ARCADIS Design & Consultancy for natural and built assets

IRON GATES RESIDENTIAL DEVELOPMENT

Revised

Engineering Services and Civil Infrastructure Report

23 JULY 2019

GOLDCORAL PTY LTD
IRON GATES RESIDENTIAL DEVELOPMENT

Revised
Engineering Services and Civil Infrastructure Report

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REVISIONS

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04	21/07/2015	Amended to address Richmond Valley Council RFI	BF	BL
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06	10/05/2016	Amended to Include RFI Response	DC	BL
07	1/11/2018	Revised Report	GD	GD
08	23/07/2019	Final RFI Response	LP	GD

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REVISION 08

This Report was revised on 23rd July 2019 in order to Consolidate the Engineering Services Report and to include all amendments to the Report and include the additional details outlined in the response to RVC's recent Information Request dated 2nd February 2019. Below is a list of amendments and additions made to this report and the general engineering documents.

- Figure 1.1 was amended to incorporate consistent aerial images of the site.
- Section 3.2 was amended to include revised cut/fill earthworks volumes and provide clarity on expected haulage route and earthworks construction.
- Section 4 has been amended for slight changes to presentation and description of road design. Reference has been made to the separately prepared traffic engineering report.
- Section 6 has been amended for changes in presentation of outcomes of the BMT WBM OSD assessment letter.
- Section 9.1 has been amended to include a 40% duplex loading and reference to the Arcadis Water Network Capacity Assessment (Appendix G), which analyses the impact of the development on the Evans Head Water Network and shows no additional issues are caused by the development.
- Section 9.2 has been amended to include a 40% duplex loading and reference to the Arcadis Sewer Network Capacity Assessment (Appendix H), which analyses the capacity of the existing Evans Head sewer network and the future planning strategy to cater for the Iron Gates development.
- Section 9.3 has been amended to include new servicing connection locations for electrical and telecommunications reticulation.
- Section 10 has been added to address the development's flood emergency response strategy and discuss the impacts of regional flooding on the development and wider Evans Head region.
- Section 11 has been amended to include revised recommendation and outcomes of the prepared engineering material and summarise the new findings of this report.
- The Civil Engineering Drawings in Appendix A include the amendments to engineering components in accord with latest lot layout for the 184 Lot subdivision (Appendix F).
- Additional Reports have been prepared, collated and added to this report, including:
    - A Water Network Capacity Assessment in Appendix G.
    - A Sewer Network Capacity Assessment in Appendix H.
    - A Traffic Assessment Report in Appendix I.
    - The Arcadis Stage 1 Preliminary Contamination Report in Appendix J.
    - An Acid Sulphate Investigation and Soil Management Plan in Appendix K.
    - A Dewatering Management Plan in Appendix L.
    - A letter of supply for Electrical and Telecommunication in Appendix M.
    - A Site Analysis Plan and Design Response Plan in Appendix N.

1 INTRODUCTION

Arcadis has been engaged by Goldcoral Pty Ltd to prepare a revised Engineering Services and Civil Infrastructure Report for a Development Application for a total of 184 lots including 175 residential lots subdivision know as *Iron Gates,* located approximately 2km west of Evans Head.

The development involves the construction of 175 residential lots, with a minimum size of 600m^2, associated civil infrastructure such as internal roads, stormwater drainage, sewer and potable water services are also proposed. This revised report is to accompany an amendment to DA2015/0096 for the Iron Gates Residential Subdivision. This revised report deals with the engineering services and civil infrastructure component of the development and the engineering planning issues associated with the development application.

1.1 SITE DESCRIPTION

The subject site is known as *Iron Gates* and is surrounded by protected vegetation areas on the northern and eastern boundaries and the Evans River on the western and southern boundaries. The site is located over the following allotments:

- Lot 163 DP 831052, Lots 276 and 277 DP 755624, Crown Road Reserve between Lots 163 DP 831052 and Lot 276 DP 755724, Crown Foreshore Reserve and Iron Gates Drive, Evans Head NSW.

The main access to the site is via Iron Gates Drive to the east. Evans River is located directly to the south of the site. A site locality plan is shown in Figure 1-1 below.

Figure 1-1 Site Locality

The site has previously been developed with existing roads, sewer, stormwater and water infrastructure located on the site. The condition of the existing infrastructure on site is unknown however, where applicable testing will be undertaken to determine existing condition prior to Construction Certificate. The site was previously cleared in the mid 1990's however it has since been naturally vegetated.

1.2 LOT TOPOGRAPHY

The site features grades ranging from 0.5% to 11%. The eastern portion of the site is very flat and features very minimal grades of approximately 0.5%. This portion of the site features two (2) man made channels running from north to south to help facilitate flows to Evans River. A ridge is located on the western side of the site with an elevation of 22m AHD. Steep grades of approximately 11% are located in this area as the ridge flattens out to the east.

1.3 TOTAL AREA OF LAND

The total residential area of the site is approximately 18 ha.

1.4 PROPOSED DEVELOPMENT

The Iron Gates Development Proposal includes One Hundred and Eighty Four (184) Lot Subdivision including:

- One Hundred and Seventy Five (175) Residential Lots;
- Three (3) Residue Lots
- Four (4) Public Reserves
- One (1) Drainage Reserve
- One (1) Sewer Pump Station Lot
- Upgrading of Iron Gates Drive
- Demolition of Existing Structures Onsite
- Subdivision Work including road works, drainage, water supply, sewerage, landscaping and embellishment work and street tree planting

The proposed development is to feature 175 residential allotments. Allowances have been made in accordance with the North Coast Regional Plan 2036 in the Equivalent Tenement loadings for 40% of these to be duplex lots i.e. townhouses or other semi-attached dwellings. Duplex lots may not eventuate but is considered a conservative assessment of the site. The proposed development will utilise as much of the existing infrastructure as possible, including roads, stormwater, sewer and water infrastructure, pending on adequacy testing. Where necessary, existing infrastructure will be upgraded to ensure that it meets the standards of RVC and Northern Rivers Local Government (NRLG). Future infrastructure will be provided as an extension to the existing infrastructure and will be integrated into the previous existing design.

2 REFERENCE DOCUMENTS

This report should be read in conjunction with the following documents:

- Arcadis Engineering Drawings;
- Northern Rivers Local Government – Guidelines for Development and Subdivision of Land- January 2006;
- Northern Rivers Local Government – Development Construction Specification – Quality System Requirements – August 2013;
- NSW MUSIC Modelling Guidelines - August 2010;
- Evans Head Future Sewage Strategy Report – May 2010;

3 EARTHWORKS AND GRADING

3.1 SITE GRADING

Site grading has largely been dictated by existing ground levels, minimum and maximum road grades and drainage requirements.

Existing roads have been maintained at existing levels with allotments raised where necessary to comply with 100 year ARI flood levels.

All lots have been designed to achieve FFL above Flood Planning Levels of 3.6m. This assumes a minimum Earthworks level of 3.3m and a 300mm house slab.

3.2 EARTHWORKS QUANTITIES

The Iron Gates earthworks design estimates that earthwork volumes will not be balanced and fill will be imported. Table 3-1 below presents a summary of the estimated earthworks quantities and assume no compaction factors, road boxing or topsoil striping.

Table 3-1 Summary of Estimated Earthworks Quantities

Total Cut Volume (m3)	Total Fill Volume (m^3)	Balance Volume (m^3)
130,103	194,672	64,569

All imported fill will be sourced from local quarries with the truck haulage route nominated as being Woodburn-Evans Head Road, Woodburn Street, Wattle Street and Iron Gates Drive. The imported material will consist generally of sand fill as well as RMS specification road base and aggregates. It is expected that the earthworks activities will occur over a 16 week period and all fill will be placed in accordance with AS3798 under level 1 supervision, with all unsuitable material removed from the site.

3.3 RETAINING WALLS

In areas that have significant grade or level difference, retaining walls may be used. It is proposed that either a concrete sleeper or reinforced block walls will be used.

Roads adjacent to the environmental zone have been assessed and where required retaining walls may be provided. In these situations, the safety of both pedestrians and vehicles are considered paramount. Assessments have been undertaken and the use of a 'W' Beam guard rail will be used to minimise the risk of errant vehicles. Walls greater than, 1.0m will include a "2 rail" handrail system for pedestrian safety.

Due to a significant level difference between the proposed subdivision and the environmental zone west of Proposed Road 6 a 6.25m retain wall is proposed. The wall will be structurally designed as part of the Construction Certificate design.

Refer also to "Response to Information Request dated 11/05/2016 Items 1 & 2"

1. Section 3.2; The 6.25 metre retaining wall is considered visually excessive. Council requires a stepped embankment be provided. Please provide a revised design detail for this request.

