



Amberfield Development

Weston Lea Ltd

Water Supply

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1. Executive Summary

Jacobs was engaged by Weston Lea Ltd to identify water supply constraints for an overall first stage of 1,000 lots to be developed within the Peacocke Structure Plan Area (SPA). Our brief included confirming modelling assumptions to implement the modelling terms of reference in the MoU, engaging the subconsultant to run the model on an initial water supply concept, reviewing and refining the concept and reporting the outcomes.

The modelling brief and parameters were agreed with Hamilton City Council under the terms of the MoU. Jacobs' technical team liaised with the Council during the modelling, and once the modelling had been completed Glenn Boyd from Hamilton City Council (in an email on 1/12/2016) confirmed that the results in principle were positive and supported the progression of the report to the Project Steering Group.

Through this process, Jacobs have developed an indicative water supply solution to the development area and identified specific technical aspects that may influence staging of the 1,000 lots, including:

- Consideration of existing capacity without upgrades to provide for substages of development
- Possible temporary staging solutions for substages of development
- Long term solutions which will provide for not just the 1,000 lots but the future growth zone.

The solution that Jacobs is recommending for the first 1,000 lots is a 2.24km long, 250mm diameter pipe with a 150mm diameter pipe rider main also installed. The solution provided meets commonly accepted infrastructure standards and is efficient and effective in providing for growth. Existing levels of service have been maintained, with positive impact on the system performance due to the recommended connection to the Peacockes Lane watermain.

2. Existing water supply.

The main water treatment plant for Hamilton is situated to the north west of the Peacocks SPA. See Figure 1

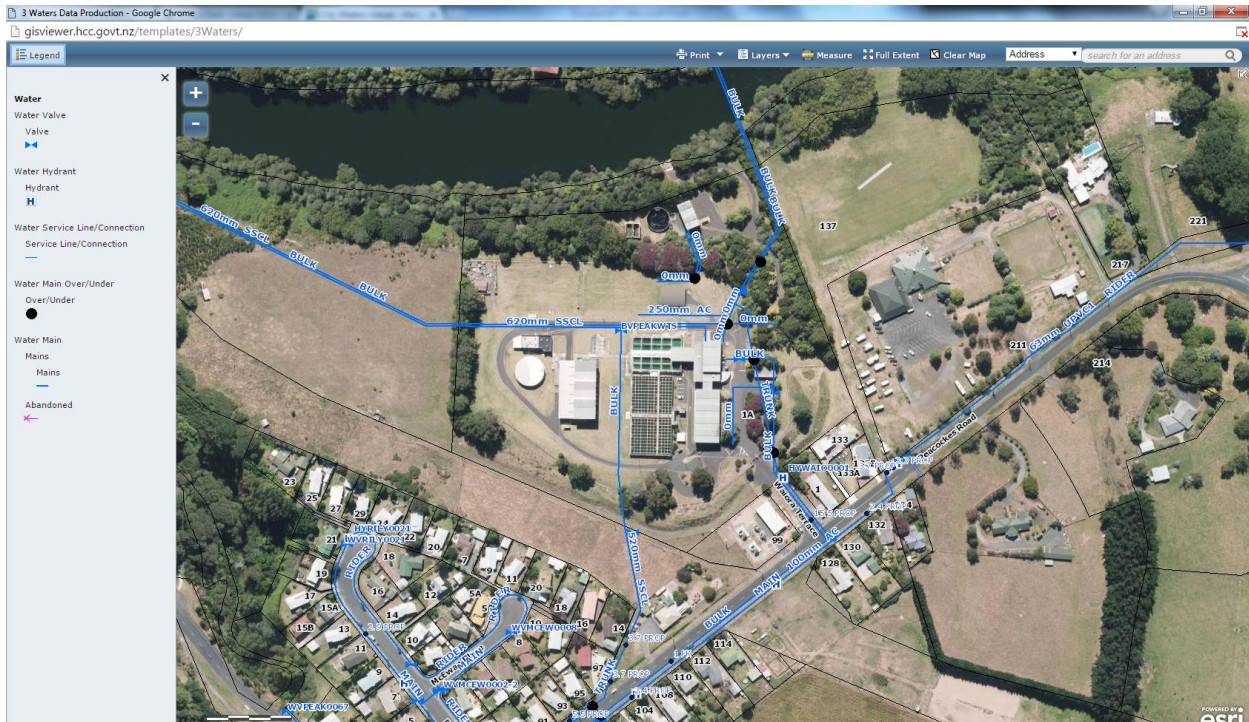


Figure 1 Hamilton Water Treatment Plant

The plant produces water at an average head of 70m for transmission around Hamilton. Depending on the head loss through the main pipe to the development, and given the imminent completion of the filling main into the existing Hamilton South Reservoir, the maximum contour for supply to the development would be 50mRL (maximum development for 2 storey houses).

There are two small diameter (63mm) water mains supplying rural properties in the Peacocks SPA. These are not sufficient to supply the proposed development as the head loss to supply the design flows for even a few hundred lots would be too high. It is also not possible to provide for firefighting water supply through these mains as again the head loss would be too high to achieve the flow rates required.

3. Concept

The existing treatment works provide enough water and head to supply the first 1,000 lots of the Amberfield Development but there is no pipeline to transfer the required flow to the area proposed for the first development. Our concept solution to supply water to the 1,000 lots was to install a 2.24km long, 250mm diameter pipe with a 1.5km long, 150mm diameter pipe rider main also installed.

In developing the concept solution, we used the Infrastructure Technical Specifications from Hamilton City Council to calculate the required flows for water supply to the development. The results of these calculations are shown below:

Table 1 Water Supply to Peacockes SPA

Number of lots	1,000	2,000	3,000
People per lot	2.7	2.7	2.7
Demand per person per day (l)	260	260	260
Average daily demand (l)	702,000	1,404,000	2,106,000
Average demand (l/s)	8.125	16.25	24.375
Peak demand factor	5	5	5
Peak day demand (l/s)	40.6	81.3	121.9

Key figures from the technical specifications are:

- People per lot: 2.7
- Demand Per person per day: 260 l
- Peak demand factor: 5
- Firefighting water supply classification: FW2, 750l/min or 12.5l/s within 135m and an additional 12.5l/s within 270m.

In accordance with the technical specifications of Hamilton City Council a rider main is included in the planning for this development to provide resilience and some level of service should one of the mains be damaged. The length of main pipeline required to supply water to the first 1,000 lots is 2.24km. A rider pipeline would be placed on the opposite side of the road from the main pipeline that is 1.5km in length. Once the main supply pipeline and the resilience rider main reach the development, it is expected that the larger water mains within the development that run parallel with Peacockes Road will provide the resilience for the overall network.

The firefighting water supply requirements for classification FW2 are 750 l/min or 12.5 l/s within 135m and an additional 750l/min or 12.5l/s within 270m with a residual head when running at this flow of 10m. This is exceeded by the peak design flow above for all pipeline combinations considered.

4. Modelling

After formulating the concept, Mott MacDonald were engaged by Jacobs to undertake modelling to confirm the solution. The brief for the modelling was agreed with HCC under the MoU. A copy of the Mott MacDonald report is attached as Appendix B to this report. The report refers to the Adare development which was the former name for this project.

The Mott MacDonald modelling confirmed that the level of service is expected to be met both in terms of pressure and firefighting capacity in the proposed development. Pressure is predicted to exceed 20m at all times and the fire flow FW2 can be met for all scenarios.

Modelling has confirmed that the firefighting flow is supplied by the suggested 250mm water main with a 150mm rising main and that the residual head available is acceptable.

Head losses below 2.5m/km are predicted in the proposed 250mm diameter main pipeline and 150mm rider main if 1,000 lots are connected. This head loss is within an acceptable range.

Considering the existing network operations, the Amberfield development is predicted to have a positive impact on the system performance due to the recommended connection to the Peacockes Lane watermain.

In the future scenarios once the dedicated filling line is built in the Hamilton South and Hillcrest Zones and are serviced from the Hamilton South Reservoir the proposed development will have an effect in reducing the minimum pressure in the Hillcrest Zone along Cambridge Road by about 0.9m. This is an existing low pressure area and HCC are recommended to consider options for addressing this issue in their long term asset planning.

