# Nukuhau Structure Plan Development

## Desktop Study - Water and Wastewater

8 July 2020

CONFIDENTIAL

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## Document History and Status

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### *Revision Details*

| Revision | Details |
|---|---|
| 00 | Incorporate Wastewater modelling report – changes in Section 6.2, 7.3 and 8 |
| 01 | Revised report to reflect latest houses/lots – change from 736 No to 800 No. |
| 02 | Revised Section 5.2 Water Infrastructure- and Appendix B1 (and Appendix B2) |

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# Disclaimers and Limitations

This desktop study has been prepared by WSP exclusively for the Nukuhau Structure Plan development. The information for the water and wastewater modelling is based on the Taupo District Council (TDC) records and on information and recommendations made by TDC. The findings in this Report are based on and are subject to the assumptions specified in the Report and 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.

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# 1 Introduction & Purpose

This desktop study reports on the bulk water and wastewater of the planned Nukuhau Structure Plan development. The purpose of this report is to outline the water demands and wastewater design flows as calculated according to TDC Code of Practice (2009), outline the impact of the development on the bulk infrastructure of the water and wastewater networks, and provide high level costing.

# 2 Locality

The Nukuhau Structure Plan Development is located north of the town, Taupō, and falls within the Taupō District Council (TDC) jurisdiction area. The development consists of six (6) portions and are located on private and/or open areas. The locality of the planned development can be viewed in Figure 1 below.

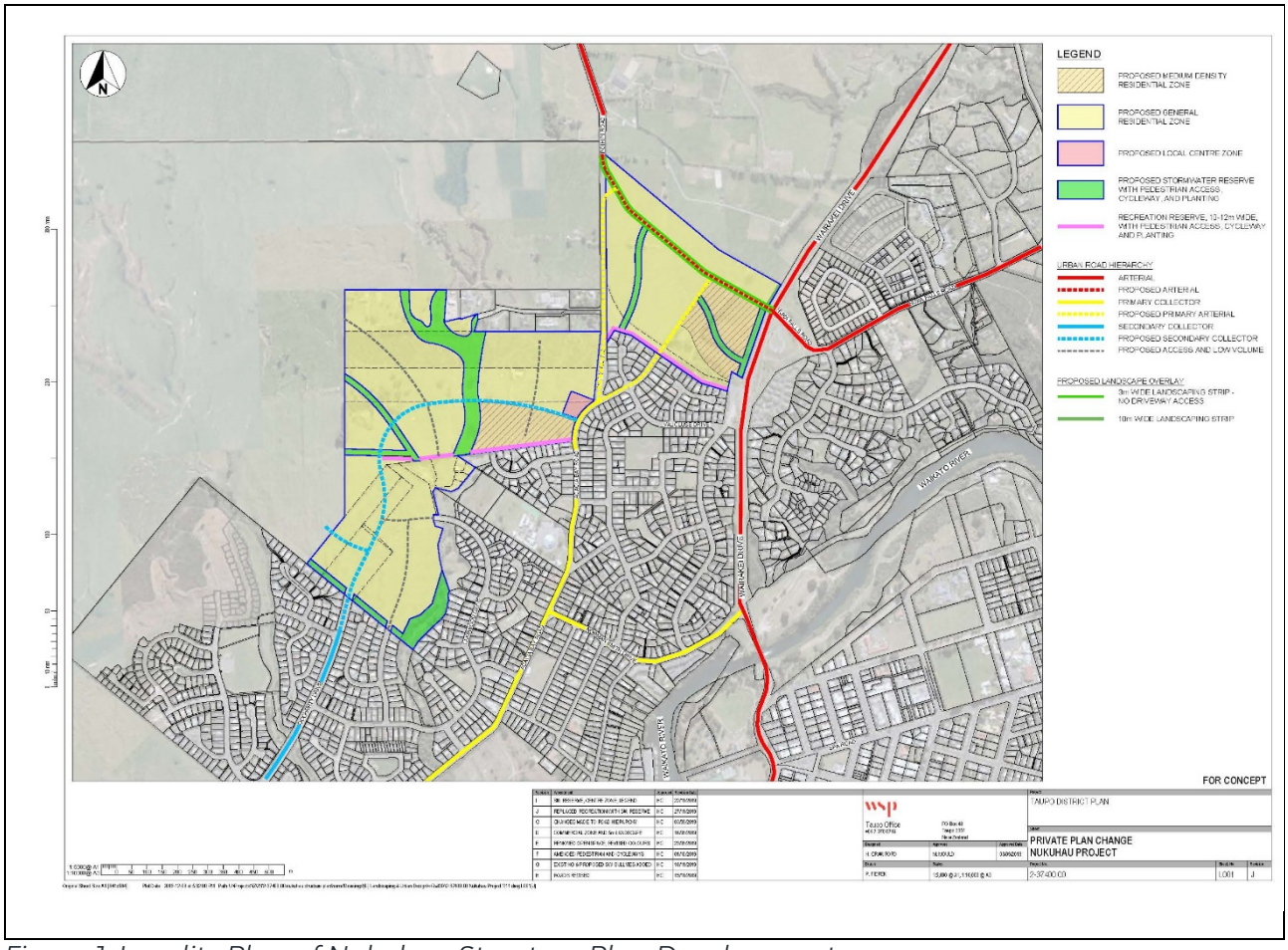


*Figure 1: Locality Plan of Nukuhau Structure Plan Development.*

# 3 Land usage

The Nukuhau Structure Plan Development is planned as residential development. The table below Table 1 shows the various portions and the planned number of Household Unit Equivalent (HUE)/Lots per portion.

*Table 1: Planned Development Land Usage.*

| Development Portion | Estimated Lots (HUE) |
|---|---|
| Portion 1 | 93 |
| Portion 2 | 149 |
| Portion 3 & 4 | 239 |
| Portion 5 | 151 |
| Portion 6 | 168 |
| **Total** | 800 |

# 4 Flow calculations

## 4.1 Water Demand Calculation

All demand calculations are based on Clause 6.11.5 of the TDC Code of Practice for Land Development 2009.

### *4.1.1 TDC Code of Practice Parameters*

TDC guideline parameters for the water demand of residential areas indicates that the water demand must be the worst case between Scenarios *Peak Domestic Demand* and/or *Combined Fire and Domestic Demand*

*Peak Domestic Demand parameters*

- Allowance of 400 litres/person/day;
- 2.69 persons/HEU;
- Allowance of 400 litres/day/HEU for irrigation;
- Peak factor of 5;
- The domestic demand must not be less than Peak Annual Demand (l/s) defined in ***Appendix K of the SNZ PAS 4509: 2008 New Zealand Fire Service Firefighting Water Supplies Code of Practice.***

*Combined Fire and Domestic Demand*

- Fire flow required by Tables 1 and 2 of SNZ PAS 4509:2008 New Zealand Fire Service Firefighting Water Supplies Code of Practice.;
- Two thirds of the Peak Domestic Demand.

### *4.1.2 Development Water Demand*

The water demand for each development was calculated and based on the TDC guideline parameters. The calculations of the water demand for each portion can be viewed in ***Appendix A*** of this document. The water demand of each portion can be viewed below in Table 2. The table shows the development portion, the amount of HUE in that portion and then the calculated water demand, respectively.

*Table 2: Development Water Demand.*

| Development Portion | Estimated HUE | 2/3 x Domestic Demand | Fire Flow | Total Water Demand |
|---|---|---|---|---|
| Portion 1 | 93 | 7.0 l/s | 12.5 l/s | 19.5 l/s |
| Portion 2 | 149 | 9.4 l/s | 12.5 l/s | 21.9 l/s |
| Portion 3 & 4 | 239 | 13.7 l/s | 12.5 l/s | 26.1 l/s |
| Portion 5 | 151 | 9.5 l/s | 12.5 l/s | 22 l/s |
| Portion 6 | 168 | 10.1 l/s | 12.5 l/s | 22.6 l/s |

## 4.2 Wastewater Design Flow Calculation

All wastewater design flow calculations are based on Clause 5.3.5.1 of the TDC Code of Practice for Land Development 2009.

### *4.2.1 TDC Code of Practice Parameters*

Residential flow

- Average dry weather flow (ADWF) of 250 litres/day/person;
- Diurnal peaking factor (PF) of 2.3;
- Wet weather infiltration factor (WWIF) of 3.5;

### *4.2.2 Development Wastewater Design Flow*

The calculations of the design flows for each portion can be viewed in ***Appendix A*** of this document. The wastewater design flow of each portion can be viewed below in Table 3. The table shows the development portion, the amount of HUE in that portion and then the calculated design flow respectively, according to the Code of Practice and five (5) times the Average Dry Weather Flow.

*Table 3: Development Wastewater Design Flows*

| Development Portion | Estimated HUE | Wastewater Design Flows (Code of Practice TDC) | 5 x ADWF |
|---|---|---|---|
| Portion 1 | 93 | 5.8 l/s | 3.6 l/s |
| Portion 2 | 149 | 9.4 l/s | 5.8 l/s |
| Portion 3 & 4 | 239 | 15.0 l/s | 9.3 l/s |
| Portion 5 | 151 | 9.5 l/s | 5.9 l/s |
| Portion 6 | 168 | 10.6 l/s | 6.6 l/s |

# 5 Water infrastructure

## 5.1 Existing Water Network

The planned development area is bordered by the existing water network. The planned development area is located within the two water network zones – the Taupō West Zone and the Taupō Nukuhau Zone. Portion 6 falls within the Taupō Nukuhau Zone and is serviced by Nukuhau Pump Station. Portions 1 to 5 falls within the Taupō West Zone and are serviced by Woodward Pump Station. Figure 2 below, shows the extent of the existing water network and the location of the water pump stations.

The existing water network from the pump stations consist of 50 mm, 100 mm and 150 mm diameter pipelines and are mainly AC and uPVC pipelines.

## 5.2 Proposed Water Network Upgrades

An investigation into the existing network was undertaken by WSP to check how the planned development/s water demand can be accommodated within the existing bulk infrastructure of the Council, and if any upgrades of the existing water network are required. The investigation report can be viewed in ***Appendix B1*** with an additional reservoir memo in Appendix B2. The 2019 Infoworks WS Pro hydraulic model was used in the completed Taupō to Acacia Bay connection concept design study. The model was set up to investigate the current 2020, and future demand scenarios for 2025, 2035 and 2050.

The assessment and modelling were based on all the portions being developed simultaneously.

The assessment modelling results indicates that;

Nukuhau Structure Plan development has an impact on the existing water infrastructure network. The works that need to be upgraded are the following;

- Woodward pump station upgrades (full extent to be scoped with the further design phases – non project related investigation indicated extensive electrical upgrades required). The electrical upgrade works identified were the transformer, switch board/s, generator, telemetry.
- Upgrading of water pipe network along from Woodward pump station all along;
  I. Sections of Woodward street,
  II. Vaucluse Drive.
  III. Sections of Acacia Bay road.
  IV. Herapeka street, and
  V. Waitene Lane


*Figure 2: Existing Water Network.*

*Table 4: Existing Water Network Sections - Upgrade Requirements.*

| Pipe Type | Year | Diameter (mm) | Asset ID | Length (m) | Current Condition According to TDC GIS | Proposed Upgrade Diameter |
|---|---|---|---|---|---|---|
| uPVC | 2001 | 50 | WMN01853 | 246 | Good | 150 |
| uPVC | 2001 | 50 | WMN09914 | 17 | Good | 150 |
| uPVC | 2001 | 50 | WMN14267 | 30 | Good | 150 |
| uPVC | 2001 | 50 | WMN02577 | 2 | Good | 150 |
| uPVC | 2000 | 150 | WMN02140 | 66 | Good | 200 |
| uPVC | 2000 | 150 | WMN02208 | 14 | Good | 200 |
| uPVC | 2000 | 150 | WMN02345 | 15 | Good | 200 |
| uPVC | 2000 | 100 | WMN02649 | 23 | Good | 150 |
| uPVC | 2000 | 100 | WMN01998 | 11 | Good | 150 |
| uPVC | 2000 | 100 | WMN02341 | 70 | Good | 150 |
| uPVC | 1999 | 100 | WMN12366 | 28 | Good | 150 |
| uPVC | 2000 | 150 | WMN02752 | 31 | Good | 200 |
| uPVC | 2000 | 150 | WMN02570 | 44 | Good | 200 |
| uPVC | 2000 | 150 | WMN02494 | 18 | Good | 200 |
| uPVC | 2000 | 150 | WMN02273 | 8 | Good | 200 |
| uPVC | 2000 | 150 | WMN12247 | 1 | Good | 200 |
| uPVC | 2000 | 150 | WMN02720 | 58 | Good | 200 |
| uPVC | 2000 | 150 | WMN01815 | 55 | Good | 200 |
| uPVC | 2000 | 150 | WMN02177 | 30 | Good | 200 |
| uPVC | 2000 | 150 | WMN02343 | 59 | Good | 200 |
| uPVC | 2000 | 150 | WMN12659 | 43 | Good | 200 |
| uPVC | 2000 | 150 | WMN14252 | 3 | Good | 200 |
| uPVC | 2000 | 150 | WMN14303 | 14 | Good | 200 |
| uPVC | 2000 | 150 | WMN14237 | 7 | Good | 200 |
| uPVC | 2000 | 150 | WMN02708 | 23 | Good | 200 |
| AC | 1970 | 150 | WMN02276 | 2 | Poor | 200 |
| uPVC | 2000 | 150 | WMN02762 | 1 | Good | 200 |
| AC | 1970 | 150 | WMN01868 | 19 | Poor | 200 |
| AC | 1970 | 150 | WMN02830 | 62 | Poor | 200 |
| AC | 1970 | 150 | WMN02589 | 2 | Poor | 200 |
| AC | 1970 | 150 | WMN02888 | 32 | Poor | 200 |
| AC | 1970 | 150 | WMN02339 | 60 | Poor | 200 |
| AC | 1970 | 150 | WMN12488 | 6 | Poor | 200 |
| AC | 1970 | 150 | WMN02562 | 12 | Poor | 200 |
| AC | 1970 | 150 | WMN02500 | 53 | Poor | 200 |
| AC | 1970 | 150 | WMN02906 | 48 | Poor | 200 |
| AC | 1970 | 150 | WMN02607 | 3 | Poor | 200 |
| AC | 1970 | 150 | WMN12330 | 2 | Poor | 200 |
| uPVC | 1996 | 100 | WMN02116 | 9 | Excellent | 150 |
| uPVC | 1996 | 100 | WMN02998 | 61 | Excellent | 150 |

| | | | | | | |
|---|---|---|---|---|---|---|
| uPVC | 1996 | 100 | WMN03012 | 54 | Excellent | 150 |
| uPVC | 1996 | 100 | WMN01818 | 4 | Excellent | 150 |
| uPVC | 1996 | 100 | WMN02433 | 2 | Excellent | 150 |
| uPVC | 1996 | 100 | WMN02467 | 27 | Excellent | 150 |
| uPVC | 2006 | 100 | WAMN1275 | 31 | Excellent | 150 |
| uPVC | 2006 | 100 | WMN12650 | 41 | Excellent | 150 |
| uPVC | 2006 | 100 | WAMN1286 | 59 | Excellent | 150 |
| uPVC | 2006 | 100 | WAMN1284 | 32 | Excellent | 150 |
| uPVC | 2006 | 100 | WMN12043 | 3 | Excellent | 150 |

The table above indicates the type of pipe, year of installation, existing pipe diameter, TDC asset ID number, the approximate length of section, the current condition according to TDC GIS information and the proposed new pipe diameter for that section.


