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GDC Future Development Modelling Assessment - Water Supply

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CONFIDENTIAL



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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Gore District Council ('**Client**') in relation to the letter *Growth Area Servicing Scoping Assessment Offer of Service - July 2022* ('**Purpose**') and in accordance with the Short Form Agreement with the Client dated 4 August 2022. 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 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 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 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.

1 Summary

WSP was engaged by Gore District Council (GDC) to undertake a water supply network impact assessment for the development areas in Gore and Mataura. The assessment included identifying:

- The current system constraints.
- The impacts on the Mataura and Gore water supply networks with the new developments.
- Network upgrades required to accommodate the demands from the new developments.

Network performance and level of service (LoS) constraints were identified in the existing Gore and Mataura hydraulics models for an Average Day Peak Week (ADPW) demand. All developments in both networks require pipe upgrades to achieve the LoS.

2 Scope

Figure 2-1 shows the location of the future developments that were added to the Gore Model:

- Gore West (Residential)
- Gore South (Industrial)
- Gore West North (Residential)



Figure 2-1 Gore developments

Figure 2-2 shows the location of the future developments that were added to the Mataura model; Mataura East (Residential) and Mataura South (Industrial).



Figure 2-2 Maitua developments

3 Assumptions

3.1 Hydraulic Model – Model Build

The Gore Average Day Peak Week (ADPW) and Maitua ADPW hydraulics models were used to carry out the assessment in InfoWorks Pro 2023.0.2. The hydraulic models were updated and calibrated in 2011. The models are likely to be missing upgrades and increased population post 2011, which may influence demand in the network. We recommend carrying out a full model update and calibration to increase the confidence of the results for this and future modelling assessments. For this modelling assessment it was assumed that the wells and treatment processes can provide sufficient water to maintain the water in the reservoirs.

3.2 Model Operation

We have assumed that the operation of the network is still the same as it was in 2011 (refer to 'Gore and Maitua Water Supply Model report, 2011, OPUS'), unless otherwise specified.

3.2.1 Gore

The Jacobston and Coopers wells provide the water supply for the Gore network. Most of the network is gravity feed from the East Gore and Hilbre Avenue reservoirs. However, there are a series of pumps that boost water to the higher elevation properties. Figure 3-1 shows the Gore Network currently in the model, where the developments will be provided mostly by the Hilbre Ave Reservoir and pumps.

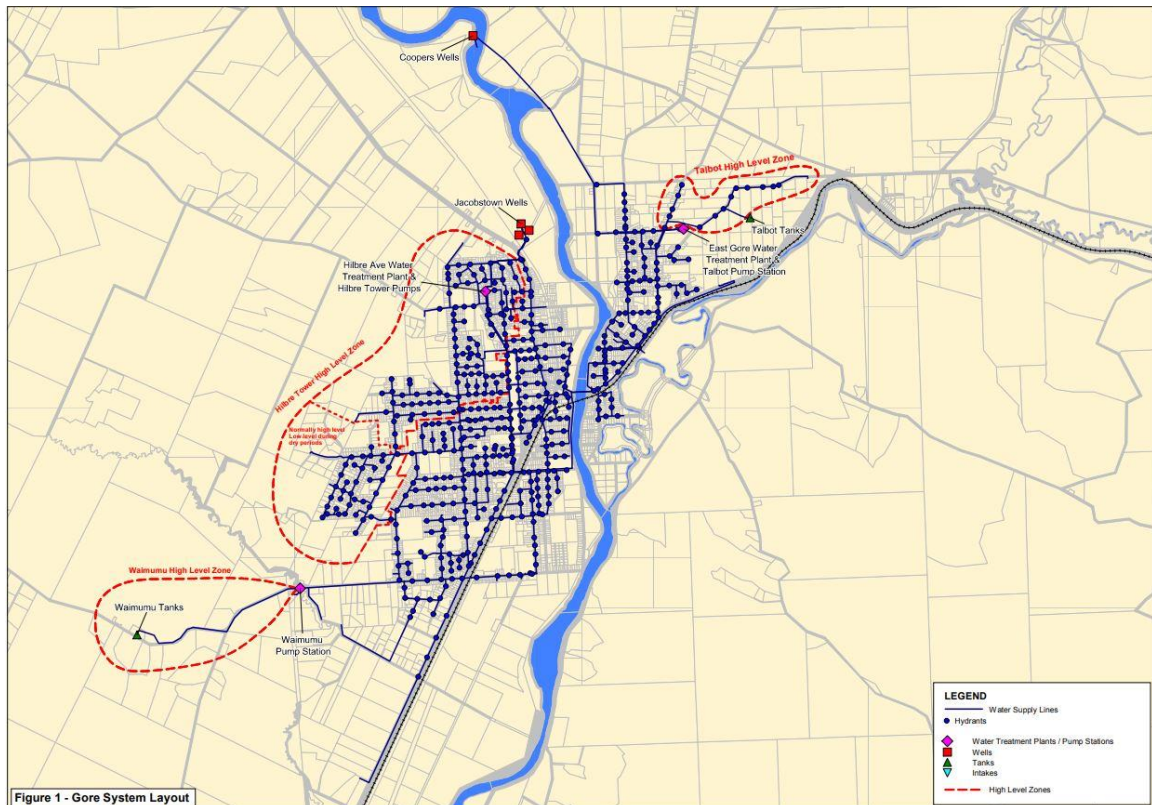


Figure 3-1 Gore water supply network

The model updates made to the Gore Model for the Thomas Street Water Supply assessment were carried through to this modelling assessment (Refer to *Thomas Street Water Supply Assessment Completed 12 July 2022*). This included:

- The BUPA Retirement Village – Assumed to have a commercial profile with an average peak day demand of 0.97l/s.
- A DN150 PVC(U) pipe upgrade along Reaby Road and the end of Charlton Road.
- A DN150 PVC(U) new water main along Falconer Road

In addition, the Talbot Street tanks are now redundant. These have been replaced by 2 x Variable Speed Drives (VSD) pumps in a duty assist arrangement at the East Gore Treatment plant.

3.2.2 Mataura

The Mataura and Paper Mill Reservoirs supply the water to Mataura township by gravity. The properties around McKelvie Heights are at higher elevations and are supplied by gravity from two tanks (McKelvie Tanks) near the raw water reservoir. These tanks are supplied by two booster pumps. Figure 3-2 shows the Mataura Network currently in the model, where the developments will be provided by the Mataura and Paper Mill Reservoirs.

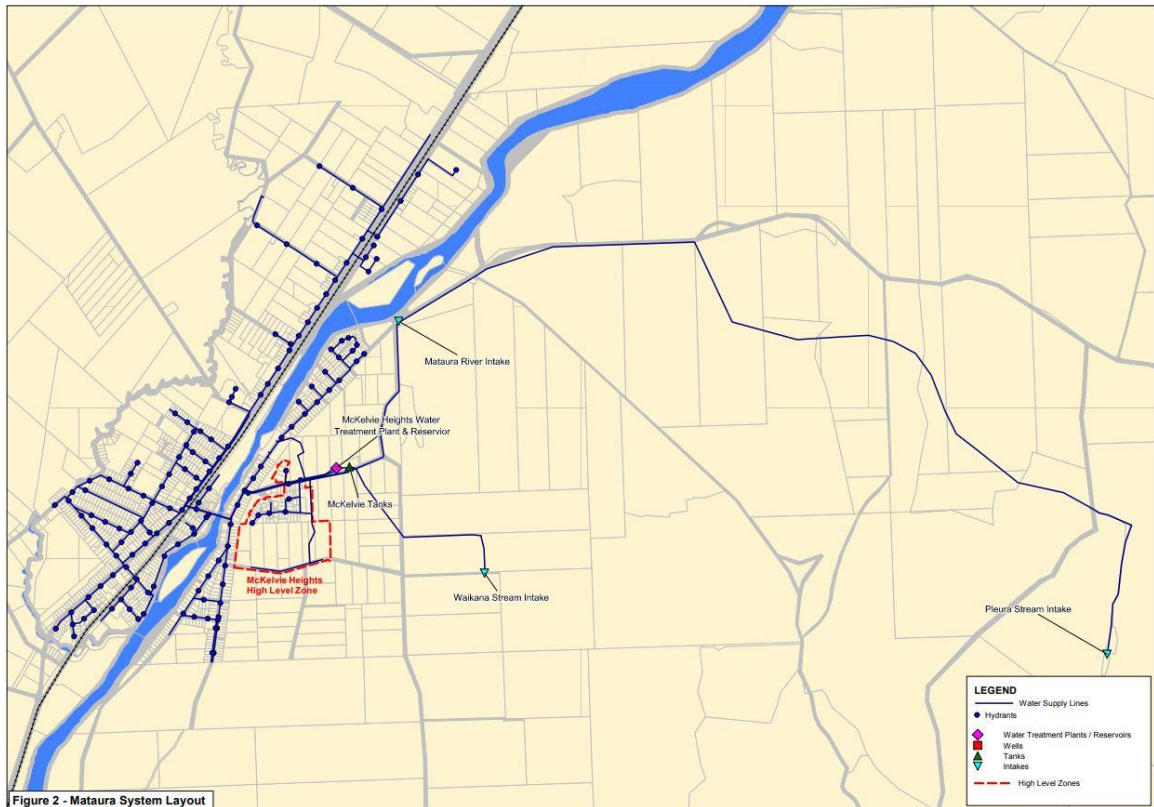


Figure 3-2 Mataura water supply network

4 System Performance Criteria

The following LoS requirements were targeted for the new developments based on the Gore District Council Subdivision and Land Development Bylaw 2019:

- A customer minimum pressure LoS of 25 m.
- Headlosses less than 3 m/km for pipes greater than DN 200 and less than 5 m/km for pipes less than DN 150.
- Velocities less than 2 m/s. This is high for a target velocity, and we recommend targeting velocities of between 1.2 m/s - 1.5m/s for trunk/pump mains.
- FW2 fire flow– minimum flow of 25 L/s and minimum residual pressure of 10 m at two thirds of peak demand.

5 Gore Modelling Assessment

5.1 Current System Constraints

The existing Gore Water Supply network has:

- No pressure level of service issues. All pressures are above 25m, with two marginal failures at the end of Eversfield (22 m) and Saleyard Road (21 m) due to elevation.
- Velocities are less than 1.5 m/s.
- There are seven pipelines (4.1 km) that have maximum headlosses more than 10 m/km due to undersized pipes in the network.
- 264 hydrants of the 529 hydrants in the existing network do not meet FW2 requirements.

Refer to APPENDIX A for all pressure and headloss figures.

5.2 Development Demands

Table 5-1 summaries the demand that was added to the existing network. The leakage value was assumed to be 200 L/prop/day for both the residential and commercial developments.

Table 5-1: Demand details for the Gore Model

Development Area	Area (m ²)	Demand Profile	No. of Prop	Demand (m ³ /day)	Peak Commercial Light (l/s)	Peak Commercial Heavy (l/s)	Average Commercial Light (l/s)	Average Commercial Heavy (l/s)
Gore West North	259,129	Residential	216	207				
Gore South	896,195	Commercial			44	143	20	64
Gore West	856,607	Residential	428	410				

The commercial peaking factors were based on the peak commercial design flows of light 0.4 L/s/ha and heavy 1.3 L/s/ha, these are in accordance with NZ4044:2010 Land Development and Subdivision Infrastructure.