Table 2 Results from modelling for development of 1,000 lots

Scenario		Minimum Pressure	Maximum Head Losses	Fire Flow
500 Lots	Single 250mm	30.5	0.7	Can meet residential fire flow (FW2 – 25 l/s)
	250mm + 150mm	31.0	0.4	
	Single 375mm	31.8	0.1	
	375mm + 150mm	31.8	0.1	
1000 Lots	Single 250mm	26.1	2.4	
	250mm + 150mm	28.0	1.6	
	Single 375mm	30.7	0.3	
	375mm + 150mm	30.8	0.3	

The modelling considered the development of 500 and 1,000 lots so head losses for the larger developments above were not considered at this stage. We note that if a 250mm pipeline and a 150mm rider pipeline are installed together, this arrangement would service approximately 1370 lots.

The results of the modelling were presented to HCC in a report, and they responded that in principle the concept is looking good.

5. Future plans

Hamilton City Council are constructing a dedicated filling line from the existing water treatment works to Hamilton South Reservoir due to be completed on 30th June 2018. Once the dedicated filling line is built by HCC from the water treatment works to the Hamilton South Reservoir, the water main supplying the proposed Amberfield Development should be connected to the 750mm diameter main at the intersection between Wairoa Terrace and Peacockes Road.

This move of connection point has the effect of increasing the head available to supply the Amberfield Development. Development of housing could take place up to the 50m contour and there would still be sufficient head to meet the required levels of service.

Note that at the 50m contour development should be limited to a maximum of two storey buildings.

Hamilton City Council is proposing a network of pipes planned to supply growth to the south of Hamilton. This includes a 250mm diameter from the water treatment plant to the Peacockes SPA on the 2040 design horizon, however, HCC have indicated their intention to complete these additions far sooner than 2040. Timelines will be confirmed in June 2018. A further network of pipes supplying water from the Hamilton South Reservoir will also supply this area. The design flow for the full 10,000 lots is 405l/s. We would recommend this as one of the modelling scenarios to be run by HCC. This would confirm that HCC are planning to accommodate the future development in their plans. Once this zone is supplied from the Hamilton South Reservoir, development of lots could take place up to the 60m contour with flow to the properties by gravity. This would need to be confirmed by further modelling and discussions with HCC.

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6. Conclusion

The first 1,000 lots could be serviced for water supply by a 2.24km long, 250mm diameter pipe with a 150mm diameter pipe rider main also installed. To achieve 20m head at every property and given the imminent connection to the Hamilton South reservoir, the development should take place below the 50m RL contour.

The proposed pipeline should connect to the existing pipeline along Peacockes Lane to increase the level of service for the rural housing in that area.

Once the dedicated filling line is built by HCC from the water treatment works to the Hamilton South Reservoir, the water main supplying the proposed Amberfield Development should be connected to the 750mm diameter main at the intersection between Wairoa Terrace and Peacockes Road.

The proposed 250mm diameter main with the 150mm rider main could service up to 1370 lots according to our calculations. This is greater than the 1,000 lots recommended as a maximum by Mott Macdonald.

Note that when this zone is planned to be supplied by Hamilton South Reservoir and some of the bulk mains across the Peacockes SPA, from the Reservoir to Peacockes Road, have been installed, development can take place up to the 62/60m contour. This would need to be confirmed by further modelling. If Weston Lea wished to progress significantly beyond the 1,000 lots at an elevation above RL50 prior to the Peacockes SPA bulk main construction, interim alternatives such as building a boost pump station could be explored with Council. Council have, however, indicated that booster pumps are their least preferred option, and other designs should be considered first.

We also note that HCC peaking factor of 5 is considerably higher than observed in recorded diurnal flows in the wastewater network, so are expected to be slightly conservative. Pressure monitoring during development would confirm if this is the case and if so, may enable slight further extension of service than otherwise expected.

Further development above this will require either:

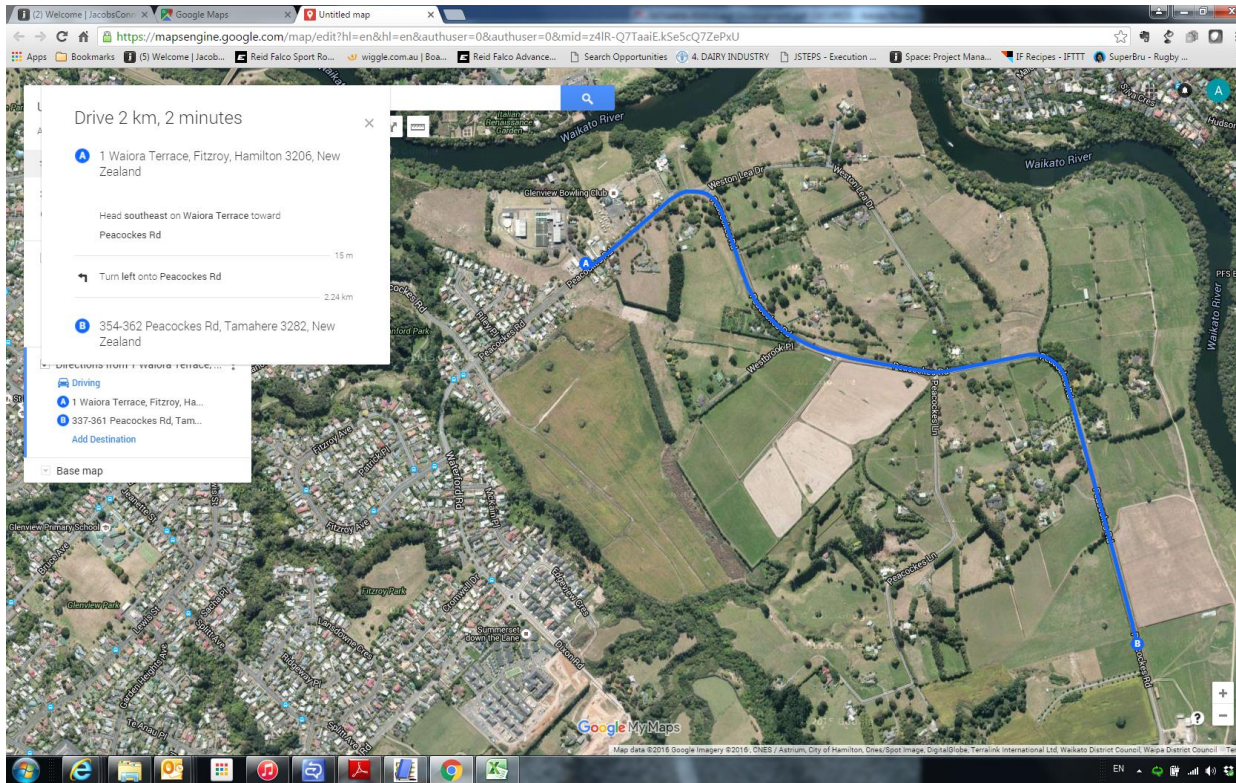
- implementation of the HCC's water supply master plan to create ring mains
- Installation of additional pumping capacity to supply the Amberfield Development.

7. Recommendation

We recommend that a 250mm water supply main with a 150mm rider main is installed to provide water supply to the first 1,000 lots.

A 250mm water supply main is part of the HCC long term plan for the area and discussions should take place with them about when the investment is intended to be made.

Appendix A. Proposed pipeline route



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Appendix B. Amberfield Development Impact Assessment by Mott Macdonald.

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9 September 2016

Adare Development - Water Impact Assessment

Dear Jess

This letter summarises the results of the assessment undertaken for the proposed Adare development consisting of up to 1,000 lots along Peacockes Rd, on the southern side of the existing Hamilton water supply network in the Hamilton South catchment.

Background

In June 2016 Mott MacDonald was commissioned by Jacobs to assess the system performance in terms of Level of Service (LOS) and firefighting capacity in the proposed Adare development. The impact of this development on the remaining of the Hamilton City Council (HCC) network was also investigated.

In this analysis we have used the latest HCC water supply model. The existing network was updated with all recently constructed water mains in this area. Eight scenarios were investigated, with and without additional demand from the proposed development for existing and interim operational conditions. These are detailed in the Scenarios Investigation section of this letter.

The result of this assessment is presented below.

