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Engineering

Water Cycle Management Plan

Proposed Industrial Subdivision
"Warner Industrial Park" Stage 1 and Stage 2

Property:
Lots 4, 6-8 DP 239704
Lots 15-19, 25-26 DP 259306
Lot 5 DP 259531
Lot 9 DP 239704
Hue Hue Road and Sparks Road, Jilliby

Applicant:
Warnervale LF Pty Ltd

Date:
December 2021

Working Beyond Expectations

adw johnson

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
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Executive Summary

ADW Johnson was commissioned by Warnervale LF Pty Ltd to prepare a Water Cycle Management Plan (WCMP) for the proposed industrial subdivision of Lots 4 & 6-8 DP 239704, Lots 15-19 & 25-26 DP 259306, Lot 5 DP 259531 and Lot 9 DP 239704, Hue Hue Road and Sparks Road, Jilliby. The preparation of this WCMP has been undertaken to accompany a modification to Project Approval (PA) MP07_0162 for the proposed industrial subdivision.

The PA currently consists of two stages being Stage 1 and Stage 2. The main objective of the modification of the PA is to split Stage 1 into four subsequent stages being Stage 1A, 1B, 1C and 1D. The current Stage 2 in the PA is to remain unchanged in terms of staging and is still expected to be developed after the proposed Stage 1A-1D is developed due to access arrangements and servicing.

This WCMP is required as a result of the modification to the PA and is to meet requirements in relation to existing hydrology, total water cycle management, erosion and sediment control, on site detention and water quality. This report only focuses on Stage 1 of the development as the stormwater arrangements for Stage 2 are not expected to be modified from that under the original PA as Stage 2 is self-sufficient in terms of stormwater treatment.

The proposed development is located within the Central Coast Council (CCC) LGA and specifically within the Wyong Employment Zone (WEZ). The WEZ area falls within the Porters Creek Wetland catchment for which a number of previous studies and strategies have been completed. The previous studies and strategies helped inform the 'Integrated Water Cycle Management Strategy Wyong Employment Zone (WEZ)', November 2006 (IWCMS 2006) which outlined the stormwater requirements and objectives of the WEZ area. The PA references the IWCMS 2006 which has been noted as being outdated by CCC and as such correspondence has occurred with CCC to determine updated stormwater objectives for the proposed development.

The proposed development contains a stormwater design which incorporates a combination of at source treatment on each lot as well as end of line treatment to satisfy both water quality and quantity stormwater objectives. Water sensitive urban design solutions have been incorporated into the design along with stormwater reuse options to provide improved water quality runoff from the site in addition to providing a reduction in stormwater volumes discharging from the site post development.

Stormwater quality modelling has been completed for the proposed development which indicates that the modified PA stormwater design meets reduced water quality pollutant reduction target requirements as discussed with CCC and reduces the stormwater volume discharging from the development. Stormwater quantity modelling has been completed for the proposed development which indicates that the modified PA stormwater design limits post development peak flows to pre development peak flow levels for all design storms from the 1 year ARI up to and including the 100 year ARI design storm.

Flooding currently occurs within the site as a result of three watercourses (blue lines) that traverse the site. The watercourses convey stormwater runoff from upstream in addition to the flows from the proposed development to the three culverts under the M1. Flood modelling was previously completed as part of the PA to show that the proposed development would be developed above the 100 year ARI flood event with a 300mm freeboard to the proposed lots. This report outlines the updated flood modelling completed for the interim case of Stage 1A to show that Stage 1A is flood free in the 100 year ARI.

A preliminary erosion and sediment control plan has been completed for the proposed development to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the site to downstream waterways during the construction period. By using the basins as temporary sediment basins during construction, the required volume using the Blue Book is achieved several times over, therefore reducing impacts to downstream environments well beyond current best practice.

Overall, the works proposed in this WCMP should achieve a positive outcome for the management and treatment of stormwater runoff from the proposed development. Modelling indicates that, through the implementation of the proposed WCMP, all of Council's requirements in relation to stormwater water quality, stormwater quantity and stormwater volume are met.

1. Introduction

ADW Johnson was commissioned by Warnervale LF Pty Ltd to prepare a Water Cycle Management Plan (WCMP) for the proposed industrial subdivision of Lots 4 & 6-8 DP 239704, Lots 15-19 & 25-26 DP 259306, Lot 5 DP 259531 and Lot 9 DP 239704, Hue Hue Road and Sparks Road, Jilliby. The preparation of this WCMP has been undertaken to accompany a modification to Project Approval (PA) MP07_0162 for the proposed industrial subdivision.

The PA currently consists of two stages being Stage 1 and Stage 2. The main objective of the modification of the PA is to split Stage 1 into four subsequent stages being Stage 1A, 1B, 1C and 1D. The current Stage 2 in the PA is to remain unchanged in terms of staging and is still expected to be developed after the proposed Stage 1A-1D is developed due to access arrangements and servicing.

This report forms part of the modification to the PA, providing assessment of the existing site and hydrology, the proposed development, site constraints, Council's stormwater management requirements, the proposed stormwater control facilities, environmental protection works and the erosion and sediment controls to meet the Councils requirements.

This report only focuses on Stage 1 of the development as the stormwater arrangements for Stage 2 are not expected to be modified from that under the original PA as Stage 2 is self-sufficient in terms of stormwater treatment.

The location of the site is shown in ***Figure 1***.

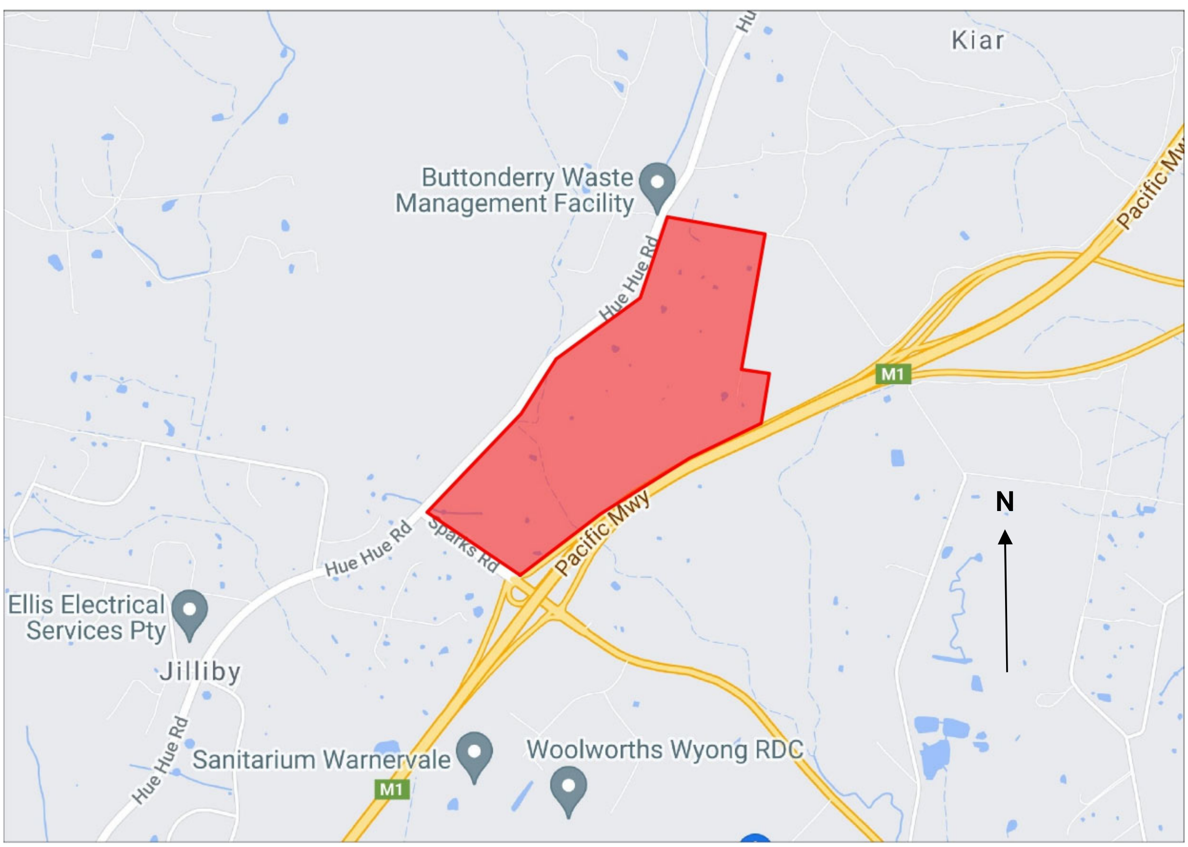

Figure 1 - Site Locality

2. Site Description

2.1 EXISTING SITE

The site, as depicted in ***Figure 2*** below, has an area of approximately 104ha and is well vegetated with varying levels of disturbance. The site is located within the CCC LGA and specifically within the WEZ. The site has frontage to Hue Hue Road, Sparks Road and Kiar Ridge Road, and the M1 Pacific Motorway runs parallel to the south eastern boundary of the site. The existing vegetation and geomorphology are further described in **Section 2.2** below.

Figure 2 - Existing Site

The site is primarily IN1 zoned land with E2 conservation areas surrounding the Buttonderry Creek riparian corridor and areas adjacent to the M1 Pacific Motorway. Rural residential land is located to the north of the site with Buttonderry Waste Management Facility located to the north west of the site. Industrial land is located south east of the M1 Pacific Motorway and also forms part of the WEZ. E2 zoned environmental conservation and management land runs along the western boundary of Hue Hue Road as well as the Council owned area bounded by the motorway, Kiar Ridge Road, and Lot 5 DP 259531 and Lot 9 DP 239704. EEC and sparse areas of high-quality habitat are located within the Buttonderry Creek riparian corridor and generally within the E2 zoned land.

The topography of the land mainly consists of a number of built up areas which gradually slope towards low lying areas along the south-east boundary of the site. A significant built up area exists in the north west corner of the site where slopes are between 4-6% with a maximum slope of 18%.

The southern upslope areas of the site have slopes in the range of 2-5% which transition to 1% slopes within the low-lying areas along the motorway boundary. Most of the site's elevation is between 18 and 20m AHD with a maximum and minimum height of 32m and 17m AHD respectively.

The site contains a number of existing dams as well as existing watercourses (blue lines) located within the development site which convey flows from three external catchments upstream to the downstream culverts located under the M1. Refer to ***Figure 3*** below.

Buttonderry Creek traverses the southern portion of the site from the Hue Hue Road boundary to the motorway boundary, conveying upstream external flows from a 628ha upstream catchment to a 4200mm wide by 4000mm high concrete box culvert (invert RL 16.25) under the motorway. Here within this will be referred to as the Southern M1 culverts.

A less defined watercourse (Kiar Ridge Watercourse) conveys external upstream flows from the Kiar Ridge catchment to the north of the site, which is approximately 108ha in size, under Kiar Ridge Road and through the northern half of the site to three combined 3000mm wide by 1500mm high concrete box culverts (invert RL 17.25) under the motorway. Here within this will be referred to as the Northern M1 culverts. Note the watercourse has been shown differently in **Figure 3** to that on other topographical maps based on ground truthing.

A second minor watercourse (Southern Watercourse) carries flows from an external 17.5 ha catchment from the south west corner of the site to Buttonderry Creek through a DN900 pipe culvert. This watercourse converges with Buttonderry Creek within the site and as such also discharges under the M1 via the southern box culverts.

The existing site has a smaller internal catchment that is located through the middle of the site that discharges under the motorway through two DN1500 pipe culverts (invert RL 16.90) that are between the Northern and Southern M1 Culverts. These pipe culverts take overflow from the Northern and Southern M1 Culverts when the banks of the watercourses are overtopped. Here within this will be referred to as the Middle M1 culverts.

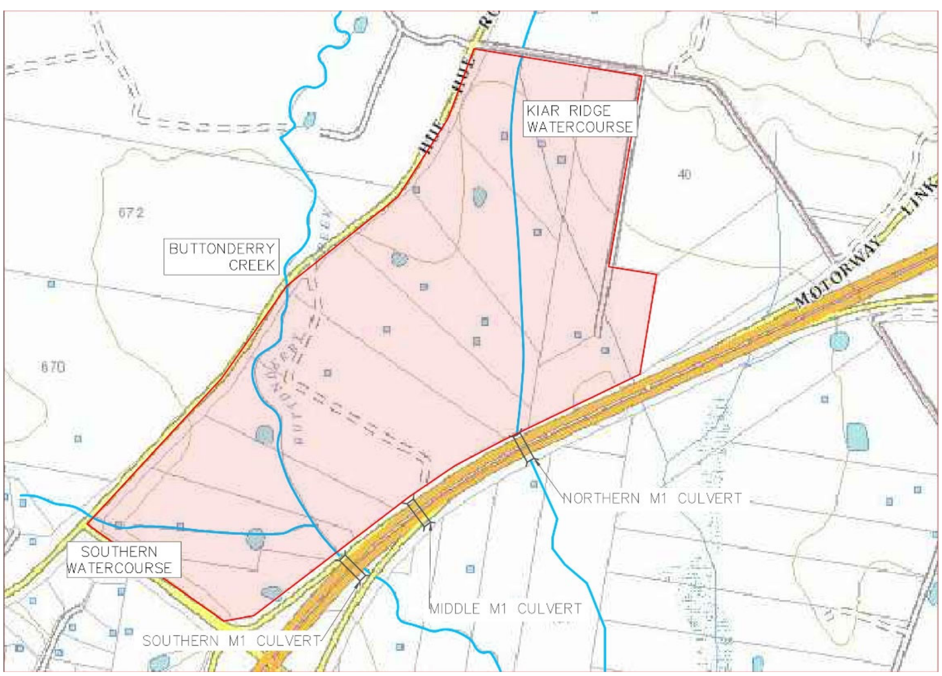

Figure 3 – Watercourse and M1 Culvert Plan

The levels of the three M1 culverts hold a significant role in determining what stormwater control methods are available within the broader stormwater management strategy for the site.

2.2 EXISTING GEOMORPHOLOGY

The soil landscape of the site can be characterised by two soil groups. A majority of the soil of the site belongs to the Wyong Soil Landscape Group as a clayey sandy silt topsoil. Soils from the Gorokan Soil Group were also identified to exist in the southern and north eastern portions of the site between 0.5m and 1.5m deep. Areas where soil belongs to the Gorokan Soil Group also correspond with elevated areas of the site, namely the north west and north east corners of the site, where slopes exceed approximately 1-2%. The southern half of the site contains weaker soil conditions including clay/silt topsoil and loose sands with underlain extremely low strength bedrock. The northern half of the site has been identified to contain higher strength soils like stiff clays and medium dense sand. The soil profiles of the site are mainly underlain by the Tuggerah rock formation with areas to the west belonging to the Patonga Claystone formation.

In general, groundwater is not common within the site subsurface soil profile which has been demonstrated by geotechnical pit investigation. Field test results indicated that groundwater was only present in the south eastern portion of the site where there is a lower elevation and greater presence of weak soils.

Additional information regarding the specific geomorphology and field test results can be obtained using the geotechnical report prepared by Douglas Partners (2008), (Report on Preliminary Geotechnical Investigation, Proposed Warner Business Park Corner Hue Hue Road and Sparks Road, Warnervale).

2.3 PROPOSED DEVELOPMENT

The proposed development comprises of 90 lots in total split across two stages being Stage 1 with 69 lots and Stage 2 with 21 lots. To service the lots typical industrial elements such as roads, drainage infrastructure, services and landscaping will be required.

The main objective of the modification of the PA and this report is to split Stage 1 into four subsequent stages being Stage 1A (pink), 1B (blue), 1C (green) and 1D (yellow). The current Stage 2 (red) in the PA is to remain unchanged in terms of staging and is still expected to be developed after the proposed Stage 1A-1D is developed due to access arrangements and servicing. The proposed staging can be seen in ***Figure 4***.

It is noted that this report focuses on Stage 1 only as the stormwater arrangements for Stage 2 are not expected to be modified from that under the original PA as Stage 2 is self-sufficient in terms of stormwater treatment.

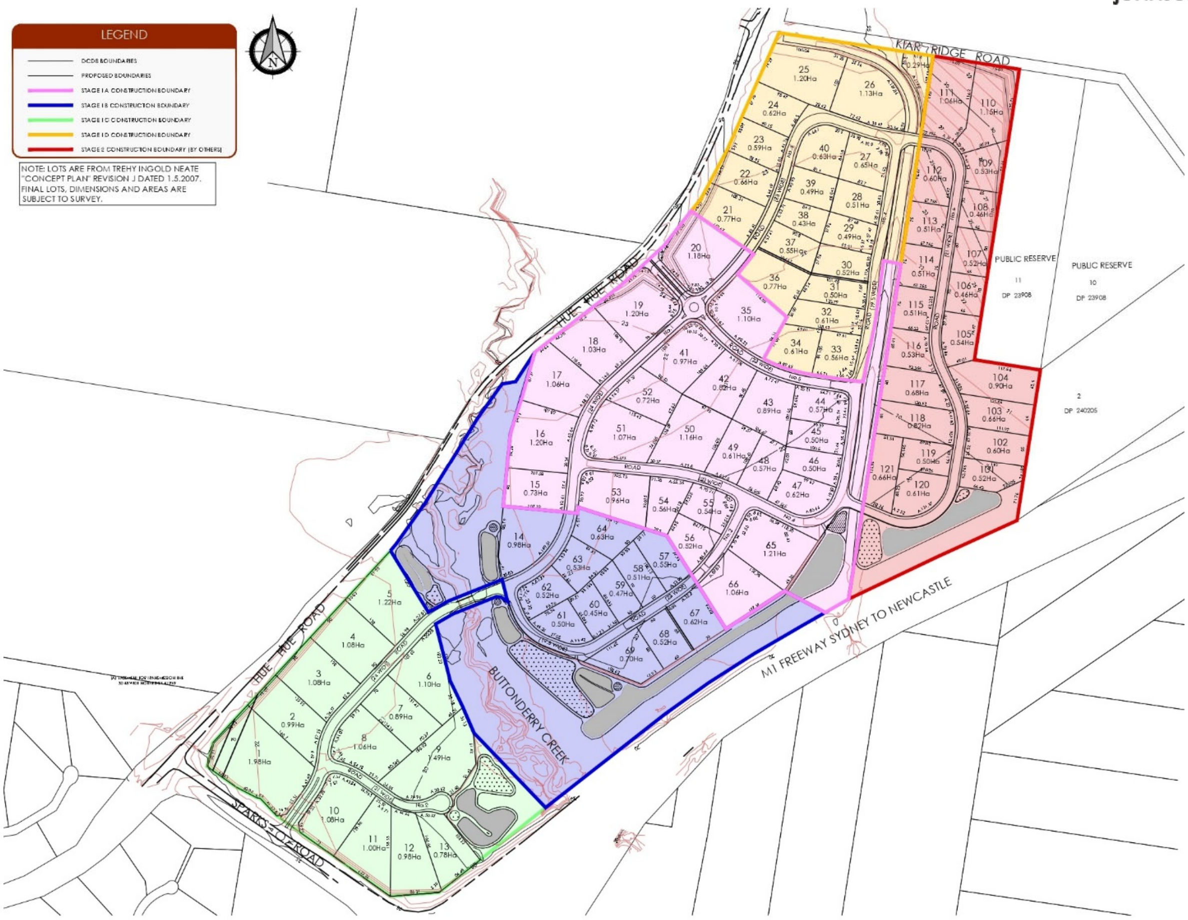

Figure 4 - Proposed Development Master Plan (ADWJ)

3. Existing Documentation

Central Coast Council (formally Wyong Shire Council) have previously engaged Ecological Engineering (EE) to prepare "Water Sensitive Urban design Solutions for Catchments above Wetlands – Catchment Hydrologic Indices and Urban Water Management Performance Objectives, Nov 2004". The hydrologic information determined by the EE investigations was then expanded to determine "Modelling Rationale for the Porters Creek Stormwater Harvesting Strategy, May 2006" from which an "Integrated Water Cycle Management Strategy Wyong Employment Zone (WEZ), November 2006" (IWCMS 2006) was prepared.

The criteria from these studies were then adapted by Council as the basis for the technical information contained in their Draft Development Control Plans "Wyong Water Sensitive Urban Design (June 2008)" and Wyong Employment Zone (February 2008)". These documents provide objectives for development at both an individual lot and precinct level which will comply with the regional controls necessary to maintain the critical hydroperiod for Porters Creek Wetland.

Since the time of issue of the PA and the adoption of the IWCMS 2006 objectives, CCC's thinking has changed and a number of the objectives within the IWCMS 2006 are no longer applicable. Most notably the pumping of stored water from the proposed development site to the Wyong Wier.

Furthermore, CCC have noted that an updated IWCMS is being prepared, however there is no current completion date for this document. As such dialogue has occurred between ADWJ and CCC to determine applicable objectives for the development site. The objectives outlined in Council's correspondence will therefore take precedence over the IWCMS 2006 as they are more recent and relevant regarding the hydrology of Porters Creek Wetland. Thus, the stormwater strategies discussed in this report will follow the objectives outlined in recent Council correspondence but will also draw on existing objectives from the IWCMS 2006 where still relevant.

4. Objectives

4.1 CONCEPT STORMWATER DESIGN

A concept stormwater design is required to demonstrate that stormwater runoff can be effectively and efficiently conveyed from the proposed subdivision to the existing receiving waters. The stormwater design is required to consider adjacent properties and ensure no nuisance runoff occurs onto these properties. The stormwater design is to consider the outcomes from the assessment of the existing hydrology to minimise the impact on the medium or high-quality EEC within the Buttonderry Creek riparian corridor or downstream ecosystems like the Porters Creek Wetland following development.

4.2 STORMWATER QUANITITY

The stormwater system designed for the proposed development is to limit changes in flow rate, flow duration and overland flow path areas downstream. It is required that the post-development peak flow from the proposed development shall not exceed the pre-development peak flow for all design storm events ranging from the 1 year ARI storm event to the 100 year ARI storm event. Differences in pre-developed and post-developed peak flows will be measured from downstream of the culverts under the M1 motorway to account for the total combined hydrograph for the site. This requires the modelling and design of stormwater detention and control facilities in XP-RAFTS which is detailed further in **Section 6.0**.

4.3 STORMWATER QUALITY / WATER SENSITIVE URBAN DESIGN

The stormwater design for the proposed subdivision is to adopt Water Sensitive Urban Design (WSUD) principles throughout the development to promote sustainable and integrated land and water resource management.

4.3.1 Natural Overland Flow

The proposed stormwater system aims to preserve natural overland flow into adjacent habitats regarding end of line discharge. This objective is particularly relevant to stormwater lines that discharge into the Buttonderry Creek riparian corridor where there are sensitive habitats. The stormwater strategy proposed in this WCMP will aim to minimise stream disturbance due to erosion and scour for 3 month and 1.5 year ARI storms.

4.3.2 Urban Stormwater

The stormwater drainage system must effectively remove the nutrients and gross pollutants from the site prior to the runoff entering the existing downstream waterways.

The guidelines for stormwater quality treatment objectives are expressed as mean annual reductions of pollutant loads. The target objectives were set based on correspondence with CCC which allowed reduced water quality targets in terms of suspended solids, phosphorous and nitrogen on the proviso that oils and hydrocarbons were targeted as these are generally more prevalent in an industrial development. The target objectives obtained are shown in Table 4.1.

Table 4.1 - Stormwater Treatment Objectives

Pollutant	Stormwater Treatment Objectives
Total Suspended Solids (TSS)	80% retention of the average annual load
Total Phosphorus (TP)	45% retention of the average annual load
Total Nitrogen (TN)	35% retention of the average annual load
Litter	Retention of litter greater than 50 mm for flows up to the 1.5 year ARI peak flow
Coarse Sediment	Retention of sediment coarser than 0.125 mm for flows up to the 1.5 year ARI peak flow
Oil and Grease	No visible oils for flows up to the 1.5 year ARI peak flow

The objective of this report is to demonstrate that the water quality objectives for the proposed development comply with the requirements of the Project Approval Modified Conditions as outlined above in Table 4.1.

4.4 ASSESSMENT OF POTENTIAL IMPACTS/WATER BALANCE

In consultation with Central Coast Council, it is required that the Warner Industrial Park development will prevent increased runoff volumes from the project site during frequent storms. Therefore, the post-developed annual runoff volume entering Buttonderry Creek shall not exceed a 10% increase when compared to pre-developed annual runoff volume. For frequent rain events (1 in 3-month ARI), post-developed runoff volume shall not exceed a 0% increase when compared to pre-developed runoff volume. A water balance assessment will be completed to verify any potential indirect impacts related to hydrology.

4.5 TOTAL WATER MANAGEMENT

An objective of the Warner Business Park stormwater strategy will be to maximise the capture and reuse of rainwater to reduce potable water demands for the development. To achieve this, it is required that rainwater tanks will be installed as 1 kL per 100m^2 of roof area and will have 50% capacity or more 24 hours prior to a storm event to ensure storage is available. The development is to incorporate water retention or reuse measures to reduce the demand on potable water.

4.6 EROSION AND SEDIMENTATION CONTROL

Erosion and sediment control measures need to be implemented during any construction activities on the proposed subdivision to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream drainage.

5. Overall Stormwater Strategy

From the assessment of the site hydrology and in compliance with Council requirements, a stormwater strategy has been completed for the proposed subdivision. The strategy has been prepared to indicate the proposed stormwater infrastructure required to convey runoff from the site and upstream contributing catchments to the discharge locations. The stormwater strategy has been designed in accordance with WSUD practices to meet water quality and peak flow attenuation requirements and best replicate the existing hydrology.

The stormwater strategy will be presented for the ultimate scenario as well as interim scenarios for each subsequent stage. Stormwater infrastructure that is relevant to all stages will be detailed in the ultimate scenario and the specific stormwater controls used in each sub-stage will be explained further in each interim scenario.

5.1 ULTIMATE SCENARIO

The ultimate scenario for the Warner Industrial Park encompasses the full development site of both Stages 1 and 2 which is proposed to be comprised of Stage 1A, Stage 1B, Stage 1C, Stage 1D and Stage 2, refer to the exhibits. This report only focuses on Stage 1 of the development as the stormwater arrangements for Stage 2 are not expected to be modified from that under the original PA as Stage 2 is self-sufficient in terms of stormwater treatment.

The pre and post development catchment areas for the ultimate scenario are shown below in Tables 5.1 and 5.2 and Exhibits 1 and 2.

Table 5.1 – Pre-Developed Catchment Areas

Catchment	Pre-Developed Area (ha)
Catchment A	16.61
Catchment B	17.04
Catchment C	31.67
Total	**65.32**

Table 5.2 – Post-Developed Catchment Areas

Catchment	Post-Developed Area (ha)
Catchment 1A	13.86
Catchment 1B	2.78
Catchment 2	14.21
Catchment 3	21.97
Catchment 4	12.40
Total	**65.22**

5.1.1 Rainwater Tanks

In accordance with the objectives in **Section 4.0**, rainwater tanks will be installed on all industrial lots in the development.

It has been conservatively assumed that the rainwater tanks will service 40% of the area of each lot (80% of the roof area with the maximum building area being 50% of the lot) and will be provided as required to satisfy a capacity of 1 kL per 100m^2 of roof area.

The capturing of rainwater for reuse will reduce potable water demand and contribute towards a sustainable water balance for the development. The rainwater tanks will enable water captured to be used for reuse for outdoor landscaping, the laundry, toilet flushing, hot water and other uses.