Arcadis understands that the proposed wall could be considered visually excessive however in order to minimize the visual impact and use the wall as a feature, the development is proposing to create a green wall.

Figure 1 to 3 below show an example of the proposed treatment.

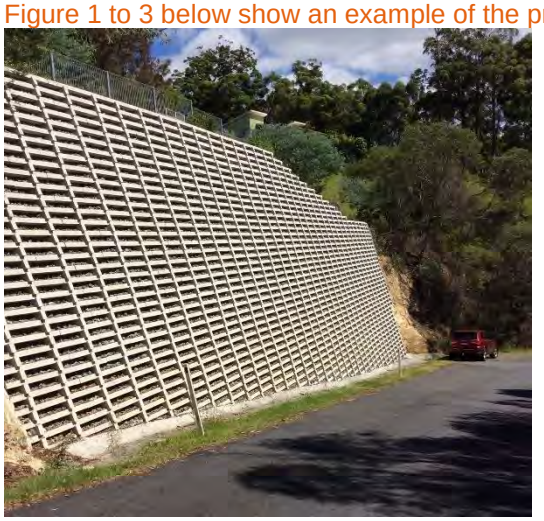


Figure 2- Retaining Wall without Vegetation

Figure 3- Example 1 of Green Wall

Figure 4- Example 2 of Green Wall

The open web construction and use of free draining material eliminates two common causes of failure in retaining walls — namely build-up of hydrostatic pressure and the destructive pressure of tree root systems.

The high quality precast concrete components provide for long-term durability and will not rot or warp.

Concrete crib walls are specifically designed to allow speed and ease of construction for minimum cost and require little or no maintenance. The standard, quality components allow for the most economical solutions for various wall heights.

A Concrib crib wall can be planted with flowers, shrubs, or creepers, using the spaces in the face of the wall. This allows the wall to blend in with any existing or proposed environment. Is it possible that we could "green" the wall with a variety of plants suitable for the Richmond Birdwing Butterfly.

To promote the Richmond Birdwing Butterfly the following plants are suggested:

> *Adult Richmond Birdwing butterflies will feed on nectar from flowers of many native plants, including native frangipani (Hymenosporum flavum), pavetta (Pavetta australiensis), black bean (Castanospermum australe) and lilly pillies (Syzygium species), as well as several exotic flowers, e.g. buddleia, pentas, honeysuckle, bougainvillea, impatiens and hibiscus. They prefer white and red blooms to other colours.*
>
> *The caterpillars (or larvae) only feed naturally on two species of vines – the lowland Richmond birdwing vine (Pararistolochia praevenosa) and the mountain aristolochia (Pararistolochia laheyana).*

These plants are proposed to be cultivated across the wall facing in order to assist in recovery of the breeding habitats for the butterfly.

Refer to Planit Drawing Iron Gates Cribb Wall Landscape Details. (attached).

2. To be noted: Plan C140 Rev 04. Ch 0 to 110 - MC1004 has a narrowing of the pavement to lessen the impact on environmental grounds with barriers and an elevated pedestrian platform. Plan C122 indicates retaining walls up to 1.5m with a pedestrian walkway on the side. -The width will need to be 2.5m wide to comply with cycleway standards and suitable balustrading to elevated walkways.

   Arcadis has amended Plan C140 to show a 2.5m wide pedestrian walkway to comply with Council's cycleway standards. Suitable balustrading will be provided with details provided during Construction Certificate Application.

4 ROADS

Vehicle access is currently provided via 1.2km of road known as Iron Gates Drive, located west of Evans Head. Iron Gates Drive has a rural residential cross section with a 2 lane sealed carriageway of 6.0m and shoulders of 0.5m-1.0m and a concrete footpath on the southern side. This road connects the existing Wattle Street in Evans Head to the proposed residential subdivision located at the western end of the road.

Pedestrian access will be provided as standard in the estate's road reserves in accordance with RVC policy. It is understood that all footpaths and bikeways must be designed in compliance with Council standards and be approved for construction prior to construction works.

4.1 INTERNAL ROADS

4.1.1 DESIGN VEHICLE

The design vehicle used in geometry checks for the internal roads is a 9.9m garbage truck with a 12.5m single unit vehicle (truck/bus) used to check all roundabouts. Fire trails have been checked based on a fire tank 7.8m long and 2.4m wide.

Design turning paths were used to determine where local increases in pavement width were required to ensure that the design vehicle could negotiate turns and bends without striking or mounting the kerb.

Where necessary, 'No Stopping' signs will be provided to ensure that required turning areas are free of parked vehicles.

4.1.2 ROAD GEOMETRY AND WIDTH

Road geometry design has generally been undertaken in accordance with Northern Rivers Local Government's (NRLG) Development and Subdivision of Land, 2006'.

The table and notes below in figure 4-1 are an extract from this document.

GEOMETRIC ROAD DESIGN

Table D.1.5 Characteristics of Roads in Residential Subdivision Road Networks

Road Type	Maximum Traffic Volume (vpd) [1]	Maximum Speed [2] (km/h)	Carriageway Width (m)[3][10] Min	Parking Provisions Within Road Reserve	Kerbing [4]	Footpath Requirement [18] minimum	Bicycle path Requirement	Verge Width (m) minimum (each side)	Minimum Road Reserve Width (m)
Access Street	100	40	6	Carriageway	Mountable	No	No	3	14
Local Street	2000	50	7-9	Carriageway	Mountable	Network Dependent	Network Dependent	3.5	15-17
Collector Street	3000	50	11	Carriageway	Mountable	One side [18]	Network Dependent	3.5	18
Distributor Road	3000+	60	13	Carriageway	Upright	One Side	Network Dependent	3.5	20

NOTES:

1. For single dwelling allotments apply traffic generation rate of 10 vehicles per day (vpd)/allotment (equivalent to approximately one vehicle per hour (vph) in the peak hour) unless a lower rate can be demonstrated. Lower rates can be applied to multi-unit dwellings based on locally derived rates.
2. See Clauses D1.09 and D1.11 on designing for specific operating speeds.
3. Widening required at bends to allow for wider vehicle paths (using AUSTROADS Turning Templates).
4. Where kerbing is not required a flush pavement edge treatment can be used. Maximum carriageway widths required if barrier kerbing used.
5. Requires:
   (i) Provision for widening to 5.0m if necessary in the future.
   (ii) Verge parking as noted with scope for additional spaces.
6. Minimum width required to provide for pedestrians, services, drainage, landscape and preservation of existing trees. Add additional width on one side for future widening of carriageway to 5.0m if required. For two lane carriageway design, no provision for widening required.

Figure 4-1 Geometric Road Design – NRLG Development & Subdivision of Land

There are 2 types of roads proposed for the Iron Gates Residential Subdivision. Details of the roads are presented in Table 4-1 and are generally consistent with the works in Council's LGA.

Table 4-1 Summary of Road Type Characteristics

Road Name	Road Type	Pavement Width
Proposed Road 1	Local Street*	11.0 (CH0-320) 9.0 (CH320+)
Proposed Road 2	Local Street*	9.0
Proposed Road 3	Local Street	9.0
Proposed Road 4	Local Street	9.0
Proposed Road 5	Collector Road*	7.0 (CH20 – 140) 11.0 (0-20; 140+)
Proposed Road 6	Local Street	9.0
Proposed Road 7	Local Street *	9.0
Proposed Road 8	Local Street	9.0
Proposed Road 9	Local Street	9.0
Proposed Road 10	Local Street	9.0
Proposed Road 11	Local Street	9.0

*The table above shows the predominant dimensions. These may vary slightly from what has been shown. Park Edge roads have reduced verge width.

A section of the Proposed Road 5 between chainage 20 and 140 has been designed with a reduced verge and pavement width to minimise impacts on the environmentally protected areas to the north and south of the road. The adopted cross-section shown on Drawing C140-AA007094-07 in Appendix A, shows two 3.5m lanes without the additional 2m parking zones on each side of the road. Safety barriers (guard rails) have been adopted on both sides of the road to help in minimizing the total width. No verge is proposed on the northern edge of the road. Along the southern edge a 2.5m wide elevated platform will be provided as a pedestrian connection between the wider sections of the road.

All roads will be provided with mountable layback kerb and channel along both edges.

The exception to the above is for "Park Edge" roads that run adjacent to either open space or environmental areas. In this instance a "barrier" style kerb and gutter will be used along with a reduced verge width. This verge width may vary depending on the requirements for paths and guard rail as mentioned above. The typical road cross sections within the current Development Approval package show these details.