Assumptions

Demand Calculation

The first stage of the Adare development – Stage 2A consists of 1,000 lots. The impact of 500 and 1,000 lots has been investigated as part of this study. It was assumed that the proposed Adare development would be included into the existing Hamilton South Zone. We have considered that the proposed peak instantaneous demand would be equivalent to a demand of 260 l/day/person multiplied by a peaking factor of 5 as specified in the Hamilton City Development Manuals. The peak

increase in demand was calculated based on an average of 2.7 persons per lot, and represents approximately 20.3l/s and 40.6l/s for 500 and 1,000 lots respectively (instantaneous peak demand).

Number of lots	Instantaneous Peak Demand (L/s)
500	20.3
1000	40.6

Network Operation

The impact of the proposed development on the water network was assessed for two sets of conditions:

- Current network operation – Adare development fed from the local network via the 250mm pipe along Wairoa Terrace
- Addition of a dedicated filling line between the WTP and the Hamilton South Reservoir, planned to be commissioned in 2018 – the Hamilton South Zone, including the Adare development, and the future Hillcrest Zone are serviced by gravity from the Hamilton South Reservoir. This scenario is based on the following assumptions:
 - Rototuna Zone, Maeroa Zone, Fairfield Zone and Whitiara Zone closed
 - Orange Zone extended
 - Hillcrest Rd boosted

For each set of condition, four network configurations have been considered to connect the proposed development to the existing network:

- Single 250mm diameter PE water main.
- 250mm diameter PE water main with interconnected 150mm rider main.
- Single 375mm diameter PE water main.
- 375mm diameter PE water main with interconnected 150mm rider main.

All mains have been modelled following the preferred water supply connection shown in Figure 1 below. The additional 150mm rider main was modelled on the opposite side of the road from the main pipeline to the development.



Figure 1 - Preferred Connection Alignment

Scenarios Investigated

The table below summarises the scenarios investigated for 500 and 1,000 lots for the two sets of conditions described above:

Scenarios Investigated	Single 250mm		250mm + 150mm		Single 375mm		375mm + 150mm	
Current Network Operations	500	1000	500	1000	500	1000	500	1000
Addition of Dedicated Filling Line	500	1000	500	1000	500	1000	500	1000

These scenarios were run with and without additional demand resulting from Adare development and system performance was compared to assess the impact of the proposed development on the existing HCC water network.

Proposed Connection Point

It was assumed that the proposed development would be connected to the existing 250mm pipe along Waiora Terrace at the intersection with Peacocks Rd (see Figure 2 below).

Once the dedicated filling line has been built and the proposed Adare development is fed by gravity from the Hamilton South Reservoir, the watermain servicing the development needs to be connected to the existing 750mm as shown on the figure below. Too much head will be lost if the development remains connected to the 250mm main. Connecting to the 750mm watermain is in line with the Master Plans recommendations. The 750mm main is currently used as bulk main so the proposed development cannot be serviced from this main until the future dedicated filling main is in operation (2018).

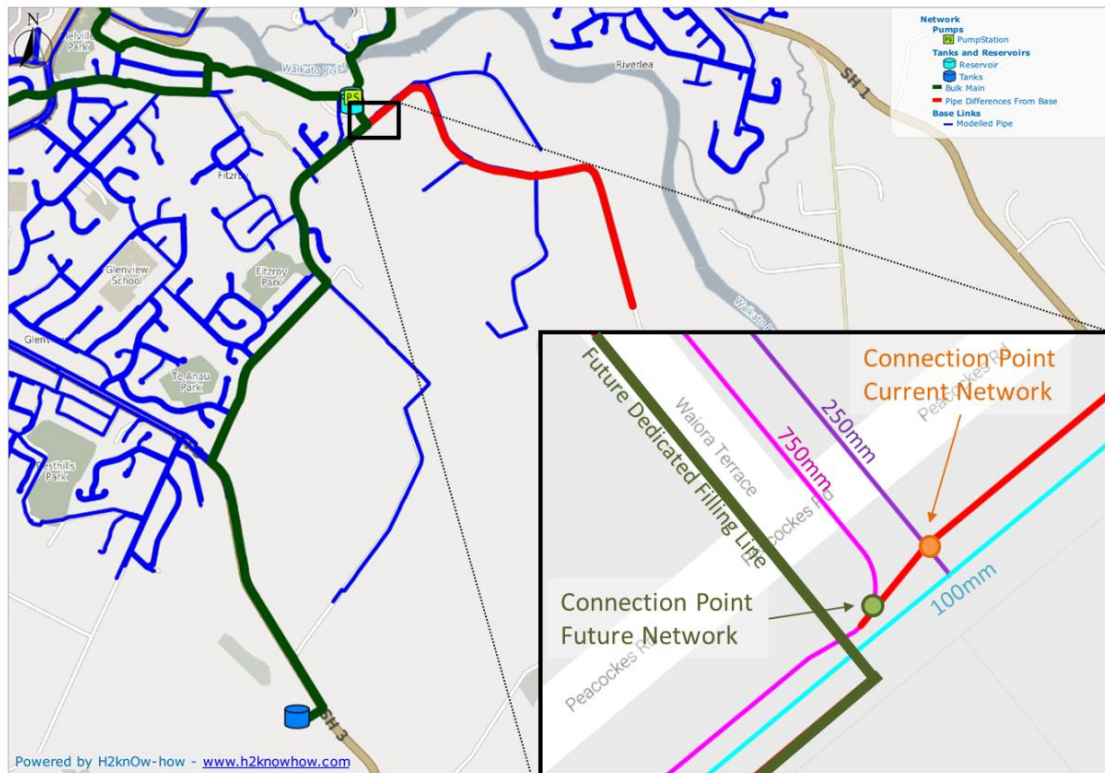


Figure 2 –Adare Development Proposed Connection Point

Current Network Operation

System Performance Analysis in the Proposed Development

This section describes the results of the system performance analysis undertaken for each scenario after including the proposed development demand. We assumed a maximum elevation of 45m. Results have been analysed to check that levels of service can be met in the Adare development without any network modification. The table below summarises the results in terms of minimum pressure and fire flow.

Scenario		Minimum Pressure	Maximum Head Losses	Fire Flow
500 Lots	Single 250mm	30.5	0.7	Can meet residential fire flow (FW2 – 25 l/s)
	250mm + 150mm	31.0	0.4	
	Single 375mm	31.8	0.1	
	375mm + 150mm	31.8	0.1	
1000 Lots	Single 250mm	26.1	2.4	
	250mm + 150mm	28.0	1.6	
	Single 375mm	30.7	0.3	
	375mm + 150mm	30.8	0.3	

The level of service is expected to be met both in terms of pressure and firefighting capacity in the proposed development: pressure is predicted to exceed 20m at all time and residential fire flow (FW2 – 25 l/s) can be met for all eight scenarios.

Head losses below 2.5m/km are predicted in the proposed 250, 350 and 150mm proposed watermain whether a 500 or 1,000 lot development is connected.

System Performance Analysis in the Remaining of the Network

This section describes the results of the system performance in the remaining of the Hamilton South Zone water network. Results have been analysed to assess the effect of the proposed development for each scenario.

Figure 3 below shows the existing system performance in the Hamilton South Zone, without the proposed development. Properties along Peacockes Lane are currently experiencing low pressure (<10m) due to a small diameter (20mm) pipeline servicing this area. To overcome this issue, we recommend connecting the water supply pipeline servicing the Adare development to the Peacockes Lane watermain, as seen on Figure 4 below. The Peacockes Lane properties 'existing and future demand has no impact on the system performance in the proposed development. The recommended connection has been modelled in all scenarios.

