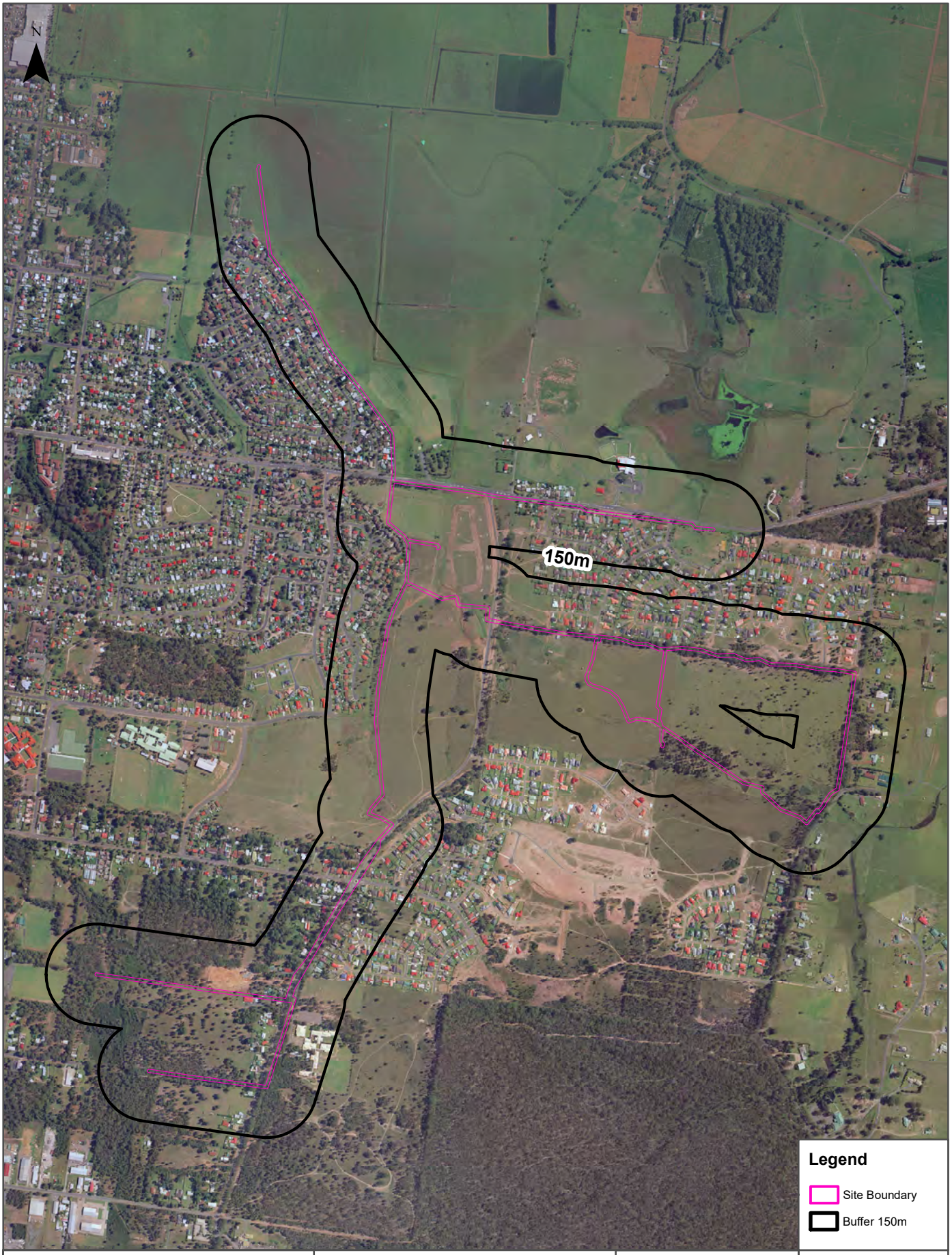
Proposed Sewer Upgrade, South Nowra, NSW 2540

