

Christchurch City Council

CASHMERE PARK RESIDENTIAL DEVELOPMENT WATER SUPPLY MODELLING ASSESSMENT

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CONFIDENTIAL





CASHMERE PARK RESIDENTIAL DEVELOPMENT WATER SUPPLY ASSESSMENT

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EXECUTIVE SUMMARY

WSP has carried out a water supply development assessment for the proposed Cashmere Park residential development. The purpose of this assessment was to investigate if the development meets the Level of Services (LoS) criteria and will meet fire flow requirements.

The following scenarios have been conducted in this assessment.

MODEL	SCENARIO	DESCRIPTION
Base Model	LoS assessment	The network was tested for minimum pressure and maximum headloss criteria.
Base Model + Proposed development on Cashmere Park development demands	LoS assessment	The network was tested for minimum pressure and maximum headloss criteria.
	Fire flow assessment	The network was tested for FW2 fire flow criteria

The results of the modelling assessment are summarised in the table below.

MODEL	SCENARIO	SUMMARY
Base Model	LoS assessment Pass	- Minimum pressure and maximum headloss criteria are generally met. - The minimum pressure in the localised network is between 60-70 m. - The wells for the Western part of the Central zone are at capacity for peak hour demand.
Base Model + Proposed Cashmere Park development demands	LoS assessment Fail	- The network experiences high headloss, with sections on Sparks Road, Cashmere Road, and Leistrella Road exceeding 20m/km. These pipes will need to be upsized to improve capacity and meet LoS performance criteria. - Minimum pressure criteria is met as the proposed development can maintain a minimum pressure between 60-70 m. - The minimum pressure of the localised network has decreased by 7-8 m. - The Worsley St reservoirs are required to support peak day /hour demand to supplement the extra demand of 214 m³/hour, resulting in a reservoir level drop of 0.6m over 24-hours.

MODEL	SCENARIO	SUMMARY
	Fire Flow Assessment Pass	• All six key hydrants pass the FW2 criteria, as they achieve the required fire flow while maintaining a residual pressure of 10 m. • The localised network maintain a minimum pressure greater than 10 m as well. • The headloss issues of the new and existing pipes remain the same as the LoS assessment.

In summary,

- The existing supply sources to the Western part of the Central zone are at their maximum capacity during peak hour demand.
- Cashmere Park development meets the minimum pressure criteria, however, some parts of the localised network experience a drop in pressure between 7-8 m, as the water pump stations are running at capacity, and the Worsley reservoir is supplying the zone
- Some sections of the internal pipe network within the development have higher headlosses (>10 m/km). This can be resolved by upsizing the internal pipe network to DN200.
- The existing network also requires upgrades to resolve high headloss in several locations within the network, namely along Sparks Road and Cashmere Road.
- The proposed development meets FW2 fire flow criteria. The internal pipe network headlosses will improve if upgraded to DN200.
- New sources (wells) will be required to support future development and provide resilience (security of supply) within the Central zone, and to ensure major reservoir levels can be maintained i.e. Worsley Reservoir.

1 PROJECT BACKGROUND

1.1 INTRODUCTION

Christchurch City Council (Council), on behalf of a plan change applicant has engaged WSP to carry out a demand and fire flow assessment of a proposed residential development in Cashmere Park.

The proposed development contains 396 residential lots with a peak demand of 0.15 L/s per lot with a total peak demand of 59.4 L/s. The proposed development is located within the Central Water Supply Zone (WSZ). Four water supply connections to the development from the existing network are proposed, as summarised below:

1. DN 100 CI pipe on Cashmere Rd
2. DN 100 AC pipe on Leistrella Road
3. DN 100 AC pipe on Northaw Road
4. DN 200 CI pipe on Sparks Rd

An overview of the proposed development and water supply network is shown in Figure 1-1.



Figure 1-1: Overview of the new development and proposed pipe network

1.2 OBJECTIVES

The objective of this study is to assess the Level of Services (LoS) and available fire flow to the proposed residential network.

The proposed development will be tested against the residential (FW2) fire flow criteria as per the New Zealand Fire Service Code of Practice (CoP).

The locations of the hydrants within the proposed development are currently not available. Therefore, for this assessment, we have allocated twelve hydrants to the proposed network. The distance between each hydrant is 135 m as per the CoP. Figure 1-2 shows the approximate locations of hydrants.



Figure 1-2: Overview of the new development and hydrant locations

2 INFORMATION / DATA PROVIDED TO THE CONSULTANT

This section summarises the information received from the Council and the assumptions applied for this assessment.