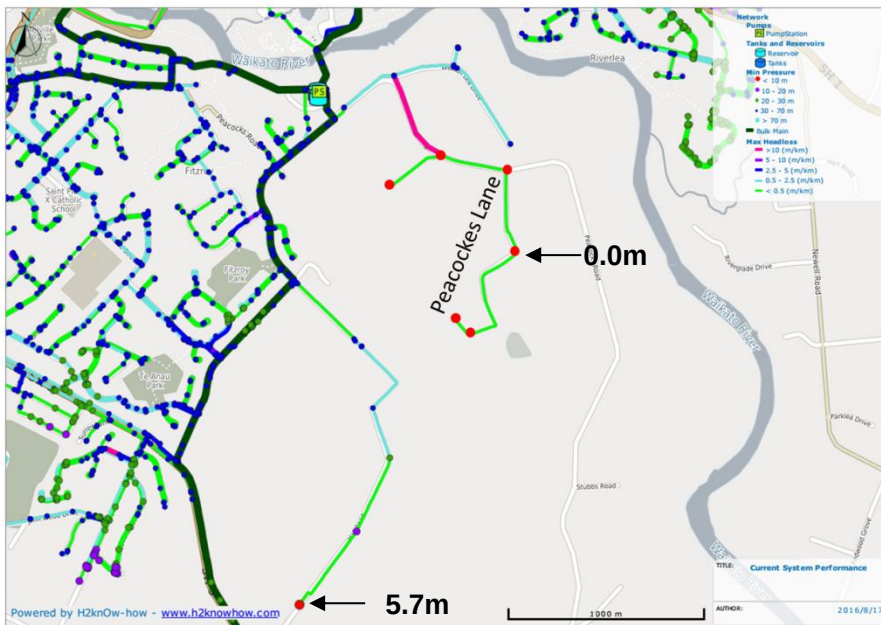


Figure 3 - Current System Performance

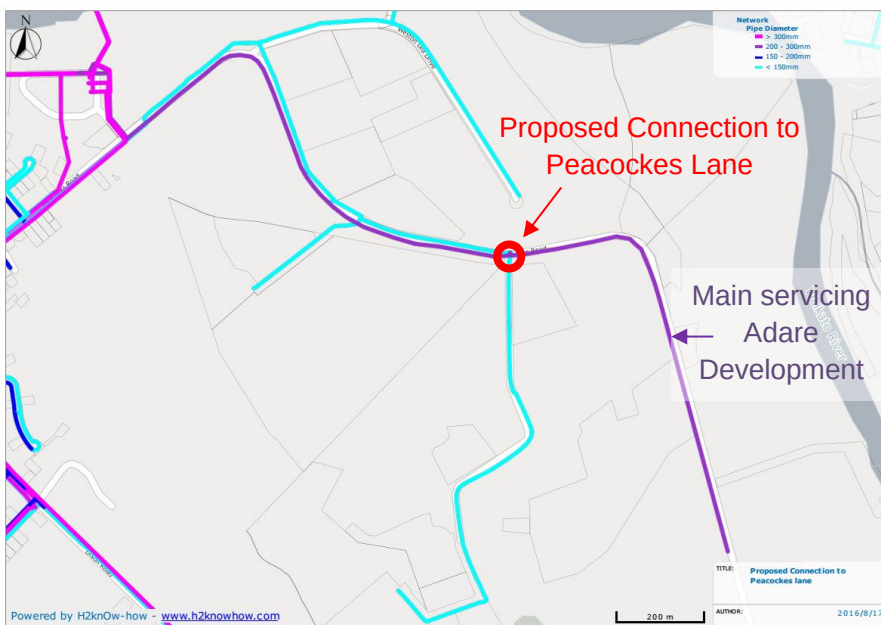


Figure 4 - Proposed Connection to Peacocks Lane

Figure 5 to Figure 12 below show the predicted minimum pressure and maximum head losses in the Hamilton South Zone network considering a 500 and 1,000 lot development.

