BARKER RYAN STEWART

Urban Land and Housing Pty Ltd

Stormwater Management Report

Development Details Stages 8-15

Lochinvar Ridge, Lochinvar

November 2024

ENGINEERING
PLANNING
SURVEYING
CERTIFICATION

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Rev No.	Status	Date	Comments
A	DA sub	5/11/2021	
B	Council comments	26/05/2022	
C	Council comments	23/12/2022	
D	Revised Layout	14/03/2023	
E	DA Modification - Revised Layout and Basin Configuration	15/11/2024	

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1 Introduction

This report has been prepared to detail the results of the concept design of the stormwater management system of the proposed development of stages 8-15 at Lochinvar Ridge and complement the updates following the feedback from Maitland Council in their RFI dated 20/02/2024 and email from Sam Dart dated 13/02/2024 regarding the modification to basin configuration.

In considering the stormwater management at the site, this investigation will consider the following:

- The OSD and WSUD requirements for the release area, being each development is to cater for its own requirements in accordance with Chapter 18, Part C – Design Guidelines of the Maitland City Council DCP.
- The existing site conditions and catchments.
- Pre-development flow rates obtained from Council for the hydrology modelling undertaken as a part of the Lochinvar Flood Study (WMA 2019).
- The design and installation of on-site detention storage to control the storm events from a 1% AEP to 50% AEP storm events in accordance with AR&R 2019.
- The design and installation of wetland basins to satisfy the water quality requirements for the site.
- Stormwater management and maintenance issues associated with the proposed infrastructure.
- The approved masterplan for the release area.

2 Site Location and Development Proposal

2.1 Site Location

The site of the proposed development is described as Lot 3 in DP 1256730. This lot is known as 70 Christopher Road, Lochinvar. The location of the site is in Figure 1 below.

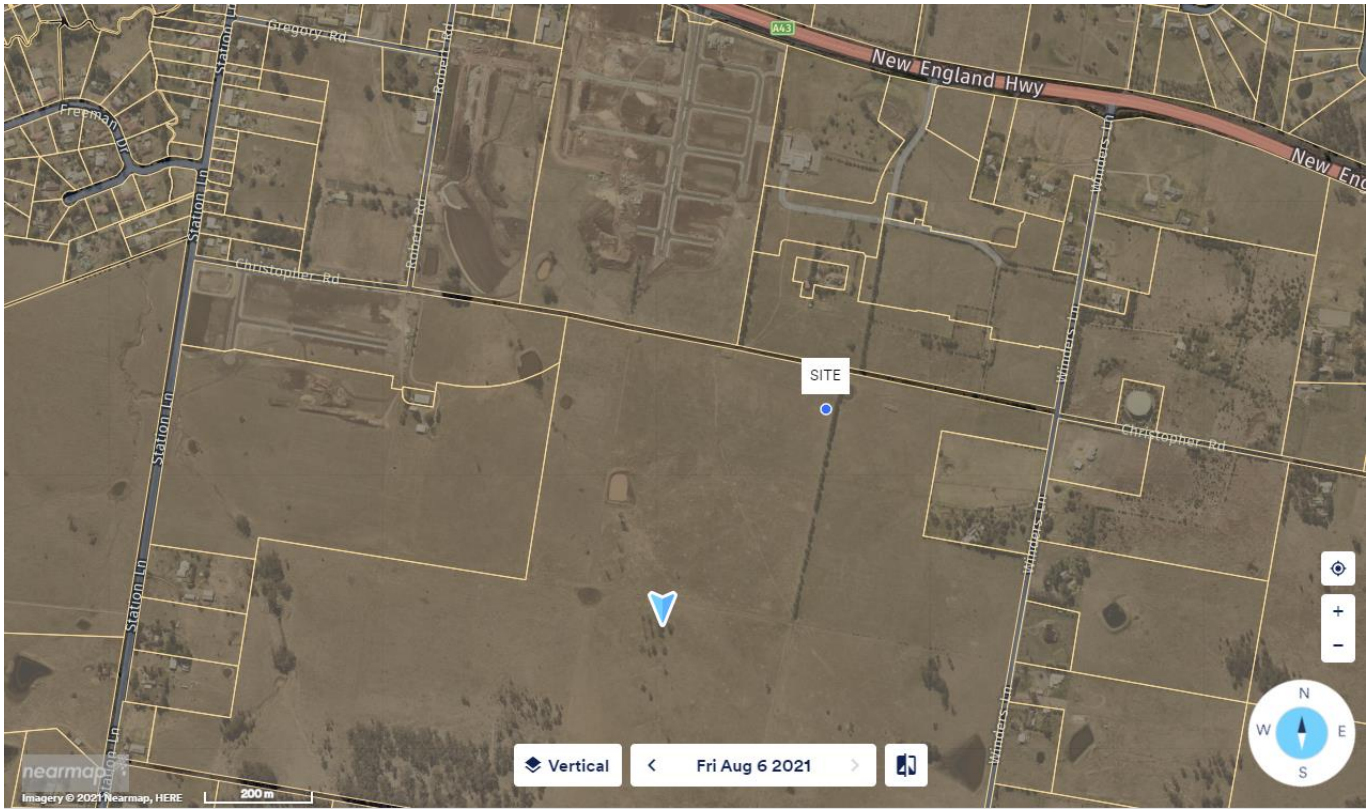

Figure 1 – Site Location

2.2 Existing Site

The subject land is predominantly cleared land that is currently used for grazing. Access to the New England Highway is currently via Winders Lane, however with stages 1 to 7 being completed it will either be through those stages or should the proposed adjoining subdivision to the sites west be constructed first (on 40 Springfield Drive, Lochinvar) then through that land.

The land is cleared of native vegetation and is vegetated with pasture grasses. The topography of the subject land is described by a series of ridge lines and parallel gullies ranging from RL33m to RL70m Australian Height Datum (AHD). Either side of the ridge lines, the surface is moderately sloping, at up to 5 degrees (9%) toward three watercourses. The ridge lines extend from the south-west corner toward the north-east and another ridge extends from the eastern boundary toward the northwest. Soils occurring on site are assumed to contain high clay content and therefore of low infiltration potential.

2.3 Proposed Development

The subject land is bound by the New England Highway in the north, Winders Lane in the east, a ridge to the south and Station Lane to the west. A number of smaller sized allotments within the footprint of the site will be absorbed into the layout, remaining as separate entitlements with a street frontage and access to services provided through subdivision.

Figure 2 - Proposed development and Staging Layout

Development of this parcel is included within the first stage of the current Lochinvar Urban Release Area and is subject to the specific requirements of the Lochinvar Development Control Plan (DCP) as well as the city-wide DCP. The property is subject to the Maitland Local Environmental Plan 2011, being zoned R1 General Residential in accordance with the provisions of the LEP. Areas within the western portion of the subject land have been identified for future commercial, medium density and educational end purposes.

Road connections are intended to be provided to future residential development to the west and southwest. Christopher Road, being an unformed road, bisects the subject land from west to east. It is intended to close this road as part of the subdivision works.

The stormwater elements discussed in this report are intended to be viewed as being designed to concept level only and will be further refined with on-going adjustments to the structure plan for each stage and subsequent Development Applications.

2.4 Primary waterways

There are two watercourses that originate within the subject land, each being tributaries of Lochinvar Creek. These watercourses are wide and relatively shallow being better described as natural gullies temporarily subject to flows immediately after rain events. A series of farm dams are positioned on the watercourses each of varying size. The two watercourses define the outlets from the subject land as follows:

2.4.1 Christopher Road Depression

This depression drains along the unformed Christopher Road towards Robert Road. This catchment collects a gully draining from the property known as "Pindale" which fronts Winders Lane and is classified as a first order stream.

2.4.2 Southern Depression

The southern depression drains into the property known as 72 Station Lane (which is also being developed) before also draining under Christopher Road and joining with the above-mentioned depression. This watercourse is also identified as a first order stream under the Strahler System and becomes a second order just before reaching the downstream boundary of the site. This watercourse is typically dry apart from immediately after rainfall.

3 Stormwater Design

A stormwater network model was prepared in accordance with the requirements of Australian Rainfall and Runoff (2019) and Maitland City Council's Manual of Engineering Standards (2014). Design of the drainage network incorporated Council's preferred standards for inlet capacity calculations, pipe roughness and pit loss configurations. The design was modelled as a dynamic stormwater model in DRAINS software.

Following feedback from Maitland council in their RFI dated 20/02/2024 and email from Sam Dart, dated 13/02/2024 it was advised that pre-development flow rates are to be obtained from the hydrology modelling undertaken as part of the Lochinvar Flood Study (WMA 2019). Further discussion is provided in the sections below.

3.1 Performance Criteria

The stormwater modelling of the proposed stormwater network has been undertaken for all storm events up to and including the 1% AEP storm event. The network was designed to satisfy all performance criteria detailed in Council's Manual of Engineering Standards. The results of the 10% (minor event) and 1% AEP (major event) stormwater analysis for the entire network are presented in the civil drawings.