2.1 PROPOSED RESIDENTIAL SITE DEMANDS

A summary of information related to the proposed residential development sites received from the client has been listed in Table 2-1.

Table 2-1: Summary of proposed residential demands

DEVELOPMENT	DEMAND CATEGORY	AREA (HA)	PEAK DEMAND (L/s)	WATER SUPPLY SOURCE
Cashmere Park residential development	Residential - Central	30	54.9	Spreydon St Well Hillmorton St Well Addington St Well

2.2 PERFORMANCE CRITERIA

The following performance criteria were used for the hydraulic assessment:

- **Level of Service (LoS) – Minimum pressure:** 200 kPa (20m) pressure at customer connection
- **Pipe Performance** – Maximum pipe headloss of 10 m/km under normal conditions and maximum pipe headloss of 5 m/km for trunk mains; and maximum velocity ≤ 1.5 m/s for normal conditions, < 3.0 m/s for emergency conditions.
- **Fire flow Assessment New Zealand Fire Service Code of Practice;** SNZ PAS 4509:2008 and subsequent amendments, to the satisfaction of the New Zealand Fire Service. Table 2-2 lists the minimum fire flow requirements (for a single hydrant).

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

CODE	DESCRIPTION	MAX. NUMBER OF HYDRANTS TO PROVIDE FLOW	REQUIREMENTS	
			Required Fire Flow (L/s)	Residual Pressure at Required Fire Flow (m)
FW2	Residential	2	25	10

2.3 ASSUMPTIONS

The following assumptions have been applied for this modelling assessment:

- WSP has used the InfoWorks WS Pro current peak day demand (PDD) model for this assessment:
 - Model Name: CCC Peak Day Demand Model:
 - o Network: Cashmere Park Development - Peak Day network
 - o Control: Cashmere Park Development - Peak Day Network - Control
 - o Demand Diagram: Peak Day Demand 02/02/2020
 - Run Files: Cashmere Park Development Run Group
- WSP has used elevation data from LINZ to allocate ground levels to the proposed developments.

3 MODELLING ASSESSMENT

3.1 BASE MODEL RESULTS

3.1.1 EXISTING WELL CAPACITY

A review of the primary pump stations supporting the Cashmere Park development was carried out to determine the available capacity at the Addington, Spreydon, and Hillmorton pump stations. Table 3-1 is a summary of their respective surface pump capacities and modelled outputs.

Table 3-1: Summary of well capacities and outputs

PUMP STATION	PUMP	CAPACITY (M ³ /HOUR)	ACTUAL (M ³ /HOUR)
Hillmorton Station Well	Surface Pump 1	225	313.5
Spreydon Station Well	Surface Pump 1	225	242.0
	Surface Pump 2	250	236.4
Addington Station Well	Surface Pump 1	230	254.5

As shown, 3 out of 4 pumps exceed their design capacity. While Spreydon pump 1 and Addington pump 1 capacities exceed by approx. 10%, Hillmorton pump 1 capacity exceeds significantly. This indicates that there is no available well capacity at peak hour demand to supply the Western part of the Central Zone. Noting that the Worley Reservoirs also supply this area of the network, and essentially operate as an additional pump station during peak demand.

3.1.2 NETWORK PERFORMANCE ASSESSMENT

This section presents the base model outcomes of the network before adding the proposed residential development.

Figure 3-1 shows the minimum pressure and maximum unit headloss results in the base model.

