

TE MIRO WATER

STORMWATER MANAGEMENT PLAN

LOCHRIDGE ESTATE

September 2026



Version Control

Version	Date	Author	Reviewer	Change Description
1.0	21 September 2026	Arun Gopi and Saeid Nia	John Male and Mike Chapman	DRAFT
2.0	23 September 2026	Arun Gopi and Saeid Nia	John Male and Mike Chapman	FINAL

This report has been prepared for Lochridge Estate Limited for the project described to us and its extent is limited to the scope of work agreed between the client and Te Miro Water Limited and the data available for the design and/or model build. No responsibility is accepted by Te Miro Water Limited, or its directors, servants, agents, staff, employees, or subcontractors related to the inherent flood model limitations, or the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purpose.

The modelled flood levels are based on an existing ground surface generated from LIDAR. We recommend a site survey is undertaken of existing levels to compare to LIDAR prior to setting any foundation or floor level.

TE MIRO. WATER

SUMMARY OF COMPLIANCE

GEOTECH	No geotechnical assessment has been undertaken for the site. Landcare Research S-Maps shows the site is dominated by well-draining, allophonic and pumice soil. As per Taupo District Council Code of Practice for Development of Land, in the absence of comprehensive on-site soakage tests, the maximum soakage rate in natural pumice conditions is to be assumed as no more than 1500mm/hr. Based on this, a design soakage rate of 750mm/hr has been used for on-lot soakage device designs with a factor of safety of 2.
RECEIVING ENVIRONMENTT	The existing site runoff flows through overland flow paths (OLFPs) and gullies within the development site. It is proposed that these OLFPs remain as the receiving environment for secondary flows, eventually discharging to the Otakatake Stream on the west and Okaia Stream on the east of the site.
WATER QUALITY	Water quality (WQ) will be managed via roadside swales treating runoff from the road surfaces. Grassed swales have been sized to provide a residence time of greater than 9 minutes, achieving treatment requirements. Dual treatment has been proposed for the new road sections, and this is achieved via four centralized bioretention devices positioned near the low point of the road catchments.
INITIAL ABSTRACTION	Initial abstraction (Ia) will be managed via centralized bioretention devices for the road catchments and via soakage onsite for the individual lots. The lots will also have on-lot tanks for water supply.
EXTENDED DETENTION VOLUME	The extended detention volume (EDV) will be managed via centralized bioretention devices for the road catchments and via on-lot soakage and rain tanks for the individual lots.
PRIMARY STORMWATER MANAGEMENT	Primary stormwater management, up to the 10-year ARI event, will be managed on-lot via onsite soakage system. This includes on-site soakage for the JOALs and shared accessways as well. The primary event for the road reserves will be managed via conveyance through the swale network and discharge to the OLFPs and gullies.
OVERLAND FLOW PATHS AND SECONDARY STORMWATER MANAGEMENT	OLFP and secondary stormwater conveyance above the 10-year ARI event will be managed by mimicking the existing OLFPs and via some diversion swales within the development. The diversion swales will manage the overland flows safely through the site away from the building pads and discharge to the gullies at appropriate outlet locations. All outlets will be provided with scour protection designed for the 100-year ARI storm event.

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1 WHAKATAKINGA | INTRODUCTION

Te Miro Water Consultants Limited (TMW) has been engaged by Lochridge Estate Limited to prepare a Stormwater Management Plan (SMP) for the Lochridge Estate development located within Kinloch, Taupō, New Zealand. The development comprises a rural large-lot residential subdivision incorporating residential building platforms, internal roads, right of ways, shared accessways and jointly owned access lots. The purpose of this SMP is to demonstrate how stormwater generated from the development will be managed in a manner that protects receiving environments, maintains natural hydrological processes, and aligns with current stormwater design guidance and best practice.

Lochridge Estate is a rural large-lot residential subdivision located in Kinloch, Taupō (Figure 1). The development incorporates residential lots, internal roads, jointly owned access lots (JOALs), rights of way and shared accessways within a predominantly pastoral landscape.

This Stormwater Management Plan outlines the existing site conditions, receiving environment and proposed stormwater management framework for the development (Figure 2). The report demonstrates how stormwater will be managed in accordance with applicable regulatory requirements while maintaining the site's natural drainage characteristics.

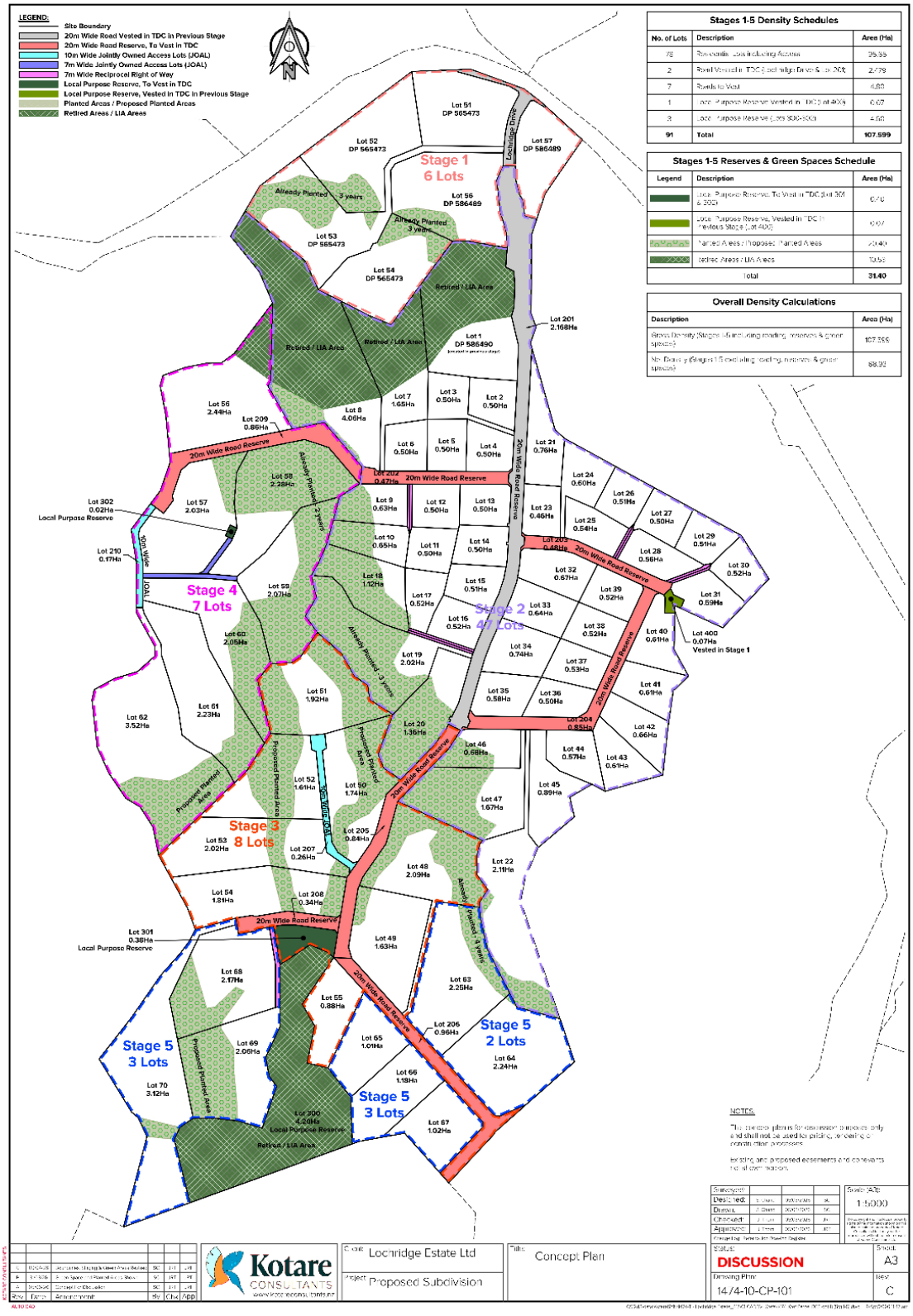


Figure 1. Lochridge Estate.

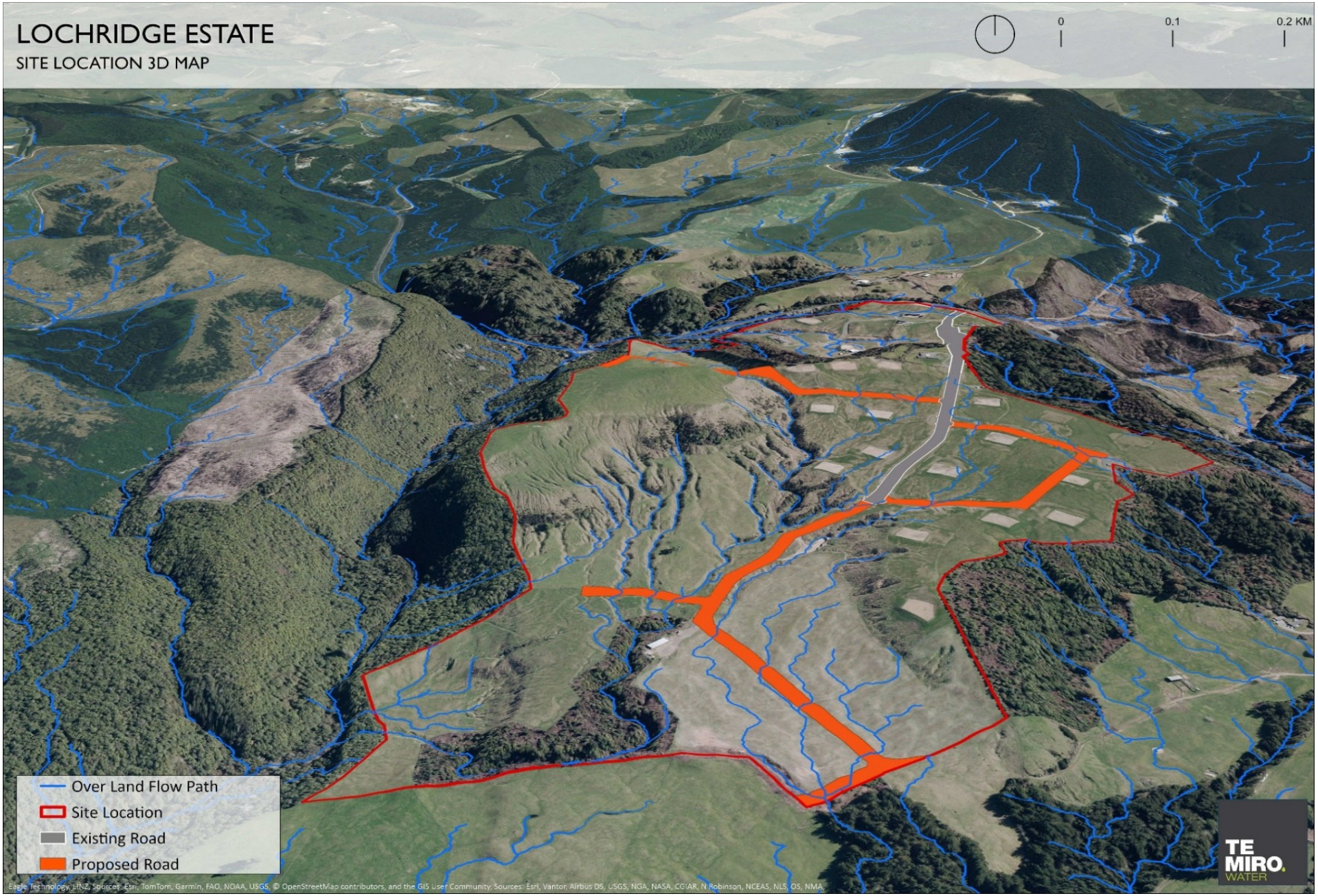


Figure 2. Existing site conditions with existing and proposed road and OLFP.

The stormwater management is summarised as follows:

- Initial abstraction (Ia) and Extended Detention Volume (EDV) provided via soakage and centralised bioretention devices.
- On-lot rainwater tanks (for water supply), overflowing to soakage, will be required to privately manage individual lot runoff up to the 10-year ARI event. Roofs are to be non-contaminating material.
- On-lot soakage systems will be sized to manage the 10-year ARI event runoff from all impervious areas within the lots (including driveways, roofs and other hardstand areas).
- Grassed swales provide water quality treatment for all new road runoff and provide safe conveyance to the appropriate outlet locations.
- Centralised bioretention devices provide secondary treatment of road runoff and hence assist in achieving dual treatment for all new road catchments.
- The shared accessways, JOALs and ROWs are provided with swales for treatment and soakholes to manage runoff up to the 10-year ARI event.
- Secondary stormwater conveyance above the 10-year ARI event will be managed by mimicking the existing overland flow paths and via some diversion swales within the development. The diversion swales will manage the overland flows safely through the site away from the building pads and discharge to the gullies at appropriate outlet locations.
- All outlets will be provided with scour protection designed for the 100-year ARI storm event.

1.1 OBJECTIVES

The purpose of this Stormwater Management Plan (SMP) is to provide a stormwater management framework for the Lochridge Estate rural large-lot residential development in Kinloch, Taupō. The SMP has been prepared to demonstrate that stormwater generated from the development can be managed in a sustainable manner that protects receiving environments, maintains natural drainage patterns, and aligns with current stormwater management best practice.

The objectives of the SMP are to:

- Incorporate a water sensitive design approach that manages the impacts of the rural residential subdivision with respect to Te Ture Whaimana o Te Awa o Waikato, RITS and WRC guidelines.
- Provide stormwater quality treatment for roads and hardstand surfaces.
- Avoid high contaminant yielding roof/cladding materials.
- Ensure scour and erosion are mitigated through EDV, Ia management, swale networks with non-erosive velocities, and riprap protection at overland flow path outlet locations to receiving environments.

- Retain and utilise existing overland flow paths, gullies, and natural drainage features to safely convey secondary stormwater flows during larger rainfall events while avoiding adverse effects on neighbouring properties and downstream environments.
- Provide a robust and maintainable stormwater solution that supports the long-term operation of the development while preserving the low-density rural-residential character of Lochridge Estate.

The overall objective of the proposed stormwater management approach is to mimic the site's natural drainage processes by managing stormwater close to its source through rainwater harvesting, soakage disposal, and swale treatment systems, thereby reducing runoff volumes and protecting downstream receiving environments.

1.2 RELEVANT PROVISIONS

This technical design document has been developed with consideration given to the relevant provisions in the following statutory and guidance documents:

- Resource Management Act 1991 (RMA)
- Te Ture Whaimana o Te Awa o Waikato (Vision and Strategy for the Waikato River)
- Waikato Regional Plan
- Waikato Regional Infrastructure Technical Specifications (RITS)
- Waikato Regional Council Stormwater Guideline (TR2020/07)
- Taupō District Council Code of Practice for Development of Land
- New Zealand Building Code Clause E1 Surface Water
- NZS 4404:2010 Land Development and Subdivision Infrastructure

2 WHAKAMĀRAMA WHĀNUI | BACKGROUND

Lochridge Estate is an existing residential development that has previously been granted resource consent, with a portion of the development already constructed. Stage 1 has been completed in accordance with the approved design and is not proposed to be altered as part of the current development proposal.

The remaining stages of the development, comprising Stages 2 to 5, are proposed to be developed in accordance with the revised layout, with intensification proposed for Stage 2 only. The proposed changes include revisions to lot sizes, lot configuration and stage boundaries. As these changes differ from the currently consented development, a variation to the existing resource consent is required.

This Stormwater Management Plan (SMP) has been prepared to support the proposed consent variation. The SMP documents the revised development proposal and establishes an updated stormwater management framework for the remaining stages of Lochridge Estate. In particular, the SMP considers the changes to the development layout, lot sizes and staging, and identifies the proposed stormwater management approach for both the public and private components of the development.

The stormwater management strategy has been developed with reference to current stormwater management guidelines, relevant regulatory requirements and contemporary best-practice principles. The SMP provides a framework for managing stormwater quantity, water quality and overland flow paths, while recognising that detailed design elements will be developed and confirmed as the individual stages progress.

The completed Stage 1 infrastructure is treated as an existing condition within this assessment and remains unchanged. The focus of this SMP is therefore on the proposed changes associated with Stages 2 to 5 and the integration of the revised stormwater management system with the existing and previously consented infrastructure.

The site comprises gently undulating terrain with established drainage depressions and vegetated gullies that form the primary stormwater pathways. Existing runoff is conveyed through these natural features before discharging to the wider receiving environment.

2.1 EXISITING CATCHMENT AND TOPOGRAPHY

Lochridge Estate is located within the Kinloch area on the north-western side of Lake Taupō and comprises a rural large-lot residential development situated on elevated land overlooking the surrounding landscape. The site occupies a predominantly pastoral setting and has been developed around the existing topography, with building platforms established on suitable elevated areas while retaining significant areas of open grassed land and natural vegetation.

The site is characterised by gently undulating terrain with localised ridgelines, shallow depressions and several prominent gullies located around the perimeter of the development area. Existing ground levels generally fall from the central and northern portions of the site towards the surrounding gullies and lower-lying drainage corridors. These landforms have naturally influenced the pattern of stormwater runoff and continue to provide the primary conveyance pathways for overland flow during larger rainfall events.



Figure 3. Current land use.

The current land use (Figure 3) is predominantly pastoral grassland with limited existing impervious surfaces. Development has been undertaken at a relatively low density, with large residential lots and substantial open space retained between building platforms. As a result, the proportion of impervious area across the catchment remains low when compared with a conventional urban subdivision. This allows stormwater management to focus on source control and infiltration-based solutions rather than extensive piped reticulation systems.

Existing runoff from the site is understood to occur predominantly as shallow sheet flow across the grassed surfaces before converging into local depressions and natural drainage features. The surrounding gullies and vegetated drainage corridors provide the primary receiving environments for both existing and future stormwater flows. No upstream urban catchments discharge through the site, with runoff generally generated from local rainfall falling directly within the development area.

The subdivision layout has been designed to generally maintain the existing drainage regime by preserving natural overland flow paths and directing stormwater towards existing drainage corridors. The proposed stormwater management approach therefore seeks to mimic the site's natural hydrological processes by utilising on-lot

soakage systems, rainwater harvesting, and roadside swales to infiltrate and treat stormwater prior to discharge to the existing receiving environment.

Overall, the site's gently rolling topography, low impervious coverage, and presence of natural drainage features make it well suited to a water-sensitive stormwater management approach that promotes groundwater recharge, minimises runoff volumes, and protects the surrounding receiving environments. Figure shows the existing catchments map and Figure 5 shows the topography heat map created from LIDAR 1m DEM.

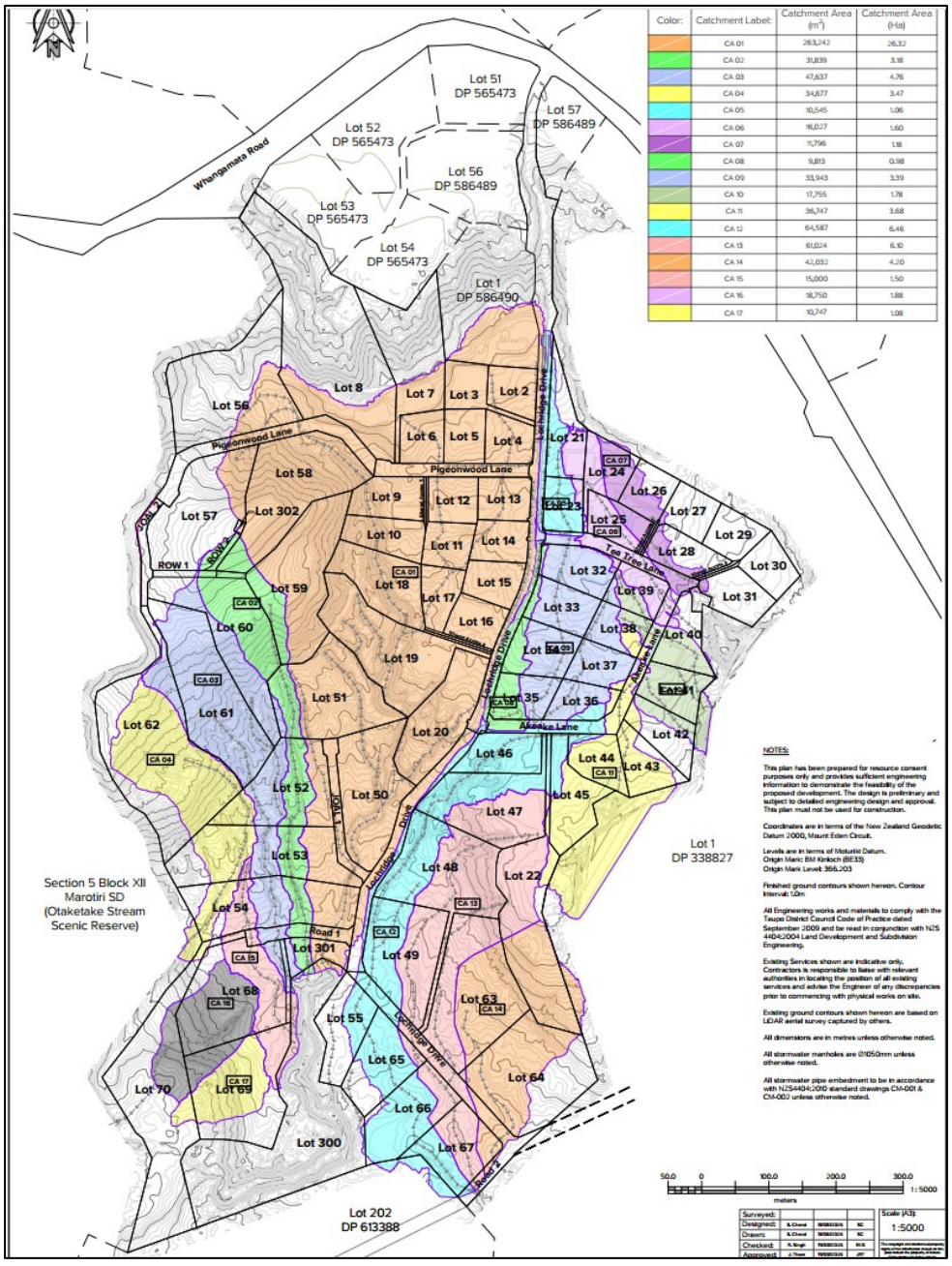


Figure 4. Existing catchment map (pre-development)

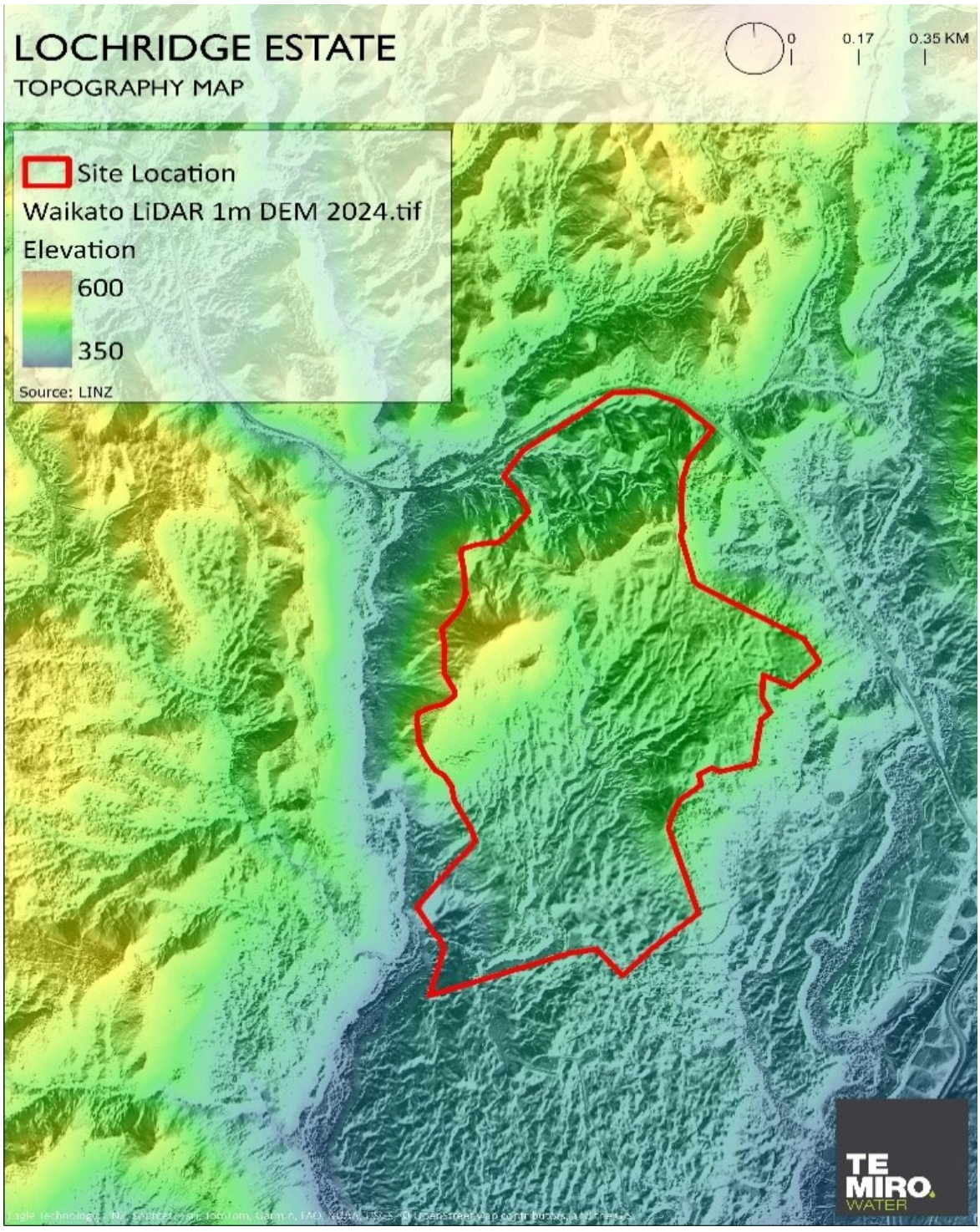


Figure 5. Site topography, created from Waikato LIDAR 1m DEM 2024.

2.1.1 Overland Flow Paths

The Lochridge Estate site contains several natural drainage depressions and overland flow pathways that have developed in response to the existing topography. These gullies form the primary receiving environments for secondary stormwater flows and provide a natural conveyance mechanism for runoff generated during larger rainfall events.

Based on the existing site topography, there are no upstream urban catchments discharging through the development area. Existing overland flow paths are predominantly generated by local runoff from within the site and are intercepted by the surrounding natural drainage features. The runoff follows shallow flow paths across grassed surfaces, ultimately discharging towards the gullies located along the site boundaries.

The subdivision design has generally been developed to work with the existing topography and maintain these natural drainage patterns. Existing low points and drainage corridors have been retained wherever practicable, allowing secondary stormwater flows to continue following natural pathways during larger storm events. This approach reduces the need for extensive stormwater infrastructure and assists in maintaining the pre-development hydrological regime.

Figure shows the overland flow path in existing site conditions.