For the 10% AEP and 1% AEP storm events, inlets were assessed with blockage factors of 0.8 (ie 20% blockage) for on-grade pits and 0.5 (ie 50% blockage) for sag pits.

3.2 WBNM Calibration

As discussed above it was requested by council that the pre-development flows be obtained from the hydrology modelling undertaken as part of the Lochinvar Flood Study (WMA, 2019). Council supplied the WBNM modelling files and peak medians flows for a number of storm events to assist determination of the site-specific pre-development flow rates.

The WBNM model prepared as part of the Lochinvar Flood Study used the following parameters mostly obtained from the AR&R Datahub:

Table 1 – WBNM Model Parameters

Parameter	Value
Lag Parameter	1.7
Pervious Initial Loss	27mm
Pervious Continuing Loss	2.9mm
Impervious Initial Loss	1mm
Impervious Continuing Loss	0mm
Pre-Burst Rainfall	Median Pre-burst Depths

Due to the size of the catchment within the Lochinvar Flood Study, Approx. 16.5Km^2, Areal Reduction Factors (ARF) were applied to represent the reduced probability of point rainfall data occurring over the

entire catchment. ARF factors that were applied within the Lochinvar Flood Study can be found below in Figure 3.
It should be noted that AR&R 2019 specifies that ARF values should be applied based on the catchment area of interest, which in the case of the Lochinvar Flood Study is 16.5Km^2. However, in the case of the basin design for Lochinvar Ridge in which this report is focused, the catchment of interest is far less than 1Km^2 meaning an ARF of 1.0 should be applied to all events and durations.

For the purposes of this report the ARF reduced flows, as requested by council, have been used for the pre-development catchments within the modelling. As application of the ARF parameters within DRAINS is difficult, it was decided that varying the Lag Parameter was an easier option as this only impacted the WBNM catchments (Pre-developed Catchments). The results compared to those flows obtained by WMA along with the adjusted lag parameters can be found in Table 2.

Duration	AEP							
(min)	50%	20%	10%	5%	2%	1%	0.5%	0.2%
60	0.91	0.90	0.90	0.89	0.88	0.87	0.87	0.86
90	0.93	0.92	0.91	0.90	0.89	0.88	0.88	0.86
120	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87
180	0.95	0.94	0.93	0.92	0.90	0.89	0.88	0.87
270	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89
360	0.97	0.96	0.95	0.95	0.94	0.94	0.93	0.92
540	0.97	0.97	0.97	0.96	0.96	0.96	0.95	0.95
720	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.95
1080	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97
1440	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
1800	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
2160	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98
2880	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
4320	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Figure 3 – Areal Reduction Factors (Source: Lochinvar Flood Study - WMA, 2019)

Table 2 – WBNM Flow comparison

Event - Lag	50% AEP (m3/s)	Lag = 1.85	20% AEP (m3/s)	Lag = 2.05	10% AEP (m3/s)	Lag = 2.10	5% AEP (m3/s)	Lag = 2.15	2% AEP (m3/s)	Lag = 2.15	1% AEP (m3/s)	Lag = 2.15
Catchment	WMA	BRS	WMA	BRS	WMA	BRS	WMA	BRS	WMA	BRS	WMA	BRS
L068	0.367	0.368	0.645	0.641	0.849	0.863	1.147	1.16	1.69	1.75	2.029	2.12
L069	0.438	0.446	0.785	0.762	1.038	1.05	1.344	1.37	1.977	1.93	2.462	2.37
L070	0.601	0.604	1.034	1.03	1.427	1.44	1.886	1.87	2.537	2.52	3.06	3.09
L071	0.786	0.783	1.432	1.41	1.997	1.95	2.539	2.58	3.292	3.31	4.056	4.13
L073	0.396	0.396	0.681	0.687	0.929	0.926	1.238	1.24	1.858	1.86	2.273	2.28
L074	0.618	0.622	1.049	1.05	1.43	1.47	1.89	1.89	2.624	2.58	3.345	3.21

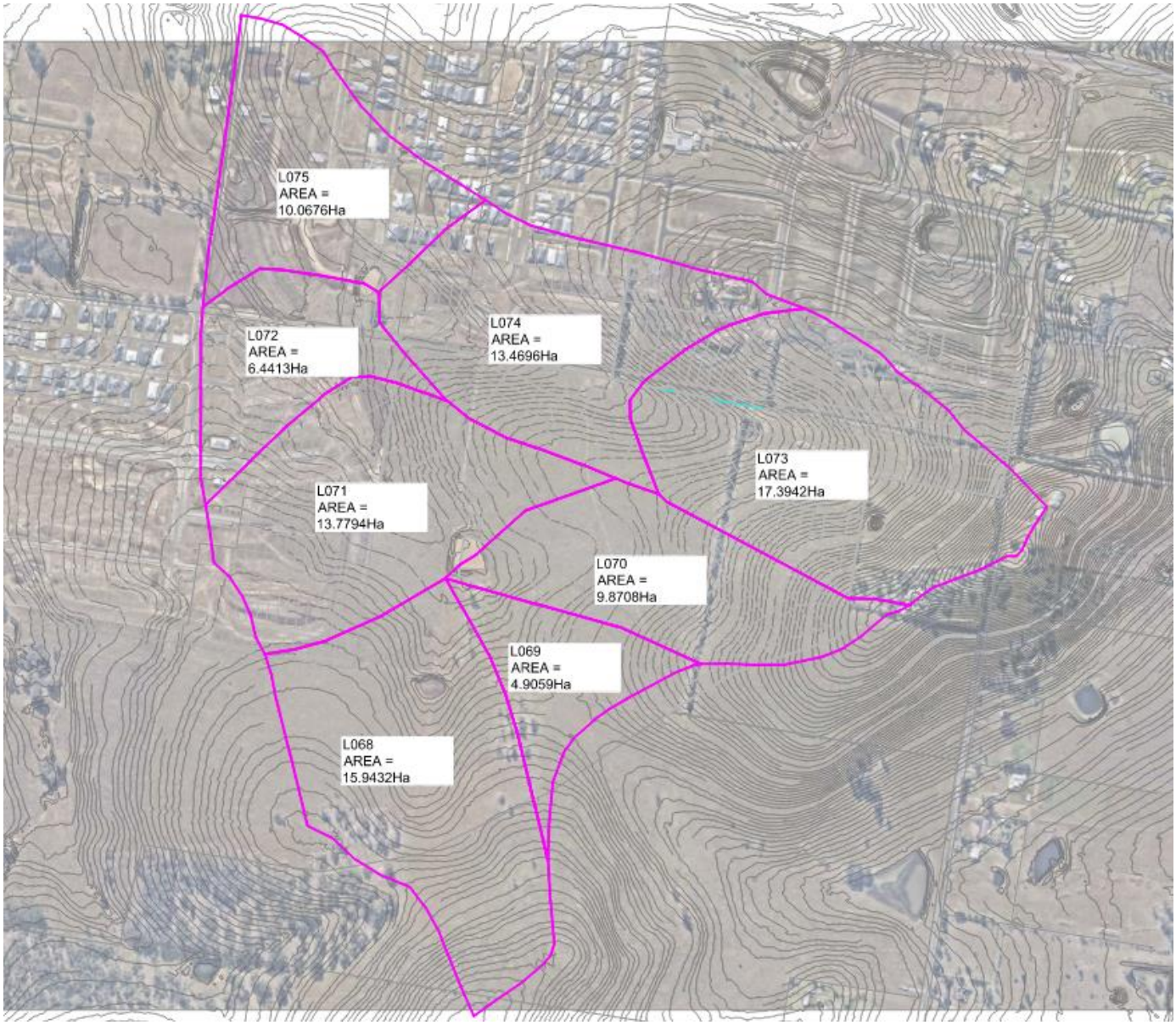

Figure 4 – Lochinvar Flood Study Existing Catchment Plan

3.3 Existing and Proposed Catchments

The stormwater extents for the pre-development scenario were confirmed by catchment delineation of LIDAR contours for the area. This plan shows the full extents of upstream catchments draining to the watercourses across the subject land. The northern catchment is to be drained through an underground truck pipe drainage running in alignment with Christoper Road. The southern catchment is to drain into the existing watercourse in the north-west corner within the site boundaries.

The pre-developed catchment condition was modelled as per the impervious area's determined as part of the Lochinvar Flood Study. The post-developed catchments were modelled as 65% impervious for residential lots and 70% impervious for road corridors.

Catchment hydrology for the pre-development catchments was undertaken using WBNM (Watershed Bounded Network Model) within DRAINS using a varying Lag Parameter depending on the storm AEP event. Catchment hydrology for the post-developed catchments was based on the ILSAX model regime using a Soil Type of C(3) and Antecedent Moisture Condition (AMC) of 3.

