ADW JOHNSON PTY LIMITED
ABN 62 129 445 398

Sydney
Level 35 One International Towers
100 Barangaroo Avenue
Sydney NSW 2000
02 8046 7411
sydney@adwjohnson.com.au

Central Coast
5 Pioneer Avenue
Tuggerah NSW 2259
02 4305 4300
coast@adwjohnson.com.au

Hunter Region
7/335 Hillsborough Road
Warners Bay NSW 2282
02 4978 5100
hunter@adwjohnson.com.au

Engineering

Working Beyond Expectations

Stormwater Management Plan, Water Sensitive Urban Design Strategy & Erosion and Sediment Control Plan

Proposed Apartment Building Development

Property:
Lot 11 DP 577062
23 Fisher Road, Dee Why

Applicant:
Hamptons By Rose Pty Ltd

Date:
February 2019

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	Issued for Review	3rd September 2018	BM	IB
B	Minor Wording	4th September 2018	BM	IB
C	OSD Added	5th February 2019	BM	IB
D	SW layout amended	21st February 2019	BM	IB

Executive Summary

ADW Johnson Pty Ltd has been commissioned by Hamptons By Rose Pty Ltd to prepare a Stormwater Management Strategy for the proposed development of Lot 11 DP 577062, also known as 23 Fisher Road, Dee Why.

This report is to accompany the DA plans and documentation to provide evidence that the proposed onsite stormwater management controls are in accordance with Northern Beaches Council specifications.

An analysis of the existing site reveals that a ridge line currently bisects the site, sending flows to the east and west towards Civic Parade and Fisher Street respectively. A high point within Fisher Road sends flows either north or south depending on their discharge location. Flows heading south are eventually captured by the same stormwater lintel as the flows discharging to Civic Parade.

A Drains model was prepared to determine the amount of detention storage needed in order to meet Northern Beaches Council requirements. The northern catchment was found to require approximately 50m3, whilst the southern catchment was found to not require a stormwater detention facility.

A water quality analysis was undertaken using the MUSIC program, to determine the water quality controls required in order to meet Council's standards. It was determined that the proposed treatment train of rainwater tanks, litter baskets and Jellyfish cartirdges would provide adequate treatment to meet the pollutant reduction targets set out by Council.

A suitable erosion and sedimentation control plan has been incorporated with a range of controls to ensure the site is adequately protected during construction.

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EXHIBITS

APPENDICES

1.0 Introduction

1.1 BACKGROUND

ADW Johnson Pty Ltd has been commissioned by Hamptons by Rose Pty Ltd to prepare a Stormwater Management Strategy for the proposed 130 apartment residential development of Lot 11 DP 577062.

This report is to accompany the DA documentation to provide evidence that the proposed on site stormwater management controls are in accordance with Northern Beaches Council specifications.

2.0 Site Description

2.1 EXISTING SITE

The proposed development site is located at 23 Fisher Road, Dee Why and is described as Lot 11 DP 577062.

The subject site, as seen in Figure 1, is approximately 1.06ha in size and is bound to the west by Fisher Road, to the south by St David Avenue, to the north by existing commercial development and to the east by Civic Parade.

Figure 1 – Site Locality

A number of existing residential properties and associated hardstand areas are currently located on the site. Amongst the existing buildings is the Pacific Lodge, a heritage listed building.

Existing vegetation consists of scattered trees around the existing built form, with denser vegetation along the eastern boundary.

A ridgeline currently bisects the site in a north-south direction, directing the majority of runoff generated by the site to the east and west. Runoff flowing to the west of the site discharges to Fisher Road whilst runoff to the east discharges to Civic Parade. It is however noted that runoff entering the southern end of Fisher Road drains south towards David Avenue where it then drains east to Civic Parade. This is discussed further in section 4.1.

The natural grades throughout the site generally range from 10-20%, with steeper grades at the northern end of the site with grades reaching up to 70% on an existing rock wall.

The existing site can be seen in **Exhibit 1**.

2.2 PROPOSED DEVELOPMENT

The proposal is to develop 130 apartments in three (3) buildings over a common two (2) level basement parking structure and associated driveway from Fisher Road. The apartment

mix is 39 x 1 bedroom apartments, 70 x 2 bedroom apartments and 21 x 3 bedroom apartments. The basement will contain 190 – 195 parking spaces.

It is noted that, whilst the majority of existing buildings are to be demolished, the Pacific Lodge (heritage building) is to be retained, along with a large portion of the existing vegetation along the Eastern boundary.

The proposed development can be seen in **Exhibit 2**.

3.0 Council Requirements

Water Sensitive Urban Design (WSUD) principles for the Northern Beaches Council seek to limit the impact of urbanisation on the water cycle. WSUD principles include:

- Minimise the volume of stormwater runoff;
- Reduce the run-off and peak flows from urban developments by local detention basins and minimising impervious areas;
- Treating urban stormwater to best practice standards for reuse and/or discharge to receiving waters;
- Reducing potable water demand through water efficiency, stormwater harvesting and wastewater reuse;
- Minimising wastewater generation and treatment of wastewater so that it can be reused;
- Integrating vegetated stormwater treatment into the landscape, so as to provide increased biodiversity, amenity and micro-climate benefits which can reduce the heat island effect; and
- Providing green infrastructure and green links to improve habitat corridors.

3.1 STORMWATER QUANTITY

Generally, stormwater quantity controls are required on developments to ensure the post developed peak flows are less than or equal to the pre developed flows and that overland flows are managed in a safe manner.