In accordance with Central Coast Council requirements, each of the tanks are expected to have a first flush system installed to further improve stormwater runoff quality prior to being discharged from the site.

Rainwater tanks will also have a 50% limit on capacity at all times to ensure that sufficient storage is available for detention purposes at the beginning of a storm event. This is expected to occur by having a discharge pipe with an orifice plate half way up the rainwater tank system to allow a slow release discharge. The exact requirements will be determined as part of the CC design and will be put on the 88b instrument for each lot.

Rainwater tanks have been provided on each proposed lot in water quality modelling simulations.

5.1.2 On-lot Detention

To maintain pre-development peak flows into Buttonderry Creek, it is proposed that each lot will provide on-site detention (OSD) to reduce post-development peak flows. This will apply to all lots in the ultimate scenario. Underground OSD tanks or similar will be fitted with an overflow pipe which will convey excess flow from the lot area and overflow from rainwater tanks to the pit and piped road stormwater network. Lot owners will be responsible for providing underground OSD tanks or similar and meet pre-development peak flows for lots under a caveat in their 88b instrument.

Lot areas will be modelled as 0% impervious for stormwater quantity modelling to account for reductions in peak flows by on-lot detention. This will result in end of line stormwater detention controls needing to detain post development flows from road catchments and pre development lot flows during modelling.

5.1.3 Pit and Piped Drainage

Pit and piped drainage will be designed and installed in the road network for all post-developed catchments. Piped drainage sizing and design will be on the basis of a minor/major storm event capacity system, having hydraulic design capacity for the 20-year storm event consistent with Council requirements. Flow widths in the minor and major storm events and freeboard requirements for the piped stormwater network will comply with Central Coast Council Design Guidelines.

5.1.4 Dynamic Storage

Although minor infiltration will be considered in the modelling of stormwater runoff, large scale infiltration measures will not form a major part of the development's stormwater strategy due to the underlying clay soils. As such, water balance will be improved through mass revegetation within stormwater detention facilities and open areas like the Buttonderry Creek riparian corridor.

In the ultimate scenario, mass revegetation of the development's open areas will reduce the runoff volume of the site during frequent storms and promote natural wetting and drying cycles of the Porters Creek Wetland.

5.1.5 Primary GPT

Primary GPTs will be installed to treat runoff prior to stormwater control facilities for each post-developed catchment in the ultimate scenario. The primary GPT will be a Humegard GPT acceptable to Council requirements and will provide primary treatment by removing course sediments and gross pollutants prior to secondary treatment. Primary GPTs have been included in the modelling of water quality for the proposed development.

5.1.6 Secondary Hydrocarbon Traps

Additional to the primary GPTs, secondary hydrocarbon traps will be provided as an end of line treatment device for each post-developed catchment in the ultimate scenario. The secondary hydrocarbon traps will be a Humeceptor acceptable to Council requirements and will provide secondary treatment by removing oils, greases, phosphorus, nitrogen, suspended solids and hydrocarbons. Secondary hydrocarbon traps have been included in the modelling of water quality for the proposed development.

5.1.7 Sedimentation Basin

Permanent sedimentation basins will be provided as OSD controls for post-developed catchments 1, 2 and 3 in interim scenarios and remain within the ultimate scenario. The proposed sedimentation basins will serve two primary functions regarding stormwater quantity and quality management. Firstly, the sedimentation basins will incorporate flow release controls to detain stormwater flows for storm events ranging from the 1 year ARI up to the 100 year ARI. Secondly, mass vegetation of the basins will improve the quality of runoff and act as a natural water reuse measure.

All permanent and temporary sedimentation basins will not include a permanent pool depth.

5.1.8 Open Drainage Channel

For the ultimate scenario, an open drainage channel is proposed to convey flows from the upstream northern Kiar Ridge Catchment and the post-developed Catchment 4 to the northern culverts under the M1 motorway, refer to exhibits. The channel will feature three cascading sedimentation basins formed by retaining walls which will attenuate frequent storms with a simple control outlet.

For water quality treatment, the cascading sedimentation basins will filter coarse sediments for the post-developed Catchment 4 prior to the upstream Kiar Ridge catchment flows entering the channel. The channel will also be mass vegetated to provide dynamic storage and the further capture of sediment prior to discharge downstream.

5.1.9 High Flow Bypass

A high flow bypass will be installed for the post-developed Catchment 1 to cater for the runoff volume generated by the south western upstream catchment. In the pre-developed scenario, the south western upstream catchment diverted flows through the proposed Stage 1C area through a natural watercourse. The high flow bypass will be sized for the upstream catchment and mimic the existing watercourse to discharge into Buttonderry Creek. The high flow bypass swale will be fitted with rip rap scour protection and a level spreader at the outlet.

5.2 STAGE 1A INTERIM SCENARIO

The Stage 1A interim scenario will detail the specific permanent and temporary water quality and quantity treatment controls used for the operation of Stage 1A prior to the construction of Stage 1B and 1C.

The permanent stormwater management controls that will be constructed as part of the Stage 1A interim scenario will remain until the ultimate scenario is completed. Runoff from the majority of the road and lot catchments in Stage 1A will be treated by a permanent primary GPT and secondary hydrocarbon trap prior to discharge into Basin 3. Basin 3 will act as a sedimentation basin during the construction of Stage 1A and remain as a permanent OSD control which will be heavily vegetated to allow water reuse and improve water quality.

A portion of the permanent open drainage channel will be constructed as part of Stage 1A to convey direct flows from Lot 20 as well as the Kiar Ridge Catchment and sheet flow from the northern portion of the site. The open drainage channel will be extended further in the ultimate scenario.

Temporary stormwater management controls will be constructed and used as part of Stage 1A until later stages are constructed, after which they will be removed. During the construction of Stage 1A, a temporary sediment basin will be constructed within future Lot 69. The sediment basin will convey flows from the southern portion of Stage 1A during construction via temporary swale drains. Once Stage 1A is fully constructed, the temporary sediment basin will only cater for an IAD line servicing Lots 15-19 and a small road catchment which will headwall to a temporary swale drain to reach the basin.

A temporary swale will also be required on the future Lot 33 to convey flows from an existing watercourse in the northern portion of the site to the open drainage channel. The temporary swale will remain until Stage 1D is built and the fully constructed open drainage channel is capable of replacing the function of the existing watercourse.

A temporary berm along the eastern boundary of the open drainage channel will form part of Stage 1A interim works with the function of preventing increased flood levels on adjacent land east of the proposed site. The temporary berm will remain until Stage 2 is constructed and the adjacent land is filled. The function of the temporary berm will be further detailed in **Section 9**.

5.3 STAGE 1A/1B/1C INTERIM SCENARIO

The Stage 1A/1B/1C interim scenario details the permanent stormwater controls that will operate during and after Stage 1A, 1B and 1C are constructed. Stage 1A details will be as per **Section 5.2**. Stage 1B and 1C will be constructed simultaneously prior to the construction of Stage 1D. The construction of Stage 1B and 1C will mean that the temporary swale and temporary sediment basin will be removed and replaced with the Stage 1B controls. There will be no temporary stormwater controls as part of this interim scenario.

Basin 2 will be constructed as part of the Stage 1B earthworks to capture sediment and runoff during construction and will remain as a permanent detention control for the ultimate scenario. Once earthworks are complete, a permanent primary GPT and secondary hydrocarbon trap will be constructed to treat stormwater runoff prior to discharge into Basin 2. Basin 2 will be heavily vegetated to allow water reuse and improve water quality.

Basin 2 will be required to discharge into the Buttonderry Creek riparian corridor and the southern box culverts under the M1 motorway due to level constraints. As such, the headwall outlet of the basin will be fitted with a level spreader and rip rap scour protection to maintain natural sheet flow conditions similar to the pre-development scenario. Provision of these controls will also ensure minimal stream disturbance to Buttonderry Creek as outlined in **Section 10**.

Stage 1C will be simultaneously constructed with stage 1B and will have stormwater controls specific to its circumstances.

Basin 1 will be constructed during the earthworks phase of Stage 1C to capture sediment from the construction site and will remain as a permanent detention and water quality control in the ultimate scenario. During the operation of Stage 1C, Basin 1 will act as a sedimentation basin to detain flows and provide water quality treatment through mass revegetation. A primary GPT and a secondary hydrocarbon trap will be installed for the operation of Stage 1C to treat stormwater runoff prior to discharge into Basin 1.

Once the pit and piped road stormwater network is constructed for Stage 1C, a high flow bypass will be constructed to bypass flows from an upstream catchment around Basin 1 and into Buttonderry Creek. To maintain natural sheet flow conditions and minimise stream disturbance, rip rap and a level spreader will be constructed at the outlets of both Basin 1 and the high flow bypass. Both Basin 1 and 2 will discharge to the southern culvert under the M1 motorway via Buttonderry Creek.

6. Stormwater Quantity

The proposed stormwater strategy, as detailed in **Section 5**, uses a combination of pit and pipe networks and WSUD elements to capture and convey stormwater runoff from the site. The subject site is subdivided into a series of catchments for the post development scenario. Parameters of catchment areas, imperviousness, catchment slope and rainfall losses are used to simulate the catchment response to storm events to generate hydrographs and estimate the peak discharge. The parameters used during the modelling and the results of the modelling are outlined in the subsequent sections.

6.1 MODELLING

XP-RAFTS modelling was used to demonstrate the on-site stormwater detention required to reduce post development peak flows back to or less than pre development peak flows for all storm events from the 1 year ARI to the 100 year ARI design storms.

6.1.1 Mannings 'n'

Mannings 'n' is the catchment roughness factor; this value is adjusted to represent the different response of rural and urbanised catchments, impervious and pervious surfaces. Table 6.1 shows the adopted 'n' values.

Table 6.1 – XP-RAFTS Mannings 'n' Values

Parameter	Catchment Condition	Value
Mannings 'n'	Impervious	0.015
	Pervious	0.035

6.1.2 Losses Data

XP RAFTS modelling was undertaken using initial and continuing losses. The values adopted for the model can be found in Table 6.2 below.

Table 6.2 – Initial and Continuing Loss Values

Impervious		Pervious	
Initial	Continuing	Initial	Continuing
1.0 mm	0 mm	10mm	2.5 mm

6.1.3 Rainfall Data

Design Rainfall intensity-frequency-duration (IFD) for the site was obtained using Bureau of Meteorology ARR 1987 rainfall data for Jilliby as it best represented the rainfall for the development site.

6.1.4 Catchment Data

The areas of the post development catchments as shown in **Exhibit 2** are outlined in table 6.3.

Table 6.3 – Post Developed Catchment Areas

Catchment	Type	Total Area (ha)	% Impervious	Impervious Area (ha)	Pervious Area (ha)
Catchment 1A	Lots	12.41	0%	0.00	12.41
	Roads	1.45	70%	1.02	0.44
	Total	**13.86**	**7%**	**1.02**	**12.85**
Catchment 1B	Lots	2.32	0%	0.00	2.32
	Roads	0.46	70%	0.32	0.14
	Total	**2.78**	**12%**	**0.32**	**2.46**
Catchment 2	Lots	11.65	0%	0.00	11.65
	Roads	2.56	70%	1.79	0.77
	Total	**14.21**	**13%**	**1.79**	**12.42**
Catchment 3	Lots	18.56	0%	0.00	18.56
	Roads	3.41	70%	2.39	1.02
	Total	**21.97**	**11%**	**2.39**	**19.58**
Catchment 4	Lots	10.42	0%	0.00	10.42
	Roads	1.98	70%	1.38	0.59
	Total	**12.40**	**11%**	**1.38**	**11.01**
Total		**65.22**	**11%**	**6.90**	**58.32**

6.1.5 Basin Data

Onsite Detention (OSD) basins have been sized and concept outlet configurations have been prepared to enable modelling of the site and demonstrate that the basins reduce post development peak flows back to or less than pre development peak flows. The details for the permanent basins for the ultimate scenario are as follows:

Table 6.4 – Basin 1 Data

Basin Parameter	Detail
Outlet Controls	Stormwater pit cutout – 3 x 0.525mØ – IL RL 17.0m AHD
	900 x 1200mm G.S.I.P – IL RL 17.8m AHD
	Weir – 10m length, IL RL 18.1m AHD
Total Storage at 100 year Stage	2820 m3 at IL RL 18.057m AHD
Basin invert level at outlet	IL RL 17.0m AHD

Table 6.5 – Basin 2 Data

Basin Parameter	Detail
Outlet Controls	Stormwater pit cutout – 0.4 x 4m – IL RL 17.2m AHD
	Weir – 10m length – IL RL 18.4m AHD
Total Storage at 100 year Stage	1160 m3 at IL RL 17.634m AHD
Basin invert level at outlet	IL RL 17.2m AHD

Table 6.6 – Basin 3 Data

Basin Parameter	Detail
Outlet Controls	Stormwater pit cutout – 0.5 x 1.0 – IL RL 17.5m AHD
	Stormwater pit cutout – 0.2 x 0.8 – IL RL 18.1m AHD
	600 x 600 G.S.I.P – IL RL 19.2m AHD
	Weir – 10m length - IL RL 19.4m AHD
Total Storage at 100 year Stage	5340 m3 at IL RL 19.386m AHD
Basin invert level at outlet	IL RL 17.5m AHD

Table 6.7 – Cascading Basin 1 Data

Basin Parameter	Detail
Outlet Controls	2 x 0.375mØ pipes – IL RL 19.6m AHD
Total Storage at 100 year Stage	1090 m3 at IL RL 20.4m AHD
Basin invert level at outlet	IL RL 19.6m AHD

Table 6.8 – Cascading Basin 2 Data

Basin Parameter	Detail
Outlet Controls	2 x 0.375mØ pipes – IL RL 18.8m AHD
Total Storage at 100 year Stage	1440 m3 at IL RL 19.6m AHD
Basin invert level at outlet	IL RL 18.8m AHD

Table 6.9 – Cascading Basin 3 Data

Basin Parameter	Detail
Outlet Controls	2 x 0.375mØ pipes – IL RL 17.78m AHD
Total Storage at 100 year Stage	1440 m3 at IL RL 18.58m AHD
Basin invert level at outlet	IL RL 17.78m AHD

These OSD basins are all permanent detention controls which will be constructed at different stages of the project but will remain in the development for the ultimate scenario. Further detail on the basins modelled can be observed in Exhibits 3 to 10.

6.2 RESULTS – ULTIMATE SCENARIO

In accordance with Council requirements, modelling has been undertaken to demonstrate compliance with water quantity objectives for stormwater runoff from the proposed development prior to discharge of stormwater into downstream waterways.

The results of the modelling for the ultimate scenario are detailed below in Table 6.10. Table 6.10 shows the pre-developed and post-developed peak flows as observed from downstream where the flows from all M1 culverts converge.

Table 6.10 – Pre and Post Development Peak Flows for Entire Site– Ultimate Scenario

ARI Storm Event (Year)	Pre-Developed Peak Flow (m³/s)	Post-Developed Peak Flow with Detention (m³/s)	% Reduction - Pre-Developed to Post-Developed Peak Flow
1	2.16	1.959	9.3%
2	3.159	2.796	11.5%
5	4.57	3.973	13.1%
10	5.431	5.056	6.9%
20	6.565	6.209	5.4%
50	7.632	7.189	5.8%
100	8.857	8.334	5.9%

The above results show that the post developed detained peak flows are less than the pre developed peak flows for all storm events in the ultimate scenario.

6.3 RESULTS – STAGE 1A INTERIM SCENARIO

The following results detail the pre-developed and post-developed peak flows for the Stage 1A interim scenario. This scenario is as described in **Section 5.2** of this report. Note that for the purposes of water quantity modelling, the Stage 1A scenario still models the remainder of the site, other than Stage 1A, as pre developed to allow the comparison of pre to post detention results downstream of the development. This has been completed as a result of the post development catchments being different to the pre development catchments in terms of size and discharge location.

Table 6.11 – Pre and Post Development Peak Flows – Stage 1A Interim Scenario

ARI Storm Event (Year)	Pre-Developed Peak Flow (m³/s)	Post-Developed Peak Flow with Detention (m³/s)	% Reduction - Pre-Developed to Post-Developed Peak Flow
1	2.16	1.459	32.5%
2	3.159	2.096	33.6%
5	4.57	3.474	24.0%
10	5.431	4.135	23.9%
20	6.565	5.041	23.2%
50	7.632	7.093	7.1%
100	8.857	8.583	3.1%

The above results show the significant reduction in post development flow from pre development flows for the smaller storm events with the larger storm events having the post development flows closer to that of the pre development scenario. The reason for this is because the Cascading Basins detain some of the pre developed Stage 1D catchment in the post developed scenario. Furthermore, as part of the Stage 1A post development scenario a temporary sediment basin is proposed which only has a weir as an outlet as it will be used as a construction basin and will be pumped out between storm events. This outlet configuration means that the smaller storm events are contained within the basin with no discharge.

6.4 RESULTS – STAGE 1A/1B/1C INTERIM SCENARIO

The results for the Stage 1A/1B/1C interim scenario are detailed in Table 6.12. The Stage 1A/1B/1C scenario models the reduction of post-developed peak flows after the construction of Stage 1B/1C and prior to the construction of Stage 1D.

Table 6.12 – Pre and Post Development Peak Flows – Stage 1A/1B/1C Interim Scenario

ARI Storm Event (Year)	Pre-Developed Peak Flow (m^3/s)	Post-Developed Peak Flow with Detention (m^3/s)	% Reduction - Pre-Developed to Post-Developed Peak Flow
1	2.16	1.944	10.0%
2	3.159	2.767	12.4%
5	4.57	4.517	1.2%
10	5.431	5.231	3.7%
20	6.565	6.317	3.8%
50	7.632	7.375	3.4%
100	8.857	8.481	4.2%

The above results show that there is a significant reduction in post development flow from pre development flow for the 1 year ARI and 2 year ARI storm events with all other storm events having the post development peak flow slightly less than that of the pre development peak flow. Note that for the 5 year ARI storm event and larger storm events, there is an alignment between the hydrographs for the Cascading Basins and Basin 3, hence the smaller reduction in peak flows.

7. Water Quality/Water Sensitive Urban Design

The proposed stormwater system detailed in **Section 5** uses a combination of pit and pipe networks and water sensitive urban design elements to convey and treat stormwater runoff from the site. It is intended to use a combination of treatment devices within the drainage system to remove nutrients and sediments from the stormwater prior to the runoff leaving the site.

7.1 TREATMENT DEVICES

The following treatment controls were utilised to improve the water quality of runoff over the developed catchment:

- **Rainwater Tanks** – Rainwater tanks are proposed to be installed for each industrial lot. The tanks will be fitted with first flush devices and be fitted to have indoor use of the rainwater collected. Rainwater tanks are an at source treatment control.
- **Gross Pollutant Traps/Hydrocarbon Traps** – As part of the development it is proposed to use underground proprietary gross pollutant traps and hydrocarbon traps. Gross Pollutant Traps remove gross pollutants, coarse sediments and pollutants prior to further detention and treatment downstream. The secondary Humeceptor GPT will also contribute towards the removal of industrial pollutant loads such as oils, greases and hydrocarbons. Both Humegard primary GPTs and Humeceptor Secondary GPTs were used for modelling.
- **Vegetated Sediment Basins** – To accurately model the mass revegetation that is proposed for the sedimentation basins, swales have been used during modelling to allow for vegetation to be included. The swales modelled have been adjusted to suit the basin dimensions.

7.2 MODELLING

The software used for the water quality modelling was MUSIC. This program is well regarded as industry best practice for analysis of the effectiveness of treatment mechanisms on the quality of stormwater runoff from a development site of this size.

MUSIC-link for Council has been used for the modeling for this site. Using Council's MUSIC-link enables the simplification of the development and assessment of MUSIC models. Council's MUSIC-link enables the model to adopt all of Council's preferred parameters such as rainfall, evapotranspiration data, lowland soil characteristics and pollutant generation rates.

The modelling of water quality treatment in MUSIC does not allow for the observation of hydrocarbon pollutant loads which are required to be reduced according to the objectives outlined in **Section 4**. As these results are unavailable through MUSIC modelling, hydrocarbon reduction results have been sourced from the Humeceptor system Technical Manual provided by Humes. The results are illustrated in Figure 5. Note that looking at the results of the Humeceptor only is very conservative as the end of line basins will further reduce hydrocarbon pollutant loads.

Table 1 – HumeCeptor® system performance summary

Pollutant	Average removal efficiency	Details
TSS	80%	Laboratory and field results, stable, hardstand, roads, commercial and industrial sites
TN	37%	Field results
TP	53%	Field results
Chromium	44%	Field results
Copper	29%	Field results
TPH	65%	<10 ppm inflow concentration
	95%	10 ppm - 50 ppm inflow concentration (typical stormwater)
	99%	>500 ppm inflow concentration (emergency spills)

Figure 5 – Humeceptor performance results for Total Petroleum Hydrocarbon (TPH) removal (Source: Humes)

As can be seen in **Figure 5** the TPH removal by the Humeceptor for typical stormwater is 95% based on an inflow concentration of 10 ppm to 50 ppm.

Results for the ultimate scenario are presented in **Section 7.3** and results for the interim staging scenarios are detailed in **Section 7.4-7.5**.

7.2.1 Catchment Data

Overall catchment areas used in MUSIC modelling were identical to those used for stormwater quantity modelling in XP-RAFTS. Table 7.1 shows the catchment and sub-catchment areas for different treatment nodes which are specific to MUSIC modelling.

Table 7.1 – Catchment and Sub Catchment Areas

Catchment	Sub Catchment	Total Area (ha)	% Impervious	Impervious Area (ha)	Pervious Area (ha)
Catchment 1A	Roofs	4.96	100%	4.96	0.00
	Lots	7.45	83%	6.18	1.27
	Road Reserve	1.45	70%	1.02	0.44
Subtotal	-	**13.86**	-	**12.16**	**1.71**
Catchment 1B	Roofs	0.93	100%	0.93	0.00
	Lots	1.39	83%	1.15	0.24
	Road Reserve	0.46	70%	0.32	0.14
Subtotal	-	**2.78**	-	**2.40**	**0.38**
Catchment 2	Roofs	4.66	100%	4.66	0.00
	Lots	6.99	83%	5.80	1.19
	Road Reserve	2.56	70%	1.79	0.77
Subtotal	-	**14.21**	-	**12.25**	**1.96**
Catchment 3	Roofs	7.42	100%	7.42	0.00
	Lots	11.14	83%	9.24	1.89
	Road Reserve	3.41	70%	2.39	1.02
Subtotal	-	**21.97**	-	**19.05**	**2.91**
Catchment 4	Roofs	4.17	100%	4.17	0.00
	Lots	6.25	83%	5.19	1.06
	Road Reserve	1.98	70%	1.39	0.59
Subtotal	-	**12.4**	-	**10.75**	**1.65**
Total		**65.22**	**87%**	**56.61**	**8.61**

The combination of 'Roof' and 'Lot' sub catchments have been modelled as 90% impervious to accurately model pollutant loads from impervious surfaces. This differs from stormwater quantity modelling where lots were modelled as 0% impervious to account for on lot detention requirements.

7.3 RESULTS - ULTIMATE SCENARIO

In accordance with Council requirements, modelling has been undertaken to demonstrate compliance with water quality objectives for stormwater runoff from the proposed development prior to discharge of stormwater into the downstream waterways. In this section, the water quality treatment results for the ultimate scenario will be presented in Table 7.2.

Table 7.2 – Ultimate Scenario Pollutant Loads and Reductions

Pollutant	Source Load	Residual Load	Modelled Reduction (%)	Target Reduction (%)
Flow (ML/yr)	740	705	4.8	-
Total Suspended Solids (kg/year)	99100	16500	83.3	80
Total Phosphorus (kg/year)	197	98.8	49.9	45
Total Nitrogen (kg/year)	1620	1010	37.9	35
Gross Pollutants (kg/year)	18500	0	100	90

As can be seen above, for the ultimate scenario the development exceeds the water quality targets.

7.4 RESULTS - STAGE 1A INTERIM SCENARIO

The Stage 1A interim scenario results will be based on the treatment train effectiveness of flows leaving Basin 3 as well as the Lot 15-19 flows leaving the temporary sediment basin on future Lot 69 and the Lot 20 flows leaving the cascading basins. As it is expected that Stage 1B/1C will be constructed rolling on after the construction of Stage 1A it is assumed that there will only be a short period where these lots are treated by temporary WSUD devices.

The results of the stage 1A interim scenario modelling are shown in Table 7.3 below.

Table 7.3 – Post-Developed Stage 1A Outflow Pollutant Loads and Reductions

Pollutant	Source Load	Residual Load	Modelled Reduction (%)	Target Reduction (%)
Flow (ML/yr)	259	235	9.2	-
Total Suspended Solids (kg/year)	38300	5810	84.8	80
Total Phosphorus (kg/year)	73.7	32.9	55.4	45
Total Nitrogen (kg/year)	567	329	42	35
Gross Pollutants (kg/year)	6370	0	100	90

As can be seen above, for the Stage 1A interim scenario the development exceeds the water quality targets.

7.5 RESULTS - STAGE 1A/1B/1C INTERIM SCENARIO

Results for the Stage 1A/1B/1C scenario will be provided for the end of line treatment train effectiveness following discharge from Basin 1, Basin 2 and Basin 3. The Stage 1A/1B/1C interim scenario for MUSIC modelling is best represented by the post-developed catchment 1 (1A and 1B combined), 2 and 3. It is important to note that the upstream catchment flows for the south-western portion of the site will bypass the primary GPT, secondary hydrocarbon trap and sedimentation basin treatment through a splitter pit that will divert it along a high flow bypass swale. Therefore, the upstream catchment flows will not be included as part of the MUSIC modelling for the stage 1A/1B/1C interim scenario.

The results of the stage 1A/1B/1C interim scenario modelling are shown in Table 7.4 below.

Table 7.4 – Post-Developed Stage 1A/1B/1C Pollutant Loads and Reductions

Pollutant	Source Load	Residual Load	Modelled Reduction (%)	Target Reduction (%)
Flow (ML/yr)	547	517	5.5	-
Total Suspended Solids (kg/year)	76800	12200	84.2	80
Total Phosphorus (kg/year)	150	72.9	51.5	45
Total Nitrogen (kg/year)	1200	735	38.7	35
Gross Pollutants (kg/year)	13600	0	100	90

As can be seen above, for the Stage 1A/1B/1C interim scenario the development exceeds the water quality targets.

8. Water Balance

Council amendments to the original IWCMP 2006 state objectives for water balance for discharge to the Buttonderry Creek riparian corridor for the 1 in 3 month ARI storm event. Runoff volume for frequent storms and annual runoff volume discharged into Buttonderry Creek is a consideration for the site considering potential downstream impacts on Porters Creek Wetland drying cycles. Therefore, the Warner Industrial Park development aims to maintain a water balance which achieves these objectives and limits post-development runoff impacts on important downstream wetlands and habitats.

The original stormwater strategy under the IWCMS 2006 included the storage of stormwater runoff in basins on site and pumping the excess water volumes from the site to Wyong Creek via a pipeline along Hue Hue Road. Since the time of this proposed strategy Council have noted that this method is no longer preferred.

