infrastructure & development consulting

Vacy Village South – Stage 5

DA Stormwater Management Report

March 2026

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1 Introduction

Infrastructure & Development Consulting (IDC) have been commissioned by Cornish Group to prepare a stormwater management strategy for the proposed residential subdivision at Vacy, known as Vacy Village South – Stage 5. This report will be lodged with Dungog Shire Council (Council) to support the Development Application (DA) and outlines the modelling procedures and outcomes for stormwater and infrastructure management strategies for the site.

The results as outlined in this report and documented on the IDC drawings address the following items:

- Review of existing stormwater conditions;
- Design of a stormwater quantity strategy to convey flows to appropriate discharge points;
- Assessment of overland flow safety;
- Design of a stormwater quality strategy to ensure pollutants discharged from site do not exceed existing conditions; and
- Measures to achieve Council's water quantity and quality objectives.

2 Site Description

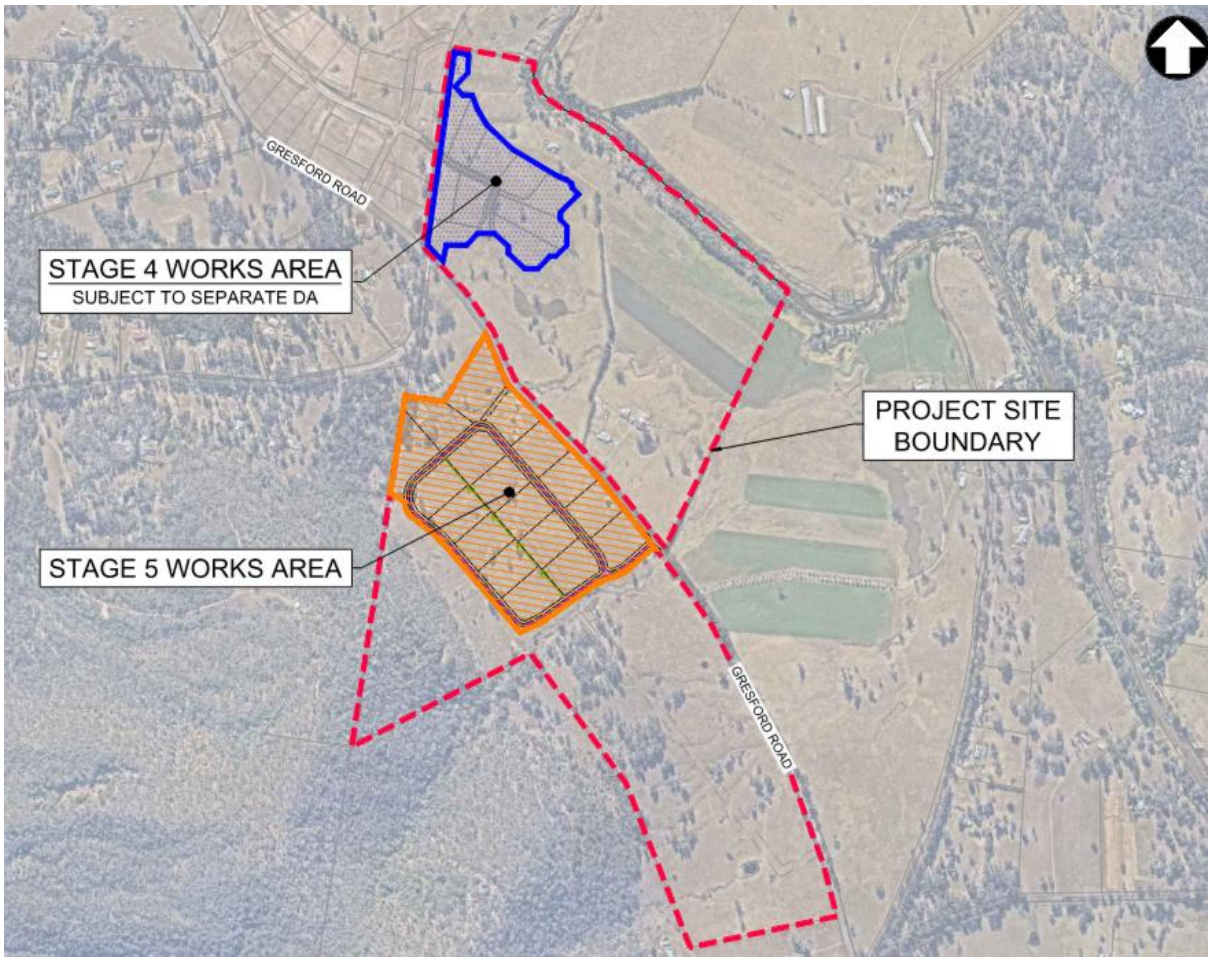
Site Location

The subject site is located at 598 Gresford Road, Vacy, within the Dungog Shire Local Government Area, approximately 40 km north-east of Maitland in the Hunter Region of New South Wales. Vacy is a small rural village situated along the Paterson River valley and is characterised by low-density residential development, rural residential lots, and surrounding agricultural and environmentally sensitive lands.

2.1

The site forms part of the broader Vacy Village South subdivision and is legally described as Lot 123 DP1063557. The land is zoned R5 Large Lot Residential under the Dungog Local Environmental Plan, with areas of adjoining land zoned for environmental protection. The Stage 5 works represent a continuation of the approved staged subdivision pattern extending south of Gresford Road.

Figure 1 - Site Location



Source: Nearmap Imaging 2024

Proposed Subdivision Layout

The proposed Stage 5 subdivision comprises the creation of 18 rural residential lots and an associated road network within the southern portion of the broader Vacy Village South landholding.