In the event of blockages within the system, emergency flow paths will be designed to cater for the major storm event (1 in 100 year ARI) with adequate freeboard to adjacent habitable floor levels without causing risk to property or people.

In accordance with Northern Beaches Council engineering specification stormwater detention modelling is to be undertaken assuming the pre developed site is 0% impervious.

3.2 STORMWATER QUALITY

The intent of the water quality targets are to improve the quality of stormwater runoff, which will also improve the health of creeks and waterways, and enhance urban amenity.

The guidelines for stormwater quality treatment objectives are expressed as mean annual reductions of pollutant loads. The target objectives were obtained from Northern Beaches Council WSUD guidelines (Section 2.2.1) and are shown below in Table 1.

Table 1 – Water Quality Treatment Objectives

Pollutant	Retention Criteria
Suspended Solids	**85%** reduction in the post development mean annual load
Total Phosphorus	**65%** reduction in the post development mean annual load
Total Nitrogen	**45%** reduction in the post development mean annual load
Gross Pollutants	**90%** reduction in the post development mean annual load (for pollutants greater than 5mm in diameter)

3.3 STORMWATER RETENTION

The intent of stormwater retention requirements defined by Northern Beaches Council is to mimic the pre-developed runoff losses such that the post development and pre-development runoff hydrographs are similar in terms of volume, peak and shape for the full range of design events. This can be achieved through implementing rainwater tanks to capture and retain runoff from impervious surfaces (whether roof, paving or road carriageway), retain it for a relatively long time, and slowly release it elsewhere in the water cycle.

The use of rainwater tanks which are connected for internal use (toilet flushing and washing machine) and external reuse (garden irrigation) are encouraged for all developments within the Northern Beaches Council.

Rainwater tanks shall comply with the following:

- Be fitted with a first-flush device that causes initial rainwater run-off to bypass the tank and must drain to a landscaped area. The first flush device will not be permitted to connect to the stormwater system;
- Have a sign affixed to the tank stating the contents is rainwater;
- Be constructed or installed in a manner that prevents mosquitoes breeding, such as the use of mesh to protect inlets and overflows;
- Have its overflow connected to an existing stormwater drainage system that does not discharge to an adjoining property, or cause a nuisance to adjoining owners;
- Pumping equipment must be housed in a soundproof enclosure;
- Where the rainwater tank is interconnected to a reticulated water supply, it must be installed in accordance with Plumbing Code of Australia, particularly backflow/cross connection prevention requirements.

3.4 EROSION AND SEDIMENTATION CONTROL

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

4.0 Stormwater Quantity

A stormwater drainage concept plan has been prepared to demonstrate how the stormwater runoff for the catchment is captured and transported to the downstream drainage infrastructure. The concept stormwater plan can be seen in **Exhibit 2.**

4.1 CATCHMENT ANALYSIS

An analysis of the existing site was undertaken in order to determine the current discharge locations and direction of flows once they leave the site.

As mentioned in section 2.1, there is a ridge line running north south within the site which directs the majority of flows generated to either Fisher Road in the west or Civic Parade in the east.

A review of the detail survey for the site indicates that flows discharging to Civic Parade are collected by a series of stormwater lintels and conveyed to a low point on the corner of Civic Parade and St David Avenue. The flow is then further conveyed east along St David Avenue.

Further review of the detail survey indicates that there is an existing high point on Fisher Road close to the southern traffic island associated with the Fisher road roundabout. Flows discharging from the subject site to the north of this high point are conveyed north along Fisher Road and are collected by a series of stormwater lintels before being conveyed north along Fisher Road.

Flows discharging to the south of the high point are conveyed south along Fisher Road within the kerb and gutter before turning east along St David Avenue and ultimately being captured within the stormwater lintel on the corner of St David Avenue and Civic Parade.

It is noted that during a site visit, up to eight (8) kerb outlet pipes were observed within the kerb, south of the high point on Fisher Road indicating that the majority of existing buildings on the site discharge to Fisher Road.

Based upon the above analysis it is noted that whilst a ridge line bisects the site, the majority of the flows discharging from the existing site are ultimately captured within the same stormwater system draining east along St David Avenue. Accordingly, the modelling outlined in the following sections assumes only two pre developed catchments for the entire subject site.

4.2 MODELLING

The quantity of required storage to reduce the post developed discharge from the site to less than or equal to the pre developed discharge for various storm events was analysed using the 'Drains' software, which uses the runoff routing method.

The parameters used for the modelling can be found in the subsequent sections and whilst a screenshot of the Drains model can be seen in **Appendix A**.

4.2.1 Rainfall Data

The 'Drains' program was used to model the hydrology of the site for various storm durations ranging from the five (5) minute up to and including 4.5 hours. In accordance with section 4.3 of the "Warringah Council On-Site Stormwater Detention Technical Specification" (OSD Specification), sourced from the Northern Beaches Council website, detention modelling was undertaken for the 5, 20 and 100 year ARI storm events.

The IFD rainfall data adopted within the model was sourced from the Bureau of Meteorology website, using the online IFD data tool.

4.2.2 Catchments

As mentioned in section 4.1 above, the existing site ultimately discharges to two (2) outlet locations, being north of the Fisher Road roundabout and the corner of St David Avenue and Civic Parade. For the purposes of this report the catchments have been identified as "northern" and "southern" respectively.

The predeveloped catchments and discharge locations adopted within the modelling can be seen in **Exhibit 1** whilst a summary of their parameters can be seen in **Table 2** below.

