Hamilton City Council

Peacocke – Waikato River Bridge and Strategic Services

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Transport Network Management Plan

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BLOXAM BURNETT & OLLIVER

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Client	Hamilton City Council	
Client representative	Alasdair Gray	
BBO details	Bloxam Burnett & Olliver (BBO) Level 4, 18 London Street, Hamilton 3240	
BBO representative	Cameron Inder, Transportation Engineering Manager	
BBO rep. contact details	+64 21 715 377	cinder@bbo.co.nz
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1. Introduction

1.1 Report Purpose

Bloxam Burnett & Olliver Ltd has prepared this Transport Network Management Plan (TNMP) for the Peacocke Waikato River Bridge and Strategic Services project (the Project), in accordance with the Southern Links Designation Condition 24 (SLDC 24). This Project is the first stage of road network development that will form the wider Southern Links network in time. This designation condition requires the submission of a TNMP for certification by the Territorial Authority Chief Executive or nominee.

SLDC 24 states that the objective of the TNMP is to
"*Provide a framework to ensure that any adverse effects associated with the operation of the project can be avoided, remedied or mitigated"*

This is about ensuring that the operation of the Project, as a first stage of the Southern Links network, integrates with the wider existing transport network environment in such a way that ensures a safe, convenient and attractive "interim" transport network.

The Project adopts a new approach to multi-modal transportation provision for Hamilton with significant focus on safety for all users, quality of amenity and connectivity for future residents of Peacocke. A step change will be observed through prioritising safety and connectivity of non-motorised transport, and access by future Public Transport over traffic flow efficiency. This approach to the infrastructure design will be the catalyst for the area enjoying long term environmental benefits and the new active mode opportunities being available to all user abilities. This document is not intended to provide technical engineering guidelines. Those are presented in the Project Design Philosophy Statement. Rather, it is to describe the key transport management and design objectives and principles, and identify any effects and mitigation required on the external network due to Peacocke Strategic Transport Network project.

The report considers the likelihood and potential significance of traffic changes resulting from the project, the adequacy of the affected network sections to cater for the demands for all modes, the potential duration of the effects based on planned network changes and areas where intervention may be required.

1.2 Peacocke Structure Plan

The Peacocke area, south of the Waikato River, was incorporated into Hamilton City from Waipa District Council in 1989 as part of the city's long-term urban development plan.

The existing Peacocke area is characterised by a mixture of rural activities and rural/residential lifestyle blocks. Peacockes Road is predominantly a narrow country road with low traffic volumes, no walking and cycling infrastructure and basic intersection layouts with no-exit side roads. The network is insufficient for providing a safe and efficient urban transportation environment to support the planned residential development.

In 2007, Hamilton City Council (HCC) produced a Structure Plan for the Peacocke area to serve as a strategic framework to guide future urban development. This includes a new strategic transportation network of roads and off-road walking and cycling paths. The key objective of the Structure Plan transport network is to deliver improved safety, accessibility, and multi-modal connectivity for the future transportation of people, goods and services. The Transportation network for the Structure Plan is copied into Appendix A from the Hamilton City Council website.

1.3 The Southern Links Network

The Project is essentially the first stage of the wider Southern Links network, which is illustrated in Figure 1. Southern Links consists of approximately 21 kilometres of State Highway and 11 kilometres of urban arterial roads within the Peacocke growth area. The Project extents are identified within the dashed circle.

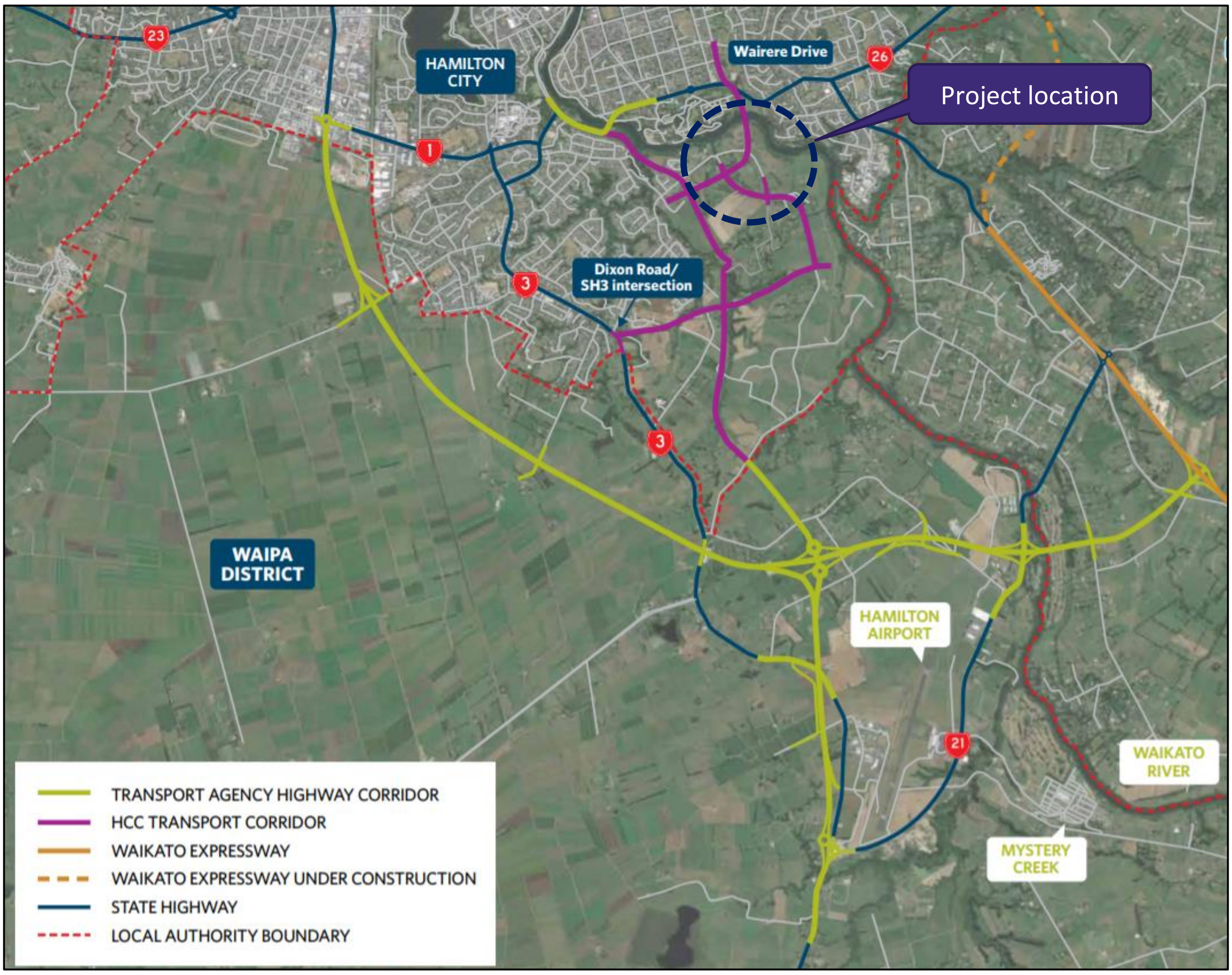


Figure 1 – The Southern Links Network (courtesy of NZTA Southern Links project website)

1.4 Project Design Philosophy Objectives

This TNMP provides an overview of the key design objectives and requirements. Greater detail of the design elements can be found in the *Peacocke Strategic Transport Network Design Philosophy Report* in Appendix B.

The Project design is founded on new concepts and objectives promoted by Hamilton City Council (HCC), for road safety, public transport, walking, cycling and other path users. These are:

- Adopt Vision Zero: A transportation system that is designed to return zero deaths and serious injuries from incidents in future.
- Provide high priority for public transport accessibility, and multi-modal connectivity to encourage the use of PT and active (and alternative[1]) modes, if necessary, at the expense of network efficiency for private vehicle users.

[1] Such as: e-bikes, e-scooters, electric wheelchairs, etc.

- Maximising the people moving capacity of the road, by enabling efficient use of the network by buses and high occupancy vehicles.
- Providing flexibility in the design to cater for evolutionary and step changes in the transportation system.

In addition, the Project is to be achieved within the designation boundaries secured as part of Southern Links project, without alterations (unless pursued under non-notified processes).

1.5 Hierarchy of Intersection Types

HCC accepted directions set by the project team that describes the philosophical approach for the future intersection forms along the major and minor arterial roads within Peacocke. A hierarchy of intersection forms were discussed and agreed between HCC and relevant stakeholders to guide the design philosophy. These are listed below from highest order and preference to the least, based on achieving the key design objectives described in Section 1.4.

The starting point for selecting the form of future intersections on the minor or major arterial roads within Peacocke is the highest level (Grade Separation of conflicting paths), with decisions about practicability and purpose being made before moving to the next (lower) level in the hierarchy.

1. Grade separation of all movements.
2. Roundabouts with grade separation for active modes.
3. Signalised intersections with grade separation for active modes. Vehicle speeds to be managed through use of raised platforms on the approaches, or tables across the whole intersection.
4. Signalised intersections with signalised crossings for active modes. Vehicle speeds to be managed through use of raised platforms on the approaches, or tables across the whole intersection.
5. Roundabouts with "build-outs" (or similar) provided for active mode crossings being made at-grade.
6. Signalised intersections with signalised crossings for active modes. No physical control of vehicle speeds.
7. Priority controlled (Give Way) intersections.

2. Project Overview

A general arrangement plan for the Project is shown below in Figure 2.

The Project extents includes:

- A new Waikato River Bridge and northern tie-in to the new Wairere Drive / Cobham Drive Interchange (under construction).
- The western tie-in terminates at the future North-South Arterial intersection. Road stubs will be provided on each intersection approach to enable future connection.
- The southern tie-in terminates approximately 400m beyond the Peacockes Road/Peacockes Lane intersection to tie-in with the existing Peacockes Road cross-section. The Project facilitates the ongoing urban upgrade of Peacockes Road to the south as residential development continues in future.
- Weston Lea Drive severed by the extension of the Ring Road south of the Waikato River to the future North-South Arterial. Weston Lea Drive will become West and East cul-de-sacs, with the eastern section accessed from an extension to Peacockes Road via a new four-arm intersection with Peacocke Lane.
- The northern tie-in of upgraded Peacockes Road ties-in with the existing network (near the Water Treatment Plant) as close to the North-South Arterial as practical so that further upgrading of the corridor is not required in future.
- The tie-in of Peacockes Lane is immediately after its intersection with Peacockes Road, to ensure future alignment and urbanisation of Peacockes Lane is not constrained.

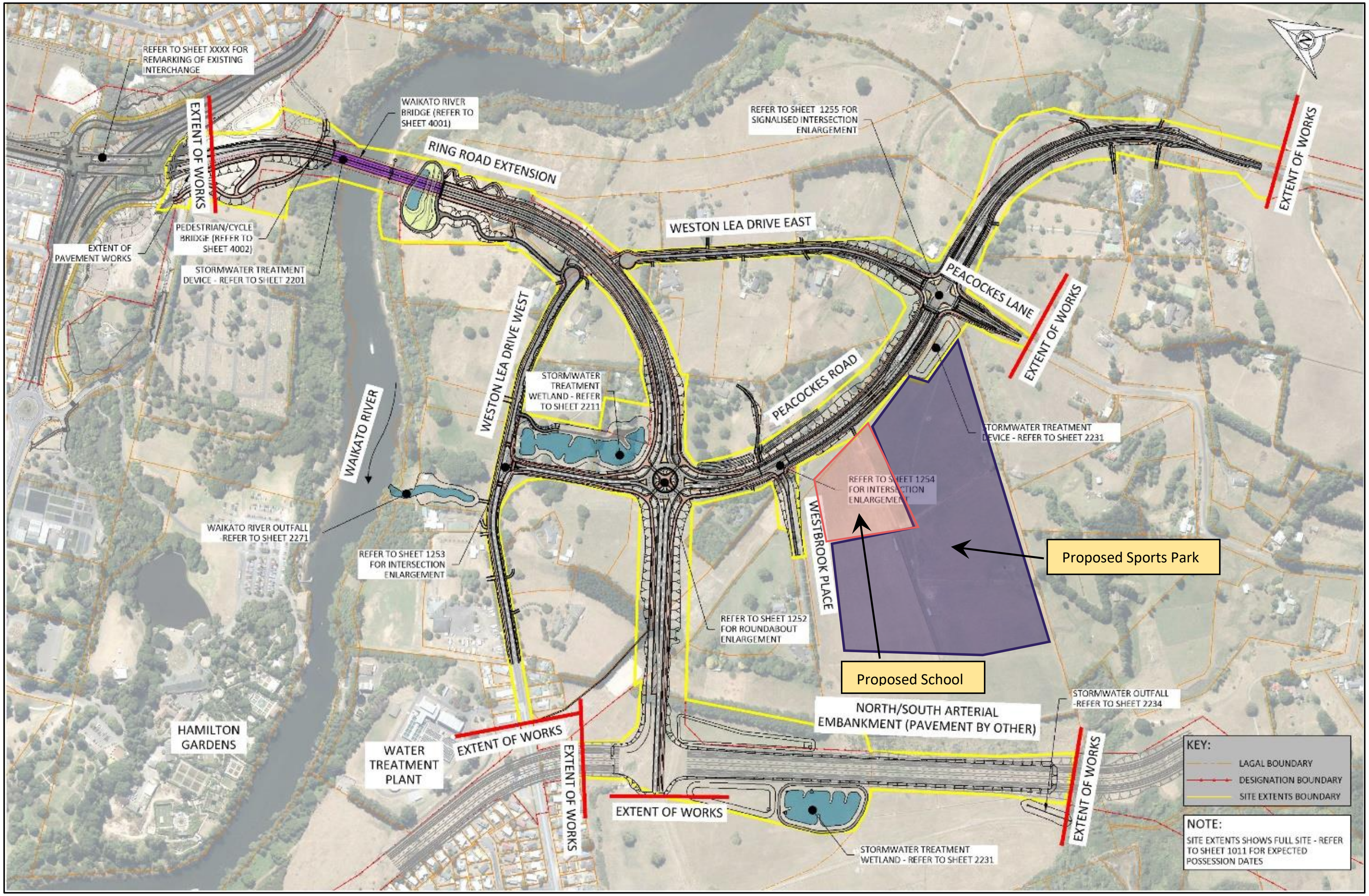


Figure 2 – Project Overview Plan

3. Project Effects on the Network

3.1 The Existing Network

A key TNMP objective is to provide a framework to avoid, remedy or mitigate transportation related effects "associated with the operation of the project". This is different to assessing the transportation effects of the future development on the performance of the Project network. Instead, it involves assessing how the existing transport network will be affected by the existence of the Project before the full network is completed and as residential development in Peacocke takes place.

The existing Peacocke transportation network shown in Figure 3 is from Google Earth images. It shows the network context for Peacockes Road, with northward connections to the city limited to just Bader Street or Dixon Road to Ohaupo Road, due to the deep gully systems and the Waikato River. To the south, Peacockes Road connects to Raynes Road where traffic then accesses SH3 to Te Awamutu or SH21 to the airport or SH1.

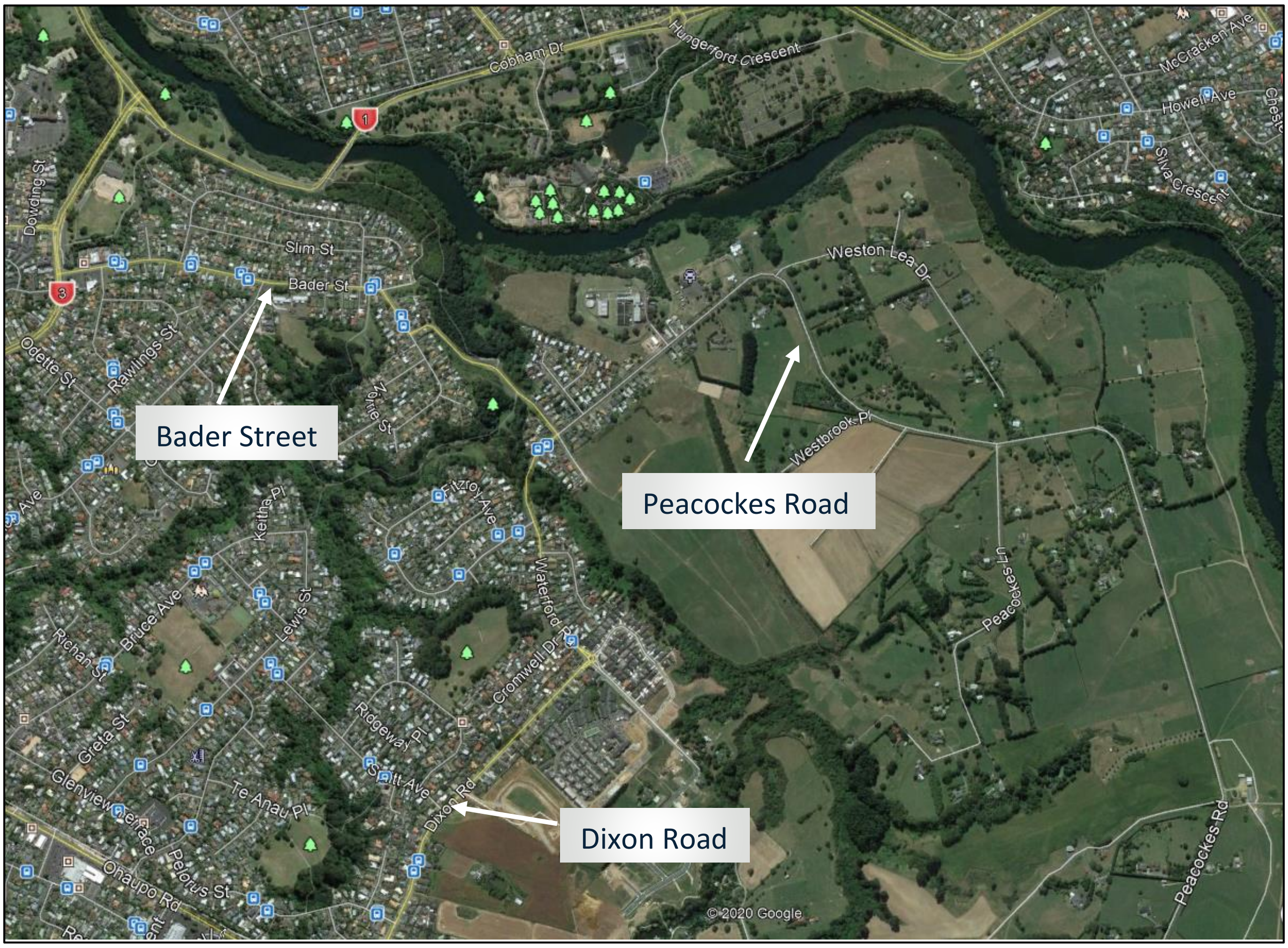


Figure 3 – Peacockes Road Network (Google Images)

In the near term, the intersection of Ohaupo Road (SH3) and Dixon Road will be modified to allow only left in, left out from Dixon Road and right-turn in movements from Ohaupo Road. Right turn out traffic heading towards the CBD will use a new roundabout intersection on SH3 located south of Dixon Road. This is planned for completion by 2021 and as part of creating a southern gateway access for the first stages of Peacocke residential development. It will also significantly improve the safety of the SH3 / Dixon Road intersection by reducing traffic volumes in and out of Dixon Road, and removing the critical right turn out movement. Accordingly, despite this planned network change in the near term, two connectivity options between Peacocke and the city will remain during construction and operation of the Project network.

3.2 Construction Traffic and Construction Diversion Effects

Peacockes Road traffic will undergo various temporary diversions to allow construction of the new roundabout at the Ring Road extension / Peacockes Road intersection. These will be local diversions with no long-term wider network effects expected to be generated. Temporary traffic management measures will be planned and implemented to avoid adverse impacts on safety during the diversion period.

Travel times increases can be expected but will be relatively small and only experienced by residents of Weston Lea Drive and Peacockes Road area. The combined ADT volume of Weston Lea Drive and Peacockes Road affected by the works is just 840 vpd.

Construction traffic is anticipated to be up to 100 heavy vpd and 100 light vpd. Construction traffic will be managed as part of the Construction Traffic Management Plan in accordance with Designation Condition 24.1e.

3.3 Operational Effects of the Project

Upon opening, the Waikato River bridge connection to the Ring Road will add a third transportation access between Peacocke and the city.

While it is likely that some land use development will proceed in Peacocke during construction of the Project, the "Day 1" traffic volumes on Peacockes Road will still be very low in comparison to the eventual volumes generated by the growth cell land use development (i.e. housing development will be the major instigator of increased traffic on Peacockes Road and the Project network, not the Project itself). Section 7 identifies that the future volume on Peacockes Road with full residential build out and Southern Links network completion will be in the order of 20,000 vpd.

However, the modelling demonstrates that most of this 20,000 vpd connects either to the Ring Road or the North/South Arterial road to Cobham Drive rather than diverting through the existing access streets, Dixon Road and Bader Street. Access to these two streets becomes much more convoluted for traffic on Peacockes Road in future once the Major North/South Arterial Road is completed. This is seen in Figure 2.

The only transportation effects directly due to the Project relate to external traffic being potentially drawn through the area to connect to a destination outside of Peacocke.

Given the network constraints and three city access points, there are four potential through-route options created by the Project. The four routes, illustrated on the next page, are between:

1. Hamilton East and Ohaupo Road, via the Ring Road extension
2. Hamilton East and the Airport, via Peacockes Road
3. Waikato Hospital and the Airport, via Bader Street and Peacockes Road
4. Hospital/Bader/Glenview and Hillcrest/University, via Bader Street and Peacockes Road.

A summary comparison of the attractiveness of each route is presented in Table 1 to

Table 4, followed by an explanation of each route.

3.3.1 Potential Route 1

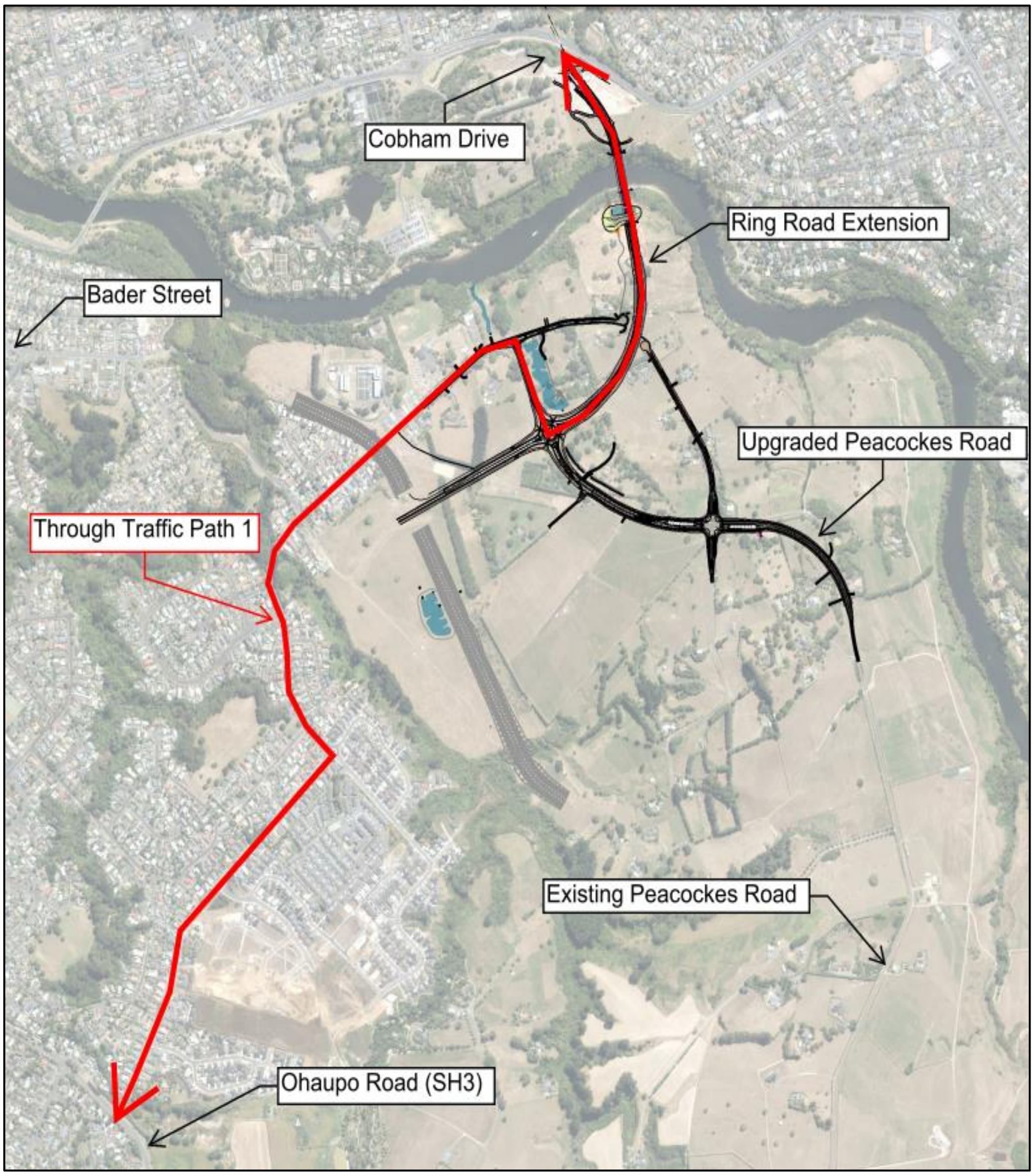


Figure 4 – Potential Route 1 Hamilton East to Ohaupo Road

Route 1 is approximately 4km long from Cobham Drive to Ohaupo Road and passes through two roundabout intersections and 2.7km of residential streets as shown in Figure 4. Travel times on this new route have been estimated based on an average speed of 35kh/h during all peak periods on all roads, with the exception of the Ring Road extension (assumed 50km/h during the AM and PM peak periods and 55km/h during the off-peak period). The expected travel times for this route is shown in Table 1.

Bluetooth detectors are installed by HCC in many locations around the city network to collect continuous data on traffic route patterns and travel times. From this, the average travel time information for the existing route via Cobham Drive, Normandy Avenue and Ohaupo Road, between common start and end points with Potential Route 1, is presented in Table 1. The length of the existing route is 5.6km. The Bluetooth data indicates that the existing route experiences congestion during the AM and PM peak periods resulting in travel times of approximately 18 minutes and 14 minutes respectively.

By comparison, the overall travel time for Route 1 is estimated to be a little over 6 minutes, making this potential through-traffic route approximately 12 minutes and 8 minutes faster during the AM and PM peak hours respectively. Furthermore, during the off-peak period Route 1 is approximately 5 minutes faster than the existing path.

However, although this comparison shows that the Project provides an attractive alternative route for bypassing the existing congested area, the demand volume for this route is expected to be very low for the following reasons:

1. The Bluetooth data indicates that the traffic volume travelling between the common start and end points for these routes is very low, approximately 1% to 2% of the Ohaupo Road volume near Dixon Road. That is approximately 150 to 310 vpd out of 15,500 vpd. Estimated peak hour volumes are summarised in Table 5.
2. Melville is predominantly a residential area with no significant employment nodes or shopping attractions that would generate high demand between Hamilton East and the southern extents of Ohaupo Road. This is reflected in the Bluetooth data results above.
3. The potential alternative route connects to Ohaupo Road at the very southern extent of residential development in Melville, requiring back-tracking by the vast majority of local residents in order to use it. Accordingly, it is expected that this route is most appealing to external trips in and out of Hamilton SH3 with origin or destination in Hamilton East.
4. Furthermore, the Hamilton Section of Waikato Expressway will open in late 2021 (before the Peacocke Project), providing a new efficient alternative route via SH21 for motorists travelling between the eastern side of Hamilton, the Airport and externally on SH3. Accordingly, effects of potential trip diversion from Ohaupo Road via Peacocke project route 1 are expected to be minor to negligible.

Table 1: Route 1 Assessment Summary

	Ohaupo Rd to Hamilton East via Normandy Avenue	Ohaupo Road to Hamilton East via the Ring Road extension	Difference	Conclusion
Option	**Existing Route 1 (5.6km)**	**Potential Route 1 (4km)**		
AM peak travel time	00:18:36	00:06:11	- 00:12:25	• Potential Route 1 provides a much shorter travel time through the Project network than its corresponding existing route. • Therefore, worst case scenario is 100 % of the traffic on this route diverts (which is about 1 to 2% of existing traffic on Ohaupo Road at Dixon Road in the peak periods). • However, the Waikato Expressway – Hamilton Section will also provide a viable alternative for motorists travelling from the south and into the city centre via the Ruakura Interchange and hence it is assumed that traffic diverted through the Project road network could conservatively be approximately 50% of existing vehicles between these zone pairs.
PM peak travel time	00:14:04	00:06:11	- 00:07:53	
Off-peak travel time	00:11:55	00:06:03	- 00:05:52	

3.3.2 Potential Route 2

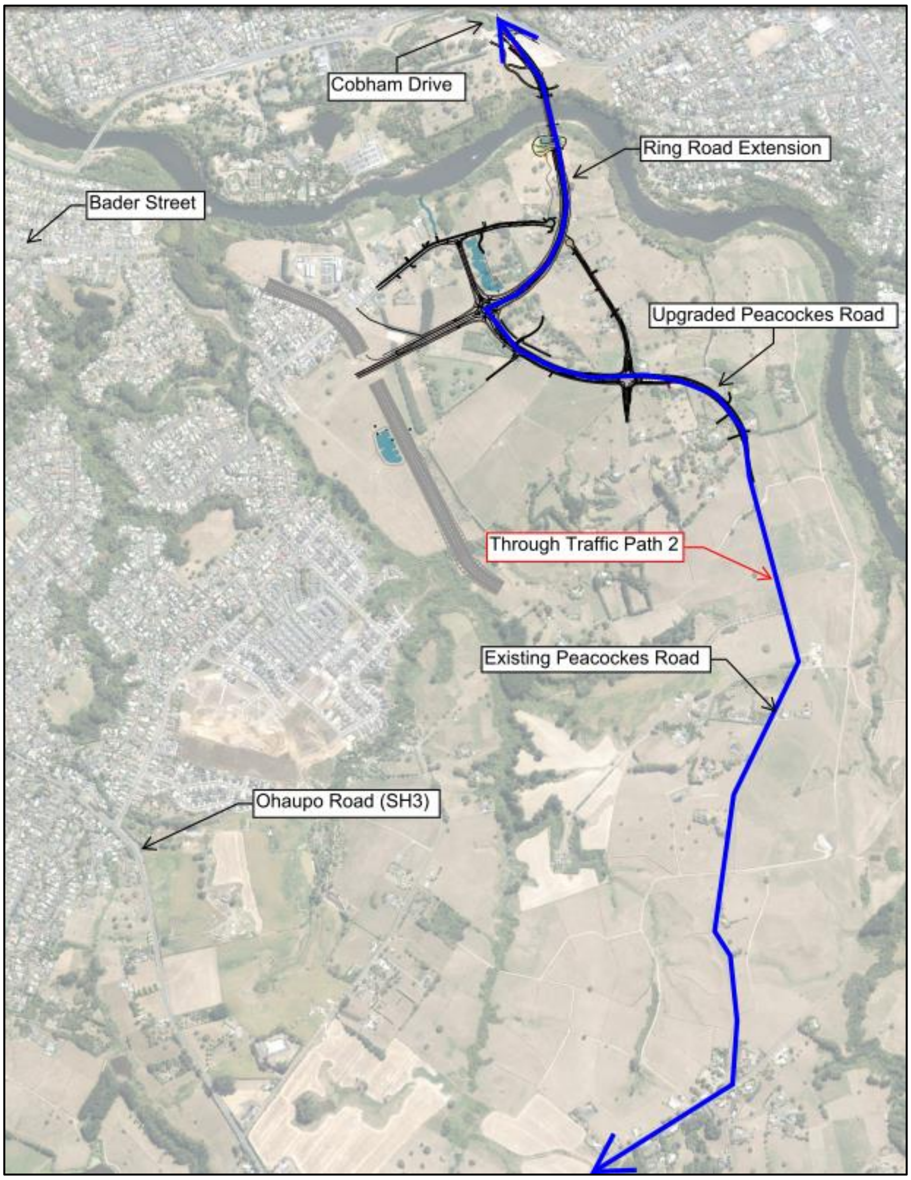


Figure 5 – Potential Route 2 Hamilton East to the Airport, via Peacockes Road

Travel times for "Route 2" have been compared against those for two existing quickest routes to the airport. Measurements are between common start and end points of Cobham Drive at the new SH1 / Wairere Interchange, and the intersection of SH21 / Raynes Road (this intersection is off the page to the bottom right in Figure 5). The SH21 / Raynes Road intersection is where Route 2 and the existing quickest routes meet hence it is not necessary to extend the route through to the airport.

The two existing route options are referred to as Existing Route 2A and 2B, and are compared against predicted Route 2 travel times as shown in Table 2.

Potential Route 2

Potential Route 2 is approximately 10.3km from SH21 / Raynes Road intersection to Cobham Drive / Wairere Drive Interchange via Peacocks Road with an estimated travel time of 11 minutes during AM and PM peak periods and 10 minutes during off-peak. The potential Route 2 travel time was based on an average speed of 55 km/h during the AM and PM peak hours and 60km/h during off-peak period and taken into consideration the intersections and the narrow / winding country roads.

Existing Route 2A

Existing Route 2A is approximately 12.2km from SH21 / Raynes Road intersection to Cobham Drive / Wairere Drive Interchange via Normandy Avenue / Ohaupo Road roundabout. Travel time for this route was estimated using a combination of both the HCC Bluetooth data and Google Maps estimated travel time. This is likely to be the least favourite route of the three considering the congestion experienced northwards from Dixon Road, as highlighted in existing Route 1.

Existing Route 2B

Existing Route 2B is 8.7km and follows the existing route from SH21 / Raynes Road intersection to Cobham Drive / Wairere Drive Interchange via SH1 / Tamahere Interchange. The travel times via this route has been obtained using Google Maps.

Given the existing SH 1 route (Route 2B) is less complex and more direct between Hamilton East and the airport, Potential Route 2 through the Project is unlikely to become a more popular route between Hamilton East and the Airport. Accordingly, trip diversion to the new road network from this OD pairs is unlikely.

Table 2: Route 2 Assessment Summary

	SH21 / Raynes Road Intersection to Hamilton East via Normandy / Ohaupo Roundabout	SH21 / Raynes Road Intersection to Hamilton East via Tamahere Interchange Roundabout	SH21 / Raynes Road Intersection to Hamilton East via Peacockes Road	Difference	Conclusion
Option	**Existing Route 2A (12.2km)**	**Existing Route 2B (8.7km)**	**Potential Route 2 (10.3km)**	**Between Existing Route 2B and Potential Route 2**	
AM peak travel time	00:24:36	00:11:00	00:11:11	+ 00:00:11	• Route 2 is almost three minutes faster than the comparative Route 2B during the PM peak period. • However, Route 2B is expected to become less congested in the PM peak after the opening of the Hamilton Bypass in 2021, thus making the travel time potentially comparative with Route 2. • Potential Route 2 is more complex and unappealing in comparison to Route 2B as it passes through narrow rural sections of Peacockes Road. Furthermore, the upgraded section of Peacocke Road
PM peak travel time	00:20:04	00:14:00	00:11:11	- 00:02:49	
Off-peak travel time	00:17:55	00:10:00	00:10:15	+ 00:00:15	

	SH21 / Raynes Road Intersection to Hamilton East via Normandy / Ohaupo Roundabout	SH21 / Raynes Road Intersection to Hamilton East via Tamahere Interchange Roundabout	SH21 / Raynes Road Intersection to Hamilton East via Peacockes Road	Difference	Conclusion
					will be flanked by housing development works for 3-4 years after opening, which is likely to add delay and uncertainty for through traffic. • Given the above, it is expected that most drivers will continue to prefer Route 2B as this is expected to continue to provide the more direct and higher quality road than Route 2 through Peacockes Road south and Raynes Road. • Hence, a conservative 20% of the traffic heading towards the University / Hillcrest has been assumed to be diverted from Raynes Road onto the Project network.

3.3.3 Potential Route 3

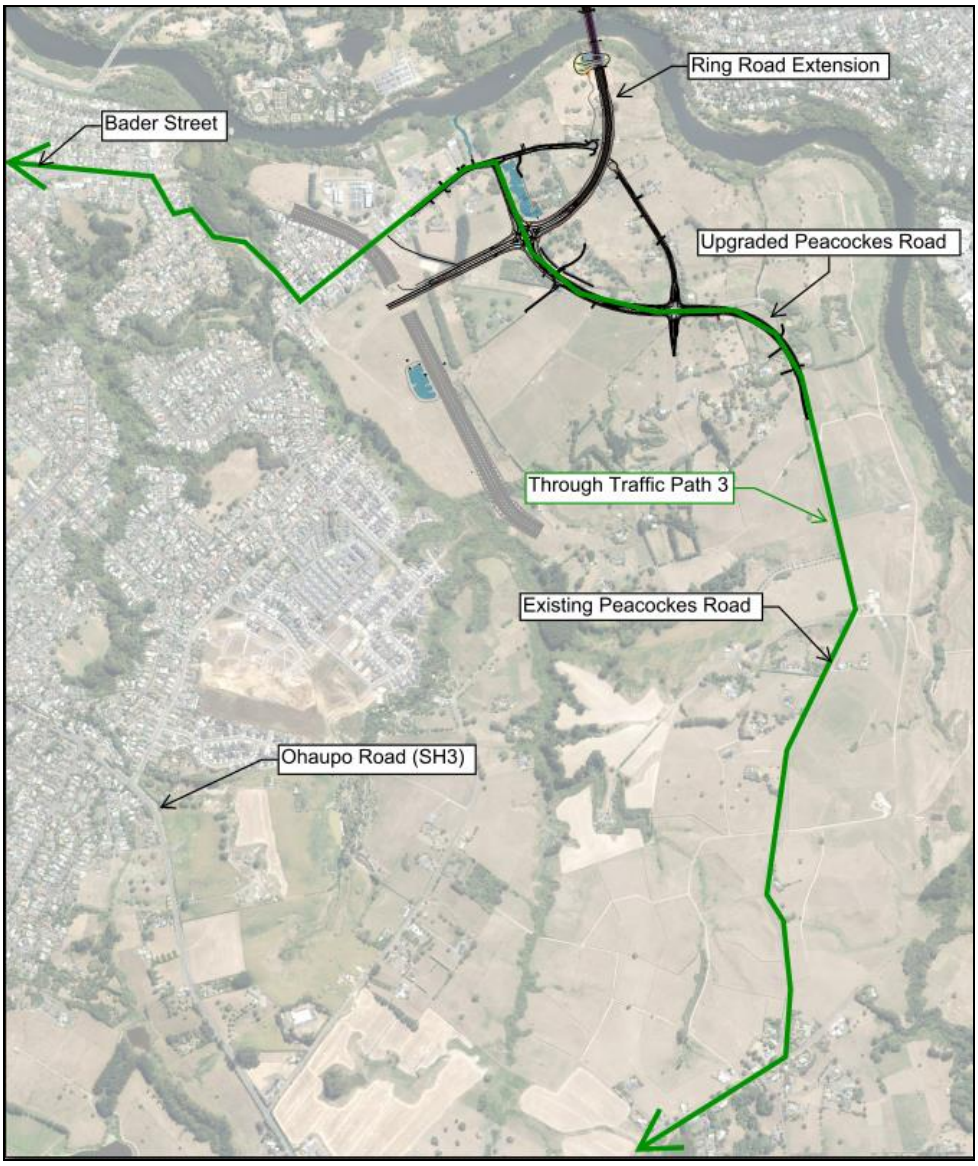


Figure 6 –Route 3 Waikato Hospital to the Airport, via Bader Street and Peacockes Road

Route 3 considers travel between Peacockes Road / Raynes Road intersection and the Waikato Hospital. The existing route described below follows SH3 while this alternative is via Peacockes Road (rural) and Bader Street as shown in Figure 6. The length of Route 3 from Normandy Ave / Bader Street intersection to the Peacockes Road / Raynes Road intersection is 7.6km. Peacockes Road south of Weston Lea Drive East will continue to have an operating speed of 70- 80 km/h but the northern residential sections of Bader Street and Peacockes Road combined with the new intersections on the Project are likely to reduce the overall average speed to 50-55km/h. The distance of Route 3 from Normandy Ave / Bader Street intersection to the Waikato Hospital is approximately 1km and the speed is estimated to be 45-50km/h.

The expected travel times for Route 3 are presented in Table 3 on the basis of using the lower range of speeds during peak periods and the higher range during the off-peak period.

The corresponding existing route from Peacockes Road / Raynes Road intersection to Waikato Hospital via Ohaupo Road is approximately 5.7km long. Posted speed limits on Ohaupo Road are 60km/h through Melville, then changes to 100km/h just south of Dixon Road. Google Maps calculates the typical travel time to Waikato Hospital as 8 minutes for off-peak periods. This relates to an average speed of 43 km/h. However, based on the travel times detected by the Bluetooth sensors, delays are expected north of Dixon Road during the AM and PM peak periods. About 3 minutes is added to the off-peak travel time to reflect the delays expected during AM and PM peak hours.

Table 3: Route 3 Assessment Summary

	Peacockes Road / Raynes Road Intersection to Waikato Hospital Glenview via Normandy / Ohaupo Roundabout	Peacockes Road / Raynes Road Intersection to Waikato Hospital Glenview to via Bader Street and Peacockes Road	Difference	Conclusion
Option	**Existing Route 3 (5.7km)**	**Potential Route 3 (8.6km)**		
AM peak travel time	00:11:00	00:10:27	- 00:00:33	• Potential Route 3 provides an alternative route for bypassing the congested area north of Dixon Road by saving approximately 33 seconds during peak periods. • This is relatively insignificant, and no traffic is expected to be diverted to use the Project road network as the existing SH3 route is less complex and more direct. • However, to be on the conservative side, approximately 10% of traffic heading to the Waikato Hospital from SH3 has been assumed to be diverted.
PM peak travel time	00:11:00	00:10:27	- 00:00:33	
Off-peak travel time	00:08:00	00:09:29	+ 00:01:29	

While the Project provides an alternative route for bypassing Ohaupo Road, the existing SH3 route is expected to remain the most popular route as it is less complex and more direct. The existing route is only approximately 30 seconds less efficient in terms of travel time during peak periods, which we do not consider would be enough to offset the complexity and perceived lack of directness of potential Route 3.

On this basis, it is predicted that no more than 10% of traffic travelling between the Waikato Hospital and SH3 would divert to Route 3 through the Project network. This amounts to approximately 33 trips in the peak hours, which is an insignificant amount of traffic. The combined total increase in traffic volume using Peacocke Road and Bader Street due to the combination of diversion trips on the new routes is summarised in Table 5.

3.3.4 Potential Route 4

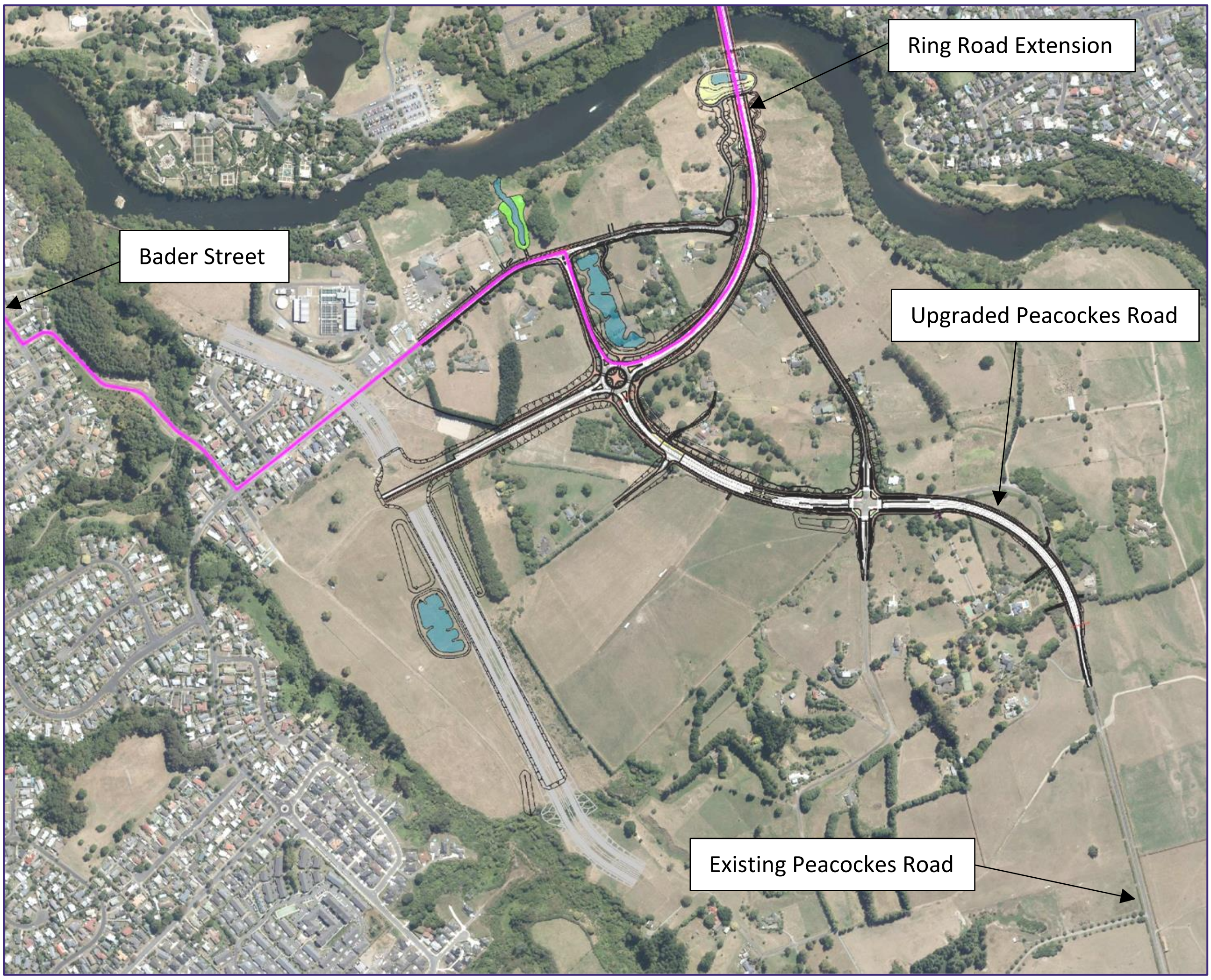


Figure 7 – Route 4 Waikato District Hospital to Waikato University, via Bader Street and Peacockes Road

Route 4 considers travel between Waikato Hospital and Waikato University / Hillcrest via the new bridge. This route is approximately 6.4 km in length. Travel time measurements are between common start and end points of the SH1 / Ohaupo Road intersection, and the intersection of Wairere Drive / Naylor Street.

Assuming an average speed of approximately 35km/h during all peak periods on all roads, with the exception of the Ring Road extension into Peacocke (assumed 50km/h during the AM and PM peak periods and 55km/h during the off-peak period), and Lorne Street towards the hospital (assumed 45km/h during the AM and PM peak periods and 50km/h during the off-peak period), the expected travel times for Route 4 are compared with the existing in Table 4.

The existing route is via Lorne Street and Cobham Drive, both currently designated SH1. The distance is approximately 5.4 km, so is 1 km shorter than potential Route 4.

The existing route carries significant peak hour traffic volumes and experiences some congestion as a result. Bluetooth data obtained from HCC indicate that the expected travel time on the existing route is approximately 4 minutes slower than the potential Route 4 during peak periods. This is likely to reduce following the opening of the Hamilton Bypass (expressway section).

Table 4: Summary of Route 4 Options

	Waikato Hospital Glenview to Waikato University Hillcrest via SH1 / Galloway St Roundabout	Waikato Hospital Glenview to Waikato University Hillcrest via Bader Street and Peacockes Road	Difference	Conclusion
Option	**Existing Route 4 (5.4km)**	**Potential Route 4 (6.4km)**		
AM peak travel time	00:13:37	00:09:04	- 00:4:33	• Route 4 provides shorter travel times during peak periods than the corresponding existing route, and is therefore likely to be attractive to a reasonable volume of traffic. • However, the following key events will occur in the interim: ○ Waikato Expressway – Hamilton Section opens to the public in 2021, and is expected to reduce volumes on Cobham Drive and Normandy Ave. ○ Bader Street safety improvement works (lower speed area). This is likely to deter local trip diversion to Route 4 further, and any remaining diverted traffic to Route 4, the added traffic will be subjected to slower speeds for improved safety for the Bader Street community. • Given these two key diversion deterrents, we expect that approximately 20%-30% of traffic travelling between the Hospital and Waikato University on Cobham Drive will divert to Route 4 through the Project Network. • This equates to approximately 21 vehicles per peak hour (30% has been assumed for this assessment).
PM peak travel time	00:13:24	00:09:04	- 00:04:20	
Off-peak travel time	00:13:04	00:08:37	- 00:04:27	

Based on the conclusion in Table 4, some trip diversion through Route 4 can be expected although the effects on the network are likely to be managed through the introduction of planned works on Bader Street to reduce speeds and improve safety for all road users, including walking and cycling.

3.4 Likelihood and potential significance of traffic changes

Routes 1 and 4 are the most likely to attract diverted trips due to significantly shorter travel times through the Project network than the corresponding existing routes.

2 and 3 are less likely to attract diverted trips, however, a conservative percentage of trips has been assumed to be diverted for the purpose of this assessment.

Table 5 summarises the affected road sections and combined traffic volumes that may be attracted to them upon completion of this first stage of the Peacock Strategic Transport network. The potential traffic has been based on a subjective assessment of attractiveness and the likely proportion of traffic that would divert[2].

[2] E.g. Assuming 15,500vpd on SH3 at Dixon Road, 12% peak traffic, 60/40 directional split and 30% attracted to University/Hillcrest with half of the traffic preferring the Waikato Expressway = 15,500 x 12% x 60% x 2% x 50% = 11vph additional traffic.

Table 5: Summary comparison of the attractiveness of each potential route

Route	Road section	Existing traffic (vpd) [Obtained from HCC 2018 Traffic Counts and Mobile Roads]	Existing peak hour traffic (vph)	Possible diversion traffic per peak hour (vph)	High numbers of peds / bikes	Safety issues (based on 5 year CAS data)	Conclusion (Suggested Actions)
1	Dixon Road	2,800	420 (15% peak traffic)	11	Moderate	No obvious issues identified	• Monitor traffic volumes (predictions well within capacity of existing road) • Low speed management, if needed
1	Waterford Road	2,470	296 (12% peak traffic)	11	Moderate	No obvious issues identified	• Monitor traffic volumes (predictions well within capacity of existing road) • Low speed management, if needed • Consider upgrade to Peacockes Road / Waterford Road intersection
1, 3 & 4	Peacockes Road (btw Waterford Rd and Weston Lea Dr)	1,200	168 (14% peak traffic)	11 (Route 1) + 33 (Route 3) + 21 (Route 4) Total = 65	Moderate	No obvious issues identified	• Monitor traffic volumes (predictions well within capacity of existing road) • Temporary effect until North–South arterial is built
2 and 3	Peacocke Rd rural	693	104 (15% peak traffic)	15 (Route 2) + 33 (Route 3) Total = 48	No	1. Crash pattern identified with vehicles losing control at bends (9 crashes)	• Monitor traffic volumes (predictions well within capacity of existing road) • Consider speed reduction to 60 km/h in rural section especially at area where existing crash cluster occurs

Route	Road section	Existing traffic (vpd) [Obtained from HCC 2018 Traffic Counts and Mobile Roads]	Existing peak hour traffic (vph)	Possible diversion traffic per peak hour (vph)	High numbers of peds / bikes	Safety issues (based on 5 year CAS data)	Conclusion (Suggested Actions)
3 & 4	Peacockes Road (btw Norrie St and Waterford Rd)	4,800	576 (12% peak traffic)	33 (Route 3) + 21 (Route 4) Total = 54	Moderate	No obvious issues identified	• Monitor traffic volumes (predictions well within capacity of existing road) • Low speed management, if needed • Review pedestrian / cycling connectivity • Investigate off-road connection along North-South corridor
3 & 4	Norrie Street	1940	233 (12% peak traffic)	33 (Route 3) + 21 (Route 4) Total = 54	Moderate	No obvious issues identified	• Monitor traffic volumes (predictions well within capacity of existing road) • Investigate upgrade to Peacockes Road / Norrie Street intersection in the long-term
3 & 4	Bader Street	9,000	1,080 (12% peak traffic)	33 (Route 3) + 21 (Route 4) Total = 54	High	High Risk Corridor 1. 21 crashes identified in last 5 years (excluding cashes at SH3 intersection). 2. Crash pattern identified with vehicles losing control at Bader Street /	• Monitor traffic volumes • Safety improvements at SH3 / Bader Street intersection underway soon (prior to construction of Waikato River Bridge Project) • Adjust signal phasing to suit priority

Route	Road section	Existing traffic (vpd) [Obtained from HCC 2018 Traffic Counts and Mobile Roads]	Existing peak hour traffic (vph)	Possible diversion traffic per peak hour (vph)	High numbers of peds / bikes	Safety issues (based on 5 year CAS data)	Conclusion (Suggested Actions)
						Norrie Street bend (4 crashes) 3. Crash pattern identified with parked vehicles.	

3.5 Potential duration of the effects based on planned network changes

The Peacocke network will significantly change in mid-2023 when the new Waikato River bridge opens. Peacockes Road urban upgrade and the East – West arterial to Peacockes Road are currently expected to be completed by 2024/25.

The Hamilton Section of the Waikato Expressway will be completed and open to the public in 2021. This is expected to have the effect of reducing traffic volumes and congestion on SH3 (Ohaupo Road) and SH 1 through Hamilton (Cobham Drive, Normandy Ave, Lorne Street and Kahikatea Drive).

Given the short period between future works coming on stream and the likely reduction in congestion on the existing key arterial roads, additional investment in interim safety improvement works is not expected to be justified given the expected diversion volumes on Peacockes Road (north of East -West arterial), Dixon Road, Waterford Road and Bader Street.

3.6 Conclusion for Operational Effects of the Project

In conclusion, the volume of through traffic using the Project network is unlikely to be significant in the interim period before the next stage of the Southern Links is completed. As presented in Table 5, Peacockes Road (between Waterford Road and Weston Lea Drive) is predicted to attract the highest volume of diverted trips (65 vph). However, this is only a temporary effect until North – South arterial is built and is well within the capacity of a typical urban road.

Based on the crash data obtained, only Bader Street is identified as a high-risk corridor. Although the Project is predicted to add approximately 50vph onto Bader Street, safety improvements will be underway soon making Bader Street safe and slower for all road users.

It is also expected that the Waikato Expressway (when completed in 2021) will reduce volumes on SH3 and SH1 within Hamilton, thus easing congestion and delay on the existing road network which will reduce the through traffic diversion to the proposed Project road network.

Accordingly, the transportation effects resulting from diverted traffic onto the wider network as an outcome of the operation of the Project are expected to be minor to negligible. This assessment forms the basis of the recommended mitigation measures identified in Table 5.

4. Project Components

4.1 Waikato River Bridge

The new Waikato River Bridge, as shown in Figure 8 will become the 7th bridge in the City over the Waikato River. It will provide a new strategic transport and services connection directly to Wairere Drive Ring Road, which is being extended to Cobham Drive at the present time. The bridge will be a significant feature within the landscape and has been designed with specific aesthetic and functionality requirements to meet the expectations of HCC and other stakeholders.

The bridge deck width is designed to accommodate four vehicle lanes, a flush central median and two active transport mode paths, plus roadside barriers. As shown further on in Section 5.1, the path on the western side of the bridge will be delineated as 2.5m wide cycle path, and separate 2.0m wide footpath. The path on the eastern side will be a 3.5m wide shared walking/cycling path. Two of the four traffic lanes will be for general traffic, and the remaining two lanes will be for use as bus lanes and/or high occupancy vehicle lanes when future demand requires.

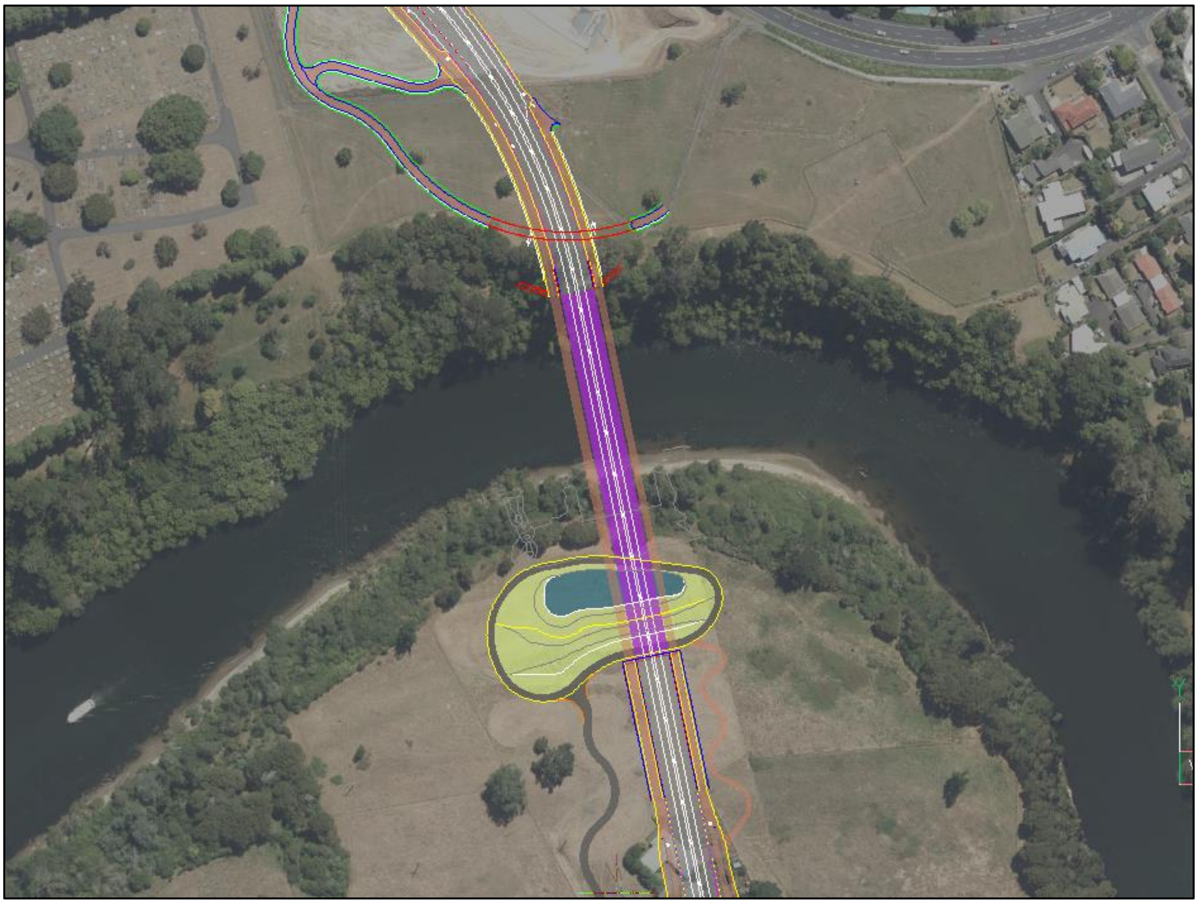


Figure 8: Waikato Rive Bridge Geometric Layout – Spans shown in purple.

4.2 Ring Road Extension Geometric Layout

The Ring Road Extension is a four-lane, two-way flush median divided Major Arterial Transport Corridor. This is made up of one lane for general traffic and one lane for public transport in each direction, as shown in Figure 9. Traffic volumes on the Ring Road Extension are predicted to be approximately 22,000 vehicles per day (vpd) by 2041, based on 2041 traffic volumes predicted by BBO through the manual trip assignment. Active modes have been accommodated and encouraged by separate paths on each side of the road. In addition, the kerb side lane (PT lane) will be 4.2m wide to provide road space for cyclists that choose to use the vehicle carriageway.

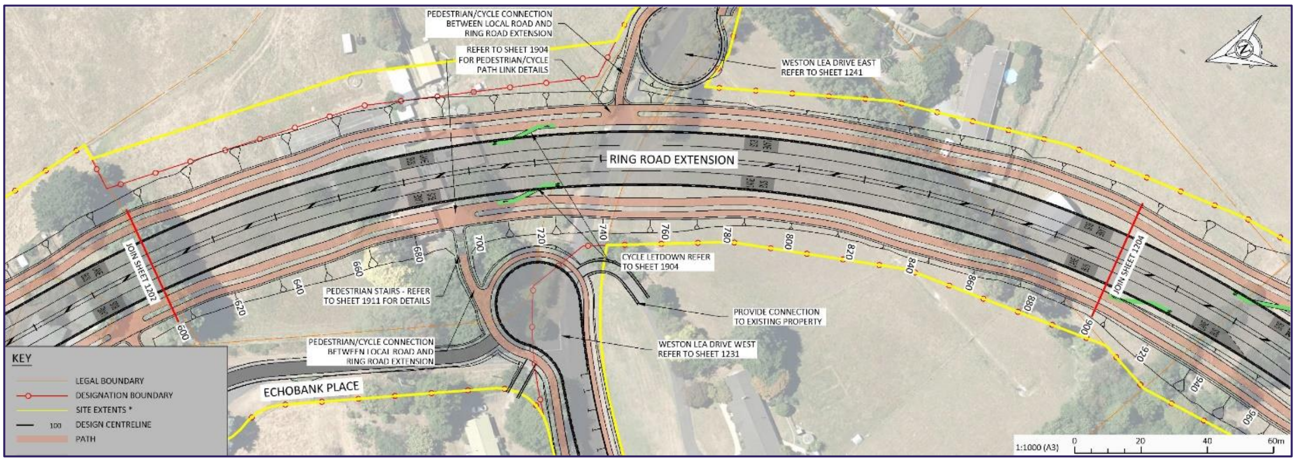


Figure 9: Ring Road Extension Geometric Layout

4.3 Ring Road Extension/ Peacockes Road Roundabout Geometric Layout

Based on the hierarchy philosophy, the highest rated intersection, between the Ring Road Extension and Peacockes Road, which fits within the designation boundaries is a roundabout with grade separation for pedestrians and cyclists, as shown in Figure 10. Based on 2041 predicted flows (refer to Section 8.3), this intersection is predicted to operate at an acceptable level of service during the AM and PM peaks respectively (SIDRA Modelling outputs can be found in Table 6 and Table 7 under Section 8.3). The roundabout has been designed in accordance with AGRD Part 4B with a central island radius of 20m and a dual lane circulating carriageway 9.5m wide. The intersection will meet the minimum sightline requirements, as stated in HCC District plan.