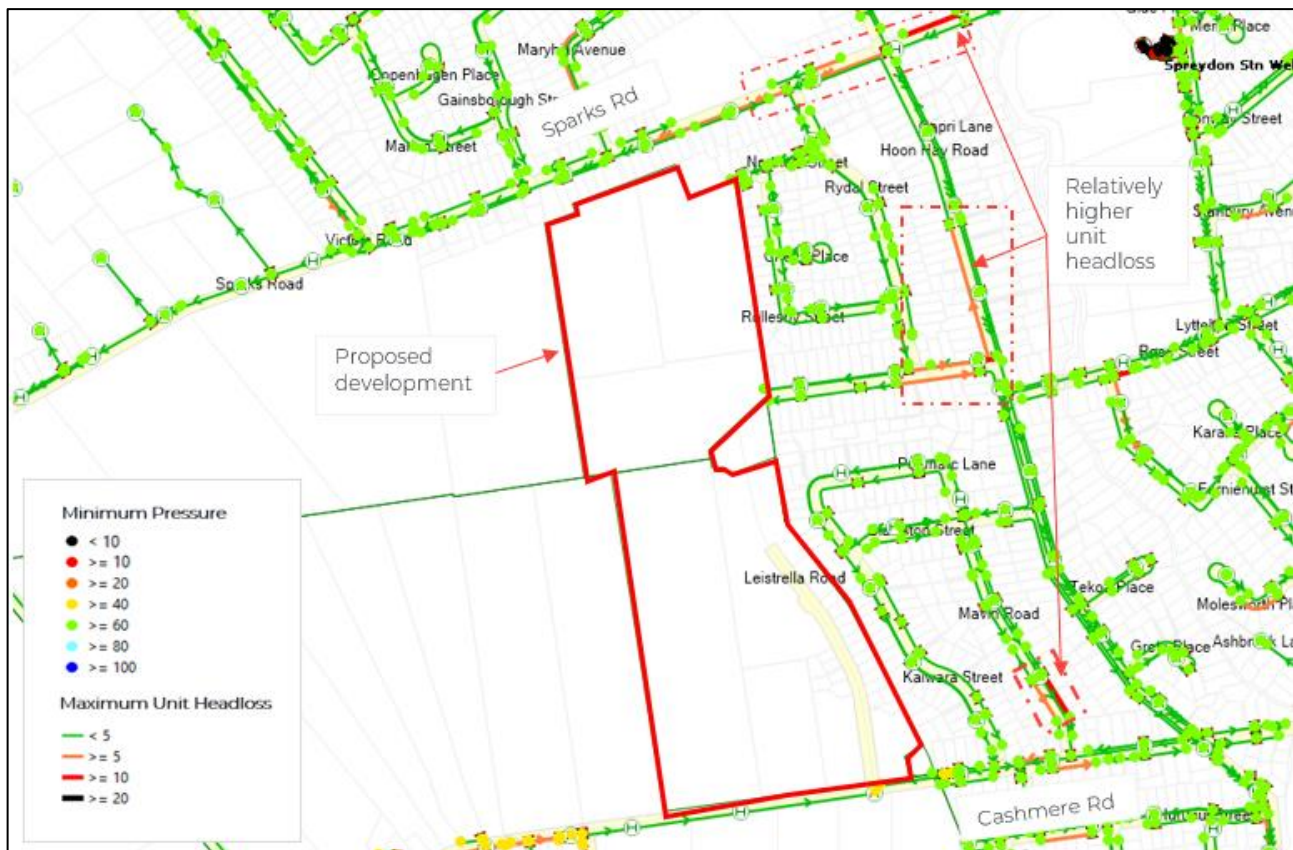


Figure 3-1: LoS results of the base model.

As shown in Figure 3-1, the minimum pressure in the existing localised water supply network is typically between 60-70 m.

The localised pipe network meets the headloss criteria, as the maximum unit headloss of the pipes is generally less than 1.5 m/km. There are some pipe sections (i.e., on Leistrella Rd, Hoon Hay Rd, Mavi Rd, and Sparks Rd) experiencing high headlosses (>5 m/km) as shown in the figure above.

In summary, the existing network is capable of maintaining the LoS requirements. However, as previously mentioned, the supply points for the Western part of the Central Zone are at (already exceeding) their maximum well capacities. Therefore, additional demand will have a negative impact on the network performance.

The following section describes the extent of the impact on the network performance with the Cashmere Park development included.

3.2 CASHMERE PARK RESIDENTIAL DEVELOPMENT

This section discusses the modelling results after including the demand of the proposed Cashmere Park residential development to the existing hydraulic model.

The proposed residential peak instantaneous demand of 59.4 L/s was added to the base model.

3.2.1 WELL CAPACITY WITH THE PROPOSED DEVELOPMENT

Similar to the previous scenario, the well capacity was assessed. As previously described, all three sources supplying Western part of the Central Zone are at maximum capacity. Table 3-2 is a summary of their respective surface pump capacities and actual outputs.

Table 3-2: Summary of well capacities and outputs

STATION	PUMP	CAPACITY (M ³ /HOUR)	ACTUAL (M ³ /HOUR)
Hillmorton Station Well	Surface Pump 1	225	319.3
Spreydon Station Well	Surface Pump 1	225	246.5
	Surface Pump 2	250	240.2
Addington Station Well	Surface Pump 1	230	254.4

As shown in the table, the output values have not significantly changed. This was expected as the pumps were already at their maximum capacity, and therefore not able to deliver the additional demand to supply the Cashmere Park Development.

