Appendix A- Stormwater technical design philosophy

Memorandum

To	[redacted], Wellington Water
cc	
From	[redacted]
Date	2 October 2023
Subject	Stormwater Technical Design Philosophy
Reference	1091097.TT.2100.PRW.ME.DM.0012.Stormwater Design Philosophy

1 Introduction

Options are being developed, culminating in a preferred option, to reduce flooding within the catchment of the Opahu Stream. The primary focus of these options will be to reduce flooding:

- within the identified growth area
- of residential homes (floor levels) and access to the houses
- of arterial roads identified by HCC[1]

Of secondary importance is reducing flooding:

- to residential land adjacent to dwelling spaces or access and egress routes.

The workshop participants would have liked to have had a secondary emphasis on reducing flooding to commercial and industrial properties, however the funding agreement with Kāinga Ora is to enable predicted housing growth only.

The goal of the design is to allow for growth within the catchment by reducing both existing and future flooding. This will be measured by a comparison with future flooding scenarios (allowing for growth and climate change impacts). A Level of Service (LOS) requirement has not been defined, therefore option selection will be guided by the principle of delivering as much reduction of flood risk as possible (measured by the estimated number of flooded residential floors and length of arterial road), within an affordable budget[2]. This assessment will be carried out on the shortlisted

[1] HCC has provided a list of critical roads, none of which lie within this catchment. T+T will continue to work with HCC to identify whether any arterial routes or primary collectors need to be considered in the assessment.
[2] The affordable budget is generally taken to be the funding already committed, however, any options that provide considerable additional benefits or resilience for a small additional spend, as assessed using the sensitivity results, will also be presented.

options to guide the choice of a preferred option. The aspiration is that future flooding is at least no worse and preferably less than what is predicted today.

Infrastructure planned under this project will be designed to be both resilient to flood events themselves (i.e., to have confidence that it will perform as expected) and also resilient to uncertainty in the design parameters for future flooding. Additionally, any measures that show promise in improving resilience to flooding in the catchment will be highlighted in the reporting, even if these lie outside the scope of the options developed within this project.

2 Target design event

Our target event is the 1% AEP[3] future event and this is the main event for which flood benefits will be modelled. We will also, however, for the preferred option model the 1% AEP present-day event and the 10% AEP future event, in order to understand the full spectrum of risk.

The target event for measuring flood benefits doesn't correspond to a flood reduction or infrastructural LOS, which has not been defined. Infrastructure will be sized for at least 10% AEP flows in line with Wellington Water's Regional Standard. Some elements may be designed for larger flows, but not necessarily for 1% AEP.

3 Uncertainties and key assumptions

Several important inputs to the design are subject to uncertainties. These include:

- Sea level rise,
- Climate change impacts on rainfall intensity,
- Changes in runoff due to growth.

Given that the factors above are likely to impact all options in relatively equal measure, for our options comparison, in order to meet timelines for delivery of Stage 1 we will adopt the following for design, in line with the latest guidance from Wellington Water:

- Increased rainfall due to climate change: new allowances as advised by Wellington Water and included at the end of this memo. This is a greater allowance than has been used to date.
- Relative sea Level rise due to climate change and vertical land movement: new allowances as advised by Wellington Water and included at the end of this memo. This is a sea level rise of approximately 1.7m.
- Growth: hydraulic neutrality, ie. no increase
- 10% AEP concurrent event in the Hutt River

Once we have a preferred option, we will examine the sensitivity of the outcomes to the above uncertainties and make suitable recommendations around design envelopes, infrastructure sizing and/or futureproofing in order to manage these risks.

Other key assumptions include:

- Where the preferred option may be influenced by an existing under-capacity network (as evidenced by significant flooding in the 10%AEP flood map), we will seek advice from Wellington Water/HCC about reasonable assumptions to be made around future network upgrades. Where practicable, the possibility of these will be taken into account in the sizing

[3] With climate change, sea level rise and growth allowed for

of the preferred option. We will work with HCC to define the preferred approach to this within budget constraints.

- Approvals will be obtained from Wellington Water for departures from its standard infrastructure sizing requirements, if needed (this will be addressed in subsequent stages of design).
- For options to be viable, they must lie within the funded threshold of [redacted] (including professional services) for the stormwater projects. This consists of funding from Kāinga Ora and HCC and is split approx. [redacted] and [redacted] respectively between the Melling and Woburn pipelines.
- That the focus on the Opahu Stream as the main constraint to stormwater network performance and cause of flooding, is correct.
- Additional penetrations through or under the stopbanks (beyond what is already consented) should be avoided.