*Figure 3: Illustration of the Proposed Water Upgrades*

Figure 3 above illustrates the water upgrades required, the 'red' line is the proposed 150 mm (ID) upgrades and the 'green' line is the proposed 200 mm (ID) upgrades. The total length of upgrades required are the following;

- 150 mm diameter approximate length is 860 m,
- 200 mm diameter approximate length is 800 m.

The figure also indicates the location of the Woodward pump station.

According to the assessment it would be ideal if each of the portions can have two connection points to the water main network. In the Long-Term Plan of TDC a new reservoir is planned to be built near Poihipi Road that will service the areas by gravity, this is scheduled for years 2024/26.

# 6 Wastewater Infrastructure

## 6.1 Existing Wastewater Network

The area surrounding the planned development land, is serviced by an existing gravity wastewater network that flows across the floodgate crossing the Waikato River and runs towards the Wastewater Treatment works. This network can be viewed below in Figure 4.


*Figure 4: Existing Wastewater Network*

## 6.2 Proposed Wastewater Network Upgrades

CDM Consultants LTD were tasked with the wastewater modelling of the new wastewater flows into the existing TDC wastewater network. The assessment was undertaken to check if the new development can be accommodated within the existing network. The full report can be viewed in ***Appendix C.*** In terms of the condition of the existing network this was not investigated and cannot be commented on. Just before reporting on the assessments, plan portions 1, 2, 5 and 6 have some watershed constraints on site. The water shedding will have an impact on a potential gravity network system of each development portion. We haven't looked or investigated any internal wastewater network of the proposed development. For this desktop study potential connection points have been identified.

**The major concern is that crossing of the wastewater (from the west) over the Waikato River crossing, and along Tongariro Street, will not be sufficient and are a hydraulic constraint. There is currently a planned upgrade of these works schedule for 2021, but the Nukuhau Structure Plan development flows have not been included. TDC will need take in account this development when these design works are undertaken**.

From the assessment report, for portions 3 & 4, the assessment shows that the existing wastewater network has sufficient capacity (up to a point of the Waikato River crossing upstream manhole/s) to accommodate the proposed development flow of ***9.3 l/s***. This route can be viewed in Figure 5. The potential manhole connection point for the development is existing wastewater manhole SAGMH1469 in Figure 5. The long section of the line is within the CDM report as Long section 2.

From the assessment report, for portion 5, the assessment shows that the existing wastewater network has sufficient capacity (up to a point of the Waikato River crossing upstream manhole/s) to accommodate the proposed development flow of ***5.9 l/s***. This route can be viewed in Figure 6. The potential manhole connection point for the development is existing wastewater point SAGND0001 in Figure 7. The long section of the line is within the CDM report as Long section 1.

From the assessment report, for portions 1 & 2, the assessment shows that the existing wastewater network has limited capacity to accommodate the proposed development flow of ***8.6 l/s.*** There is a 311 m section that requires further investigation. This route can be viewed in Figure 7. The potential manhole connection point for the development is existing wastewater point SAGMH1495 in Figure 7. The further investigation could lead to potential upgrade of the lines in diameter size, of which the full impact is not known as the downstream pipes are also 150 mm diameter pipes. The long section is within the CDM report as Long section 4.

From the assessment report, for portion 6, the assessment shows that the existing wastewater network has limited capacity to accommodate the proposed development flow of ***6.6 l/s.*** There is a 781 m section that requires further investigation and mitigation work. This route can be viewed in Figure 8. The potential manhole connection point for the development is existing wastewater point SAGMH1480 and node SANND0280 in Figure 8. The further investigation could lead to potential upgrade of the lines in diameter size, of which the full impact is not known as various diameter pipes are affected. The long section is within the CDM report as Long section 3.

From the above there is an impact on the existing wastewater network of which sections could potentially require upgrade work. In terms of the condition of the existing network this was not investigated and cannot be commented on. An alternative to potential upgrades of the existing wastewater network, is a possibility of installing a new wastewater line (total length of approximately 1500 m) all the way of the development portions 1, 2 and 6 if the upgrades proof vast of the existing network. This must be further investigated as concept shows some level constraints on the vertical alignment. The upgrade at the river crossing is required for all portions.

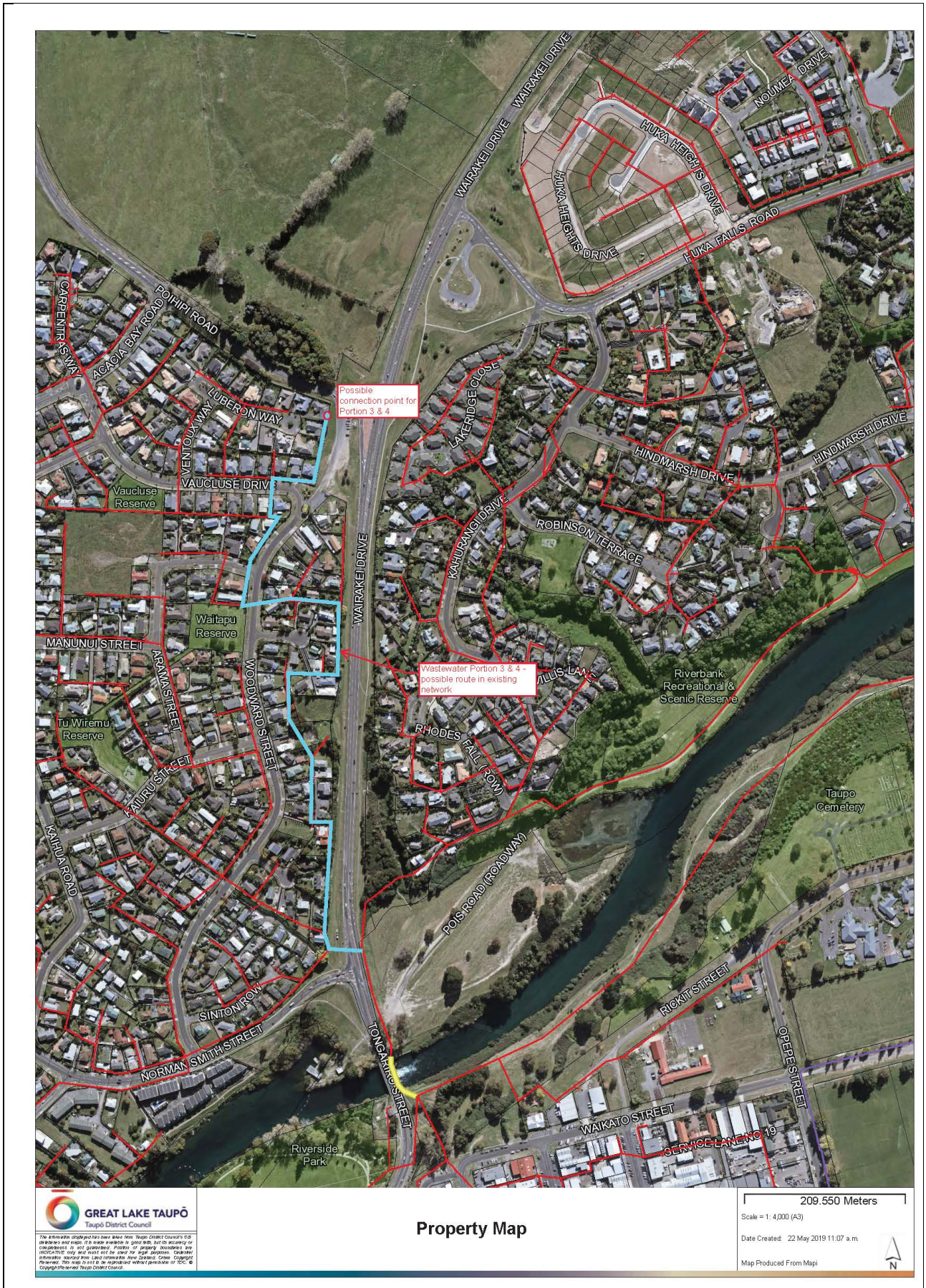


*Figure 5: Portions 3 & 4 Potential Wastewater route in the existing network.*


*Figure 6: Portion 5 Potential Wastewater route in the existing network*


*Figure 7: Portions 1 & 2 Potential Wastewater route in the existing network*


*Figure 8: Portion 6 Potential Wastewater route in the existing network*

# 7 Costing

## 7.1 Development Contributions

Using Table 10, in the TDC Development Contributions Policy 2018, potential development contributions for the water and wastewater of the Nukuhau Structure Plan Development are set out in Table 5 below.

*Table 5: Nukuhau Structure Plan Development Contributions*

| Development Contribution Area | Water Contribution (per HUE) excl GST | Wastewater Contribution (per HUE) excl GST |
|---|---|---|
| *Reference:*<br><br>*Taupō Town* | $5,360.00 | $7,446.00 |
| | Total Water Development Contribution Per Portion<br><br>NZD ($) | Total Wastewater Development Contribution Per Portion<br><br>NZD ($) |
| Portion 1 | 498,480.00 | 692,478.00 |
| Portion 2 | 798,640.00 | 1,109,454.00 |
| Portions 3 & 4 | 1,281,040.00 | 1,779,594.00 |

| | | |
|---|---|---|
| Portion 5 | 809,360.00 | 1,124,346.00 |
| Portion 6 | 900,480.00 | 1,250,928.00 |

The above is only an indication of potential development contributions and must be finalized in agreement with TDC.

## 7.2 Water Upgrades

A construction cost estimate at this stage for the water upgrades is as follows;

- 150 mm diameter – 860 m @ $325.00/m = $ 301,000
- 200 mm diameter – 800 m @ $ 485.00/m = $ 388,000
- Woodward PS upgrades – lump sum $ 610,000

The full extent of the works will be known once the detailed design has been done, from there the construction estimate will be derived.

## 7.3 Wastewater Upgrades

The extent of upgrades of the existing network is unknown at this stage. The new line construction estimate is as follows;

- 225 mm diameter – 1500 m @ $480.00/m = $720,000

The full extent of the works will be known when the further investigation work is completed, and detail designs are done.

# 8 Recommendations

This report is only a desktop study report and was compiled to check what effect the extents of the proposed Nukuhau Structure Plan Development will have on the existing water and wastewater infrastructure of Taupō District Council. The following recommendations have been made;

- Each portion of the development to be supplied by two or more water supply points.
- The proposed 200 mm and 150 mm watermain upgrades to be approved by TDC. An agreement to be reached with TDC in order to check the potential share of cost to poor conditions of the pipe work.
- The upgrading of Woodward Pump Station.
- The connection of the development to the wastewater network with conditions outlined by TDC.

# Appendix A
# Nukuhau Structure Plan: Water and Wastewater Demand Calculation Sheet

2-37400.00 NUKUHAU STRUCTURE PLAN

WATER AND WASTEWATER DEMAND CALCULATIONS Revision 03

SEPARATE WATER DEMAND Date: 10-Dec-19

| DEVELOPMENT INFORMATION | | | | PEAK DOMESTIC DEMAND - Taupō DISTRICT COUNCIL CODE OF PRACTICE FOR DEVELOPMENT OF LAND CLAUSE 6.11.5 | | | | | | | | | | | | COMBINED FIRE AND DOMESTIC DEMAND | | | WORST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | FIRE FLOW | SNZ PAS 4509:2008 | | | | | |
| PORTION | PARCEL ID | SIZE ($m^2$) | ESTIMATED TOTAL HOUSES/ PLOTS | FLOW A-(FLOW - L/PERSON/DAY) | PERSON/HEU | DEMAND FLOW A - LITRE | FLOW B - IRRIGATION ALLOWANCE L/DAY/HEU | DEMAND FLOW B - LITRE | TOTAL FLOW(DEMAND A + DEMAND B) | PEAK FACTOR | PEAK DEMAND (LITRE) | DEMAND FLOW RATE L/S | $Q_{PEAK}$ | Table 1 | Table 2 | | 2/3 X DOMESTIC DEMAND | TABLE 2 FLOW | TABLE 2 FLOW PLUS 2/3 DOMESTIC (L/S) | WATER DEMAND PER DEVELOPMENT |
| Portion 1 | 4316877 | 90936 | 93 | 400 | 2.69 | 100068 | 400 | 37200 | 137268 | 5 | 686340 | 7.944 | 10.455 | FW2 | 12.5 | | 6.970 | 12.500 | 19.470 | 19.470 |
| Portion 2 | 4563545 | 145540 | 149 | 400 | 2.69 | 160324 | 400 | 59600 | 219924 | 5 | 1099620 | 12.727 | 14.083 | FW2 | 12.5 | | 9.389 | 12.500 | 21.889 | 21.889 |
| Portion 3 & 4 | 6956581 | 336049 | 239 | 400 | 2.69 | 257164 | 400 | 95600 | 352764 | 5 | 1763820 | 20.415 | 18.984 | FW2 | 12.5 | | 13.610 | 12.500 | 26.110 | 26.110 |
| Portion 5 | | 211074 | 151 | 400 | 2.69 | 162476 | 400 | 60400 | 222876 | 5 | 1114380 | 12.898 | 14.202 | FW2 | 12.5 | | 9.468 | 12.500 | 21.968 | 21.968 |
| Portion 6 | | 149845 | 168 | 400 | 2.69 | 180768 | 400 | 67200 | 247968 | 5 | 1239840 | 14.350 | 15.193 | FW2 | 12.5 | | 10.129 | 12.500 | 22.629 | 22.629 |

SEPARATE WASTEWATER DEMAND/DESIGN FLOW

| PORTION | PARCEL ID | SIZE ($m^2$) | ESTIMATED TOTAL HOUSES/ PLOTS | ADWF PARAMETER L/PERSON/DAY | PERSON/HEU | | | Average Dry Weather Flow (ADWF) | | DIURNAL PEAK FACTOR | PEAK (LITRE) | WET WEATHER INFILTRATION FACTOR (WWIF) | TDC Code of Practice DESIGN FLOW (L/S) | 5x ADWF (L/S) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portion 1 | 4316877 | 90936 | 93 | 250 | 2.7 | | | 62775 | | 2.3 | 144382.5 | 3.5 | 5.849 | 3.63 |
| Portion 2 | 4563545 | 145540 | 149 | 250 | 2.7 | | | 100575 | | 2.3 | 231322.5 | 3.5 | 9.371 | 5.82 |
| Portion 3 & 4 | 6956581 | 336049 | 239 | 250 | 2.7 | | | 161325 | | 2.3 | 371047.5 | 3.5 | 15.031 | 9.34 |
| Portion 5 | | 211074 | 151 | 250 | 2.7 | | | 101925 | | 2.3 | 234427.5 | 3.5 | 9.496 | 5.90 |
| Portion 6 | | 149845 | 168 | 250 | 2.7 | | | 113400 | | 2.3 | 260820 | 3.5 | 10.566 | 6.56 |

## NUKUHAU WATER DEMAND

The following are calculations of the Water demand of each of the Portions of the Nukuhau Structure Plan Development and is an explanation of the calculation spreadsheet as seen above.

### Portion 1

Portion 1 size – 93 plots/houses.

