Appendix 9: Water & Wastewater Assessment

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WATER & WASTEWATER ASSESSMENT - RIDER PARK STRUCTURE PLAN (PG/0034/21)

R001-v6.2

Powerup Business Consulting Limited



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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE – WATER AND WASTEWATER ASSESSMENT SCOPE

Harrison Grierson have been engaged by Powerup Business Consultants to carry out a water and wastewater assessment in support of a private plan change application to Waipa District Council (WDC). The intention of the plan change application is to allow the development of the Rider Park property within and adjoining the C5 Growth Cell for residential purposes immediately .

The C5 Growth Cell is currently earmarked for development post 2035. The Cambridge area is experiencing high demand for residential properties; this has resulted in numerous areas designated for development post 2035 having their planning conditions revised to meet the demand. Some of these areas are already at advanced stages of development. This Rider Park Plan Change application includes most of the C5 Growth Cell (45.7Ha of 61Ha[1]) as well as an additional 52.9Ha of adjacent rural property to the east (refer Figure 1). Section 2 provides a breakdown of the properties included in this assessment.

This water and wastewater assessment asses the existing infrastructure and outlines the required engineering solutions to support the Rider Park private plan change area (referred to as the Plan Change Area in this report).

The Plan Change Area (PCA) covers an area of 98.6Ha, bound by Leamington to the west, Maungatautari Road to the south, an un-named gully to the east and the Waikato River to the north as shown in Figure 1. The PCA is shown in Figure 2.

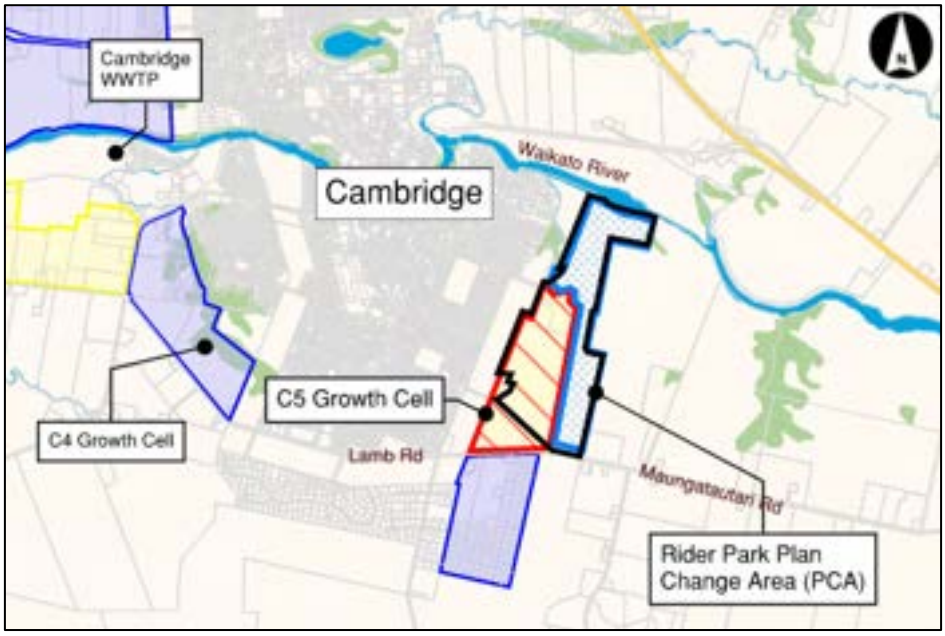


FIGURE 1 LOCALITY MAP

[1] WDC GIS Maps – area includes road reserves etc

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2.0
SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Address	Maungatautari Road, Cambridge, Waipa
Site Location	 **FIGURE 2: PROJECT LOCATION (WAIPA DISTRICT COUNCIL MAPS)**
Legal Description	**TABLE 1: PROPERTY DETAILS**

DESCRIPTION	LEGAL DESCRIPTION	AREA (HA)
C5 Growth Cell (Only properties included in the PCA)	Lot 4 DPS 60022	34.38
	Lot 3 DPS 60022	6.89
	Lot 2 DP 476497	0.17
	Lot 1 DP 409671	4.03
	Lot 2 DP 409671	0.25
Total PCA within C5 Growth Cell		**45.72**
Additional properties outside of C5 Growth Cell	Lot 1 DP 529457	52.63
	Lot 2 DP 506407	0.29
Total outside C5 Growth Cell		**52.93**
Total Plan Change Area (PCA)		**98.64**

PCA Area	98.64 Ha
Local Authority	Waipa District Council (WDC)
Zone	C5 Growth Cell: Deferred Residential Zone PCA Properties outside C5 Growth Cell: Rural Zone
Future Growth Waipa 2050	C5 Growth Cell: C5 Residential PCA Properties outside C5 Growth Cell: within Urban Limits
Existing Topography	The site is within the greater Cambridge Urban Limits. The PCA properties are approximately 2000m long and about 600m wide, resulting in a gross area of approximately 98.6Ha. The PCA is generally flat in contour, falling gently from an elevation of around RL 75m in the southeast along Maungatautari Road boundary to a natural gully two thirds into the property. There is a second lower platform to the north of the gully followed by a steep drop to a smaller platform before dropping into the Waikato River at the northern boundary of the PCA. The top of the gully bank is

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	at approximately RL 72m and the top of the Waikato Riverbank is at approximately RL 39m. A topographic survey plan of the area is included in Appendix 1. The southern two-thirds of the PCA can broadly be split into two terraces at approximately RL 75m and RL72m. The smaller terraces to the north of the gully are at approximately RL 68m and RL 50m. The PCA includes a natural gully area as well as steep riverbank sections that are considered un-developable. These areas currently make up about 15% of the total area, however this is expected to change once the earthworks has been designed and geotechnical assessments completed.
Existing Structures and Land Use	The majority of the area is in rural use, although there are also some residential properties along the Maungatautari Road and Leamington boundaries.
Existing Services	**Water Supply** The PCA is currently outside the Cambridge Water Supply area, however, there is a public 50mm diameter rural water supply on the northern side of Maungatautari Road with multiple metered 20mm connections servicing existing residential properties. WDC have two bulk 375mm diameter water supply pipes on both sides of Maungatautari Road. These mains deliver potable water from the Hicks Road and Karapiro water treatment plants. These bulk mains connect into the network at Leamington but also continue as bulk mains along Carlyle and Scott Streets to supply Cambridge, north of the Waikato River. The pipes gradually reduce diameter to a 250mm diameter pipe across the Victoria Street bridge and a 300mm diameter pipe across Shakespeare Street bridge. The bulk water pipes also supply water to the rural supply pipe already mentioned. There are also some 20mm diameter residential connections to properties on the south of Maungatautari Road. **Wastewater** There are no public sewer networks servicing the PCA. The Cambridge gravity wastewater network starts within the Leamington suburbs on the western boundary of the PCA, generally flowing northwest and along the southern bank of the Waikato River to the wastewater treatment plant on Matos Segedin Drive. There is a small, 100mm diameter, wastewater rising main located on the southern side of Maungatautari Road. This rising main conveys wastewater from Karapiro and discharges into the Leamington gravity network at the corner of Arnold Street and Shakespeare Street. The downstream gravity pipe at this location is a 300mm diameter pipe.
Proposed Development	The intended subdivision is expected to be made of residential properties as well as commercial developments intended to service the new subdivision.

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This private plan change proposes a change to Medium Density Residential Zone with freehold lots typically between 500m^2 and 1000m^2.

Subject to the design of the final lot layout the expectation is that the PCA will have a maximum of 994 lots with up to 1,987 dwellings (as permitted under the Medium Density Residential Zone rules). This is approximately 25 dwellings per hectare or 68 people/Ha.

While the total PCA area is 98.64 hectares the net developable area totals 81.4 hectares as shown in Tabel 2. All water and wastewater calculations are based on this area.

TABLE 2: PLAN CHANGE DEVELOPMENT YIELDS

	AREA (HA)	MAXIMUM NUMBER OF DWELLINGS
PCA Net Developable (Residential)	79.5	1,987[2]
PCA Net Developable (Commercial)	1.9	N/A
PCA Combined Developable Area	81.4	N/A

[2] This is based on gross area and does not make allowance for land area allocated to roading or stormwater management

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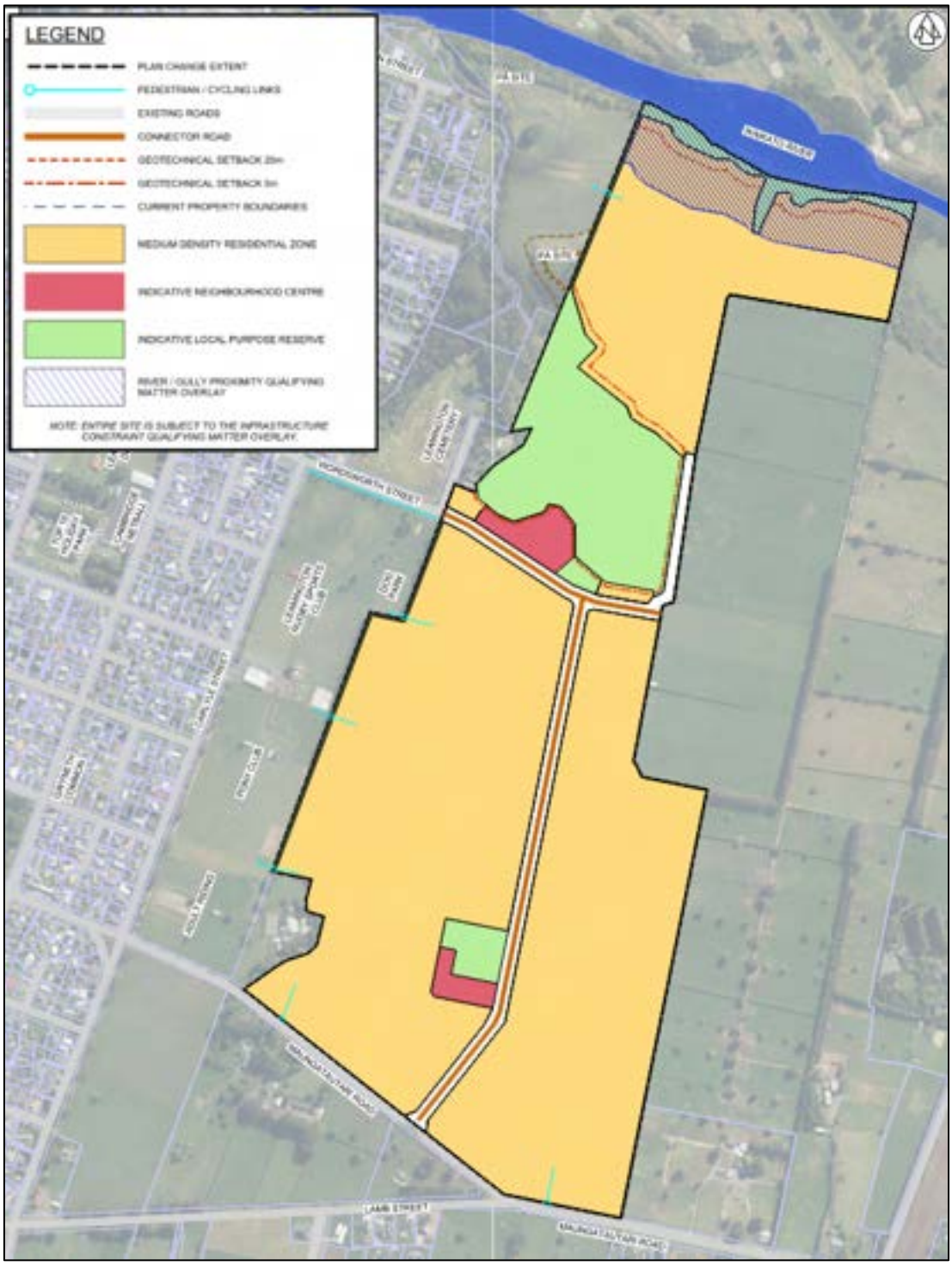


FIGURE 3 STRUCTURE PLAN GENERAL ARANGEMENT

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3.0
WATER SUPPLY

3.1 BACKGROUND REVIEW

The following documents were reviewed during the preparation of this report:

- The Waikato Regional Infrastructure Technical Specifications (RITS)
- The Waipa District Development and Subdivision Manual
- Opus Waipa District Wide Water Supply Strategy (DWWSS), 2014
- Waipa District Council Water Supply Bylaw 2013

Consultation with WDC staff (Robin Walker, Melissa Allfrey and Tony Coutts) has also been undertaken regarding existing infrastructure and programmed upgrades.

3.2 EXISTING NETWORK

Figure 4 shows the PCA in relation to the Cambridge water network. The PCA falls just outside the Cambridge municipal water supply network, however the WDC Water Supply Bylaw (Cl. 9.2.5 (b)) states that provision of a new connection outside of a water supply area is a discretionary decision by Council.

There are two bulk 375mm diameter water supply pipes on both sides of Maungatautari Road delivering the bulk of Cambridge's potable water supply from the Hicks Road and Karapiro water treatment plants. These bulk mains connect into the network west of the PCA at Leamington but also continue as bulk mains to supply the rest of Cambridge.