4 Residual risk

We recognise that no design will eliminate the flood hazard and that areas of flood risk will still remain. This includes:

- Areas of flood hazard that couldn't be fully addressed by the preferred option.
- Risk due to events larger than what was designed for.
- Risks due to infrastructure failures (such as pump failure).

We will identify this residual risk and communicate it to HCC.

Appendix A: New climate change guidance from WWL

From: [redacted]
Sent: Thursday, September 21, 2023 11:06:40 am
To: Hutt Stormwater IAF [redacted]
Cc: [redacted]

Subject: RE: Hutt IAF stormwater projects

Hi [redacted]

Here are new requirements for sea level rise and climate change as presented in Table 1 below. The relative sea level rise (RSLR) and SSP pathways are referred to in the Interim guidance on the use of new seal level rise projections (MFE 2022) . For the climate change allowances, the RCP 8.5 scenario is referred to in the Coastal hazards and climate change: Guidance for local government (MFE 2017). Our intention is that the project team will consider the most efficient way of incorporating these changes into the design methodology, we are happy to discuss further if useful.

Table 1. Summary of proposed approaches for sea level rise and rainfall.

Category	Sea Level rise allowance	Rainfall
-Base-case scenario for modelling and project work.	RSLR out to 2130 for SSP5-8.5M scenario	Rainfall figures based on HiRDs V4 RCP 8.5 scenario for year 2100.
-Dynamic freeboard modelling for district plan flood extents and minimum floor levels. -Stress testing for critical projects	RSLR out to 2130 for SSP5-8.5H+ scenario	Rainfall figures based on HiRDs V4 RCP 8.5 scenario for year 2100, scaled-up to suit current dynamic freeboard testing method.
RSLR = Relative Sea Level Rise		

Kind Regards,

[redacted]

Appendix B- Stormwater pump station design

Memorandum

To	[redacted] Tonkin & Taylor
cc	[redacted]
From	[redacted]
Date	8th March 2024
Subject	Storm Water Pump Station Design
Reference	**1091097.TT.2100.PRW.ME.CV.87. Stormwater Pump Stations Technical Design Philosophy Memo**

PUMP STATION DESIGN TECHNICAL NOTE

General context

Mott MacDonald are working with Tonkin & Taylor to deliver a pre-feasibility options study for reducing flooding in the Lower Hutt catchment through the Hutt Water Infrastructure for Growth stormwater design for Hutt City Council. This memo outlines the pump station design philosophy during the options assessment phase. Tonkin & Taylor have managed all catchments and hydraulic modelling, and Mott MacDonald designs are based on the flow values and hydraulic intake locations from Tonkin & Taylor's assessment. Flow to the pump stations will be collected from local stormwater network connections and diverted from the Opahu Stream to avoid flooding of properties.

Three options were considered following the longlist assessment, comprising of four pump stations in total. These were further developed during the shortlisting stage. The proposed location of the pump stations has been selected by Tonkin + Taylor, who have also provided design flows for each based on early / preliminary modelling. A summary of each shortlisted pump station is provided in the table below.

Table 0-1: Summary of Proposed Pump Stations

Option	Proposed Location of Pump Stations	Design Discharge (m^3/s)
1B – Eastern Hutt School Pump Station	At the northern end of Eastern Hutt School	2 m^3/s in total, comprising of 1 m^3/s contribution from a new gravity stormwater main, and 1 m^3/s from the neighbouring Opahu Stream via a new intake structure
4.1 – Chilton St James School Pump Station	At Waterloo Road, east of Chilton St James School	2.5 m^3/s from Opahu Stream
4.2 – Riddiford Pump Station	At or in the vicinity of the Hutt Bowling Club carpark, off Myrtle Road	Discharging to the Hutt River independent of Chilton St James Pump Station: 3 m^3/s from nearby Opahu Stream

Option	Proposed Location of Pump Stations	Design Discharge (m^3/s)
5 – Hutt Recreation Ground	At northwestern corner of Hutt Recreation ground	3 m^3/s in total, comprising of 1.5 m^3/s from each of two new stormwater mains from Opahu Stream

Options for combining discharge from the two option 4 pump stations (Chilton St James and Riddiford) have been assessed during the long and shortlist stages. This included a "Daisy chain" option with Chilton St James Pump Station discharging into the Riddiford Pump Station wetwell. Combined discharge has been discounted at this stage due to a number of factors, including increased depth of the wetwell at Riddiford Gardens.