Refer also "Response to Information Request dated 11/05/2016 Items 3". Inserted below.

3 To be noted: Plan C140 Rev 04. Ch 0 to 110 - MC1004 has a narrowing of the pavement to lessen the impact on environmental grounds with barriers and an elevated pedestrian platform. Plan C122 indicates retaining walls up to 1.5m with a pedestrian walkway on the side. -The width will need to be 2.5m wide to comply with cycleway standards and suitable balustrading to elevated walkways.

Arcadis has amended Plan C140 to show a 2.5m wide pedestrian walkway to comply with Council's cycleway standards. Suitable balustrading will be provided with details provided during Construction Certificate Application.

4.1.3 ROAD GRADING

Roads have been graded to ensure that parameters as presented in NRLG's 'Development and Subdivision of Land, 2006' are met. Table 4-2 presents minimum, maximum and typical road grades proposed for Iron Gates Residential Subdivision.

Table 4-2 Summary of Minimum and Maximum Road Grades Used

Road Type	Minimum Road Grade	Maximum Road Grade
Local Street	0.5%	16.0%
Collector Street	0.5%	5.5%
Fire Trail	0.5%	2.5%

All roads have generally been designed with 3% cross fall.

4.1.4 ROAD PAVEMENT

Preliminary flexible road pavement designs have been prepared based on assumed subgrade CBR of 3.0% and presented in the design drawings. These designs are indicative only and subject to detail design and actual subgrade testing.

Table 4-3 below presents a summary of design criteria and overall pavement thickness for the site:

Table 4-3 Summary of Design Criteria for Pavement Thickness

	Local Access	Local Road	Collector Road
ESA #	$3x10^5$	$3x10^5$	$1x10^6$
Assumed CBR	3.0%	3.0%	3.0%
Asphaltic Concrete (AC 10)	50 mm*	50 mm*	50 mm*
Base	150 mm	150 mm	150 mm
Sub Base	150 mm	250 mm	360 mm
Total Pavement Thickness	350 mm	450 mm	560 mm

*2x25mm AC-10 – 2nd layer postponed until the majority of houses are constructed and occupied.

ESA extracted from section D2.04 Design Traffic of the Northern Rivers' Development Design Specification D2, Pavement Design

4.1.5 FOOTPATH

Footpaths will be provided generally in accordance with NRLG's standard drawing R07. Shared paths for collector roads are intended to be provided at the time of construction. All footpaths within local roads are proposed to be postponed until the majority of the houses are constructed and occupied.

4.2 EXTERNAL ROADS - IRON GATES DRIVE

As Iron Gates Drive has been constructed approximately 20 years ago and the original design information is not easily available, the road has been assessed via a recent topographic survey to determine the original design intent. The assessment has been split into Horizontal Alignment, Vertical Grades, Design Speed, Cross Section, Pavement and Pedestrian Facilities.

In order to determine if the existing road would comply with current standards the design has been compared to the current Northern Rivers Local Government Guidelines for Development and Subdivision of Land and AUSTROADS.

4.2.1 HORIZONTAL ALIGNMENT

The existing road has been surveyed and imported into the 12D modelling software. From there an alignment was produced to create a best fit to the existing surveyed centreline.

The horizontal alignment consists of a series of straights and horizontal curves. The radii of these existing curves were noted to vary from R150m to R1750m. The R150 occurs at the southern end of Iron Gates Drive joining to an existing roundabout within the future development.

4.2.2 VERTICAL ALIGNMENT

The existing road vertical alignment has been assessed by matching a design alignment to the surveyed centreline as closely as possible. The longitudinal grades of the existing pavement have been determined to vary between 0.35% to 2.1% (approximately). The grading technique used consists of a series of crests and four sags to combat the original flat terrain.

A long section has been provided within Appendix E.

4.2.3 CROSS SECTION AND PAVEMENT

The existing cross section has been assessed based on the existing topographic survey. The assessment shows the existing section represents a Rural Residential profile in accordance with the D1.27 Carriageways section of the Geometric Road Design Aus-Spec for Northern Rivers – Local Government, Table T1.27. This table nominates 6m seal with 1m shoulders for rural roadways up to 500AADT and for rural residential roads. The existing profile consists of a pavement width of approximately 6m at 3% cross fall with varying verge widths consistent with the guidelines. It should be noted that in some areas the road does not have the full 1m shoulder as required within T1.27.

Figure 4-2, an extract from Northern Rivers Local Government Guidelines for Development, shows 7.5m seal and 1.5m shoulders for major roads over 1000 AADT. Iron Gates Drive will need to be classified as a Rural Major Road (over 1000AADT with 2×10^6 design ESAs) based on the proposed residential population.

D1.27 CARRIAGEWAYS

1. Carriageway widths for rural roads should generally be as follows:

Table T 1.27 – Carriageway and seal widths for rural roads

Local Government Area	Minor no through road up to 150 AADT	Minor road up to 1000 AADT	Major road over 1000 AADT	Rural Residential
Ballina **Byron** **Kyogle** **Richmond Valley** **Clarence Valley**	6m seal 0.5m shoulders	150 – 500 AADT 6m seal 1m shoulders 500 – 1000 AADT 7m seal 1.0m shoulders	7.5m seal 1.5m shoulders	6m seal 1m shoulders
Lismore	See City of Lismore Development Control Plan No. 28 - Subdivision			

2. Carriageway width to existing road shall generally be in accordance with Table T1.27 but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering Services or delegated officer

Figure 4-2 NRLG Road Carriageway widths

The guidelines also state that carriageway width to an existing road shall generally be in accordance with Table T1.27 but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering Services or delegated officer.

On areas of horizontal curves, super elevation has been provided to a maximum of 5% cross fall. Two typical road cross sections have been detailed within the Engineering Plans in Appendix E.

4.2.4 PEDESTRIAN FACILITIES

The existing road has a 2m wide concrete footpath on the southern side running the full length of the road. A duplication of this path has not been considered.

4.2.5 DESIGN SPEED

Based on the above, the current road geometry and future amendments, the design speed has been determined to be 70km/hr which incorporates a minimum horizontal radii of 200m with 5% super elevation. It should be noted that the radius 150m at the connection the existing roundabout is used to slow driver speeds as they approach the roundabout.

Both the vertical grading and horizontal alignment provide sufficient stopping sight distance for a 70m/hr design speed. It is recommended that the signed speed for Iron Gates Drive to be 60km/hr.

4.2.6 IRON GATES DRIVE COMPLIANCE

Arcadis has reviewed the cross section of the existing Iron Gates Drive in relation to the Northern Rivers Geometric Road Design in particular section D1.27 which reads “Carriageway width to existing road shall generally be in accordance with Table T1.27, but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering services or delegated office”.

The existing road profile, which include a 6m sealed carriageway and 1m of shoulders, is insufficient to comply with current bushfire management regulations and standards and therefore must be upgraded prior to the issue of a Subdivision Certificate. An upgrade is proposed to be undertaken with the internal construction works to widen the pavement to an 8m full width carriageway seal and 1m of shoulders to comply with both bushfire management requirements and section D1.27 of the Geometric Road Design Aus-Spec for Northern Rivers – Local Government.

In support of the reduced width application we note that this proposed access road is a section of 60km/h low speed rural road, with low truck volume and is arguably supported by Austroads Table 4.3 Urban Arterial roads width, which shows lanes varying from 3.0 to 3.5 for use in low speed roads with low truck volumes. Additional information and support for the proposed width increase is included in the TTM traffic engineering report.

Table 4-4 below shows the predicted traffic volumes resulting from the proposed development. The existing Iron Gates Drive road construction has capacity for approximately 30% of the entire development, and should be upgraded prior to 30% occupancy (or 50% without any duplex construction).

Table 4-4 Predicted Iron Gates Drive Traffic Volume

Number of House constructions	Annual Average Daily Traffic *
175	1685#

*Based on calculations described in TTM traffic report

Includes 40% duplex allowance

Based on 1685 Average Annual Daily Traffic, Iron Gates Drive should be classed Rural road with over 1000 AADT and therefore 2 x 10^6 design ESA's and a prime and 2 coat flush seal is required in line with AUS-PEC#1.

4.2.7 PROPERTY ACCESS ROAD – FIRE TRAIL

A fire trail will be provided along the eastern boundary of the development to the rear of lots, to ensure that vehicle access is provided to the full perimeter of the development. All perimeter roads and the fire trail will be suitably fitted with water supply infrastructure (mains and hydrants) for use by emergency services. For further information, reference should be made to the Arcadis engineering drawings and Bushfire Management Plan prepared by Bushfire Risk.