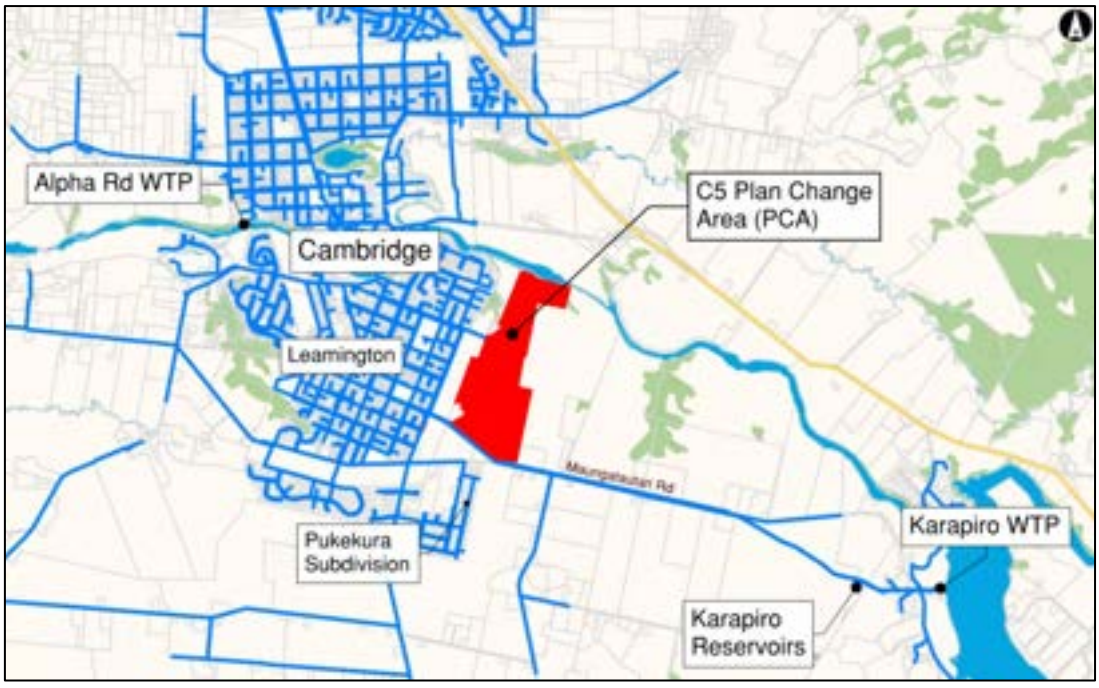


FIGURE 4 CAMBRIDGE WATER SUPPLY (WDC GIS MAPS)

The two bulk mains deliver gravity flow from elevated reservoirs at Karapiro. To control the pressure within the Cambridge reticulation there are pressure reducing valves (PRV) located on each line (Shown in Figure 6); one on Browning Street and one on Kingsley Street. These PRV's are adjusted to balance the pressure. As the demand

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increases, residual pressures in the network will drop and they will eventually be phased out.

The Alpha Road water treatment plant is on the northern side of the Waikato River and considered to have an insignificant impact on the water supply to the PCA. This treatment plant is currently used to assist in meeting high summer water demands. There are plans to upgrade this plant however the primary focus will be to meet the water demand north of the Waikato River.

The bulk water pipes also supply water to the rural residences along Maungatautari Road.

With the exception of the 375mm diameter bulk main along Carlyle Street, most of the reticulation mains along the eastern boundary of Leamington are 100mm diameter pipes. There is a 150mm diameter main along Carlyle Street south of Maungatautari Road. There is also a 180mm diameter PE pipe on Lamb Street supplying the Pukekura Subdivision on the southern boundary of the PCA.

The WDC water modelling confirms the supply provided by the two bulk supply pipes is expected to meet the water demand of Cambridge until 2050. Local plan changes have resulted in some areas being developed out of sequence to the model, however the PCA is included in the 2050 modelling. The only planned changes for this supply is the decommissioning of the Karapiro reservoirs. These will be replaced with a new reservoir and booster pumps located along Maungataurtari Road.

3.3 HYDRAULIC MODEL ASSESSMENT

As part of this assessment, the Client engaged WSP through WDC to carry out a water supply modelling assessment. A copy of the assessment memo is included in Appendix 3.

3.4 DESIGN FLOWS

The DWWSS 2014, states that WDC use a rate 261 L/person/day. This correlates with the RITS daily domestic rate of 260 L/person/day for residential subdivisions. The current peak factor for Cambridge was found to be 1.69 in 2014 and it was WDC's intention to maintain this peak factor. The WSP model recommends a peak factor of 2.2. This is lower than the RITS requirement of a peak factor of 5

3.4.1 NORMAL PEAK DEMAND

Water supply design flows for the PCA based on the layout (Appendix 2), 2.7 persons per dwelling and the lower peak factor of 2.2 are summarised in Table 3, below. Staging is in the expected order of development and areas are based on developable area only.

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TABLE 3: DESIGN WATER SUPPLY FLOWS

	CATCHMENT AREA (HA)	POPULATION[1]	AVERAGE DAILY DEMAND (m3/D)	PEAK FLOW[2] (l/s)	FIRE FLOW FW2 (l/s)
PCA Residential (Net Developable Area)	79.49	5,366	1,395	35.5	46.3
PCA Commercial (Net Developable Area)	1.89	57	15	0.4	25.3
Total Developable Area	**81.38**	**5,423**	**1,410**	**35.9**	**60.9**

Note 1: Calculation is based on 5.4 Persons per lot 2.7 Persons Per Dwelling for residential and 30 people/Hectare for commercial area
Note 2: Peak Flow is based on the reduced peak factor of 2.2

3.4.2 FIRE FIGHTING DEMAND

The WDC Water Supply Bylaw 2013 states that Council is under no obligation to provide an on-demand supply for fire protection purposes at any particular flow or pressure or maintain existing pressures or flows. It is noted that this is in contradiction to Section 6.2.3.3 of the RITS which states that "Council's standard design meets the FW2 firefighting requirements at the street boundary for residential areas and provides FW3 for other zones."

It is proposed to supply a minimum of an FW2 Water Supply Classification within the reticulated network as per the hydraulic modelling carried out by WSP in Appendix 3. PAS NZS 4509:2008 states that FW2 requires 25 l/s to be provided from a maximum of 2 fire hydrants. The fire demand should be applied on top of 60% of the peak flow.

3.4.3 WATER SUPPLY NETWORK ALLOCATION

WDC have confirmed that the PCA is included in the 2050 water model carried out by their consultant. Based on the PCA proximity to the bulk supply lines there should be adequate supply for the PCA development. With the exception of decommissioning the reservoirs and constructing the booster pump station, most of the upgrades identified in the modelling are downstream of the PCA. The recent plan changes (like Plan Change 13) have had an impact on the staging of the modelling, however WDC have confirmed that the resultant demand will dictate the pace of their infrastructure upgrades, and they are currently able to service the 2035 growth areas.

3.4.4 WSP HYDRAULIC MODELLING OUTCOMES

The hydraulic modelling process identified three stages of development to be assessed (stages, as shown in Figure 5, refer to the WSP water model report, not development stages):

- Stage 1 – identified as a nominal 23Ha to determine existing capacity within the network to start the development.
- Stage 2 – the existing C5 Growth Cell (59Ha)
- Stage 3 – C5 Growth Cell and PCA properties outside the C5 growth cell, an area greater than the PCA (112.5Ha)

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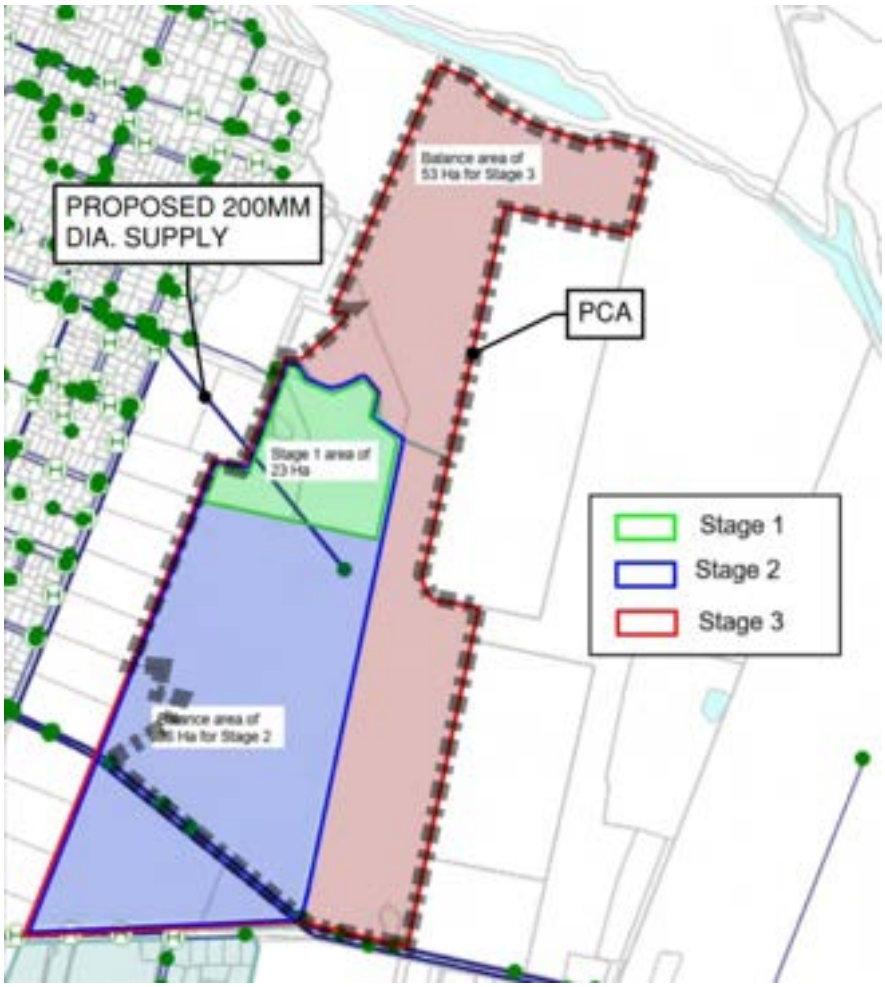


FIGURE 5 LAND AREAS AS SHOWN IN WSP REPORT

The model results are included in Appendix 3. In summary the results indicated that a single 200mm diameter pipe connected to the existing 100mm diameter pipe on the corner of Worsdworth and Carlyle streets would be able to supply Stages 1 and 2 (C5 Growth Cell portion of the PCA) without any significant pressure loss to the existing supply system. Supplying the full PCA resulted in some existing areas in Lower Leamington showing pressure drops below the accepted 20m head.

3.5 PROPOSED WATER SUPPLY

The WSP report has indicated that there is adequate capacity within the existing network to supply the C5 Growth Cell area (59Ha) but not the full PCA (112Ha). The WSP report recommends re-running the model once the PCA network has been designed to identify upgrade requirements.

The WSP model had the full 112.5Ha area (including the PCA) supplied from a single supply point located on the existing 100mm diameter pipe located on the corner of Worsdworth and Carlyle streets. The model results have identified significant headlosses within the network. The main Karapiro delivery bulk mains are still shown to be operating within acceptable level of service with minor changes in pressure. This is an indication that these existing bulk mains can supply the PCA with to-be-determined network upgrades.

An alternative to upgrades within the existing Leamington network to service the full PCA would be to have another connection directly off the existing network in Lamb

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Street. This would create a looped network through the PCA which, hydraulically, may be a preferred option; shown in Figure 6 below.

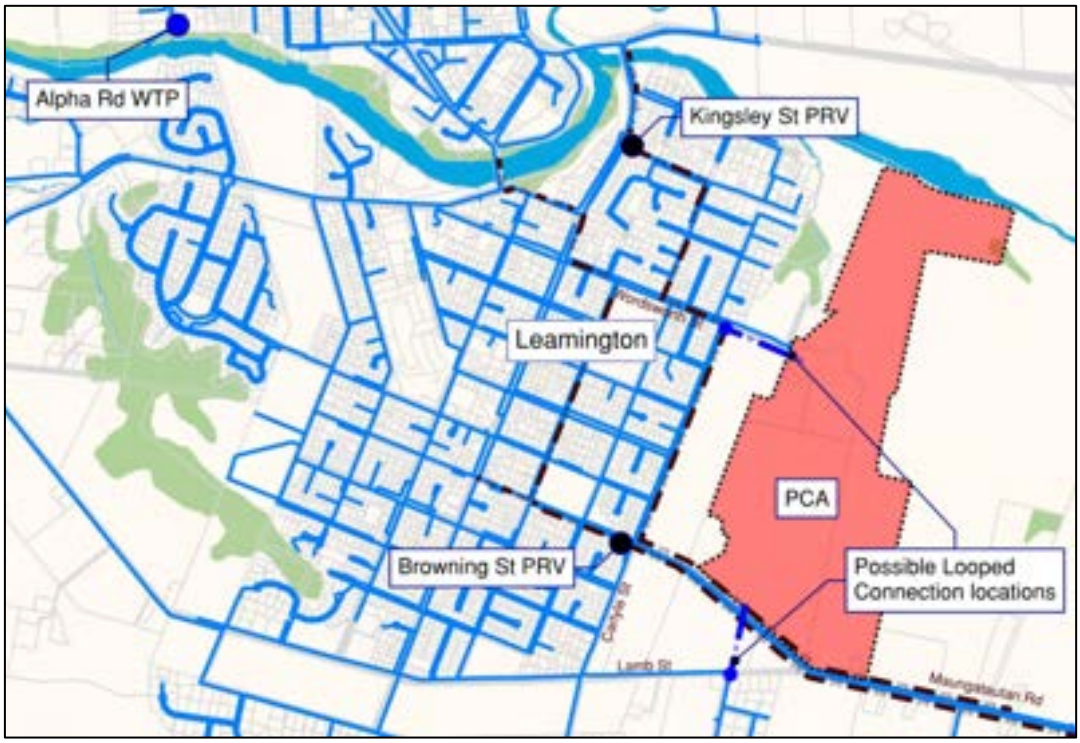


FIGURE 6 PCA WATER CONNECTIONS

As the supply is currently gravity fed with pressure controlled with PRV's there are also possibilities to adjust the pressure to accommodate the demand and associated pressure reductions caused by bringing the PCA online.

An alternative option would be for the PCA to incorporate a balancing reservoir and booster pump within the development. The reservoir would enable the development to supply peak flows during the day and refill during the off-peak periods when there is spare capacity within the bulk supply lines. This option is less favourable due to the added infrastructure and maintenance requirements of having a reservoir and pump station, but could be considered as an interim solution should development of the PCA precede network upgrades.

3.6 LONG TERM WATER DEMAND

It is well recognised that as growth continues, the demand for water will also increase, sometimes reaching close to the limits of sources of supply.