The additional Cashmere Park development demand, of 214 m³/hour is supplied from the Worsley reservoirs, and the three pump stations referenced in Table 3-2. This causes the depth of the reservoir to drop by an extra approx. 1 m compared to the base model results. The impact of this on the network is discussed in the following sections of this report.

Cashmere Park development is proposed to have four connections to the existing water supply network. The flow at each supply point is listed in Table 3-1 below.

Table 3-3: Flow at each connection point

CONNECTION POINT	PEAK FLOW (L/S)
Cashmere Road	15.15
Sparks Road	26.46
Northaw Road	9.56
Leistrella Road	8.32
Total	59.49

3.2.2 NETWORK PERFORMANCE ASSESSMENT

A network performance assessment was carried out to assess the impact of the new development to meet LoS, and to confirm the impact on the existing network.

Figure 3-2 shows the minimum pressure and maximum unit headloss results for this scenario.

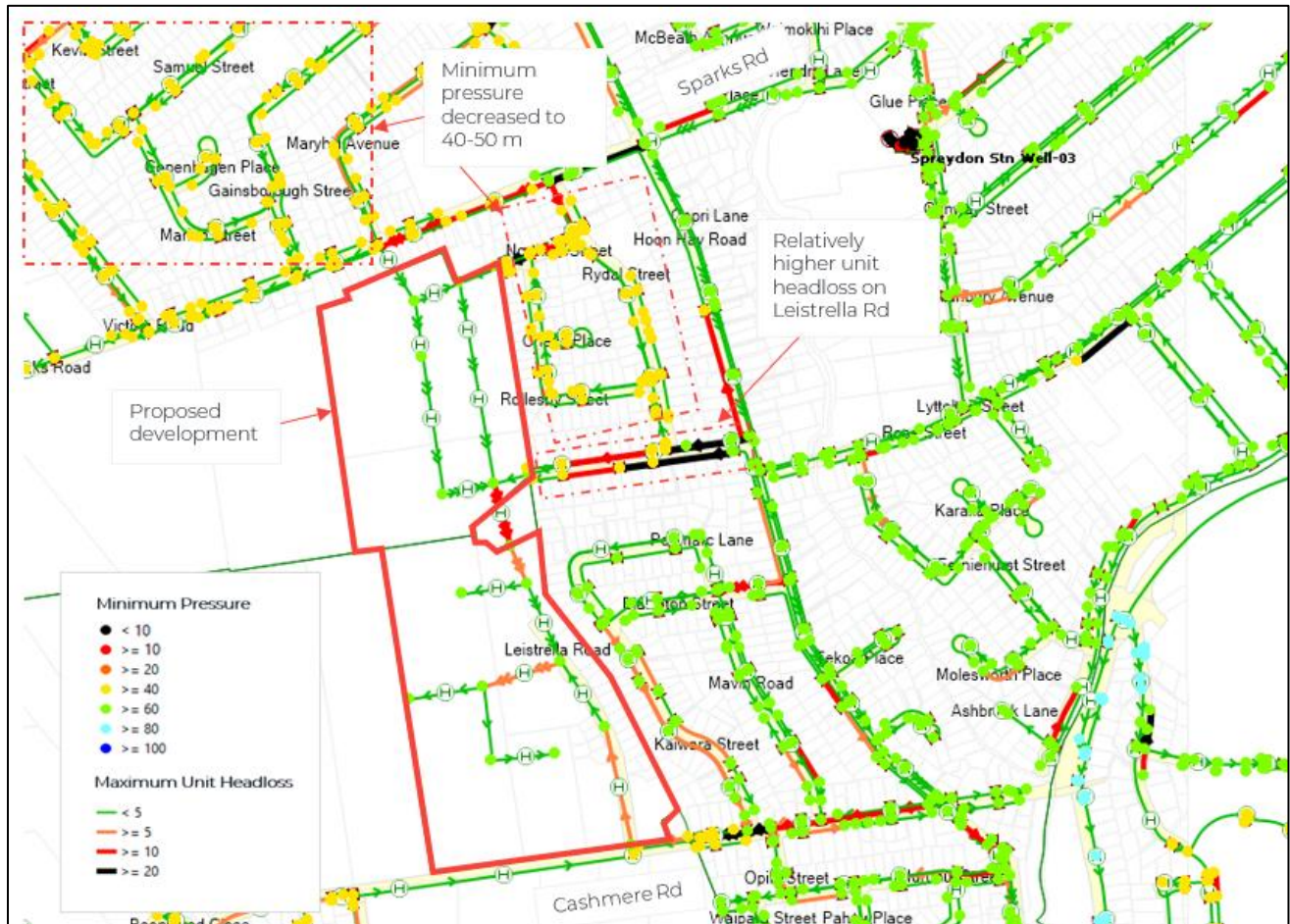
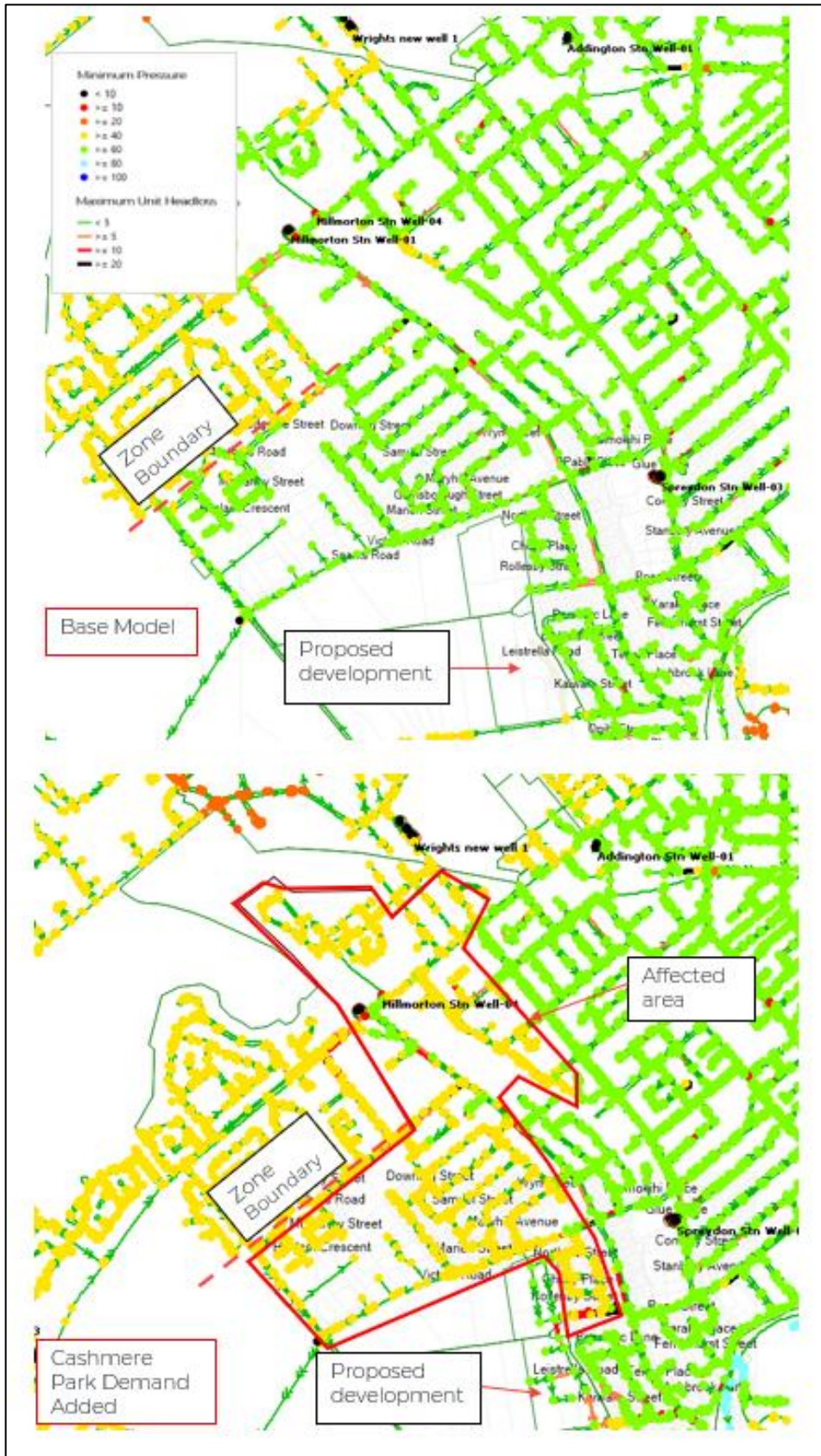


Figure 3-2: LoS after adding the proposed Cashmere Park residential demand

As shown in Figure 3-2, the minimum pressure within the proposed development site is between 60 – 70 m. The minimum pressure in some parts of the localised network is experiencing a reduction in pressure by approx. 7-8 m when compared to the base model results. This is the case for properties in Northway St, Rollesby St, Rydal St, Chevy Place, and the properties between Sparks Rd and Halswell Rd.