Using the TDC parameters, the;

*Peak Domestic Water Demand*

Flow A = 93 No x 400 litres/person/day x 2.69 persons/HUE

= 100 068 litres/day

Flow B = 93 No x 400 litres/HUE/day

= 37 200 litres/day

Total Demand = Demand Flow A + Demand Flow B

= 100 068 litres/day + 37 200 litres/day

= 137 268 litres/day

Peak Demand = 137 268 litres/day x 5

= 686 340 litres/day

= 7.944 l/s

Appendix K Peak Annual Demand Q (residential less than 1000 dwellings)

$Q_{Peak}$ = 0.596 x $D^{0.632}$ (l/s), where D = number of dwellings

= 0.596 x $(93)^{0.632}$

= 10.455 l/s

The Peak Demand is less than the Peak Annual Demand of Fire Flow, thus the Peak Domestic Water Demand is taken as 10.455 l/s.

*Combined Fire and Domestic Demand*

According to Table 1 of SNZ PAS 4509 the estimated Fire Flow Water Supply Category is FW2 (with the assumption that the planned developments will not be multi storey apartment blocks), and according to Table 2 the fire flow at a fire hydrant must be 12.5 l/s.

The Combined Fire Flow and Domestic Demand = 2/3 x Peak Domestic + 12.5

= 2/3 x 10.455 + 12.5

= 6.97 + 12.5

= 19.47 l/s

Worst case scenario is the combined fire flow and domestic demand. The estimated Water Demand for Portion 1 will be 19.47 l/s

## Portion 2

Portion 2 size – 149 plots/houses.

Using the TDC parameters, the;

*Peak Domestic Water Demand*

Flow A = 149 No x 400 litres/person/day x 2.69 persons/HUE

= 160 324 litres/day

Flow B = 149 No x 400 litres/HUE/day

= 59 600 litres/day

Total demand = Demand Flow A + Demand Flow B

= 160 324 litres/day + 59 600 litres/day

= 219 924 litres/day

Peak Demand = 219 924litres/day x 5

= 1 099 620 litres/day

= 12.727 l/s

Appendix K Peak Annual Demand Q (residential less than 1000 dwellings)

$Q_{Peak}$ = 0.596 x $D^{0.632}$ (l/s), where D = number of dwellings

= 0.596 x $(149)^{0.632}$

= 14.083 l/s

The Peak Demand is less than the Peak Annual Demand of Fire Flow, thus the Peak Domestic Water Demand is taken as 14.083 l/s.

*Combined Fire and Domestic Demand*

According to Table 1 of SNZ PAS 4509 the estimated Fire Flow Water Supply Category is FW2 (with the assumption that the planned developments will not be multi storey apartment blocks), and according to Table 2 the fire flow at a fire hydrant must be 12.5 l/s.

The Combined Fire Flow and Domestic Demand = 2/3 x Peak Domestic + 12.5

= 2/3 x 14.083 + 12.5

= 9.389 + 12.5

= 21.889 l/s

Worst case scenario is the combined fire flow and domestic demand. The estimated Water Demand for Portion 2 will be 20.161 l/s

## Portion 3 & 4

Portions 3&4 size – 239 plots/houses.

Using the TDC parameters, the;

*Peak Domestic Water Demand*

Flow A = 239 No x 400 litres/person/day x 2.69 persons/HUE

= 257 164 litres/day

Flow B = 239 No x 400 litres/HUE/day

= 257 164 litres/day

Total demand = Demand Flow A + Demand Flow B

= 257 164 litres/day + 95 600 litres/day

= 352 764 litres/day

Peak Demand = 352 764 litres/day x 5

= 1 763 820 litres/day

= 20.415 l/s

Appendix K Peak Annual Demand Q (residential less than 1000 dwellings)

$Q_{Peak}$ = 0.596 x $D^{0.632}$ (l/s), where D = number of dwellings

= 0.596 x $(239)^{0.632}$

= 18.984 l/s

The Peak Demand is higher than the Peak Annual Demand of Fire Flow, thus the Peak Domestic Water Demand is taken as 20.415 l/s.

*Combined Fire and Domestic Demand*

According to Table 1 of SNZ PAS 4509 the estimated fire flow Water supply category is FW2 (with the assumption that the planned developments will not be multi storey apartment blocks), and according to Table 2 the fire flow at a fire hydrant must be 12.5 l/s.

The combined fire flow and domestic demand = 2/3 x Peak Domestic + 12.5

= 2/3 x 20.415+ 12.5

= 13.610 + 12.5

= 26.110 l/s

Worst case scenario is the Combined Fire Flow and Domestic Demand. The estimated Water Demand for Portion 1 will be 26.110 l/s.

## Portion 5

Portion 5 size – 151 plots/houses.

Using the TDC parameters, the;

*Peak Domestic Water Demand*

Flow A = 151 No x 400 litres/person/day x 2.69 persons/HUE

= 162 476 litres/day

Flow B = 151 No x 400 litres/HUE/day

= 60 400 litres/day

Total demand = Demand Flow A + Demand Flow B

= 162 476 litres/day + 60 400 litres/day

= 222 876 litres/day

Peak Demand = 222 876 litres/day x 5

= 1 114 380 litres/day

= 12.898 l/s

Appendix K Peak Annual Demand Q (residential less than 1000 dwellings)

$Q_{Peak}$ = 0.596 x $D^{0.632}$ (l/s), where D = number of dwellings

= 0.596 x $(151)^{0.632}$

= 14.202 l/s

The Peak Demand is higher than the Peak Annual Demand of Fire Flow, thus the Peak Domestic Water Demand is taken as 14.202 l/s.

*Combined Fire and Domestic Demand*

According to Table 1 of SNZ PAS 4509 the estimated fire flow Water supply category is FW2 (with the assumption that the planned developments will not be multi storey apartment blocks), and according to Table 2 the fire flow at a fire hydrant must be 12.5 l/s.

The Combined Fire Flow and Domestic Demand = 2/3 x Peak Domestic + 12.5

= 2/3 x 14.202+ 12.5

= 9.468 + 12.5

= 21.968 l/s

Worst case scenario is the Combined Fire Flow and Domestic Demand. The estimated Water Demand for Portion 5 will be 21.968 l/s

Portion 6

Portion 6 size – 168 plots/houses.

Using the TDC parameters, the;

*Peak Domestic Water Demand*

Flow A = 168 No x 400 litres/person/day x 2.69 persons/HUE

= 180 768 litres/day

Flow B = 168 No x 400 litres/HUE/day

= 67 200 litres/day

Total demand = Demand Flow A + Demand Flow B

= 180 768 litres/day + 67 200 litres/day

= 247 968 litres/day

Peak Demand = 247 968 litres/day x 5

= 1 239 840 litres/day

= 14.35 l/s

Appendix K Peak Annual Demand Q (residential less than 1000 dwellings)

$Q_{Peak}$ = 0.596 x $D^{0.632}$ (l/s), where D = number of dwellings

= 0.596 x $(168)^{0.632}$

= 15.193 l/s

The Peak Demand is less than the Peak Annual Demand of Fire Flow, thus the Peak Domestic Water Demand is taken as 15.193 l/s.

*Combined Fire and Domestic Demand*

According to Table 1 of SNZ PAS 4509 the estimated fire flow Water supply category is FW2 (with the assumption that the planned developments will not be multi storey apartment blocks), and according to Table 2 the fire flow at a fire hydrant must be 12.5 l/s.

The Combined Fire Flow and Domestic Demand = 2/3 x Peak Domestic + 12.5

= 2/3 x 15.193 + 12.5

= 10.129+ 12.5

= 22.629 l/s

Worst case scenario is the Combined Fire Flow and Domestic Demand. The estimated Water Demand for Portion 6 will be 22.629 l/s

## NUKUHAU WASTEWATER DESIGN FLOW

The following are calculations of the Wastewater Design Flows of each of the Portions of the Nukuhau Structure Plan Development and is an explanation of the calculation spreadsheet as seen above.

### Portion 1

Portion 1 size – 93 plots/houses.

Using the TDC parameters, the,

ADWF = 93 houses x 2.7 person/dwelling x 250 litres/day/person

= 62 775 litres/day

Adding the Diurnal Peak Factor of 2.3 then the Peak Flow equals to;

Peak Demand = 62 775 x 2.3

= 144 383 litres/day

Adding the WWIF of 3.5 = 144 383 x 3.5

= 721 915 litres/day

= 8.36 l/s Wastewater Design Flow

Calculation of the wastewater design flows based on 5 x the ADWF

= 5 x 62 775 litres per day

= 313 875 litres per day

= 3.63 l/s

Portion 2

Portion 2 size – 149 plots/houses.

Using the TDC parameters, the,

ADWF = 149 houses x 2.7 person/dwelling x 250 litres/day/person

= 100 575 litres/day

Adding the Diurnal Peak Factor of 2.3 then the Peak Flow equals to;

Peak Demand = 100 575 x 2.3

= 231 323 litres/day

Adding the WWIF of 3.5 = 231 323 x 3.5

= 809 631 litres/day

= 9.371 l/s Wastewater Design Flow

Calculation of the wastewater design flows based on 5 x the ADWF

= 5 x 100 575 litres per day

= 502 875 litres per day

= 5.82 l/s

Portion 3 & 4

Portion 3 & 4 size – 239 plots/houses.

Using the TDC parameters, the,

ADWF = 239 houses x 2.7 person/dwelling x 250 litres/day/person

= 161 325 litres/day

Adding the Diurnal Peak Factor of 2.3 then the Peak Flow equals to;

Peak Demand = 161 325 x 2.3

= 371 048 litres/day

Adding the WWIF of 3.5 = 371 048 x 3.5

= 1 298 668 litres/day

= 15.031 l/s Wastewater Design Flow

Calculation of the wastewater design flows based on 5 x the ADWF

= 5 x 161 325 litres per day

= 806 625 litres per day

= 9.34 l/s

Portion 5

Portion 5 size – 151 plots/houses.

Using the TDC parameters, the,

ADWF = 151 houses x 2.7 person/dwelling x 250 litres/day/person

= 101 925 litres/day

Adding the Diurnal Peak Factor of 2.3 then the Peak Flow equals to;

Peak Demand = 101 925 x 2.3

= 234 428 litres/day

Adding the WWIF of 3.5 = 234 428 x 3.5

= 820 498 litres/day

= 9.496 l/s Wastewater Design Flow

Calculation of the wastewater design flows based on 5 x the ADWF

= 5 x 101 925 litres per day

= 509 625 litres per day

= 5.9 l/s

Portion 6

Portion 6 size – 168 plots/houses.

Using the TDC parameters, the,

ADWF = 168 houses x 2.7 person/dwelling x 250 litres/day/person

= 113 400 litres/day

Adding the Diurnal Peak Factor of 2.3 then the Peak Flow equals to;

Peak Demand = 113 400 x 2.3

= 260 820 litres/day

Adding the WWIF of 3.5 = 260 820 x 3.5

= 912 870 litres/day

= 10.566 l/s Wastewater Design Flow

Calculation of the wastewater design flows based on 5 x the ADWF

= 5 x 113 400 litres per day

= 567 000 litres per day

= 6.56 l/s

# Appendix B1
# Nukuhau Structure Plan: Water Modelling Report – June 2020

# Nukuhau Structure Plan Development Desktop Study - Water (Addendum)

## 1 Introduction

This document is an addendum to the following report (WSP-Opus, 2019), and supersedes Section 5 (Water Infrastructure) and Appendix B – Water Modelling Report.

### 1.1 Scope and limitations

This report ('Report') has been prepared by WSP exclusively for Taupō District Council ('Client') in relation to the Nukuhau Structure Plan Development ('Purpose') and in accordance with the Nukuhau OOS dated November 8, 2017. The findings in this Report are based on and are subject to the assumptions specified in the Report and those listed in Section 5. 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.

### 1.2 Purpose and assumptions

The purpose of this Report is to confirm the required mains upgrades to supply the new Nukuhau developments have not changed significantly between the original Epanet Model (2018) analysis and the current InfoWorks WS Pro model, build and calibration 2019.

### 1.3 Background

There have been many recent development enquiries and projects running concurrently by Taupō District Council (TDC) that are inter related when looking at the wider Master Plan for Taupo water infrastructure.

Figure 1-1 below identifies the locations of all developments currently known within Taupō and Acacia Bay.

For this addendum, the developments of interest are those within the Nukuhau Structure Plan (Reference iii, Section 5), but include the adjacent developments planned because they will have an impact on development of infrastructure requirements.

*Table 1-1 : Nukuhau development demand summaries*

| | | | A | B = 2/3B | C | D = B + C |
|---|---|---|---|---|---|---|
| Portion | Size (m2) | Estimated Lots (no.) | Qpeak (L/s) | Domestic Demand (L/s) | Fire Flow (L/s) | Total Demand (L/s) |
| 1 | 90,936 | 93 | 10.46 | 6.97 | 12.5 | 19.47 |
| 2 | 145,540 | 149 | 14.08 | 9.39 | 12.5 | 21.89 |
| 3 & 4 | 336,049 | 239 | 18.98 | 13.7 | 12.5 | 26.1 |
| 5 | 211,074 | 151 | 14.20 | 9.47 | 12.5 | 21.97 |
| 6 | 149,845 | 168 | 15.19 | 10.13 | 12.5 | 22.63 |
| TOTALS | 933,444 | 800 | 72.91 | 48.62 | | |

Table 1-1 above tabulates the demand calculations used for the modelling work from ref: (WSP-Opus, 2019).

## 1.4 Design criteria

The design criteria follow that of the Taupō Code of Practice (Reference i, Section5). The criteria are summarised below in Table 1-2.

*Table 1-2 : Taupo District Council Altered requirements to PART 6 NZS 4404: 2004 WATER SUPPLY*

| Clause | Item | Requirement |
|---|---|---|
| 6.3.7.1 | Sizing of Mains | Residual pressures due to peak demand shall be a minimum of 300 kPa (30 m) |

There is no clear guidance in design pressurised rising mains, however best practice states the diameter of a rising main should be such as to keep the velocity of the water fairly low, and consequently the head lost in friction. A speed of up to 1.5 m/s. should not be exceeded, and if it is, a thought should be given to installing a larger diameter pipe, balancing this against lower friction head and small pumping units.

System performance of the network was carried out using the calibrated model with the following targets for level of service as tabulated below in Table 1-3.

*Table 1-3 : Performance measures*

| Performance measure | Level of Service | Comments |
|---|---|---|
| High Pressure in pipe | Less than 80 m | High pressures indicate high risk of failure |
| Low Pressures at node | Greater than 15 m | Indicator for customer pressure satisfaction |
| Low Pipe Velocities | Greater than 0.1 m/s | Low velocity increases quality risks |
| High Pipe Velocities | Less than 1.3 m/s | High velocities indicate undersized pipes |
| Pipe Headloss | Less than 5 m/km | High headloss indicates poor condition or undersized pipes |

Comprehensive technical and economic calculation may be very labour-intensive and complicated, so optimal values of pumped water velocity, taken from reference materials, drawn up based on experimental findings, are used in practice as summarised below (Table 1-4).