Table 3 Catchment Summary

Catchment	Pre-Development Area (Ha)	Post-Development Area (Ha)	Pre-Development Impervious	Post-Development Impervious
North	24.27	22.123	0%	65% (Note 3.76 Ha is assumed Undeveloped)
South	36.67	36.76	0%	65% (Note 5.26 Ha is assumed Undeveloped)

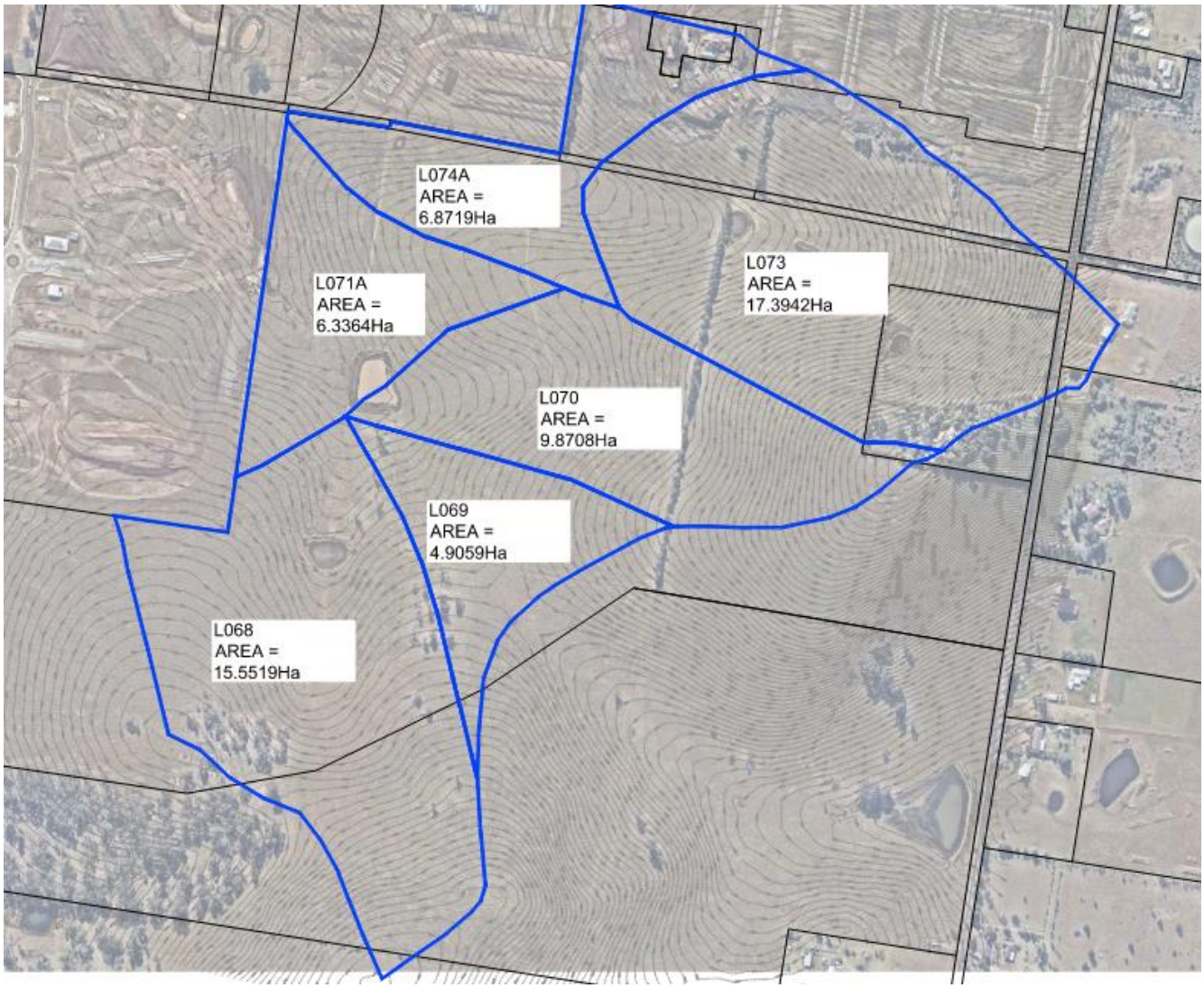

Figure 5 – Existing Catchment Plan

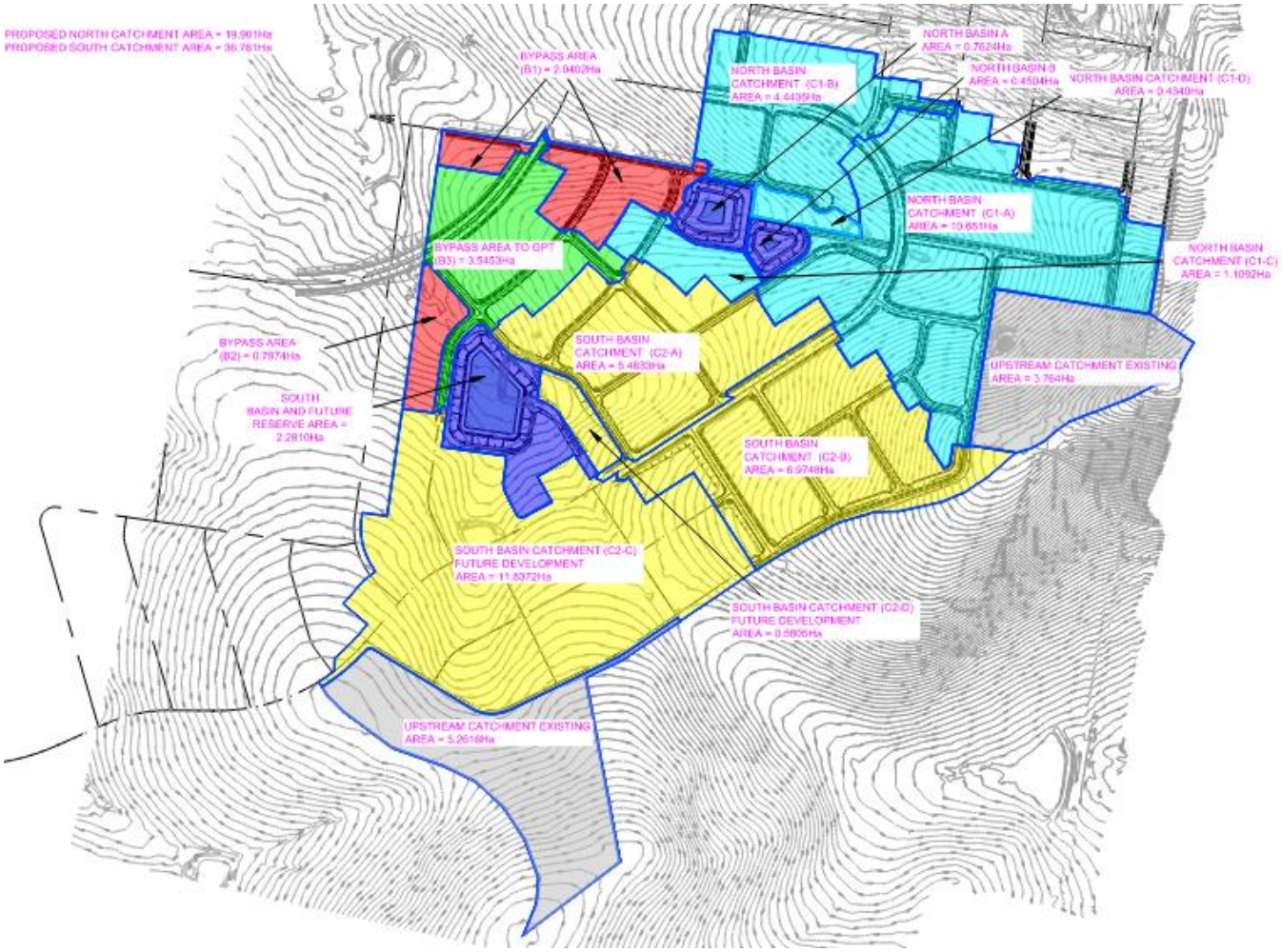

Figure 6 - Proposed Catchment Plan

4 Planning Guidelines

Developments within the Lochinvar Urban Release Area are subject to Council's DCP particularly, Part B - Environmental Guidelines, Part C - Design Guidelines and Part F9 – Lochinvar Urban Release Area.

4.1 DCP Part B: Environmental Guidelines

Future residential housing construction on the subject land will be subject to the general requirements of Council's DCP Part B with particular relevance in this report to Part B.2 – Domestic Stormwater. Domestic stormwater must be controlled through the use of on-site stormwater harvesting and retention systems to the requirements of the NSW State Government's Building Sustainability Index (BASIX). Although the implementation of on-site rainwater storage and harvesting will change the release of flow to the stormwater system, the effects of compliance with BASIX will be ignored for this report. In this report the discharge from all developed areas or lots within the site will be considered as uncontrolled flow with a 65% impervious and 35% pervious catchment.