To mitigate this and to aid in promoting best practice in water sensitive design, rainwater reuse, where appropriate, may be considered. If some of the water can be harvested and stored, then it can be used to offset the treated potable demand. This water can be used for non-potable uses such as garden irrigation and toilet flushing.

The most economic time to introduce the infrastructure to enable harvesting and reuse is at the initial building development point.

The implementation of individual water metering has also shown to reduce domestic water consumption; however these are dictated by the requirements of the RITS.

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4.0
WASTEWATER

4.1 BACKGROUND REVIEW

The following documents were reviewed during the preparation of this report:

- The Waikato Regional Infrastructure Technical Specifications (RITS)
- NZS 4404:2010 Land Development and Subdivision Infrastructure
- Wastewater Treatment and Disposal Activity Management Plan 2015 - 2025
- Opus Wastewater Issues Report, 2013
- Opus C7 Growth Cell – Wastewater Assessment, 2017
- WSP Memo – Cambridge Growth Cell C4 Wastewater Capacity Assessment, 10 September 2021

Correspondence with WDC staff (Robin Walker, Melissa Allfrey and Tony Coutts) was also had regarding existing infrastructure and proposed upgrades.

WSP have also prepared Wastewater Modelling Assessment memos that are included in Appendix 4.

4.2 EXISTING NETWORK

Currently all the wastewater generated within Cambridge is conveyed by a gravity network to the Wastewater Treatment Plant (WWTP) on the Southern bank of the Waikato River on the western border of the urban limit (Figure 7). The wastewater generated from the northern part of Cambridge crosses the Waikato River on the pipe bridge, west of the River Garden residential development. The gravity main across the pipe bridge was recently upgraded to a 700mm diameter CLS pipe. The northern network then joins the southern network and flows in a 600mm diameter gravity trunk main past Matos Segedin Wastewater Pump Station to the WWTP. This portion of trunk main is known to surcharge and was recommended to be upgraded to 975mm diameter pipes by 2025 in the 2013 Cambridge and Te Awamutu Wastewater Master Plan. With the current rates of development within Cambridge it is expected that the current developments will advance this upgrade.

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FIGURE 7 EXISTING WASTEWATER NETWORK (WDC GIS MAPS)

4.3 WASTEWATER NETWORK ASSESSMENT

WSP have carried out a wastewater network assessment. Copies of the memos are included in Appendix 4, and discussed further in section 4.4.2.

The closest wastewater network to the PCA is the Leamington gravity network on the western boundary of the PCA. This network generally flows northwest to Pope Terrace then follows the top of the Waikato Riverbank before joining the northern flows at the junction from the pipe bridge.

There is also a 100mm diameter, wastewater rising main located on the southern side of Maungatautari Road. This rising main conveys wastewater from Karapiro and discharges into the Leamington gravity network at the corner of Arnold Street and Shakespeare Street. The downstream gravity pipe at this location is a 300mm diameter pipe.

The C4 Growth cell, to the west of the PCA, is being developed with the initial phases of construction recently completed. The C4 wastewater conveyance route pumps to the top of Cambridge Road, then gravity flow to Matos Segedin Drive and discharges into a manhole (MH1093351 on the WDC GIS Maps) on the 600mm diameter main trunk. A portion of the completed C4 construction works included the construction of the 315 PE100 falling main from the top of Cambridge Road. The discharge location is the portion of trunk main that surcharges and is due to be upgraded to a 975mm diameter trunk main.

4.4 DESIGN FLOWS

Section 5.2.4.2 of the RITS sets out the following criteria for the calculation of wastewater flows:

- Domestic average daily flow is 200 litres per person per day.
- Infiltration allowance is 2,250 litres per hectare per day.
- Surface water ingress allowance is 16,500 litres per hectare per day.
- Peaking factor based on Table 5.2.

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- Population equivalent is based on Medium Density Residential and expected to be 25 dwellings per hectare and 2.7 people per dwelling,
- Commercial zones are based on the RITS population equivalent rate of 30 people per hectare
- Gross contributing land area upstream of the wastewater pipe is defined as the total catchment area, excluding the main gully reserve land, but including land within legal road boundaries

Average daily flow

ADF = (infiltration allowance x catchment area) + (water consumption x population equivalent)

Peak Daily Flow

PDF (l/s) = ((infiltration allowance x catchment area) + (peaking factor x water consumption x population equivalent))/86400

Peak inflow and infiltration factor

PIIF (l/s/ha) = infiltration allowance + surface water ingress

Peak wet weather flow

PWWF (l/s) = ((infiltration allowance x catchment area) + (surface water ingress x catchment area) + (peaking factor x water consumption x population equivalent))/86400

The wastewater design flows have been based on 25 dwellings/Ha of developable area using the RITS parameters and are summarised in Table 4, below.

TABLE 4: WASTEWATER DESIGN FLOWS

DEVELOPMENT STAGE	AREA (Ha)	POPULATION EQUIVALENT	AVERAGE DAILY FLOW (M3/DAY)	PEAK WET WEATHER FLOW (l/s)
PCA Residential (Net Developable Area)	79.49	5.366	1,252	49.55
PCA Commercial (Net Developable Area)	1.89	57	16	1.29
Total Developable Area	**81.38**	**5,423**	**1,272**	**50.30**

4.4.1 WASTEWATER NETWORK ALLOCATION

It is understood that the Leamington gravity network is operating near capacity. The available capacity and upgrades required for increased capacity are discussed further in section 4.4.2. In summary the existing Leamington network can receive an additional 6 l/s of flow during peak wet weather events.

4.4.2 WSP MODEL ASSESSMENT

WSP have built and manage the wastewater model for Cambridge. They were engaged by the client to carry out an assessment of the available capacity of the network to initially identify available capacity within the network and subsequently engaged to identify upgrades required to meet the initial stages of the development.

1. Initial WSP Assessment (2022)

The initial brief provided to WSP was to assess the impacts of discharging wastewater from a portion of the development to a manhole on Wordsworth Street, Leamington. Their engagement also assessed the full PCA development discharging into the future

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975mm diameter trunk main at Matos Segedin Drive. Their initial assessment memo is included in Appendix 4 (September 2022).

For the interim stages a flow rate of 12 l/s was used. This is based on an assumed development area of roughly 23 Ha. The assessment identified some refinement as some of the pipe runs were identified as having negative grades resulting in capacity pinch points in the network and providing inaccurate results. (These pipes were re-surveyed and the model re-run with pipes at correct grades in 2023).

The assessment of the proposed 975mm trunk main at Matos Segedin Drive (downstream of the negative grade pipes) was confirmed as being adequate to accommodate the full flow from the PCA.

2. 2023 WSP Assessment

The second run of the model with corrected pipe grades was run under three scenarios:

- Scenario 1 – to run the model for Stage 1 with an estimated PWWF of 12 l/s;
- Scenario 2 – to identify the maximum available capacity within the network without any network upgrades;
- Scenario 3 – to assess the impact of wastewater detention during peak periods and utilising available off-peak capacity within the existing network;
- Scenario 4 to identify upgrade requirements to accommodate PWWF of 12 l/s.

The memo and results are included in Appendix 4 (Dated 22 August 2023). The outcomes are summarised below.

The same discharge location (manhole 20160912112115) at the corner of Wordsworth and Tennyson streets was used to run Scenario 1. This run identified numerous multiple downstream pipes as requiring upgrades to accommodate an additional 12 l/s during PWWF.

Scenario 2 identified an available capacity within the network during PWWF to be 6 l/s without any upgrades required.

In order to be able to discharge 12 l/s without any network upgrades (Scenario 3) would require significant operational storage volume (expected to be in the order of 500m3) with continuous pumping of 6 l/s during the day and 10 l/s between 12am and 5am. This scenario is considered too risky to manage and too costly to implement.

Scenario 4 identified 520m of pipe upgrades on Wordsworth Street and 250m of pipe upgrades further downstream along Burns Street. The pipe upgrades would require existing 225mm diameter pipes to be increased to 300mm diameter.

4.4.3 WASTEWATER TREATMENT PLANT CAPACITY

WDC recently extended their WWTP consent to the end of 2025. This was an interim consent to allow WDC sufficient time to determine and implement the appropriate action to cater for wastewater treatment for the greater Cambridge area from 2026 onwards.

Major upgrades to the existing WWTP are under construction with completion expected in 2026. This will accommodate projected flows up to 2065. The C5 Growth cell is included in the Cambridge growth projections.

The proposed upgrades to the WWTP would effectively increase the treatment capacity from the current (interim consent) ADF of 6,400 m^3/d to 8,250 m^3/d on completion of Stage 1 (2026) and 11,300 m^3/d on completion of Stage 2, almost doubling the treatment capacity.

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Stage 2 is expected circa 2035 however the application and WDC staff have confirmed that the Stage 2 upgrades will be dictated by actual realised growth within Cambridge. The ultimate treatment capacity and the consented treated effluent discharge volume are estimated based on ultimate Waipa 2050 growth development. It holistically has not accounted for additional growth areas and significant increases in development density. Should additional town development require further treatment capacity and / or consented volume that would be addressed under WDC future growth strategies.

4.5 IMPACTS OF WDC STAGING AND TIMING

The current development within Cambridge is progressing at a much faster rate than expected. As a result of this, WDC's planned staging of upgrades is no longer aligned with the current rate of development and WDC have indicated that monitoring of flow generation will be the trigger for planned developments.

The development of the PCA will most likely be phased, with sales of each phase determining the development of the next phase. Developing the full PCA could take 15 to 20 years so it will be important for the developer and WDC to continue engagement to ensure that the infrastructure and development occur at the same pace.

WDC have already shown their intention to encourage development in Cambridge by reviewing their current masterplan, advancing some of the upgrades.

4.6 PROPOSED WASTEWATER NETWORK

On-site wastewater treatment and soakage is not considered to be feasible for this site based on the anticipated volume of wastewater that will be generated and lot sizes.

The topography of the PCA is essentially two relatively flat terraces making up the southern two thirds and a smaller third terrace at the northern end divided by a natural, deep gully.

The PCA area will be serviced by a network of gravity wastewater pipes. Based on the elevation of PCA relative to the adjacent gravity network we believe the PCA network will be too deep to have a gravity connection. The PCA gravity network will discharge into a pumpstation, or pumpstations that will pump the wastewater out of the PCA

The network system, pipe sizes and pumpstations will be subject to detailed design in conjunction with the Resource Consent and Engineering Plan Approval process.

4.7 WASTEWATER CONVEYANCE

The wastewater pumpstations will ultimately discharge into the existing gravity network for treatment at the Cambridge Wastewater Treatment Plant (WWTP).

The outcome of the WSP wastewater modelling has identified a flow rate of 6l/s can be discharged to the Leamington network without any network upgrades. The modelling also identified that 12 l/s can be discharged to the Leamington network provided certain downstream upgrades are carried out. As the identified pipes are to be upgraded from 225mm diameter pipes to 300mm diameter pipes (effectively doubling the capacity of this portion of the network) it is expected that further modelling may actually result in additional capacity (above 12 l/s) being available within the network. This may be investigated and confirmed with further modelling runs in the future. At this stage however, it is expected that the first stage of development would discharge into the Leamington network.

The balance of the wastewater from the PCA would be dependent on construction of a new rising main following Lamb Street around the southern side of Leamington and then around the C4 Growth Cell on Cambridge Road. The rising main would discharge

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at the top of the hill on Cambridge Road into the C4 WW Outfall gravity network and discharge into the main wastewater trunk (manhole 1093351) as shown in Figure 8.

The rising main route is approximately 4km but has the advantage of being laid within a rural road reserve where the expectation is that conventional open trench methods could be used to lay the rising main.

The proposal to have the first stage (6 l/s) discharge into the Leamington network will allow a portion of the development to proceed without requiring a large capital cost of constructing a pump station and rising main to the C4 Cambridge Road falling main.

Based on the proposed development density of 25 dwellings per hectare a net developable area of approximately 8.2Ha (205 dwellings) would generate a peak wet weather flow of 6 l/s.

The C4 WW Outfall gravity pipe has been sized to accommodate the PCA flows. Table 7 provides an indication of gravity pipe sizes required to accommodate the peak flows from C4 and the Rider Park PCA. The C4 Outfall gravity has been constructed as a sealed 315 PE100 gravity pressure main. The pipe velocity at a flow of 88 l/s is 1.4m/s; the expected maximum capacity of a pipe this size would be approximately 100 l/s.

TABLE 7: GRAVITY PIPE SIZE

CATCHMENT AREAS	NOMINAL DIAMETER (MM)	PIPE GRADE (%)	PDWF (L/S)	PWWF (L/S)	PIPE CAPACITY (L/S)
C4 Growth Cell[3]	300	0.33%	14	27	56
C5 PCA	375	0.33%	35	50	101
C4 and C5 PCA	375	0.33%	49	77	101
C4 Outfall Main	267	6.3%-0.25%	Pressure gravity main capacity > 77 l/s		

[3] *Peak flows from Cambridge Growth Cell C4 Wastewater Capacity Assessment Memo, WSP, 10/09/2021*

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FIGURE 8 WASTEWATER OPTIONS

5.0 SUMMARY AND RECOMMENDATIONS

Our assessment has demonstrated that there are adequate and appropriate options to service the development of the PCA from an infrastructure perspective. These options will be selected and refined as part of the resource consent / detailed design process.

Our assessment concludes that:

Potable water supply and firefighting can be provided from the existing supply from the Karapiro Water Treatment Plant, however WDC have indicated that approximately half the development can be serviced with a 200mm diameter connection from Leamington however additional connection points to service the entire PCA will need to be confirmed with water modelling at a later date.

Wastewater can be reticulated across the development with options available for conveyance to the Cambridge Wastewater Treatment Plant.

The development of the PCA will be phased, with sales of each phase determining the development of the next phase. Developing the full PCA is expected to take at least 12 years so it will be important for the developer and WDC to continue engagement to ensure that the WDC infrastructure and the development occur at the same pace.

With expected demands on fresh water supply becoming strained as a result of climate change, water efficiency measures such as rainwater harvesting, and grey water recycling are well established technologies in New Zealand and can provide benefits in the form of reduced demand on water supply and wastewater treatment. The feasibility of implementing these measures should be investigated further during the detailed design stage of the development.