*Table 1-4 : Pipeline optimal velocities*

| Flow type | Item | Optimal velocity (m/s) |
|---|---|---|
| Gravity | Low viscosity fluids (water) | 0.5 – 1.3 |
| Pumping | Suction | 0.8 – 2.0 |
| | Delivery | 1.5 – 3.0 |

From previous projects carried out for TDC, an agreed maximum velocity of 2.4 m/s is used for pipe sizing on pumped delivery mains.

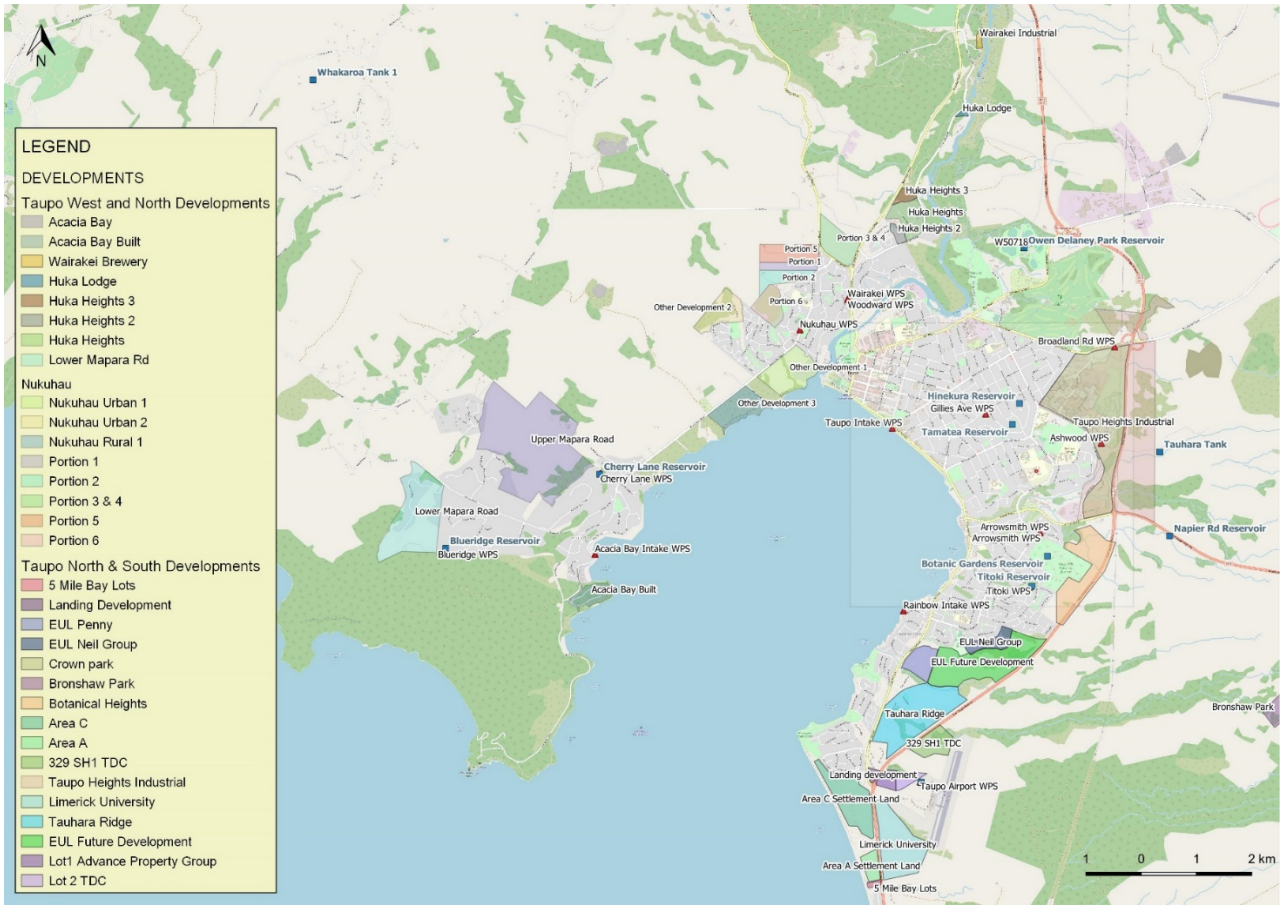


*Figure 1-1 : Taupō and Acacia Bay known developments (current to 2050)*

# 2 Water infrastructure

## 2.1 Existing Water Network

The planned development area is bordered by the existing water network as shown in the schematic below.

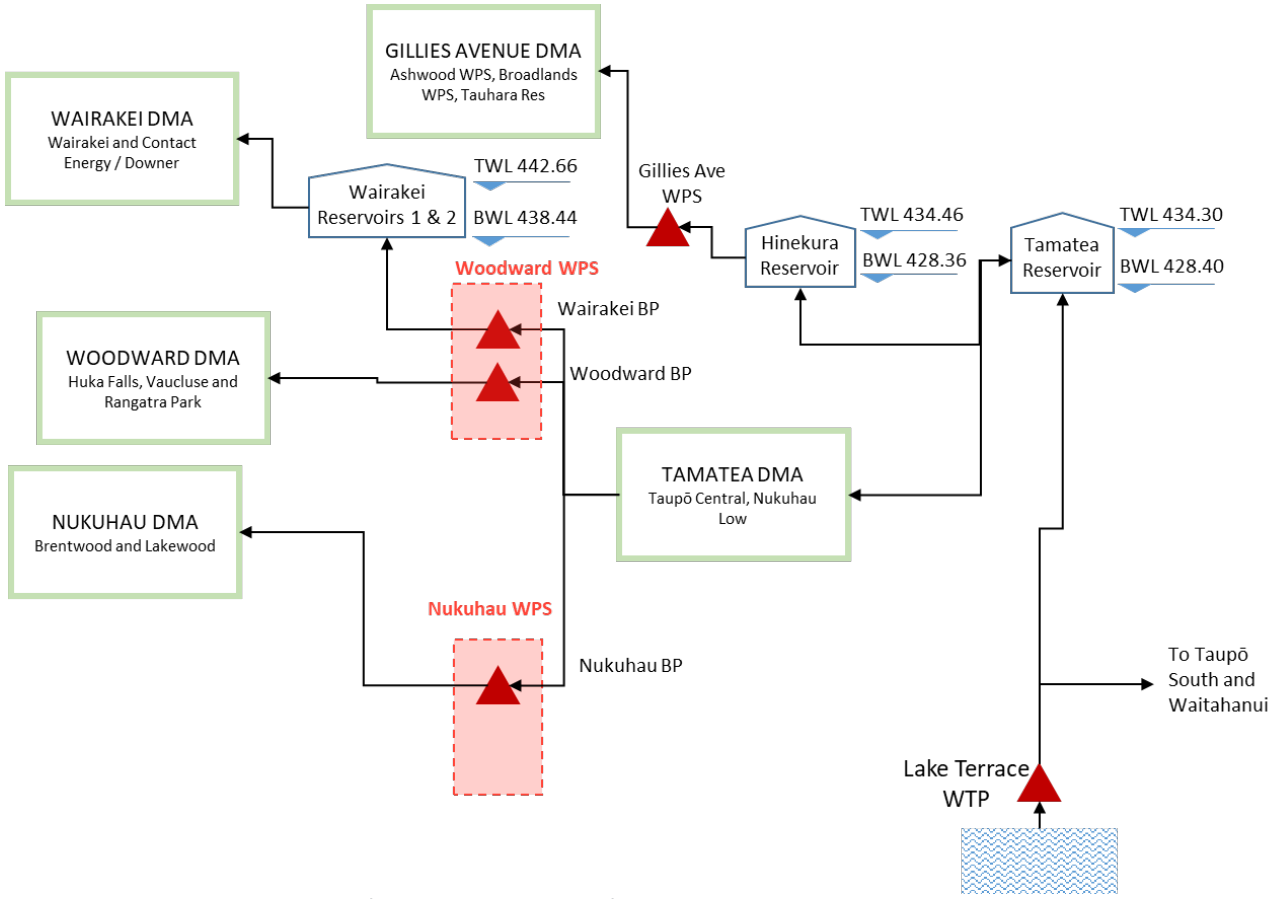


*Figure 1-1 : Taupō West supply arrangement schematic*

The planned development area is located within the two District Metered Areas (DMA) – Woodward DMA and Nukuhau DMA.

- Portion 6 falls within the Nukuhau DMA and is serviced by Nukuhau Water Pump Station (WPS).
- Portions 1 to 5 falls within the Woodward DMA and are serviced by Woodward WPS.

Figure 2-2 below, shows the extent of the existing water network and the location of the water pump stations.

The existing water network from the pump stations consist of 50 mm, 100 mm and 150 mm diameter pipelines and are mainly AC and uPVC pipelines.

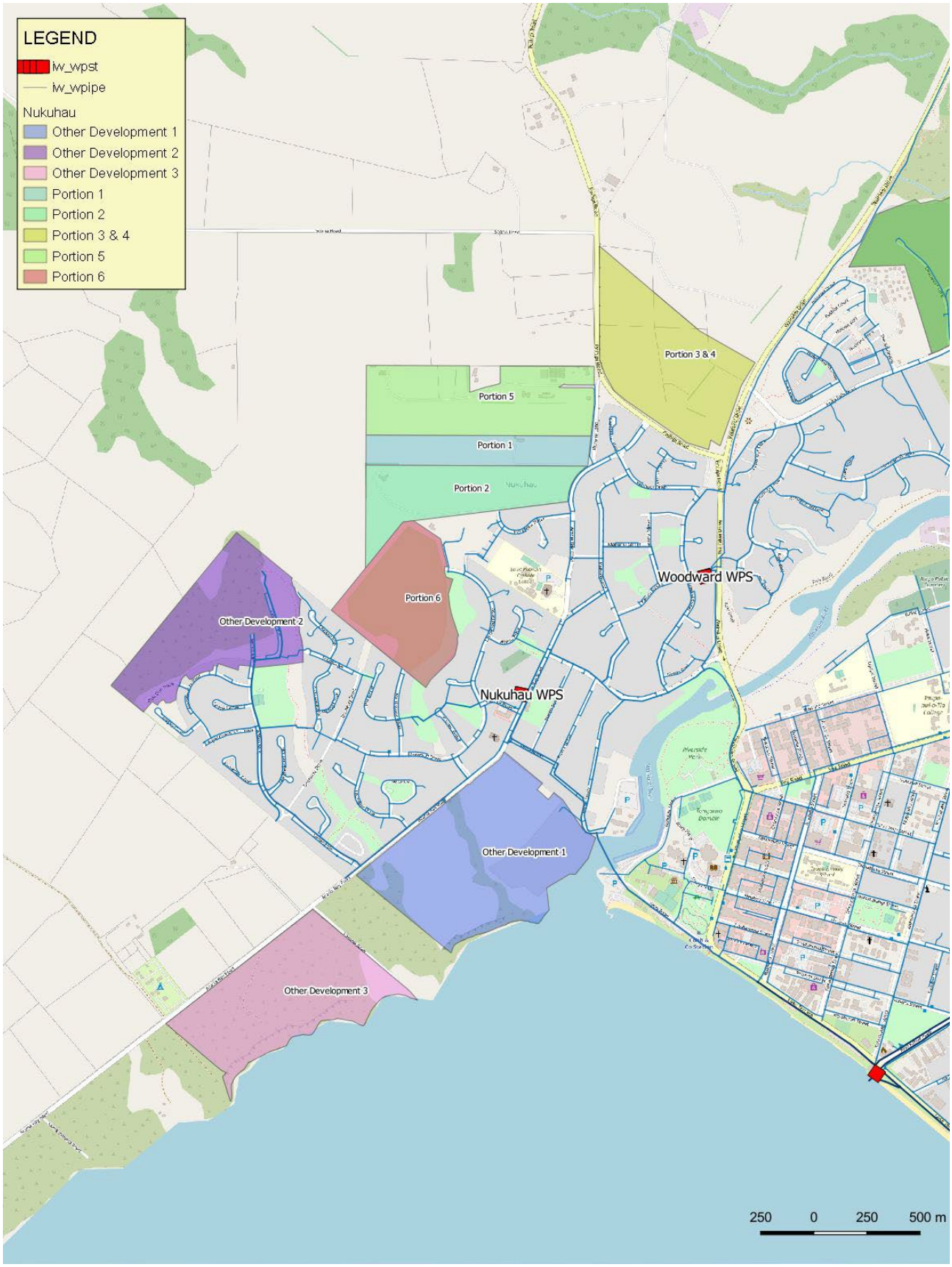


*Figure 1-2 : Nukuhau development locations*

An investigation into the existing network was undertaken by WSP to check how the planned development/s water demand can be accommodated within the existing bulk infrastructure of the Council, and if any upgrades of the existing water network are required, Section 5 – Ref ii.

Following that report the Taupō water supply hydraulic model (Infoworks WS Pro 2019) was completed and new developer enquiries have been developed using this model.

This investigation has been revisited and has used the current calibrated model, including the recent Taupō to Acacia Bay connection and respective developments in Acacia Bay, which were not included in the previous model (Epanet 2018) analysis.

The recommendations included:

1. The previous Epanet water model, 2018 Peak Demand Taupō Model, was used for the assessment and our report highlighted that the findings from the that analysis must be confirmed when the new calibrated model of TDC is completed in August 2019.

2. No other developments in the surrounding area were taken in account for this assessment. The assessment and modelling were based on all the portions being developed simultaneously.

The assessment modelling results concluded that;

- Portions 1 to 5 will be supplied from the Woodward Pump Station and the existing water network and configuration will not meet future demands and fire flow requirements. The existing water network requires an upgrade of the mains and new pump sets.
- Portion 6 will be supplied by Nukuhau Pump Station and the current network and pump duty will be sufficient to meet future demands and fire flow requirements.
- The proposed water upgrades are along Watene Street, Vaucluse Drive, Woodward Street, in Acacia Bay Road towards Poihipi Road and at the Woodward Pump Station.

The water upgrades required, are as follows:

- 150 mm diameter approximate length is 430 m,
- 200 mm diameter approximate length is 800 m.

Per the assessment, it would be ideal if each of the portions can have at least two connection points to the water main network.

In the Long-Term Plan of TDC a new reservoir is planned to be built near Poihipi Road that will service the areas by gravity, this is scheduled for years 2024/26.

# 3 Revised modelling assessment

This section details the modelling work carried out to confirm the findings of the last assessment and includes potential options for the Woodward and Nukuhau DMAs, once the Brentwood and Poihipi reservoirs are online.

## 3.1 Validation of Nukuhau development supply with Infoworks model

The 2019 Infoworks WS Pro hydraulic model was used in the completed Taupō to Acacia Bay connection concept design study. The model was set up to investigate the current 2020, and future demand scenarios for 2025, 2035 and 2050.

The developments included in the model that are supplied via the Tamatea DMA and respective booster stations are tabulated below in Table 1-5.