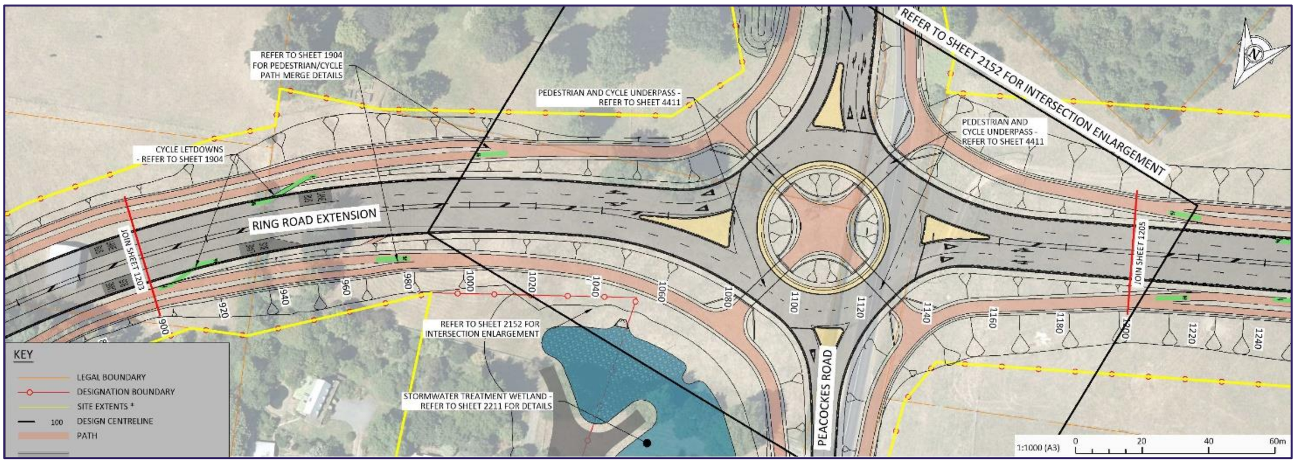


Figure 10: Ring Road Extension / Peacockes Road Roundabout Geometric Layout

4.4 Peacockes Road Geometric Layout

Peacockes Road currently has an estimated AADT of 580 to 600 vpd. The upgraded section of Peacockes Road in this project will become a Minor Arterial Transport Corridor with a posted speed limit of 40km/h, which will increase to 60km/h at the southern tie-in (existing road). Traffic volumes on Peacockes Road (in the section between the East-West Arterial and Ring Road extension) are predicted to be approximately 21,000vpd by 2041 (based on 2041 traffic volumes predicted by BBO through the manual trip assignment), corresponding to an approximate peak flow rate of 1,100 vehicles per hour in each direction.

Two bus stops and on-street parking for up to 55 spaces is available until such time as adjoining land-use development is in place with appropriate off-street parking. Once this occurs, the road space used for parking could be reassigned to provide school bus parks and wider cycle lanes. The location also coincides with the likely location of a sports park to be developed on the adjacent land. Waikato Regional Council has not yet confirmed where future public transport routes will be in the area, however provision has been allowed for such along Peacockes Road and Ring Road via Waikato River Bridge.

Pedestrian and cycle pathways will be provided on either side of the urban Peacockes Road, as shown in Figure 11. Raised pedestrian crossings are provided at locations that match expected future desire lines, giving pedestrians and cyclist safe opportunities to cross the road at a convenient location where traffic speeds are forcibly reduced. The raised pedestrian crossings, with the combination of a raised intersection (Peacockes Road / Westbrook Place) are new safety innovations promoted by HCC for reducing the potential for death and serious injuries to transport users in future.

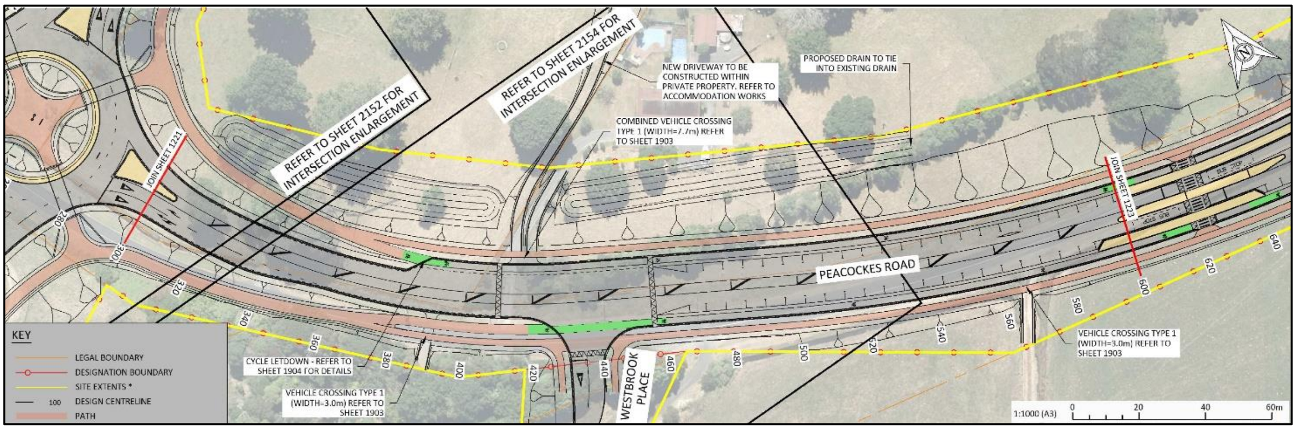


Figure 11: Ring Road Extension / Peacockes Road Roundabout Western Tie-in Geometric Layout

4.5 Peacockes Road/ Weston Lea Drive East Intersection Geometric Layout

The new signalised intersection includes four approaches positioned approximately at right angles to one another, and the whole intersection is raised as a platform to provide speed management, as shown in Figure 12. A fundamental strategic design requirement for the intersection was to prioritise safety and accessibility for active mode users. This includes providing separate paths and signalised crossing facilities for cyclists and pedestrians, limiting the width of the intersection (minimising traffic lanes) and providing single stage crossings across each of the four roads at the intersection. Public Transport (refer to section 6.1) was also prioritised over general traffic capacity and efficiency.

To prioritise public transport over general traffic, the configuration and phasing provides a straight ahead early-start signal for public transport from the marked left turn lane on both Peacockes Road approaches. This avoids the need for exclusive bus lanes that would widen the overall intersection and crossing lengths significantly, potentially disadvantaging the safety of pedestrians and cyclists. This is similar to the successful bus priority measure on Anzac Parade in Hamilton, which gives an exclusive early start signal for buses and allows them to travel straight ahead from the left turn lane.

Additional crossing locations are provided upstream and downstream of the signal intersection. This aligns with the Design Philosophy that seeks safety and connectivity for active mode users, and promoting public transport use over general traffic efficiency.

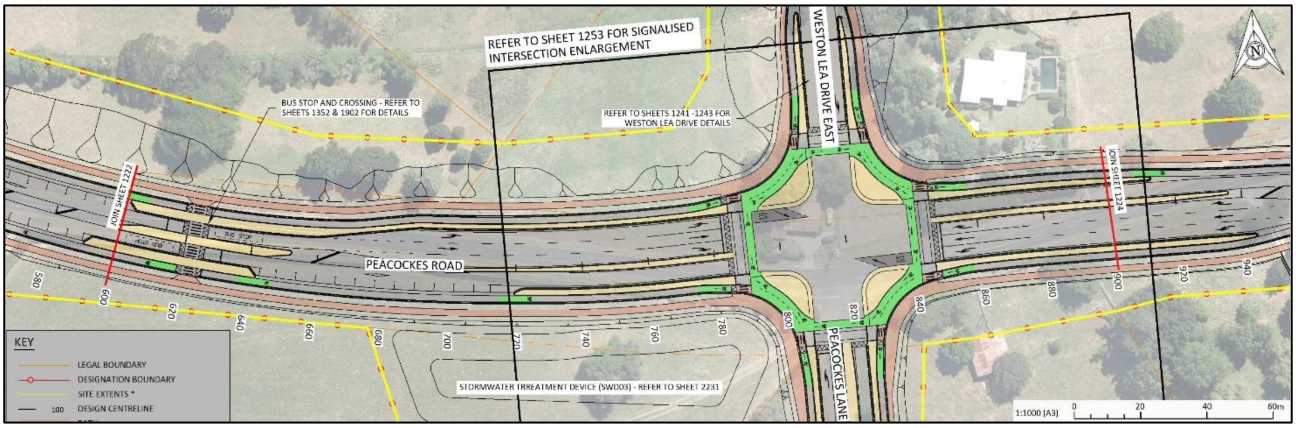


Figure 12: Ring Road Extension / Peacockes Road Roundabout Eastern Tie-in Geometric Layout

4.6 Weston Lea Drive (West and East) Geometric Layout

Weston Lea Drive is currently an undivided low volume cul-de-sac road that branches off Peacockes Road. It has a 5m carriageway width with an estimated AADT of 240 vpd. The existing Weston Lea Drive will be bisected by the extension of the Ring Road, as such cul-de-sacs (Weston Lea Drive West and East) are to be constructed on both sides of the Ring Road, as shown in Figure 13 and Figure 14. The new connection from the current Weston Lea Drive cul-de-sac to Peacockes Road has been designed as a T-junction while the eastern end of Weston Lea Drive will extend to tie into the Peacockes Road and Peacockes Lane intersection to enable connectivity. The provision of pedestrian pathways and on-street parking will be provided along both Weston Lea Drive West and East. Both roads will continue to operate as a low volume local road.

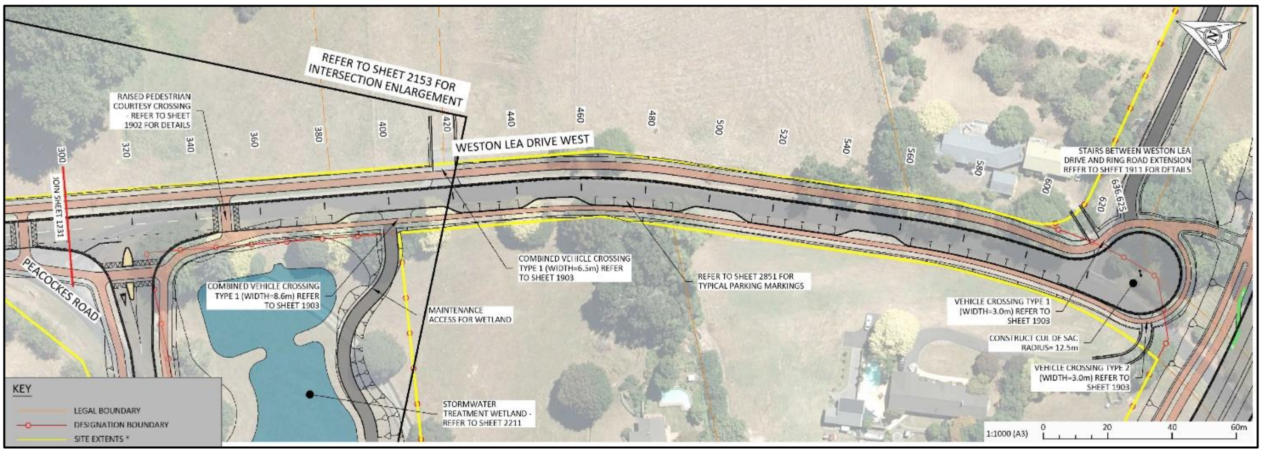


Figure 13: Weston Lea Drive West Geometric Layout

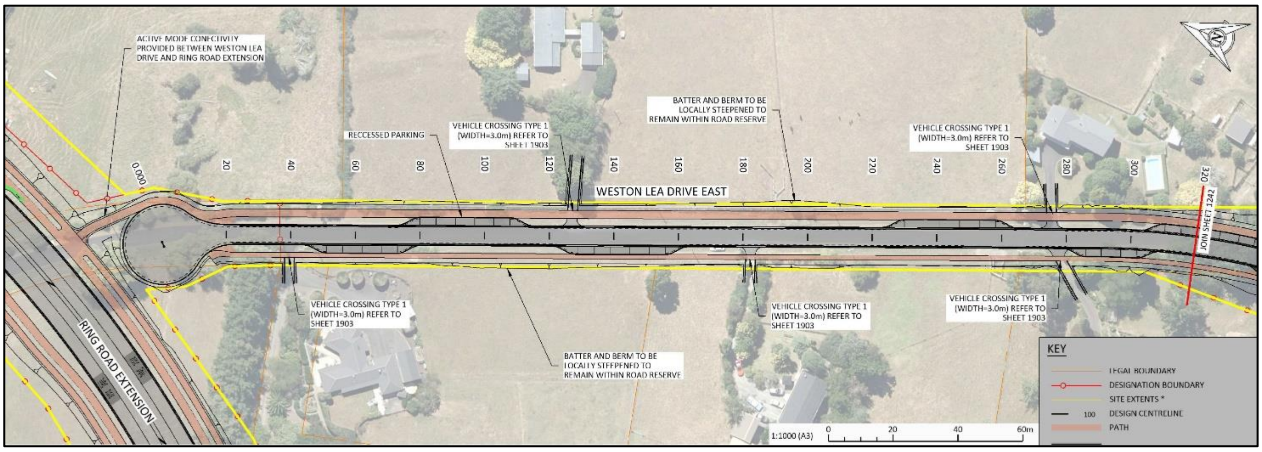


Figure 14: Weston Lea Drive East Geometric Layout

4.7 Road Safety Audit

A Detailed Design RSA has been completed including Client decisions, therefore, no residual matters to address.

4.8 Post implementation Review

A Post Implementation Review will be conducted by Hamilton City Council in collaboration with the NZ Transport Agency, in accordance with condition 24.3 following the construction of the Peacocke development.

5. Pedestrian and Cycle Connectivity

Pedestrian and cycling facilities are integrated in the design in support of HCC's biking plan and the Peacocke Concept Landscape Management Plan (CLMP). The surrounding area will be complemented with a network of attractive high-quality pedestrian and cycling routes that will enhance a positive experience within the Peacocke area.

The proposed Te Awa Riverside pedestrian and cycle facility is currently proposed on both the northern and southern side of the Waikato River. To the northern side, the shared path facility is routed through the Wairere/Cobham Drive interchange, although the proposed bridge link will adjust the alignment and improve overall connectivity.

To the southern side of the River, it is proposed that the Te Awa Riverside will traverse along the bank of the Waikato River. This will provide opportunities to develop the riverside bank in and around the bridge abutment as a public open space with access to the river, the inclusion of a jetty, terraces, furniture and associated planting. Additionally, the space will integrate with the Project's cycling and pedestrian facilities providing suitable grades between areas to promote access for all users. Off road walking and cycling routes enable active user to be physically separated from motorised traffic, which is critical where vehicle flows are high.

A comprehensive pedestrian and cycling network within Peacocke development will improve accessibility to public transport, public facilities and places of employment. A general arrangement of the pedestrian and cycling connectivity is provided in Figure 15 to Figure 21 below. All pedestrian/cycle and shared paths are consistent with current best practice guidelines for moderate demand volumes.

5.1 Waikato River Bridge Cross Section

A pedestrian footpath of 2m wide and cycle path of 2.5m wide will be provided on the western side of the bridge which will be separated by a delineation (line marking or change in surfacing), as shown in Figure 15. A shared path of 3.5m wide will be provided on the eastern side. The pathways are also attractive as it will provide a scenic view overlooking Hamilton in all directions. A concrete safety barrier will be provided to separate the pedestrian / cycle facilities from the main carriageway. Barriers / fencing will also be used on the outside edges of the bridge, tops of retaining walls for the prevention from falling. Waikato River Bridge will integrate with existing paths through Hamilton Gardens to create a pleasant recreational off-road loop as well as providing commuter routes to and from the city.

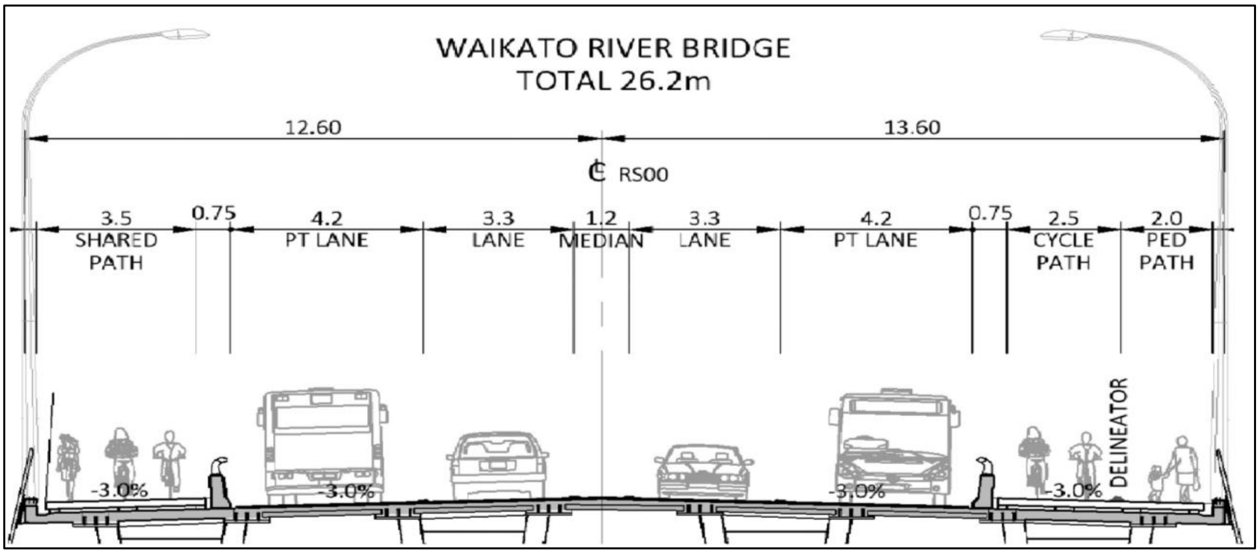


Figure 15: Waikato River Bridge Cross Section

5.2 Ring Road Extension Cross Section

Pedestrian and cycle paths will be provided on both sides of Ring Road Extension, as shown in Figure 16. The design shows that pedestrian and cycle pathways will be physically separated from motorised traffic, which is a key component where vehicle flows are high to ensure the safety of pedestrians and cyclists. A 2.5m wide pedestrian linkage, in the form of a stairway and a shared pathway are proposed on either side of Ring Road. This pedestrian linkage is located between the Ring Road extension and the two cul-de-sacs (Weston Lea Drive West and East) as shown in Figure 13 and Figure 14 above.

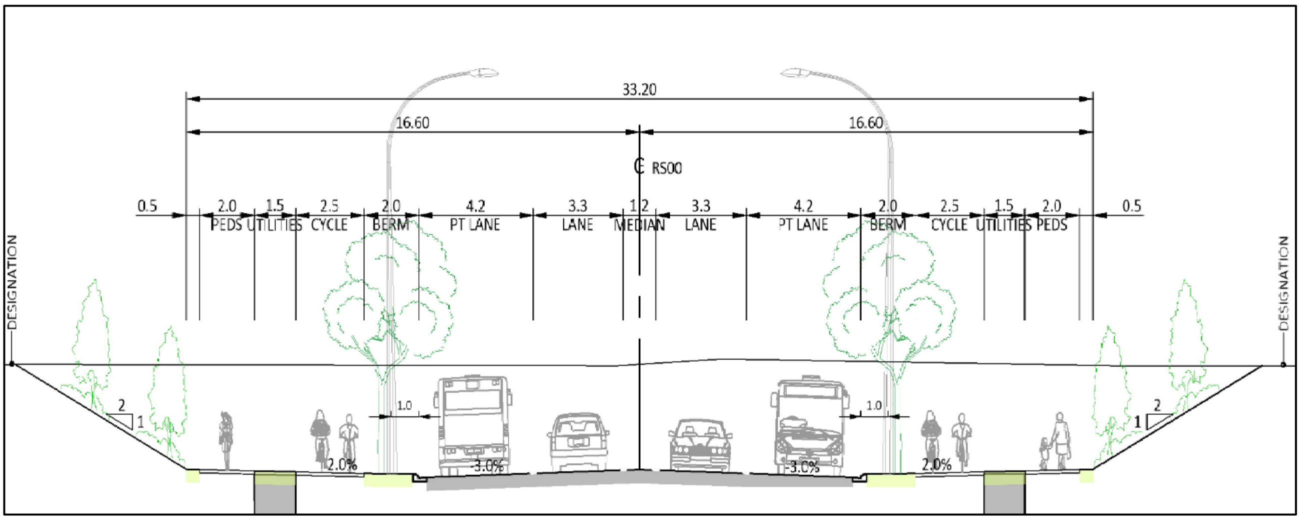


Figure 16: Ring Road Extension Cross Section

5.3 Ring Road / Peacockes Road roundabout grade separated crossings

The design of the Ring Road / Peacockes Road roundabout will divert pedestrians and cyclists to an underpass beneath the roundabout, as shown in Figure 17. This immediately provides a high level of convenience, safety and connectivity for all active mode travellers in all directions. The underpass will prevent pedestrians and cyclists from impeding on traffic which will likely have a positive effect on traffic flows. The underpass walls are to be painted in 'Hit Grey' or other colour required by HCC, and lighting shall be in accordance with the requirements set out in RITS (clause 3.2.20.11).

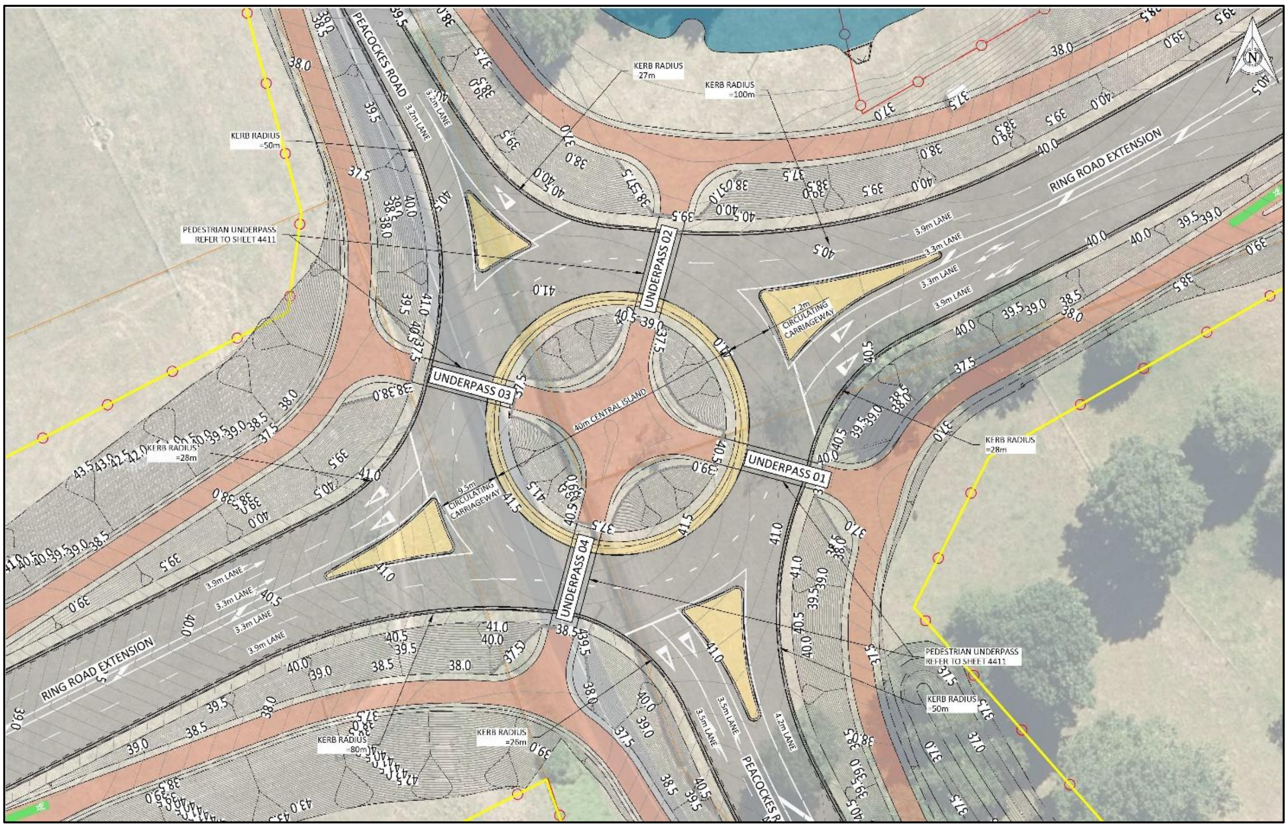


Figure 17: Ring Road / Peacockes Road roundabout grade separated crossing

5.4 Peacockes Road Cross Section

Pedestrian pathways and cycle lanes along Peacockes Road will continue to be physically separated from motorised traffic, as shown in Figure 18. The configuration was designed in such a way that the bus platform and the utilisation of on-street parking provides a type of safety barrier between the cycle lanes and general traffic, as this section of Peacockes Road is likely to experience high cycling activity. Further south, cycle lanes are adjacent to the live lane separated by a solid white line, while pedestrian pathways will continue to be separated from the motorised traffic on either side of the road. The pedestrian and cycle paths will be 2m and 2.3m wide, respectively, which is consistent with current best practice guidelines. For added safety, a raised pedestrian crossing will be provided along Peacockes Road (refer to Figure 23), reducing vehicle speeds which will allow pedestrians to cross the road in a safer manner. Raised pedestrian crossings are aligned with the Safe System approach that recognises that humans, as road users, make mistakes and are vulnerable to crashes. This traffic calming device lower the overall speed of vehicles to a Safe System collision speed.

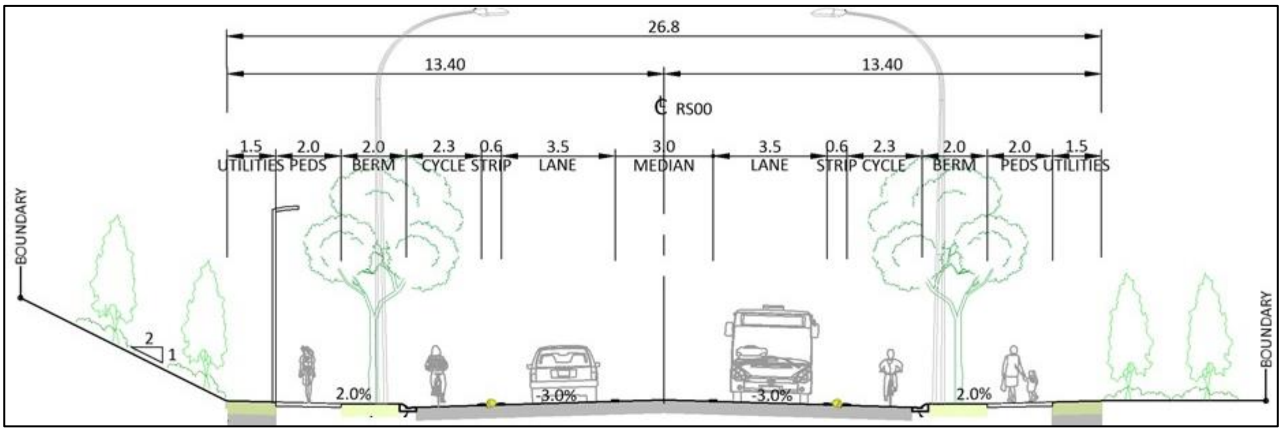


Figure 18: Peacockes Road Cross Section

5.5 Peacockes Road / Weston Lea Drive East Signalised intersection crossing

Peacockes Road / Weston Lea Drive East / Peacockes Lane signalised intersection is designed on the basis of the Copenhagen style layout with fully segregated signalised crossing facilities for pedestrians and cyclists. Cyclists that wish to avoid sharing the intersection with general traffic are provided with an exclusive clockwise travel lane around the intersection to enable safe and complete connectivity to all exits while minimising crossing conflicts with other cyclists and pedestrians. Signal phasing design is such that cycle and pedestrian signal crossings have an early-start on the left turn that runs in the same stage. Since cyclists are travelling in the clockwise direction on these crossings it means the early-start is essentially full protection from opposing vehicle movements. However, the signal phasing provides partial protection to pedestrians from left turn traffic since pedestrians can walk in in the anti-clockwise direction on the crossings.

Suitable ground markings, drop kerb facilities and signs will be provided for pedestrians and cyclists, including ingress and egress ramps for cyclists accessing the shared path facilities.

This is a raised platform intersection, as shown in Figure 19, with ramp gradients designed to slow vehicles to no more than 30kph through the intersection. According to the Waka Kotahi NZ Transport Agency's (Waka Kotahi) Standard Safety Intervention Toolkit, raised intersections are used as vertical speed control elements that promote survivable impact speeds for pedestrians if hit by a vehicle travelling through the intersection.

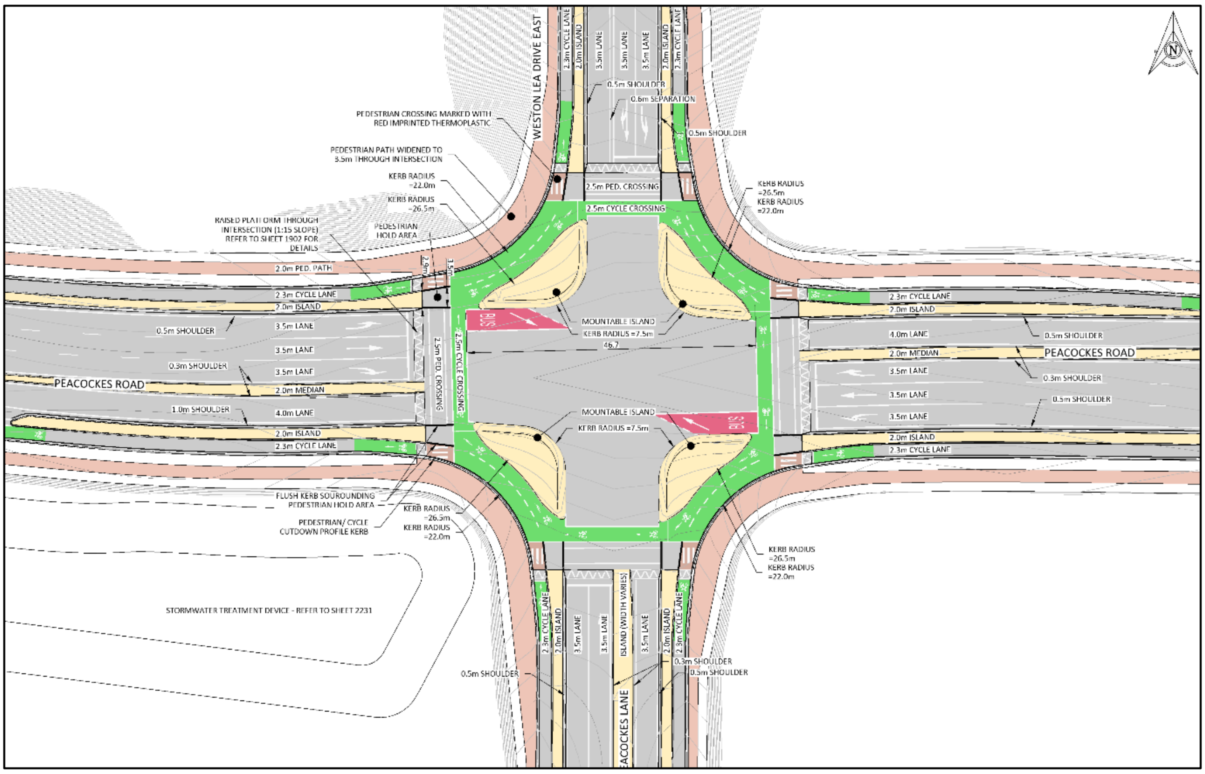


Figure 19: Peacockes Road / Weston Lea Drive East Signalised intersection crossing

5.6 Weston Lea Drive (West and East) Cross Section

As discussed, in section 4.6, Weston Lea Drive will be divided into two cul-de-sacs: namely Weston Lea Drive West and Weston Lea Drive East, as shown in Figure 20 and Figure 21 respectively. Both Weston Lea Drive West and Weston Lea Drive East will provide pedestrian pathways on either side of the road, completing the connectivity needed for residential access. An active mode connectivity links to Ring Road via pedestrian access ways are proposed at the end of the cul-de-sacs, which allow for a faster and shorter route to Hamilton Garden and the City Centre.

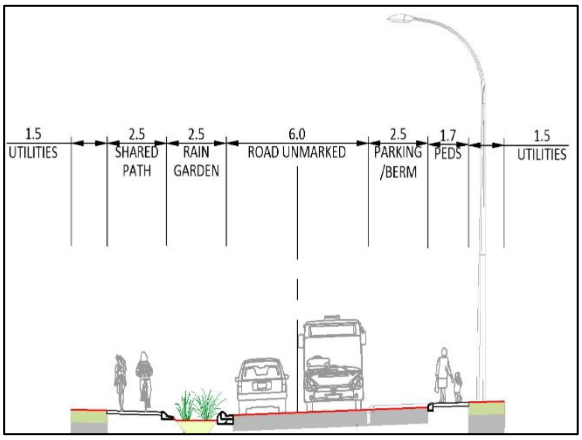


Figure 20: Weston Lea Drive West Cross Section

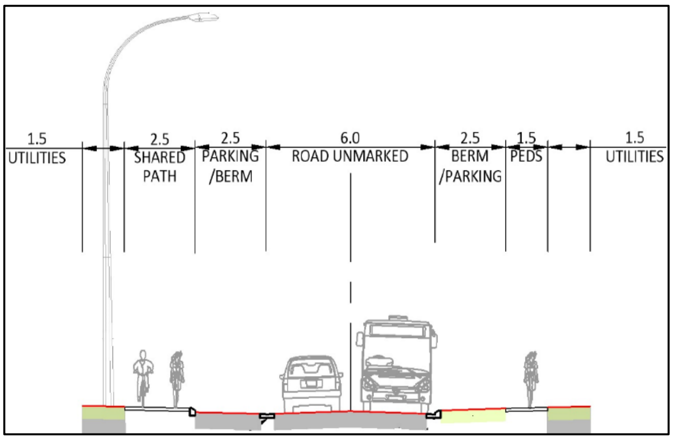


Figure 21: Weston Lea Drive East Cross Section

5.7 Road Marking & Signage

All street signage will be in accordance with the requirements of the Transport Agency's Manual of Traffic Control Devices and Manual of Traffic Signs and Markings and specific signage layouts will be provided for the extent of the Project. Pavement markings will initially be applied with Transport Agency standard specification NZTA M/7 paint materials, which will include RITS requirements. Road marking and signage form an essential part of a successful transport strategy; therefore, special care was taken into consideration with the placement of road marking and signage. It is important that sufficient signs/road marking are displayed to allow drivers time to comprehend and safely react. Advance warning signs will be a contributing factor for the speed environment as well as clear and consistent signs which will help avoid driver confusion and sudden manoeuvres that could result in serious high-speed crashes.

5.8 Tactile Pavers

Tactile pavers for the blind and vision impaired pedestrians are provided at all intersections and crossing points where applicable. The tactile pavers were designed in accordance with Waka Kotahi's RTS 14 (Guidelines for facilities for blind and vision impaired pedestrians) and provide pedestrians with visual and sensory information.

Audible Tactile Traffic Signals (ATTS) are located at the Peacockes Road / Weston Lea Drive East signalised intersection. The ATTS is a push-button system at traffic signals that make a continuous beeping sound to indicate that it is safe to cross the road. Providing this type of facility will help the visually impaired with their orientation and making the intersection pedestrian friendly.

5.9 Summary of Pedestrian and Cycling Facilities

The future pedestrian and cycling design within Peacocke area aligns with the Peacocke Structure Plan. Universal access for people with special needs are addressed in the planning and designing stage. The project also provides a network of walking and cycling pathways that will benefit active modes, reduce carbon emission, reduce congestion and improve the general public's wellbeing. Pedestrian and cycling facilities will be integrated into the design of roundabouts with pedestrian/cycle priority systems to be included within the traffic light systems at the Peacockes Road / Weston Lea Drive East intersection. Suitable ground markings, drop kerb facilities and signage will be provided for pedestrians and cyclists and will include ingress and exit points for cyclist that access shared path facilities

6. Public Transport Infrastructure

According to the Regional Infrastructure Technical Specifications 2018 (RITS), 400m is an acceptable walking distance to public transport. However, a shorter distance shall be considered near centres and major public transport routes.

HCC has expressed a desire to set a very high level of service for public transport operations in the Peacocke area. As such, HCC has requested that a dedicated traffic lane and bus priority measures are provided to serve public transport in the future. The original Southern Links Investigation Transport Modelling Report also concluded that the possibility of an express bus routes to the airport via Peacocke's would be faster and shorter to use Cobham Drive and the new bridge at the Wairere Drive Extension rather than the western side of the river from State Highway 3. WRC are currently looking at proposed bus routes within the Peacocke area and would ideally prefer that buses are the first form of transport to operate along the new corridor.

There are currently two bus services (Comet via Glenview and Fitzroy #12) that operates on the western extent of Peacocke, as shown in Figure 22. Bus route 12 Fitzroy currently operates on a small section of Peacockes Road, between Norrie Street and Waterford Road. The service operates seven days a week including public holidays and travels between Hamilton Transport Centre and Dixon Road.

We are aware that Waikato Regional Council has presented a working paper to HCC on bus planning in the Peacocke area. The proposals in this paper are yet to be discussed with HCC staff and has no current status. Hence, any changes in public transport solutions that come from this working paper should be considered in subsequent reviews of this TNMP once it has been agreed with and approved by HCC.

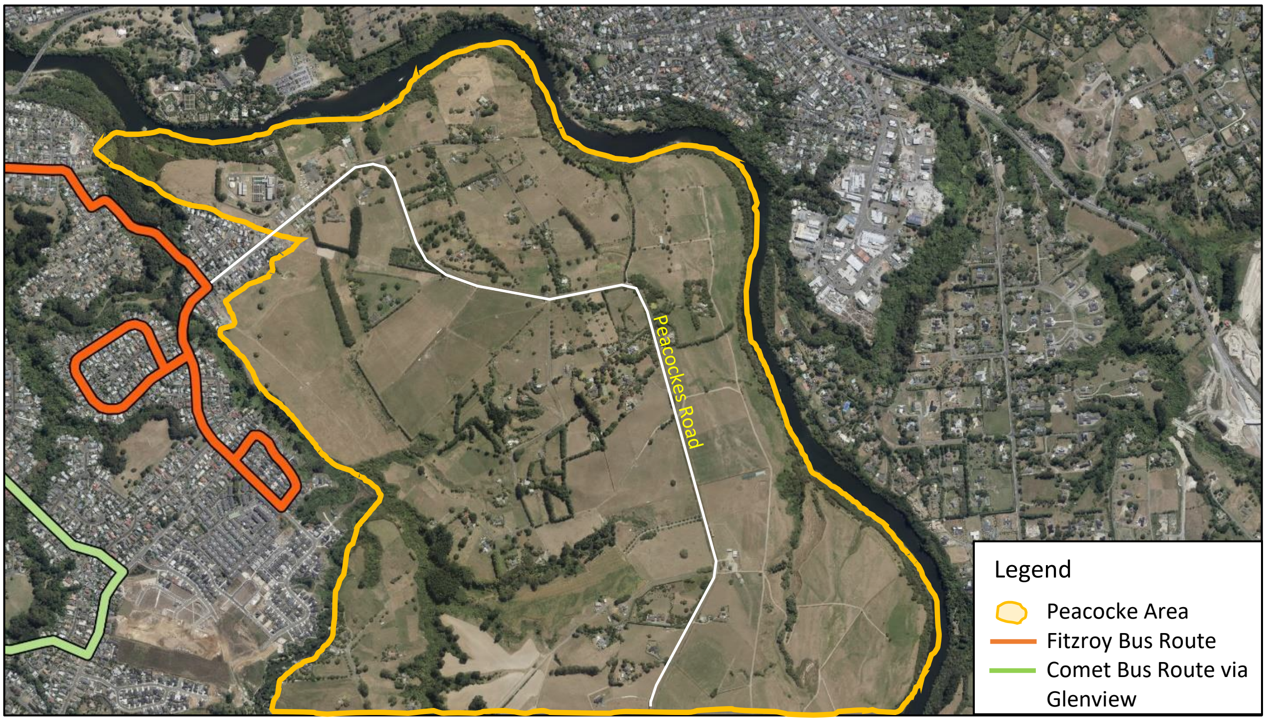


Figure 22: Existing public Transport Routes

The provision for future public transport along Peacockes Road and Ring Road will be prioritised. The bus service will operate mostly in mixed traffic with priority measures at the higher end of the threshold that will include dedicated lanes, signal prioritisation and various queue-jumping mechanisms which will be discussed in Chapter 8.

A bus stop will be provided on either side of Peacockes Road, as shown in Figure 23 and will be within a reasonable walking distance of public facilities and places of employment. The development footprint is extensive, and pedestrians along Weston Lea Drive West would be required to walk a longer distance in order to access public transport.

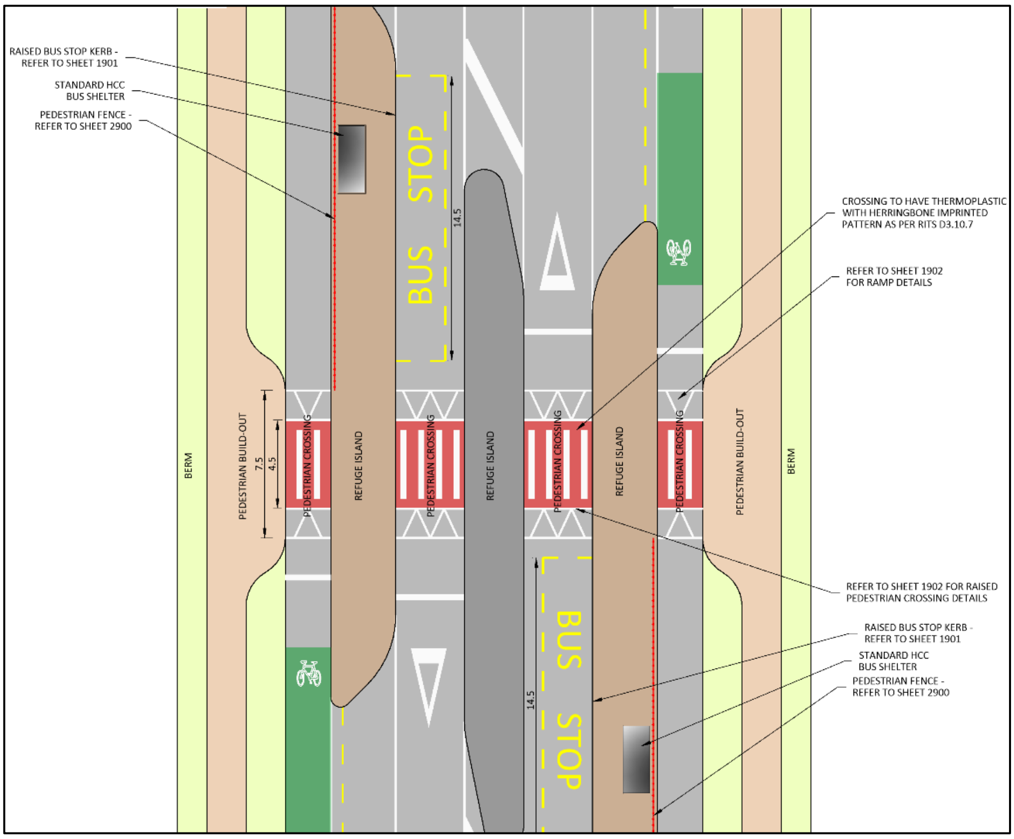


Figure 23: Proposed Bus Stops and Bus Shelters

Kerbside boarding along Peacockes Road were designed for universal accessibility (raised floor platform / level boarding) for wheelchair passengers. The platform will have sufficient space for a bus shelter and bus stop and will be constructed in accordance with the RITS standard (not including the “mini” shelter) and coordinated with positions of pedestrian crossing points. Final positions of bus stops will be agreed with HCC Transportation staff.

Bus stops will not be indented into the roadside, instead buses will stop within the lane while passengers are boarding and alighting as this will improve safety and efficiency for public transport. As a result, Peacockes Road will experience prolonged delays during the AM and PM peak periods.

The advantage is that public transport vehicles can operate more efficiently and safely as they do not have to enter and leave the traffic stream at each stop. Overall, the safety and active mode capacity of the road corridor will be increased with this approach.

HCC has expressed a desire to reduce reliance on private vehicles and encourage the use of public transport and active modes. However, provision for bus stops along Ring Road Extension was not required since any future services using this route are likely to be express services that would not stop along this route; therefore, no bus stop infrastructure has been provided within the design.

6.1 Bus Priority at Peacockes Road / Weston Lea Drive East Signalised Intersection

The signal and phasing layout plan for Peacockes Road / Weston Lead Drive Eats is provided in Figure 24 with the standard sequence starting with phase D, E, F and A.

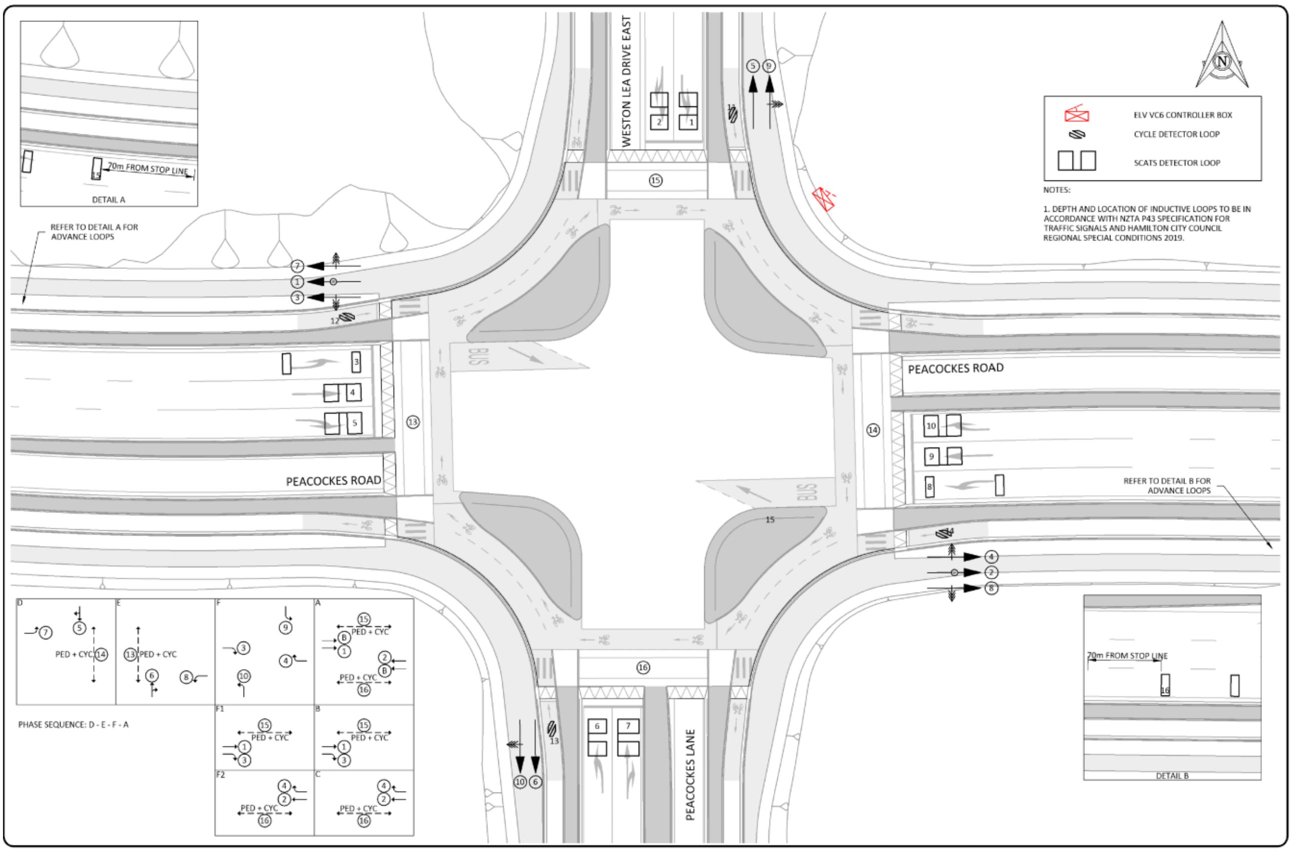


Figure 24 – Peacockes Road / Weston Lea Drive East Intersection Phasing Signals

Buses experience excessive delays at intersections due to congestion as they operate on a fixed route. Therefore, it was necessary to segregate buses from the main traffic stream and prioritise bus movements at the Peacockes Road / Weston Lea Drive East signalised intersection through the aid of bus detector loops and queue-jumping. Buses will operate in both directions of Peacockes Road and form part of the through moving traffic. Priority for buses is provided through the allowance of buses to use the left turn lanes which will enable them to jump-ahead of the through moving traffic with the provision of a bus signal jump start during the signal phasing. This will reduce the journey travel time and improver service regularity for buses.

6.2 Summary of the Future Public Transport Service

The design aims to prioritise public transport vehicles through the aid of bus detector loops and queue-jumping in order to operate more efficiently and safely. The provision of public transport will contribute to a lower vehicle ownership and parking demand.

7. Future Demand Volumes

7.1 Waikato Regional Transportation Model (WRTM)

The WRTM is a multi-modal strategic planning tool that forecasts travel demand based on future land use and road network changes. The current WRTM has 2,500 zones and is calibrated to 2013 census data and traffic volumes on strategic network links. The model has forecast years 2021, 2031, 2041 and 2051 which is based on the National Institute of Demographic and Economic Analysis (NIDEA) “low” growth projections.

The 2041 WRTM version released in 2017 (file reference: WL41BBAALLB3 and WL41BBPALLB3) was reviewed by BBO, NZTA and HCC in collaboration with other recognised traffic modellers in Hamilton at the start of the Project. It was agreed by all in those meetings that there were seemingly significant inconsistencies between the original Southern Links designation models and the WRTM in terms of projected traffic volumes using the future strategic network. The group of engineers also agreed that the WRTM was the more up to date and appropriate tool to use, but that it predicted unrealistically low demand volumes for 2041. The group agreed that the reasons needed to be understood and so NZTA commissioned WRTM TRACKS developer, Stantec to compare the land use inputs to the designation models and the WRTM. Stantec identified a number of differences outside of Peacocke area, and approximately 1000 more households in Peacocke in the designation models, but neither were the clear reason for the significantly lower volumes in the WRTM. Accordingly, BBO undertook additional work in the WRTM, with all the zones within the Peacocke Structure Plan area updated, including zone loading positions as this influence’s volumes at intersections nearby. The updates were done in collaboration with Tony Denton, the Infrastructure Planning Manager for HCC. Mr Denton had provided his prediction information on household numbers within 34 developable areas in Peacocke, with different densities and development timelines. The sketch provided by Mr Denton is attached in Appendix C.

With this information, BBO worked closely with Stantec in developing a Peacocke WRTM 2041 project model (file reference: WL41S1AALL5A and WL41S1PALL5A). This project model was used to forecast the Strategic network traffic volumes, to help guide the design on the basis of full build-out in 20 years (2041).

The 2041 AM and PM peak two-hour volumes from the Peacocke WRTM 2041 project model, by direction are presented in Figure 25 and Figure 26, respectively. The volumes are presented in a two-hour peak period where it was converted to one-hour volumes using a factor of 0.55. This peak hour factor was provided by Stantec.

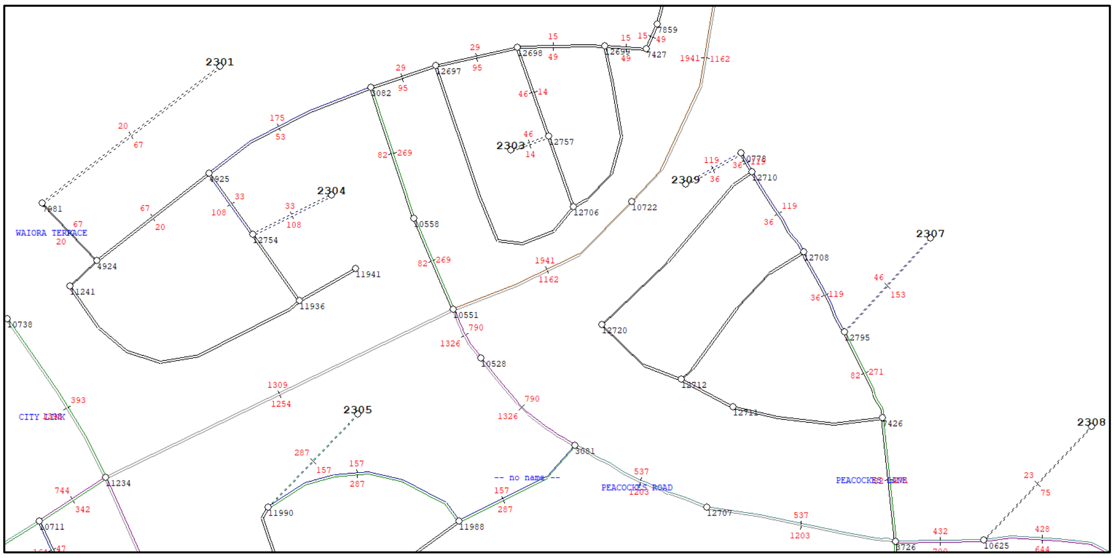


Figure 25: Peacocke WRTM 2041 Project Model AM Peak 2-hour Volumes
(file reference: WL41S1AALL5A)

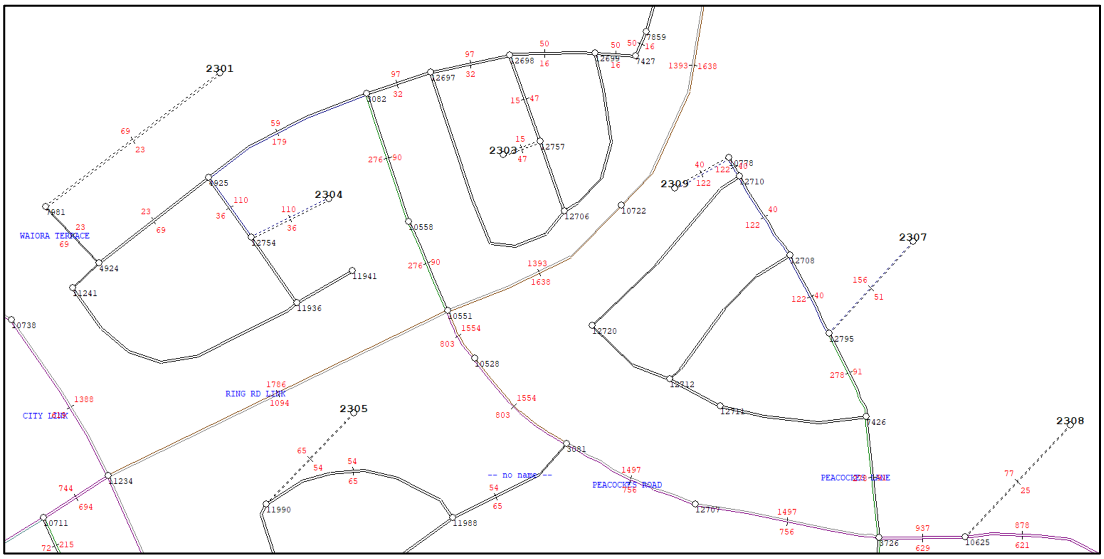


Figure 26: Peacocke WRTM 2041 Project Model PM Peak 2-hour Volumes
(file reference: WL41S1PALL5A)

The Peacocke WRTM 2041 project model predicted volumes are an improvement over the initial WRTM volumes, however, the demand flows around Peacockes Road (fundamental to the Project) required further attention. BBO, therefore, carried out a manual trip calculation and assignment in an attempt to derive more realistic and robust traffic volumes for the future road network within this Project area. This work concentrated particularly on Peacockes Road and the two key intersections, the Ring Road / Peacockes Road roundabout and Peacockes Road / Weston Lea Drive intersection. The 2041 traffic volumes used in this refinement assessment were based on 14 developable areas adjacent to Peacockes Road, out of the 34 areas in the Structure Plan zone. Refer to Figure 28 below.

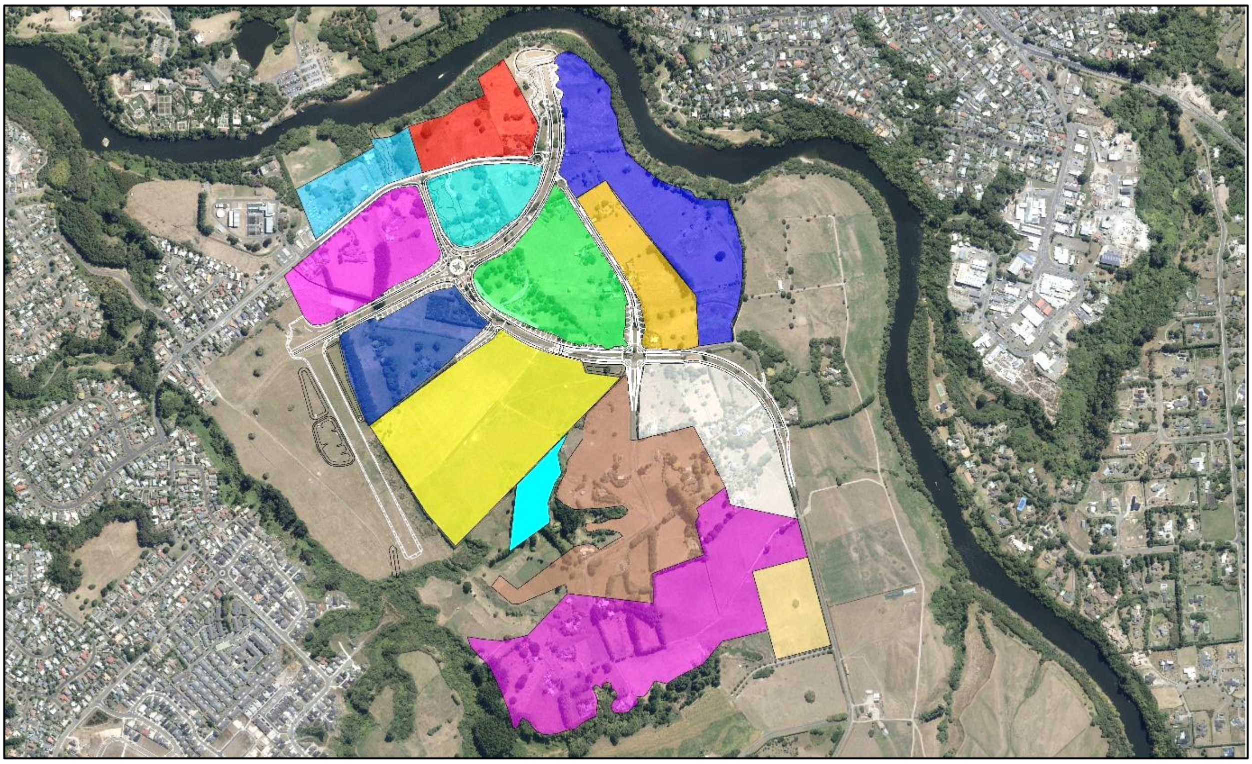


Figure 27: The 14 Developable Areas of direct influence to the Project network

The 2041 traffic volumes predicted by BBO through the manual trip assignment are similar to that obtained from the Peacocke WRTM 2041 project model, however, the volumes differ along Peacockes Lane, Weston

Lea Drive East and Westbrook Place. A more conservative approach was assumed in terms of traffic generation and trip distribution in the manual trip assignment. Therefore, the Peacocke WRTM 2041 project model volumes were not used in this assessment but instead were only used as a comparison to BBO's manually assigned 2041 traffic volumes.

The predicted 2041 demand volumes derived from the manual trip assignment are shown in Figure 28 to Figure 31.