There are numerous site constraints which influence the available methods to reduce stormwater runoff volumes entering Buttonderry Creek. Geotechnical testing of the site soil profile conducted by Douglas Partners revealed that the site is underlain by impermeable clays with an estimated conservative infiltration rate of 0.36 mm/hr. Impermeable soils can significantly limit available infiltration methods that typically reduce runoff volumes. Further information regarding the soil profile and groundwater properties of the site are detailed in Douglas Partners (2008), (Report on Preliminary Geotechnical Investigation, Proposed Warner Business Park Corner Hue Hue Road and Sparks Road, Warnervale).

Another site constraint that can influence water balance for the proposed site is the highly impervious nature of industrial zoned infrastructure. According to Council Design Guidelines 2018, Industrial lots must be modelled as 90% impervious for stormwater quantity modelling. This poses a significant challenge as impervious surfaces increase runoff volumes dramatically in comparison to pre-developed scenarios.

Measures have been taken to reduce the runoff volume entering Buttonderry Creek for frequent storm events and on an annual basis for the Warner Industrial Park. Mass revegetation has been modelled and proposed for open areas and stormwater detention facilities to increase the uptake of runoff by dynamic storage in plants. Whilst this methodology has been adopted, it is not possible to model the uptake of water by plants in terms of reducing the runoff volume from the site.

Furthermore, stormwater harvesting measures have been implemented through the modelling of rainwater tanks in MUSIC and reuse has been modelled to reduce potable water demands for the development. Modelling has been conducted in a conservative manner due to the complexities of accurately calculating water reuse from the future development of each lot.

Results for the water balance and annual runoff for pre-developed and post-developed catchments entering Buttonderry Creek have been provided in Table 8.1.

Table 8.1 – Pre-Developed and Post-Developed Annual Runoff Volume for Southern Culvert

Catchment	Flow (ML/yr)	Flow with Treatment (ML/yr)	Modelled Reduction (%)
Pre Developed Catchment 1	66.2	66.2	0
Total	**66.2**	**66.2**	**0**
Post Developed Catchment 1	179	171	4.2
Post Developed Catchment 2	151	143	5.3
Total	**330**	**314**	**4.7**

As can be seen from Table 8.1, the pre developed stormwater runoff volume of 66.2ML/yr is significantly less than the post developed stormwater runoff volume of 330ML/yr prior to treatment. The treatment of the post development stormwater runoff volume through on lot reuse and infiltration provides a conservative 4.7% reduction in annual runoff volume for Buttonderry Creek and the Southern M1 Culvert.

9. Flooding

The proposed development must consider flooding impacts caused by earthworks activities as it lies within the Wyong Shire Council (now Central Coast Council) Flood Planning Zone. The stormwater strategy and proposed solutions regarding flooding impacts will be approached on an interim and ultimate scenario basis.

The proposed development site will require considerable earthworks fill as part of the construction of each stage. As such, the strategy for mitigating flood levels, both on neighbouring property and downstream infrastructure and habitats, will be to incorporate compensatory storage where possible within the permissible boundary of construction works for the site. Compensatory storage will primarily be included within the temporary construction sediment basins and permanent sedimentation basins proposed for the interim and ultimate scenarios. The stormwater detention controls which will contribute to compensatory storage for the site include:

- Basin 1 (permanent sedimentation basin)
- Basin 2 (permanent sedimentation basin)
- Basin 3 (permanent sedimentation basin)
- Open drainage channel (permanent drainage structure)
- Stage 1A sediment basin (temporary for stage 1A interim scenario)

An important consideration for the detention structures that contribute to the compensatory storage for the site will be the availability of capacity when flood waters from Buttonderry Creek and the Kiar Ridge catchment enter the site. Modelling has been carried out to demonstrate that stormwater runoff from the site will be discharged from the detention structures prior to the arrival of upstream flood waters. The proposed stormwater detention structures will only detain road catchment flows as lots will have their catchment flows detained by underground OSD tanks or similar (see **Section 5**). As the upstream external catchment are significant in size and are heavily vegetated, they will have significant lag time before large flows occur through the site. As such it is expected that the discharge from the site will occur prior to the external catchment flows being conveyed through the site.

Consultation with flood modelling sub-consultants has revealed the potential for increased flood levels on the future Stage 2 land due to earthworks fill within the flooding zone for the Stage 1A interim scenario. It is proposed that a temporary berm structure will be built along the eastern boundary of the open drainage channel to remove any increase in flood levels on the future Stage 2 land. The berm structure will remain throughout all interim scenarios until the construction of Stage 2 begins and the ultimate scenario is reached. The berm is proposed to be between 0.5m and 2.3m high with a 600mm diameter pipe constructed in line with the low point adjacent to the berm. The pipe will have a one way flap valve to allow water from an existing dam on the future Stage 2 to drain to the proposed open drain.

Further detail on preliminary flood modelling for the Stage 1A interim scenario is available in **Appendix C**. Flooding impacts are subject to change with further modelling for other interim and ultimate scenarios.

10. Stream Disturbance

The proposed strategy for dealing with stream disturbance regarding Buttonderry Creek will involve measures that limit post-development peak flows for 3 month and 1.5 year ARI storm events. Another component of the proposed strategy is to preserve natural sheet flow conditions within the Buttonderry Riparian Corridor and prevent scour of the surrounding areas.

As mentioned in **Section 5**, Basin 1 and Basin 2 will have discharge outlets with rip rap scour protection and level spreaders to maintain sheet flow conditions and reduce discharge velocity to avoid scour of sensitive habitats within the Buttonderry Creek riparian corridor. These measures will ensure that the nature of sheet flow in areas surrounding Buttonderry Creek will remain undisturbed.

Furthermore, Buttonderry Creek is to be revegetated in accordance with the PA documentation and a future Vegetation Management Plan. The revegetation works will include revegetating disturbed areas where basin stormwater outlet pipes are constructed.

The basins are proposed to have scour protection measures constructed as required based on the flood velocities to ensure no scour protection occurs.

In reference to the peak flow results presented in **Section 6**, measures have been taken to reduce post-development peak flows for frequent rain events to minimise stream disturbance of Buttonderry Creek.

11. Erosion and Sedimentation Control

Erosion and sedimentation control measures need to be implemented during any construction on the proposed subdivision to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream waterways. Preliminary Erosion and Sedimentation Control Plans are presented in Exhibits 11-15. The attached Erosion and Sedimentation Control Plans are only indicative plans as other Erosion and Sedimentation Control Plans will be provided as part of bulk earthworks and construction certificate drawings. A further plan will also be provided by the contractor before construction takes place.

During the construction period, it is recommended that the temporary and permanent sedimentation basins are constructed early during construction works to contain sediment runoff. For the Stage 1A interim scenario, this will involve the immediate construction of Basin 3 and the temporary sediment basin located on Lot 69. Once sediment controls are established, runoff can safely be conveyed to them through a network of berms and swale drains. The Stage 1B/1C scenario will require the permanent Basin 1 and Basin 2 to be immediately constructed after which berms and swales can convey runoff. Permanent sedimentation basins will require immediate vegetation coverage once construction works are finalised.

It is also recommended that an appropriate Erosion and Sedimentation Control Plan is implemented throughout the entire construction period to minimise the quantity of sediments being conveyed to the temporary sediment basin.

12. Conclusion

This report has been completed to support a modification to the PA for the Warner Industrial Park. The report outlines the CCC stormwater objectives and how these are achieved in both interim and ultimate development scenarios.

A treatment train process/stormwater system containing a pit and pipe network in addition to rainwater tanks and an end of line GPT/Humeceptor has been designed to convey the stormwater runoff to proposed sedimentation basins located around the site.

XP RAFTS modelling has demonstrated that the proposed sedimentation basins enable the post development peak flows to be reduced back to the pre development peak flow levels for the 1 year ARI through to the100 year ARI storm event for the ultimate scenario and each permanent basin.

MUSIC modelling has been used to demonstrate that the treatment train for runoff from the proposed development complies with the performance target objectives of CCC prior to discharge from the site.

Total water management has been included during the design and modelling of the proposed development so as to incorporate water retention and reuse measures to reduce the demand on potable water as well as reduce total stormwater runoff volume from the site.

Impacts of earthworks fill on increased flood levels have been considered and mitigated by the provision of compensatory storage in all temporary and permanent sedimentation basins for interim and ultimate scenarios.

An Erosion and Sedimentation Control Plan has also been prepared for construction of the proposed development, as per Council's requirements.

Overall, the works proposed in this WCMP are designed to achieve a positive outcome for the management and treatment of stormwater runoff from the proposed development. Modelling indicates that through the implementation of the proposed WCMP, all of Council's requirements in relation to water quantity, water quality and flooding will be met.

13. References

Australian Runoff Quality (ARQ) Engineers Australia

Central Coast Council (2018) - Design Guidelines

Douglas Partners (2008), (Report on Preliminary Geotechnical Investigation, Proposed Warner Business Park Corner Hue Hue Road and Sparks Road, Warnervale).

J. Wyndham Prince (2009) – Warner Industrial Park Water Management Scheme

Wyong Shire Council (2006) - Integrated Water Cycle Management Strategy

Exhibits

Exhibit 1	Pre-Developed Catchment Plan
Exhibit 2	Post Developed Catchment Plan
Exhibit 3	Basin No.1 Detail Plan
Exhibit 4	Basin No.1 Section
Exhibit 5	Basin No.2 Detail Plan
Exhibit 6	Basin No.2 Section
Exhibit 7	Basin No.3 Detail Plan
Exhibit 8	Basin No.3 Section
Exhibit 9	Cascading Basins Detail Plan
Exhibit 10	Cascading Basins Sections
Exhibit 11	Erosion and Sediment Control Plan Stage 1A – Sheet 1
Exhibit 12	Erosion and Sediment Control Plan Stage 1A – Sheet 2
Exhibit 13	Erosion and Sediment Control Plan Stage 1B/1C
Exhibit 14	Erosion and Sediment Control Plan Stage 1D
Exhibit 15	Erosion and Sediment Control Details & Notes

PRE-DEVELOPMENT CATCHMENT PLAN

SCALE 1:4000

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	20.12.21	INITIAL ISSUE	J.J	J.Y.	DATUM: CONTOUR INTERVAL: 1.0m	A1 1:4000 / A3 1:8000	

drawing title: EXHIBIT 1: PRE DEVELOPMENT CATCHMENT PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-001

client: WARNERVALE LF Pty Ltd

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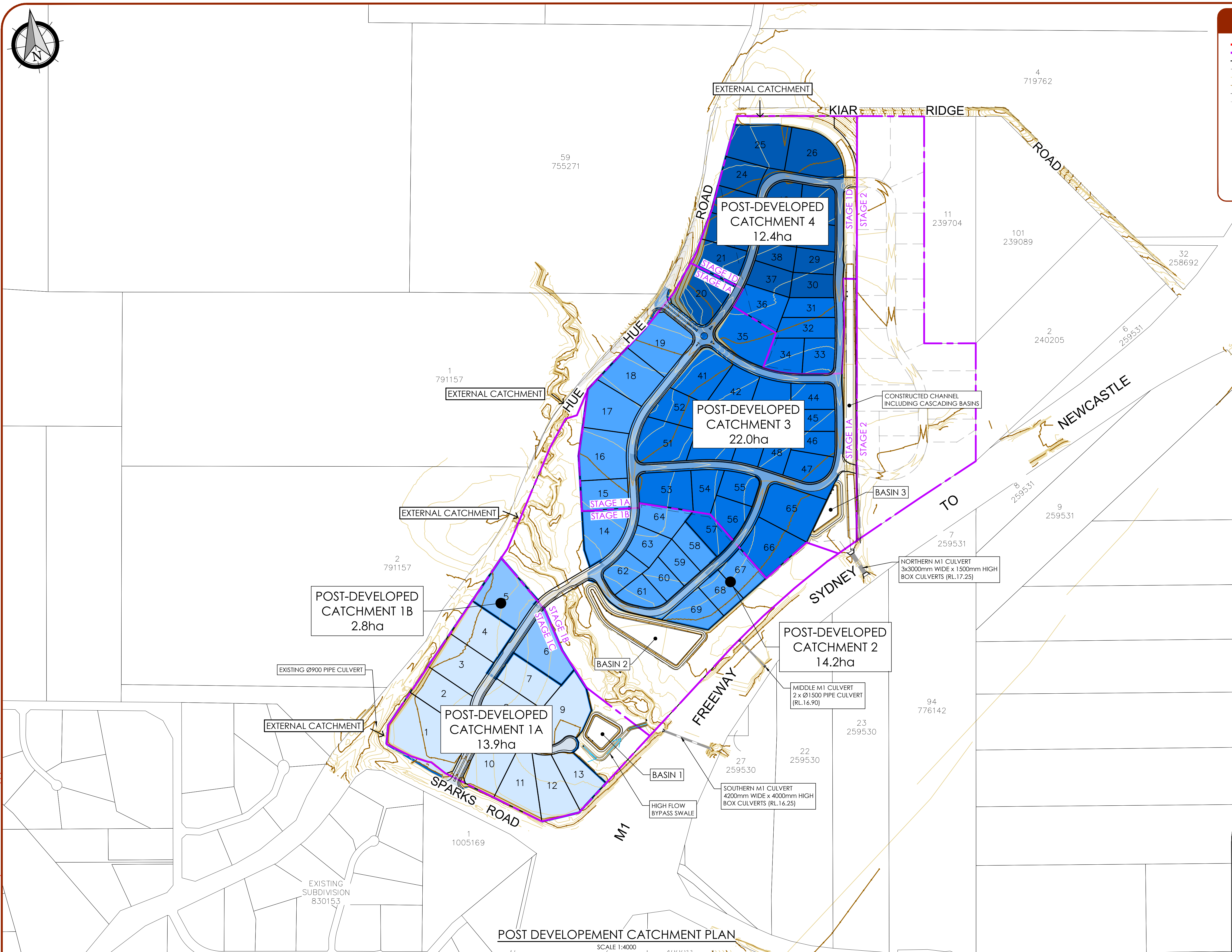

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title:

EXHIBIT 2: POST DEVELOPMENT CATCHMENT PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-002

client: WARNERVALE LF Pty Ltd

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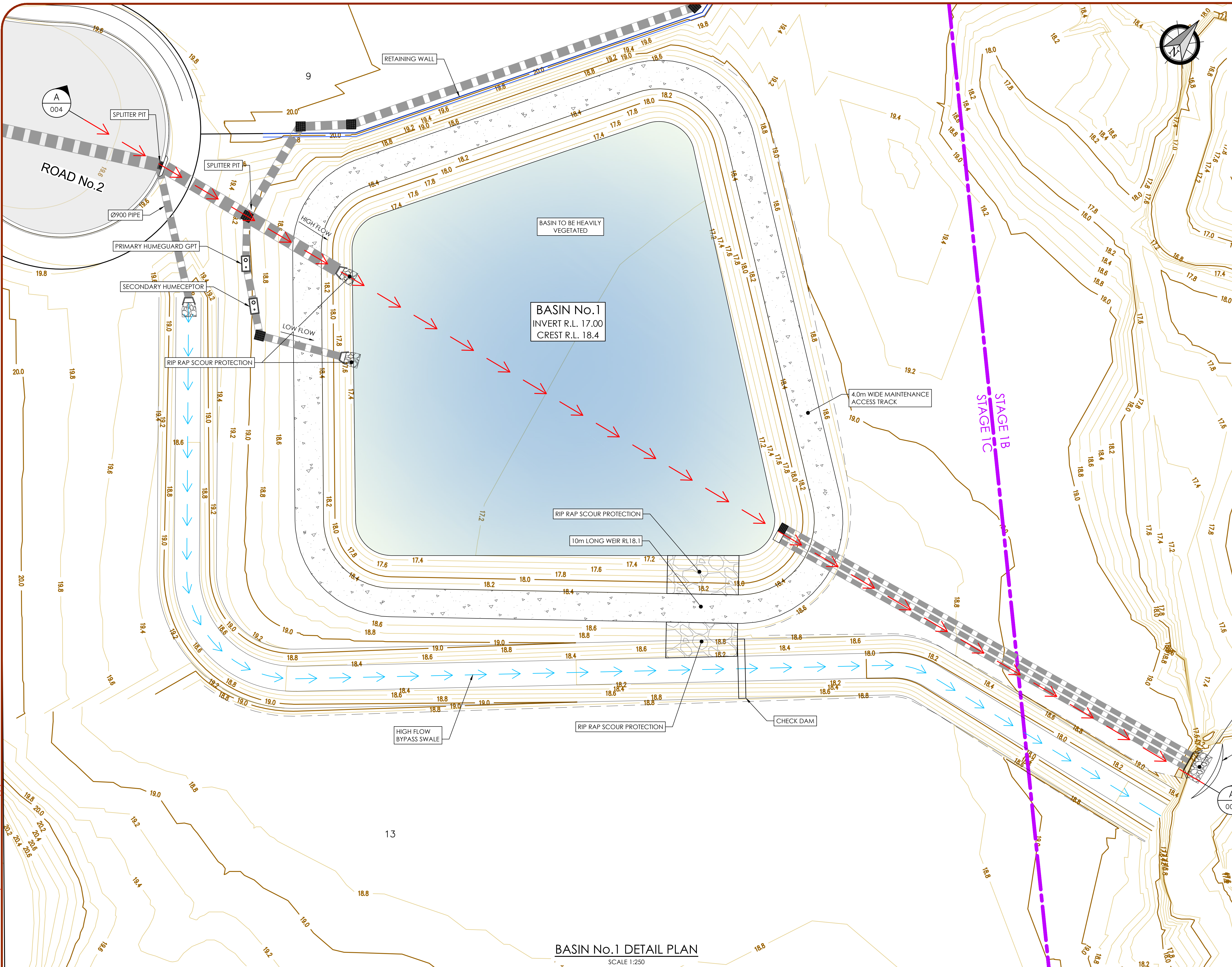

BASIN No.1 DETAIL PLAN

SCALE 1:250

LEGEND

- SITE BOUNDARY
- STAGE BOUNDARY
- PROPOSED LOT BOUNDARY
- DCDB BOUNDARY
- MAJOR CONTOUR
- MINOR CONTOUR
- PROPOSED STORMWATER
- PROPOSED SWALE
- PROPOSED SW PIT
- PROPOSED GPT/HUMECEPTOR
- PROPOSED LINTEL
- PROPOSED HEADWALL

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	20.12.21	INITIAL ISSUE	J.J	J.Y.	DATUM: CONTOUR INTERVAL: 0.2m	A1 1:250 / A3 1:500 (0, 5.0, 10.0, 12.5m)	

drawing title:
EXHIBIT 3:
BASIN No.1
DETAIL PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-003

client: WARNERVALE LF Pty Ltd

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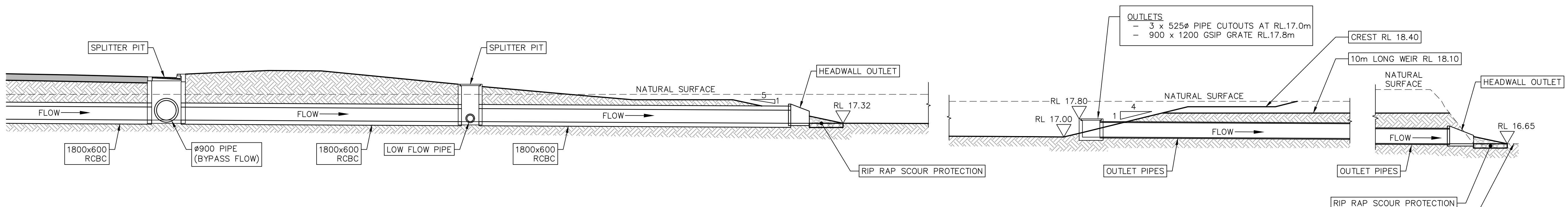

BASIN 1 – SECTION

SCALE 1:100

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190628-WCMP-004

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drawing title:
EXHIBIT 4:
BASIN No.1
SECTION

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-004

client: WARNERVALE LF Pty Ltd

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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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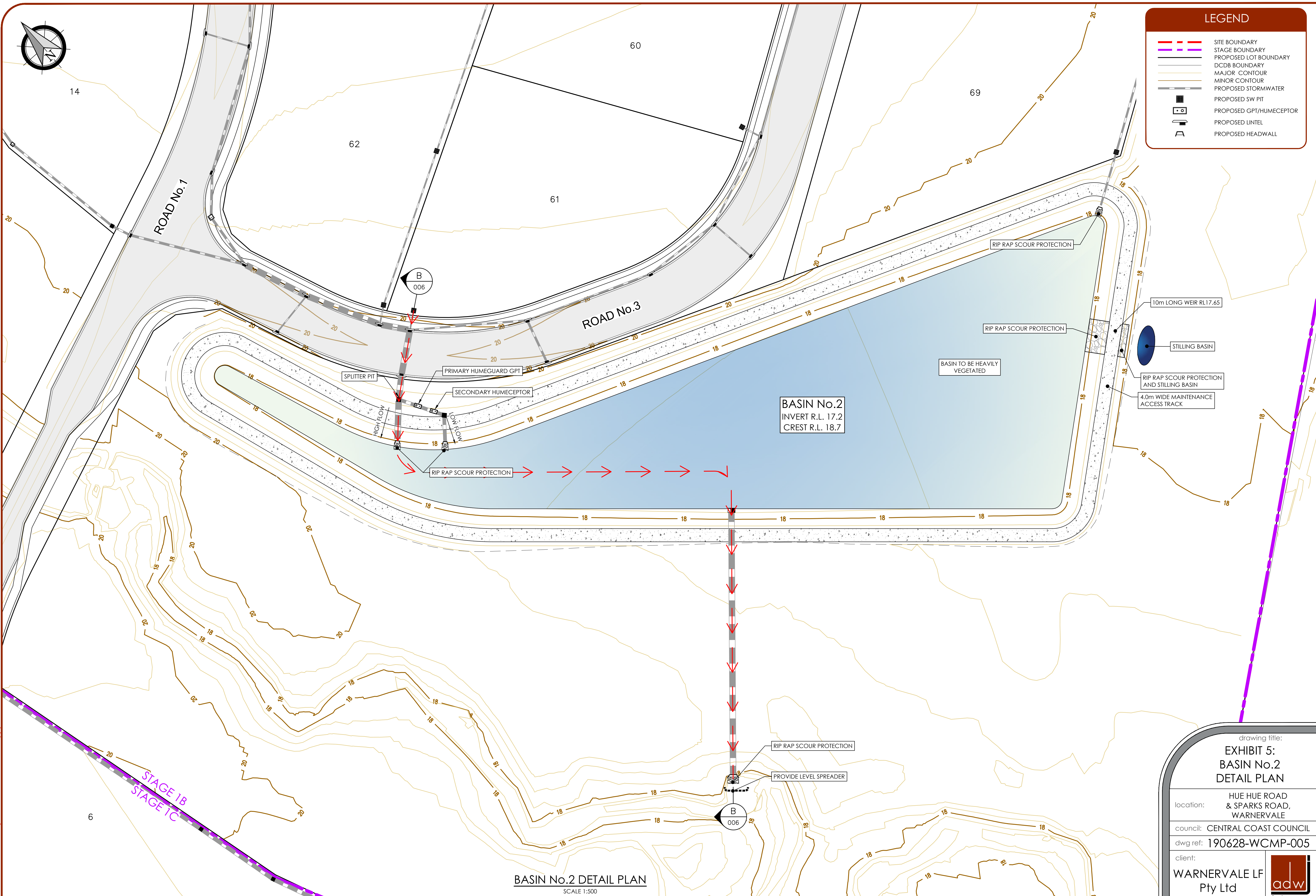

BASIN No.2 DETAIL PLAN

SCALE 1:500

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drawing title: EXHIBIT 5: BASIN No.2 DETAIL PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

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dwg ref: 190628-WCMP-005

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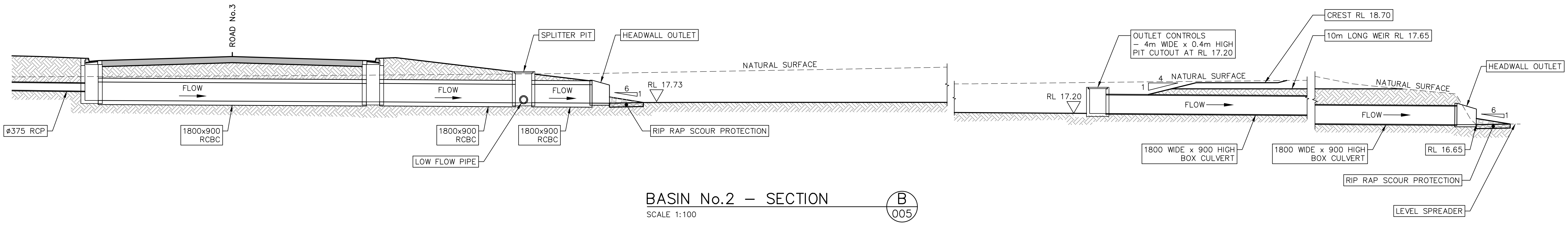

BASIN No.2 – SECTION
SCALE 1:100
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005

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drawing title:
EXHIBIT 6:
BASIN No.2
SECTION

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-006

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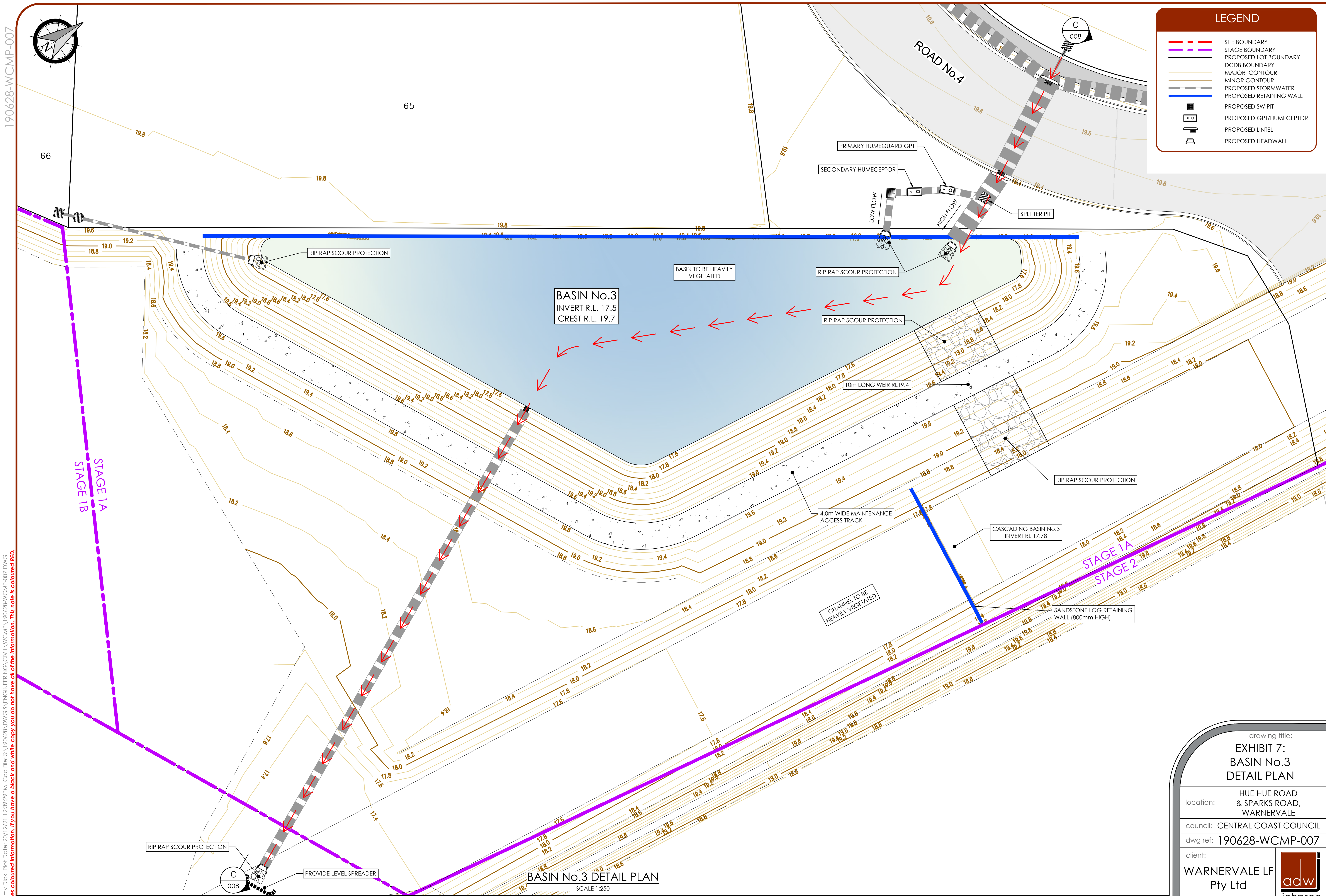