Aerial Imagery 2009

Proposed Sewer Upgrade, South Nowra, NSW 2540

Aerial Imagery 2002

Proposed Sewer Upgrade, South Nowra, NSW 2540

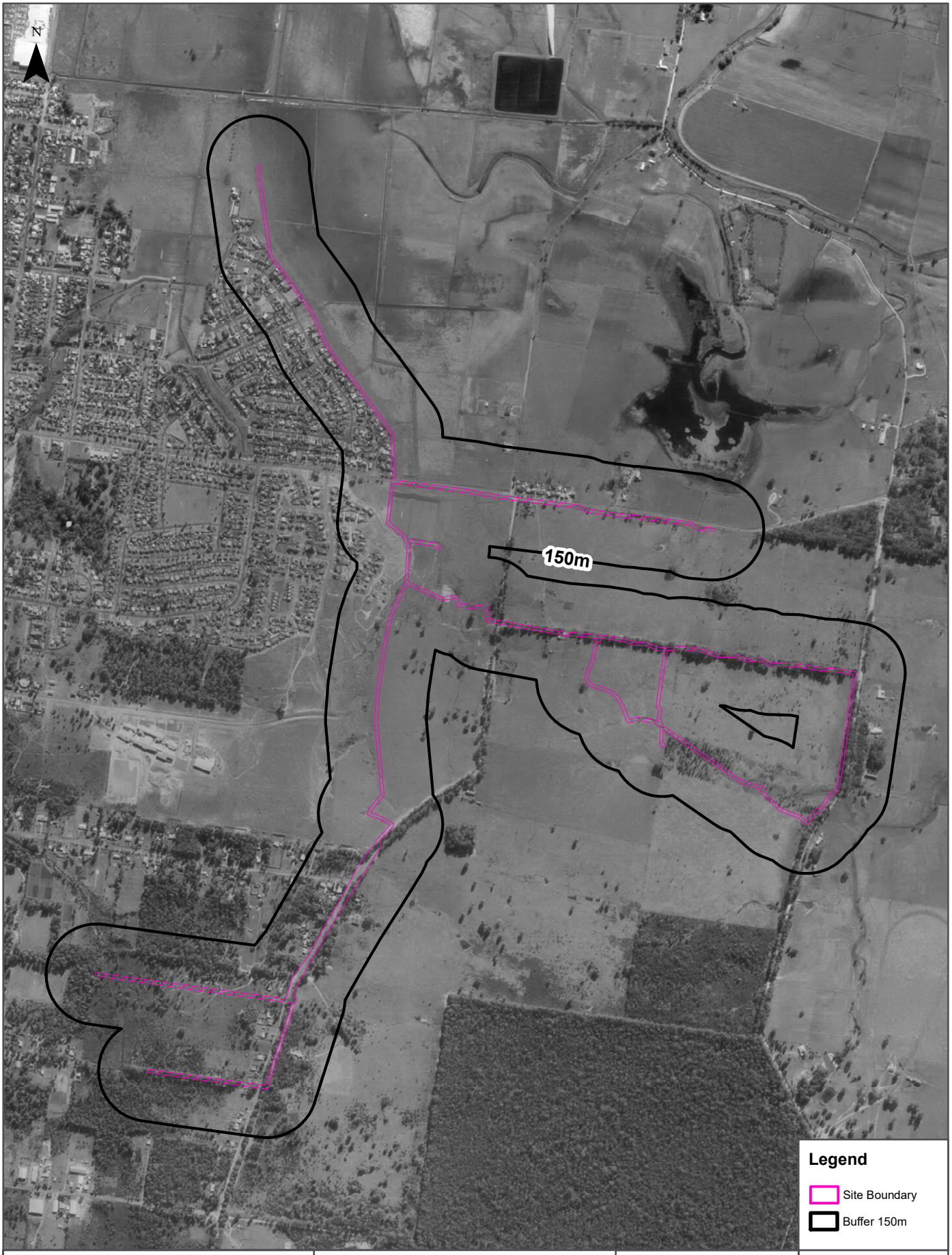


Aerial Imagery 1993

Proposed Sewer Upgrade, South Nowra, NSW 2540

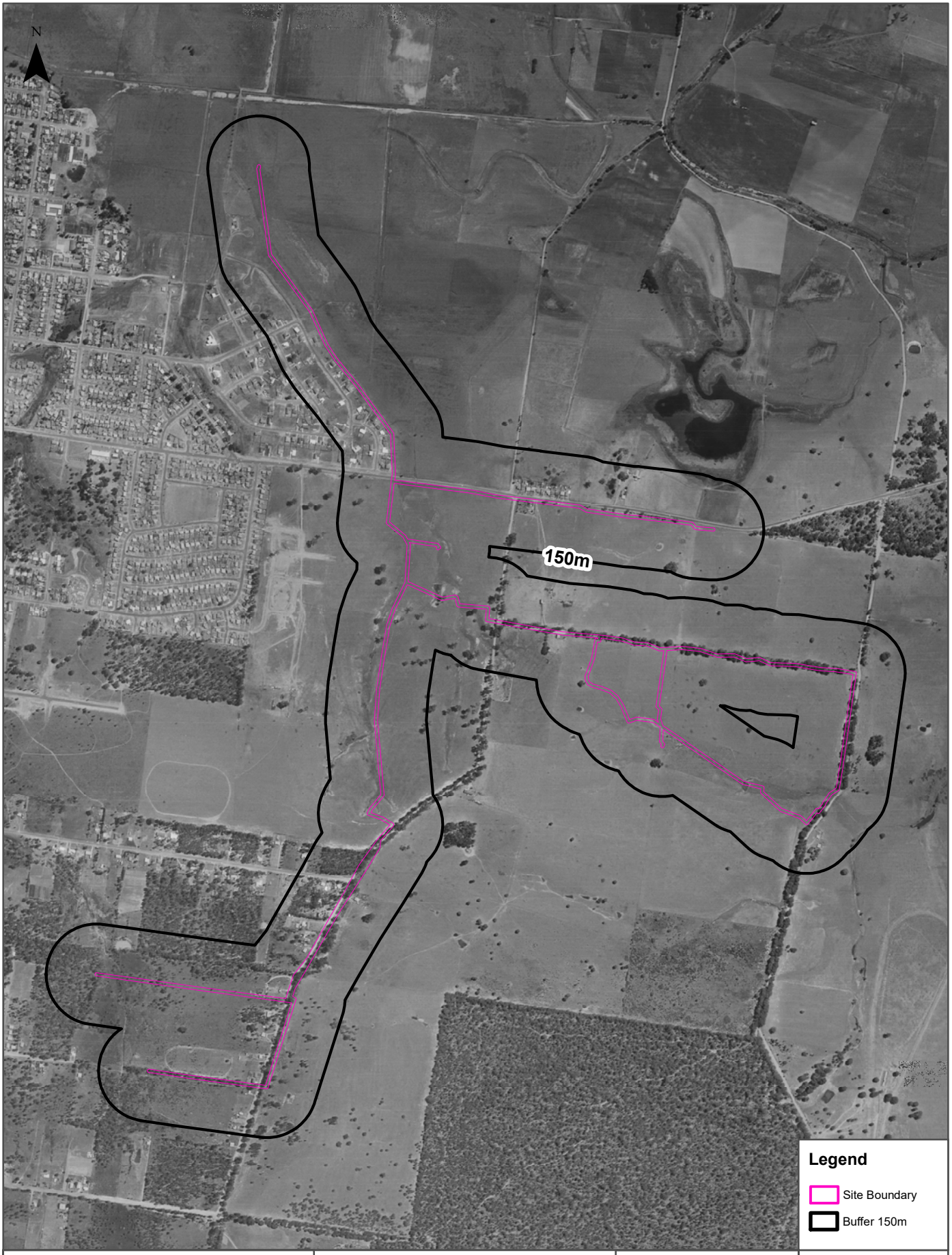
Aerial Imagery 1984

Proposed Sewer Upgrade, South Nowra, NSW 2540



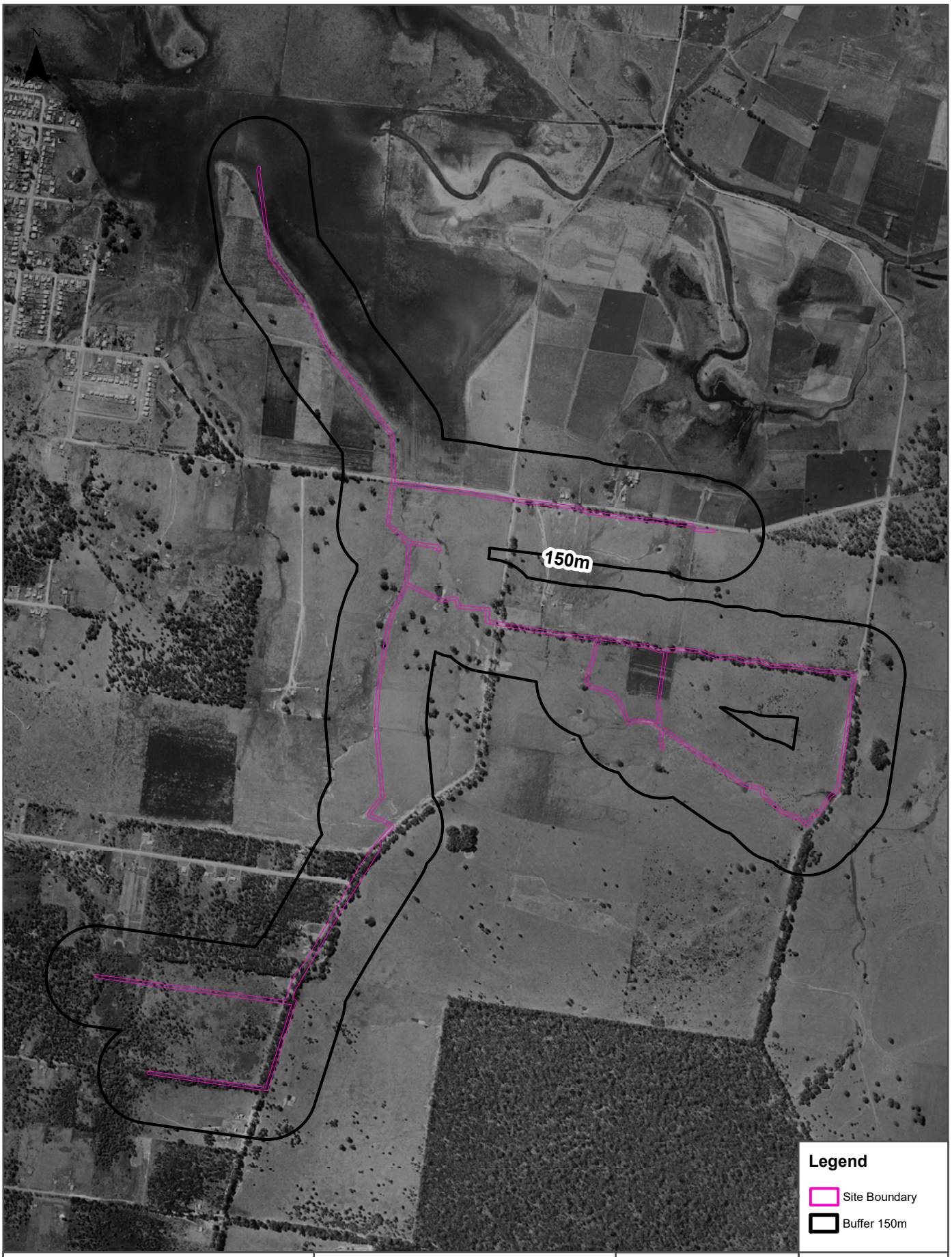
Aerial Imagery 1974

Proposed Sewer Upgrade, South Nowra, NSW 2540



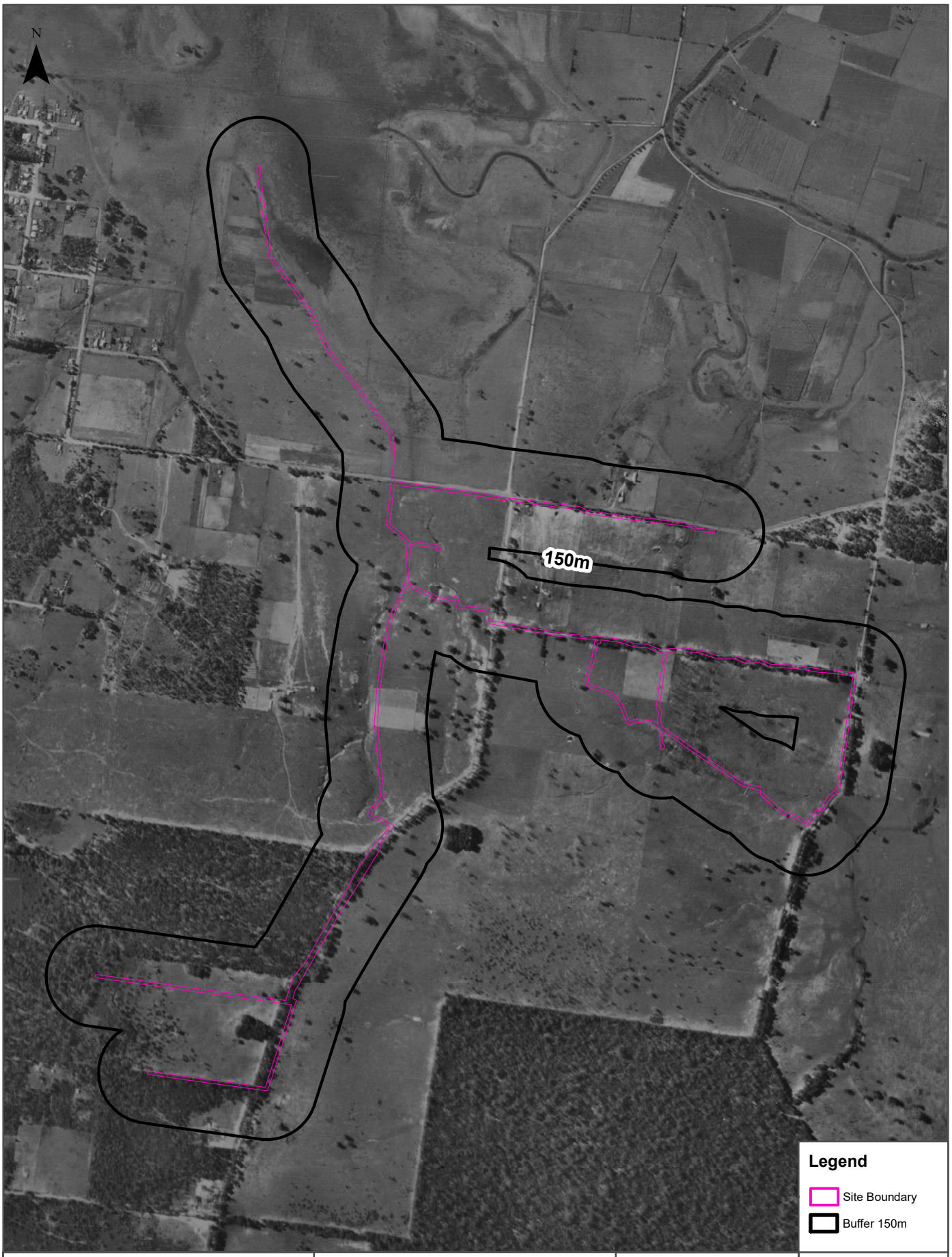
Aerial Imagery 1961

Proposed Sewer Upgrade, South Nowra, NSW 2540



Aerial Imagery 1949

Proposed Sewer Upgrade, South Nowra, NSW 2540



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APPENDIX

E

ODOUR ASSESSMENT

REPORT

SEWAGE PUMPING STATION

SOUTH NOWRA, NSW

ODOUR ASSESSMENT
RWDI # 2103265
19 October 2021

SUBMITTED TO

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DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	29 September 2021	John Wassermann	Ben Lawrence
A	Final	18 October 2021	John Wassermann	Ben Lawrence

NOTE

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RWDI

RWDI is a team of highly-specialised consulting engineers and scientists working to improve the built environment through three core areas of practice: building performance, climate engineering and environmental engineering. More information is available at www.rwdi.com.

QUALITY ASSURANCE

RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued for the following scope: The provision of consultancy services in acoustic engineering and air quality; and the sale, service, support and installation of acoustic monitoring and related systems and technologies.

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1 INTRODUCTION

1.1 Background

Shoalhaven Water, Council's Water Utility is responsible for the collection, treatment and disposal of wastewater (treated sewage) safely back into the environment for the Shoalhaven area.

Shoalhaven Water is proposing to replace the South Nowra surcharge main. As part of this project, it is proposed to construct a new South Nowra Sewage Pumping Station (SPS) on the reserve along Greenwell Point Road. CARDNO have conducted an initial Odour Risk Assessment as part of the concept and detail design of the South Nowra Surcharge Main upgrades. The Odour Risk Assessment has identified the new South Nowra SPS as a potential to cause odour impacts.

1.2 Purpose of this Report

RWDI Australia Pty Ltd (RWDI) has been commissioned to provide an assessment of potential odour impacts associated with the new South Nowra Pumping Station.

The odour assessment presented herein has been conducted in general accordance with the NSW EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (the Approved Methods).

2 SITE DESCRIPTION

A new South Nowra SPS is proposed to be constructed on the reserve along Greenwell Point Road behind the house on Kameruka Crescent and Clipper Road South Nowra.

The SPS site is shown in **Figure 1**.

Figure 1: Site Location

2.1 Sensitive Receptors

The nearest and most potentially affected sensitive receptors to the SPS are identified in **Table 1** and shown in **Figure 2**.