4.2 DCP Part C: Design Guidelines

The following objectives are identified in the DCP as guiding subdivision design with respect to the stormwater impacts:

Objectives

- Provide an effective stormwater management system that is sustainable and requires minimal maintenance;
- Protect and enhance water quality/quantity and habitat value of downstream waterways and environment;
- Prevent erosion and runoff during site preparation, construction and ongoing use of the land to minimise cumulative impacts on receiving waterways;
- Retard the flow of water into the natural drainage system and mitigate impacts from stormwater runoff, ensuring that the rate of post-development stormwater discharge is no greater than the pre-development stormwater discharge;
- Cater for flows entering the site and ensure that there are no adverse effects from flows leaving the site;
- Encourage the use of rainwater tanks as a means of reducing separate stormwater detention requirements and achieving more sustainable water re-use within the dwelling and for landscaping purposes;
- Ensure that drainage systems are designed for safety and that the systems avoid any potential for stormwater inundation of habitable floor areas;
- To maintain and enhance the quality of water and catchment health.

4.3 1.3 DCP Part F9: Lochinvar Urban Release Area

Developments within the Lochinvar Urban Release Area are subject to Council's DCP Part F with the relevance to this report being Section 1.5 - Development Requirements - Stormwater & Water Quality Management Controls. The following guidelines and stormwater management controls are extracted from the DCP.

Stormwater & Water Quality Management Controls

- The stormwater and water quality management controls shall be consistent with the principles of Water Sensitive Urban Design (WSUD) Targets.
- The number and location of WSUD elements should be determined by modelling to develop the WSUD strategy for the site, and be integrated with the overall design and wider catchment.
- Long-term maintenance costs are to be identified in the design of the WSUD elements and are to be submitted to Council for consideration prior to acceptance of the WSUD strategy.
- Development Applications need to ensure that post-development stormwater flows do not exceed pre-development stormwater flows.
- Development applications are to identify Stormwater detention areas in accordance with the nominated locations identified in Figure 11, and supported by the flood Study prepared by ADW Johnson dated September 2015. It should be noted that the locations of the stormwater detention basins form part of the wider trunk drainage network, to which developers will be required to make contributions under the Lochinvar Section 94 Contributions Plan.
- Stormwater calculations shall be based upon the ultimate development state of the catchment. The time of concentration is the time from the most remote part of the catchment to the catchment outlet. (ie from the top of Greed Creek and Lochinvar Creek to the New England Highway)
- No development can occur in the Greedy Creek or Lochinvar Creek catchments unless sufficient regional basin(s) are constructed to mitigate any impacts on Hunter Close catchment.
- Minimum road widths may need to be increased on account of WSUD features such as swales.
- Swales may be accepted where it can be demonstrated that they will meet Council's performance and maintenance objectives and facilitate safe and effective movement of pedestrians and vehicles.
- Swales may be considered on the outside of perimeter roads where no residential access is provided. Swales shall not exceed 4% gradient.
- Flow control measures shall be used where grades in swales exceed 4%.
- Where practical, WSUD elements may be incorporated in a centre depressed median of dual carriage roads.
- Wherever possible, existing natural drainage gullies should form part of a stormwater and runoff drainage management system. Detention basins and / or wetlands to alleviate stormwater peaks and retain pollutants can be considered on-line only for 1st and 2nd order streams.
- Wetlands should be well-designed creating an attractive and safe amenity, and be highly visible for both the adjoining residents and passers-by.
- Walking paths should have frequent contact adjacent to the wetland edge.
- Vegetation should be designed such that generous unobstructed view of the wetland is available.
- Emergent macrophytes should be minimal and manageable.
- Slopes surrounding wetlands should be gentle and offer convenient tractor mowing access.
- Flat grassed areas that potentially may be water-logged should be avoided.
- Gullies intended to be left in their natural state should be assessed, and if necessary enhanced to offset the need for maintenance.
- In general, grassed areas must be kept to a minimum for maintenance purposes, and wetland and gullies should offer a sense of ownership to the public.

5 Flooding Assessment

The subject land is located on the eastern half and upper reaches of the Lochinvar Creek Catchment that drains under the New England Highway to the Hunter River. The contributing catchment is presented in Attachment B and is identified as being above the 1 in 100 year planning flood level.

The subject land is significantly elevated above the Hunter River and is consequently not subject to backwater flooding from the Hunter River.

5.1 Flood Studies

A study by ADW Johnson in 2015 considered the flooding impacts within the Lochinvar Urban Release Area as a result of rainfall on the contributing catchment. The ADW study quantified the peak flood flows in each of the main tributaries of Lochinvar Creek, including the watercourses across the subject land and provided comment on proposed capital works for major culvert and detention basins located through the Lochinvar Urban Release Area.

All basins within the proposed development are not identified as capital works and will be considered in context with the proposed road layout to optimise the areas required for development and stormwater treatment.

6 Water Quality

6.1 Water Quality Analysis

Water quality modelling was performed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) program. The MUSIC model was established using the parameters recommended in the draft MUSIC modelling guidelines[1] for source and pollutant nodes. Soil parameters were based on a clay soil in accordance with the modelling guidelines. Rainfall and evapo-transpiration data spanned a 12-year simulation period of 6 minute rainfall increments from 1997 to 2009.

The method of compliance used in this design is a NORBE approach where the post-development pollutant loads from the site is reduced back to that of the pre-development volumes which is an acceptable approach used widely.

6.2 Treatment Controls

Gross pollutants and coarse suspended sediments will be collected using Gross Pollutant Trap's (GPT) which were adopted from proprietary MUSIC nodes obtained from Humes. The high-flow bypass for the GPT nodes was set to ensure full capture of the 1 in 3-month design flow so as to satisfy the litter pollutant treatment target. The GPT's comprise of HumeGuard's that range in size from the HG18 up to a HG30. Larger flows arriving at the basins will be surcharged via splitter pit arrangements into the basin to reduce the size of each of these units and are to be placed at every piped discharge point in the system where possible.

A summary of the treatment node parameters is provided in Table 4.

The wetland basins were modelled as wetland nodes with parameters as outlined in Table 4. Rainwater tanks for each lot were not modelled for simplicity. The MUSIC model schematic is provided in Appendix A and the catchment plan is shown in Appendix B.

Table 4 MUSIC Wetland Treatment Node Parameters

Parameter	NORTH A	NORTH B	SOUTH
Source Node Area (ha)	19.901		31.499
Area Draining to Basin	11.545		27.157
Area Bypassing Basin	2.040		4.343
Low-flow bypass (m^3/s)	0	0	0
High-flow bypass (m^3/s)	100	100	100
Surface area (m^2)	2892.6	1563.3	7389.4
Extended Detention Depth (m)	0.20	0.20	0.20
Permanent Pool Volume (m^3)	3110.7	1210.9	6095.7
Initial Volume (m^3)	3110.7	1210.9	6095.7
Vegetation Cover (% of surface area)	10	10.0	10
Exfiltration Rate (mm/hr)	0	0	0
Evaporative Loss as of %PET	125	125	125
Equivalent Pipe Diameter (mm)	55	35	55
Overflow Weir Width (metre)	300	300	300
Notional Detention Time (hrs)	51	68	130

6.3 Results

The modelled mean annual concentrations for each pollutant type; Total Suspended Sediment (TSS), Total Phosphorus (TP), Total Nitrogen (TN) and Gross Pollutants (GP) are shown below in Table 5 for the complete site.

Table 5 Total Catchment Treatment Train

Pollutants	TSS	TP	TN	GP
	kg/yr	kg/yr	kg/yr	kg/yr
Post-Development Receiving Node	10400	30.5	394	586
Pre-Development Receiving Node	22000	62.9	460	2160

The MUSIC model results show compliance with NoRBE treatment requirements.

7 Water Quantity

7.1 Hydrology

A computer model was established using DRAINS software to model 50% AEP, 20% AEP, 10% AEP, 5% AEP and 1% AEP storm events using the recommended parameters in Australian Rainfall and Runoff 2019.

7.2 Rainfall

Rainfall at each node was simulated from temporal patterns for storm events ranging from 15 minutes through to 720minutes. Appendix B contains output plots for each storm event and catchment.

7.3 Fraction Impervious

Each catchment was considered as 100% pervious in the pre-developed condition to reflect the pasture land present on the site. Impervious contributing areas for the existing dwelling and Winders Lane were ignored for the pre-developed case. The developed catchments were modelled having 65% impervious area in the post –developed case.

7.4 Loss Model

The Horton infiltration curve was implemented in the hydrology with a clay soil (ILSAX soil type 3) and Antecedent Moisture Condition (AMC) of 3, representing relatively wet conditions prior to start of storm.