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drawing title:
EXHIBIT 7: BASIN No.3 DETAIL PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE
council: CENTRAL COAST COUNCIL
dwg ref: 190628-WCMP-007
client: WARNERVALE LF Pty Ltd

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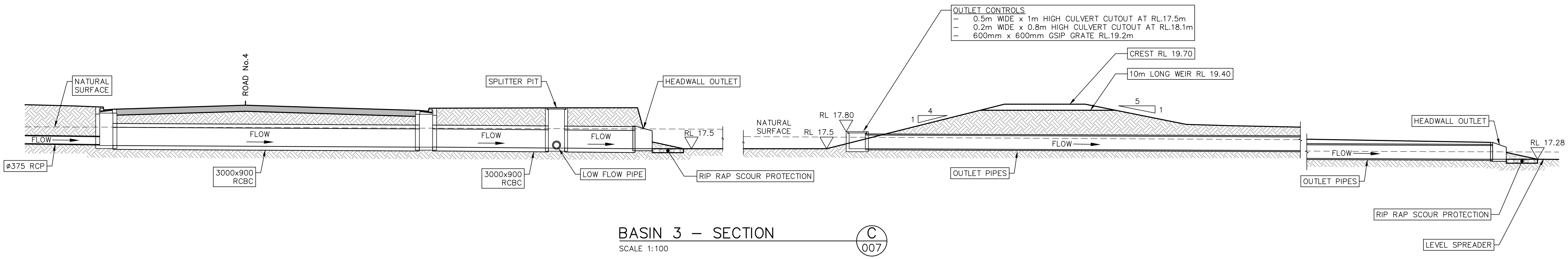

BASIN 3 – SECTION (C / 007)
SCALE 1:100

drawing title:
EXHIBIT 8:
BASIN No.3
SECTION

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-008

client: WARNERVALE LF Pty Ltd

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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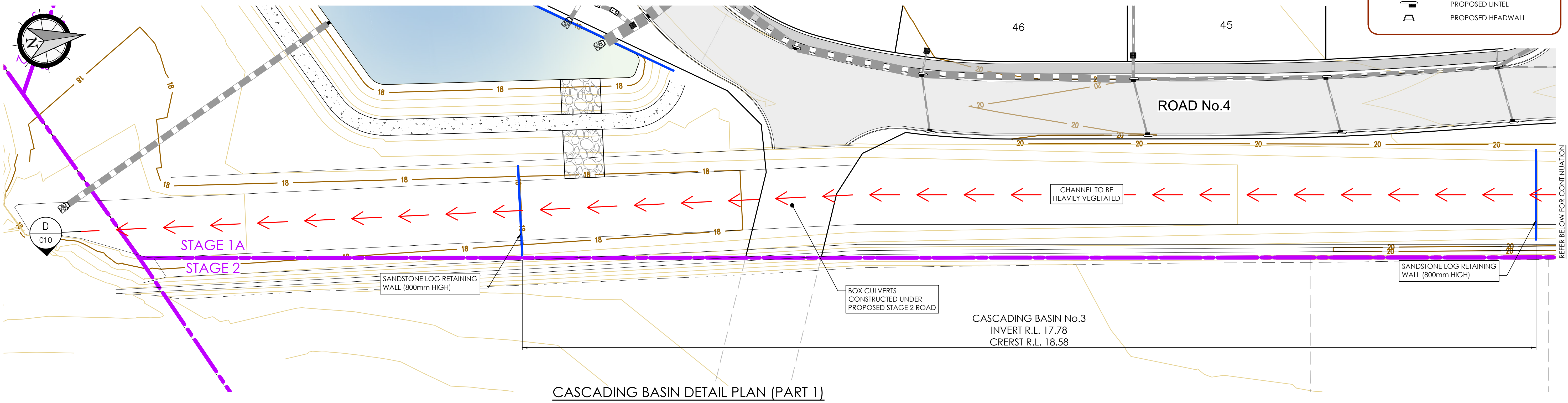
190628-WCMP-009

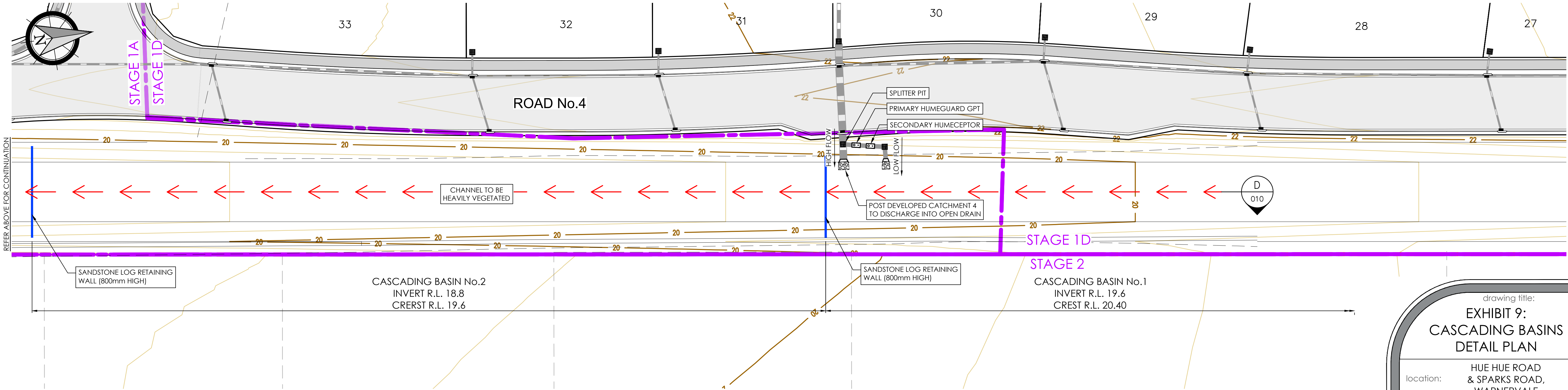
LEGEND

- SITE BOUNDARY
- STAGE BOUNDARY
- PROPOSED LOT BOUNDARY
- DCDB BOUNDARY
- MAJOR CONTOUR
- MINOR CONTOUR
- PROPOSED STORMWATER
- PROPOSED SWALE
- PROPOSED SW PIT
- PROPOSED GPT/HUMECEPTOR
- PROPOSED LINTEL
- PROPOSED HEADWALL



CASCADING BASIN DETAIL PLAN (PART 1)

SCALE 1:500



CASCADING BASIN DETAIL PLAN (PART 2)

SCALE 1:500

drawing title:

EXHIBIT 9: CASCADING BASINS DETAIL PLAN

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

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dwg ref: 190628-WCMP-009

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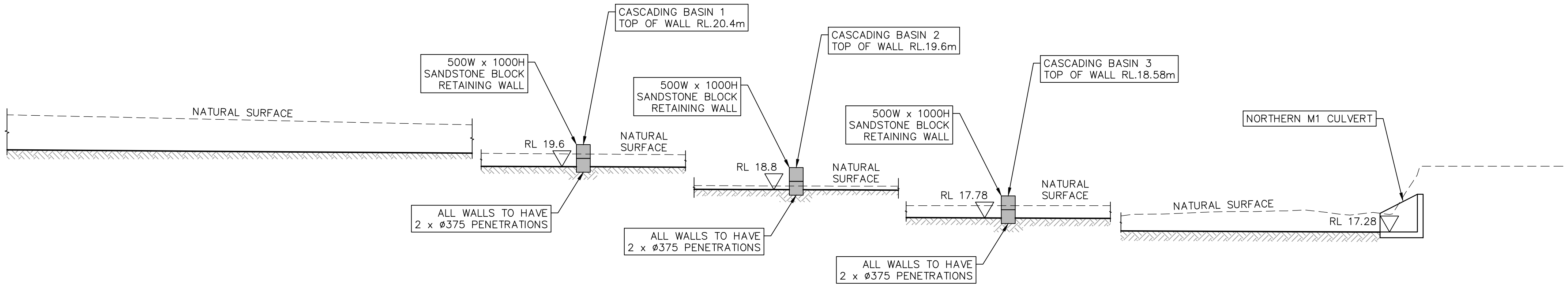
190628-WCMP-010



CASCADING BASINS – SECTION D/009

SCALE 1:100

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drawing title:
EXHIBIT 10:
CASCADING BASINS
SECTION

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-010

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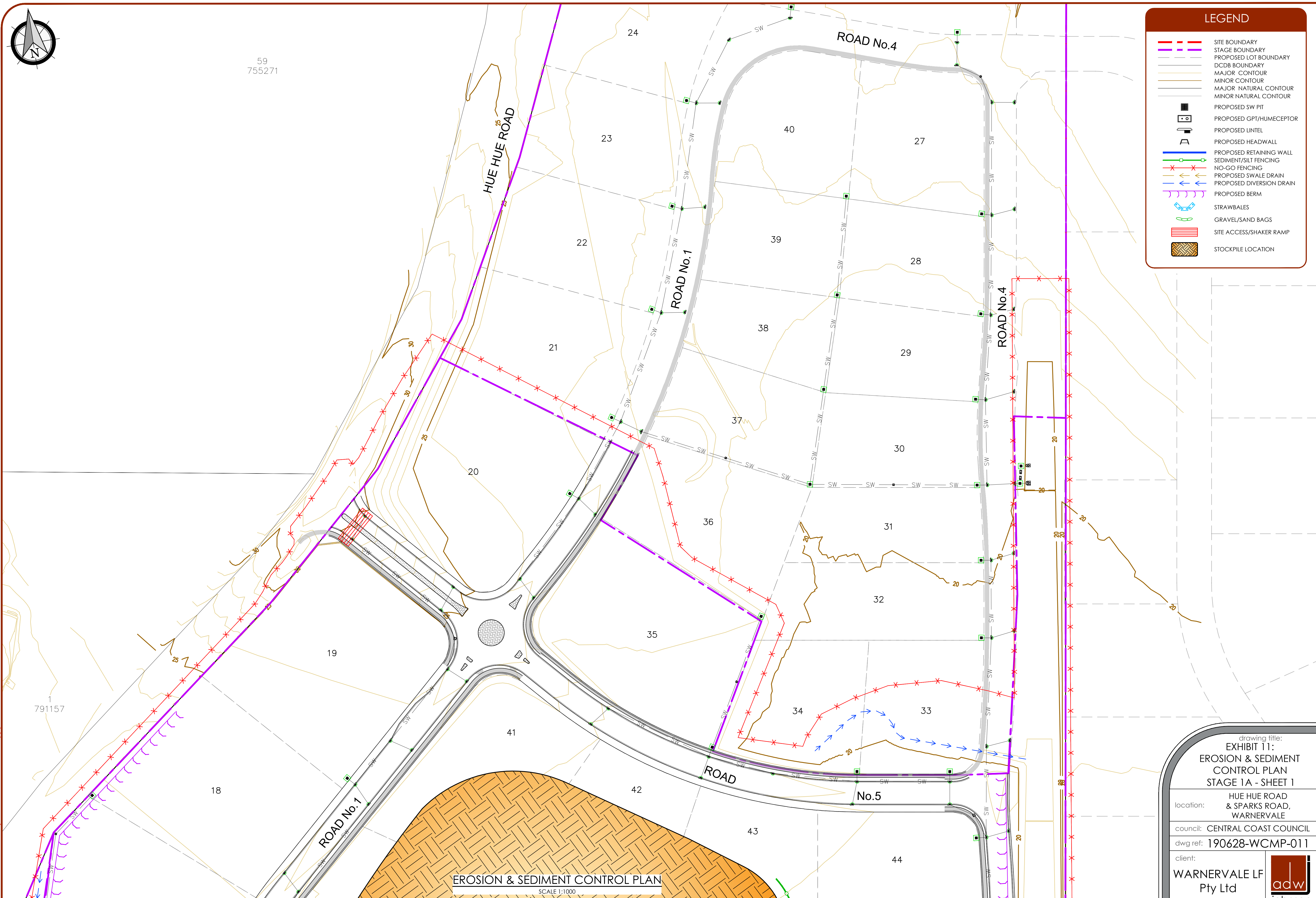

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Plotted By: Jeremy Dick Plot Date: 20/12/21

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drawing title:
EXHIBIT 11:
EROSION & SEDIMENT CONTROL PLAN
STAGE 1A - SHEET 1

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-011

client: WARNERVALE LF Pty Ltd

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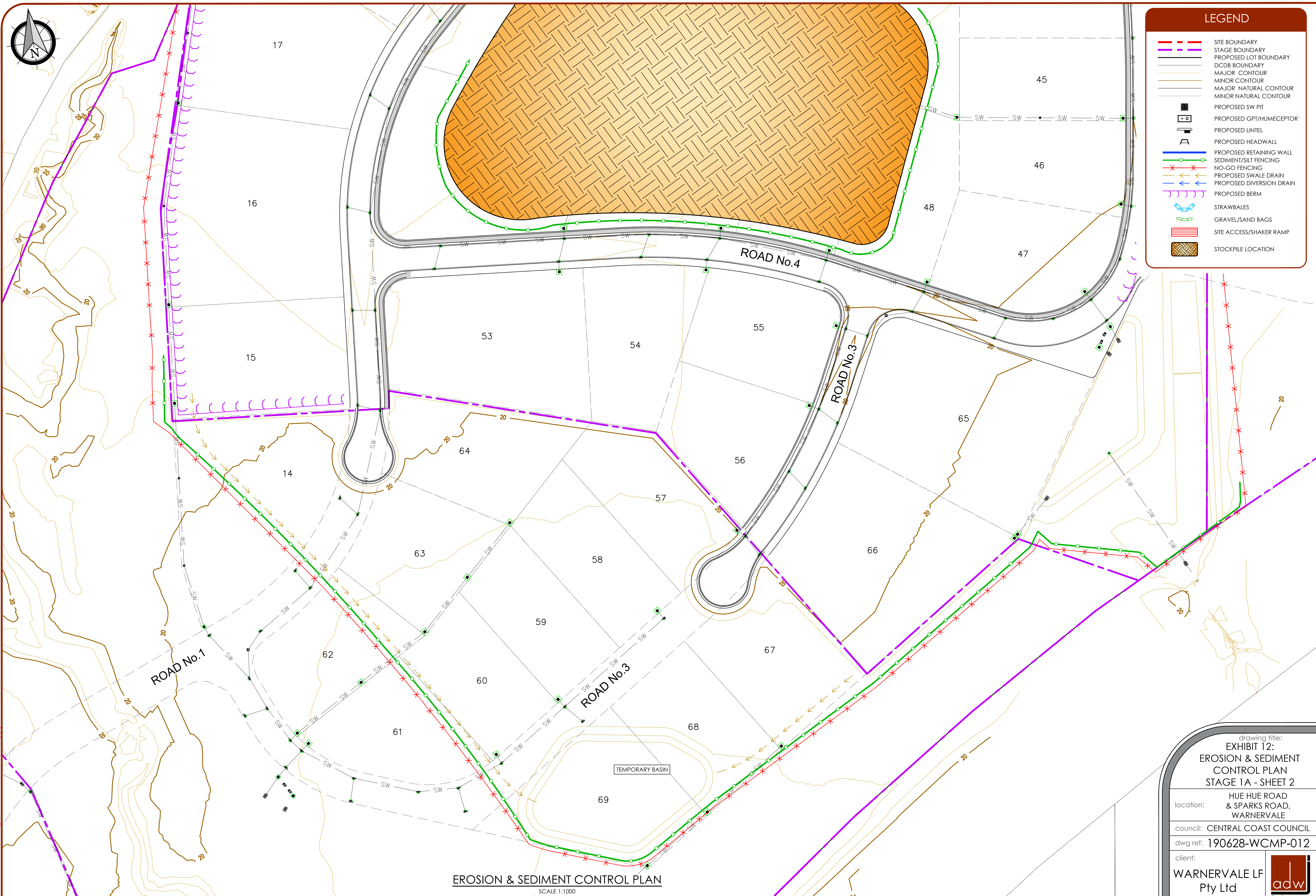

EROSION & SEDIMENT CONTROL PLAN

SCALE 1:1000

ver.	date	comment	drawn	pm
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level information: DATUM: CONTOUR INTERVAL: 0.5m

scale (A1 original size): A1 1:1000 — 0 — 25 — 50m — A3 1:2000

notes:

drawing title:
EXHIBIT 12:
EROSION & SEDIMENT CONTROL PLAN
STAGE 1A - SHEET 2

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-012

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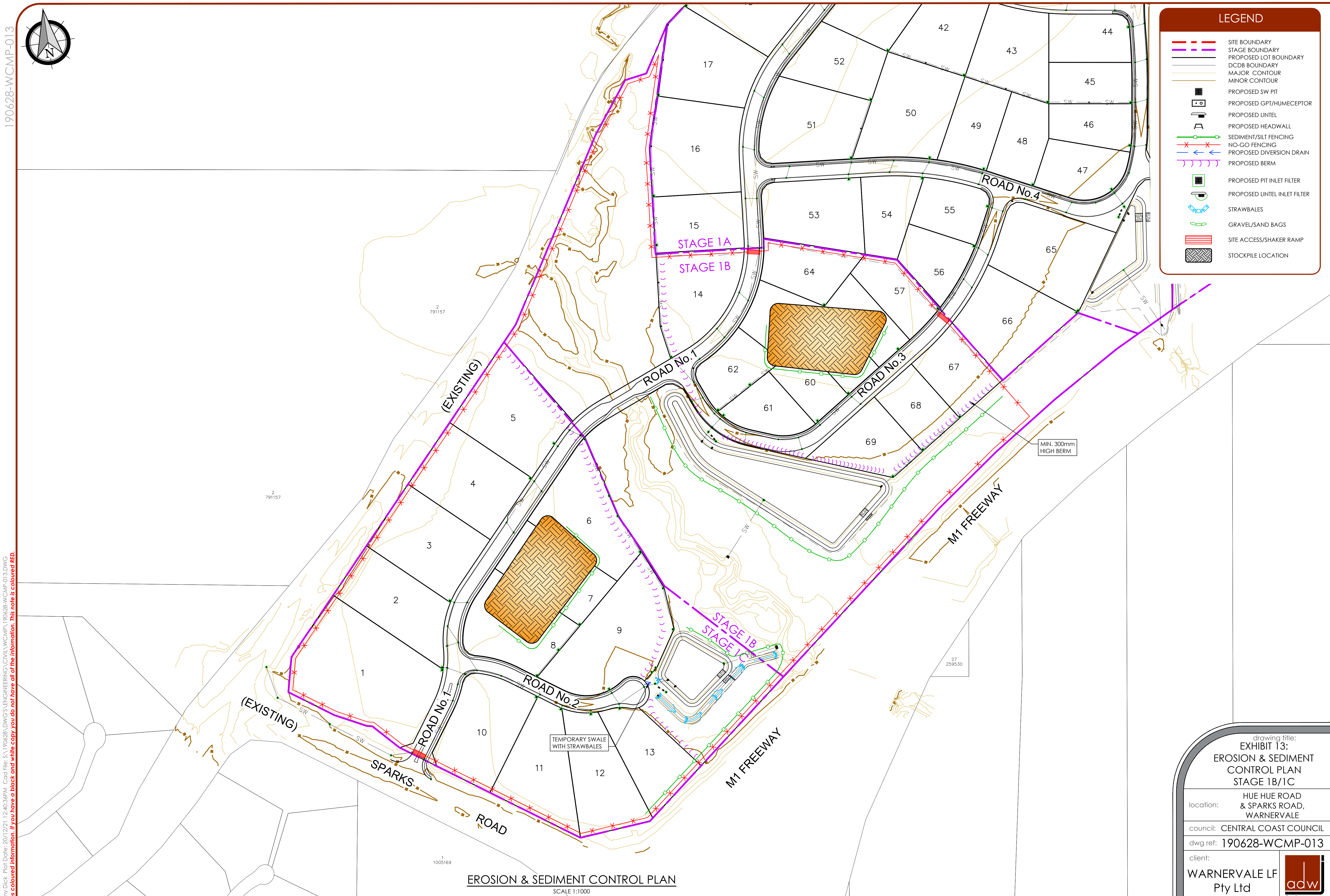

EROSION & SEDIMENT CONTROL PLAN

SCALE 1:1000

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title:
EXHIBIT 13: EROSION & SEDIMENT CONTROL PLAN STAGE 1B/1C

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-013

client: WARNERVALE LF Pty Ltd

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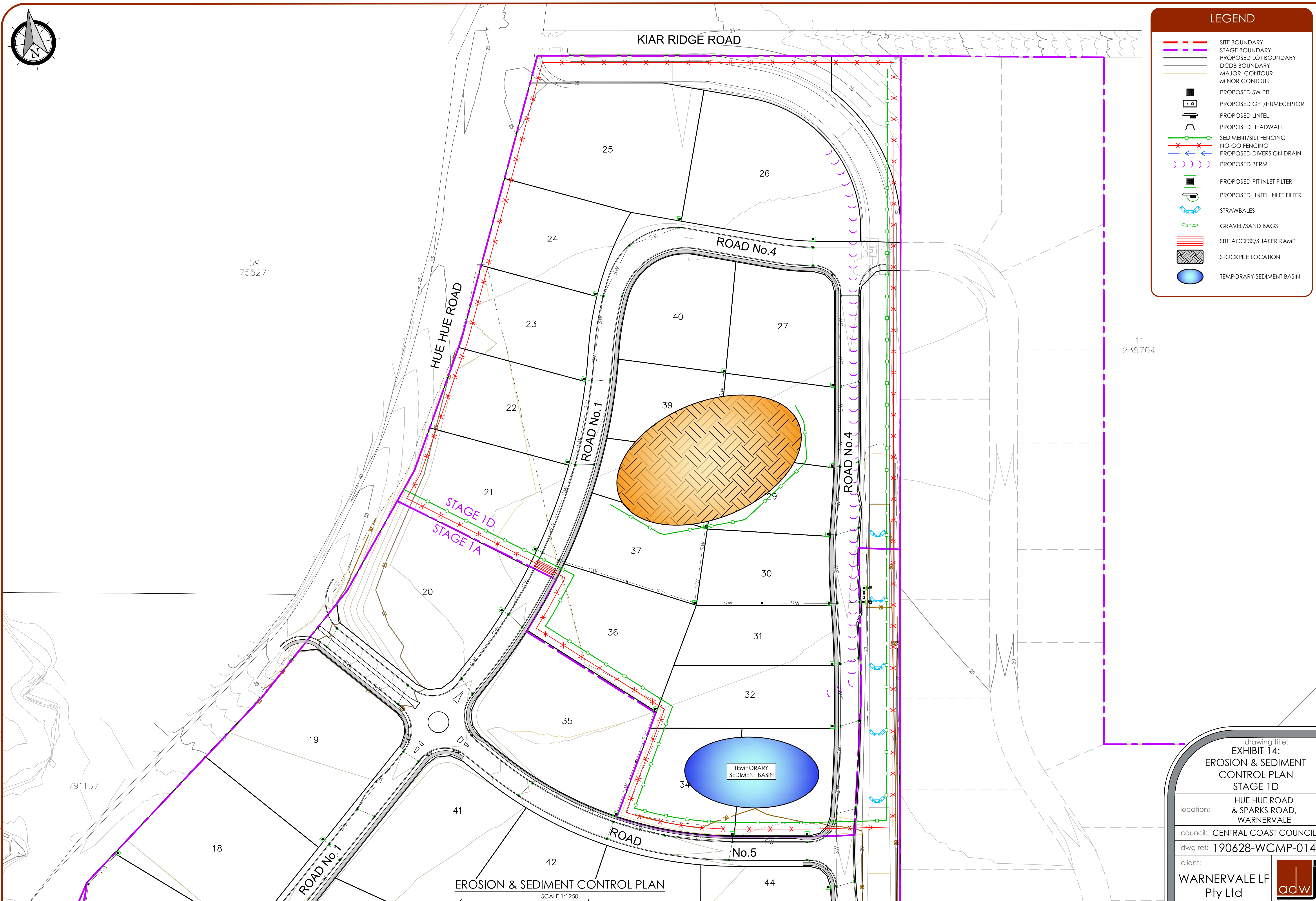

190628-WCMP-014

working beyond expectations

drawing title:
EXHIBIT 14:
EROSION & SEDIMENT CONTROL PLAN
STAGE 1D

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-014

client: WARNERVALE LF Pty Ltd

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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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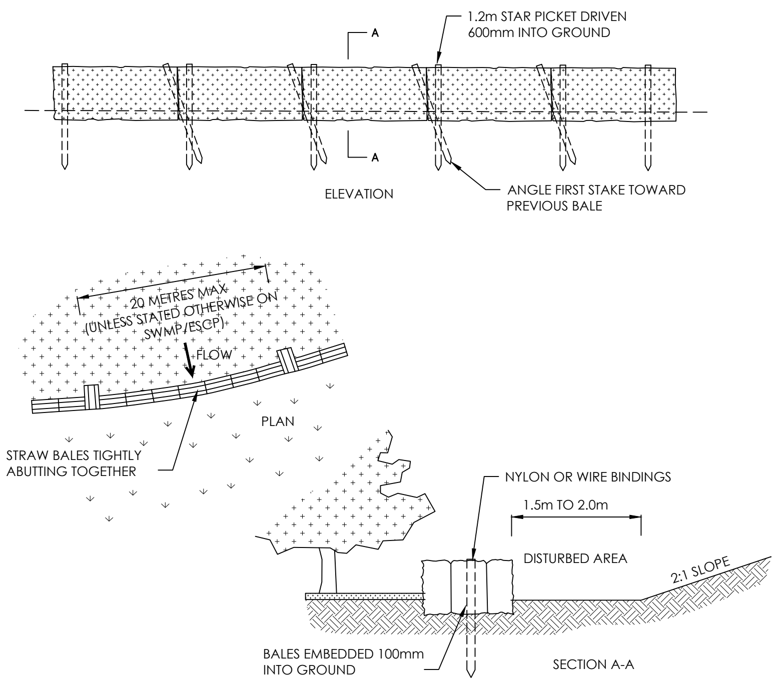
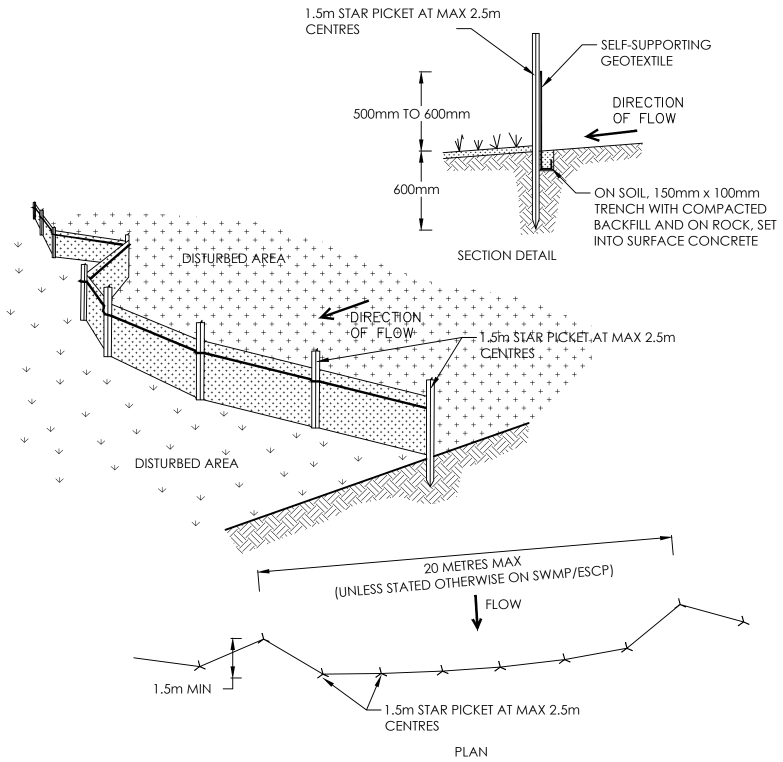


STRAW BALE FILTER (SD6-7)

N.T.S.