5 ROAD STORMWATER DRAINAGE WORKS

5.1 EXISTING STORMWATER DRAINAGE CHARACTERISTICS

The existing site consists of multiple catchments and features an extensive stormwater drainage network that has been inoperative since its construction in the mid 1990's. The network consists of multiple stormwater reticulation pipes ranging in size from Ø375mm at upstream locations to Ø825mm at downstream outlets. The drainage configuration also makes use of open drainage channels collecting stormwater from the various drainage systems to direct stormwater south of the project site towards Evans River.

5.2 PROPOSED STORMWATER DRAINAGE INFRASTRUCTURE

As part of the proposed works the existing open drainage channel along the eastern boundary of proposed lots 1 to 21 will be filled. In addition to the filling of the open channel the proposed road layout and levels has precluded the utilization of any existing drainage infrastructure.

5.2.1 DRAINAGE DESIGN STANDARDS

The proposed road stormwater drainage network has been designed to comply with the Northern Rivers Local Government Handbook of Stormwater Drainage Design – D5-Stormater Drainage Design.

The proposed system will safely convey major and minor flows to the Evans River. Design rainfall intensities have been adopted from Council's Guidelines as follows:

- Minor system - Urban Residential - 5 years ARI
- Major System – 100 year ARI

Stormwater pits have been positioned to suit the proposed road geometry and generally maintain a maximum flow width of 2.5m from face of kerb during the minor design storm event (5 year ARI).

All overland flow paths are designed to cater for the 100 year ARI storm event by maintaining a velocity-depth product of 0.4 or less and maximum flow depth equal or less than 200mm.

5.2.2 HYDRAULICS CALCULATION

The preliminary hydraulic calculation was conducted using PC_DRAIN software using the Rational Method to generate flows.

The model represents all catchments collected via a pit and pipe network designed to cater for the minor flows with considerations to major design storms. All areas are gravity drained with overland flow in excess of pipe capacity safely directed to Evans River.

On grade pits have been assumed to be 10% blocked whilst sag pits have been assumed to be 20% blocked. Field inlets have been assumed with 50% blockage. Minimum lintel size is 2.4m in sags.

MHWS water level have been used as the initial level for the hydraulic grade line calculations with Ku losses being calculated depending on diameter, flows and pipe angles.

150mm Freeboard has been generally maintained to top of grate levels for the design storm in accordance with Council guidelines.

The preliminary pipe diameter is presented in the engineering drawings Appendix A.

5.2.3 OVERLAND FLOW CHECK

Generally overland flow in excess of pipe capacity will be contained within the road corridor and will comply with Councils flood safety design criteria. In a single location (Proposed Road 10) flows in excess of pipe capacity will be conveyed overland through a dedicated open space between lots 108, 104, 118 and 103.

Based on the preliminary stormwater assessment approximately 0.23 m3/s will travel south at the previously discussed location with maximum 0.08m depth and 0.04 vxd.

6 ON SITE DETENTION

Due to the proximity of the development to the river mouth an investigation was conducted by BMT WBM to show that in this case, the application of detention devices would not achieve the desirable effects of stormwater flow mitigation, rather worsening flows overall in the regional catchment if flows from the development were detained.

As discussed in the NSW Floodplain Development Manual, consideration must be given on a merit based approach in such circumstances where the use of OSD may counterproductive, and in turn a traditional rapid disposal method is more applicable, where stormwater is discharged readily from developed areas in the lower portion of regional catchments. The WBM Study concluded that "by directly discharging runoff into the river, the water can be drained from the Evans River system with the receding tide. Most runoff will then be drained prior to the larger, regional flows passing through the Evans River, either from Upper Evans River catchment runoff or from Richmond River overflow. Therefore, BMT WBM recommends against using OSD to delay the release of floodwaters from the proposed development site."

Based on the WBM BMT study the site will not provide OSD. The full study is included in Appendix C.

7 WATER QUALITY

Water quality areas on the Site have been modelled and designed in accordance with the 'Draft NSW MUSIC Modelling Guidelines'- WBM BMT August 2010 and the Richmond Valley Development Control Plan 2012 – Section I9: Water Sensitive Urban Design. Accordingly, the objectives of this element are to:

- Protect the values and quality of receiving waters for human (commercial, recreational, aesthetic, public health) and ecological purposes.
- Promote and implement stormwater quality source control.
- Implement appropriate and safe stormwater quality devices for the target pollutant and site conditions.

Applicable water quality performance targets are provided within the Richmond Valley Development Control Plan 2012 – Section I9.4.3 and are detailed in Table 7-1 below:

Table 7-1 Stormwater Quality Targets Extract

Contaminant	Target
Coarse Sediment - 0.1 to 0.5mm (Total Suspended Solids)	80%
Total Phosphorus	45%
Total Nitrogen	45%
Litter (Gross Pollutants)	70%

7.1 SOURCE NODE INPUT DATA

Water quality assessment has been undertaken using MUSIC computer software (Version 6.1.0). Catchments have been estimated from CAD base drawings assuming road areas as 70% impervious (based on CoGC standard road sections considering verge and footpath) and allotment areas being comprised of 70% roof area and 30% ground area, of which 30% of this ground area has been considered to be impervious.

The site has been delineated into three primary catchments, illustrated on the engineering drawings included in Appendix A for reference.

- Catchment A – The northern portion of the site discharging towards the northern boundary;
- Catchment B – The area of the site located to the north-east of the central ecological zone discharging towards the Evans River; and
- Catchment C – The south-western area of the site, split into three sub-catchments each discharging to a segment of bio-retention before discharging towards the Evans River.

A summary of the modelled MUSIC source nodes and their assumed imperviousness has been provided in Table 7-2 below:

Table 7-2 Summary of Source Node Imperviousness

Source Node	MUSIC Source Node	Imperviousness (%)	Area (ha)
A-Roof Source Node	Residential Roof	100	0.661
A-Road Source Node	Residential Road	70	0.595
A-Ground Source Node	Residential Ground	30	0.284
B-Roof Source Node	Residential Roof	100	3.530
B-Road Source Node	Residential Road	70	2.209
B-Ground Source Node	Residential Ground	30	1.513
B-Road Bypass Source Node	Residential Road	70	0.374
C1-Roof Source Node	Residential Roof	100	0.471
C1-Road Source Node	Residential Road	70	1.057
C1-Ground Source Node	Residential Ground	30	0.202
C2-Roof Source Node	Residential Roof	100	2.273
C2-Road Source Node	Residential Road	70	3.707
C2-Ground Source Node	Residential Ground	30	0.974
C3-Roof Source Node	Residential Roof	100	0.903
C3-Road Source Node	Residential Road	70	0.760
C3-Ground Source Node	Residential Ground	30	0.387

7.2 TREATMENT SYSTEMS INPUT DATA

7.2.1 BIO-RETENTION AREAS

The bio-retention areas have been designed specifically in accordance with Water by Design Bio-Retention Technical Design Guidelines (2014). A saturated zone has been implemented in the bio-retention basin within catchment B improving the denitrification process and allowing for additional moisture storage for plant sustenance. The remaining proposed bio-retention basins have been designed without submerged zones. General parameters for the bio-retention areas have been modelled as per the tables below:

Table 7-3 Summary of Proposed Bio-retention Properties

Parameter	Value			
	Bio B	Bio C1	Bio C2	Bio C3
Surface Area (m²)	95	80	225	200
Filter Area (m²)	80	75	210	180
Extended Detention Depth (m)	0.3	0.3	0.3	0.3
Filter Media Depth (m)	0.4	0.4	0.4	0.4
Weir Width (m)	4	4	4	4
Submerged Zone with Carbon	Yes	No	No	No

Table 7-4 Summary of Proposed Bio-retention Dimensions

Parameter	Value
	All Bio-Retention Basins
Hydraulic Conductivity	200mm/hr
Orthophosphate Content	40mg/kg
TN Content of Filter Media	400mg/kg
Base Lined?	Yes
Vegetation Properties	Vegetated with effective nutrient removal plants

7.2.2 GROSS POLLUTANT TRAPS

The gross pollutant traps included in the treatment train have been designed as per the Draft MUSIC Modelling Guidelines for New South Wales (August 2010 issue). Four GPTs have been proposed for the site, to be used as pre-treatment devices before discharge into secondary treatment devices (bio-retention basins). The minimum performance criteria have been adopted, stated below:

Table 7-5 GPT Treatment Not Inputs Extract (Adopted from Alison et al 1998)

Parameter	Value	
	Input (mg/L)	Output (mg/L)
Total Suspended Solids (TSS)	0	0
	75	75
	1000	350
Total Phosphorus (TP)	0.00	0.00
	0.50	0.50
	1.00	0.85
Total Nitrogen (TN)	0.0	0.0
	0.5	0.5
	5.0	4.3
Gross Pollutants	0	0
	15	1.5

7.2.3 INFILTRATION PITS

Due to existing soil conditions comprising high infiltration rates (refer to Appendix D for geotechnical investigation results), infiltration pit systems have been introduced into the treatment train in Catchments A & B to supplement the proposed bio-retention and swale systems. Individual infiltration pits are proposed on a per lot basis to allow for further treatment of roof areas (modelled as lumped infiltration system for lumped roof catchment areas).