5.3 Methodology

The developments were assessed individually and collectively. All developments were represented as one customer point connected to the existing network via a hydrant, where:

- Gore West North had an elevation of 116.13 m
- Gore South had an elevation of 70 m.
- Gore West had an elevation of 112.17 m.

Two scenarios were applied to represent commercial demand (Gore South Development), one as heavy demand (64 l/s) and the other as a light demand (20 l/s). The average demand applied to each residential property was 757 L/prop/day.

Fire flow was run at 2/3 of the peak demand for all the hydrants in the network.

5.4 Results

Table 5-2 summaries the modelling results when the developments were added to the network. All upgrades have a Colebrook white value of 0.03 mm. ***All recommend pipe sizes have not been optimised and are only an indication of upgrades required.*** Refer to APPENDIX A for the pressure and headloss figures.

Table 5-2: Gore Modelling Assessment Results

Development	Minimum Pressure at Development	Impact on Pressures in the Existing Network	Additional Headlosses in the existing Network	Velocities	FW2 fire flow meet	Length and size of upgrades to meet LoS and FW2
Existing Network	-	All pressures are above 25m, with two marginal failures at the end of Eversfield (22 m) and Saleyard Road (21 m) due to this nodes being at higher elevations.	There are seven pipelines (4.1 km) that have maximum headlosses more than 10 m/km due to undersized pipes in the network.	All velocities are less than 1.5 m/s	264 hydrants of the 529 hydrants in the network do not meet FW2 requirements.	Pipes throughout the network are currently undersized for the provision of fire flow.
Gore West North (Residential)	27 m	No impact on the existing network pressure	Headlosses in the pipes servicing the development (Crewe St) increase from 0.004m/km to 2.5m/km (< than 3m/km). All other headlosses remain similar to the existing network.	All velocities are less than 1.5 m/s	Additional 7 hydrants do not meet FW2 requirements on top of the existing network failures (264 hydrants). These are all located near the development. The development does not receive FW2.	Upgrades will be required to meet FW2 fire flow.: 157m of DN 180 (Internal Diameter (ID): 151.2 mm) PE100 PN12.5 at the start of Reaby Rd 420m of DN 250 (ID: 212.3 mm) PE 100 PN12.5 from the Hilbre Pump Station to Broughton St/Crewe St Intersection
Gore West (Residential)	Pressures drop below 0m	The pressures around the pipes servicing the development drop below 20 m.	Headlosses in six of the pipes (approx. 2.1 km) supplying the development increase above 10m/km.	Velocities in the pipe from 116 Coutts Road to 21 Eversfield Rise (208 m) increase to 8.1 m/s. All other velocities in the network are less than 1.5 m/s.	No fire flow test was completed as the pressure level of service cannot be achieved so FW2 will not be meet.	Upgrades will be required to meet the Level of Service and FW2 requirements: 3.1 km of DN 250 PE100 PN12.5 (ID: 212.3 mm) from the Hilbre pump station along Elizabeth Street to Coutts Road. The hydrant for Gore West has a marginal failure – 24L/s. Upsizing the recommended upgrades above would resolve this.
Gore South (Industrial) – Heavy Demand	The network does not have the capacity to service the development					Upgrades Will be required to meet the Level of Service and FW2 requirements:

Development	Minimum Pressure at Development	Impact on Pressures in the Existing Network	Additional Headlosses in the existing Network	Velocities	FW2 fire flow meet	Length and size of upgrades to meet LoS and FW2
						5.1km of DN 450 (ID: 382.3 mm) PE100 PN12.5 from the Hilbre Ave Reservoir to the Gore South Development
Gore South (Industrial) – Light Demand		The network does not have the capacity to service the development				Upgrades Will be required to meet the Level of Service and FW2 requirements: 5.1km of DN 355 (ID: 301.6 mm) PE100 PN12.5 from the Hilbre Ave Reservoir to the Gore South Development *Note Beattie Street hydrant is additional failure on top the existing failures for fire flow. Further upsizing the pipe upgrades above would ensure this hydrant meets FW2 fire flow requirements.
All networks with light commercial demand		The network does not have the capacity to service the development due to Gore South and West				Combine all residential upgrades and light upgrades from above. Development of this option will required localised upgrades and pipe upsizing to reduce the increase in headlosses in the localised pipes supplying the development. The hydrant for Gore West no longer meets fire flow requirements – 23L/s. Upsizing the recommended upgrades above would resolve this.
All networks with heavy commercial demand		The network does not have the capacity to service the development due to Gore South and West				Combine all residential upgrades and heavy upgrades from above. Development of this option will require localised upgrades and pipe upsizing to reduce the headlosses in the localised pipes supplying the development. With these upgrades in place there is still an additional 25 FW2 hydrant failures including the hydrants at Gore West and Gore West North. Development of this option will require localised upgrades and pipe upsizing to meet fire flow requirements.

5.5 Results Summary

Upgrades will be required for all developments individually and collectively to meet the LoS requirements. Figure 5-1 summaries all the upgrades required for the developments.

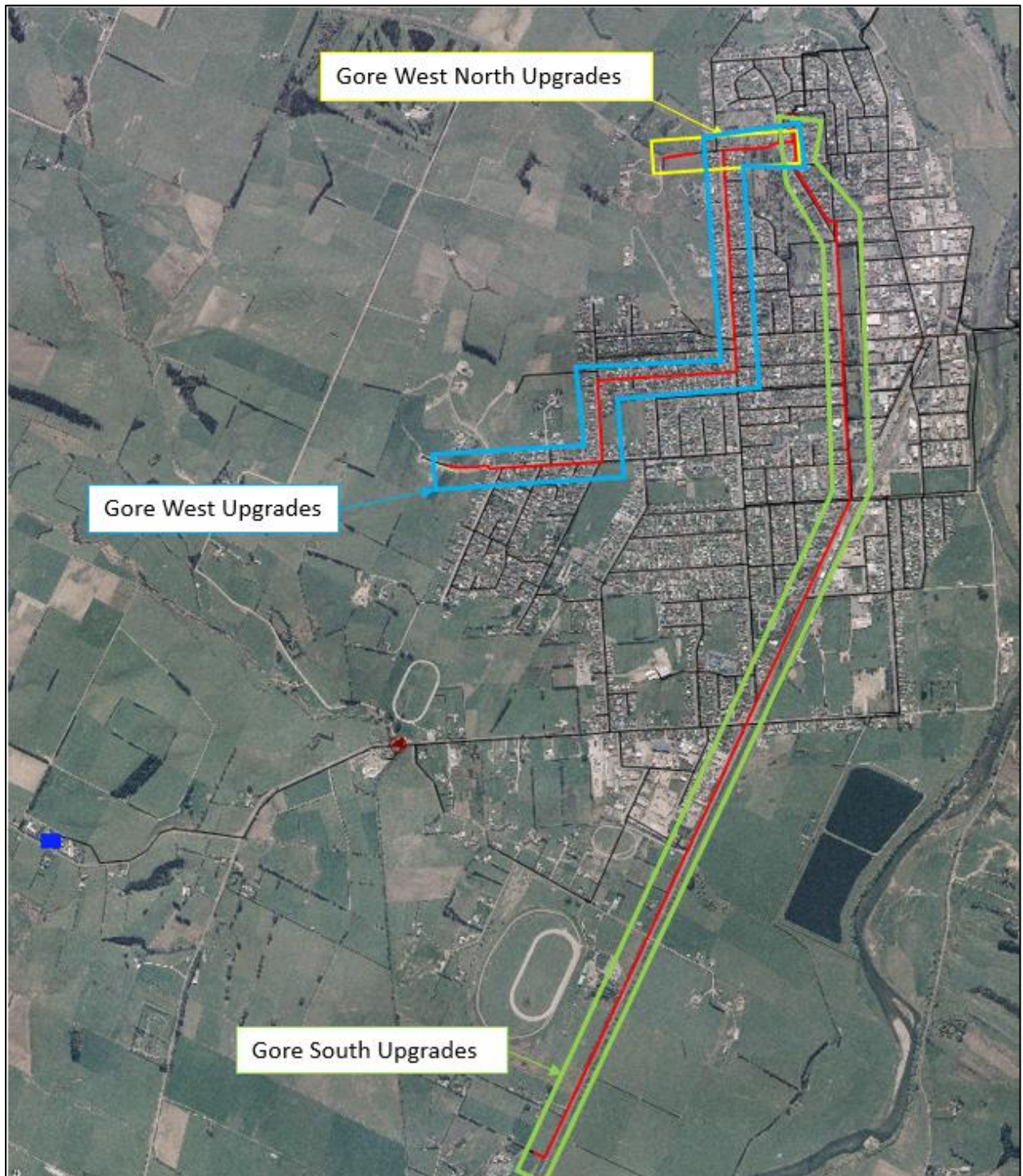


Figure 5-1: Upgrades Required for all future Developments in the Gore Network

5.5.1 Level of Service

With the upgrades in place the LoS is meet at all developments. A comparison of the network with and without upgrades for pressure, velocity and headloss is outlined below. All comparisons below are with the light commercial demand, as the heavy demand is considered extreme and will require significant upgrades.

5.5.1.1 Pressure

Without the upgrades the network does not have the capacity to cater for the developments. With all upgrades in place all pressures are greater than 25m.

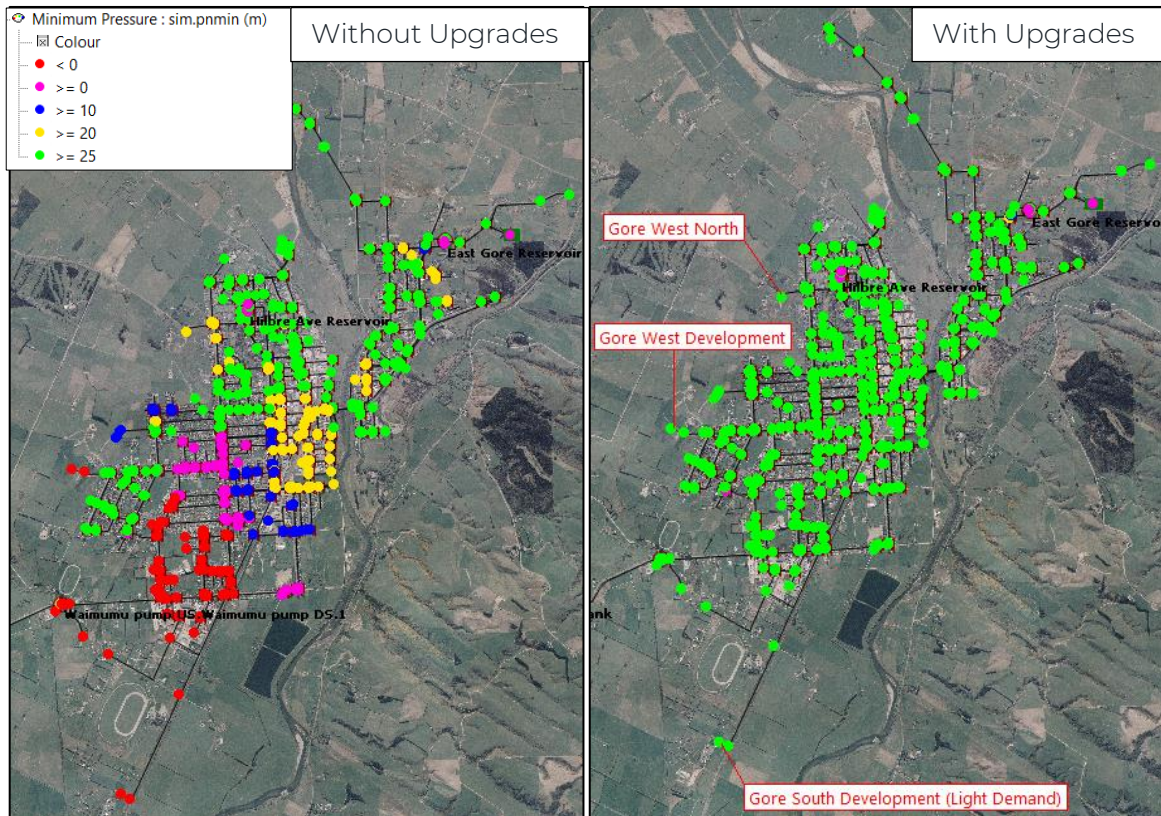


Figure 5-2: Pressures in the Gore Network with and without Upgrades

5.5.1.2 Headlosses

Without the upgrades the network does not have the capacity to service the developments. The upgrades will reduce headlosses in the pipelines servicing the developments.