*Table 1-1 : Nukuhau, Acacia Bay and Wairakei development demand summaries*

| Development name | Total demand (L/s) | Demand in stages (L/s) | | | |
|---|---|---|---|---|---|
| | | 2020 | 2025 | 2035 | 2050 |
| Portion 1 | 6.97 | 6.97 | | | |
| Portion 2 | 9.39 | 9.39 | | | |
| Portion 3&4 | 12.66 | 13.7 | | | |
| Portion 5 | 9.47 | 9.5 | | | |
| Portion 61 | 10.13 | 10.13 | | | |
| Huka Heights | 7.30 | 7.30 | | | |
| Huka Lodge | 3.47 | 3.47 | | | |
| Nukuhau Urban 1 | 13.02 | 13.02 | | | |
| Nukuhau Urban 2 | 7.30 | 7.30 | | | |
| Nukuhau Rural 1 | 4.71 | 4.71 | | | |
| Upper Mapara Rd | 9.82 | 9.82 | | | |
| Lower Mapara Rd | 7.30 | 7.30 | | | |
| Huka Heights 2 | 2.64 | 2.64 | | | |
| Huka Heights 3 | 1.10 | 1.10 | | | |
| Wairakei Commercial | 0.58 | 0.58 | | | |
| Wairakei Hotel | 2.44 | 2.44 | | | |

*Note1 – Portion 6 is the Nukuhau Portion*

The schematic (Figure 1-4 and Figure 1-5) below illustrates from which DMAs the respective developments will be supplied. The key aspects noted are that most developments are in boosted DMAs and therefore the existing pump duties and suction pressures will be affected with increased demand.

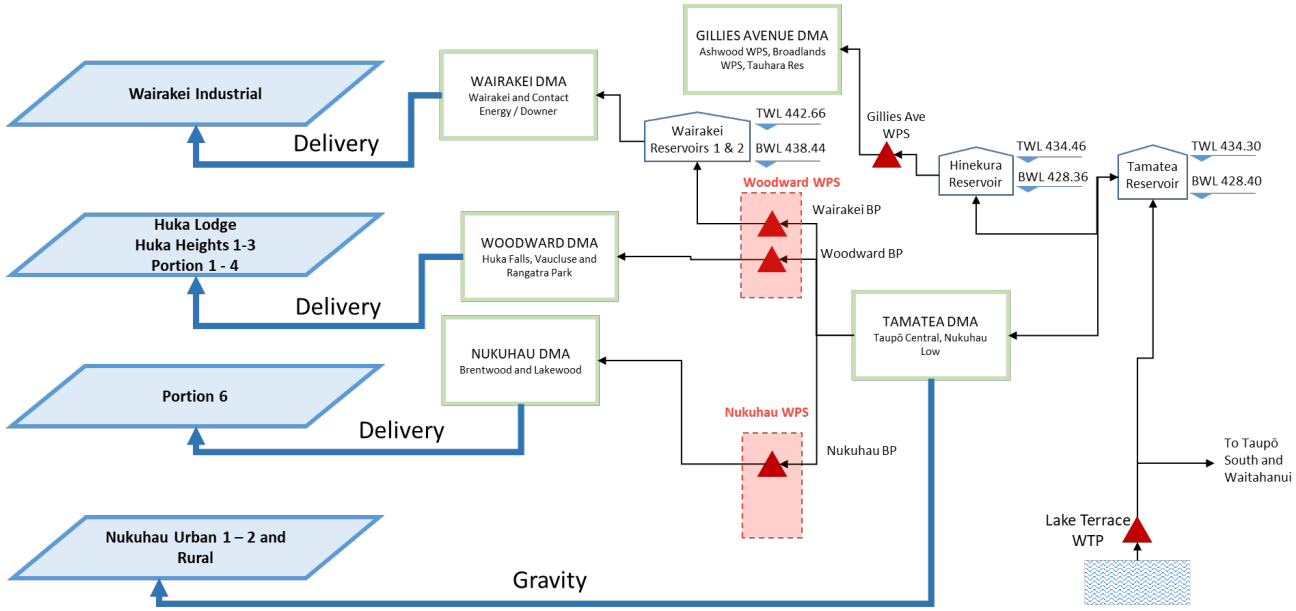


*Figure 1-1 : Schematic of how developments are to be supplied Taupō West*

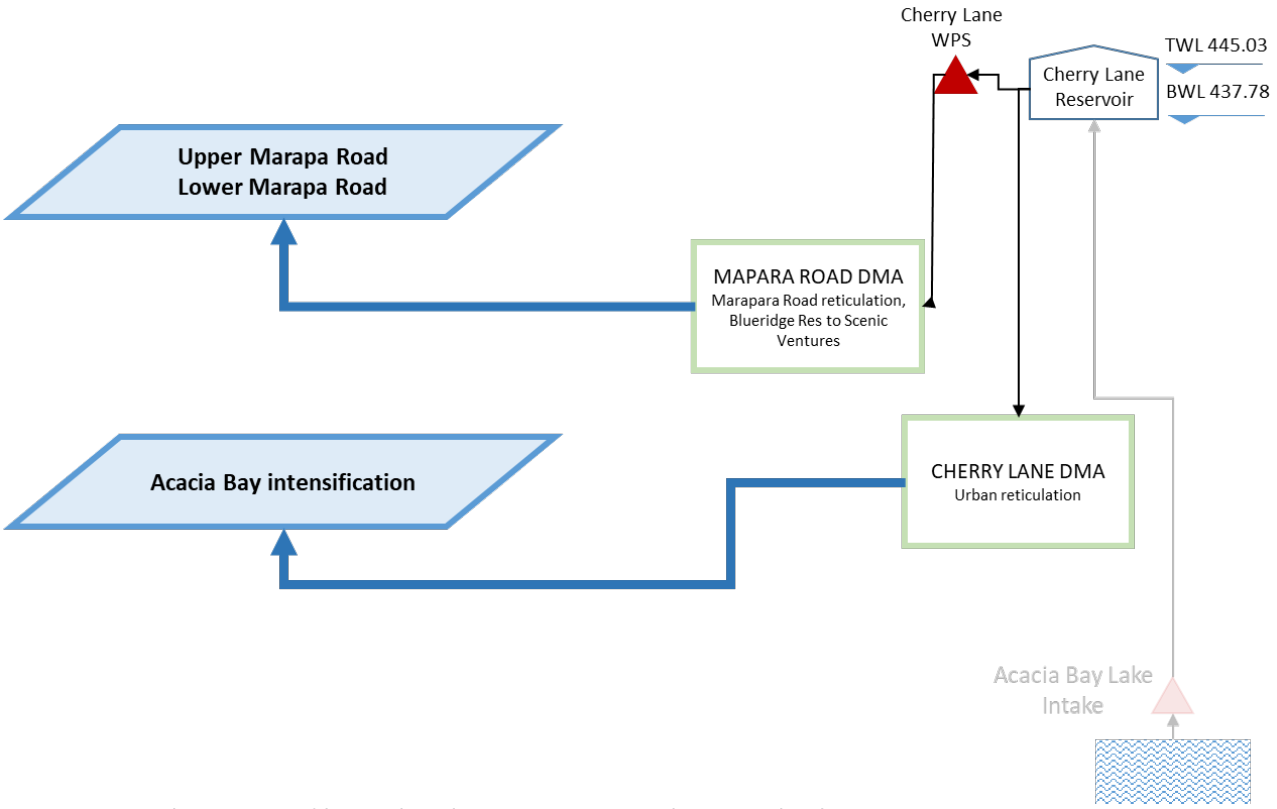


*Figure 1-2 : Schematic of how developments are to be supplied Acacia Bay*

The Nukuhau water analysis and Acacia Bay to Taupō Connection studies are associated with the Nukuhau Structure Plan will only look at the developments that are to be supplied by Tamatea Reservoir (via Woodward and Nukuhau WPS) and Acacia Bay.

## 3.2 Baseline model results

The baseline model (Calibration Peak Day demand model) was used to current network deficiencies.

The model calibration indicated the following issues that need to be checked and reassessed.

- In Acacia Bay, there is high headloss along Mapara Rd and Acacia Heights Dr, where diameters decrease below 100 mm.
- The suction side of Woodward and Wairakei WPS: the pipes along Wairakei Drive, Tongariro Street over the bridge and Woodward Street experience high headloss when the pumps are on during peak times.
- Wairakei Reservoir trunk main: experiences high headloss from the golf course to the roundabout where the diameter reduces to 100 mm.

The above indicate even prior to the new developments some mains upsizing is required to maintain sufficient suction pressures to these WPS at peak times.

## 3.3 2025 model results

The 2025 development demands (Table 3 1 above) where added to the model and the model assessed for level of service.

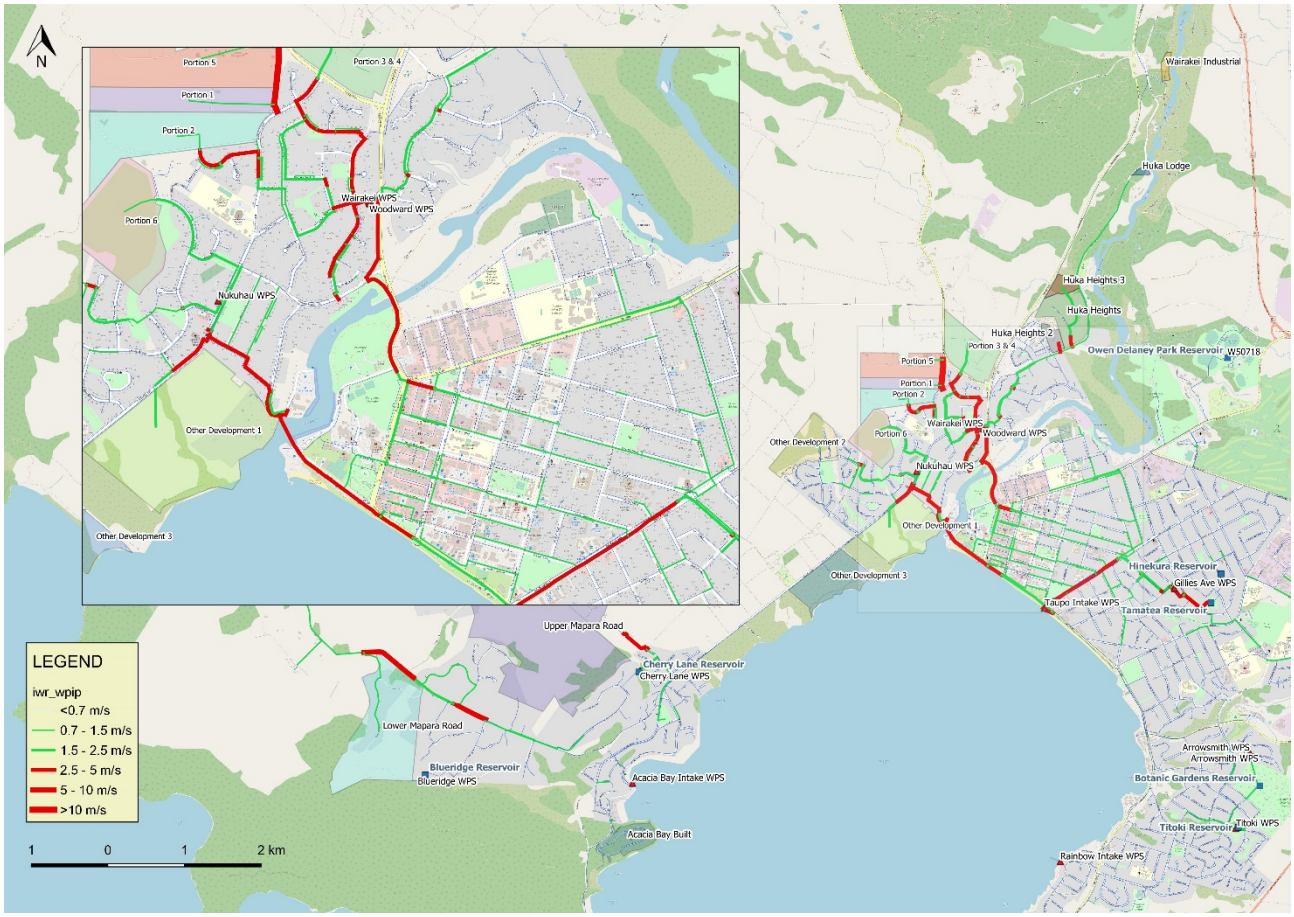


*Figure 1-3 : Level of service maximum velocities*

The model results confirm the following, the results from the original desktop study hold and are summarised below in Section 3.3.1 and additional upgrades summarised in Section 3.3.2 and shown on Figure 1-7 below.

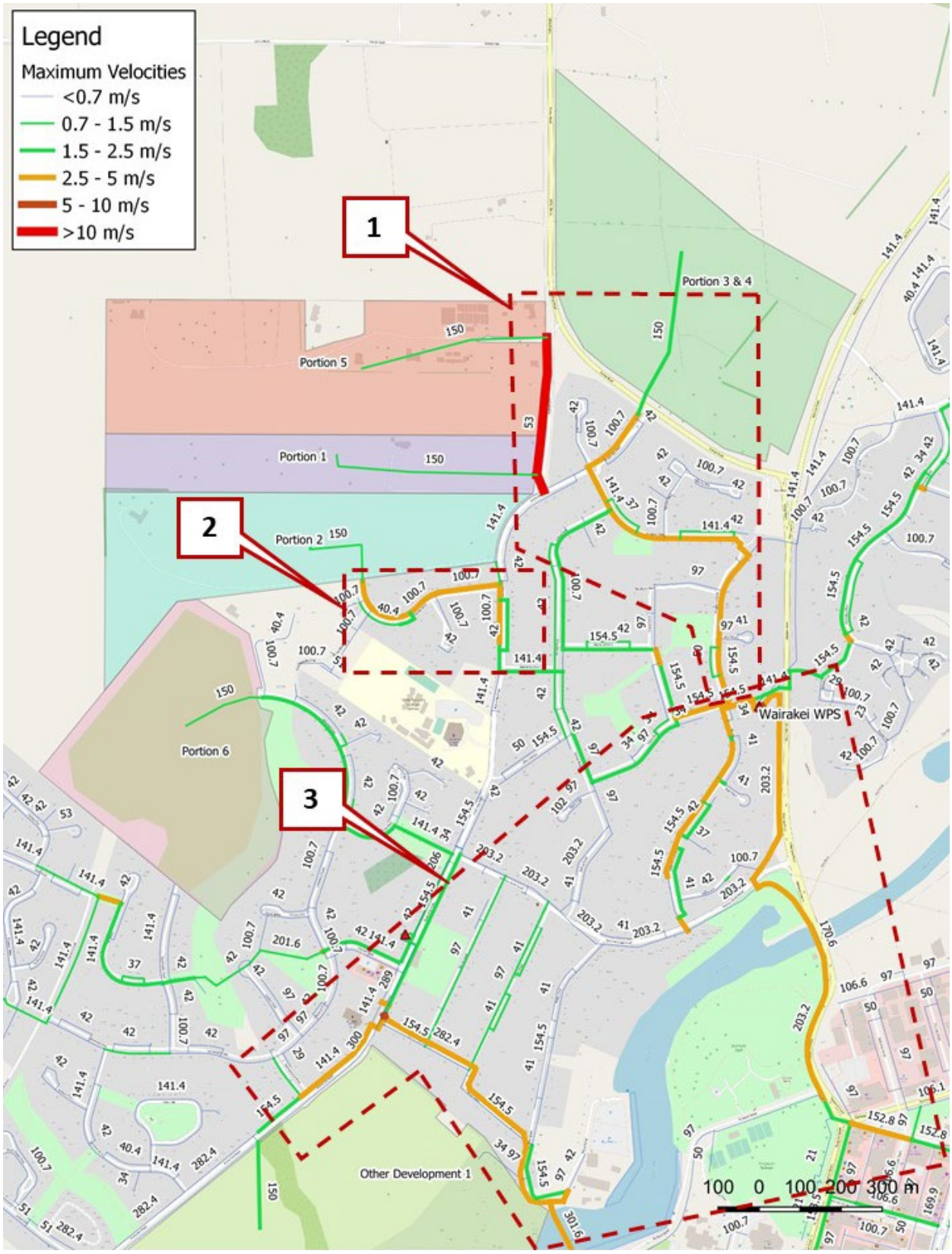


*Figure 1-4 : Water infrastructure upgrades*

### 3.3.1 *Desktop study water upgrades*

A construction cost estimate at this stage for the water upgrades (Figure 1-7 – Item 1), is as follows;

- 150 mm diameter – 430 m @ $325.00/m = $ 139,750.00
- 200 mm diameter – 800 m @ $ 485.00/m = $ 388,000.00
- Woodward PS upgrades – lump sum $ 610,000.00. A recent investigation at Woodward PS has shown some significant electrical upgrades required in the excess of $510,000. Major electrical upgrades such transformer, generator, switchboards, telemetry have been identified by an independent contractor (not related to Nukuhau Structure Plan study). For the purpose of this report the electrical upgrades are noted and the potential upgrade cost is listed.