The proposed infiltration pits have been designed as per the Draft MUSIC Modelling Guidelines for New South Wales (August 2010 issue) with exfiltration rates confirmed from geotechnical investigations. Additionally, these infiltration pits have been designed to provide sufficient capacity to store inflow for a 1 in 3 month Average Recurrence Interval storm event with emptying time of less than 24 hours (approximately 2.5m3 storage for 150m2 of roof area with fill at 30mm nominal particle size).

It should be noted that lots generally drain to the front of lot towards the adjacent road reserve. These infiltration systems are not proposed in lieu of inter allotment drainage, with their sole purpose being to act as stormwater quality treatment devices. All flows in excess of infiltration capacity will be directed to the road reserve where inter allotment drainage is not proposed. General parameters for the infiltration pits have been modelled as per Table 7-6 below:

Table 7-6 Summary of Proposed Infiltration Pit Parameters

Parameter	Catchment A	Catchment B
Total Surface Area (m²)	73	389
Total Filter Area (m^2)	73	389
Total Unlined Filter Media Perimeter (m)	34.2	79
Surface Area per Lot (m^2)	4.86	
Filter Area per Lot (m^2)	4.86	
Unlined Filter Media Perimeter per Lot (m)	8.82	
Extended Detention Depth (m)	1	
Infiltration Media Depth (m)	0.4	
Exfiltration Rate (mm/hr)	180 (Geotechnical Investigations revealed generally higher values but minimum hydraulic conductivity conservatively adopted)	
Evaporative Loss	0% of PET	

A typical drainage strategy is represented in Figure 7-1 below:

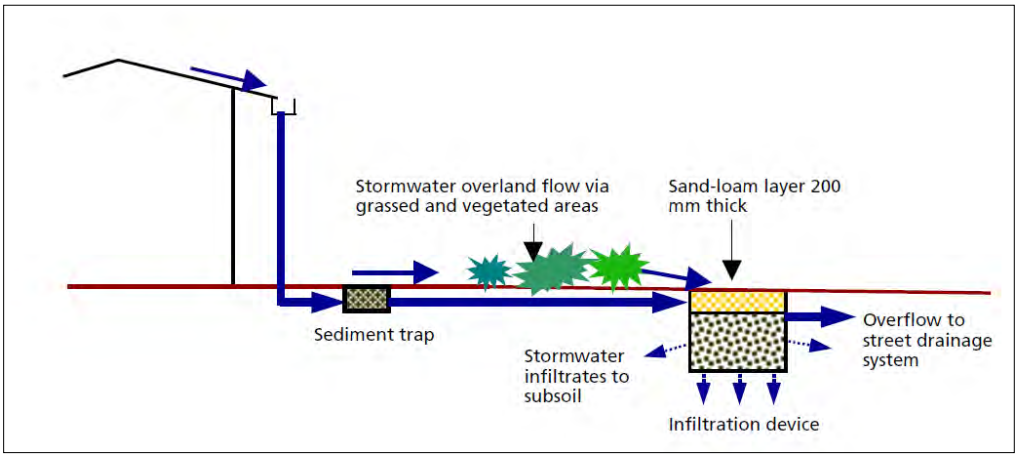


Figure 7-1 Typical Drainage Strategy

Refer also to "Response to Information Request dated 11/05/2016 Item 5"

5 Section 7.2.3 Infiltration pits are 1m deep and almost $5m^2$. Council has concerns;

What are the risks to a saturated sub base for the roads?
To avoid any risks of saturating road sub-base, all roads will be provided with subsurface drainage in accordance with The Northern River Council Specs.

Impact to/from driveways?
Driveways will be coordinated during detailed design to avoid clashes with drainage system.

How is overflow from the pits to be managed without causing nuisance stormwater flows to adjoining land owners. Council preference is for the overflow to be discharged to street kerb or via Internal Allotment Drainage (IAD).

Flows will be captured and conveyed to the infiltration system, with overflow being directed to the street kerb system. Refer figures 4 and 5 below shows a typical infiltration system details. It should also be noted that all proposed lots typically fall to the road with no inter allotment needed.