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6.0
LIMITATIONS

6.1 GENERAL

This report is for the use by Powerup Business Consulting Limited only and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

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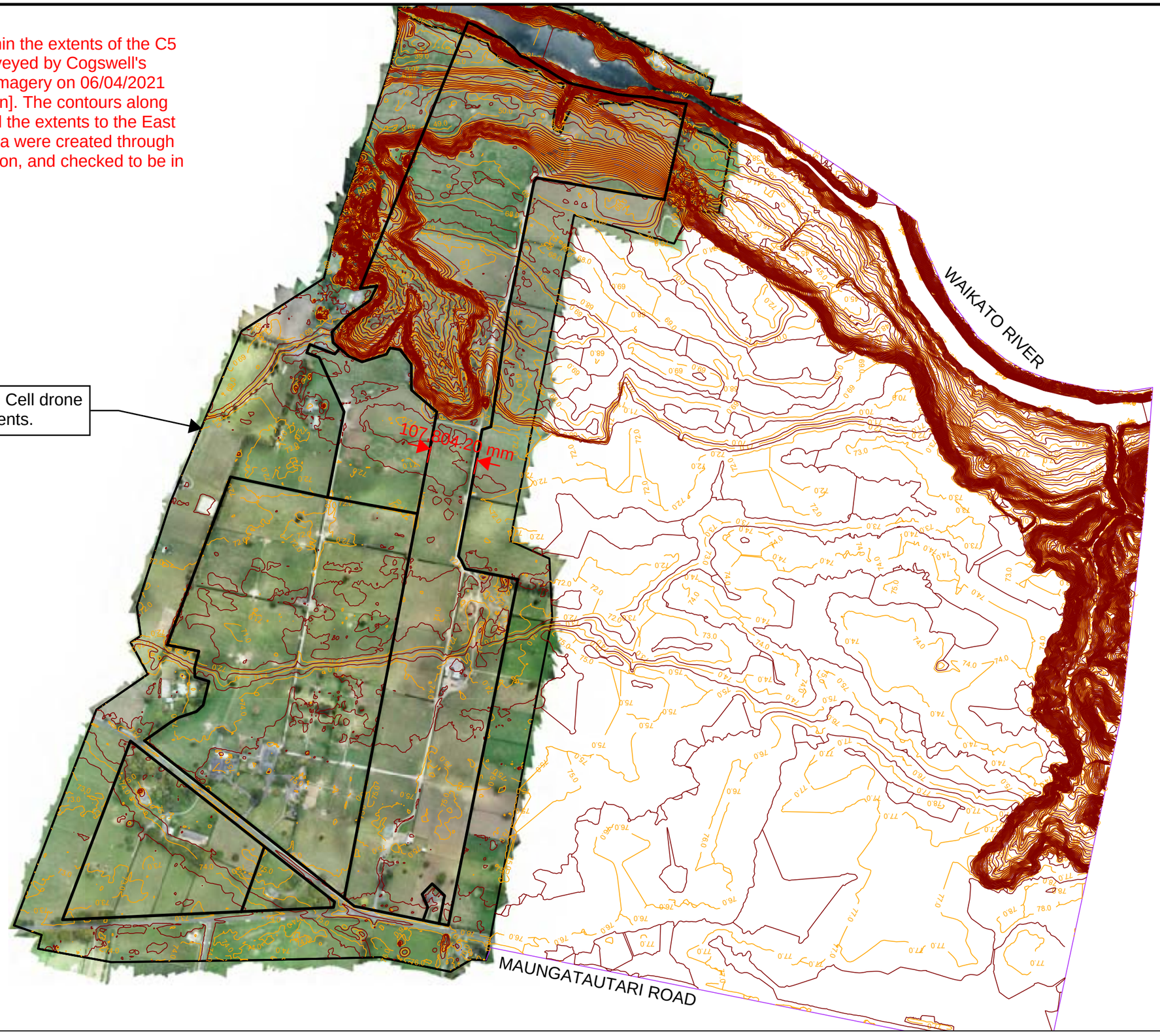
APPENDICES

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APPENDIX 1
PCA TOPOGRAPHIC SURVEY

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NB: The contours within the extents of the C5 Growth Cell were surveyed by Cogswell's through drone aerial imagery on 06/04/2021 [extents shown on plan]. The contours along the Waikato River and the extents to the East of the Growth Cell area were created through WDC LiDAR information, and checked to be in terms of our survey.



COGSWELL
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Ref: 4518 www.cogswell.co.nz

UAV Survey of C5 Growth Cell and LiDAR of Further Eastern Extents

PREPARED FOR: P. Roycroft

SCALE: 1:9000

ORIGINAL PLAN SIZE: A3
SHEET: 1 of 1

DRAWN: BG
DESIGNED:
CHECKED:

DATE: 24/08/21

NOTE: BOUNDARIES AND DIMENSIONS AND AREAS ARE APPROXIMATE AND SUBJECT TO ALTERATION BY APPROVAL OR SURVEY.
LEVELS ARE IN TERMS OF Moturiki Datum 1953.
ORIGIN OF LEVELS - BB 98: RL=39.303.

REV: A

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PLOT FILE: 4518-Contours EAST-1, PLOTTED: Tue Aug 24 11:47:14 2021

Document Set ID: 11598791
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APPENDIX 2
PROPOSED STRUCTURE PLAN GENERAL ARANGEMENT

Document Set ID: 11598791
Version: 1, Version Date: 17/12/2025

A1

LEGEND

- PLAN CHANGE EXTENT
- PEDESTRIAN / CYCLING LINKS
- EXISTING ROADS
- CONNECTOR ROAD
- GEOTECHNICAL SETBACK 20m
- GEOTECHNICAL SETBACK 5m
- CURRENT PROPERTY BOUNDARIES
- MEDIUM DENSITY RESIDENTIAL ZONE
- INDICATIVE NEIGHBOURHOOD CENTRE
- INDICATIVE LOCAL PURPOSE RESERVE
- RIVER / GULLY PROXIMITY QUALIFYING MATTER OVERLAY

NOTE: ENTIRE SITE IS SUBJECT TO THE INFRASTRUCTURE CONSTRAINT QUALIFYING MATTER OVERLAY.

ADDISON STREET
PĀ SITE
WAIKATO RIVER
PĀ SITE
LEAMINGTON DOMAIN
LEAMINGTON CEMETERY
WORDSWORTH STREET
TOP 10 HOLIDAY PARK
CAMBRIDGE NETBALL
LEAMINGTON RUGBY SPORTS CLUB
DOG PARK
CARLYLE STREET
GWYNETH COMMON
PONY CLUB
ADULT RIDING
MAUNGATAUTARI ROAD
LAMB STREET
MAUNGATAUTARI ROAD

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CLIENT: CAMBRIDGE C5 STRUCTURE PLAN
REF: 4518

PROJECT: C5 RESIDENTIAL GROWTH CELL

TITLE: ZONING & POLICY AREAS

SCALE: N.T.S
DATE: SEPT 2025
DRAWING: 4518-C5-001
REV: C

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PLOTTED: Fri Sep 5 14:50:54 2025

APPENDIX 3
HYDRAULIC ASSESSMENT FOR C5 DEVELOPMENT – WATER RETICULATION (WSP)

Document Set ID: 11598791
Version: 1, Version Date: 17/12/2025

Memorandum

To	Paul Roycroft
Copy	Jivir Viyakesparan, Kristina Macnaughtan, Sanjana Prakash
From	Pramodi Galabadage
Office	Hamilton
Date	8 June 2023
File/Ref	3-39620.00
Subject	Hydraulic Assessment for C5 Development – Water Reticulation
Status	Final

1 Introduction

As requested by Waipa District Council, Powerup Business Consulting has engaged WSP to carry out a Water Supply Modelling assessment for proposed C5 development. The proposed C5 development, which WSP has currently modelled is shown in Figure 1-1.

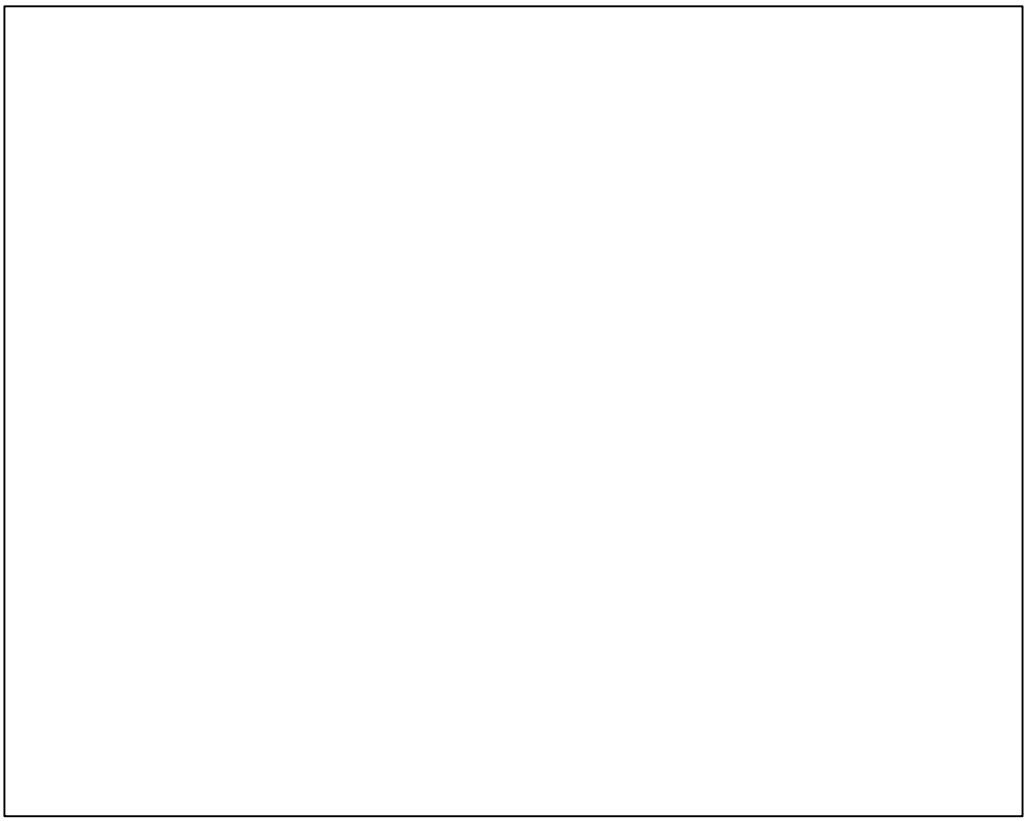


Figure 1-1 Location of Existing C5 Development

WSP
Hamilton
Level 2, 160 Ward Street (Bryce Street Entrance), Hamilton 3204
Private Bag 3057, Waikato Mail Centre, Hamilton 3240

+64 7 838 9344
wsp.com/nz

150 YEARS IN AOTEAROA

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The developer has proposed to stage the development (3 stages) and to add more land area to the existing C5 development.

Table 1-1 shows the staging of C5 development and the total land area proposed with the respective demands. Further details are explained in Modelling Scenarios (Section 4).

Table 1-1 Proposed staging and land area.

Stage	Total Land Area (ha)	Balance Area (Ha)	Peak Demand (L/s)	Peak Factor
1	23	N/A	6.85	2.2
2 (currently modelled)	59	36	12.73	N/A
3	112.5	53	33.52	2.2

Stage 2 is already modelled in the current 2022 Cambridge base model. The total land areas, peak demands, and peak factor for stage 1 and 3 were provided by the client.

Figure 1-2 shows the proposed staging and total land area for each stage of the C5 growth cell.

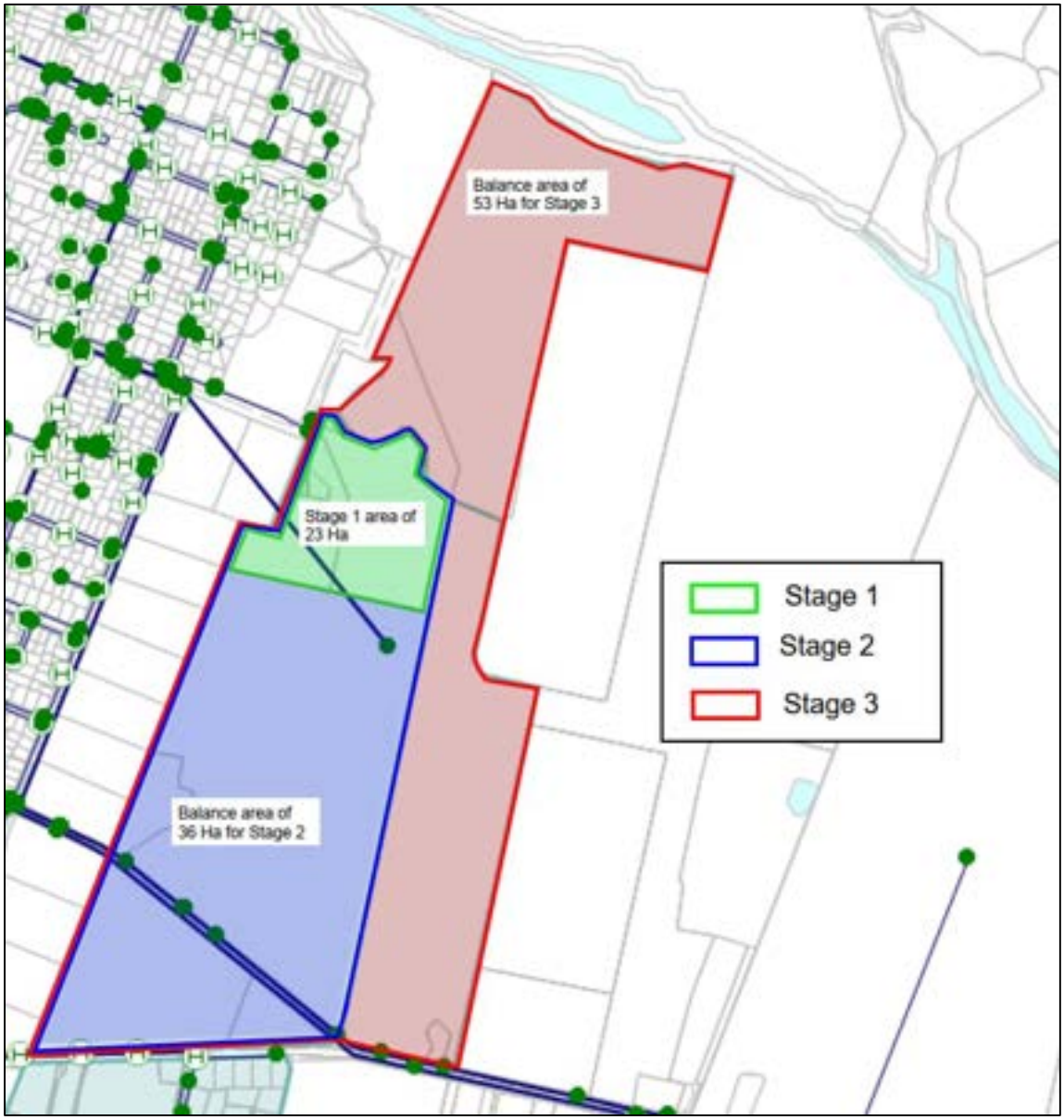


Figure 1-2 Staging and land areas proposed for C5 development.