Table 1: Sensitive Receptors

Receptor ID	Address
R1	8 Clipper Road
R2	10 Clipper Road
R3	6 Kameruka Crescent
R4	12 Kameruka Crescent
R5	14 Kameruka Crescent
R6	18 Kameruka Crescent

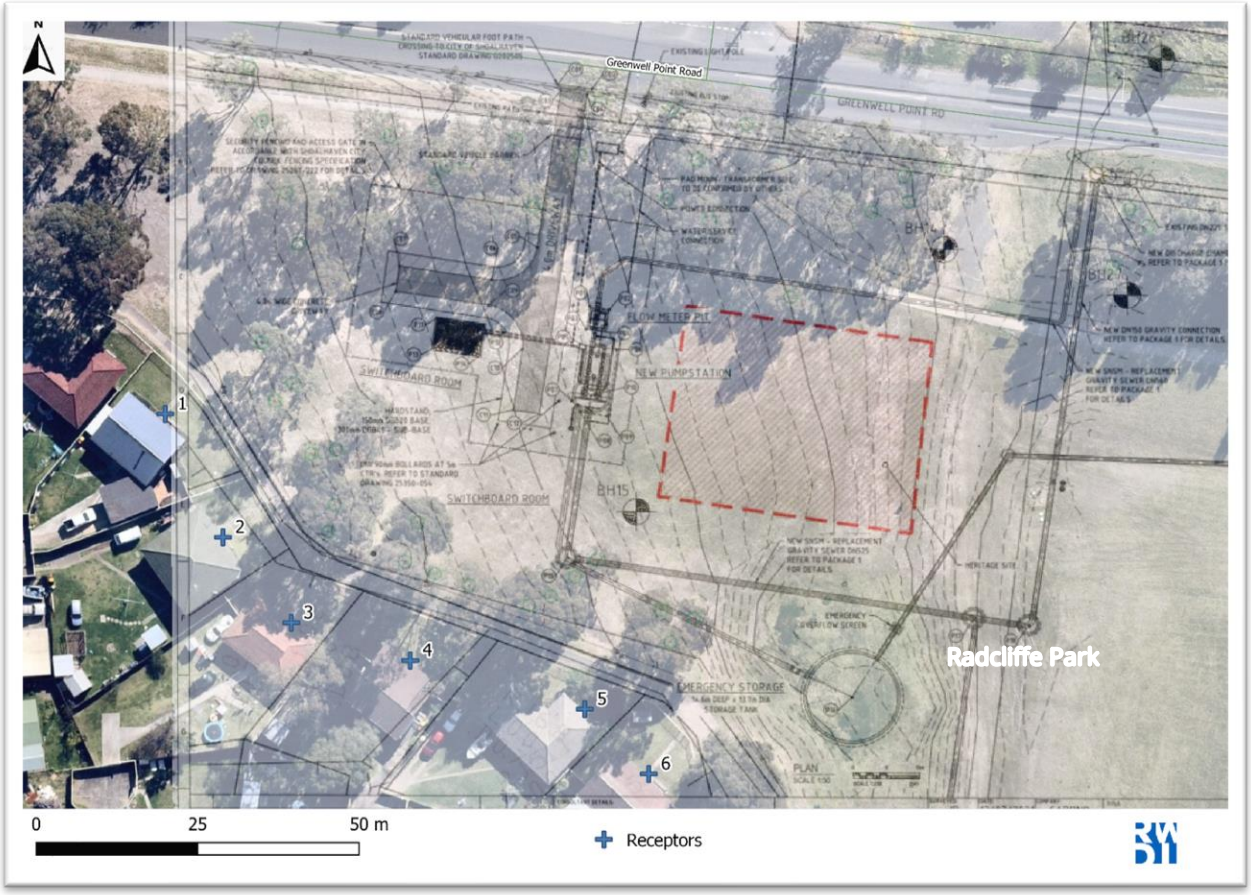


Figure 2: Sensitive Receptors

3 ODOUR CRITERIA

3.1 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods) sets out applicable impact assessment criteria for odour.

3.2 Impact Assessment Criteria

NSW legislation prohibits emissions that cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character and so on and to determine whether the odour would unreasonably interfere with the comfort and repose of the normal person. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists, and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus, by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

The range of a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. Therefore, there can be a wide range of variability in the way odour response is interpreted.

It should be noted that odour refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical very rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations, odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odorous pollutants, or more simply odour.

For developments with potential for odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that it reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

Table 2 presents the relevant impact assessment criteria, expressed in odour units, for complex mixtures of odorous pollutants.

Table 2: Impact Assessment Criteria – Complex Mixtures of Odorous Pollutants

Population of affected community	Impact assessment criteria (OU) [a]
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

a. 99th percentile noise-response time.

The Proposal is located in an urban area. Therefore, an impact assessment criterion of 2.0 OU has been adopted for this assessment.

4 ODOUR ASSESSMENT

4.1 Modelling Methodology

To assess potential odour impacts from the vents at the SPS, a Level 1 screening level odour impact assessment for the Proposal has been conducted per the NSW EPA *Approved Methods* (EPA, 2016) using the AERMOD screening method. A Level 1 impact assessment is very conservative as it assumes worst case 'synthetic' meteorological data and it considers the 100th percentile dispersion model predictions. To account for the time-averaging limitations of the dispersion model, peak-to-mean ratio of 2.3 has been incorporated into the odour modelling in accordance with the NSW EPA *Approved Methods* (EPA, 2016).

4.2 Emissions Inventory

4.2.1 Potential Odour Sources

The main potential source of odour from the SPS is the vent. Wastewater pump stations are an integral component of sewage systems. As wastewater flows into a pump station before a pumping cycle begins, the water level rises and physically displaces air. The displaced air carries with it odourous compounds that may result in an odour nuisance. H_2S (hydrogen sulphide) is by far the most dominant odour-causing compound in the venting air.

A typical vent design is shown in **Figure 3**.