CONSTRUCTION NOTES:

1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES. STRAWS ARE TO BE PLACED PARALLEL TO GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm IN THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE THE BALES ARE PLACES 1 TO 2 METRES DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THAT ENSURES THE INTEGRITY OF THE BALES IS RETAINED - THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.

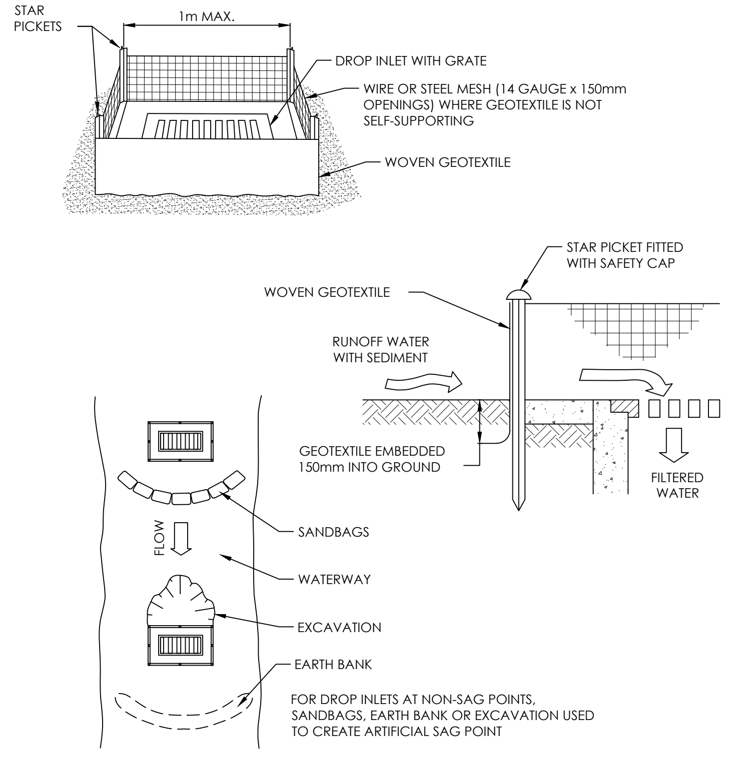


SEDIMENT FENCE (SD6-8)

N.T.S.

CONSTRUCTION NOTES:

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

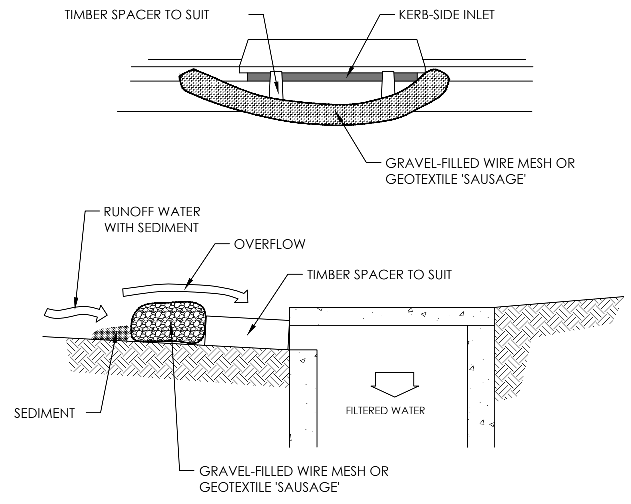


GEOTEXTILE INLET FILTER (SD6-12)

N.T.S.

CONSTRUCTION NOTES:

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. REFER STANDARD DRAWINGS 6-7 & 6-8 FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1 METRE CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.



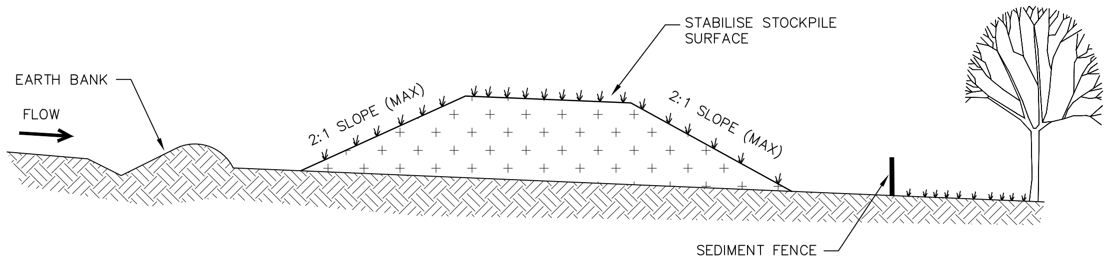
NOTE: THIS PRACTICE ONLY TO BE USED WHERE SPECIFIED IN AN APPROVED SWMP/ESCP.

MESH AND GRAVEL INLET FILTER (SD6-11)

N.T.S.

CONSTRUCTION NOTES:

1. INSTALL FILTERS TO KERB INLETS ONLY ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS SECTION ABOUT 150mm HIGH x 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

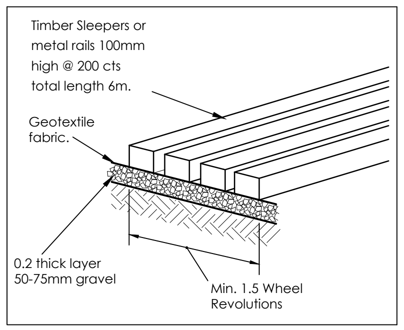


STOCKPILES (SD4–1)

N.T.S.

CONSTRUCTION NOTES:

1. PLACE STOCKPILES MORE THAN 2 (PREFERABLY 5) METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10.
5. CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-8) 1 TO 2 METRES DOWNSLOPE.



SHAKER RAMP

drawing title: EXHIBIT 15: EROSION & SEDIMENT CONTROL DETAILS & NOTES

location: HUE HUE ROAD & SPARKS ROAD, WARNERVALE

council: CENTRAL COAST COUNCIL

dwg ref: 190628-WCMP-015

client: WARNERVALE LF Pty Ltd

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	20.12.21	INITIAL ISSUE	J.J	J.Y.	DATUM: CONTOUR INTERVAL:	NOT TO SCALE	

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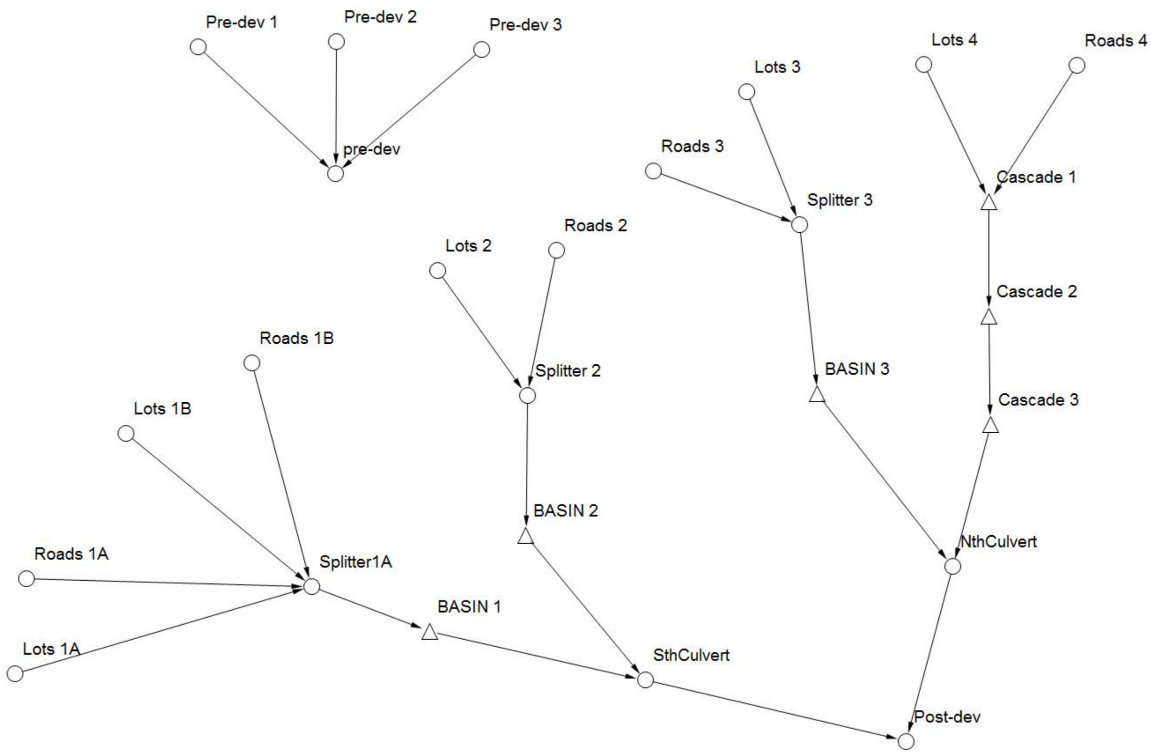
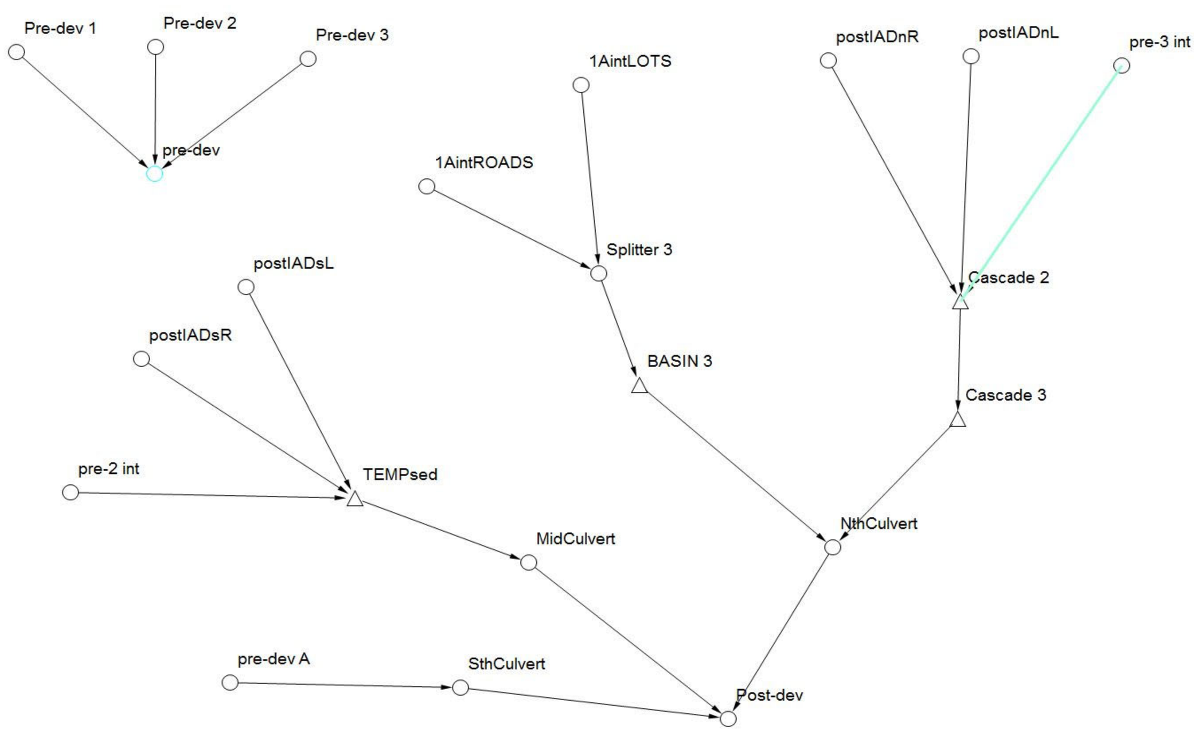
Appendix A

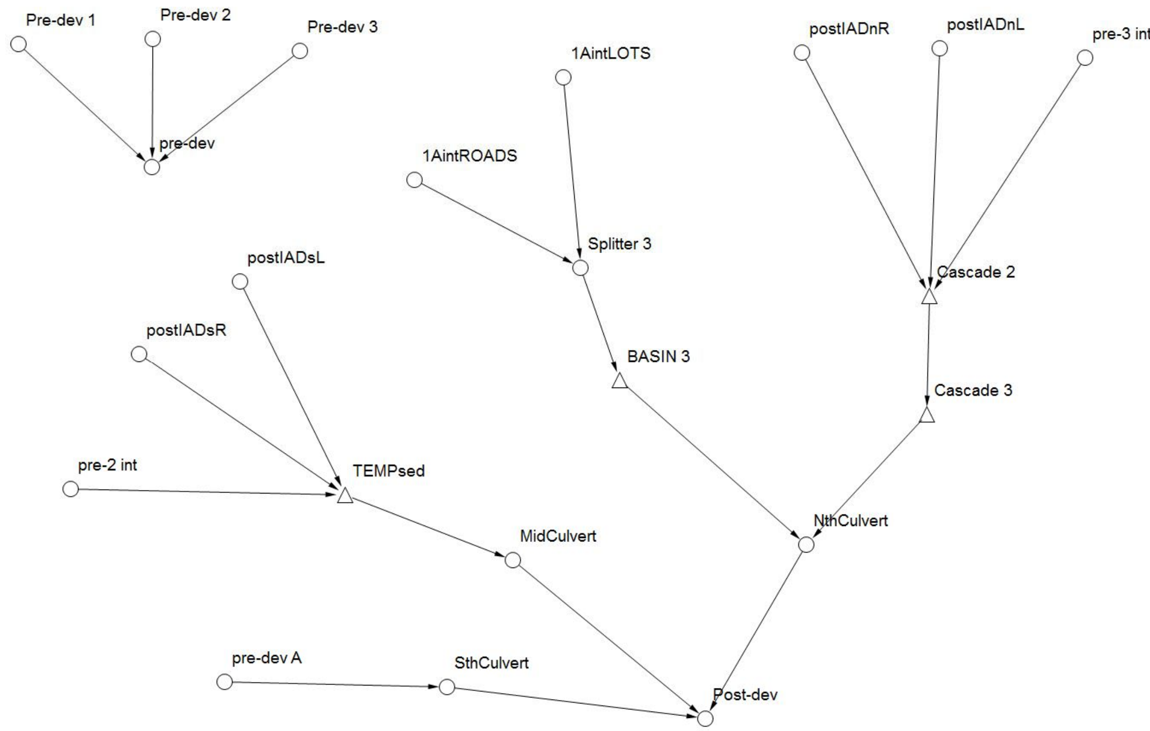
XP Rafts Details



Ultimate Scenario



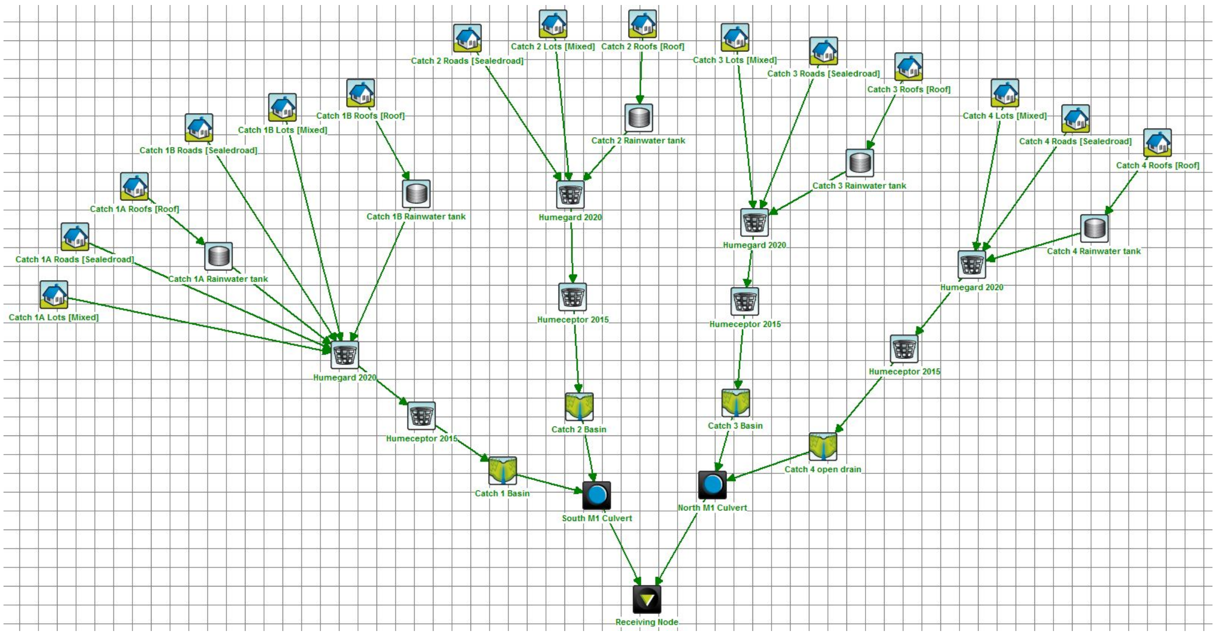
Stage 1A Interim Scenario



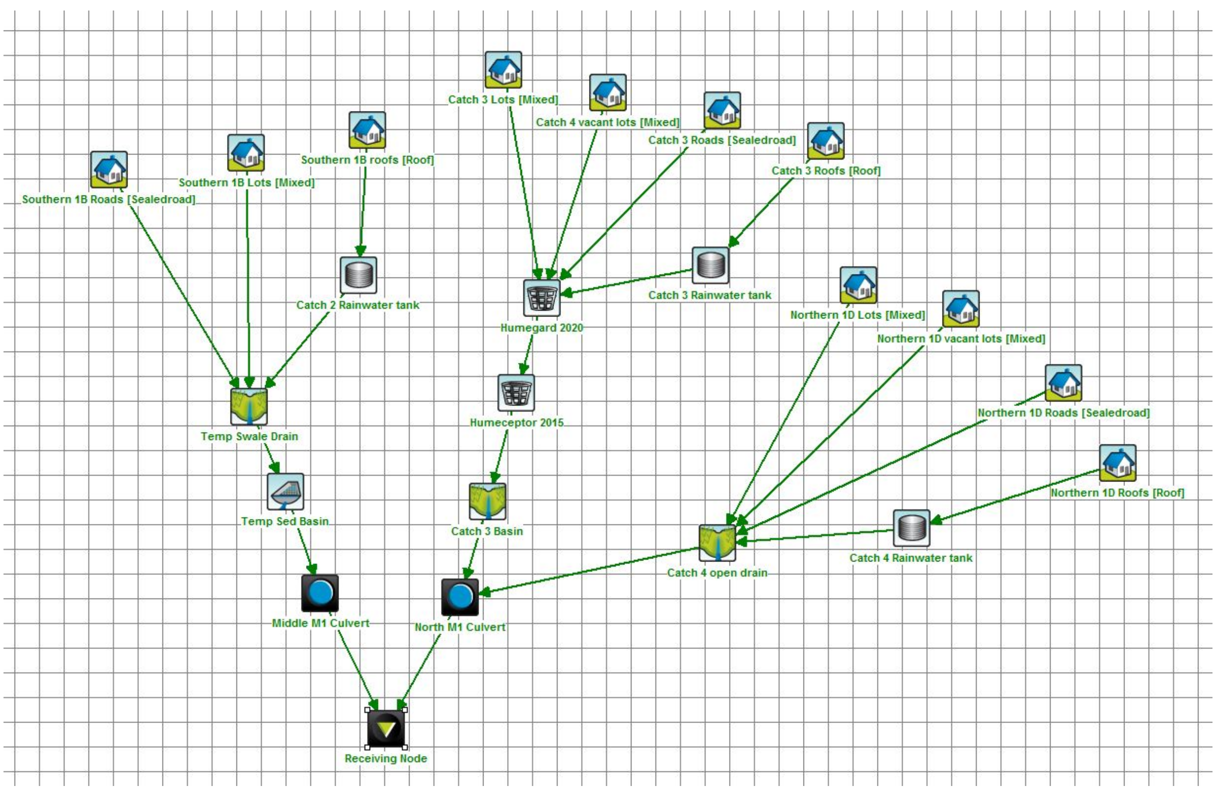
Stage 1A/1B/1C Interim Scenario

Appendix B

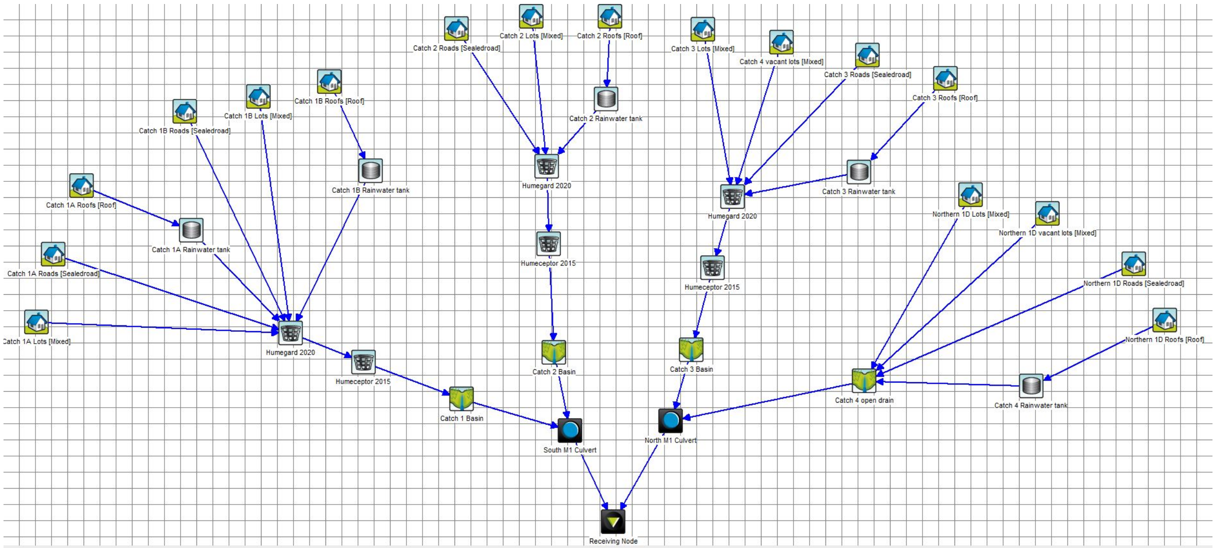
MUSIC Details and MUSIClink



Ultimate Scenario



Stage 1A Interim Scenario



Stage 1A/1B/1C Interim Scenario

MUSIC-*link* Report

Project Details		Company Details	
Project:	Warner Industrial Park	**Company:**	ADW Johnson Pty Ltd
Report Export Date:	20/12/2021	**Contact:**	Brody Upton
Catchment Name:	MUSIC Ultimate Scenario	**Address:**	5 Pioneer Avenue, Tuggerah
Catchment Area:	68.931ha	**Phone:**	0420377707
Impervious Area*:	87.49%	**Email:**	brodyu@adwjohnson.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Lowland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	4.79%	Rain Water Tank Node	5	Urban Source Node	15
TSS	83.4%	Swale Node	4		
TP	49.9%	GPT Node	8		
TN	37.5%				
GP	100%				

Comments

- Exfiltration rates for all basin controls assumed to be 0.36 mm/hr as per geotechnical report.
- Bed slopes for swales, open drainage channels and basins range from 0.4-0.5% due to site constraints.
- Permanent sedimentation basins modelled as swales with 0.8m vegetation height to model mass revegetation.
- Bypass rates are based on 3-month ARI peak flows from RAFTS with lots modelled as 0% impervious

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.401
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.274
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.258
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.241
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.258
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.274
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.401
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.241
Receiving	Receiving Node	% Load Reduction	None	None	4.79
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TP % Load Reduction	45	None	49.9
Receiving	Receiving Node	TSS % Load Reduction	80	None	83.4
Urban	Catch 1A Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1A Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1A Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1A Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1A Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 1A Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 1A Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1A Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1A Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1A Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 1A Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 1A Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 1A Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 1A Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 1A Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 1A Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1A Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 1A Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 1B Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1B Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1B Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1B Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1B Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 1B Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 1B Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1B Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1B Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1B Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Catch 1B Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 1B Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 1B Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 1B Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 1B Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 1B Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1B Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 1B Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 2 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 2 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 2 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 2 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 2 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 2 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 2 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 2 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 2 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 2 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 2 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 2 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 2 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 2 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 2 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 2 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 2 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 2 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 3 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 3 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 3 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 3 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 3 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 3 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 3 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 3 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Catch 3 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 3 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 3 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 3 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 4 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 4 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 4 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 4 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 4 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 4 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 4 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 4 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 4 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 4 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 4 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 4 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 4 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 4 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 4 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 4 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 4 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 4 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Receiving	Receiving Node	TN % Load Reduction	45	None	37.5
Swale	Catch 1 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 1 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 1 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 2 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 2 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 2 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 3 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 3 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 3 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 4 open drain	Bed slope	0.02	0.05	0.004
Swale	Catch 4 open drain	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 4 open drain	Vegetation height (m)	None	0.5	0.8

Only certain parameters are reported when they pass validation

MUSIC-*link* Report

Project Details		Company Details	
Project:	Warner Industrial Park	**Company:**	ADW Johnson Pty Ltd
Report Export Date:	20/12/2021	**Contact:**	Brody Upton
Catchment Name:	MUSIC Stage 1A Interim Scenario	**Address:**	5 Pioneer Avenue, Tuggerah
Catchment Area:	25.26ha	**Phone:**	0420377707
Impervious Area*:	81.52%	**Email:**	brodyu@adwjohnson.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Lowland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	9.18%	Rain Water Tank Node	3	Urban Source Node	11
TSS	84.8%	Swale Node	3		
TP	55.4%	Sedimentation Basin Node	1		
TN	42%	GPT Node	2		
GP	100%				