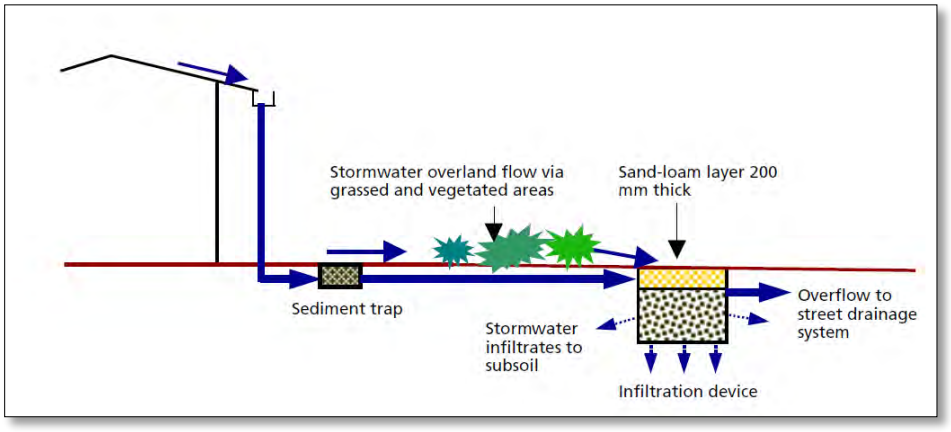


Figure 2- Typical Infiltration Strategy

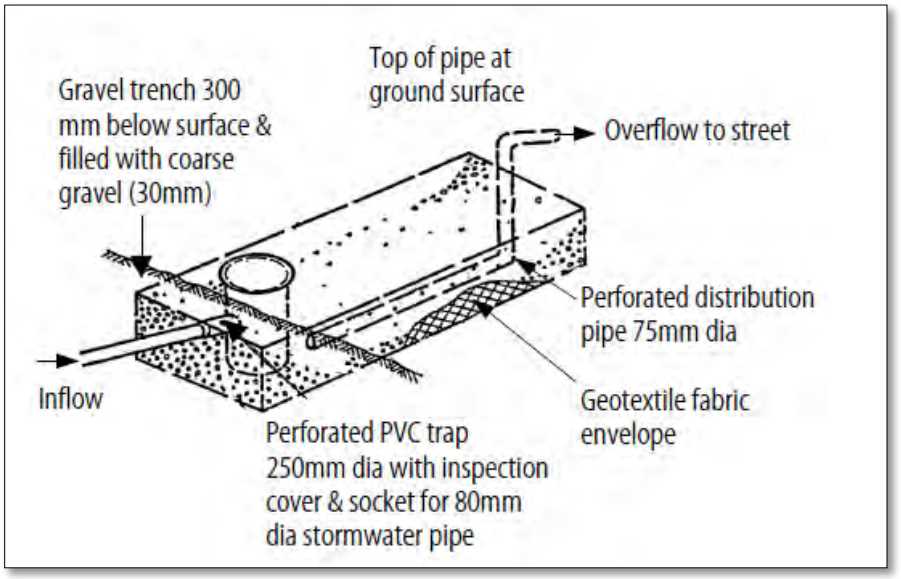


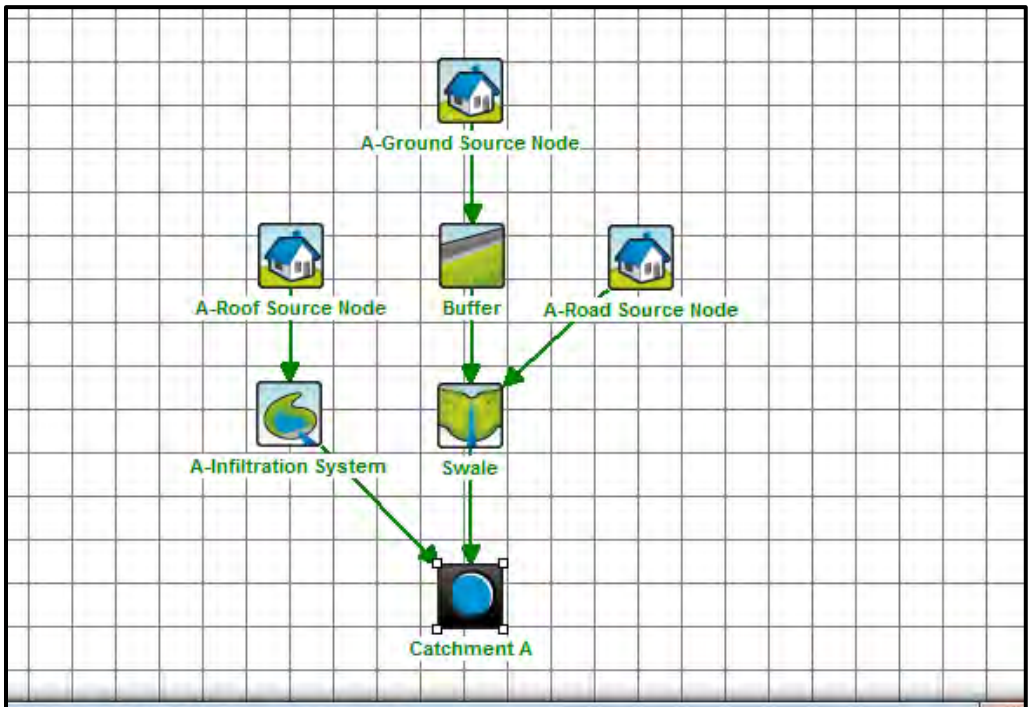
Figure 3- Infiltration System Details

- How are the pits be protected from future owners constructing over the pits or reducing the effectiveness of the pit. An easement on tittle may be an appropriate method to protect this infrastructure.

An easement for Stormwater will be provided over each device. This will be detailed during the detailed design phase of the project.

7.3 MUSIC MODELLING RESULTS

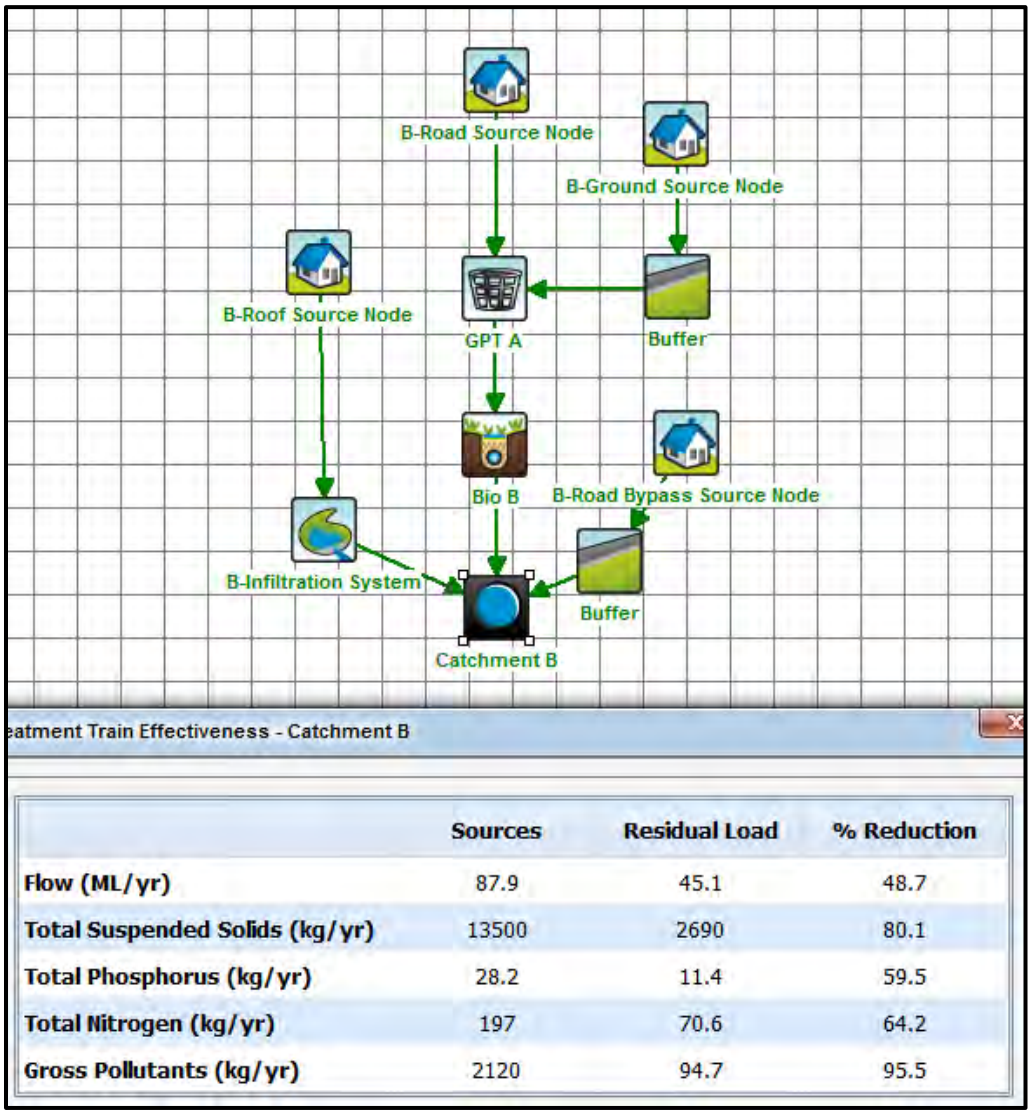
The developed site has been modelled in accordance with the sub-catchment regime to ensure each catchment meets pollutant reduction objectives as presented in Figure 7-4, Figure 7-5 and Figure 7-4 below.



eatment Train Effectiveness - Catchment A

	Sources	Residual Load	% Reduction
Flow (ML/yr)	17.6	9.22	47.7
Total Suspended Solids (kg/yr)	2850	540	81.1
Total Phosphorus (kg/yr)	6.01	1.94	67.7
Total Nitrogen (kg/yr)	39.5	18.8	52.4
Gross Pollutants (kg/yr)	425	0	100

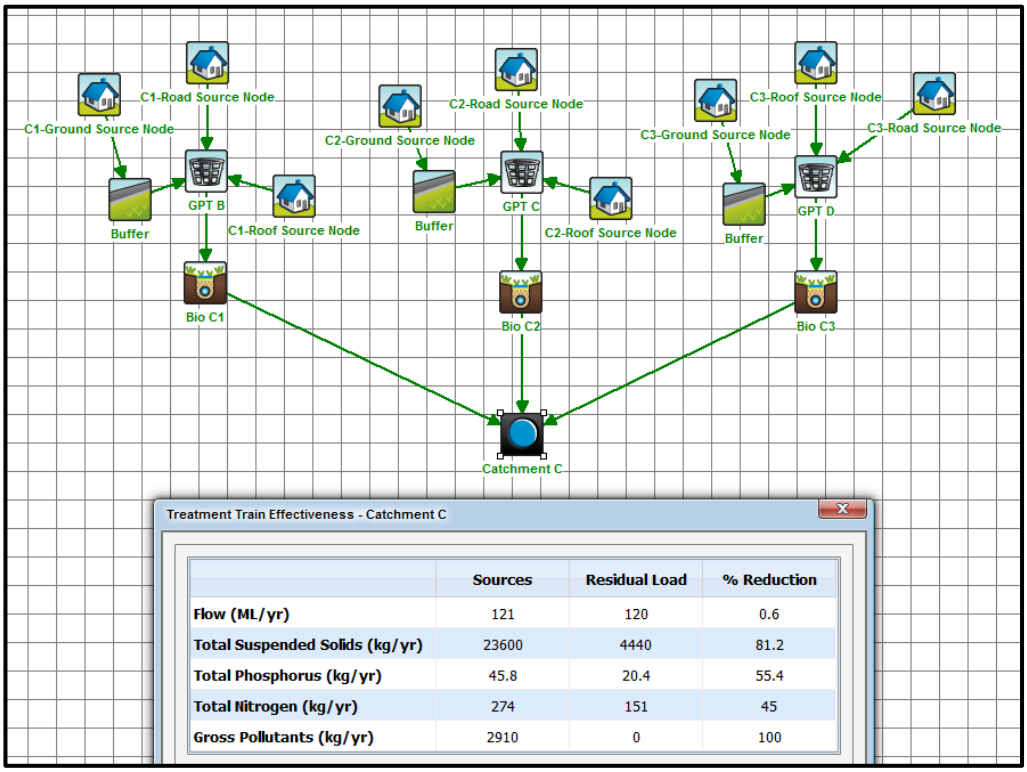
Figure 7-4 Catchment A MUSIC Layout and Pollutant Reduction Results



eatment Train Effectiveness - Catchment B

	Sources	Residual Load	% Reduction
Flow (ML/yr)	87.9	45.1	48.7
Total Suspended Solids (kg/yr)	13500	2690	80.1
Total Phosphorus (kg/yr)	28.2	11.4	59.5
Total Nitrogen (kg/yr)	197	70.6	64.2
Gross Pollutants (kg/yr)	2120	94.7	95.5

Figure 7-5 Catchment B MUSIC Layout and Pollutant Reduction Results



	Sources	Residual Load	% Reduction
Flow (ML/yr)	121	120	0.6
Total Suspended Solids (kg/yr)	23600	4440	81.2
Total Phosphorus (kg/yr)	45.8	20.4	55.4
Total Nitrogen (kg/yr)	274	151	45
Gross Pollutants (kg/yr)	2910	0	100

Figure 7-6 Catchment C MUSIC Layout and Pollutant Reduction Results

8 SEDIMENT AND EROSION CONTROL

Erosion and sediment control will be installed and maintained in accordance with NRLG's requirements and Landcom's Managing Urban Stormwater, Soils and Construction ('Blue Book').