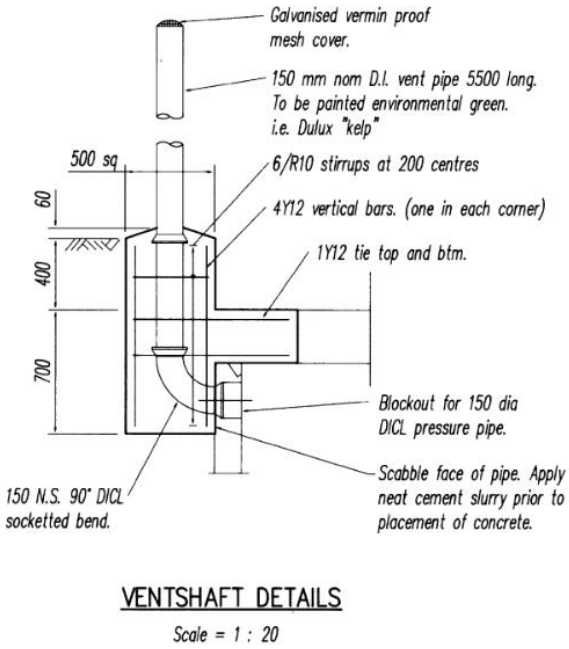


Figure 3: Typical Vent Details (supplied by CARDNO)

Vents can be fitted with odour control units.

4.2.2 Design

The design of the SPS has been conducted by CARDNO and is presented in **Figure 4**.

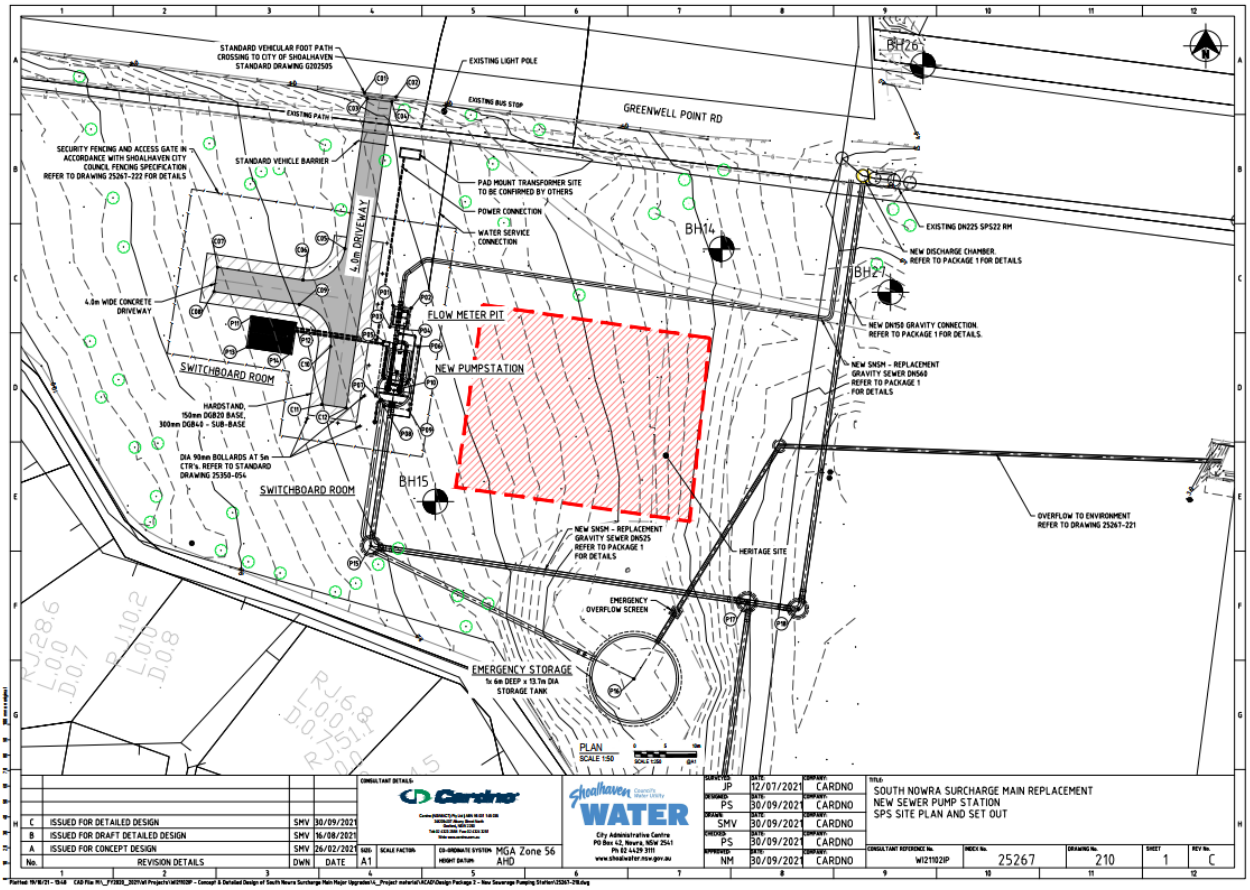


Figure 4: SPS Design

4.2.3 Modelled Sources

Four scenarios have been modelled to inform the design, namely:

- Scenario 1 – 5.5 metre high vent without an odour control unit;
- Scenario 2 – 5.5 metre high vent with an odour control unit;
- Scenario 3 – 3 metre high vent with an odour control unit;
- Scenario 4 – 2 metre high vent with an odour control unit; and
- Scenario 5 – 1 metre high vent with an odour control unit

Odour emissions from the Proposal have been calculated based on information provided by CARDNO. The proposed odour control unit would be similar to a McBerns ZC 1500 Odour Filter with pre filter and fan (See Appendix A).

Table 3 summarises the key parameters of the sources.

Table 3: Modelled Sources

Source	Coordinates (MGA 56)		Release Height above ground (m)	Vent Diameter (m)	Flow Rate (m^3/s)	Odour Concentration (OU/m^3)
	Northing (m)	Easting (m)				
Scenario 1 SPS Vent	282,303	6,136,589	5.5m	0.15	0.09	Hydrogen Sulphide (H_2S) ≤ 0.5 ppm Mercaptans (Thiols) ≤ 0.2 ppm Odour concentration ≤ 5,000 Odour Units (OU/m^3)
Scenario 2 SPS Vent	282,303	6,136,589	5.5m	0.15	0.1736	Hydrogen Sulphide (H_2S) ≤ 0.05 ppm Mercaptans (Thiols) ≤ 0.02 ppm Odour concentration ≤ 500 Odour Units (OU/m^3)
Scenario 3 SPS Vent	282,303	6,136,589	3m	0.15	0.1736	Hydrogen Sulphide (H_2S) ≤ 0.05 ppm Mercaptans (Thiols) ≤ 0.02 ppm Odour concentration ≤ 500 Odour Units (OU/m^3)
Scenario 4 SPS Vent	282,303	6,136,589	2m	0.15	0.1736	Hydrogen Sulphide (H_2S) ≤ 0.05 ppm Mercaptans (Thiols) ≤ 0.02 ppm Odour concentration ≤ 500 Odour Units (OU/m^3)

Source	Coordinates (MGA 56)		Release Height above ground (m)	Vent Diameter (m)	Flow Rate (m^3/s)	Odour Concentration (OU/m^3)
	Northing (m)	Easting (m)				
Scenario 5 SPS Vent	282,303	6,136,589	1m	0.15	0.1736	Hydrogen Sulphide (H_2S) ≤ 0.05 ppm Mercaptans (Thiols) ≤ 0.02 ppm Odour concentration ≤ 500 Odour Units (OU/m^3)

4.3 Predicted Odour Concentrations

The predicted 100th percentile odour concentrations at sensitive receptors are presented in **Table 4**.

The results show exceedance of impact assessment criterion of 2.0 without an odour control unit and a 5.5 metre vent (Scenario 1) and demonstrates compliance with the established impact assessment criterion of 2.0 OU when an odour control unit is included in the design.

Predicted odour contours near the SPS with various vent heights are shown in **Figure 5**, **Figure 6**, **Figure 7**, **Figure 8** and **Figure 9**.