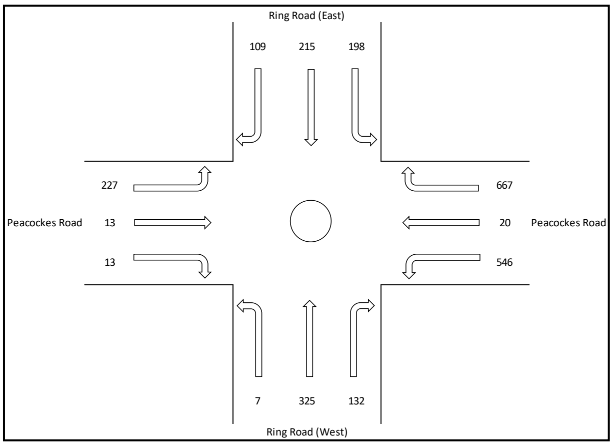


Figure 28: Ring Road/Peacockes Road roundabout (AM Peak)

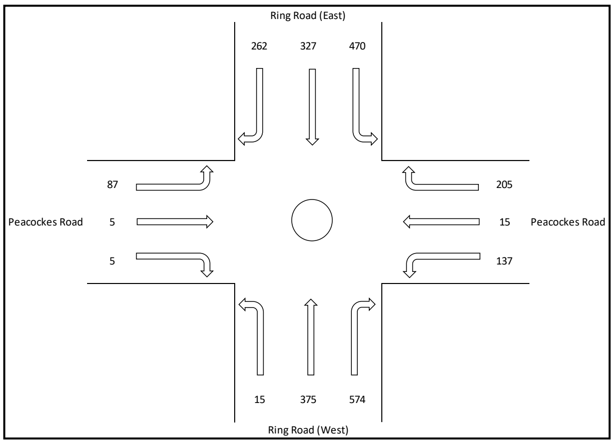


Figure 29: Ring Road/ Peacockes Road roundabout (PM Peak)

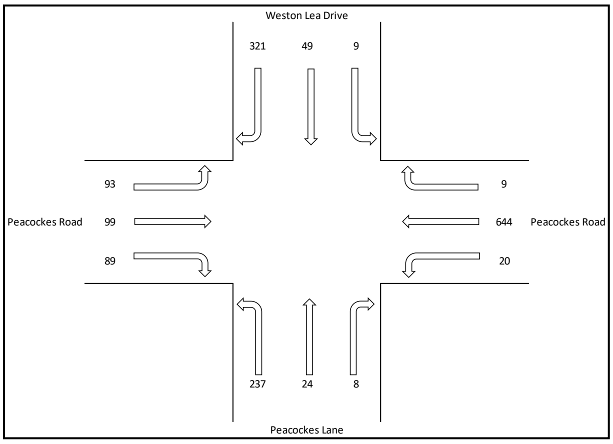


Figure 30: Peacockes Road/Weston Lea Drive intersection (AM Peak)

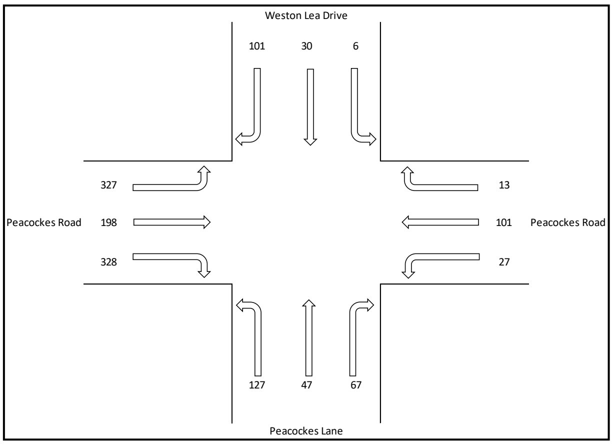


Figure 31: Peacockes Road/Weston Lea Drive intersection (PM Peak)

8. Future Intersection Performance

8.1 Intersection Layout

As already highlighted, the two key intersections within the Project network are:

- Ring Road / Peacockes Road roundabout; and
- Peacockes Road / Weston Lea Drive East / Peacockes Lane signalised intersection.

These intersections have been designed on the basis of the foreseeable travel modes and demand volumes from the wider completed development, and in accordance with HCC's design philosophy objectives.

The intersection configurations, shown below in Figure 32 and Figure 33, were derived from assessments in SIDRA Intersection v 8.0 software (for the Roundabout) and PTV VISSIM micro-simulation (for the signalised intersection) using the predicted 2041 AM and PM peak hour demand flows described in Section 7.

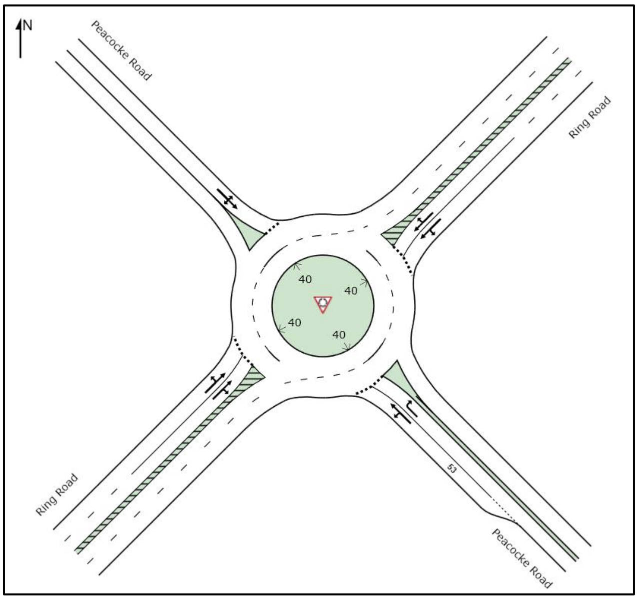


Figure 32: Ring Road / Peacockes Road roundabout

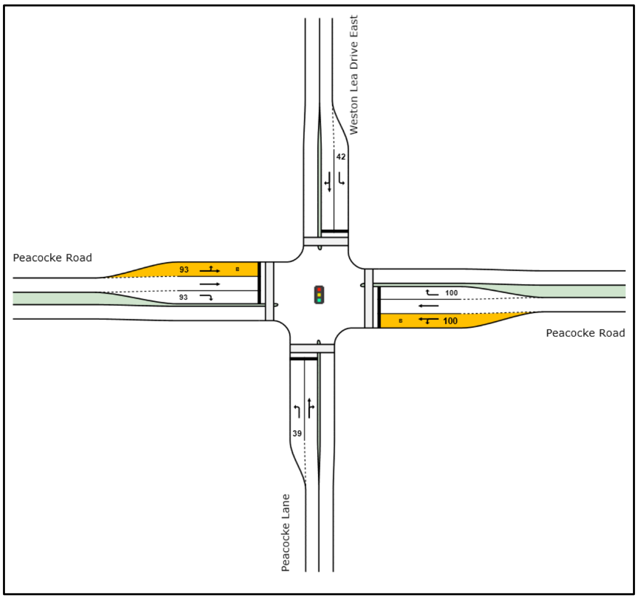


Figure 33: Peacockes Road / Weston Lea Drive East signalised intersection

8.2 Capacity Analysis

The Level of Service (LoS) and 95th percentile vehicle queue length for the 2041 AM and PM Peak hour scenarios are summarised in Tables 6 to 9, respectively.

Level of Service is a measure used to assess the operation of existing transportation infrastructure, as well as the effectiveness of infrastructure improvements. LOS is categorised in letters A to F, with A being the best and F being the worst, based on the average control delay experienced by vehicles at the intersection approaches. Broadly it can be defined as follows:

A = Free flow
B = Reasonably free flow
C = Stable flow
D = Approaching unstable flow
E = Unstable flow
F = Forced or breakdown flow

8.3 Ring Road / Peacockes Road Roundabout

Figure 34 and Figure 35 show that the roundabout operates well with performance ranging between LOS A and B during the 2041 AM and PM Peak period, and an average queue ranging from just one to four vehicles per lane. The greatest congestion is on the Ring Road approach during the PM Peak period operating at a LOS C and D, with an average queue of 6 and 7 vehicles per lane. This is still a relatively low level of congestion that should cause no issues for Public Transport travel time reliability.

The SIDRA lane performance summary is provided in Tables 1 and 2 on the follow page.

This design meets HCC's objectives and priorities for the Project to provide efficiency for public transport and a high level of safety for all users. The network of underpasses at this roundabout ensure safety, convenience and a high quality of amenity for non-motorised transport modes.

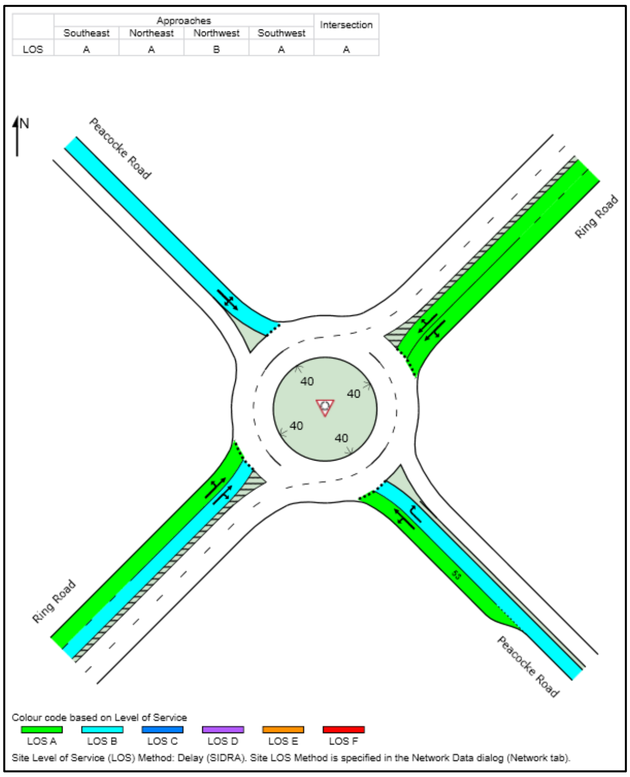


Figure 34: 2041 AM Peak Level of Service by Lane

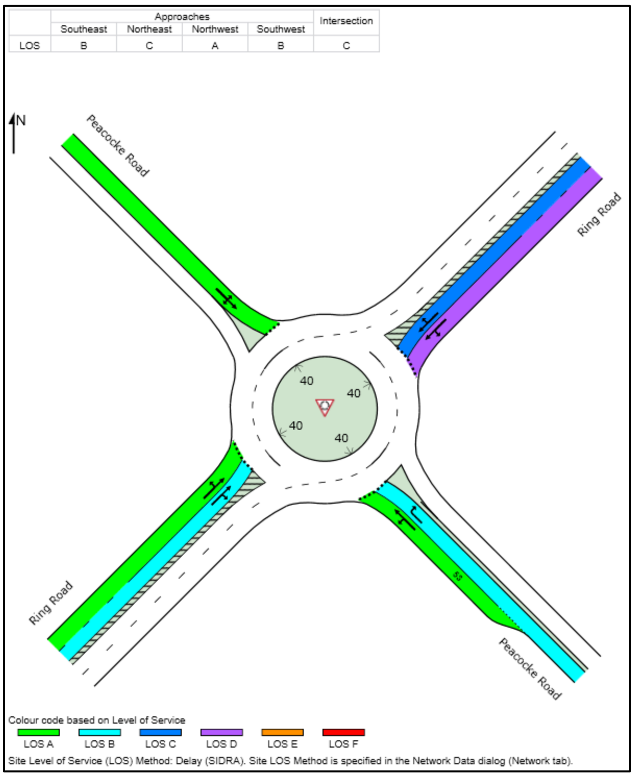


Figure 35: 2041 PM Peak Level of Service by Lane

Table 6: Ring Road / Peacockes Road Roundabout – 2041 AM Peak

Lane Use and Performance															
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
SouthEast: Peacocke Road															
Lane 1	596	4.8	508	4.8	929	0.546	100	6.2	LOS A	1.4	10.1	Short	53	0.0	NA
Lane 2[d]	702	5.0	598	5.0	994	0.602	100	12.7	LOS B	1.7	12.6	Full	130	0.0	0.0
Approach	1298	4.9	1106[N1]	4.9		0.602		9.7	LOS A	1.7	12.6				
NorthEast: Ring Road															
Lane 1[d]	274	5.0	274	5.0	1134	0.242	100	4.0	LOS A	0.6	4.1	Full	500	0.0	0.0
Lane 2	275	2.9	275	2.9	1136	0.242	100	6.5	LOS A	0.6	4.0	Full	500	0.0	0.0
Approach	549	4.0	549	4.0		0.242		5.2	LOS A	0.6	4.1				
NorthWest: Peacocke Road															
Lane 1[d]	266	0.0	266	0.0	555	0.480	100	11.8	LOS B	1.3	9.1	Full	220	0.0	0.0
Approach	266	0.0	266	0.0		0.480		11.8	LOS B	1.3	9.1				
SouthWest: Ring Road															
Lane 1[d]	253	4.9	253	4.9	794	0.319	100	6.6	LOS A	0.8	5.9	Full	400	0.0	0.0
Lane 2	236	5.0	236	5.0	740	0.319	100	10.7	LOS B	0.8	5.8	Full	400	0.0	0.0
Approach	488	4.9	488	4.9		0.319		8.6	LOS A	0.8	5.9				
Intersection	2602	4.2	2410[N1]	4.5		0.602		8.7	LOS A	1.7	12.6				

Table 7: Ring Road / Peacockes Road Roundabout – 2041 PM Peak

Lane Use and Performance															
	Demand Flows		Arrival Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	Aver. Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
SouthEast: Peacocke Road															
Lane 1	160	4.5	151	4.5	594	0.253	100	7.5	LOS A	0.6	4.6	Short	53	0.0	NA
Lane 2[d]	216	5.0	203	5.0	665	0.305	100	13.5	LOS B	0.8	6.0	Full	130	0.0	0.0
Approach	376	4.8	354[N1]	4.8		0.305		10.9	LOS B	0.8	6.0				
NorthEast: Ring Road															
Lane 1	495	5.0	495	5.0	519	0.953	100	39.7	LOS D	7.0	51.2	Full	500	-19.5[N3]	0.0
Lane 2[d]	620	2.8	620	2.8	720	0.862	90[5]	23.6	LOS C	5.9	42.4	Full	500	0.0	0.0
Approach	1115	3.8	1115	3.8		0.953		30.7	LOS C	7.0	51.2				
NorthWest: Peacocke Road															
Lane 1[d]	102	0.0	102	0.0	443	0.230	100	9.0	LOS A	0.4	3.0	Full	220	-1.2[N3]	0.0
Approach	102	0.0	102	0.0		0.230		9.0	LOS A	0.4	3.0				
SouthWest: Ring Road															
Lane 1	411	4.8	411	4.8	775	0.530	62[5]	7.0	LOS A	1.4	10.4	Full	400	0.0	0.0
Lane 2[d]	605	5.0	605	5.0	714	0.848	100	18.9	LOS B	3.3	24.4	Full	400	-19.5[N3]	0.0
Approach	1016	4.9	1016	4.9		0.848		14.1	LOS B	3.3	24.4				
Intersection	2608	4.2	2586[N1]	4.3		0.953		20.6	LOS C	7.0	51.2				

8.4 Peacockes Road / Weston Lea Drive East Intersection

As described in Section 6, the Peacockes Road / Weston Lea Drive East signalised intersection has been designed with full cycle and pedestrian crossing phase protection, and bus priority early-start signals on both approaches of Peacockes Road, as shown in Figure 36.

The early start PT signals avoid the need for exclusive bus lanes, which widen the entire intersection resulting in longer crossing times and increased delays for pedestrians and cyclists. The design assumes Public Transport is provided exemption to use the left turn traffic lane to go straight ahead when the early-start PT signal is called by an on-board transponder.

Given the full pedestrian protection and PT priority complexities the modelling of the intersection performance could not be reliably achieved using SIDRA Intersection. Instead BBO used PTV VISSIM micro-simulation to demonstrate the working bus priority and obtain performance statistics for Buses, private traffic and non-motorised users. The following Figures and Tables relate.

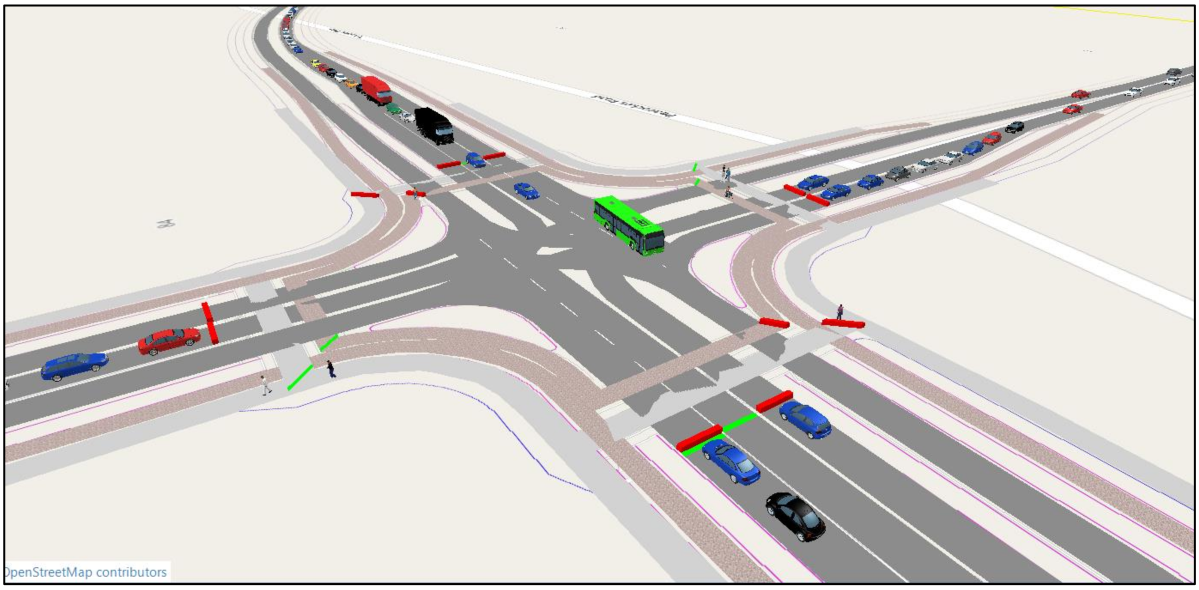


Figure 36: 2041 AM Peak Peacockes Road / Weston Lea Drive intersection, looking South

Table 8: Peacockes Road / Weston Lea Drive East Signalised Intersection – 2041 AM Peak

Approach Road Movement	Level of Service	Av. Queue (m)	Mean Max. Queue (m)	PT Travel Time Delay (s)	Private Veh Travel Time Delay (s)
Peacockes Rd North					
Left	D	2.2	39	-	-
Through	C	2.2	39	68	29
Right	D	2.2	39	50	53
Peacockes Rd South					
Left	E	110	449	-	-
Through	E	110	449	64	74
Right	F	103	402	-	-
Peacockes Lane					
Left	F	92	245	173	183
Through / Right	F	3	29	-	-

Approach Road Movement	Level of Service	Av. Queue (m)	Mean Max. Queue (m)	PT Travel Time Delay (s)	Private Veh Travel Time Delay (s)
Weston Lea Drive E					
Left	F	0	11	-	-
Through / Right	F	91	218	-	-

8.4.1 AM Pedestrian and Cyclists delay

Pedestrian travel time and delay was measured from one corner of the intersection to the opposite corner, which captures the walk time and delay using two signalised crossings.
Walk distance = 105m. Average journey time is 134s, including an average delay time of 59 seconds.

Similarly, the travel time was measured for two protected cycle path routes around the perimeter of the intersection, recognising that the cycle paths allow clockwise travel only. The measured paths were Southbound Right Turn, and Northbound Right Turn. Both path lengths are 125m in total.

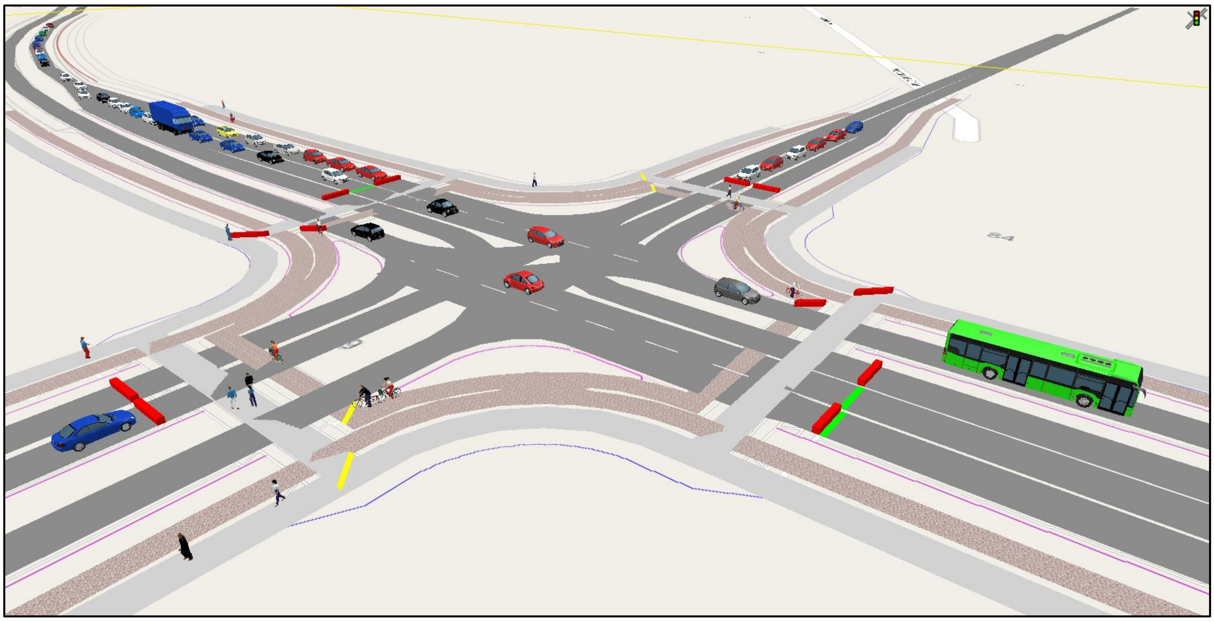


Figure 37: 2041 PM Peak Peacockes Road / Weston Lea Drive intersection, looking North.

Table 9: Peacockes Road / Weston Lea Drive East Signalised Intersection – PM Peak

Approach Road Movement	Level of Service	Av. Queue (m)	Mean Max. Queue (m)	PT Travel Time Delay (s)	Private Veh Travel Time delay (s)
Peacockes Rd North					
Left	D	60	360	-	-
Through	E	60	360	50	53
Right	D	64	335	85	59
Peacockes Rd South					
Left	D	3	46	-	-
Through	D	3	46	47	37
Right	C	0	0	-	-

Approach Road Movement	Level of Service	Av. Queue (m)	Mean Max. Queue (m)	PT Travel Time Delay (s)	Private Veh Travel Time delay (s)
Peacockes Lane					
Left	D	12	83	53	47
Through / Right	E	12	72	-	-
Weston Lea Drive E					
Left	F	1	9	-	-
Through / Right	F	55	132	-	-

8.4.2 PM Pedestrian and Cyclists delay

Pedestrian Average journey time is 138s, including an average delay time of 62 seconds.
For the cyclist southbound right turn, the average journey time is 144s including an average delay of 68s.
For the cyclist northbound right turn, the average journey time is 191s including an average delay of 120s.

8.5 Summary

The analysis was calculated based on conservative flow prediction scenarios for the 2041 AM and PM peak periods. The models show an indication of the expected performance of the two intersections once the Peacocke growth cell is fully completed.

Peacockes Road / Weston Lea Drive East intersection is the worst performing of the two intersections for general traffic flow. However, the design is based on prioritising safety and connectivity for pedestrians and cyclists followed by future bus services.

The results show that the intersection operates relatively poorly in terms of Level of Service for general traffic. The dominant flow direction in the AM Peak is northbound on Peacockes Road, which is LOS E with a maximum queue of 449m (75 veh) and an average queue length of 110m (18 veh). Buses do get caught in this queue as evidenced by the travel time delays. However, in most cases the bus delays are less than the general traffic.

The PM peak provides improved performance over the AM but is still LOS E overall.

To reduce the delay to buses would require very long bus lanes, or more through lanes on Peacockes Road in both directions. However, this would increase the delay to non-motorised transport, and reduce the safety for these modes by creating longer crossings giving more exposure to crashes with vehicles. So, the design represents the priority the HCC wishes to afford non-motorised and public transport.

9. Conclusions - Project Summary Table

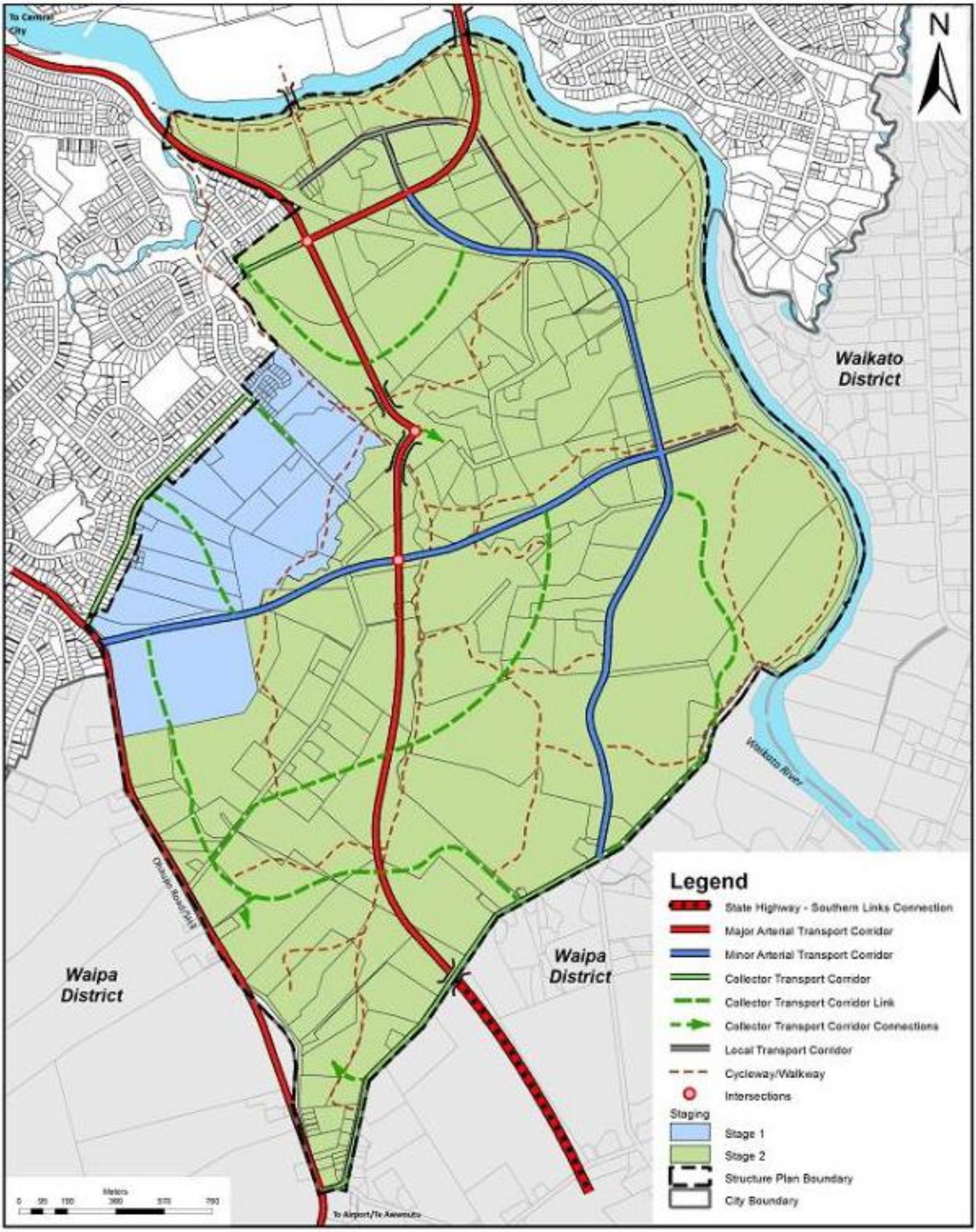
The following table provides an overview of where the relevant Designation Condition is addressed in this TNMP.

Designation Condition 24.1	Requirement	How addressed by project	Suggested Actions
Version	**Signature**	**Issue date**	
d	An updated Design Philosophy Statement that establishes the standards, philosophies and references for construction final design outcomes required to achieve the objective of the TNMP. This shall include the intersection design philosophy as a part of a whole-route approach to road and intersection management and operation	Refer to Section 1.4	None required
e	The localised traffic impacts together with accompanying mitigation measures required as a direct or indirect result of road closures, diversions, new intersection arrangements and other measures needed to accommodate the Project;	Refer to Section 3.2 No adverse impacts are envisaged on the local transport network as a result of this project. However, we note that existing traffic will need to be diverted onto an alternative corridor during the construction phase	Consider interventions to deal with existing issues that may be exacerbated by additional traffic. All road sections: Monitor traffic volume and introduce speed management if needed. Waterford Rd: Consider upgrade to Peacockes Road / Waterford Road intersection Peacockes Rd (btw Norrie Street and Waterford Road): Review pedestrian / cycling connectivity and investigate off-road connection along North-South corridor. Norrie Street: Investigate upgrade to Peacockes Road / Norrie Street intersection in the long-term.

Designation Condition 24.1	Requirement	How addressed by project	Suggested Actions
Version	Signature	Issue date	
			Bader Street: Adjust signal phasing to suit priority.
f	The provision of cycle infrastructure and the design of cycle features and whether they are consistent with current best practice guidelines;	Section 5 addresses current best practice guidelines, while section 5.1 to 5.7 addresses cycle infrastructure along the internal roads	None required
g	The provision of pedestrian infrastructure and whether the design of pedestrian infrastructure is consistent with current best practice guidelines;	Section 5 addresses current best practice guidelines, while section 5.1 to 5.7 addresses cycle infrastructure along the internal roads	None required
h	Consideration of staged bus service infrastructure	Refer to Section 6	Respond to WRC and HCC service proposals when available.
1	Bus priority detection equipment at all signalised intersections along the route;	Refer to section 6.1 – Figure 24 Prioritising bus movement at the signalised intersection through the aid of bus detector loops and early-start signals for buses.	None required
2	Bus stopping lay-bys at appropriate locations along the route;	Refer to section 6 - Figure 23 Buses will stop within the lane while passengers are boarding and alighting as this will improve safety and efficiency for public transport	Review requirements after outcomes from WRC PT working paper are finalised and agreed upon.
3	Passenger waiting facilities and shelters with bus information as part of the final road design; and	Refer to section 6 - Figure 23 Kerbside boarding along Peacockes Road were designed for universal accessibility	None required
4	Bus priority measures at all non-signalised, controlled intersections;	Bus stops are within the traffic lane on Peacockes Road rather than laybys, enabling buses to stay ahead of traffic and have a clear lane ahead after each stop. Refer to Section 6.	None required

Designation Condition 24.1	Requirement	How addressed by project	Suggested Actions
Version	**Signature**	**Issue date**	
i	The provision of pedestrian and cyclist connectivity to and from Hamilton Gardens and along the Waikato River and Peacocke gully system;	Refer to section 5 and 5.1. Waikato River Bridge paths integrate with existing paths to Hamilton Gardens	HCC to champion future opportunities to build upon connections provided in this project.
j	The provision of pedestrian and cyclist connectivity from areas west of the Peacocke North-South Major Arterial to areas east of the arterial in the vicinity of the Glenview Club.	This is outside the scope of work and will be dealt with in the next phase of Peacocke Strategic Network design	None required
24.2	Road Safety Audit for the relevant stage of the Project in accordance with NZ Transport Agency's Road Safety Audit (RSA) for Projects	Refer to section 4.7 A Detailed Design RSA has been completed, and there are no residual concerns to be addressed.	None required
24.3	Post Implementation Review (PIR) in accordance with NZ Transport Agency's PIR policy, having regard to the Project objectives and the objectives of the TNMP	Refer to section 4.8	Undertake RSA post-construction in 2023.

Appendix A – Peacocke Structure Plan Transport Network



To Central City
Waikato District
Waikato River
Waipa District
Waipa District
Ohaupo Road/SH3
To Airport/Te Awamutu
N
Legend
State Highway - Southern Links Connection
Major Arterial Transport Corridor
Minor Arterial Transport Corridor
Collector Transport Corridor
Collector Transport Corridor Link
Collector Transport Corridor Connections
Local Transport Corridor
Cycleway/Walkway
Intersections
Staging
Stage 1
Stage 2
Structure Plan Boundary
City Boundary
Meters

Appendix B – Design Philosophy Report

Hamilton City Council

Peacocke Development
Design Philosophy Statement

Contract Number:
PSP 17482 - Peacocke Strategic Transport

Document Control

Project Identification	
File Path	Synergy12d://10.7.120.14/145900 - Peacocke Strategic Transport/97 Deliverables/Design Philosophy Statement
Project Manager	Jeremy Gibbons
Organisation	Bloxam Burnett & Olliver Ltd 4th Floor, 18 London Street, Hamilton 3204
Project Name	Peacocke Development
Document Name	Design Philosophy Statement
Applicable Contracts	PSP 17482 – Peacocke Strategic Transport
Project Numbers	145900

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6	Dave Morton	CMW Geosciences (NZ) Ltd, Tauranga	PDF
7	Adrian Morton	Adrian Morton Landscape Architect, Hamilton	PDF
8	Simon Chapman	Ecology NZ	PDF
9	Grant Edwards	Edwards White Architects	PDF

Document History and Status					
Version	**Updates**	**Prepared**	**Reviewed**	**Approved**	**Issued**
V1	Draft Report	Jeremy Gibbons	31/7/19	2/8/19	2/8/19
V2	Final Report – includes comments from HCC	Jeremy Gibbons	N/A	N/A	15/10/19

Table of Contents

1 Introduction

1.1 Purpose of Design Philosophy Statement

This Design Philosophy Statement (DPS) documents the scope, standards and assumptions that will apply to the development of the Detailed Design for Peacocke Strategic Transport (PST).

1.2 Report structure

Section 1 of this report introduces the design philosophy at a high level, including a description of the general project scope.

The PST will be designed in accordance with the design references (standards and guidelines, approved departures and outcomes of previous safety audits) listed in Section 2.

Specific design criteria and assumptions for each element of the design are described in Sections 3 to 17.

Appendix A of this report includes a set of drawings that present an update to the latest project scope and help describe the design philosophy and scope describe within the content of this report.

Appendix B includes a copy of the Environmental Mitigate Statement, which summarises the specific environmental measures/aspects that need to be taken in to account when developing the detailed design. Where necessary, the relevant standards and design requirement have been reflected within the content of this Design Philosophy Report.

Appendix C includes a copy of the Environmental and Social Responsibility (ESR) screen, prepared in accordance with Z/19.

1.3 Abbreviations

The abbreviations used throughout this Detailed Design Philosophy Statement are presented in Table 1.3.

Table 1.3
Abbreviations

Abbreviation	Description
AEE	Assessment of Environmental Effects
AEP	Annual Exceedance Probability
AGRD	Austroads Guide to Road Design
BBO	Bloxam Burnett & Olliver (consultant company leading the project team)
CLMP	Concept Landscape Management Plan
CPTED	Crime Prevention Through Environmental Design
D&C	Design and Construct
DBC	Detailed Business Case
DoC	Department of Conservation
EMMP	Environmental Management and Monitoring Plan
Ha	hectare
HCC	Hamilton City Council
HCV	Heavy Commercial Vehicle
HGL	Hydraulic Grade Line
HIF	Housing Infrastructure Fund
HOV	High Occupancy Vehicle
HPMV	High Productivity Motor Vehicle
ITS	Intelligent Transport System
ICMP	Integrated Catchment Management Plan

Table 1.3 Abbreviations	
Abbreviation	**Description**
LOS	Level of Service
NDD	Normal Design Domain
m	Metre
NIWA	National Institute of Water and Atmospheric Research
OGPA	Open graded porous asphalt
ONRC	One Network Road Classification
PGAR	Preliminary Geotechnical Appraisal Report
PHGA	Peak Horizontal Ground Acceleration
PST	Peacocke Strategic Transport (relates to work undertaken as part of PSP 17482)
PVGA	Peak Vertical Ground Acceleration
RITS	Regional Infrastructure Technical Specifications
RMA	Resource Management Act 1991
RRPM	Reflective Raised Pavement Marker
SAC	Structural Asphaltic Concrete
SAR	Scheme Assessment Report
SID	Safety In Design
SSSHA	Site Specific Seismic Hazard Assessment
NZTA	New Zealand Transport Agency (the Transport Agency)
TLA	Territorial Local Authority
TWWG	Tangata Whenua Working Group
vpd	Vehicles per day
vph	Vehicles per hour
WRC	Waikato Regional Council
WRTM	Waikato Regional Transportation Model

1.4 Design development

This Preliminary Design Philosophy Statement will form the basis for development of the Detailed Design and Project Specification/Principal's Requirements (as necessary).

Further to the Instruction for Service (IFS) Contract Scope, Section 6.8, the Design will:

- Develop the Preliminary Design to achieve compliance with the conditions of statutory approvals.
- Illustrate the required scope, character and form of the project.
- Prove the constructability and viability of the project.
- Ensure that consent requirements have been identified so that all necessary consents can be obtained by Hamilton City Council (HCC) prior to construction.
- Appropriately respond to and/or address issues identified in any road safety audit.
- Address Safety in Design principles and Vision Zero Approach principles.
- Consider issues related to constructability and access for construction (i.e. address how the project will be constructed, not just what will be constructed).
- Identify design standards that attract significant cost for little benefit and recommend outcomes that offer best value for money.
- Identify and rigorously challenge 'no-go' design elements and undocumented minimum requirements in consultation with HCC.
- Be developed to a stage sufficient to enable a reliable Cost Estimate to be produced.
- Be developed to a stage where significant risks to the successful delivery of the project have been identified and treated and included in the cost estimate.

1.5 Scope of works

This Design Philosophy Statement is based on the following project scope:

- Bridge over Waikato River – this will be a landmark structure that will also be required to transport utility services across the river.
- Pedestrian/cycle bridge over Wairere Drive on the north bank of the river.
- 1,600m extension of the Hamilton Ring Road.
- An upgrade of the existing Peacockes Road from rural to urban, complete with all utility services.
- An upgrade of the existing Weston Lea Drive from rural to urban, complete with all utility services.
- Intersection of the Hamilton Ring Road with Peacockes Road.
- Intersection of the Hamilton Ring Road with the future north-south arterial.
- Three new stormwater treatment devices and discharges to stream and river.
- Approximately 1.6km of strategic water supply pipeline (from treatment plant to Wairere Drive).
- Approximately 1.7km of strategic wastewater pipeline (from Peacocke to Wairere Drive).
- Approximately 1,400m of new trunk wastewater gravity main.
- Approximately 3,000m of new trunk wastewater rising main.
- Approximately 1,525m of new trunk water supply pipeline.
- Utilities in the road corridor required to service adjacent land.
- Landscaping.
- Incorporating and providing for strategic utilities in construction documentation and drawings.
- Tie-in works.

Apart from the change in bridge form for the Waikato River Bridge and the specific arrangement of the road cross-section details and intersection forms, the scope of works described above is generally aligned with that discussed and recommended in the Scheme Assessment Report (Opus/AECOM 2013).

The tie-in of the works in order to integrate with existing or proposed future works are critical. The PST scope includes the following:

1) At the northern tie-in, the project ties-in to the new Wairere/Cobham Interchange currently under construction, just south of the westbound on/off-ramps.
2) At the western tie-in, the project includes the Ring Road/North-South Arterial intersection, the design for which needs to consider the optimal vertical alignment for the North-South Arterial to facilitate its future development. Road stubs will be provided on each intersection approach to enable future connection.
3) At the southern tie-in the project extends approximately 400m beyond the Peacockes Road/Peacockes Lane intersection to tie-in with the existing Peacockes Road cross-section. The design also needs to facilitate ease of future upgrade of Peacockes Road. As such, the design for the balance of the Peacockes Road will be advanced from the tie-in position to its intersection with the East-West Arterial to a level sufficient to ensure good project integration (approximately 30% to 50% design stage).
4) The tie-in of Peacockes Road (North) with the existing network (near the Water Treatment Plant) will be positioned as close to the North-South Arterial as practical so that further upgrading of the corridor is not required, but will also ensure that the future cul-de-sac (when the North-South Arterial is built) does not result in superfluous construction.
5) Weston Lea Drive (west).
6) Weston Lea Drive (east).
7) The tie-in with Peacockes Lane will occur as quickly as possible after its intersection with Peacockes Road. The position will ensure future upgrading of Peacockes Lane is not constrained.

These termination points are shown diagrammatically in Figure 1.5 below, including reference numbering to tie-in positions, as described above. Key issues to address at these tie-ins are:

- Continuity of design and operating speeds across the tie-in positions (i.e. wider urbanised cross-section with kerb and channel, leading to existing narrower rural road cross section with grass berms).
- Continuity of design strings in both vertical and horizontal context, including matters such as cross-over of stormwater management treatments and changes in access control.
- Ensuring temporary transitions are trafficable and robust (including for vehicles and active transport modes);

- Staging of works to keep the transportation network operational.
- Continuity of signage.

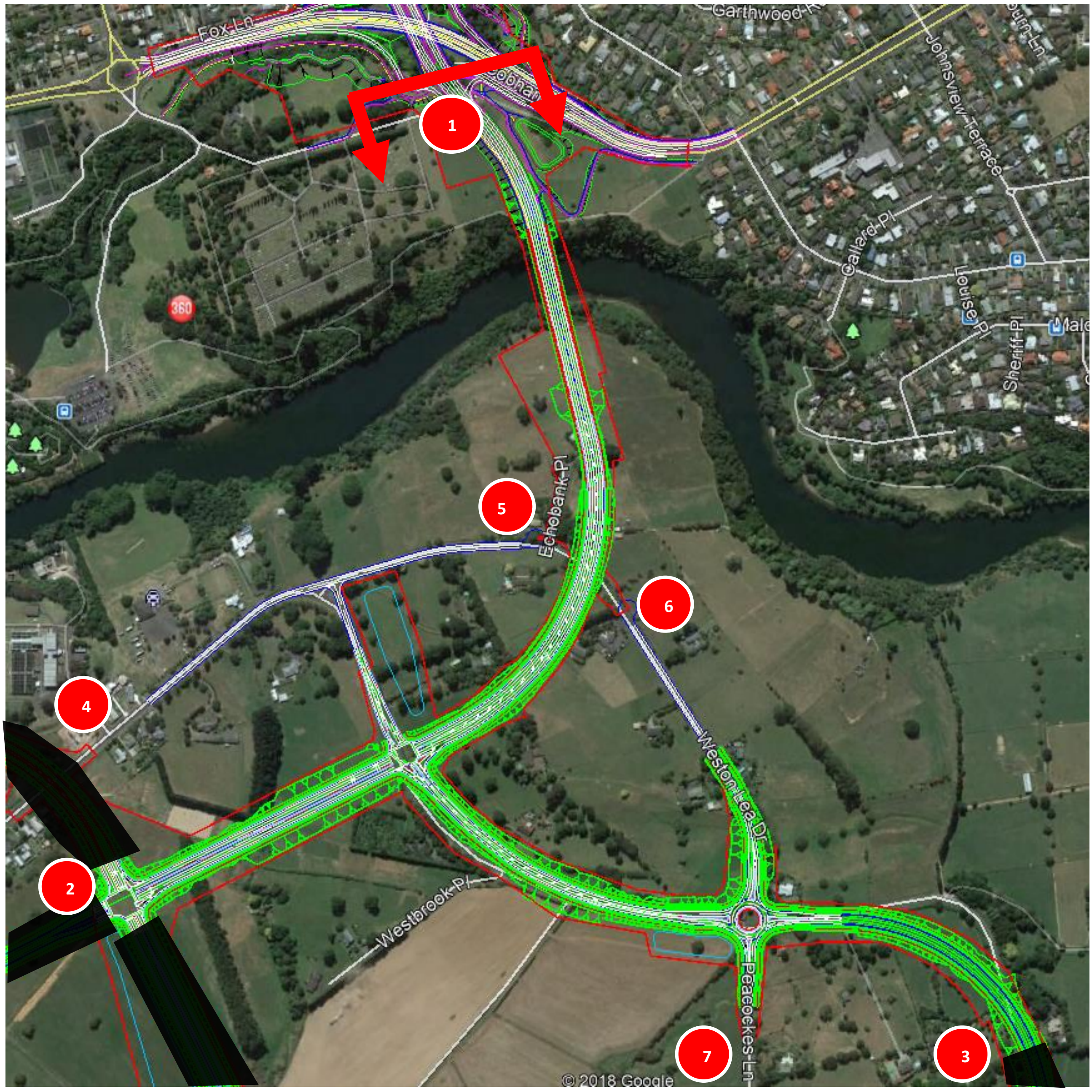


Figure 1.5: Location of tie-in positions on PST

2 Design references

2.1 Reference documents

The Detailed Design will be developed on the basis of the standards and guidelines listed in Table 2.1, specific documents identified in those reference documents as providing acceptable means of compliance, and specific standards detailed in the following sections of this Design Philosophy Statement.

Table 2.1
Reference Documents

Document	Source	Version
Geometric Design		
Guide to Road Design (all parts) using NDD values unless otherwise stated in this Design Philosophy Statement.	Austroads	current versions
Manual of Traffic Signs and Markings: Parts II & III	NZTA	
New Zealand On Road Tracking Curves for Heavy Motor Vehicles (RTS 18)	NZTA	2007
Regional Infrastructure Technical Specifications (RITS)	Waikato LASS	2018
Cycling Network Guidance: • Planning a cycling network • Designing a cycling facility	NZTA	Web version
Traffic Control		
Regional Infrastructure Technical Specifications (RITS) – Section 3.7 relating to Traffic Signals	Waikato LASS	2018
Land Transport Rule: Setting of Speed Limits 2017	MOT	2017
Speed management guide	NZTA	2016
Land Transport Rule: Traffic Control Devices	NZTA	2004
Traffic Control Devices Manual	NZTA	2011
Manual of Traffic Signs and Markings: Parts I, II & III	NZTA	
Guide to Traffic Management Series (all parts)	Austroads	current versions
Road Safety Barriers		
AS/NZS 3845.1 Road Safety Barrier Systems and Devices: Part 1	Standards NZ	2015
Standard Specification M/23, M/23 Notes and M/23 Appendices A and B	NZTA	current versions
Various Technical Memoranda relating to road safety barriers	NZTA	current versions
Various Technical Advice Notes relating to road safety barriers	NZTA	current versions
Various RSB Standard Drawings relating to road safety barriers	NZTA	current versions
Bridge Manual	NZTA	Third Edition Amendment 2
Guide to Road Design (Part 6)	Austroads	current versions
Drainage		
Stormwater Treatment Standard for State Highway Infrastructure	NZTA	2010
Highway Surface Drainage A Design Guide for Highways with a Positive Collection System	NZTA	1977
Technical Memorandum TM-2502: Preferred method for calculating road surface water run-off in New Zealand	NZTA	2014
Guide to Road Design (Part 5)	Austroads	current versions
Regional Infrastructure Technical Specifications (RITS)	Waikato LASS	2018
Climate Change Effects and Impacts Assessment A Guidance Manual for Local Government in New Zealand	MfE	2008
Stream Crossings (LM05)	TM	
Hydrological and Hydraulic Guidelines	TM	2012
Hydraulic Design of Energy Dissipaters for Culverts and Channels (FHWA HEC14)	USDOT	2006
Design of Roadside Channels with Flexible Linings (FHWA HEC15)	USDOT	2005
Evaluating Scour at Bridges (FHWA HEC-18)	USDOT	2012

Table 2.1 Reference Documents		
Document	**Source**	**Version**
Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition, Volumes 1 and 2 (FHWA HEC-23)	USDOT	2009
Debris Control Structures, Evaluation and Countermeasures (FHWA HEC-9)	USDOT	2005
Bridge Scour (Melville and Coleman), except where superseded by HEC-18, HEC-23, and HEC-9	WRP	2000
Roughness Characteristics of New Zealand Rivers	NIWA/WRP	1998
Standard Specifications F Series (for drainage materials and construction)	NZTA	current versions
Fish passage guidance for state highways	NZTA	2013
NZTA P46 Stormwater Specification	NZTA	2016
Earthworks		
Bridge Manual (for stability of cut and fill batter slopes)	NZTA	Third Edition Amendment 2
Structures		
New Zealand Building Code	MBIE	current versions
Bridge Manual	NZTA	Third Edition Amendment 2
Road Research Bulletin 84, Volume 2 Seismic Design of Bridge Abutments and Retaining Walls	NZTA	1990
Technical Report 97-022 Method and Recent Developments in Research using both SPT and CPT Data	NCEER	1997
CPT and SPT Based Liquefaction Triggering Procedures	Boulanger and Idriss	2014
Research Report 553 The Development of Design Guidance for Bridges in New Zealand for Liquefaction and Lateral Spreading Effects	NZTA	2014
AS 4678 Earth Retaining Structures	Standards Australia	2002 with amendments to 2008
NZS 3101 Concrete Structures Standard	Standards NZ	2006 with amendments to 2008
AS/NZS 1170.2 Structural Design Actions – Wind Actions	Standards NZ	2011 with amendments to 2013
NZS 1170.5 Structural Design Actions – Earthquake Actions	Standards NZ	2004
AS 2159 Piling Design and Installation	Standards Australia	2009 with amendments to 2010
Road Research Unit Bulletin No. 70: Creep and Shrinkage in concrete bridges	NZTA	1984
Bridging the Gap: Urban Design Guidelines	NZTA	2013
Protective coatings for steel bridges: a guide for bridge and maintenance Engineers	NZTA	2014
TAN #17-09 Verification testing of steel materials	NZTA	2017
Pavements		
Guide to Pavement Technology (all parts)	Austroads	current versions
New Zealand Guide to Pavement Structural Design	NZTA	June 2017
Regional Infrastructure Technical Specifications (RITS)	Waikato LASS	2018
Chip Sealing in New Zealand	NZTA	2005
Standard Specifications B, M, P and T Series (for pavement and surfacing materials and construction)	NZTA	current versions
TAN #17-01 (for roundabout asphalt depth)	NZTA	current version
Landscaping and Urban Design		
NZTA Landscape Guidelines (Final Draft) September 2014	NZTA	2014

Table 2.1 Reference Documents		
Document	**Source**	**Version**
New Zealand Urban Design Protocol	MfE	2005
Bridging the Gap: NZTA urban design guidelines	NZTA	2013
Guide to Road Design (Part 6)	Austroads	current versions
Regional Infrastructure Technical Specifications (RITS)	Waikato LASS	2018
Standard Specification P39	NZTA	2013
Acoustics		
Guide to assessing road-traffic noise using NZS 6806 for state highway asset improvement projects	NZTA	2011
Guide to state highway road surface noise	NZTA	2014
State highway noise barrier design guide	NZTA	2014
State highway construction and maintenance noise and vibration guide	NZTA	2013
State Highway Guide to Acoustics Treatment of Buildings (Draft)	NZTA	2015
Environmental Plan (Section 2.1 Noise)	NZTA	2008
Street Lighting		
AS/NZS 1158 Lighting of Roads and Public Spaces	Standards NZ	2005 with amendments to 2015
Standard Specification M/26	NZTA	2012
Standard Specification M30	NZTA	2014
Regional Infrastructure Technical Specifications (RITS)	Waikato LASS	2018

2.2 Approved departures

No departures from HCC's mandatory and advisory standards are currently held for PST. However, departures may be submitted for the approval of HCC as development of the Detailed Design proceeds.

2.3 Safety audits

A Road Safety Audit for the Preliminary Design of the entire Southern Links Project was undertaken in 2012 by AECOM/Opus. This audit identified a number of safety issues/concerns that needed to be addressed or considered in subsequent design phases. Given the scale of the Southern Links project many of the issues raised were at a relatively high level and covered philosophical issues that would normally be addressed through standard design refinement. As such, those issues are not repeated here. However, in respect to specific issues relating directly to this project, the following matter was identified, which will be addressed as part of the Detailed Design for this project:

- Unsheltered right-turn bays at intersections along Peacockes Road.

For clarity, as a minimum a Road Safety Audit will be sought at completion of the Detailed Design (i.e. prior to construction), and immediately following completion of construction (post-construction audit). These reports, including designer responses to audit comments, will be submitted to HCC Transportation team for decision-making.

2.4 Building Consents

No building consents have yet been sought from Hamilton City Council. A dispensation for the building consent relating to the Waikato River Bridge (specifically) will be sought in accordance with Building Act 2004, Schedule 1, part 1, section 2(a).

2.5 Environmental and social design statement

The PST corridor is a designated route that is covered by one set of overarching designation conditions. In addition, there is currently one resource consent for the project that covers the bridge to be constructed over the Waikato River.

The specific conditions of the designation and/or resource consent have not been repeated in this document, but can be referred to in detail within Sections 9 and 10 (and Appendix F) of the PST Background Report.

In short, the construction of the PST project is expected to be constructed and operated in a way that is at least environmentally neutral. That is, the vegetation to be removed is of minimal environmental significance and there will be no net long term effects on the corridor or any waterway, including the Waikato River. As a result, the project requires a number of environmental mitigation measures for vegetation, fauna, and aquatic habitats disturbed by the completion of the works.

Appendix B of this report includes an Environmental Mitigation Statement (EMS). This is a document that identifies the actual and potential environmental effects associated with the PST project, and then describes the means by which those effects will be mitigated through detailed design. The EMS takes into account the design, designation and consent objectives for the PST as well as a preliminary Environmental and Social Responsibility Screen (Appendix C) used to identify high level themes and issues. Where relevant, the specific scope and standards that relate to the mitigation have then been incorporated within this design philosophy document.

3 Design criteria and assumptions - Geometric design

3.1 Over-arching design approach

The approach to design for this project adopts a number of relatively new concepts which seek to change the focus from designing for cars towards designing for an improved human-centric outcome. While these concepts could be against more traditional car-centric outcomes, they have been agreed (and supported) by Hamilton City Council and associated key stakeholders.

In summary, the design philosophy governing the geometric design for mid-block sections (i.e. between intersections) includes:

- Adopting Vision Zero: A transportation system with features to minimise the risk of deaths and serious injuries.
- Promotion of public transport and encouraging active (and alternative[1]) modes, if necessary, at the expense of reduced performance of the network from the point of view of (low occupancy) private car users.
- Maximising the people moving capacity of the road, by enabling efficient use of the network by busses and high occupancy vehicles.
- Providing flexibility in the design to cater for evolutionary and step changes in the transportation system.
- Working within the designation boundaries secured as part of Southern Links project, without alterations (unless pursued under non-notified processes).

3.2 Cross sections

3.2.1 Ring Road extension

Traffic volumes on the Ring Road Extension are predicted to be approximately 22,000vpd by 2041 (based on Traffic Modelling Report by Opus/AECOM). This indicates that peak traffic flow rates will be in the order of 1,100 vehicles per hour in each direction, which represents approximately 60% to 70% of the theoretical capacity of a single lane. Therefore, one operational traffic lane in each direction is sufficient from a capacity point of view. In comparison to other bridges in Hamilton City, this also represents a relatively high level of operational traffic service. For example, Cobham bridge has a single lane in each direction and currently has a traffic volume of 31,000 vpd.

The terrain is relatively flat so the eventual design will not result in vertical grades that affect truck speeds to the extent that an additional lane would be required.

Hamilton City Council (HCC) has expressed a desire to set a very high level of service for public transport operations in the Peacocke Development area. As such, they have requested that a dedicated traffic lane is provided to serve public transport vehicles, although use by other High-Occupancy Vehicles (HOV) may be an option that HCC will consider in the future.

Accordingly, a median divided urban arterial road with four continuous lanes is to be provided (this is consistent with the outcome from the HIF DBC). This shall be made up of (in each direction) one lane for general traffic and one lane for public transport (and potentially HOV vehicles).

Active modes will be accommodated by separate paths on each side of the road for pedestrians (2.0m width) and cyclists (2.5m width). In addition, the kerb side lane (bus lane) will be 4.2m wide to provide road space for cyclists that choose to use the vehicle carriageway.

3.2.2 Peacockes Road

Traffic volumes on Peacockes Road (in the section between the East-West Arterial and Ring Road extension) are predicted to be approximately 21,000vpd by 2041 (based on Traffic Modelling Report by Opus/AECOM), corresponding

[1] Such as: e-bikes, e-scooters, wheelchairs etc

to an approximate peak flow rate of 1,100 vehicles per hour in each direction. This is similar to the traffic flow rate of the Ring Road Extension, but, with a Minor Arterial status, it will have a lower level of service as a result of side friction from adjoining accesses, local road intersections, parking, bus stops and pedestrian crossings.

While a multi-lane carriageway would be necessary to maintain optimum levels of service for car-based operation, HCC has expressed a desire to reduce reliance on private vehicles and encourage the use of public transport and active modes. As such, the recommendation is to have a separated cycle lane and one traffic lane in each direction, with the traffic lane shared by cars and public transport vehicles.

To improve safety and efficiency for public transport vehicles, bus stops will not be indented into the roadside. Instead, busses will stop within the lane while setting down and picking up passengers. Operational levels of service for cars on this carriageway will be reduced (to LOS E during peak periods[2]) as a result. However, the advantage is that public transport vehicles can operate more efficiently and safely as they do not have to enter and leave the traffic stream at each stop and overall the safety and people moving capacity of the road corridor will be increased.

To facilitate access to adjoining properties and accommodate turning lanes (where needed) for local road intersections, the carriageway will include a 3.0m wide flush median. In addition, 2.3m wide (parallel) parking bays will be included in the cross-section at strategic locations. The parking locations will be progressively discussed and agreed with HCC transportation staff during the detailed design phase.

Active (and alternative) modes will be accommodated by a 2.0m wide off-road path on each side, and 2.3m wide on-road cycle lanes that are separated from the vehicle lane with raised “zebra/armadillo” separators.

3.2.3 Other local roads

Low volume (<5,000vpd) local road cross sections will have a single lane in each direction and no median. Footpaths will be provided on both sides (unless specific constraint requires provision only on one side[3]). Bicycles will use the vehicle carriageway.

3.2.4 Cross section dimensions and details

Cross-section dimensions and details are presented in Table 3.2.4. Refer also to the Concept Drawings in Appendix A.

Table 3.2.4
Cross-section Dimensions & Details

Element	Proposed Standard	Comments
Shoulder widths: a) Ring Road Extension b) Other roads	 0.0m 0.0m	 Refer to Note 1.
Median Widths: a) Ring Road Extension b) Peacockes Road c) Low volume local roads	 1.2m 3.0m 0.0m	 The width is measured between centres of the edge line markings.
Traffic lane widths: a) Ring Road Extension (LH lane) b) Ring Road Extension (RH lane) c) All other roads	 4.2m 3.3m 3.5m	 Refer to Note 2. The width is measured from the centreline of the markings and to the face of kerbing.
Footpath: a) Ring Road Extension	 2.0m	 Both sides. Refer to Note 3.

[2] LOS E on an urban corridor represents an operating condition that is relatively congested and close to capacity (V/C of around 80% or higher). Flow rates becomes irregular and speeds rarely reach the posted limit during peak periods. For intersections, delays for LOS E operating conditions could exceed 55 seconds/vehicle.
[3] No such constraints have been identified to date

Table 3.2.4 Cross-section Dimensions & Details		
Element	**Proposed Standard**	**Comments**
b) Peacockes Road c) Low volume local roads	2.0m 1.5m	Both sides. Both sides (unless only required on one side).
Off road cycling facilities: a) Ring Road Extension b) Peacockes Road c) Low volume local roads	 2.5m 2.5m None	 Refer to Note 3.
On road cycle lane: a) Ring Road Extension b) Peacockes Road c) Low volume local roads	 None 2.5m None	 Refer to Note 1. Refer to Note 4. Cyclists use the vehicle carriageway.
Normal crossfall	3.0%	
Super elevation	None	All roads are crowned at the centreline.
Berms and utility strips	Various	Refer to Concept Drawings in Appendix A.
Note 1: Although there is no edge line to create a marked shoulder, the Ring Road Extension has a wide kerbside lane to provide road space for on-road cyclists.		
Note 2: The LH lane width is 4.5m on the Waikato River Bridge because of the proximity of the edge barrier.		
Note 3: On the eastern side of the Waikato River Bridge, a single 3.5m wide shared path is provided, rather than separate footpath and cycleway.		
Note 4: A 0.6m separator strip is included in addition to the 2.5m cycle lane.		

Consideration has been given to having a 3.0m wide median on the Ring Road Extension to accommodate the possibility of a future rail service (such as light rail). However, the PST Background Report reviewed this requirement and recommended that any future light rail service (if installed in the future) would be better served within one of the other traffic lanes (such as the bus lane), without any operational detriment. A wider median would have no significant other benefit. Safety benefits would be minimal (particularly if a median barrier is installed) and there is no intention to have a raised or planted median.

3.2.5 Waikato River Bridge cross section

On the Waikato River Bridge, separate 2.0m wide footpath and 2.5m wide cycle paths are provided on the western side, although separation is provided by delineation (e.g. line marking or change in surfacing) rather than a utility corridor to reduce the overall bridge width. A single 3.5m wide shared path is provided on the eastern side, again, to reduce the overall bridge width.

There is a vehicle barrier on the bridge separating the vehicle carriageway from the off-road cycle path (a landscape strip provides separation between the vehicle carriageway and off-road cycle path on the standard ring road cross section). The width of the left hand traffic lanes on the bridge has therefore been increased by 0.3m compared with the standard Ring Road cross section, to provide on road cyclists with the equivalent amount of road space at handlebar height as they have on the standard Ring Road cross section with no barrier.

Fencing to provide safety from falling for pedestrians will be provided on the outside edge of the structure. This is expected to be integrated with architectural features on the edge of the bridge.

3.2.6 Road safety barriers

Median barriers are not proposed to be installed on mid-block sections of any of the roads. With a proposed speed limit of 60km/h on the Ring Road, median barriers are arguably not required to meet Vision Zero objectives. However, the proposed flush medians on the Ring Road and Peacockes Road would not prevent median barriers from being installed in the future, albeit, for the Ring Road, to reduced standards with respect to shy line offset and sight distance on curves.

