Appendix E – Three Waters Design Summary

Mill Road Structure Plan Three Waters Design

1.1 Introduction

The three waters (water, wastewater and stormwater) concept has been developed in conjunction with the transportation concept as the majority of the three waters infrastructure will be contained in the proposed road reserves. The structure plan has been designed to make the most of the natural topography which allows for efficient gravity based drainage (wastewater and stormwater) systems with minimal pump stations. The design has been developed to align with the requirements of NZS4404 and WDC's associated supplement document and makes use of existing infrastructure where possible.

Below summarises the development of the concept design for each of the three waters.

1.1.1 Stormwater

The stormwater concept was developed using the following key assumptions:

- The entire structure plan area will be roofed and/or sealed in the future. This is a conservative approach that allows for future intensification as the Structure Plan does allow for some green space. This assumption affects the stormwater runoff coefficient, which is a variable used to estimate the portion of rainwater that will be converted into stormwater runoff. It takes into account the integrated effects of evaporation, natural retention and soakage/infiltration. The Compliance Document for New Zealand Building Code Clause E1 Surface Water lists the coefficient to be used for different surfaces / land uses and has been referenced to select a runoff coefficient of 0.9 (or 90%).
- No allowance has been made for further development upstream of the Structure Plan area.
- The latest version of WDC's validated 1D/2D stormwater model for this area has been used to size both the internal and downstream stormwater infrastructure.

Internal Stormwater Infrastructure

A map of the proposed configuration of the stormwater network within the structure plan area is given in Appendix E of the Structure Plan. This has been selected to follow the general topography of the site (falling from the northwestern corner down to the southeast) and discharges into the downstream section of the existing Mill Road Drain. This configuration minimises the extent of earthworks required for the creation of the primary and secondary stormwater systems. The stormwater general configuration was also selected to enable a staged approach to development.

In general, it is proposed the system will consist of a primary stormwater pipe network that is sized to convey flows from a 1 in 10 year storm event. Secondary overland flow paths will be provided by way of the road corridors and/or road side swales and are sized to cope with a 1 in 200 year rainfall events as per WDC requirements. Both storm events include an allowance for climate change as per WDC's supplement document to NZS 4404.

Currently the site does not have an even grade and there are some localised, relatively shallow, low points. The roading layout has been selected to intercept these low points so that they can be drained as much as reasonably possible. Where this is not possible, it has been assumed that some site contouring will be required during development to resolve these issues. This includes the current Mill Road open drain within the structure plan area. It is proposed that this drain be relocated to remain within the private property but run along the northern property boundary to minimise the impact this will have on the area of land practically available for development while minimising the amount of earthworks required.

Essential to the stormwater layout is the proposed open drain running along the southern boundary of the structure plan area. The drain acts as a “catch all” for the stormwater runoff from the Structure Plan area and is sized to cope with a 1 in 200 year storm event. An open drain is the most cost effective way of conveying the large flows in this area of the stormwater reticulation. It will also aid in creating delineation between the manufacturing zone and the land to the south which is currently zoned rural but may one day be residential and reduces the potential for reverse sensitivity complaints.

The open drain allows for a staged approach to development without high cost infrastructure being required up front. The drain can initially be shaped for only the first few stages of development and can then be augmented as development progresses at relatively minimal additional cost.

It is also proposed that an open drain be constructed across part of the northern Structure Plan boundary. This drain is designed to intercept the overland flows coming from the rural catchment to the north and convey the flow directly into the stormwater system. It may be possible to construct this drain within the rural zoned land, to minimise the impact to the higher valued manufacturing zoned land.

No provision for stormwater attenuation, other than a small area in the southeastern corner, has been made within the Structure Plan area. The existing attenuation area near the intersection of Mill Road and Raukau Road will nolonger be required once the Mill Road infrastructure and downstream upgrades are in place. This allows the majority of the land within the structure plan area to be available for development. Attenuation is proposed downstream of the structure plan area as discussed below.

Downstream Stormwater Infrastructure

A map showing the extent of the downstream stormwater upgrades required to cater for the development associated with the Mill Road structure plan area is presented in Appendix E of the Structure Plan.