Table 4: 100th Percentile Predicted Odour Concentration

Receptor ID	Odour Concentration (goal = 2.0 OU)	Complies? Yes/No
Scenario 1 – (5.5 metre high vent without an odour control unit)		
R1	5.9	No
R2	7.2	No
R3	8.2	No
R4	11.0	No
R5	11.3	No
R6	7.3	No
Scenario 2 – (5.5 metre high vent with an odour control unit)		
R1	0.59	Yes
R2	0.72	Yes
R3	0.82	Yes

Receptor ID	Odour Concentration (goal = 2.0 OU)	Complies? Yes/No
R4	1.10	Yes
R5	1.13	Yes
R6	0.73	Yes
Scenario 3 – (3 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.76	Yes
R3	0.87	Yes
R4	1.20	Yes
R5	1.25	Yes
R6	0.78	Yes
Scenario 4 – (2 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.76	Yes
R3	0.88	Yes
R4	1.22	Yes
R5	1.27	Yes
R6	0.79	Yes
Scenario 5 – (1 metre high vent with an odour control unit)		
R1	0.61	Yes
R2	0.77	Yes
R3	0.88	Yes
R4	1.23	Yes
R5	1.28	Yes
R6	0.79	Yes

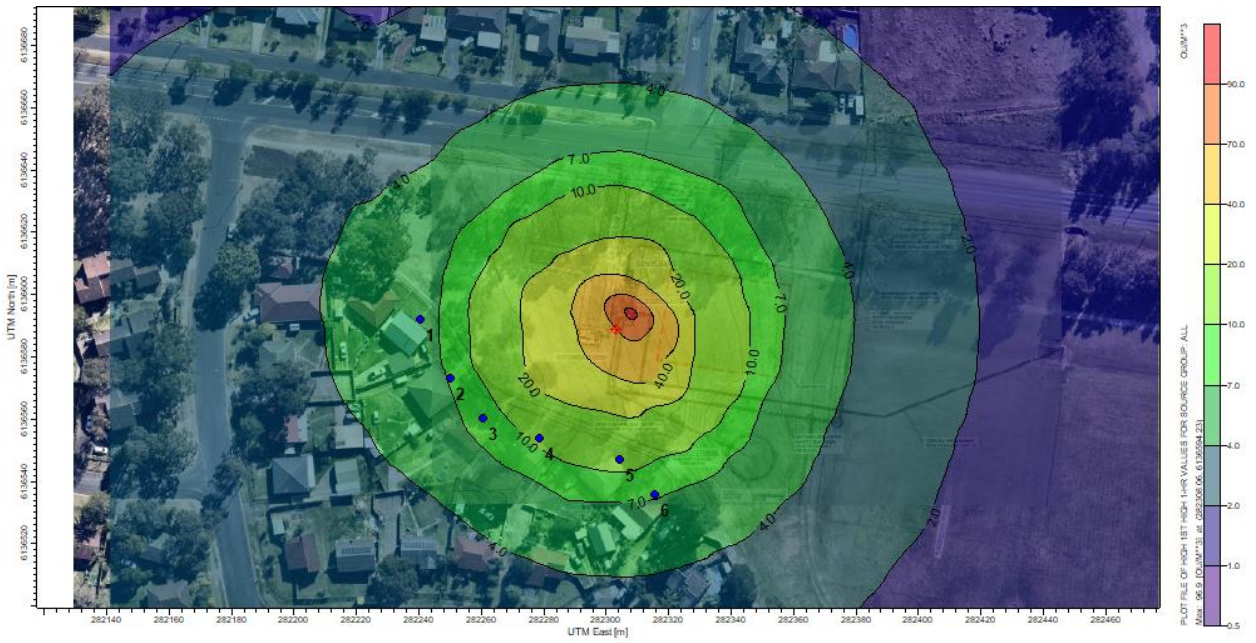


Figure 5: Odour Contour – SPS (Scenario 1 – 5.5 metre high vent without an odour control unit)

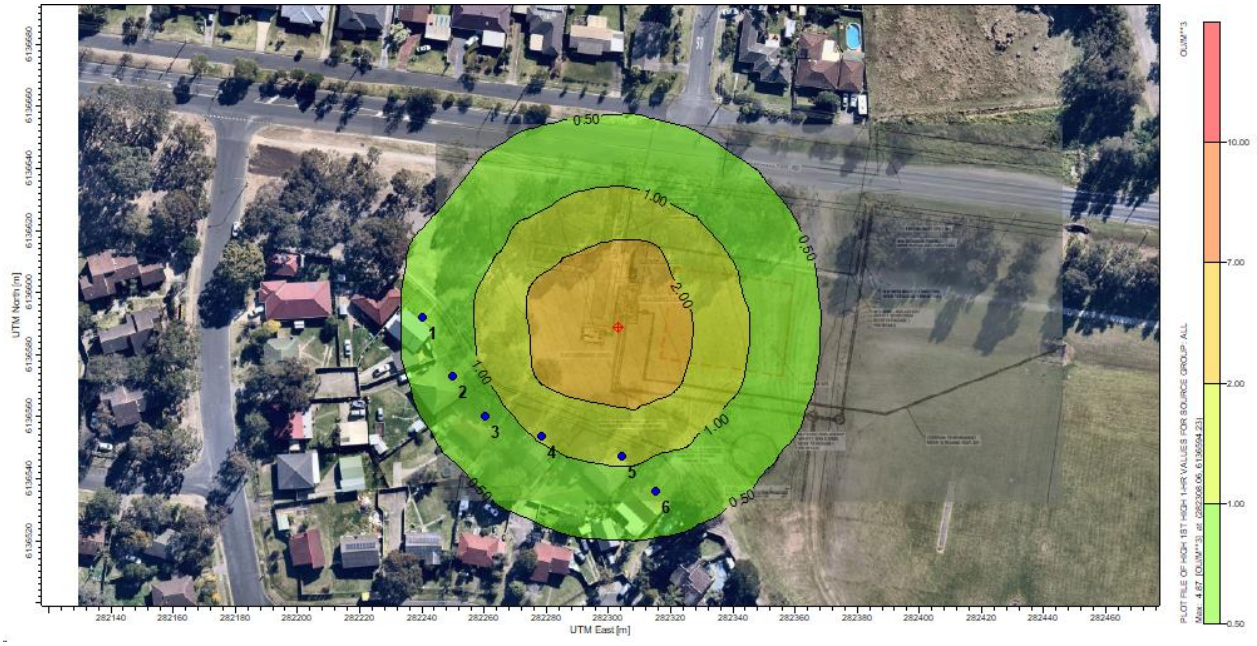


Figure 6: Odour Contour – SPS (Scenario 2 – 5.5 metre high vent with an odour control unit)

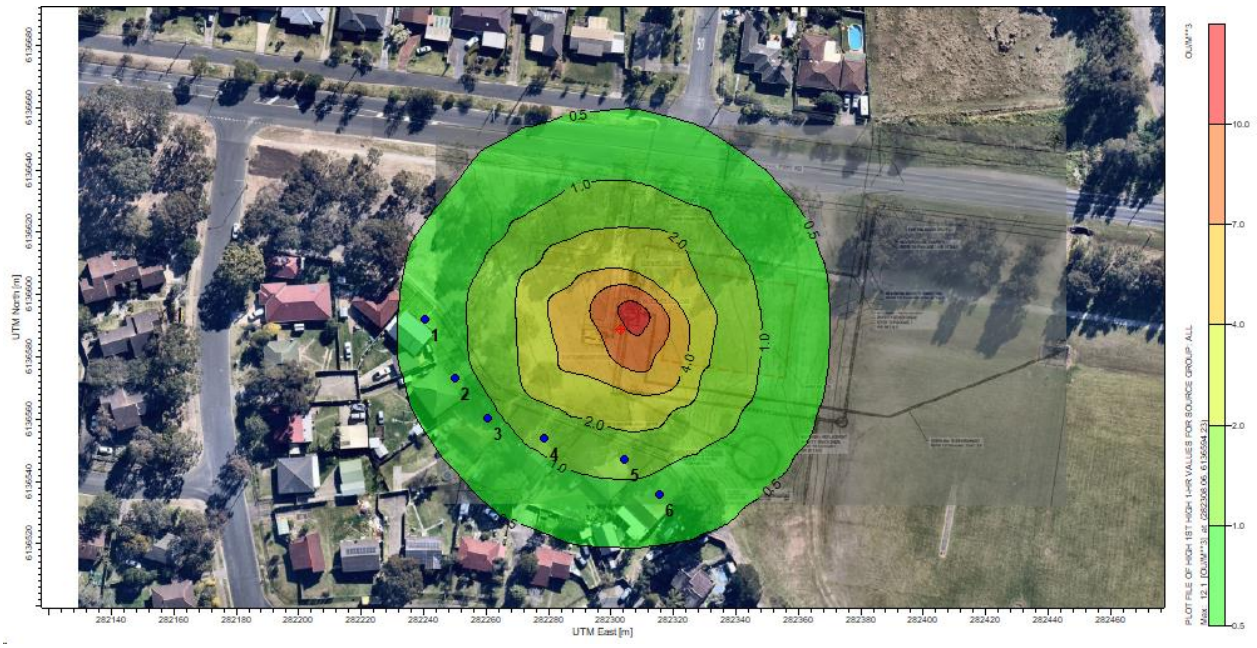


Figure 7: Odour Contour – SPS (Scenario 3 – 3 metre high vent with an odour control unit)