The purpose of this assessment is to identify whether the proposed development stages meet the Level of Service as per RITS and WDC guidelines and the New Zealand Fire Flow Standards (SNZ PAS 4509:2008, New Zealand Fire Service – Firefighting Water Supplies Code of Practice).

The water supply assessment will also investigate the impact of the proposed development of C5 Development on the existing Leamington network.

The proposed plans of the staging and additional land area have been provided on the 31 May 2023.

As per the client provided information, the supply point to the proposed additional area of C5 development is the DN 100 main (asset ID: 3340677) on the corner of Wordsworth Street and Carlyle Street as shown in Figure 3-1.

2 Acceptance Criteria

The following criteria were used for the hydraulic assessment:

- **LoS – Minimum pressure**: 200 kPa (20 m) pressure at every connection point as per RITS and WDC guidelines.
- **LoS – Total Headloss**: Total Headloss (m/km) of the proposed pipe and the existing supply pipe was also investigated as per NZS 4404:2010.
    - 5 m/km for DN ≤ 150 mm diameter.
    - 3 m/km for DN ≥ 200 mm diameter.
- **Fire flow:** New Zealand Fire Service Code of Practice; SNZ PAS 4509:2008 and subsequent amendments, to the satisfaction of the New Zealand Fire Service. *Table 2-1* below lists the minimum fire flow requirements (for a single hydrant).

Table 2-1. Fire Flow Requirements as per Fire Fighting Water Supply Code of Practice

Code	Description	Requirements	
		Minimum Fire Flow (L/s)	**Minimum Residual Pressure at Required Fire Flow (m)**
FW2	Residential	12.5	10

Limitations in the hydraulic modelling software only allow the fire flow analysis for one hydrant at a time. Therefore, WSP has adopted a methodology used for Wellington Water for a similar exercise, as explained below.

For residential fire flows (FW2), the flow from a single hydrant is used to assess the likely flow from two hydrants. If the average flow is greater than or equal to 25 L/s, the flow from one hydrant meets the FW2 requirements. The use of this approach also creates a buffer to cater to any uncertainty in the models.

Therefore, WSP used the values listed in Table 2-2 to test the fire hydrants.

Table 2-2 Fire Flow Requirements used by WSP in this assessment

Fire Flow Classification	Minimum Required Flow (L/s)	Minimum Residual Pressure (m)
FW2	25	10

As the exact numbers and locations of the hydrants within the growth cell are currently unknown, we will be assigning exceptional flows onto the C5 node to assess the fire flow requirements.

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3 Model Assumptions

The following models will be used in this assessment.

- 2022 Cambridge Base Model was used to conduct the water supply modelling assessment.
- 2022 Cambridge base model included the full demands of C1, C2, C3, C4 & C6 growth cells.
- The DN 225 pipe upgrade on Lamb Street will be included in all the scenarios to support C4 growth cell.
- The water supply modelling assessment does not include significant commercial development on the C5 project site.
- The demands created by the additional area were allocated to a single (C5) node via the currently modelled (proposed) DN 200 PVC pipe.
- WSP will provide high-level recommendations to support the development if needed.
- No model updates will be made apart from the work stated in the Offer of Service.

Figure 3-1 shows the currently modelled (proposed) DN 200 PVC pipe with the single node used to allocate the demand for proposed C5 development. The supply point for C5 development is the DN 100 main PVC pipe at the corner of Wordsworth St and Carlyle St.

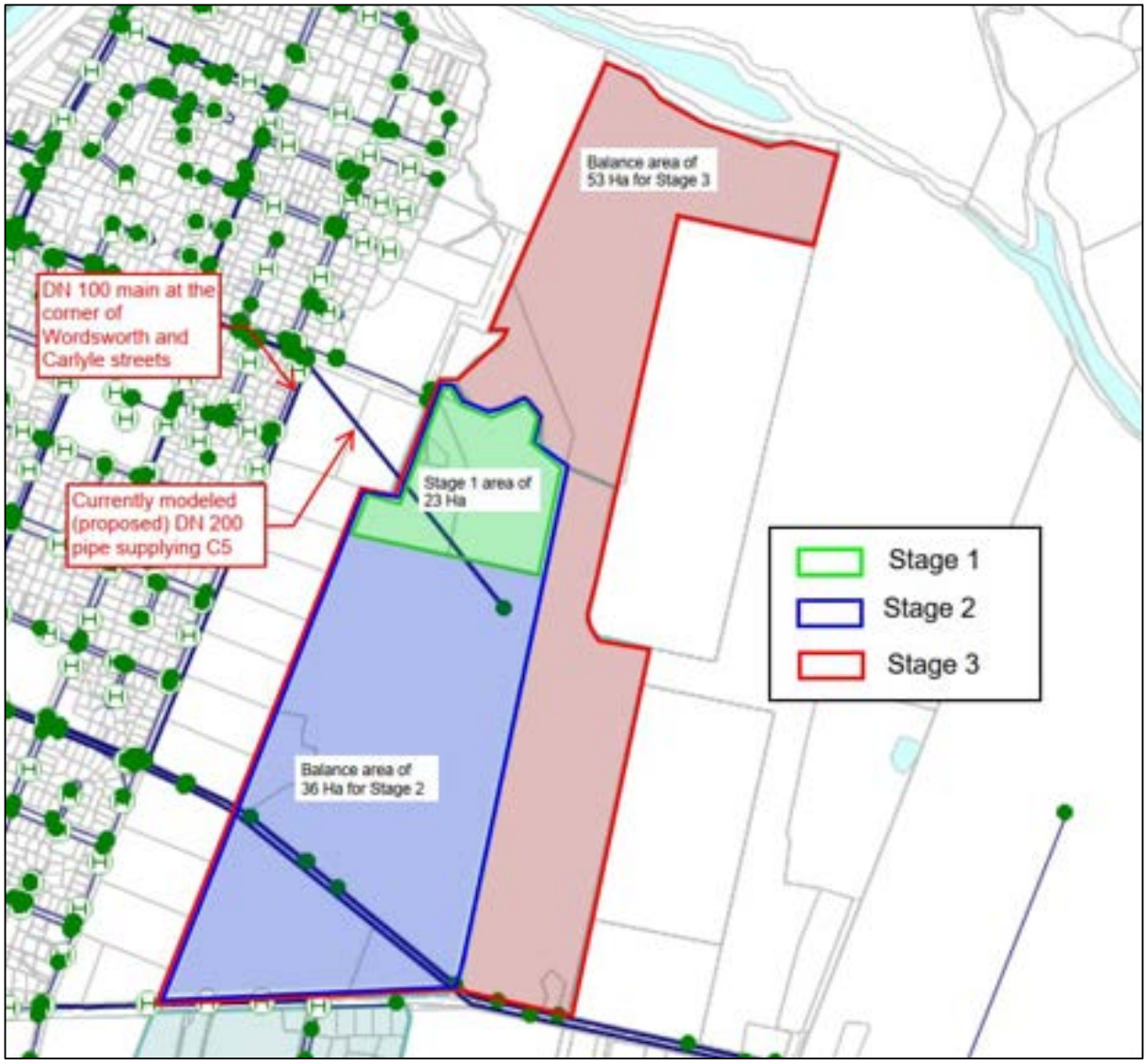


Figure 3-1 Existing DN 200 pipe for C5 development connected to DN 100 main.

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Table 3-1 shows the demand calculations for different staging.

Table 3-1 Proposed Development Demands

	Stage 1	Stage 2	Stage 3
Land Area (Ha)	23	59	112.5
Peak Demand (L/s)	6.85	12.73	33.52
Modelling Peaking Factor (from Cambridge demand profile)	2.41	2.41	2.41
Total PDD assigned to the model (L/s)	**2.84**	**5.29**	**13.91**
Leakage (L/s)	0.284	0.529	1.391

4 Modelling Scenarios

Table 4-1 summarises the modelling scenarios, which have been discussed and confirmed with WDC.

Table 4-1 WS Modelling Scenarios

Scenario	Demand	Network
1	2022 demand (including C1, C2, C3, C4, and C6 growth cell demands) + **Stage 1 C5 demand**	WDC 2022 base model
2	2022 demand (including C1, C2, C3, C4, and C6 growth cell demands) + **Stage 2 C5 demand**	
3	2022 demand (including C1, C2, C3, C4, and C6 growth cell demands) + **Stage 3 C5 demand**	

5 Methodology

The methodology used for the water supply hydraulic assessment is as follows:

- Set up three different scenarios in the model to represent the three development stages.
- Allocate the demand calculated for each stage (refer to the demand calculation table (Table 3-1) on to the C5 node along with the leakage values.
- Run the models and confirm if the proposed water reticulation network meets WDC's LoS requirements.
- Allocate exceptional flows at the node for fire flow (FW2 fire flow demands) and confirm if the development can meet FW2 criteria.
- Provide high-level recommendations on network upgrades to meet the WDC's level of service and fire flow requirements if required.
- Provide a short technical memorandum of analysis model results.

6 Model Results

6.1 Scenario 1 - C5 Development Stage 1

Scenario 1 was carried out to investigate the resulting LoS of the stage 1 of C5 development. In this stage, a total area of 23 Ha will be developed.

Figure 6-1 shows the minimum pressure and maximum headloss results for C5 and the surrounding area.



Figure 6-1 Scenario 1 LoS results

As shown in the Figure 6-1, the original C5 Growth cells meets the minimum pressure requirement of 20 m.

The DN 200 PVC supply pipe to C5 growth cell has a maximum headloss less than 1.5 m/km. The DN 100 main at the corner of Wordsworth St and Carlyle St has a maximum headloss of 3.0 m/km during the peak hours.

In addition, the surrounding Leamington networks maintains a minimum pressure above 20 m (the min pressure ranges between 20 m – 40 m).

6.2 Scenario 2 - C5 Development Stage 2

Scenario 2 was carried out to investigate the resulting LoS of the stage 2 of C5 growth cell. In this stage, an additional area of 36 Ha will be developed (Stage 2 has 59 Ha in total including the 23 Ha of stage 1).

Figure 6-2 shows the minimum pressure results and maximum headloss results for stage 2 of C5 development.



Figure 6-2 Scenario 2 LoS results

As shown in Figure 6-2, scenario 2 meets the WDC's LoS requirements as the minimum pressure if the growth cell is above 20 m.

The maximum headloss of the DN 200 PVC supply pipe is less than 1.5 m/km within the C5 growth cell. However, the maximum headloss of the DN 100 main at the corner of Wordsworth St and Carlyle St has increased to 5.9 m/km during the peak hours.

There are no noticeable LoS issues in the wider Leamington network as a result of additional demand. The minimum pressure and maximum headloss in the surrounding area has no significant changes compared to scenario 1.

6.3 Scenario 3 - C5 Development Stage 3

Scenario 3 was carried out to investigate the resulting LoS of the stage 3 of C5 growth cell. In this stage, an additional area of 53 Ha will be developed (stage 3 has 112 Ha in total including the 23 Ha of stage 1 and 36 Ha of Stage 2).

Figure 6-3 shows the minimum pressure results and maximum headloss results of the C5 development with a total area of 112.5 Ha.