Currently the Mill Road drain discharges into the Titoki Wetland which then drains into the Heads Road industrial area stormwater system. There are known capacity constraints in the Heads Road system at present, without increased flows from the proposed development in the Structure Plan area. For this reason the design allows for a new 1350 mm stormwater main be installed in Mosston Road to intercept the flows from the Mill Road drain upstream of the Tiktoki wetland and discharge them directly into the Whanganui River. It should be noted that this main will also provide some service to the Springvale residential growth area and is currently under construction.

A connection to the Tiktoki wetland will be retained to allow base flows to continue through to the wetland to maintain water levels in dry weather. The existing culvert, where the Mill Road drain crosses Mosston Road, will be restricted using an orifice plate so that only baseflows enter the wetland and larger flows will be diverted the 1350 mm Mosston Road stormwater main.

An attenuation area on the Mill Road drain between the structure plan area and the proposed Mosston Road pipeline is included in the concept design. The purpose of this structure is to restrict peak flows entering the Mosston Road pipeline allowing this pipe to be of a more constructible size. The attenuation area also meets low impact design principles laid out in NZS4404. The extent of the attenuation area outside of the structure plan zone is restricted by a large hill on the northern boundary and the existing high pressure gas mains on the southern boundary. To accommodate for the storage volume required, the attenuation area does encroach on a small portion of the Structure Plan area.

The attenuation area has not been sized to achieve peak flow hydraulic neutrality. That is to say that even with the attenuation area, the peak stormwater flow leaving the fully developed structure plan area will be greater than it is with the current level of development. A larger scale attenuation area is not achievable without further encroaching on the developable space within the structure plan area.

The Mill Road drain between the proposed attenuation area and Mosston Road will require augmentation (deepening and widening) to cope with the increased runoff associated with the development of the

Structure Plan area. It probable that WDC will take over ownership / form access easements for this drain so that it can be maintained in the future.

Modelling Results

As discussed above, the latest version of WDC's validated 1D/2D stormwater model for this area has been used to size both the internal and downstream stormwater infrastructure. Presented in Appendix E of the Structure Plan is a map showing the extent of flooding predicted in a 1 in 200 year rainfall if none of the downstream infrastructure upgrades proposed above were to be constructed. The second map, shows how the proposed upgrades resolve the flooding in the same rainfall event.

The modelling was carried out assuming a fully developed Springvale Structure Plan area as described in the Whanganui District Council Springvale Structure Plan prepared by GHD. The proposed stormwater upgrades make allowances for the findings of the groundwater assessments discussed in section 5.2 of the structure plan document.

1.1.2 Wastewater

Two options relating to the type of industry that may occupy the Structure Plan area were considered when creating the Wastewater concept for the Mill Road Structure Plan as discussed below:

- Light Industry – Design flow rate = 0.4 l/s/ha
  - Typical industry types would include manufacturing activities with minimal water demand other than for sanitary/staff purposes.
- Medium Industry – Design flow rate = 0.7 l/s/ha
  - Typical industry types would include manufacturing activities with some process water demand plus allowances for sanitary/staff purposes.

These design figures are sourced form NZS4404 and include allowances for both sanitary wastewater and tradewaste flows including the associated peaking factors. To put these figures into context, a typical residential development in Whanganui with a lot size averaging 700 m² including allowance for the road reserve would have a peak design flowrate in the order of 0.5 to 0.6 l/s/ha.

It should be noted that the above figures are an average across the entire Structure Plan area. Some land uses (including some of the sites already developed along Rakau Road), such as large warehousing or small manufacturing sites with large storage areas, will produce significantly less wastewater per hectare than that listed above.

Heavy industry and/or an allowance for wet industry were not considered in detail due to the known capacity constraints downstream. The cost associated with required downstream upgrades for such flows would likely prohibit development in the area.

The latest version of WDC's calibrated citywide wastewater model has been used to size both the internal and downstream wastewater infrastructure. The target level of service is to allow for zero untreated wastewater discharges to the environment in flow events equal to or less than a 1 in 1 year flow event. This is the common target adopted across WDC's existing wastewater network.

Internal Wastewater Infrastructure

Maps of the proposed configuration of the wastewater network within the structure plan area for both light and medium industry types are given in Appendix F of the Structure Plan. The general configuration has been selected to make use of the topography (so that a traditional gravity system can be utilised with minimal pump stations), tie into the existing infrastructure where possible and be cognisant of the proposed development staging.