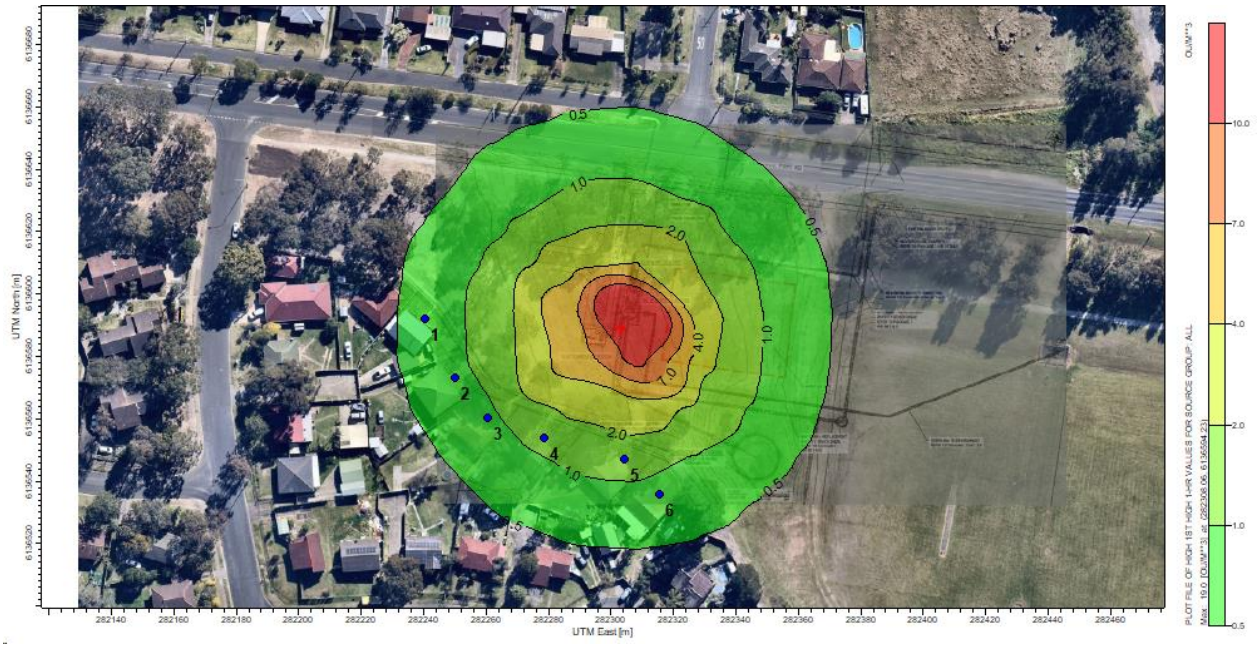


Figure 8: Odour Contour – SPS (Scenario 4 – 2 metre high vent with an odour control unit)

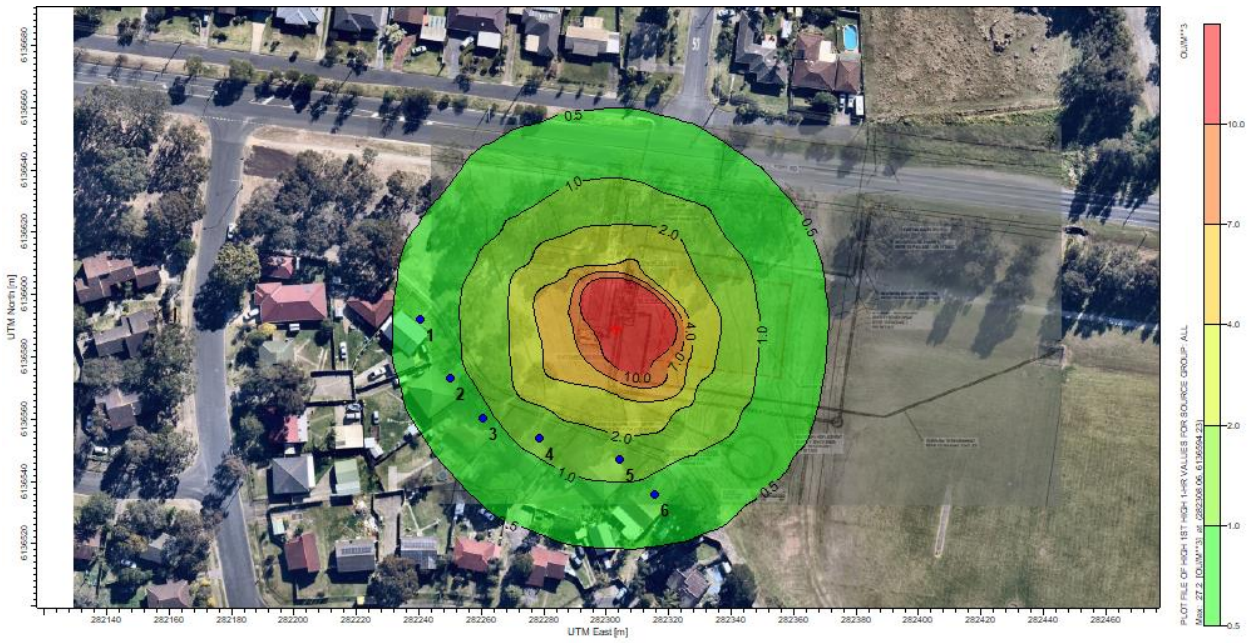


Figure 9: Odour Contour – SPS (Scenario 5 – 1 metre high vent with an odour control unit)

It can be observed from **Figure 6**, **Figure 7**, **Figure 8** and **Figure 9** that if an odour control unit is installed, the vent height does not vary the 2 OU contour appreciably, it only changes the potential odour impact in the immediate area around the vent. As such, a 1 or 2m vent with odour control unit would be adequate to minimise odour impacts at the closest receptors.

5 CONCLUSION

A new South Nowra Pumping Station is proposed to be constructed on the reserve along Greenwell Point Road behind the house on Kameruka Crescent and Clipper Road South Nowra.

RWDI Australia Pty Ltd (RWDI) has been commissioned to provide an assessment of potential odour impacts associated with the Proposal.

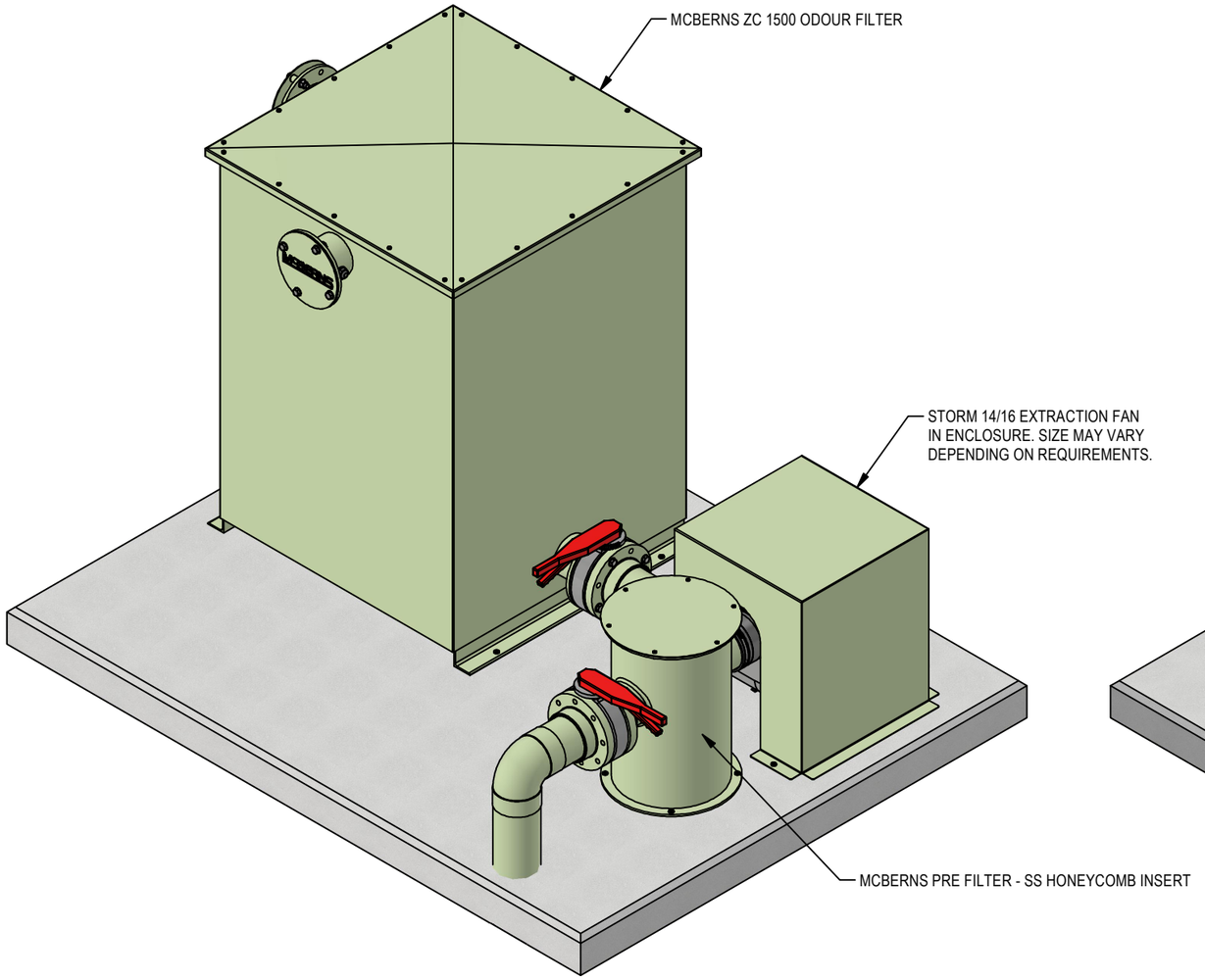
A Level 1 screening level odour impact assessment for the Proposal has been conducted per the NSW EPA's *Approved Methods*.

The results of the assessment shows that the SPS exceeds the impact assessment criterion of 2.0 if an odour control unit is not included in the design.