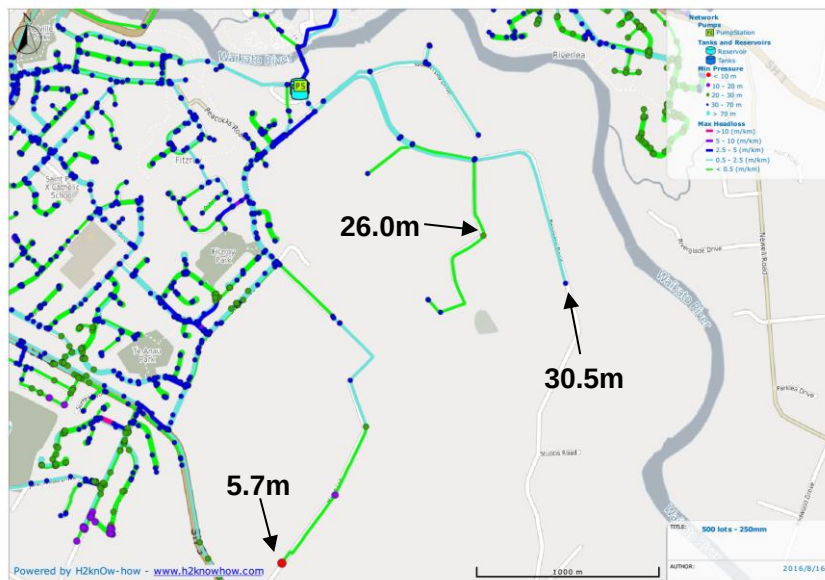


Figure 5 - 500 lots - 250mm Connection

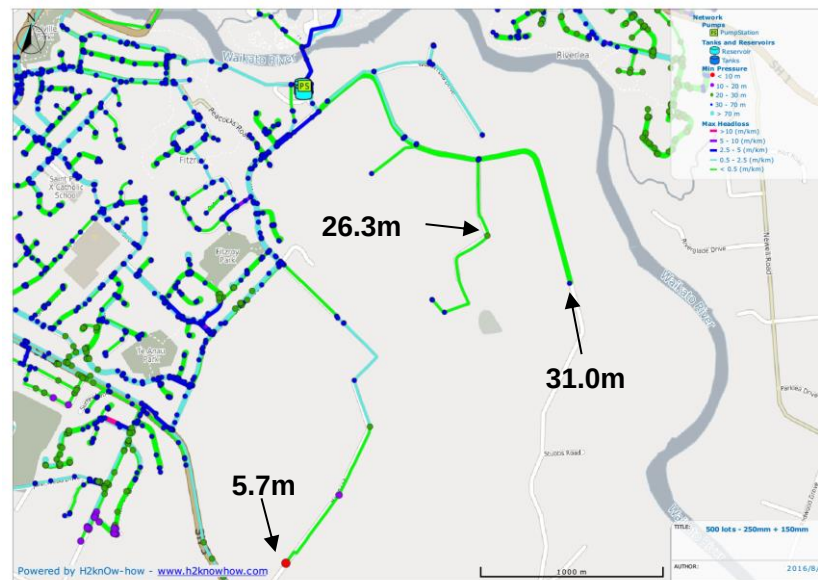


Figure 6 - 500 lots - 250mm + 150mm Connection

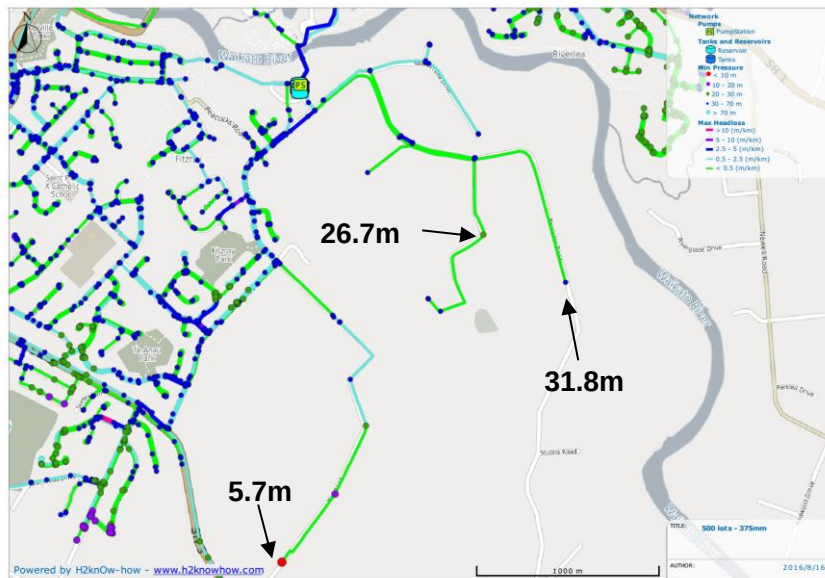


Figure 7 - 500 Lots - 375mm Connection

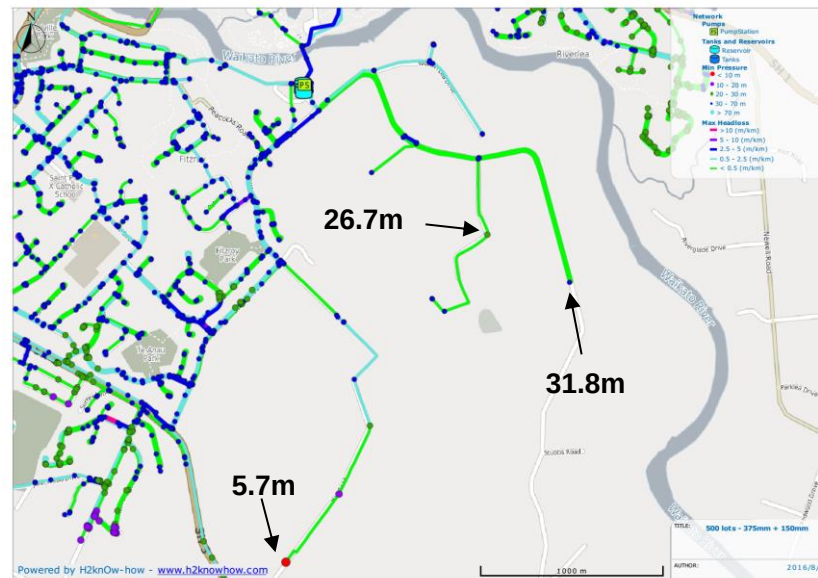


Figure 8 - 500 Lots - 375mm + 150mm Connection

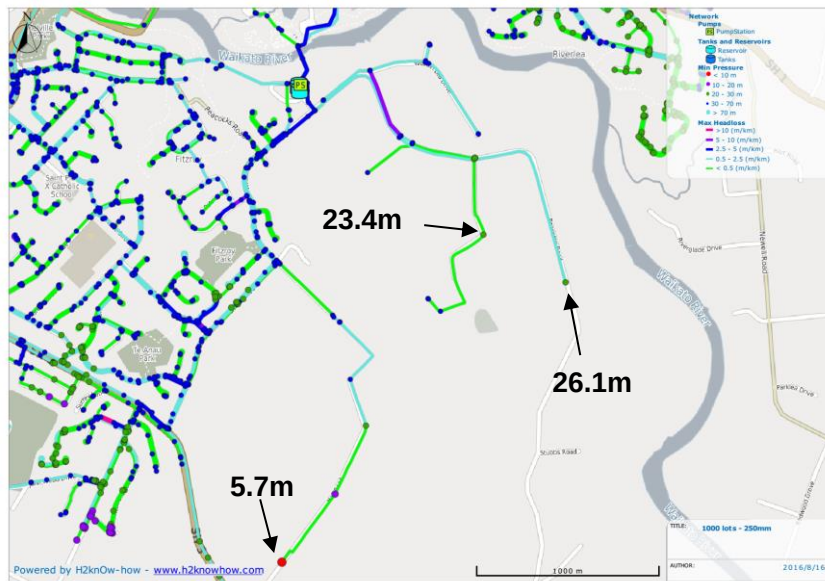


Figure 9 - 1000 Lots - 250mm Connection

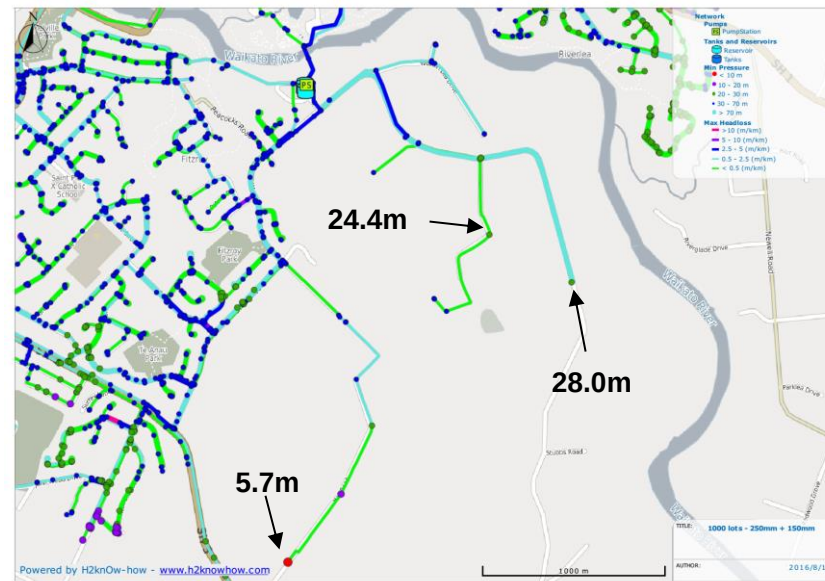


Figure 10 - 1000 Lots - 250mm + 150mm Connection

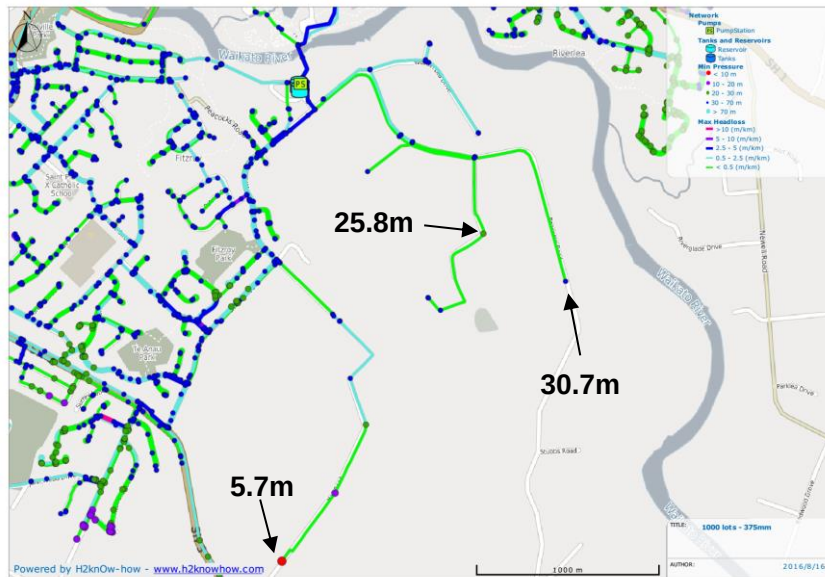


Figure 11 - 1000 Lots - 375mm Connection

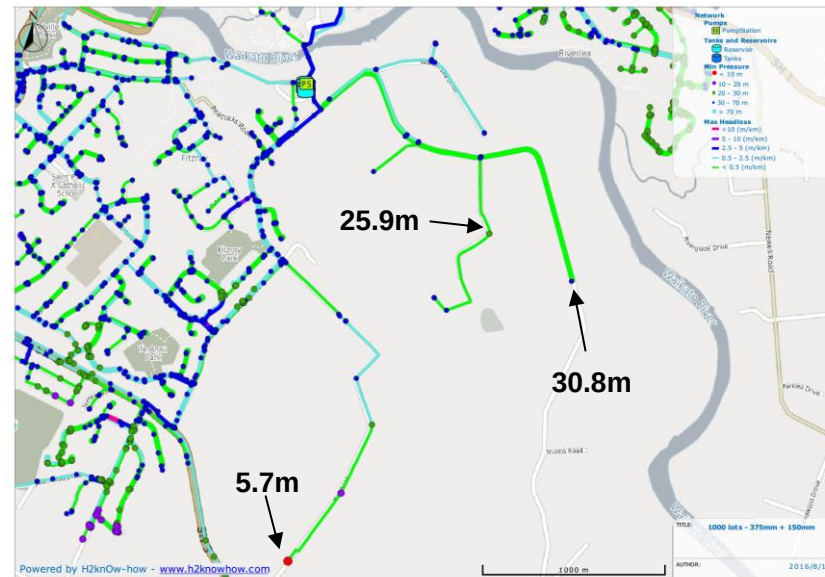


Figure 12 - 1000 Lots - 375mm + 150mm Connection

As shown on the figures above, the proposed development is predicted to have a positive impact on the existing HCC network for all scenarios assessed thanks to the recommended connection to the Peacockes Lane watermain. This connection significantly increases the pressure in this area.

As seen in the table below, pressure at the connection point remains practically unchanged with the Adare Development additional demand.