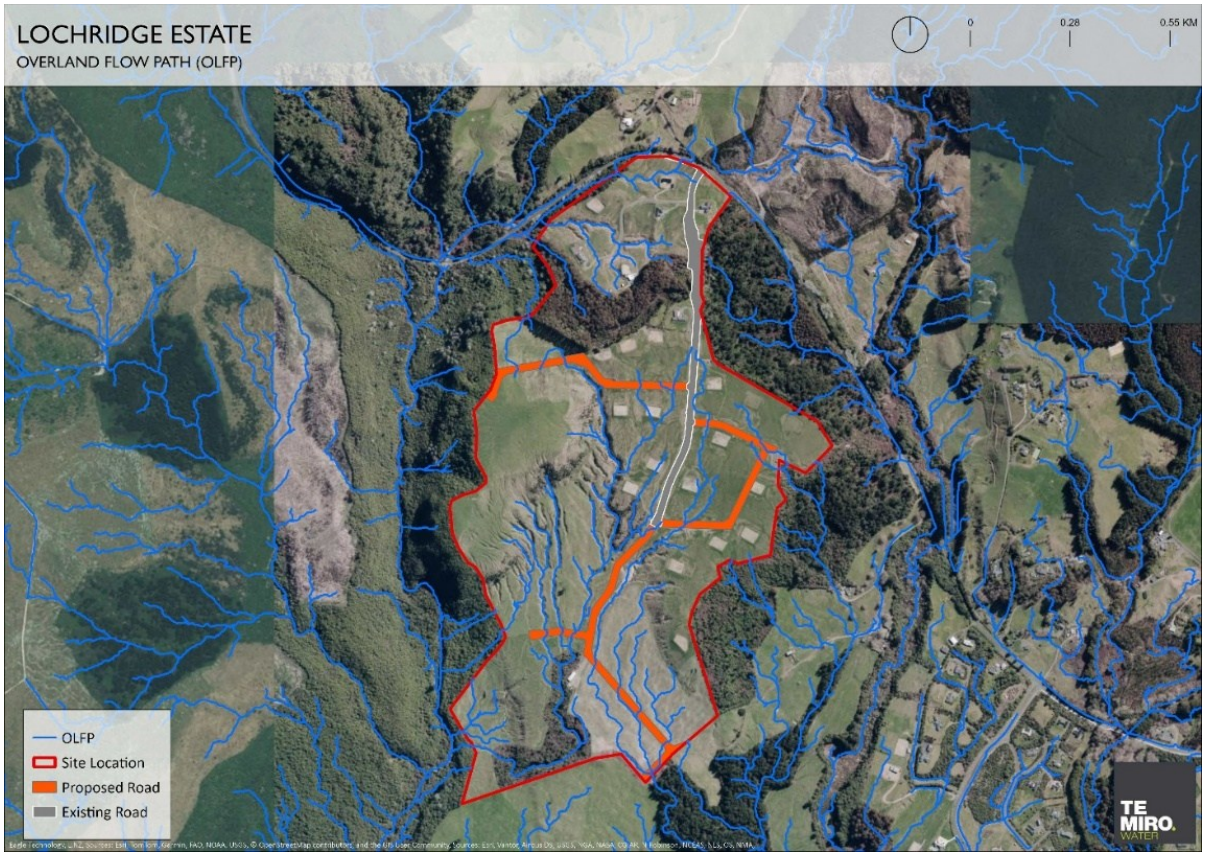


Figure 6. Overland Flow Path in existing conditions.

2.2 SOILS, GROUNDWATER, AND HYDROGEOLOGY

2.2.1 Surface Soils

The soils, groundwater conditions, and hydrogeological characteristics of the site are key considerations in the development of the stormwater management strategy for Lochridge Estate. Due to the rural large-lot nature of the development and the relatively low proportion of impervious surfaces proposed, the stormwater approach has been designed to maximise onsite infiltration and groundwater recharge using private soakage systems.

The Kinloch area is generally underlain by volcanic deposits associated with the Taupō Volcanic Zone. Previous investigations within the wider Kinloch catchment indicate that the area is predominantly characterised by pumice-derived soils and reworked volcanic deposits that typically exhibit moderate to high infiltration potential. These geological conditions are favourable for soakage-based stormwater management systems and support the use of infiltration as the primary means of stormwater disposal where suitable ground conditions can be demonstrated.



Figure 7. Soil classification at site.

Landcare Research S-Map information and geotechnical investigations undertaken for the development indicate that the site is primarily underlain by free-draining pumice soils suitable for soakage-based stormwater management. Figure below shows the soil classification and Figure drainage characteristics. The soils are of Hydrological Group A (well-drained).

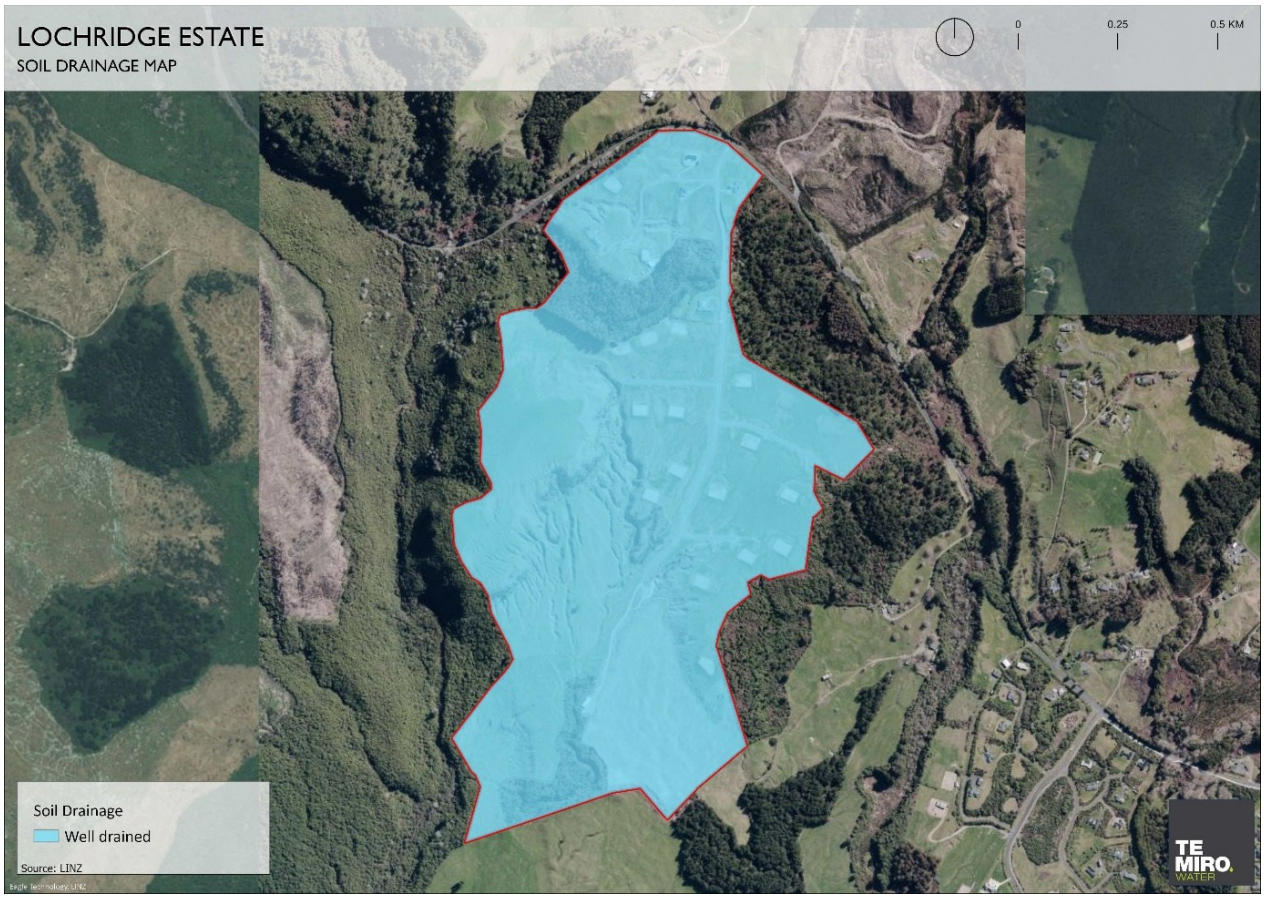


Figure 8. Soil drainage classification at site.

2.2.2 Geotechnical Investigations

No site-specific geotechnical investigation has been undertaken for this assessment. Consequently, soakage design assumptions have been based on Landcare Research S-Map information and the Taupō District Council Code of Practice for Development of Land. Site-specific infiltration testing should be undertaken during detailed design to confirm final soakage device sizing.

The Kinloch catchment overlies groundwater systems that contribute to downstream receiving environments, including Lake Taupō and associated wetlands and streams. As a result, stormwater management approaches that replicate natural recharge processes and minimise concentrated discharges are generally preferred. No significant groundwater-related constraints have been identified that would preclude the use of soakage systems within the development.

2.3 RECEIVING ENVIRONMENT

The site is situated approximately 2km north of Lake Taupo and consists of a moderately steep north to south catchment. The site is flatter in north and northeast areas. The existing site runoff flows through overland flow paths (OLFPs) and gullies within the development site. It is proposed that these OLFPs remain as the receiving environment for secondary flows, eventually discharging to the Otakatake Stream on the west and Okaia Stream on the east of the site. *Figure* shows the existing overland flow path in the existing conditions.

3 MAROHITANGA | PROPOSAL

The proposed development comprises a rural residential subdivision supported by an internal road network, shared accessways, JOALs and associated infrastructure.

Stormwater management infrastructure has been integrated into the subdivision layout and comprises:

- On-lot soakage systems.
- Roadside swales for treatment and conveyance.
- Centralised bioretention devices for secondary treatment.
- Retained and modified overland flow paths for secondary conveyance.
- Culverts to maintain catchment connectivity and stormwater passage beneath roads and accessways.

Figure illustrates the proposed stormwater management layout.

4 RAUTAKI | STRATEGY

4.1 STORMWATER MANAGEMENT APPROACH

Stormwater management for Lochridge Estate adopts a treatment train approach consistent with RITS and Waikato Regional Council guidelines. Runoff generated within the development is managed through a combination of source controls, treatment devices and secondary flow pathways that collectively address water quality, stormwater quantity and conveyance requirements.

The overall stormwater layout is shown in Figure

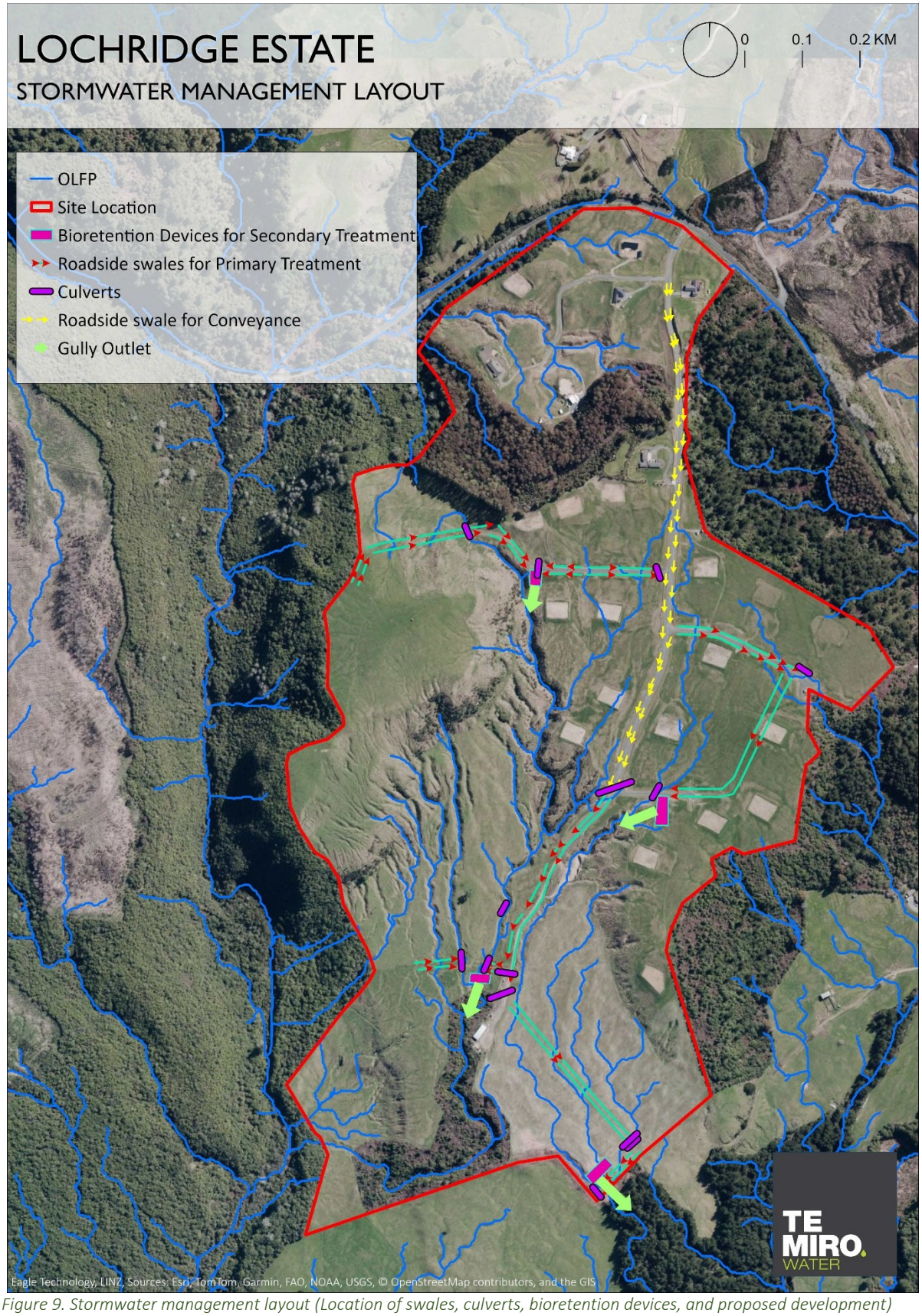


Figure 9. Stormwater management layout (Location of swales, culverts, bioretention devices, and proposed development)

4.2 CATCHMENT RUNOFF - HYDROLOGY

NIWA HIRDS v4 24-hour rainfall data was utilised to complete the stormwater runoff assessment is provided in the Table 1 below. For stormwater device sizing, the design rainfall used climate change (CC) scenario SSP5-8.5.

Table 1. Rainfall data used for the assessment (source from HIRDS).

ARI	Historic Rainfall (mm)	SSP5-8.5 Rainfall (mm)
2-year	67.20	86.55
10-year	101.00	133.72
100-year	153.00	205.63

The SCS Curve Number Method was used to complete the stormwater runoff calculations (presented in Appendix B), with rainfall parameters shown in Table 1.

4.3 WATER QUALITY TREATMENT

4.3.1 Roadside swales for primary treatment

Roadside swales have been incorporated throughout the road network to provide primary water-quality treatment and safe conveyance of stormwater flows. The swales have been sized and designed in accordance with the following key considerations:

1. Provision of water-quality treatment for frequent rainfall events and conveyance of secondary flows up to the 100-year ARI event (with climate change) to appropriate overland flow path (OLFP) locations.
2. Capacity to accommodate runoff from upper contributing catchments where roadside swales intercept these flows.
3. Culvert crossings at individual lot entrances are excluded from this SMP and will be addressed at the detailed design stage.
4. Achievement of a minimum residence time of 9 minutes for effective contaminant removal.

The intention is to protect the ultimate Lake Taupo receiving environment from contaminant runoff by treating the contaminants at source during smaller rainfall events. All road catchments are proposed to discharge to grassed swales, which provide both primary treatment and controlled conveyance to designated outlet locations.

Two typical swale geometries have been adopted across the development:

- Type A - 1.0 m base width
- Type B - 0.5 m base width

Typical cross-sections for both swale types are shown in Figure 11, and the corresponding dimensions are summarised in Table 2. All treatment swales achieved residence times between 11 and 58 minutes, exceeding the minimum requirement of 9 minutes. Road catchments contributing to each swale are identified in Figure 12, with detailed sizing calculations provided in Appendix B. Swale type assignments for each road segment are listed in Table 3.

Stormwater runoff from the road carriageway and ROWs will be treated via the swale network and conveyed during larger storm events (up to the 100-year ARI including climate change scenario SSP5-8.5) to the existing OLFP system, thereby maintaining a naturalised flow regime. Swale locations are shown in Figure 12 and summarised in Table 3. A typical road-reserve cross-section, as designed by Kotare Consultants, is provided in Figure 10, with the two standard swale types illustrated in Figure 11.

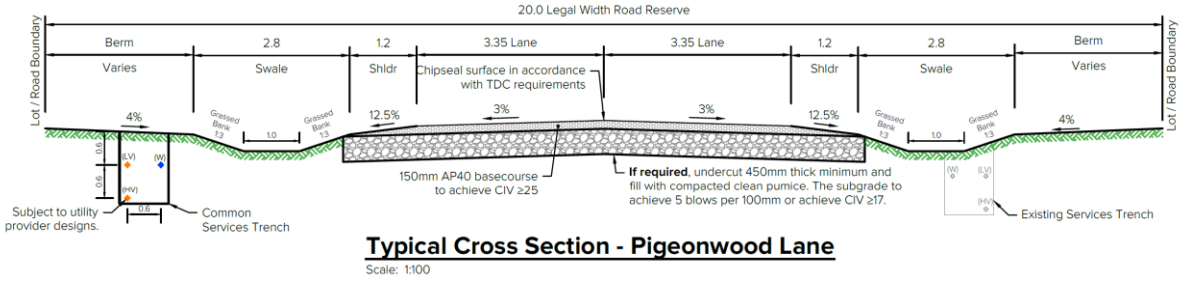


Figure 10. Typical cross section of dual crossfall right of way with swales on either side (provided by Kotare Consultants).

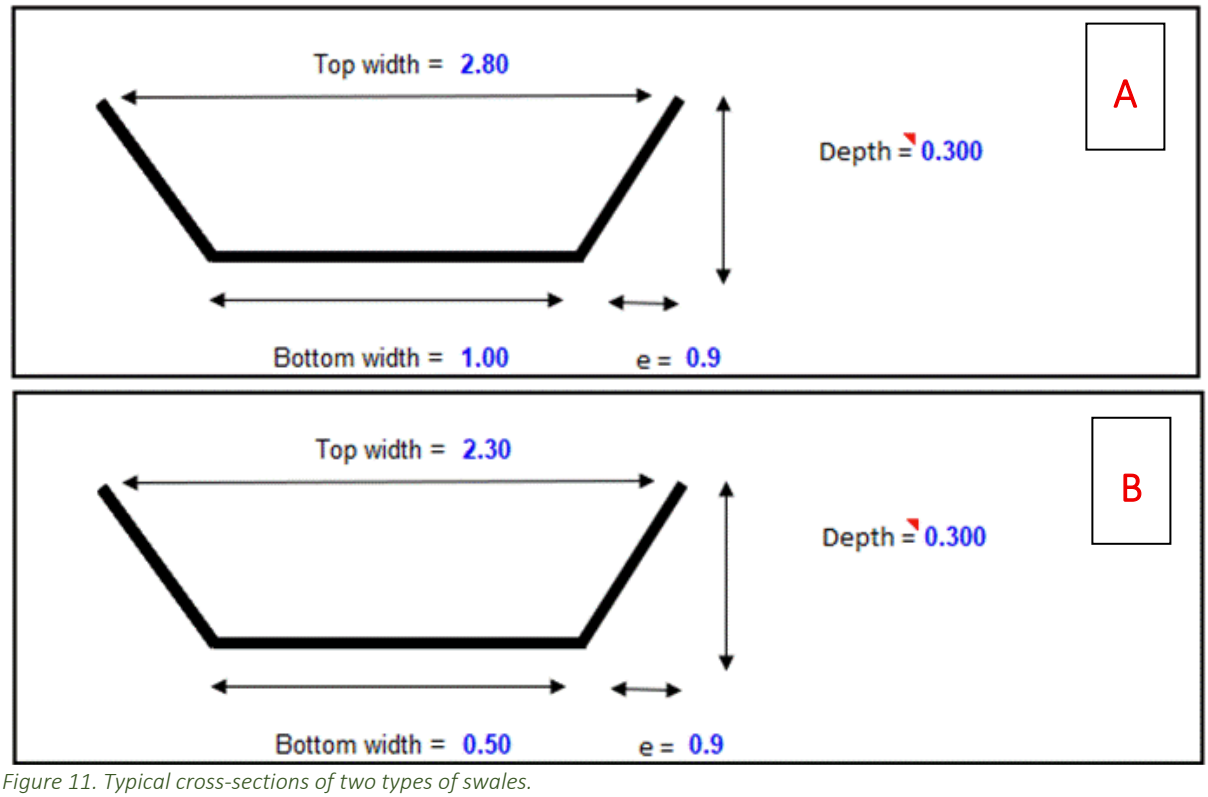


Figure 11. Typical cross-sections of two types of swales.

Table 2. Dimensions for two typical swale geometries.

Swale type	Base width (m)	Top width (m)	Side slope	Depth (m)
A	1.0	2.8	1:3	0.3
B	0.5	2.3	1:3	0.3

*Table 3. Swale type assignment for each road segment**

Swales	Swale Type	Comments
Pigeonwood Lane (Ch: 0 to 180) North	A	
Pigeonwood Lane (Ch: 180 to 623) North & South	A	Check dams required on steep grade sections
JOAL 2 West	A	
Tea Tree Lane North	A	
Akeake Lane Treatment	A	Check dams required on steep grade sections
Lochridge Drive (Ch: 623 to 1020) West	A	Check dams and erosion protection required
Lochridge Drive (Ch: 715 to 1020) East	A	Check dams required on steep grade sections
Lochridge Drive Ext (Ch: 1020 to 1380) West & East	A	Check dams required on steep grade sections
Lochridge Drive Ext (Ch: 1380 to 1764) West	A	
Lochridge Drive Ext (Ch: 1380 to 1764) East	A	Erosion protection may be required at some areas
Road 1 North	A	
Road 2	A	Erosion protection required
Pigeonwood Lane (Ch: 0 to 180) South	B	
Shared Access 1	B	Check dams required on steep grade sections
ROW 1	B	Check dams required on steep grade sections
ROW 2	B	Check dams required on steep grade sections
Shared Access 2	B	
Shared Access 3	B	Underdrain required as grade is 0.9%
Shared Access 4	B	
JOAL 1 West & East	B	Check dams required on steep grade sections
Road 1 South	B	

* Final sizing and design will be confirmed at detailed design stage.

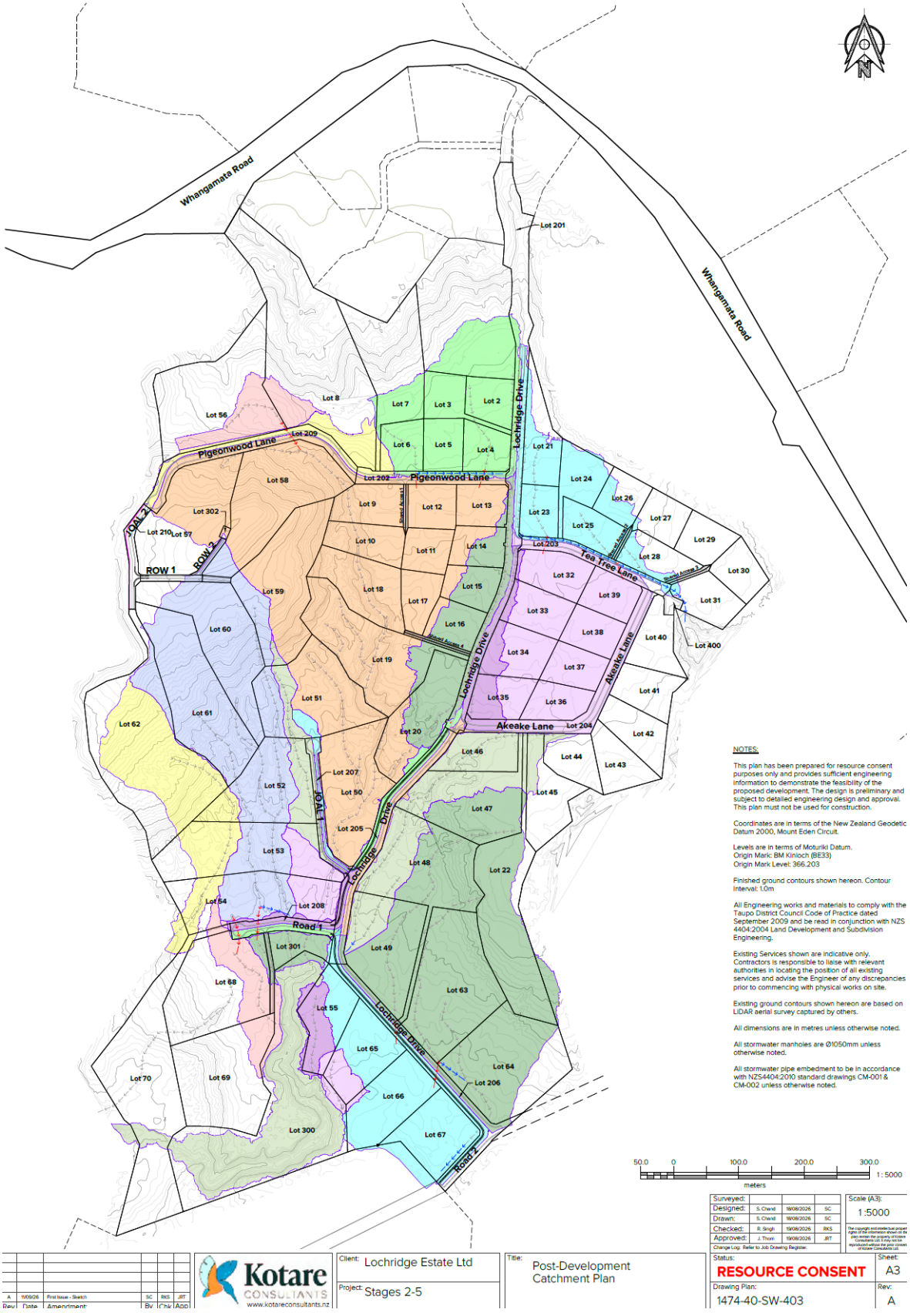


Figure 12. Post-development catchments, upstream the swales and culverts.

4.3.2 Centralised bioretention devices for secondary treatment

Centralised bioretention devices are proposed to provide secondary treatment of road runoff and hence assist in achieving dual treatment for all new road catchments. The preliminary sizing of these devices required to manage the extended detention volume (EDV) from the contributing catchments have been undertaken and the bioretention areas required are summarised in Table 4 below.

Table 4. Preliminary size of bioretention devices

Catchments	Bioretention area required
Pigeonwood Lane (Ch: 180 to 623) North & South	55m^2
Akeake Lane Treatment	76m^2
Lochridge Drive Ext (Ch: 1020 to 1380) West & East, and Road 1 (North & South)	93m^2
Lochridge Drive Ext (Ch: 1380 to 1764) West & East, and Road 2 (North & South)	68m^2

The sizing is based on the bioretention device design procedure outlined in the WRC guidelines (TR20-07) document. A schematic of a typical cross section of a raingarden is shown in Figure 13 below, with detailed sizing calculations provided in Appendix B. The proposed bioretention device locations are presented in Figure 14.

Final configuration or device selection is to be confirmed at detailed design stage (natural raingarden, concrete surround raingarden from HYNDS, Filterra biofiltration system from SW360, etc).

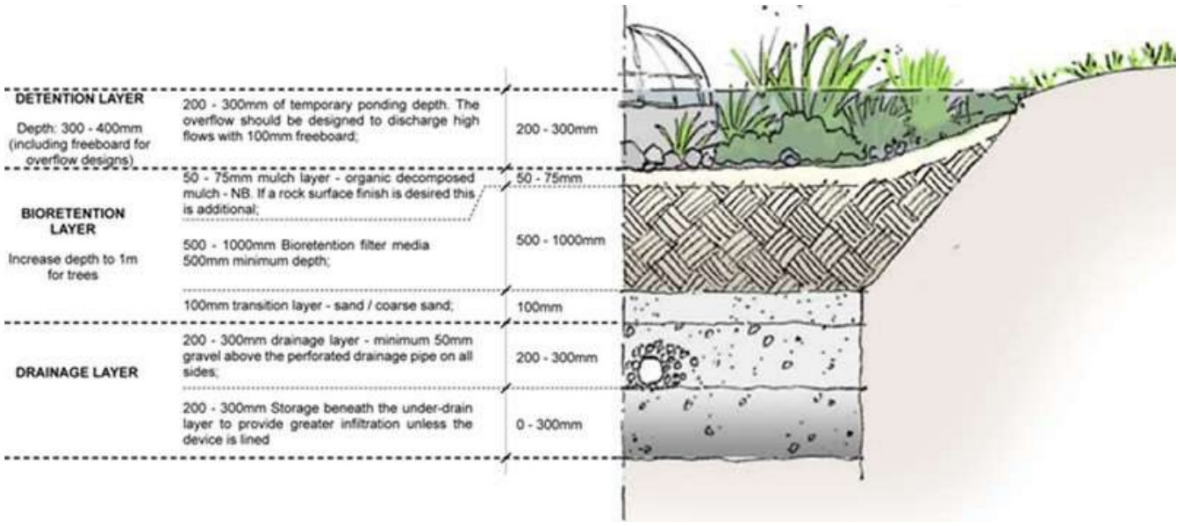


Figure 13. A schematic of a typical cross-section of a raingarden (WRC Guidelines TR20-07).