Figure 3-3 shows the extent of the pressure drop across the Western part of the Central Zone.



As the water pump stations are at maximum capacity, Worsley reservoirs supplement the additional demand resulting in the reservoir level dropping by an additional 1 m over the 24 hours, when compared to the base model as shown in Figure 3-4.

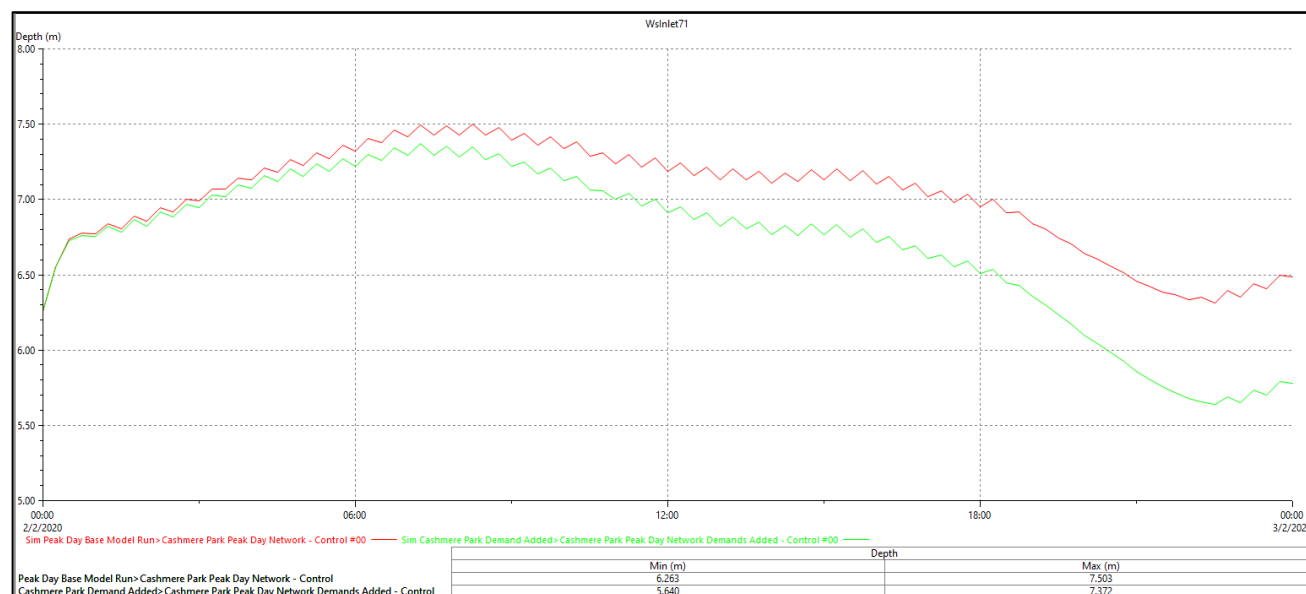


Figure 3-4: Depth pattern of Worsley Reservoir

As shown in the figure above, the reservoir falls further in the second scenario, where the Cashmere Park demand is added, resulting in a 7-8 m pressure drop in the localised area.

Some sections of the DN 150 pipes within the proposed development experience a maximum unit headloss greater than 10 m/km. The internal pipe network may need to be updated to DN 200 to resolve the headloss issues.

In addition, sections of the existing DN 100 mains on Leistrella Rd, DN 200 main on Sparks Rd, and DN 100 main on Cashmere Rd have maximum headlosses greater than 20 m/km. The pipe headloss at the Spreydon Station well outlet also exceeds 20 m/km. These existing pipes will need to be upgraded to reduce excessive headlosses to improve network capacity.

The internal pipe network for Cashmere Park development was upgraded to DN 200 to investigate the headloss. As shown in Figure 3-5 maximum unit headloss of the internal pipe network has reduced and meets the performance criteria.



Figure 3-5 : LoS results after internal pipe network is upgraded to DN 200

3.2.3 FIRE FLOW

A fire flow assessment was carried out to investigate if the proposed residential development meets the FW2 fire flow criteria. As mentioned in the previous Section 1.2, twelve hydrants were allocated to the proposed network 135 m apart from each other as per the New Zealand Fire Fighting CoP. From the twelve hydrants, six key hydrants were chosen to test for FW2 criteria, based on the location and the ground levels.