Comments

- Exfiltration rates for all basin controls assumed to be 0.36 mm/hr as per geotechnical report.
- Bed slopes for swales, open drainage channels and basins range from 0.4-0.5% due to site constraints.
- Permanent sedimentation basins modelled as swales with 0.8m vegetation height to model mass revegetation.
- Bypass rates are based on 3-month ARI peak flows from RAFTS with lots modelled as 0% impervious
- Temporary sediment basin for stage 1A has a single weir outlet control and has been modelled with a small 5mm pipe outlet to satisfy MUSIC input parameters. Sediment basin has 2m extended detention depth above permanent pool volume as runoff will be pumped prior to storm events.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.401
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.401
Receiving	Receiving Node	% Load Reduction	None	None	9.18
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TP % Load Reduction	45	None	55.4
Receiving	Receiving Node	TSS % Load Reduction	80	None	84.8
Sedimentation	Temp Sed Basin	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	Temp Sed Basin	High Flow Bypass Out (ML/yr)	None	None	0
Urban	Catch 3 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 3 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 3 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 3 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 3 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 3 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 3 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 3 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 3 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 3 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 3 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 3 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 4 vacant lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 4 vacant lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 4 vacant lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 4 vacant lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 4 vacant lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 4 vacant lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Northern 1D Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Northern 1D Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Northern 1D Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Northern 1D Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Northern 1D Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Northern 1D Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Northern 1D Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Northern 1D Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Northern 1D Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Northern 1D Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Northern 1D Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Northern 1D Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Northern 1D vacant lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D vacant lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Northern 1D vacant lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D vacant lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D vacant lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Northern 1D vacant lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Southern 1B Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Southern 1B Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Southern 1B Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Southern 1B Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Southern 1B Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Southern 1B Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Southern 1B Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Southern 1B Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Southern 1B Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Southern 1B Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Southern 1B Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Southern 1B Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Southern 1B roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Southern 1B roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Southern 1B roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Southern 1B roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Southern 1B roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Southern 1B roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Receiving	Receiving Node	TN % Load Reduction	45	None	42
Sedimentation	Temp Sed Basin	Extended detention depth (m)	0.25	1	2
Sedimentation	Temp Sed Basin	Notional Detention Time (hrs)	8	12	47200
Swale	Catch 3 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 3 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 3 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 4 open drain	Bed slope	0.02	0.05	0.004
Swale	Catch 4 open drain	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 4 open drain	Vegetation height (m)	None	0.5	0.8
Swale	Temp Swale Drain	Bed slope	0.02	0.05	0.005
Swale	Temp Swale Drain	Exfiltration Rate (mm/hr)	0	0	0.36

Only certain parameters are reported when they pass validation

MUSIC-*link* Report

Project Details		Company Details	
Project:	Warner Industrial Park	**Company:**	ADW Johnson Pty Ltd
Report Export Date:	20/12/2021	**Contact:**	Brody Upton
Catchment Name:	MUSIC Stage 1A-1B-1C Interim Scenario	**Address:**	5 Pioneer Avenue, Tuggerah
Catchment Area:	52.104ha	**Phone:**	0420377707
Impervious Area*:	84.67%	**Email:**	brodyu@adwjohnson.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Lowland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	5.49%	Rain Water Tank Node	5	Urban Source Node	17
TSS	84.2%	Swale Node	4		
TP	51.5%	GPT Node	6		
TN	38.7%				
GP	100%				

Comments

- Exfiltration rates for all basin controls assumed to be 0.36 mm/hr as per geotechnical report.
- Bed slopes for swales, open drainage channels and basins range from 0.4-0.5% due to site constraints.
- Permanent sedimentation basins modelled as swales with 0.8m vegetation height to model mass revegetation.
- Bypass rates are based on 3-month ARI peak flows from RAFTS with lots modelled as 0% impervious

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.401
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.274
GPT	Humeceptor 2015	Hi-flow bypass rate (cum/sec)	None	99	0.258
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.258
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.274
GPT	Humegard 2020	Hi-flow bypass rate (cum/sec)	None	99	0.401
Receiving	Receiving Node	% Load Reduction	None	None	5.49
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TP % Load Reduction	45	None	51.5
Receiving	Receiving Node	TSS % Load Reduction	80	None	84.2
Urban	Catch 1A Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1A Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1A Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1A Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1A Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 1A Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 1A Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1A Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1A Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1A Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 1A Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 1A Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 1A Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 1A Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 1A Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 1A Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1A Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 1A Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 1B Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1B Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1B Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1B Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1B Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 1B Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 1B Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 1B Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 1B Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 1B Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 1B Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 1B Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Catch 1B Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 1B Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 1B Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 1B Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 1B Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 1B Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 2 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 2 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 2 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 2 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 2 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 2 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 2 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 2 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 2 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 2 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 2 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 2 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 2 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 2 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 2 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 2 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 2 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 2 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 3 Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 3 Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 3 Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Catch 3 Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 3 Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 3 Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 3 Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Catch 3 Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Catch 3 Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Catch 3 Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Catch 3 Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Catch 3 Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Catch 3 Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Catch 3 Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Catch 3 Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Catch 4 vacant lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Catch 4 vacant lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Catch 4 vacant lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Catch 4 vacant lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Catch 4 vacant lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Catch 4 vacant lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Northern 1D Lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D Lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Northern 1D Lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D Lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D Lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Northern 1D Lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Northern 1D Roads	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D Roads	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Northern 1D Roads	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D Roads	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Northern 1D Roads	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Northern 1D Roads	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Northern 1D Roofs	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Northern 1D Roofs	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Northern 1D Roofs	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Northern 1D Roofs	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D Roofs	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Northern 1D Roofs	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3
Urban	Northern 1D vacant lots	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Northern 1D vacant lots	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Northern 1D vacant lots	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Northern 1D vacant lots	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Northern 1D vacant lots	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Northern 1D vacant lots	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Receiving	Receiving Node	TN % Load Reduction	45	None	38.7
Swale	Catch 1 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 1 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 1 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 2 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 2 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 2 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 3 Basin	Bed slope	0.02	0.05	0.005
Swale	Catch 3 Basin	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 3 Basin	Vegetation height (m)	None	0.5	0.8
Swale	Catch 4 open drain	Bed slope	0.02	0.05	0.004
Swale	Catch 4 open drain	Exfiltration Rate (mm/hr)	0	0	0.36
Swale	Catch 4 open drain	Vegetation height (m)	None	0.5	0.8

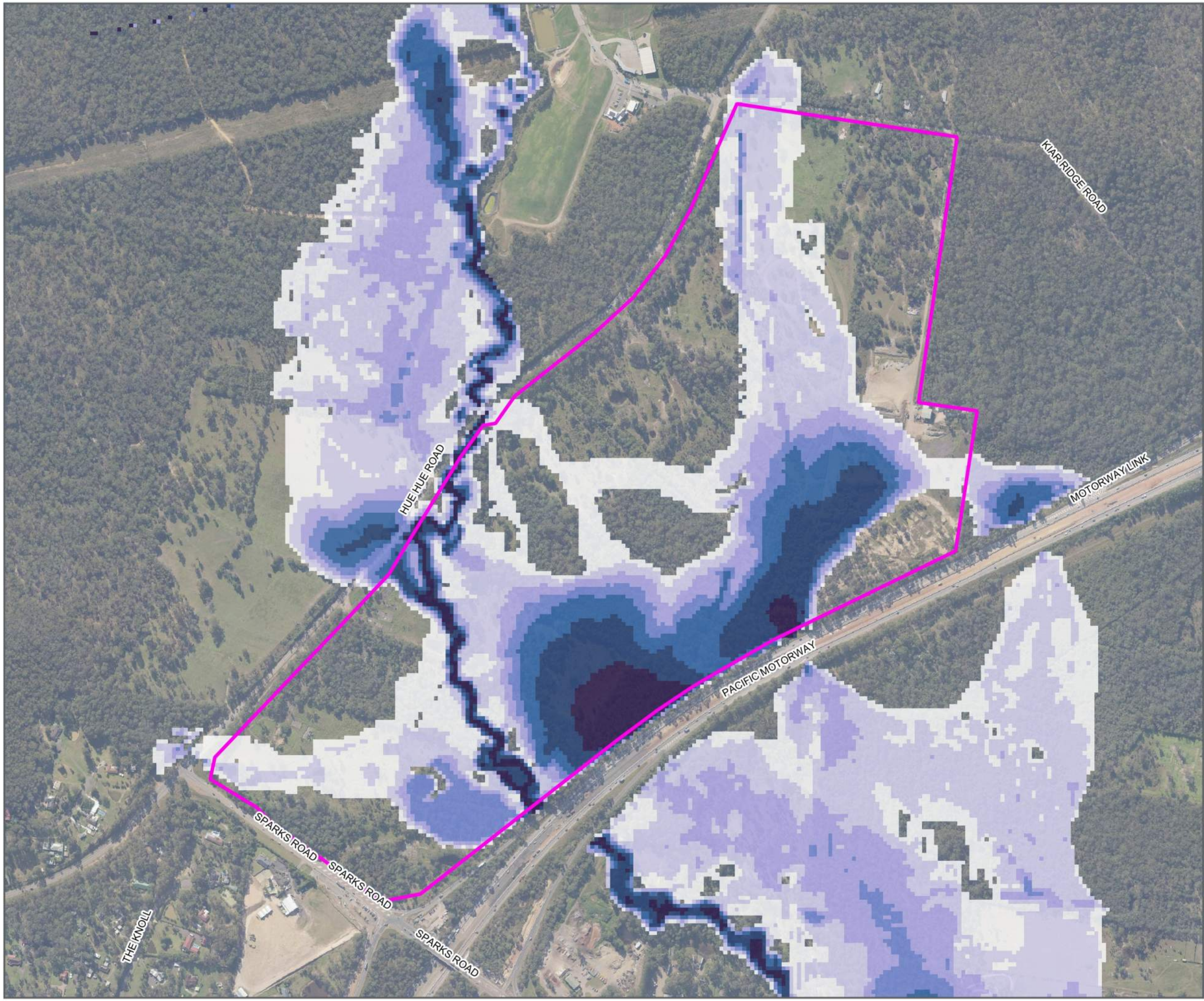
Only certain parameters are reported when they pass validation

Appendix C

Flooding Results Stage 1A

Warnerval Industrial Park

Existing
Flood Depth
100 Year ARI



Legend

Full Site Area

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

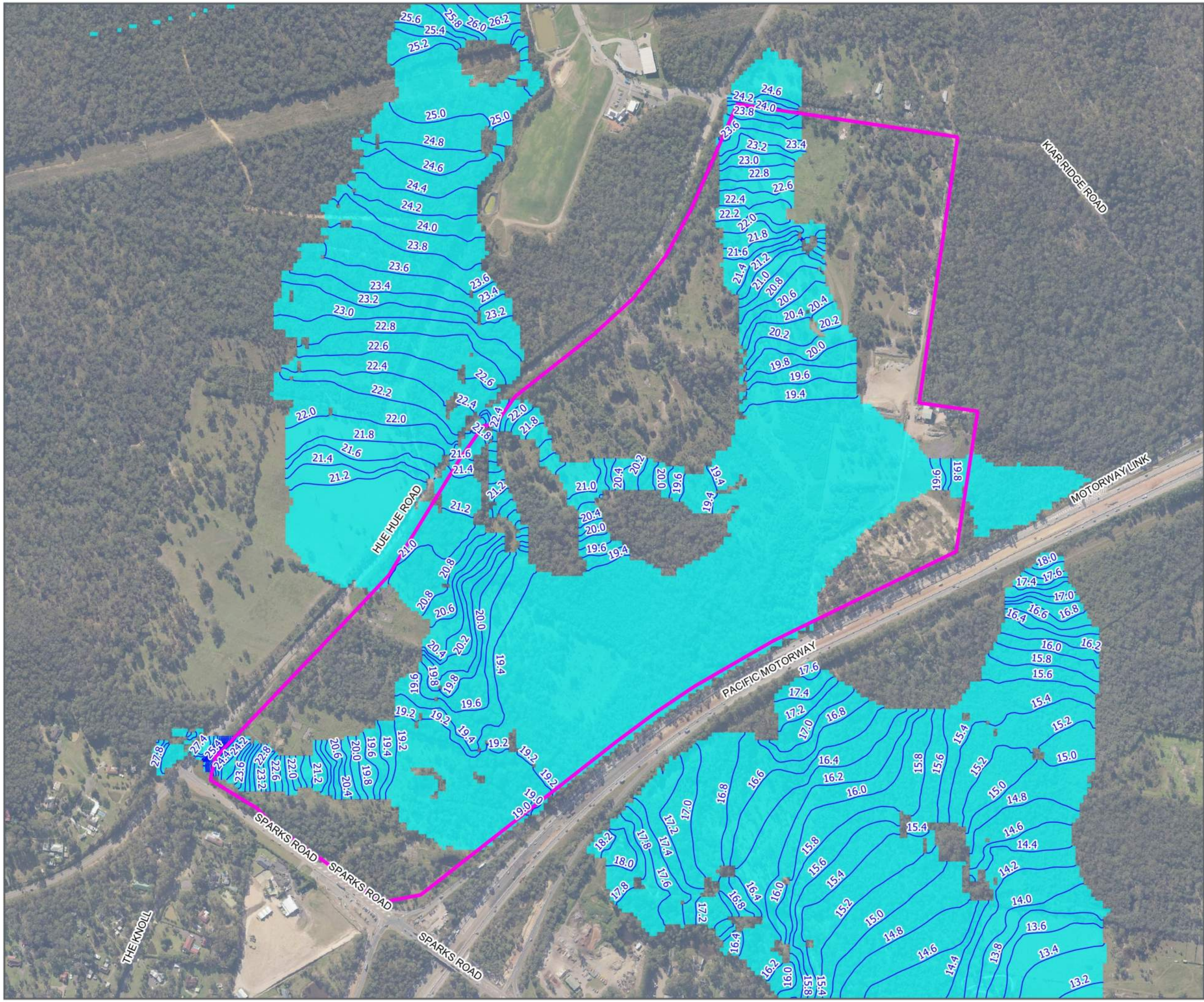
FIGURE A1

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing
Water Level Contours
100 Year ARI

Legend

- Full Site Area
- 0.2m Flood Level Contour (mAHD)
- Flood Extent

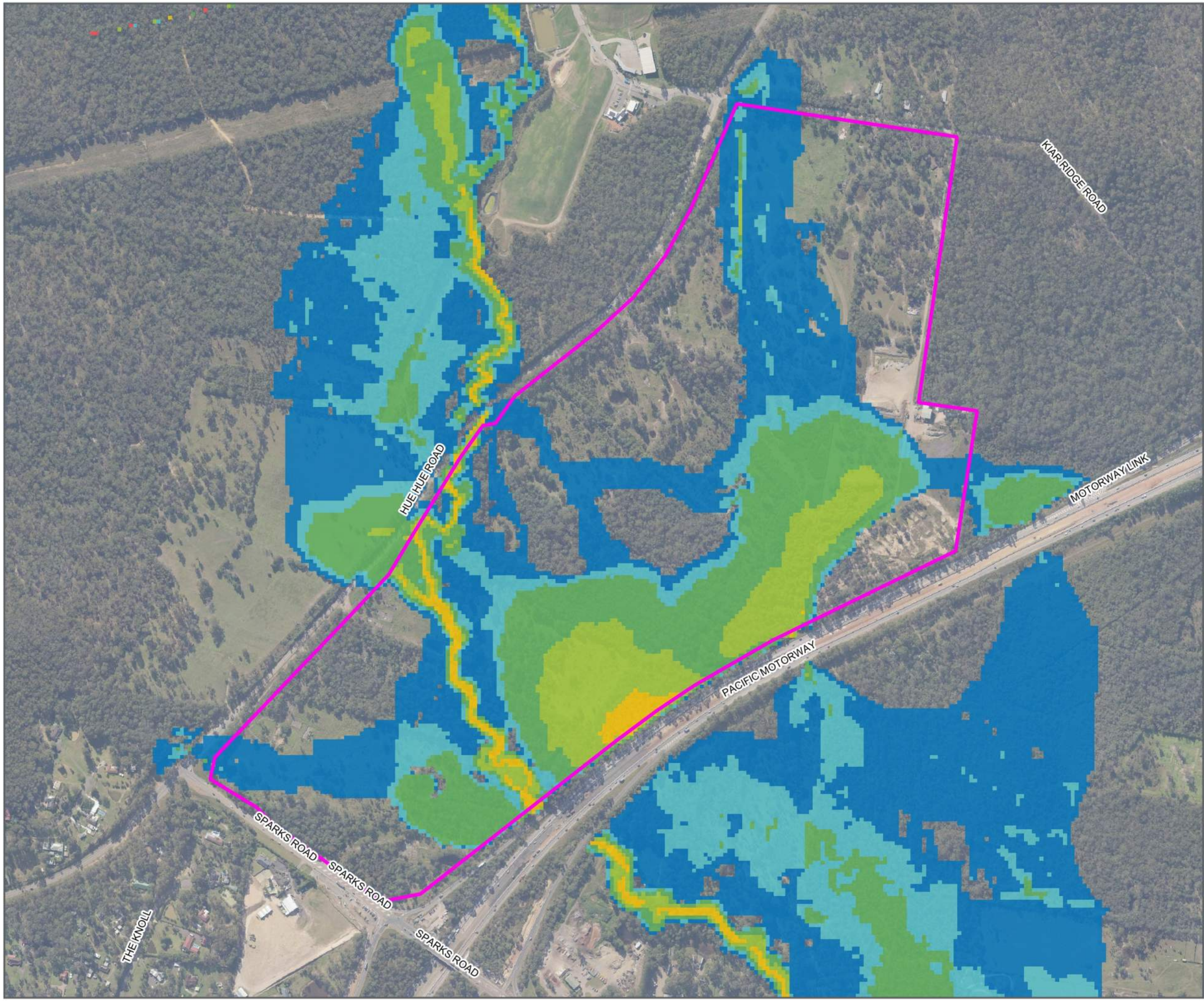
FIGURE A2

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing
Hazard Categories (H1-H6))
100 Year ARI

Legend

- Full Site Area

Hazard Category

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

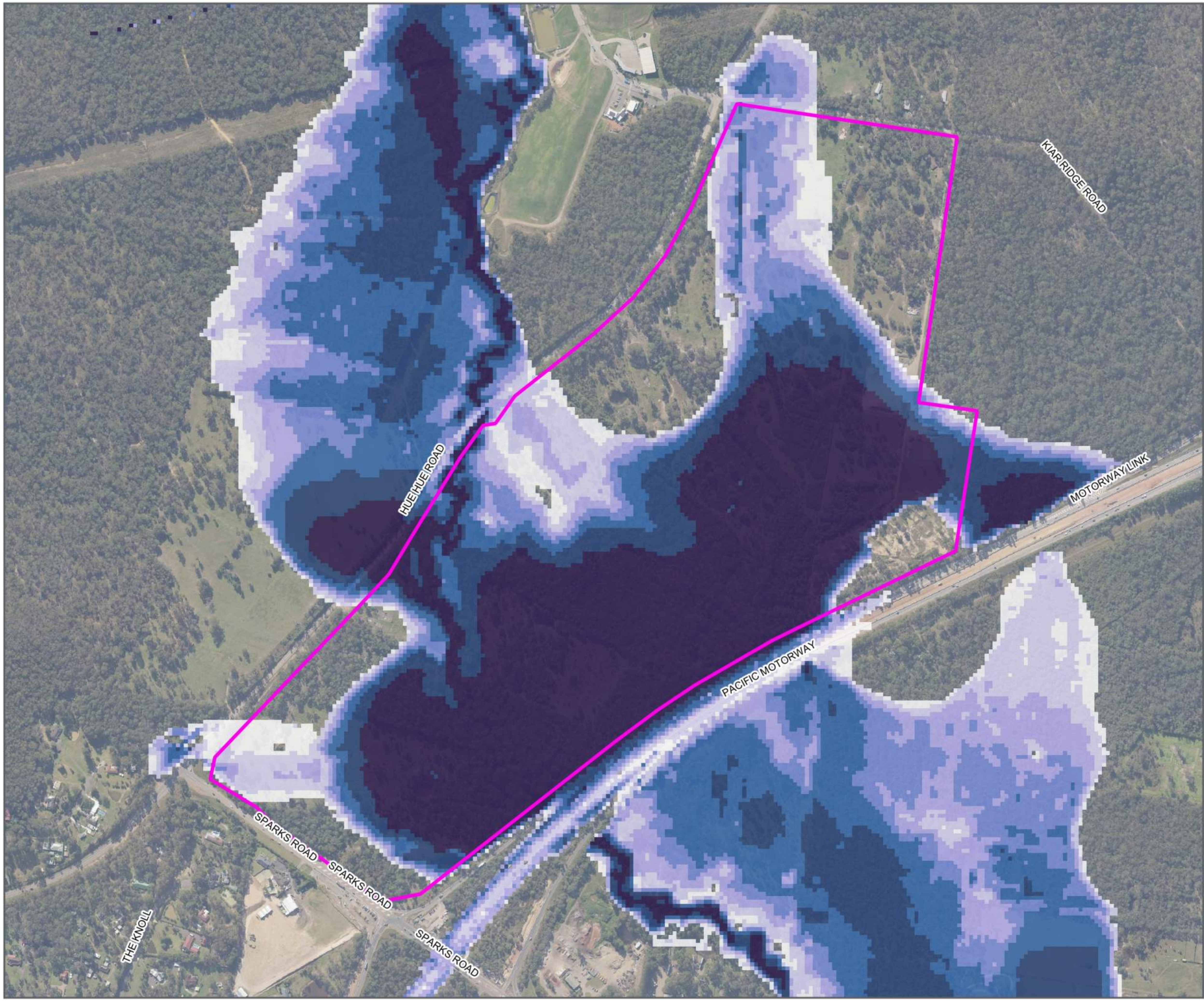
FIGURE A3

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing
Flood Depth
PMF

Legend

Full Site Area

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

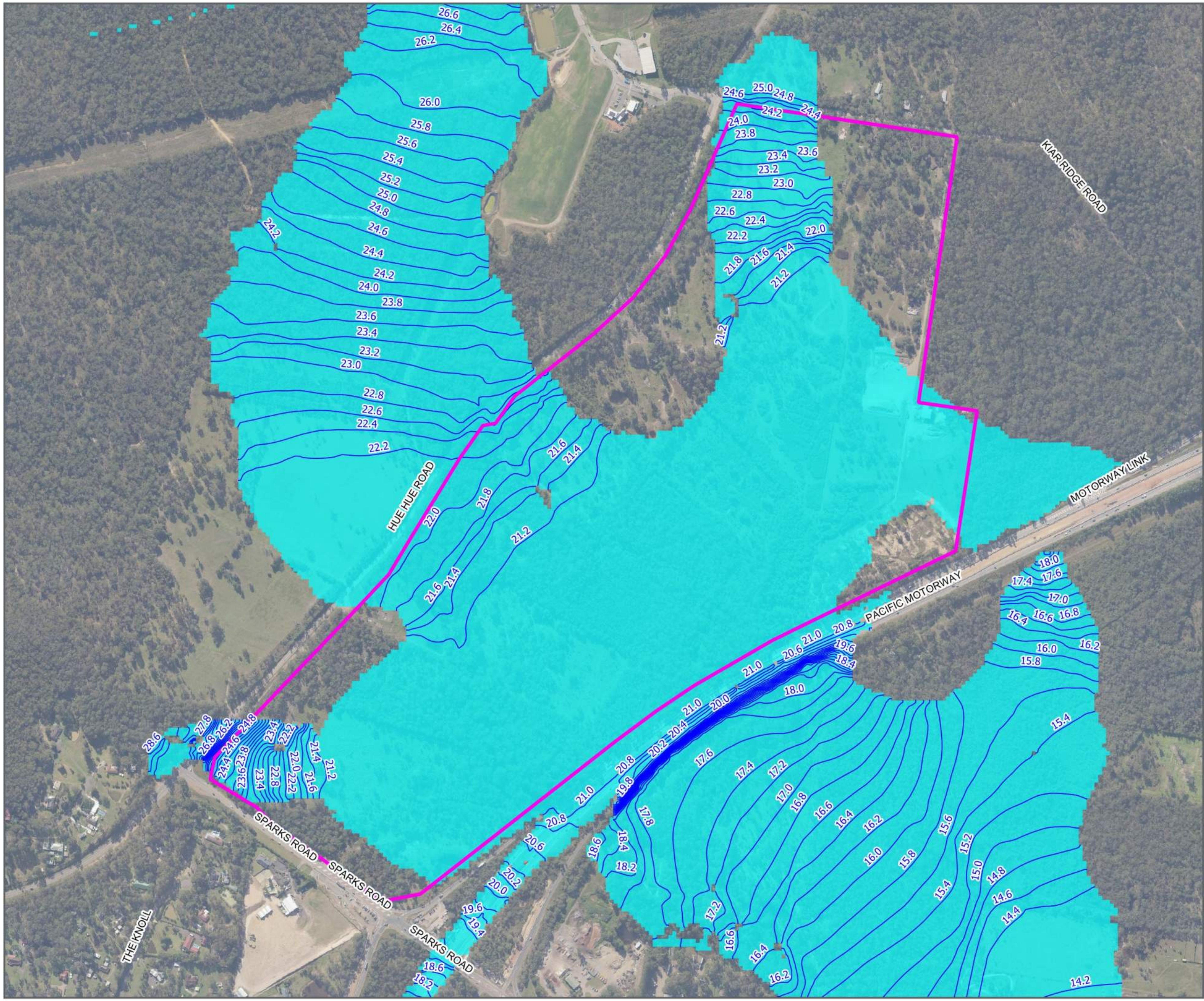
FIGURE A4

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing
Water Level Contours
PMF

Legend

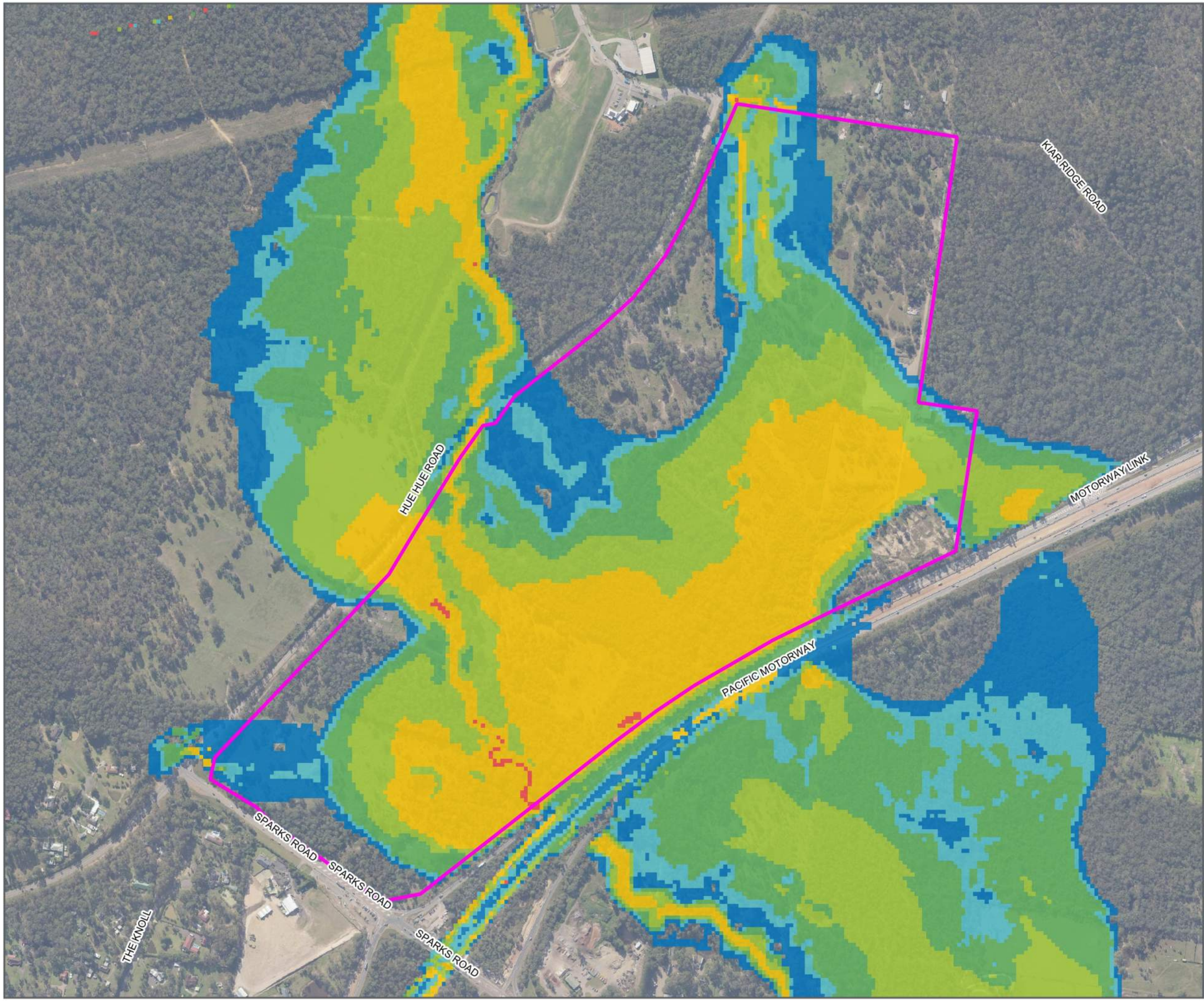
- Full Site Area
- 0.2m Flood Level Contour (mAHD)
- Flood Extent