Figure 4. Location of bioretention devices

4.4 PRIMARY FLOW MANAGEMENT

4.4.1 Private lot typical soakage device sizing

Stormwater needs to be managed at source on private lots from all impervious areas. The intention is to protect the ultimate Lake Taupo receiving environment from contaminant runoff as per the TDC and WRC guidelines. We achieve this by treating contaminants at source during smaller rainfall events.

The design criteria are proposed to be met in the following ways for private lots:

- Roof materials are to be made of non-contaminant leaching materials.
- Pre-treatment of roof runoff may be provided via leaf/litter guards prior to disposal to rain tank and soakage device.
- Each lot is proposed to have rainwater tanks for water supply. A rain tank would reduce pressure on the soakage device by limiting flow. Sizing of these tanks are outside the scope of this SMP.
- All rain tank overflows, and private drainage will discharge to soakage systems on lot, designed for flows up to the 10-year event. Overflow above 10-year from the soakage system will be dispersed via sheet flow within each lot. No direct connection to gully/channel shall be established to avoid concentrating outflows.
- The overland flow paths will need to be diverted around the building platforms.

Typical soakage pit sizing is provided in Figure 15. For example, a 10m long x 5m wide x 2.2m deep (including a cover of 600mm) pit is required to manage runoff from a 10-year event from a Lot impervious area of 1,500m^2. The soakage rate used for the soak pit sizing is 750mm/hr (with a factor of safety of 2), and soakage assumed through base only. The design is in accordance with the RITS Manual and the NZBC Clause E1; Surface Water.

VARIABLES	UNITS			
C		0.9		
		Duration	ARI	
I	mm/h	60m	10	46.94
A	m^2	1500		
		Sr	Factor of Safety	
Sr	mm/h	1500	2	750
		Length	Width	
A_{sp}	m^2	10	5	50
		Cover	Max Depth	
Depth	m	0.6	2.2	

CALCS	UNITS	
R_c	m^3	63.368
V_{SOAK}	m^3	37.500
V_{STOR}	m^3	25.868
V_{PIT}	m^3	68.073
D_{PIT}	m	1.961
T_{SOAK}	h	0.690

Figure 15. Typical On-lot Soakage Pit Dimensions (Pit size in red rectangle)

4.4.2 JOALs, ROWs and Shared accessways soakage device sizing

The shared accessways, JOALs and ROWs are provided with swales for treatment and soakholes to manage runoff up to the 10-year ARI event. Typical soakhole sizing in accordance with TDC's Code of Practice for Development of Land is undertaken. The soakhole is designed to manage a 10-year ARI rainfall event of 1 hour duration, with a maximum of 25% of the runoff lost to soakage during this period i.e a minimum of 75% of the runoff will be stored in the soakhole itself which eventually drains away. The soakhole will be constructed with porous liners in accordance with TDC standard drawing (Plan 14) shown below in Figure 16. A typical design of one soakhole per 320m^2 catchment area is proposed at this concept design stage. The preliminary design is based on a design soakage rate of 375mm/hr, diameter of the porous concrete risers is 900mm and the depth of soak hole is 6m.

Final design and soakhole numbers will be confirmed at detailed design stage once the actual soakage rates are confirmed.

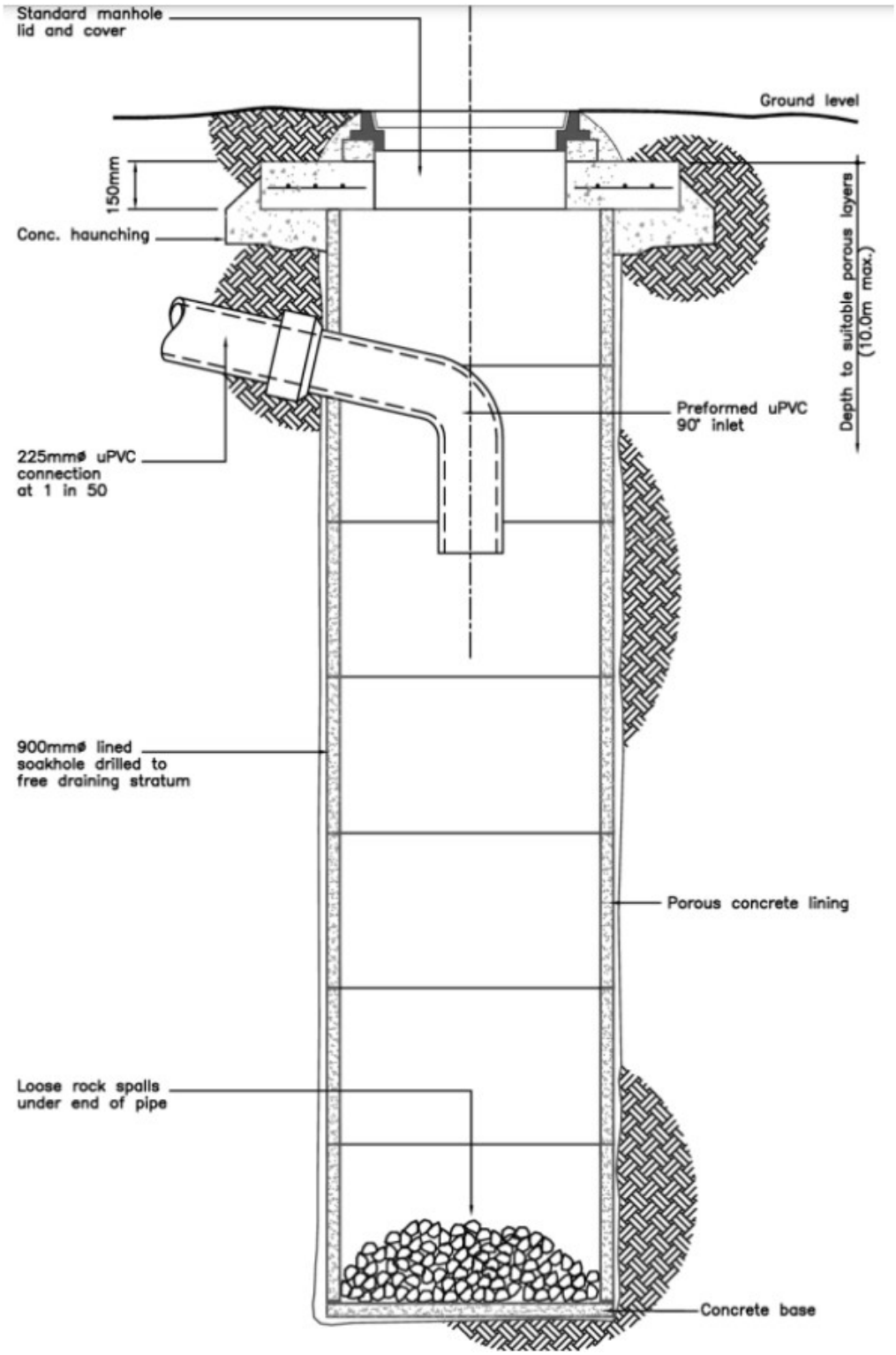


Figure 16. Typical Soak Hole Design as per TDC standard drawing (Plan 14)

4.5 SECONDARY FLOW CONVEYANCE

Existing overland flow paths (OLFPs) traverse the site and discharge toward the main gullies on the eastern and western boundaries. As shown in Figure 6, several OLFPs require localised realignment to accommodate the revised road layout. These paths have been redirected and consolidated where necessary to ensure they pass beneath roads with minimal disturbance while maintaining natural drainage patterns.

Secondary flows above the 10-year ARI event and up to the 100-year ARI event will be conveyed via a combination of retained OLFPs, diversion swales, and culverts. These elements safely direct runoff through the development, away from building platforms, and toward appropriate outlet locations within the receiving gullies.

Culverts have been preliminarily sized to accommodate runoff from road catchments and individual lot contributions for the 100-year ARI event. Minimum cover of 0.5 m has been applied when determining pipe inverts. HY-8 software was used for hydraulic assessment, with runoff calculated using the SCS Curve Number Method and rainfall depths adjusted for climate change under the SSP5-8.5 (2080–2100) scenario. Culvert locations and sizes are shown on the Kotare Consultants stormwater drawings in Appendix A, with detailed calculations provided in Appendix B.

4.5.1 Scour And Erosion Management

Erosion control or scour protection measures will be incorporated at detailed design stage for the following stormwater components:

- All outlets will be provided with scour protection designed for the 100-year ARI storm event.
- Swales with gradients steeper than 5%, where check dams or additional stabilisation may be required.

4.6 OPERATION AND MAINTENANCE

A detailed Operation Maintenance and Monitoring Plan (OMMP) will be prepared at the detailed design stage for engineering approval and will cover off:

- Swale network operational purpose and maintenance.
- Bioretention devices operational maintenance and purpose.
- Soakage devices operational maintenance and purpose.
- Built stormwater network operational maintenance and purpose

5 WHAKAKAPINGA | CONCLUSIONS

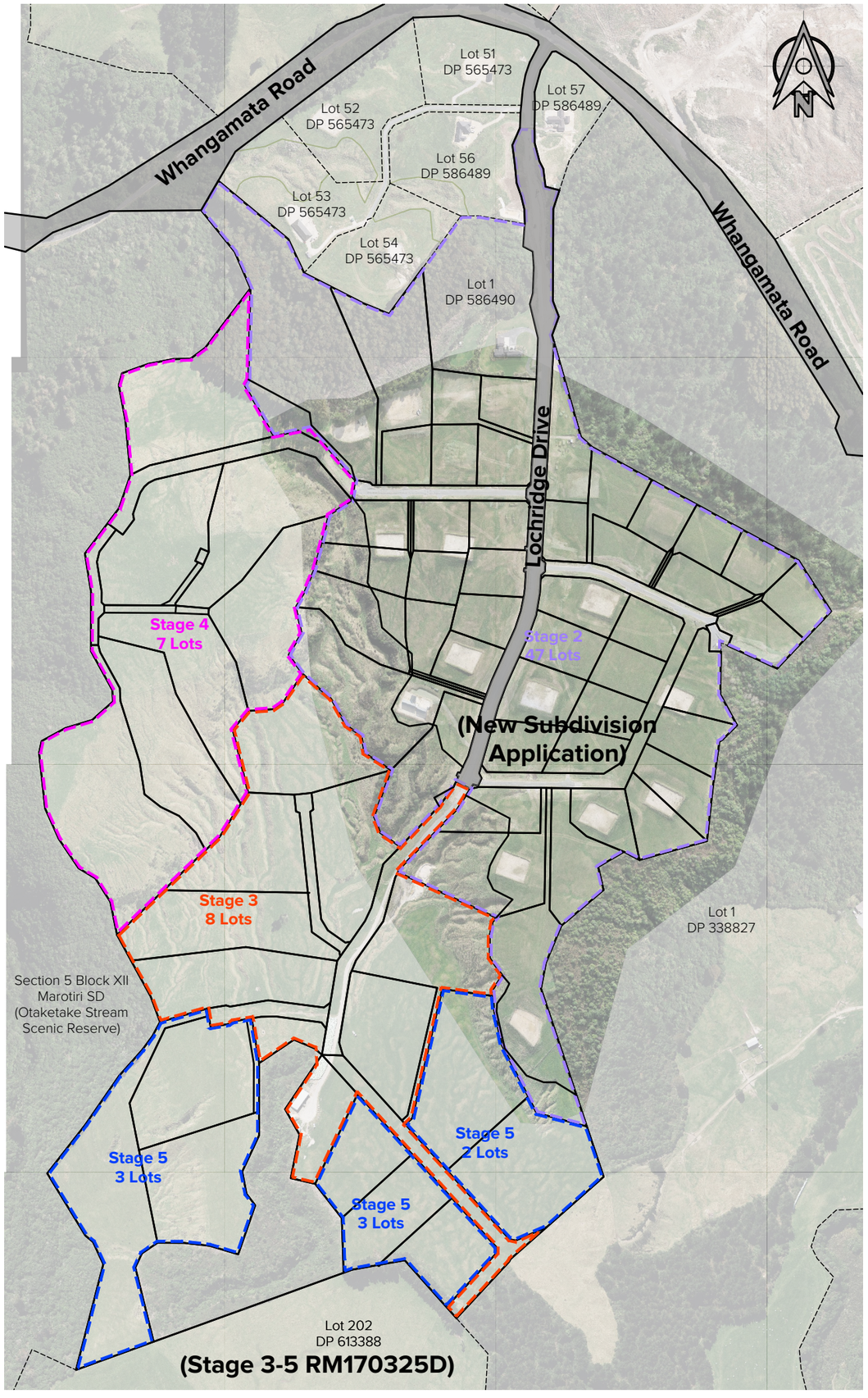
This Stormwater Management Plan demonstrates that stormwater generated by the Lochridge Estate development can be effectively managed through a combination of soakage systems, swales, bioretention devices and retained overland flow paths. The conclusions are:

- The stormwater management strategy for Lochridge Estate applies a water-sensitive design approach that protects downstream environments and maintains natural hydrological processes.
- Stormwater is managed at source through on-lot soakage systems, rainwater harvesting, and non-contaminating roof materials, reducing runoff volumes and limiting contaminant generation.
- Roadside grassed swales provide primary water-quality treatment and safe conveyance, achieving residence times well above the 9-minute requirement and supporting dual-treatment outcomes when combined with centralised bioretention devices.
- Primary flows (up to the 10-year ARI event) are managed via infiltration-based systems across private lots, JOALs, ROWs, and shared accessways, minimising reliance on downstream infrastructure.
- Secondary flows are conveyed through retained overland flow paths, diversion swales, and culverts that preserve natural drainage patterns and direct flows away from building platforms.
- All stormwater outlets incorporate scour protection designed for the 100-year ARI event including climate change allowances, ensuring erosion risks are appropriately mitigated.
- The integrated treatment-train approach aligns with RITS, WRC stormwater guidelines, and Taupō District Council requirements, providing a robust and maintainable long-term solution.
- Final device sizing, geotechnical confirmation, and detailed design refinements will be completed at the next design stage.



ĀPITIHANGA
APPENDICES

6 ĀPITIHANGA A | APPENDIX A – DRAWINGS



STAGES 2 - 5

LOCHRIDGE ESTATE LIMITED

LOCHRIDGE DRIVE, KINLOCH, TAUPO

SEPTEMBER 2026

ENGINEERING PLANS

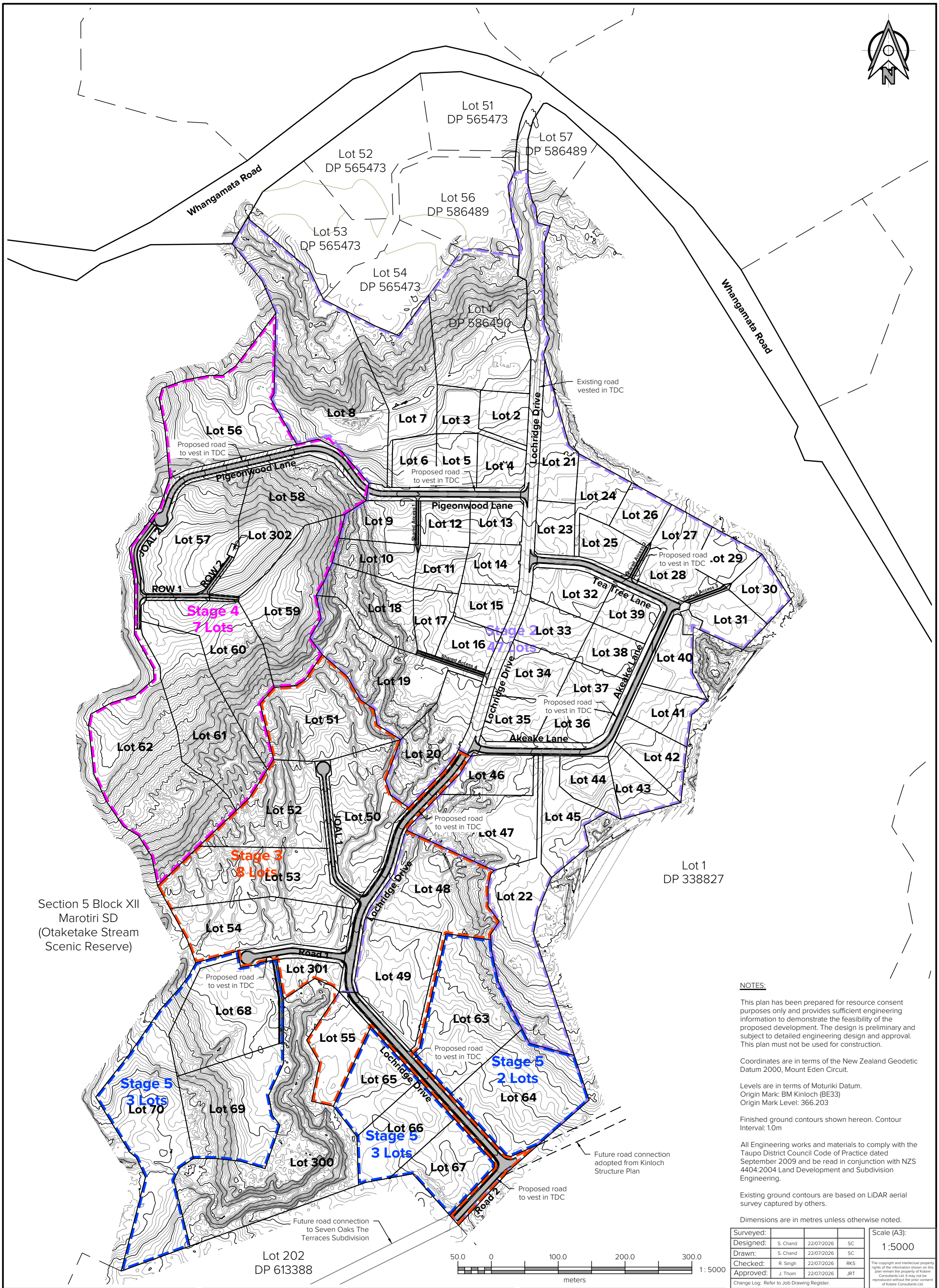
Drawing #:	Drawing Title:	Revision:
	General	
1474-00-GR-001	Cover Sheet & Site Location Plan	B
	Earthworks	
1474-20-EW-201	Overall Finished Contour Plan	B
1474-20-EW-202	Finished Contour Plan (Enlarged)	B
1474-20-EW-203	Finished Contour Plan (Enlarged)	B
1474-20-EW-204	Overall Cut & Fill Plan	B
1474-20-EW-205	Cut & Fill Plan (Enlarged)	B
1474-20-EW-206	Cut & Fill Plan (Enlarged)	B
1474-20-EW-211	Erosion & Sediment Control Plan Sheet 1 of 2	B
1474-20-EW-212	Erosion & Sediment Control Plan Sheet 2 of 2	B
1474-20-EW-213	Erosion & Sediment Control Details	B
	Roading	
1474-30-RD-301	Roading Network Plan	B
1474-30-RD-302	Pigeonwood Lane Plan, Long & Typ. Cross Section	B
1474-30-RD-303	Tea Tree Lane Plan, Long & Typ. Cross Section	B
1474-30-RD-304	Akeake Lane Plan, Long & Typ. Cross Section	B
1474-30-RD-305	Lochridge Drive Plan, Long & Typ. Cross Section	B
1474-30-RD-306	JOAL 1 Plan, Long & Typ. Cross Section	B
1474-30-RD-307	Road 1 Plan, Long & Typ. Cross Section	B
1474-30-RD-308	JOAL 2, ROW 1 & 2 Plan, Long & Typ. Cross Section	B
1474-30-RD-321	Local/Collector Road Junction Vehicle Tracking	B
1474-30-RD-322	JOAL/ROW Junction Vehicle Tracking	B
1474-30-RD-331	Sight Distance Assessment	B
1474-30-RD-332	Sight Distance Assessment	B
1474-30-RD-333	Sight Distance Assessment	B
	Stormwater	
1474-40-SW-401	General Arrangement Plan	B
1474-40-SW-402	Pre-Development Catchment Plan	B
1474-40-SW-403	Post-Development Catchment Plan	B
1474-40-SW-404	Stormwater Layout Sheet 1 of 7	B
1474-40-SW-405	Stormwater Layout Sheet 2 of 7	B
1474-40-SW-406	Stormwater Layout Sheet 3 of 7	B
1474-40-SW-407	Stormwater Layout Sheet 4 of 7	B

Drawing #:	Drawing Title:	Revision:
1474-40-SW-408	Stormwater Layout Sheet 5 of 7	B
1474-40-SW-409	Stormwater Layout Sheet 6 of 7	B
1474-40-SW-410	Stormwater Layout Sheet 7 of 7	B
	Water Reticulation & Services	
1474-60-WT-601	General Arrangement Plan	B
1474-60-WT-602	Water Reticulation & Services Layout Sheet 1 of 7	B
1474-60-WT-603	Water Reticulation & Services Layout Sheet 2 of 7	B
1474-60-WT-604	Water Reticulation & Services Layout Sheet 3 of 7	B
1474-60-WT-605	Water Reticulation & Services Layout Sheet 4 of 7	B
1474-60-WT-606	Water Reticulation & Services Layout Sheet 5 of 7	B
1474-60-WT-607	Water Reticulation & Services Layout Sheet 6 of 7	B
1474-60-WT-608	Water Reticulation & Services Layout Sheet 7 of 7	B

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Status:	Sheet:
RESOURCE CONSENT	A3
Drawing Plan:	Rev:
1474-00-GR-001	B

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Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

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Existing ground contours are based on LiDAR aerial survey captured by others.

Dimensions are in metres unless otherwise noted.

Surveyed:			
Designed:	S. Chand	22/07/2026	SC
Drawn:	S. Chand	22/07/2026	SC
Checked:	R. Singh	22/07/2026	RKS
Approved:	J. Thom	22/07/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): 1 :5000

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Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Roading Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

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AUTO CAD

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Client: Lochridge Estate Ltd

Project: Stages 2-5

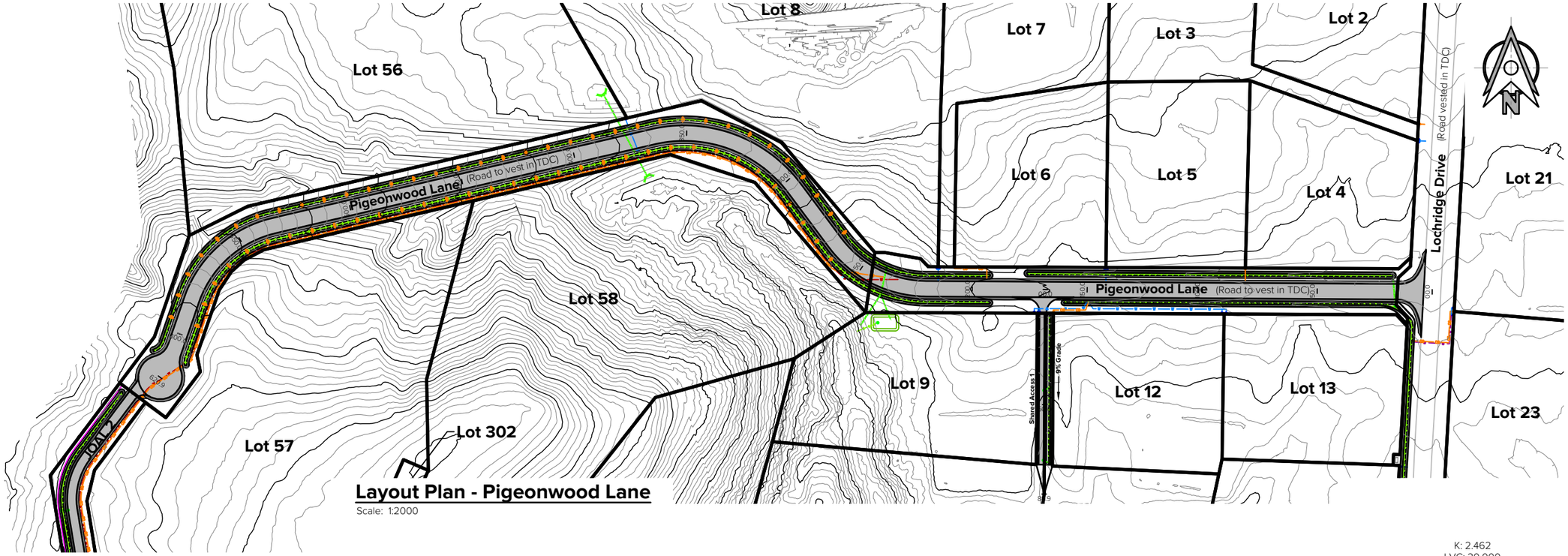
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Sheet: A3

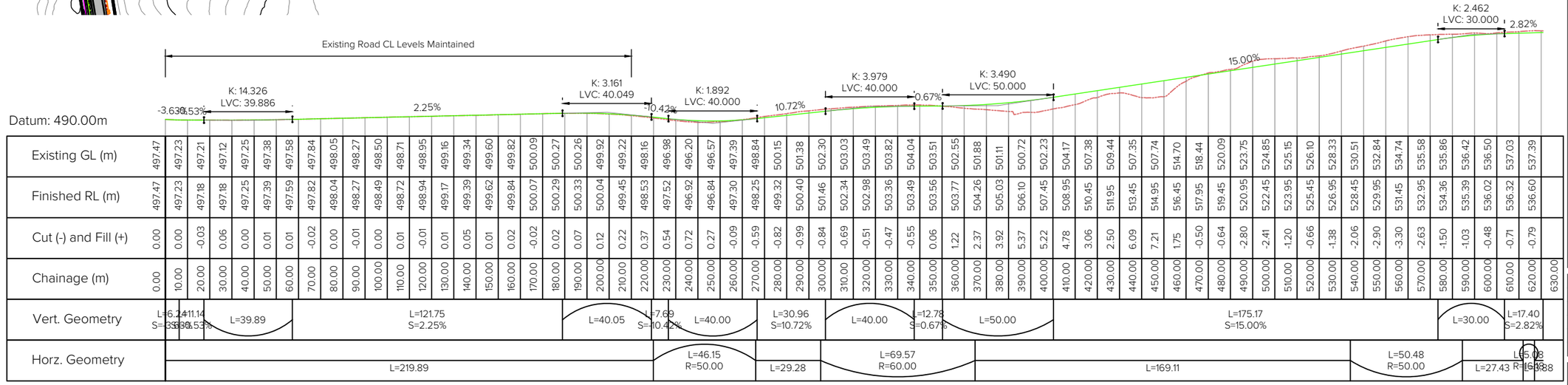
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Rev: B