The addition of the Gore South Development results in an increase in headlosses in the localised pipes servicing the development compared to the existing network. Further localised upgrades will be required to reduce these headlosses.

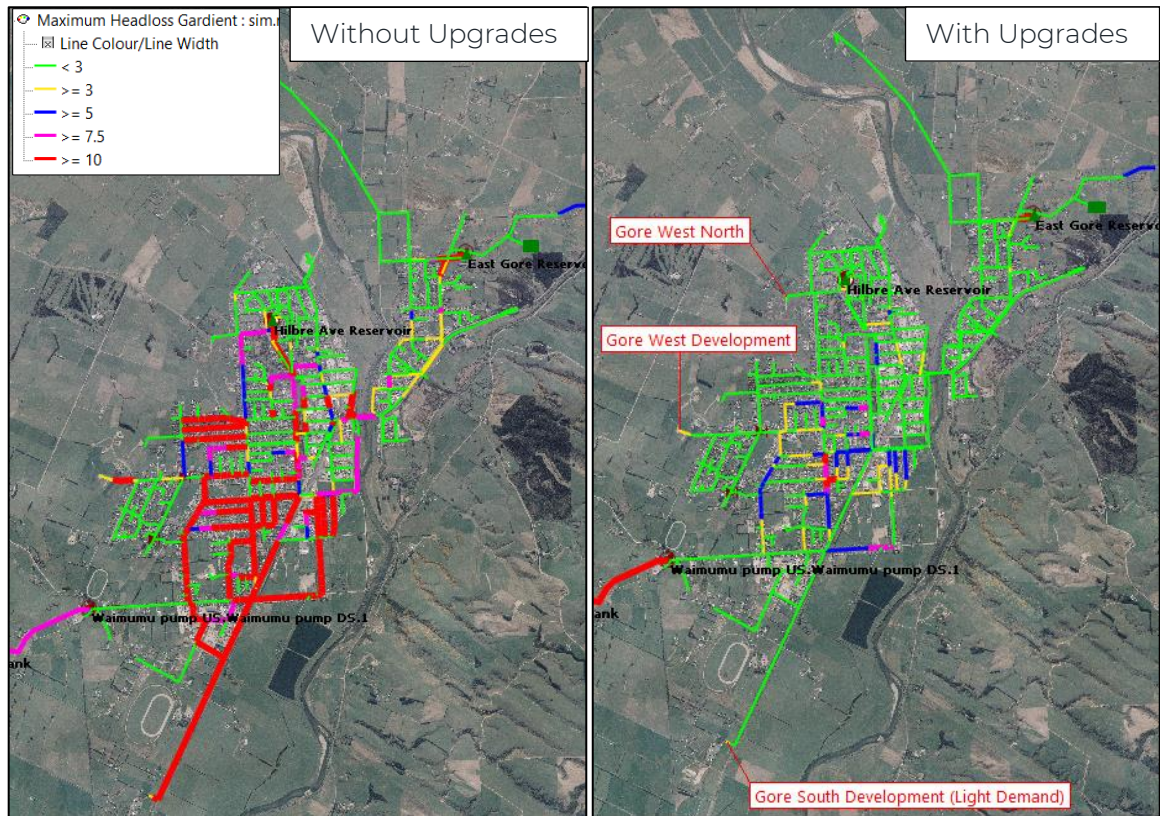


Figure 5-3: Headlosses in the Gore Network with and without Upgrades

5.5.1.3 Velocities

With the upgrades in place all velocities are reduced to less than 1.5 m/s. There is an increase in some of the localised pipes servicing the developments compared to the existing model. However these are all less than 1.5 m/s.

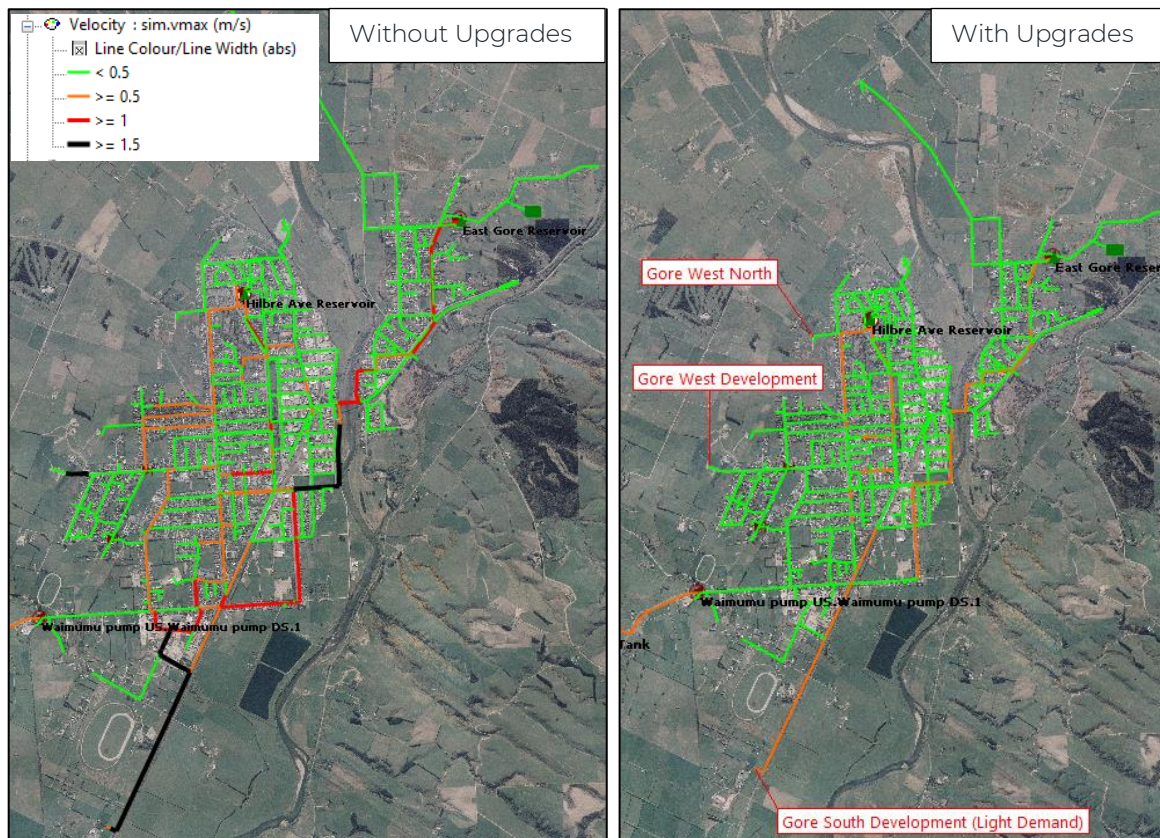


Figure 5-4: Headlosses in the Gore Network with and without Upgrades

6 Matura Modelling Assessment

6.1 Current System Constraints

The existing Matura Water Supply network has:

- No pressure level of service issues. All pressures are above 25 m, with some marginal failures at 67 Crawford Street (13m) and around the reservoirs.
- Velocities less than 1.5 m/s.
- Most headlosses are less than 3m/km. Maximum headlosses are more than 10m/km along Bridge Street (156m).
- 85 hydrants of the 153 hydrants in the existing network do not meet FW2 requirements.

6.2 Development Demands

Table 6-1 summaries the demand that was applied to the network. The leakage value was assumed to be 200l/prop/day for a new development for both residential and commercial.

Table 6-1 Demand details for Mataura Model

Development Area	Area (m ²)	Demand Profile	No. of Properties	Demand (m ³ /day)	Peak Commercial Light (l/s)	Peak Commercial Heavy (l/s)	Average Commercial Light (l/s)	Average Commercial Heavy (l/s)
Mataura East	328128	Residential	164	298.35	-	-	-	-
Mataura South	1263388	Commercial	-	-	63	202	27	89

The commercial peaking factors were based on the peak commercial design flows of light 0.4 L/s/ha and heavy 1.3 L/s/ha, these are in accordance with NZ4044:2010 Land Development and Subdivision Infrastructure.

6.3 Methodology

The developments were assessed individually and collectively. Both development demands were spread across two customer points, and connected to a single hydrant:

- The demand for the Mataura East development is split equally among two areas, North and South of Doctors Road, considering 82 plots on each area.
- The demand for Mataura South was located along Mcilwraith Road and off the New Zealand State Highway (Near Saleyard Road).

Two scenarios were applied to represent commercial demand (Mataura South Development), one as heavy demand (89 l/s) and the other as a light demand (27 l/s). The average demand applied to each property was 1,681 L/prop/day.

6.4 Modelling Results

Table 6-2 summaries the modelling results. All upgrades have a Colebrook white value of 0.03 mm. *All recommend pipe sizes have not been optimised and are only an indication of upgrades required.* Refer to APPENDIX A for the pressure and headloss figures.

Table 6-2: Maitara Modelling Results

Development	Minimum Pressure at Development	Impact on Pressures in the Existing Network	Additional Headlosses in the existing Network	Velocities	FW2 fire flow meet	Length and size of upgrades to meet LoS and FW2
Existing Network	-	All pressures are above 25 m, with some marginal failures at 67 Crawford Street (13m) and around the reservoirs.	Most headlosses are less than 3m/km. Maximum headlosses are more than 10m/km along Bridge street (156m).	All velocities are less 1.5 m/s.	85 hydrants do not meet FW2 fire flow requirements.	Pipes throughout the network are currently undersized for the provision of fire flow.
Maitara East	North Side – 51m South Side – 24.5m	Almost all nodes have pressures greater than 25 m except at 67 Crawford Street (11 m) and around the reservoirs i.e. high elevation.	Headlosses increase to over 5m/km along Doctors Rd and the pipe servicing the South side of the development. All other headlosses remain similar to the existing network	Velocities increase along Doctors Rd (0.6 m/s) and in the pipe servicing the South side of the development (0.55 m/s) from approx. 0.2 m/s. All velocities remain less than 1.5 m/s.	Additional 33 hydrants cannot meet FW2. The west side of the development cannot achieve FW2.	Upgrades Will be required to meet the Level of Service and FW2 requirements: 478 m of DN 250 (ID:152.7 mm) PE100 PN12.5 from the reservoir to the South side of the development.
Maitara South (Heavy)	The network does not have the capacity to service the development					Upgrades Will be required to meet the Level of Service and FW2 requirements: 611 m OF DN 125 (ID: 106.1 mm) PE 100 PN12.5 along Burton Road 3.8 km of pipe greater than DN 450 (ID: 382.3 mm) PE 100 PN12.5 from the Maitara reservoir to the Maitara South development
Maitara South (Light)	The network does not have the capacity to service the development					Upgrades Will be required to meet the Level of Service and FW2 requirements: 611 m OF DN 125 (ID: 106.1 mm) PE 100 PN12.5 along Burton Road

		3.8 km of DN 355 (ID: 301.6 mm) PE 100 PN12.5 from the Mataura Reservoir to both customers in the development
Combined Developments (Heavy Commercial Demand)	As above the network cannot supply the commercial demand and hence the network does not have the capacity to service all the developments.	Combine all residential upgrades and heavy upgrades from above. A pipe size greater than DN450 (ID: 382.3 mm) PE100 PN12.5 will be required as the headlosses are greater than 3m/km
Combined Developments (Light Commercial Demand)	As above the network cannot supply the commercial demand and hence the network does not have the capacity to service all the developments.	Combine all residential upgrades and light upgrades from above.