Approach and general assumptions

Diversion structures

The pump station intakes have side weirs along the Opahu Stream bank. Hydraulic structures downstream of these weirs have been included to maintain overflow conditions at the weir locations during high flows. Detailed hydraulic modelling and sediment analysis has not been undertaken at this stage. Refinement of the diversion structures, and pump station locations, depths, and flood water levels will be carried out as the design develops following modelling and analysis and subject to confirmation of space availability on site.

The conceptual design for diversion structure weir levels is based on the flood water levels obtained from a HECRAS simulation (https://www.hec.usace.army.mil/software/hec-ras/), using Wellington Water Flood Hydrographs for the Opahu stream. The HECRAS model was used during this stage of the design due to the lack of a hydrological model to determine flood levels at the weir locations.

The levels of the intake weirs are a function of the hydraulic and stream channel conditions upstream and downstream of the intake weir. At this stage in the design, the Froude number has been calculated as being less than 1 ($Fr<1.0$) based on the flow rate and available LIDAR data of the stream profile. The proposed intake weirs are best suited for cases where the Froude number (Fr) < 1.0. To allow for the possibility that the Froude number increases to $Fr>1.0$ following further investigation, topographical surveys and modelling we have assumed that the river cross section upstream and downstream may need to be adapted to optimize intake performance and prevent inundation of adjacent properties. It is currently proposed that the slopes of the revised stream bank will be regraded through cut and fill, and grassed to minimise erosion. This has not been designed in detail at this stage and is therefore an allowance only. Extents are indicatively shown on the drawings.

The hydraulic structure design follows the gravity structure design methodologies outlined in various standards and guidelines, including:

ANCOLD – Australian National Committee on Large Dams, ANCOLD 2013 - Guidelines on design criteria for concrete gravity dams 2013,

USBR – United States Bureau for Land Reclamation USBR, Design of Small Dams, 3rd Edition (1987),

USACE – US Army Corps Engineering Manual, Gravity Dam Design, EM 1110-2-2200,

NZSOLD – New Zealand Society on Large Dams – ISBN 978-0-908960-65-1,

ANSI - American National Standards Institute – Hydraulic Design, ANSI/HI 9.8.1998,

May, R. W. P., Bromwich, B.C., Gasowski, Y. and Rickard, C. E. (2003). *Hydraulic design of side weirs.* Thomas Telford Publishing

Foundations have been designed at this stage using a load combination case of:

Deadload + Hydrostatic Load + Uplift Load + Silt load. The weir overflow rates range from 1 m^3/s - 3 m^3/s depending on the site. Seismic loads will be assessed once actual site data (design information) is confirmed

The design assumes that the ground conditions, following ground improvements are stable and suitable for structural loading. At this stage, ground improvements assumed have been detailed in section 1.1.2 below. The detail and requirement for any ground improvement will need to be reviewed following site-specific geotechnical investigations.

1.1.1 Hydraulic design criteria

The hydraulic design has focused on surface flood diversion structures and pumped systems to divert flood waters. A high level HECRAS model was developed as a design aid, from the LiDAR only, using hydrographs provided by Wellington Water for the 10 year ARI plus climate change event with a free tailwater condition. The model was used to set the preliminary crest weir elevation height, these elevations may change following hydraulic modelling of different flood scenarios and combinations for the Hutt River and Opahu Stream at later design stages.

The calculations for the intake weirs follow the method set out in Hydraulic design of side weirs (May, 2003). The design flow for the side weir is based on the proposed diverted flood flow rate at the intake point for each pump station site. The required diverted flow rates are achieved by varying the intakes' weir crest levels (overflow height) and the lengths of the crest of the side weirs.

The weir length optimisation is constrained by the fact that the area is heavily built up, and inundation of private properties during extreme floods must be minimised. Additionally, the highest weir crest level for the side weir is governed by the flood water level in the main channel and the proposed freeboard level (between the overflow level and the top of the bank) at the peak flood flow rate. Freeboard levels have been assumed in the weir design calculations. The HECRAS model was used to provide the peak flood level to feed into the weir level design.