Table 2: Pre-developed catchment properties

CATCHMENTS	AREA (ha)	IMPERVIOUS		PERVIOUS	
		%	Tc (mins)	%	Tc (mins)
Northern	0.31	-	-	100	5
Southern	0.75	-	-	100	5

In accordance with the Warringah Council OSD specification, for the purposes of the detention modelling, the existing site was assumed to be 0% impervious.

The post-development catchments were broken up based upon the proposed architectural drawings and anticipated grading of the subject site. The architectural drawings indicate that the post developed site will discharge to the same two outlet locations as the existing site. The post developed catchments can be seen in **Exhibit 2** whilst a summary of their parameters can be seen in **Table 3** below.

Table 3: Post-developed catchment properties

CATCHMENTS	TOTAL AREA (ha)	ROOF		IMPERVIOUS		PERVIOUS	
		AREA (ha)	Tc (mins)	AREA (ha)	Tc (mins)	AREA (ha)	Tc (mins)
Northern	0.36	0.20	5	0.06	5	0.10	5
Southern	0.70	0.29	5	0.02	5	0.39	5

4.3 RESULTS

The Drains model, adopting the above mentioned parameters, was used to analyse the peak flows from the pre and post developed catchments and determine the required detention storage to comply with the Warringah Council OSD specification. The results of the Drains modelling for the northern catchment can be seen in **Table 4** below.

Table 4: Northern Catchment Modelling Results

ARI Storm Event (yr)	Pre Development Peak Flow (m^3/s)	Post Development Peak Flow (without Detention) (m^3/s)	Post Development Peak Flow (with Detention) (m^3/s)
5	0.11	0.15	0.11
20	0.16	0.20	0.15
100	0.20	0.25	0.18

From the results shown in **Table 4** above, it can be seen that the post developed flows within the northern catchment exceeded the pre developed flows, and as such, an underground stormwater detention tank was required to reduce the flows back to pre-developed levels. A summary of the proposed OSD tank parameters can be seen in **Table 5** below.

Table 5: OSD Tank Parameters

Tank Parameter	Detail
Outlet Controls	300mm PVC pipe with 260mm orifice plate @ 0m 225mm PVC pipe with 160mm orifice plate @ 0.74m*
Tank Surface Area	$40m^2$
Tank Depth	1.3m
Max Water Depth (100 year ARI)	1.26m
Total Storage at 100 year ARI Stage	$50.4m^3$

** Levels are relative to bottom of tank.*

It is proposed to provide the OSD tank underneath the proposed driveway off Fisher Road. The tank has been located in order to avoid any impact on the existing tree located on the adjacent property to the north of the site. The tank location can be seen in **Exhibit 2**.

The results for the southern catchment can be seen in **Table 6** below.

Table 6: Southern Catchment Modelling Results

ARI Storm Event (yr)	Pre Development Peak Flow (m^3/s)	Post Development Peak Flow (m^3/s)
5	0.27	0.27
20	0.38	0.37
100	0.48	0.46

From the results shown in **Table 6** above, it can be seen that post developed flows within the southern catchment are equal to or less than the pre developed levels without the need for a detention structure. An analysis of the pre and post developed catchments reveals that the proposed layout of the post developed site reduces the amount of area discharging to the southern outlet and hence there is no need of a detention structure.

4.4 DOWNSTREAM INFRASTRUCTURE CAPACITY

One of the main needs to provide stormwater detention on development sites is to ensure that the capacity of the existing downstream infrastructure is sufficient. To ensure the capacity of the infrastructure downstream of the proposed outlet locations is not exceeded a review of the existing and proposed flows has been undertaken.

It is noted that despite the Warringah Council OSD specification requiring that the pre developed flows be calculated based upon the site being 100% pervious, the current site is made up of a number of impervious areas. A review of the detail survey indicates the actual impervious percentage of the northern and southern catchments is 26% and 45% respectively.

Accordingly, an analysis was undertaken to determine the flows leaving the subject site using the actual impervious percentage calculated from the detail survey.

The results of this analysis, and a comparison with the theoretical 100% pervious and post developed flows can be seen in **Tables 7 and 8** below.

Table 7: Northern Catchment Analysis Results

ARI Storm Event (yr)	Pre Development Peak Flow (0% Impervious) (m^3/s)	Pre Development Peak Flow (26% Impervious) (m^3/s)	Post Development Peak Flow (with detention) (m^3/s)
5	0.11	0.12	0.11
20	0.16	0.16	0.15
100	0.20	0.20	0.18

* Pre developed flows are the same due to rounding

It can be seen from the results in **Table 7** above that the actual flows leaving the northern catchment are equal to or greater than both the pre developed (0%) and post developed flows. As such it is considered that the development will not have an impact on the capacity of the downstream infrastructure within Fisher Road.

Table 8: Southern Catchment Analysis Results

ARI Storm Event (yr)	Pre Development Peak Flow (0% Impervious) (m^3/s)	Pre Development Peak Flow (45% Impervious) (m^3/s)	Post Development Peak Flow (without detention) (m^3/s)
5	0.27	0.30	0.27
20	0.38	0.40	0.37
100	0.48	0.50	0.46

It can be seen from the results in **Table 8** above that the actual flows leaving the southern catchment are greater than both the pre developed (0%) and post developed flows. As such it is considered that the development will not have an impact on the capacity of the downstream infrastructure within Civic Parade and St David Avenue.

It is also noted that a portion of the current southern catchment discharges via kerb outlets to Fisher Road, whilst the post developed southern catchment will largely discharge directly to the stormwater pit in Civic Parade. As such it is considered that the development will reduce gutter flows within Fisher Road and St David Avenue.