6.5 Results Summary

Upgrades will be required for all developments individually and collectively to meet the LoS requirements. Figure 6.1 summaries all the upgrades required for the developments.

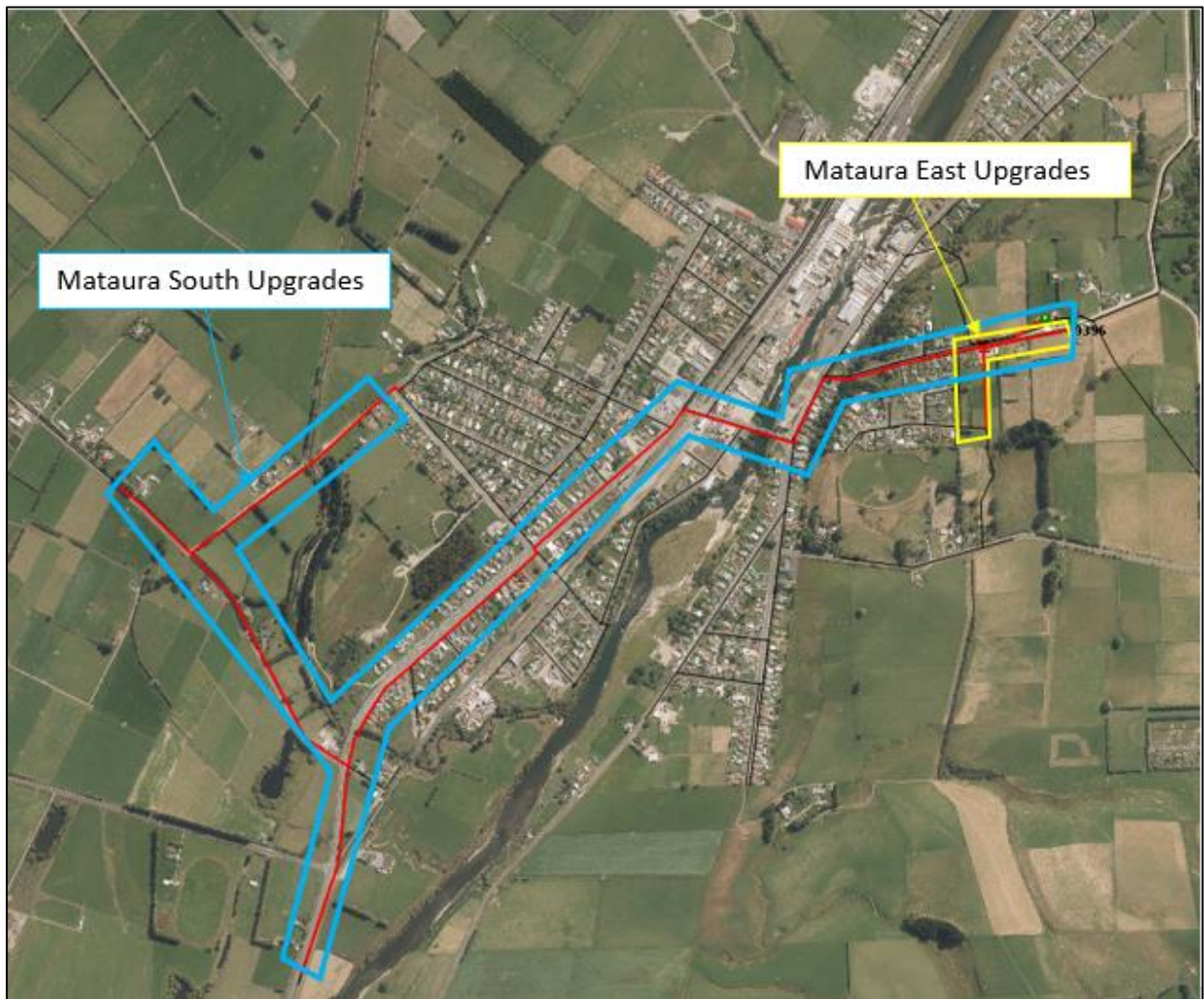


Figure 6-1: Upgrades Required to Service the Future Developments in Mātaura

6.5.1 Level of Service

With all the upgrades in place the level of service is meet for all developments. A comparison of the network with and without upgrades for pressure, velocity and headloss is outlined below. All comparisons below are with the light commercial demand as the heavy demand is considered excessive and will result in significant network upgrades for the Mātaura system.

6.5.1.1 Pressure

Without the upgrades the network does not have the capacity to cater for the developments. With all upgrades in place all pressures are greater than 25m.

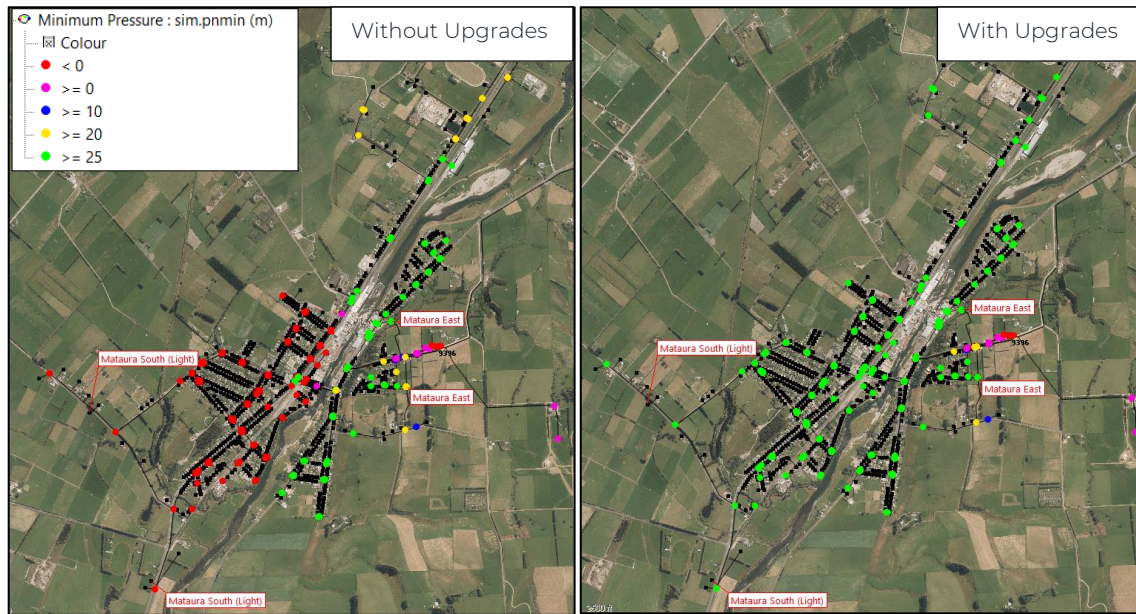


Figure 6-2: Pressures in the Matura Network with and without Upgrades

6.5.1.2 Headlosses

Without the upgrades the network does not have the capacity to cater for the developments. The upgrades reduce the headlosses in the pipelines servicing the developments and throughout the network.

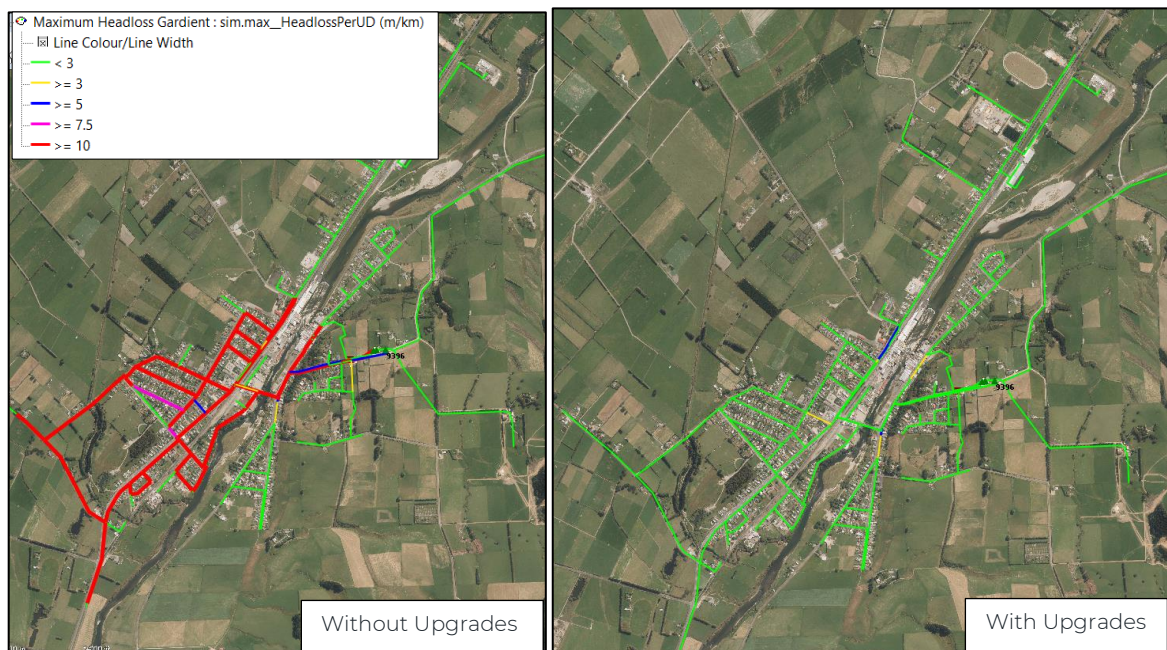


Figure 6-3: Headlosses in the Matura Network with and without Upgrades

6.5.1.3 Velocities

With the upgrades in place all velocities are reduced to below 1.5 m/s. There is an increase in velocities along SH93 from Doctors Road to Kana St compared to the current model. However, these are still less than 1.5 m/s.



7 Conclusions and Recommendations

In summary, pipe upgrades will be required for both Maitava and Gore to service the future developments. Potential upgrades to service the developments in the Gore Network are outlined in the tables below.