Roadside barriers are proposed for the Waikato River Bridge and approaches, and any other locations where the roadside hazard risk may be unacceptable, such as adjacent to roadside retaining walls and steep batters.

Roadside hazards such as street trees will be protected with barriers where necessary, although the design philosophy will be to minimise the need for barriers by providing sufficient offset to trees and managing vehicle speeds.

3.2.7 Kerbing

Any kerbing positioned immediately adjacent to where cyclists normally ride will have a mountable profile, which will reduce the risk of pedal strike. In addition, catch-pits adjoining carriageway that may contain cyclists shall (wherever possible) be recessed behind the kerb and not positioned out in the cycle lane.

The minimum grade for kerb and channel will be 1:300. On vertical curves where the tangent grade is less than 1:300, kerb and channel will either be eliminated by the design (less preferred) or additional catch pits will be provided to prevent ponding of water against the kerb (preferred outcome).

3.2.8 Utility corridors and berms

The location of utility corridors and berms (landscape strips) is shown on the Concept Drawings in Appendix A. The location of utility strips and berms has been chosen to provide:

- Separation of the footpath from the boundary at vehicle entranceways (to improve inter-visibility).
- Separation between footpaths and cycle paths.
- Separation between paths and the vehicle carriageway, so that path crossfalls and grades are not affected by vehicle crossings.

3.2.9 Stormwater drainage assets

Road drainage will generally utilise kerb and channel with pit and pipe systems to convey road runoff to stormwater treatment and/or detention systems located outside the transport corridors.

3.2.10 Batter slopes, fences and boundaries

There is an expectation that adjoining land will be progressively developed (for residential purposes) and result in substantial reshaping of the contours immediately adjoining the transport corridors to maximise development potential. As such, cut and fill slopes are likely to be refined as knowledge of adjoining development profiles are known and/or retrofitted in due course if/when development occurs. In the interim, the cut and fill batter slopes will be largely optimised for the transport corridor (in the first instance) in order to keep the footprint within the designation boundary. Exceptions to this approach will be on a case-by-case basis and determined on a win-win outcome for both HCC and the adjoining landowner.

Therefore, fill batter slopes will typically be 2:1 or flatter (to enable interim grazing), with stockproof fences located a minimum of 1.0m behind the formed (usable) cross-section (i.e. outside the utility corridor and/or pathways as appropriate). The area between the formed cross-section and the stockproof fence will be designed for ease of maintenance.

Given the acquisition process already underway it is possible that the legal boundaries will not initially follow the fence line position. As such, retrospective land disposal (and/or update to legalisation surveys) may be undertaken to optimise the position of the legal boundary outside of any stormwater drainage assets and cycle paths (so that these assets are within the road reserve), and ideally at the tops of fill slopes to minimise the residual road reserve footprint.

In cut situations the stock proof fence will generally be located at the top of the batter until future development contours are known. However, like above, there is an expectation that eventual legal boundaries will be optimised to retain HCC assets within the road reserve, but ultimately seeking to minimise the residual road reserve footprint. Cut slopes will typically be 2H:1V, subject to satisfying geotechnical demands.

3.3 Geometric design parameters

3.3.1 Speed Parameters

Proposed speed limits and design speeds are presented in Table 3.3.

Table 3.3 Speed Parameters and Locations			
Section	**Location**	**Design Speed**	**Posted Speed Limit**
Ring Road extension	Wairere Cobham Interchange to North-South Arterial	70km/h (horizontal) 60km/h (vertical)	60km/h
Peacockes Road	Ring Road Extension to Peacockes Lane	50km/h	40km/h[4]
	Peacockes Lane to southern tie-in	60km/h	50km/h[4]
	North of Ring Road Extension	50km/h	40km/h[4]
Weston Lea Drive	North of Ring Road Extension	50km/h	40km/h
	South of Ring Road Extension	50km/h	40km/h

Elsewhere on the Ring Road speed limits of up 80km/h are currently in use, although this varies along its length and is proposed to be 60km/h on approach the the Cobham-Wairere Interchange (immediately north of this project). Use of a 60km/h speed limit is proposed for the Ring Road extension covered within this project, to enable consistency of control, and the approach to lowered speed environments is in keeping with Vision Zero goals. A 60km/h speed limit should limit 85th percentile speeds to around 70km/h, reducing the risk of death and serious injury in the event of head-on and runoff road crashes (when compared to 80km/h posted speed limits with 85th percentile speeds around 90km/h). Posting lower speed limits without positive reinforcement may not result in the desired lowering of operating speeds. In response, there are a number of factors that will positively contribute to the desired outcomes (of controlling speeds) and/or additional approaches that could be undertaken to reinforce/enforce compliance with posted speeds, such as:

- Proximity to major junctions (Cobham-Wairere Interchange and Ring Road/Peacocke Road roundabout) will likely break up trip momentum to encourage lower journey speeds
- Only two lanes will be used by general traffic (other two lanes will be PT dedicated), which will increase vehicle interaction and result in less free-flow conditions
- A major feature within the Ring Road Extension is the Waikato River Bridge, which incorporate a narrowed cross-section and TL-5 concrete barriers. This (somewhat) constrained environment will help control the higher operating speeds.
- Geometric design features should be focused at the lower spectrum of design speeds to help encourage a lower speed domain within the area. For example, the use of adverse crossfall and lower range horizontal/vertical curves will set a speed environment that is more comfortable at lower speeds.
- If needed, lane widths could be narrowed from the optimal width and/or inclusion of painted chevrons within shoulders to help reinforce a narrowing effect to encourage lower speed environment.
- The use of speed actuated vehicle approach speed signs could be readily incorporated within the corridor to promote better speed management. Similarly, the use of speed cameras could be readily included to help with speed enforcement.

In response to the above, the proposed design speed on Ring Road Extension for horizontal geometric design is 70km/h, being 10km/h greater than the proposed speed limit (in accordance with AGRD guidelines), whilst the design speed for vertical geometry is 60km/h rather than 70km/h. This outcome will result in a number of significant cost savings in relation to the vertical design of the Waikato River bridge (and approach works) whilst not significantly affecting the safety outcome of the corridor. In simplest terms, the difference in road safety for a change from 70km/h to 60km/h in the vertical context is not as significant as it would be for a compromise in the horizontal geometric design. For example, the vertical design is governed by sight distance requirements to a 200mm high object (opposed to 0m object height) and in an urban environment the occurrence of objects on the carriageway is low and collisions with small objects

[4] In the future, any locations of high pedestrian/cycle activity is expected to have a lower speed limit of 30km/h (such as town centre and outside any schools). These lower speed limits could be controlled by variable messaging.

seldom result in deaths or serious injuries. Equally, the provision of a multi-lane corridor on Ring Road Extension also enables greater opportunity for manoeuvring around objects (into adjoining carriageway) if they are not observed until the last available chance. This outcome is discussed further within Section 3.3.7 below.

3.3.2 Sight distance

Sight distances will be based on the AGRD desirable minimum normal design domain values for all parameters, including a reaction time (alert) of 2.0 seconds and coefficient of longitudinal deceleration of 0.36g.

3.3.3 Design vehicles

All road alignments and intersections will be checked for the turning movements of an HPMV (modelled using an 18m semi-trailer per LTNZ RTS 18, with a dimension of 9.4m from king pin to rear axis of trailer). Bridge design will cater for the standard 'Highway Normal' HN and 'Highway Overload' HO components of the loading regime as defined in the Bridge Manual published by the Transport Agency.

For clarity, and in accordance with RTS 18, the urban city bus has characteristics most similar to those of a "large rigid truck" design vehicle, so this design vehicle has been used to represent the "design bus" for this project.

3.3.4 Design vehicle clearances

The preferred minimum clearance (wheel-track to kerb and body to furniture) will be 1.0m, with the geometric design of the carriageway providing an absolute minimum clearance of 0.6m. Transverse location of design vehicles used for bridge design will satisfy the requirements of the Bridge Manual published by the Transport Agency.

3.3.5 Over-dimensioned vehicles

Although desirable given the increasing use of pre-fabrication in residential building construction, HCC has confirmed that these transport corridors do not need to make specific provision for over-dimensioned vehicles. This is because there is no specific provision for over-dimension vehicles on Wairere Drive. In

3.3.6 Horizontal alignment

Design of the horizontal alignment will be in accordance with AGRD, Part 3, Section 7. Super-elevation is not being provided for the local roads within this project scope.

In general, minimum horizontal curve radii will likely be driven by limitations of effects from adverse crossfall. The starting position for minimum curve radii shall therefore be:

- 300m for the Ring Road Extension (70km/h design speed).
- 200m for Peacockes Road south of Peacockes Lane (60km/h design speed).
- 130m for most other local roads (50km/h design speed).

Broken Back horizontal curves may be applied on low speed alignments (less than 50km/h posted speed) in order to realise value for money solutions. However, the use of broken back curves shall not be a starting point for the design.

The horizontal alignment will be similar to the Scheme Design but with some refinement to the horizontal curves to accommodate the constraints of the property footprint, help resolve geotechnical constraints, provide value for money solutions, and to ensure compliance with designation and consent conditions.

3.3.7 Vertical alignment

Design of the vertical alignment will be in accordance with AGRD, Part 3, Section 8.

Required vertical clearances to structures and utilities are given in Sections 8 and 15.

All road corridors will be designed to ensure the carriageways are not impassable by a 1% AEP design flood event.

All road corridors will include street lighting, so comfort criteria will govern the design of sag curves.

The vertical alignment will be similar to the Scheme Design but with some refinement to the design to accommodate the constraints of the property footprint, help resolve geotechnical constraints, provide value for money solutions, and to ensure compliance with designation and consent conditions. As such, (as discussed in Section 3.3.1 above) the design speed in the vertical context of Ring Road Extension is intended to be the same as the posted speed limit, opposed to 10km/h above (as per the approach in the horizontal context). The following table has therefore been prepared to compare the relative difference in outcomes for arrange of factors when comparing a 60km/h and 70km/h vertical design speed, respectively.

Table 3.4
Effects on geometric outcomes for various input geometric conditions

Design speed	Deceleration rate	Reaction time	Object height	SSD	K-value reqd	Comments
60km/h	0.36g	1.5s	0m	64m	18.8	Heightened reaction
60km/h	0.36g	2.0s	0m	73m	24.0	Ideal operation
60km/h	0.36g	2.5s	0m	81m	29.8	Slow reactions
60km/h	0.46g	2.0s	0m	64m	18.7	Max deceleration rate
60km/h	0.23g	2.0s	0m	95m	41.0	Slow deceleration rate
60km/h	0.36g	2.0s	0.2m	73m	11.8	Standard object height
70km/h	0.36g	1.5s	0m	83m	31.1	Heightened reaction
70km/h	0.36g	2.0s	0m	92m	38.9	Ideal operation
70km/h	0.36g	2.5s	0m	102m	47.5	Slow reactions
70km/h	0.45g	1.5s	0m	72m	23.6	Max decel rate and heightened reaction
70km/h	0.23g	2.0s	0.2m	123m	33.7	Slow deceleration rate
70km/h	0.36g	2.0s	0.2m	92m	19.1	Standard object height
	Denotes conditions better than normal					
	Denotes conditions less than ideal					

Therefore, to minimise the volume of earthworks and the height of retaining walls and fill embankments, vertical curve K values will generally be based on Austroads desirable minimum values. For the Ring Road Extension, this includes K(min) =12 for crest curves and 6 to 10 for sag curves.

3.4 Property accesses

New property accessway/entrances will be provided for every individual lot that adjoins the new road construction. Where possible, the newly formed entranceway will coincide with the current entrance position, However, diversion of some accessways may be necessary to integrate the entrance to new works whilst still achieving necessary design standards.

The design will seek to contain any realignment of accessways within the available designated footprint. Where this is not possible further discussion will be undertaken by the affected landowner to reach a suitable outcome, and where necessary seek the necessary license to occupy to complete those works.

The standard of any new/realigned accessway will match the condition of the existing access, whilst considering any requirements relating to new pavement materials/surfacing/grades/curvature/vehicle types/drainage etc, in accordance with the RITS. Expectations are for the access to comply with the RITS within the road boundary (including designation), whilst accepting there may be a need for temporary/staged development, and ultimately adopting the existing accessway condition as soon as practicable within the private property. The details of these outcomes will be discussed with the affected landowner.

4 Design criteria and assumptions – Intersections

4.1 Over-arching design approach

As with the geometric design for mid-block sections, HCC has provided clear direction on the philosophical approach to design for the PST intersections, which is now described and documented below:

Intersection forms shall respond to the following requirement (in decreasing levels of importance):

- Achieving Vision Zero safety objectives.
- Encouraging active modes.
- Public transport prioritization.
- Car efficiency.

This design approach leads to a logical hierarchy as a starting point for determining the intersection forms along the major and minor arterial roads, although there may be constraints that modify the preferred form at particular sites.

4.2 Hierarchy of intersection forms

Of utmost importance is consideration of personal harm. Therefore, grade separation of all vehicle conflicts and conflicts between modes is most desirable. Where full grade separation is not practicable then the most vulnerable users should be grade separated and the number of remaining conflict points should be minimised. Lastly, the risks from the remaining conflicts should be minimised.

This approach leads to the following intersection form hierarchy. The starting point for selecting the form of an intersection should be at the highest level, with decisions about practicability being made before moving to the next (lower) level in the hierarchy:

1. Grade separation of all movements.
2. Roundabouts with grade separation for active modes.
3. Signalised intersections with grade separation for active modes. Vehicle speeds to be managed through use of raised platforms on the approaches, or tables across the whole intersection.
4. Signalised intersections with signalised crossings for active modes. Vehicle speeds to be managed through use of raised platforms on the approaches, or tables across the whole intersection.
5. Roundabouts with "build-outs" (or similar) provided for active mode crossings being made at-grade.
6. Signalised intersections with signalised crossings for active modes. No physical control of vehicle speeds.
7. Priority controlled (Give Way) intersections.

In all cases above, public transport will be given priority at intersections, such as advanced start at signals, bus lane prioritisation at roundabout approaches, or via bus stop design/positioning at preceding stops as described in Section 3.2.2 and as per details shown in Figure 13.9.

During the detailed design process, the consideration of this intersection form hierarchy will be tested for each relevant intersection within PST. Outcomes from this assessment (and the relative benefits, dis-benefits, and risks) will be documented within design memorandums to enable informed decision-making. Where outcomes require a trade-off (such as significant impacts on operational performance, significant additional costs, or potential impacts on project programme) these decisions will be elevated to HCC Governance for endorsement and ultimate decision-making.

4.3 Intersection operational performance

Each intersection will be modelled using appropriate traffic modelling software to help optimise lane arrangements and for reporting of operational performance. Models of other intersection forms may be built to test practicality and to help inform the decision-making required in Section 4.2 above.

While traffic efficiency may not be the deciding factor in selecting intersection forms, the operational performance may be an important aspect to communicate with various stakeholders so there are no surprises once the infrastructure is built and operational. Performance criteria will be documented, including average delays, queue lengths, volume/capacity ratios and levels of service.

5 Design criteria and assumptions - Drainage

5.1 General design philosophy

Sheet 145900-001A-0202 of Appendix A illustrates the general intent of managing stormwater for the PST project. In summary, all stormwater from the carriageway will be collected (by channel and/or kerb & channel) and reticulated to a treatment stormwater device (typically wetlands) before discharging to natural watercourses. In some constrained locations the use of rain gardens may be needed, however widespread use of swales (for conveyance and/or treatment) is not feasible within the designated footprint or aligned with the ultimate long-term urban development of the area.

5.2 Design life

The design life of all stormwater infrastructure will be 100-years.

5.3 Design events

The various elements of the drainage system will be designed for the design events presented in Table 5.2.

Table 5.2
Drainage Design Events

Element	Design Event	Criteria
Surface drainage for Arterial Roads	10% AEP 1% AEP	At least 2.5m of the left-hand traffic lane to have no encroachment of stormwater flow. At least one lane to remain passable and flow depth <150mm deep and velocity <1.0m/s.
Surface drainage for Local roads	To meet RITS System Design requirements	
Piped drainage infrastructure	10% AEP	HGL must not be higher than 1.0m below the finished carriageway level or, where pipe cover is 1.0m or less, ½ the distance between top of pipe and finished carriageway level.
Cross culverts	5% AEP	Culvert must convey the design event without the flow reaching the soffit or obvert.
Cross culverts	1% AEP	Must convey flow in a manner that does not result in increased flooding outside of the designation. Ponding behind the culvert embankment to be <1.0m above the soffit, or less if necessary, to prevent scour due to high water velocities around the culvert entrance and exit.

The Detailed Design will be developed using rainfall information acquired through the NIWA High Intensity Rainfall Design System 4 (HIRDS 4) for the site location and fitted to the 24-hour rainfall distribution from TP-108.

The design event flows will consider the effects of climate change, as required by the RITS.

5.4 Cross culverts

Culverts crossing will be installed to generally maintain the existing drainage patterns. This approach avoids risks arising from modification of existing drainage routes.

Culverts will be sized based on catchment areas, assessed runoff, existing drain capacity and RITS requirements.

Where settlement of fill embankments will be significant, temporary culverts may be installed during construction, with the permanent culverts being installed after 90% of consolidation settlement has occurred.

Where culverts need to provide for fish passage, they will be designed according to NIWA – New Zealand Fish Passage Guidelines, April 2018.

5.5 Carriageway surface drainage

The design will provide sufficient inlet capacity to meet the levels of service in Table 5.2.

Catch pits will be detailed to be safely traversable by cyclists and to carry HN-HO-72 vehicle wheel loading.

Consideration will be given in the reticulation and treatment system design to omitting the need for sumps in catch pits, thereby avoiding the need for sump cleaning.

Grated inlets to piped stormwater systems will have a bypass that enables the inlet to remain effective should the grate become clogged with debris.

Manholes will be located clear of the carriageway and preferably in locations where they are safe to inspect and maintain without traffic control.

5.6 Stormwater run-off from bridges

A positive collection system will be provided on all bridges. Stormwater from the vehicle carriageway will drain through slots in the barriers then beneath the cycle and pedestrian paths (which are elevated on pedestals so there is a large void beneath) to a channel at the edge of the bridge. The channel is expected to run the full length of the bridge and discharge to off-bridge piped reticulation and ultimately to a treatment system. The bridge drainage channel will be shrouded by the proposed architectural panels on the sides of the bridge.

5.7 Stormwater treatment

All runoff from road carriageways will be treated to achieve 70% removal of suspended solids from water quality rainfall events (1/3rd of the 2-year/24hr storm). Natural systems are proposed for treatment of carriageway stormwater runoff.

The preferred method of stormwater treatment is via wetlands, although others treatment options will be considered such as bio-retention. Infiltration will also be considered where applicable to help maintain base flow in the Mangakōtukutuku Stream.

5.8 Stormwater attenuation

Attenuation will be provided for the treatments devices that discharge into existing gullies and drains. Attenuation will not be needed for the devices that discharge directly into Waikato River.

5.9 Integrated Catchment Management Plan (ICMP)

HCC is preparing an Integrated Catchment Management Plan (ICMP) for the overall Peacocke Development area. To date, the prime focus of the Peacocke ICMP has related to stormwater management, and specifically identification of (developed) sub-catchment boundaries, identification of preferred location of treatment devices, and identification/confirmation of where opportunities exist to coordinate the stormwater management devices for ultimate development needs with those devices proposed as part of PST works.

The detailed design for stormwater treatment devices on PST project are expected to be completed well in advance of finalizing the Peacocke ICMP. However, the general philosophy of the ICMP is already known and these have been incorporated into the design principles for PST wherever possible. In general, this includes:

- Adoption of assumed sub-catchment boundaries defined by the ICMP
- Post-development stormwater inflow volumes to be accommodated within shared devices (i.e. water to be received in addition to PST project)
- Adoption of preferred form of (shared) stormwater treatment devices

- Defining the respective contribution of footprint for stormwater devices between wider development and those from PST directly (to allow discussion about cost-share etc)
- Agreement on position of outlets from stormwater treatment device
- Adoption of preferred outfall details and arrangements as developed by the ICMP (where outfalls do not already exist)

HCC have indicated a desire to design and construct all stormwater management devices that combine the needs of both PST and ultimate development needs. This embraces the purpose of the ICMP and directly aligns with one of the overarching project objectives for facilitating early development, where possible. Where the combined solution results in works outside the designated footprint; significantly increased project scope (and cost); delays to starting the PST project works - then HCC may decide to separate stormwater requirements to cater for PST project alone. If this occurs, the design intent is to arrange the devices so they can be readily adapted in the future if/when needed.

6 Design criteria and assumptions - Earthworks

6.1 Design loads

The Peak Horizontal Ground Accelerations (PHGA) and associated earthquake magnitudes used for seismic design at the Damage Control Limit State (DCLS) shall be taken from the magnitude-unweighted data included in the supplied Site-Specific Seismic Hazard Study, but seismic demands are not to be less than 70% of those derived from the Transport Agency *Bridge Manual*, Section 6 using key parameters presented in Table 6.1.

Table 6.1 NZS 1170.5 parameters for Peak Horizontal Ground Accelerations at DCLS	
Factor	**Class D: Deep or soft soil**
$C_{0,1000}$	**0.28**
Slopes associated with bridges	
AEP	1:2500
R_u	1.8
Magnitude	5.9
Slopes not associated with bridges but supporting the PST carriageway	
AEP	1:1000
R_u	1.3
Magnitude	5.9

AEP identified in Table 6.2 shall also be used when selecting PHGA and Magnitude combinations for DCLS design from the Site-Specific Seismic Hazard Study. Seismic actions other than at DCLS shall be obtained by modifying Return Period Factor R from R_U as tabulated above to suit different AEP requirements as defined in the Bridge Manual published by the Transport Agency.

Designs shall be checked for potential liquefaction, including settlement, deformations and lateral spread, where appropriate. Liquefaction analyses will be undertaken to a depth of 20m.

6.2 Factors of Safety

Cut and fill slopes will generally adopt the following factors of safety:

- Long term embankments and cuts: F > 1.5
- End of construction embankments: F > 1.3
- Temporary conditions for cuts and fills: F > 1.2
- Seismic design case for cuts and fills: F > 1.1

Due to the rapidly reversing nature of earthquake loading, factors of safety less than unity will be accepted for the worst-case seismic design situation, provided the failure is not sudden or catastrophic and resulting displacements are assessed as being manageable.

Models will be developed for all critical fill embankments. The model will take account of both stability and settlement.

In situations where the conventionally adopted factors of safety prove uneconomic, specific factors of safety may be determined using a risk-based approach and proposed to the Transport Agency.

6.3 Seismic Performance Requirements for Earthworks

Seismic performance requirements for earthworks associated with bridges or other structures will satisfy the performance requirements for those bridges or other structures.

Seismic performance requirements for earthworks not associated with bridges or other structures will (if practical) satisfy the requirements of NZTA Bridge Manual Table 6.1 and associated text. Such a solution represents the preferred standard.

Where the requirements of Table 6.1 (and associated text) are identified to require substantial cost, particularly for ground improvement, to achieve Table 6.1 criteria, then:

- Alternative solutions will be identified which offer enhanced cost-effectiveness in conjunction with less demanding performance requirements.
- Technically compliant and alternative proposals will both be developed and submitted to HCC for consideration and selection of an acceptable solution. The material submitted to HCC will include performance expectations for each potential solution, couched in terms of Bridge Manual Table 6.2 and associated text.
- The solution accepted by HCC will be presented as part of the Detailed Design.
- Any compromise of Table 6.1 requirements implicit in the selected solution will be carefully drafted to define the minimum acceptable standard.

This proposal reflects the HCC's expressed preference to adopt a risk-aware rather than risk-averse stance under such circumstances, in the interest of providing technically appropriate cost-effective engineering solutions to such projects. This proposal mirrors the approach proposed by BBO for other recent contracts.

6.4 Batter Slopes

Design of cut and fill batter slopes will consider factors including:

- Designation and property boundary constraints.
- Local and global slope stability.
- Constructability.
- Effects on cut and fill balance.
- Drainage design.
- Resistance to erosion.
- Proposed landscape treatments.
- Maintenance cost and safety.
- Size of the road footprint.
- Final location of stock fences and opportunities for grazing.

Batter slopes steeper than 2:1 will be avoided where possible. If they cannot be avoided, specific consideration will be given to landscape treatments to avoid failure due to slumping of topsoil and vegetation.

6.5 Fill Sources and Spoil Disposal Sites

In general, there is an expectation that there will be an excess of cut material from this project. However, the quality of the cut material for various uses as structural fill needs to be confirmed. As such, there is still a potential need to identify a suitable fill source and there is a definite need for a local disposal site.

Potential sources and disposal sites will be identified with suitable locations and sufficient capacity to efficiently accommodate Detailed Design earthworks. This could include consideration of land areas in the vicinity of the project, or potentially looking to balance earthworks with other associated projects being undertaken in the wider Peacocke Development area (for example East-West Arterial).

Due to the expected high moisture content and sensitivity of many of the soils to be won from excavation to design levels, the earthworks design will be conservative regarding the assessment of quantities of materials suitable for use as structural fill. Assumptions regarding spoil disposal requirements will also be conservatively based.

Adjacent landowners will be consulted regarding the best way to rehabilitate areas disturbed by the works in order to maximize the productive capacity and future sale value of the land.

7 Design criteria and assumptions – Ground improvements

7.1 Ground improvements design

The design will provide for ground improvements at the abutments of proposed bridges if necessary, to satisfy the requirements of Section 6.2 above.

The need for ground improvements beneath the PST embankments will be assessed during design development, considering:

- Achievement of overall serviceability requirements for the bridges and embankments post design event.
- Value for money.
- The availability of alternative routes and the rapidity with which repairs could be affected.

It is proposed that the Detailed Design will present an optimized set of ground improvement extent and type and standard beneath the PST embankments and at other specific locations, and that this data is used as a standard against which any alternative tender ground improvement solution is compared and evaluated.

8 Design criteria and assumptions - Bridges

8.1 Design life

The design life for all bridges will be 100 years.

8.2 Design loads

Pertinent design loads include all individual load cases and load combinations prescribed by the Transport Agency Bridge Manual.

8.2.1 Live Loads

Traffic loads will conform to the HN-HO-72 load regime, including the 1.35 load factor on HN loads at SLS as required by the current edition of the Transport Agency *Bridge Manual*.

Live loads for pedestrian bridges will be 5kPa.

Allowance will be made for loads expected to be imposed by utility services as identified in consultation with utility service operators and HCC as territorial local authority. These requirements will be documented and accommodated in the Detailed Design bridge proposals.

8.2.2 Flood Loads

Ultimate Limit State flood conditions for bridges over waterways will include log collision loading, considered as a CO load in Transport Agency *Bridge Manual*, Table 3.2, Case 3C without concurrent traffic loading.

Ultimate Limit State flood conditions for bridges over waterways will also include debris loading, considered as an additional FW load applied subsequent to the log load specified above, as defined in Transport Agency *Bridge Manual*, Table 3.2, Case 2C (i.e. concurrent with floodwater pressure and buoyancy loads with scour, and concurrent with HN traffic loading).

8.2.3 Seismic Loads

The design Damage Control Limit State (DCLS) horizontal ground accelerations shall be derived from recommendations of the Site-Specific Seismic Hazard Study supplied. Horizontal ground accelerations adopted for any limit state shall be no less than 70% of values for that limit state which have been determined from the Transport Agency *Bridge Manual* in conjunction with NZS 1170.5 for the specific site location and exposure, using key parameters as presented in Table 8.2.3A.

Table 8.2.3A
NZS 1170.5 parameters for "Design-level" Horizontal Ground Accelerations at DCLS

Factor	Class D: Deep or soft soil
AEP (River Bridge)	1:2500
AEP (Pedestrian bridge)	1:500
R_u	1.8
Z	0.16
N (T,D)	-
S_p	1.0

When developing seismic demands for structures using the weighted data provided by the Site-Specific Seismic Hazard Study (SSSHS):

- The AEP parameters tabulated above are to be used in conjunction with spectral shapes provided by the Study when developing "design-level" DCLS seismic demands.
- Collapse-avoidance limit state seismic demands (CALS) appropriate to major earthquakes are to be taken as 150% of "design-level" DCLS seismic demands unless otherwise recommended by the SSSHS.
- Serviceability limit state seismic demands (SLS) appropriate to minor earthquakes are to be taken as 25% of "design-level" DCLS seismic demands unless otherwise recommended by the SSSHS.

When developing seismic demands for structures using the weighted data provided by NZS 1170.5:

- All parameters tabulated above are to be used in conjunction with the spectral shapes in NZS 1170.5, Table 3.1 and Figure 3.2 when developing "design-level" seismic demands.
- CALS seismic demands are to be taken as 150% of "design-level" DCLS seismic demands.
- SLS seismic demands are to be taken as 25% of "design-level" DCLS seismic demands.

Bridge design will be developed on the basis that:

- Both liquefied and non-liquefied soil conditions will be considered in combination with inertial loading acting on the seismic weight of the bridge.
- The effect of lateral spread resulting from liquefied soil conditions will be considered as a stand-alone "post-earthquake" load case.
- Lateral spread will not be considered as concurrent with inertial loading as a composite "during-earthquake" load case unless the percentage of the DCLS or CALS hazard at the site due to magnitude 7.5 or larger earthquake is estimated by the SSSHS to exceed 20% (refer Bridge Manual Clause 6.3.5 iii).
- Consecutive "design-level" DCLS earthquake events will be considered.
- A single major CALS earthquake event will be considered.

The performance requirements for various seismic events are presented in Table 8.2.3B.

Table 8.2.3B
Seismic Performance Requirements

Seismic Event(s)	Performance Requirements
Repeat minor SLS event	As specified in *Bridge Manual*, Table 5.1 for minor SLS earthquake (R = 25% R_u; approximate AEP (River Bridge) = 1:100) Nil ductility demand Nil permanent displacement
Single DCLS event	As specified in *Bridge Manual*, Table 5.1 for design level DCLS earthquake (R = 100% R_u; AEP (River Bridge) = 1:2,500, AEP (Ped Bridge) = 1:500)
Repeat DCLS event	As specified in *Bridge Manual*, Table 5.1 for major CALS earthquake (R = 100% R_u; AEP (River Bridge) = 1:2,500, AEP (Ped Bridge) = 1:500)
Single CALS event	As specified in *Bridge Manual*, Table 5.1 for major CALS earthquake (R = 150% R_u; approximate AEP (River Bridge) = 1:10,000)

8.3 Displacements

The design will be developed on the basis that:

a) Compliance with the displacement limits specified in Transport Agency *Bridge Manual*, Sections 6.1.2 and 6.6.9 and Table 6.1 is not required, other than satisfying the upper bound of specified permanent displacements. Where upper bound permanent displacements are presented for varying hazard factor Z then the limits nominated for hazard factor Z ≥ 0.4 will be satisfied. Upper bound displacement limits will be regarded as total displacement limits which are acceptable following earthquake, irrespective of whether they result from:

- Inertial effects and/or soil movement.
- Liquefied and/or non-liquefied soil conditions.
- Compounding effects of concurrent and/or consecutive seismic events.

This proposal is more conservative than some expressed design opinion that permanent displacement limits apply to each of these situations if considered separately. It is however less conservative than adopting the permanent displacement limits specific to hazard factor Z, reasoning that there appears to be little justification for tailoring ***quantitative*** permanent displacement performance requirements to seismic exposure providing that the ***qualitative*** performance requirements for the various nominated limit states as outlined in b) to d) below are satisfied. HCC acceptance of this approach is sought:

b) Nil-damage is the summary performance requirement under exposure of a structure to the one or more Minor (SLS) earthquake event.

c) Survival is the summary performance requirement under exposure of a structure to either a single Major (CALS) earthquake event or duplicate Design-level (DCLS) earthquake events.

d) Performance requirements for the intermediate single "Design-level" (DCLS) earthquake event are to some extent negotiable: the preferred and target standard is satisfaction of Transport Agency Bridge Manual, Table 5.1 criteria, but the potential to optimise cost and programme with modest departures from these criteria is recognised. Formal HCC acceptance of any such departure will be sought.

Permanent displacements will be assessed using three methods under liquefied soil conditions and three methods under non-liquefied soil conditions. All conclusions will be reported together with comment on the applicability of each method, and this set of data will be used to formulate judgment-based design recommendations.

8.4 Vertical clearances

The basic minimum soffit level for any bridge over a waterway will be set at 1.20m above AEP 1:100 flood level in accordance with Bridge Manual clearance criteria where the flood level assessment shall include for the effects of climate change. Vertical clearance under exposure to flood is not expected to represent a significant challenge for this project, but the basic minimum soffit level will only be reduced if assessment of potential debris load in any catchment upstream of the bridge justifies a reduction in freeboard from 1.20m to 0.60m, subject to HCC acceptance.

Assessment of climate change effects will if possible be based on data and guidance sourced from the Waikato Regional Council and supplemented by information provided from Mercury Energy (operating the Waikato Dam system). If such data is insufficient to support a credible analysis then flood levels will be assessed based on flood assessment without consideration of climate change effects, but with waterway discharges increased by 20%, or such greater allowance as may be required by the Waikato Regional Council.

The basic minimum soffit levels for the pedestrian bridge over a road carriageway will be set at (minimum) 5.3m vertical clearance above the finished carriageway level, over the full width of the carriageways between barrier faces and any required working widths beyond. This level is based on the Bridge Manual requirement for pedestrian bridges being 200mm greater than adjacent traffic bridges. In setting this basic minimum soffit level HCC have accepted that it provides a reduced standard (from that required for over-dimension vehicles) and is based on vertical clearances provided elsewhere on the route (such as 5.1m vertical height at the Cobham Drive Bridge on Wairere/Cobham Interchange); and there being an efficient alternative route for over-dimension vehicles elsewhere on the network.

Navigation clearance for the Waikato River Bridge is satisfied by virtue of the bridge soffit being 19.5m above the 1% AEP river level. This is higher than the soffit of the adjacent Cobham Bridge downstream.

8.5 Horizontal clearances

The minimum horizontal clearances for bridges crossing road carriageways are to satisfy Transport Agency *Bridge Manual* Figure A-4, with the "working width" beyond barrier face identified in Figure A-4 satisfying the dimensional requirements of *Bridge Manual* Clause 3.4.18 vii.

As directed by HCC, minimum horizontal clearances for each specific bridge will not cater for over-dimension vehicles passing under or over that bridge.

Pier and abutment positions for the Waikato River Bridge have been developed in consultation with stakeholders and will comply with resource consent conditions.

8.6 Cross-section

8.6.1 Minimum Dimensions

Cross-sections for carriageways carried by each proposed bridge will satisfy the minimum dimensions in Sections 3.2.4 and 3.2.5.

8.6.2 Edge Barriers

Edge barrier systems mounted on bridges will be tailored to the requirements of user groups.

T80HT and PA HT F-profile rigid concrete barriers with oval steel top rails are recognised by Bridge Manual Table B2 as providing the preferred means of achieving a high TL-5 standard of protection for vehicle traffic, and their 1270mm height between top of steel rail to top of surfacing is recognised by Bridge Manual Clause B6.6 as being generally acceptable for cyclist protection. Hence T80HT or PA HT barrier systems are proposed at the edges of traffic lanes/carriageways.

Where bridge width includes pedestrian and cycle paths located beyond the carriageway then it is proposed that the outer edge of the path will be equipped with a barrier system which satisfies:

- The requirements of Bridge Manual Clause B6.4 for both pedestrians and cyclists.
- Building Code safety from falling requirements, including requirements specific to structures frequented by small children.

All barriers on bridges will be designed on the basis of conventional overstrength philosophy to protect the deck structure supporting the barrier in the event of the barrier being overcommitted under collision loading.

On-bridge barriers will transition to off-bridge barrier systems in accordance with standardised barrier transition systems such as those developed by Texas DoT for Texas HT / T80HT systems, recognising the need to cater for other demands such as:

- Longitudinal load imposed by semi-rigid approach barriers as nominated by *Bridge Manual* Table B4, but not greater than the overstrength of the least robust element of a standard Transport Agency approved anchorage detail.
- Steel rail continued beyond bridge abutment to the position where the barrier without rail satisfies Building Code safety from falling requirements; and adopting standardised rail terminations or other detail acceptable to the Transport Agency to avoid spearing hazards and other risks.

Barrier transition systems between semi-rigid and rigid barrier systems will be designed to resist TL-5 collision force normal to the barrier plane in conjunction with all concurrent retention actions, and other actions such as those identified above, but need not be designed for flexural overstrength of the barrier where doing so would risk damage to a more fundamental structural component.

This requirement for transition design is more demanding than general practice and is not achieved by many standard solutions, but it reflects recent Transport Agency requirements.

8.7 Aesthetics

Bridge aesthetics will satisfy the project-specific requirements of the Concept Landscape Management Plan (and ultimately the Landscape Management Plan, once prepared), but has been a significant element of consideration when developing the preferred structural form of the bridge.

Aesthetic priorities will impact on design choices for all elements, including superstructure and substructure form, and the detail of those forms. Further information on aesthetics is included within the description of architectural features specific to each of the bridges (i.e. Section 8.10.4 and 8.11.4).

8.8 Whole of Life

The required 100-year design life for all concrete structural elements will be achieved utilising appropriate combinations of concrete quality and cover. The use of supplementary cementitious materials will also be considered to provide enhanced durability without impacting adversely on creep/shrinkage behaviour. It is proposed that elements of bridge structure will be designed for one of the following exposure categories as summarized from NZS 3101 Table 3.1, and presented in Table 8.8 below.

Table 8.8
NZS 3101 (Table 3.1)

Surface and exposure environment		**Exposure classification**					
Exposure to seawater	Tidal / splash / spray						C
	Permanently submerged				B2		
Exposure to fresh water (soft water)	Running water					U	
	Water pressure					U	
	Water contact				B2		
Exposure to fresh water (other than soft water)	Running water				B2		
	Water pressure				B2		
	Water contact			B1			
Above-ground atmospheric exposure	Coastal frontage				B2		
	Coastal perimeter			B1			
	Inland		**A2**				
Exposure to ground contact	**Direct contact with non-aggressive soil**		**A2**				
	DPM protection from direct soil contact	A1					
Interior exposure	Repeated wetting & drying		A2				
	Fully enclosed following construction	A1					

It is proposed that Exposure Classification B1 will be used as the base standard for reinforced concrete design. This classification is more demanding than expected conditions (bold italics), but the substantial durability performance advantage which results is achievable at minimal cost increment.

Precast concrete elements may attract a less conservative Exposure Classification which satisfies code requirements, recognizing the potential for enhanced quality control.

It is proposed that the Detailed Design will adopt structural steel components. Weathering steel is currently under consideration for the main stringer beams, recognizing that the climate is suitable for weathering steel and recognizing the whole-of-life advantages resulting from the reduction in maintenance (particularly repainting) implicit in the use of weathering steel for components where ready access is not available. Weathering steel is also under current consideration for the relatively accessible pier stems and for secondary steelwork such as edge protection rails.

At this stage the use of conventional structural steel on exposed structural element is not envisaged. However, if its use is eventually required then all components which utilise (conventional) structural steel will satisfy the requirements of the Transport Agency document "*Protective Coatings for Steel Bridges*", with specific reference to:

- AS/NZS 2312: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, including macro-climate effects.
- HERA R4-133: New Zealand Steelwork Corrosion and Coatings Guide.

The above requirements will consider, address, and respond to potential matters of chemical/corrosion interaction between respective structural steel elements (e.g. unprotected weathering steel and reaction with conventional structural steel).

Tender documents will require compliance with *Protective Coatings for Steel Bridges* in respect of accreditation of applicators.

Tender documents will also require demonstration of the provenance of steel materials used in structural steel, reinforced concrete and pre-stressed concrete, including the requirement to satisfy TAN #17-09 "Verification testing of steel materials".

8.9 Low damage seismic bridge systems

A conventional approach to seismic design is proposed for the purposes of Detailed Design, considering both traditional force-based methods and the displacement-based methods introduced in the 3rd amendment of the 3rd edition of the *Bridge Manual* published by the Transport Agency. This approach recognizes that familiarity with force-based methods offers some advantages, and that displacement-based methods have been identified by the Transport Agency as preferred. Where conclusions of the 2 methods differ then the bridge design will cater for the envelope of the 2 methods.

8.10 Waikato River crossing

8.10.1 Design approach

The proposed bridge must address the substantial difference in existing ground level between the high north true bank and the low south true bank. The north true bank is very steep, and while ready construction access is available to ground at the top of the slope, access for foundation construction between top of bank and bottom of bank is not practical. The shallow angle of the south true bank provides good access for construction plant, although the founding soils are less robust than available at the opposite bank.

Design development to date has sought to keep permanent bridge elements, and construction activities beyond the river channel, recognizing that it is highly undesirable from a cultural perspective for construction to encroach on the channel. For the purposes of design, the river channel has been assumed to be defined by low winter flow levels. Whilst the existing bridge resource consent requires no permanent bridge elements within the river channel, some construction activities within the defined "low-winter flow level" may be unavoidable, in which case the Project team will work with the tangata whenua working group (TWWG) to agree on a suitable methodology (e.g. undertaken in periods of low flow/dry season etc), and will still be required to demonstrate how the activities can be undertaken in compliance with the requirements of the relevant resource consents.

The proposed bridge form comprises a 'Y'-profile pier at the south true bank; a major span extending over the river to the north true bank, and a major span of comparable length providing visual balance extending away from the river. Short approach spans beyond the major spans may offer technical and / or cost advantage and will be considered as part of detailed design.

The vertical alignment centerline lies in cut on the north true bank, but the upstream edge of the bridge will require local retention works. One focus of detailed design will be to balance the required height and extent of retention works, enhancement of stability of the steep slope of the north true bank, and the possibility of a short approach span. The solution adopted will need to demonstrate both technical competence and cost effectiveness.

Stability of the flat slopes at the south true bank appears less challenging, but the less robust surficial soils require careful assessment of bearing capacity for the mechanically stabilized (MSE) walls proposed at the abutment. Liquefaction of some subsoil layers (on the south bank) is anticipated, and the design of the central pier (and its foundations) will need to cater for the consequences, including adverse impact on stability and the potential for lateral spread caused by flowing materials. Close collaboration between structural and geotechnical designers is warranted and overlap of modelling of the critical soil-structure interaction is proposed.

Based on the initial assessment of the affected reach of the Waikato River, the central pier has been located outside the permanently wet footprint of the river (as defined by the low winter flow level). The location of the pier on the inside of the river bend makes potential scour at the pier less severe and relatively traditional scour protection is expected. On the northside of the river (on the outside of the river bend) there is a higher risk of natural ongoing scour. However, scour at this location is not expected to require any specific treatment to protect the bridge structure, although this will depend what slope stability treatment (if any) is adopted to enhance the global stability of the northern riverbank.

The anticipated height of the bridge will well exceed the estimated design flood level with well in excess of 1.2m freeboard requirement so is not a determining factor in the design of the structure.

Design goals, with regard to the potential impacts on the Waikato River:

- In the existing condition, the river and floodplain are very stable. The bridge design will be developed to maintain this geomorphic stability.
- The bridge design will minimise or avoid increases in upstream flood levels. At a minimum, the proposed bridge will be designed to avoid creating new flood burdens on landowners within and adjacent to the affected river reach.
- The proposed bridge will be designed to minimise the need for scour countermeasures in the river channel, as much as possible. By minimizing the need for scour countermeasures, environmental impact is also minimised.

8.10.2 Bridge deck drainage

The vehicle carriageway is expected to drain through slots in the barriers then beneath the cycle and pedestrian paths (which are elevated on pedestals so there is a large void beneath) to a channel at the edge of the bridge. The channel will run the full length of the bridge and discharge to off-bridge piped reticulation and ultimately to a treatment system. The bridge drainage channel is expected to be shrouded by the proposed architectural panels on the sides of the bridge.

8.10.3 Provision for inspection and maintenance

Abutments and piers will be readily accessible from ground level, although the height of the deck at the primary pier position will warrant careful consideration of stability of access plant. Consideration will be given to the provision of a permanent firm and level area at the pier which is suitable for supporting a scissor lift.

Conventional bridge inspection plant will give access to external faces of the outer stringer beams which are most exposed to environmental deterioration. Access will be available to the interior faces of all stringer beams will be available over the full length of the bridge, with entry points provided through one or both abutment walls.

Stainless steel sockets will be placed in the soffit of the reinforced concrete deck to facilitate access using roped access techniques or scaffolding over the full width of the bridge should such access be necessary.

8.10.4 Architecture

Section 11.4.1 (below) provides description of the five over-arching design principles that were established to act a as guide throughout the design process.

The architectural input for the Waikato River bridge aims to generate a cohesive and integrated user experience which brings together the practical and economic requirements of a successful structure, with an aesthetic that is both sympathetic to the landscape and natural environment, as well as being sensitive and responsive to the diverse cultural context in which it serves.

The following provides some specific context to the architectural elements that will be developed/refined during the detailed design phase.

a) MATERIALS

Desired Outcomes

To employ a versatile visual language with a consistent material palette that generates a cohesive aesthetic for the whole bridge and the wider project, introduces a humanely scaled level of detail, and makes reference to the important and relevant cultural context.

Chosen Material Palette

- Precast Concrete - Versatile, durable, commonly used in bridge construction, low maintenance, locally available. Large variety of finishes available.
- Corten steel - durable, low maintenance. Light relative to strength. Has an inherently textured surface.
- Timber – Durable, introduces a natural material with a softer tactile experience for the mixed-use space.
- Concrete Pavers - Durable, locally produced, introduces a humanely scaled module associated with urban design and landscaping.

b) SUPPORT STRUCTURE

Desired Outcomes

To create a support structure that visually reduces the mass of the overall bridge.

Figure 8.10.1: Concept illustration of the central pier (support structure) of the Waikato River Bridge

The Woven Column Structure and Plinth

- The crossing over of the Corten steel columns of the "Y" form provides a strong support system which allows the members to remain relatively fine and allows the structure to narrow at the waist and the flare out to meet the plinth.
- The plinth practically provides a solid base up to the level of the of the highest predictable flood level and prevents flood debris becoming tangled in the columns.
- Visually the plinth provides a solid mass for the relatively delicate columns to project from.
- This bridge occupies a beach that would once have been a place of trade between Maori and Europeans as goods moved up and down the river. The weave of the structure references the traditional Maori kete bag used

for the transport of locally grown produce traded along the river. It also makes a subtle reference to the weaving of cultures - both the historic coming together on the beach for trade, and the current cultural diversity that is enjoyed in Kirikiriroa.

- The structure employs the overall bridges' material palette of Corten steel and concrete.
- The concrete base provides an opportunity for a pattern relief referencing cultural motif and iconography and visually connecting it with other relief patterns elsewhere in the project.

South Abutment

- Small unitised precast concrete panels with relief or texture variation will be used to visually modulate the large vertical faces.

c) BRIDGE PATHWAYS (MIXED-USE)

Desired Outcomes

A safe and enjoyable space for pedestrians and cyclists to cross the river and have a meaningful visual experience of the Waikato river and other natural landscape features.

Figure 8.10.2: Concept illustration of the bridge pathway arrangement on the Waikato River Bridge

Spatial Approach

- Mixed used cycle way and pedestrian way to provide for a more flexible space allowing for a wider range of users;
- Space will be subtlety delineated using surface treatment and seating elements to encourage cyclists to use the space closest to the road and pedestrians closest to the balustrade.

Raised Mixed-Use Walkway

Figure 8.10.3: Concept illustration of the raised walkway on the Waikato River Bridge

- A raised path structure which sits above the main structural deck and allows water flow underneath.
- Allows for a flat structural deck providing long term flexibility for future use.
- Allows for storm-water collection at outside edge avoiding penetrations through structural deck.
- Provides a clean surface for pedestrian and allows road runoff to flow underneath.
- Allows for a higher level of perceived safety and therefore better user experience.
- Allows gradient of walkway to be independent of the road gradient and more comfortable for pedestrians.
- Allows for a wider range of surface treatments to pedestrian way.

Concrete barrier between motor vehicles and mixed used walkway
- Allows for walkway balustrade to remain lightweight with a high level of transparency.
- Protects pedestrians and cyclists and creates a safe environment for families with small children.
- Provides a greater perceived level of safety and therefore enhances pedestrian experience.
- Reduces driver distraction.
- Provides an opportunity for controlling storm-water runoff from road across pedestrian and cycleway.
- Moveable barriers provide flexibly for future configurations.

Balustrade and Handrail
- Uses thin vertical members to provide highest level of transparency and enhance user experience of the river.
- Good visibility through the barrier allow for the experience of children and people occupying the seating.
- Sloped surface to top edge is a climbing deterrent.
- Corten steel materiality ties into the other bridge components and is a low maintenance option.
- The extension of the balustrade verticals down past the bridge deck obscures the main bridge structure and provides an opportunity to manipulate the visual form of the bridge from below. The length of this extension is adjusted along the length of the bridge to visually fine up the centre.
- The fine grain detail of the balustrade adds a human scale to the mixed-use area. This references a visual language more ready associated with pedestrian orientated urban space that roading.

Seating and space indicating elements
- Provide a subtle visual distinction of space for walking or standing and a space for cyclists creating a safer experience for both.
- Create places to stop and rest or meet and greet or pause and connect with visual experience of the river and natural surroundings.
- Provide opportunity for lighting.
- Provides an opportunity to introduce more tactile objects and materials associated with landscaping or urban design rather than those which are more generally associated with roading.

Surface treatment

- Provides an opportunity to delineate spaces along the journey over the bridge and introduce a more human scale to its experience.
- Contributes to design of the space as a landscaped experience rather than simply a transport corridor.
- Provides an opportunity to subtly delineate the boundary between cyclists and pedestrians.

Lighting

- All lighting to be specifically focused and designed to reduce light spill and create a safer environment for the local native bat colonies.
- Large overhead lighting placed to the edge of the pedestrian way to allow for inspection vehicle access.
- Low lighting built into seating will provide surface illumination while preventing light spill.

Suicide prevention

- Suicide prevention was a strong consideration during the optioneering for the preferred structural form of the bridge. The preference for a single layer deck system (where pedestrians/cyclists/vehicles etc) were on the same platform level (meaning increased observations and activity) and within line of sight of each other was a positive outcome towards improving suicide prevention (increased human contact).
- Physical barriers to the outside of the bridge is provided on both sides of the structure to delay or stop suicidal acts. The edge treatment is expected to be developed so it has no intermediary rails within the barrier, except at the top of the edge treatment (being 1.4m in height) and having the barrier treatment being leaned inwards makes climbing of the edge protection more challenging.
- The top of the edge treatment will be angled (providing a pointed top edge) to make the barrier more difficult to stand on, and/or more uncomfortable to rest upon. This seeks to deter the final act of a potential suicide victim by increasing the resting period before jumping or enabling them to reconsider impulsive acts.
- The provision of lighting on the structure/pathways will make potential suicide victims more visible to others – allowing increased opportunity for contact to be made or reporting of behaviour to authorities. It might also deter those potential victims looking for “low-key” and/or dark areas to complete their act. There is also an opportunity to incorporate lighting arrangements that are more inspirational or motivational, which could be incorporated within the wider landscape/urban design features being accommodated elsewhere within the project. Where lighting is used, lighting columns will be positioned away from the edges of the bridges so that they cannot be used to help climb the edge barrier protection.

8.11 Pedestrian/cycle bridge (north of River)

8.11.1 Design methodology

The design philosophy for the pedestrian/cycle bridge is less advanced than that for the River Bridge. However, the structural form for the pedestrian bridge is expected to be light weight structural steel frames, supported by reinforced concrete or structural steel piers. Cable-supported structures are also being considered, but unlikely to be required from a structural demand (i.e. aesthetic outcome). Eventual structural form will be progressively optimized to meet both the aesthetic and cost criteria throughout the detailed design phase.

8.11.2 Bridge deck drainage

Stormwater runoff from this bridge will be allowed to sheet across the cross-section and conveyed to either end of the bridge by ponding against the edges of the bridge. No water will be allowed to run directly off the structure in an uncontrolled fashion. Any stormwater from this structure will be managed and connected to other stormwater management devices, as necessary.

8.11.3 Provision for inspection and maintenance

Abutments and columns will be readily accessible from ground level, although the height of the deck at the column connections will warrant careful consideration of stability of access plant. Consideration will be given to the provision of a permanent firm and level area at the columns, which is suitable for supporting a scissor lift.

Conventional bridge inspection plant will give access to external faces of the beams which are most exposed to environmental deterioration.

Roped access is not considered necessary.

8.11.4 Architecture

The design of the pedestrian/cycle bridge will celebrate the gateway/threshold between the two sides of the Waikato River by utilizing design features such as a Tomokanga/marker or threshold waharoa as integrated components of the bridge.

Desired Outcomes
To create a safe and enjoyable space for pedestrians and cyclists to cross the road. To capitalize on the opportunity to create memorable and meaningful marker for the entry point to the Peacocke area.

Figure 8.11: Concept illustration of the Pedestrian/Cycle Bridge (north side of Waikato River)

The "Pou" support structure

- Design of the tall vertical posts with the bridge crossing between makes a strong reference to the Maori "Tomokanga" which are gateway structures that mark edges of territory and significant places. The gateway welcomes guests and locals to the area.
- The location of the river crossing marks an important location in defining cultural areas and hapu. The footbridge as a gateway becomes a symbol of crossing over that important threshold of territory but also represents connection and acknowledges a hope for unity amongst all people who now share the land.
- The vertical support elements make a strong reference to the symbolic Maori pou whenua structures which mark places of significance.
- The side of the pou provide an opportunity for a culturally significant artwork or relief pattern.
- The interlocking concrete base and steel top detail.

Balustrade

- Thin verticals reference Maori pa defensive palisade fences structures and creates a reference to the Nukuhau pa (and others).
- Uses same materiality and structural strategy as the main bridge balustrade.

Single Span

- The foot bridge profile has a sufficient depth under the deck to allow the bridge to traverse the road in a single span.

9 Design criteria and assumptions – Retaining walls

9.1 Design life

The design life of retaining walls and retention elements will be 100 years.

The design life of reinforced concrete components will be achieved utilizing appropriate combinations of concrete quality and cover. The use of supplementary cementitious materials will also be considered, to provide enhanced durability without impacting adversely on creep/shrinkage behaviour.

Timber retaining walls are not currently anticipated to be adopted but may be considered for minor retention works which can be replaced without adverse impact on the HCC roading network or other retained development. As an additional precaution, the minimum durability treatment nominated for the timber components of any such wall will be one stage more robust than stipulated for a 50-year design life in the anticipated exposure. This proposal recognizes the lack of proven durability records for timber for 100-year design life, but also expert opinion that an approach of this type is expected to prove adequate. HCC direction is sought regarding the acceptability of this proposal.

9.2 Design loads

Design of retaining walls will take into account all foreseeable immediate and future excavations, using the Transport Agency *Bridge Manual* Section 6 as the base reference.

Design of cantilever retaining walls will take into account unplanned excavations by assuming excavation in front of the wall of 0.5m or 10% of the total retained height, whichever is the greater, under ULS conditions. Allowances for future excavation will be nominated on the drawings.

Groundwater conditions at each wall location will be assessed to determine the most unfavourable conditions that could occur in extreme circumstances. Groundwater conditions for the SLS check will assume the most unfavourable conditions that are likely to occur in normal circumstances.

Seismic design shall be based on a combination of the philosophy defined by the Transport Agency *Bridge Manual* and the specific proposals for other elements of the project as follows:

- *Bridge Manual* Section 6.2.2 for liquefaction/stability/displacement criteria for retaining walls shall be interpreted as ***Design Criteria and Assumptions: Earthworks*** Section 6.1 above.
- *Bridge Manual* Section 6.2.3 for structural design of retaining walls shall be interpreted as ***Design Criteria and Assumptions: Bridges*** Section 8.2.3 above.

9.3 Deflections

Predicted sliding displacements of retaining walls under design seismic loading will not exceed the maximum limits specified in the Transport Agency *Bridge Manual*, Sections 6.1.2 and 6.6.9 and Table 6.1, but the approach to permanent displacement limits described in Section 8.3 above is again proposed, provided that:

- These displacements do not adversely affect adjacent structures and services.
- It can be demonstrated that bridge piles and other structural elements reliant on the walls can accommodate these displacements without exceeding their elastic limits or capability to carry concurrent demands, as described in Section 8 above.

10 Design criteria and assumptions – Pavements and surfacing

10.1 Pavement system selection

The design philosophy seeks to build on the lessons learned by the New Zealand Transport Agency and others in reviewing a number of significant infrastructure projects where pavement failures have occurred sooner than predicted by the designers. Some of these lessons will appear obvious in hindsight but it can be tempting for designers, asset owners and contractors to ignore best practice in an attempt to reduce costs. Some of the lessons include:

- Good foundations (subgrade layers and embankment formation) for road pavements are essential.
- If savings must be made due to budget considerations, it is better to save money in the upper layers rather than the lower layers, as foundation issues in pavements are very expensive to remedy and disruptive to traffic.
- Compaction of pavement layers is important to prevent rutting. Upper layers cannot be adequately compacted if lower layers are not stiff enough. Too much compaction can also be an issue.
- Rutting will occur if the basecourse can be further densified by traffic. This has occurred on projects where in theory the density targets and required numbers of roller passes have been completed.
- Cement modified basecourse, used in some state highway pavements to improve resistance to rutting, has not been successful.
- Material properties matter and require constant monitoring for compliance.
- Cement stabilizing is a complex logistical operation requiring good planning and a detailed knowledge of a number of critical success factors to achieve consistent results. Accordingly, stabilizing work needs to be closely monitored by experienced practitioners.
- Constant focus on best practice handling techniques is required throughout the aggregate production, stockpiling, loading, transport and spreading processes to achieve compliant particle size distribution and limit segregation.
- Sources of moisture must be dealt with, including from below, from above (through the surfacing), from the sides, and trapped in the pavement layers during construction.

The above lessons have been considered when selecting the pavement layer and surfacing system for the PST pavements. Note that the calculation of layer thickness using layered elastic analysis (CIRCLY) will be one of the final steps in the detailed design process, rather than the starting point for design.

The proposed pavement system for all road types will consist of:

- A well-drained in-situ subgrade in cuttings, or a structural fill subgrade over embankments.
- A subgrade improvement layer of imported pit sand. Local pit sands are relatively inexpensive and have proven to perform well as long as silt content is controlled.
- Sub-basecourse of premium aggregate (e.g. WHAP65).
- Cement stabilization of the sub-basecourse, if necessary, to limit deflections on the top of the sub-base layer (thereby providing a good anvil on which to compact the basecourse layer). Alternatively, the use of a geogrid at the subgrade/subbase interface could be considered as a potential alternative to stabilization.
- Unbound M4 basecourse.
- Chipseal surfacing with not less than 3.0l/m^2 (TBC) residual bitumen.
- Asphalt wearing course if required for noise mitigation and/or ride quality. Note: the use of chipseal could be used on low volume local roads (such as Weston Lea Drive) to help reduce project costs, but is not preferred at this time as the outcome would be unusual for a new development, affects the ride quality for cyclists, and could have consequences on achieving noise mitigation requirements.

Design traffic above 10^7 ESA typically causes rutting problems for M4 basecourse. Heavy traffic volumes are expected to be well below this for the PST arterials, therefore a well-constructed unbound M4 basecourse is expected to perform adequately. However, the PST forms the first tranche of infrastructure within the Peacocke Development area so may experience a higher portion of construction related traffic that could significantly impact the pavement performance. As such, a more detailed assessment of actual axle loading on the pavement to account for generic traffic growth predictions will be undertaken during the detailed design phase. In saying this, more expensive options such as foam bitumen stabilization or wholesale deep lift asphalt over the main corridor length is unlikely to be deemed necessary.

Intersections may eventually require structural asphalt in the upper layers due to traction forces from steering and braking. However, to save cost given that initially traffic volumes will be relatively low, this could be inlaid later once damage to the pavement and surfacing warrants it. HCC advice will be sought regarding whether to include SAC initially or defer to a later date.

10.2 Structural design

The design traffic loading and structural design will be based on the methods referred to in the New Zealand guide to pavement evaluation and treatment design (NZTA 2018).

Structural design will check layer thicknesses to confirm that the damage factors calculated using CIRCLY are very low even when using pessimistic assumptions for the stiffness of all pavement layers. Layer thicknesses may be adjusted to values greater than theoretically required to reflect construction considerations.

It is important not to over-estimate subgrade CBR values. Subgrade CBR for design will be estimated from soaked CBR tests on undisturbed samples from cuttings, and from potential fill materials recompacted in the laboratory to densities expected to be achieved in the field. These tests will be repeated during construction to verify the soaked CBR values.

Benkelman Beam deflection targets will be calculated for the various stages of construction (top of SIL, top of sub-basecourse and top of basecourse) using the expected range of constructed pavement layer properties so that the performance of the pavement can be verified as each layer is constructed.

Design of cement stabilized sub-base layers will be based on the stabilized layer withstanding the full design traffic loading in the un-cracked state. Again, conservative values for the stiffness of the cement stabilized layer and the underlying layers will be used in the CIRCLY analysis, to avoid overly optimistic predictions of performance.

10.3 Pavement materials

Standard NZTA and RITS specifications will be utilised for pavement materials. In addition, RLT and ethylene glycol testing will be used to assess aggregates for susceptibility to weathering. Sources (quarries) with known durability issues will be avoided.

For stabilized sub-base a coarser grading envelope will be specified through the middle sieve sizes to account for the approximately 5% increase in percent passing each sieve caused by the mixing process. This will limit the risk of cracking which can occur with stabilized mixes which are too fine.

10.4 Pavement construction

Opportunity will be taken at each stage of construction to assess the as-constructed layers by Benkelman Beam testing to verify the design before proceeding with the next layer.