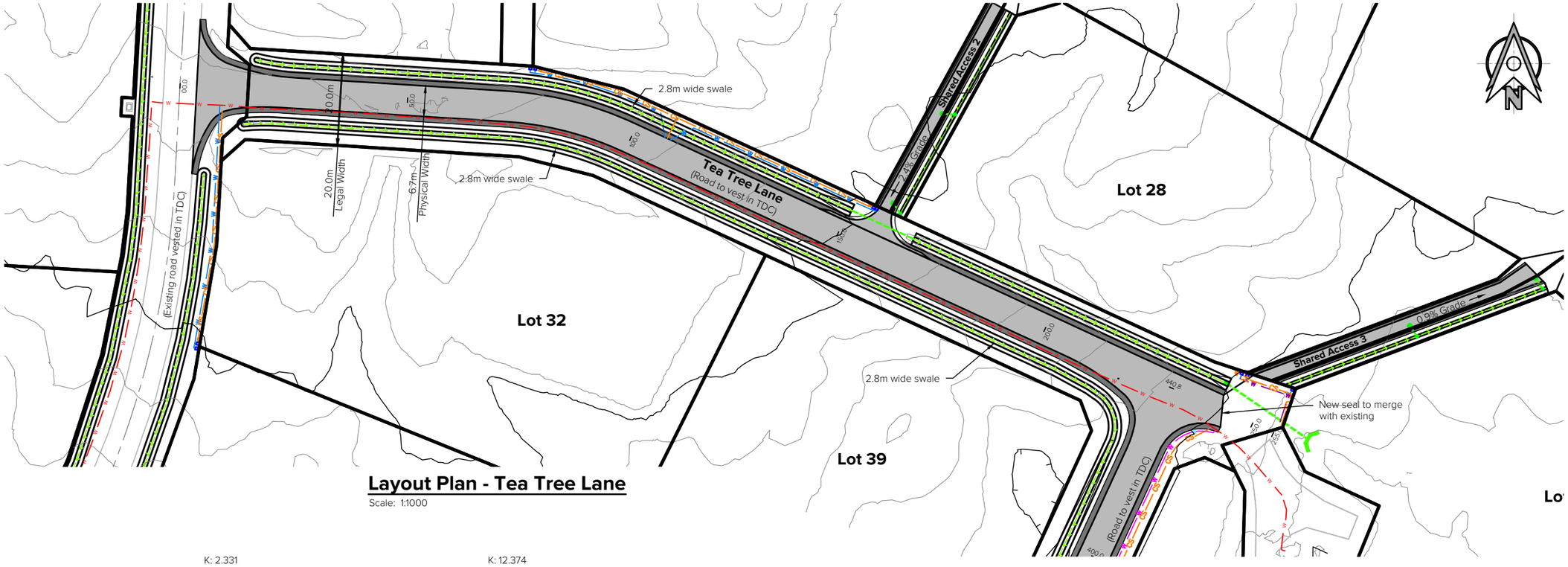
Layout Plan - Pigeonwood Lane

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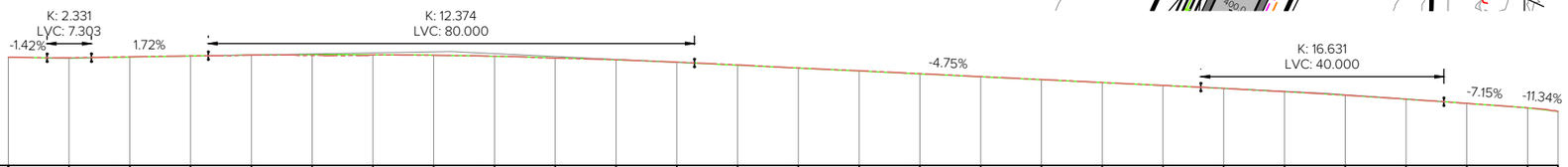
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Layout Plan - Tea Tree Lane

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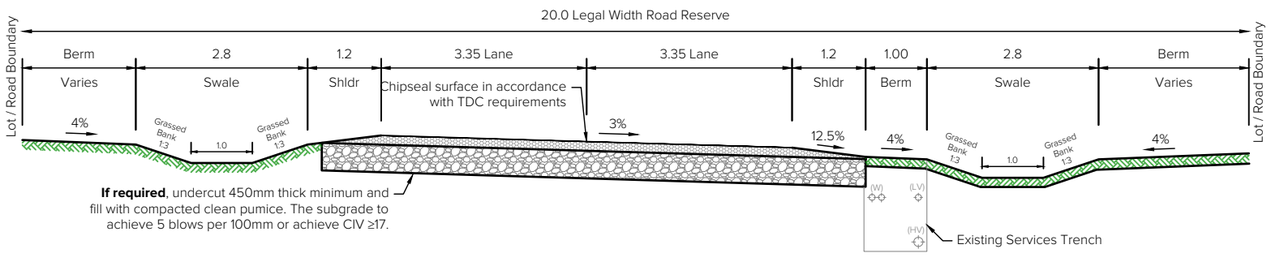


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Finished RL (m)	492.72	492.61	492.75	492.93	493.08	493.15	493.14	493.06	492.89	492.64	492.31	491.90	491.43	490.95	490.48	490.00	489.53	489.05	488.58	488.10	487.62	487.09	486.51	485.86	485.15	484.42	483.85
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Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00	180.00	190.00	200.00	210.00	220.00	230.00	240.00	250.00	255.01
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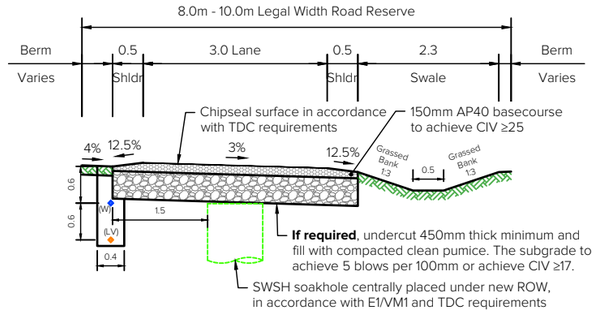
Long Section - Tea Tree Lane

Scale: 1:1000



Typical Cross Section - Tea Tree Lane

Scale: 1:100



Typical Cross Section - Shared Access 2 & 3

Scale: 1:100

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1 : 1000

meters

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LEGEND:

- Site Boundary
- Proposed Road Seal
- Proposed 1.2m Wide Road Shoulder
- Proposed Road Swale
- Proposed 1.5m Wide Footpath

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Roading Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Roading - Tea Tree Lane
Plan, Long & Typ. Cross Section

Project:
Stages 2-5

Surveyed:				
Designed:	S. Chand	22/07/2026	SC	
Drawn:	S. Chand	22/07/2026	SC	
Checked:	R. Singh	22/07/2026	RKS	
Approved:	J. Thom	22/07/2026	JRT	

Change Log: Refer to Job Drawing Register.

Scale (A3): As Shown

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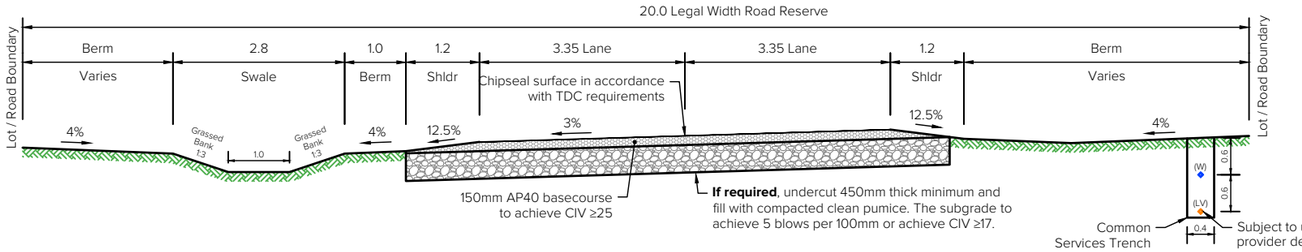
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Rev: B

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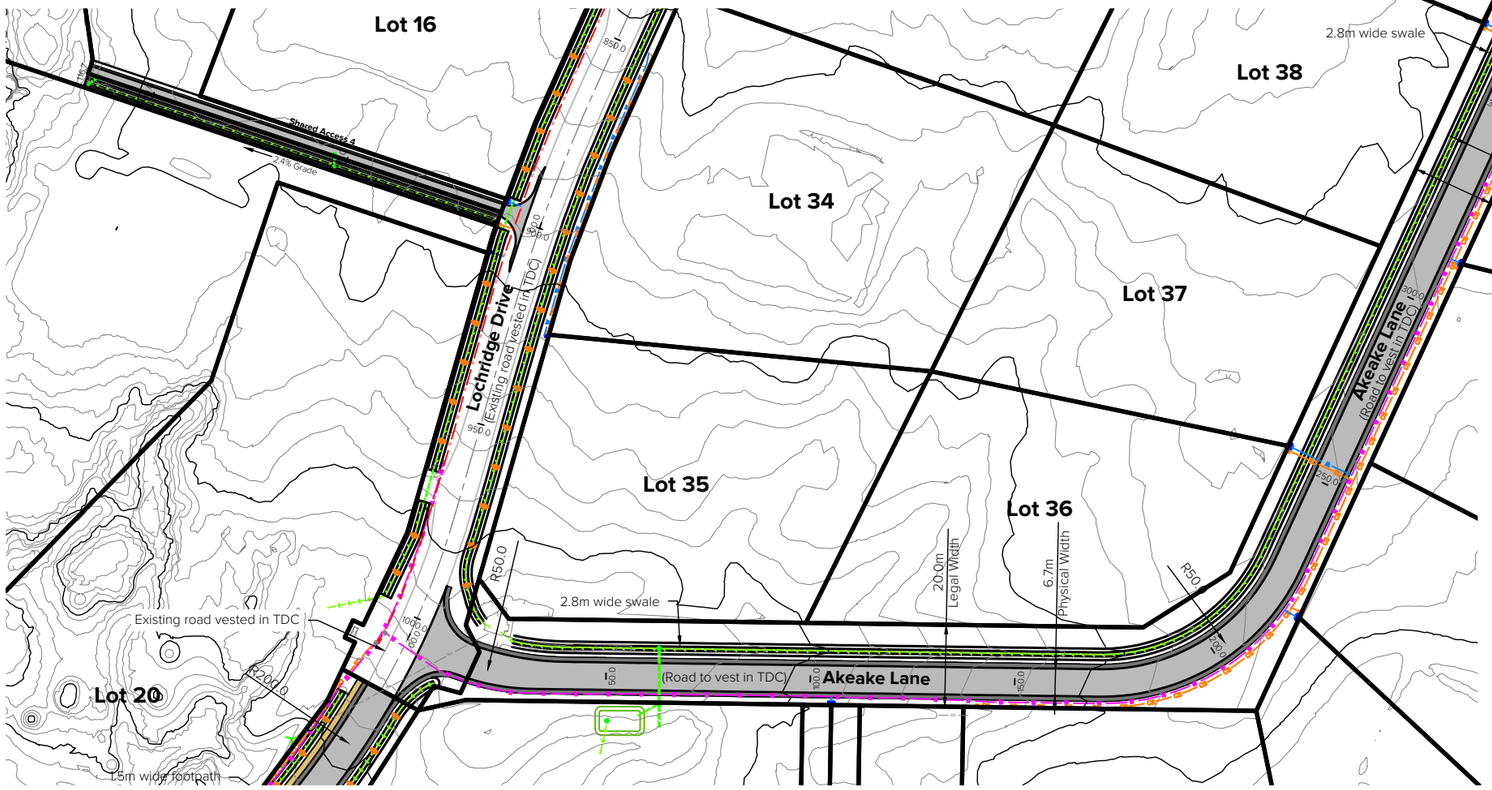
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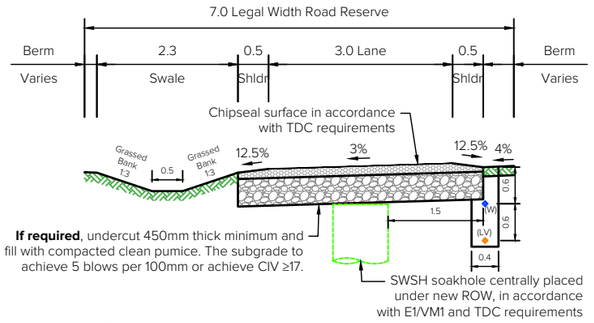
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Layout Plan - Akeake Lane

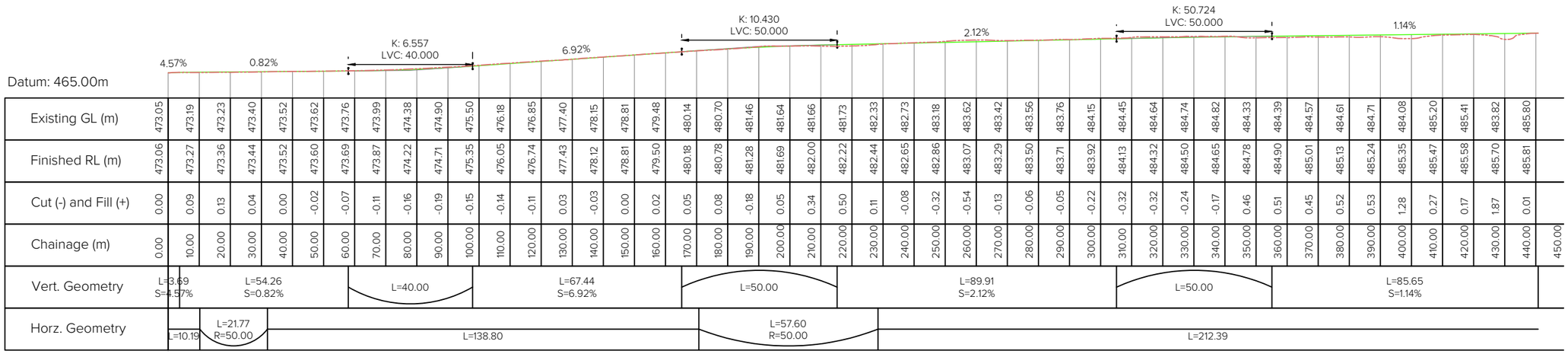
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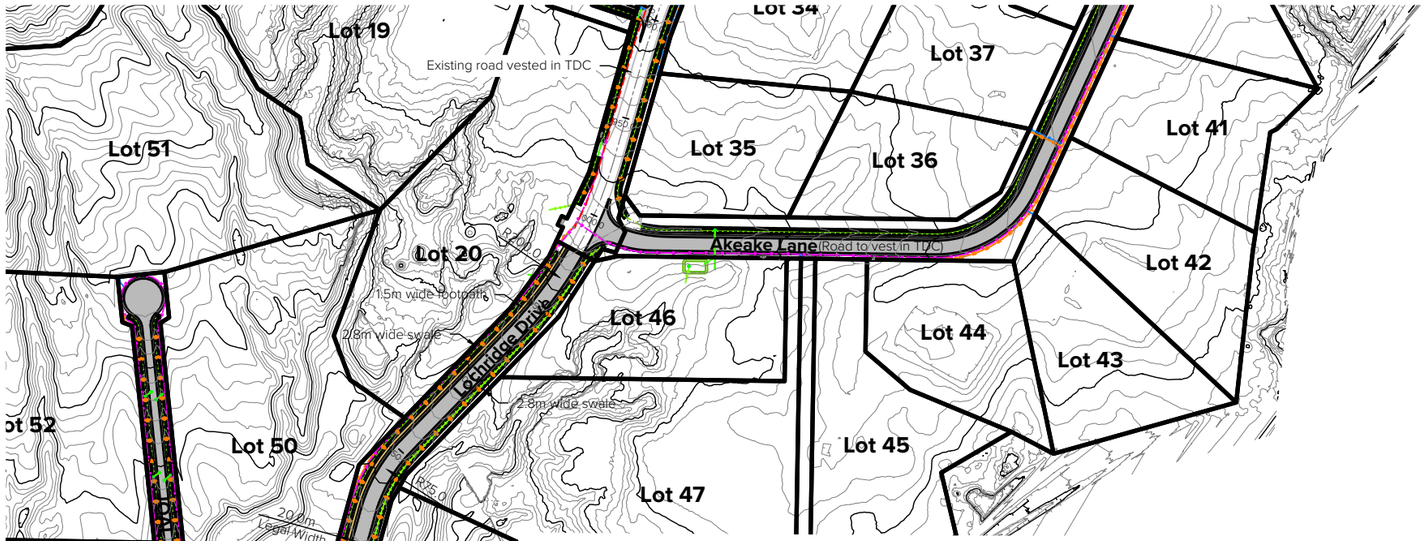
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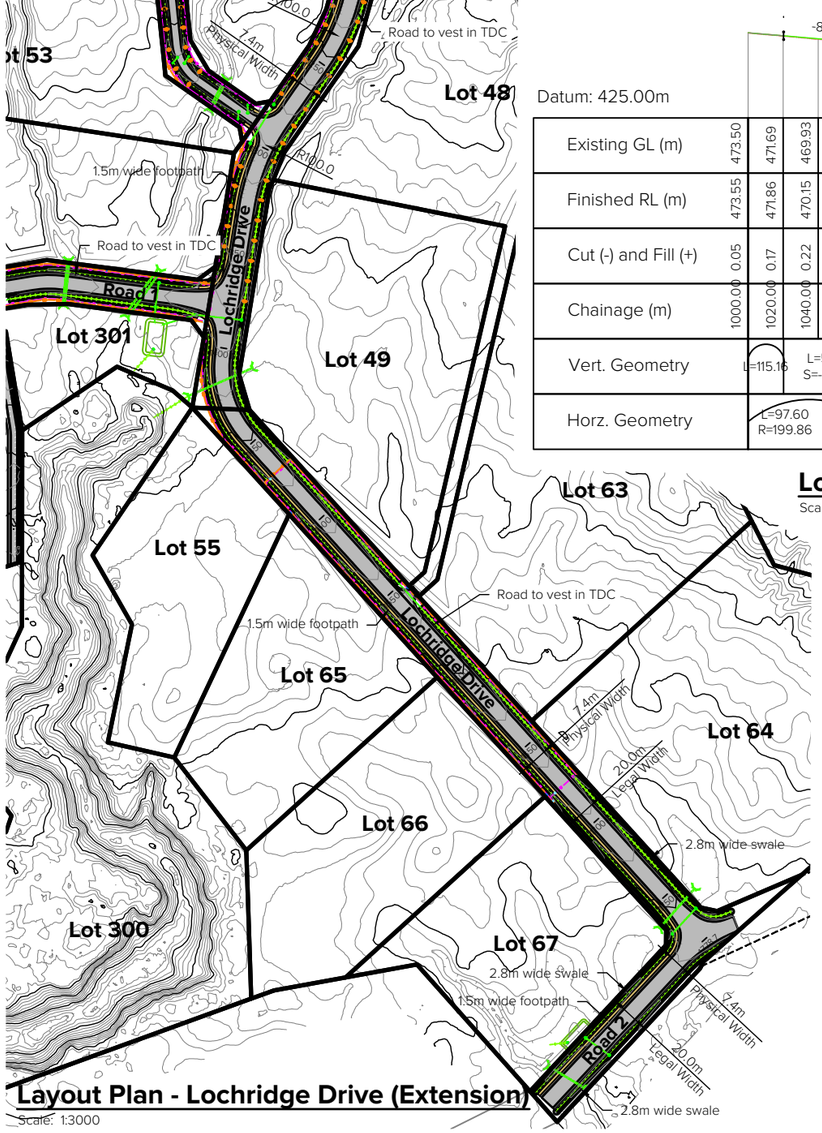
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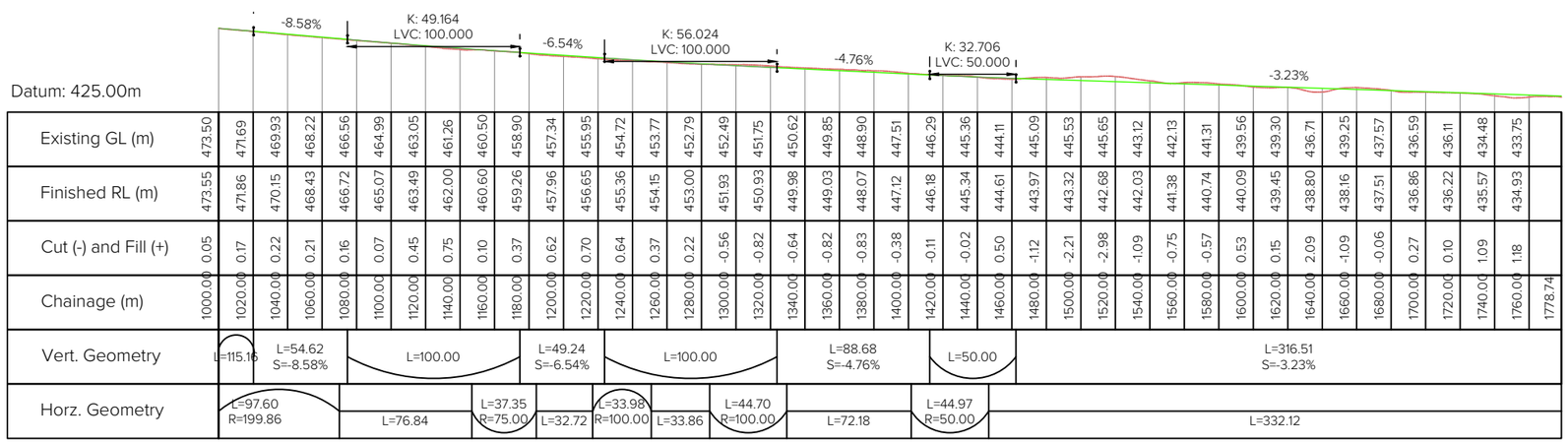
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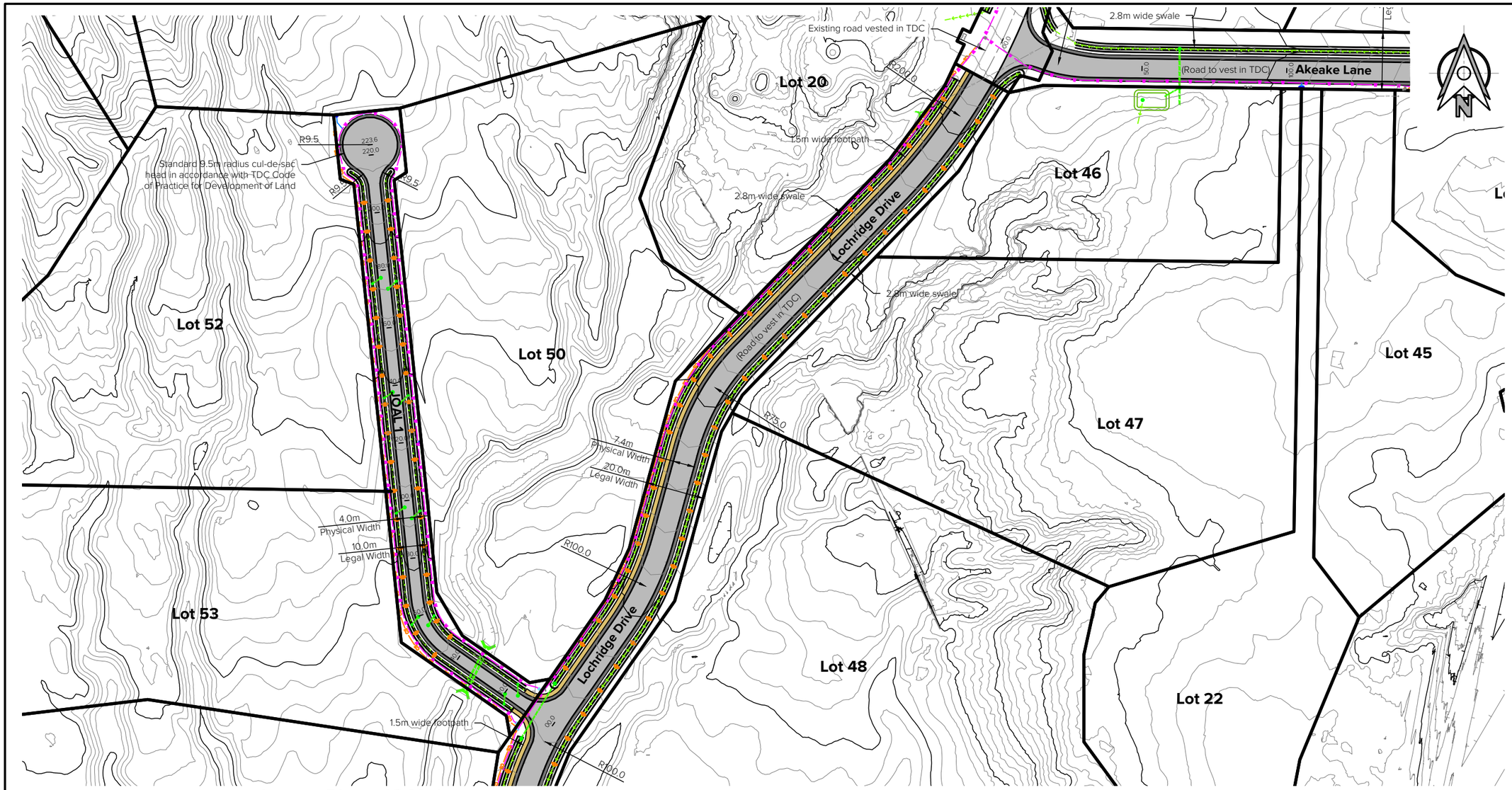
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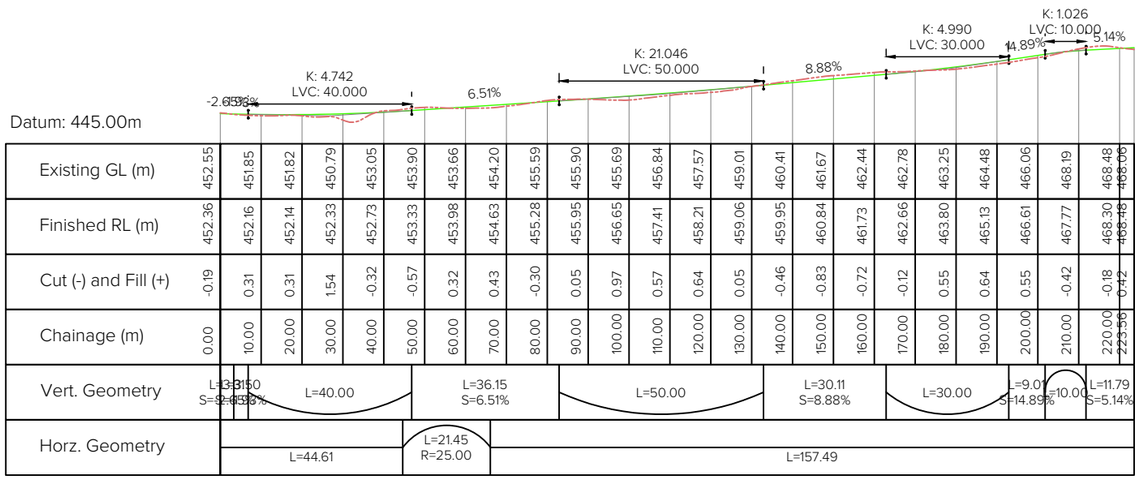
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Layout Plan - JOAL 1

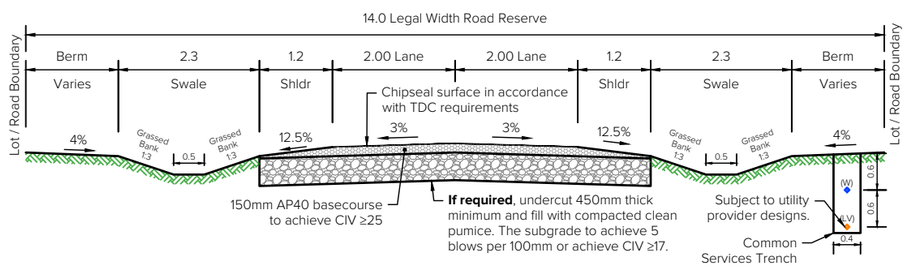
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Finished RL (m)	452.36	452.16	452.14	452.33	452.73	453.33	453.98	454.63	455.28	455.95	456.65	457.41	458.21	459.06	459.95	460.84	461.73	462.66	463.80	465.13	466.61	467.77	468.30	468.48
Cut (-) and Fill (+)	-0.19	0.31	0.31	1.54	-0.32	-0.57	0.32	0.43	-0.30	0.05	0.97	0.57	0.64	0.05	-0.46	-0.83	-0.72	-0.12	0.55	0.64	0.55	-0.42	-0.18	0.42
Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00	180.00	190.00	200.00	210.00	220.00	223.56
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Long Section - JOAL 1

Scale: 1:1500



Typical Cross Section - JOAL 1

Scale: 1:100

15.0 0 30.0 60.0 90.0

1 : 1500

meters

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Origin Mark Level: 366.203

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LEGEND:

- Site Boundary
- Proposed Road Seal
- Proposed 1.2m Wide Road Shoulder
- Proposed Road Swale
- Proposed 1.5m Wide Footpath

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Roading Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Roading - JOAL 1
Plan, Long & Typ. Cross Section

Project:
Stages 2-5

Surveyed:			
Designed:	S. Chand	22/07/2026	SC
Drawn:	S. Chand	22/07/2026	SC
Checked:	R. Singh	22/07/2026	RKS
Approved:	J. Thom	22/07/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): As Shown

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Status: RESOURCE CONSENT

Sheet: A3

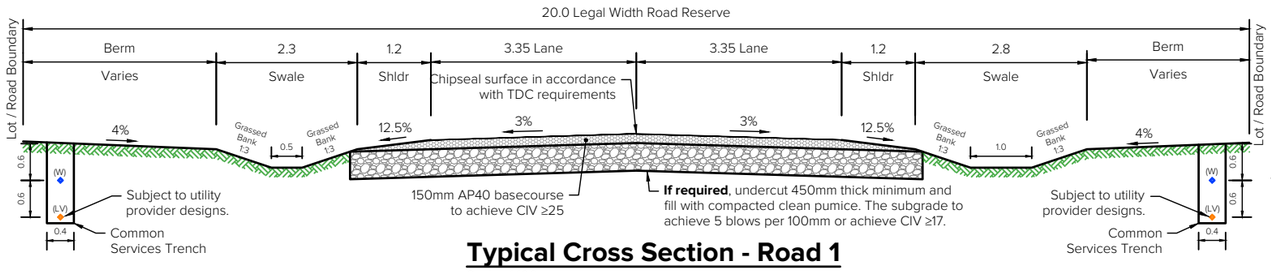
Drawing Plan: 1474-30-RD-306

Rev: B

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AUTO CAD

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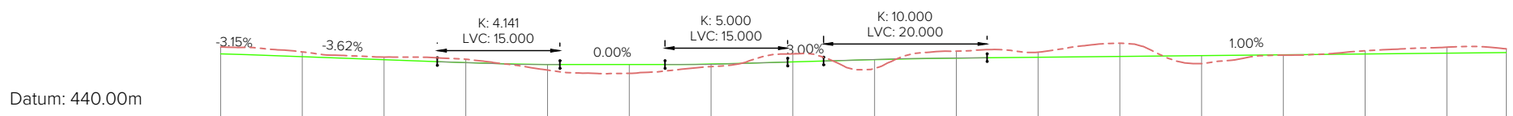


Typical Cross Section - Road 1

Scale: 1:100

Layout Plan - Road 1

Scale: 1:750



Datum: 440.00m

Existing GL (m)	448.98	448.38	447.74	447.48	446.15	445.75	446.57	448.13	446.36	448.46	448.35	449.44	446.95	447.97	448.51	448.95	448.76
Finished RL (m)	448.13	447.79	447.43	447.07	446.83	446.83	446.89	447.15	447.43	447.61	447.72	447.82	447.92	448.02	448.12	448.22	448.29
Cut (-) and Fill (+)	-0.84	-0.59	-0.32	-0.41	0.68	1.08	0.32	-0.99	1.07	-0.85	-0.62	-1.62	0.98	0.05	-0.39	-0.73	-0.46
Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	157.26
Vert. Geometry	L=3.24 S=-3.15%	L=23.29 S=-3.62%	L=15.00	L=12.85 S=0.00%	L=15.00	L=4.41 S=3.00%	L=20.00	L=63.51 S=1.00%									
Horz. Geometry	L=82.74	L=14.72 R=50.00	L=59.81														

Long Section - Road 1

Scale: 1:750

7.5 0 15.0 30.0 45.0
1 : 750
meters

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NOTES:

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Coordinates are in terms of the New Zealand Geodetic Datum 2000, Mount Eden Circuit.

Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

All Engineering works and materials to comply with the Taupo District Council Code of Practice dated September 2009 and be read in conjunction with NZS 4404:2004 Land Development and Subdivision Engineering.

Existing ground contours are based on LiDAR aerial survey captured by others.

Dimensions are in metres unless otherwise noted.

LEGEND:

- Site Boundary
- Proposed Road Seal
- Proposed 1.2m Wide Road Shoulder
- Proposed Road Swale
- Proposed 1.5m Wide Footpath

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Roading Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Roading - Road 1
Plan, Long & Typ. Cross Section

Project:
Stages 2-5

Surveyed:			
Designed:	S. Chand	22/07/2026	SC
Drawn:	S. Chand	22/07/2026	SC
Checked:	R. Singh	22/07/2026	RKS
Approved:	J. Thom	22/07/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): As Shown

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Status: **RESOURCE CONSENT**

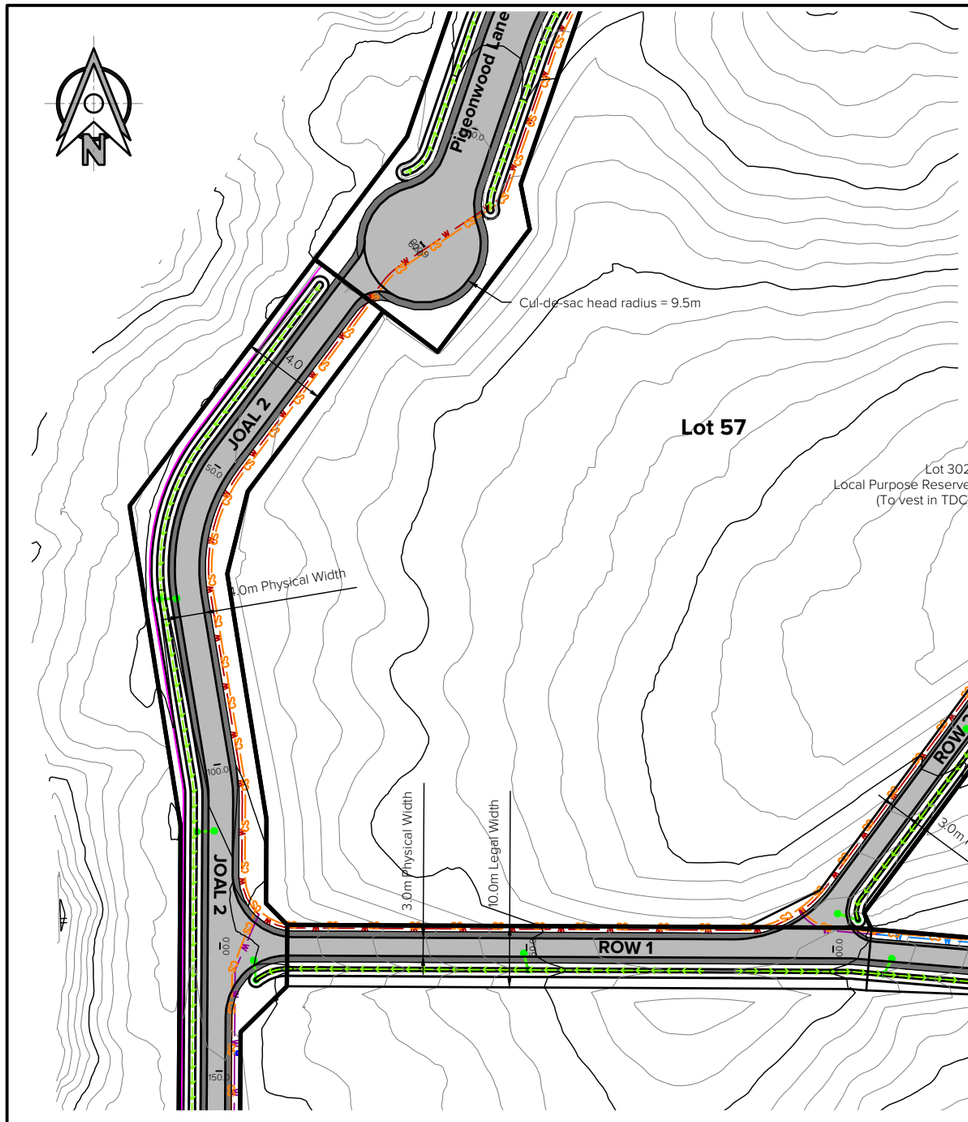
Sheet: A3

Drawing Plan: 1474-30-RD-307

Rev: B

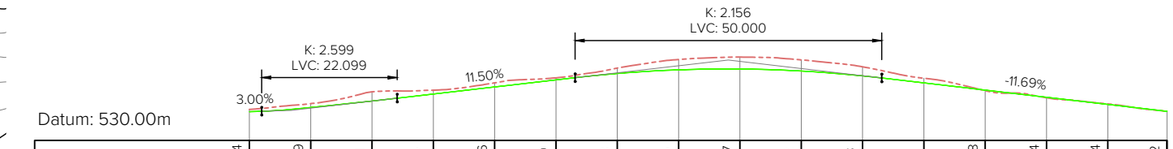
KOTARE CONSULTANTS
AUTO CAD

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Layout Plan - JOAL 2, ROW 1 & ROW 2

Scale: 1:1000

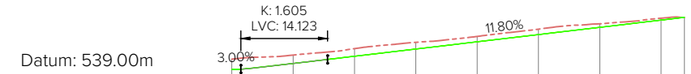


Datum: 530.00m

Existing GL (m)	535.04	535.99	537.91	538.17	539.36	540.19	541.78	543.16	543.57	543.12	541.98	540.11	538.08	536.94	535.94	534.72
Finished RL (m)	534.68	535.35	536.41	537.55	538.70	539.85	540.89	541.49	541.62	541.30	540.50	539.36	538.19	537.02	535.85	534.72
Cut (-) and Fill (+)	-0.37	-0.64	-1.50	-0.62	-0.66	-0.34	-0.89	-1.68	-1.95	-1.82	-1.48	-0.76	0.11	0.08	-0.09	0.00
Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	149.65

Long Section - ROW 1

Scale: 1:1000

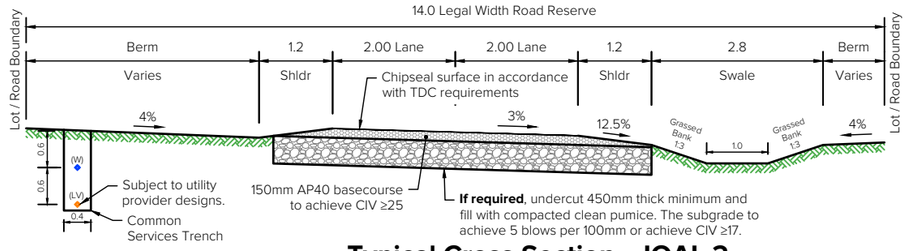


Datum: 539.00m

Existing GL (m)	542.67	543.33	544.39	545.42	546.37	547.57	548.43	549.35	549.45
Finished RL (m)	541.00	541.97	543.14	544.32	545.50	546.68	547.86	549.04	549.49
Cut (-) and Fill (+)	-1.67	-1.37	-1.25	-1.10	-0.87	-0.89	-0.57	-0.31	0.03
Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	73.81

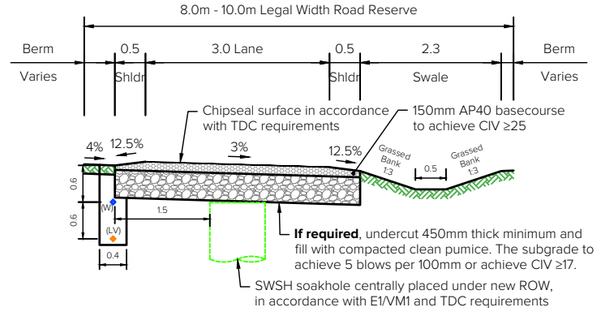
Long Section - ROW 2

Scale: 1:1000



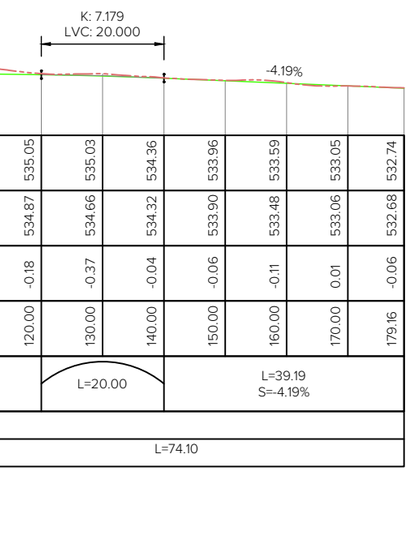
Typical Cross Section - JOAL 2

Scale: 1:100



Typical Cross Section - ROW 1 & 2

Scale: 1:100



Datum: 525.00m

Existing GL (m)	537.38	536.48	536.37	535.84	536.22	535.92	534.89	535.77	535.57	535.78	535.23	536.07	535.05	535.03	534.36	533.96	533.59	533.05	532.74
Finished RL (m)	536.63	536.72	536.51	536.29	536.09	535.90	535.73	535.58	535.43	535.29	535.15	535.01	534.87	534.66	534.32	533.90	533.48	533.06	532.68
Cut (-) and Fill (+)	-0.75	0.24	0.14	0.45	-0.13	-0.02	0.84	-0.19	-0.13	-0.48	-0.07	-1.05	-0.18	-0.37	-0.04	-0.06	-0.11	0.01	-0.06
Chainage (m)	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00	179.16
Vert. Geometry		L=10.18 S=0.94%	L=14.13 S=-2.20%	L=50.00							L=45.69 S=-1.40%			L=20.00		L=39.19 S=-4.19%			
Horz. Geometry		L=8.17	L=6.70 R=15.00	L=33.36			L=24.28 R=30.00			L=29.99	L=2.96 R=15.00		L=74.10						

Long Section - JOAL 2

Scale: 1:1000

10.0 0 20.0 40.0 60.0

1 : 1000

meters

NOTES:

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Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

All Engineering works and materials to comply with the Taupo District Council Code of Practice dated September 2009 and be read in conjunction with NZS 4404:2004 Land Development and Subdivision Engineering.

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LEGEND:

- Site Boundary
- Proposed Road Seal
- Proposed 1.2m Wide Road Shoulder
- Proposed Road Swale
- Proposed 1.5m Wide Footpath

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Roading Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Roading - JOAL 2, ROW 1 & 2
Plan, Long & Typ. Cross Section

Project:
Stages 2-5

Surveyed:			
Designed:	S. Chand	22/07/2026	SC
Drawn:	S. Chand	22/07/2026	SC
Checked:	R. Singh	22/07/2026	RKS
Approved:	J. Thom	22/07/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): As Shown

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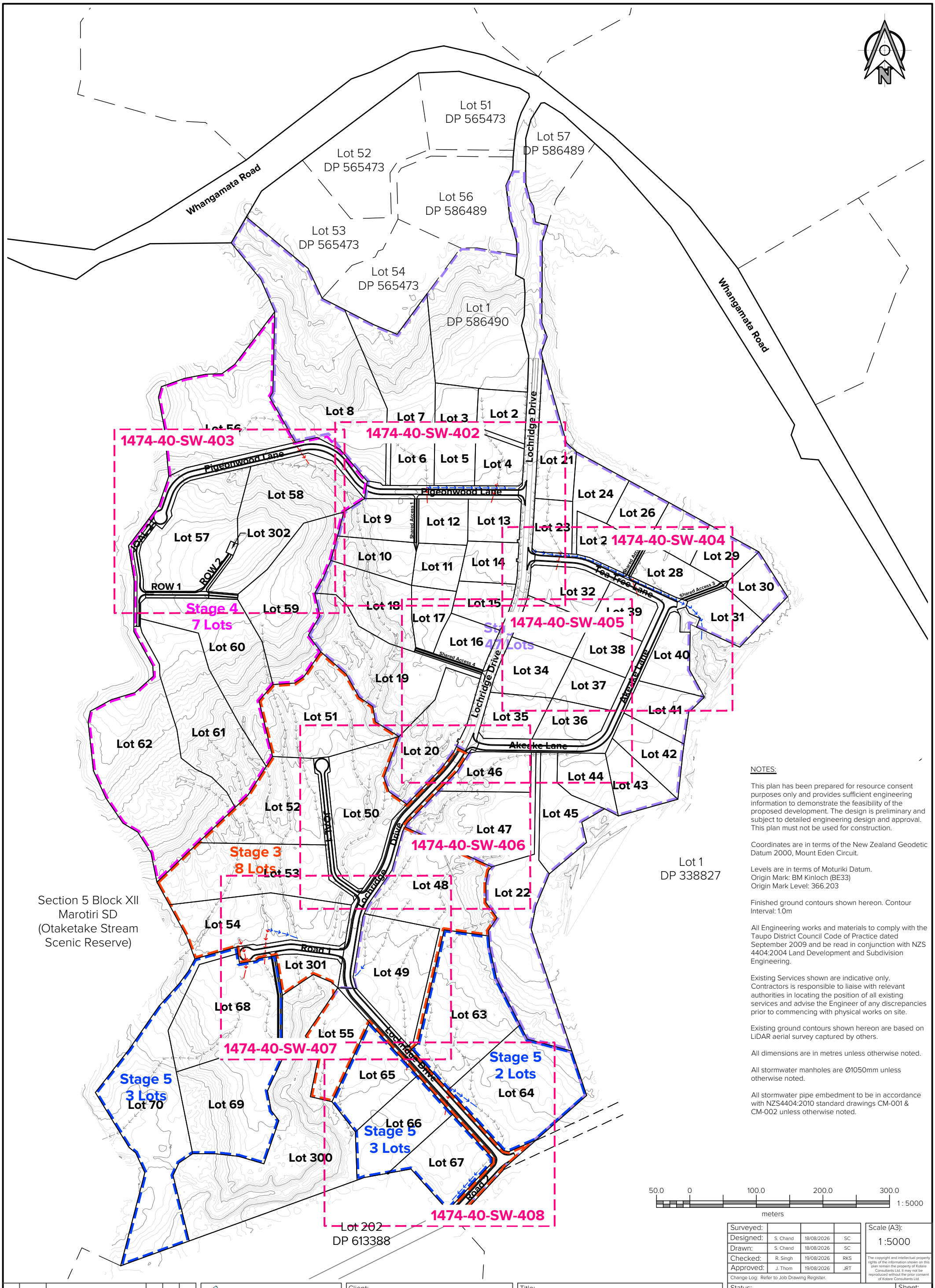
Status: RESOURCE CONSENT

Sheet: A3

Drawing Plan: 1474-30-RD-308

Rev: B

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AUTO CAD



NOTES:

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Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

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All dimensions are in metres unless otherwise noted.

All stormwater manholes are Ø1050mm unless otherwise noted.

All stormwater pipe embedment to be in accordance with NZS4404:2010 standard drawings CM-001 & CM-002 unless otherwise noted.

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Stormwater Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

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AUTO CAD

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Client: Lochridge Estate Ltd

Project: Stages 2-5

Title: Stormwater General Arrangement Plan

Surveyed:			
Designed:	S. Chand	18/08/2026	SC
Drawn:	S. Chand	18/08/2026	SC
Checked:	R. Singh	19/08/2026	RKS
Approved:	J. Thom	19/08/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): 1 :5000

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Status: **RESOURCE CONSENT**

Sheet: A3

Drawing Plan: 1474-40-SW-401

Rev: B

Pre-Development Catchment Information

Color:	Catchment Label:	Catchment Area (m^2)	Catchment Area (Ha)
	CA 01	263,242	26.32
	CA 02	31,839	3.18
	CA 03	47,637	4.76
	CA 04	34,677	3.47
	CA 05	10,545	1.06
	CA 06	16,027	1.60
	CA 07	11,796	1.18
	CA 08	9,813	0.98
	CA 09	33,943	3.39
	CA 10	17,755	1.78
	CA 11	36,747	3.68
	CA 12	64,587	6.46
	CA 13	61,024	6.10
	CA 14	42,032	4.20
	CA 15	15,000	1.50
	CA 16	18,750	1.88
	CA 17	10,747	1.08

Whangamata Road

Lot 51 DP 565473
Lot 52 DP 565473
Lot 53 DP 565473
Lot 54 DP 565473
Lot 56 DP 586489
Lot 57 DP 586489
Lot 1 DP 586490

Lot 202 DP 613388

Lot 1 DP 338827

Section 5 Block XII Marotiri SD (Otaketake Stream Scenic Reserve)

Pigeonwood Lane
Lochridge Drive
Akeake Lane
Tea Tree Lane
JOAL 1
JOAL 2
ROW 1
ROW 2
Road 1
Road 2
Shared Access 1
Shared Access 2
Shared Access 3
Shared Access 4

Lot 1, Lot 2, Lot 3, Lot 4, Lot 5, Lot 6, Lot 7, Lot 8, Lot 9, Lot 10, Lot 11, Lot 12, Lot 13, Lot 14, Lot 15, Lot 16, Lot 17, Lot 18, Lot 19, Lot 20, Lot 21, Lot 22, Lot 23, Lot 24, Lot 25, Lot 26, Lot 27, Lot 28, Lot 29, Lot 30, Lot 31, Lot 32, Lot 33, Lot 34, Lot 35, Lot 36, Lot 37, Lot 38, Lot 39, Lot 40, Lot 41, Lot 42, Lot 43, Lot 44, Lot 45, Lot 46, Lot 47, Lot 48, Lot 49, Lot 50, Lot 51, Lot 52, Lot 53, Lot 54, Lot 55, Lot 56, Lot 57, Lot 58, Lot 59, Lot 60, Lot 61, Lot 62, Lot 63, Lot 64, Lot 65, Lot 66, Lot 67, Lot 68, Lot 69, Lot 70, Lot 300, Lot 301, Lot 302

CA 01, CA 02, CA 03, CA 04, CA 05, CA 06, CA 07, CA 08, CA 09, CA 10, CA 11, CA 12, CA 13, CA 14, CA 15, CA 16, CA 17

NOTES:

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Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

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All stormwater pipe embedment to be in accordance with NZS4404:2010 standard drawings CM-001 & CM-002 unless otherwise noted.

50.0 0 100.0 200.0 300.0
meters
1 : 5000

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Stormwater Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

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Surveyed:			
Designed:	S. Chand	18/08/2026	SC
Drawn:	S. Chand	18/08/2026	SC
Checked:	R. Singh	19/08/2026	RKS
Approved:	J. Thom	19/08/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3): 1 :5000

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Client: Lochridge Estate Ltd

Project: Stages 2-5

Title: Pre-Development Catchment Plan

Status: RESOURCE CONSENT

Sheet: A3

Drawing Plan: 1474-40-SW-402

Rev: B

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AUTO CAD

Lot 51
DP 565473

Lot 57
DP 586489

Lot 52
DP 565473

Whangamata Road

Lot 56
DP 586489

Lot 53
DP 565473

Lot 54
DP 565473

Lot 1
DP 586490

Whangamata Road

Lot 8
Lot 56
Lot 7
Lot 3
Lot 2
Lot 6
Lot 5
Lot 4
Lochridge Drive
Lot 21
Pigeonwood Lane
Pigeonwood Lane
Lot 24
Lot 26
Lot 58
Lot 9
Lot 12
Lot 13
Lot 23
Lot 27
Lot 57
Lot 302
Lot 10
Lot 11
Lot 14
Lot 25
Lot 29
JOAL 2
ROW 2
ROW 1
Tea Tree Lane
Lot 28
Lot 30
Lot 32
Lot 39
Lot 59
Lot 18
Lot 17
Lot 15
Lot 33
Lot 31
Lot 60
Lot 16
Lot 38
Lot 40
Lot 34
Lot 37
Lot 19
Lochridge Drive
Akeake Lane
Lot 51
Lot 35
Lot 36
Lot 41
Lot 61
Lot 62
Lot 20
Akeake Lane
Lot 42
Lot 46
Lot 44
Lot 43
Lot 52
Lot 50
Lot 45
JOAL 1
Lot 47
Lot 53
Lot 48
Lot 22
Lochridge Drive
Lot 54
Road 1
Lot 301
Lot 49
Lot 68
Lot 63
Lot 55
Lochridge Drive
Lot 65
Lot 64
Lot 70
Lot 69
Lot 66
Lot 300
Lot 67
Road 2

Section 5 Block XII
Marotiri SD
(Otaketake Stream
Scenic Reserve)

Lot 1
DP 338827

Lot 202
DP 613388

NOTES:

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Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

All Engineering works and materials to comply with the Taupo District Council Code of Practice dated September 2009 and be read in conjunction with NZS 4404:2004 Land Development and Subdivision Engineering.

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All stormwater manholes are Ø1050mm unless otherwise noted.

All stormwater pipe embedment to be in accordance with NZS4404:2010 standard drawings CM-001 & CM-002 unless otherwise noted.

50.0 0 100.0 200.0 300.0
meters
1 : 5000

Surveyed:					
Designed:	S. Chand	18/08/2026	SC		
Drawn:	S. Chand	18/08/2026	SC		
Checked:	R. Singh	19/08/2026	RKS		
Approved:	J. Thom	19/08/2026	JRT		

Change Log: Refer to Job Drawing Register.

Scale (A3): 1 :5000

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Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Stormwater Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

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Client: Lochridge Estate Ltd

Project: Stages 2-5

Title: Post-Development Catchment Plan

Status: RESOURCE CONSENT

Sheet: A3

Drawing Plan: 1474-40-SW-403

Rev: B

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NOTES:

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Coordinates are in terms of the New Zealand Geodetic Datum 2000, Mount Eden Circuit.

Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

All Engineering works and materials to comply with the Taupo District Council Code of Practice dated September 2009 and be read in conjunction with NZS 4404:2004 Land Development and Subdivision Engineering.

Existing Services shown are indicative only. Contractors is responsible to liaise with relevant authorities in locating the position of all existing services and advise the Engineer of any discrepancies prior to commencing with physical works on site.

Existing ground contours shown hereon are based on LiDAR aerial survey captured by others.

All dimensions are in metres unless otherwise noted.

All stormwater manholes are Ø1050mm unless otherwise noted.

All stormwater pipe embedment to be in accordance with NZS4404:2010 standard drawings CM-001 & CM-002 unless otherwise noted.

LEGEND:

- Site Boundary
- New Stormwater Swale Drain
- New RCRRJ Culvert
- New Stormwater Scruffy Manhole
- New Stormwater Soakhole
- New Stormwater Checkdam
- Existing Overland Flow Path (OLFP)
- New Overland Flow Path
- Existing Overland Flow Path Removed

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Stormwater Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Stormwater General Layout
Sheet 1 of 7

Project:
Stages 2-5

Surveyed:			
Designed:	S. Chand	18/08/2026	SC
Drawn:	S. Chand	18/08/2026	SC
Checked:	R. Singh	19/08/2026	RKS
Approved:	J. Thom	19/08/2026	JRT

Change Log: Refer to Job Drawing Register.