Table 7-1: Gore Upgrades Required to Service the Developments

Development	Location	Size	Length
Gore West North	Start of Reaby Rd	DN 180 (ID: 151.2 mm)	157 m
	Hilbre Pump Station to Broughton St/Crewe St Intersection	DN 250 (ID: 212.3 mm)	420 m
Gore West	Hilbre Pump station along Elizabeth Street to Coutts Road	DN 250 (ID: 212.3 mm)	3.1 km
Gore South (Heavy)	Hilbre Ave Reservoir to the Gore South Development	DN 450 (ID: 382.3 mm)	5.1 km
Gore South (Light)	Hilbre Ave Reservoir to the Gore South Development	DN 355 (ID: 301.6 mm)	5.1 km

Table 7-2: Maitava Upgrades Required to Service the Developments

Development	Location	Size	Length
Maitava East	Maitava Reservoir to the south side of the development	DN 250 (ID: 212.3 mm)	278 m
Maitava South (Heavy)	Burton Road	DN 125 (ID: 106.1 mm)	611 m
	Maitava Reservoir to the Maitava South Development	Greater than DN 450 (ID: 382.3 mm)	3.8 km
Maitava South (Light)	Burton Road	DN 125 (ID: 106.1 mm)	611 m
	Maitava Reservoir to the Maitava South Development	DN 355 (ID: 301.6 mm)	3.8 km



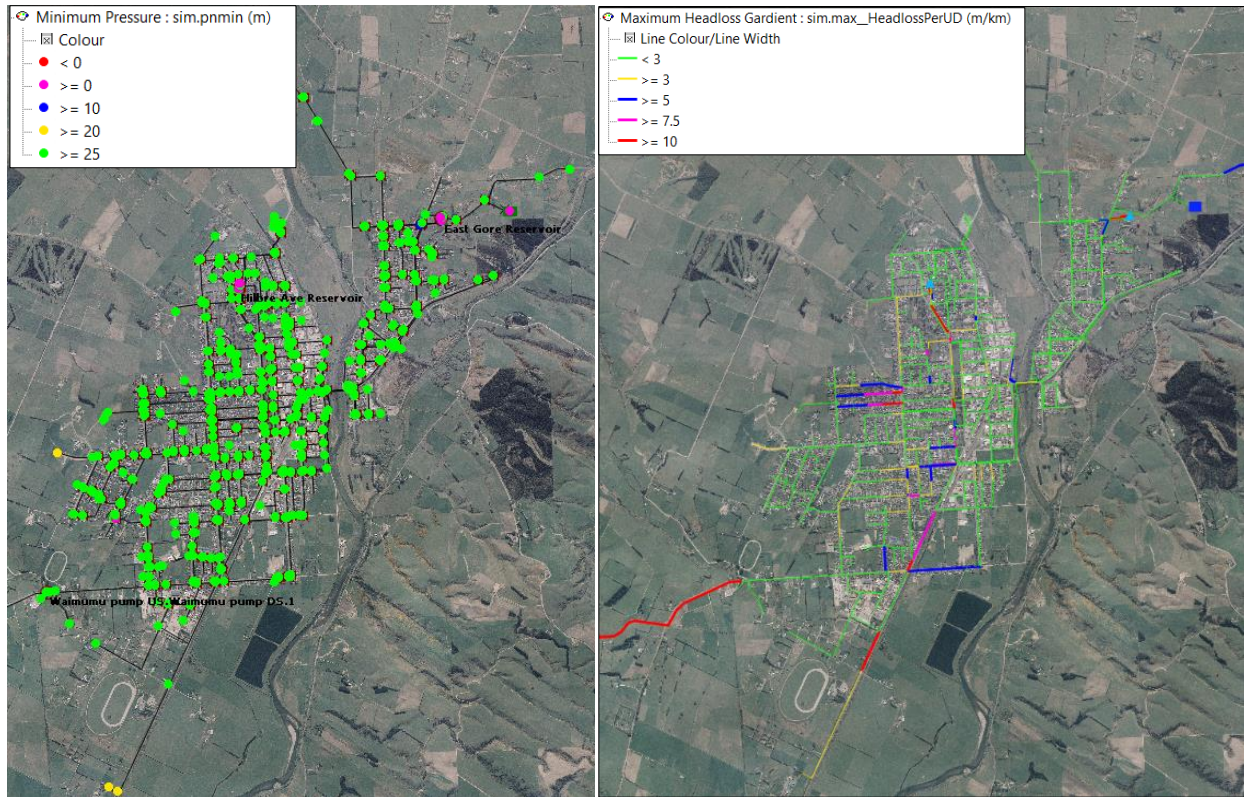
We recommend:

- Optimising the recommended pipe upgrades for both networks.
- Checking the additional demand added by the development does not result in the network exceeding the bore consent.
- A source treatment capacity assessment is carried out to confirm the availability of supply to meet the development demands.
- Reviewing and confirming whether the commercial demand is light or heavy.
- Models were last updated and calibrated in 2011. The models are likely to be missing upgrades and increased population post 2011, which may influence demand in the network. We recommend carrying out a full model update and calibration to increase the confidence of the results.
- Assess the commercial developments with FW3 as part of a wider fire flow study for the Gore and Mataura townships.
- GDC to carry out a water and wastewater Master Plan to look at investment approaches to service growth including current/future Level of Service, resilience, risk e.t.c.

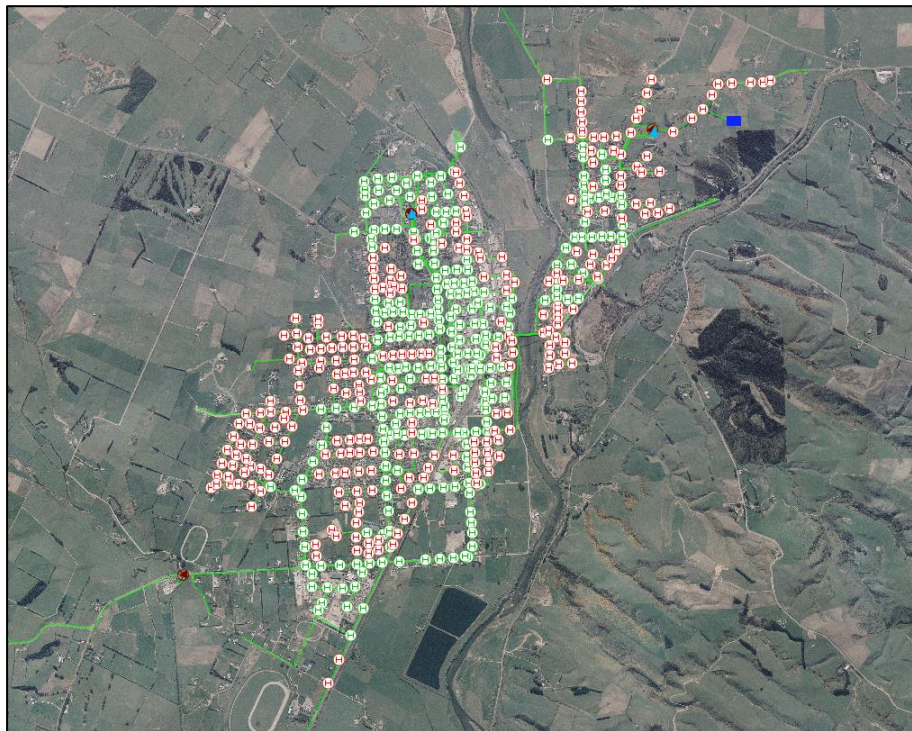
Appendix A

Gore Modelling Results

Current Network Level of Service:

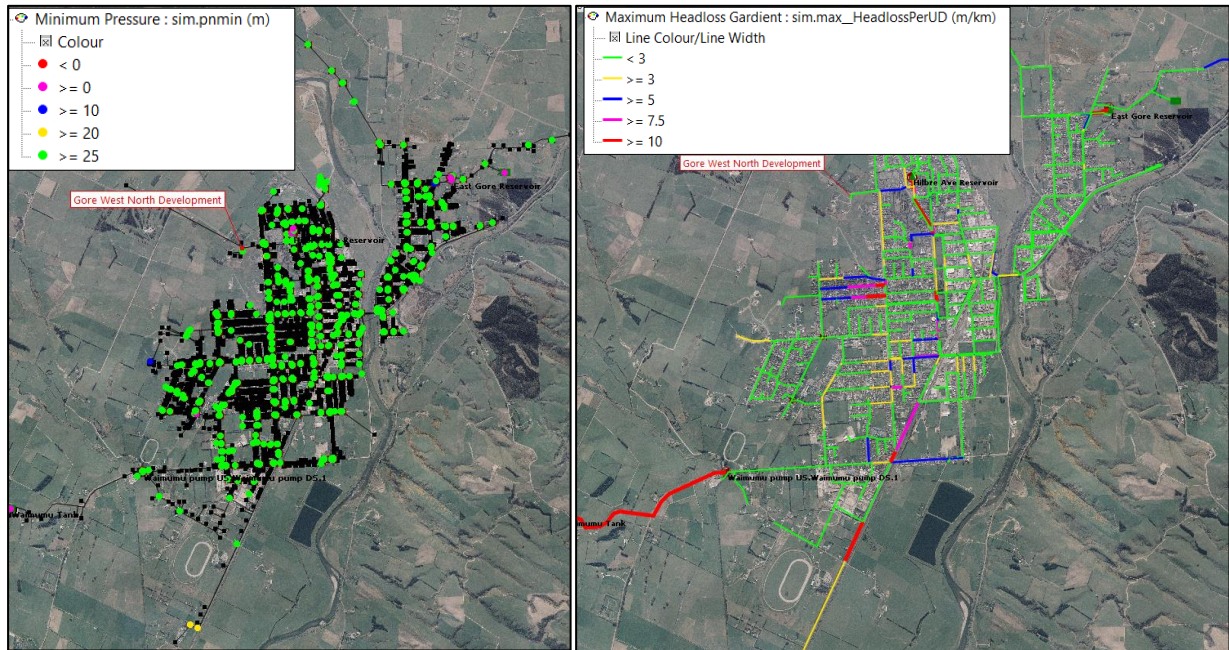


Current Network Constraints – Minimum Pressures (Left) and Headlosses (Right)

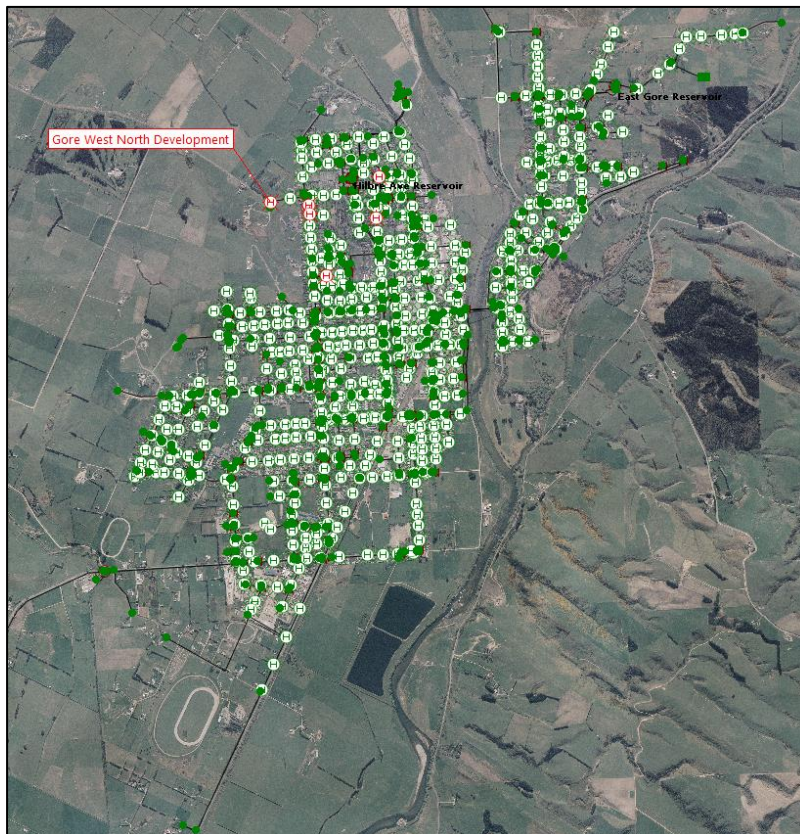


Hydrants that currently do not FW2 fire flow requirements in the Existing Model (Red)