Density targets and rolling patterns will be established by the usual methods involving laboratory testing and plateau tests. However, density targets can be wrong for a number of reasons and, by themselves, are unlikely to replace the experience of construction crews when determining whether a layer is finished (e.g. achieving “tinging” under the roller). The aim will be to work the basecourse particles into a condition as dense as possible, short of causing particle break down. This will minimise post construction rutting.

Emerging intelligent compaction (IC) technology has the potential to improve compaction by adjusting vibration amplitude and frequency on the fly to optimize compaction, as well as identifying under-compacted areas and preventing over-compaction. Contract documents will require all primary compaction plant to be IC equipped and operators appropriately trained in its use.

Cement stabilizing (if adopted) is a complex operation involving large numbers of plant items and requires good planning and a detailed knowledge of a number of critical success factors. Prior to commencement, Contractors will be required to submit a Production Plan for approval which addresses all aspects of the stabilizing operation (if relevant). This will be tested on a trial section prior to full scale production.

Stabilized sub-base (if relevant) will not be "pre-cracked" and instead will be protected from trafficking until cured.

10.5 Surfacing

Surfacing needs to provide adequate waterproofing of the basecourse layer. Chip seals with not less than 3.0l/m^2 residual bitumen will be applied.

Asphalt surfacing will be applied as required for noise attenuation or ride quality. It may not be required initially, until traffic volumes build, and the number of noise sensitive receivers warrants low noise surfacing. Small chip sizes or asphalt surfacing will be used where cyclists must travel on the road.

10.6 Pavement drainage

An effective pavement drainage system is required to ensure water drains quickly from the pavement layers and is prevented from entering. Pavement drains will be included at the lower edges of the pavement layers for all pavements, including on embankments.

The pavement drainage system is not intended to drain groundwater in road cuttings. An effective system for capture, collection and discharge of groundwater seeping from the sides and base of cuttings shall be installed in addition to and at a lower level than the pavement drainage system.

Pavement drains will generally begin and end at catch pits or manholes. Otherwise, a rodding/flushing point will be installed at the ends.

11 Design criteria and assumptions – Landscaping & urban design

11.1 Introduction

The urban and landscape design approach to the PST will aim at creating an integrated design where engineering and environmental aspects meet the requirements of HCC. It will apply best practice landscape and urban design principles to provide a culturally sensitive design that minimises the landscape and visual effects of the project and responds to the ecological requirements of the Ecological Management and Monitoring Plan (EMMP).

The vision for PST is to create a robust roading network that is multi modal and enhances the urban fabric of the area, while catering to future uses that are planned within the area. To this extent, it must be visually stimulating, attractive and express a localised 'sense of place' that is unique to this area of Hamilton, without compromising safety and efficiency requirements.

To achieve HCC's urban design aspirations, the PST will focus on balancing the infrastructure requirements and the need to maintain and enhance the amenity and liveability of the local community. In addition, the Project will utilise guidance from the Southern Links Urban and Landscape Design Framework (ULDF) and the Peacocke Concept Landscape Management Plan (CLMP). These documents provide the general design requirements/desired outcomes for the design of the project. To achieve the requirements, the landscape and urban components of the project will focus on the following aspects:

- Ensure an integrated road network linking the Hamilton Ring Road with the current SH1, and the future Peacocke area to improve access and safety for all road users.
- Ensure high design quality of the transport network in terms of amenity, aesthetics of the experience, accessibility, safety and landscape context.
- Support a wider range of transport choices through the provision of safe and user-friendly cycle and pedestrian facilities and bus lanes that includes the application of crime prevention through environmental design (CPTED) principles.
- Provide all road network users with a coherent design based on an overarching theme that responds to the differing context across the network while meeting community aspiration.
- Incorporate design treatments that moderate the scale of the project while providing quality aesthetic design outcomes that contribute and reinforces the character of the area.
- Encourage environmentally responsive design to maintain and enhance the ecological value, improve water quality and uphold the visual amenity of the area.
- Consider aspects 'beyond the pavement' to integrate neighbouring land uses with particular focus on the integration and maintenance of surrounding open space.

11.2 Landscape character

The Peacocke development area traverses a variety of landscape character areas with the PSP area located within the Waikato River terrace character area, which sits on the peri-urban edge of Hamilton and is characterised by lifestyle block properties, open pastoral land with landforms of river terraces, gullies and escarpments. In addition, a number of historical and cultural sites occur in and around the PSP area including former Pa sites, the Redoubt, and Hamilton Gardens.

Land use and vegetation types vary across the area and is currently pastoral with hedgerows and shelter belts with a variety of large exotic and native trees scattered across the landscape. Native vegetation is typically associated with the gully system, although some remnants of kahikatea are scattered across the landscape. Views vary depending on topography and vegetation, but more expansive views can be obtained from the rolling hills to the south.

The challenge is to achieve a sense of place while considering the varied landscape character and future uses proposed for the area. In addition, the roading network is not just a utility - but it forms an important public space and multi-use environment in its own right. Therefore, the landscape and urban design aspects of the project will contribute to creating an environment that is designed responsively to the surroundings and the needs of users, while aiming to maintain and enhance the ecological value of the area.

11.3 Urban and landscape design opportunities

To help meet the urban design requirements of HCC, the project should incorporate the following design opportunities/principles to achieve a road network that:

- Is context sensitive where it contributes to the character and community by responding and connecting to the surrounding landscape, cultural and environmental setting.
- Reflects an integrated design approach with cohesive and innovative solutions embracing all aspects of design including structures, highway furniture, landforms, storm water, cultural elements and planting.
- Ensure an integrated road network, linking the Hamilton Ring Road with the current SH1 (Cobham Drive) and future Peacocke area to improve access and safety for all road users.
- Integrate adjacent land uses with particular focus on the integration and maintenance of the surrounding open space.
- Support a wider range of transport choices through the provision of safe and user-friendly cycle and pedestrian facilities and bus lanes.
- Improved access for public transport users.
- Ensure integration with future infrastructure projects.
- Incorporate design treatments that moderate the scale of the project while providing quality aesthetic design outcomes that contribute and reinforces the character of the area.
- Contribute to the ecological enhancement to increase habitat and improved water quality.
- Has continuity in style and character across the transport network.
- Recognises and incorporates opportunities for cultural/art interventions and achieves these within design/construction solutions.
- Provides best practice management and maintenance approaches to achieve outcomes as promoted and expected by HCC.
- Is cost-effective base on a whole-of-life cost assessment.

11.4 Key urban and landscape design components

The following components of the project will require particular focus from an urban, landscape and environmental design perspective due to their size, scale, function and significance. The design and integration of these components will play an important role in terms of achieving positive urban design and landscape outcomes, which in turn will contribute to the overall character of the project and the local area. Key components include:

- Waikato River bridge structure.
- Road hierarchy - major and minor arterials.
- Integration and interface with (proposed) adjacent land uses.
- Intersections and roundabouts.
- Integration of earthworks.
- Integrated storm water.
- Integrated cycle and pedestrian facilities.
- Street and open space furniture.
- Retaining walls, fencing and noise walls.
- Landscape and ecological planting.
- Cultural and heritage values.
- Whole-of-life.
- Maintenance and specification requirements.

11.4.1 Waikato bridge

The Waikato River bridge will provide a new link across the Waikato River and will be a strategic link between Hamilton East residential area and the Peacocke development area. The bridge will be a significant feature within the landscape and will be designed with an appropriate level of aesthetic design and functionality to meet the requirements and expectations of HCC and other stakeholders. Recommendations made in the EMMP will be incorporated into the bridge design, particularly in relation to lighting, vegetation removal and reinstatement and bat flight paths.
The bridge design is more than just providing a transportation bridge and will aim at encompassing the multi-modal transport needs that also combines strong visual aesthetics, cultural aspects to contribute to the character and identity of the area. The combination of the components and response to the variety of stakeholder requirements will need to be managed carefully to ensure the integrity of the totality of the design provides a distinct landmark bridge design.

Initial design concepts that have been progressed to date for the River Bridge aim at balancing a simple and functional engineering structure with integrated aesthetic cultural elements. To this extent the bridge incorporates an efficient 'Y' form pier with a visually strong cultural basket/weave theme, steel beams and a simple deck formation with outer bridge railings to achieve a slender and elegant bridge form. As an integral part of the overall bridge design and identity/character, a pedestrian bridge with strong visual form that incorporates large piers at each end creates a waharoa/gateway environment to the northern side of the river. The gateway importantly connects two local iwi while marking the threshold/approach to the river corridor, but also provides a seamless connection for the Te Awa Riveride across the Major Arterial.

To date the Waikato Bridge design has been developed in accordance with the following objectives:

- Provides a landmark bridge structure that contributes to Hamilton's variety of bridges.
- The provision for multiple transport modes (vehicles, public transport, walking and cycling).
- The incorporation of strategic services (wastewater, water, electricity and telecommunications).
- Minimization of adverse environmental effects.
- Ensuring value for money by utilizing a simple structural form.
- Forms a gateway/landmark structure.

To ensure the bridge provides a landmark, user friendly bridge, which responds to the variety of requirements and meets stakeholder expectations, the bridge design approach will encompass the following design principles:

Experience
The design will be experiential in that it meets the needs of multi-modal transport requirements that responds to the variety of users and their needs. This will also include connectivity that develops strong linkages, the provision safe separated facilities and include places for pausing and experiencing the surrounding environment in and around the bridge.

Flexibility/Versatility
This will focus on the deck design to enable flexibility and changeability to accommodate future transport modes and requirements that may include a consistent profile to the deck, moveable barriers, and suitable drainage. The design process will aim at optimizing the deck width and consider maintenance aspects and durability of materials.

Kaitiaki
This principle encompasses development of community, visual amenity and ecological aspects. Therefore, the design will respond to fauna (particularly bats), water quality and guardianship of the culturally significant location and environment. Other aspects include considerations for safety both during construction and operation and will include design aspects to prevent suicide.

Connections
This will include providing safe connections for vehicles, public transport and other forms of transport (cycle and pedestrian), particularly where they tie into and improve existing or proposed facilities (Te Awa/Wairere and Cobham Drive facilities etc) to improve the overall functionality and network options.

Landmark/Memorable
The bridge structures will encompass a cultural narrative that responds to the two main iwi located either side of the river with the idea of gateways that respond to the crossing of the river and along the river corridor (being a gateway into Hamilton/Kirikiriroa). In addition, the design will celebrate the gateway/threshold between the two iwi that are situated either side of the river by utilizing design features such as a Tomokanga / marker or threshold waharoa as integrated components of the bridge.

11.4.2 Road hierarchy - major and minor arterials

Major arterial
The Major Arterial transport corridor will provide four lanes (two of which will be dedicated as public transport lanes) with the hard shoulder forming part of the traffic lane (i.e. no marking of shoulders. This aligns with HCC definition of function being principally *for the movement of significant levels of goods and people between parts of the City and beyond*

The carriageway will include kerb and channel to manage and capture stormwater flows and include HCC standard lighting requirements. Property access will not be achievable directly from the Major Arterial, which aims at avoiding local traffic with the main traffic flows.

Off road pedestrian and cycling facilities will be provided with unmarked on road commuter facilities sharing the outer traffic (public transport) lanes, although these will link with the off-road facilities.

Due to the urban character of the Main Arterial, continuous barriers will not be incorporated into the road. Due to the narrow width of the median and to prevent maintenance risk, the median will be hard surfaced (flush) and without planting.

Minor arterial
The 'minor arterial' road will connect with the Major Arterial roads to allow the movement of high levels of goods and people. Typically, residential property access will be managed via collector roads interfacing with the Minor Arterials, but consideration to the streetscape may include incorporation of access to housing to provide an 'active' frontage. Off road pedestrian and cycle facilities will be included adjacent to the arterial and will incorporate drainage swales/stormwater gardens and 'clumps/groups' of street trees and ecological planting where-ever possible with the intent to separate the cycling/pedestrian facilities from the carriageway, while promoting ecological enhancement.

11.4.3 Integration and interface with (proposed) adjacent land uses

A number of specific opportunities to tie in and further develop the Project's facilities have been identified and will be further developed during the detail design stage. Adjacent land uses will typically include residential development, although a number of the adjacent sites have no definitive proposals developed at this stage. Where development proposals are being progressed by adjacent landowners/developers then our design team will work closely to ensure a suitable interface is achieved with the aim of place creation through quality design. An example of this will be the consideration of features that look to introduce, enhance and promote the play and inclusive outcomes sought by Hamilton City Council's Play Strategy (2019 – 2039).

Wairere/Cobham Drive
The Wairere and Cobham Drive Interchange has undergone detail design and construction has commenced, which will require the PST Project to tie in with the transport network. Further opportunities exist to 'tie in' and develop the pedestrian and cycling facilities, plus open spaces that incorporate ecological enhancements to the area. These opportunities will be assessed and developed during the detail design stage to ensure a fully integrated design proposal is achieved.

Peacocke Open Space Sport Facility
Proposals for the Peacocke Sports Park Facility have been developed and are currently subject to planning approval. The facility will be located to the southern side of Peacockes Road and will include a feeder access road off Peacockes Road to cater for future residential development and the sports park facility. The proposals also contain connecting pedestrian and cycle linkages that will need to tie into the Peacockes Road shared path facilities. The proposed sports

park facility area is elevated higher than the current Peacockes Road and gradients/road heights will need to be considered to ensure a suitable interface.

Te Awa Riverside Walk/River Edge

The proposed Te Awa Riverside pedestrian and cycle facility is currently proposed on both the northern and southern side of the Waikato River. To the northern side, the shared path facility is routed through the Wairere/Cobham Drive interchange, although the proposed bridge link will adjust the alignment and improve overall connectivity.

To the southern side of the River, it is proposed that the Te Awa Riveride will traverse along the bank of the Waikato River, which will provide opportunities to develop the riverside bank in and around the bridge abutment as a public open space with access to the river, the inclusion of a jetty, terraces, furniture and associated planting. Additionally, the space will integrate with the Project's cycling and pedestrian facilities providing suitable grades between areas to promote access for all users.

Retirement Village

Initial concept proposals for a retirement village to the southern side of the Waikato (east of the bridge) have been developed. Opportunity exists to work with the landowner to improve the interface between the development and the Project to avoid unsightly development and promote the concept of an active and attractive streetscape environment (rather than back end development). In addition, there are opportunities to work with the developer to connect and provide access to the river edge and maintain public thoroughfare, and therefore discussions with the developer will be undertaken during the detail design stage.

11.4.4 Intersections and roundabouts

As intersections and roundabouts will form part of the 'urban fabric' careful design of these features will aim at providing safe environments for all users. A consistent approach to intersections and roundabouts design will be undertaken to provide an easy to navigate and logical user experience. Pedestrian and cycling facilities will be integrated into the design of roundabouts with pedestrian/cycle priority systems to be included within the traffic light systems at the intersection. Suitable ground markings, drop kerb facilities and signage will be provided for pedestrians and cyclists and will include ingress and exit points for cyclist that access shared path facilities.

All roundabouts and interchanges are expected to incorporate suitable hard landscape features (paths, crossings, decorative elements (such as inset rocks/paving etc), safe zones islands, hold railings and flush kerbs) with any remaining space being fully planted to visually enhance the location, promote safety and minimise long term maintenance requirements.

11.4.5 Integration of earthworks

The design principles for earthworks will typically aim at minimizing the overall footprint of the road, minimise the visual impact and avoid encroachment into gullies, water courses/bodies and areas of indigenous vegetation or quality exotic tree specimens. In addition, earthwork formations will ensure overland stormwater flows are integrated to provide an efficient means of capturing and treating stormwater run-off.

In general, all cut and fill batters will be formed to a 1h:2v batter slope. Flatter batters will be used where the designation footprint allows, and/or when optimizing cut/fill balances, and/or when the arrangement may better suit long-term development plans (i.e. beyond the designation footprint. However, in all cases the batters will exclude benching and be designed to allow for top soiling, planting and mulching (where necessary). Landforms along the minor road, will be kept as close to existing levels as possible but vertical alignment may be adjusted to meet future development proposals where necessary.

Topsoil strip and storage will be undertaken to ensure soil quality is maintained (height limited to 2.0m, avoid be tracked or moved when wet) to allow re-use. Where grassed slopes are to be used that require mowing these will be no steeper then 1v:4h to allow safe maintenance activities. Where notable or large specimen trees occur, then localized adjustments to earthworks and slopes will be undertaken in order to retain the tree.

11.4.6 Integrated stormwater

Integrated stormwater solutions will be provided (that will meet the RITS requirements) along both the Major and Minor Arterial routes. Stormwater facilities will tie into low-lying areas where wetlands will be developed for the management and treatment of stormwater. Wetlands will be designed with a 'natural form' with benching and shelving to allow for a variety of wetland and riparian planting types, plus include access to the forebay to allow future maintenance. Where practicable, stormwater swales/rain gardens will be integrated into the streetscape, and will typically be located at the base of fill batters to minimise the extent of earthworks, while taking into consideration vehicle ingress points, cycle and pedestrian facilities, and where slopes or space is constrained then the use of rain gardens will be utilised.

Bridge runoff will be collected and treated off the bridge deck, but the bridge will include catch pits, pipes to collect and transfer storm water beyond bridge abutments to appropriate devices for treatment.

Appropriate soil mixes and plant selection will be integrated into the design to help absorb and filter contaminants before stormwater flows to surrounding ground pipes, drains and streams. Wetland and swale/rain garden plant species will be selected to be robust and suitable for a range of (dry/wet) conditions and to minimise maintenance requirements and to enhance wildlife habitat/provide potential food sources.

11.4.7 Integrated cycle and pedestrian facilities

Pedestrian and cyclist facilities will support HCC's biking plan and the Peacocke CLMP to provide a fully connected, comfortable, attractive high-quality pedestrian and cycling network to encourage high use of the facilities. The approach will aim at providing a hierarchy of paths that tie into existing and proposed facilities that add to the amenity and connectedness of the public network and provide quality links back to the Hamilton City central business district (CBD).

A hierarchy of paths will be incorporated into the design with on shoulder commuter cycling facilities and primary off-road shared facilities providing connectivity between residential areas and other major facilities (schools, shops and parks or commuter routes such as Te Awa River Ride) and Hamilton CBD. Secondary paths are aimed at pedestrian use, but also are sufficiently wide for cyclists but are not aimed as a dedicated shared cycle path facilities. Secondary paths may relate to open space environments or link between residential areas and the primary shared paths. Opportunities for tertiary/trail paths, which are more informal tracks may be included to provide connections between main facilities or around wetlands or open spaces.

The following design principles will be applied to the design of path facilities:

- Design aligns with RITS requirements and encompasses CPTED with clear and logical orientation of paths and signage with open views to allow surveillance to provide a safe environment for cyclists and pedestrians.
- Off road shared paths (with permanent surfacing) are for use by pedestrians and cyclists that connect to existing facilities and local open spaces and proposed facilities (i.e. village center and sports park) within the Peacocke area.
- Integrate crossing points (at grade or underpass) across roads to maintain connectivity between neighborhoods and to allow access to neighborhood facilities.
- On road cycling facilities will include road space for commuter cyclists along the major arterial. Facilities will include integrated access points to allow commuter cyclists to move easily and safely between the on and off-road facilities. To facilitate this, flush thresholds will be included to allow cyclists to safely move between facilities and include ground markings.
- The Waikato River bridge will incorporate designated pedestrian and cycle facilities that will link into the proposed Wairere and Cobham Drive Interchange facilities and to the proposed riverside walk facilities to both the northern and southern side of the Waikato River.
- Where possible shared facilities will be separated as far away from the carriageway as practicable and provide adequate space for landscape treatment around transitions, while providing separation from the road carriageway.
- Lighting standards of main routes will be to P3 standards and will also be subject to EMMP considerations.
- Paths shall ensure ease of maintenance access and operations.
- Shared paths will be direct, convenient to use, safe, and as smooth and continuous as possible with maximum forward visibility with minimal hazard risk for cyclists, pedestrians and riders.
- Pedestrian and cycleway furniture (bollards, handrails etc) and signage will be integrated into the design to aid safety but will also consider functionality aspects.

- Where practicable, all utility service lids will be located within the allocated utility corridor (berm between carriageway and paths) and clear of path facilities.

Consideration will be given to CPTED requirements with the use of low edge plant mixes to maintain open views and surveillance to provide a safe environment for cyclists and pedestrians. Refer to Section 14 for further details.

11.4.8 Street and Open Space Furniture

All street furniture (barriers, signage, lighting and road markings) will be in accordance with HCC and NZTA guidelines and requirements with consideration being given to enable ease and safety of access and maintenance. Open space furniture will be designed or selected based on robust and durable items and will utilise HCC standard suite where possible.

Open Space Furniture

- HCC standard open space furniture suite will be utilised where possible.
- Open space furniture positions will avoid cycle or pedestrian conflicts, consider CPTED aspects in terms of location and ensure ease of maintenance around features (i.e. include concrete bases/mow strips).
- Street furniture will utilise durable materials that are easily replaceable and will be chosen in consultation with HCC Transportation team.

Signage

- All street signage will be in accordance with HCC and NZTA standards and specific signage layouts will be provided for the extent of the Project (each road type and intersection).
- Other signage for pedestrian, cycle and open space wayfinding and information boards will utilise HCC's standard signage suite.

Street Lighting

- Street lighting for each road type will incorporate standard equipment that can be readily sourced for maintenance and replacements. This shall include the use of standard "Oclyte" poles (with the exception of the Waiakto River Bridge where decorative poles may be used) and LED lanterns that satisfy RITS requirements (Section 3.3.20). Design shall be undertaken in accordance with AS/NZ 1158 and reference is made to NZTA M26 and M30 in relation to maintenance/warranty expectations and approved materials. Consideration will be given to the lighting requirements outlined within the EMMP in relation to light locations, lighting (LUX) levels and spill relating to bat flight paths and habitat areas.
- Primary shared pedestrian and cycle facilities will be lit to P3 standards and will also be subject to EMMP considerations.
- The EMMP has some specific requirements (or restrictions) to how lighting is provided on the Waikato River Bridge to help mitigate potential adverse effects to bat habitat and local ecology. Lighting standards for vehicle lanes will be incorporated to provide consistent light levels across the bridge. Pedestrian lighting will be incorporated into the railing/balustrade design to minimise light spill beyond the bridge deck. Any feature lighting will need to be managed in relation to EMMP requirements and will be integrated into the overall bridge design to achieve a high aesthetic while considering the effects on the river environment.

Safety barriers

As the Peacocke area will be an urbanised environment as development progresses, the general strategy is to avoid having concrete or wire rope safety barriers (where possible) to maintain the urban character. However, this needs to be balanced against the Vision Zero strategy for protecting against harm to humans. At this stage, barriers are only envisaged on the river bridge, where concrete barriers will be provided to separate the pedestrian/cycle facilities from the main carriageway. However, the Major Arterial cross-section (Ring Road Extension) provides for a central median that is sufficient to incorporate a central median barrier in the future, if deemed necessary/appropriate. Barriers/fencing for protection from falling will also be used on the edges of the bridge, tops of retaining walls and other areas where fall heights require fall prevention barriers/fencing.

Utilities

Where above ground utility services such as substations are required, these will be located a minimum of 5m from the road edge and clear of stormwater overland flow paths. These above ground features should also incorporate fencing and landscape planting to soften the visual appearance.

11.4.9 Retaining walls, fencing and noise walls

Retaining Walls

- Where retaining walls are required, the context/location will be considered in relation to the final choice of materials, which may include concrete keystone blocks or gabion wall structures.
- Areas along cycleway/pedestrian paths or at underpasses will utilise keystone block wall units with a capping unit to provide a quality finish.
- Keystone walls will be constructed with a preference of a sloping top to walls, but where a step is required then these will be between 300 to 500mm with each step being a minimum of 4m apart.
- Fall protection fencing will be integrated into the design in accordance with requirements of F4 of the Building Act (safety from falling). However, design will purposely avoid the use of standardised pool fence as fall protection barriers.
- Where possible the use of planting to the top and bottom of the wall will form part of the overall design solution to help anchor and soften the retaining walls.
- Wall patterns will be developed in consultation with TWWG, based on the Peacocke CLMP cultural theme approach;
- Drainage solutions will be integrated/accommodated into the structure.

Fencing

Although no specific location has been identified for fencing, it is possible that fences may be required to define boundaries. Where fences are required, the location and context will be considered in terms of design requirements, materials and finishes. Typically, timber fences will be appropriate, but consideration will be given to the streetscape and appearance with a design that avoids/minimises the potential for graffiti (open railings, hit and miss batten). Colors will be restricted to recessive dark colors to minimise the visual appearance and allow for planting to help screen/soften the fence.

Noise Walls

- At this stage no requirements for noise walls have been identified, but this may be subject to further noise investigation studies.
- Where/if required the construction will utilise a 'family' of materials that will include concrete or timber with a 50-year design life and 20 years minimum to first maintenance.
- Noise wall fencing will run parallel with the road corridor, incorporate a simple pattern and allow for planting to both sides of the fence.
- The design will integrate with stormwater features to ensure the integrity of noise barrier is maintained.

11.4.10 Landscape and ecological planting

Landscape and ecological planting will be based on the Peacocke CLMP, which outlined the general planting approach for streetscapes, wetland and swales plus open space environments. In addition, the CLMP provided preliminary species lists that will be utilised and refined where necessary. Recommendations from the Environmental Management and Monitoring Plan (EMMP) will be incorporated into the landscape and ecological planting proposals.

The objectives and approach for the landscape development for the Project includes:

- The NZTA's P39 landscape specification will be utilised, which will cover vegetation clearance, subsoil preparation works, top soiling, eco-plant sourcing, planting preparation, planting, grassing, pest control and maintenance.
- The proposals will predominantly utilise indigenous planting to steep cuts and fill slopes, and along road margins to screen and soften views while enhancing ecological habitat. In general, mown slopes will be avoided through the use of planting, but where grassed slopes occur, they will have a maximum slope of 4H:1V. Slopes steeper than 4:1 will be reinstated with topsoil and will be planted.
- Maintain views particularly to/of open spaces, gullies and the Waikato River Bridge.
- Planting of tree and shrub species appropriate to the local soil and climatic conditions that complement the existing vegetation and contributes to the ecological enhancement of the area, including eco-sourcing wherever possible.
- Incorporate a predominantly planted verge to separate pedestrian and cyclist facilities from the carriageway.
- Recognition of the need for landscape treatment appropriate to the speed and scale of the viewer. That is, smaller scale detail treatment relative to pedestrian and cycle ways with bolder, broader scale treatment relative to faster moving traffic.
- Retention of existing vegetation where appropriate.

- Retention and enhancement of river edge habitat, swales and wetland to enhance wildlife habitat and food sources, which align with the EMMP requirements.
- Softening of structures such as noise walls, headlight glare fences and retaining walls.
- Follow recommendations of CPTED, particularly maintaining safe environments in association with public space, footpath and cycle facilities.
- Minimise long term maintenance requirements with the use of appropriate plant mixes.

Streetscape/Open Spaces

- Low growing plant mixes that maintain visibility and sightlines will be utilised in and around roundabouts and interchanges, although where appropriate taller trees may be required to support bat fly-over points. Careful placement of specimen trees to visually emphasis intersections and roundabout areas will be incorporated as appropriate.
- Native street trees will be predominantly utilised, which will vary in accordance with the road type to help define the character and wayfaring of each road type. Trees will typically be arranged in informal groups to provide a more resilient street tree environment and to aid ecological enhancement.
- The use of the low grow mixes will be incorporated typically along the edge of the carriageway, pedestrian and cycle paths and on the edge of landscape restoration planting, plus in and around highway and street furniture.
- Steeper cut or fill embankments will be planted with a combination of low grow edge mixes adjacent to the carriageway with taller ecological re-vegetation planting beyond.

Swale and Wetland Planting

- Swales are unlikely to be able to be developed within the cross-section of most transport corridors due to constraints within the future urban area. Instead, most transport corridors will collect and convey stormwater runoff through kerb and channel and a reticulated network connecting with planted wetlands. These wetlands will be designed to filter and treat the stormwater runoff to maintain water quality and attenuate volumes (where appropriate) during major storm events, before discharge to suitable waterway outlets.
- A combination of wetland plant species will be utilised that will withstand periodic inundation with dry tolerant riparian species situated on the sides of the wetlands.
- Stormwater wetlands will be designed with natural forms that incorporate 'platforms' to provide the varying growing environments to support a range of plant species that promote a range of wildlife habitats and add biodiversity.
- Appropriate tree species will be included along the upper margins of wetlands to increase the habitat value of and help regulate water temperature. However, trees will be placed away from forebay maintenance areas to ensure ease of maintenance.

Existing Vegetation and Tree Protection

- Fencing requirements will be developed during the detailed design stage of the Project for trees identified for retention. This will include post and mesh wire fencing located at the tree/vegetation drip line and will be installed for the duration of the construction works to ensure construction vehicles and storage of materials are excluded from these areas.

11.4.11 Cultural and heritage values

A number of culturally sensitive sites occur in and around the PST project area and provide the opportunity to incorporate a cultural narrative design approach to the Project. Ongoing cultural design workshops will be held with stakeholder iwi (TWWG) during the detailed design stage with the aim of developing appropriate themes and designs in line with the opportunities identified in the Peacocke CLMP. It is recommended that HCC consider setting a suitable budget at an early stage to ensure expectations and outcomes can be appropriately managed for items that are not integrated into design components (i.e. for standalone cultural pieces/artwork).

Integrated cultural design interventions that have been identified and will be developed during the detail design stage include the following:

- Bridge features including abutment, railing design and bridge pier locations.
- Bridge/river edge area treatment and design.
- Pedestrian and cyclist safety railing design.
- Pedestrian and cyclist underpass art interventions/design.

- Cycleway node locations and open space.
- Retaining wall pattern design.
- Roundabout paving design.
- Plant species selection (embankment planting, re-vegetation, wetlands and swales, cycleway node and stopping points).
- Identification of pou/marker locations and designs.
- Input into locating and development of interpretative signs.
- Naming of bridges, new (or altered) roads, paths and parks.
- Demarcation of Pa and archaeology sites.

11.5 Whole of life

All urban and landscape design proposals will be designed to have a design life of not less than 50 years and require minimal maintenance for the first 20 years of the project. Coatings will have a minimum design life of 10 years. The design will include provision of appropriate measures to:

- Avoid the risk of graffiti and vandalism.
- Protect the visual integrity of the Project.
- Ensure there is adequate access for maintenance.
- Establish and maintain self-sustaining landscape planting.

HCC's Transportation team will be consulted regarding plant species to ensure a robust long-term environment is achieved.

11.6 Maintenance and Specification Requirements

In accordance with the Peacocke CLMP, the Transport Agency's *P39 Standard Specification for Highway Landscape Treatments (2013)* will be utilised for construction/implementation standards and requirements. The P39 Specification together with project specific requirements will set out the minimum standards for performance, quality and workmanship. This will accompany the Detailed Design Landscape Plans and Plant Schedules.

Contract requirements for the construction and maintenance period will include:

- The development of a Landscape Maintenance and Management Plan for at least a 2-year period (ideally 5-year period subject to HCC approval) after hand over, as part of the Asset Owner's Manual.
- Maintenance proforma to record site maintenance activities.
- Risk management associated with landscape activities.
- Storm water and wetland management documentation.

12 Design criteria and assumptions – Acoustics

12.1 Design conditions

The designations contain conditions in respect of operational noise. The Detailed Design will provide mitigation for operational noise at any dwellings on land not owned by the Crown for the purposes of the PST that were in existence at the time the notice of requirement for the PST was lodged, where the noise levels of the designation conditions cannot be complied with.

Mitigation may be in the form of (in order of preference of treatment) a quiet road surface, barriers (or noise fencing), specific noise insulation for the dwelling or a combination thereof.

12.2 Property Agreements

The design will comply with any conditions of property agreements that relate to noise.

13 Design criteria and assumptions – Traffic services

13.1 Street and pedestrian lighting infrastructure

Please refer to the Landscape and Urban Design section of this DPS (Section 11.4.8).

13.2 Pavement markings

Pavement markings will initially be applied with Transport Agency standard specification NZTA M/7 paint materials (including RITS requirements for this type of paint marking) then, following second coat sealing and asphalt surfacing, re-applied with high performance road marking materials complying with NZTA M/20.

13.3 Signs

All signs will be in accordance with the requirements of the Transport Agency's *Manual of Traffic Control Devices* and *Manual of Traffic Signs and Markings*.

Roadside signs will be standard pole mounted signs if there is sufficient room in the berm. Otherwise, cantilever supports will be installed behind safety barriers. Overhead gantries are not expected to be required.

Legends, including destinations, will be agreed with Hamilton City Council.

13.4 Traffic signals

Traffic signals, if used, will be designed in accordance with NZTA P43 and RITS requirements. All signal designs will be subject to review and approval by HCC.

An independent traffic signal audit is also recommended to review safety and operational issues. These audits shall be undertaken at completion of the detailed design and again as part of the commissioning phase.

13.5 Delineation

Edge barriers will be fitted with yellow reflectors mounted on the top of the post.

Edge marker posts are not expected to be required as the roadway is completely lit.

13.6 Safety barriers

Barriers will comply with NZTA M23, the various NZTA Technical Memoranda, Technical Advice Notes and RSB standard drawings and the interim acceptance notices listed on the NZTA M23 web page.

13.7 Cycle separators

The proposed separation strip between the vehicle carriageway and on road cycle lanes consists of two parallel edge lines 0.60m apart with proprietary zebra/armadillo cycle dividers (refer to https://plasback.co.nz/zebra-cycle-dividers/).

The arrangement of the dividers needs to allow for refuse collection trucks to pass over/between the dividers to reach bags and bins placed on the berm. Appropriate arrangement of the dividers will be devised considering the proposed design vehicle for refuse collection and any specific requirements determined from consultation with the HCC Infrastructure Alliance and refuse operators (as directed).

13.8 ITS and Smart Hamilton infrastructure

ITS and Smart Hamilton infrastructure such as fibre ducts, pull pits junction pits, CCTV cameras and the like will be included as directed by HCC. This can be incorporated relatively easily prior to construction of pavement layers, but would ideally be decided prior to start of project tendering (to allow competitive pricing and incorporation within construction drawings) in early April 2020.

13.9 Bus stops

Bus stops will be designed in accordance with the RITS standard (not including the "mini" shelter) and coordinated with positions of pedestrian crossing points. Final positions of bus stops will be agreed with HCC Transportation staff.

The HCC Transportation team have indicated that the shelters, where possible, should enable "Adshel" type features to be incorporated within the shelter, thereby requiring suitable underground electricity ducts to enable power supply to be provided to each shelter.

Bus stops will be provided on Minor Arterial Roads only on this project.

The general arrangement of bus stops are presented in Figure 13.1 below:

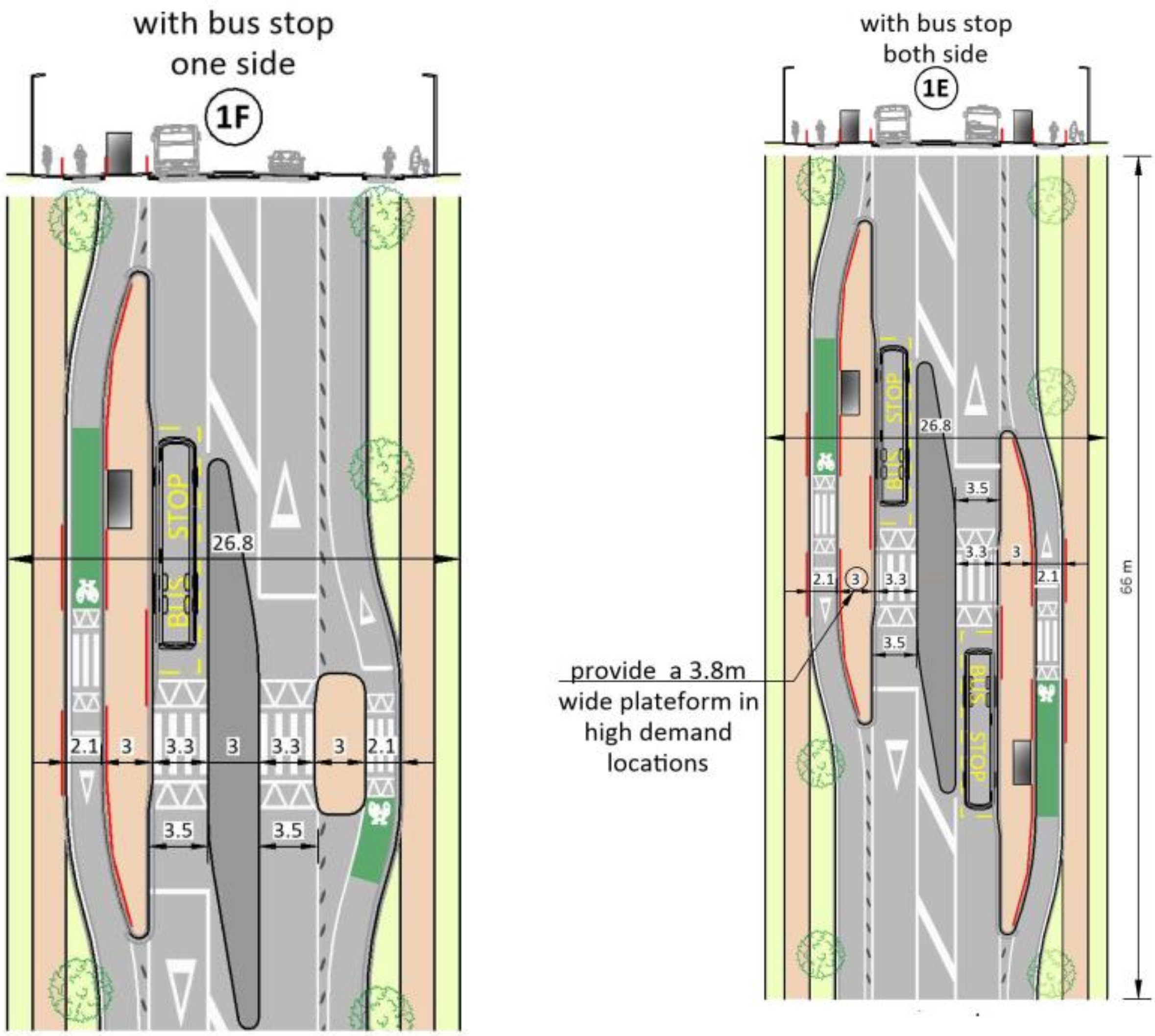


Figure 13.9: General bus stop arrangements on Minor Arterial Roads

The installations will include raised safety platforms ahead of the bus stop, including across the cycle lane. Platform height will match "accessible bus stop" height kerbing.

14 Design criteria and assumptions – Pedestrian and cycle facilities

14.1 Pedestrian and cycle facilities

Please refer to the Landscape and Urban Design section of this DPS (Section 11.4.7).

Proposed locations and widths of footpaths, cycle paths and shared paths are shown on the Concept drawings in Appendix A.

Facilities at Intersections will be developed in accordance the design philosophy for intersections presented in Section 4.

Paths shall generally be plain concrete, although other materials may be used for special purposes in feature areas such as bridges and intersections, to integrate with other landscape and urban design concepts.

15 Design criteria and assumptions – Utility services

15.1 Service relocations

Relocation of services will be undertaken if they are directly affected by this project. In general, there is an expectation that existing above ground services (that are affected) will be relocated beneath ground. Ultimately, all existing above ground services within the Peacocke Development area are envisaged to be relocated beneath ground (as development occurs), however, this project is unable to make this an explicit requirement. Instead, the design for this project has allocated space within the cross-section for utility services to be directly buried during construction, and/or ducts installed to allow future installation (as development is undertaken or demand calls for services). Where the services provide betterment to the supplier, it will be up to the utility provider to install these services (or to relocate them beneath ground).

Consideration of construction sequencing for the Detailed Design will determine whether any relocation prior to contract award is warranted to reduce programme risk. As an example, the WEL Networks line over the Waikato River are currently being programmed to be temporarily relocated to avoid clash with the bridge construction. Once the bridge is constructed these WEL Network lines will be accommodated within the new structure.

Quotations and draft methodologies will be obtained from utility owners for the purpose of preparing the estimate. However, actual relocation requirements will be determined and priced by tenderers, as the extent and scope of relocations is likely to be dependent on the tenderer's construction and staging methodologies.

15.2 Strategic services

Strategic services included in the project are:

- Approximately 1.6km of strategic water supply pipeline (from the Hamilton water treatment plant to Wairere Drive).
- Approximately 1.7km of strategic wastewater pipeline (from the Peacocke development area to Wairere Drive).

The location and design of these services will be directed by HCC.

15.3 Trunk Services

Trunk services to be included in the arterial roads to service the greater Peacocke development area include:

- Approximately 1,400m of new trunk wastewater gravity main.
- Approximately 3,000m of new trunk wastewater rising main.
- Approximately 1,525m of new trunk water supply pipeline.

The location and design of these services will be directed by HCC.

15.4 Utilities to service adjoining land

Utility networks parallel to the transport corridor to allow connection into adjoining property without disruption to the transport corridor will be installed where such needs can be reliably established. These utilities will include the likes of:

- Water supply fire mains and rider mains.
- Stormwater pipelines (where this aligns with outcomes from the ICMP).
- Ducts for power and gas.
- Ducts for communications (fibre) infrastructure.

Laterals will also be provided to adjoining land to allow for future development where the location and size of such connections can be predicted, based on land use advice provided by HCC. These laterals will (where practicable and reasonable) coincide with the position of access points to same property.

15.5 Provision for Future Services

Provision will be made to retrofit future services within structures and road corridors, as determined from discussions with utility owners.

Existing utility operators within the road corridor as well as potential new utility operators will be canvassed to determine their future needs. Recommendations will then be made to HCC regarding provision for future services within the road corridor and on structures parallel to and crossing the route.

15.6 Integration with the Waikato River Bridge

Allocation of space on the Waikato River bridge for services across the Waikato River is a key issue that must be carefully addressed to avoid the need for future retrofit and eliminate the possibility of having to attach utilities to the exterior of the bridge. Issues to be addressed include:

- Identification of all current and future service needs.
- Allocation within the bridge beams.
- Requirements for safe access to the interior of the bridge, including walkways and ventilation.
- Design of penetrations through abutments.
- Jointing requirements to allow for differential movement and flexing.
- Service chambers and turn outs at abutments (including access for possible replacement of displacement joints).

Current expectations for service provision on the bridge include:

- Strategic wastewater – one 630mm OD PE pipe and one 355mm OD PE pipe (potentially flanged steel pipe within bridge structure when not supported in earthfill)
- Strategic water – two 650mm OD PE pipes (potentially flanged steel pipe within bridge structure when not supported in earthfill)
- Gas – 160mm OD gas main located within a 250mm ID duct (either PVC or PE100 (black))
- Electricity – 33kV, 11kV, and 400V duct provision (number of ducts to be confirmed by allow for minimum of six individual ducts)
- Telecommunications (including fibre) – number of ducts to be confirmed but expectation for three individual ducts

15.7 Consultation

The following utility service authorities will continue to be consulted:

- FirstGas
- WEL Networks
- Chorus
- Vodafone
- FX Networks (Vocus Group)
- Ultrafast Fibre
- Hamilton City Council
- Waikato Regional Council
- Land Information NZ

15.8 Safe Access

Provision for safe access to utility services will be discussed with utility owners. Equipment to enable remote metering will be installed for road lighting installations.

Within the River Bridge structure there is an expectation that access provision will be provided within each of the (3m deep) bridge beams with consideration of grated walkways (within the base of the beams) being along the full length of the structure. Suitable access hatches at each end of the bridge will be provided, as will other requirements relating to potential confined spaces, such as: ventilation, harness/winch extraction equipment, lighting, electronic monitors etc.

16 Maintenance criteria

16.1 General

Input will be sought from the HCC Transportation Non-Civils Manager (at the Infrastructure Alliance) to understand the maintenance issues experienced in the area, particularly in respect of graffiti.

As well as paying attention to the details of the physical works to reduce maintenance costs, the design of the road alignment, earthworks, batters, drainage and landscaping will seek in an integrated way to reduce the footprint of the completed infrastructure, thereby minimizing the area of land that Hamilton City Council has to maintain and maximizing the area of land available for disposal after construction.

Where land within the designation is modified by the works but will later be available for disposal, in conjunction with the Land Disposal Strategy, consideration will be given to the effects of construction on the future value of that land. In some instances, this may result in restrictions on use by the Contractor and/or investment in improved rehabilitation techniques.

16.2 Maintenance Access

The design will provide the safest practical access for periodic maintenance of:

- Grassed areas within the road reserve not fronting private property and requiring mowing by HCC.
- Planted areas and wetlands.
- Stormwater treatment/attenuation devices.
- Terminals, lamps and other street lighting equipment.
- Traffic signal controllers.

Consideration will also be given to safe parking for maintenance vehicles.

Steep batters will be hard landscaped to avoid the need for maintenance. Integral strong points for rope access to steep areas will be provided if inspection is likely to be required.

16.3 Corrosion Protection

Primary structural members which are constructed in steel and which are not easily accessed or replaced will be will either be constructed using appropriately detailed weathering steel or will be corrosion protected with a system capable of achieving a time to first maintenance of at least 40 years unless otherwise agreed with HCC as road controlling authority.

Secondary structural members (such as barrier and handrails) which are constructed in steel and which are readily accessible for maintenance and replacement will be corrosion protected with a system capable of achieving a time to first maintenance of at least 25 years unless otherwise agreed with HCC as road controlling authority.

Other secondary structural members which are constructed in steel and which are modular and replaceable (such as light poles and guard rails) will be corrosion protected with a system capable of achieving a time to first maintenance of 10 to 25 years unless otherwise agreed with HCC.

Structural steelwork placed below ground will include surplus steel thickness in accordance with the Heavy Engineering Research Association's published recommendations for the nominated 100-year design life. Combinations of sacrificial thickness and surface coating will also be considered, with reference to AS 2159 and the Heavy Engineering Research Association's published recommendations.

16.4 Bridge Components

Elimination of expansion joints by using integral or semi-integral bridge abutments is increasingly favored, both in New Zealand and internationally, because of the reduced initial construction cost, reduced ongoing maintenance cost, reduced traffic disruption during joint replacement and improved ride quality for road users. Similarly, the reduction or elimination of bearings through monolithic connection between superstructure and substructure can yield significant advantage in initial cost and throughout the life of the structure.

Integral or semi-integral bridge abutments are expected to prove viable and cost-effective in most bridge locations and will be adopted wherever possible, but the length of the Waikato River Bridge is such that neither integral nor semi-integral treatment may prove viable.

Where bearings are required, elastomeric bearings will be preferred over pot bearings.

Jacking facilities will be provided for bearing replacement, wherever bearings are used.

Structures will provide for the passage of services and will be designed to accommodate in-service excavation to access services for maintenance, without need for specialist retention works.

Bridge and retaining wall components will be selected to discourage vandalism and/or minimise maintenance required as a result of vandalism. This will include consideration of:

- Positioning of components susceptible to vandalism.
- Mass of segmental wall units.
- Use of vandal-resistant materials and graffiti guard.
- Use of landscape planting in front of walls.

16.5 Ground Retention Systems

Ground retention solutions (such as timber retaining walls) with a design life less than 100 years will only be used in locations where they can be replaced without disruption to live traffic operation.

16.6 Planting

Reference should also be made to Section 11.6 (above).

Planting will be designed with the objective of:

- Avoiding and mitigating maintenance requirements.
- Minimising maintenance requirements (e.g. weed control, grazing).
- Minimising the impact of landscape maintenance activities on traffic (e.g. provision of access for maintenance, safe parking for maintenance vehicles).

The HCC Transportation team will be consulted regarding any preferences they have regarding planting and grassing, and types of hard surfaced areas. The cost of maintaining these surfaces will be considered in the selection of landscape treatment types and locations. Feedback to date has indicated that large areas of grass requiring mowing are both a significant cost and a safety issue, as can landscaping areas if positioned very close to traffic without providing reasonable separation distances or good access provisions. Ultimately, the design will seek to minimise the amount of mowing required and landscaped areas will have dedicated and planned access points to keep operations vehicles clear of live traffic.

17 Construction methodology and site access

17.1 General

The construction methodology and site access provisions will be developed as the Detailed Design is progressed, and modifications made to the Detailed Design if necessary, to ensure it can be constructed in a manner which is cost efficient and minimises disruption to road users and stakeholders.

17.2 Enabling Works

Opportunities for early works will be identified as the Detailed Design is developed. Where such early works will bring programme and/or cost advantages and/or reduces underlying project risk to the project without limiting opportunities for the physical works contractor, these will be discussed with the Project Manager and implemented as instructed. This could include:

- Selected service relocations (such as the WEL Networks Powerline Relocation over the river).
- Selected accommodation works from property agreements.
- Vegetation clearance.
- House removal.
- Access tracks to enable early site establishment.
- Advanced ecological mitigation planting.

17.3 Waikato River bridge

Good access for construction plant and materials is available beyond the top of the right and left true banks of the Waikato River. Hence foundation construction will not be difficult, although the potential for stability enhancement of the steep right true bank to be required is noted, as is the potential for soil improvement to be required to reduce liquefaction potential and enhance post-liquefaction performance in the vicinity of pier and abutment foundations on the left true bank.

Initial expectations for the construction of the northern bridge abutment will involve establishment of stepped platforms to be excavated on the north bank to position each bored pile and to allow a containment area around the pile for excavated materials. The platform will need to be contoured to ensure sediment and debris does not risk travelling down the northern bank and into the river (i.e. erosion and sediment control plans will be challenging). Given the change in shape of the northern bank across the cross-section of the road it is likely that each pile will have its own platform level. In addition, the current arrangement would require a relatively large retained wall to be constructed between each of the northern abutment piles in order to contain earth fill behind the abutment line. This would result in a relatively large and stepped retained system beneath the bridge. The alternative to this arrangement is the development of an additional span (land span) to change the pile line (at the northern landing point) to a traditional pier arrangement and create the abutment approximately 20m further inland. This decision will be made during the detailed design phase (before end of 2019) and will largely depend on review of optimum construction methodology and opportunity to reduce seismic-induced earth-restrained systems (e.g. soil nails) on the northern bank.

Construction of the superstructure of the Waikato River Bridge will introduce greater challenges associated with the length of the main spans of the bridge, and the height and complexity of the preferred pier stem structure.

The interlocking leg members of the 'Y'-pier will require meticulous attention to ensure acceptable fabrication tolerances are achieved. Completion of welded connections between legs is expected to be most practical on site, necessitating the provision of appropriate controlled conditions for welding, testing of welds, and corrosion protection of (at least) weld zones. Erection of the 'Y'-piers will not be unduly demanding in terms of weight, but temporary foundations and ties between legs are expected to be necessary to ensure structural stability at each stage of construction.

Deep steel stringer beam members will be required, introducing demanding fabrication and transport logistical requirements. Once fabricated and on site, erection and installation of the deep stringer beams will require the use of heavy craneage and working at height to connect components.

Construction of the deck slab and rendering the deck slab composite with the supporting steel stringer beams is orthodox and is not seen as unduly demanding. A combination of precast concrete permanent formwork and reinforced concrete deck overlay is proposed to complete efficient construction of a simple and robust superstructure.

The detailed design documentation will include a notional construction sequence and construction system which has been supported by analysis, but temporary works will remain the Contractor's responsibility, and it is probable that no tenderer will opt to follow the notional construction sequence in all respects. Contract documentation will ensure that the demarcation between responsibilities for temporary and permanent works is clear, including the Contractor's obligations for design and design review certification of temporary works.

17.4 Construction Traffic Management

Construction traffic management is a requirement that needs to be addressed as part of the project designation requirements. Given the effects are highly dependent on works undertaken on adjoining projects and planned urban developments, this is a matter that needs to be managed/controlled at a wider (Peacocke Development area) network basis opposed to a local project level. This is to ensure all outcomes are well-coordinated and planned by all parties. To assist in this Construction Traffic Network Management process, the following provides a brief summary of the key aspects/details that need to be considered in respect to this PST project:

- The contract period is expected to extend over a 2.5-year period, and construction activity will be seasonal.
- At its peak, there are expected to be approximately 80 HCV movements per day (in each direction) in addition to approximately 70 worker vehicles per day. This peak is expected be in the summer of 2021/2022.
- There are only two (general) road network access points to the PST project area. Both these access corridors are not ideal and include:
  - Through the urban area of Dixon Road and/or Bader Street
  - Through the rural area of Peacockes Road/Raynes Road
- Key issues with each of these access corridors include:
  - Dixon Road/Bader area:
    - Residential area with associated safety issues mixing HCV's with residential activities (such as school kids, regular access points, cyclists etc).
    - Minor works safety improvements proposed for Bader Street – potential damage to new works and/or restriction to HCV tracking.
    - Noise/dust/nuisance complaints by a large residential population.
  - Peacockes Road/Raynes Road:
    - Low standard rural road with relatively narrow cross-section and areas where low sight distances are achieved.
    - Currently used by an increasing volume of rat-runners seeking to avoid existing roadwork activities on the State highway network.
    - Existing condition of pavement is very poor, with indication that pavement will not be able to withstand predicted HCV content.
- There are a number of potential solutions that need to be considered, and we recommend the following is discussed with the wider HCC and Peacocke Development team in order to agree on how best to manage construction traffic effects:
  - Public relations – information on effects being well publicized so no surprises.

- Tender documentation to ensure construction traffic effects are well considered in their submissions, with credit (monetary incentives) being provided for construction methods that seek to minimise effects.
- Consider restriction of routes for construction related traffic – key questions about how to manage/police this, commercial limitations of outcomes (i.e. extra cost), how to isolate PST effects from those of other developments etc.
- Further staging of works to limit peak construction traffic (but probably extend duration of works), or to facilitate early completion of the River bridge to provide construction site access to balance of Peacocke area (programme and cost implications).
- Consider what improvements are needed to each corridor to manage effects and get those works either constructed in advance of PST project, or as part of the PST scope. Options include:
  - Speed limit changes
  - Intersection improvements/restrictions/road closures
  - Network signage
  - Pavement rehabilitations (primarily Peacockes Road)
  - Additional safety improvements – particularly on residential roads
  - Footpaths/cycleways built in advance
- Do nothing (or do minimum) and just accept there will be noise/nuisance complaints and requirement to patch the roads (i.e. these are legal roads that anyone can use).

17.5 Temporary carriageways

17.5.1 Weston Lea Drive

During construction of Peacockes Road upgrade, there is an expectation that existing traffic will need to be diverted on to an alternative (temporary) corridor. The simplest way would involve completion of Weston Lea Drive (at least to enable connectivity) early in the construction phase and diversion of Peacockes Road traffic on to the Weston Lea Drive alternative route. This would enable Peacockes Road to be realigned and upgraded without disruption from operational traffic (with the exception of maintaining access to adjoining properties).

17.6 Accessway (driveways) into work site

Construction access proposals will be developed in conjunction with the Detailed Design. Access to much of the site is relatively straight forward from existing roads The Project Manager will be advised at the earliest opportunity if access over private land and/or outside of the designation is considered desirable.

17.7 Earthworks cut/fill balance

Currently a surplus of excavated material is envisaged (over and above that required for filling) of approximately 100,000 to 150,000m^3, requiring an area for local disposal. Options include:

- Formation of an embankment for the North-South Arterial.
- Transfer of material to the East-West Arterial construction site (current shortage of fill material), subject to arranging property access and management of temporary stockpiles, potentially for a number of years.
- Local disposal within adjoining properties to help form ultimate property development levels, subject to landowner agreement.
- Disposal off site (least favoured option).

17.8 Erosion and sediment control

Construction and maintenance of erosion and sediment control measures will be considered in the Detailed Design and discussed directly with Waikato Regional Council. A draft Erosion and Sediment Control Plan will be produced to support the resource consent application, to confirm that controls are feasible within the designation and for cost estimation purposes.

18 Implications for procurement

A procurement strategy will be prepared during the detailed design phase to respond to latest project knowledge and feedback from industry. At this time the following procurement details are envisaged:

- Procurement as one-single project package
- Likely to be traditional – Measure and Value contract
- High-level of interest from construction industry
- Call for registrations of interest – November 2019
- Shortlisting – January 2020 to February 2020
- Tender proper – April to June 2020
- Award – late July 2020

The following matters are the key things that the project team will continue to think about that relate to the procurement process and may also have an influence on the design as it continues to be developed:

a) Potential staging of construction works – e.g. splitting up the Waikato River bridge (and approaches – interchange to Weston Lea Drive) from balance of local road works.

b) Potential inclusion of the Strategic Wastewater (N4) pump station within project scope.

c) Identification of design elements that could be refined (designed) by the contractor – this could include elements that are low risk or have low consequence of the outcome, or be elements that HCC requires less control over the eventual outcome. Examples could include fixing details of bridge edge treatments, lifting eyes on walkway slabs etc. Contract could seek to incentivize opportunities for contractor to identify these opportunities and share in a portion of the net savings returned.

d) Enabling contracts could be let in advance of the main contract – such as services relocations, vegetation removal, fencing, ground improvements (including preload set up) etc.

e) Potential for HCC to pursue the direct appointment of (a) preferred supplier of some construction elements (such as supply and installation of pedestrian/cycle bridge). Interface issues will be critical.

f) There is currently a high risk that there is a delay in access to some key properties (or delay in consent issue) that may affect how project staging can be undertaken (aim to make work elements less reliant on completion of other features).

g) There is currently an expectation that the project works will include a significant volume of excess fill. Opportunities should be pursued to identify areas of potential disposal (flattening batters, filling low spots, agreement with adjoining landowners etc), or outcomes that seek to minimise the amount of material cut (steepen batters). Other options include cross-boundary investigation for use of material on other projects (such as North-South Arterial or East-West Arterial) or potentially use within private developments etc.

h) Community response to construction traffic matters could influence how access to the site is managed – restriction of routes, time of day etc.

i) Construction cost estimates could exceed budget some further refinement/optimization of the design may be necessary, and/or removal of some (less critical) design elements. Need to identify critical and complementary design elements.

j) Weather – different construction methodology and/or programme in response to inclement weather.

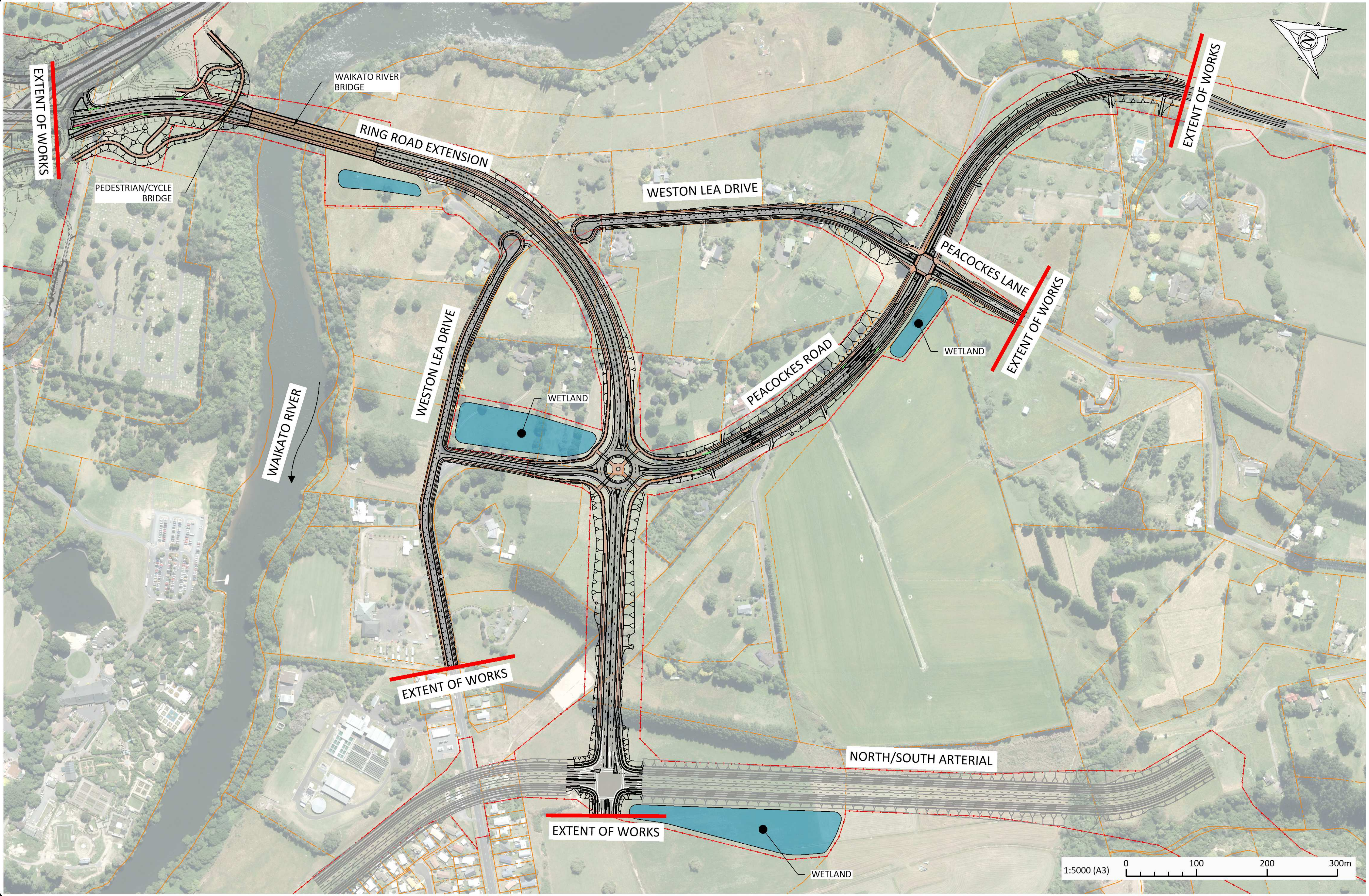
k) Different contractors may have preferred bridge launching methods and/or equipment that could change how the bridge structural elements are developed. Important to make sure that assumed construction methodology is tested with a range of contractors, and/or ensure design is developed in a way that is less reliant on one particular method.

l) The wetland outlet structures are significant, particularly the Pirrit outlet, which will likely require specialist skills to achieve the desired landscape/hydraulic/aesthetic outcome. The contractor will need to be well versed with these requirements during the tender phase to ensure they cover the necessary skills and account for the costs related to this discrete item.

m) Lead-times for specific supply elements (e.g. supply from service agents, weathering steel, Strategic Water/Wastewater pipes etc). Important to understand these in completing the design as some specified elements (particularly non-standard elements) may have more/less lead-in period and ensuring the procurement/construction programme makes allowance for these leads.

n) Interface with contractors on adjoining projects (such as Wairere-Cobham or N4 pump station). Allowances may need to be made to any restriction imposed by adjoining works or how crossovers of project footprints (site possession) or construction traffic may be managed. Completely independent accesses/site offices etc may be needed, and likewise shared accesses/sites may need to be well defined.