7.5 Time of Concentration

Time of concentration for each of the model nodes was based on the Kinematic Wave equations adopted in AR&R. The surface roughness coefficient adopted was n=0.21 for urban lots in accordance with Council's Manual of Engineering Standards. The results of such analysis generally gave minimum times of 5 minutes for directly connected impervious surfaces such as roads and roofs, and pervious area times dependent on flow path length, slope and roughness.

The pre-developed flows were determined by splitting up the North and South catchments into smaller sub-catchments (Less than 10Ha) to more accurately calculated pre-development runoff. Attachment B includes a pre-development catchment plan.

7.6 Southern Basin Future Layout Plan

The southern detention and water quality basin is proposed to capture future upstream development stages which will form part of a separate application. To indicate how this will connect with the proposed design for stages 8-15 an indicative plan has been prepared.

The drawing presented is presented in Attachment C.

7.7 Water Quantity Results

Stormwater quantity results were analysed for individual basins as well as overall catchment scenarios. The results for each basin at are detailed in Table 6 below.

Table 6 Basin Discharge Summary

Basin	North Basin A		North Basin B		South Basin	
Storm Events	**FLOW (m^3/s)**	**TWL (m)**	**FLOW (m^3/s)**	**TWL (m)**	**FLOW (m^3/s)**	**TWL (m)**
50%	0.372	46.26	0.92	47.91	0.31	42.51
20%	0.797	46.63	1.08	48.19	0.98	42.79
10%	1.05	46.79	1.16	48.42	1.30	42.95
5%	1.38	46.90	1.28	48.67	1.43	43.11
2%	1.74	46.97	1.49	49.04	1.90	43.34
1%	2..02	47.03	1.57	49.32	2.04	43.57

Results for the stormwater modelling are shown in Table 7 below and show the pre-developed flows for each catchment as well as the post developed attenuated flows. The results indicate that the developed system adequately reduces the peak discharge to less than or equal to the pre-developed discharge from the development.

Table 7 - Stormwater Peak Outflow Result

	North Catchment (North Basin A and B)				South Catchment (South Basin)			
	Predeveloped Results		Post-developed Results		Predeveloped Results		Post-developed Results	
AEP Event	**Peak Outflow Q (L/s)**	**Storm Duration (ID)**	**Peak Outflow Q (L/s)**	**Storm Duration (ID)**	**Peak Outflow Q (L/s)**	**Storm Duration (ID)**	**Peak Outflow Q (L/s)**	**Storm Duration (ID)**
50%	508	6 hour (Storm 5)	479	1h (Storm 5)	678	6h (Storm 5)	617	30m (Storm 4)
20%	857	3 hour (Storm 4)	800	2 hour (Storm 5)	1,180	6h (Storm 5)	1,160	6h (Storm 6)
10%	1,200	3 hour (Storm 6)	1,160	3 hour (Storm 4)	1,670	6h (Storm 2)	1,580	2h (Storm 6)
5%	1,530	3 hour (Storm 6)	1,500	3 hour (Storm 8)	2,180	6h (Storm 2)	1,870	2h (Storm 7)
2%	2,160	90 min (Storm 5)	1,880	2 hour (Storm 7)	2,840	2h (Storm 6)	2,450	90m (Storm 5)
1%	2,680	90 min (Storm 5)	2,340	90 min (Storm 5)	3,590	2h (Storm 6)	2,780	2h (Storm 4)

8 Maintenance

Stormwater controls located in the road reserve or drainage reserve are to be ultimately managed and maintained by Maitland City Council. Sediments and gross pollutants will be collected in gross pollutant traps, located in accessible locations near the inlet to each basin. The GPT unit should be cleaned every twelve months or following each major event, with an inspection carried out once in every three months.

The ultimate maintenance burden for the wetland basins will be fully borne by Council. Macrophyte planting is to be monitored to ensure adequate treatment of pollutants.

Basins are susceptible to inundation during a storm event. This presents a safety risk to Council; appropriate signage would be required to warn the public of the danger.

The frequency of maintenance is higher for the primary treatment (GPT) and lesser for the secondary treatment (wetland basins). The configuration of these control structures will be designed to reflect the need to access these for maintenance purposes based on the maintenance frequency.

9 Recommendations

The investigations undertaken in preparing this report have shown that the stormwater generated from the proposed development can be adequately managed through the provision of appropriate drainage basins and water quality infrastructure on the site.

The specific results from the investigations undertaken have demonstrated that:

1. The proposed development provides three OSD basins that reduce the post development flows down sufficiently to enable the peak flows from the post development scenario to be reduced down to levels of no more than the pre-development peaks.
2. The basins are large enough to cater for water quality structures (Wetland basin) to be placed in the base of the basins. These wetland basins together with GPT's placed at the entry into the basins will reduce the pollutant load sufficiently to ensure the water quality requirements of post to pre are satisfied.

The implementation of the systems and measures described above would provide an adequate means of disposing of runoff generated by the proposed development on the site.

10 References

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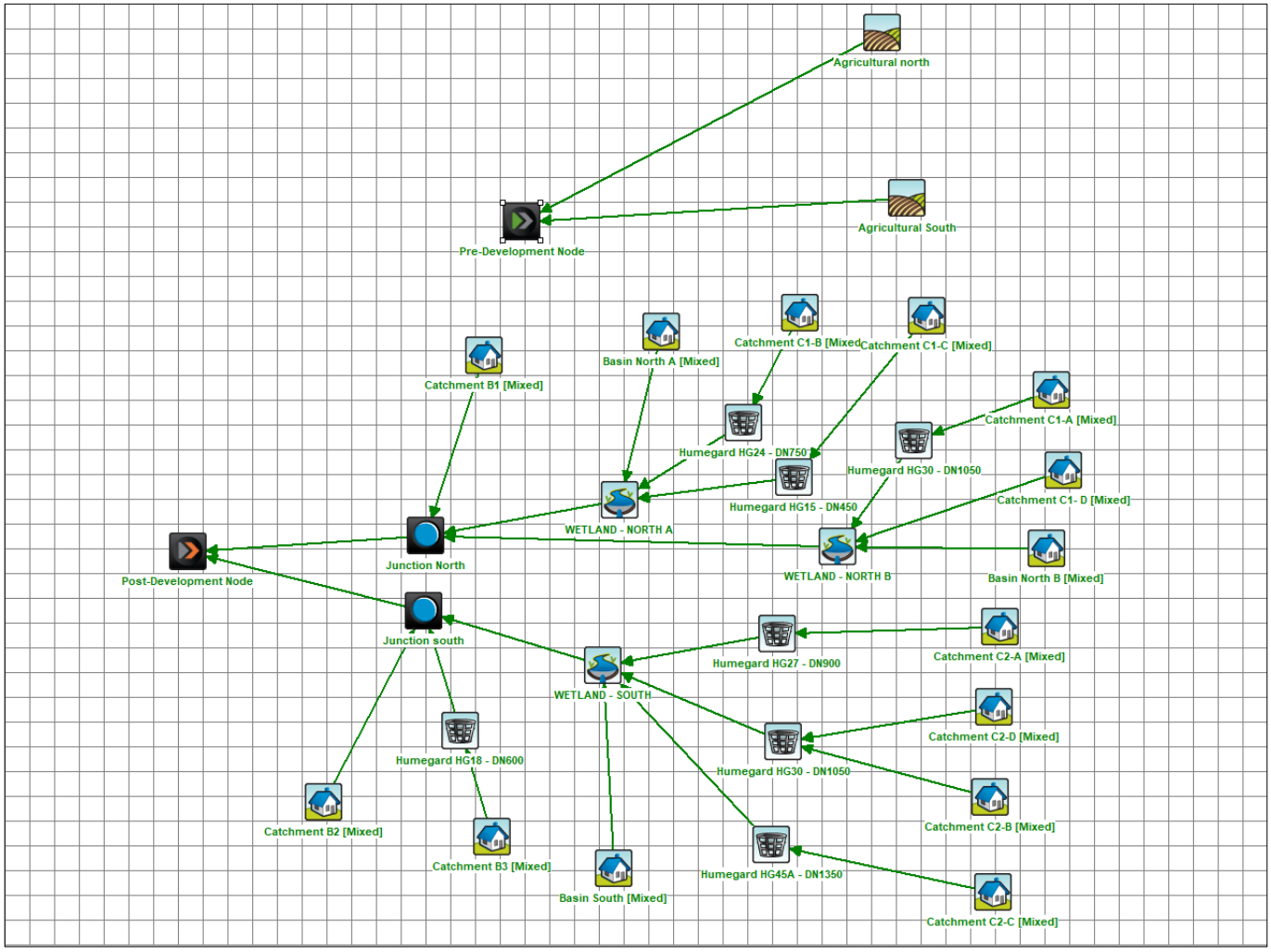
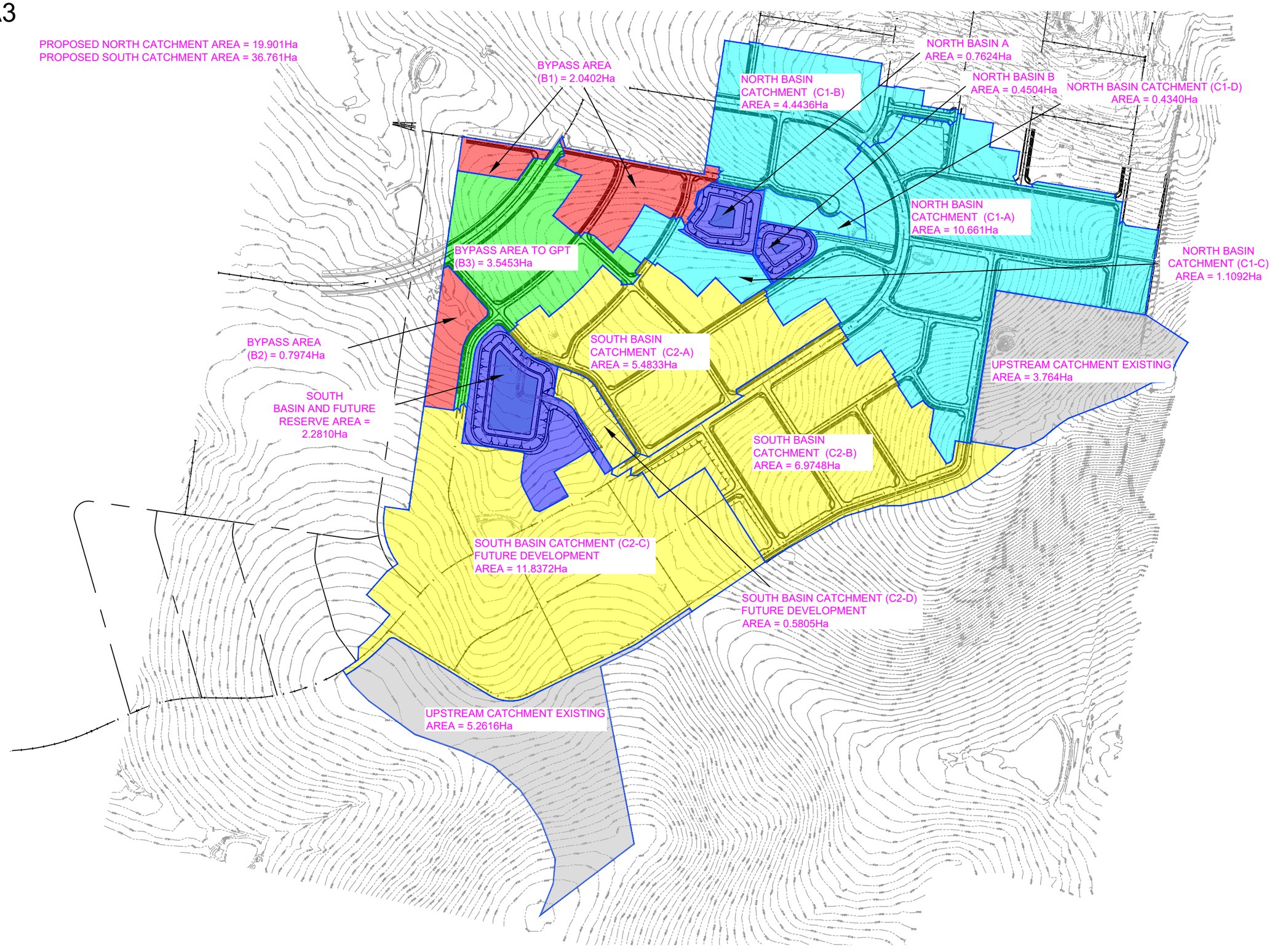
Attachment A – MUSIC MODEL