Gore West North Development



Gore West North Constraints – Minimum Pressures (Left) and Headlosses (Right)

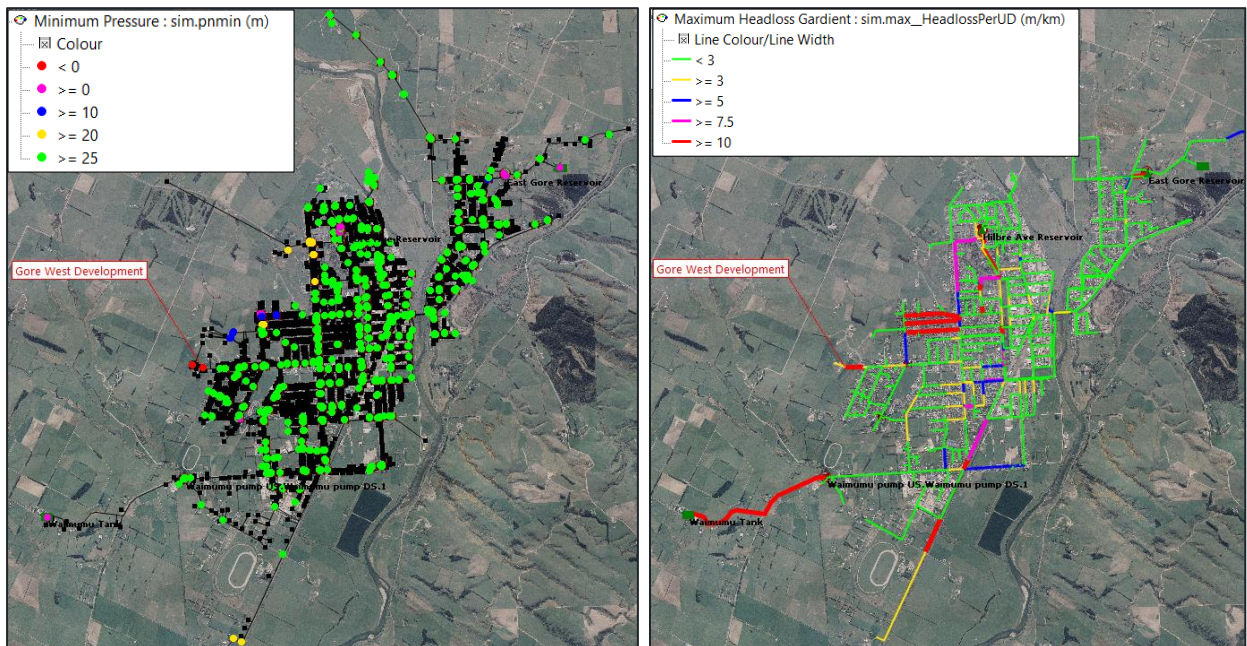


Additional Hydrants that Fail (Red) in the network with Gore West North

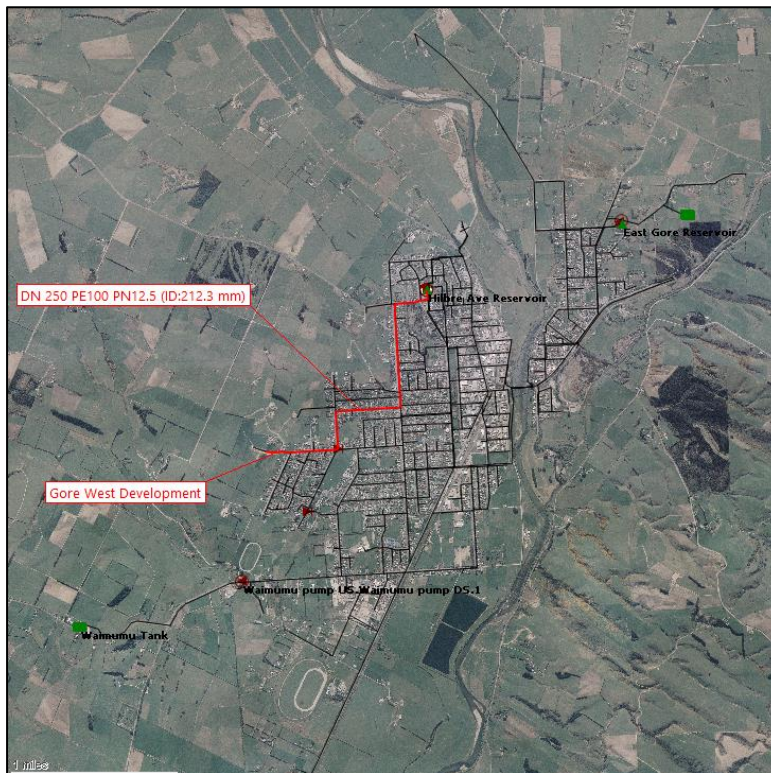


Upgrades Required to service the Gore West North Development

Gore West Development Level of Service:

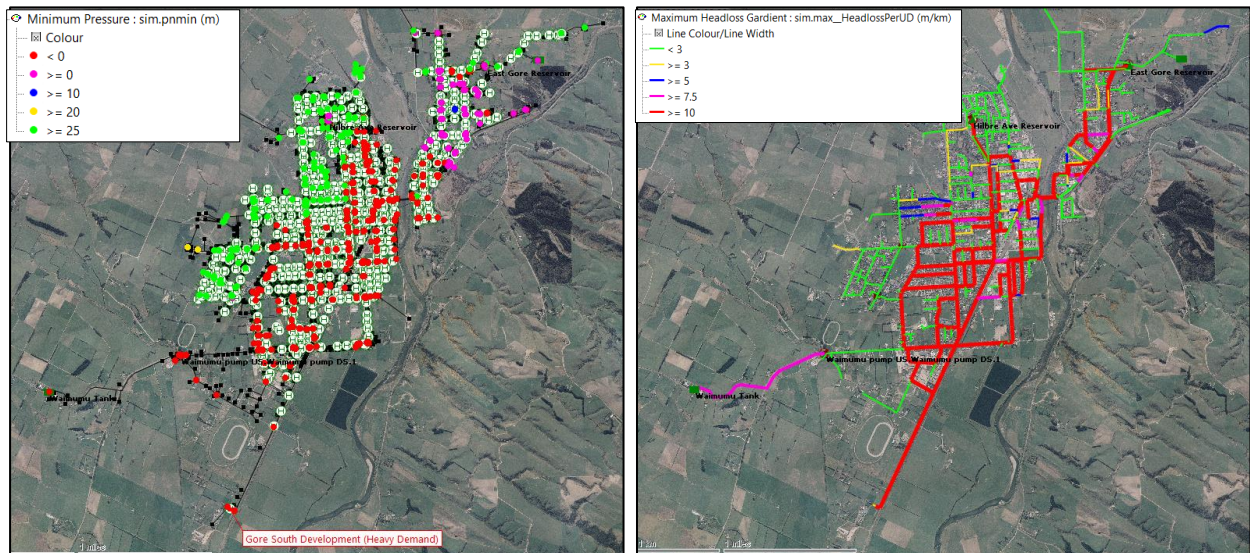


Gore West Constraints – Minimum Pressures (Left) and Headlosses (Right)

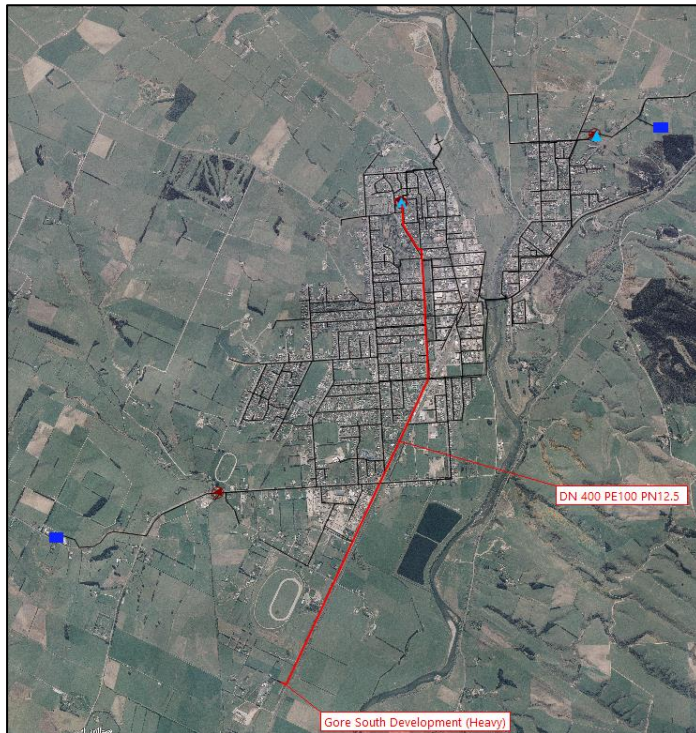


Upgrades Required to service the Gore West Development

Gore South Development (Heavy Commercial Demand) Level of Service

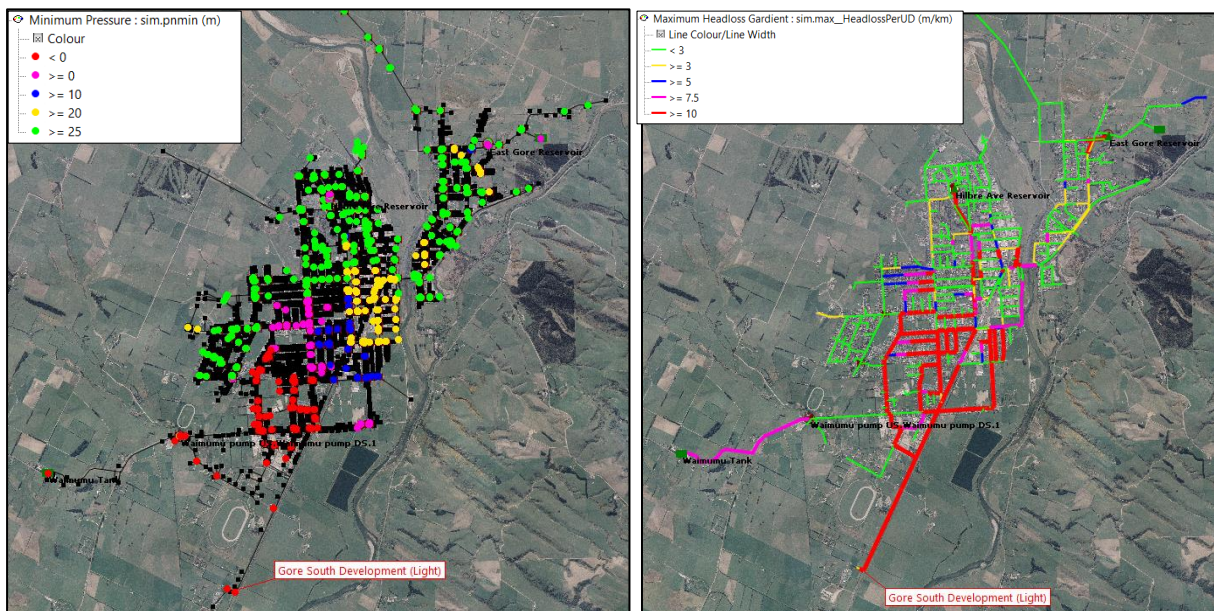


Gore South (Heavy Commercial) Constraints – Minimum Pressures (Left) and Headlosses (Right)