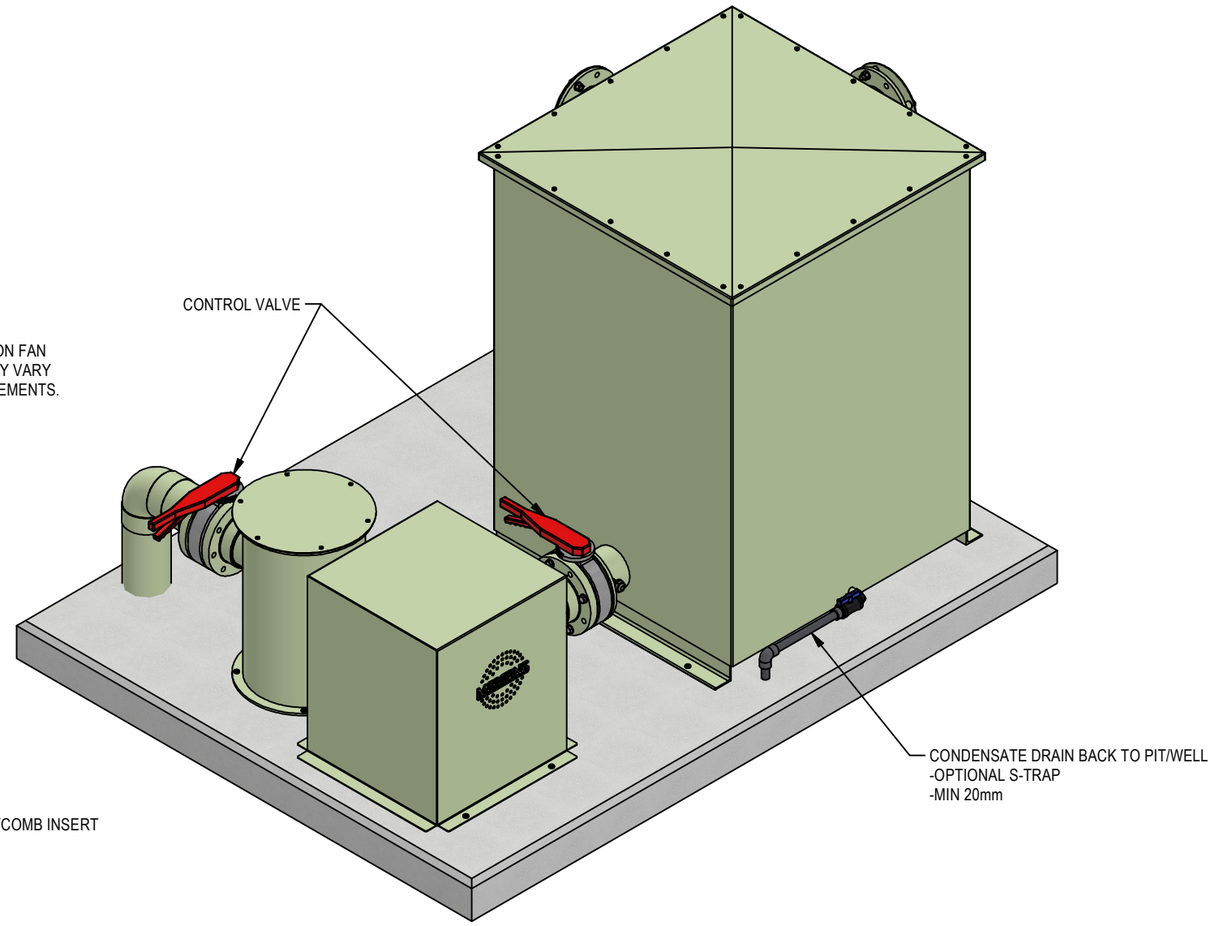
Predicted odour concentrations at nearby sensitive receptors comply with the established impact assessment criterion of 2.0 OU when an odour control unit is included in the design at all modelled heights.

APPENDIX A

ZC 1500 ODOUR FILTER WITH PRE FILTER & FAN



ISOMETRIC VIEW



ISOMETRIC VIEW

UNLESS NOTED OTHERWISE:

- REPRESENTATION ONLY.
- DIMENSIONS GIVEN IN MILLIMETERS.
- DIMENSIONS GIVEN ARE APPROXIMATE AND MAY VARY.
- DO NOT SCALE FROM DRAWINGS.
- IF IN DOUBT OR UNCLEAR, CONSULT MCBERNS PTY LTD.

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ABN: 56 060 984 107

REV	DESCRIPTION	DATE	APPROVED
1	CHANGED STORM EXTRACTION FAN DETAILS	12/07/2021	C. DATSON
2			
3			
4			
5			
6			

UNLESS NOTED OTHERWISE:
X. = ± 1mm
X.X = ± 0.5mm
X.XX = ± 0.1mm

3RD ANGLE PROJECTION

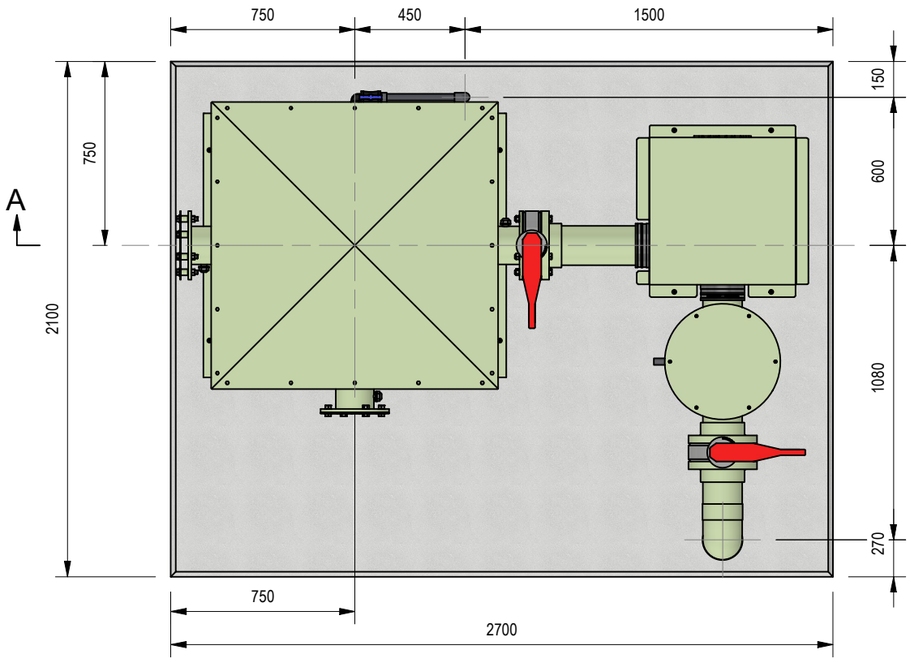
DRAWN BY: C. DATSON	DESCRIPTION: ZC 1500 ODOUR FILTER WITH PRE FILTER & FAN				
CHECKED BY: S. DARBY	SCALE: DO NOT SCALE	MATERIAL:		DRAWING NUMBER: 211-0004	
DATE: 5/10/2021	PROJECT NO: ####	PART NUMBER: 211-0004	MASS:	REV: 1	SHEET: 1 / 3

UNLESS NOTED OTHERWISE:

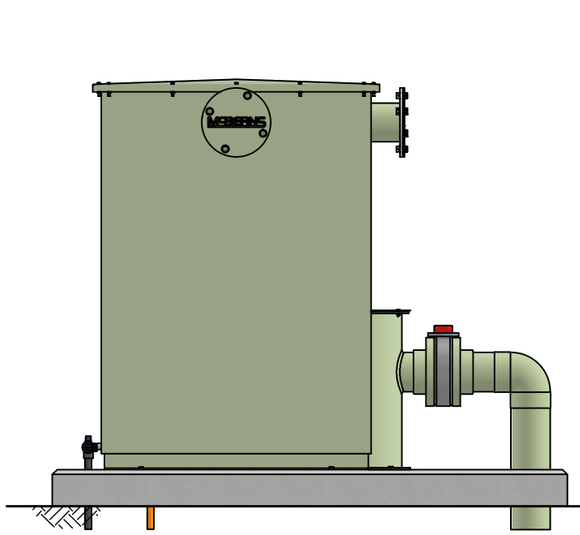
- REPRESENTATION ONLY.
- DIMENSIONS GIVEN IN MILLIMETERS.
- DIMENSIONS GIVEN ARE APPROXIMATE AND MAY VARY.
- DO NOT SCALE FROM DRAWINGS.
- IF IN DOUBT OR UNCLEAR, CONSULT MCBERNS PTY LTD.

ACCESS NOTE:
THE CONCRETE SLAB SHOWN ASSUMES ACCESS ALL AROUND THE ODOUR FILTER SYSTEM. ENSURE A MINIMUM OF 600mm CLEAR ACCESS SPACE ALL AROUND SYSTEM.