Appendix A – Concept Drawings



REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

Version 3.0 - September 2017

DESIGNED: LV
CHECKED: CM
DRAWN: AA
APPROVED: JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: GENERAL OVERVIEW PLAN

STATUS: PRELIMINARY
DATE: 30/07/2019
SCALE (ORIGINAL SIZE A3): 1:5000
DRAWING NUMBER: 145900-001A-1200
REVISION: A

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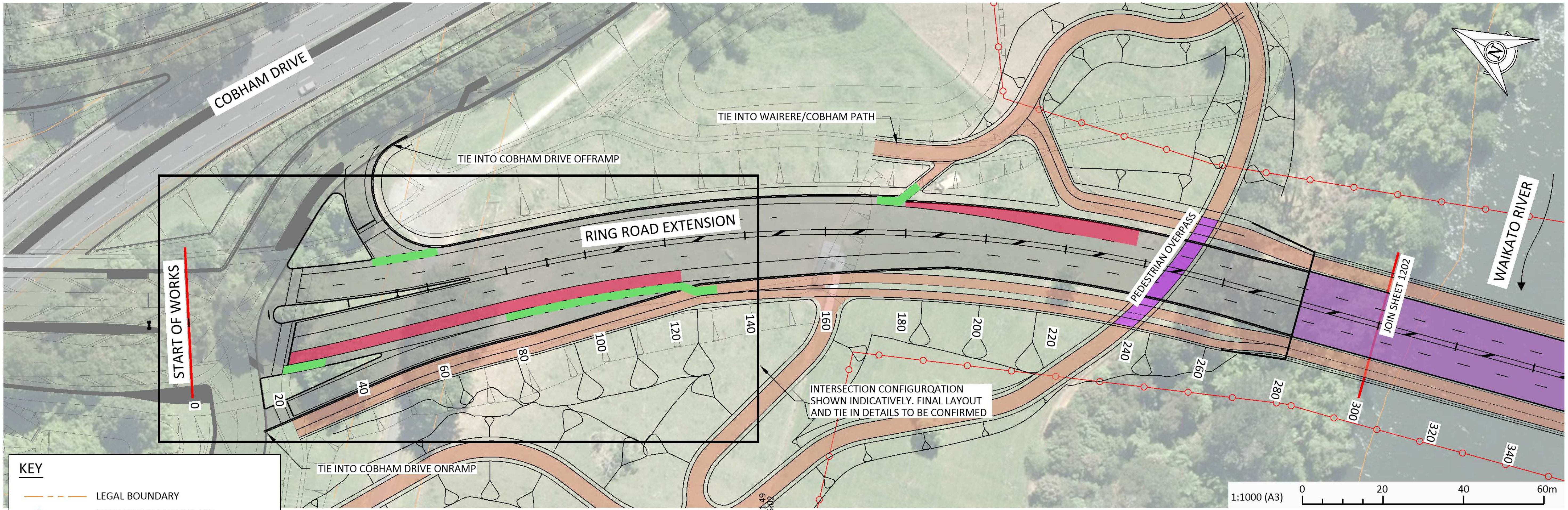

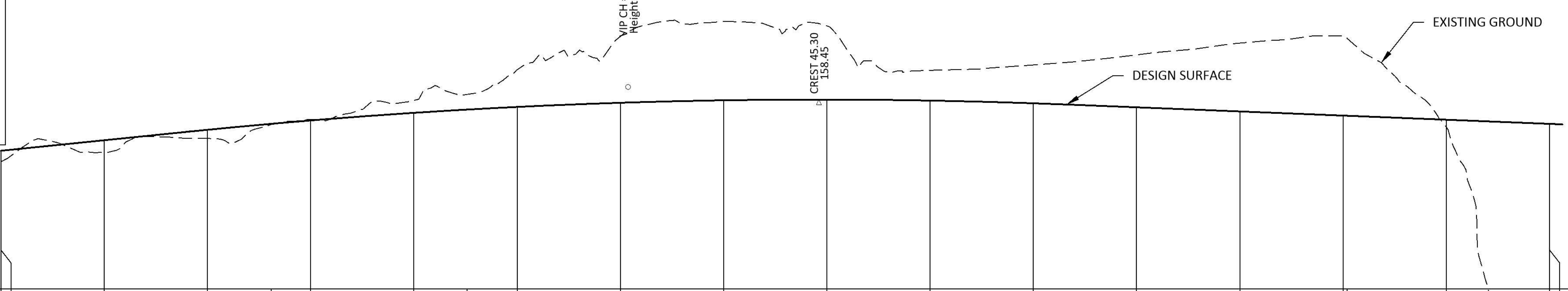

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LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

Version 3.0 - September 2017

DESIGNED: LV
CHECKED: CM
DRAWN: AA
APPROVED: JG
mx model version:

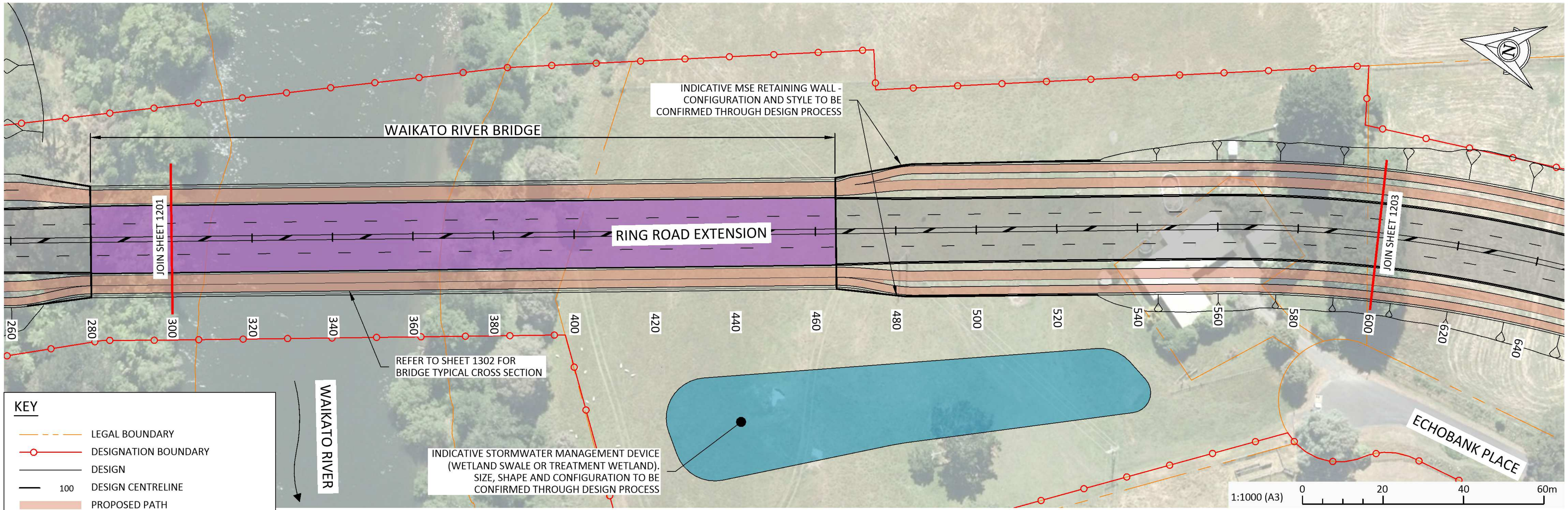
BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

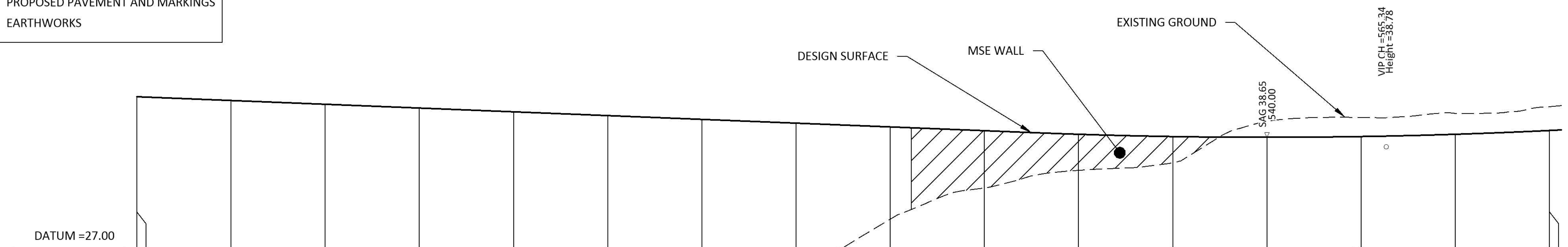
DRAWING: RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 1

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): AS SHOWN
DRAWING NUMBER: 145900-001A-1201
REVISION: A



KEY

- LEGAL BOUNDARY
- DESIGNATION BOUNDARY
- DESIGN
- 100 DESIGN CENTRELINE
- PROPOSED PATH
- PROPOSED PAVEMENT AND MARKINGS
- EARTHWORKS



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CONTROL LEVELS	42.95 42.95	42.55	42.15	41.75	41.35	40.95	40.55	40.15	39.75	39.35	38.97	38.73	38.65	38.73	38.97	39.37 39.37
EXISTING GROUND	17.03 17.03	7.67	10.00	12.09	14.94	21.15	23.47	25.29	29.98	33.27	35.15	35.95	40.35	40.74	41.18	41.89 41.89
DEPTHS	-25.92 -25.92	-34.88	-32.15	-29.66	-26.41	-19.80	-17.08	-14.86	-9.77	-6.08	-3.82	-2.78	1.70	2.01	2.21	2.52 2.52
CHAINAGE	300.00 300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00 600.00

LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM | DRAWN: AA | APPROVED: JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 2

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): AS SHOWN
DRAWING NUMBER: 145900-001A-1202
REVISION: A

Version 3.0 - September 2017

C:\12dsynergy\data\10.7.120.14\Peacocke - Design_4923\03 Drawings\145900-001A\145900-001A-1202.dwg 2/8/2019 3:53 PM mliu

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY
100mm
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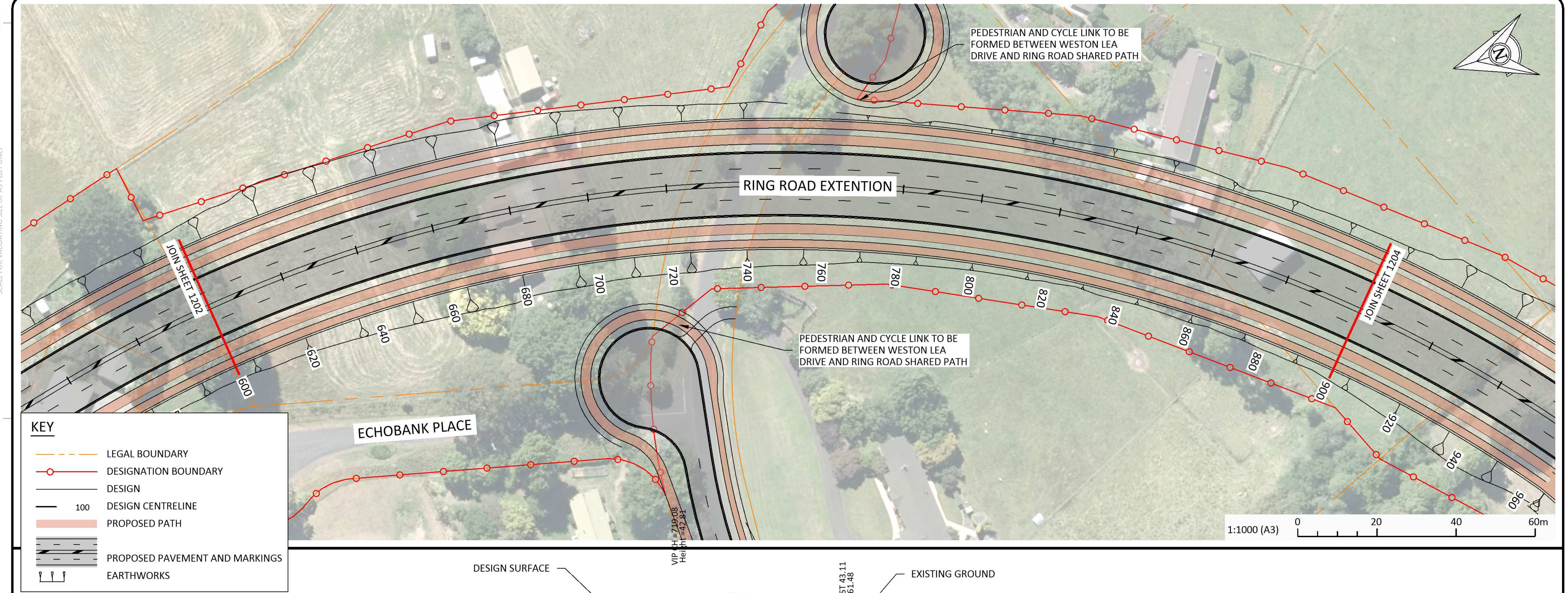

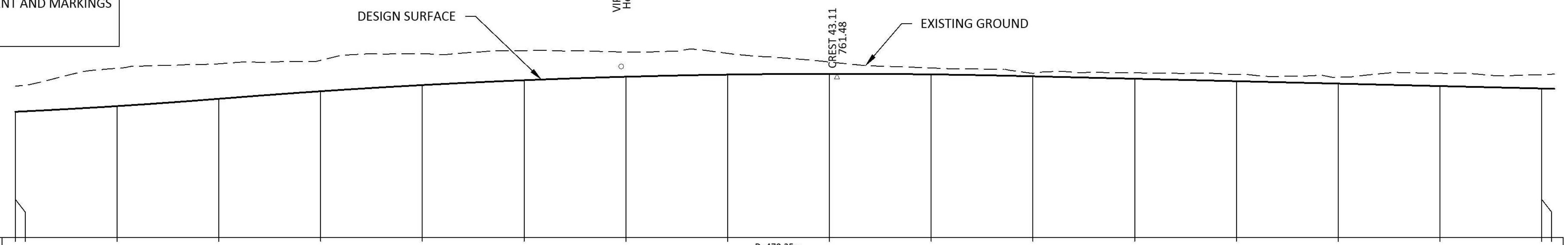

DATUM =27.00

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VERTICAL DATA	K=25.00 L=150.67 P=4.03%		K=30.00 L=156.81								P=-1.20% L=208.18					
CONTROL LEVELS	39.37 39.37	39.93	40.65	41.39	42.00	42.48	42.82	43.03	43.11	43.05	42.86	42.62	42.38	42.14	41.90	41.66 41.66
EXISTING GROUND	41.89 41.89	43.65	44.09	44.44	45.08	45.40	45.25	45.12	44.27	43.69	43.15	43.20	43.04	42.77	43.16	43.03 43.03
DEPTHS	2.52 2.52	3.72	3.44	3.04	3.08	2.92	2.43	2.09	1.16	0.63	0.28	0.58	0.66	0.63	1.25	1.37 1.37
CHAINAGE	600.00 600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00 900.00

LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG	
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR	

DESIGNED LV | CHECKED CM
DRAWN AA | APPROVED JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

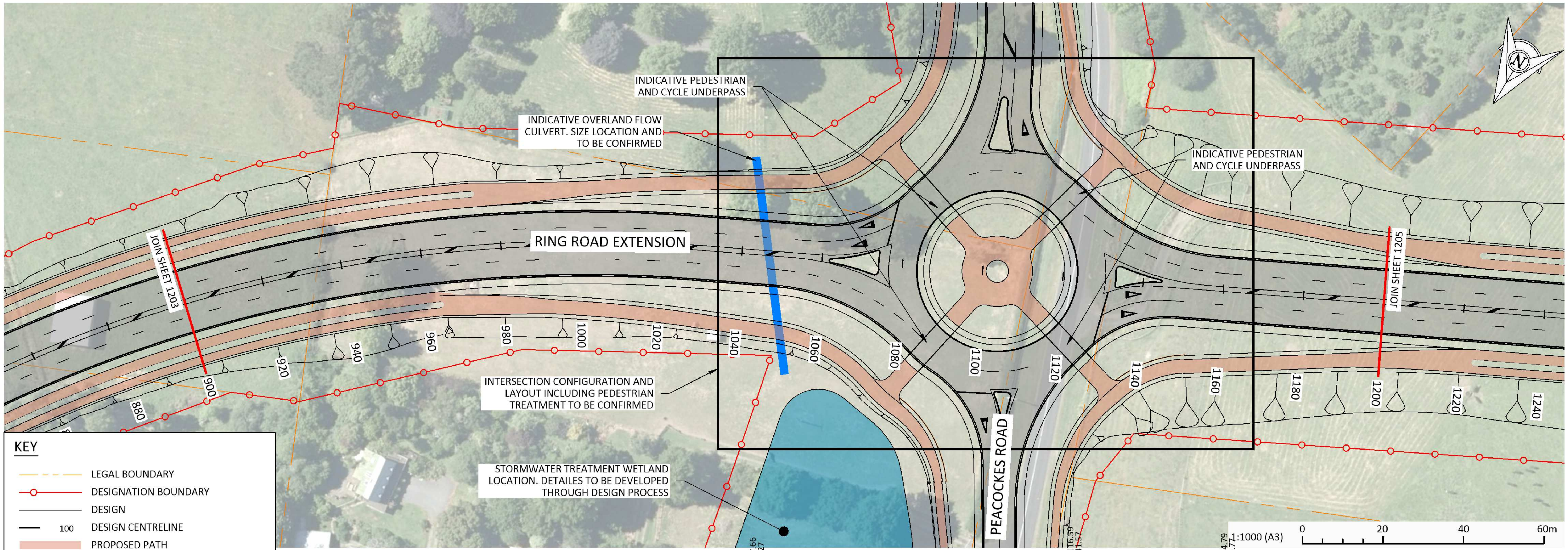
CLIENT
Hamilton City Council
Te kaunihera o Kirikiriroa

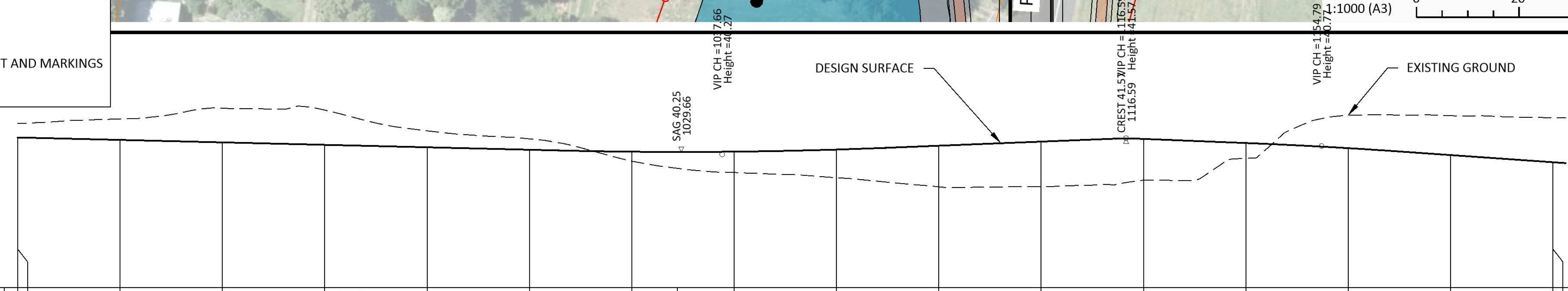
PROJECT
PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING
RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 3

STATUS
PRELIMINARY

DATE 19.07.2019
SCALE (ORIGINAL SIZE A3) 1:1000
DRAWING NUMBER 145900-001A-1203
REVISION A





HORIZONTAL DATA	D=470.35m R=350.00 L=470.35							D=780.38m								
VERTICAL DATA	P=-1.20% L=208.18						K=20.00 L=63.99			P=2.00% L=44.94		K=1.00 L=4.00	P=-2.00% L=21.21	K=20.00 L=29.97	P=-3.50% L=223.38	
CONTROL LEVELS	41.66 41.66	41.42	41.18	40.94	40.70	40.46	40.27	40.28	40.48	40.86	41.26	41.52	41.12	40.62	39.94	39.24 39.24
EXISTING GROUND	43.03 43.03	43.47	44.52	44.34	42.31	41.53	39.35	38.24	37.73	36.84	36.84	37.48	39.62	43.83	43.79	43.60 43.60
DEPTHS	1.37 1.37	2.05	3.34	3.40	1.61	1.06	-0.93	-2.03	-2.75	-4.02	-4.42	-4.04	-1.50	3.21	3.85	4.36 4.36
CHAINAGE	900.00 900.00	920.00	940.00	960.00	980.00	1000.00	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00	1160.00	1180.00	1200.00 1200.00

LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

DESIGNED LV | CHECKED CM
DRAWN AA | APPROVED JG
mx model version:

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Phone +64-7-838 0144, Fax +64-7-839 0431

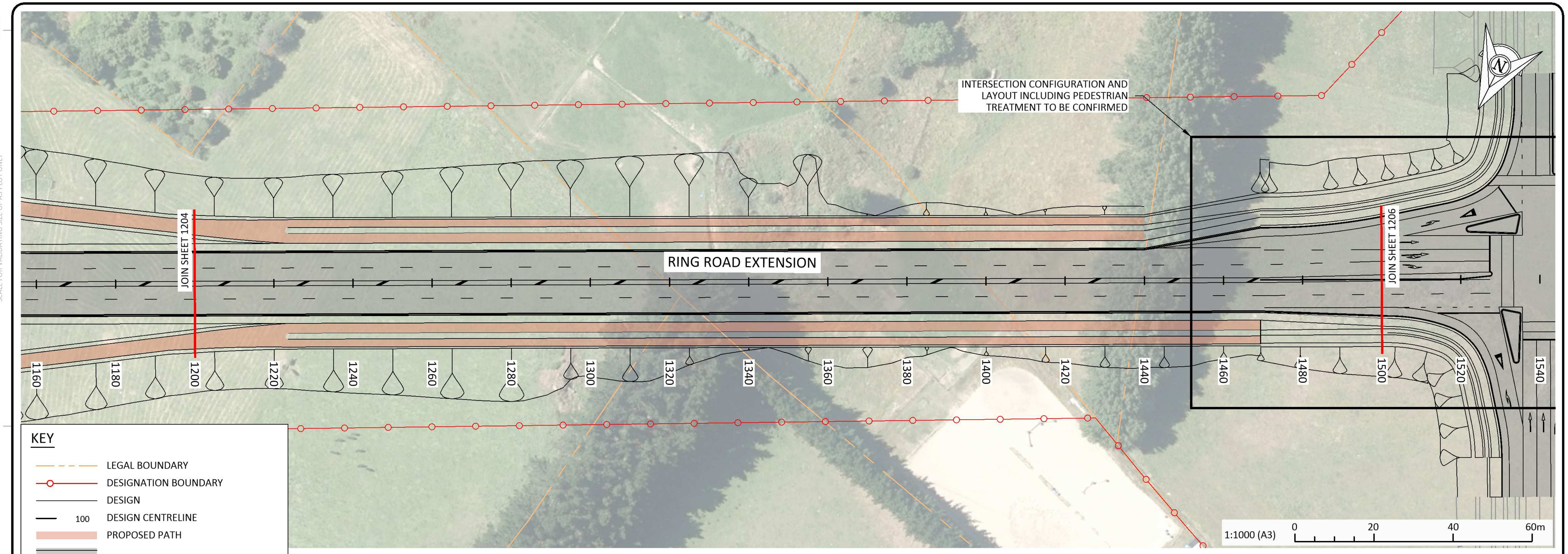
CLIENT
Hamilton City Council
Te kaunihera o Kirikiriroa

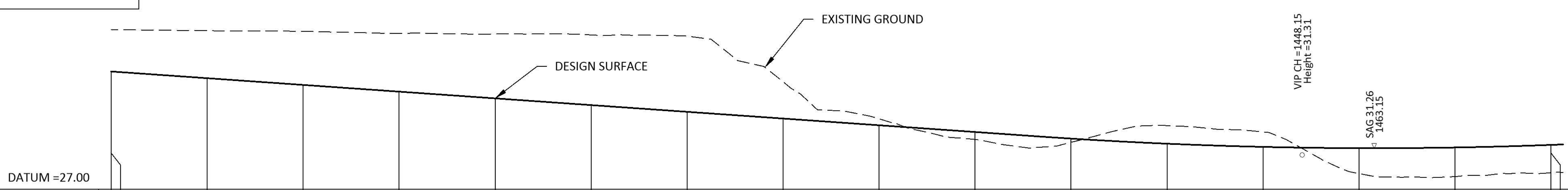
PROJECT
PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING
RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 4

STATUS
PRELIMINARY

DATE 19.07.2019
SCALE (ORIGINAL SIZE A3) 1:1000
DRAWING NUMBER 145900-001A-1204
REVISION A





HORIZONTAL DATA	D=780.38m															
VERTICAL DATA	P=-3.50% L=223.38										K=20.00 L=110.00					
CONTROL LEVELS	39.24 39.24	38.54	37.84	37.14	36.44	35.74	35.04	34.34	33.64	32.94	32.25	31.72	31.39	31.26	31.33	31.60 31.60
EXISTING GROUND	43.60 43.60	43.50	43.42	43.21	43.14	43.05	42.92	38.18	34.32	32.17	31.87	33.61	32.95	28.62	28.30	28.71 28.71
DEPTHS	4.36 4.36	4.96	5.57	6.07	6.70	7.30	7.88	3.83	0.67	-0.78	-0.38	1.88	1.56	-2.64	-3.03	-2.89 -2.89
CHAINAGE	1200.00 1200.00	1220.00	1240.00	1260.00	1280.00	1300.00	1320.00	1340.00	1360.00	1380.00	1400.00	1420.00	1440.00	1460.00	1480.00	1500.00 1500.00

LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED LV | CHECKED CM | DRAWN AA | APPROVED JG

mx model version:

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CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 5

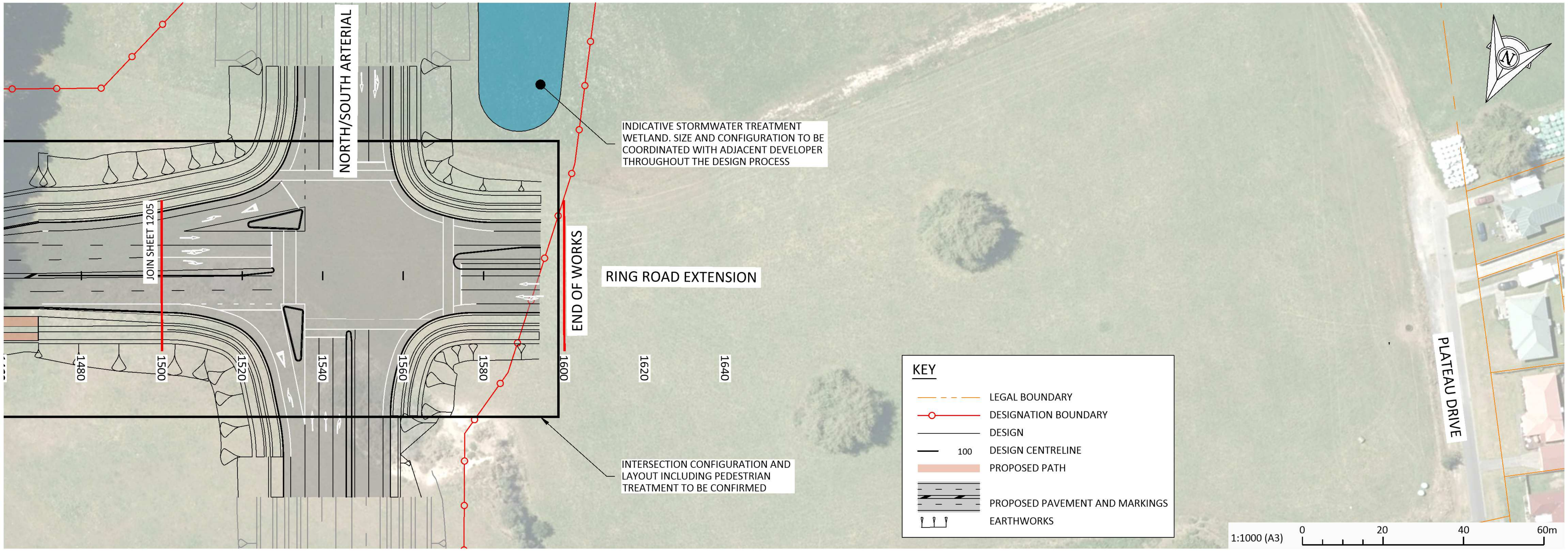
STATUS: PRELIMINARY

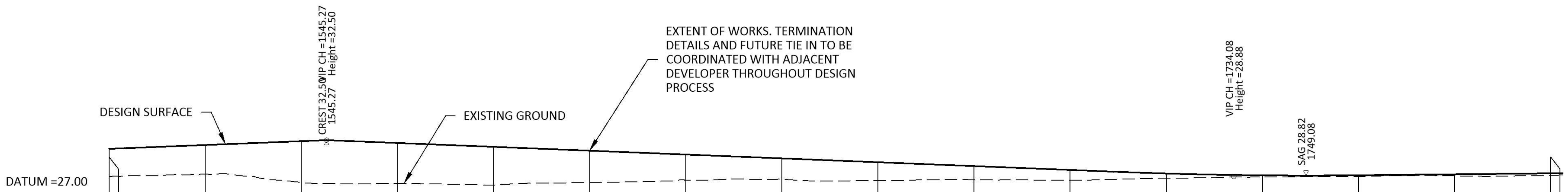
DATE: 19.07.2019

SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-1205

REVISION: A





HORIZONTAL DATA: D=780.38m

VERTICAL DATA: K=20.00, L=110.00 | P=2.00%, L=42.12 | P=-2.00%, L=163.81 | K=20.00, L=50.00 | P=0.50%, L=50.23

CHAINAGE	CONTROL LEVELS	EXISTING GROUND	DEPTHS
1500.00	31.60	28.71	-2.89
1500.00	31.60	28.71	-2.89
1520.00	31.99	28.96	-3.03
1540.00	32.39	28.11	-4.29
1560.00	32.21	28.00	-4.21
1580.00	31.81	27.84	-3.96
1600.00	31.41	28.09	-3.32
1620.00	31.01	28.36	-2.65
1640.00	30.61	28.44	-2.16
1660.00	30.21	28.30	-1.91
1680.00	29.81	28.40	-1.41
1700.00	29.41	28.34	-1.07
1720.00	29.04	28.54	-0.50
1740.00	28.84	28.68	-0.17
1760.00	28.85	28.72	-0.13
1780.00	28.95	28.79	-0.16
1800.00	29.05	28.85	-0.20
1800.00	29.05	28.85	-0.20

LONGSECTION ALIGNMENT RS00

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM | DRAWN: AA | APPROVED: JG
mx model version:

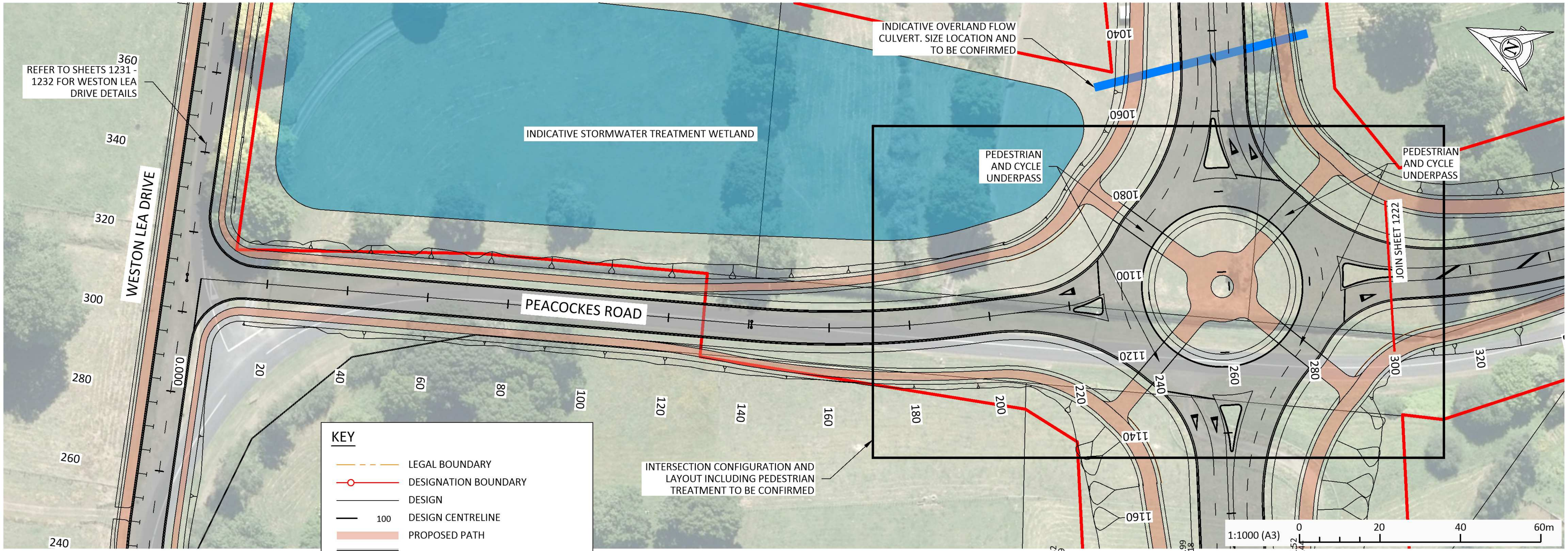
BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

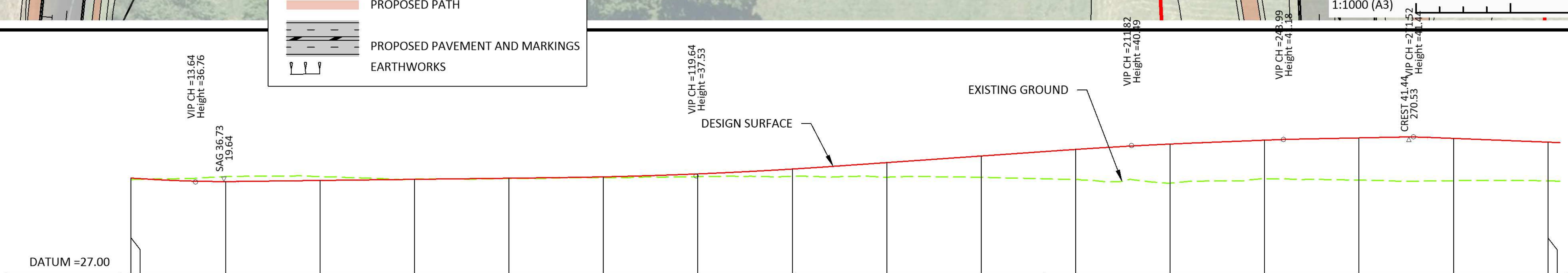
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: RING ROAD EXTENSION - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 6

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1206
REVISION: A





HORIZONTAL DATA: D=140.7m | D=52.57m R=-250.00 L=52.57 | D=65.01m | D=51.19m

VERTICAL DATA: P=-3.00% L=4.64 | K=5.00 L=18.00 | P=0.60% L=68 | K=20.00 L=58.00 | P=3.50% L=48.18 | K=20.00 L=30.00 | P=2.00% L=15.17 | K=4.00 L=4.00 | P=1.00% L=22.55 | K=2.00 L=5.97 | P=-1.99% L=65.17

CONTROL LEVELS	37.09 37.09	36.73	36.84	36.96	37.08	37.22	37.54	38.05	38.73	39.43	40.13	40.70	41.11	41.35	41.29	40.90 40.90
EXISTING GROUND	36.94 36.94	37.24	37.25	36.99	37.04	37.13	37.25	37.29	37.18	37.19	36.93	36.55	37.01	36.88	36.82	36.80 36.80
DEPTHS	-0.15 -0.15	0.52	0.41	0.03	-0.04	-0.09	-0.29	-0.76	-1.55	-2.24	-3.20	-4.14	-4.10	-4.47	-4.48	-4.10 -4.10
CHAINAGE	0.00 0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00 300.00

LONGSECTION ALIGNMENT RS10

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM | DRAWN: AA | APPROVED: JG

mx model version:

BLOXAM BURNETT & OLLIVER

Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 1

STATUS: PRELIMINARY

DATE: 19.07.2019

SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-1221

REVISION: A

Version 3.0 - September 2017

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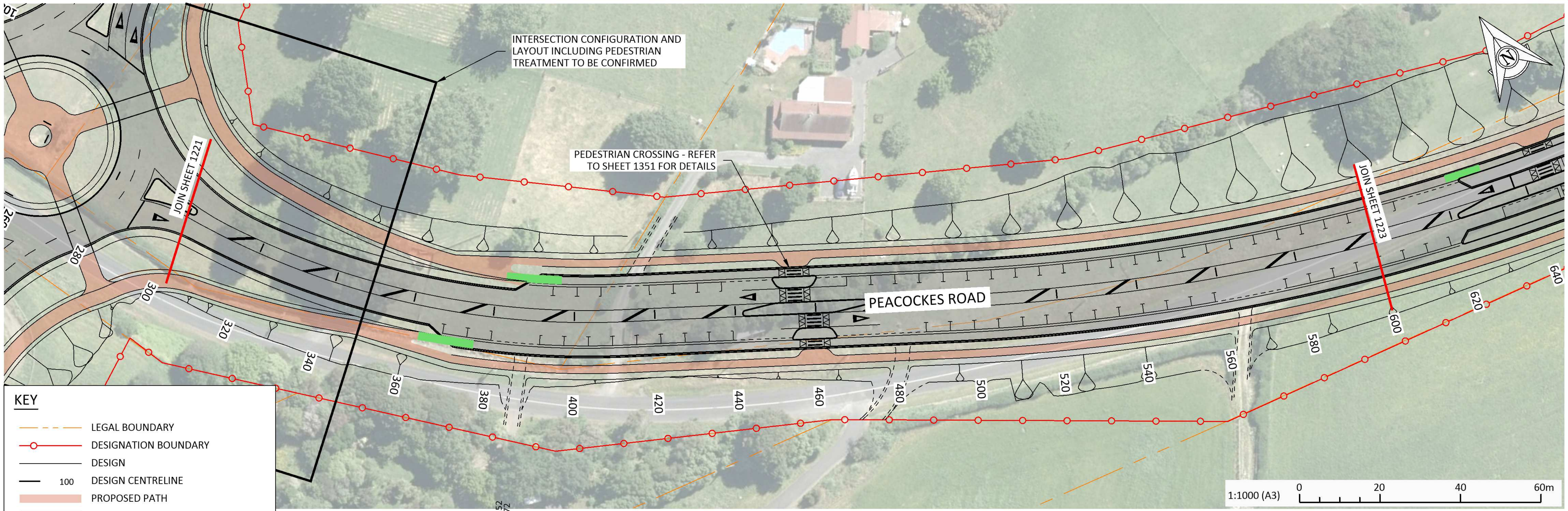
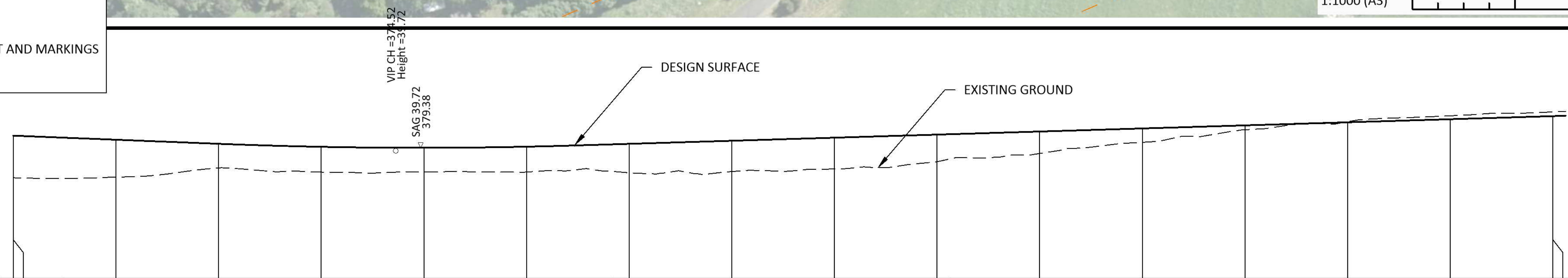
SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY 100mm 0



KEY

- LEGAL BOUNDARY
- DESIGNATION BOUNDARY
- DESIGN
- 100 DESIGN CENTRELINE
- PROPOSED PATH
- PROPOSED PAVEMENT AND MARKINGS
- EARTHWORKS



DATUM =27.00

HORIZONTAL DATA: D=51.19m | D=106.96m, R=-200.00, L=106.96 | D=65.84m | D=295.34m, R=-500.00, L=295.34

VERTICAL DATA: P=-1.99%, L=65.17 | K=20.00, L=69.71 | P=1.50%, L=229.03

CHAINAGE	CONTROL LEVELS	EXISTING GROUND	DEPTHS
300.00	40.90	36.80	-4.10
300.00	40.90	36.80	-4.10
320.00	40.50	36.85	-3.65
340.00	40.10	37.75	-2.35
360.00	39.81	37.35	-2.46
380.00	39.72	37.37	-2.34
400.00	39.82	37.35	-2.47
420.00	40.10	37.28	-2.82
440.00	40.40	37.40	-3.00
460.00	40.70	37.65	-3.05
480.00	41.00	38.37	-2.63
500.00	41.30	39.16	-2.14
520.00	41.60	40.25	-1.35
540.00	41.90	41.47	-0.43
560.00	42.20	42.26	0.06
580.00	42.50	42.83	0.33
600.00	42.80	43.21	0.41
600.00	42.80	43.21	0.41

LONGSECTION ALIGNMENT RS10

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED LV | CHECKED CM | DRAWN AA | APPROVED JG | mx model version:

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Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

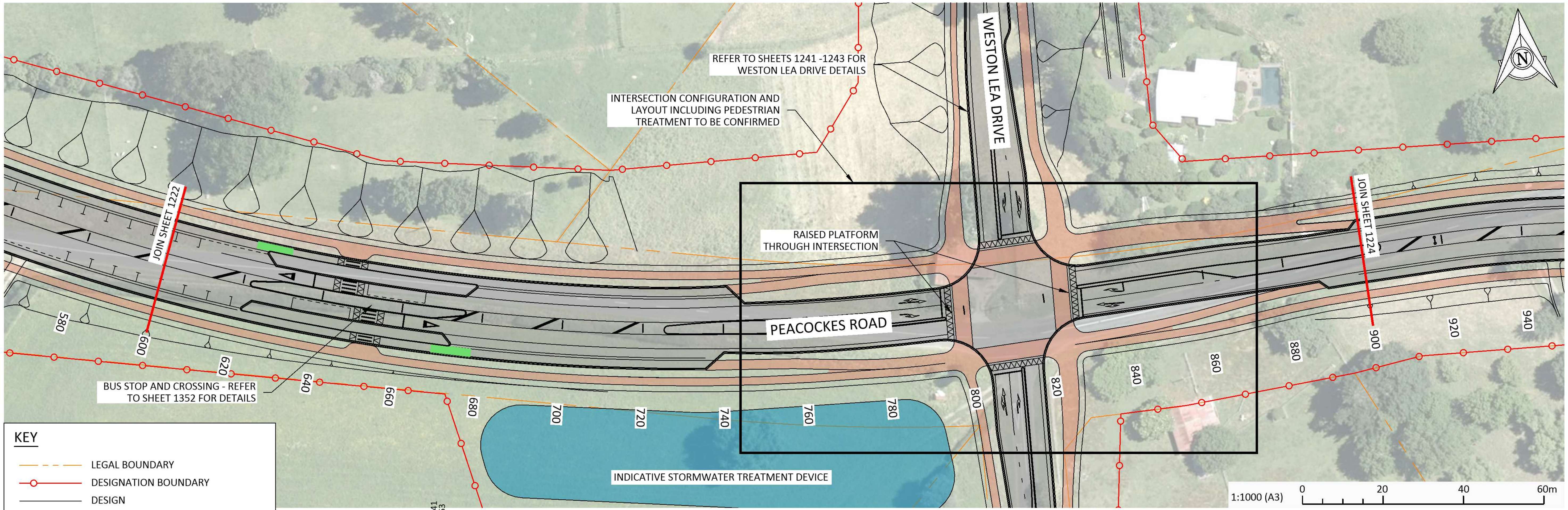
PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 2

STATUS: PRELIMINARY

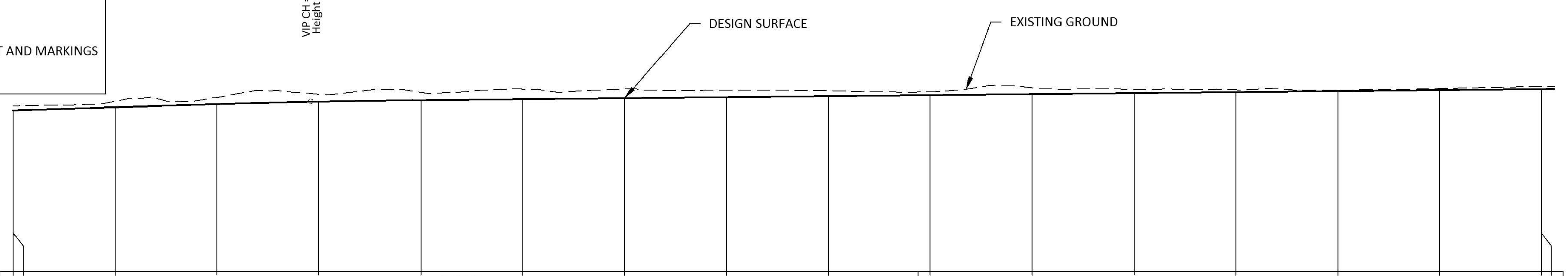
DATE: 19.07.2019 | SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-1222 | REVISION: A



KEY

- LEGAL BOUNDARY
- DESIGNATION BOUNDARY
- DESIGN
- 100 DESIGN CENTRELINE
- PROPOSED PATH
- PROPOSED PAVEMENT AND MARKINGS
- EARTHWORKS



DATUM =27.00

HORIZONTAL DATA: D=295.34m, R=-500.00, L=295.34 | D=150.4m

VERTICAL DATA: P=1.50%, L=229.03 | K=40.00, L=40.00 | P=0.50%, L=714.26

CHAINAGE	600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00
CONTROL LEVELS	42.80 42.80	43.10	43.40	43.64	43.78	43.88	43.98	44.08	44.18	44.28	44.38	44.48	44.58	44.68	44.78	44.88 44.88
EXISTING GROUND	43.21 43.21	43.68	44.06	44.36	44.56	44.89	44.89	44.78	44.73	44.62	45.01	44.88	44.81	44.79	44.94	45.13 45.13
DEPTHS	0.41 0.41	0.58	0.66	0.72	0.78	1.00	0.91	0.70	0.54	0.34	0.62	0.40	0.22	0.11	0.15	0.25 0.25

LONGSECTION ALIGNMENT RS10

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM
DRAWN: AA | APPROVED: JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 3

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1223
REVISION: A

Version 3.0 - September 2017

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SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY
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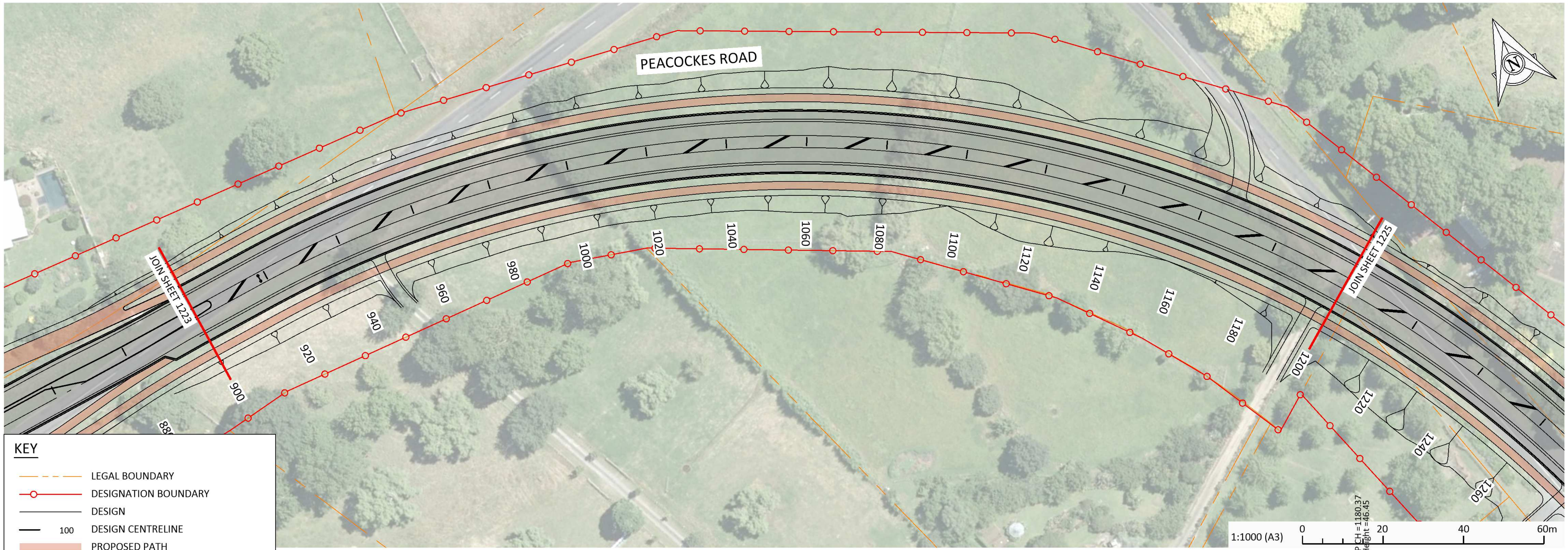

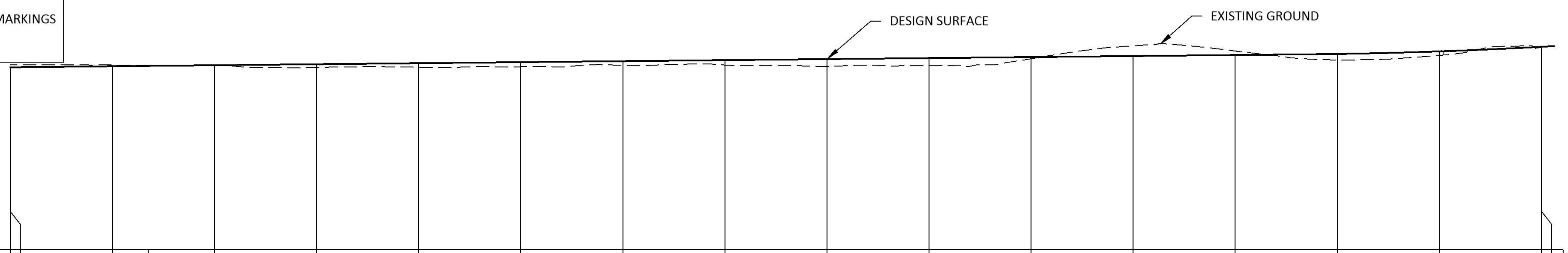

HORIZONTAL DATA	D=149.44m	D=409.42m R=280.00 L=409.42														
VERTICAL DATA	P=0.50% L=476.41														K=20.00 L=51.11	
CONTROL LEVELS	44.88 44.88	44.98	45.08	45.18	45.28	45.38	45.48	45.58	45.68	45.78	45.88	45.98	46.08	46.19	46.44	46.89 46.89
EXISTING GROUND	45.13 45.13	45.11	45.07	44.88	44.89	44.94	45.07	45.10	44.97	45.04	45.72	46.98	46.48	45.60	46.05	46.86 46.86
DEPTHS	0.25 0.25	0.12	-0.02	-0.31	-0.40	-0.45	-0.41	-0.48	-0.72	-0.74	-0.16	1.00	0.39	-0.59	-0.39	-0.04 -0.04
CHAINAGE	900.00 900.00	920.00	940.00	960.00	980.00	1000.00	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00	1160.00	1180.00	1200.00 1200.00

LONGSECTION ALIGNMENT RS10

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

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A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

DESIGNED: LV | CHECKED: CM
DRAWN: AA | APPROVED: JG
mx model version:

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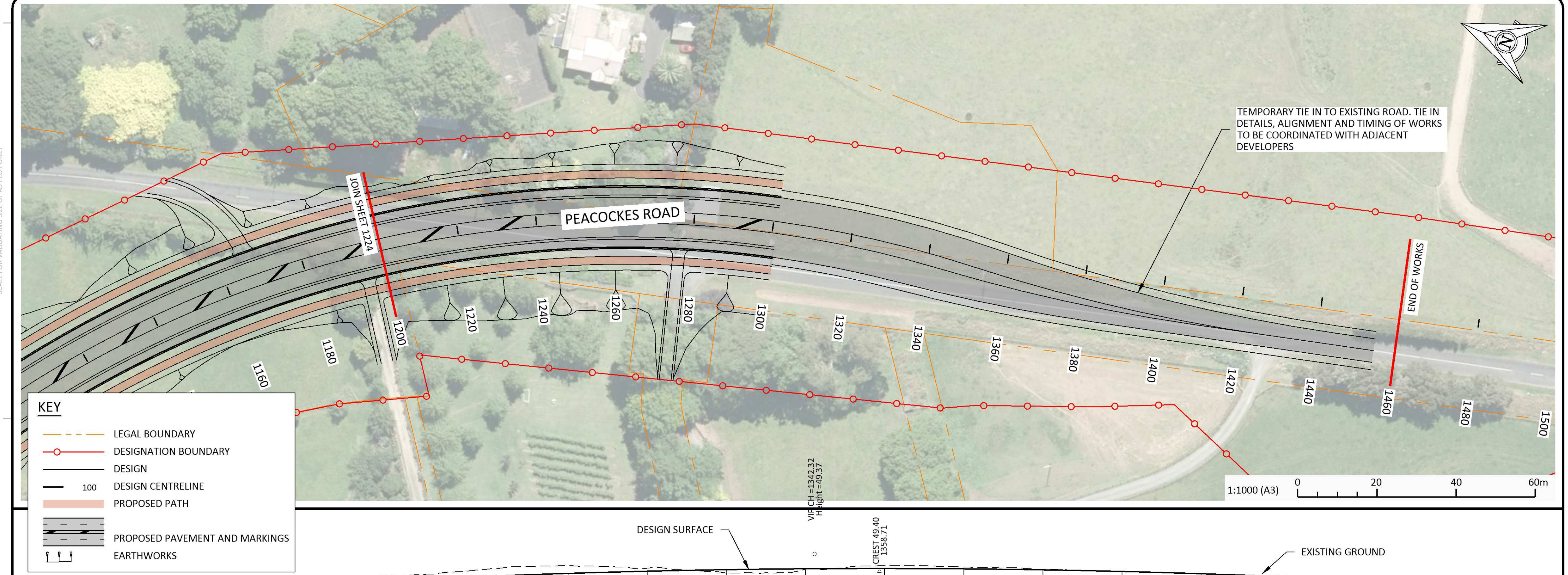
Phone +64-7-838 0144, Fax +64-7-839 0431

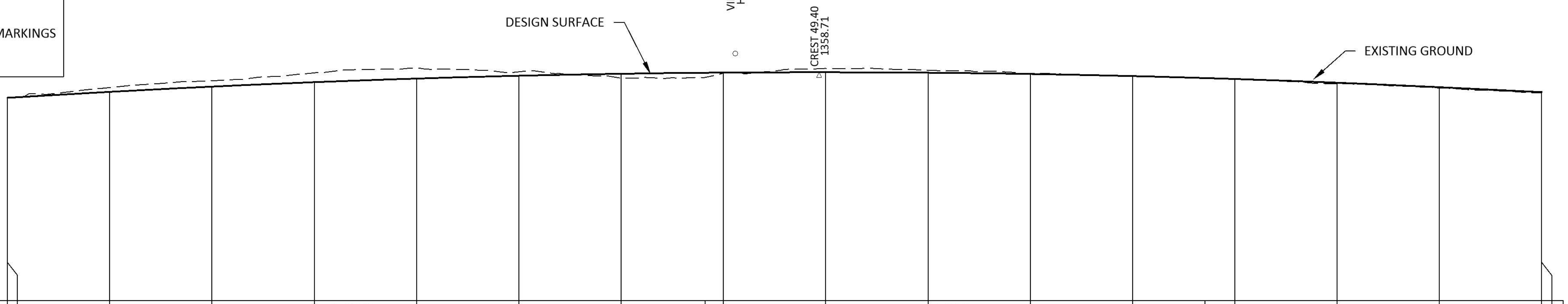
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 4

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1224
REVISION: A





HORIZONTAL DATA	D=409.42m R=280.00 L=409.42								D=97.71m R=-800.00 L=97.71				D=65.82m			
VERTICAL DATA	P=3.06% K=20.00 L=51.11						K=50.00 L=272.78								P=-2.40% L=21.29	
CONTROL LEVELS	46.89 46.89	47.48	47.99	48.43	48.78	49.06	49.25	49.37	49.40	49.36	49.23	49.03	48.74	48.38	47.93	47.45 47.45
EXISTING GROUND	46.86 46.86	47.90	48.57	49.34	49.79	49.44	48.82	49.31	49.77	49.60	49.28	49.01	48.73	48.28	47.85	47.36 47.36
DEPTHS	-0.04 -0.04	0.42	0.58	0.91	1.01	0.38	-0.43	-0.06	0.37	0.24	0.05	-0.01	-0.01	-0.09	-0.08	-0.09 -0.09
CHAINAGE	1200.00 1200.00	1220.00	1240.00	1260.00	1280.00	1300.00	1320.00	1340.00	1360.00	1380.00	1400.00	1420.00	1440.00	1460.00	1480.00	1500.00 1500.00

LONGSECTION ALIGNMENT RS10

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED LV · CHECKED CM · DRAWN AA · APPROVED JG · mx model version:

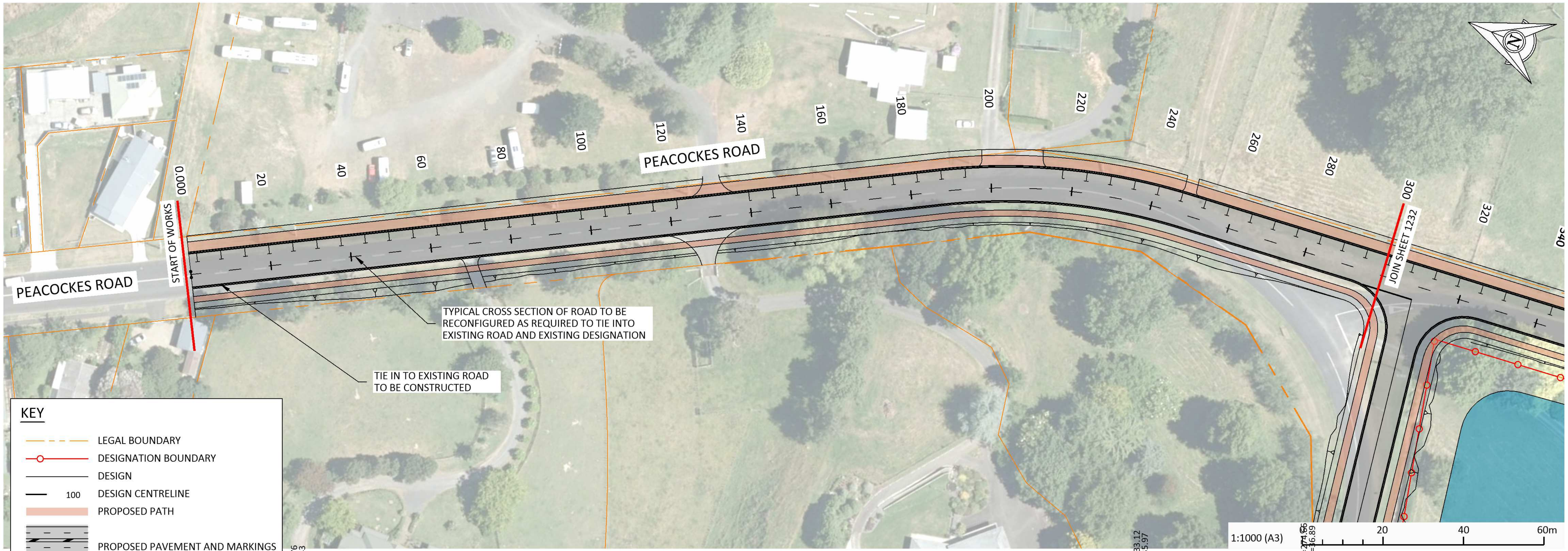
BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