Upgrades Required to service the Gore South Development (Heavy)

Gore South Development (Light Commercial Demand) Level of Service

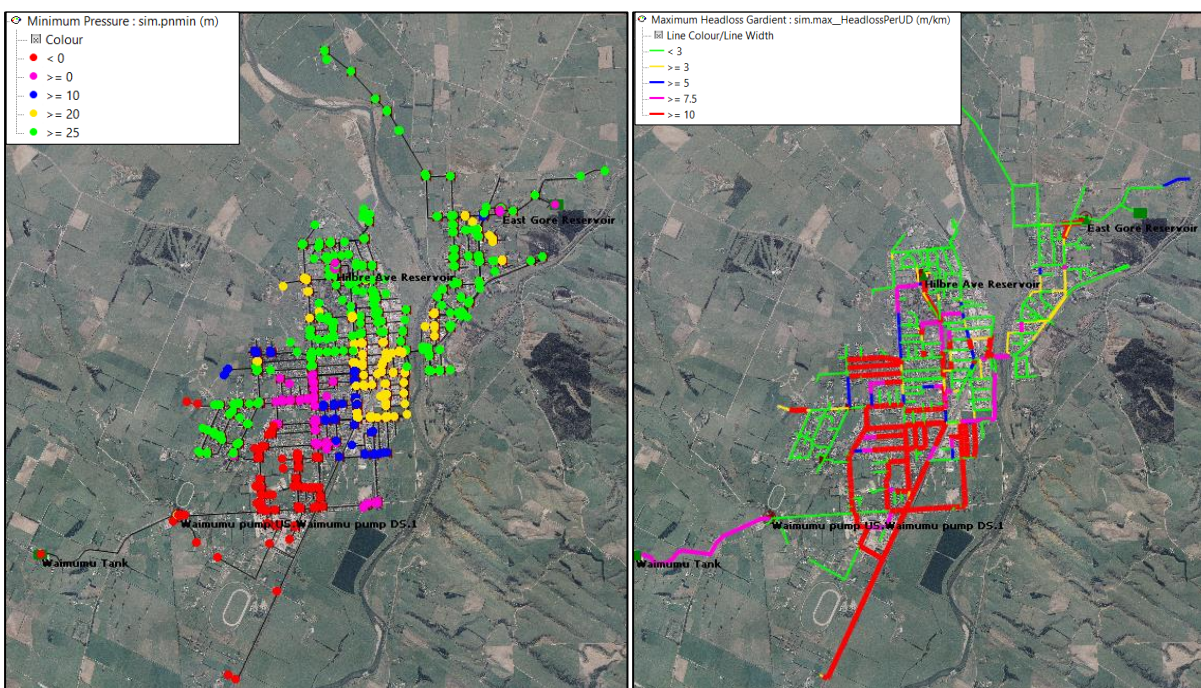


All developments (Light Commercial) – Minimum Pressures (Left) and Headlosses (Right)



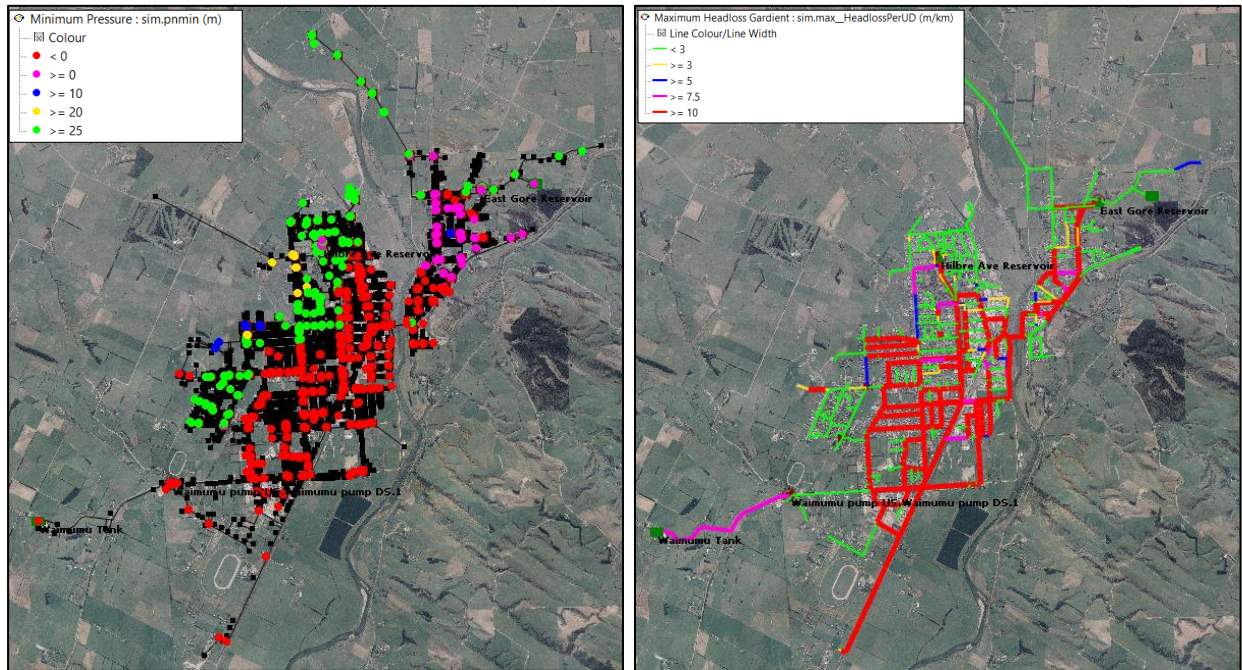
Upgrades Required to service the Gore South Development (Light)

All Developments (Light Commercial Demand) Level of Service



All developments (Light Commercial) – Minimum Pressures (Left) and Headlosses (Right)

All Developments (Heavy Commercial Demand) Level of Service



All developments (Heavy Commercial) – Minimum Pressures (Left) and Headlosses (Right)

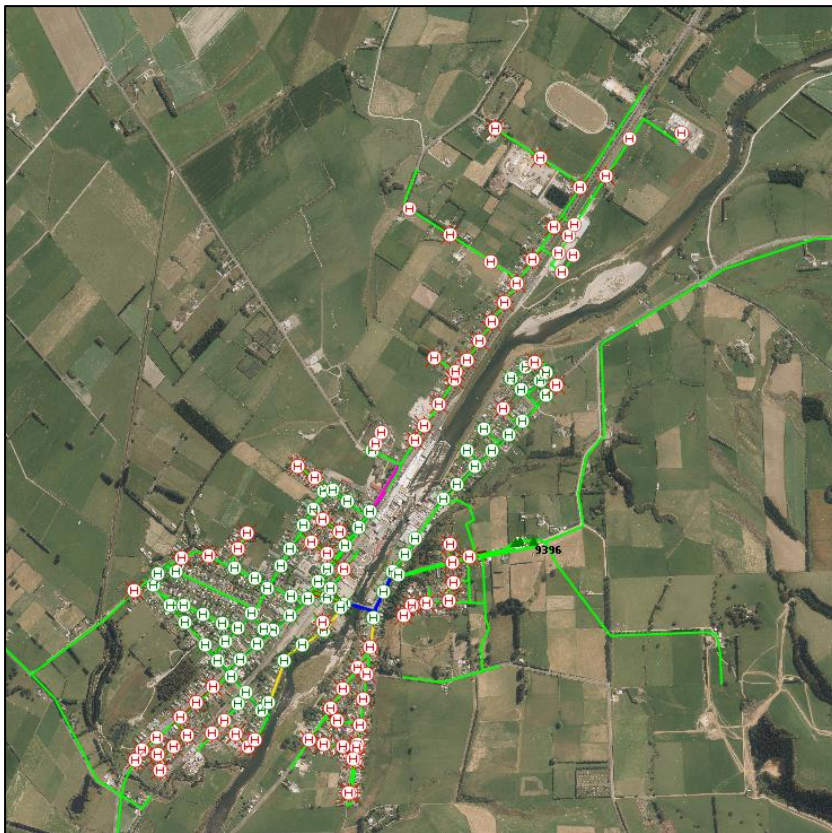
Appendix B

Mataura Modelling Results

Existing Network Level of Service

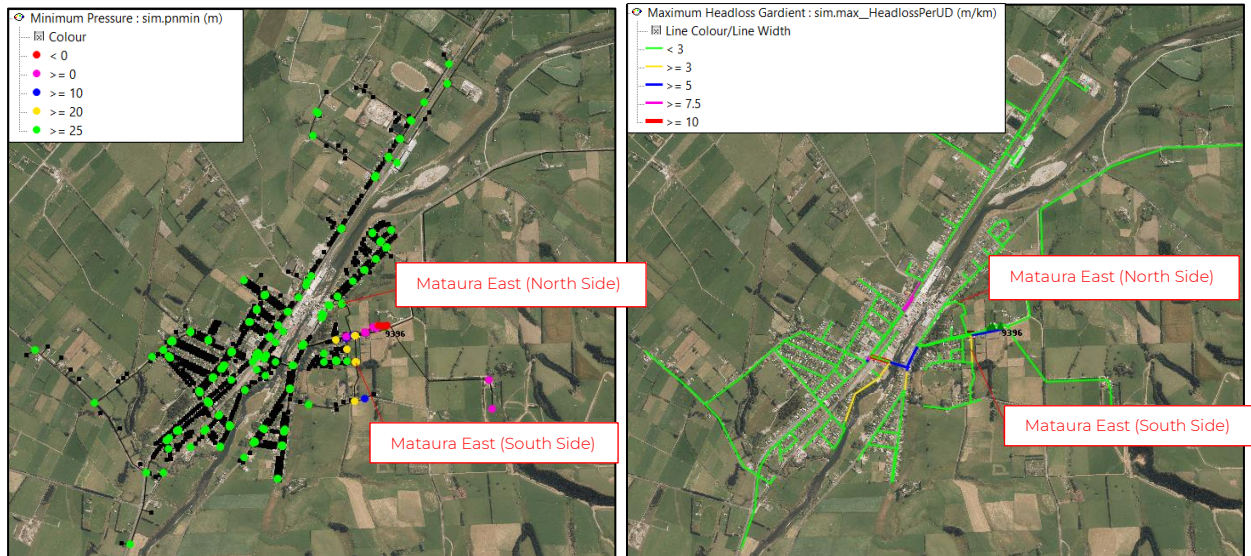


Current Network Constraints – Minimum Pressures (Left) and Headlosses (Right)



Hydrants that currently do not FW2 fire flow requirements in the Existing Model (Red)

Mataura East Level of Service



Mataura East – Minimum Pressures (Left) and Headlosses (Right)