Agricultural north
Agricultural South
Pre-Development Node
Catchment C1-B [Mixed]
Catchment C1-C [Mixed]
Basin North A [Mixed]
Catchment B1 [Mixed]
Catchment C1-A [Mixed]
Humegard HG24 - DN750
Humegard HG30 - DN1050
Humegard HG15 - DN450
Catchment C1- D [Mixed]
WETLAND - NORTH A
Junction North
Post-Development Node
WETLAND - NORTH B
Basin North B [Mixed]
Junction south
Humegard HG27 - DN900
Catchment C2-A [Mixed]
WETLAND - SOUTH
Catchment C2-D [Mixed]
Humegard HG18 - DN600
Humegard HG30 - DN1050
Catchment C2-B [Mixed]
Catchment B2 [Mixed]
Catchment B3 [Mixed]
Humegard HG45A - DN1350
Basin South [Mixed]
Catchment C2-C [Mixed]

Attachment B – Catchment Plans

A3



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METRES
1:5000

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B	RESPONSE TO COUNCIL RFI	JT	27/05/2022
C	RESPONSE TO COUNCIL RFI	JT	23/12/2022
D	REVISED LOT LAYOUT	AM	14/03/2023
E	FOR DA MODIFICATION	JT	15/11/2024

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HUNTER P: 02 4966 8388
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ABN: 26 134 067 842

Client: Urban. Land Housing

LOCHINVAR RIDGE
STAGES 8-15 DEVELOPMENT APPLICATION

ATTACHMENT B - MUSIC CATCHMENT PLAN

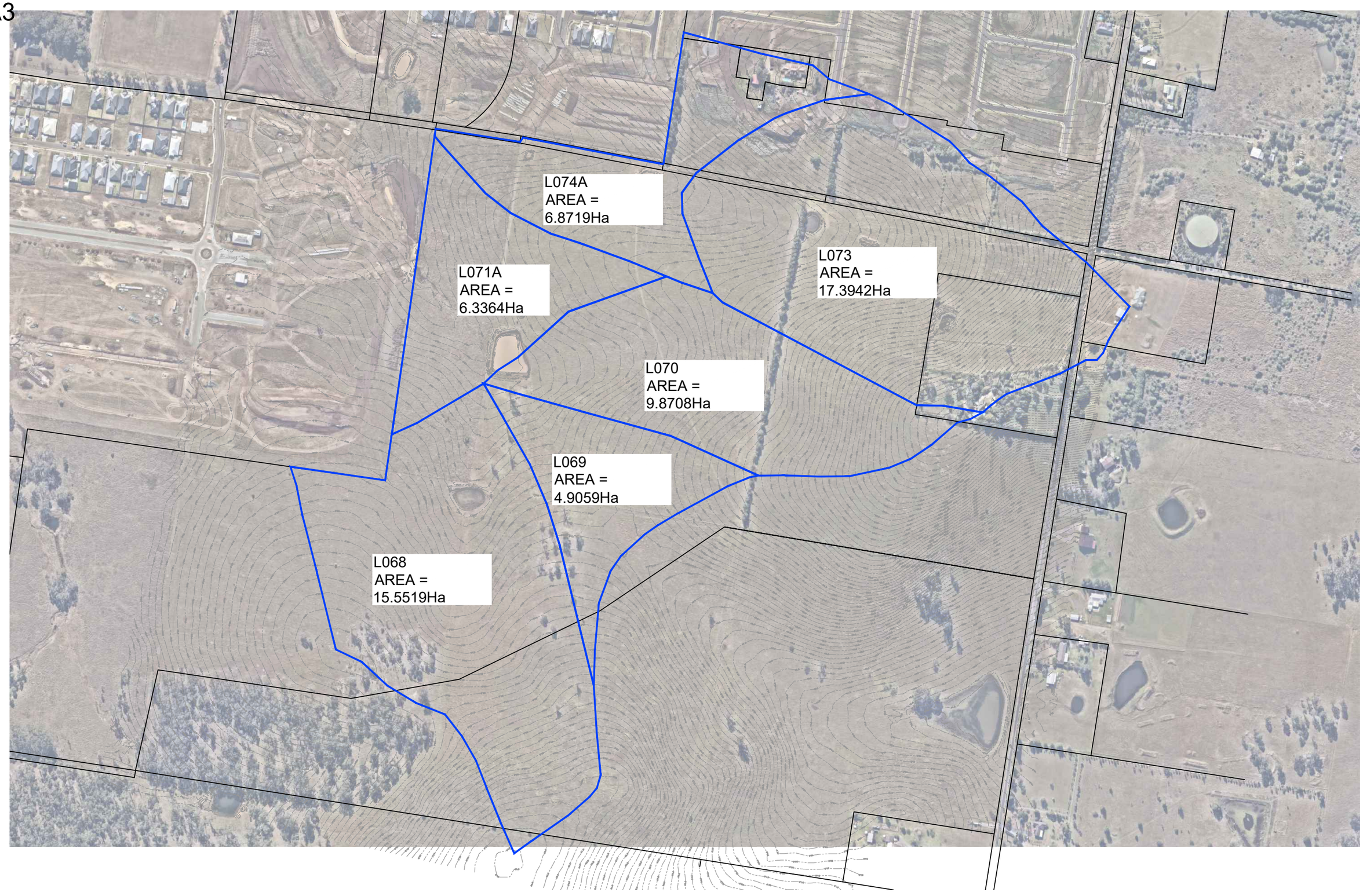
NORTH

Designed: JT
Drawn: JT
Checked: GJ

Scales: AS SHOWN
Datum: A.H.D.