Due to the topography of the area, hydraulic model results for the flow rates at the side weirs produced low, almost stagnant velocities (0.1-0.2m/s). This did not align with the anecdotal descriptions of flooding behaviour relayed to the team from the St Orans caretaker during a site visit and does not align with pictures of localised flooding. Therefore, to determine a weir sizing at the side weir intake points at this stage in the design, a theoretical flow rate based on an assumption of 0.6 m/s open channel flow velocity coupled with LIDAR was used.

These assumptions should be revisited as the project design develops and a more detailed model of the stream is available.

The design of the river intake structures is expected to comprise:

i. A hydraulic control structure and diversion weir coupled with wing walls to divert the flow to the overflow weir and an upstream and downstream apron to prevent scour and improve stability.

ii. A downstream channel section linking the weir to the draw-off structures.
iii. An offtake chamber with coarse and fine trash racks.
iv. A scour system for the downstream channel and the offtake chamber
v. Stop logs for flow control into the pump station.
vi. Depending on the site conditions, a draw-off system to the wet well, consisting of pipework or a channel, is necessary.

The diversion side weir is sized based on the equation below:

$$Q_S = \eta\sqrt{g}Lh_O^{1.5}\left[J - K\left(\frac{L}{B}\right)F_O\right]$$

Equation 6.5 (May 2003)

Where:

n = Weir Efficiency
h_o = Calculated head above weir
L = Crest length of overflow weir
g = gravitational acceleration
h_o/L = Hydraulic Constant
J = Constant dependent on h_o/L obtained from Hydraulic graphs
ho/p = Hydraulic Constant
Qs = Diverted flow rate m^3/s
K = Constant Dependent on h_o/p obtained from Hydraulic graphs
B = Channel Breadth
F_o = Froude Number Downstream of main channel

Pump station

1.1.2 Foundations

The sketch in Figure 1 was provided by T+T and is a preliminary foundation option for pump stations and intake structures. It comprises:

- 1m thick raft foundation comprising compacted granular fill.
- Ground improvements beneath the raft foundation comprising: 5m deep controlled modulus columns, typically 1.5m interlocking grid 600mm diameter CFA piles as shown on yellow zone on sketch below.
- Controlled modulus columns as per the above, to varying depth as shown in green zones on sketch below. Depth reduces as distance increases from the structure.
- Compacted granular fill around the side zones.

Depth of Aquifer is approx. 15-20m below ground level, shallowest in the north areas of the project which apply for this option. A cautious construction methodology is required for piling works

(temporary or permanent) and sheet piling around pump stations (as well as site investigations). Sheet piling into dense gravels may not be possible. CFA or contiguous bored piles may be an option.
Piping and heave in base of excavations is to be managed / mitigated in construction methodology.
This is conceptual only at this point in time and was developed for costing purposes. Therefore, design and detail of these foundations should be completed during the design development.