9 PROPOSED UTILITY SERVICES PROVISION

9.1 POTABLE WATER

9.1.1 EXISTING WATER SUPPLY INFRASTRUCTURE

The site features an existing water reticulation system located within the verge of the existing road network. This reticulation features pipes ranging from Ø100mm to Ø300mm designed to service a previous lot layout.

Connection to the project site is currently through the Ø300mm main located within the Iron Gates Drive road reserve which runs along the length of Iron Gates Drive – Wattle Street before turning through Mangrove Street and connecting to the existing Ø250mm AC main located within the eastern verge of Elm Street.

9.1.2 PROPOSED WATER SUPPLY INFRASTRUCTURE

Connection for the proposed development to the RVC water supply network will be provided via a connection to the existing Ø300mm main located south-east of the project site within the Iron Gates Drive reserve. Again, it is proposed to maximise utilisation of the existing network however the adequacy of the current water reticulation is to be determined to ensure compliance with RVC standards. The internal potable water network shall be the subject of detailed design during the Construction Certification phase of the project.

9.1.3 PROJECTED DEVELOPMENT LOADINGS

Network Loadings

The development has been assessed under two loading cases in order to better determine the anticipated impact it will have on the surrounding network. These cases are the:

- **Planned Demand** – A demand assigned to the site via discussions with Richmond Valley Council based on the Evans Head Future Sewage Strategy report;
- **Actual Demand** – The calculated demand for the property based on proposed architect plans and conversion rates from the 'AUS-SPEC#1 Development and Design Manual'.

In accordance with the 'AUS-SPEC#1 Development and Design Manual'; section D11.06, Table 9-1 and Table 9-2 below show the calculations of Equivalent Persons (EPs) derived from both discussions with Richmond Valley Council and what is actually proposed on site.

Table 9-1 RVC Planned Demand as per Pre-Lodgement Meeting Minutes

Category	Conversion Rate (EP/ET)	Planned Demand (ET)	Planned Demand (EP)*
RVC Current Water Allowance	3.2	**100**	**320**

*3.2EP/ET – AUS-SPEC#1 Development and Design Manual D11.06

There are 175 lots proposed on site. 105 of these are assumed to have a loading of 1ET (3.2EP) per lot as per the RVC Development Guidelines. The other 70 have been assumed to be dual occupancy and have an applied loading of 2ET (6.4EP) per lot

Table 9-2 Proposed Development Loadings

Category	Units (No.)	Demand Rate (ET/unit)	Proposed Demand (ET)	Conversion Rate (EP/ET)	Proposed Demand (EP)*
Standard Single Dwelling Unit	105	1	105	3.2	**336**
Standard Dual Dwelling Unit	70	2	140	3.2	**448**
		Total	**245**		**784**

*3.2EP/ET – AUS-SPEC#1 Development and Design Manual D11.06

The difference in EPs between what has been planned and what is proposed is therefore **464 EPs**.

There is a difference between the current planned case as per Council's Local Area Plan and the developed case equivalent tenement calculations of 464 EP. A detailed assessment of the impact of increased loadings on the surrounding water infrastructure have been undertaken in the 'F0001-10027302-AAR' prepared by Arcadis and included in Appendix G.

9.1.4 INTERNAL WATER NETWORK

The developer shall, as part of the development works, construct an internal water reticulation service for the proposed development in accordance with the relevant building code requirements.

A water network design will be undertaken by a qualified hydraulic engineer for the proposed development to determine adequate levels of services for all internal firefighting flows and services demands.

9.1.5 CAPACITY OF EXISTING EXTERNAL WATER

A Water Network Capacity Assessment has been undertaken to determine the effects of the development on the surrounding water infrastructure. The assessment prepared by Arcadis in Appendix G indicates that once fully developed and in-use, the Iron Gates development will have no additional impact on the Evans head potable water network. This is true for both standard and fire flow events.

9.2 SEWER

9.2.1 EXISTING SEWERAGE INFRASTRUCTURE

The project site currently possesses a sewerage reticulation network dating back to a previous development attempt, consisting of Ø225mm mains cumulating at the south-east corner of the project site where a pump station is located. This station is equipped with a dual rising main configuration consisting of two Ø100mm rising mains, one which was to be used to cater for the first stage of the previous Development Application and a second to service future developments.

These rising mains are located within the Iron Gates Drive road reserve and follow Iron Gates Drive through Wattle Street and Mangrove Street to an existing Ø150mm gravity main.

9.2.2 PROPOSED SEWERAGE SUPPLY INFRASTRUCTURE

Connection for the proposed development to the RVC sewerage network will be provided via a sewerage reticulation network internal to the project site subject to a detailed sewer network capacity assessment ensuring adequate capacities are provided to service the development. Connection to the existing DN 100 rising main is to occur from the existing south-eastern pump station, to be pumped along Iron Gates Drive to the connection point in Mangrove Street. This connection point will be confirmed during detailed design with further discussion with RVC engineers.

Refer also to “Response to Information Request dated 11/05/2016 Items 4”

4 Section 9.2.2; please explain what is the comparison between the original ET loading that was the input for the dual rising main, and the proposed ET loading now by the proposed subdivision. Council needs to ensure the existing infrastructure is suitably sized for the proposed development.

The report entitled Iron Gates Residential Development Engineering Services and Civil Infrastructure Rev 06 dated 10/05/2016 has been amended to make allowance for the existing lots, currently connected to the DN150 gravity sewer in Mangrove Street upstream of the existing EHPS-02 pump station. Please refer to attached sewer calculations and Section 9 of the report.

9.2.3 PROJECTED DEVELOPMENT LOADINGS

Network Loadings

The development has been assessed under two loading cases in order to better determine the anticipated impact it will have on the surrounding network. These cases are the:

- **Planned Demand** – A demand assigned to the site via discussions with Richmond Valley Council based on the Evans Head Future Sewage Strategy report;
- **Actual Demand** – The calculated demand for the property based on proposed architect plans and conversion rates from the ‘AUS-SPEC#1 Development and Design Manual’.

In accordance with the 'AUS-SPEC#1 Development and Design Manual'; section D12.06, Table 9-3 and Table 9-4 below show the calculations of Equivalent Persons (EPs) derived from both discussions with Richmond Valley Council and what is actually proposed on site. For the sewer EP calculations, the EP/ET conversion rate is taken from the GHD report which forms the basis for RVC's future sewer planning strategy.

Table 9-3 RVC Planned Demand as per Pre-Lodgement Meeting Minutes

Category	Conversion Rate (EP/ET)	Planned Demand (ET)	Planned Demand (EP)*
RVC Current Sewer Allowance	2.3	100	230

*2.3EP/ET – GHD (2010) Sewer Planning Report

There are 175 lots proposed on site. 105 of these are assumed to have a loading of 1ET (3.2EP) per lot as per the RVC Development Guidelines. The other 70 have been assumed to be dual occupancy and have an applied loading of 2ET (6.4EP) per lot

Table 9-4 Proposed Development Loadings

Category	Units (No.)	Demand Rate (ET/unit)	Proposed Demand (ET)	Conversion Rate (EP/ET)	Proposed Demand (EP)*
Standard Single Dwelling Unit	105	1	105	2.3	**241.5**
Standard Dual Dwelling Unit	70	2	140	2.3	**322**
		Total	**245**		**563.5**

*2.3EP/ET – GHD (2010) Sewer Planning Report

The difference in EPs between what has been planned and what is proposed is therefore **333.5 EPs**.