Scale (A3):
1 : 1000

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Status:
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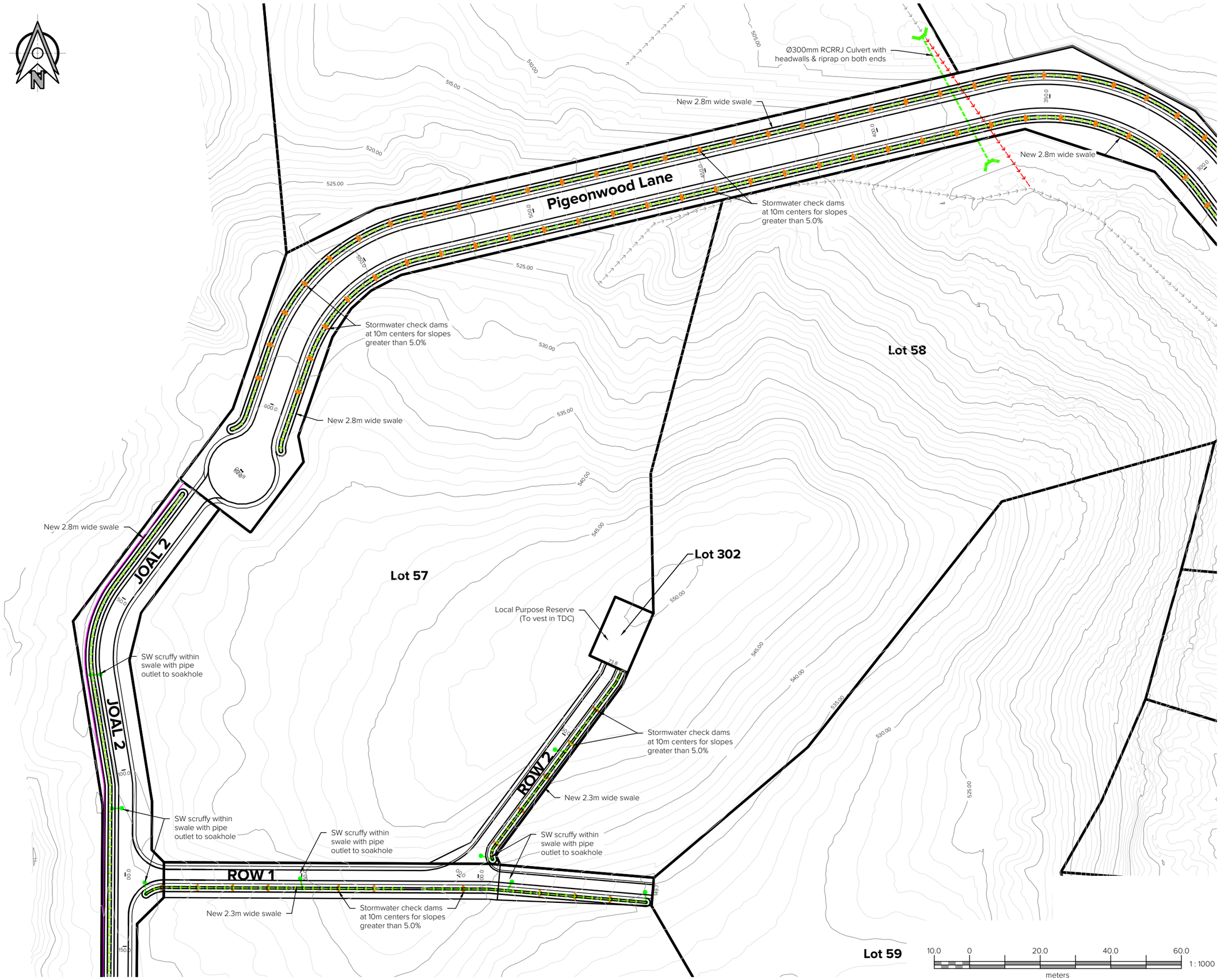
Sheet:
A3

Drawing Plan:
1474-40-SW-404

Rev:
B

10.0 0 20.0 40.0 60.0
meters
1 : 1000

KOTARE CONSULTANTS
AUTO CAD
C:\12dS\data\KotareSYN\1474-T - Lochridge Estate_417\01 CADD\3 CAD\1474-40-SW.dwg 17/Sept/2026 4:03 pm



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Levels are in terms of Moturiki Datum.
Origin Mark: BM Kinloch (BE33)
Origin Mark Level: 366.203

Finished ground contours shown hereon. Contour Interval: 1.0m

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- Site Boundary
- New Stormwater Swale Drain
- New RCRRJ Culvert
- New Stormwater Scruffy Manhole
- New Stormwater Soakhole
- New Stormwater Checkdam
- Existing Overland Flow Path (OLFP)
- New Overland Flow Path
- Existing Overland Flow Path Removed

Rev	Date	Amendment:	By	Chk	App
B	17/09/26	Stormwater Arrangement Revised	SC	JRT	JRT
A	11/09/26	First Issue	SC	RKS	JRT

Client:
Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Stormwater General Layout
Sheet 2 of 7

Project:
Stages 2-5

Surveyed:			
Designed:	S. Chand	18/08/2026	SC
Drawn:	S. Chand	18/08/2026	SC
Checked:	R. Singh	19/08/2026	RKS
Approved:	J. Thom	19/08/2026	JRT

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Origin Mark Level: 366.203

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Sheet 3 of 7

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1474-40-SW-406

Rev:
B

Lot 15

Lot 17

Lot 16

Lot 33

Lot 38

Lot 34

Lot 37

Lot 35

Lot 36

Lot 20

Lot 46

Lochridge Drive

Shared Access 4

Akeake Lane

2.8m wide swale

SW scruffy within swale with pipe outlet to soakhole

RCRRJ Culvert under vehicle crossing

Stormwater check dams at 10m centers for slopes greater than 5.0%

Existing Ø375mm SW culvert to remain for existing overland flow

New Ø525mm RCRRJ culvert to convey roadside swale runoff to the stormwater attenuation basin

SW Bioretention Device 2 = 76m²

Existing SW culvert outlet to be extended

New 2.8m wide swale

490.00 485.00 480.00 475.00 470.00

300.0 250.0 200.0 150.0 100.0

10.0 0 20.0 40.0 60.0

1 : 1000

meters

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Taupo

Title:
Stormwater General Layout
Sheet 4 of 7

Project:
Stages 2-5

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Rev:
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Existing Ø375mm SW culvert to remain for existing overland flow

Akeake Lane

New Ø525mm RCRRJ culvert to convey roadside swale runoff to the stormwater attenuation basin

SW Bioretention Device 2 = 76m²

Lot 20

Existing SW culvert outlet to be extended

New 2.8m wide swale

Lochridge Drive

New 2.8m wide swale

Lot 46

SW scruffy within swale with pipe outlet to soakhole

JOAL 1

Lot 50

New 2.3m wide swale

New 2.3m wide swale

Stormwater check dams at 10m centers for slopes greater than 5.0%

Stormwater check dams at 10m centers for slopes greater than 5.0%

New 2.8m wide swale

SW scruffy within swale with pipe outlet to soakhole

New 2.8m wide swale

Lot 47

Lot 48

Lot 22

SW Scruffy manhole at lowest point

New 2x Ø900mm RCRRJ Culvert with headwall on both ends within gully

SW scruffy within swale with pipe outlet to soakhole

SW bubble up scruffy manhole at outlet end

New Ø300mm RCRRJ culvert to convey roadside swale runoff to the stormwater attenuation basin

10.0 0 20.0 40.0 60.0
meters
1 : 1000

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Taupo

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Stormwater General Layout
Sheet 5 of 7

Project:
Stages 2-5

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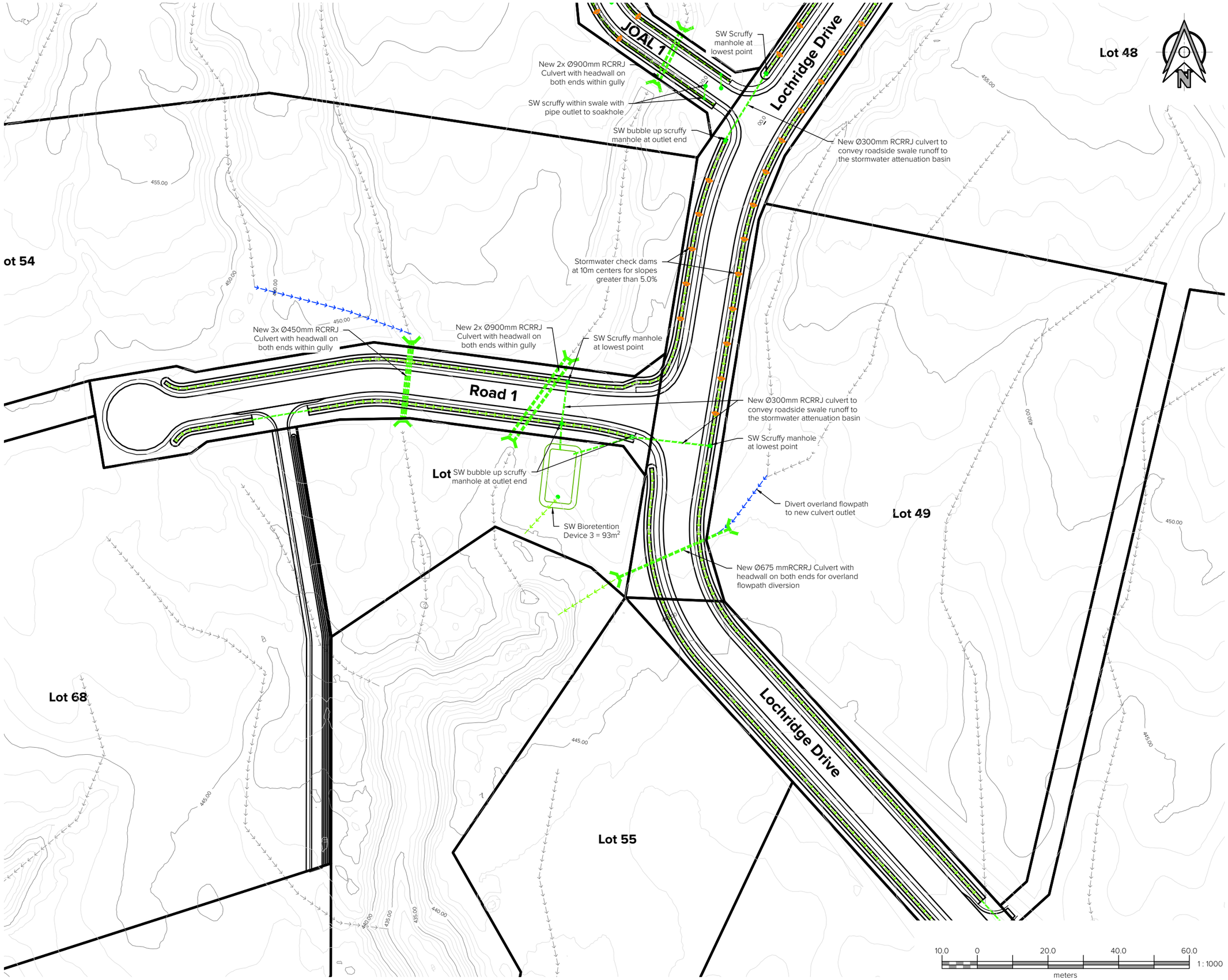
Drawing Plan: 1474-40-SW-408

Rev: B

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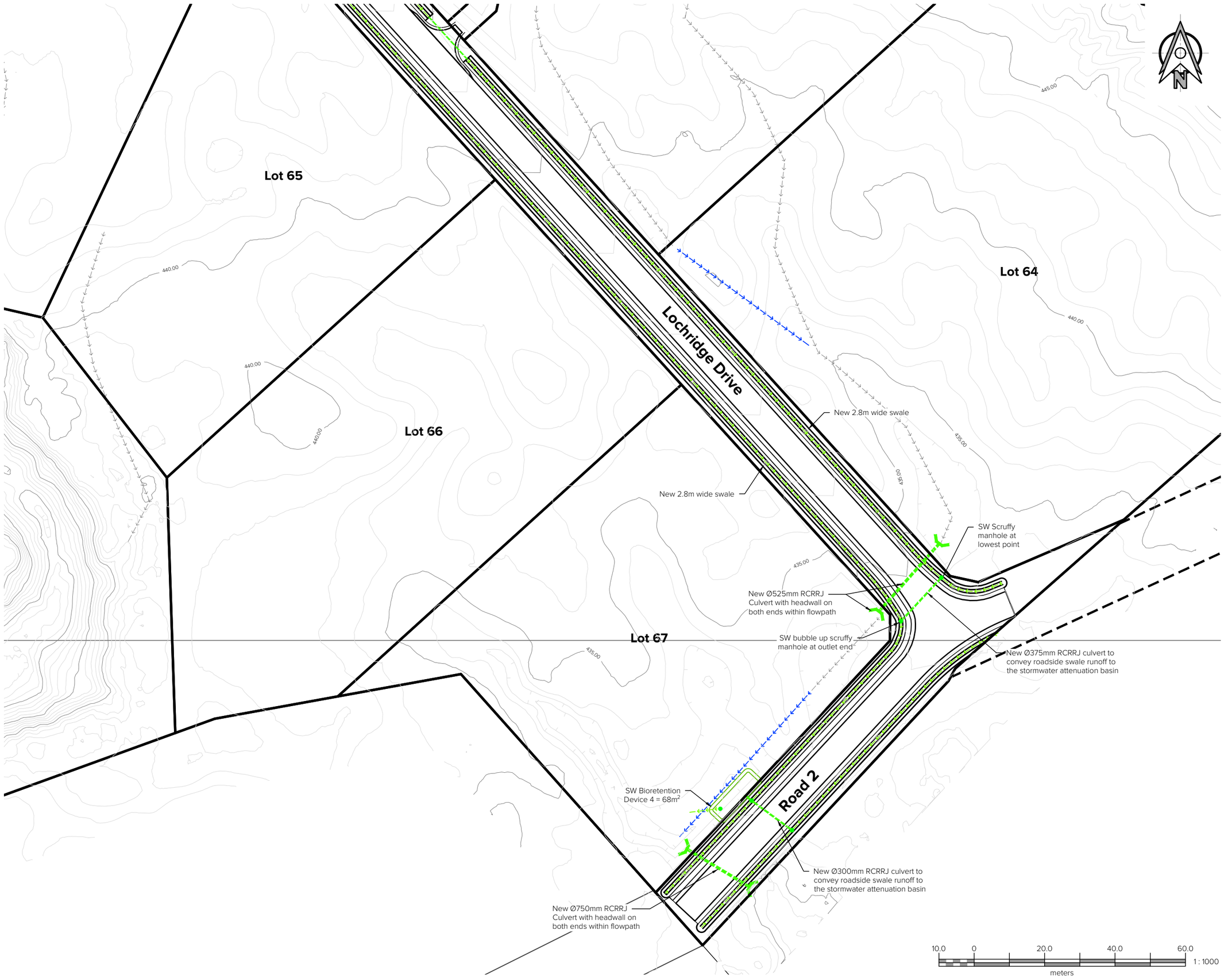
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Lochridge Estate Limited
Lochridge Drive, Kinloch
Taupo

Title:
Stormwater General Layout
Sheet 7 of 7

Project:
Stages 2-5

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LOCHRIDGE ESTATE

SITE LOCATION



LOCHRIDGE ESTATE

SITE LOCATION



LOCHRIDGE ESTATE

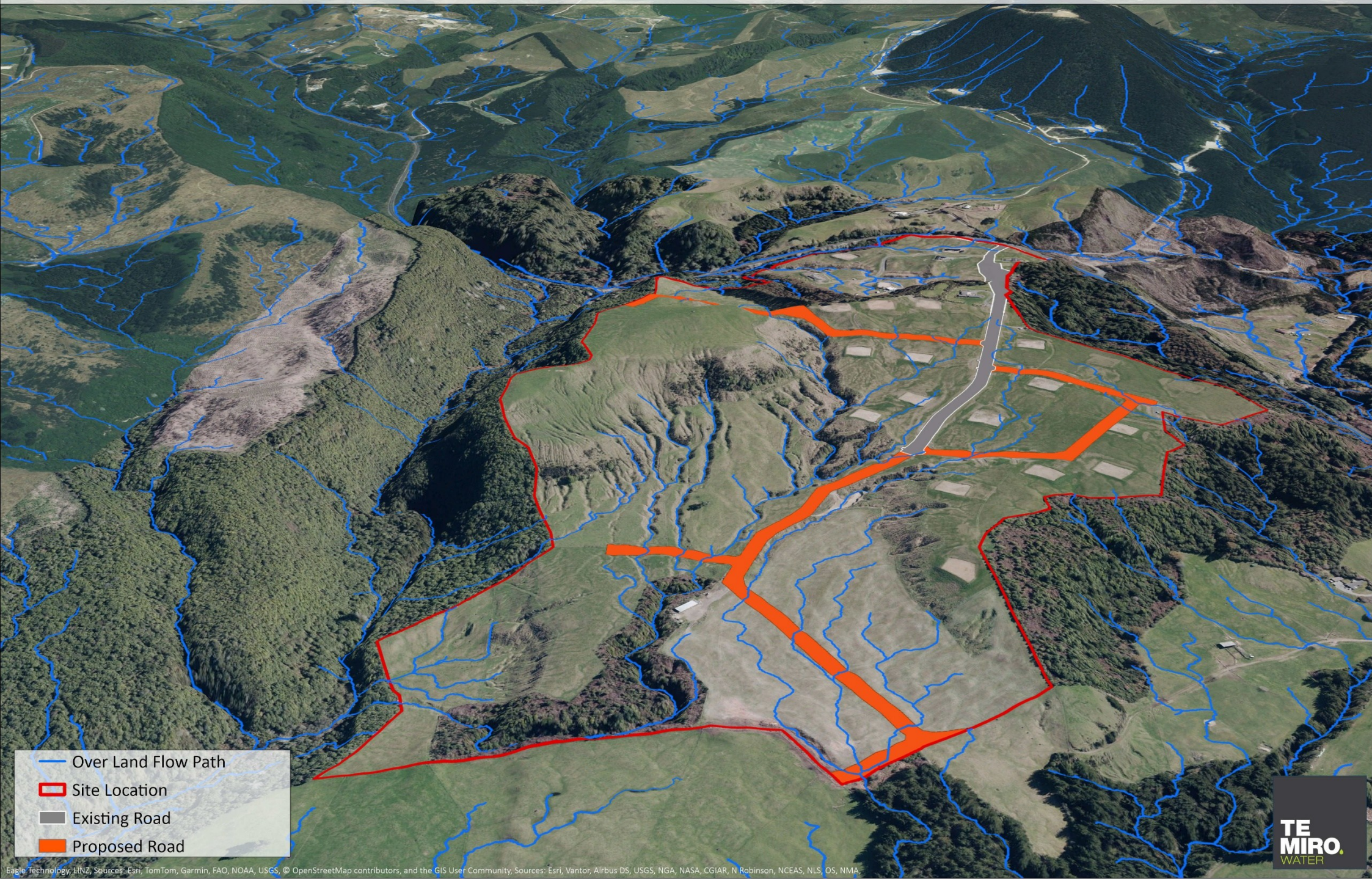
SITE LOCATION MAP



LOCHRIDGE ESTATE

SITE LOCATION 3D MAP

0 0.1 0.2 KM



TE MIRO. WATER

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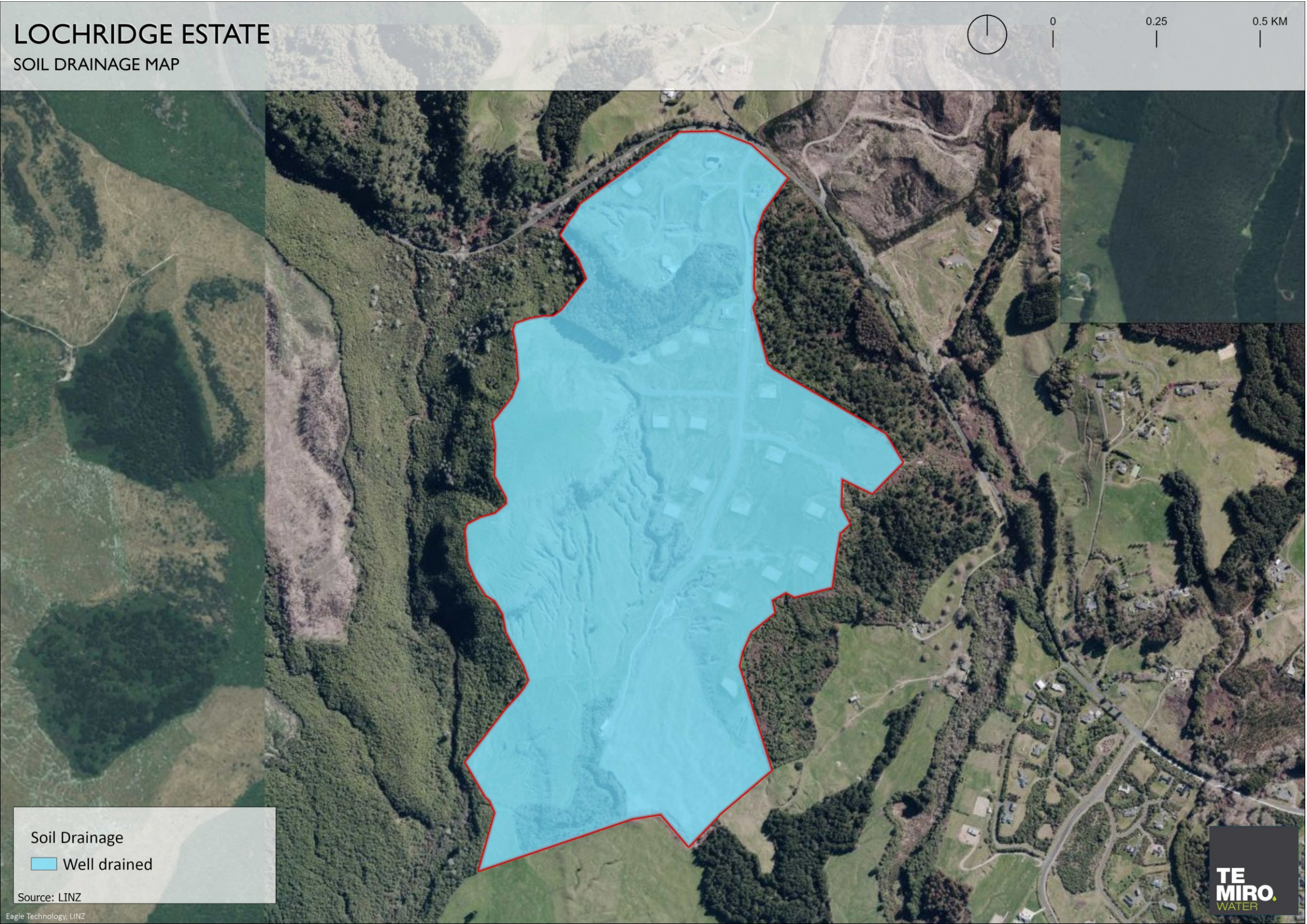
LOCHRIDGE ESTATE

SOIL CLASSIFICATION MAP



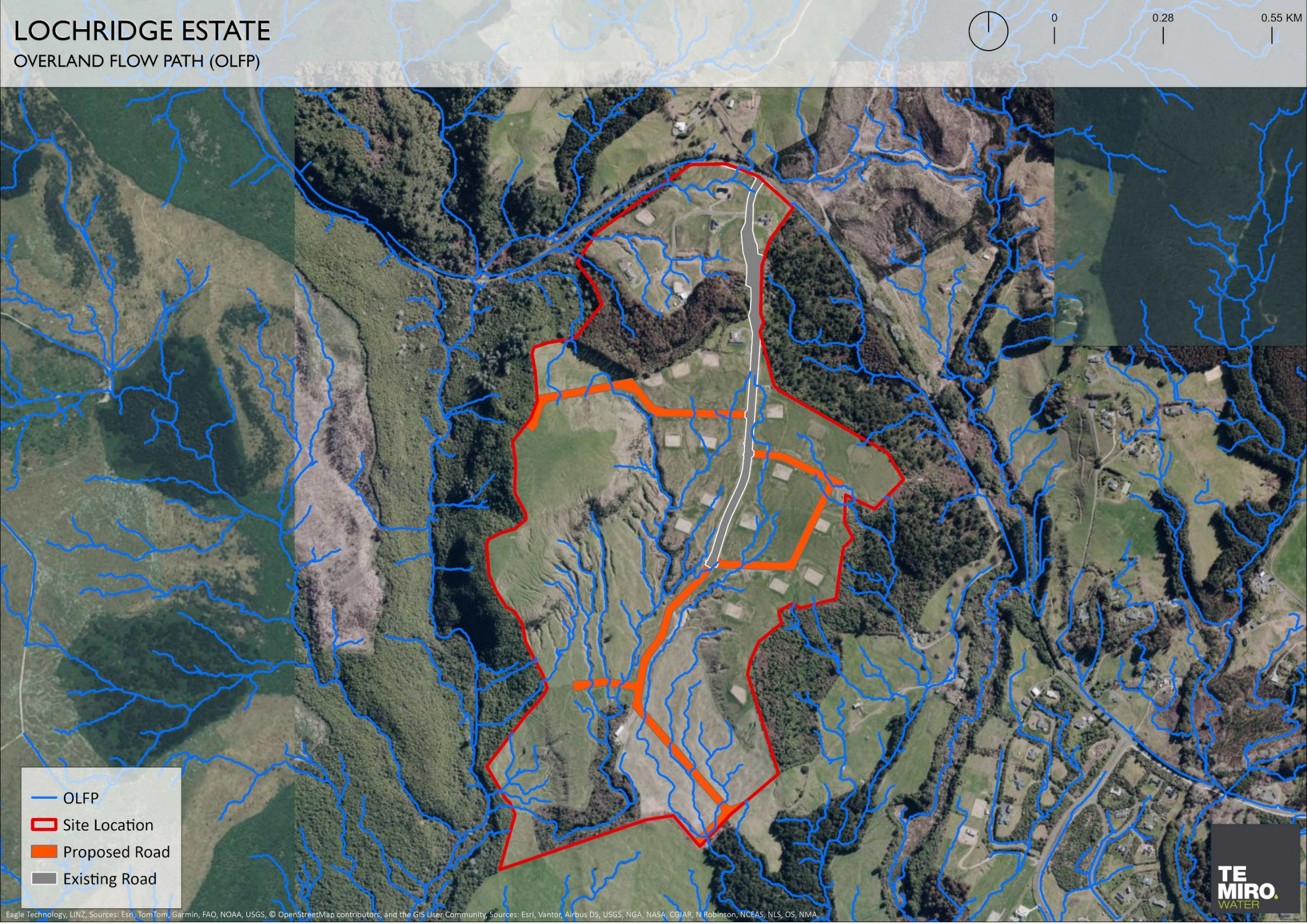
LOCHRIDGE ESTATE

SOIL DRAINAGE MAP



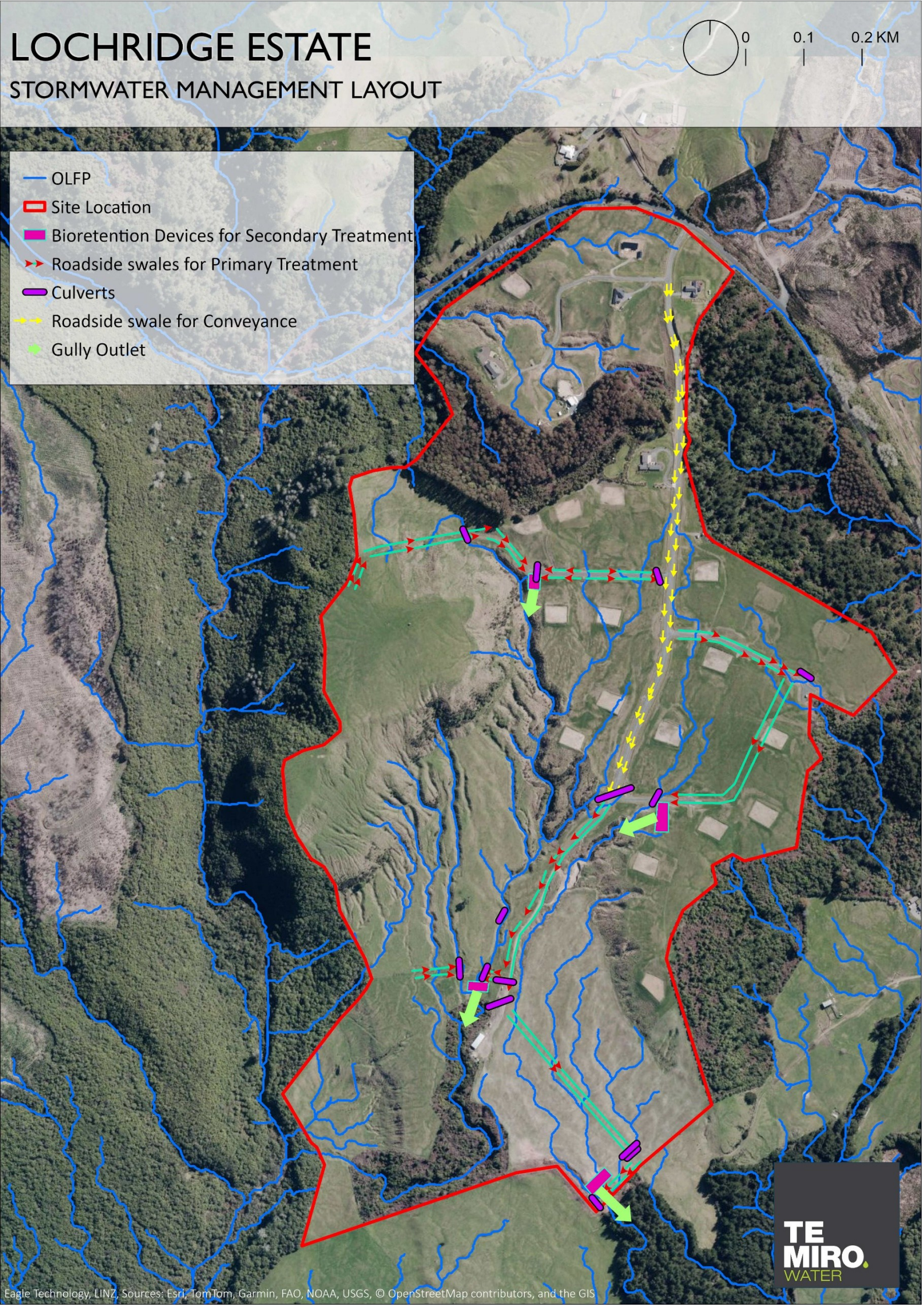
LOCHRIDGE ESTATE

OVERLAND FLOW PATH (OLFP)