The full extent of the works will be known once the **detailed design** has been done, from there the construction estimate will be derived.

### 3.3.2 *Additional water upgrades*

The model picked up a further upgrade, based on the assumption that all of Portion 2 will be supplied via a single main. A construction cost estimate at this stage for the water upgrades (Figure 1-7 – Item 2), is as follows;

- 150 mm diameter – 430 m @ $325.00/m = $ 139,750.00

### 3.3.3 *Tamatea DMA upgrades*

The upgrades highlighted in item 3 of Figure 1-7, show those lengths of mains that will be required to be up sized to maintain levels of service and suction pressures to the respective pump stations and future growth areas supplied by gravity.

These upgrades have been highlighted and detailed as part of the Taupō to Acacia Bay connection project. Reference should be made to the project report for details of the upgrades (Reference ii, Section 5). We understand that some of the upgrades have already been addressed by TDC and detail design for upgrading the feed to the Woodward PS is currently underway.

## 3.4 2035 model results

The 2035 demand scenario has been modelled as part of the Taupō to Acacia Bay connection project (Reference ii, Section 5).

TDC are proposing two new reservoirs to take advantage of elevation to the west of Taupō town centre as shown below in Figure 1-8.

It is proposed that the supply arrangement will be altered as follows:

- A new reservoir Poihipi Reservoir (TWL 481.00 m RL) will be built to feed the current Nukuhau boosted DMA. Nukuhau WPS booster set will be decommissioned, and Woodward WPS will continue feeding Woodward DMA.
- A new booster set will be installed within Woodward WPS to boost water and supply Poihipi Reservoir via a dedicated main.
- Brentwood Reservoir (TWL 426.00 m RL) is planned to act as a balancing tank, supplied via Tamatea and Hinekura Reservoirs and supply back into the Tamatea DMA.

The 2035 model included all developments to the west of Taupō and including Acacia Bay developments, including the above structure plan developments.

Once the location of the two new reservoirs was agreed, further modelling was carried out to identify the optimal pump characteristics for each scenario. This modelling stage included the future Brentwood and Poihipi Reservoirs in the 2035 and 2050 scenarios.

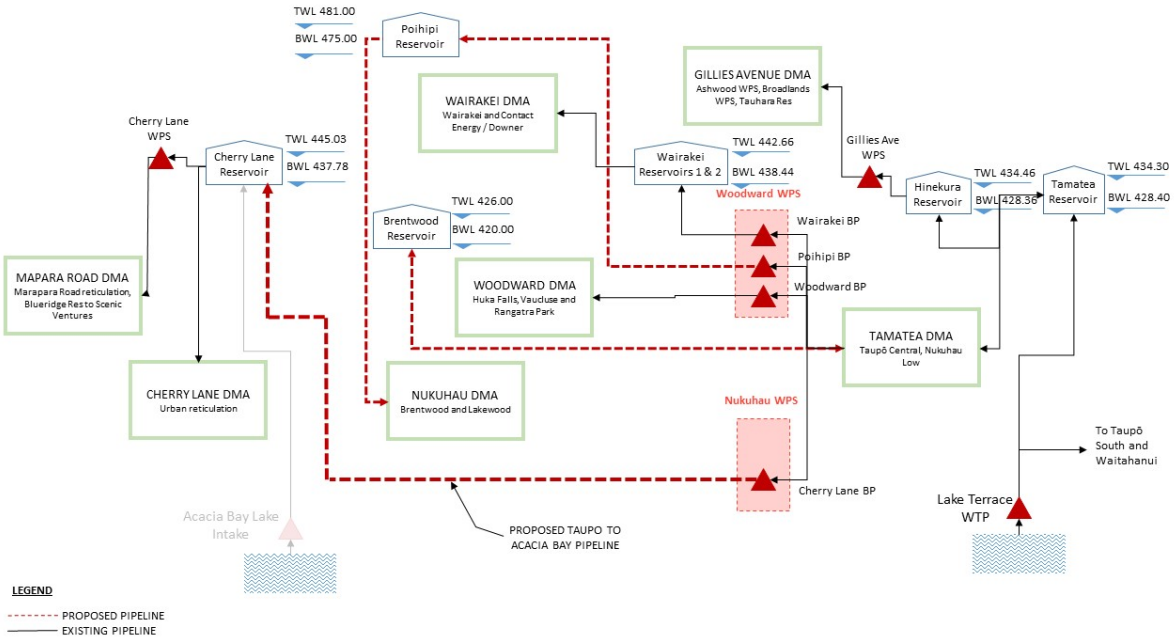


*Figure 1-5 : Taupō 2035 supply arrangement schematic*

Poihipi Reservoir was modelled with a dedicated inlet supplied from a new pump at Woodward WPS location. It would then gravity feed the area currently supplied by Nukuhau WPS and Woodward WPS, which would be decommissioned.

Brentwood Reservoir was modelled as a balancing tank with Tamatea (TWL 434.3 m RL). To balance the new tank, the frictional headloss between Tamatea and Brentwood reservoirs had to be considered. The final TWL for Brentwood was lowered to 426 m RL to compensate the losses between the reservoirs.

It was concluded that a more in-depth study would be required to analyse the impact of water quality, flow, pressures and the interaction with the existing booster pumps.

## 3.5 Nukuhau Structure Plan - Water Upgrades

Further to the assessment carried out in the above section, there was an additional requirement given the Acacia Bay modelling is based on all future growth, including the Nukuhau Structure Plan, to determine what percentage of the upgrades currently in design, are occurring because of the Nukuhau Structure Plan.

Appendix B2, attached details the assessment carried out noting that no detailed planning, re-zoning or reservoir sizing has been finalised.

The outcome of this assessment confirms the following:

- The upgrades downstream of the Woodward and Nukuhau Pump Stations confirm they are required for the structure plan.

- Those pipelines highlighted upstream of the pump stations will be required for both the Structure Plan and the Acacia Bay connection to maintain enough suction pressures to the pump stations.

# 4 Recommendation for Nukuhau Structure Plan water

The following summarises the required upgrades based in the assessment carried out with the latest hydraulic model and inclusive of all developments expected to the west of Taupō and in Acacia Bay and including the new Taupō to Acacia Bay pipeline.

## 4.1 Nukuhau Structure Plan upgrades

Nukuhau Structure Plan development has an impact on the existing water infrastructure network. The works that need to be upgraded are the following;

- Woodward pump station upgrades (full extent to be scoped with the further design phases).
- Upgrading of water pipe network along from Woodward pump station all along;
    - Sections of Woodward street,
    - Vaucluse Drive.
    - Sections of Acacia Bay road.
    - Herapeka street, and
    - Waitene Lane

## 4.2 Tamatea DMA upgrades

Those upgrades highlighted in item 3 of Figure 1-7, show those lengths of mains that will be required to be up sized to maintain levels of service and suction pressures to the respective pump stations and future growth areas supplied by gravity.

These upgrades have been assessed and detailed as part of the Taupō to Acacia Bay connection project. Reference should be made to the project report for details of the upgrades (Reference ii, Section 5). We understand that some of the upgrades have already been addressed by TDC and detail design for upgrading the feed to the Woodward PS is currently underway.

# 5 References


I. Council, T. D. (2009). Code of Practice - Shecdule 6: Part 6 NZS 4404: 2004 Water Supply. Taupo: NZ Standards.

II. WSP. (2020). Options Assessment - Acacia Bay connection to Taupo - Hydraulic Investigations Report. Taupo.

III. WSP-Opus. (2019). Nukuhau Structure Plan Development - Desktop Study - Water and Wastewater. Taupo: WSP Opus.

# Appendix B2
# Nukuhau Structure Plan – Water upgrades Memo

# Memorandum

| | |
|---|---|
| To | Jaco van de Merwe |
| Copy | Marten Beiermann |
| From | Jivir Viyakesparan |
| Office | Hamilton |
| Date | 8 July 2020 |
| File/Ref | 2-37400.00 |
| Subject | Nukuhau Structure Plan - Water Upgrades |

# 1 Background

There have been many recent development enquiries and projects running concurrently by Taupō District Council (TDC) that are inter related when looking at the wider Master Plan for Taupo water infrastructure.

For this addendum, the developments of interest are those within the Nukuhau Structure Plan,

# 2 Impact on reservoir sizing

The following summarises the demand split of the Nukuhau structure plan demands into the proposed supply reservoir zones.

*Table 1-1: Nukuhau development demand summary*

| Portion | Total Peak Day Demand (L/s) | Proposed Supply DMA | Total Peak Day Demand (ML) |
|---|---|---|---|
| 1 | 4.16 | Woodward PS | 2.44 |
| 2 | 6.67 | Woodward PS | |
| 3 & 4 | 10.69 | Woodward PS | |
| 5 | 6.76 | Woodward PS | |
| 6 | 7.05 | Nukuhau PS | 0.61 |
| TOTALS | 35.33 | | 3.05 |

Source of demands: Taupō/Acacia Bay Calibrated Model Peak Day demands (excluding leakage).

The supply areas taken from the model and the proposed Nukuhau developments are summarised below in Table 1-2. The demands listed below account for the existing future demand, so include all the developments within the residential zoned areas.

*Table 1-2 : Supply DMA demands*

| Supply areas | Existing (ML) | Developments (ML) | Percentage Contribution developments make to future demands |
|---|---|---|---|
| Woodward PS | 1.34 | 2.44 | 64% |
| Nukuhau PS | 2.92 | 0.61 | 13% |

# 3 Impact of developments on upgrades

The following two Figures show the impact of the development demands on infrastructure upgrades.

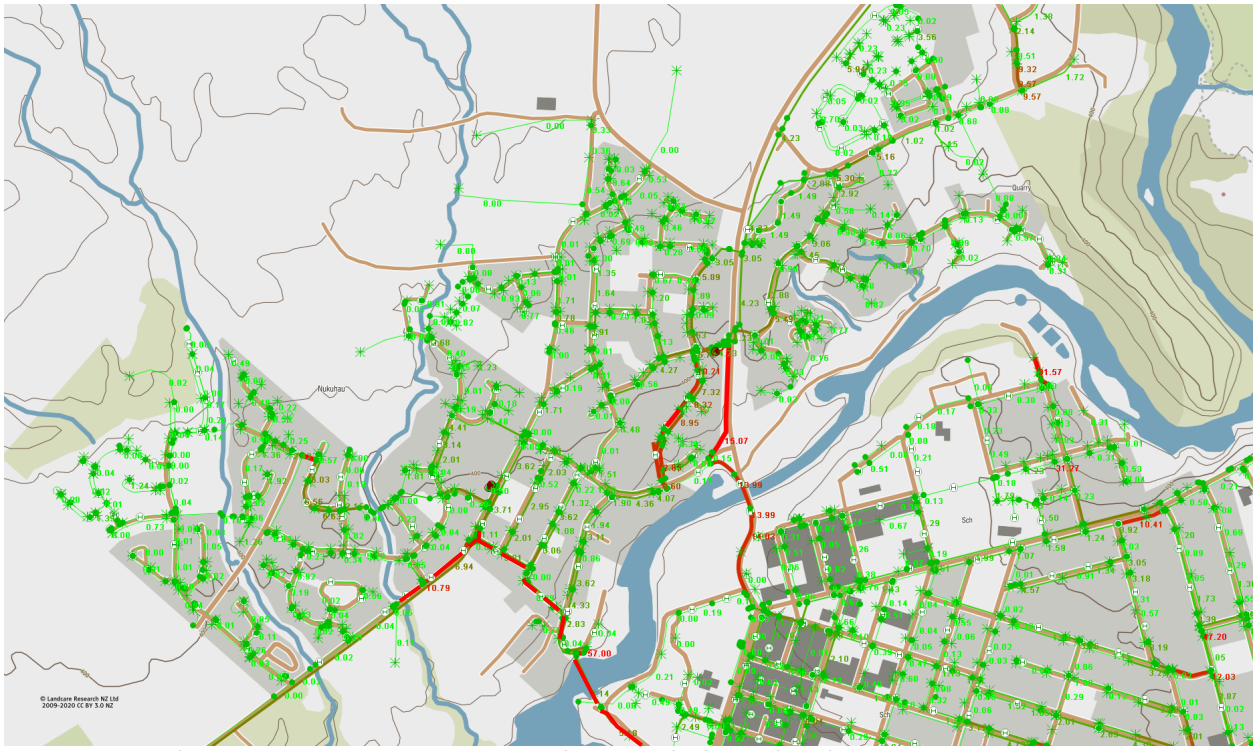

*Figure 1-3: Infrastructure requirements without Nukuhau developments*

Figure 1-3 shows that with the Acacia Bay connection operating there is no adverse impact to upstream pipelines within the Tamatea Reservoir zone.