The gravity pipelines have been configured to have a depth to invert of between 1 m and 3.5 m based on the existing topography / LIDAR, whilst complying with the minimum grade requirements of NZS4404.

There is one exception where the depth is 4.0 m for a short section where the pipeline passes through a small elevated area. However, this is unlikely to be a problem once re-contouring has been completed to provide the stormwater overland flow path in this area.

Light Industry Internal Wastewater Infrastructure

To cater for light industry, the majority of the gravity pipelines will be 150 mm in diameter (the minimum allowable size for wastewater reticulation as per NZS 4404) with the exception of 415 m of 225 mm diameter wastewater main along the southern boundary road west of Manuka Street. The existing 300 mm main in the Structure Plan portion of Manuka Street is of sufficient capacity to cater for light industry and will not require up grade.

Three pump stations are required within the structure plan area as tabulated below.

Table 1: Pump station requirements – light industry

Location	Catchment	Design Flow Rate	Rising Main
Towards the southeast corner of the structure plan area	Southeastern quadrant of structure plan area (bounded by Mill Road and Manuka Street).	8 l/s	570 m long, 150 mm diameter to discharge into the Manuka Street main.
Towards the southwest corner of the structure plan area	Eastern quarter of structure plan area.	12 l/s	25 m long, 150 mm diameter to discharge into proposed 225 mm gravity main.
Existing wetwell on Mill Road	Area north of Mill Road and east of the Rakau Road properties.	6 l/s	Existing 355 m long, 150 mm diameter rising main in Mill Road.

Medium Industry Internal Wastewater Infrastructure

To cater for medium industry, the majority of the gravity pipelines will be 150 mm in diameter (the minimum allowable size for wastewater reticulation as per NZS 4404) with the exception of 745 m of 225 mm diameter wastewater main along the southern boundary road west of Manuka Street. The existing 300 mm main in the structure plan portion of Manuka Street is of sufficient capacity to cater for medium industry and will not require up grade.

The same three pump stations detailed in Table1 are alos required for medium industry, however they will require increased flow capacity as summarised below.

Table 2: Pump station requirements – medium industry

Location	Catchment	Design Flow Rate	Rising Main
Towards the southeast corner of the structure plan area	Southeastern quadrant of structure plan area (bounded by Mill Road and Manuka Street).	14 l/s	570 m long, 150 mm diameter to discharge into the Manuka Street main.
Towards the southwest corner of the structure plan area	Eastern quarter of structure plan area.	20 l/s	25 m long, 150 mm diameter to discharge into proposed 225 mm gravity main.

Existing wetwell on Mill Road	Area north of Mill Road and east of the Rakau Road properties.	11 l/s	Existing 355 m long, 150 mm diameter rising main in Mill Road.

Downstream Wastewater Infrastructure

The wastewater concept allows for the entire structure plan area to drain into the existing 300 mm Manuka Street wastewater pipe. This discharge location was chosen as it is in close proximity to the structure plan area and allows for gravity discharge into the existing network.

Maps showing the extent of the downstream wastewater upgrades required to cater for the development associated with the Mill Road Structure Plan area under both the light and medium industry scenarios are presented in Appendix F of the Structure Plan.

Much of the wastewater from the Mill Road structure plan area will pass through the Tregenna Pump Station. It has been identified that this pump station requires upgrading to cope with the wastewater flows from the current level of service. The costs provided in this structure plan are for the increase in upgrades required as a result of the additional flows form the fully developed Mill Road structure plan area only.

A flow split at the intersection of Carson Street and Polson Street was closed off during the flow monitoring period and has not been reopened. As part of system improvements for the current level of service, it was proposed to open this flow split to allow some flow to bypass the Tregenna Pump Station. However, the additional flow from the Mill Road structure plan area would require further upgrades on the bypass, and therefore it is recommended that the flow split remain closed.

Light Industry Downstream Wastewater Infrastructure

The existing network on Carson Street has insufficient capacity to convey the additional flow from Mill Road. Approximately 242m of 300mm diameter gravity pipe is required to accommodate Mill Road Light Industrial growth.

Medium Industry Downstream Wastewater Infrastructure

In order to accommodate medium industry, a total of 480m of 300mm diameter gravity main is required on Carson Street. This is the entire main from Cornfoot Street to Polson Street.