Based upon the above analysis it is concluded that the proposed development will not have a negative impact on the capacity of any downstream infrastructure.

5.0 Stormwater Quality

The proposed stormwater system, as detailed in Section 4, uses a combination of pit and pipe networks and water sensitive urban design elements to convey 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.

5.1 TREATMENT DEVICES

The stormwater design for the proposed subdivision proposes to use a combination of at source and conveyance controls to treat the stormwater runoff from the site. The treatment train will be modelled for demonstration of compliance with Council's key performance objectives.

At Source

Rain Water Tanks – The roof runoff for each of the future apartment buildings will be captured by a rainwater tank, where the stormwater will receive at source treatment via a first flush system. The rainwater tank used within the MUSIC model has been modelled as a 10kL tank although it is noted that this is the minimum required size and the architects may specify a larger tank.

The re-use values were calculated based on Table 6.2 of the NSW MUSIC Modelling Guidelines. Water reuse was calculated for toilets and washing machine use, based on an average of 2.35 occupants per dwelling. This resulted in a water re-use value of 124 litres/day/dwelling – a total of 16.12kL per day between the 130 apartments. It is noted that this was split between the two proposed tanks.

An extract of Table 6.2 from the NSW Music Modelling guidelines has been provided below.

Table 6-2 Typical Water Demands for Multi-residential Dwellings (derived from data provided by Sydney Water, 2015)

Water Use	Multi-residential dwellings (litres/day/dwelling)				
	Number of occupants				
	1	2	2.35	3	4
Indoor Uses					
Toilets	27	54	63	81	108
Toilets + Washing Machine	53	105	124	158	210
Toilets + Washing Machine + Hot Water	101	202	238	304	405
All uses	157	315	370	472	629
Outdoor Uses					
All uses	88	88	88	88	88

Litter Basket – It is proposed to locate a 200µm ECOSOL litter basket, or approved equivalent, within all stormwater pits located within the northern open space catchment as well as all pits located within the proposed driveway. The litter basket allows for flows from minor storm events to be treated whilst providing a high flow bypass for the major storm events to minimise the potential for blockages.

Jellyfish – It is proposed to provide Stormwater 360 Jellyfish structures prior to discharging to the existing stormwater systems.

5.2 MODELLING

The water quality model adopted for this investigation is MUSIC (Model for Urban Stormwater Improvement Conceptualisation), which was developed by the CRC for Catchment Hydrology (CRCCH). MUSIC is suitable for catchment areas from 0.01km^2 to 100km^2. The modelling approach is based on continuous simulation, operating at time steps to match the scale of the catchment and treatment devices. The adopted time step for this investigation was six (6) minutes.

The MUSIC model can be seen in **Appendix B**.

5.2.1 MUSIC inputs

Rainfall

In accordance with Section 3.1.1 of the Northern Beaches Council MUSIC modelling guidelines, rainfall data from Sydney Observatory Hill weather station, for the period of 1981-1985 was adopted for the MUSIC model.

Evapotranspiration

The Average Sydney Potential Evapotranspiration (PET) data used within the MUSIC was also adopted form the Northern Beaches Council MUSIC modelling guidelines. A Copy of the PET data can be seen below.

Table 3: Monthly Evapotranspiration for Sydney Region

Month	J	F	M	A	M	J	J	A	S	O	N	D
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

Pollutant Loads

Pollutant loads for the multiple different source nodes were adopted from the Northern Beaches Council MUSIC modelling guidelines.

Source Nodes

Separate source nodes were set up in order to accurately represent each catchment. The proposed site was split into three (3) separate catchment types, being roof areas, residential mixed areas and paved areas.

It is noted that the eastern portion of the site is not proposed to be modified for the proposed development and as such, it has not been considered in the MUSIC modelling. It has been assumed that the Pacific Lodge building drains to the West and has therefore been included in the Western catchment.

A summary of the catchment areas can be seen in **Table 9** overleaf, whilst the catchments can be seen in **Exhibit 3**.

Table 9: Catchment Areas

Catchment	Total Area (ha)	Impervious Area (ha)	Pervious Area (ha)
Roof A	0.198	0.198	0
Roof B	0.082	0.082	0
Roof C	0.178	0.178	0
Driveway (Treated)	0.029	0.029	0
Driveway (Untreated)	0.008	0.008	0
Driveway Upstream	0.123	0.023	0.1
West	0.171	0.021	0.150

Results

A summary of the MUSIC modelling results can be seen below in **Table 10**. **Table 10** shows the pollutant loads leaving the developed site with and without the proposed pollutant control measures.

Table 10: Total Pollutant Loads and Reductions (Northern catchment)

Concentration Parameter (kg/yr)	Post Development No Control	Post Development Treated	% Reduction	% Reduction Target
TSS	256	29.4	88.5	85
TP	0.735	0.253	65.6	65
TN	7.2	3	58.3	45
GP	82.1	0.159	99.8	90

From **Table 10**, it can be seen that the proposed treatment train for the northern catchment effectively treats the runoff leaving the site and not only meets, but exceeds the targets set by council.

Table 11: Total Pollutant Loads and Reductions (Southern catchment)

Concentration Parameter (kg/yr)	Post Development No Control	Post Development Treated	% Reduction	% Reduction Target
TSS	135	13.3	90.1	85
TP	0.632	0.214	66.2	65
TN	8.19	3.34	59.2	45
GP	90.7	0.027	100	90

From **Table 11**, it can be seen that the proposed treatment train for the southern catchment effectively treats the runoff leaving the site and not only meets, but exceeds the targets set by council.