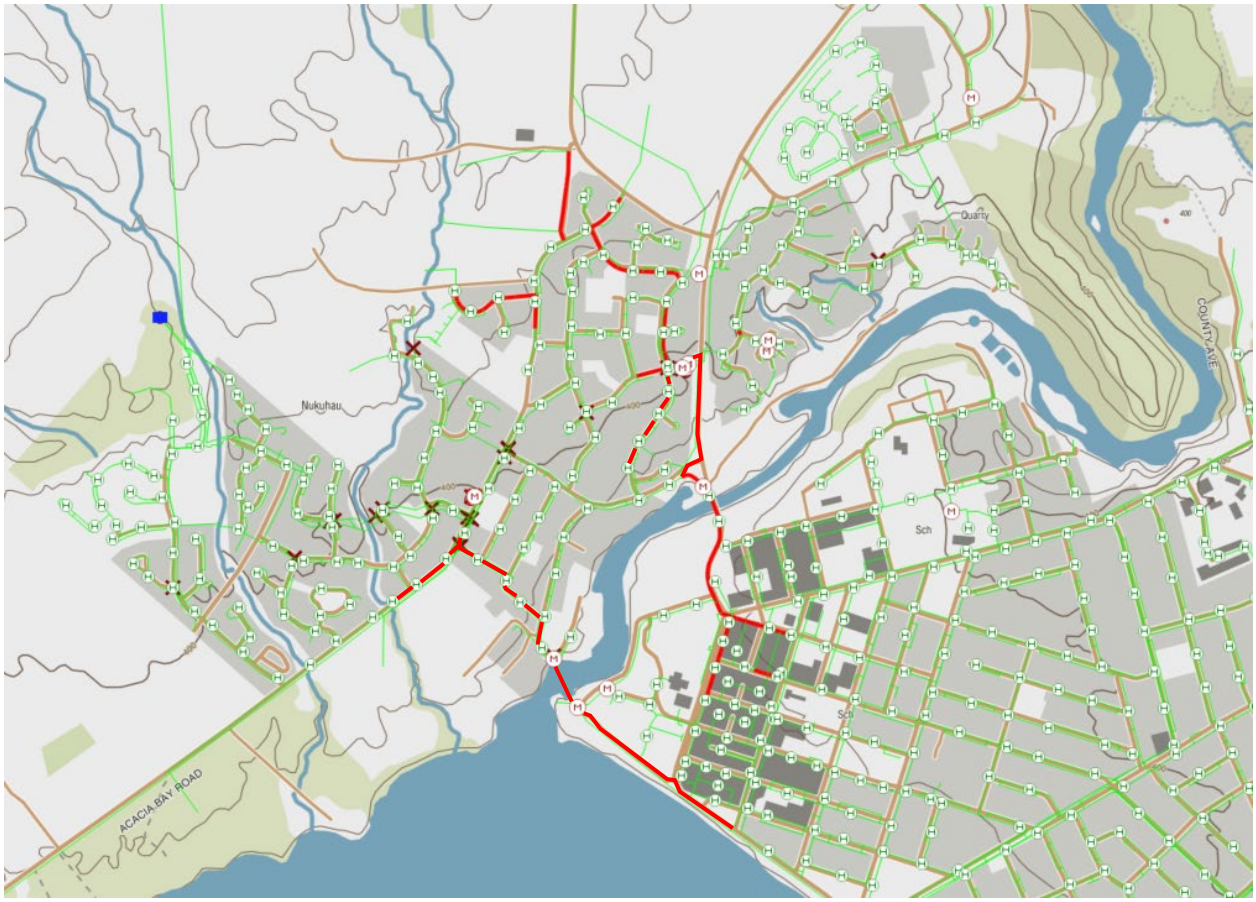


*Figure 1-4: Infrastructure upgrades requirements with Nukuhau developments*

Figure 1-4 shows the impact with the full Nukuhau developments, showing in the boosted zones of Woodward velocities greater than 2.4 m/s and in the upstream side (Tamatea gravity) pipelines with headloss gradients greater than 5 m/km.

The impact of the Nukuhau developments has an impact to the network upgrades required as shown above.  The impact is shown below in Figure 5 along Wairakei Drive and Tongariro Street.

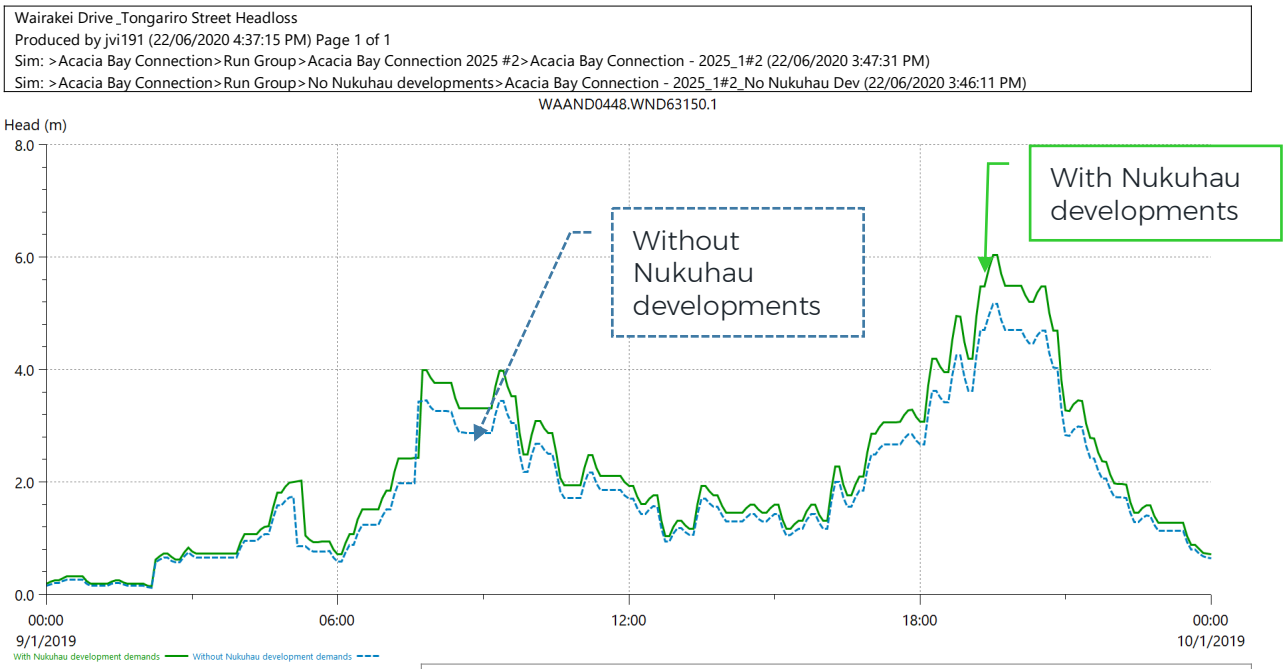


*Figure 1-5: Nukuhau development impact on Wairakei Drive and Tongariro Street*

The model shows that the maximum headloss along this section of pipeline will increase from 5.17 to 6.03 m with the inclusion of the Nukuhau developments, this relates to approximately a 17 percent increase due to the afore mentioned developments.

# 4 Conclusions

The analysis included the other future developments in Taupo as well the WPS operating with the connecting pipeline and future developments in Acacia Bay.

The above upgrades downstream of the Woodward and Nukuhau Pump Stations confirm they are required for the future developments occurring in Taupō and Acacia Bay and that the Nukuhau developments will have a small impact on some of the required upgrades upstream of the pump stations.

Those pipelines highlighted upstream of the pump stations will be required for both the Structure Plan and the Acacia Bay connection to maintain sufficient suction pressures to the pump stations.

# Appendix C
# Nukuhau Structure Plan: Wastewater Modelling report

# Technical Memo
## SEWER CAPACITY ASSESSMENT
For Nukuhau Structure Planning

TO: Hamish Crawford, Business Manager
WSP Opus, Taupo Office

PROJECT REF: 2-37400.00

FROM: Colin Meadowcroft, Project Manager/Civil Engineer
CDM Consultants Ltd

DATE: 19 December 2019

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### 1.0 PURPOSE OF MEMO

WSP OPUS (WSP) requested CDM Consultants Ltd (CDM) support with assessing available sewer capacity for a proposed Structure Plan for Nukuhau (Figure 1), on the north-west side of central Taupo.

### 2.0 BACKGROUND

The assessment relies on reviewing and updating Taupo District Council (TDC) InfoWorks CS sewer model, as developed by Harrison Grierson in 2013. For this purpose, OPUS provided recent survey which was used to check and update the model to ensure accurate pipe gradients and therefore capacities.

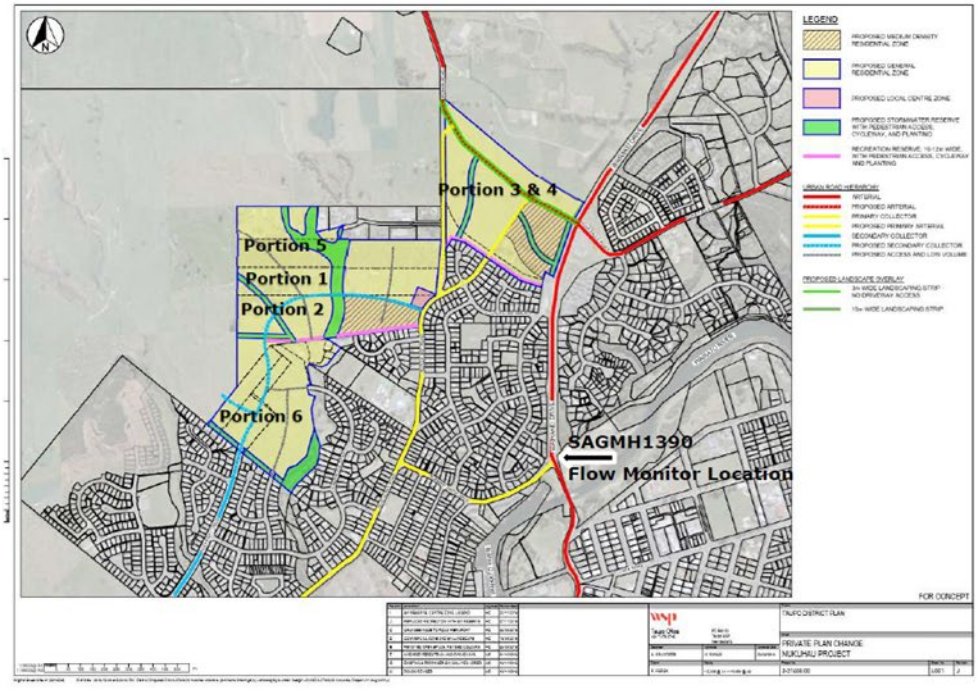



**Figure 1: OPUS Proposed Development Areas relating to Sewer Flows in Nukuhau, Taupo**

## 3.0 DEVELOPMENT DESIGN FLOWS

OPUS provided proposed design flows for consideration relative to available sewer capacity, as follows:

| *PORTION* | *Preliminary Flows for Analysis (l/s)* | *Final TDC Code of Practice DESIGN FLOWS (L/S)* | *5 x ADWF (L/S)* |
|---|---|---|---|
| Portion 1 | 5.0 | 5.8 | 3.6 |
| Portion 2 | 6.8 | 9.4 | 5.8 |
| Portion 3 & 4 | 11.8 | 15.0 | 9.3 |
| Portion 5 | 13.3 | 9.5 | 5.9 |
| Portion 6 | 9.4 | 10.6 | 6.5 |

It has been noted that the TDC Code of Practice (CoP) flows are conservative and therefore 5 times Average Dry Weather (5xADWF) was also considered which will reduce the surcharge levels from the TDC design flows.

## 4.0 MODEL UPDATES

The following review of the wastewater model was undertaken to improve confidence in the outcomes:

1. Update survey data, including manhole levels, pipe invert levels, and sewer capacity.
2. Review of sewer flow data and model calibration at relevant historic flow monitoring locations.
3. Updated model with design populations based on address points as per TDC Code of Practice (CoP).

The model updates confirmed that the sewer model is the best available tool for this assessment and is considered fit-for-purpose to inform decisions on the trunk sewers' available capacity for development.

## 5.0 CALIBRATION REVIEW

The model calibration was reviewed following the agreed updates and improvements. Significant fluctuations in Taupo's population occur due to the high number of holiday homes and tourist accommodation. Therefore, the calibration periods have been selected during peak season (Christmas holidays) with a significant rainfall event. A 100-year 24-hour equivalent rainfall event occurred on 23 January 2011 which was applied for the previous model calibration. The existing model was well calibrated at the Taupo WWTP magflow (Ref 853MAG) to the 23 January 2011 rainfall, however provides limited confidence in the smaller trunk sewers of interest. Therefore, it was agreed with TDC to use address points to calculate the maximum anticipated existing and future design population for this assessment.

## 6.0 SEWER FLOW SURVEY

Taupo trunk sewer flows were measured most recently during the peak season, from October 2017 to January 2018. The only flow monitor of relevance to this assessment recorded trunk sewer flows at manhole SAGMH1390 (Figure 1- berm of Wairakei Drive, just above Norman Smith junction). Flows measured within the incoming 525mm diameter sewer from West Nukuhau are shown on Figure 2 below. The model has a conservative existing population of 4119 with high per capita flows modelled to replicate measured flow.

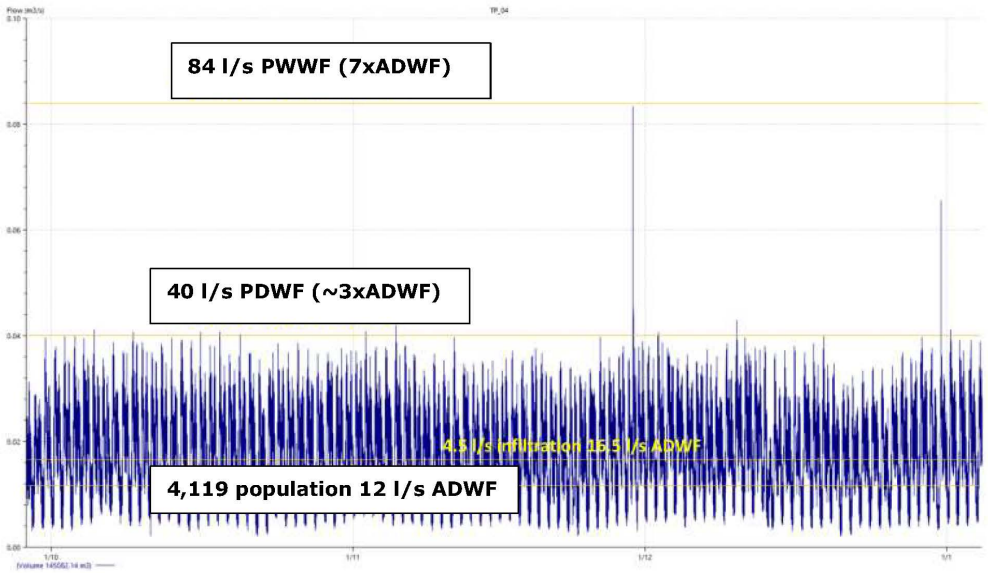



**Figure 2: Flow Survey (Reference TP04) measured in 525mm diameter SAMN1839 (2218.1)**

## 7.0 EXISTING SEWER NETWORK PERFORMANCE

There have been no reported wet weather overflows within the Taupo sewer network, however dry weather overflows have historically been an issue due to blockages. The model does not attempt to reflect dry weather overflows and is the best tool available to predict trunk sewer network performance. The model shows no ***existing*** trunk sewer network capacity issues for the existing situation, with spare capacity generally available within the 150mm diameter sewers in the steep Nukuhau suburb (Appendix A).

## 8.0 FUTURE SEWER NETWORK PERFORMANCE

The modelled trunk sewer long-sections (Appendix A) to convey future development flows along the proposed routes demonstrate where ***future*** surcharge would occur as a result of peak design flows exceeding the theoretical pipe capacity. Note that surcharge is not necessarily a problem unless it causes an overflow, and therefore further investigation is recommended to determine optimisation or mitigation where needed.

The trunk sewer siphon across the Waikato River bridge is a known hydraulic constraint, TDC currently has a trunk sewer siphon upgrade planned for June 2021 to upsize this. Timing of the proposed development will need to be assessed by TDC.

## 9.0 SUMMARY

Until the planned siphon upgrade project has been completed, there is no spare capacity of significance for additional development flows. The siphon upgrade project did not allow for the Nukuhau Structure Plan's proposed design flows given that it exceeds the existing District Plan provisions. The siphon sizing and timing will require review based on the outcome of the application.