FIGURE A5

1:7,000 Scale at A3

0 80 160 240 320 400 m

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing
Hazard Categories (H1-H6))
PMF

Legend

- Full Site Area

Hazard Category

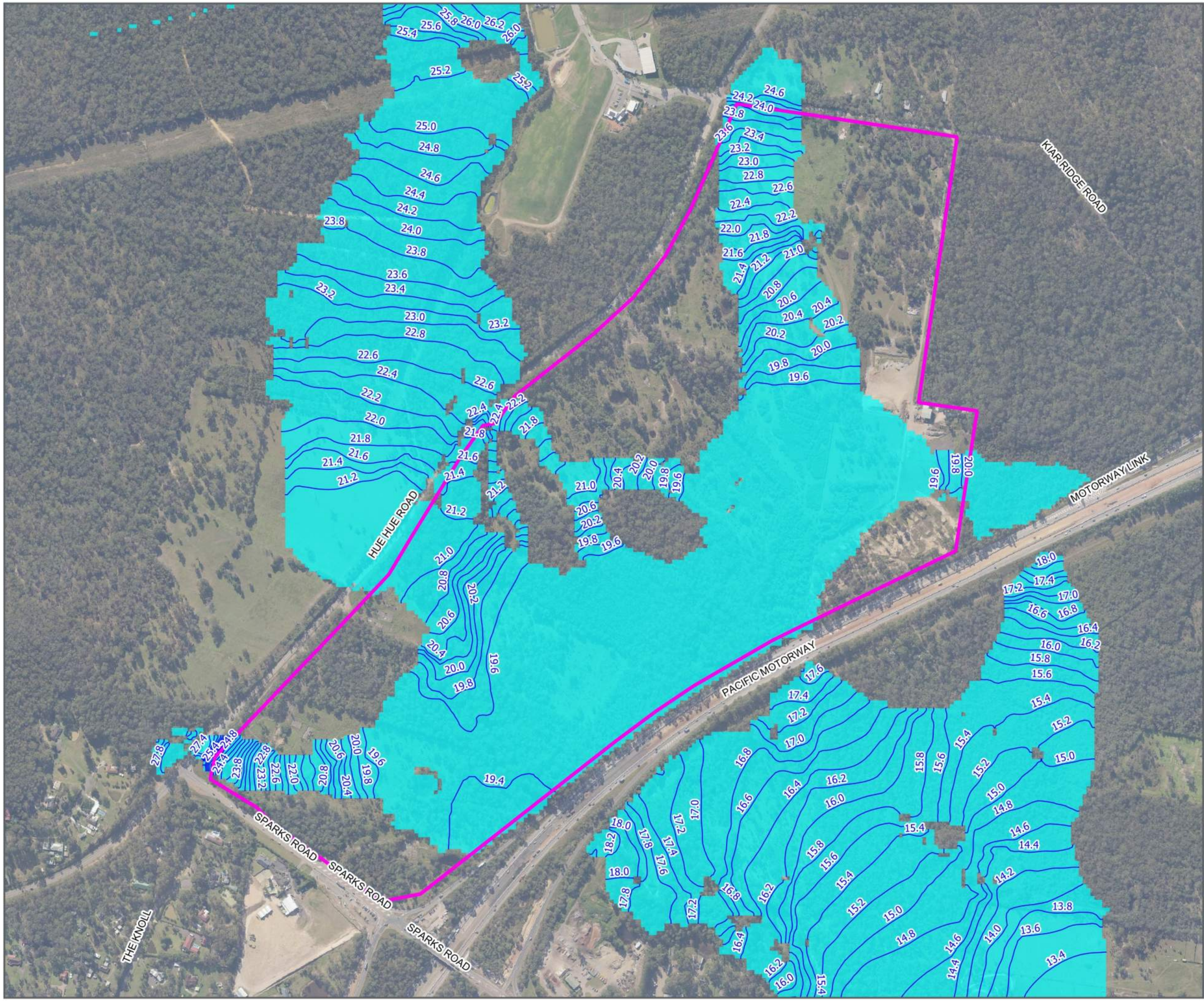
- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE A6

1:7,000 Scale at A3

0 80 160 240 320 400 m

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing-15% Rainfall Increase
Water Level Contours
100 Year ARI

Legend

- Full Site Area
- 0.2m Flood Level Contour (mAHD)
- Flood Extent

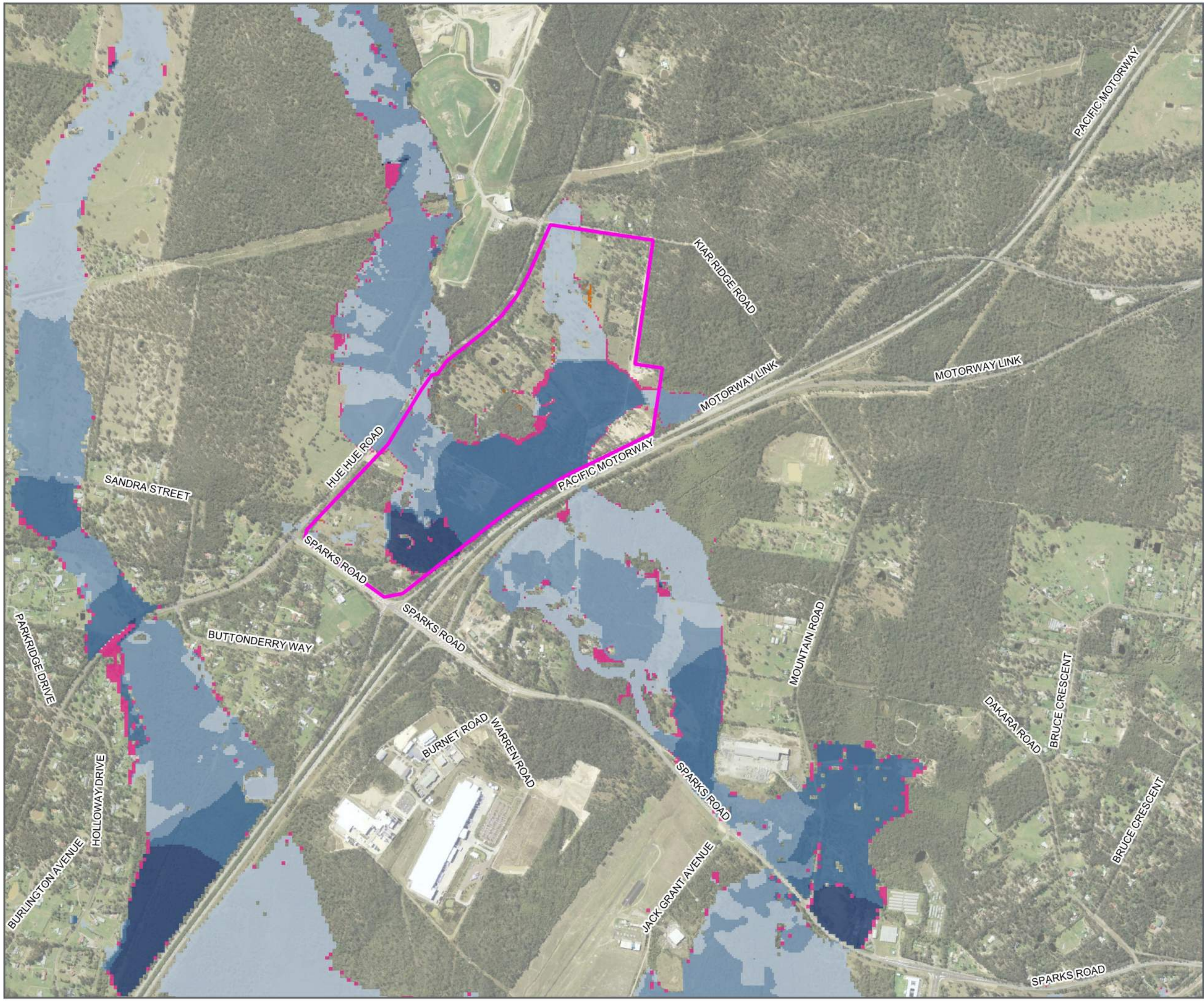
FIGURE A7

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing-15% Rainfall Increase Less Current Climate Water Level Difference 100 Year ARI

Legend

- Full Site Area

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (mm)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

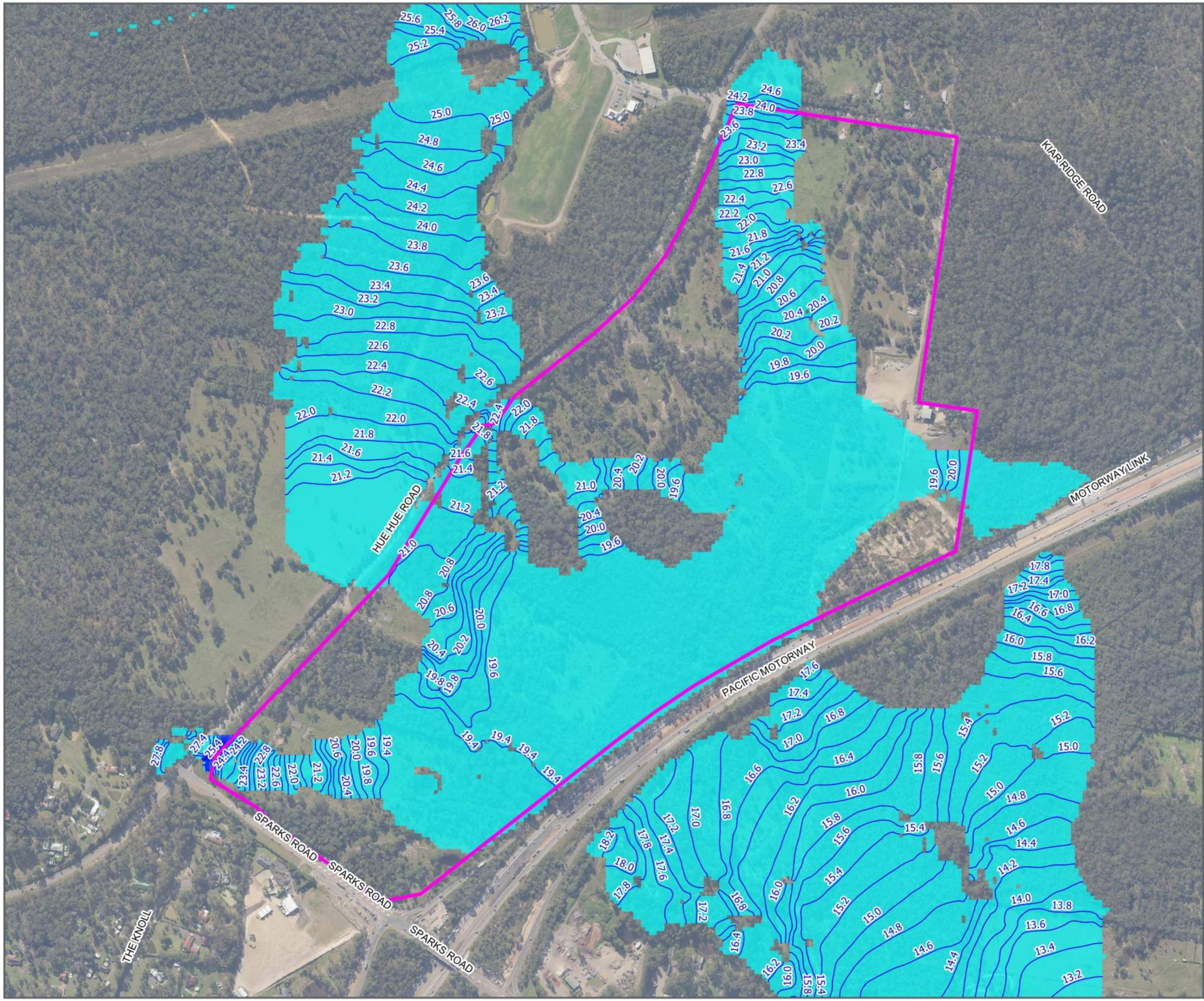
FIGURE A8

1:15,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing-Blockage Scenario
Water Level Contours
100 Year ARI

Legend

- Full Site Area
- 0.2m Flood Level Contour (mAHD)
- Flood Extent

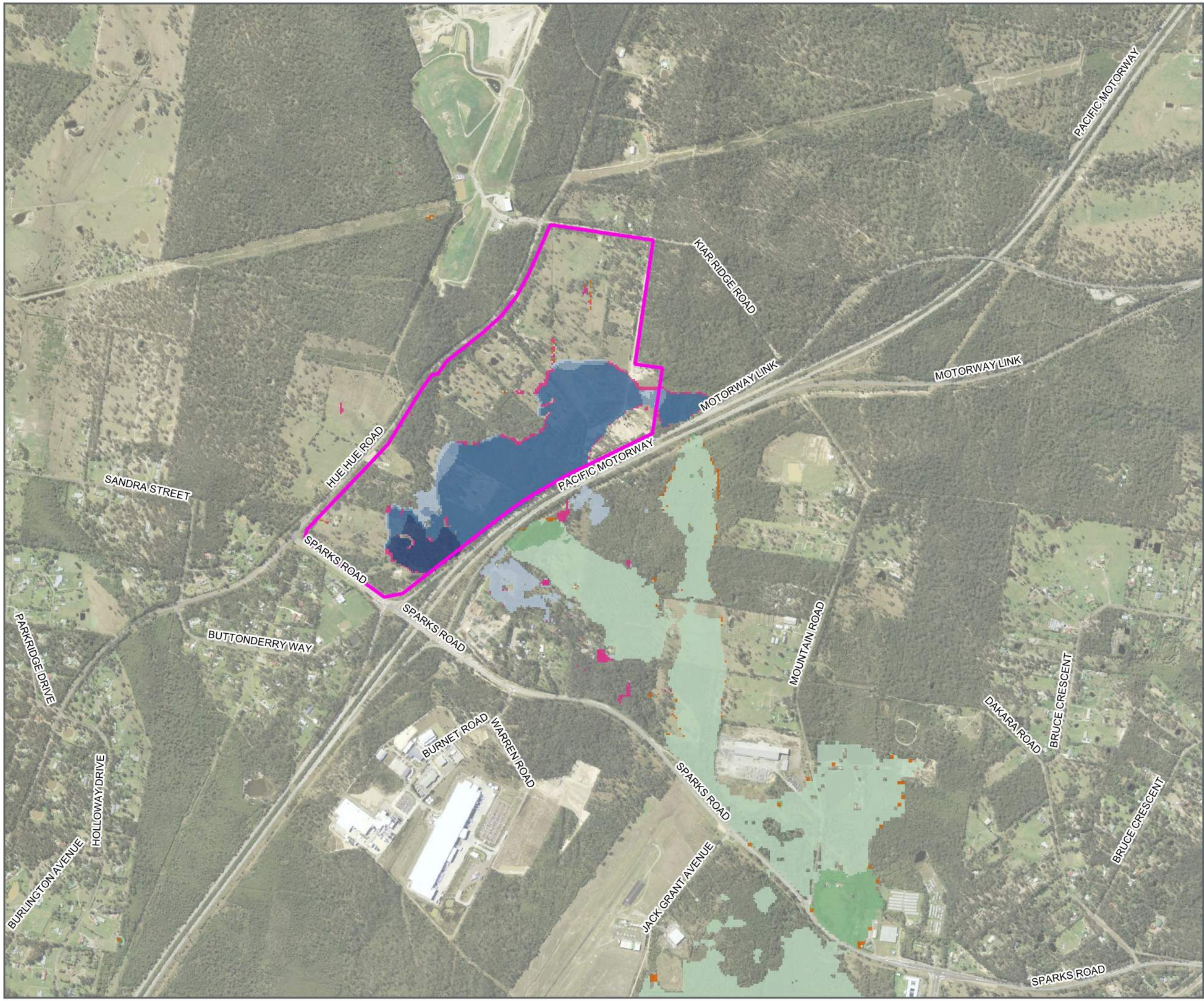
FIGURE A9

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnerval Industrial Park

Existing-Blockage Scenario Less Non-Blockage Scenario
Water Level Difference
100 Year ARI

Legend

- Full Site Area

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (mm)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

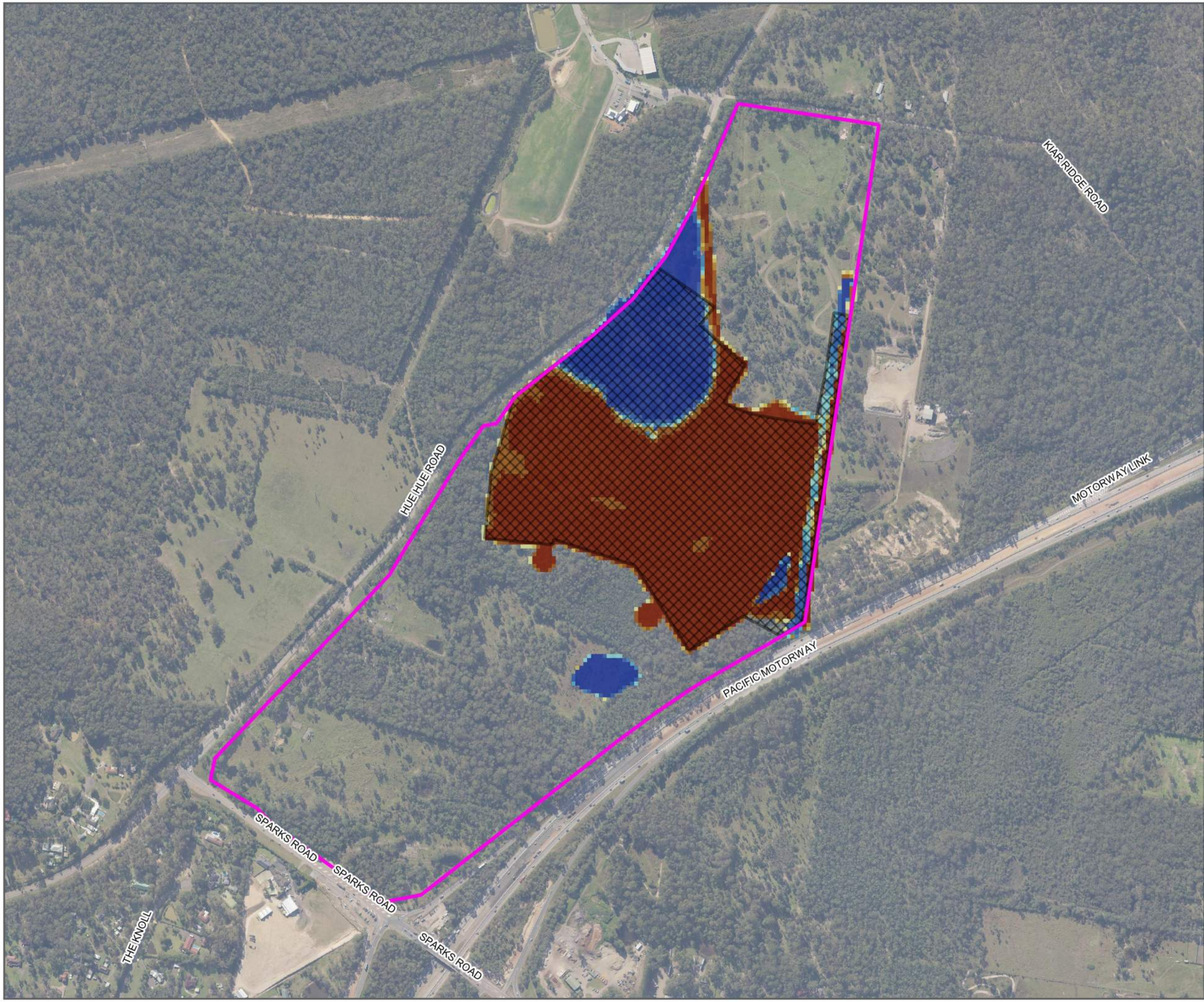
FIGURE A10

1:15,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-11-30| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211025_NW30213.qgz



Warnervale Industrial Park

Stage 1A Less Existing

Terrain Difference

Legend

- Full Site Area
- Stage 1A Boundary

Terrain Difference (m)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

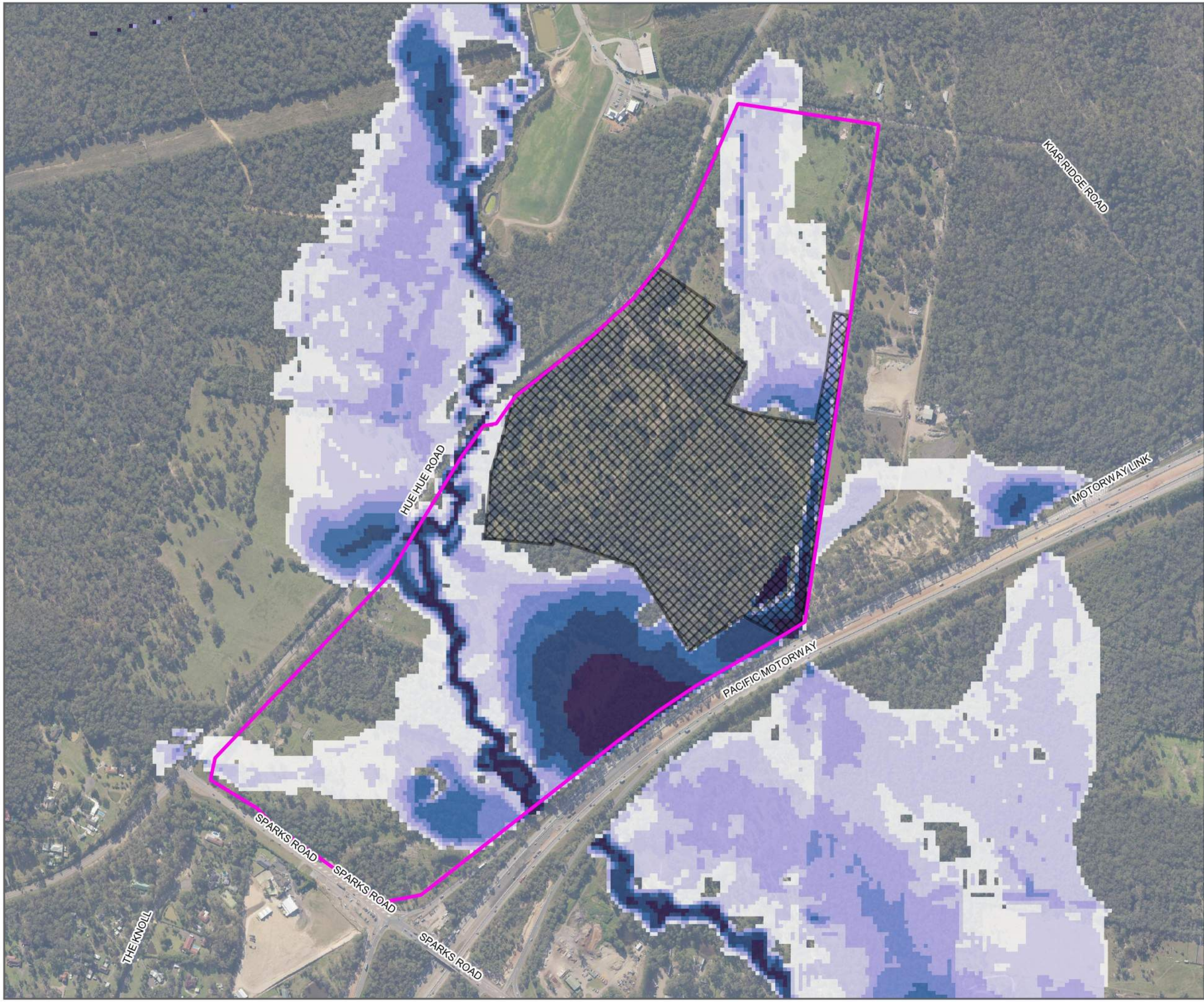
FIGURE B1

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A
100 Year ARI
Flood Depth

Legend

- Full Site Area
- Stage 1A Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE B2

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz

Warnervale Industrial Park

Stage 1A
100 Year ARI
Water Level Contours

Legend

- Full Site Area
- Stage 1A Boundary
- 0.2m Water Level Contour (mAHD)
- Flood Extent