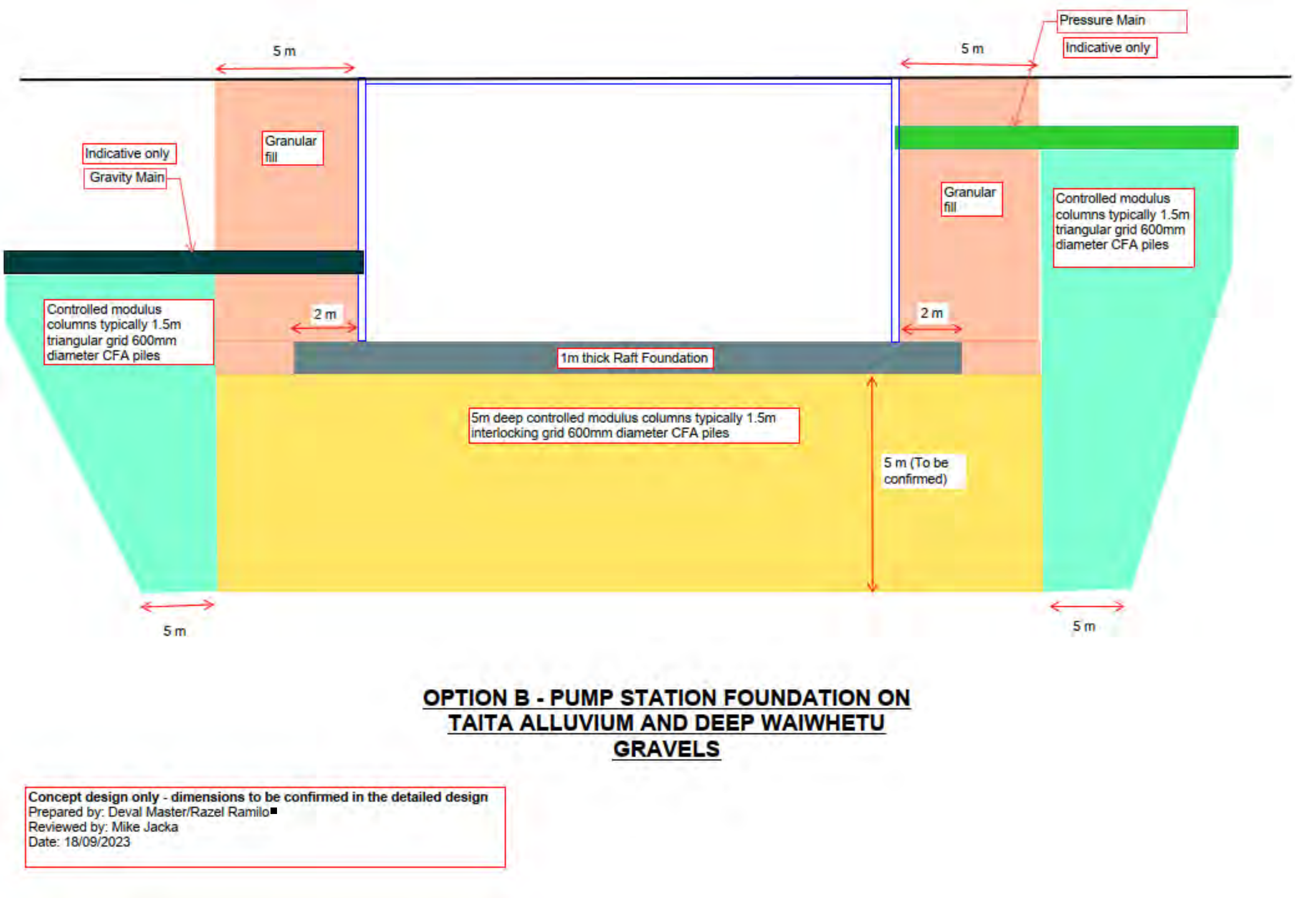

Figure 1 Indicative Pump Station foundation design

1.1.3 Inlet structure and forebay

The pump stations receive flows from a side weir adjacent to the Opahu Stream connected directly to a stilling chamber, which on most sites are in turn connected to an inlet structure via an open channel. For Eastern Hutt School (Option 1B), the stilling chamber connects to the inlet chamber via a 2m long 1500mm diameter ductile iron gravity pipe. The inlet structures are then connected to a forebay on each site that leads to the wetwell.

For the Eastern Hutt School (Option 1B) and Chilton St James (Option 4) options, additional piped flows from stormwater systems outside the Opahu Stream are also collected and transferred into the inlet structure. The flow for Eastern Hutt School has been provided through Tonkin & Taylor's hydraulic review and is 1.0 m^3/s, this has been included in the pump station design. The stormwater flow for Chilton St James is yet to be clearly defined. The the main pump station intake at this stage has been designed for 2.5 m^3/s. The pump station wetwell and electromechanical design for the pump systems are outlined in later sections of this report.

Each pump station has an inlet structure, which serves several purposes:

- It provides favourable conditions by stilling the incoming flood waters' turbulence, and kinetic energy.
- Captures suspended solids, bulk debris will be captured via screens near the river intake location.
- Flow surge modulation is provided for the pump station by attenuation of sudden peaks.
- It acts as a mixing chamber where flood waters come from multiple sources e.g. stormwater and stream abstraction.

The pump station structures have been checked for floatation and will be refined in the next stage of design as more accurate information is available. The forebay design follows the Xylem pump station guidelines and ANSI/HI 9.8-1998 guidelines for forebays with converging or diverging inlet channels into the wet well. The recommended velocity requirement is $V < 0.5$ m/s. Based on the ANSI guidelines, the wetwell floor slopes at an average gradient of 10% with an angular divergence limited to < 40° for the forebay walls against the incoming diversion channel. The elevation of adjacent structures has also been considered and will be further refined in subsequent design stages.