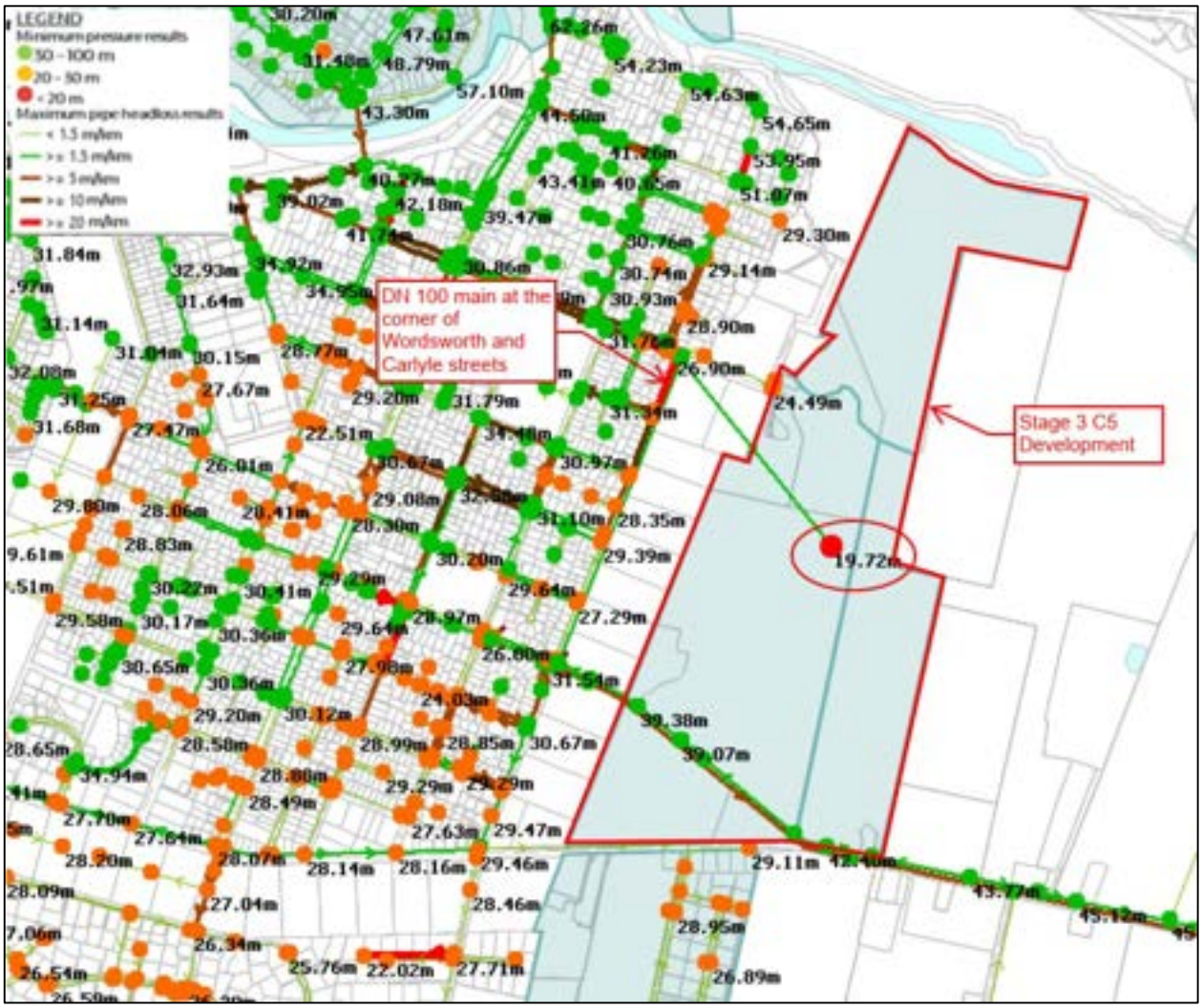


Figure 6-3 Scenario 3 LoS results

Based on the modelling results in Figure 6-3, scenario 3 does not meet the WDC's LoS requirements as the minimum pressure within the development is just below 20 m during the evening peak hours.

The maximum headloss of the DN 200 PVC supply pipe to C5 has increased to 3.5 m/km during the evening peak time. The maximum headloss of the DN 100 main at the corner of Wordsworth St and Carlyle St has increased above 20 m/km during the peak hours.

The minimum pressure in some areas in Lower Leamington has decreased from being above 30 m to between 20 – 30 m (still meets the minimum pressure requirement, but this is a decrease). The maximum headloss of some pipes have increased compared to other 2 scenarios.

We recommend carrying out another modelling assessment once the accurate water supply pipe network (structure plan for C5) and final elevation data are available.

6.4 Fire Flow

A fire flow assessment was carried out for all scenarios to determine if the development could meet FW2 fire flow requirements in each stage. An exceptional flow of 25 L/s was allocated to the node during 60% peak demand time for 30-minutes period to simulate a fire event.

The model results shows that the minimum residual pressure during this 30-minute period is above 10 m for all scenarios. This indicates that all three stages of C5 development will be able to meet FW2 firefighting requirements as per SNZ PAS 4509:2008.

Table 6-1 shows the fire flow results for both scenarios 2 and 3.

Table 6-1 FW2 fire flow results for each scenario

Scenario	Minimum Fire Flow Required (L/s)	Available Fire Flow (L/s)	Minimum Residual Pressure Required (m)	Residual Pressure at Available Fire Flow (m)
1	25	25	10	22.57
2	25	25	10	22.19
3	25	25	10	17.15

7 Conclusions and Recommendations

WSP conducted a water supply modelling assessment to investigate the proposed staging of the C5 growth cell.

Three different scenarios were modelled and assessed. The LoS results for each scenario is detailed below.

- **Scenario 1**
  Scenario 1 was carried out for stage 1 of C5 development with a total area of 23 Ha. Stage 1 of C5 development meets WDC's LoS as the minimum pressure is above 20 m. The maximum headloss of the DN 200 supply pipe is less than 1.5 m/km. Stage 1 of the C5 growth cell also meets the FW2 fire flow requirements. No noticeable issues in the wider Leamington network.

- **Scenario 2**
  Scenario 2 was carried out for stage 2 of C5 development. Stage 2 has a total area of 59 Ha including the 23 Ha of stage 1 and a balance area of 36 Ha. Stage 2 of C5 development meets WDC's LoS as the minimum pressure is above 20 m. The maximum headloss of the DN 200 supply pipe is less than 1.5 m/km. The maximum headloss of the DN 100 main at the corner of Wordsworth St and Carlyle St has increased to 5.9 m/km during the peak hours. There are no noticeable LoS issues in the wider Leamington network as a result of additional demand.

- **Scenario 3** –
  Scenario 3 was carried out for stage 3 of C5 development. Stage 3 has a total area of 112 Ha including the 59 Ha of stage 1 & 2, and a balance area of 53 Ha. WDC's LoS requirements were not achieved as the minimum pressure within the development is just below 20 m during the evening peak hours. The maximum headloss of the C5 supply pipe has also increased compared to the other two scenarios.
  The minimum pressure in some areas in Lower Leamington has also gone down from being above 30 m to between 20 – 30 m (still meets the minimum pressure requirement, but this is a decrease). The headloss of the DN 100 supply pipe at the corner of Carlyle St and Wordsworth St has increased above 20 m/km.

It is recommended to carry out another modelling assessment once the structure plans for the development is available (with the internal pipe network), along with the final elevations from the survey, prior to making any network upgrade recommendations.

Disclaimers and Limitations

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for PowerUp Business Consulting ('Client') in relation to C5 Development– Water Supply Modelling Assessment ('Purpose') and in accordance with the short form agreement with the client dated 28 February 2023 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans, and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions, and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

WSP acknowledges that the limitation that the modelling has not considered potential intensification due to the implementation of the new Medium Residential Density Standards permitting greater intensification by way of Plan Change 26 that WDC has given effect to.

Prepared by:	Reviewed by:	Approved for Release by:
		
Sanjana Prakash	Jivir Viyakesparan	James Cassidy
Water Engineering Technician	Technical Principal Engineer – Water and Wastewater	Work Group Manager – Water Resources

Appendix A

C5 Growth Cell Staging and Land Area

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Version: 1, Version Date: 17/12/2025

A1

LEGEND

- C5 GROWTH CELL EXTENTS
- STREAM
- TOP OF BANK / GULLY
- BOTTOM OF BANK / GULLY
- COLLECTOR ROAD
- LOCAL ROAD (INDICATIVE LOCATION)
- WALKING / CYCLING LINKS (INDICATIVE LOCATION)
- ROUNDABOUT
- RAISED TABLE
- EXISTING ROADS
- RESIDENTIAL ZONE
- MEDIUM DENSITY ZONE
- HIGH DENSITY ZONE
- COMMERCIAL ZONE
- LOCAL RESERVE
- SCHOOL SITE (INDICATIVE LOCATION) OR MEDIUM DENSITY ZONE
- SOAKAGE BASIN (INDICATIVE LOCATION)
- AREA OF CULTURAL SIGNIFICANCE (PA SITE)
- BORROW PIT
- TAUPO PUMICE ALLUVIUM SOIL

WAIKATO RIVER

Additional included in PC Area - 53 Ha

S15/24

LEAMINGTON CEMETERY

WORDSWORTH STREET

Total Plan Change Area 112Ha

Stage 1 - 23 Ha

CARLYLE STREET

LEAMINGTON RUGBY SPORTS CLUB

Balance of C5 PC Area (within C5 GCA)- 24 Ha

C5 Growth Cell extents

MAUNGATAUTARI ROAD

Balance of C5 Growth Cell Area - 12 Ha

LAMB STREET

MAUNGATAUTARI ROAD

DRAFT ONLY

COGSWELL SURVEYING | ENGINEERING | PLANNING	CLIENT: WORDSWORTH STREET DEVELOPMENT REF: 4518	PROJECT: C5 RESIDENTIAL GROWTH CELL	TITLE: PROPOSED STRUCTURE PLAN GENERAL ARRANGEMENT	SCALE: N.T.S DATE: 13.12.22
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APPENDIX 4
WASTEWATER MODELLING ASSESSMENT – C5 DEVELOPMENT (WSP)

Document Set ID: 11598791
Version: 1, Version Date: 17/12/2025

Memorandum

To	Matthew Farrell
Copy	Harry Baxter, James Cassidy, Anand Kumar, Kristina Macnaughtan
From	Mohit Gupta
Office	Hamilton
Date	22 August 2023
File/Ref	3-39620.00
Subject	Wastewater Modelling Assessment- C5 Development Stage 2
Status	Final Issue for Client

Executive Summary

Powerup Business Consulting has enlisted the services of WSP to assess the potential effects on the local Wastewater (WW) networks in order to support the forthcoming developments in C5 growth cells. WSP has successfully analysed the potential impacts and communicated their findings through a memorandum, outlining various scenarios and model outcomes during the initial phase on 8 September 2022.

The following scenarios mentioned in Table 1 were created as per the scope after updating the model with the latest received survey.

Table 1 Scenario Summary

Scenarios	Description	Outcomes	Remarks
Scenario 1	C5 Development with PWWF of 12 L/s drains at manhole 20160912112115 into the existing network	11 pipes surcharged	Network unable to cater PWWF of 12 l/s
Scenario 2	Discharge 6l/s into the network at manhole 20160912112115 to take total flow to 80% capacity	No pipe surcharged	Network able to cater PWWF of 6 l/s without surcharging
Scenario 3	Discharge 6l/s into the network at manhole 20160912112115 and 4 litres per second would pump into the system at MH ID 1091948 for 5 hours, from 12 AM to 5 AM.	No pipe surcharged	Scenario in theory works, however, it would be difficult to implement

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Scenario 4	Draining 12 l/s at manhole 20160912112115 with network upgrades as mentioned in section 3.4.	No pipe surcharged	Total network upgrade required is approx. length 794m of 300mm pipe
Scenario 4.1	Draining 12 l/s at manhole 1091830 with network upgrades as mentioned in section 3.5.	No pipe surcharged	Total network upgrade required is approx. length 375m of 300mm pipe

1 Introduction

Powerup Business Consulting engaged WSP to identify the impact on the local Wastewater (WW) networks to service upcoming development in C5 growth cells. WSP has identified the impact and provided a memo indicating different scenarios with model results in stage 1 on 8 September 2022.

The proposed site will contribute Peak Wet Weather flow (PWWF) of 12 l/s, this will be assessed for feasibility, into the existing wastewater network on Wordsworth Street. Figure 1-1: C5 Development layout shows the phasing of the development.

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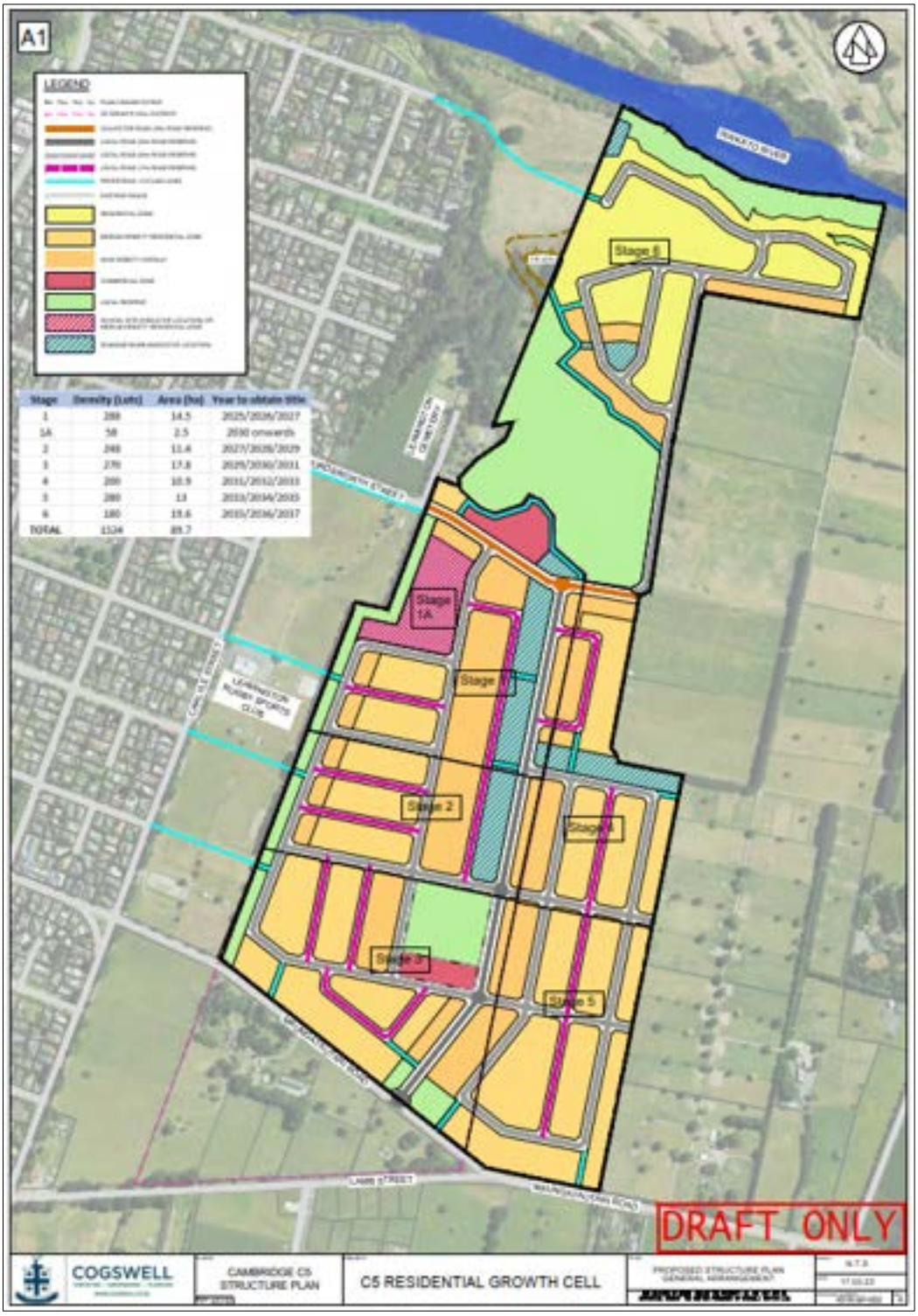


Figure 1-1: C5 Development Layout

The aim of this project is to identify the impact on the wastewater networks to service C5 development and to provide a high-level recommendation to support the development.