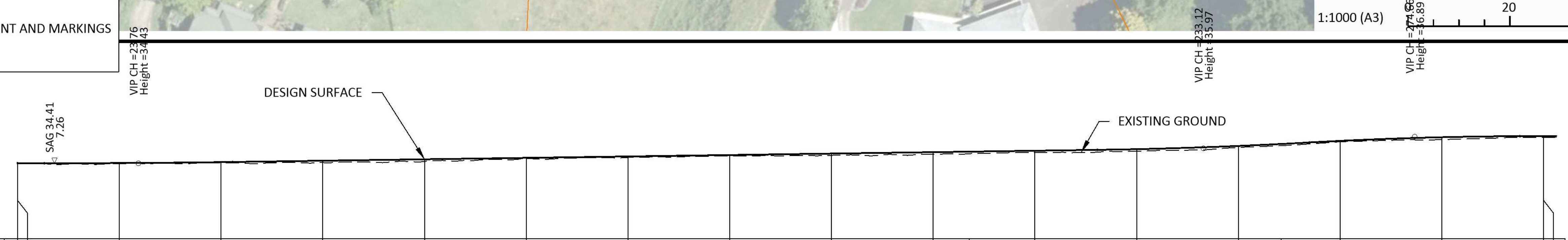
DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 5

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1225
REVISION: A



KEY

- LEGAL BOUNDARY
- DESIGNATION BOUNDARY
- DESIGN
- 100 DESIGN CENTRELINE
- PROPOSED PATH
- PROPOSED PAVEMENT AND MARKINGS
- EARTHWORKS



HORIZONTAL DATA: D=187.06m; D=61.31m, R=150.00, L=61.31; D=177.08m

VERTICAL DATA: P=-0.04%, L=5.26; K=50.00, L=37.00; P=0.70%, L=170; K=20.00, L=41.72; P=2.79%; K=16.00, L=41.37; P=0.20%, L=20.84

CONTROL LEVELS	34.41 34.41	34.42	34.51	34.65	34.79	34.93	35.07	35.21	35.35	35.49	35.63	35.79	36.11	36.60	36.96	37.07 37.07
EXISTING GROUND	34.41 34.41	34.37	34.44	34.47	34.58	34.85	34.97	35.11	35.18	35.30	35.46	35.58	35.96	36.52	36.73	36.94 36.94
DEPTHS	-0.00 -0.00	-0.06	-0.07	-0.18	-0.21	-0.08	-0.10	-0.10	-0.17	-0.20	-0.17	-0.21	-0.15	-0.09	-0.23	-0.13 -0.13
CHAINAGE	0.00 0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00 300.00

LONGSECTION ALIGNMENT RS20

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV — CHECKED: CM
DRAWN: AA — APPROVED: JG
mx model version:

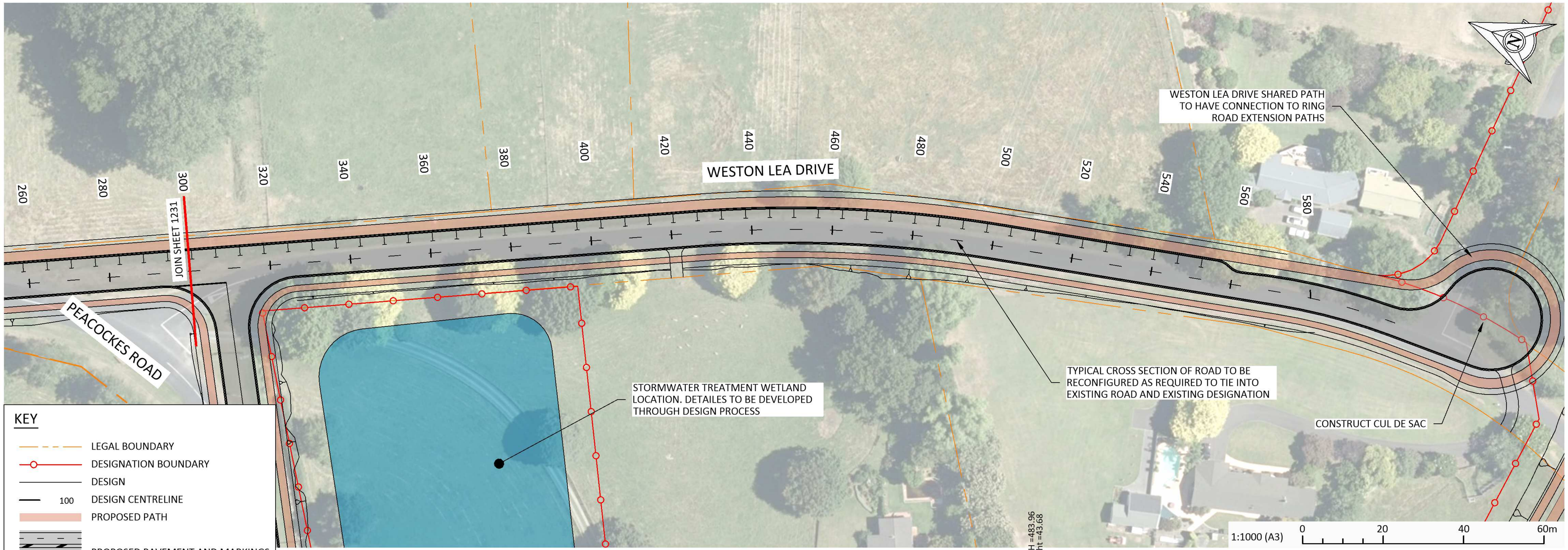
BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

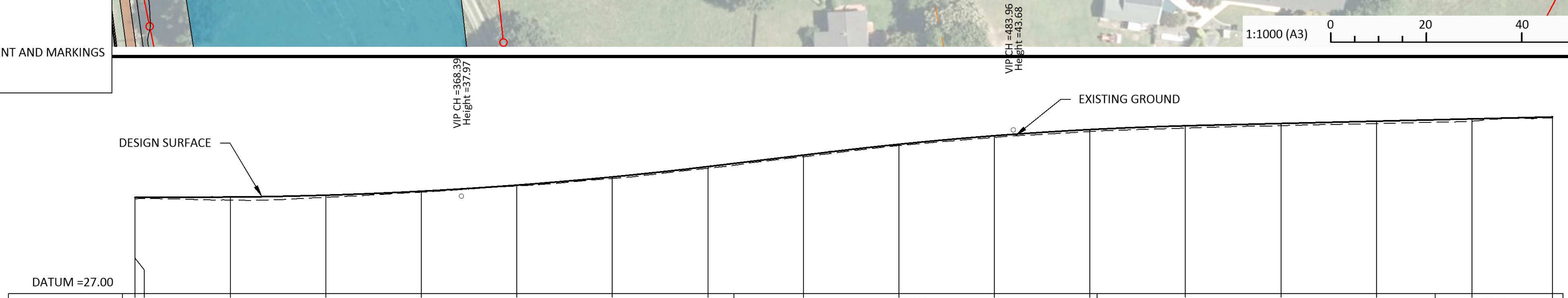
DRAWING: PEACOCKES ROAD - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 1

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1231
REVISION: A



KEY

- LEGAL BOUNDARY
- DESIGNATION BOUNDARY
- DESIGN
- 100 DESIGN CENTRELINE
- PROPOSED PATH
- PROPOSED PAVEMENT AND MARKINGS
- EARTHWORKS



HORIZONTAL DATA: D=177.08m | D=76.07m R=320.00 L=76.07 | D=70.8m | D=24.52m R=-38.75 L=24.52

VERTICAL DATA: P=0.20% L=20.84 | K=18.00 L=104.40 | P=6.00% L=24.98 | K=16.00 L=76.80 | P=1.20% L=74.49

CHAINAGE	CONTROL LEVELS	EXISTING GROUND	DEPTHS
300.00 300.00	37.07 37.07	36.94 36.94	-0.13 -0.13
320.00	37.12	36.80	-0.31
340.00	37.31	37.09	-0.22
360.00	37.73	37.63	-0.10
380.00	38.37	38.28	-0.09
400.00	39.23	39.06	-0.16
420.00	40.31	40.12	-0.19
440.00	41.51	41.34	-0.17
460.00	42.64	42.51	-0.14
480.00	43.54	43.36	-0.18
500.00	44.18	43.97	-0.21
520.00	44.58	44.33	-0.24
540.00	44.82	44.59	-0.23
560.00	45.06	44.81	-0.25
580.00	45.30	45.06	-0.23
596.85	45.50	45.38	-0.12

LONGSECTION ALIGNMENT RS20

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED LV | CHECKED CM | DRAWN AA | APPROVED JG | mx model version:

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Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES LANE - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 2

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-1232
REVISION: A

Version 3.0 - September 2017
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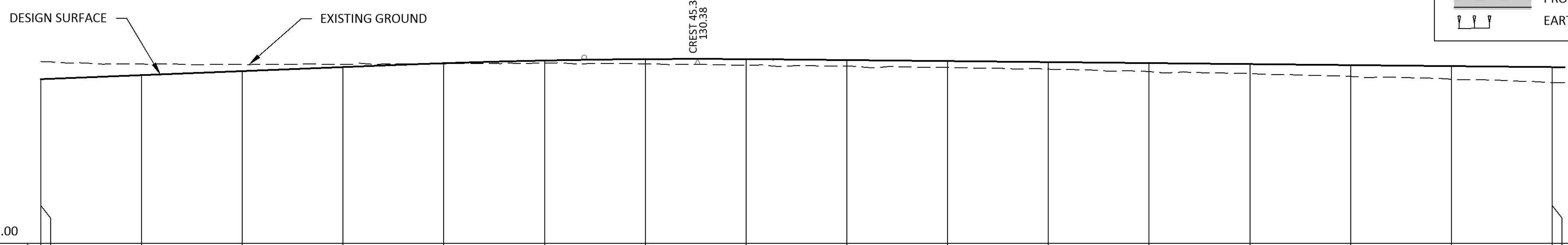
SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY 0 100mm



DATUM =27.00

HORIZONTAL DATA: D=302.4m

VERTICAL DATA: P=2.00% L=81.53 | K=30.00 L=75.00 | P=-0.50% L=315.06

CONTROL LEVELS	43.30 43.30	43.70	44.10	44.50	44.89	45.16	45.29	45.30	45.20	45.10	45.00	44.90	44.80	44.70	44.60	44.50 44.50
EXISTING GROUND	45.06 45.06	44.80	44.76	44.78	44.83	44.90	44.81	44.69	44.60	44.46	44.30	44.06	43.85	43.57	43.29	42.97 42.97
DEPTHS	1.75 1.75	1.10	0.66	0.28	-0.06	-0.25	-0.48	-0.60	-0.60	-0.64	-0.70	-0.84	-0.95	-1.13	-1.31	-1.53 -1.53
CHAINAGE	0.00 0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00 300.00

LONGSECTION ALIGNMENT RS30

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM | DRAWN: AA | APPROVED: JG

mx model version:

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Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: WESTON LEA DRIVE - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 1

STATUS: PRELIMINARY

DATE: 19.07.2019 | SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-1241 | REVISION: A

Version 3.0 - September 2017

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY 100mm 0

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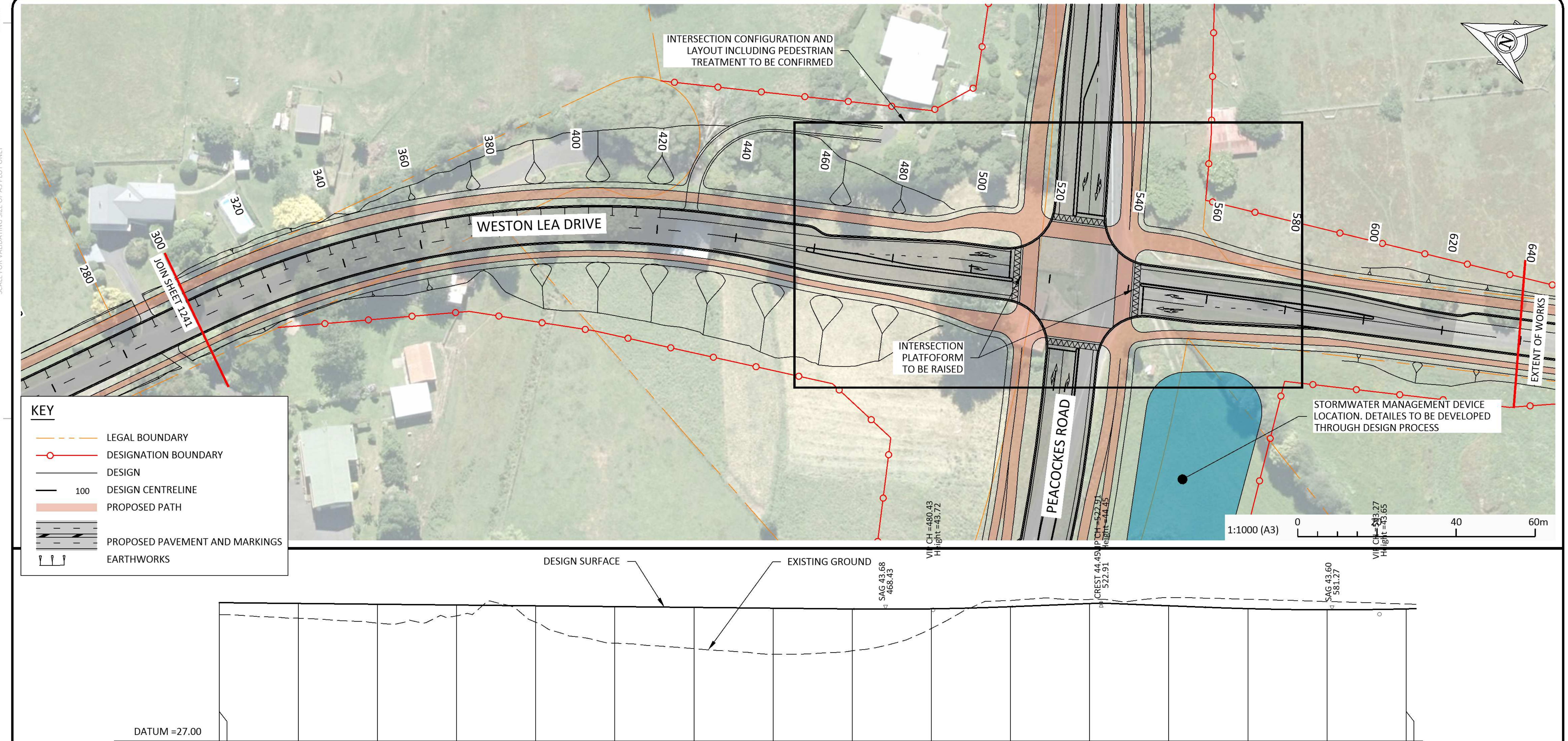

HORIZONTAL DATA: D=302.4m; D=132.35m, R=230.00, L=132.35; D=251.87m

VERTICAL DATA: P=-0.50%, L=315.06; K=16.00, L=40.00; P=2.00%, L=22.47; P=-2.00%, L=26.36; K=16.00, L=88.00

CONTROL LEVELS	44.50 44.50	44.40	44.30	44.20	44.10	44.00	43.90	43.80	43.70	43.72	43.99	44.39	44.11	43.74	43.60	43.71 43.71
EXISTING GROUND	42.97 42.97	42.54	41.91	42.82	42.03	39.38	38.69	37.97	38.41	41.24	44.77	44.90	45.14	44.92	44.64	44.33 44.33
DEPTHS	-1.53 -1.53	-1.86	-2.39	-1.38	-2.07	-4.62	-5.21	-5.83	-5.29	-2.48	0.78	0.52	1.03	1.18	1.04	0.62 0.62
CHAINAGE	300.00 300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00 600.00

LONGSECTION ALIGNMENT RS30

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500

A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

DESIGNED LV | CHECKED CM | DRAWN AA | APPROVED JG
mx model version:

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CLIENT: Hamilton City Council, Te kaunihera o Kirikiriroa

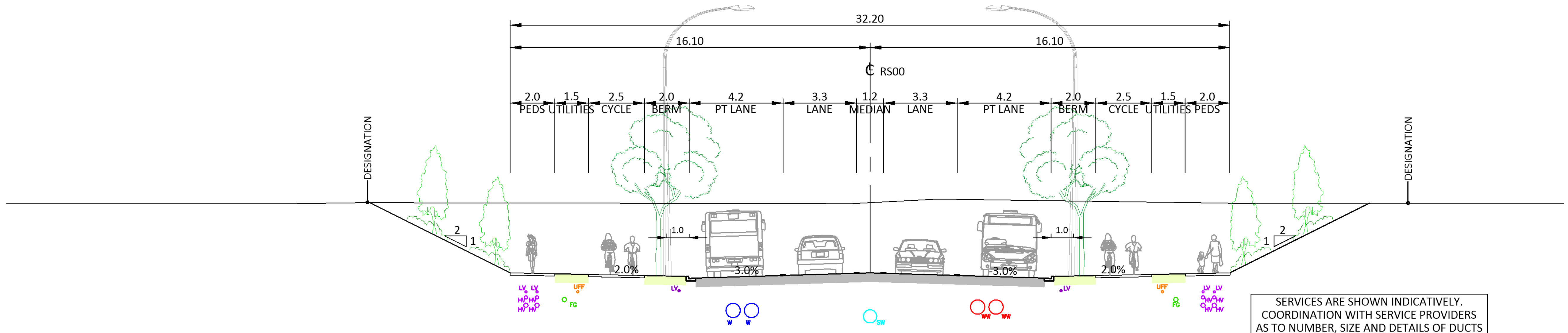
PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: WESTON LEA DRIVE - GENERAL ARRANGEMENT PLAN AND LONGSECTION SHEET 2

STATUS: PRELIMINARY

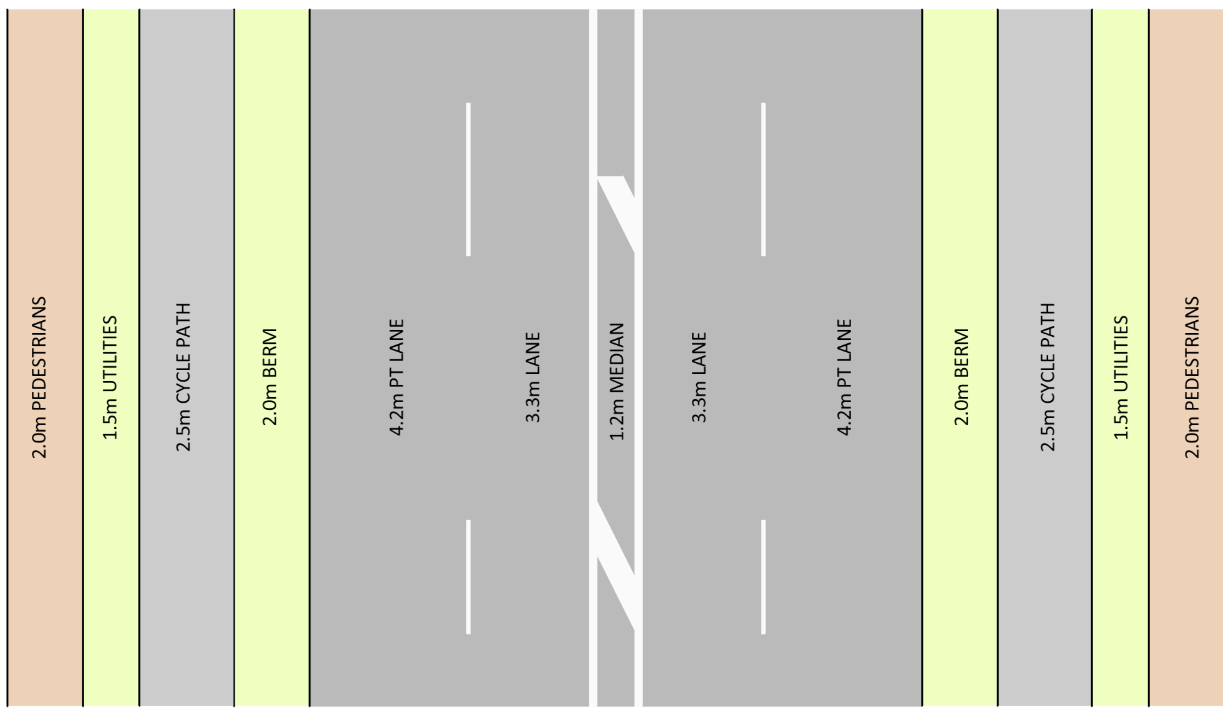
DATE: 19.07.2019 | SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-1242 | REVISION: A



SERVICES ARE SHOWN INDICATIVELY. COORDINATION WITH SERVICE PROVIDERS AS TO NUMBER, SIZE AND DETAILS OF DUCTS REQUIRED THROUGH THE DESIGN PROCESS

MAJOR ARTERIALS
(RING ROAD EXTENSION)



REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM
DRAWN: AA | APPROVED: JG
mx model version:

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Phone +64-7-838 0144, Fax +64-7-839 0431

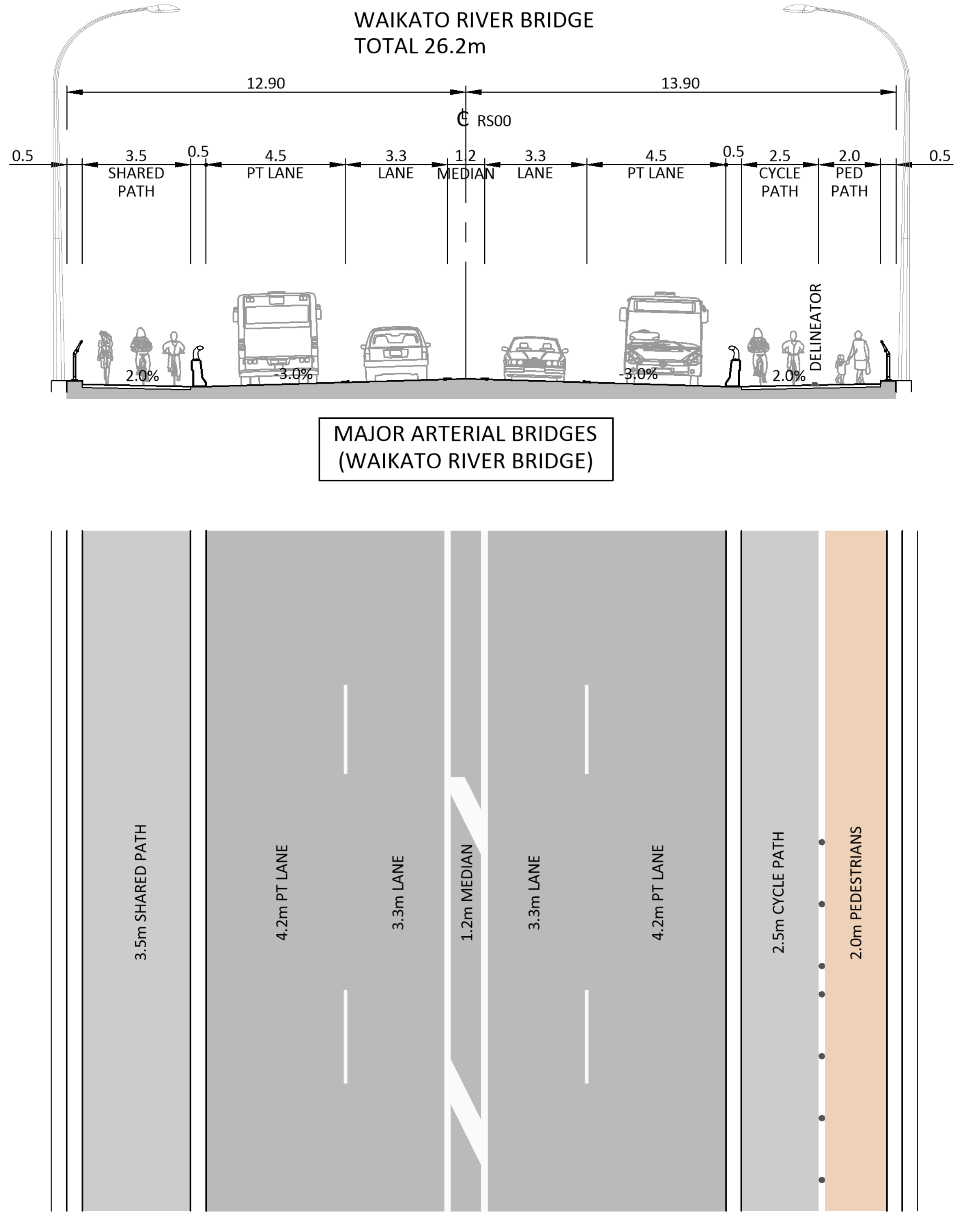
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: TYPICAL CROSS SECTIONS - MAJOR ARTERIAL ROADS

STATUS: PRELIMINARY
DATE: 30/07/2019
SCALE (ORIGINAL SIZE A3): 1:200
DRAWING NUMBER: 145900-001A-1301
REVISION: A

Version 3.0 - September 2017



A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

DESIGNED: LV	CHECKED: CM
DRAWN: AA	APPROVED: JG
mx model version:	

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

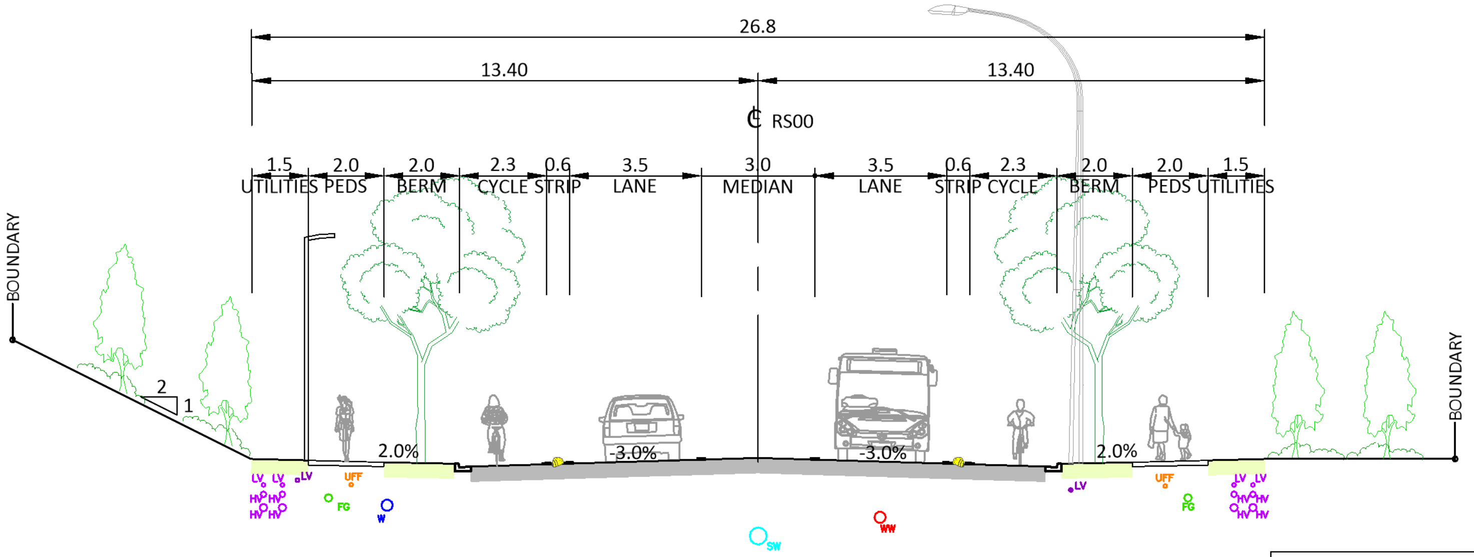
DRAWING: TYPICAL CROSS SECTIONS - MAJOR ARTERIAL ROADS

STATUS: PRELIMINARY

DATE: 30/07/2019 | SCALE (ORIGINAL SIZE A3): 1:200

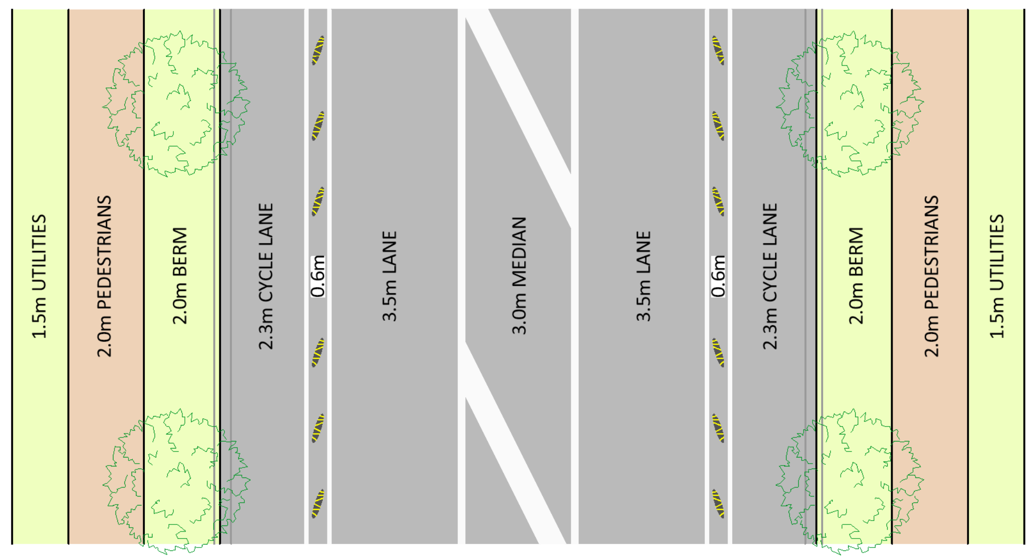
DRAWING NUMBER: 145900-001A-1302 | REVISION: A

Version 3.0 - September 2017



SERVICES ARE SHOWN INDICATIVELY. COORDINATION WITH SERVICE PROVIDERS AS TO NUMBER, SIZE AND DETAILS OF DUCTS REQUIRED THROUGH THE DESIGN PROCESS

MINOR ARTERIALS
(PEACOCKES ROAD)



SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

100mm

0

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED	LV
CHECKED	CM
DRAWN	AA
APPROVED	JG
mx model version:	

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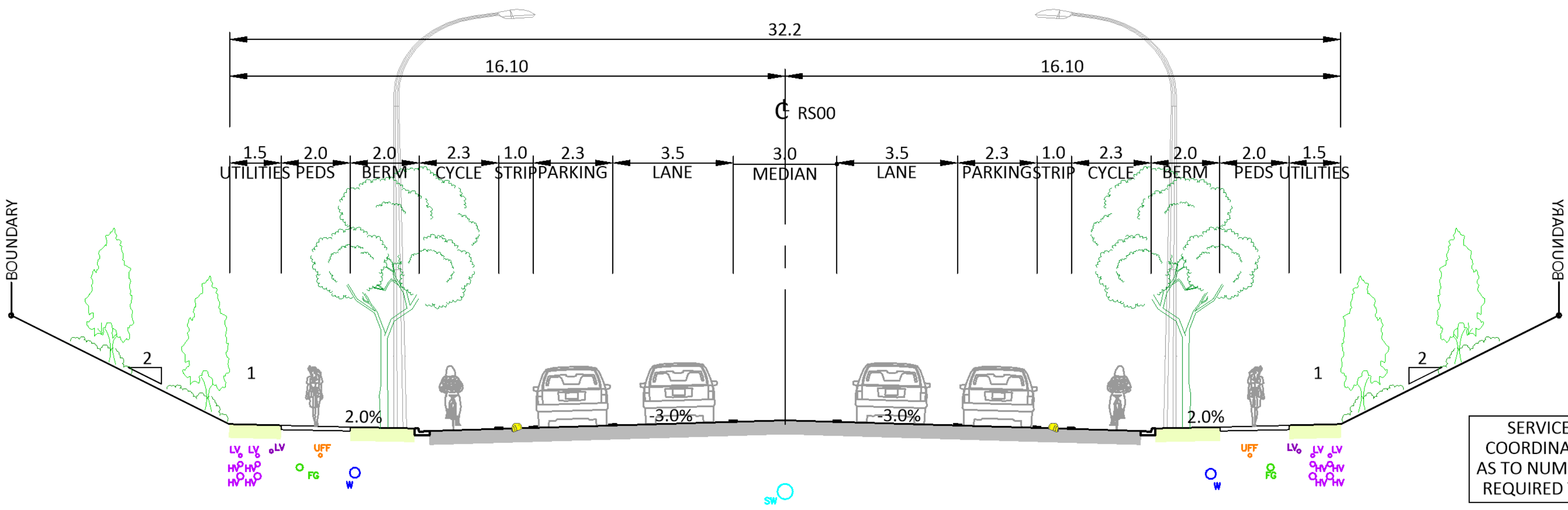
CLIENT
Hamilton City Council
Te kaunihera o Kirikiriroa

PROJECT
PEACOCKE
STRATEGIC TRANSPORT
PROJECT

DRAWING
TYPICAL CROSS SECTIONS -
MINOR ARTERIAL ROADS
WITHOUT PARKING

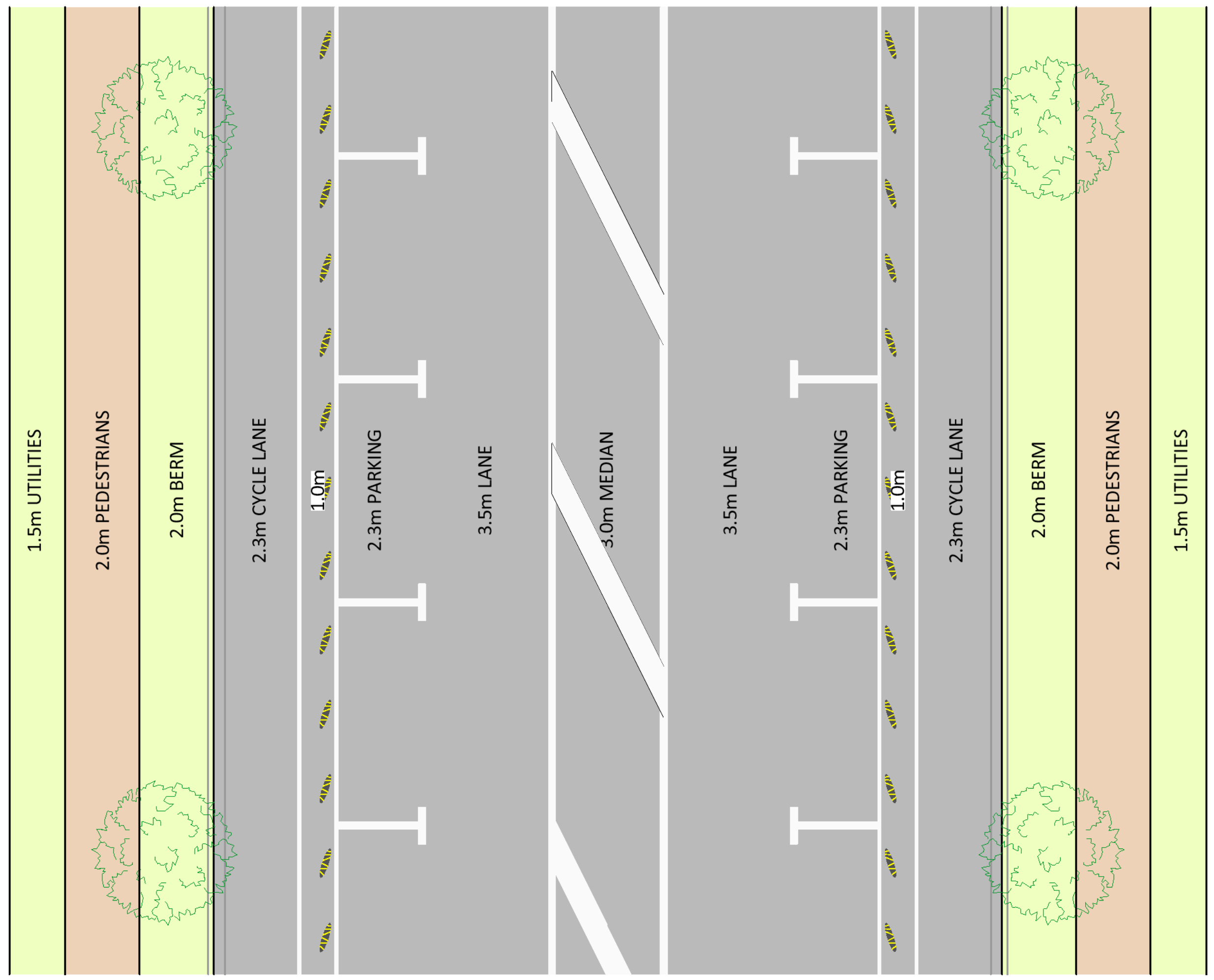
STATUS	PRELIMINARY
DATE	30/07/2019
SCALE (ORIGINAL SIZE A3)	1:200
DRAWING NUMBER	145900-001A-1311
REVISION	A

Version 3.0 - September 2017



SERVICES ARE SHOWN INDICATIVELY. COORDINATION WITH SERVICE PROVIDERS AS TO NUMBER, SIZE AND DETAILS OF DUCTS REQUIRED THROUGH THE DESIGN PROCESS

MINOR ARTERIALS
(PEACOCKES ROAD)



REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV | CHECKED: CM | DRAWN: AA | APPROVED: JG | mx model version:

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CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

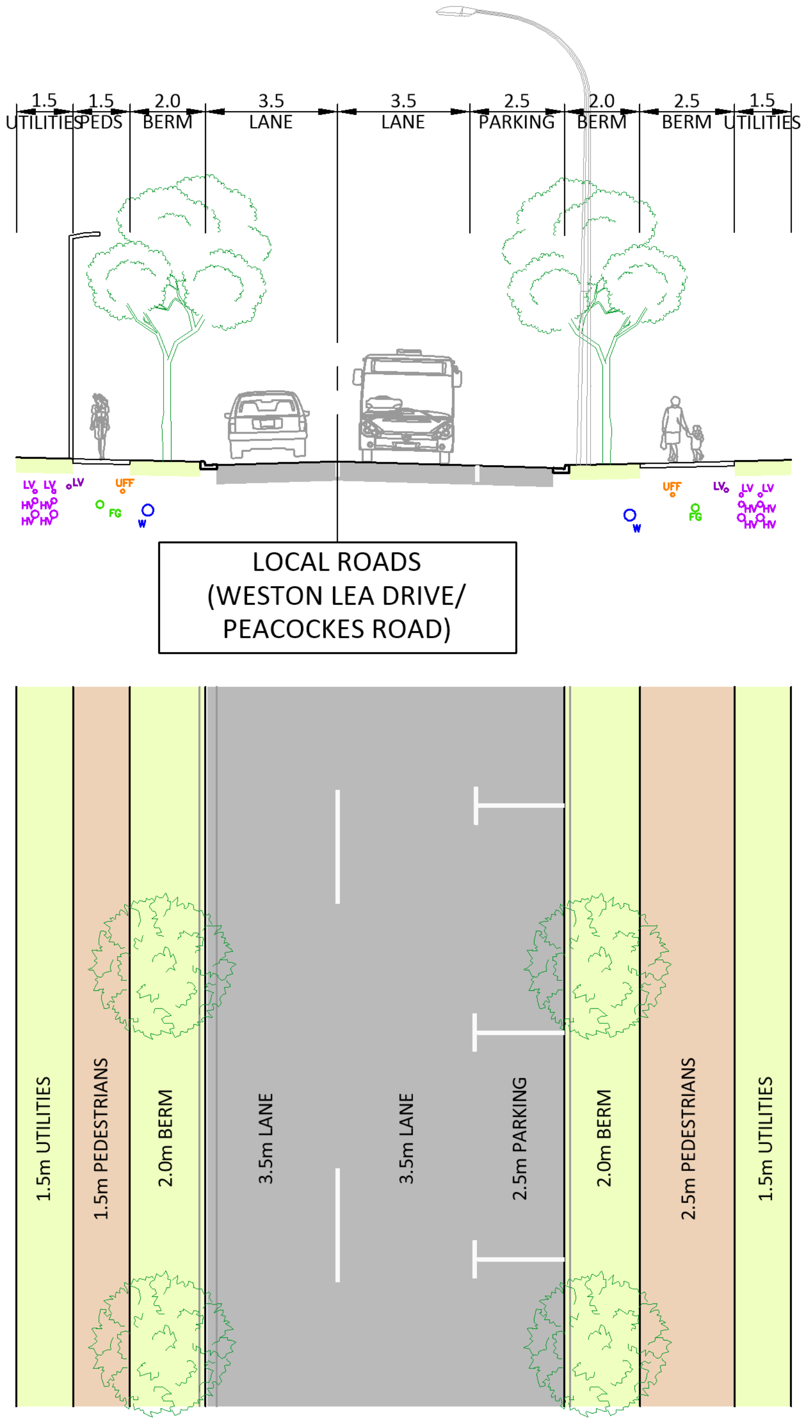
PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: TYPICAL CROSS SECTIONS - MINOR ARTERIAL ROADS WITH PARKING

STATUS: PRELIMINARY

DATE: 30/07/2019 | SCALE (ORIGINAL SIZE A3): 1:200

DRAWING NUMBER: 145900-001A-1312 | REVISION: A



SERVICES ARE SHOWN INDICATIVELY. COORDINATION WITH SERVICE PROVIDERS AS TO NUMBER, SIZE AND DETAILS OF DUCTS REQUIRED THROUGH THE DESIGN PROCESS

TYPICAL CROSS SECTION OF ROAD TO BE RECONFIGURED AS REQUIRED TO TIE INTO EXISTING ROAD AND EXISTING DESIGNATION

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

100mm

0

	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED: LV
CHECKED: CM
DRAWN: AA
APPROVED: JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: TYPICAL CROSS SECTIONS - LOCAL ROADS

STATUS: PRELIMINARY

DATE: 30/07/2019

SCALE (ORIGINAL SIZE A3): 1:200

DRAWING NUMBER: 145900-001A-1321

REVISION: A

Version 3.0 - September 2017

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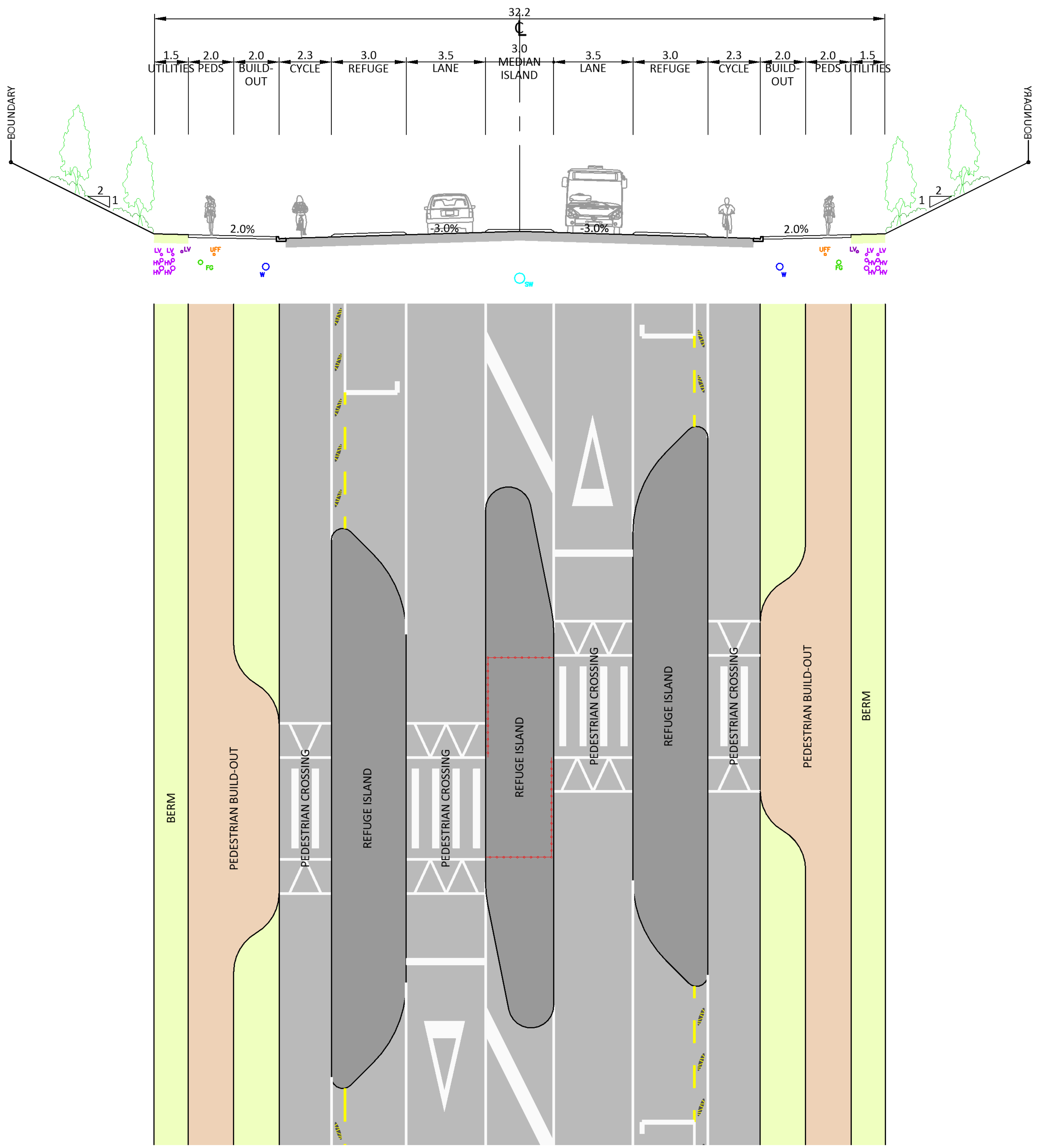


SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

C:\12dsynergy\data\10.7.120.14\Peacocke - Design_4923\03 Drawings\145900-001A\145900-001A-1351.dwg 2/8/2019 3:56 PM mliu

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED	CHECKED
LV	CM
DRAWN	**APPROVED**
AA	JG

mx model version:

BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

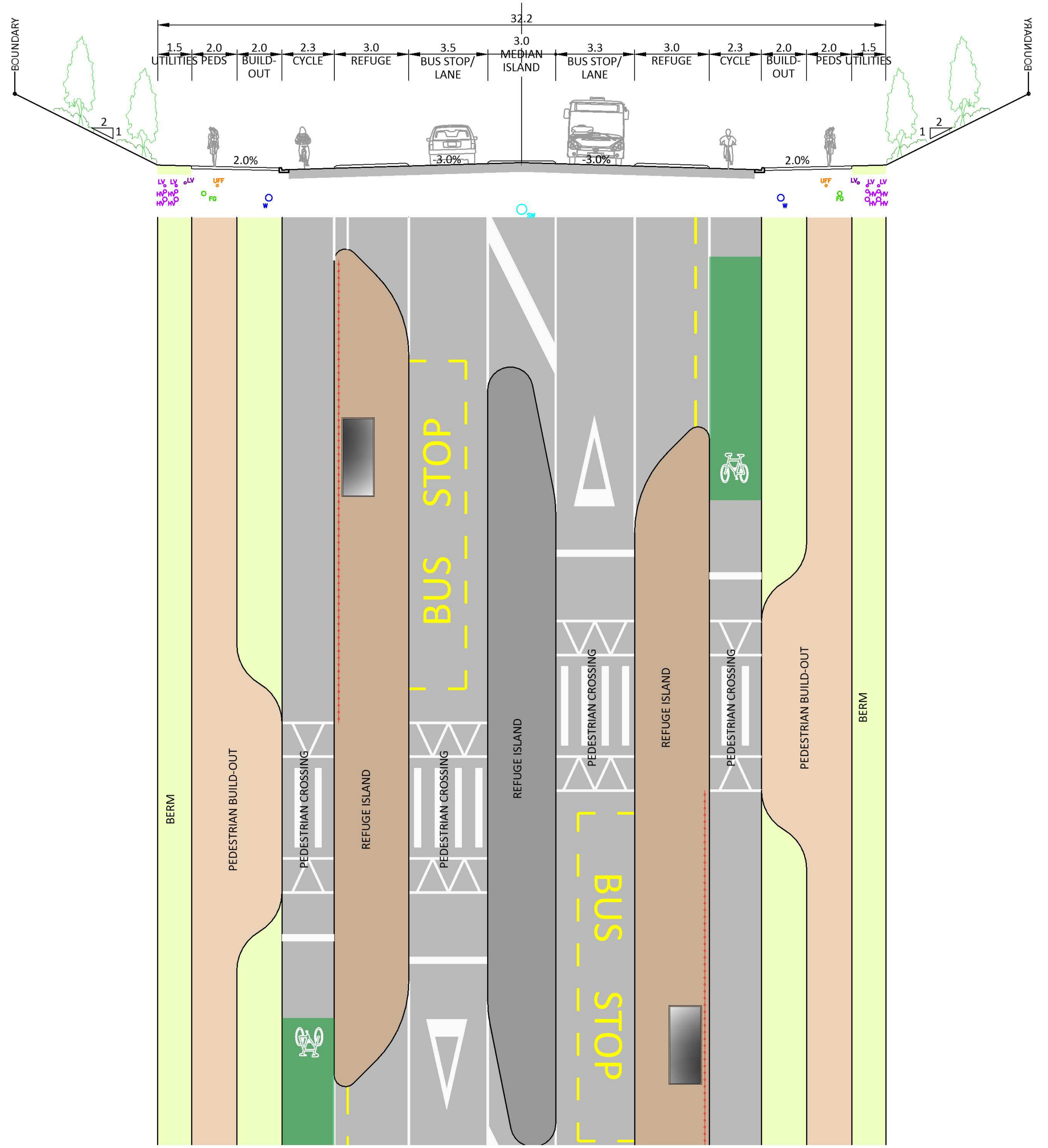
CLIENT
Hamilton City Council
Te kaunihera o Kirikiriroa

PROJECT
PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING
TYPICAL CROSS SECTIONS - PEDESTRIAN CROSSING

STATUS	
PRELIMINARY	
DATE: 26.07.2019	SCALE (ORIGINAL SIZE A3): 1:200
DRAWING NUMBER: 145900-001A-1351	REVISION: A

Version 3.0 - September 2017



A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG	
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR	

DESIGNED LV | CHECKED CM
DRAWN AA | APPROVED JG
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

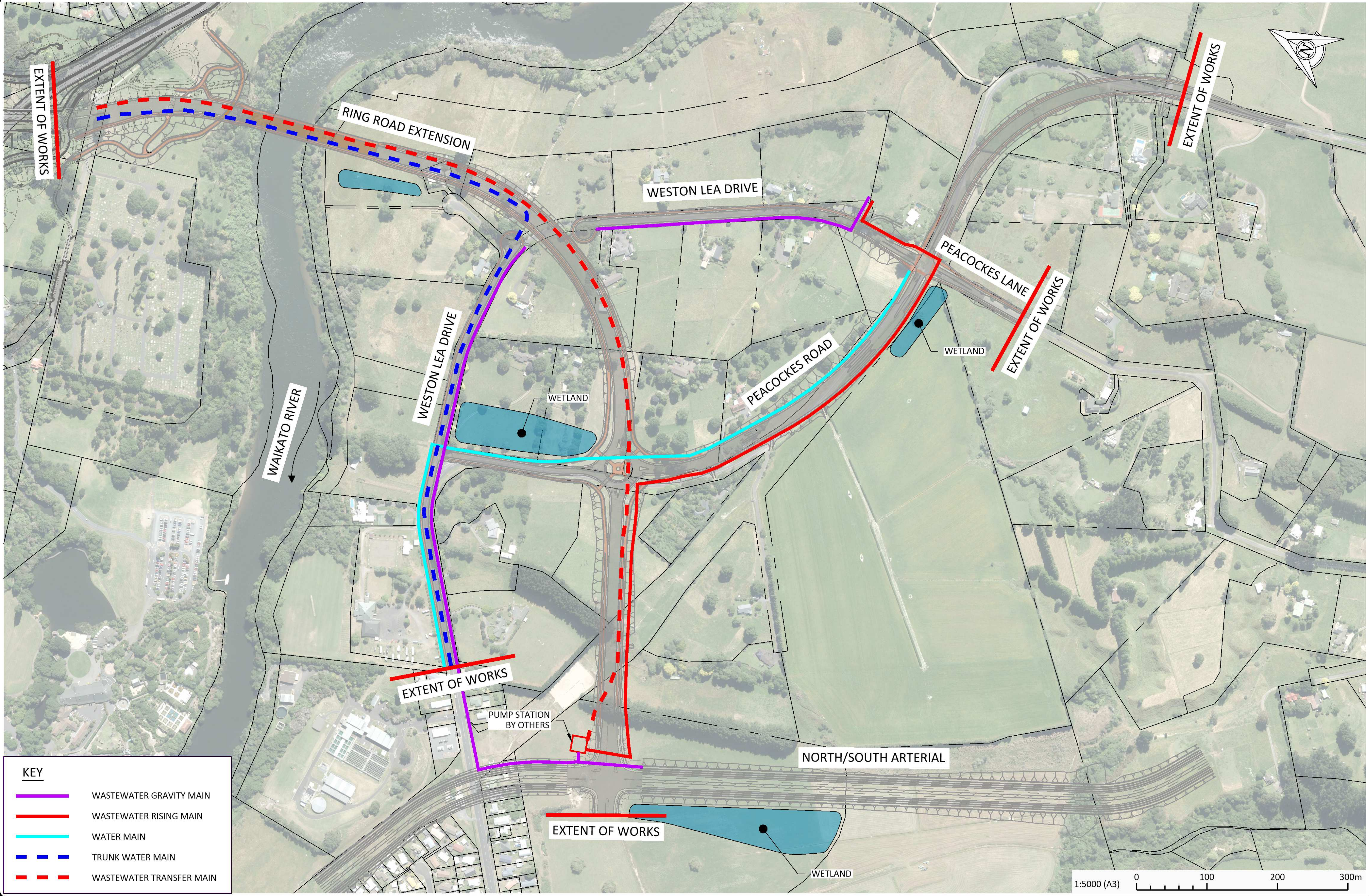
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: TYPICAL CROSS SECTIONS - IN LANE BUS STOP

STATUS: PRELIMINARY
DATE: 30/07/2019
SCALE (ORIGINAL SIZE A3): 1:200
DRAWING NUMBER: 145900-001A-1352
REVISION: A

Version 3.0 - September 2017



SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

DESIGNED - CHECKED -
DRAWN - APPROVED -
mx model version:

BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Hamilton City Council Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKE STRATEGIC SERVICES - WATER AND WASTEWATER OVERVIEW

STATUS: PRELIMINARY
DATE: 19.07.2019
SCALE (ORIGINAL SIZE A3): 1:5000
DRAWING NUMBER: 145900-001A-0201
REVISION: A

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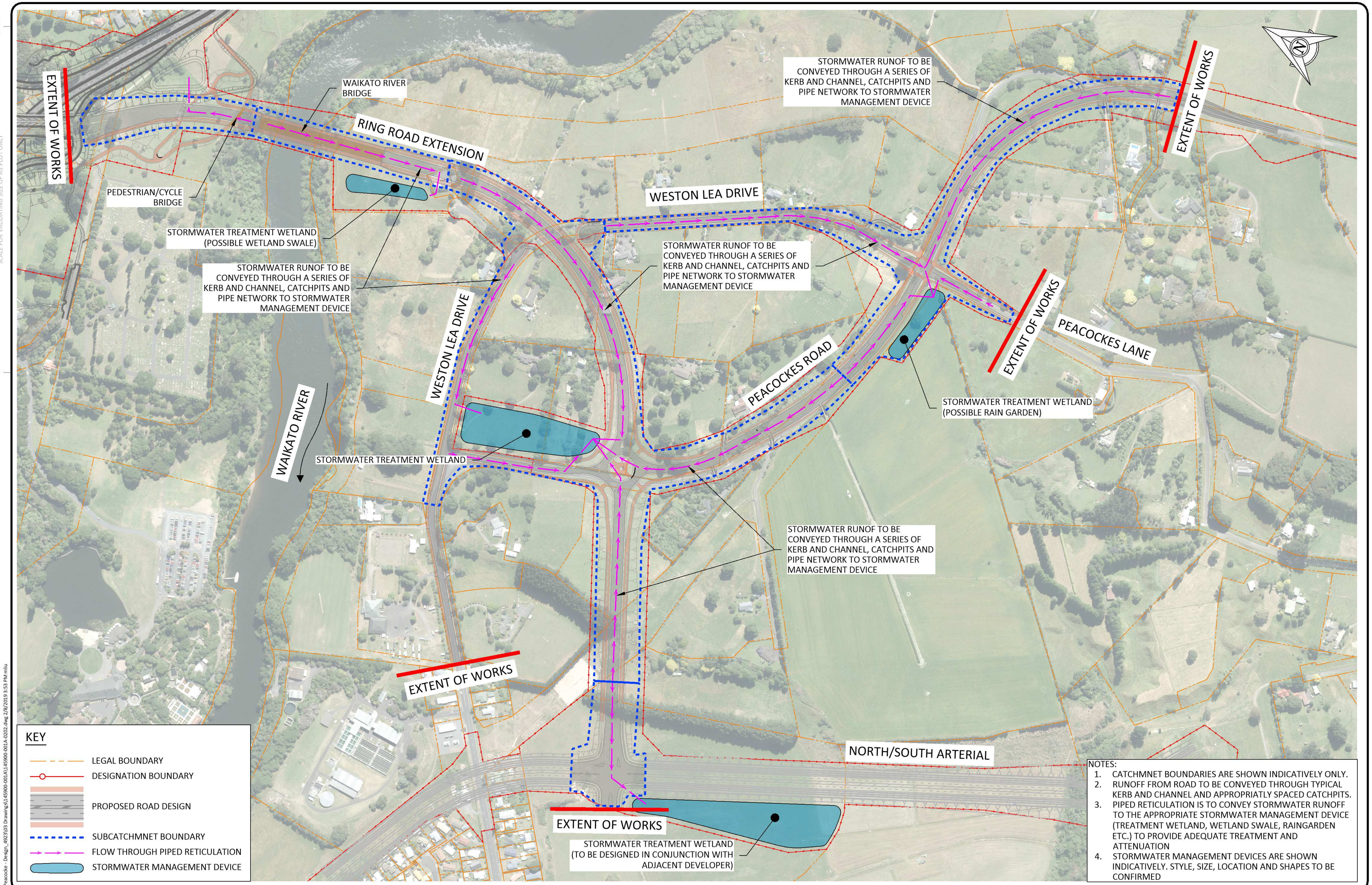

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A	02/08/2019	INITIAL ISSUE FOR INFORMATION	AA	CM	JG

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mx model version:

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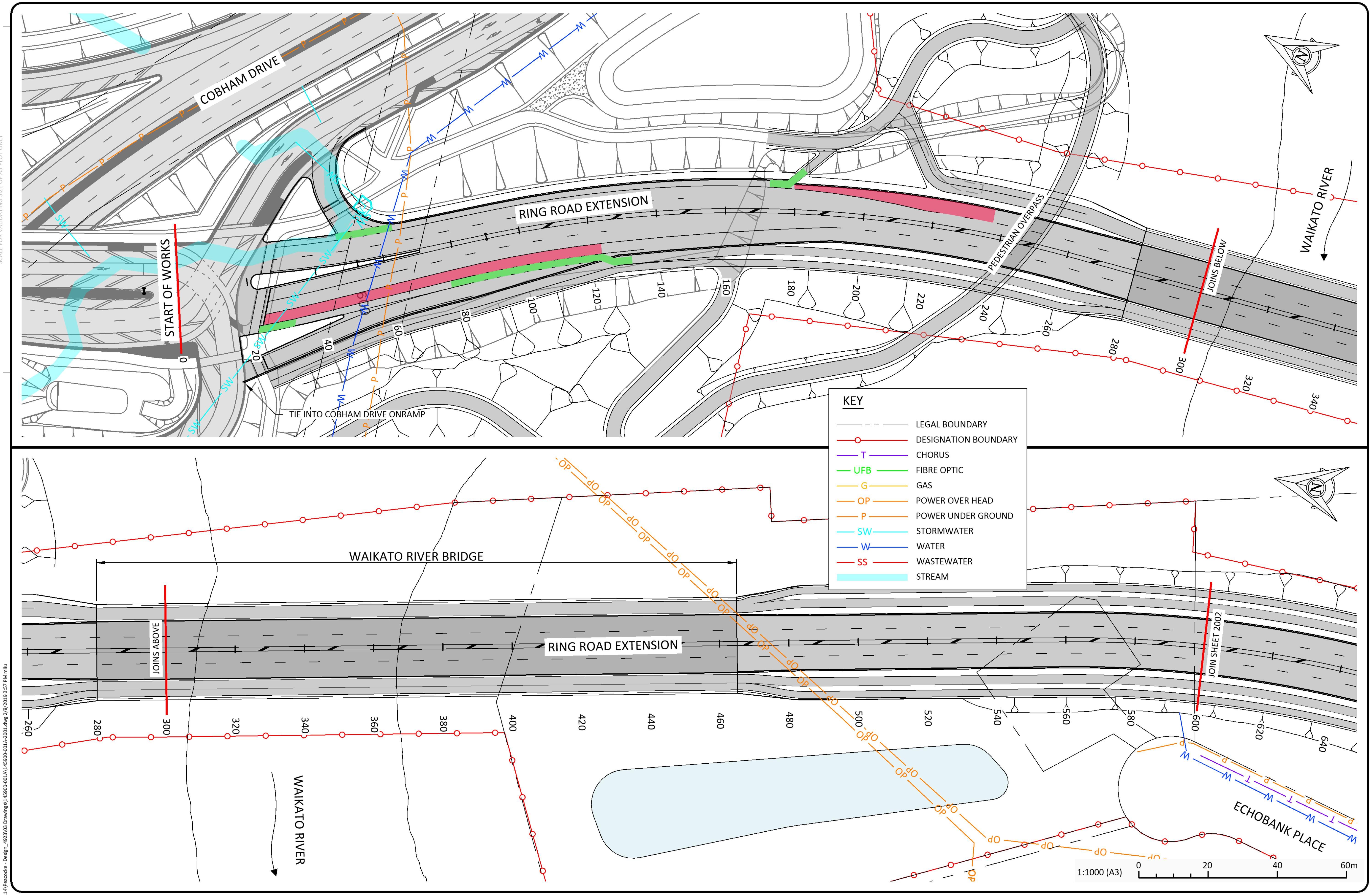
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKE STRATEGIC STORMWATER OVERVIEW PLAN