LOCHRIDGE ESTATE

STORMWATER MANAGEMENT LAYOUT



LOCHRIDGE ESTATE

TOPOGRAPHY MAP

0 0.17 0.35 KM

Site Location

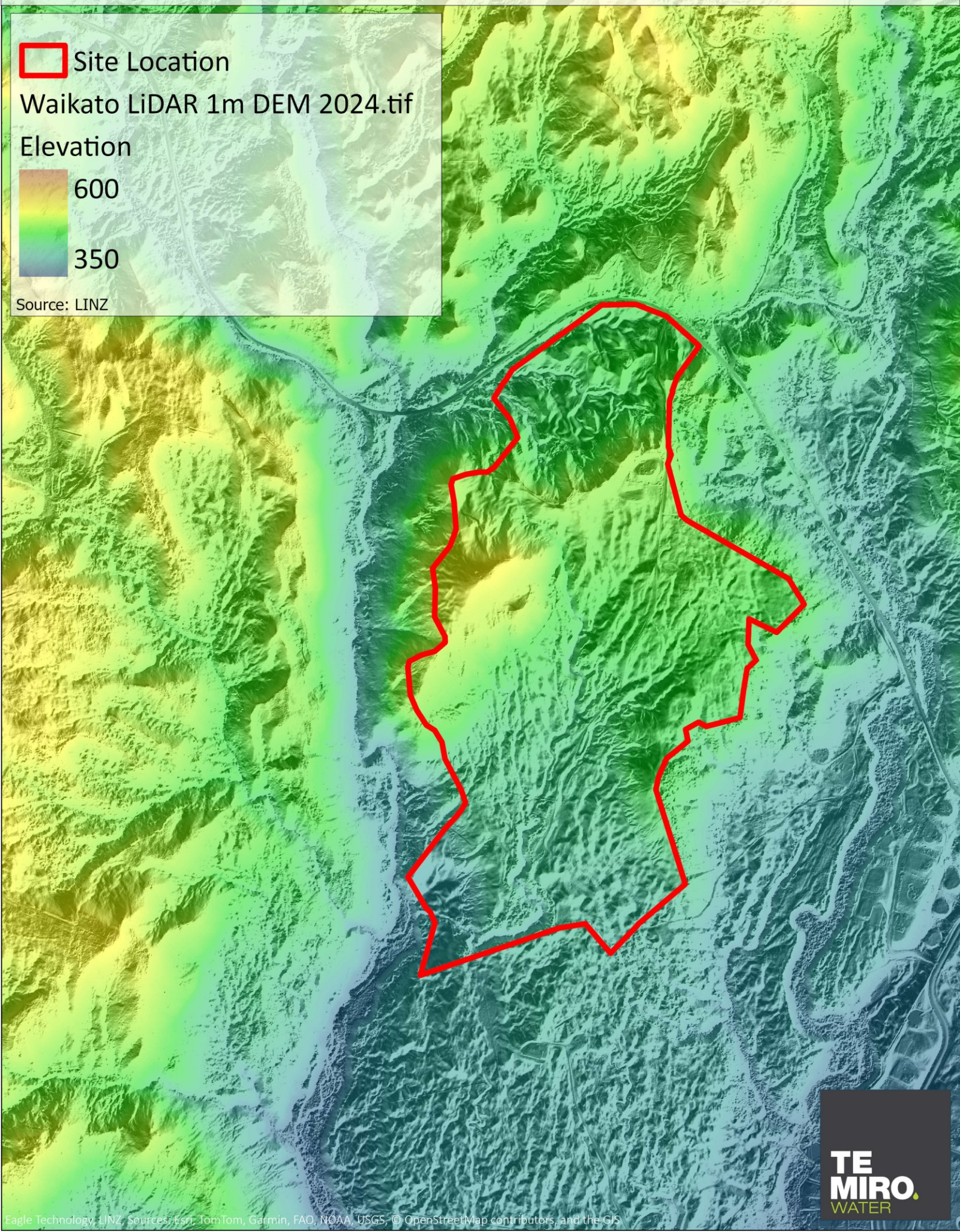
Waikato LiDAR 1m DEM 2024.tif

Elevation

600

350

Source: LINZ



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TE MIRO WATER

7 ĀPITIHANGA B | APPENDIX B – CALCULATIONS

Parameters used for runoff calculations (post-development)

Catchment (post-development)	Area(km²)	CN	Ia (mm)	Lag time (min)	Peak Flow Rate (m³/s) 2-year	Peak Flow Rate (m³/s) 10-year	Peak Flow Rate (m³/s) 100-year
Akeake Lane (565m)	0.007854	72.96	4.71	6.67	0.0566	0.1123	0.2058
Shared access 4	0.000745	73.05	4.68	6.67	0.0054	0.0107	0.0195
JOAL 1- East to Culvert	0.154968	40.30	18.81	6.67	0.2634	0.7441	1.7674
JOAL 1- up 1	0.026438	44.77	15.67	6.67	0.0596	0.1541	0.3524
JOAL 1- West	0.009681	42.43	17.23	6.67	0.0189	0.0511	0.1196
JOAL 1 - East	0.002502	52.27	11.60	6.67	0.0082	0.0195	0.0417
Lochridge Drive - Road 2	0.001162	71.83	4.98	6.67	0.0080	0.0161	0.0299
Lochridge Drive Ext (Ch: 1020 to 1380)	0.004892	66.79	6.32	6.67	0.0284	0.0594	0.1142
Culvert under LD Ch1380	0.029713	45.39	15.28	6.67	0.0694	0.1776	0.4039
Lochridge Drive Ext (Ch:1380 to 1550) E	0.034778	40.85	18.39	6.67	0.0614	0.1712	0.4050
Lochridge Drive Ext (Ch:1550 to 1764.21) E	0.002271	74.62	4.32	6.67	0.0173	0.0338	0.0610
Lochridge Drive Ext (Ch:1380 to 1764.21) W	0.001883	98.00	6.00	6.67	0.0232	0.0481	0.0917
Lochridge Drive (Ch:623 to 1020) W	0.026470	42.28	7.54	6.67	0.0183	0.0396	0.0786
Lochridge Drive (Ch:715 to 1020) E	0.009820	50.28	12.56	6.67	0.0295	0.0711	0.1547
Pigeonwood lane (Ch: 0 to 180) N	0.041921	40.17	18.92	6.67	0.0706	0.2000	0.4756
Pigeonwood lane (Ch: 0 to 180) S	0.001800	66.14	6.50	6.67	0.0102	0.0215	0.0415
Pigeonwood lane (Ch: 180 to 623) N	0.009896	51.34	12.04	6.67	0.0311	0.0745	0.1607
Pigeonwood lane (Ch: 180 to 623) S	0.019919	45.13	15.44	6.67	0.0459	0.1178	0.2686
Shared access 1	0.000506	69.90	5.47	6.67	0.0033	0.0067	0.0125
JOAL 2	0.012838	43.37	16.59	6.67	0.0266	0.0705	0.1636
ROW 1	0.001050	73.84	4.50	6.67	0.0078	0.0153	0.0279
ROW 2	0.000490	72.71	4.77	6.67	0.0035	0.0070	0.0128
Road 1- East	0.007958	39.00	19.86	6.67	0.0123	0.0360	0.0862
Road 1- North	0.002734	59.18	8.76	6.67	0.0119	0.0266	0.0542
Road 1- South	0.002236	63.68	7.24	6.67	0.0116	0.0249	0.0491
Road 1- West	0.075025	39.00	19.86	6.67	0.1162	0.3391	0.8131
South 2	0.062111	39.00	19.86	6.67	0.0962	0.2807	0.6731
Tea Tree Lane (Ch: 0 to 255) N	0.030954	41.83	17.66	6.67	0.0583	0.1592	0.3741
Shared access 2	0.000393	70.53	5.31	6.67	0.0026	0.0053	0.0099
Shared access 3	0.000505	69.38	5.61	6.67	0.0032	0.0066	0.0124
West 1	0.034676	39.00	19.86	6.67	0.0537	0.1567	0.3758

Swale Sizing Calculations

Pigeonwood Lane (Ch: 0 to 180) North

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0235	m^3/s
10-year ARI (+CC)	0.2	m^3/s
100-year ARI (+CC)	0.4756	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	2.3%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.120	m
L	Swale Length	180	m

Constant		WQ	Sub
n	Manning's n	0.25	0.03

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.14	m/s
T	Width at WQ Water Level	1.72	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	20.8	mins

Larger Flow Events

Input Parameters		10-year	100-yr	
d	Depth of water	0.121	0.187	m

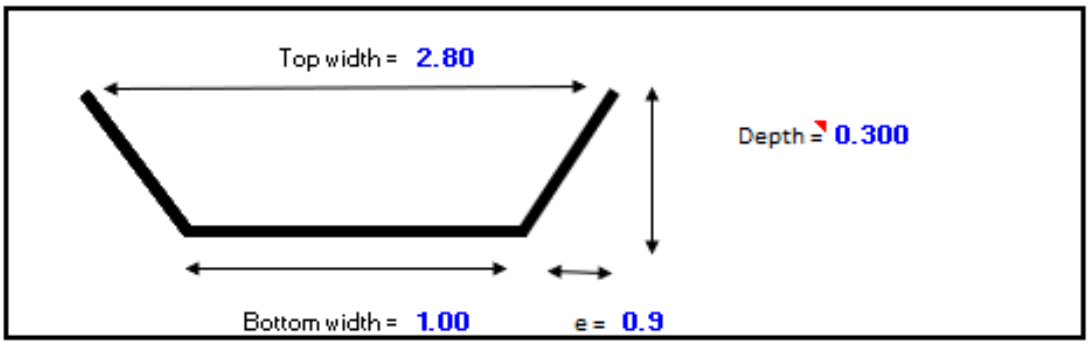
W1	$Qn/s^{0.5}$	0.040	0.095
W2	$d^{1.67}(b+Zd)$	0.040	0.095

Calculations:

T	Top Width at Water Level	1.73	2.13	m
V	Water Velocity	1.21	1.63	m/s

Should be less than 1.5 m/s or

Swale Dimensions (m)



TE MIRO. WATER

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0153	m^3/s
10-year ARI (+CC)	0.1178	m^3/s
100-year ARI (+CC)	0.2686	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters				
S	Channel Longitudinal Slope	14.8%	m/m	*Check Dams Required*
Z	Side slope H:1V	3		
d	Depth of WQ flow	0.058	m	
L	Swale Length	443	m	

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.23	m/s
T	Width at WQ Water Level	1.34	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	32.5	mins

Larger Flow Events

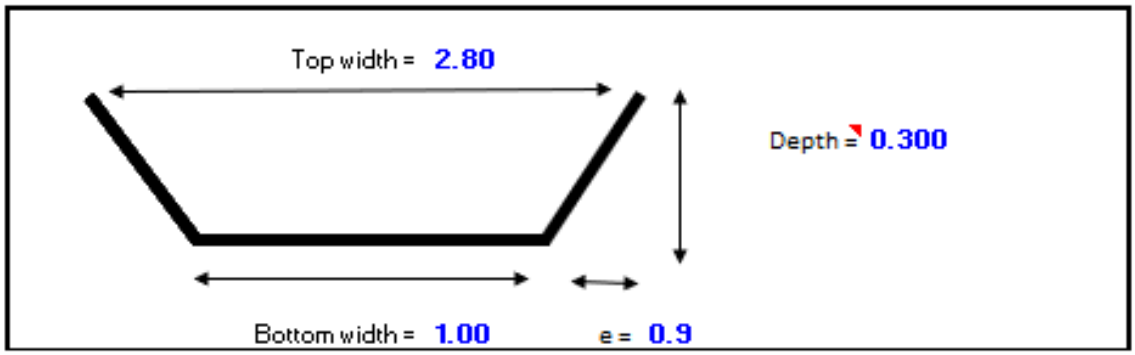
Input Parameters		10-year	100-yr	
d	Depth of water	0.106	0.161	m

W1	$Qn/s^{0.5}$	0.031	0.070
W2	$d^{1.67}(b+Zd)$	0.031	0.070

Calculations:

T	Top Width at Water Level	1.63	1.96	m
V	Water Velocity	0.84	1.13	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0089	m^3/s
10-year ARI (+CC)	0.0705	m^3/s
100-year ARI (+CC)	0.1636	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	2.5%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.070	m
L	Swale Length	180	m

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.11	m/s
T	Width at WQ Water Level	1.42	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	28.5	mins

Larger Flow Events

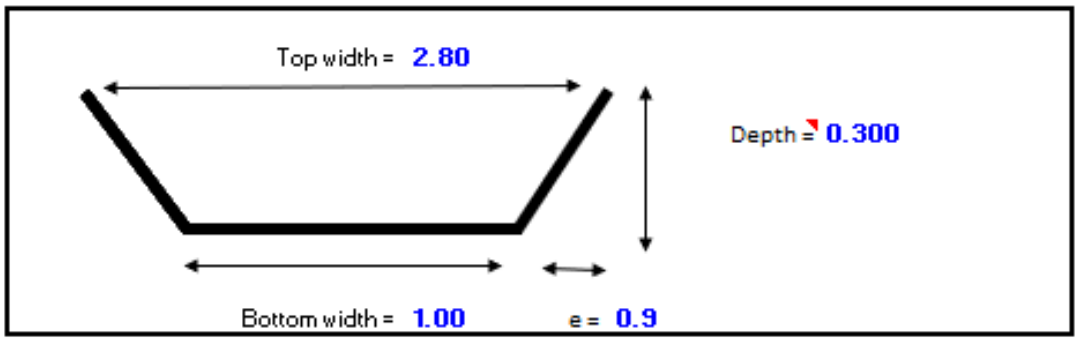
Input Parameters		10-year	100-yr	
d	Depth of water	0.129	0.197	m

W1	$Qn/s^{0.5}$	0.045	0.105
W2	$d^{1.67}(b+Zd)$	0.045	0.105

Calculations:

T	Top Width at Water Level	1.77	2.18	m
V	Water Velocity	0.39	0.52	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0194	m^3/s
10-year ARI (+CC)	0.1592	m^3/s
100-year ARI (+CC)	0.3741	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	4.8%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.089	m
L	Swale Length	255	m

Constant		WQ	Sub
n	Manning's n	0.25	0.05

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.17	m/s
T	Width at WQ Water Level	1.53	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	24.7	mins

Larger Flow Events

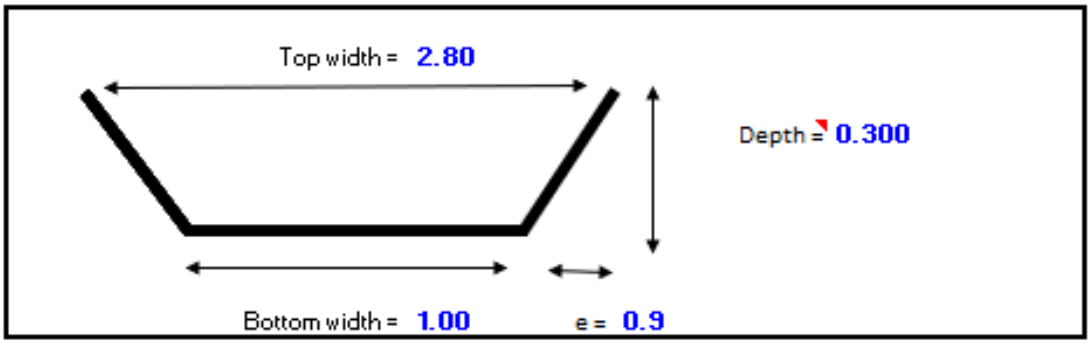
Input Parameters		10-year	100-yr	
d	Depth of water	0.116	0.178	m

W1	$Qn/s^{0.5}$	0.037	0.086
W2	$d^{1.67}(b+Zd)$	0.037	0.086

Calculations:

T	Top Width at Water Level	1.70	2.07	m
V	Water Velocity	1.02	1.37	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0189	m^3/s
10-year ARI (+CC)	0.1123	m^3/s
100-year ARI (+CC)	0.2058	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	6.9%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.079	m
L	Swale Length	565	m

Check Dams Required

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.19	m/s
T	Width at WQ Water Level	1.48	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	49.0	mins

Larger Flow Events

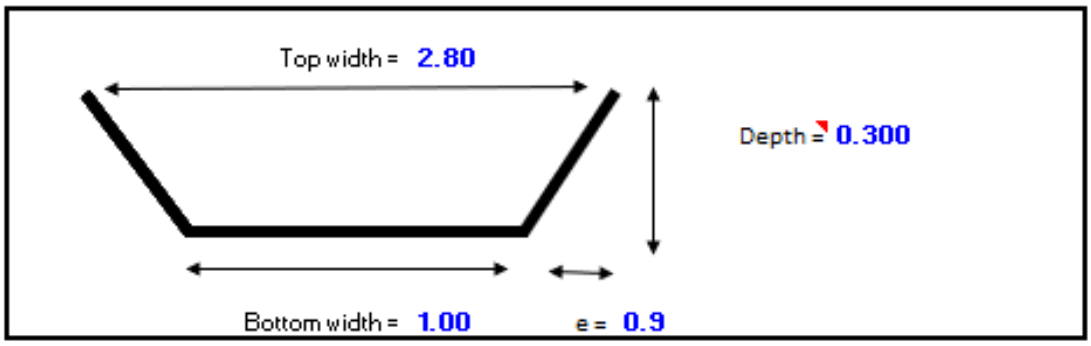
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.125	0.170	m

W1	$Qn/s^{0.5}$	0.043	0.078	
W2	$d^{1.67}(b+Zd)$	0.043	0.078	0.000

Calculations:

T	Top Width at Water Level	1.75	2.02	m
V	Water Velocity	0.65	0.80	m/s

Swale Dimensions (m)



Lochridge Drive (Ch: 623 to 1020) West

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0330	m^3/s
10-year ARI (+CC)	0.2611	m^3/s
100-year ARI (+CC)	0.5957	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters				
S	Channel Longitudinal Slope	5.5%	m/m	*Check Dams Required*
Z	Side slope H:1V	3		
d	Depth of WQ flow	0.113	m	*Swale must be planted*
L	Swale Length	397	m	

Constant		WQ	Sub
n	Manning's n	0.25	0.03

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.22	m/s
T	Width at WQ Water Level	1.68	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	30.4	mins

Larger Flow Events

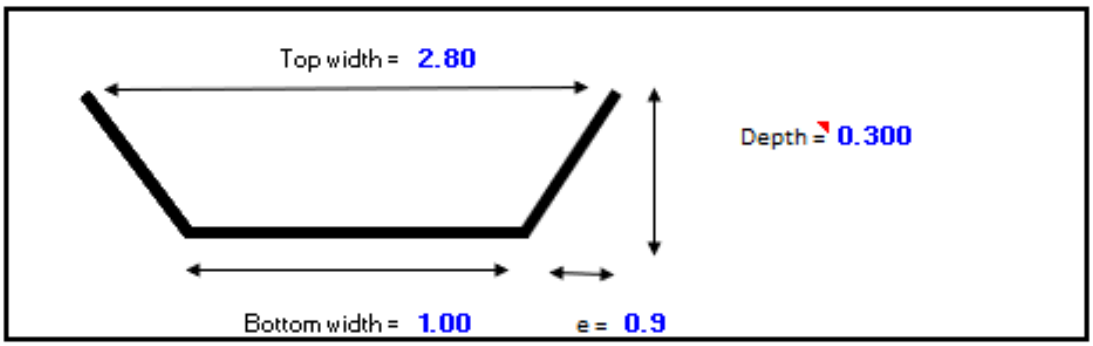
Input Parameters		10-year	100-yr	
d	Depth of water	0.110	0.168	m

W1	$Qn/s^{0.5}$	0.033	0.076
W2	$d^{1.67}(b+Zd)$	0.033	0.076

Calculations:

T	Top Width at Water Level	1.66	2.01	m	
V	Water Velocity	1.78	2.36	m/s	*Should be less than 1.5 m/s or*

Swale Dimensions (m)



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Lochridge Drive (Ch: 715 to 1020) East

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0098	m^3/s
10-year ARI (+CC)	0.0711	m^3/s
100-year ARI (+CC)	0.1547	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	5.5%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.059	m
L	Swale Length	305	m

Check Dams Required

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.14	m/s
T	Width at WQ Water Level	1.35	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	36.0	mins

Larger Flow Events

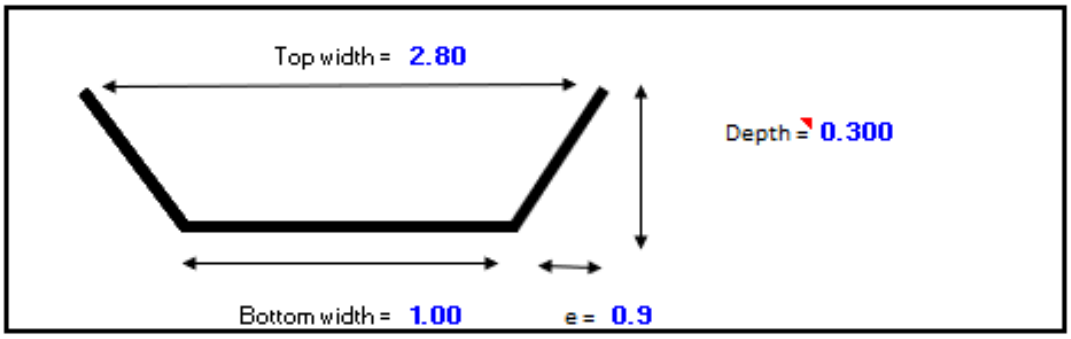
Input Parameters		10-year	100-yr	
d	Depth of water	0.105	0.156	m

W1	$Qn/s^{0.5}$	0.030	0.066
W2	$d^{1.67}(b+Zd)$	0.030	0.066

Calculations:

T	Top Width at Water Level	1.63	1.93	m
V	Water Velocity	0.52	0.68	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0095	m^3/s
10-year ARI (+CC)	0.0594	m^3/s
100-year ARI (+CC)	0.1142	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	8.6%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.051	m
L	Swale Length	360	m

Check Dams Required

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.16	m/s
T	Width at WQ Water Level	1.30	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	37.4	mins

Larger Flow Events

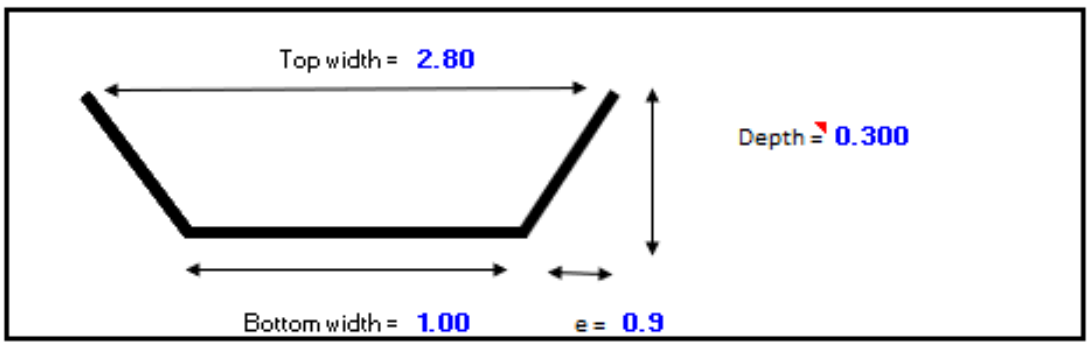
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.085	0.120	m

W1	$Qn/s^{0.5}$	0.020	0.039
W2	$d^{1.67}(b+Zd)$	0.020	0.039

Calculations:

T	Top Width at Water Level	1.51	1.72	m
V	Water Velocity	0.56	0.70	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0077	m^3/s
10-year ARI (+CC)	0.0481	m^3/s
100-year ARI (+CC)	0.0917	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	3.2%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.060	m
L	Swale Length	384	m

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.11	m/s
T	Width at WQ Water Level	1.36	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	58.6	mins

Larger Flow Events

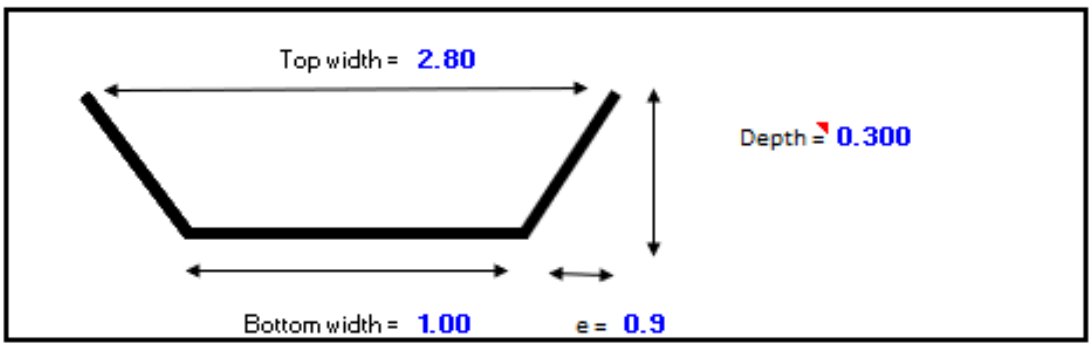
Input Parameters		10-year	100-yr	
d	Depth of water	0.099	0.137	m

W1	$Qn/s^{0.5}$	0.027	0.051
W2	$d^{1.67}(b+Zd)$	0.027	0.051

Calculations:

T	Top Width at Water Level	1.59	1.82	m
V	Water Velocity	0.37	0.47	m/s

Swale Dimensions (m)



Lochridge Drive Ext (Ch: 1380 to 1764) East

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0262	m^3/s
10-year ARI (+CC)	0.205	m^3/s
100-year ARI (+CC)	0.466	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	3.2%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.116	m
L	Swale Length	214	m

Swale must be planted

Constant		WQ	Sub
n	Manning's n	0.25	0.03

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.17	m/s
T	Width at WQ Water Level	1.69	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	21.1	mins