Waipa District Council (WDC) has requested further scope to be completed to analyse the capacity of the downstream network. After this has been completed, Powerup Business Consulting (Client) will determine the development stages of C5 as part of stage 2.

New proposed scope:

- Update the model with survey manhole data. Updating network with respect to negative gradients, GL with respect to ground model 2019. Updating the model as efficiently as possible, with existing data.

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- Scenario 1: The proposed task is to evaluate the effect of the 23-hectare development on wet weather flow (WWF) using the current model network, with a development PWWF of 12 L/s that discharges flow at manhole 20160912112115. The main goal is to determine whether the existing pipe network can support the proposed PWWF flow of 12 L/s in the WWF scenario by examining its capacity for 5 -year rainfall event.
- Scenario 2: Identify the maximum capacity available at the downstream network while having a 20% capacity reserve in the network. The objective here is to determine the maximum discharge limit from the C5 development to the network, ensuring that the pipe full capacity does not exceed 80% by maintaining a 20% capacity reserve in the downstream network.
- Scenario 3: Assess the impact of pumping the remaining off-peak capacity to increase the total flow to 80% of the existing network capacity, considering the available off-peak capacity at the pinch point upstream of manhole ID 1091948 in Wordsworth Street.
- Scenario 4: Identify existing network upgrades to support the C5 development flow of 12l/s.
- Scenario 4.1: Scenario created based on client request where the development would discharge 12 l/s into MH ID 1091830 with the necessary upgrades to the network to support C5 Development.

2 Catchment Description

Figure 2-1 displays the current wastewater network in the vicinity of the proposed development site. The discharged wastewater from the site will flow westward to manhole 20160912112115 on Wordsworth Street, connected to a 225 mm sewer. The flows will then continue along Wordsworth Street to the Cambridge wastewater treatment plant (WWTP), located approximately 4 km downstream from the initial discharge point.

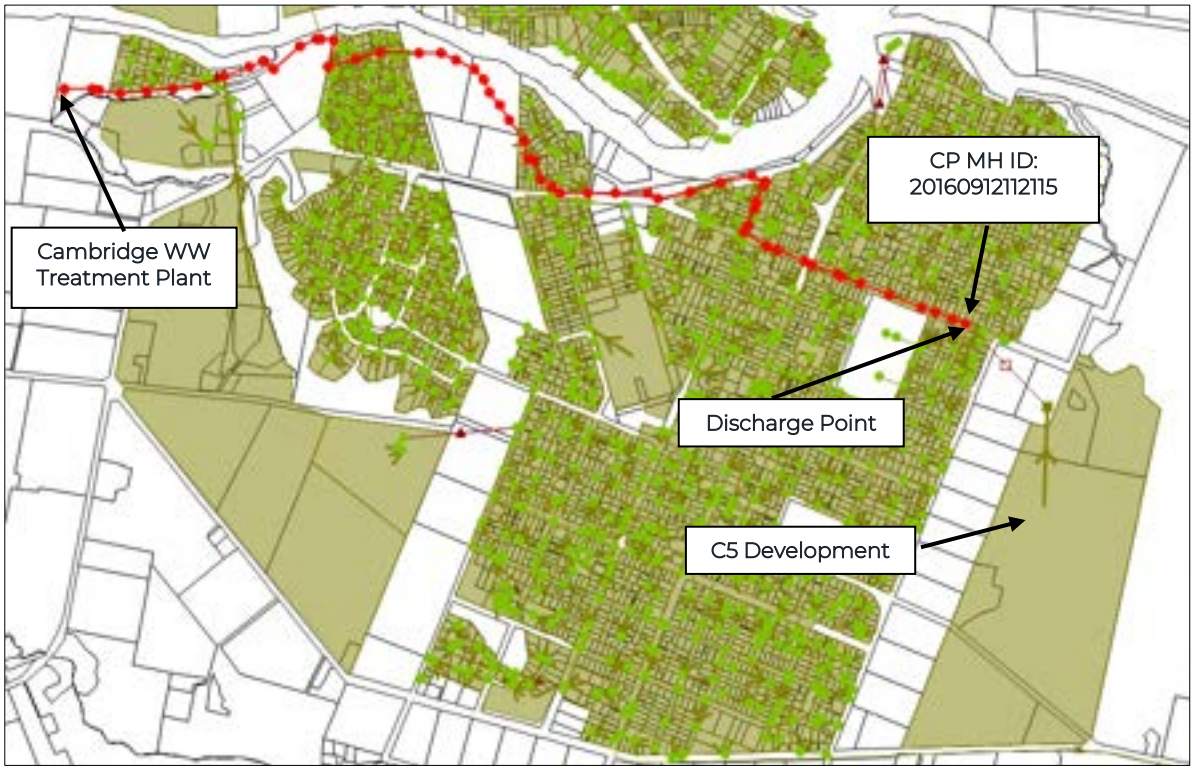


Figure 2-1: Catchment Location Plan (downstream Trunk Sewer shown in red)

The investigation utilized the 2022 Cambridge WW network model for this study. In accordance with the scope of the investigation, Stage 2 Scenario 1 was equivalent to Stage 1 Scenario 2, and all survey and model updates were implemented on this scenario. This approach allowed for a

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more streamlined and efficient analysis, as all updates were made on a single scenario without having to update the model for each separate stage. By using this methodology, the investigation was able to effectively assess the impact of the proposed development on the existing wastewater network without any disruptions to the model or analysis process.

3 Scenario Assessment

The following methodology was completed to assess the impact of the proposed development to the wastewater network.

3.1 Scenario 1 – PWWF 12 l/s

- Stage 1 Scenario 2 is considered as Stage 2 Scenario 1 for this study. The model was updated with the latest available survey data to ensure its accuracy and relevancy to the current conditions.
- Additionally, low-confidence data was updated to ensure that the model reflects the most accurate information available.
- To obtain more reliable data, the low confidence data on ground levels, invert levels, and pipe diameters were updated using online resources available on the Waipa District Council online Web Mapping System as shown in Figure 3-1 Model Update Plan.
- The received MH survey card has no information about the connected pipe diameter. So, most of the pipe diameters were checked against Waipa District Council's online Web Mapping System and updated where required.
- The PWWF (12l/s) provided for the development site was loaded directly to manhole 20160912112115.



Figure 3-1 Model Update Plan

3.2 Scenario 2

- Maximum PWWF identified for the development site was loaded directly to manhole 20160912112115 by keeping 20% capacity available at the downstream.
- Model simulations were run with WDC's design event for wastewater networks (1 in 5-year ARI 2-hour duration) for one day.

3.3 Scenario 3

- A pump was modelled to drain the remaining flow to the network at manhole ID 1091948 in Wordsworth Street during the off-peak period.

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- Model simulations were run with WDC's design event for wastewater networks (1 in 5-year ARI 2-hour duration) for one day.

3.4 Scenario 4

- Existing network upgrades to support the C5 development with 12 l/s PWWF have been investigated.
- An overview of the recommended pipes upgrade on Wordsworth Street (524m) and Burns Street (270m) is shown in Figure 3-4-1 and Figure 3-4-2 Overview of upgraded pipes respectively. Table 3-4 Proposed pipe size upgrade below summarises the upgraded pipe sizes.
- Model simulations were run with WDC's design event for wastewater networks (1 in 5-year ARI 2-hour duration) for one day.

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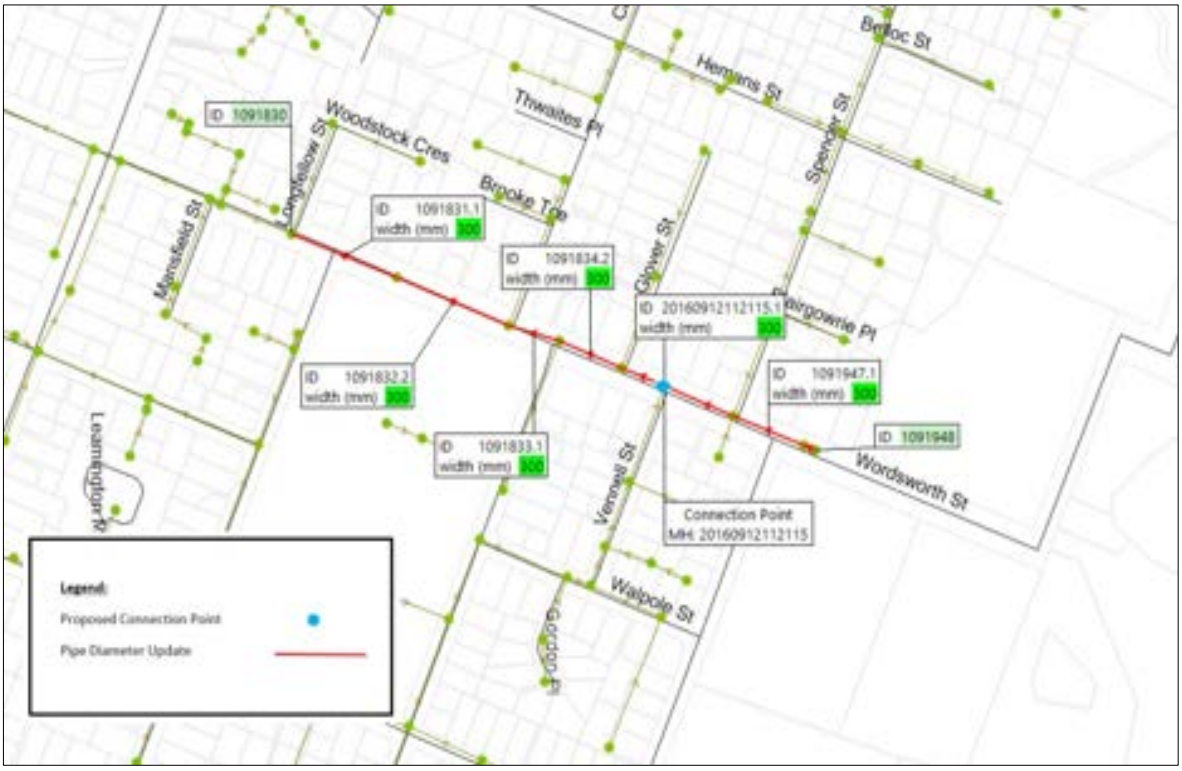


Figure 3-4-1 Overview of upgraded pipes

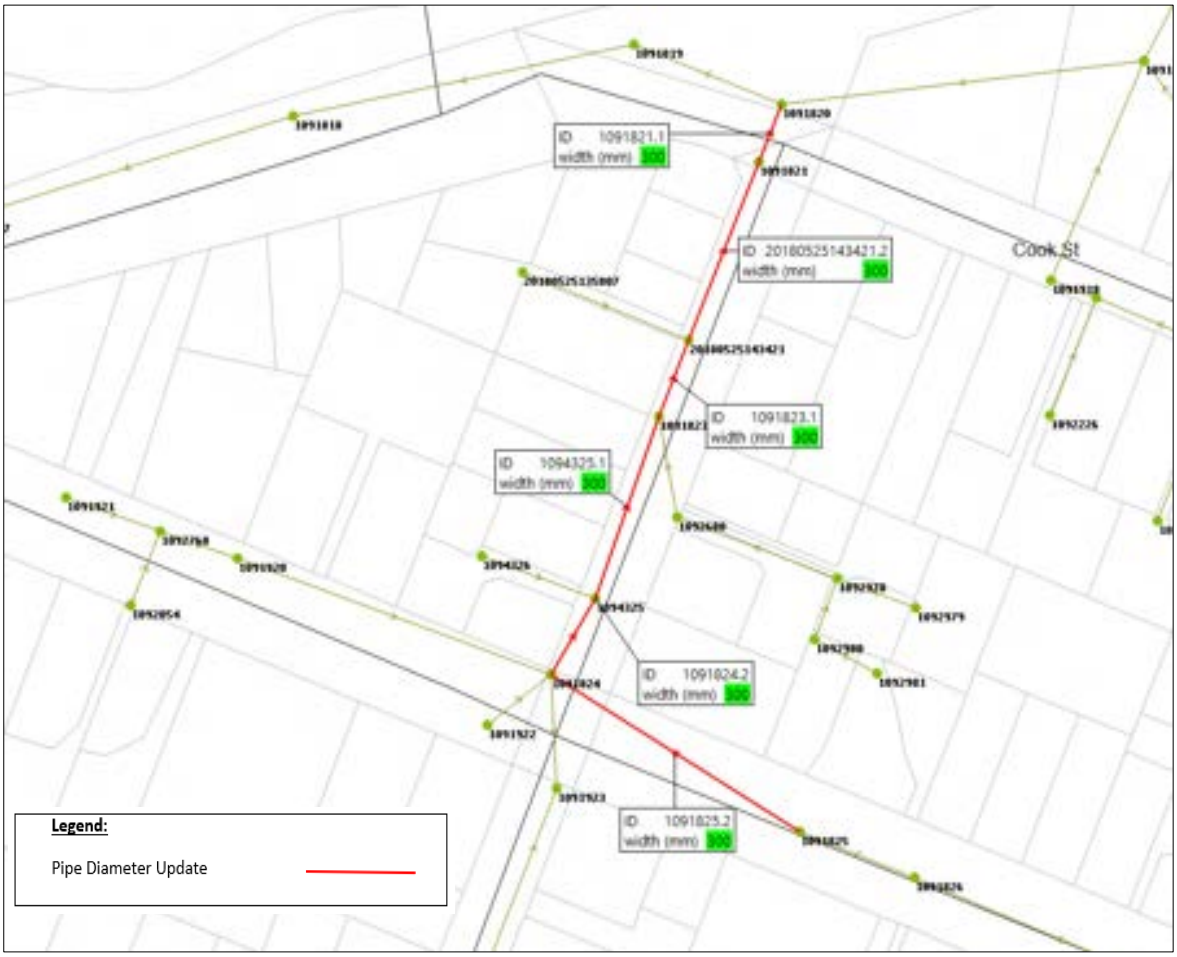


Figure 3-4-2 Overview of upgraded pipes

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Table 3-4 Proposed pipe size upgrade

Pipe ID	*Diameter in Baseline (mm)*	Diameters in Scenario 4 (mm)
1091948.1	150	300
1091947.1	150	300
1091946.2	150	300
20160912112115.1	225	300
1091834.2	225	300
1091833.1	225	300
1091832.2	225	300
1091831.1	225	300
1091825.2	225	300
1091824.2	225	300
1094325.1	225	300
1091823.1	225	300
20180525143421.2	225	300
1091821.1	225	300

3.5 Scenario 4.1

- An alternative option has been created to Scenario 4 to support C5 development.
- An alternative to upgrading the existing pipes from MH ID 1091948 to MH ID 1091830, connection point is shifted downstream as compared to scenario 4 at manhole ID 1091830 with pumping rate of 12 l/s.
- An overview of the recommended pipe upgrades on Wordsworth Street (105m) and Burns Street (270m) is shown in Figure 3-5-1 and Figure 3-5-2 respectively. Table 3-5 Proposed pipe size upgrade below summarises the upgraded pipe sizes.