This assessment has however confirmed that there is generally trunk sewer capacity available within the existing 150mm diameter sewer network, subject to some further investigation and potential mitigation as identified. Mitigation may involve upsizing or duplicating limited sections of trunk sewer to limit future surcharging.

## 10.0 RECOMMENDATIONS

It is recommended that TDC favourably considers OPUS request to connect the proposed development (as analysed) subject to reasonable conditions to satisfy Council that there are no adverse effects. This investigation has shown that the proposal can be achieved with limited mitigation work.

It is therefore recommended to undertake further survey work to complete manhole surveys where the modelling has shown potential capacity constraints. Further analysis can then be completed to confirm the recommended mitigation work.

## 11.0 LIMITATIONS

This report is for use by WSP OPUS only and should not be used or relied upon by any other person or entity or for any other project, with the exception that the relevant Territorial Authority can rely upon it for the purpose of processing those consent applications for which this report has been prepared.

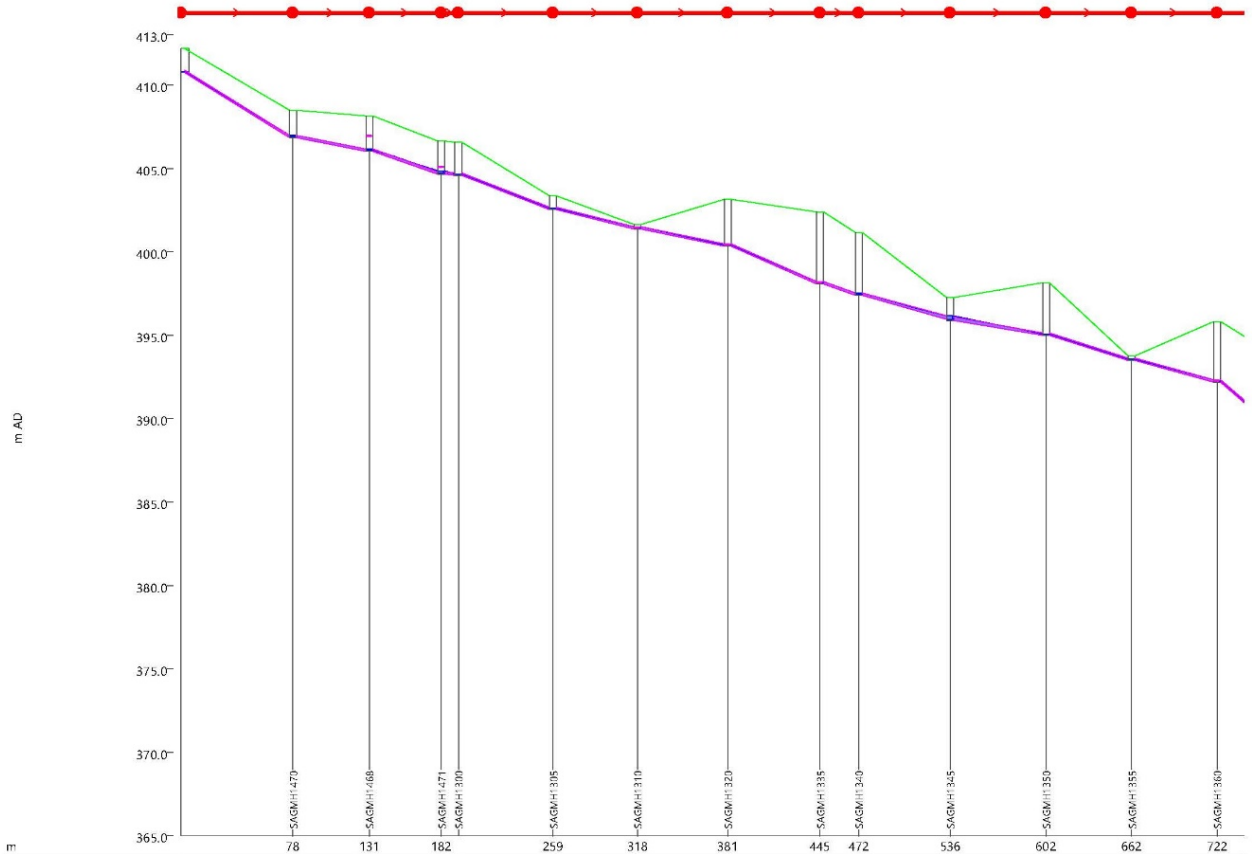
This report has been prepared for the particular project described to us, and no responsibility is accepted by CDM Consultants Ltd or its directors, servants, agents, staff, or employees for the use of any part of this report in any other context or for any other purposes.

It is emphasised that this assessment has been undertaken using theoretical design flows according to TDC Code of Practice and inflows are an unknown quantity, so may need future reduction measures by Council in the unlikely event that they exceed the theoretical design flows (approximately 8 times Average Dry Weather Flow (ADWF)).

## 12.0 **APPENDIX**

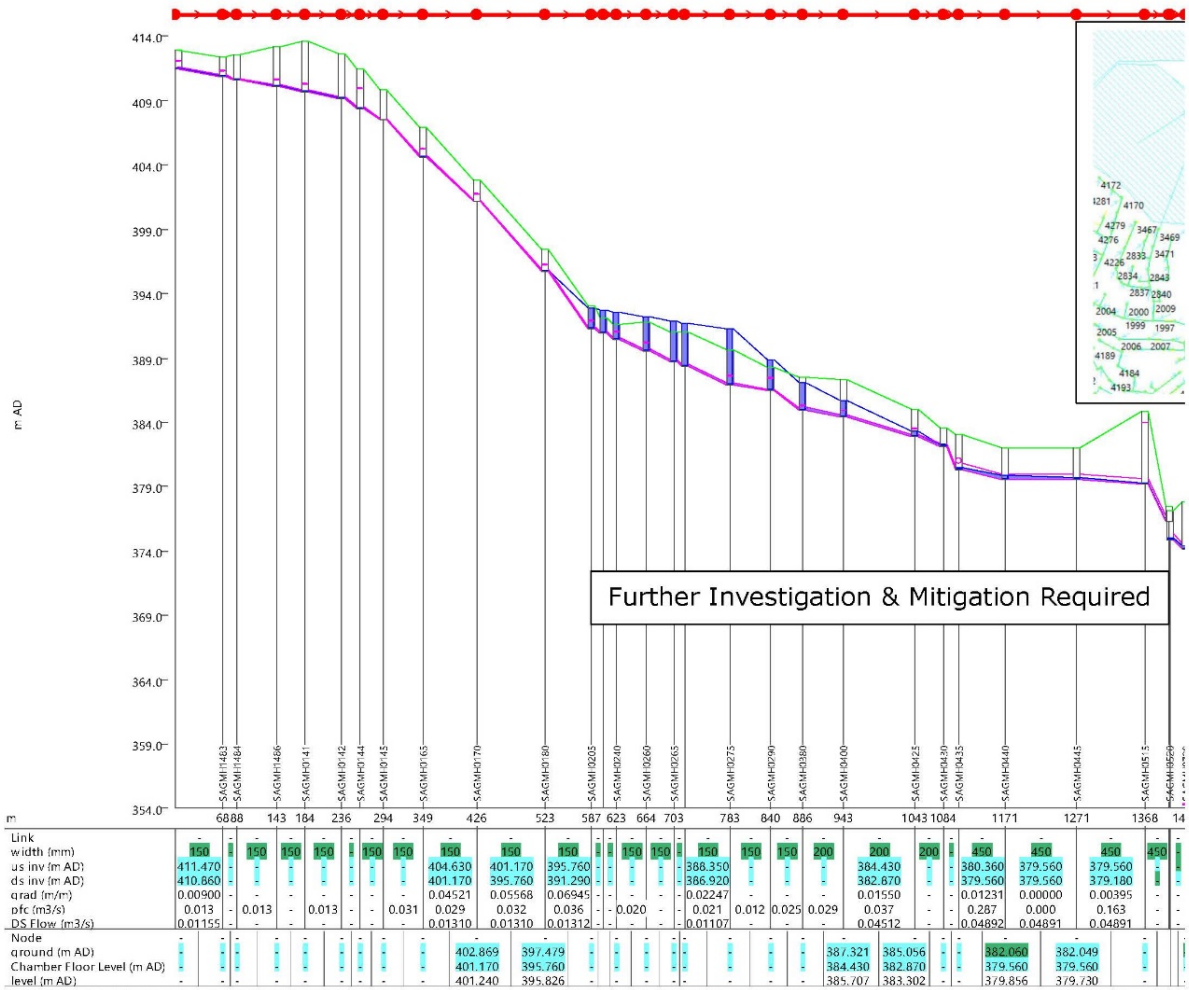
## APPENDIX A: MODELLED DESIGN FLOWS


## LONG SECTION 1: NUKUHAU PROPOSED DEVELOPMENT FLOWS FROM PORTION 5 (9.5 L/S) –

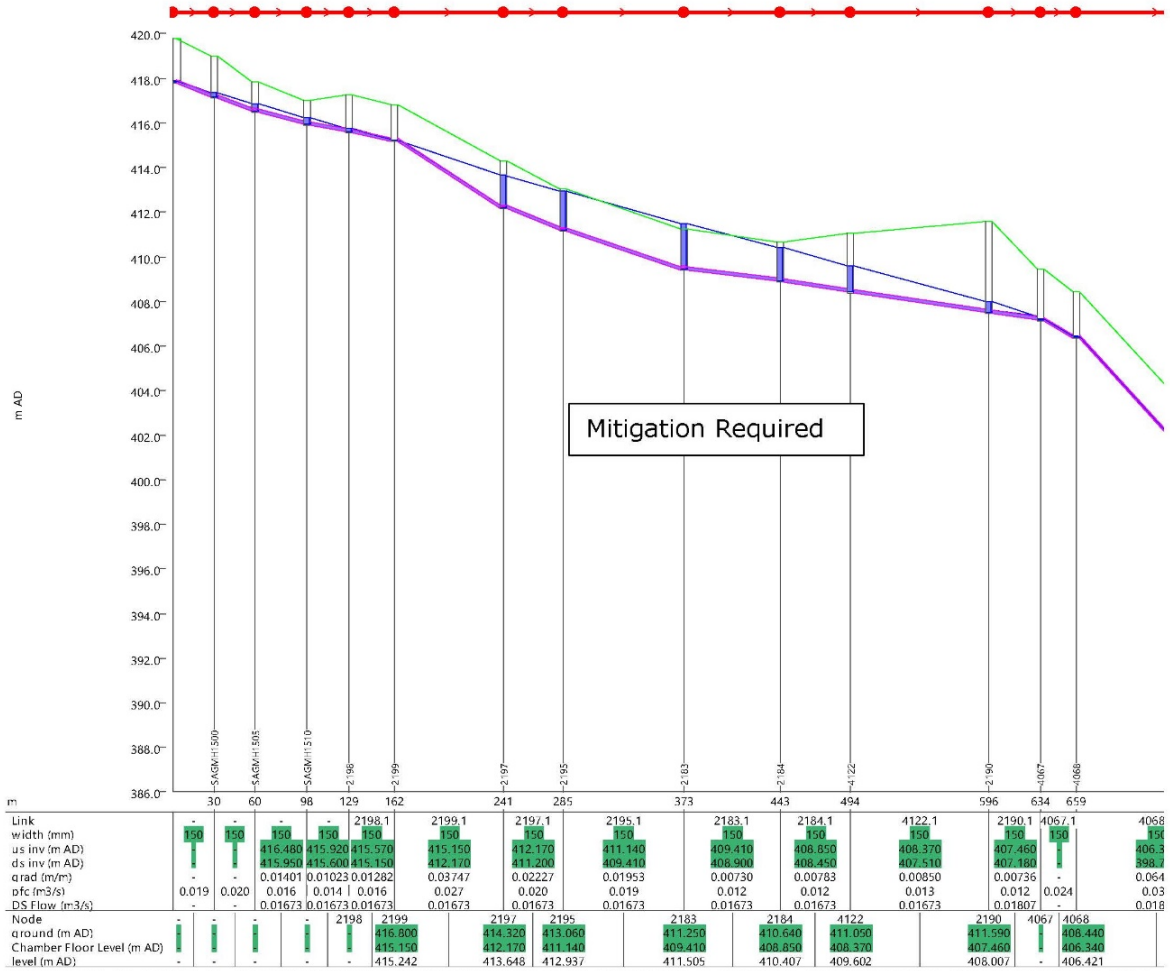



| m | | 78 | 131 | 182 | | 259 | 318 | 381 | 445 | 472 | 536 | 602 | 662 | 722 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link | SAGMH1469.1 | - | - | - | SAGMH1300.1 | SAGMH1305.1 | SAGMH1310.1 | SAGMH1320.1 | - | SAGMH1340.1 | SAGMH1345.1 | SAGMH1350.1 | SAGMH1355.1 | S/ | |
| width (mm) | 150 | 150 | 150 | | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | | |
| us inv (m AD) | 410.770 | 406.840 | 406.050 | | 404.580 | 402.530 | 401.390 | 400.340 | | 397.430 | 395.950 | 395.000 | 393.490 | | |
| ds inv (m AD) | 406.840 | 406.050 | 404.661 | | 402.530 | 401.390 | 400.340 | 398.120 | | 396.010 | 395.000 | 393.490 | 392.230 | | |
| grad (m/m) | 0.05012 | 0.01496 | 0.02754 | - | 0.03125 | 0.01936 | 0.01672 | 0.03439 | - | 0.02229 | 0.01425 | 0.02541 | 0.02096 | | |
| pfc (m3/s) | 0.031 | 0.017 | 0.023 | - | 0.024 | 0.019 | 0.018 | 0.025 | 0.022 | 0.020 | 0.016 | 0.022 | 0.020 | | |
| DS Flow (m3/s) | 0.01738 | 0.01738 | 0.01738 | - | 0.01738 | 0.01738 | 0.01738 | 0.01738 | - | 0.01738 | 0.01738 | 0.01738 | 0.01738 | | |
| Node | - | SAGMH1470 | - | - | - | SAGMH1305 | SAGMH1310 | SAGMH1320 | - | - | SAGMH1345 | SAGMH1350 | SAGMH1355 | SAGMH136 | |
| ground (m AD) | 412.220 | 408.540 | 408.160 | | 406.600 | 403.363 | 401.634 | 403.190 | 402.420 | 401.160 | 397.260 | 398.190 | 393.793 | 395.867 | |
| Chamber Floor Level (m AD) | 410.770 | 406.840 | 406.050 | | 404.580 | 402.530 | 401.390 | 400.340 | 398.120 | 397.430 | 395.950 | 395.000 | 393.490 | 392.230 | |
| level (m AD) | 410.856 | 406.980 | 406.155 | - | 404.681 | 402.650 | 401.519 | 400.437 | 398.227 | 397.543 | 396.178 | 395.108 | 393.606 | 392.307 | |

**LONG SECTION 2: NUKUHAU PROPOSED DEVELOPMENT FLOWS FROM PORTION 3&4 (15.0 L/S**




**LONG SECTION 3: NUKUHAU PROPOSED DEVELOPMENT FLOWS FROM PORTION 6 (10.6L/S)**




**LONG SECTION 4: NUKUHAU PROPOSED DEVELOPMENT FLOWS FROM PORTION 1&2 (15.2 L/**

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