6.0 Erosion and Sedimentation Control

Erosion and sedimentation control measures are required during the construction phase of the project to ensure only clean run off enters the downstream receiving waters. A suitable erosion and sedimentation control plan should incorporate a range of controls to ensure the site is adequately protected during construction.

It is noted that the erosion and sedimentation control plan included with this report is indicative only and the contractor will be required to prepare a detailed plan prior to construction commencing.

Refer to **Exhibit 4** for an erosion and sedimentation control plan.

7.0 Conclusion

This Stormwater Management Strategy has been prepared to accompany the DA plans and documentation to provide evidence that all stormwater requirements within Northern Beaches Council specifications are met for the proposed development.

Drains modelling was undertaken to analyse the existing and proposed catchments to determine the quantity of detention storage needed to meet the requirements of Northern Beaches Council.

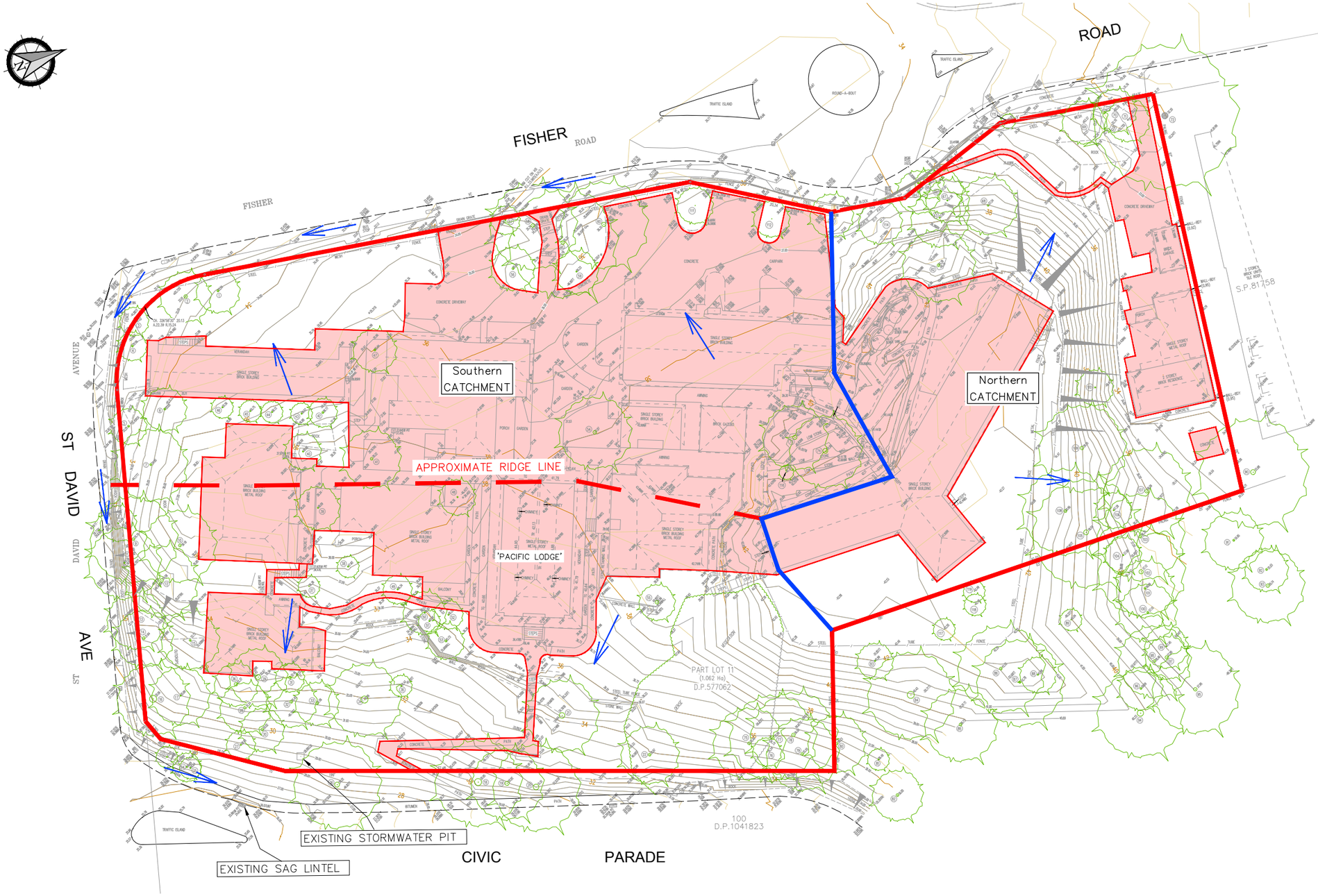
A water quality analysis was undertaken using the MUSIC program, to determine the water quality controls required in order to meet Council's standards. It was determined that the proposed treatment train of rainwater tanks, litter baskets and Jellyfish filters would provide adequate treatment to meet and exceed the pollutant reduction targets set out by Council.

A suitable erosion and sedimentation control plan has been incorporated with a range of controls to ensure the site is adequately protected during construction. This plan ensures that only clean run off enters the downstream receiving waters.

This report indicates that, from a stormwater management perspective, the development should be approved.