1.1.4 Valve chambers

The pump stations include valve chambers that are approximately 1.0 m above ground. The exact levels will be confirmed following site-specific investigations, and are largely driven by the height of the valves. The layout will be detailed in the next phase of the design and should also focus on safe access and egress as required. It has been assumed that mobile cranes will be used for any operational valve replacements and heavy lifting, which should also minimise requirements for entry into the chamber. To minimise structural heights and depths as well as on site lifting equipment, access hatches in the roof of the valve chamber have been included to provide vertical access above the pumps.

1.1.5 Generator and electrical unit

At each site, space for a generator and electrical equipment has been provided, in addition to a provisional cable route. The structure required for this equipment has not been detailed at this stage and will need to be developed during future phases. This is required to protect the generator and the electrical control panels and related ancillaries from adverse weather conditions.

1.1.6 Wetwell

The wetwells and pumps have been designed based on the maximum flow rate expected at each site. Variable speed drives (VSDs) will be used for soft starting and to reduce the pump speed and therefore flow rate for low flow scenarios; however, we have not assumed at this stage that they will decrease the volumes/depths of the pump stations due to reducing the number of starts at higher flows. Use of VSDs will be reviewed during the next phase of the design to set a control strategy based on maintaining pre-set water levels.

The wetwells have been designed as concrete structures which sit below ground level, with the roof slab flush with the ground. Hatches are required in the roof of the wetwell directly above the pumps to provide vertical access. This will allow mobile crane access for any operational and maintenance requirements. Access arrangements should be reviewed as the design is developed.

1.1.6.1 Sizing Pump Chambers

The pump station wetwell design follows the 'Design Recommendations for Pump Stations using Flygt Centrifugal or Axial Flow Pumps' guideline by Xylem, and the Wellington Water Regional Specification for Water Services, December 2021 Version 3.0.

All pump stations are assumed to have the submerged pump type (i.e. wet well only), which is typical of efficient pump station design in New Zealand. The initial layout designs for all sites used a mixture of axial and centrifugal pumps. During the shortlist design development, axial flow pumps replaced the centrifugal pumps to suit the high flow and low head characteristics of this pumping scenario.

Xylem provides guidelines for sizing the pump wetwells commensurate with the Flygt axial pump capacity, thus determining the well depth, minimum pump submergence, and operating water levels. A maximum freeboard of 1.0m is allowed in the wet wells. The freeboard may be revised to suit the dimensions shown in the drawings to achieve a consistent level (1.0m above ground) for all valve chambers.

Figure 2 illustrates the general arrangement of the pump wetwell and forebay for the Flygt axial pump, while Table 2 tabulates the depths of the wetwells for this stage of the design. These arrangements have been designed to comply with Wellington Water's specification requirement to limit the number of pump starts to eight per hour, as this impacts the relationship between the pump capacity, sump inflow, and active volumes.

Refer to the shortlist drawing set and table for dimensions of the pump station structures at each site.