		Minimum Pressure (m) at the Connection Point		Minimum Pressure (m) on Peacocks Lane		
Scenario		Without Development	With Adare Development	Without connection to watermain	With connection to watermain	
500 Lots	Single 250mm	42.5	42.3	0	26.0	
	250mm + 150mm				26.3	
	Single 375mm				26.7	
	375mm + 150mm				26.7	
1000 Lots	Single 250mm		41.7		0	23.4
	250mm + 150mm					24.4
	Single 375mm					25.8
	375mm + 150mm					25.9

Addition of Dedicated Filling Line

This section describes the system performance and impact assessment of the proposed development once the dedicated filling line has been built and the Hamilton South Reservoir services the Hamilton South and Hillcrest Zones.

System Performance Analysis in the Proposed Development

A system performance analysis has been undertaken for each scenario after including the proposed development demand. We assumed a maximum elevation of 45m. Results have been analysed to check that levels of service can be met in the Adare development without any network modification. The table below summarises the results in terms of minimum pressure and fire flow.

Scenario		Minimum Pressure	Maximum Head Losses	Fire Flow
500 Lots	Single 250mm	34.8	0.7	Can meet residential fire flow (FW2 – 25 l/s)
	250mm + 150mm	35.3	0.4	
	Single 375mm	36.0	0.1	
	375mm + 150mm	36.0	0.1	
1000 Lots	Single 250mm	30.5	2.4	
	250mm + 150mm	32.3	1.6	
	Single 375mm	35.0	0.3	
	375mm + 150mm	35.1	0.3	

The level of service is expected to be met both in terms of pressure and firefighting capacity in the proposed development: pressure is predicted to exceed 20m at all time and residential fire flow (FW2 – 25 l/s) can be met for all eight scenarios.

System Performance Analysis in the remaining of the network

This section describes the results of the system performance in the remaining of the Hamilton South and Hillcrest Zones water network. Results have been analysed to assess the effect of the proposed development for each scenario.

Figure 13 below shows the existing system performance in the Hamilton South and Hillcrest Zone, without the proposed development. Figure 14 shows the predicted system performance considering the interim network operation (Hamilton South Reservoir servicing Hamilton South and Hillcrest Zones) without Adare development, to understand the impact of the proposed development on the future system performance.

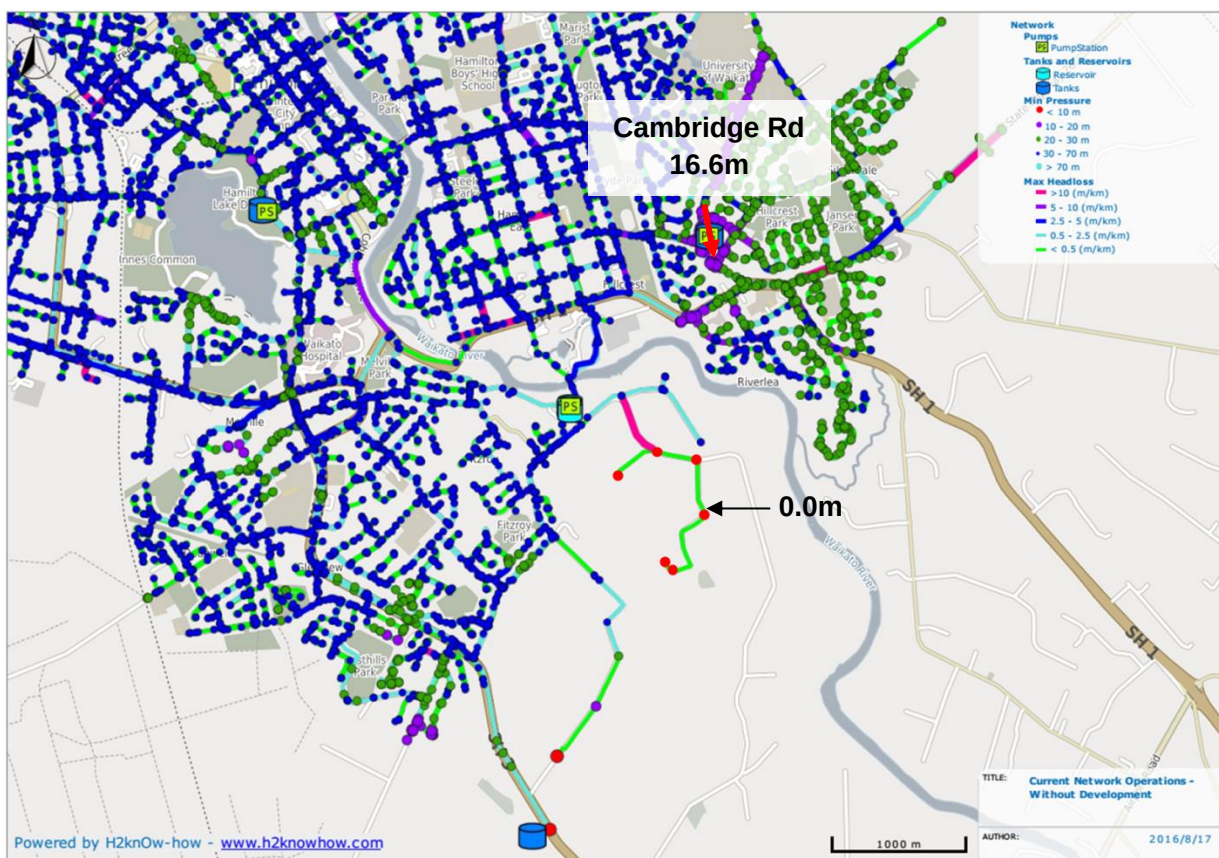


Figure 13 - Current Network Operation - System Performance Without Adare Development

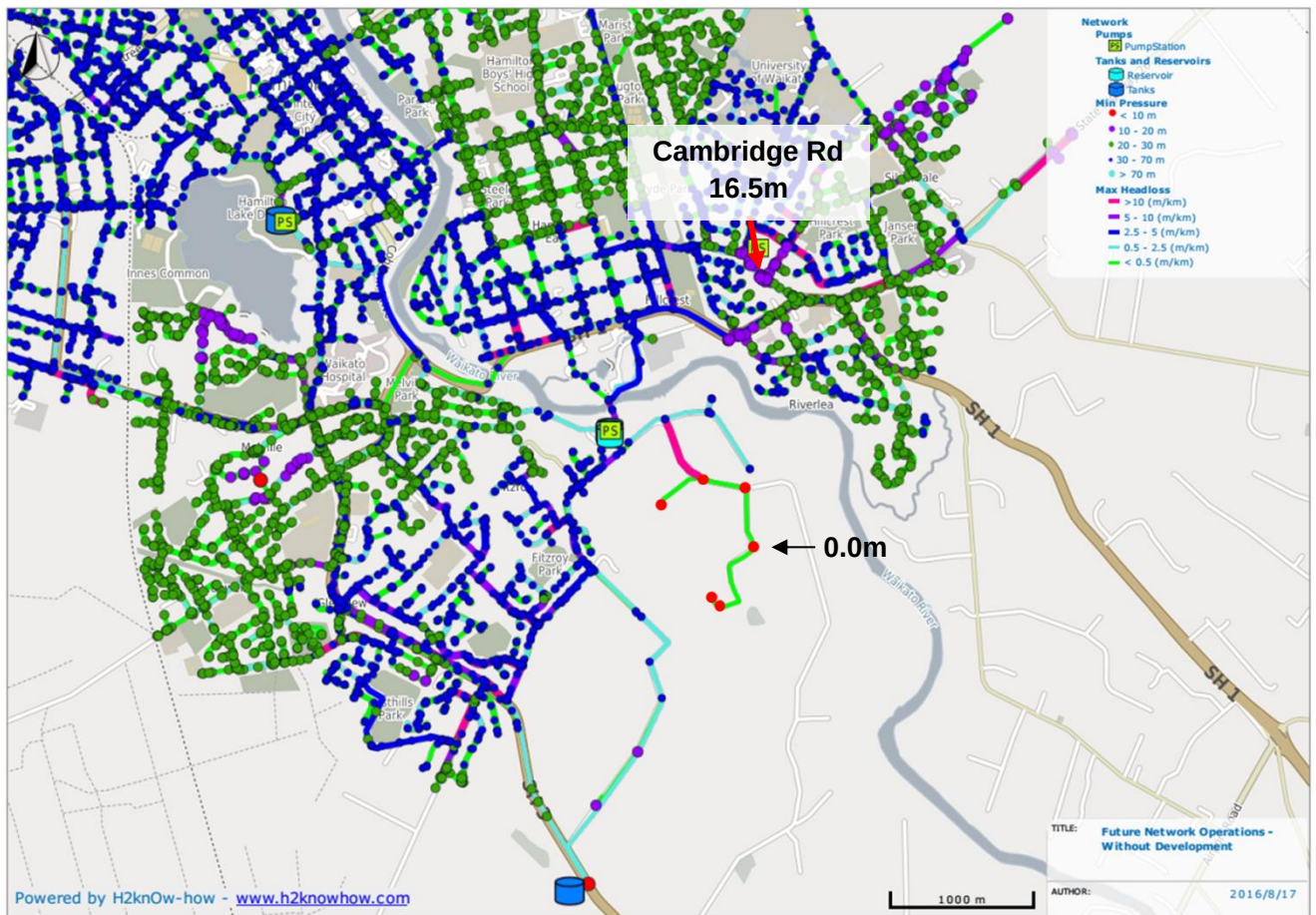


Figure 14 - Future Network Operations - System Performance without Adare Development