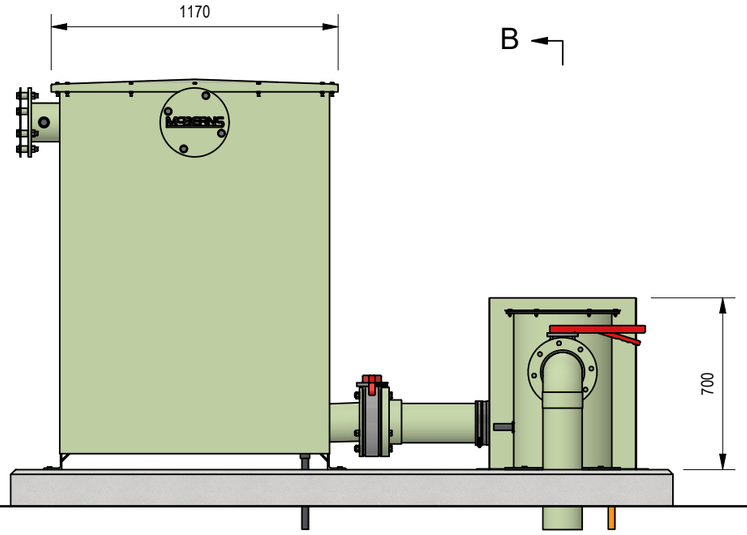
SITE LAYOUT NOTE:
THE DIMENSIONS SHOWN ARE TO BE USED AS A GUIDE ONLY AND CONTRACTOR/INSTALLER MUST CONFIRM ON SITE BEFORE INSTALLATION



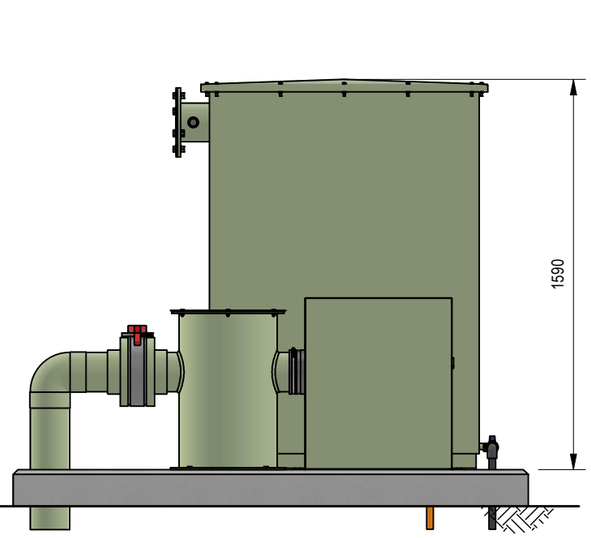
PLAN VIEW



SIDE VIEW



FRONT VIEW



SIDE VIEW

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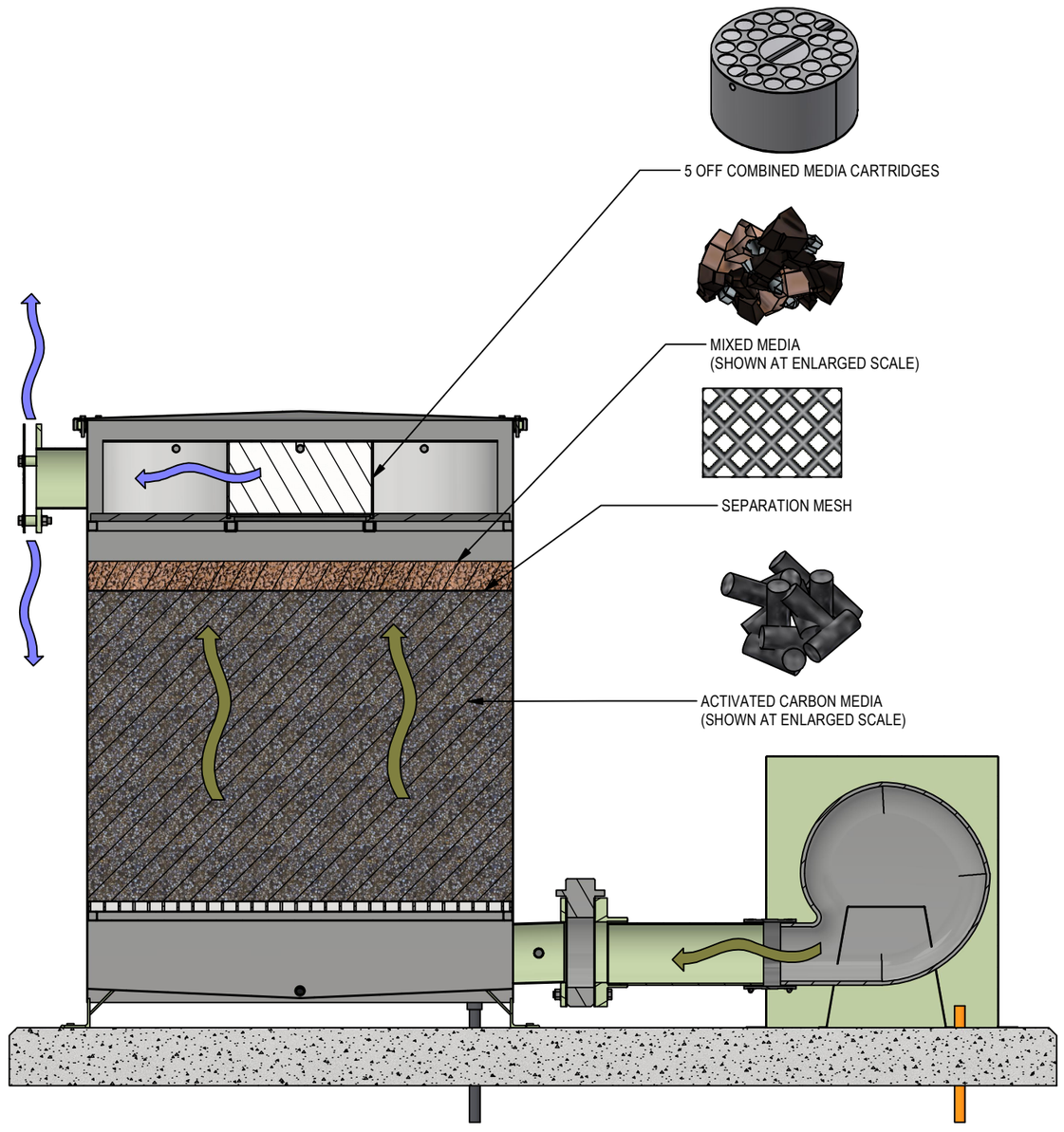
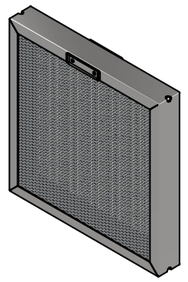
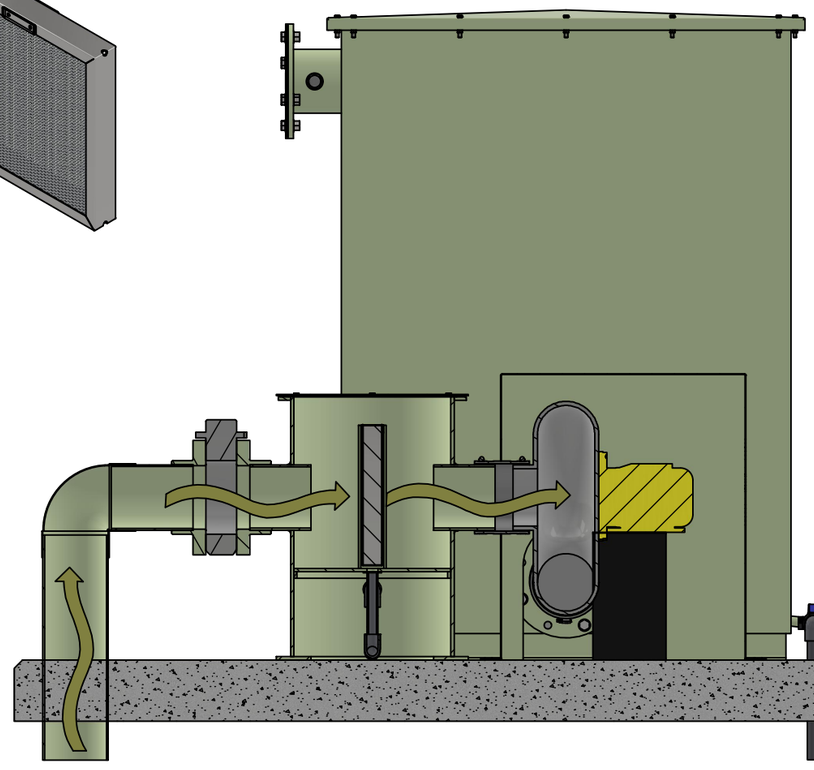
3RD ANGLE PROJECTION

DRAWN BY: C. DATSON	DESCRIPTION: ZC 1500 ODOUR FILTER WITH PRE FILTER & FAN			
CHECKED BY: S. DARBY	SCALE: DO NOT SCALE	MATERIAL:		DRAWING NUMBER: 211-0004
DATE: 5/10/2021	PROJECT NO: ####	PART NUMBER: 211-0004	MASS:	REV: 1 / SHEET: 2 / 3



SECTION A-A





SECTION B-B

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ABN: 56 060 984 107

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X.X = ± 0.5mm
X.XX = ± 0.1mm

3RD ANGLE PROJECTION

DRAWN BY: C. DATSON	DESCRIPTION: ZC 1500 ODOUR FILTER WITH PRE FILTER & FAN			
CHECKED BY: S. DARBY	SCALE: DO NOT SCALE	MATERIAL:		DRAWING NUMBER: 211-0004
DATE: 5/10/2021	PROJECT NO: ####	PART NUMBER: 211-0004	MASS:	REV: 1 / SHEET: 3 / 3