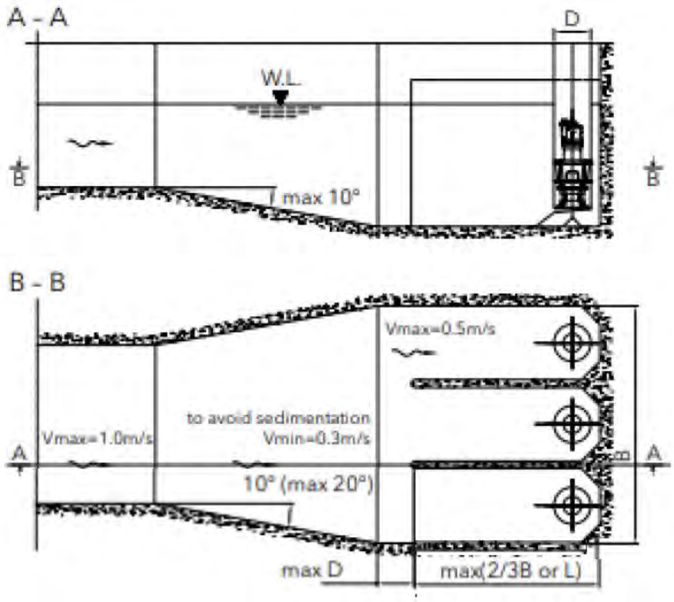

Figure 2 PS Flygt Intake guideline

Table 2 Design parameters

	Depth of Wet Well (m)	Design Flow (l/s)	Required Head (m)	Wet Well BWL (mRL)	Wet Well NWL (mRL)	Wet Well TWL (mRL)	Assume Hutt River Discharge Level (mRL)	Rising Main Length (m)	Flygt Propeller Pump Model
Eastern Hutt School PS	6.5	2000	2.7	4.70	5.63	6.56	6.0	855	PL 7101/705 3~420/N4
Riddiford Garden PS	7.5	3000	8.0	-0.25	1.47	3.19	6.0	521	PL 7081/735 3~990N4
Chilton St. James PS	8.0	2500	8.3	0.75	3.14	5.53	6.0	1383	PL 7081/735 3~990N4
Hutt Recreation Ground PS	7.5	3000	9.3	-0.50	1.35	3.19	6.0	585	PL 7081/765 3~990N4

Note: Pump head is based on average suction water level (NWL).
These figures are preliminary and subject to final design confirmation such as pump selection.

1.1.6.2 System Curve Development Methodology

System curves were developed by calculating the total discharge head comprising three individual components:

- The static head is calculated as the discharge water level minus the assumed pump station operating level.
- Pipe friction losses are calculated from a Colebrook White approximation of pipe friction losses in a pipe flowing full for each key pipe section (individual pump discharges and common rising main)
- Pipe fitting friction losses calculated using k values in the formula h_L=kv^2/2g.

System curves for total discharge head vs pump station discharge flow were generated at various flow rates. For each calculation set, three scenarios have been tested:

- Minimum head loss conditions, comprising of the static head at its minimum (pump station operating at highest water level) and assuming low pipe roughness values (k_s)
- Maximum head loss conditions, comprising of the static head at its maximum (pump station operating at lowest water level) and assuming high pipe roughness values (k_s)

- Design head loss conditions, comprising of the static head at its average (pump station operating at mid-water level) and assuming medium pipe roughness values (k_s)

Furthermore, each pump station will typically comprise multiple pumps that may operate individually or in parallel to deliver the required flow rates. The total discharge head experienced by each pump will differ slightly when more than one pump operates, compared to a single pump operation, because flows are split across the pumps (therefore, individual pipe / fitting discharge losses are lower). These have been taken into account by running calculations for single and multiple pump operations. Determining the number of pumps to use in the pump station is described below.

Rising Main Sizing

A key determinant of the total discharge head is the size of the rising main, which impacts the mean pipe velocity of the pipe at any given flow rate. One of the challenges that rising main sizing presents is that pipe velocities may fall outside of typically accepted values. If velocities are too low (typically less than 0.5 – 0.7 m/s), solids settlement can be expected in the pipeline. Head losses and pump energy usage will increase substantially at excessively high pipe velocities (typically greater than 4 m/s). Since these pump stations are expected to operate infrequently, the approach is to size the rising mains to achieve high (but still acceptable) pipe velocities at high flow rates. The benefits of doing so are:

- The cost of the rising main reduces and is likely to outweigh the higher pump energy costs.
- The pipe velocities should be high enough at lower flows to minimize the risk of solids settlement in the pipeline.

Therefore, the selection of rising main sizes was to achieve a pipe velocity below 4 m/s at the target maximum pump station discharge. For the purpose of this preliminary analysis, all rising mains were assumed to be Polyethylene PE100 (Series 1) pressure pipes according to the Register of Approved Products for Use in Water Services Infrastructure, March 2022, Revision 2.2, published by Wellington Water.

Determining Pump Selections the Number of Pumps

After developing the system curves for each pump station, the preliminary pumps were selected utilising Xylem's Xylect software. Where possible, pump selections were made such that the pumps operate within 70% to 120% of their best efficiency point flow rate, which is the accepted industry standard preferred operating range for solids-bearing pumps. Outside of this operating range, pump operational challenges may occur, such as but not limited to unstable operation and cavitation that results in impeller erosion and/or excessive pump vibration.