Plan No. 14-046-01-801
File Ref. 14-046
REV. E

A3



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ATTACHMENT B - EXISTING CATCHMENT PLAN

NORTH

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Datum: A.H.D.

Plan No.
14-046-01-802
File Ref.
14-046
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METRES
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ATTACHMENT B - PROPOSED CATCHMENT PLAN SHEET 1

NORTH

Designed: JT
Drawn: JT
Checked: GJ

Scales: AS SHOWN
Datum: A.H.D.

Plan No. 14-046-01-803
File Ref. 14-046
REV. E

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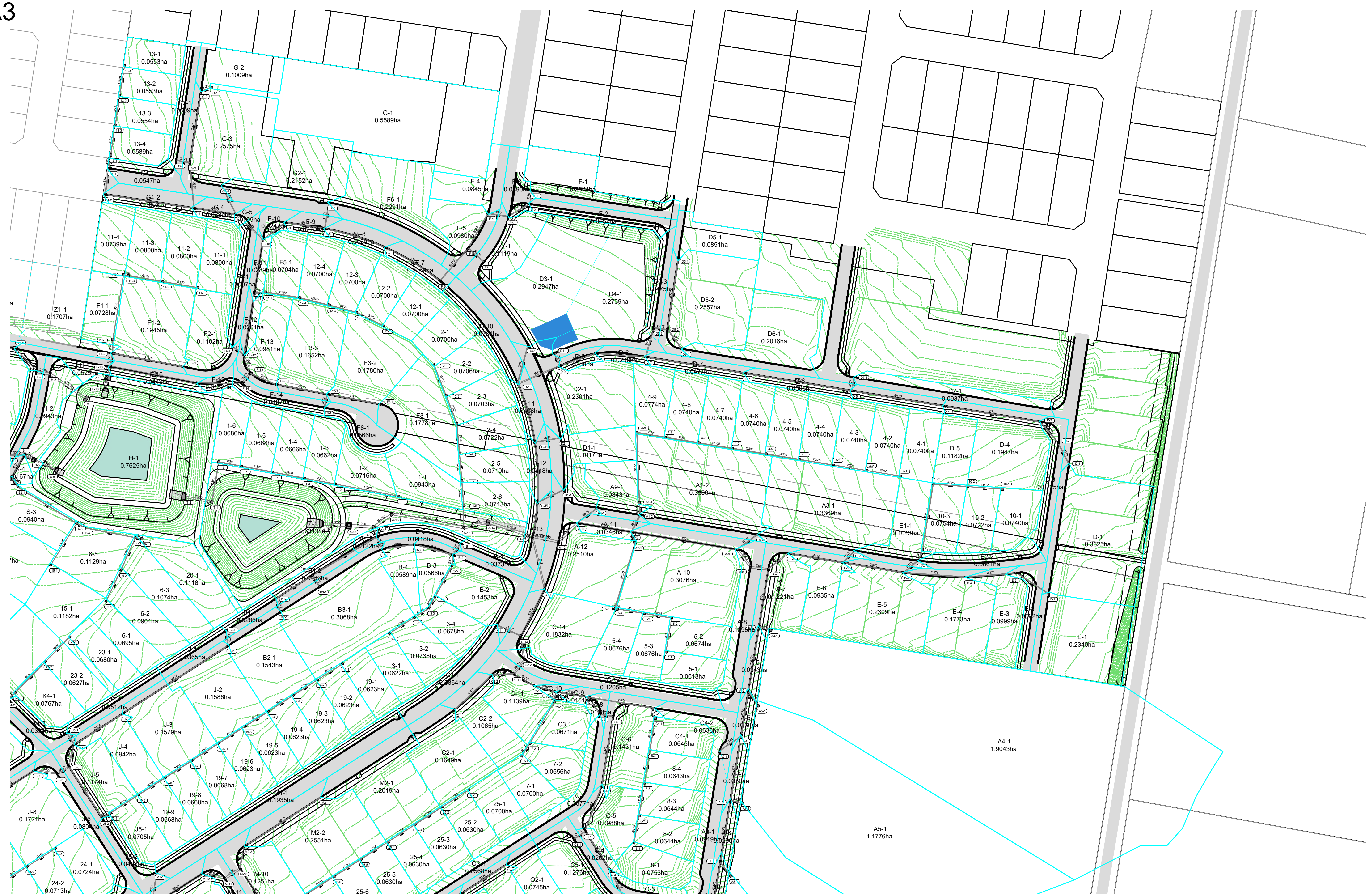

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LOCHINVAR RIDGE
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ATTACHMENT B - PROPOSED CATCHMENT PLAN SHEET 2

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Datum: A.H.D.

Plan No. 14-046-01-804
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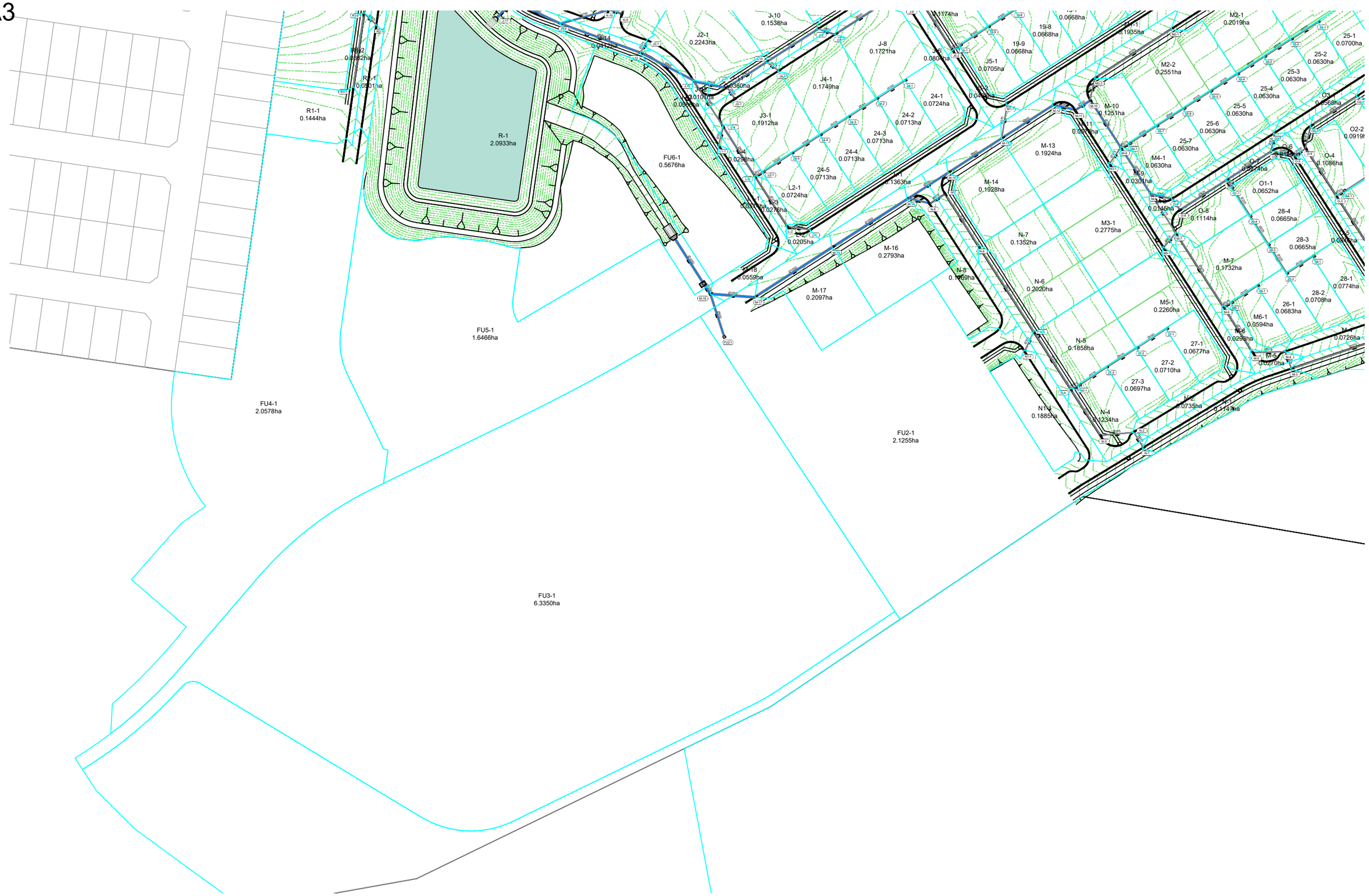

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ATTACHMENT B - PROPOSED CATCHMENT PLAN SHEET 3

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Datum: A.H.D.