In addition, approximately 195m of 375mm diameter gravity main is required on Polson Street. The existing wastewater main transitions from 375mm down to 225mm before connecting to the Carson Street wastewater main. The section of 225mm diameter wastewater main needs to be upgraded to accommodate Mill Road Medium Industrial growth.

Modelling Results

As discussed above, the latest version of WDC's calibrated city wide wastewater model for this area has been used to size both the internal and downstream wastewater infrastructure. Presented in Appendix F of the Structure Plan is a map showing the performance of the wastewater system in a 1 in 1 year wastewater flow event if none of the downstream infrastructure upgrades proposed above were to be constructed. The second map, shows how the proposed upgrades resolve these performance issues.

The modelling was carried out assuming a fully developed Springvale Structure Plan area and allows for residential infill as described in the GHD Report Whanganui City-Wide Growth Wastewater Bulk Supply Investigation (Revisited) – March 2016.

1.1.3 Water Supply

As with ~~the~~ wastewater, two options relating to the type of industry that may occupy the structure plan area were considered when creating the water concept for the Mill Road Structure Plan. These are light and medium type industries.

NZS 4404 does not give design figures for industrial water demand in the manner that it does for wastewater. Therefore the wastewater figures were used to estimate the typical water demand based on the assumption that 20% of the total water supplied will not enter into the wastewater network. The 20% is intended to account for water losses / consumption in industrial processes and evaporation/soakage that may occur.

The water concept has been sized using the following key assumptions:

- Peak water demand for light industry = 0.50 l/s/ha
- Peak water demand for medium industry = 0.88 l/s/ha
- Minimum allowable pressure at peak demand is 25 m
- The maximum fire water demand is 100 l/s, this equates to a FW4 fire water classification as per the New Zealand Fire Service Firefighting Water Supplies Code of Practice (SNZ PAS 4509:2008). Industries with large fire cells (e.g. warehouses) and/or with high fire hazard classifications are likely to require sprinkler systems to comply with the code of practice. If an individual building requires more than 100 l/s (combined sprinkler and hydrant demand) onsite storage of fire water will be required. This can be addressed on a case by case basis.
- The ultimate peak demand = 2/3 the peak water demand plus fire flow (as per SNZ PAS 4509:2008).
- Minimum allowable pressure at the ultimate peak demand is 10 m (as per SNZ PAS 4509:2008).

The latest version of WDC's calibrated citywide water model has been used to size the water infrastructure required to service the Mill Road structure plan area.

Internal Water Infrastructure

A map of the proposed configuration of the water network within the structure plan area is given in Appendix F of the Structure Plan. In general it is proposed that the reticulation in each road will consist of a 200 mm nominal bore water main on one side of the road and a 50 mm nominal bore rider main on the other, as instructed by WDC. It is noted that this deviates from NZS4404 which states that dual water mains should be used in industrial zones.

The fire demand is the determining factor as to the pipe size required, as such there is no difference in the water main sizing between the light and medium industry options.

Connecting Water Infrastructure

The Castlecliff trunk water main runs along Manuka Street and is the main point of water supply to the structure plan area. There are two existing pressure reducing valves (PRVs) near the Mill Road / Manuka Street intersection, all connections to the trunk main will be made on the low pressure side of these. Additionally, as part of the Springvale Structure Plan it is proposed that the 225 mm main be constructed to connect the existing Mill Road water main to the Fitzherbert Avenue water main. This main will also provide additional resilience to the water reticulation in the Mill Road Structure Plan area. No upgrades are required to the existing water network to service the Mill Road area provided the modelling anomaly discussed below can be resolved.

Modelling Results

As discussed above, WDC's calibrated citywide water model has been used to size the water infrastructure required to service the Mill Road Structure Plan area. Presented in Appendix F of the Structure Plan are maps showing performance of the water supply when Mill Road is fully developed. The results show that no upgrades are required to the water supply to service the Mill Road Structure plan area.

It should be noted that during model calibration, an anomaly was discovered that shows that the Castlecliff trunk main is under performing when compared to its theoretical capacity. Commonly these issues are caused by partially closed valves with the network. WDC is currently undertaking a survey to locate the cause of the anomaly. For the purposes of this Structure Plan it is assumed that this anomaly can be resolved without any capital works/expenditure.