The fire flow assessment was carried out at 60% peak day demand for 30 minutes. Table 3-4 summarises the fire flow results in reference to the hydrants shown in Figure 3-6.



Figure 3-6 : LoS after adding the proposed Cashmere Park residential demand

Table 3-4: Fire flow results

HYDRANT	FIRE FLOW ACHIEVED (L/S)	RESIDUAL PRESSURE (M)
1	25	67
2	25	60
3	25	66
4	25	67
5	25	70
6	25	68

As shown in the table, the hydrants within the proposed development are able to maintain a minimum residual pressure between 65 – 70 m at the required fire flow. Therefore, the proposed development meet FW2 fire flow criteria.

Figure 3-7 shows the LoS in the localised network during the fire flow test at each hydrant.

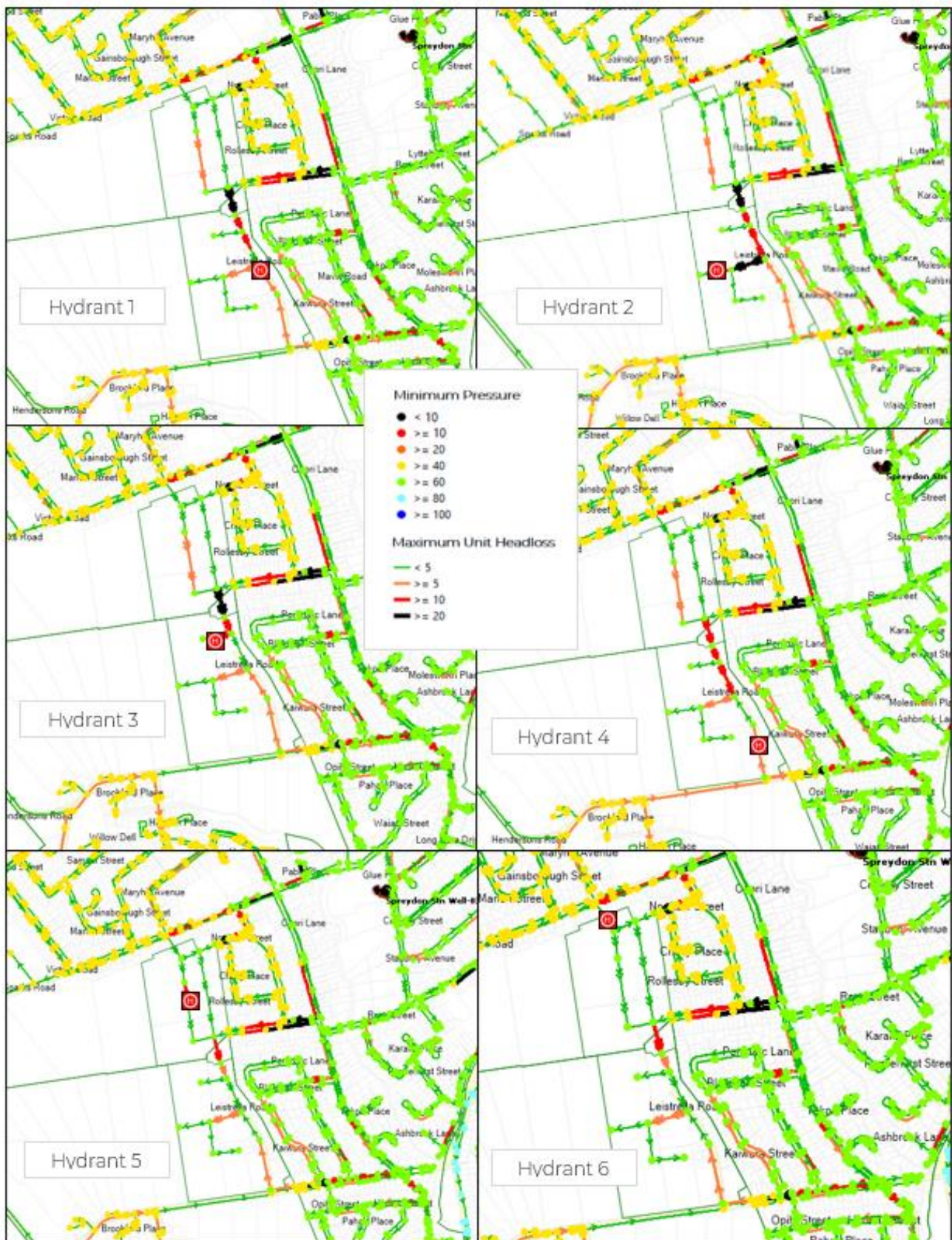


Figure 3-7: LoS results during the fire flow scenario

As shown in the figure, the minimum pressure in the localised area meets the 10 m requirement, in each hydrant test carried out. The unit headloss of the supply pipes within and outside the development exceed 20 m/km on some occasions.