Plan No.
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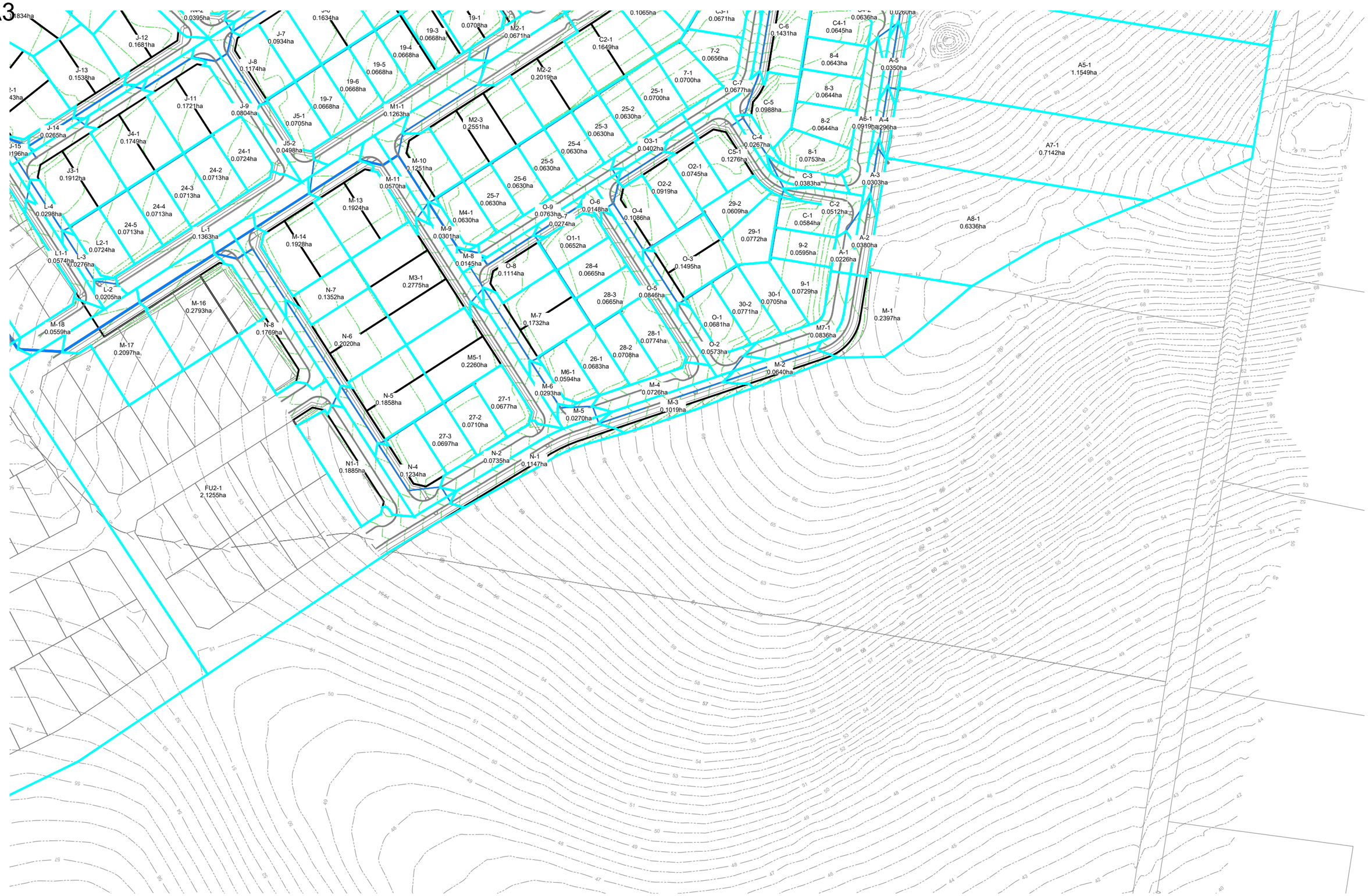

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STAGES 8-15 CONCEPT DESIGN

ATTACHMENT B - PROPOSED CATCHMENT PLAN SHEET 4

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Scales: AS SHOWN
Datum: A.H.D.

Plan No. 14-046-01-806
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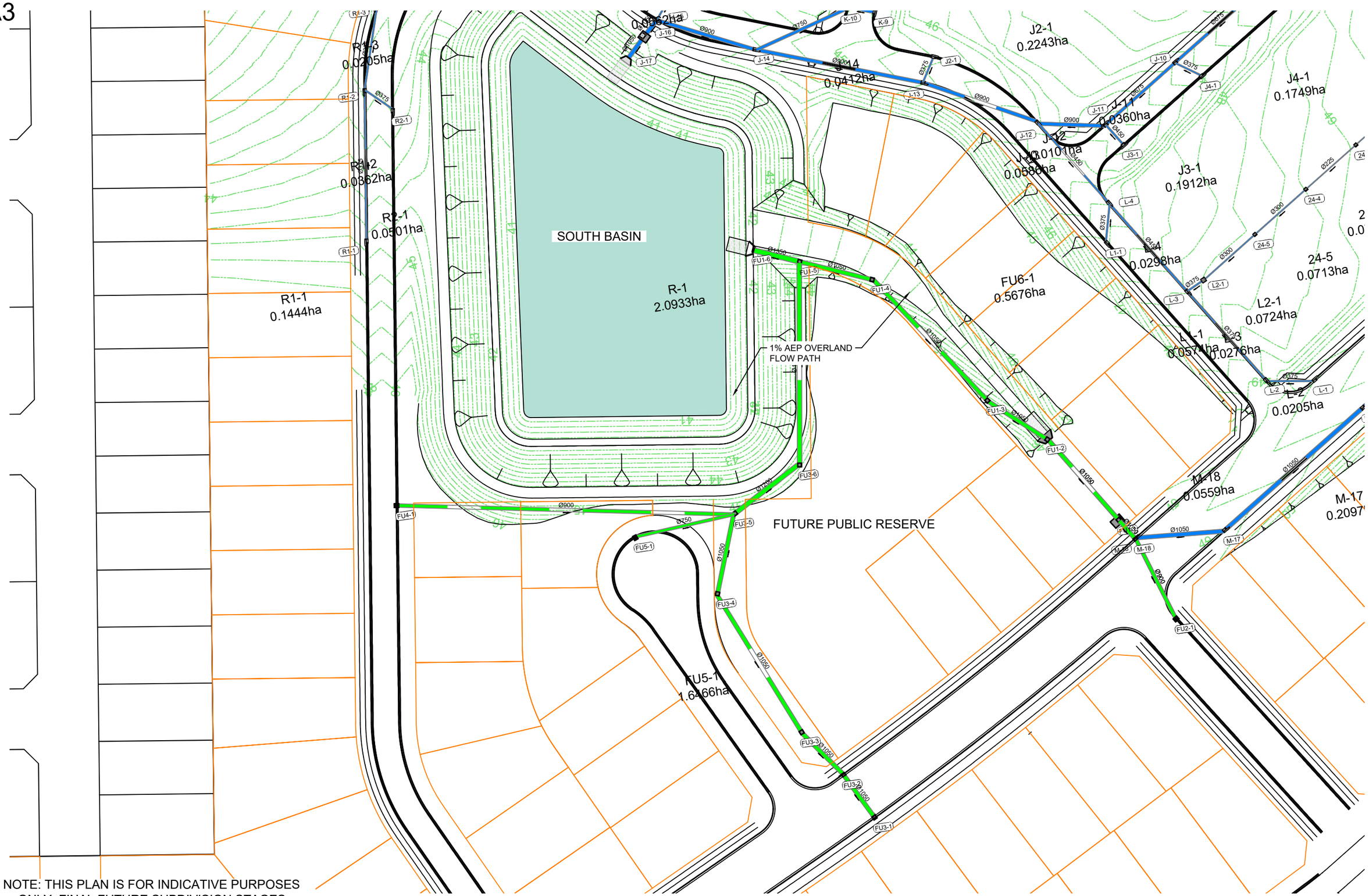
REV. D

Attachment C – Indicative Future Layout Plan

A3



NOTE: THIS PLAN IS FOR INDICATIVE PURPOSES ONLY. FINAL FUTURE SUBDIVISION STAGES SUBJECT TO CHANGE.

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LOCHINVAR RIDGE
STAGES 8-15 DEVELOPMENT APPLICATION

ATTACHMENT C - INDICATIVE FUTURE LAYOUT FOR SOUTHERN BASIN

NORTH

Designed: JT
Drawn: JT
Checked: GJ

Scales: AS SHOWN
Datum: A.H.D.

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