STATUS: PRELIMINARY
DATE: 01/08/2019
SCALE (ORIGINAL SIZE A3): 1:5000
DRAWING NUMBER: 145900-001A-0202
REVISION: A

Version 3.0 - September 2017



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	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR		

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DRAWN: ML	APPROVED: JG
mx model version:	

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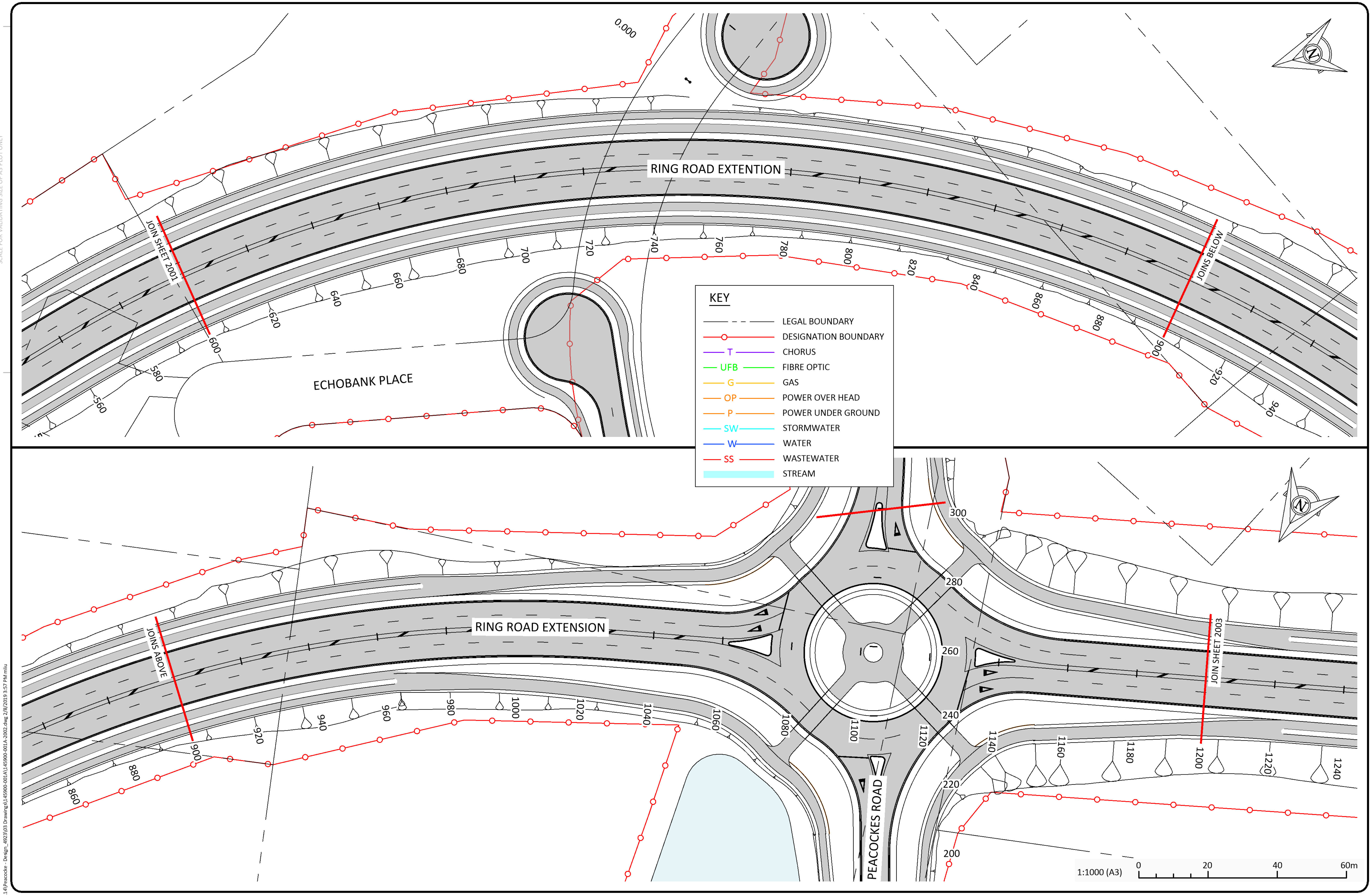
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: RING ROAD EXTENSION - EXISTING SERVICES PLAN SHEET 1

STATUS	PRELIMINARY
DATE: 02.08.2019	SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-2001	REVISION: A



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	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

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DRAWN ML
APPROVED JG
mx model version:

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CLIENT
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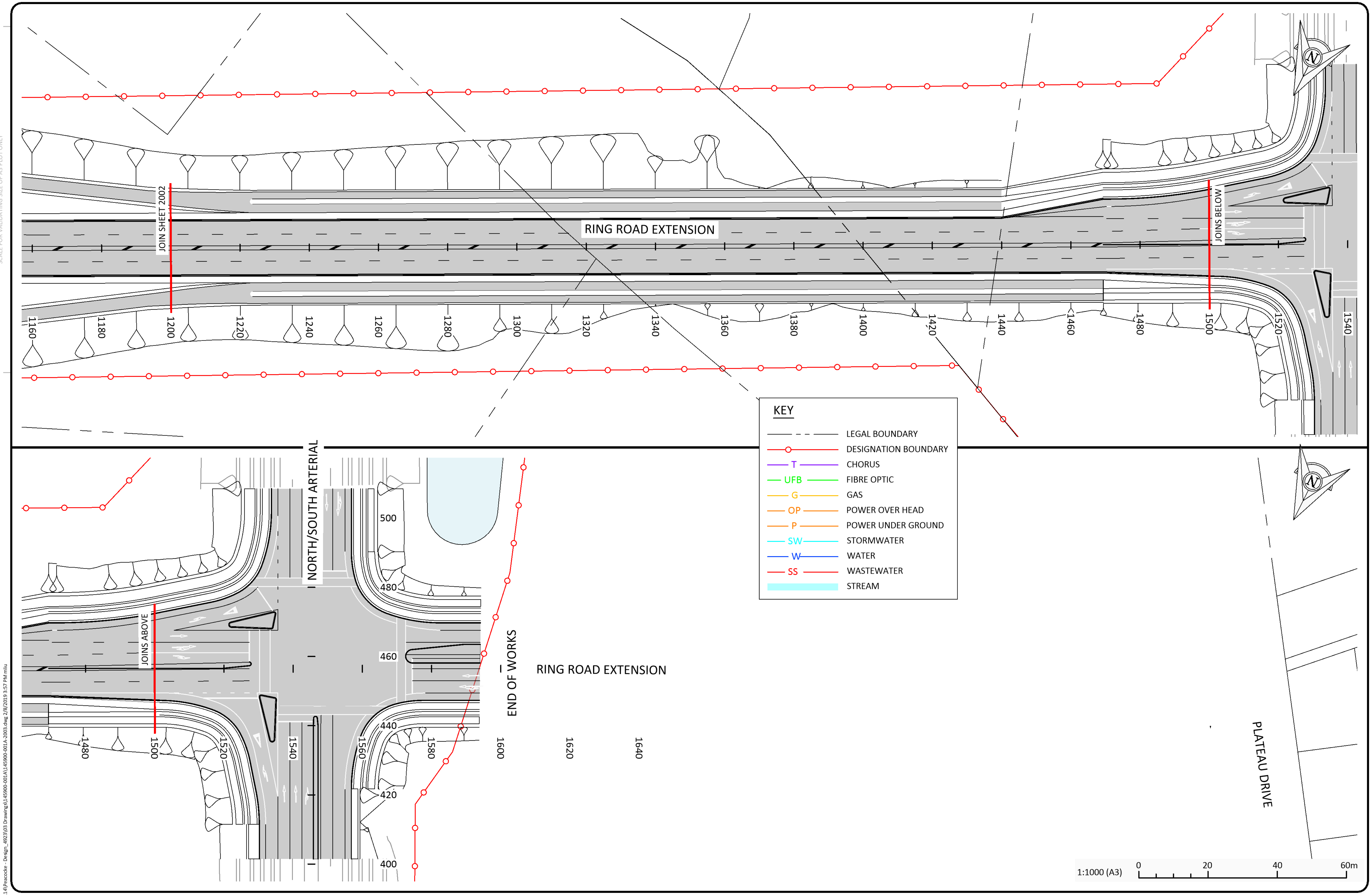
PROJECT
PEACOCKE
STRATEGIC TRANSPORT
PROJECT

DRAWING
RING ROAD EXTENSION -
EXISTING SERVICES PLAN
SHEET 2

STATUS
PRELIMINARY
DATE 02.08.2019
SCALE (ORIGINAL SIZE A3) 1:1000
DRAWING NUMBER 145900-001A-2002
REVISION A



KEY

— - —	LEGAL BOUNDARY
—o—	DESIGNATION BOUNDARY
— T —	CHORUS
— UFB —	FIBRE OPTIC
— G —	GAS
— OP —	POWER OVER HEAD
— P —	POWER UNDER GROUND
— SW —	STORMWATER
— W —	WATER
— SS —	WASTEWATER
	STREAM

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	ML	CM	JG

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CHECKED CM
DRAWN ML
APPROVED JG
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PROJECT
PEACOCKE
STRATEGIC TRANSPORT
PROJECT

DRAWING
RING ROAD EXTENSION -
EXISTING SERVICES PLAN
SHEET 3

STATUS
PRELIMINARY

DATE 02.08.2019
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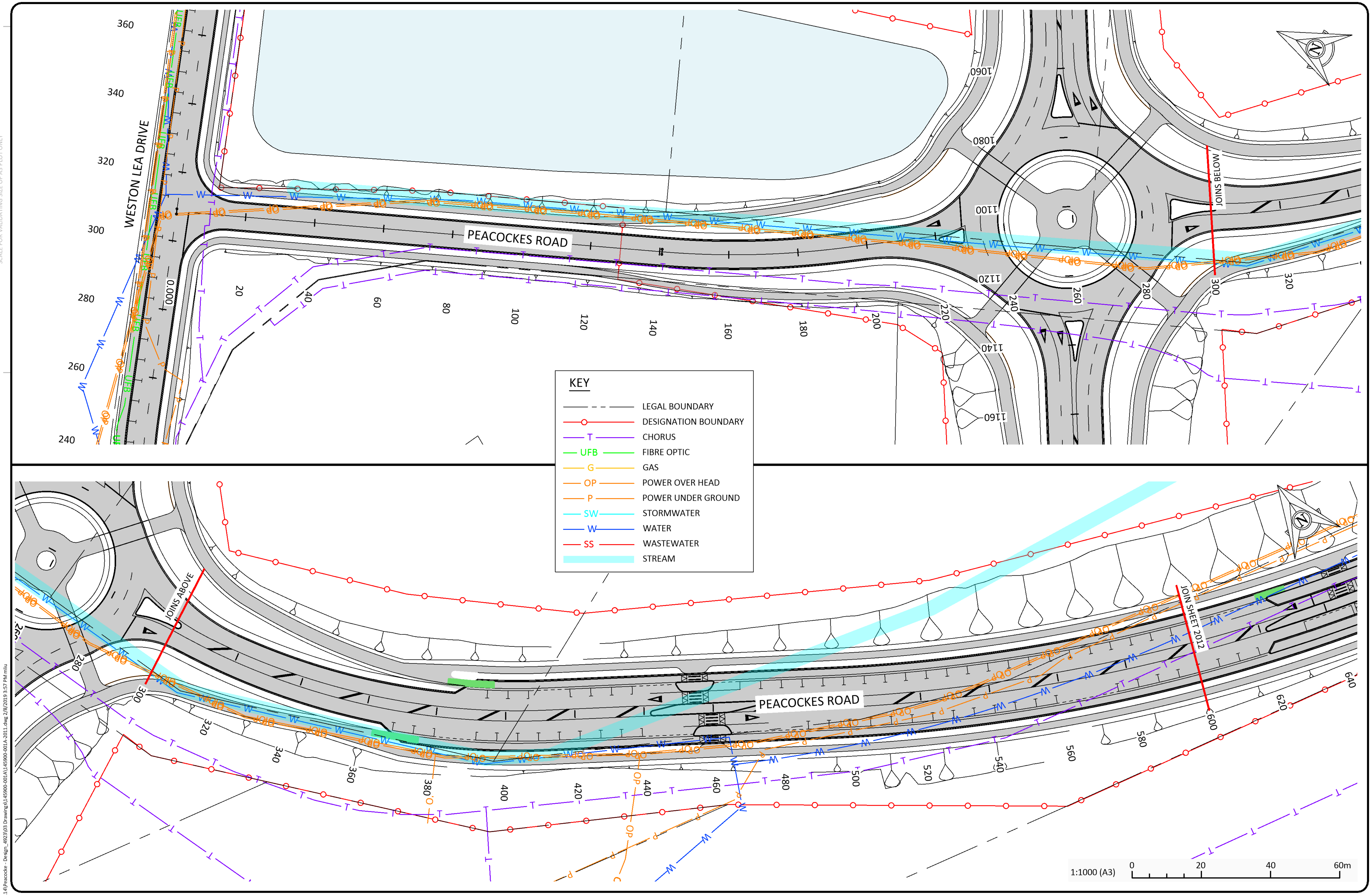
DRAWING NUMBER 145900-001A-2003
REVISION A



SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

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REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
A	02/08/2019	INITIAL ISSUE FOR INFORMATION	ML	CM	JG

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CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - EXISTING SERVICES PLAN SHEET 1

STATUS: PRELIMINARY

DATE: 02.08.2019

SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-2011

REVISION: A

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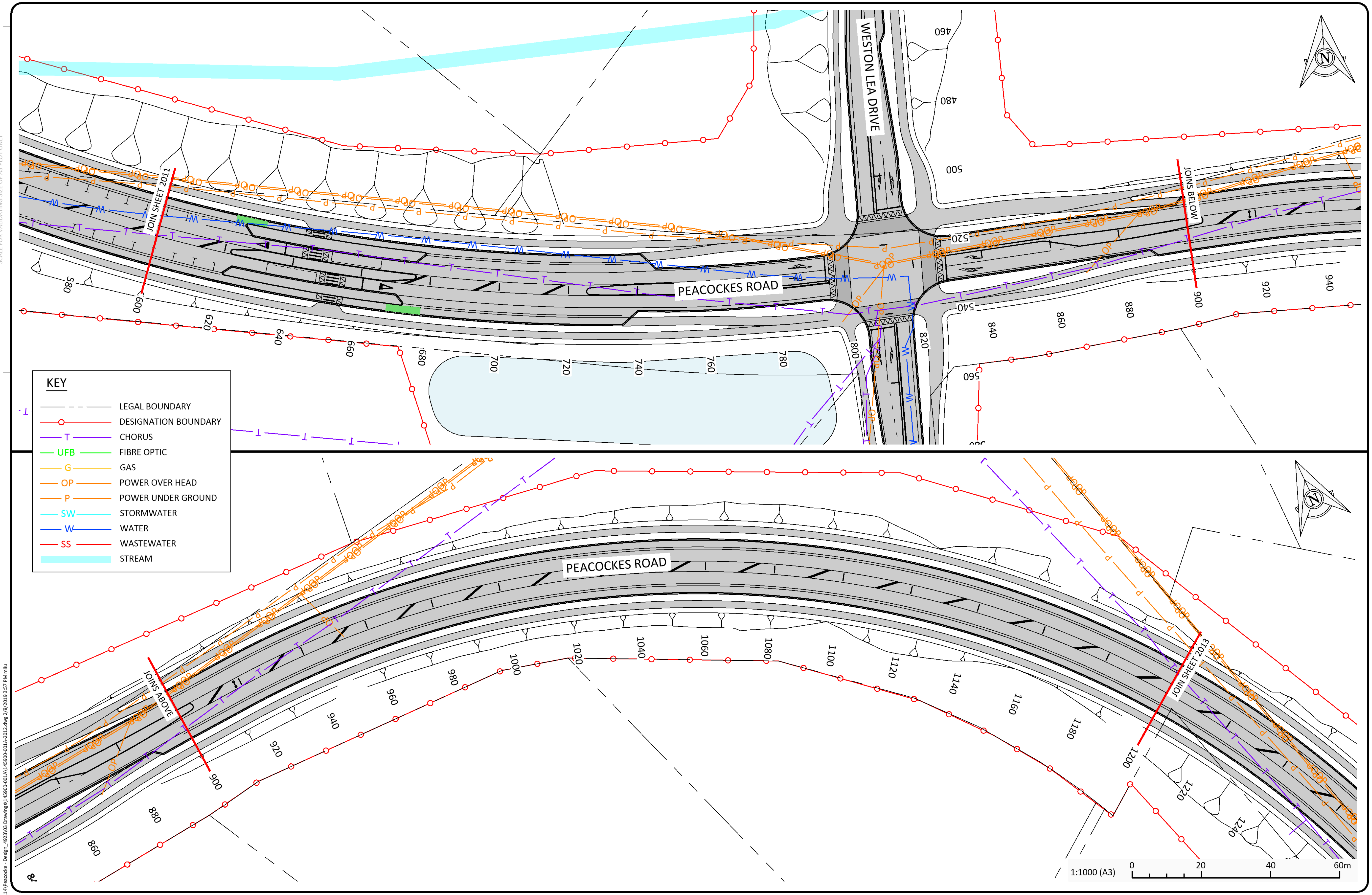

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	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

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ML	JG

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PROJECT

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STRATEGIC TRANSPORT
PROJECT

DRAWING

PEACOCKES ROAD -
EXISTING SERVICES PLAN
SHEET 2

STATUS

PRELIMINARY

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DRAWING NUMBER	**REVISION**
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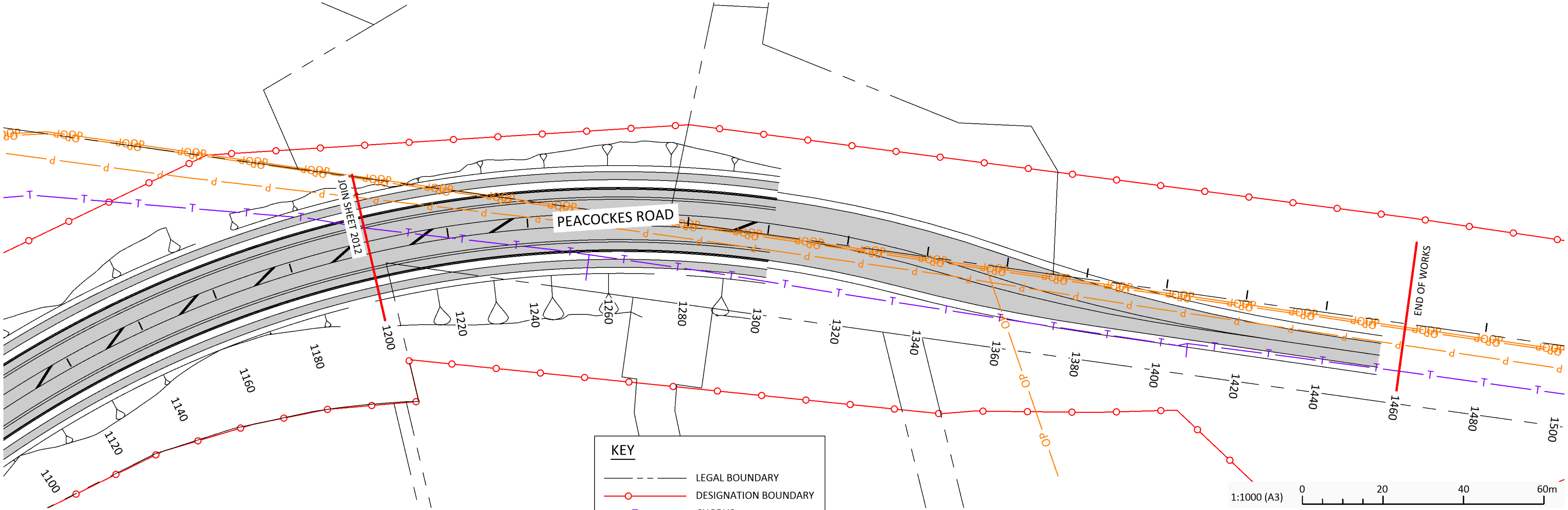

KEY

— — —	LEGAL BOUNDARY
—o—	DESIGNATION BOUNDARY
— T —	CHORUS
— UFB —	FIBRE OPTIC
— G —	GAS
— OP —	POWER OVER HEAD
— P —	POWER UNDER GROUND
— SW —	STORMWATER
— W —	WATER
— SS —	WASTEWATER
	STREAM

REV	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
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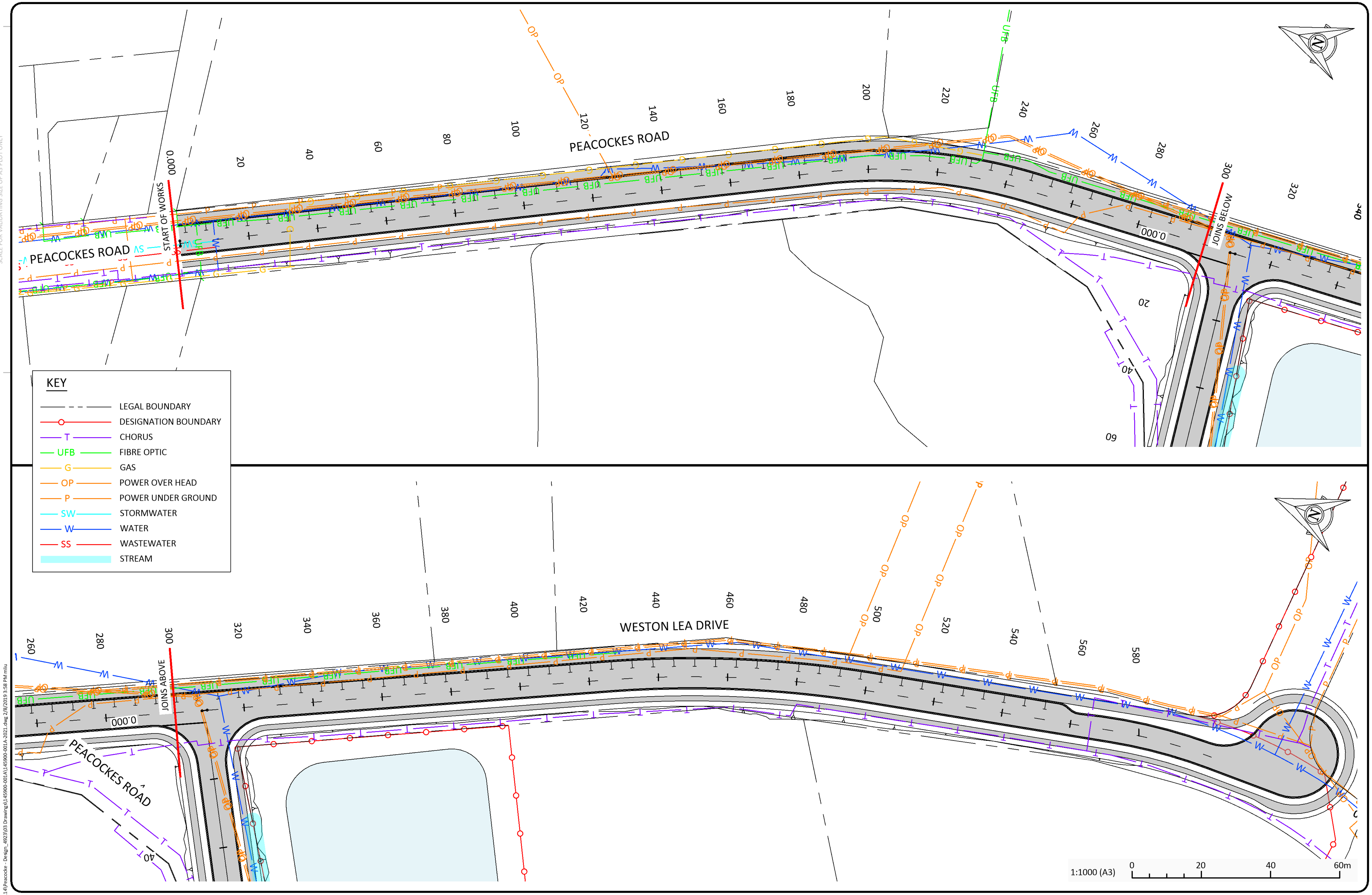
CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD - EXISTING SERVICES PLAN SHEET 3

STATUS: PRELIMINARY
DATE: 02.08.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-2013
REVISION: A

Version 3.0 - September 2017



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A	02/08/2019	INITIAL ISSUE FOR INFORMATION	ML	CM	JG

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CLIENT: Hamilton City Council
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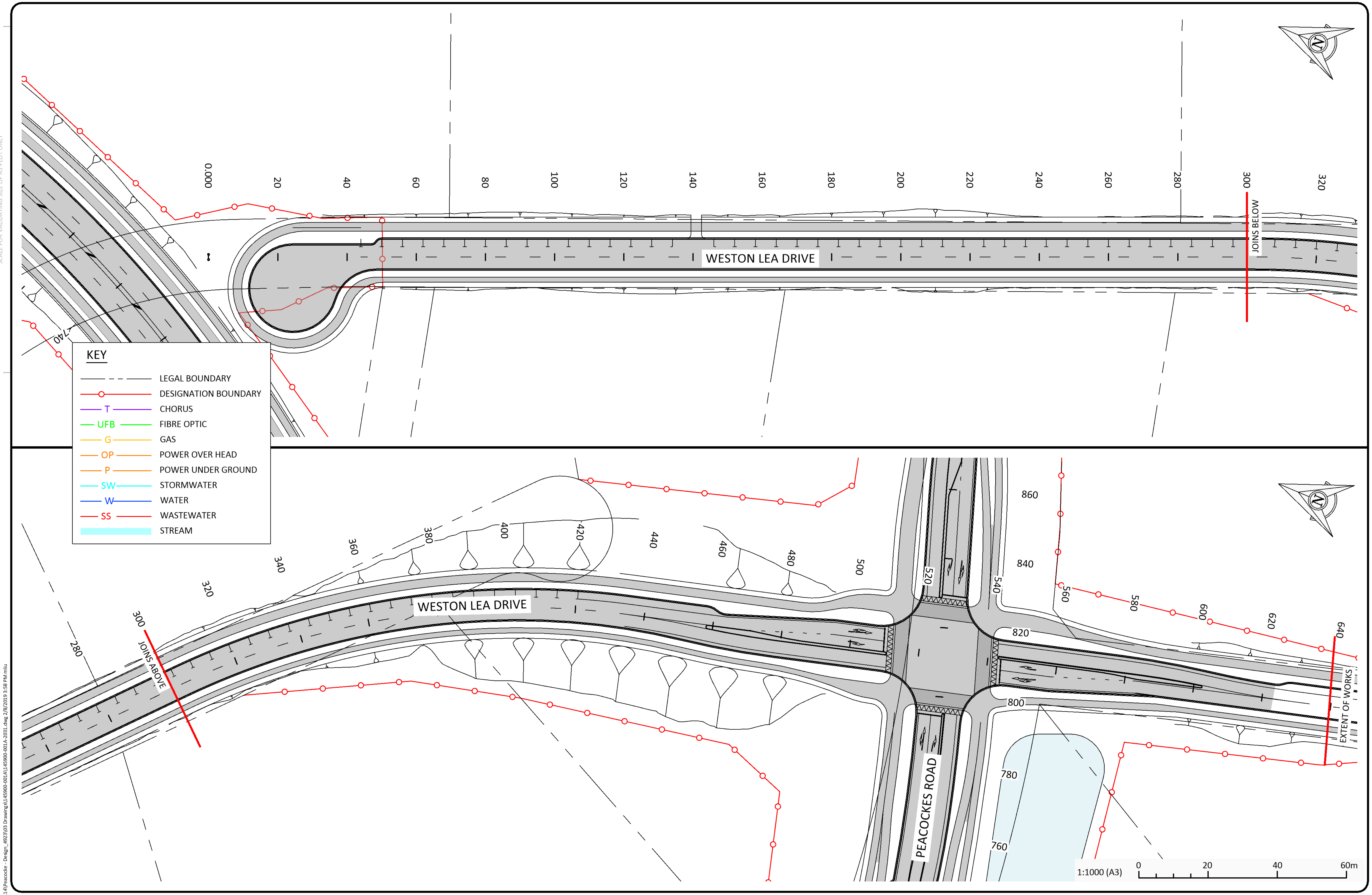
PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: PEACOCKES ROAD/WESTON LEA DRIVE - EXISTING SERVICES PLAN

STATUS: PRELIMINARY
DATE: 02.08.2019
SCALE (ORIGINAL SIZE A3): 1:1000
DRAWING NUMBER: 145900-001A-2021
REVISION: A



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CLIENT: Hamilton City Council — Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT PROJECT

DRAWING: WESTON LEA DRIVE - EXISTING SERVICES PLAN SHEET 1

STATUS: PRELIMINARY

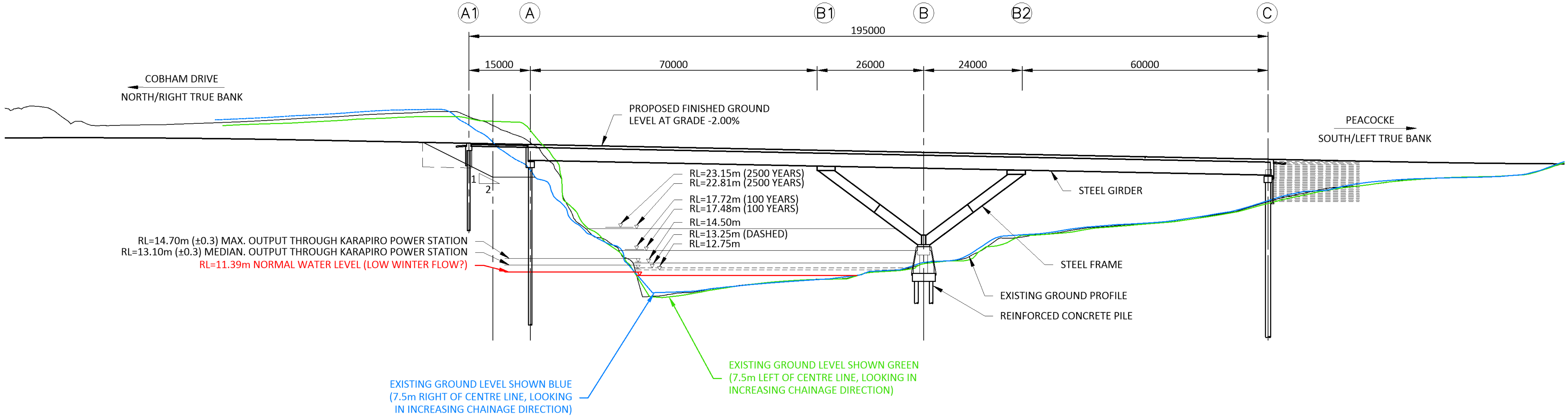
DATE: 02.08.2019

SCALE (ORIGINAL SIZE A3): 1:1000

DRAWING NUMBER: 145900-001A-2031

REVISION: A

Version 3.0 - September 2017



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DRAFT: 02/08/2019

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NOT FOR CONSTRUCTION

DRAFT COPY NOT APPROVED

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	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

DESIGNED PCH	CHECKED -
DRAWN RG	APPROVED -
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CLIENT
Hamilton City Council
Te kaunihera o Kirikiriroa

PROJECT
PEACOCKE STRATEGIC TRANSPORT

DRAWING
WAIKATO RIVER BRIDGE
OPTION 1A - Y-PIER,
STEEL - CONCRETE COMPOSITE BRIDGE

STATUS
PRELIMINARY

DATE 08/2019
SCALE (ORIGINAL SIZE A3) AS SHOWN
DRAWING NUMBER 145900-001A-0475
REVISION -

Version 3.0 - September 2017

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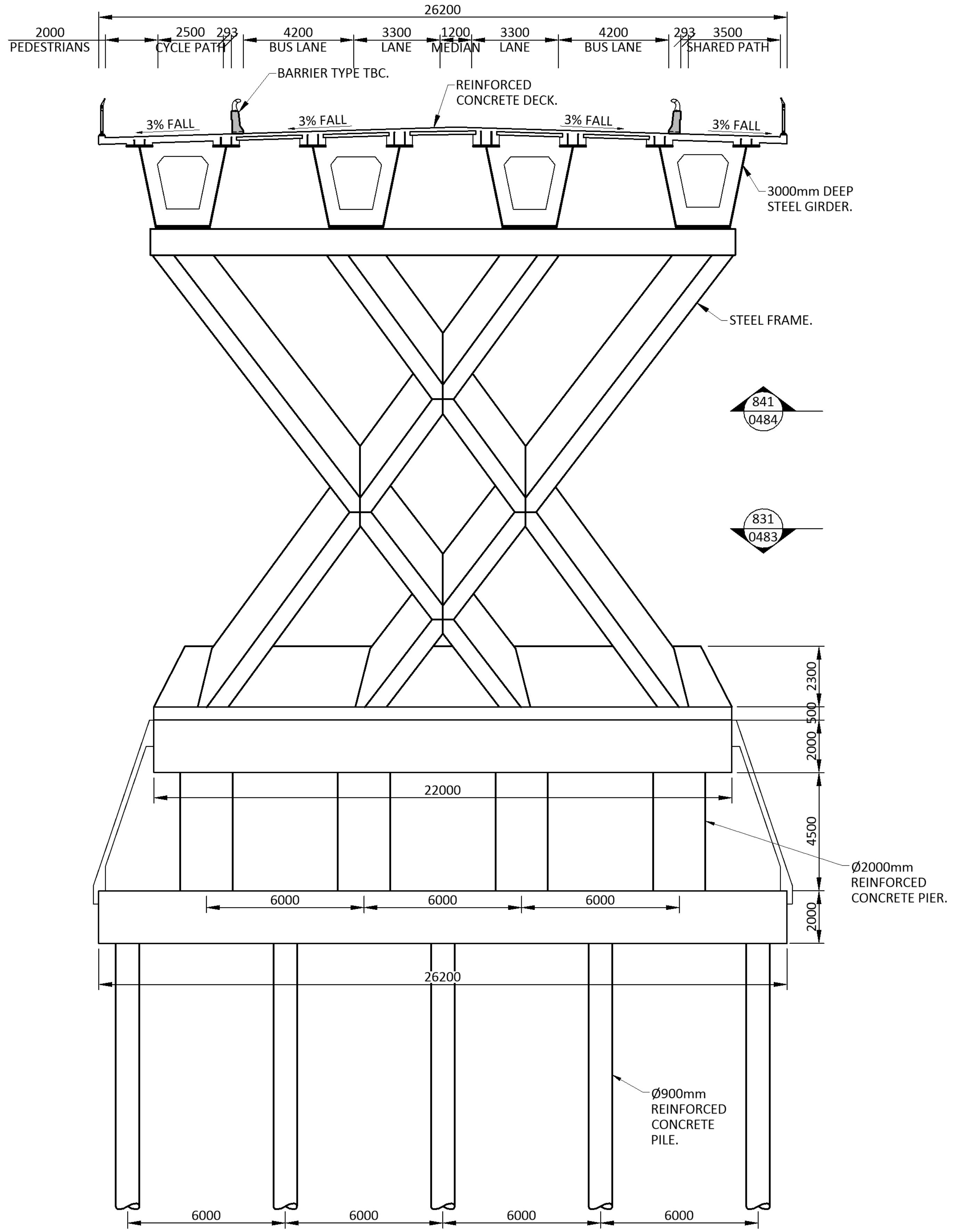

TYPICAL CROSS SECTION
1:200

DRAFT: 02/08/2019

NOT FOR CONSTRUCTION

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	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR

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APPROVED: -
mx model version:

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CLIENT: Hamilton City Council
Te kaunihera o Kirikiriroa

PROJECT: PEACOCKE STRATEGIC TRANSPORT

DRAWING: WAIKATO RIVER BRIDGE
TYPICAL CROSS SECTION

STATUS: PRELIMINARY
DATE: 08/2019
SCALE (ORIGINAL SIZE A3): AS SHOWN
DRAWING NUMBER: 145900-001A-0459
REVISION: -

Version 3.0 - September 2017

Appendix B – Environmental Mitigation Statement

Environmental Mitigation Statement

This Environmental Mitigation Statement (EMS) is intended to identify the actual and potential environmental effects associated with the Peacocke Strategic Transport Project (PST), and the means by which those effects will be mitigated through detailed design. The EMS takes into account the design, designation and consent objectives for the PST as well as a preliminary Environmental and Social Responsibility Screen used to identify high level themes and issues. The EMS which follows comprises a combination of 'embedded mitigation' (i.e. mitigatory features incorporated into the design of the development) and 'mitigation measures' (i.e. measures to prevent, reduce and offset any remaining adverse effects e.g. consent conditions).

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
Landscape and Visual Impacts	Visual change to landscape and gully environments	PST alignment has been designed to be sympathetic with surrounding natural landform and existing landscape features. As far as practically possible, it avoids encroachment into gullies, water courses and areas of indigenous vegetation.	An integrated 'green network'. A transport network that is sympathetic to the wider landscape and integrates with the landscape and land uses.
	Adverse change in character arising from the proposed development and the permanent presence of roading.	Detailed design is required to align with the approved Concept Landscape Management Plan. The CLMP promotes an informal environment whereby the transport network is 'woven' through open spaces and existing landscape features. Steep cut and fill batters are generally avoided. Max slopes are 1v:2h, but are	A robust and integrated planting design that is ecologically beneficial, attractive, coherent, durable and innovative.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		flatter where possible (unconstrainted). All slopes steeper than 1v:4h are planted/mulched. Designation conditions impose a requirement for a Landscape Management Plan prior to construction works commencing. Supplementary planting to be carried out as part of landscaping works, including gully rehabilitation and adjacent to streams. Planting has been designed to enhance existing views and vistas and to integrate the road form into the surrounding landform. Management and maintenance methodologies to ensure the survival of new or replacement plantings. Tree protection where retained specimens are within proximity of construction works (i.e. fencing of root protection zone).	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Use of transportation corridors for key utilities infrastructure thereby avoiding the need for duplicate corridors. Underground service facilities to be located within soft landscape areas to avoid the hard surface areas of roads, pedestrian and cycle facilities. Where possible, planting will be utilised at the top and bottom of retaining walls to help soften and anchor structures within the landscape. Use of broad scale native planting and incorporation of 'formalised' exotic trees to define strong 'gateway' entrance. Ecological planting to link with and complement the fragmented nature of the existing habitats.	
Social	Potential social effects include either temporary or permanent severance from community facilities.	Designation conditions impose a requirement for a Transport Network Management Plan prior to lodgement of an Outline Plan of Works.	Connect, retain and improve access between the existing built environment, open spaces and future development areas.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
	Community cohesion and accessibility, including vehicular connectivity with the local road network. Perceived personal security for pedestrians and cyclists.	Design of the PST ensures that connectivity with the local road network is maintained for all landowners, both during and after construction. CPTED principles have been incorporated into the approved Concept Landscape Management Plan. PST has been designed to support a wide range of transport choices through the provision of safe and user-friendly cycle and pedestrian facilities and bus lanes.	Incorporation of a safe, user friendly cycling and pedestrian network that links to existing and proposed facilities.
Human Health	Potential for human health impacts cause by construction effects (such as noise and dust).	Designation conditions are in place requiring a Construction Noise and Vibration Management Plan as part of a Construction Management Plan, and a Dust Management Plan prior to construction works commencing on site.	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
	Potential for HAIL sites to be located either within the PST designation, or within the construction area of interest. This is a potential health risk for construction workers. Risk to human health through the handling of hazardous substances during the construction phase. Operational noise following completion of the PST network. Road User Safety.	Preliminary Site Investigation Report (PSI) to be completed as a means of informing treatment methodology. Designation conditions are in place requiring a Contaminated Soil Management Plan and a Hazardous Substances Management Plan prior to construction works commencing on site. A Designation condition is in place requiring a Road Traffic Noise Assessment Report 6 months prior to construction works commencing. The report is to address compliance with NZS 6806:2010 – Acoustics – Road Traffic Noise – New and Altered Roads (i.e. low noise road surfacing and / or noise barriers as necessary). Incorporation of Vison Zero principles (e.g. design speed controls relative to geometrics and road user types).	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
Culture and Historic Heritage	Disturbance or removal of archaeological sites could lead to permanent loss of heritage asset.	Selection of route alignment has taken into consideration the avoidance of archaeological sites, as far as is practically possible. Access to work areas will use existing access routes as far as possible to minimise unnecessary disturbance of high probability locations. Harm to or loss of archaeological interest will be mitigated by archaeological investigation and the adherence of archaeological discovery protocols. A precautionary global archaeological authority will be applied for concurrently with regional consents and prior to construction works commencing on site. Designation condition in place requiring a Heritage and Archaeological Site Management Plan prior to construction works commencing.	Protection of archaeology and sites of cultural significance as far as is practically possible. A cultural narrative that is reflected in the design of transport infrastructure and which celebrates the historic gardening, settlement patterns and trade and transport networks traditionally associated with the area.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Potentially a requirement for a Conservation Plan if an archaeological site has sufficient significance, based on the cultural heritage assessment criteria under the Waikato Regional Policy Statement.	
	Potential for cultural significance to be overlooked in the design of roading and the proposed Waikato River bridge.	Detailed design is required to align with the approved CLMP. The CLMP promotes a cultural narrative that responds to the iwi and hapu of the area. The bridge will incorporate design features such as tomokanga or waharoa as integrated components of the bridge. Retaining walls will incorporate wall patterns developed in consultation with the TWWG. The bridge design avoids the placement of piers within the Waikato River.	
	Potential for environmental and cultural management to be perceived as 'incremental' rather than integrated and holistic.	Ecological mitigation has been developed as a 'whole of catchment ecological restoration strategy', as per recommendation of the Southern Links Tangata Whenua Working Group.	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
Ecology - General	Loss or damage to ecological habitats.	Designation condition in place requiring an Ecological Management and Monitoring Plan (EMMP) prior to works commencing on site. EMMP includes: - Avoidance of habitat where possible. - Consideration of stock proof fencing around restoration / mitigation planting. - Salvaging of indigenous flora and fauna where practicable. - Offset mitigation (habitat restoration / enhancement, habitat creation, improving water quality, designing for fauna).	A no-net-loss of terrestrial, wetland and stream biodiversity values. A robust and integrated planting design that is ecologically beneficial, attractive, coherent, durable and innovative. Designing structures for fauna
Ecology – Long Tailed Bats	Potential loss of habitat, roosts and bats.	Designation conditions are in place requiring the monitoring, management and mitigation of significant adverse effects on bats to be detailed in EMMP. EMMP includes:	Protection and enhancement of long-tailed bat habitat.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		- Minimum 1:1 restoration ratio for areas of gully, bat habitat and river margin affected by the PST designation. - Animal pest control for a period of 20 years to protect significant bat roost sites. - Measures to avoid, minimise and monitor roost removal and habitat loss, as well as habitat replacement and enhancement. - Details of alternative roosting sites, including the installation of artificial roots in advance of construction works. - Measures to minimise habitat fragmentation and alteration to bat movement. - Bat crossing points which are integrated into bridge design(s). - Reduced road lighting effects through the creation of 'dark zones' at key bat habitats. - Baffles to be considered on lighting columns to reduce spill away from roads. Establishment of buffer zones and bat hop-overs along specific locations of the project route in advance of construction.	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Street lighting to comprise warm white LED luminaries to minimise effects on bats. Avoidance of aesthetic lighting in specific locations to minimise adverse effects on bats. Pedestrian lighting to be incorporated into the design of the bridge which minimises light spill beyond the bridge deck.	
Ecology – Avifauna	Potential loss of habitat and species	Designation condition - Monitoring, management and mitigation of significant adverse effects on avifauna is detailed in EMMP.	Enhance extent and quality of habitat for native species
Ecology – Lizards	Potential loss of habitat and species	Designation condition - Monitoring, management and mitigation of significant adverse effects on lizards is detailed in EMMP.	Enhance extent and quality of habitat for native species
Ecology - Indigenous vegetation, aquatic and wetland	Potential loss of habitat and species.	Designation condition - Monitoring, management and mitigation of significant adverse effects on indigenous vegetation, aquatic and wetland species is detailed in EMMP. EMMP includes:	Protection and restoration of wetlands, lakes, rivers or streams and their margins A robust and integrated planting design that is ecologically beneficial,

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		- Minimum 3:1 offset restoration ratio for significant indigenous habitats and wetlands affected by PST designation. - Opportunities to integrate existing restoration planting on public and private land with PST restoration / mitigation planting. - Provision for the legal protection of restored areas. Where appropriate, stock proof fencing around restoration / mitigation planting. Salvaging of indigenous flora and fauna where practicable. Eco sourcing of planting species from the Waikato Ecological District, where applicable. Landscape design will allow for the extension of existing gully vegetation patterns as close to the carriageway as possible.	attractive, coherent, durable and innovative.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Culverts to incorporate fish passage if required by EEMP.	
Traffic and Transport	Impacts on the localised transport network Perceived reduction in safety for pedestrians and cyclists at intersections and roundabouts.	Only two (general) access routes are available for construction activities. CMP will include methodology for the management of construction traffic effects. Temporary Traffic Management Plan to be prepared and approved prior to construction. Road sweeping / wheel washing to avoid the transfer of debris onto the surrounding road network. Regular communications and engagement with residents and developers within the wider Peacocke Development area. Pedestrian and cycling facilities to be integrated into the design of roundabouts with pedestrian/cycle priority systems at intersections.	An integrated, high performing strategic road network that delivers the best possible service for all users.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Suitable ground markings, drop kerb facilities and signage to be provided for pedestrians and cyclists including entry and exit points for cyclists to access shared path facilities. Design allows for the use of underpasses to provide a continuous cycle link along primary shared paths All roundabouts and interchanges to incorporate suitable hard landscape features such as paths, crossings, safe zone islands, hold railings and flush kerbs to promote safety.	
	Perceived reduction in safety for pedestrians and cyclists on bridges	Suitable ground markings, path delineation and adequate width to be provided for pedestrians and cyclists.	
	Impacts on property access	PST incorporates a roading hierarchy comprising major arterials, minor arterials and collector corridors. Property access will not be achievable directly from major arterials but is provided for in collector	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		corridors and potentially on minor arterials if it supports adjacent development.	
Construction Noise and Vibration	Temporary increase in ambient noise during construction works	Plant to be regularly serviced, maintained and operated in accordance with manufacturers' instructions. Construction noise limits imposed as condition of designation. Regular monitoring of noise levels to ensure compliance with conditions. SMART warbling or broadband reversing alarms fitted to mobile plant. Limitations on the hours of operation, in noise sensitive locations. Designation condition in place requiring a Construction Noise and Vibration Management Plan as part of CMP	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
Operational Noise	Increase in operational traffic noise once additional roading is constructed.	Primary mitigation of road noise is use of asphalt surface in urban areas. Localised use of acoustic barriers may be required in discreet urban locations but is subject to further noise investigation studies.	
Air Quality	Potential for localised air quality impacts during construction.	Designation condition in place requiring a Dust Management Plan prior to construction works commencing. The Dust Management Plan will form part of the CMP developed to support regional consent applications. HGVs only use designated routes. Best practice emissions management as part of CMP. Maintain haulage roads to avoid unnecessary dust discharge.	
Water Quality	Perceived risk to water quality due to construction activities	An Erosion and Sediment Control Plan (ESCP) will be developed to support application for Regional Consents.	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
	over surface water (e.g. falling debris). Potential for adverse water quality effects caused by the discharge of contaminant run off.	Methodology provides for the construction of wetland treatment ponds which will attenuate and treat run off prior to discharge into water courses or gully environments. Design incorporates vegetated swales, where practical, as a means of water treatment.	
Bridge	Perceived safety risks for other transport modes (e.g. pedestrians and cyclists). Potential safety hazard to pedestrians and cyclists using the bridge(s) due to the possibility of falling / jumping off the bridge	Bridge cross section to incorporate suitable space for cyclists and footpath for pedestrians. Bridge incorporates lighting for road and personal safety. Effect minimised through the bridge design which incorporates a minimum 1.4m barrier along the pedestrian / cycle lane. The design will satisfy Safety from Falling requirements as detailed within the Building Act.	An iconic, safe and functional bridge over the Waikato River, with a form that responds to the land and the river and creates a strong sense of place. Urban design treatments of bridges and abutment structures to contribute to the character of the area. Design earthworks and structures to complement the surrounding landform.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
	Potential for negative perception of the bridge on the character and muri of the Waikato River.	Effect is mitigated through the iconic design of the bridge, and the avoidance of piers within the waterway. Bridge optioneering also included extensive engagement with stakeholders and the wider public.	Short and long term maintenance requirements are an integral part of bridge design.
	Potential for scouring and erosion around the southern pier of the Waikato River bridge.	Finalised bridge design will incorporate mitigation to counter pier scour. Mitigation will include voids-filled rip rap, hardening of the riverbank or similar (to be confirmed at detailed design stage).	
	Potentially adverse impact on landscape and natural character values.	Effects mitigated through design of the bridge which forms a gateway / landmark structure. Planting around the Waikato River Bridge to integrate approaches while maintaining views to the river and wider area.	
	Operational and maintenance constraints impacting on design of bridge and associated structures.	Bridge deck will be designed to enable flexibility and changeability to accommodate operational needs and future transport modes (e.g. moveable barriers).	

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		Bridge design to incorporate use of weathering steel to avoid repainting and services located with bridge beams to avoid access requirements beneath bridge. Design will ensure that all parts of the bridge are accessible from traditional roadside maintenance access platforms. Piers, MSE walls and barriers will be coated with anti-graffiti finishes.	
Hydrology and Drainage	Potential for contamination of surface water through erosion and sediment control. Potential for contamination of surface water through vehicle servicing and refuelling. Increased run off and risk of flooding due to increased permeable area and changes to drainage regimes.	An Erosion and Sediment Control Plan (ESCP) will be developed to support application for Regional Consents. The ESCP will also form part of the CMP. CMP will include methodologies for the servicing and refuelling of vehicles. Design includes provision for stormwater wetlands for attenuation and treatment If utilised, and where practical, swales will be planted with native plant species to	Integrate stormwater design and ecological planting in an informal / natural manner.

Effects Category	Predicted Changes and Potential Effects	Incorporated Measures to Avoid, Remedy or Mitigate Potentially Adverse Environmental Effects	Objectives
		reduce flow rates, filter water and improve the area's ecology. Kerb and channel to be incorporated into the carriageway design of the major arterial. The bridge design includes collection and reticulation mechanisms to transfer storm water beyond bridge abutments to appropriate treatment devices.	
Area of potential hazard risk (e.g. fault lines, significant erosion or flooding)	Recently discovered and potentially active fault zones within the Hamilton basin, including a fault crossing the bridge location.	Site-Specific Seismic Hazard Assessment has been undertaken to mitigate seismic risk.	

Appendix C – Environmental and Social Review (ESR) Screen

ENVIRONMENTAL AND SOCIAL RESPONSIBILITY SCREEN V2.FEBRUARY 2016

NZ TRANSPORT AGENCY
WAKA KOTAHI

Peacocke Strategic Transport Project

Hamilton City Council
Te kaunihera o Kirikiriroa

PROJECT LOCATION:	PROJECT PURPOSE:	DATE:	OPTION DESCRIPTION:
Peacockes	Strategic Transport	July 2019	N/A

CATEGORY		QUESTION	ANSWER	
GENERAL	G1	What is the zoning of adjacent land? Are there any encumbrances on the land? e.g. Maori Reserve or other reserve/covenants	Rural ☐	Commercial ☐
			Industrial ☐	Residential ☒
			High density residential ☐	Parks/open space ☒
	G2	Does the option disturb previously undisturbed land?	Y	N
	G3	What is the construction timeframe?	>18 months	<18 months
NATURAL ENVIRONMENT	NE1	Are there any outstanding/significant natural features (e.g. geological or geothermal)/landscapes?	Y	N
	NE2	Will the option affect the coastal marine area, wetlands, lakes, rivers, streams or their margins?	Y	N
	NE3	Will the option affect areas of the conservation estate, or areas of known significance for biodiversity or known habitats of uncommon or threatened species?	Y	N
	NE4	Is the option in an area of potential hazard risk e.g. fault lines, significant erosion, flooding, sea level rise etc?	Y	N
	NE5	Will more than 0.5 hectares of vegetation be removed?	Y	N
		What type? Exotic pasture and indigenous vegetation		
CULTURAL AND HISTORIC HERITAGE	CH1	Are there sites/areas of significance to Maori within 200m of the area of interest?	Y	N
	CH2	Are any recorded, scheduled or listed archaeological sites within 200m of the area of interest?	Y	N
	CH3	Are any scheduled, listed or other important heritage buildings/ structures within 200m of the area of interest?	Y	N
	CH4	Will the option affect the setting of any historic building/structure or archaeological site?	Y	N
	CH5	Is a group of archaeological sites or an area of historic built environment (even partially) within 200m of the area of interest?	Y	N
HUMAN HEALTH	HH1	What is the One Network Road Classification?	National ☐	Regional ☐
			Arterial ☒	Collector ☐
	HH2	Is the area of interest designated as a non-compliant airshed?	Y	N
	HH3	Are there medical sites, rest homes, schools, child care sites, residential properties, maraes or other sensitive receivers located within 200m of the area of interest?	Y	N
	HH4	Does land use within 200m of the area of interest include industrial sites, chemical manufacturing or storage, petrol stations, vehicle maintenance, timber processing/treatment, substations, rail yards, landfills or involve other activities that may result in ground contamination?	Y	N
		OR Are there HAIL or SLUR (contaminated) sites within 200m of the area of interest?	Y	N Not yet Known
SOCIAL	S1	Does the option affect access to community facilities i.e. libraries, open space etc (either temporarily or permanently)?	Y	N
			Which? Improved connectivity for Peacocke area	
	S2	Does the option affect community cohesion and accessibility including vehicular connectivity on the local road network?	Y	N
URBAN AND LANDSCAPE DESIGN	ULD 1	Are there opportunities to enhance infrastructure for, and/or improve access to, public transport and/or active modes of travel such as as walking and cycling?	Y	N
	ULD2	Does the option enhance the development potential of adjacent land where appropriate?	Y	N
	ULD3	Is the option located on a themed highway? Is the option part of or near a national cycle or walking route?	Y	N
	ULD4	Are there opportunities to enhance the urban character, landscape character and visual amenity?	Y	N

Answers and Comments	Refer to screen questions explanation to help complete this part.

1. **Summarize the potential environmental and social risks/impacts associated with this option. Consider short and long term risks and impacts.**

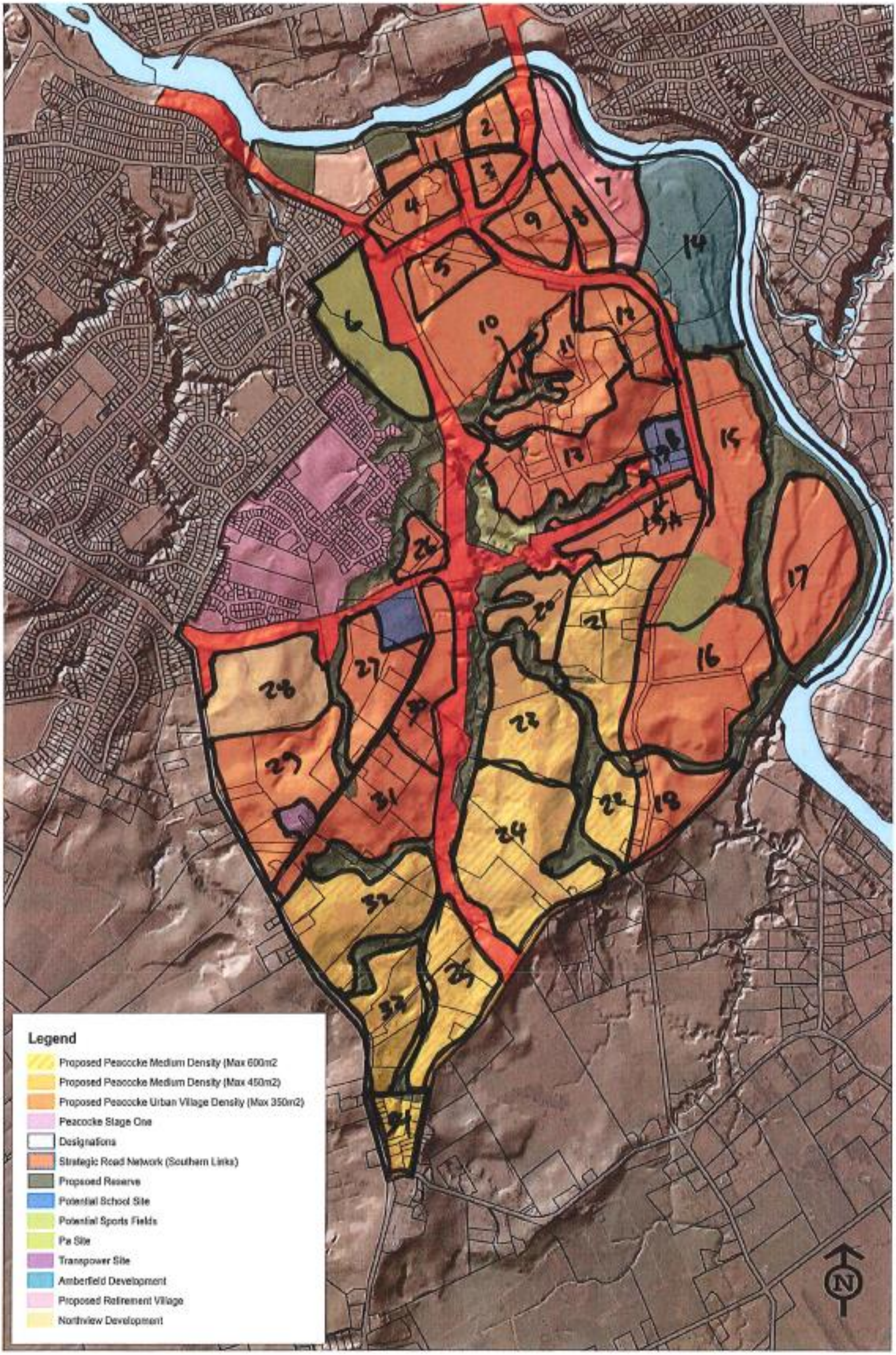
NATURAL ENVIRONMENT:	The project area is a peri-rural environment which has been heavily modified for farming, lifestyle and rural residential purposes.The Operative Hamilton City District Plan identifies the land as being Peacocke Character Zone. The northern extent of the project area crosses the Waikato River whose margins are zoned Recreation General. The river margins are affected by an Environmental Protection overlay and a Gully Slopes overlay. In addition to the Waikato River, the Peacocke area is dominated by the Mangakotukutuku Gully which supports a variety of native birds, invertebrate and reptile species and provides important habitat for long tailed bats.The landscape within the project areas is predominantly undulating. Varied soil types occur across the area and typically comprise soft silt and organic material which overlay Hinuera formation.
CULTURAL AND HISTORIC HERITAGE:	A number of archaeological features are located within the project area with sites S14/210 and S14/326 being recorded within the NZ Archaeological Association database. Both of these sites refer to the presence of Maori-made soils (Tamahere series soils) and borrow pits. These recordings are relatively common within the Waikato basin and illustrate the extent of pre-European Maaori habitation within this area. Whatukororu Pa is an historic reserve located between two arms of the Mangakotukutuku Gully near the end of Peacockes Lane. Some visible remnants of the Nokuhau Pa can be found near Stubbs / Gainsford Road.A further historic pa is located next to the water treatment plant on Peacockes Road. Historically, the project area is synonymous with gardening, settlement patterns and trade and transport networks. No heritage buildings are located within the project area.
HUMAN HEALTH:	The project area contains multiple rural residential properties, lifestyle blocks and small farm holdings: the residential component associated with these activities are the only sensitive receivers. Residential activity will nonetheless intensify within the Peacocke area because the locality is zoned as a Future Urban Area.
SOCIAL:	There are currently no schools, hospitals or community facilities within the Peacocke area, though the Peacocke Structure Plan provides for a future suburban centre at the intersection of Peacockes road and the future east-west minor arterial link. Relative to the status quo, the Peacocke Strategic Tansport project will improve community cohesion and accessibility by providing alternative routes into and out of Hamilton city, and by providing connectivity with Southern Links.
URBAN AND LANDSCAPE DESIGN:	

2. **What are the environmental, social integration, landscape design or urban design benefits or opportunities presented by this option? Particularly record opportunities that could be lost if not considered early in the design process.**

3. **Are there any impacts, risks or opportunities which require preliminary technical assessments to help understand risks or opportunities? Is further information required to support the development of the detailed business case or can it be left until the detailed business case/pre-implementation?**

Completed by	
Reviewed by Project Manager	

Appendix C – Peacocke Developable Areas Zone Sketch (HCC)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Legend
Proposed Peacocke Medium Density (Max 600m2)
Proposed Peacocke Medium Density (Max 450m2)
Proposed Peacocke Urban Village Density (Max 350m2)
Peacocke Stage One
Designations
Strategic Road Network (Southern Links)
Proposed Reserve
Potential School Site
Potential Sports Fields
Pa Site
Transpower Site
Amberfield Development
Proposed Retirement Village
Northview Development
N