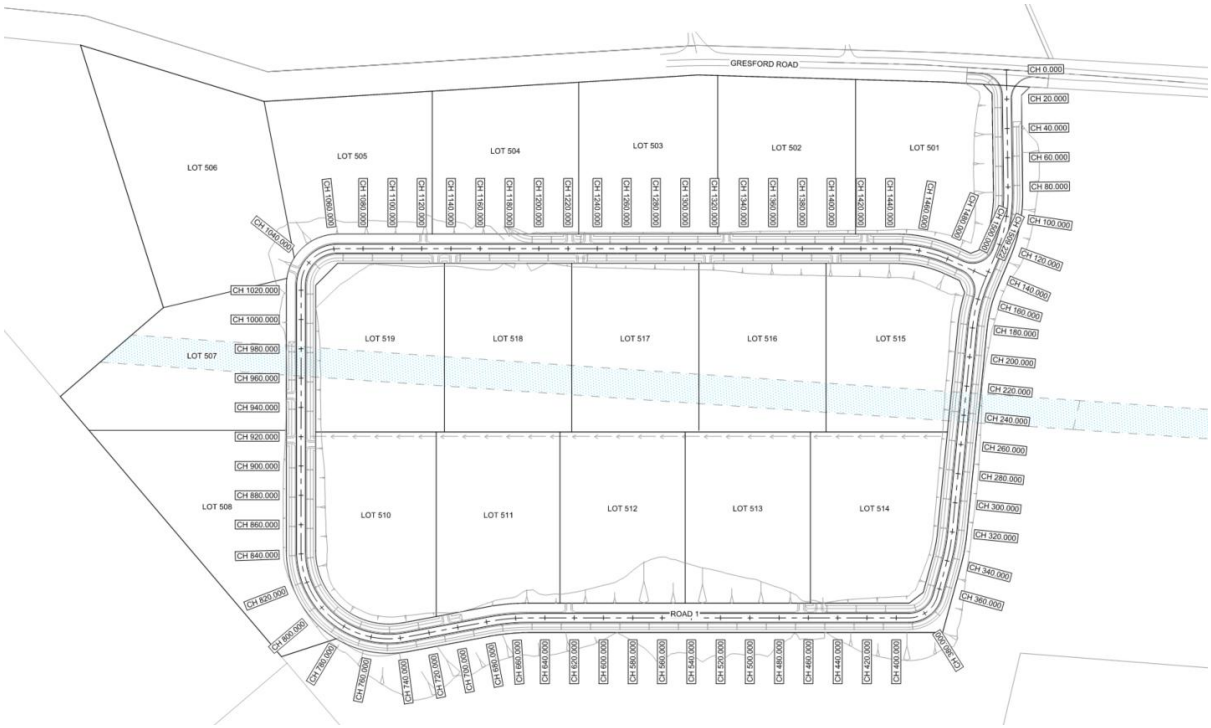
2.2 The proposed lots generally range in area from approximately 1 to 1.6 hectares, consistent with the R5 Large Lot Residential zoning and the established development pattern within Vacy Village South. Each lot is intended to accommodate a single, rural residential dwelling and associated ancillary development.

Vehicular access to the Stage 5 development is provided via a connection to the existing Gresford Road. The proposed road layout forms a looped internal access arrangement, improving connectivity and emergency access while minimising additional direct access points to Gresford Road.

The internal road is designed with open table drains along the verges, which form an integral part of the stormwater management system. Driveway crossings are provided to all lots to maintain uninterrupted drainage along the table drains. Flows from the northern portion of the site are conveyed to a culvert proposed underneath the northeastern portion of the road network and are discharged to an existing, local watercourse. Flows from the southern part of the site (from the portion of road connecting to Gresford Road) are conveyed toward a culvert and level spreader and discharged as controlled sheet flow to downstream areas, consistent with the existing drainage regime.

An existing overhead electrical transmission easement traverses the site generally in an east–west direction. The easement is retained within the subdivision layout and imposes constraints on the placement of buildings, structures, and certain vegetation in accordance with the requirements of the relevant authority. As such, no formal drainage infrastructure has been proposed within this easement.