Exhibits

190401-EX-001-D



EXISTING SITE PLAN

SCALE 1:300

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

EXHIBIT 1 - EXISTING SITE

location: FISHER ROAD, DEE WHY

council: NORTHERN BEACHES

dwg ref: 190401E-EX-001

client: HAMPTONS BY ROSE

adw johnson

central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411

www.adwjohnson.com.au

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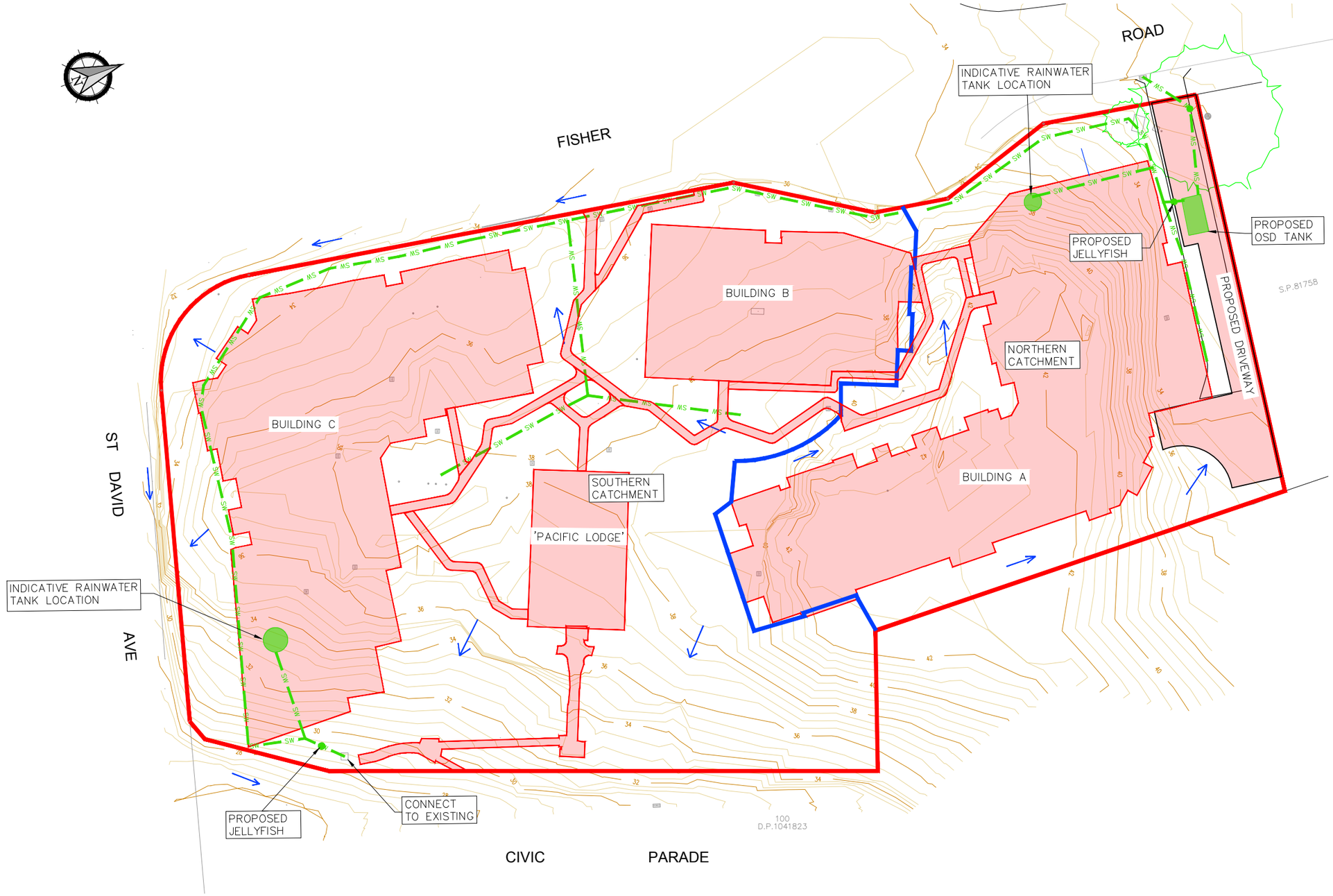

LEGEND

- SITE BOUNDARY
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- SW — PROPOSED STORMWATER
- IMPERVIOUS AREAS
- CATCHMENT BOUNDARY
- FLOW DIRECTION

CONTOUR INTERVAL: 0.5m

NOTE: –

1. BUILDING B TO DRAIN TO RAINWATER TANK LOCATED IN BUILDING C.
2. SW LAYOUT INDICATIVE ONLY. FINAL LAYOUT TO BE DETERMINED AT DETAIL DESIGN STAGE.

PROPOSED DEVELOPMENT

SCALE 1:300

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title: EXHIBIT 2 - PROPOSED DEVELOPMENT