As seen on the figures above, properties along Cambridge Rd and Hillcrest Rd are currently experiencing pressure below 20m. Once Hillcrest Rd is boosted, pressure in this area will significantly improve, however a few properties along Cambridge Rd, remaining in the non-boosted zone, will keep experiencing pressure between 15 and 20m.

Figure 15 to Figure 22 below show the predicted minimum pressure and maximum head losses in the Hamilton South Zone network considering a 500 and 1,000 lot development.

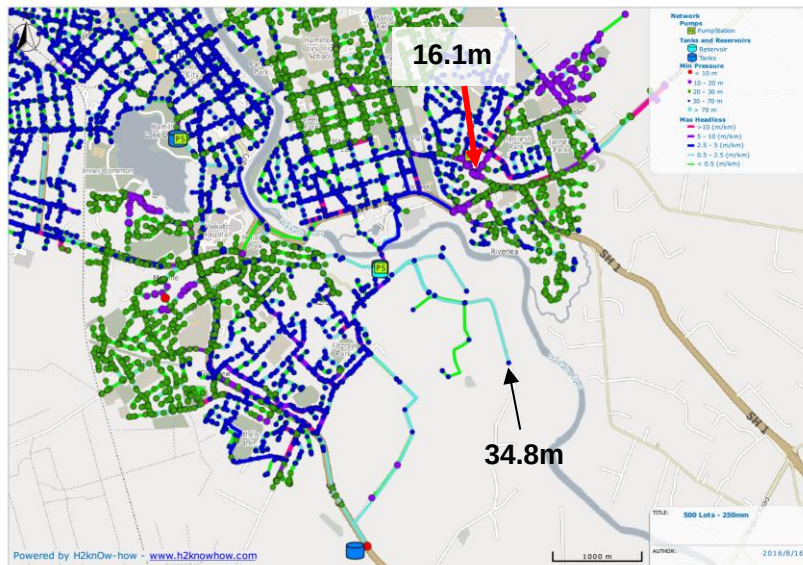


Figure 15 - 500 lots - 250mm Connection

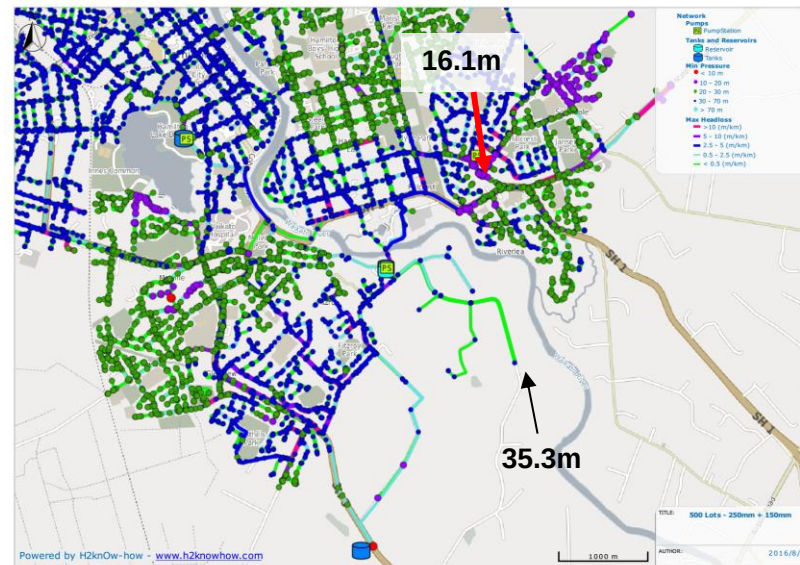


Figure 16 - 500 lots - 250mm + 150mm Connection

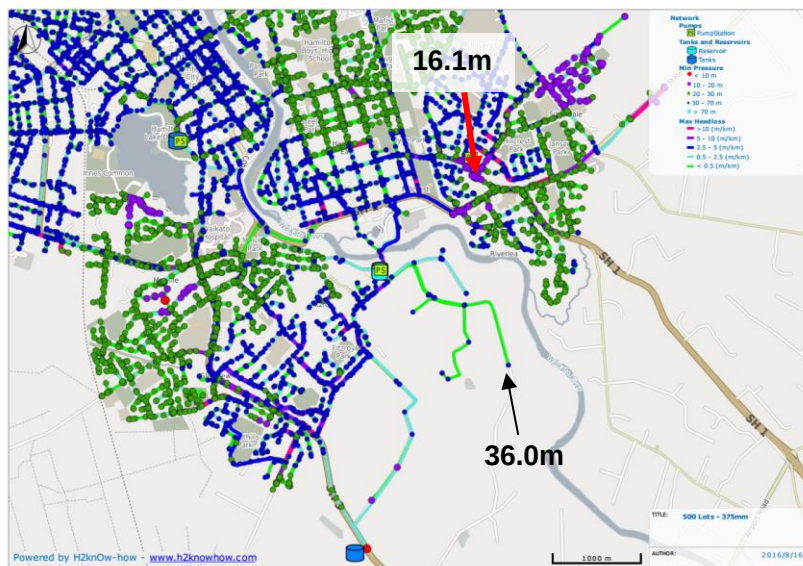


Figure 17 - 500 Lots - 375mm Connection

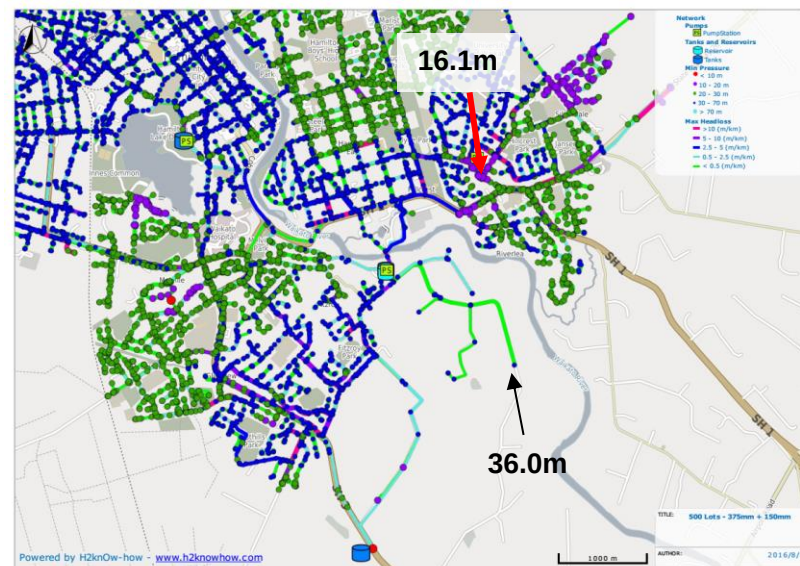


Figure 18 - 500 Lots - 375mm + 150mm Connection

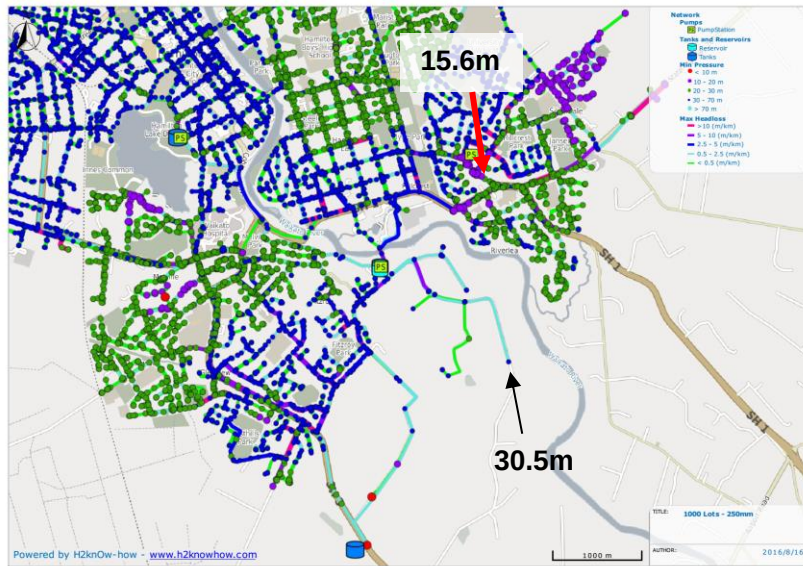


Figure 19 - 1000 Lots - 250mm Connection

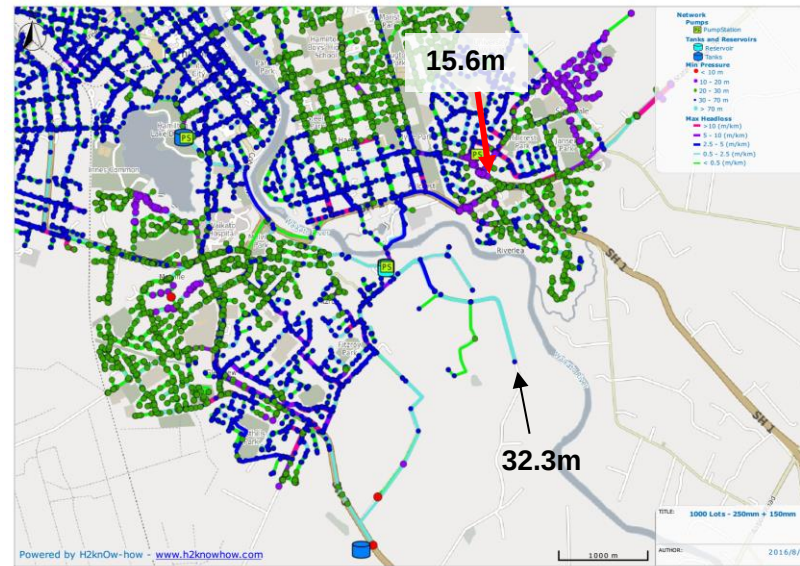


Figure 20 - 1000 Lots - 250mm + 150mm Connection

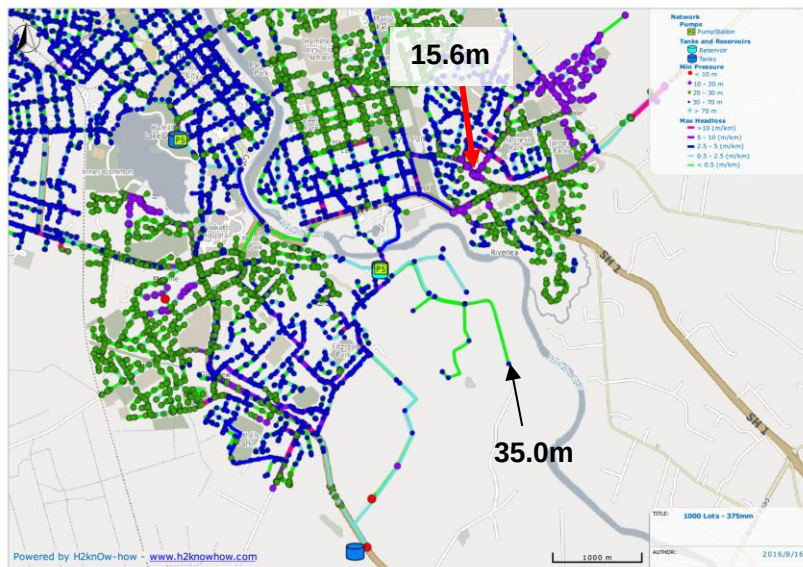


Figure 21 - 1000 Lots - 375mm Connection

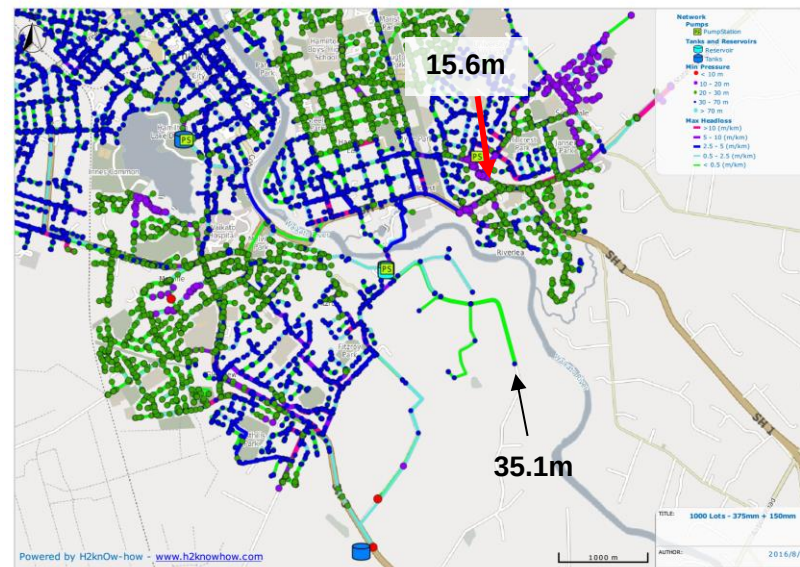


Figure 22 - 1000 Lots - 375mm + 150mm Connection

As shown on the figures above and the table below, the proposed development is predicted to have a minor impact on the future system performance for all scenarios assessed: a 500 lot development is predicted to reduce the minimum pressure by up to 0.5m in the Hillcrest Zone and a 1,000 lot development by up to 0.9m.

Scenario	Minimum Pressure (m) at the Connection Point		Minimum Pressure (m) on Cambridge Rd	
	Without Development	With Adare Development	Without Development	With Adare Development
500 Lots		46.2		16.1
1000 Lots	46.7	45.8	16.5	15.6

Conclusions and Recommendation

The level of service is expected to be met both in terms of pressure and firefighting capacity in the proposed development: pressure is predicted to exceed 20m at all time and residential fire flow (FW2 – 25 l/s) can be met for all scenarios, considering both network operations (current and interim) and four network configuration to service the development.