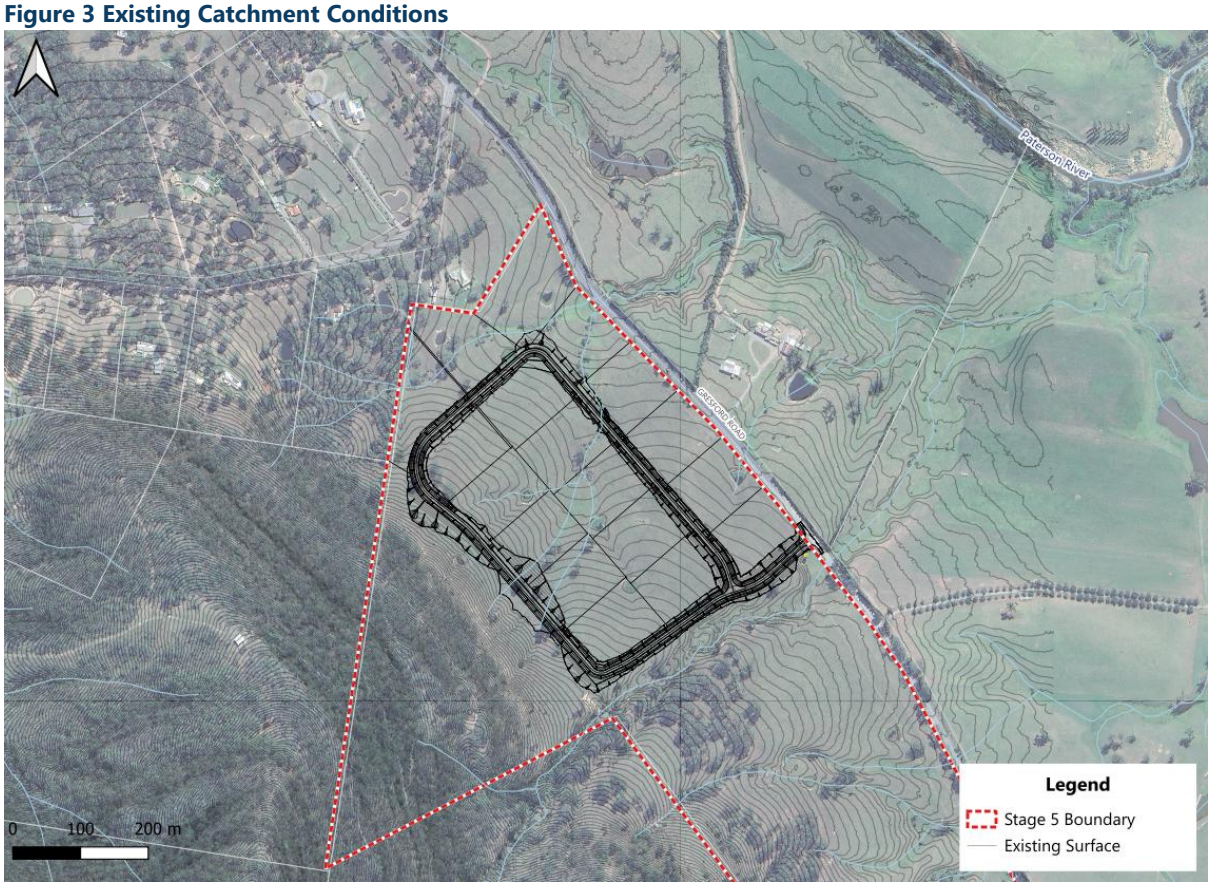
Figure 2 - Proposed Development (Easement shown in blue)



2.3 Catchment Characteristics

The Stage 5 site is characterised by gently undulating topography with surface runoff primarily draining to the northeast. Under existing conditions, runoff is conveyed via shallow overland flow paths and natural depressions toward the downstream receiving streams. These drainage characteristics are largely retained in the proposed development, with the subdivision layout and stormwater infrastructure designed to align with the existing catchment behaviour.

Figure 3 Existing Catchment Conditions



3 Stormwater Management

This section outlines the proposed stormwater management approach for Vacy Village South Stage 5, addressing both water quantity and water quality considerations in accordance with Council and NSW Government requirements. The strategy has been developed to manage post-development stormwater runoff in a manner that reflects existing site conditions, maintains downstream drainage behaviour, and avoids adverse impacts to adjoining land.

The stormwater management strategy has been informed by detailed hydrological modelling (DRAINS) and water quality modelling (MUSIC) undertaken specifically for the Stage 5 works and is supported by the proposed civil design and engineering drawings prepared by IDC.

3.1 Objectives

The key objectives of the stormwater management strategy for the Stage 5 development are to:

- Safely convey stormwater runoff generated within the development during both minor and major storm events;
- Maintain post-development flow paths and runoff characteristics consistent with existing site conditions;
- Ensure that stormwater infrastructure within the road reserve operates safely and efficiently;
- Ensure that existing flow conditions are not worsened;
- Achieve a neutral or beneficial impact on downstream water quality; and
- Comply with the requirements of Dungog Shire Council, Australian Rainfall and Runoff and relevant NSW stormwater guidelines.

3.2 Methodology

The stormwater management strategy for Stage 5 has been designed to manage runoff in a manner consistent with the existing site conditions. Existing catchment behaviour is retained by aligning drainage infrastructure with the natural topography.