9.2.4 CAPACITY OF EXISTING EXTERNAL SEWER

Due to the proposed loads imposed on the existing external sewerage network a preliminary assessment has been undertaken to determine whether it has sufficient capacity. A report prepared by GHD in May 2010 titled "*Review of Evans Head Sewerage Augmentation Strategy"* includes an assessment of various augmentation strategies in order to upgrade the existing Richmond Valley Council sewerage system to cater for future development.

After discussions with RVC engineers, Arcadis undertook detailed calculations using the general strategy adopted by RVC to cater for future development in the sewer network to determine whether sufficient capacity was for the Iron Gates development. These calculations and a discussion on the findings are found in the Arcadis Sewer Network Capacity Assessment in Appendix H. The assessment found that sufficient capacity was available in the Evans Head pump station 2 (EHPS-02) catchment, with no augmentations to the RVC future sewer planning strategy required.

A brief assessment of the 150mm diameter sewer gravity main in Mangrove Street that serves as the SRM connection point has been undertaken to ensure that it has sufficient capacity to cater for the additional flows from the Iron Gates development.

Currently there are approximately 60 Lots within the catchment connected to the DN 150 gravity sewer upstream of the EHPS-02. The DN 150 gravity pipe will have some capacity to accept flows from the Iron Gates estate, with the Sewer Network Capacity Assessment prepared by Arcadis indicating that the Iron Gates development has a total developed flow of 9.29L/s. The capacity of the 150mm diameter pipe at minimum grade is 11.35L/s. A detailed assessment of this pipe's capacity will be undertaken during Construction Certificate stage.

9.3 ELECTRICAL AND TELECOMMUNICATIONS SERVICES

The existing site is not equipped with electrical reticulation infrastructure however 'Essential Energy' Dial Before You Dig (DBYD) results have revealed the presence of an underground or earth wire structure within the south-western corner of the project site. Two electrical poles have also been located within the site in alignment with a service track to the north of the site. It is understood that the proposed development must incorporate an internal low-voltage electricity supply to all facilities within the development in order to comply with relevant legislation. Connection to electrical reticulation is proposed via infrastructure within Iron Gates Drive with ultimate connection in Wattle Street within Evans Head. Refer to Preferred Energy electrical consultants Electrical and Telecommunications Supply Availability in Appendix M for further detail and Appendix B for DBYD results.

Telecommunication services have been identified in the immediate surroundings of the site, with an underground telecommunication network being situated within the project site. This network is not connected to any working infrastructure and is therefore not live at this stage. Two elevated cable joints are also identified in the adjacent lot towards the west (Lot 163 DP831052), connecting to an elevated cable joint in Blue Pool Road. Telecommunications connection for the site will be made through new infrastructure through a design and submit process with NBN as outlined in the Electrical and Telecommunications Supply Availability in Appendix M.

Connection from the proposed development to the above-mentioned services will be undertaken by a specialist consultant and will form part of the future Construction Certification applications and approval processes through the relevant service providers.

A Level 3 Energy Accredited Service Provider will undertake the design and documentation of the electrical reticulation network. Street lighting will be installed in accordance with Authority standards and in accordance with the relevant conditions of approval and supporting consultant reports.

9.4 GAS

No allowance has been made to supply the development with reticulated gas. This will be subject to future agreement between the developer and local gas suppliers.

9.5 TESTING OF EXISTING INFRASTRUCTURE

There are areas of the development where it is proposed to utilise existing infrastructure constructed as part of a previous development design. Where this is proposed the infrastructure will be tested to ensure that it is of an appropriate quality as per the RVC Guidelines.

Water

- Pressure testing to detect leakage and defects in the pipeline including joints, thrust and anchor blocks.
- Disinfect all water mains in accordance with the specification in WSA 03 Part 4, section 13.

Sewer

- Compressed air testing of gravitation sewers;
- Ovality testing using a Council approved proving tool. Ovality should comply with the requirements specified in Chapter 402.40 – Initial Test of Gravitation Sewers of the Richmond Valley Council Construction Manual.
- Leakage test of maintenance holes. Tests should comply with Chapter 402.41 – Initial Test of Maintenance Holes of the Richmond Valley Council Construction Manual.
- Hydrostatic testing. Tests should comply with Chapter 402.45 – Hydrostatic testing of gravity mains of the Richmond Valley Council Construction Manual.
- Pressure testing of rising mains. Tests should comply with Chapter 402.47 – Testing of Rising Mains of the Richmond Valley Council Construction Manual.
- Visual inspection via CCTV cameras. Tests should comply with Chapter 402.65 – What is to be inspected of the Richmond Valley Council Construction Manual.

Stormwater

- Visual inspection via CCTV cameras. Tests should comply with Chapter 402.65 – What is to be inspected of the Richmond Valley Council Construction Manual.

10 FLOOD EMERGENCY MANAGEMENT

The proposed developed features 175 residential allotments, with all internal road areas and lot areas constructed above the current 1 in 100 year flood level. Permanent residents and visitors can move freely around the site during flood events up to the 1 in 100 year regional flood. The proposed development is connected to the Evans Head town centre by a single road, being Iron Gates Drive. Iron Gates drive is susceptible to current day 1 in 100 year flooding, with the lowest point inundated by approximately 400mm for 5 hours. It should be noted that this flooding is low velocity back water, and would be considered trafficable if required by emergency vehicles.

The proposed strategy for flood emergency management by residents and visitors will be ‘stay in place’ rather than an evacuation. Under this strategy, site occupants will be encouraged to remain within their homes for the duration of flooding, with medical emergencies to be dealt with by the emergency services. Considering the potential of emergency vehicles to travel through water inundating roads (with low velocity) and the duration of inundation being 5 hours, the development is not considered to be isolated during an emergency event. Residents will stay in place, in their homes, where emergency vehicles can access the site.

In the future sea level rise modelling for a 1 in 100 year flood of the Evans River, Iron Gates Drive will be inundated for a maximum of 9 hours and to a depth of 1.3m. No residential allotments on site will be beneath the 100 year flood level with sea level rise. The development is considered to be no more isolated than the town of Evans Head itself, given the flooding potential of roads leading out of Evans Head, including the currently under construction motorway upgrade. If this height of sea level rise is reached in the future, all medical emergencies in the Evans Head region must be dealt with through aerial evacuation.

11 CONCLUSION

This report has discussed the engineering aspects of the development of the proposed Iron Gates residential estate.

The proposed development is to feature 175 residential allotments that are proposed to utilise as much of the existing infrastructure as possible, including roads, stormwater, sewer and water infrastructure.

This report has demonstrated that the proposed development can be adequately provided with all necessary engineering services, including sewer, water, stormwater drainage, electrical and telecommunication infrastructure. It is assumed that the other existing services which are located within the vicinity of the site can accommodate the proposed development's needs.

A summary of the existing and proposed stormwater drainage infrastructure on site has been presented. The provision of on-site stormwater detention has been shown to be detrimental in the case of this development based on the BMT WBM study identifying a rapid disposal method to be more efficient in the release of flood waters.

To service the development with potable water a single water connection point is proposed to the 300mm diameter potable water main in the Iron Gates Drive verge adjacent to the site, connecting to the existing Ø250mm AC main. A Water Network Capacity Assessment has been undertaken to determine the effects of the development on the surrounding water infrastructure. The assessment prepared by Arcadis in Appendix G indicates that once fully developed and in-use, the Iron Gates development will have no additional impact on the Evans head potable water network. This is true for both standard and fire flow events.

The proposed connection to the RVC sewerage network for the proposed development will be via the dual 100mm diameter rising main adjacent to the project site within the southern verge of Iron Gates Drive, connecting to the existing Ø150mm gravity main. After discussions with RVC engineers, Arcadis undertook detailed calculations using the general strategy adopted by RVC to cater for future development in the sewer network to determine whether sufficient capacity was for the Iron Gates development. These calculations and a discussion on the findings are found in the Arcadis Sewer Network Capacity Assessment in Appendix H. The assessment found that sufficient capacity was available in the Evans Head pump station 2 (EHPS-02) catchment, with no augmentations to the RVC future sewer planning strategy required.

Electrical and telecommunication services shall be provided to the development through connection points through Iron Gates Drive and Wattle Street, from the Evans Head town centre. Electrical and telecommunications supply has been planned for by the relevant service authorities and will be subject to the development Construction Certificate applications. Additional engineering issues such as road access and earthworks have also been presented within the report.

It is anticipated that there will not be any detrimental effects of the proposed development on surrounding properties and that it is possible for all engineering services to be catered for.