Head losses below 2.5m/km are predicted in the proposed 250, 350 and 150mm proposed watermain whether a 500 or 1,000 lot development is connected. We recommend installing a 250mm ID main with interconnected 150mm ID rider main for resilience purposes.

Considering the existing network operations, the Adare development is predicted to have a positive impact on the system performance thanks to the recommended connection to the Peacockes Lane watermain. This connection is predicted to significantly increase the pressure in this area.

Once the dedicated filling line is built and the Hamilton South and Hillcrest Zones are serviced from the Hamilton South Reservoir, the proposed development is predicted to reduce the minimum pressure by up to 0.9m in the Hillcrest Zone along Cambridge Rd, already experiencing pressures below 20m. This impact is acceptable however we recommend that no more than 1,000 lots are supplied from the proposed connection point. If any more development was to occur, an option investigation would need to be undertaken to mitigate the additional demand impact on the existing network system performance.

The following is recommended:

- Install a 250mm ID main with interconnected 150mm ID rider main for resilience purposes.
- Connect the proposed watermain servicing the Adare development to the existing pipeline along Peacockes Lane to increase LOS in this area.
- Once the dedicated filling line is built, connect the proposed watermain to the existing 750mm pipeline at the intersection between Waiora Terrace and Peacockes Rd. It is not possible to connect to this main before the dedicated filling line is operating as this pipeline is currently used as bulk main.
- No more than 1,000 lots can be supplied from the proposed connection point.

Yours sincerely,

Julie Plessis

Hydraulic Engineer

Mott MacDonald New Zealand Limited