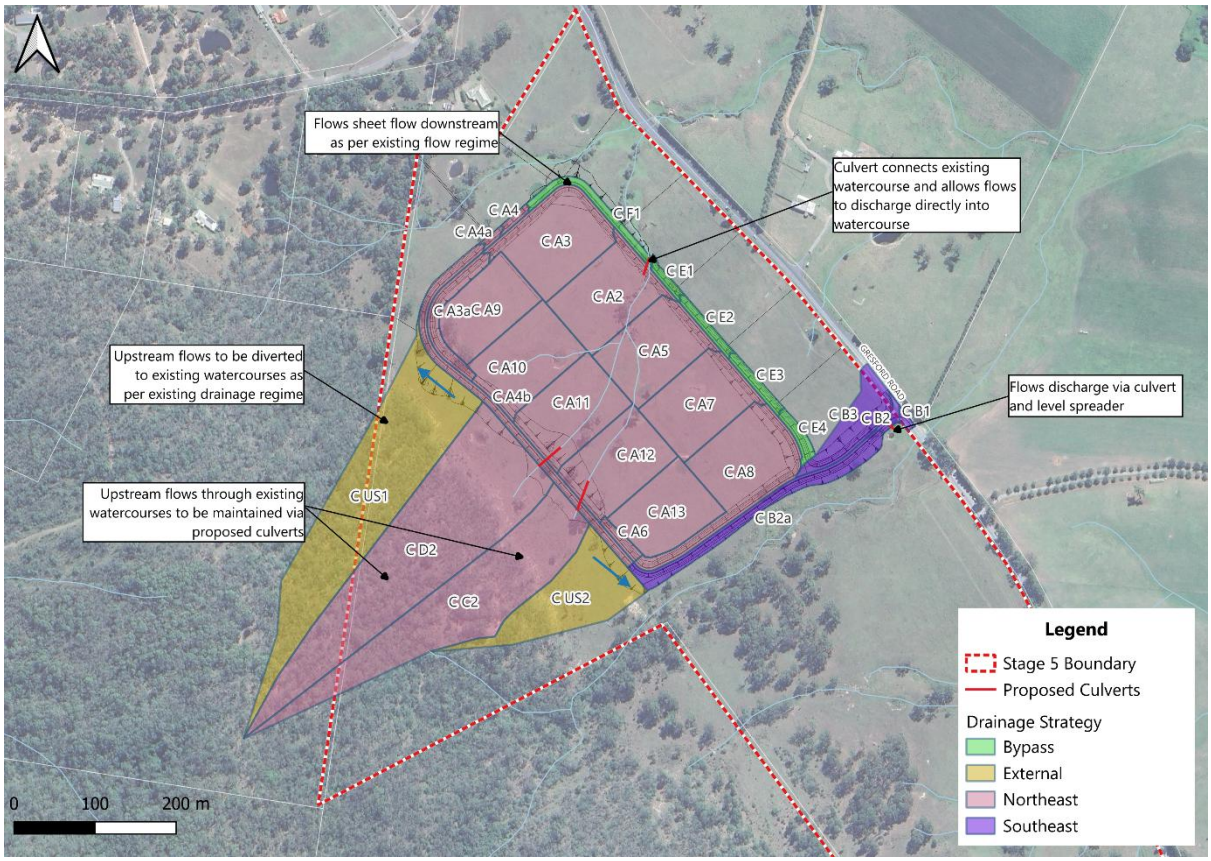
Runoff from site is collected via open table drains located within the road verge and conveyed along the road reserve in accordance with the natural site grades. For the northern portion of the site, flows are discharged from site via culvert to an existing, local downstream watercourse located near the northeastern side of the site. Flows then continue downstream to an existing headwall and culverts under Gresford Road. For the portion of road that connects directly to Gresford Road, stormwater is discharged via culvert and level spreader to promote overland sheet flow rather than concentrated point discharges. This stormwater management strategy reduces erosion potential and maintains downstream flow behaviour consistent with pre-development conditions. Flows that do not drain to the proposed table drains sheet flow downstream, as per the existing flow regime.

Upstream catchments have also been considered to ensure that the proposed drainage infrastructure is appropriately sized and that the existing drainage regime is generally maintained throughout the development. Upstream catchments draining to the northwest/southeast are

diverted to existing downstream watercourses, as per the existing flow regime, via proposed table drains. The detailed sizing of these drains are to be confirmed in future design stages. Upstream catchments that drain northeast are directed into the site via table drains and culverts, before discharging downstream to the proposed culvert near the northeastern side of the site.

The proposed drainage strategy is shown in Figure 4 below:

Figure 4 Proposed Drainage Strategy



On-lot rainwater tanks and grassed road table drains are incorporated within the development to reduce runoff volumes and provide water quality benefits (to be discussed in further detail in a later section of this report).

3.3 No formal stormwater drainage infrastructure is proposed within the existing overhead electrical transmission easement, with all stormwater management infrastructure confined to the road reserve and developed areas of the site.

Design Standards and Models

Stormwater quantity and quality outcomes have been assessed using industry-standard modelling tools, as summarised below:

- DRAINS hydrological modelling has been undertaken to assess peak flows, drainage capacity, and surface flow behaviour for both minor and major storm events;
- MUSIC modelling has been undertaken to assess pollutant generation and treatment performance for the developed site compared to existing conditions.

The modelling has been undertaken in accordance with the following standards and guidelines:

- Australian Rainfall and Runoff (2019);
- Managing Urban Stormwater: Soils and Construction (2004);
- Environmental Planning and Assessment Act (1979);
- NSW MUSIC Modelling Guidelines (2015);
- Dungog Development Control Plan (2004); and
- Dungog Local Environment Plan (2014).

Further detail on the modelling inputs, assumptions, and outcomes are provided in Sections 5.2 and 0 of this report.

4 Data

Topography

Topographic information for the site was derived from a combination of NSW Government Spatial Services LiDAR data and a detailed topographical survey prepared by Premise (Registered Surveyor) as part of the Stage 5 Plan of Subdivision.

4.1 The Premise survey provides a higher level of detail and accuracy across the proposed Stage 5 works area, including spot levels, contours, existing features, and site constraints, and has been used to inform the detailed civil design and stormwater modelling for the development.

The use of this survey data ensures that the proposed stormwater management strategy is based on an accurate representation of existing ground conditions within the Stage 5 site.

Rainfall Data

4.2 The design intensity-frequency-duration rainfall data was obtained from the BoM portal (Design Rainfall Data System 2016). Refer to Table 1 below for rainfall data.