location: FISHER ROAD, DEE WHY

council: NORTHERN BEACHES

dwg ref: 190401E-EX-002

client: HAMPTONS BY ROSE

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
www.adwjohnson.com.au

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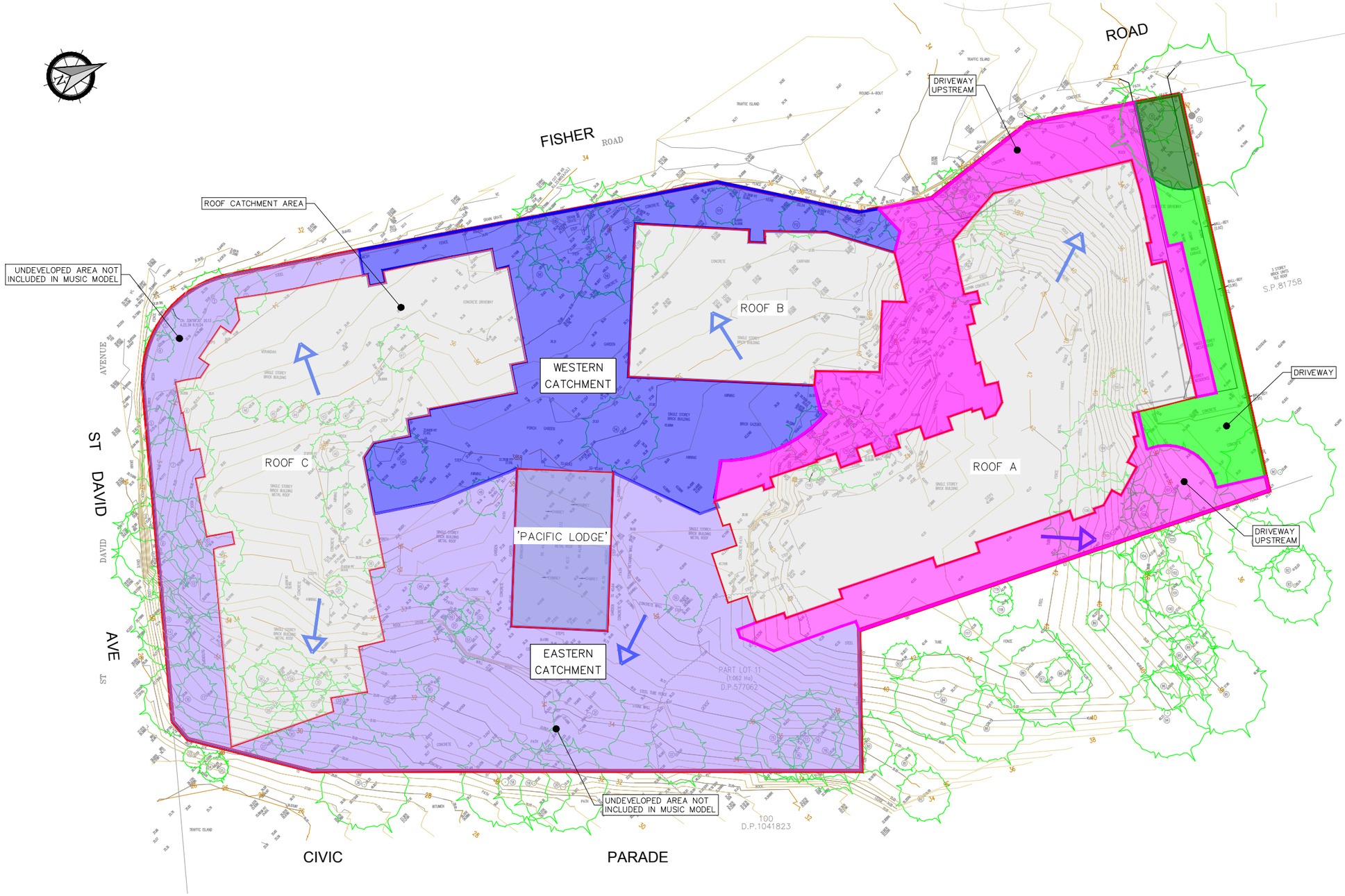
190401-EX-003-D



LEGEND

- LOT BOUNDARY
- DRIVEWAY CATCHMENT
- DRIVEWAY UPSTREAM CATCHMENT
- DRIVEWAY UNTREATED
- WEST CATCHMENT
- EAST CATCHMENT
- ROOF CATCHMENT
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE

CONTOUR INTERVAL: 0.5m

EXISTING SITE PLAN

SCALE 1:300

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
D	21.02.19	CLIENT AMENDED	GH	IB	DATUM: N/A CONTOUR INTERVAL: N/A	0 6.0 12.0 15.0m SCALE: 1:300 (FULL)	

drawing title:

EXHIBIT 3 - MUSIC CATCHMENTS

location: FISHER ROAD, DEE WHY

council: NORTHERN BEACHES

dwg ref: 190401E-EX-003

client: HAMPTONS BY ROSE

adw johnson

central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411

www.adwjohnson.com.au

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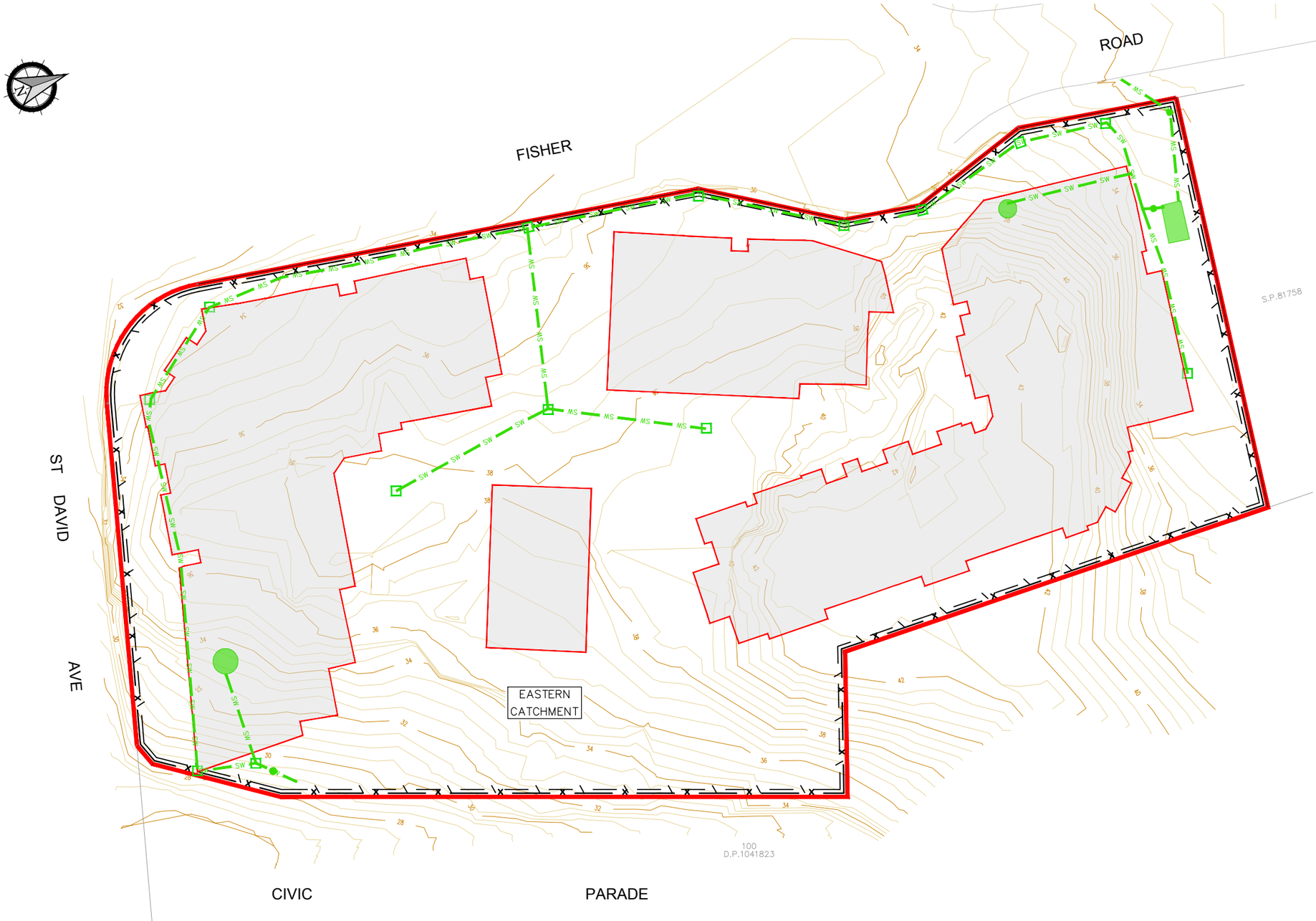


LEGEND

- LOT BOUNDARY
- PROPOSED STORMWATER
- SILT FENCE
- NO GO FENCING
- PIT INLET CONTROLS
- PROPOSED BUILDINGS
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE

CONTOUR INTERVAL: 0.5m

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
D	21.02.19	CLIENT AMENDED	BM	IB	DATUM: N/A CONTOUR INTERVAL: N/A	0 6.0 12.0 15.0m SCALE: 1:300 (FULL)	

drawing title:
EXHIBIT 4 - EROSION & SEDIMENT CONTROL PLAN

location: FISHER ROAD, DEE WHY

council: NORTHERN BEACHES

dwg ref: 190401E-EX-004

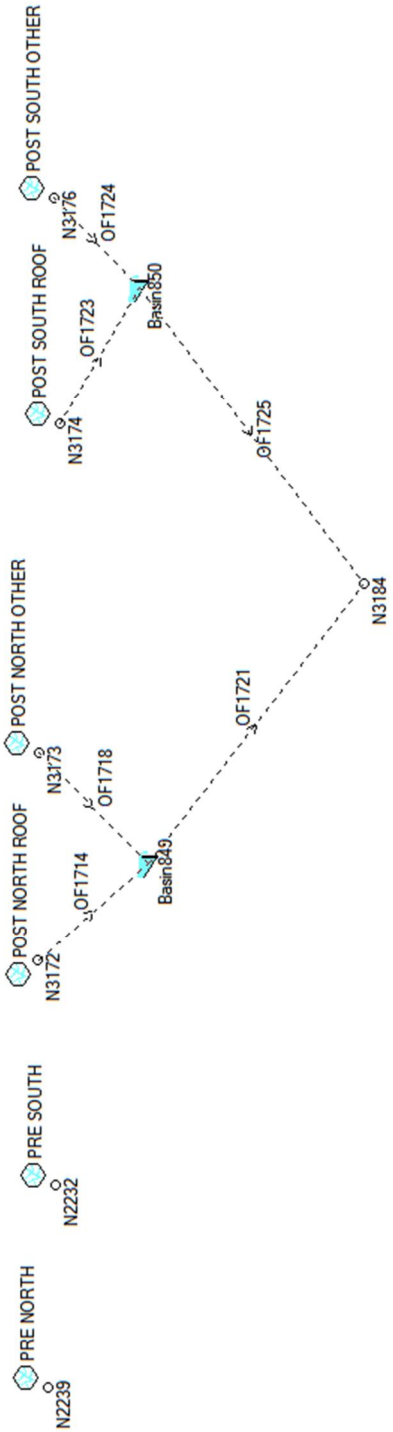
client: HAMPTONS BY ROSE

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
www.adwjohnson.com.au

working beyond expectations

Appendix A

DRAINS MODEL



Appendix B

MUSIC MODEL