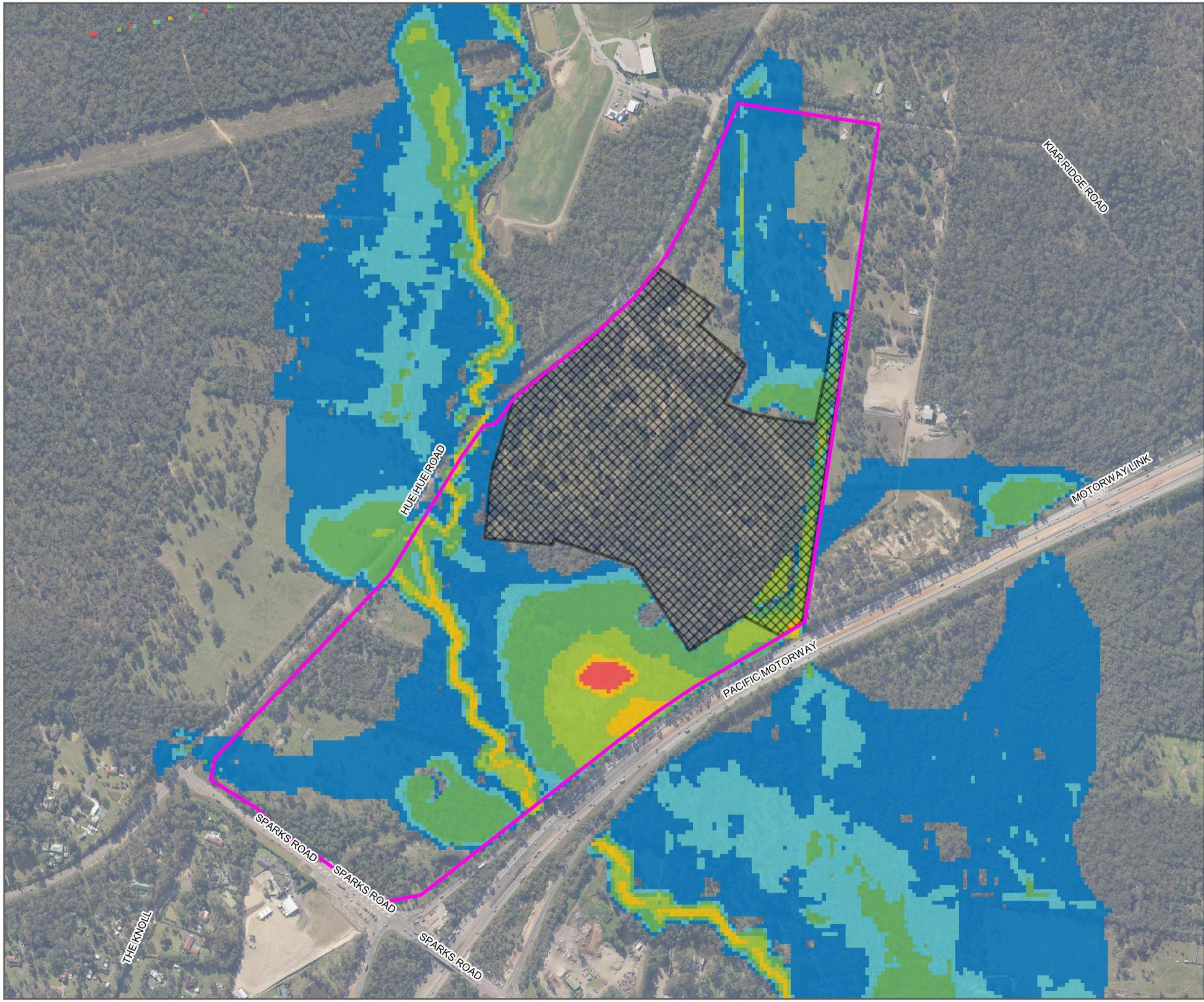
FIGURE B3

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A
100 Year ARI
Hazard Categories (H1-H6)

Legend

- Full Site Area
- Stage 1A Boundary

Hazard Category

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

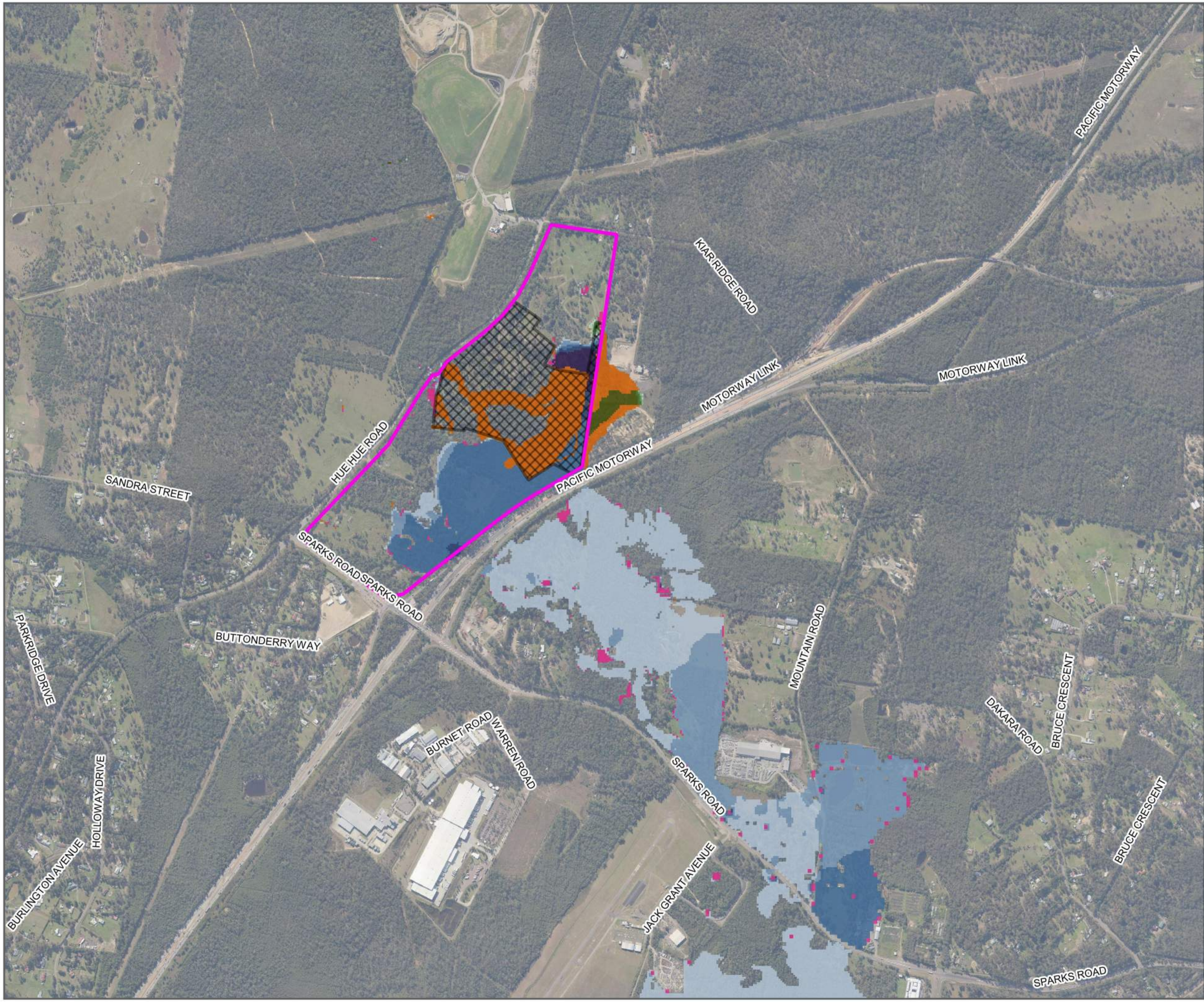
FIGURE B4

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A Less Existing
100 Year ARI
Water Level Difference

Legend

- Full Site Area
- Stage 1A Boundary

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)

- < -0.20
- -0.20 to -0.10
- -0.10 to -0.06
- -0.06 to -0.03
- -0.03 to -0.01
- -0.01 to 0.01
- 0.01 to 0.03
- 0.03 to 0.06
- 0.06 to 0.10
- 0.10 to 0.20
- > 0.20

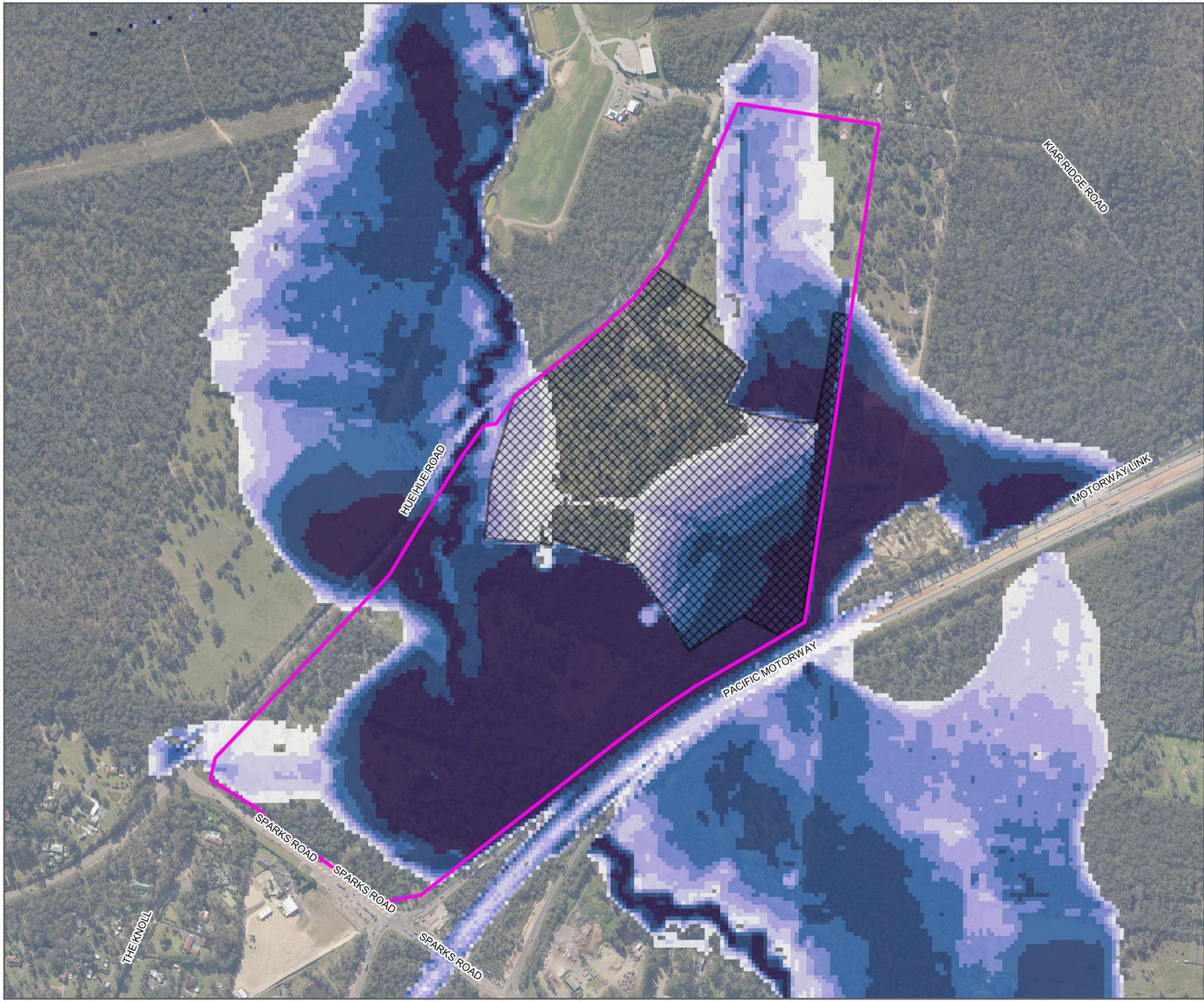
FIGURE B5

1:15,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A
PMF
Flood Depth

Legend

- Full Site Area
- Stage 1A Boundary

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

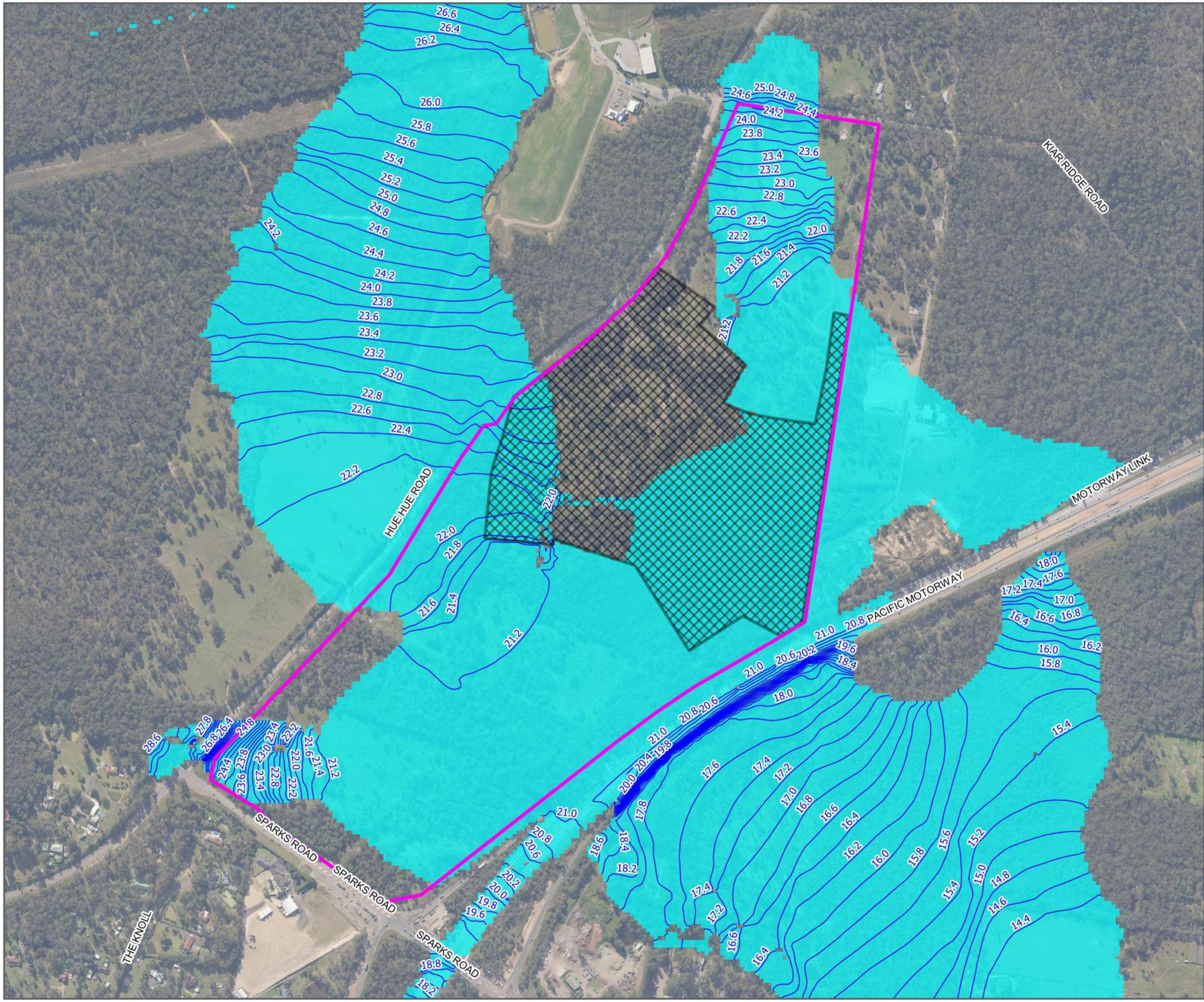
FIGURE B6

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A
PMF
Water Level Contours

Legend

- Full Site Area
- Stage 1A Boundary
- 0.2m Water Level Contour (mAHD)
- Flood Extent

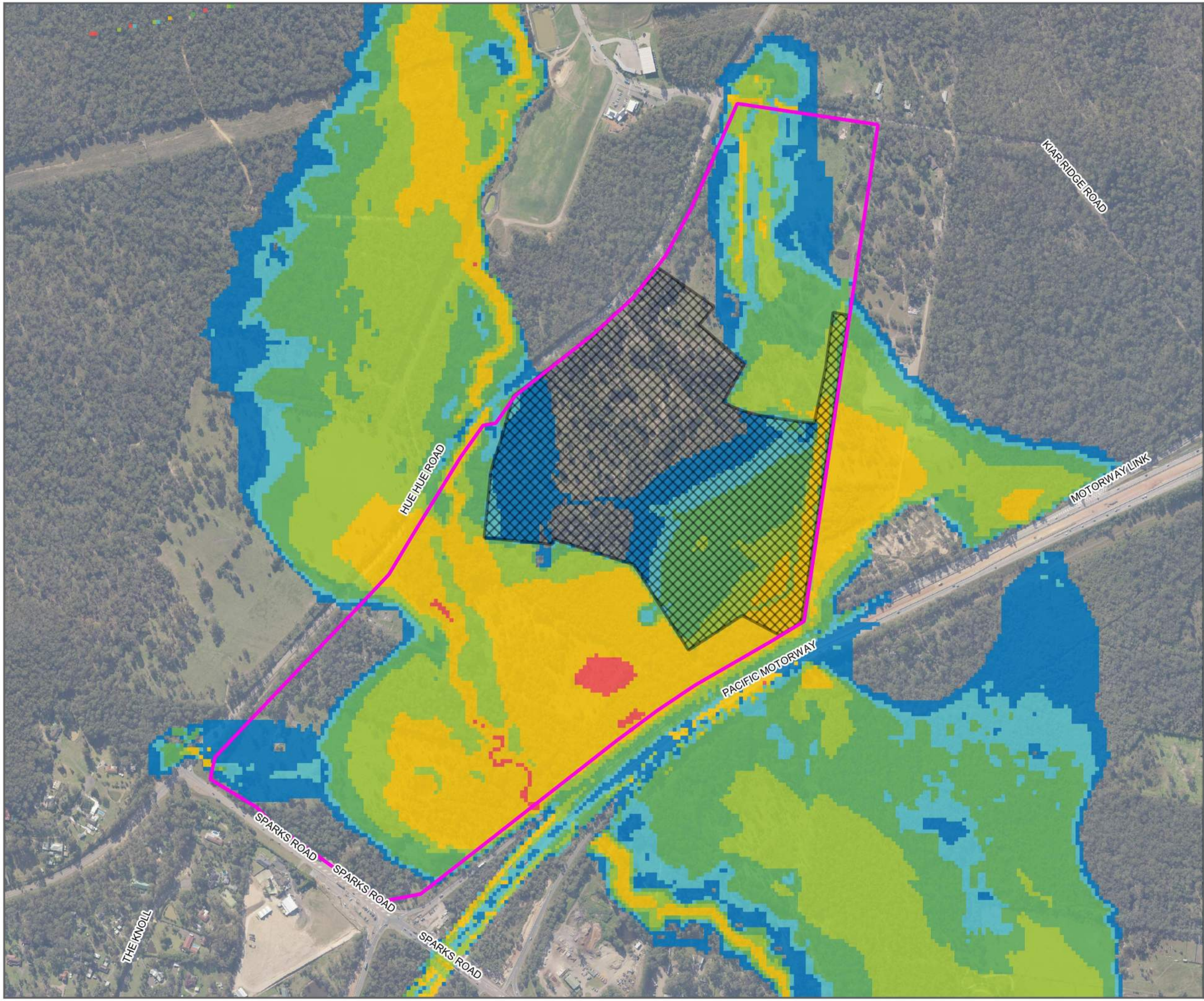
FIGURE B7

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St.Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A
PMF
Hazard Categories (H1-H6)

Legend

- Full Site Area
- Stage 1A Boundary

Hazard Category

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles. children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

FIGURE B8

1:7,000 Scale at A3

0 80 160 240 320 400 m

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz

Warnervale Industrial Park

Stage 1A-100 Year ARI+15% Rainfall Increase
100 Year ARI
Water Level Contours

Legend

- Full Site Area
- Stage 1A Boundary
- 0.2m Water Level Contour (mAHD)
- Flood Extent

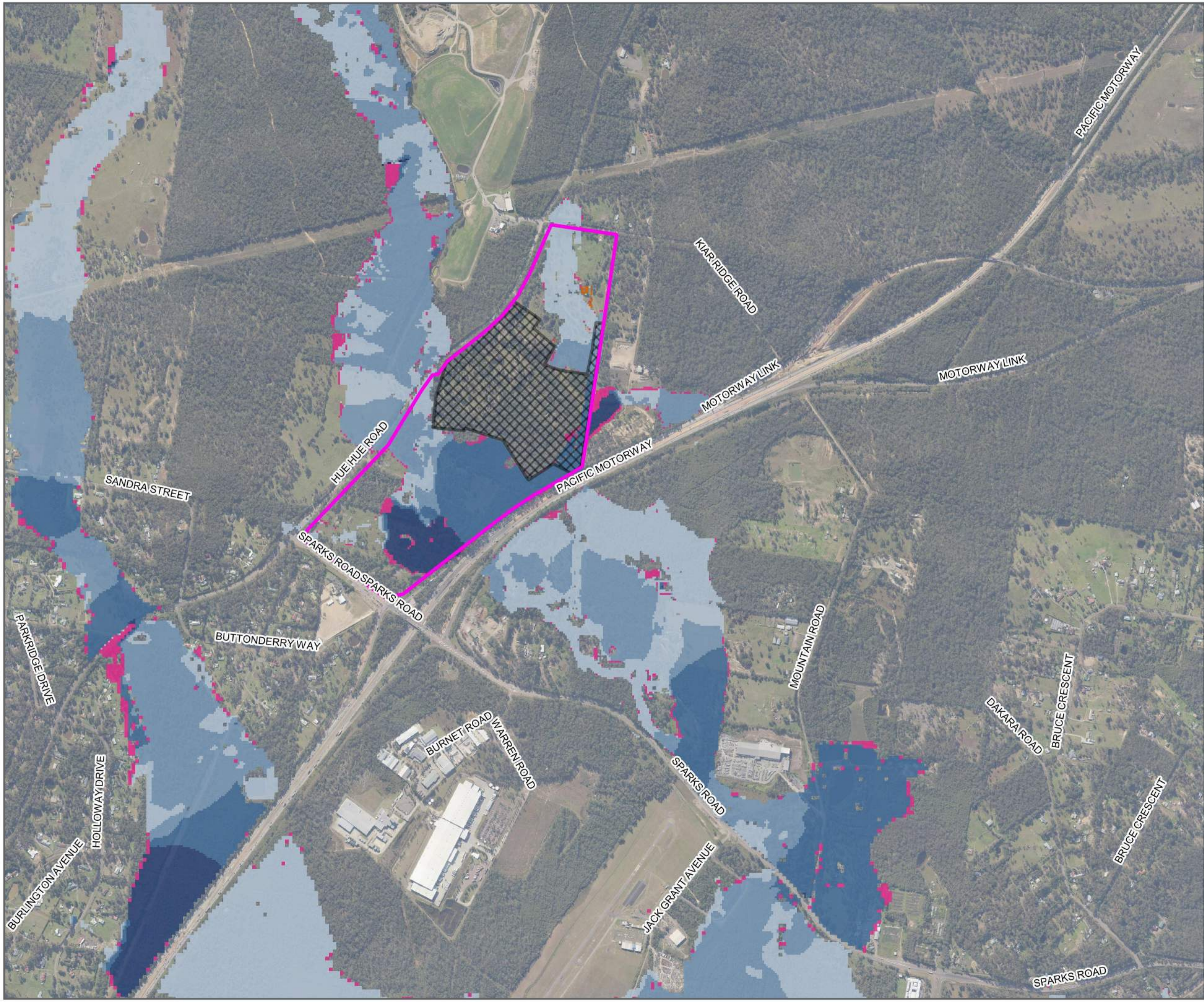
FIGURE B9

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A-15% Rainfall Increase Less Current Climate
100 Year ARI
Water Level Difference

Legend

- Full Site Area
- Stage 1A Boundary

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

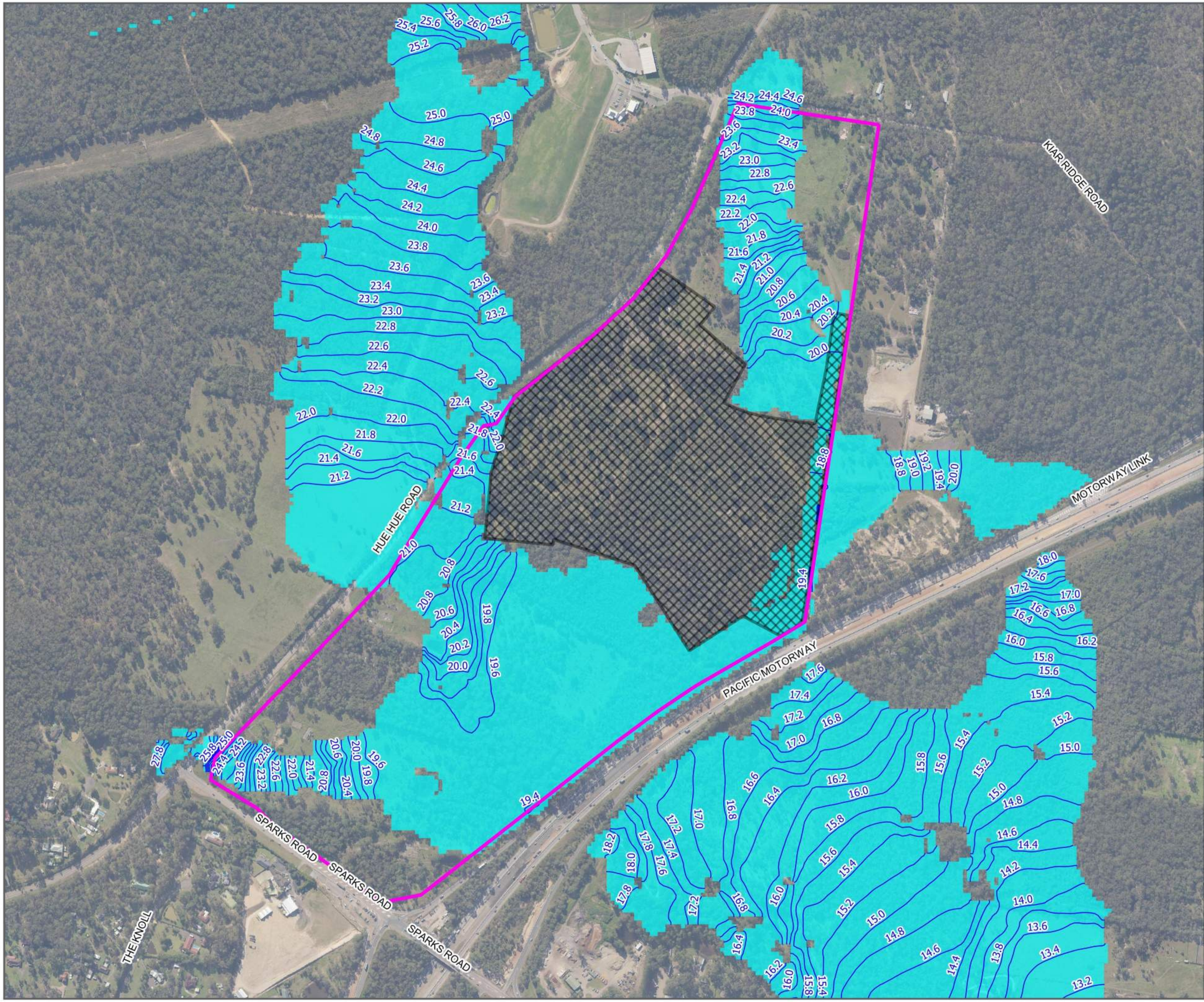
FIGURE B10

1:15,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz



Warnervale Industrial Park

Stage 1A-Blockage Scenario
100 Year ARI
Water Level Contours

Legend

- Full Site Area
- Stage 1A Boundary
- 0.2m Water Level Contour (mAHD)
- Flood Extent

FIGURE B11

1:7,000 Scale at A3

0 80 160 240 320 400 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz

Warnervale Industrial Park

Stage 1A-Blockage Scenario Less Non-Blockage Scenario
100 Year ARI
Water Level Difference

Legend

- Full Site Area
- Stage 1A Boundary

Wet & Dry Analysis

- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)

- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20
- 0.20 to 0.50
- > 0.50

FIGURE B12

1:15,000 Scale at A3

0 100 200 300 400 500 m

Cardno

Map Produced by St Leonards Water (AWE)
Date: 2021-12-20| Project: NW30213
Coordinate System: MGA Zone 56
Map: 20211219_NW30213_Stage1A_v5_2.qgz