Table 1 – Rainfall Intensity Data

Duration	10 year (mm/h)	100 year (mm/h)
5 min	151	246
10 min	120	198
15 min	101	166
20 min	86.8	143
25 min	76.7	126
30 min	68.9	113
45 min	53.5	87.5
1 hour	44.3	72.3
1.5 hours	33.8	55.0
2 hours	27.8	45.3
3 hours	21.3	34.6

Source: BoM portal (Design Rainfall Data System 2016)

5 Stormwater Management Strategy

Sediment & Erosion Control

Prior to any works commencing on site, erosion and sediment control measures will be put in place generally in accordance with *Managing Urban Stormwater: Soils and Construction 4th Edition March 2004*. These measures include:

5.1

- Installation of a 1.8m high chain wire fence covered with geotextile fabric to the perimeter of the work site area;
- A sediment basin situated towards the low point of the site for the collection of stormwater runoff during construction;
- The use of appropriate sediment diverting methods to minimise sediment in Council's stormwater drainage network/local watercourses;
- Locations for temporary stockpiling;
- Provision of a temporary truck wash down facility for vehicles exiting the site during construction.

Refer to the Sediment and Erosion Control Plan prepared by IDC for details.

Water Quantity Management

5.2

5.2.1 Design ARI

The stormwater drainage system for the Stage 5 site has been designed to convey minor storm flows associated with the 10-year Average Recurrence Interval (ARI) event within the proposed drainage infrastructure, while safely managing major storm flows associated with the 100-year ARI event with controlled overland flow paths. As such, overland flow paths are to be designed so that the maximum velocity-depth product shall not exceed $0.4m^2/s$ for pedestrian accessible areas and $0.6m^2/s$ for areas designated for vehicular use, in accordance with standard engineering practice.

This approach is consistent with Dungog Shire Council requirements and standard practice for rural residential subdivisions.

5.2.2 Catchment Areas & Proposed Land Use

Sub-catchments for the Stage 5 site were delineated based on the proposed civil road and stormwater drainage network, as well as the existing landform. The proposed road network has been used as a guide to orientate flows through the site. This allowed for the appropriate catchment areas to be directed to suitable outlets. The catchments across the site are shown in the figure and table below:

Figure 5 Post-Developed DRAINS Catchments

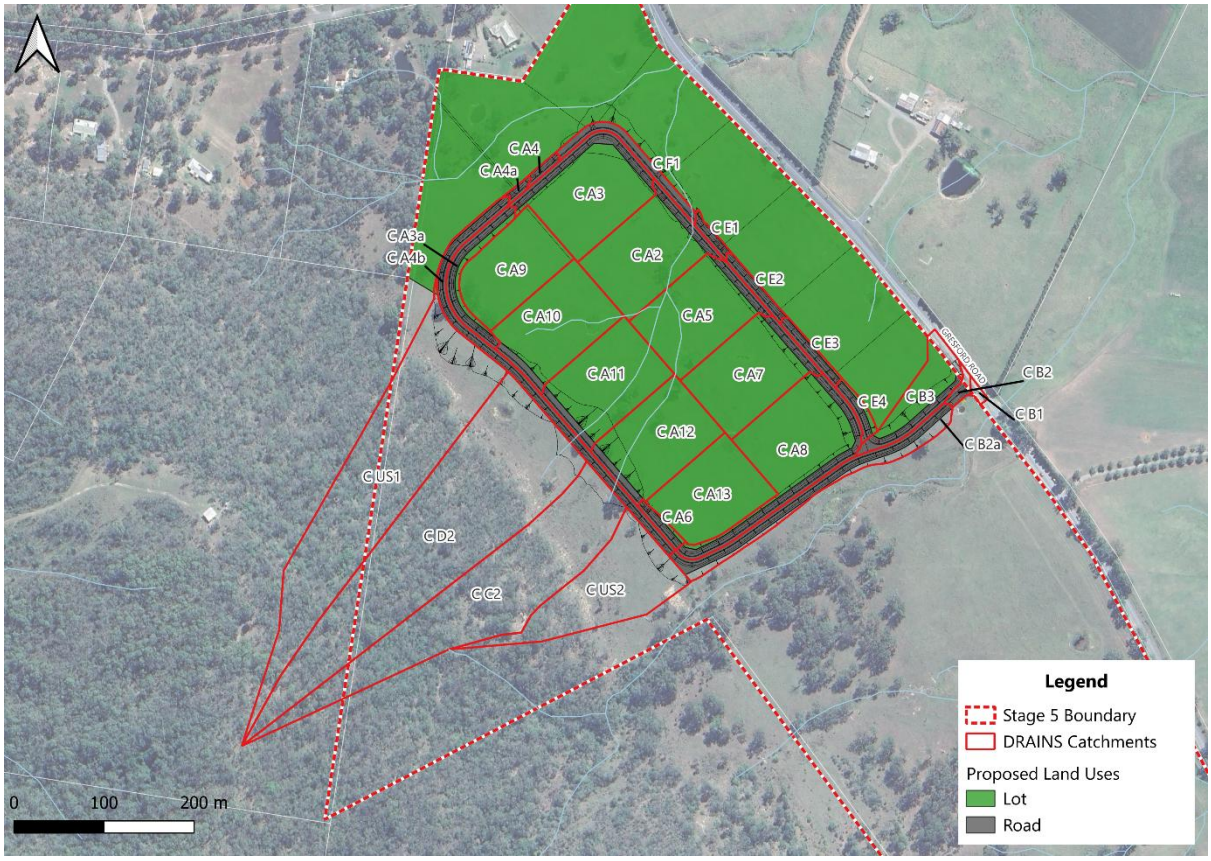


Table 2 Post-Developed DRAINS Catchment Areas

Catchment Name	Area (ha)
C A2	1.11
C A3	1.23
C A3a	0.30
C A4	0.04
C A4a	0.03
C A4b	0.54
C A5	1.08
C A6	0.08
C A7	1.09
C A8	1.37
C A9	0.92
C A10	1.08
C A11	1.08
C A12	1.08

C A13	0.95
C B1	0.03
C B2	0.06
C B2a	0.57
C B3	0.52
C C2	2.59
C D2	3.95
C E1	0.06
C E2	0.10
C E3	0.11
C E4	0.10
C F1	0.21
C US1	3.32
C US2	1.28
Total	**24.88**

It should be noted that the proposed Stage 5 development only consists of the proposed road network and subdivided lots. It is assumed that these lots will remain as per existing conditions at the time of development.