Table 3-5 Proposed pipe size upgrade

Pipe ID	*Diameter in Baseline (mm)*	Diameters in Scenario 4 (mm)
1091825.2	225	300
1091824.2	225	300
1094325.1	225	300
1091823.1	225	300
20180525143421.2	225	300
1091821.1	225	300
1091831.1	225	300

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Figure 3-5-1 Overview of upgraded pipes

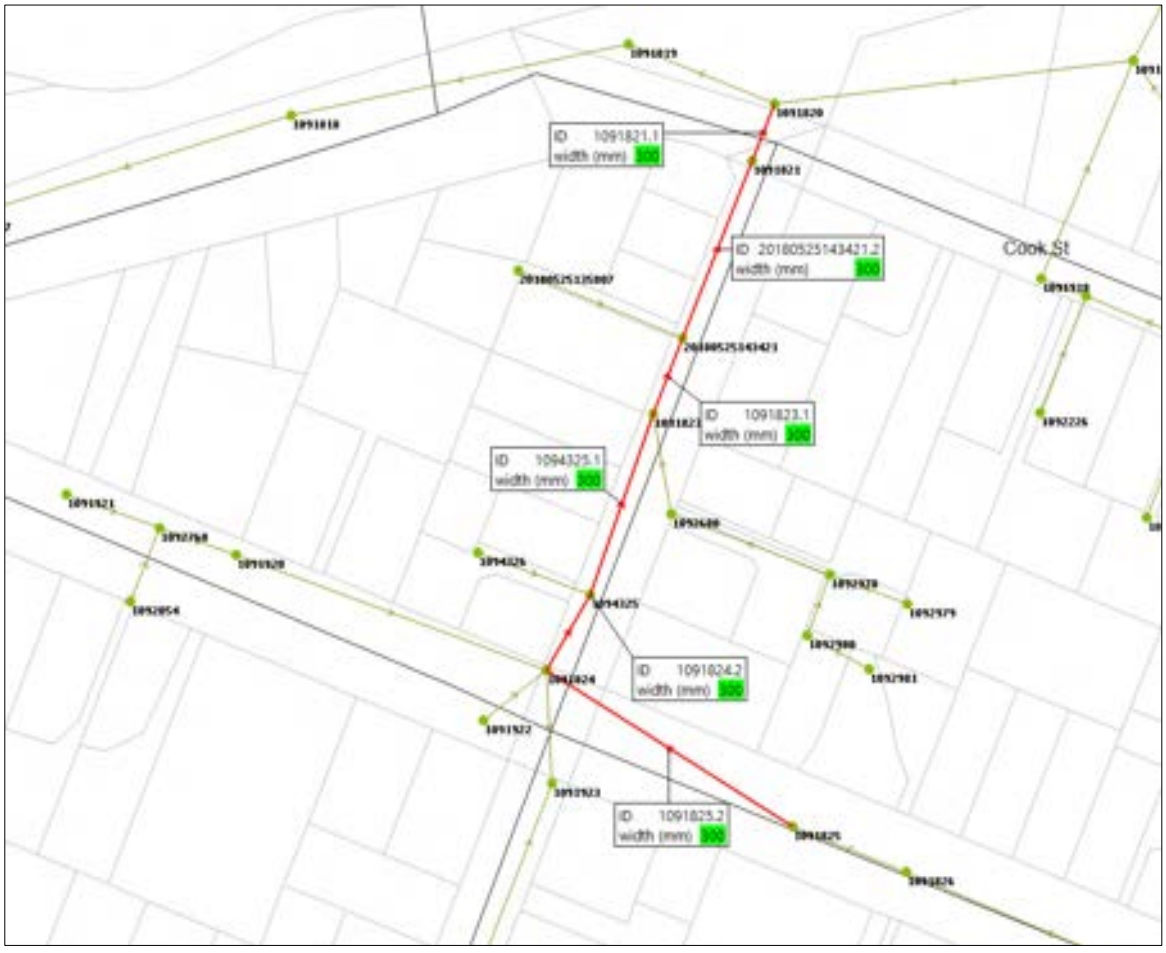


Figure 3-5-2 Overview of upgraded pipes

3.6 Analysis

The following analysis has been undertaken for Section 3.1 to 3.5.

- Potential network constraints downstream of the proposed development connection were assessed.
- The assessment of the impact of the proposed development has been undertaken in terms of:
  - ✓ Overflows
  - ✓ Surcharge State
- Table 3-5 Gravity Pipe Conditions below summarises the different pipe states.

Table 3-5 Gravity Pipe Conditions

Surcharge State	Description
<0.8	Pipe is running at its 80% capacity
0.8 < S	Pipe Capacity Exceeded 80% capacity

4 Assumptions

The following assumptions have been made in completing this work:

- The 2022 Cambridge model used as a base model for stage 2 study.
- The provided PWWF discharge from the development site has been applied to the network as a static flow.
- As per the OOS, no assessment of the wastewater treatment plant has the capacity to accept flow from the development has been undertaken.

5 Model Results

Result maps are attached in Appendix A.

5.1 Scenario 1

- As shown in Figure 6-1 , the downstream trunk sewer has available capacity without the addition of C5 development in the model result.
- Figure 6-2 provides an overview of the model with C5 development direct connection with a constant flow contribution of 12 L/s (PWWF) to the network. The following are high-level overviews of the model results.
- Accordingly, it is observed that at the downstream trunk sewer, a few pipes (specifically 1091831.1 and 1091939.1, etc) are utilizing more than 80% of their pipe full capacity.
- Simulation results show that the maximum surcharge state at pipe 1091831.1 is 1. This means that the flow depth is greater than the pipe diameter (surcharged by depth). Flow is not getting pass forwarded and backing up the system.
- With the additional flow contribution of 12 l/s from the C5 development, the number of pipes predicted to surcharge increases by 11. The increase in surcharge is generally located on Wordsworth Street near the proposed development discharge point. Refer to Figure 6-2 Scenario 1 with C5 Development for the locations of surcharge increases.
- No sewer overflows were predicted in either scenario with or without development.
- Table 5-1 provides a high-level overview of the model results discussed above.

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Table 5-1 Simulation Results Overview

Scenario	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
1: PWWF – 12 l/s	0	0	11

Note: The results shown in above table are being compared to a "base model" where no C5 development was added.

5.2 Scenario 2

- Figure 6-3 provides an overview of the model results PWWF from C5 Development restricted to 6l/s. The following is a high-level overview of the model results.
- The network has undergone several iterations to determine its capacity for conveying additional flows. The results of these iterations have indicated that the downstream trunk sewer could hold up to a peak wet weather flow (PWWF) of 6 l/s, from the development, to utilise the downstream capacity to 80%.
- No surcharged pipes were predicted in scenario 2.
- Table 5-2 provides a high-level overview of the model results discussed above.

Table 5-2 Simulation Results Overview

Scenario	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
1: PWWF – 6 l/s	0	0	0

Note: The results shown in the table are being compared to a "base model" where no C5 development was added.

5.3 Scenario 3

- Figure 6-4 provides an overview of the model results PWWF from C5 Development restricted to 6l/s and pump the remaining flow during peak off time.
- The network has undergone several iterations to determine the optimum time to pump flows back to the system.
- The optimum flow rate that can be pumped back into the system is 6 litres per second constant flow at the proposed MH 20160912112115. In addition to that, 4 litres per second would pump into the system at MH ID 1091948for 5 hours, from 12 AM to 5 AM, before a storm occurs. So, there will be 10l/s of flow in total for 5 hours which drains to the system.
- No surcharged pipes were predicted in scenario 3 (4 l/s during off-peak).
- Table 5-3 provides a high-level overview of the model results discussed above.

Table 5-3 Simulation Results Overview

Scenario	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
2 PWWF – 6 l/s + residual off peak flow of 4l/s for 5 hours	0	0	0

Note: The results shown in the above table are being compared to a "base model" where no C5 development was added.

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5.4 Scenario 4

- Figure 6-5 provides an overview of the model results with C5 development direct connection with a constant flow contribution of 12 L/s (PWWF) to identify downstream trunk sewer upgrade required. The following is a high-level overview of the model results.
- Section 3.4 shows the upgraded pipes on Wordsworth Street and Burns Street.
- Pipe diameters are proposed to be upsized to 300mm to allow flow from C5 development to be incorporated into the existing system.
- No surcharged pipes were predicted in scenario 4.
- Table 5-4 provides a high-level overview of the model results discussed above.

Table 5-4 Model Results for Scenario 4

Scenario 4	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
PWWF – 12 l/s	*0*	0	*0*

Note: The results shown in the above table are being compared to a "base model" where no C5 development was added.

5.5 Scenario 4.1

- Figure 6-6 provides an overview of the model results with C5 development connection changed to MH ID 1091830 with upgrade to the pipe network as mentioned in section 3.5.
- This option is tested as an alternative to reduce length of network upgrade required in Scenario 4.
- No surcharged pipes were predicted in scenario 4.1.
- Table 5-5 provides a high-level overview of the model results discussed above.

Table 5-5 - Model Results for Scenario 4.1

Scenario 4.1	Increase in Number of Overflows (No.)	Increase in Overflow Volume (m^3)	Increase in Number. of Surcharged Pipes (No.)
PWWF – 12 l/s- at MH ID 1091830	*0*	0	*0*

6 Conclusions

Based on the assessment detailed above, the following conclusions are made.

6.1 Scenario 1 – PWWF 12 l/s

A review of the model post-development scenario with a proposed C5 development flow of 12 L/s discharged at manhole 20160912112115 on Wordsworth Street has predicted that network surcharge will increase.

The C5 Development PWWF of 12 l/s cannot discharge directly to WW network and achieve 20% capacity reserve in the network.

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6.2 Scenario 2 – Utilising maximum capacity

The network can hold up to a peak wet weather flow (PWWF) of 6 l/s to utilise the downstream capacity to 80%.

6.3 Scenario 3 – Utilising during Peak off time

The downstream network doesn't have capacity during the peak off time to accommodate the remaining (6l/s) flow back into the system. The pump-back system has an optimum flow rate of 4 litres per second for a duration of 5 hours, from 12 AM to 5 AM, before any potential storms or peak flow events.

6.4 Scenario 4 – High-Level Recommendation

By upgrading eight pipe sizes to 300mm along Wordsworth Street, spanning approximately 520m, and replacing six pipe sizes with 300mm pipes along Burns Street, spanning approximately 250m, it would be possible to directly connect the C5 development PWWF (Peak Wet Weather Flow) at a rate of 12 litres per second discharging at MH ID 20160912112115. This upgrade would ensure that the downstream network maintains a minimum reserve capacity of at least 20%.

6.5 Scenario 4.1 – Alternative option

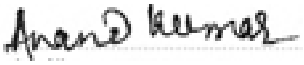
In conclusion, by upgrading one pipe size to 300mm along Wordsworth Street and replacing six pipe sizes with 300mm pipes along Burns Street, it is possible to directly connect the C5 development PWWF at a flow rate of 12 litres per second discharging at MH ID 1091830. This upgrade will ensure that the downstream network maintains a minimum reserve capacity of at least 20%.

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Powerup Business Consulting ('**Client**') in relation to assess the impact of the C5 development on the current and future Cambridge wastewater networks ('**Purpose**') and in accordance with the Wastewater Modelling Assessment – C5 Development Offer of Service dated 28/07/2022. The findings in this Report are based on and are subject to the assumptions specified in the Report and the Cambridge and Te Awamutu Wastewater Model Build, Calibration and System Assessment Report, July 2019. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the models on which this report is based, WSP has relied upon data, surveys, analyses, designs, plans and other information ('**Client Data'**) provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

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Appendix A
Model Result Maps

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Figure 6-1 Baseline model without C5 Development

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Figure 6-2 Scenario 1 with C5 Development (Note this is only 12 l/s of C5 development not the full C5 Development)

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Figure 6-3 Scenario 2 Flow restricted to 6l/s

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Figure 6-4 Scenario 3 remaining flow drains at 4l/s for 5 hours (12AM to 5AM)

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Figure 6-5 Scenario 4 Network upgrade based on connection at MH ID 20160912112115 (Recommendation)

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Figure 6-6 Scenario 4.1 Network upgrade based on connection at MH ID 1091830

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Appendix B

Stage 1 Report

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C5 Development
Memo Stage 1_Final