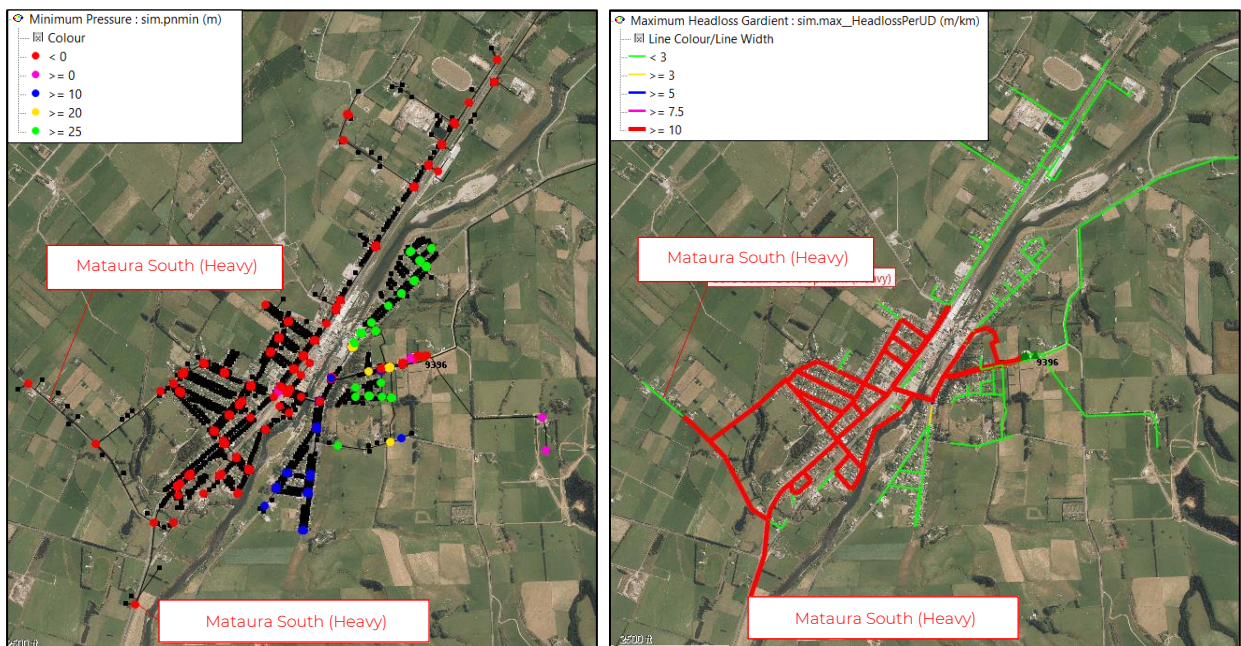


Additional Hydrants that Fail (Red) in the network with Mataura East

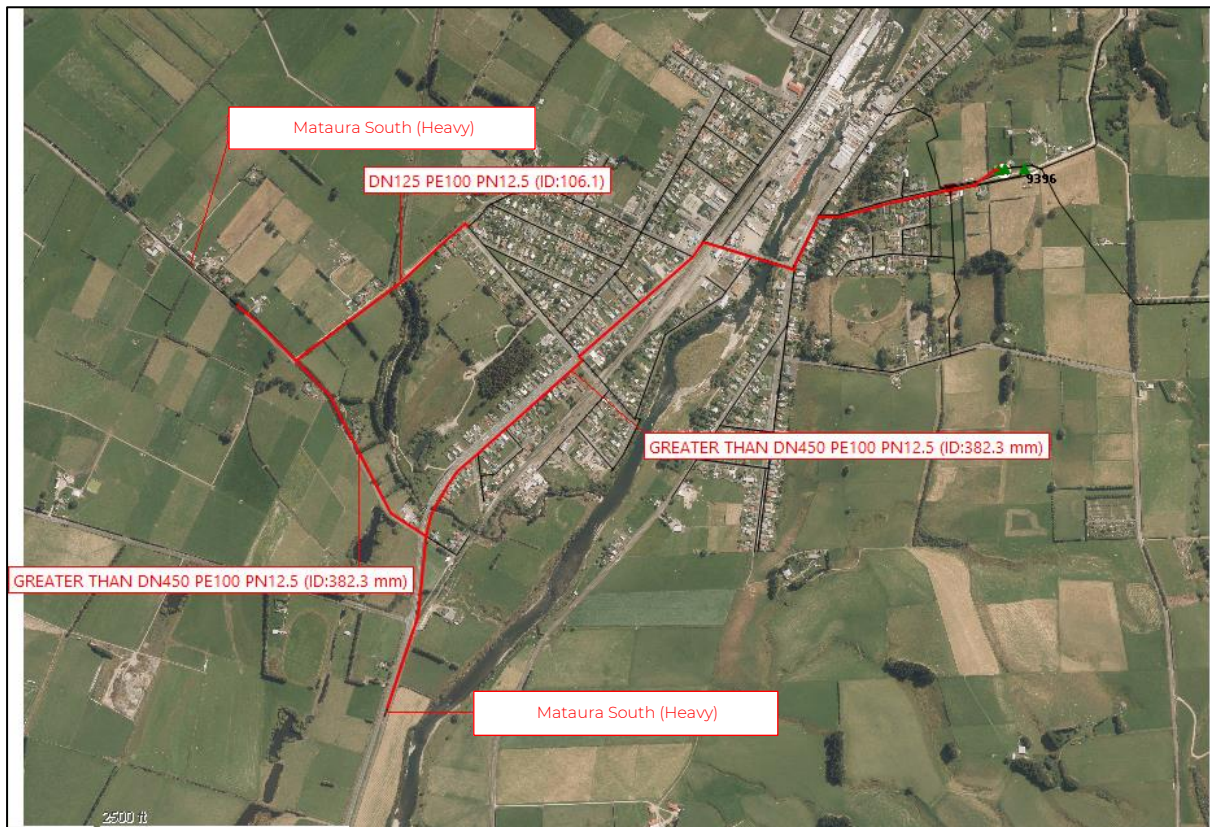


Upgrades Required to service the Matura East Network

Matura South Heavy Commercial Demand Level of Service:

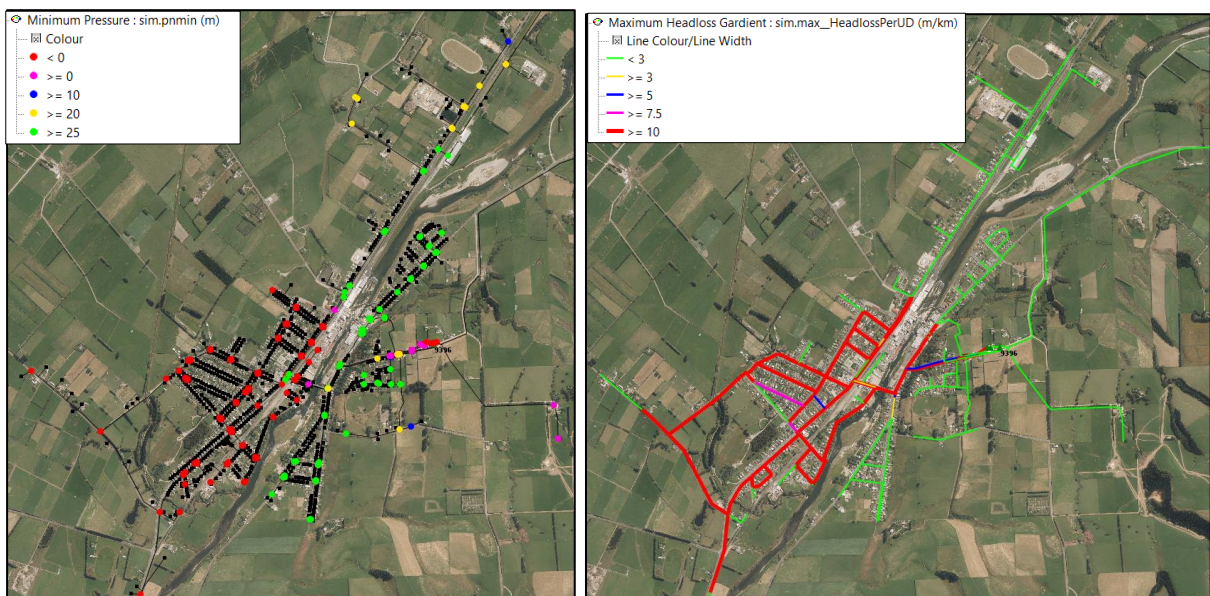


Matura South (Heavy Commercial Demand) – Minimum Pressures (Left) and Headlosses (Right)



Upgrades Required to service the Matura South Network (Heavy Demand)

Matura South Light Commercial Demand Level of Service:



Matura South (Light Commercial Demand) – Minimum Pressures (Left) and Headlosses (Right)



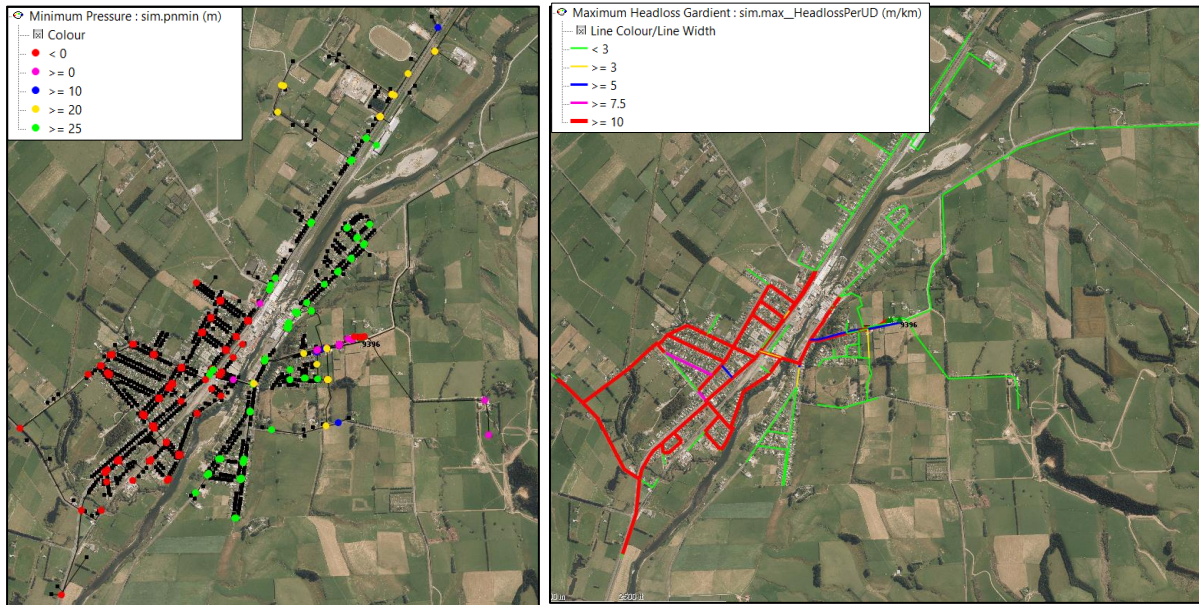
Upgrades Required to service the Matura South Network (Light Demand)

Combined Developments Heavy Commercial Demand Level of Service:



Combined Developments (Heavy Commercial Demand) – Minimum Pressures (Left) and Headlosses

Combined Developments Light Commercial Demand Level of Service:



Combined Developments (Light Commercial Demand) – Minimum Pressures (Left) and Headlosses

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