5.2.3 Impervious Fraction

Currently, the Stage 5 site is greenfield land, consisting primarily of grassed surfaces and trees. As such, the impervious fractions across the development have been calculated based on the proportion of proposed road area present within each catchment. This ensures that site conditions are accurately reflected.

5.2.4 Hydrological Model (DRAINS)

A hydrological model was developed using the DRAINS/RAFTS software package to assess runoff behaviour and drainage performance for the post-development scenario.

The model was developed using catchment areas, overland flow paths, headwalls, pits, culverts, and rainfall data representative of the Stage 5 subdivision layout. Upstream contributing catchments were included as part of the DRAINS assessment, with the flows from these catchments maintained as per the existing drainage regime. It should be noted that upstream catchments that are diverted, via table drains, to existing watercourses outside of the site (i.e.: catchments US1 and US2) have not been included in the DRAINS model. The sizing of these table drains are to be confirmed in future design stages.

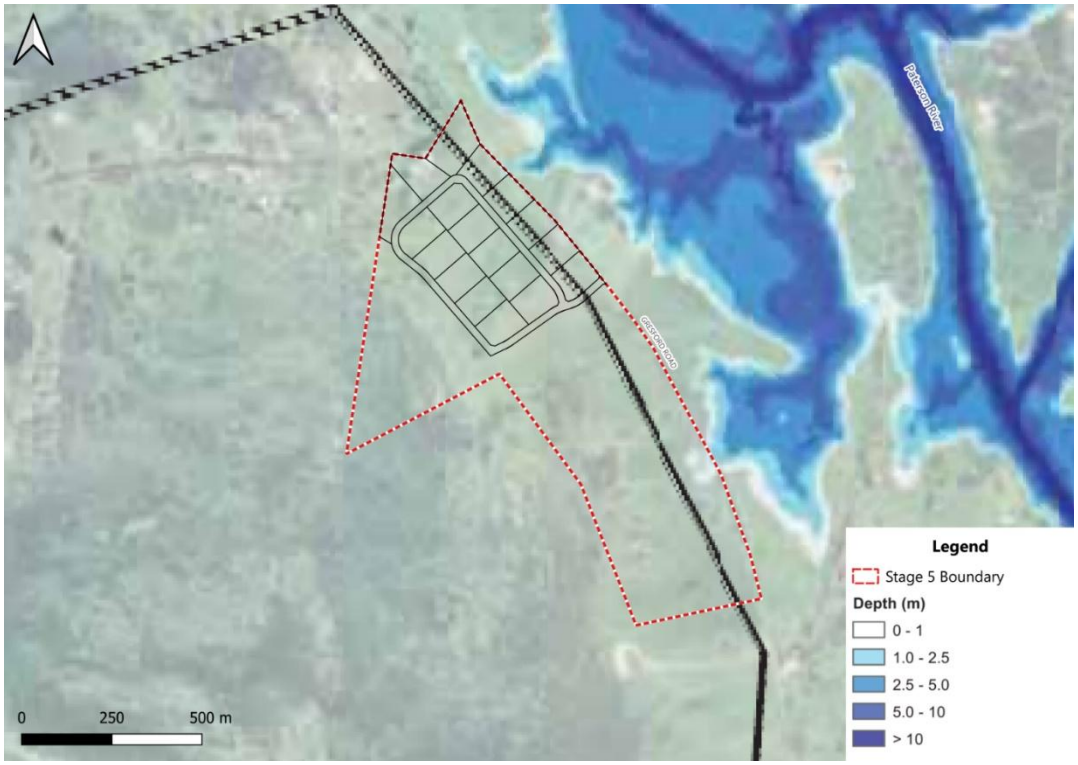
Most of the flows from site are directed to table drains and culverts within the road reserve and then discharged to one of the following points:

- Flows from the southeastern side of the site (i.e.: the portion of road that directly connects to Gresford Road) are discharged via a DN525 culvert and level spreader and sheet flow downstream as per existing conditions;
- Flows from the northern side of the site discharge via 2 x 1.2m (W) x 0.9m (H) reinforced concrete box culverts. These culverts also ensure that the connection between the upstream and downstream ends of the existing watercourse is maintained.

The remainder of the flows from site discharge downstream as per existing conditions.

Based on Council's *Paterson River Flood Study* (by WMAWater), the Stage 5 site is unaffected by flooding during the 1% AEP flood event, as shown in the figure below:

Figure 6 1% AEP Existing Flood Extents & Depth



Source: Paterson River Flood Study, WMAWater (2017)

As such, tailwater conditions at the downstream discharge locations were set to the proposed culvert obverts to ensure that downstream constraints were appropriately accounted for in the assessment.

Refer to the IDC drawing set for further details.

Figure 7 - Proposed DRAINS Model

5.2.5 DRAINS Results

The DRAINS modelling confirms that the proposed table drain and culvert network provide adequate capacity to convey minor storm flows without surcharge. During major storm events, overland flows are safely contained within the road reserve and follow defined surface flow paths consistent with the existing drainage regime.