3.3 SUMMARY

A summary of the modelling assessment is presented below:

- The existing network for the proposed development meets the LoS requirements. The minimum pressures range between 60-70 m with the existing pipe network largely meeting the headloss criteria.
- However, the existing well supply for the Western part of the Central Zone zone is at capacity at peak demand and there is no available capacity to supply additional demand.
- The inclusion of the Cashmere Park development results in a pressure drop in the localised network by approximately 7-8 m (between 50-60 m, but will meet the LoS pressure criteria. This is due to the Worsley reservoir draining at a higher rate to supplement the additional demands created by the proposed development.
- The minimum pressure within the proposed residential development is between 60-70 m.
- The internal pipe network within the development meets the headloss criteria except for some sections. In addition, the headloss results are improved when the internal pipe network is upgraded to DN 200.
- The existing network is experiencing high headloss, with some exceeding 20 m/km, these are located on Sparks Road, Cashmere Road, and Leistrella Road.
- The total flow achieved at each supply point adds up to the peak flow of 59.4 L/s required for the proposed development.
- The proposed Cashmere Park development can meet FW2 fire flow criteria. All key hydrants tested achieved the required flow of 25 L/s while maintaining a residual pressure greater than 10. The localised network also met the minimum pressure requirement of 10 m. The pipe headlosses of the internal pipe network and existing supply pipes exceed the criteria on some occasions.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Council engaged WSP on behalf of the plan change applicant to carry out a modelling assessment for the proposed Cashmere Park residential development. The key findings from this modelling assessment are summarised below.

- The existing localised network near the Cashmere Park proposed development meets the LoS requirements as the minimum pressures are typically between 60-70 m. However, the existing supply sources for the Western part of the Central Zone zone are at their maximum capacity and therefore, would not be able to meet any additional demands.
- The localised pipe network meets the headloss criteria as the maximum unit pipe headloss of most of the existing pipes are below 1.5 m/km.
- The minimum pressure within the proposed residential development is between 60-70 m after adding a peak demand of 59.4 L/s.
- Upon adding the proposed development demands, the minimum pressure in the localised network decreases by approx. 7-8 m (between 50-60 m). This is due to the existing supply sources not having sufficient capacity to meet the additional demand. The Worsley reservoir supplements the additional flows required and falls at a higher rate causing the pressure drop in the network.
- The internal pipe network mostly meets the headloss criteria except for a few sections of pipework. This can be resolved by upgrading the entire internal pipe network to DN 200.
- In addition, the existing supply pipes on Leistrella St, sections of Sparks Rd, Cashmere Rd, and the outlet pipes at Spreydon St have higher unit headlosses greater than 20 m/km. These pipes will need to be upgraded to improve capacity and meet performance criteria.
- The proposed Cashmere Park development can meet FW2 fire flow criteria. All key hydrants tested achieved the required flow of 25 L/s while maintaining a residual pressure greater than 10. The localised network also met the minimum pressure requirement of 10 m.
- The pipe headlosses of the internal pipe network and existing supply pipes exceed the criteria on some occasions. This can be improved by upgrading the internal pipe network to DN 200. The existing pipe sections will need to be upgraded.

4.2 RECOMMENDATIONS

- Additional well capacity is required for the central water supply zone to ensure the Central zone can meet future growth and to provide security of supply to the area, and ensuring the Worlsey reservoir levels can be maintained.
- The internal pipe network of Cashmere Park development needs to be upsized to DN 200 to meet the headloss criteria.
- The existing pipe sections listed should be reviewed and upgraded to achieve the headloss criteria and provide sufficient capacity for the proposed development.
 - Leistrella Road
 - Cashmere Road
 - Sparks Road
 - Spreydon station well outlet
 - Northaw Street

5 LIMITATIONS

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for Christchurch City Council ('Client') in relation to Cashmere Park Residential Assessment – Modelling Assessment ('Purpose') and in accordance with the Short Form Agreement – WS Model Query Request – Plan Change Cashmere Park Residential Development with the Client dated 10/10/2023 ('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.

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