Larger Flow Events

Input Parameters		10-year	100-yr	
d	Depth of water	0.112	0.170	m

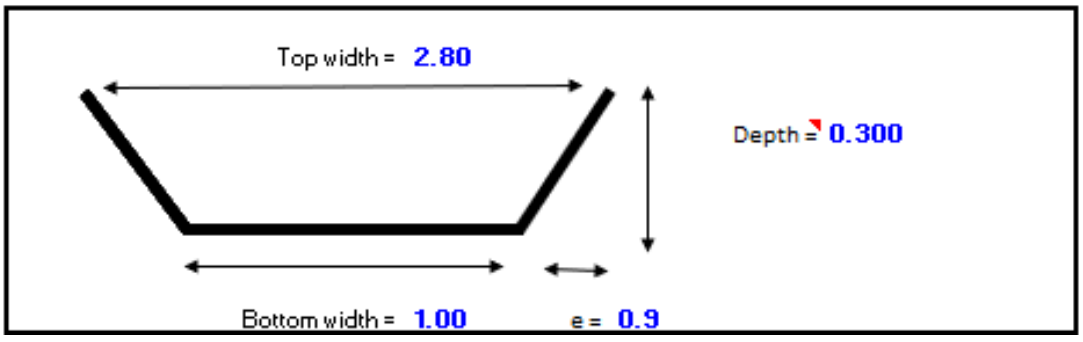
W1	$Qn/s^{0.5}$	0.034	0.078
W2	$d^{1.67}(b+Zd)$	0.034	0.078

Calculations:

T	Top Width at Water Level	1.67	2.02	m
V	Water Velocity	1.37	1.82	m/s

Should be less than 1.5 m/s or

Swale Dimensions (m)



Road 1 North

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0134	m^3/s
10-year ARI (+CC)	0.086	m^3/s
100-year ARI (+CC)	0.1684	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	3.6%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.079	m
L	Swale Length	150	m

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.14	m/s
T	Width at WQ Water Level	1.47	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	18.1	mins

Larger Flow Events

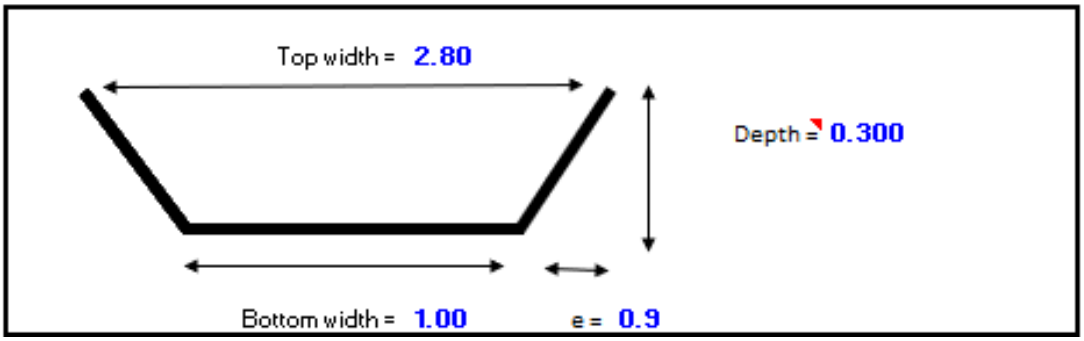
Input Parameters		10-year	100-yr	
d	Depth of water	0.128	0.181	m

W1	$Qn/s^{0.5}$	0.045	0.089
W2	$d^{1.67}(b+Zd)$	0.045	0.089

Calculations:

T	Top Width at Water Level	1.77	2.09	m
V	Water Velocity	0.48	0.60	m/s

Swale Dimensions (m)



Road 2

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0104	m^3/s
10-year ARI (+CC)	0.2692	m^3/s
100-year ARI (+CC)	0.5876	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	3.2%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.071	m
L	Swale Length	103	m

Constant		WQ	Sub
n	Manning's n	0.25	0.03

Calculations:

Water Quality Event

b	Base Width	1.00	m
V	WQ Velocity	0.12	m/s
T	Width at WQ Water Level	1.42	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	14.1	mins

Larger Flow Events

Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.128	0.191	m

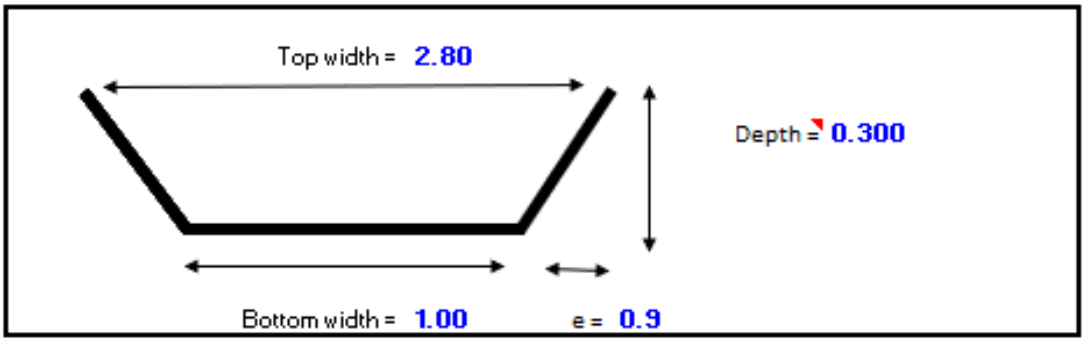
W1	$Qn/s^{0.5}$	0.045	0.099
W2	$d^{1.67}(b+Zd)$	0.045	0.099

Calculations:

T	Top Width at Water Level	1.77	2.14	m
V	Water Velocity	1.52	1.96	m/s

Should be less than 1.5 m/s or

Swale Dimensions (m)



Pigeonwood Lane (Ch: 0 to 180) South

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0034	m^3/s
10-year ARI (+CC)	0.0215	m^3/s
100-year ARI (+CC)	0.0415	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	2.3%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.058	m
L	Swale Length	180	m

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.09	m/s
T	Width at WQ Water Level	0.84	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	33.9	mins

Larger Flow Events

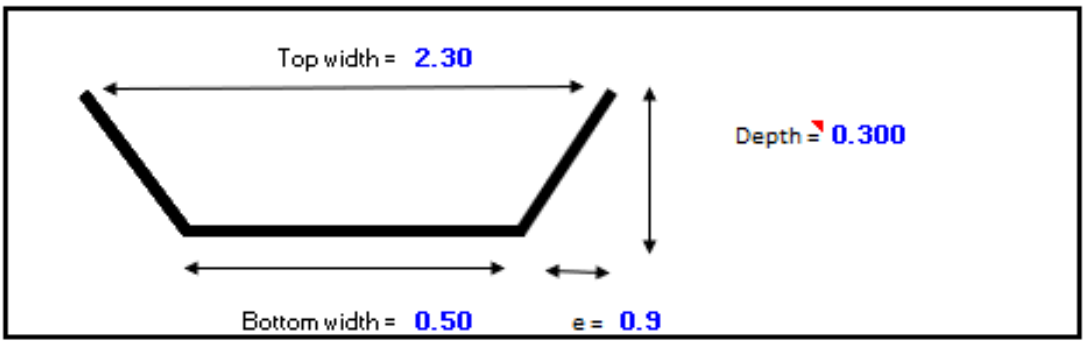
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.092	0.127	m

W1	$Qn/s^{0.5}$	0.014	0.028
W2	$d^{1.67}(b+Zd)$	0.014	0.028

Calculations:

T	Top Width at Water Level	1.05	1.26	m
V	Water Velocity	0.30	0.37	m/s

Swale Dimensions (m)



Shared Access 1

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0011	m^3/s
10-year ARI (+CC)	0.0067	m^3/s
100-year ARI (+CC)	0.0125	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	9.0%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.021	m
L	Swale Length	75	m

Check Dams Required

Constant		WQ	Sub
n	Manning's n	0.25	0.25

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.09	m/s
T	Width at WQ Water Level	0.63	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	13.7	mins

Larger Flow Events

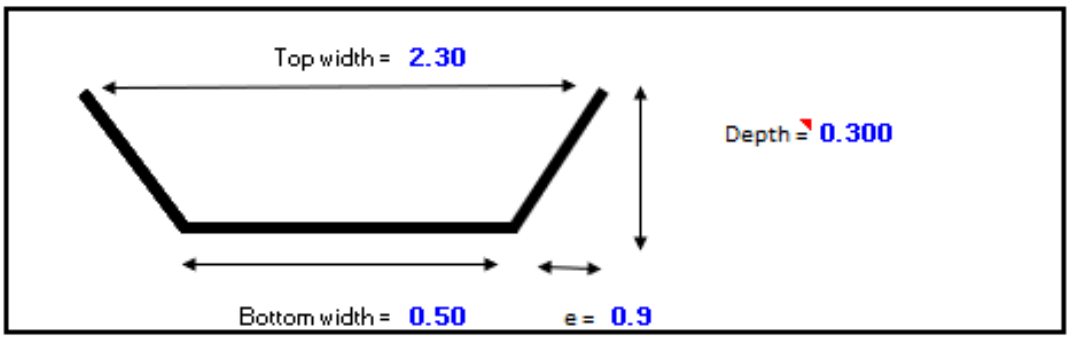
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.060	0.078	m

W1	$Qn/s^{0.5}$	0.006	0.010
W2	$d^{1.67}(b+Zd)$	0.006	0.010

Calculations:

T	Top Width at Water Level	0.86	0.97	m
V	Water Velocity	0.16	0.22	m/s

Swale Dimensions (m)



ROW 1

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0026	m^3/s
10-year ARI (+CC)	0.0153	m^3/s
100-year ARI (+CC)	0.0279	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	12.6%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.032	m
L	Swale Length	150	m

Check Dams Required

Constant		WQ	Sub
n	Manning's n	0.25	0.25

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.14	m/s
T	Width at WQ Water Level	0.68	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	17.9	mins

Larger Flow Events

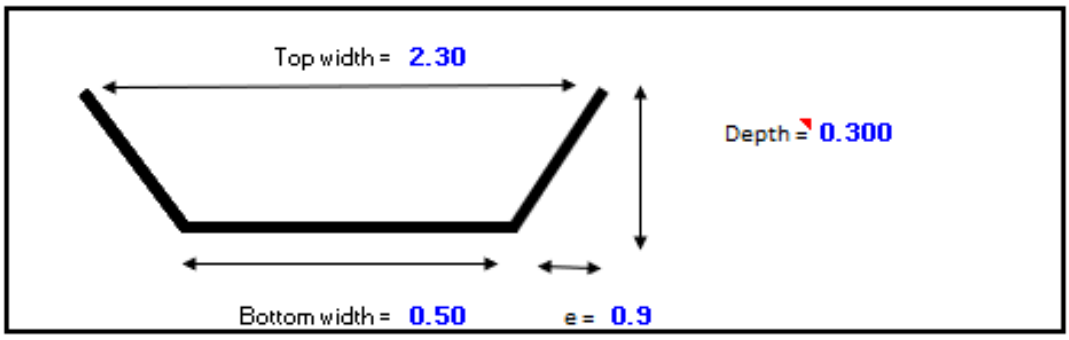
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.079	0.108	m

W1	$Qn/s^{0.5}$	0.011	0.020
W2	$d^{1.67}(b+Zd)$	0.011	0.020

Calculations:

T	Top Width at Water Level	0.97	1.14	m
V	Water Velocity	0.26	0.32	m/s

Swale Dimensions (m)



ROW 2

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0012	m^3/s
10-year ARI (+CC)	0.007	m^3/s
100-year ARI (+CC)	0.0128	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters				
S	Channel Longitudinal Slope	12.4%	m/m	*Check Dams Required*
Z	Side slope H:1V	3		
d	Depth of WQ flow	0.020	m	
L	Swale Length	70	m	

Constant		WQ	Sub
n	Manning's n	0.25	0.25

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.10	m/s
T	Width at WQ Water Level	0.63	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	11.4	mins

Larger Flow Events

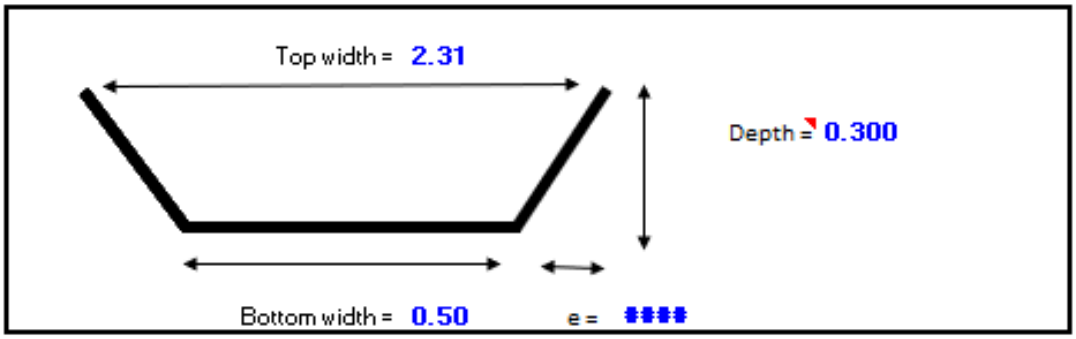
Input Parameters		10-year	100-yr	
d	Depth of water	0.051	0.072	m

W1	$Qn/s^{0.5}$	0.005	0.009
W2	$d^{1.67}(b+Zd)$	0.005	0.009

Calculations:

T	Top Width at Water Level	0.81	0.94	m
V	Water Velocity	0.21	0.25	m/s

Swale Dimensions (m)



Shared Access 2

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0009	m^3/s
10-year ARI (+CC)	0.0053	m^3/s
100-year ARI (+CC)	0.0099	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	2.4%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.027	m
L	Swale Length	61	m

Constant		WQ	Sub
n	Manning's n	0.25	0.25

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.06	m/s
T	Width at WQ Water Level	0.66	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	18.5	mins

Larger Flow Events

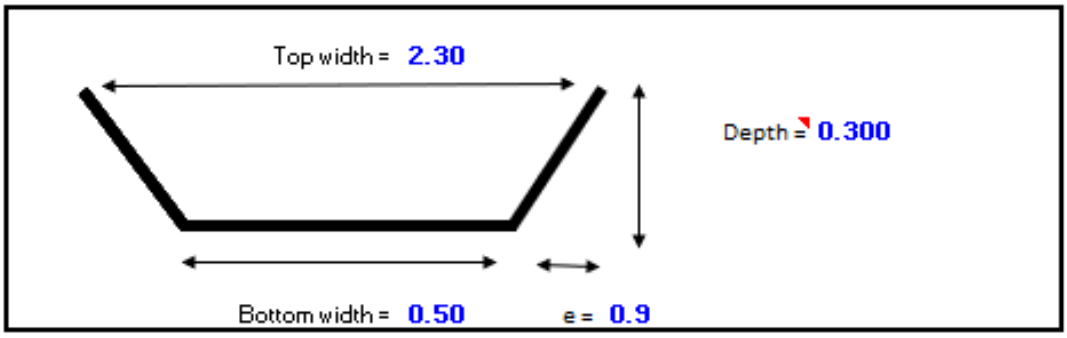
Input Parameters		10-year	100-yr	
d	Depth of water	0.072	0.098	m

W1	$Qn/s^{0.5}$	0.009	0.016
W2	$d^{1.67}(b+Zd)$	0.009	0.016

Calculations:

T	Top Width at Water Level	0.93	1.09	m
V	Water Velocity	0.10	0.13	m/s

Swale Dimensions (m)



Shared Access 3

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0011	m^3/s
10-year ARI (+CC)	0.0066	m^3/s
100-year ARI (+CC)	0.0124	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters				
S	Channel Longitudinal Slope	0.9%	m/m	*Underdrain Required*
Z	Side slope H:1V	3		
d	Depth of WQ flow	0.040	m	
L	Swale Length	57	m	

Constant		WQ	Sub
n	Manning's n	0.25	0.2

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.04	m/s
T	Width at WQ Water Level	0.74	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	21.8	mins

Larger Flow Events

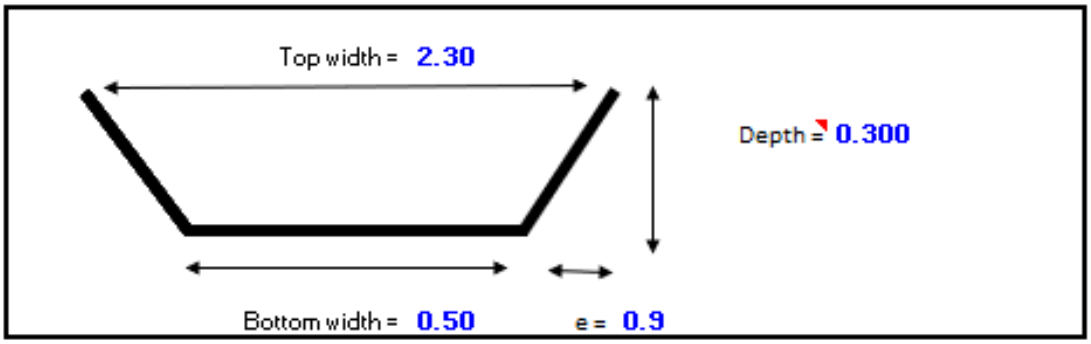
Input Parameters		10-year	100-yr	
d	Depth of water	0.090	0.123	m

W1	$Qn/s^{0.5}$	0.014	0.026
W2	$d^{1.67}(b+Zd)$	0.014	0.026

Calculations:

T	Top Width at Water Level	1.04	1.24	m
V	Water Velocity	0.10	0.12	m/s

Swale Dimensions (m)



Shared Access 4

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0018	m^3/s
10-year ARI (+CC)	0.0107	m^3/s
100-year ARI (+CC)	0.0195	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	2.4%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.040	m
L	Swale Length	106	m

Constant		WQ	Sub
n	Manning's n	0.25	0.2

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.07	m/s
T	Width at WQ Water Level	0.75	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	24.6	mins

Larger Flow Events

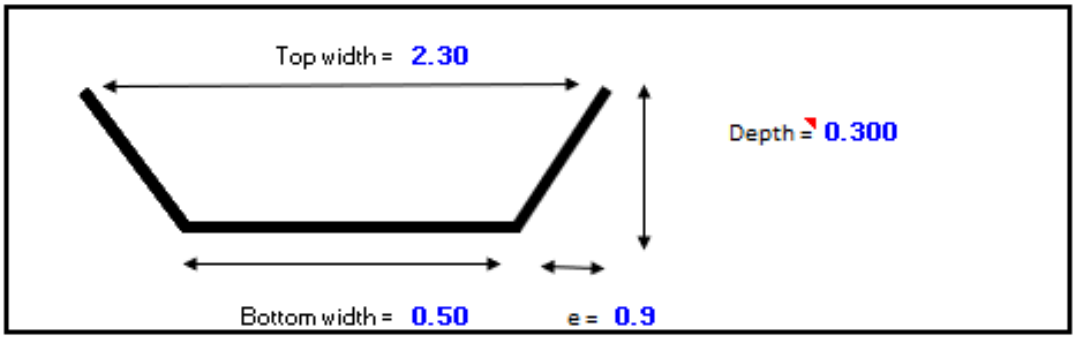
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.090	0.120	m

W1	$Qn/s^{0.5}$	0.014	0.025
W2	$d^{1.67}(b+Zd)$	0.014	0.025

Calculations:

T	Top Width at Water Level	1.04	1.22	m
V	Water Velocity	0.15	0.19	m/s

Swale Dimensions (m)



Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0063	m^3/s
10-year ARI (+CC)	0.0511	m^3/s
100-year ARI (+CC)	0.1196	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters				
S	Channel Longitudinal Slope	8.9%	m/m	*Check Dams Required*
Z	Side slope H:1V	3		
d	Depth of WQ flow	0.055	m	
L	Swale Length	220	m	

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.17	m/s
T	Width at WQ Water Level	0.83	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	21.5	mins

Larger Flow Events

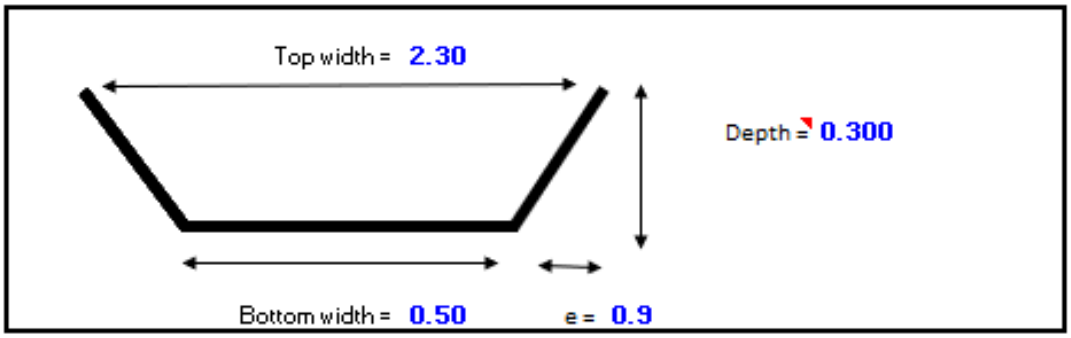
Input Parameters		10-year	100-yr	
d	Depth of water	0.100	0.150	m

W1	$Qn/s^{0.5}$	0.017	0.040
W2	$d^{1.67}(b+Zd)$	0.017	0.040

Calculations:

T	Top Width at Water Level	1.10	1.40	m
V	Water Velocity	0.64	0.84	m/s

Swale Dimensions (m)



Road 1 South

Date: 22/09/2026

Swale Catchment Size m2

Peak Design Flow Rates

Water Quality (WQ)	0.0039	m^3/s
10-year ARI (+CC)	0.0249	m^3/s
100-year ARI (+CC)	0.0491	m^3/s

Input Parameters

Peak flow rates to be taken from spreadsheet or runoff modelling software

Type: Trapezoidal Swale Grass

Input Parameters			
S	Channel Longitudinal Slope	3.6%	m/m
Z	Side slope H:1V	3	
d	Depth of WQ flow	0.054	m
L	Swale Length	150	m

Constant		WQ	Sub
n	Manning's n	0.25	0.1

Calculations:

Water Quality Event

b	Base Width	0.50	m
V	WQ Velocity	0.11	m/s
T	Width at WQ Water Level	0.83	m

Stormwater Treatment Specifications

t	Residence Time, WQ event	23.2	mins

Larger Flow Events

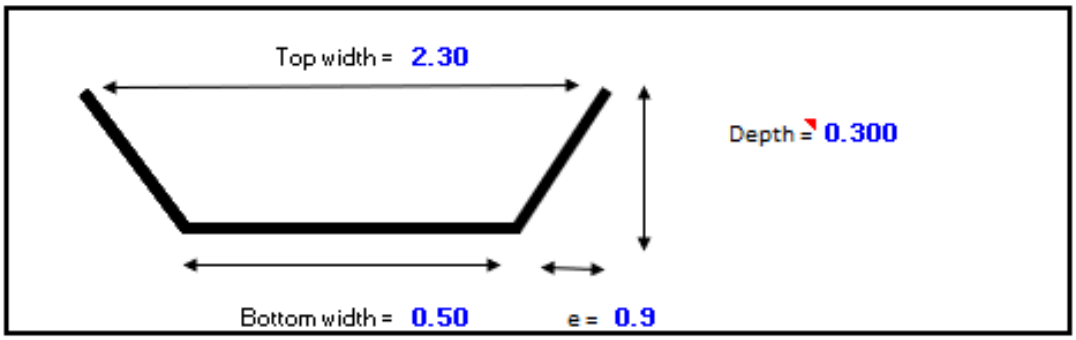
Input Parameters		**10-year**	**100-yr**	
d	Depth of water	0.088	0.122	m

W1	$Qn/s^{0.5}$	0.013	0.026
W2	$d^{1.67}(b+Zd)$	0.013	0.026

Calculations:

T	Top Width at Water Level	1.03	1.24	m
V	Water Velocity	0.37	0.46	m/s

Swale Dimensions (m)



Bioretention Device Sizing Calculations

Project	Lochridge Estate		Job No.	265	Phase							
Location			Calculated by	AG	Date			SSP5-8.5				
Developed/Existing			Verified by		Date							
Rain Garden Subcatchment	Soil Class	Cover description	CN	Total (km2)	Total Area (ha)	Storage (S) (mm)	Initial Abstraction (mm)	P24 2-year (mm/hr)	WQ P24 (2-yr 24hr / 3)	EDV = WQ *1.2	Runoff depth (mm)	Runoff volume (V)
Pigeonwood N&S (Ch180-623)	A	Impervious	47.2916	0.0298	2.982	283	14.2	86.55	28.85	34.62	1.4	41.1
Akeake Lane	A	Impervious	72.96	0.0079	0.785	94	4.7	86.55	28.85	34.62	7.2	56.7
Lochridge Drive Ext (1020-1380)	A	Impervious	65.0715	0.0148	1.475	136	6.8	86.55	28.85	34.62	4.7	69.5
Lochridge Drive Ext (1380-1764)	A	Impervious	45.8945	0.0421	4.205	299	15.0	86.55	28.85	34.62	1.2	50.9

Rain Garden Subcatchment	Catchments	EDV Storm	Minimum live storage provided above the soil media	First Calculate the surface area of a basin	Check to see if surface area is avaliable for WQ	Additional storage required upstream	Total Surface Area or Raingarden
	See SCS calculation sheet	Runoff volume (V) (m3)	40% (m3)	As = (WQV)(d)/k(h+d)t (sq.m)	Rain Garden Area (m3)	(m3)	Total Surface Area of Raingarden and EDV storage (sq.m)
Pigeonwood N&S (Ch180-623)	impervious	41.1	16.457	46.629	13.989	2.469	54.857
Akeake Lane	impervious	56.7	22.663	64.213	19.264	3.399	75.544
Lochridge Drive Ext (1020-1380)	impervious	69.5	27.794	78.749	23.625	4.169	92.646
Lochridge Drive Ext (1380-1764)	impervious	50.9	20.354	57.668	17.301	3.053	67.845

Culvert Sizing Calculations

Culvert	Catchments involved	Swale/OLF	Flow (m^3/s) 100-yr	Total flow (m^3/s)	Diameter (mm)
Pigeonwood lane (Ch: 180 to 623) L	Pigeonwood lane (Ch: 180 to 623) L	OLF	0.1080		300
Pigeonwood lane (Ch: 180 to 623) R	Pigeonwood lane (Ch: 180 to 623) R	Swale	0.4293		450
Pigeonwood lane (Ch: 0 to 180) R	Pigeonwood lane (Ch: 0 to 180) N	Swale and OLF	0.4756		450
Tea Tree Lane (Ch: 0 to 255)	Tea Tree Lane (Ch: 0 to 255) N	Swale and OLF	0.3741		375
Akeake Lane Combined	Akeake Lane (565m)	Swale and OLF	0.6494		525
Ex Lochridge Dr (at Ch: 1020)	Lochridge Drive (Ch:715 to 1020) E	OLF	0.1547		375
JOAL 1	JOAL 1 - East to Culvert	OLF	3.2603		2 x 900
Road 1- West	Road 1 - West	OLF	0.8131		3 x 450
Road 1- East	Road 1 - East + JOAL 1 West & East (100yr-10yr)	OLF	0.1769	3.437	2 x 900
	JOAL 1 - East to Culvert	OLF	3.2603		
Road 1 Swales	Road 1 N + Lochridge Dr (Ch:1020-1380)	Swales	0.1684		300
Lochridge Dr (at Ch:1380)	Lochridge Drive Ext (Ch:1020 to 1380) E Tot	Swales	0.1142		300
Lochridge Dr (at Ch:1420)	Culvert under LD Ch1380 + Akeake Combined	OLF	1.0533		675
Lochridge Drive Ext (Ch: 1380 to 1764) Swale	Lochridge Drive Ext (Ch:1550 to 1764.21) E Tot	Swale	0.4660		375
Lochridge Drive Ext (Ch: 1380 to 1764) E	South 2	OLF	0.6731		525
Road 2	Road 2 + South 2	OLF	1.2607	1.687	750
	South 1	OLF	0.4263		