The modelling demonstrates that peak post-development overland flows are safely conveyed through the site and that the stormwater system performs in accordance with Dungog Shire Council requirements for both minor and major storm events. No adverse impacts to adjoining properties or downstream drainage systems are predicted as a result of the proposed development.

Water Quality Management

Water quality management for the Stage 5 development has been designed to achieve a neutral or beneficial impact on downstream water quality when compared to existing conditions. The strategy incorporates a combination of source control, treatment within conveyance elements, and passive treatment prior to discharge from site.

5.3

The approach reflects the low-density rural residential nature of the development and avoids reliance on large treatment devices, instead utilising distributed treatment measures integrated into the subdivision layout.

5.3.1 MUSIC Modelling

Water quality modelling was undertaken using the MUSIC software package to compare pollutant loads generated under existing and post-development conditions. Separate models were developed to represent the pre-development site and the developed Stage 5 layout.

Catchments across the site were delineated based on the existing surface, proposed site grading strategy, as well as the proposed stormwater and water quality treatment strategy. The sub-catchments adopted for MUSIC modelling are shown in the table and figure below:

Table 3 - MUSIC Sub-Catchment Summary

MUSIC Sub-Catchment	Area (Ha)
M01a	0.79
M01b-1	0.66
M01b-2	0.48
M01c	0.62
M02a	2.02
M02b	8.27
M03	5.21
M04	3.92
Total	**21.96**

Table 4 Proposed MUSIC Catchments

Catchments were then separated into "Road", "Roof" and "Lot" areas as per the latest lot layout for the site and assuming a proposed dwelling roof area of 375m^2 for each lot:

Table 5 - MUSIC Catchment Land Use Breakdown

Sub-Catchment	Land Use Summary (Ha)			
	Roof	Lot	Road	Total
M01a	-	-	0.79	**0.79**
M01b-1	-	-	0.66	**0.66**
M01b-2	-	-	0.48	**0.48**
M01c	-	-	0.62	**0.62**
M02a	0.08	1.95	-	**2.02**
M02b	0.30	7.72	0.24	**8.27**
M03	0.19	4.86	0.16	**5.21**
M04	0.11	3.75	0.05	**3.92**
Total	**0.68**	**18.28**	**3.00**	**21.96**

The impervious area for the different land use types have been set as follows:

Table 6 Land Use Impervious/Pervious Area

Land Use	Impervious %	Pervious %
Roof	100	0
Lot	0	100
Road	45	55

The impervious area for the 'road' land use type has been derived based on the designed road cross sections proposed for the Stage 5 site (see civil drawings C150 – C151), to allow for a more realistic representation of the development. The carriageway is the only impervious portion of the road reserve and encompasses an area of 1.22ha across the development site. The total footprint area of the proposed road reserve is 3ha. As such, the impervious portion of the road reserve is 41% - this has been rounded up to 45% as a conservative measure within the MUSIC model.

A Geotechnical Investigation and Effluent Disposal Report has been completed by Douglas Partners for Vacy Village (*Report on Geotechnical Investigation and Effluent Disposal Assessment Proposed Subdivision - Stage 1,* File Name: 91432.00.R.001.Rev0), which is located approximately 550m northwest of the development site. This report has described the topsoil within the area as primarily being silty clay. Additionally, NSW eSPADE describes the soil within the vicinity of the site as being fine sandy clay loam/clay loam sandy. As such, the soil characteristics of a "sandy clay loam" soil have been adopted from the *NSW MUSIC Modelling Guidelines* (2015). These are shown below:

Table 7 - MUSIC Soil Parameters

Soil Properties	Value
Rainfall Threshold (mm/day)	Lot – 1.0 Roof – 0.3 Road – 1.5
Soil Storage Capacity (mm)	108
Initial Storage (% of capacity)	25
Field Capacity (mm)	73
Infiltration coefficient "a"	250
Infiltration coefficient "b"	1.3
Initial depth (mm)	10
Daily recharge rate (%)	60
Daily base flow rate (%)	45
Daily deep seepage rate (%)	0

The pollutant concentration parameters used within the model were based on the *NSW MUSIC Modelling Guidelines* (2015), as per the site classifications, which are summarised in the following table:

Table 7 - MUSIC Node Classification

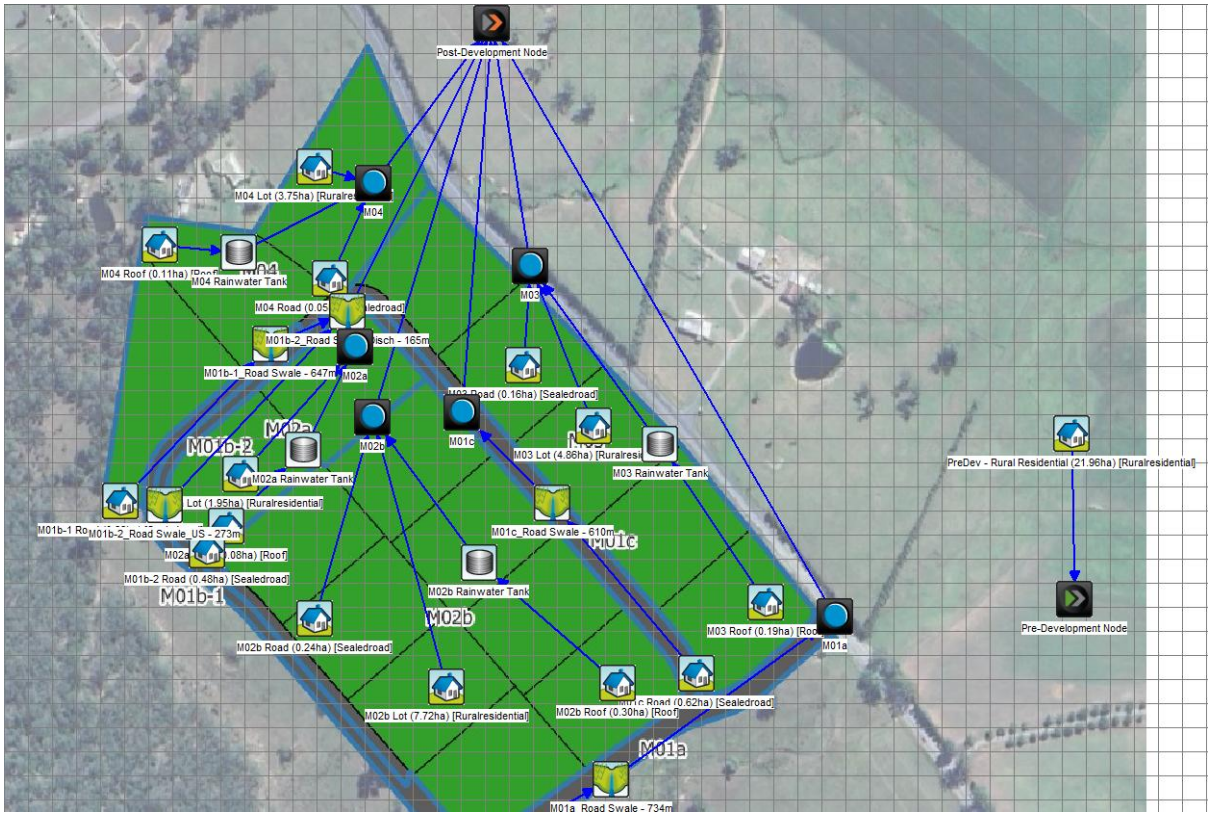
MUSIC Node	Classification
Roof	"Roofs"
Road	"Sealed Road Pavement"
Lot	"Rural"

5.3.2 Water Quality Treatment Train

The proposed water quality treatment train is described and shown in the figure below:

- Runoff from dwelling roofs on each lot will be captured by rainwater tanks for external, domestic reuse;
- Road runoff is generally treated by table drains within the road reserves;
- Lot runoff from Catchment M02a receives further treatment, as flows are directed to table drains in the road reserve;
- Flows are discharged from site as per the existing flow regime (i.e.: as overland flow or into local watercourses).

Figure 8 Pre-Development and Post-Development MUSIC Model



This distributed treatment approach is consistent with current best practice for rural residential developments and minimises maintenance requirements.

Rainwater Tanks

The following assumptions were made for the rainwater tanks in developing the proposed model:

- 10kL storage per lot;
- 100% of total roof area draining to tanks, with an assumed average roof area of 375m^2 per lot; and
- External re-use rate of 1,575kL/year/dwelling was developed assuming:
    - 25% of the lot area is to be irrigated;
    - Average lot size of 10,500m^2; and
    - Irrigation rate of 0.6m/year

Table 8 Rainwater Tank Volumes & Reuse

Sub-Catchment	No. of Lots/RWTs	Total RWT Volume (kL)	Daily Reuse (kL/year)
M02a	2	20	3,150
M02b	8	80	12,600
M03	5	50	7,875
M04	3	30	4,725

Table Drains/Swales

Parameters for the table drains were also adopted from the *NSW MUSIC Modelling Guidelines* (2015) and are as follows:

Parameter	Value
Base Width (m)	0
Top Width (m)	4
Depth (m)	0.5
Vegetation Height (m)	0.25
Exfiltration Rate (mm/hour)	0

Refer to the accompanying civil drawing set for table drain details.

5.3.3 MUSIC Results

The results of the MUSIC analysis are summarised in the following table:

Table 9 - MUSIC Results

Pollutant	Existing Residual Load (kg/yr)	Post-Developed Residual Load (kg/yr)	Neutral or Benefit Impact Achieved
Total Suspended Solids	3320	2720	Yes
Total Phosphorus	8.37	8.29	Yes
Total Nitrogen	82.7	82.6	Yes
Gross Pollutants	315	63.1	Yes

The MUSIC modelling indicates that the proposed stormwater treatment measures achieve a neutral or beneficial impact on downstream water quality for all assessed pollutants.

The results confirm that the combination of rainwater reuse and vegetated drainage elements effectively offsets increases in pollutant generation associated with development and satisfies relevant water quality objectives.

6 Summary and Conclusions

The proposed stormwater management strategy for Vacy Village South Stage 5 has been developed to address both water quantity and water quality outcomes for the subdivision in a manner consistent with existing site conditions and downstream drainage behaviour.

Hydrological modelling undertaken using DRAINS confirms that the proposed stormwater infrastructure, comprising open table drains, driveway crossings, culverts, and level spreaders is capable of safely conveying runoff generated during minor storm events and providing appropriate overland flow paths during major storm events. Post-development runoff is managed without adverse impacts to adjoining land or downstream receiving environments.

Water quality modelling undertaken using MUSIC demonstrates that the proposed treatment measures, including on-lot rainwater tanks and grassed table drains achieve a neutral or beneficial impact on downstream pollutant loads when compared to existing conditions.

In summary, the proposed stormwater management strategy for the Stage 5 development and is supported by detailed modelling and the associated IDC civil design documentation. The assessment confirms that the proposed works satisfy the relevant Council requirements and applicable NSW stormwater management guidelines and is considered suitable to support the Development Application.

All supporting plans and modelling files are available and referenced accordingly.