Table 0-3: Proposed Number of Pumps at Each Pump Station

Pump Station	Proposed Number of Pumps per Pump Station Longlist	Proposed Number of Pumps per Pump Station Shortlist
Eastern Hutt School Pump Station	4 (duty/assist/assist/standby)	3 (duty/assist/standby)
Chilton St James School Pump Station	3 (duty/assist/standby)	3 (duty/assist/standby)
Riddiford Pump Station, discharging separately to Chilton St James	3 (duty/assist/standby)	3 (duty/assist/standby)

Pump Station	Proposed Number of Pumps per Pump Station Longlist	Proposed Number of Pumps per Pump Station Shortlist
Riddiford Pump Station, discharging receiving Chilton St James flows	4 (duty/assist/assist/standby)	This arrangement was discarded and did not form part of the shortlist option.
Hutt Recreation Ground	Not Specified at this stage	3 (duty/assist/standby)

Shortlist Design Details of Pump Stations

1B Eastern Hutt School

The pump system curve in Figure 3 depictsFigure 3 two pumps delivering 2040 l/s at 2.8m head when operating in parallel and one pump delivering 1220 l/s at 1.5m head at average water levels. The pump wetwell dimensions are depicted on drawing HCC-WIG-DRW-CD-SW-004. The minimum submergence of the pumps is 2.7m above the sump floor level of the pump wetwell.

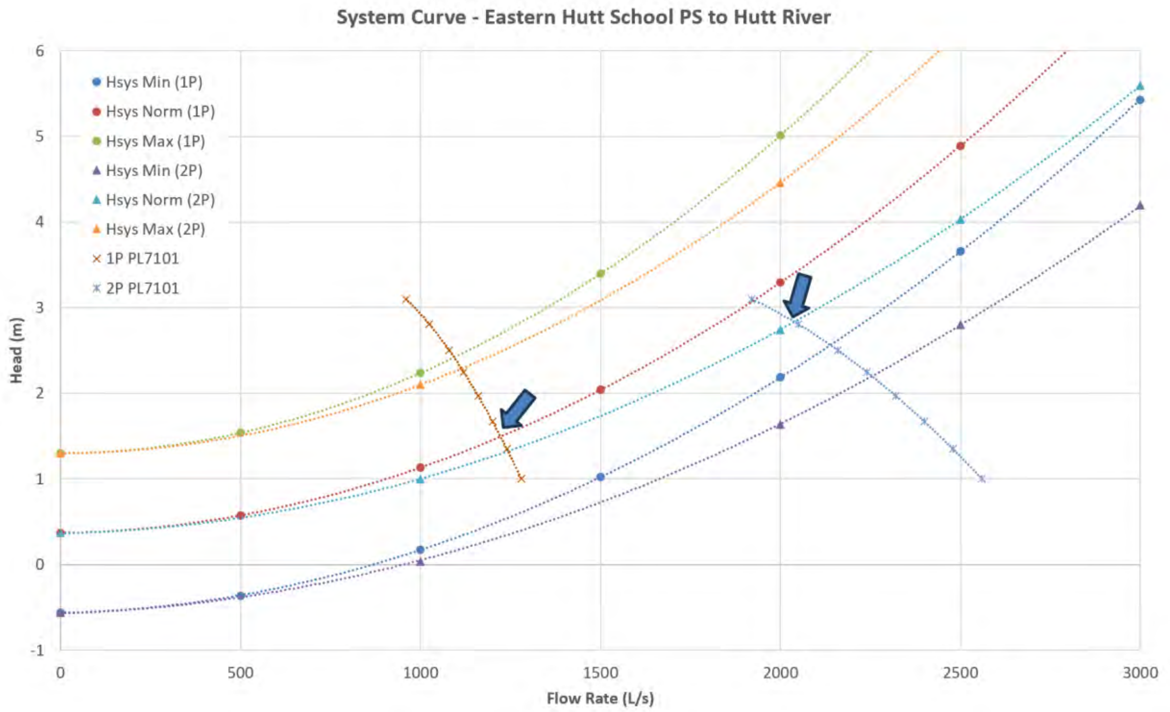

Figure 3 EHS Pump Station System curve

4.1 Chilton St. James

The pump system curve in Figure 4 depicts two pumps selected to deliver 2500 l/s at 8.3m head and one pump to deliver 1395 l/s at 5.1m at average water levels for the Chilton St. James Pump Station.

The pump wetwell dimensions are depicted on drawing HCC-WIG-DRW-CD-SW-002. The minimum submergence of the pumps is 2.25m from the sump floor level of the pump wetwell.

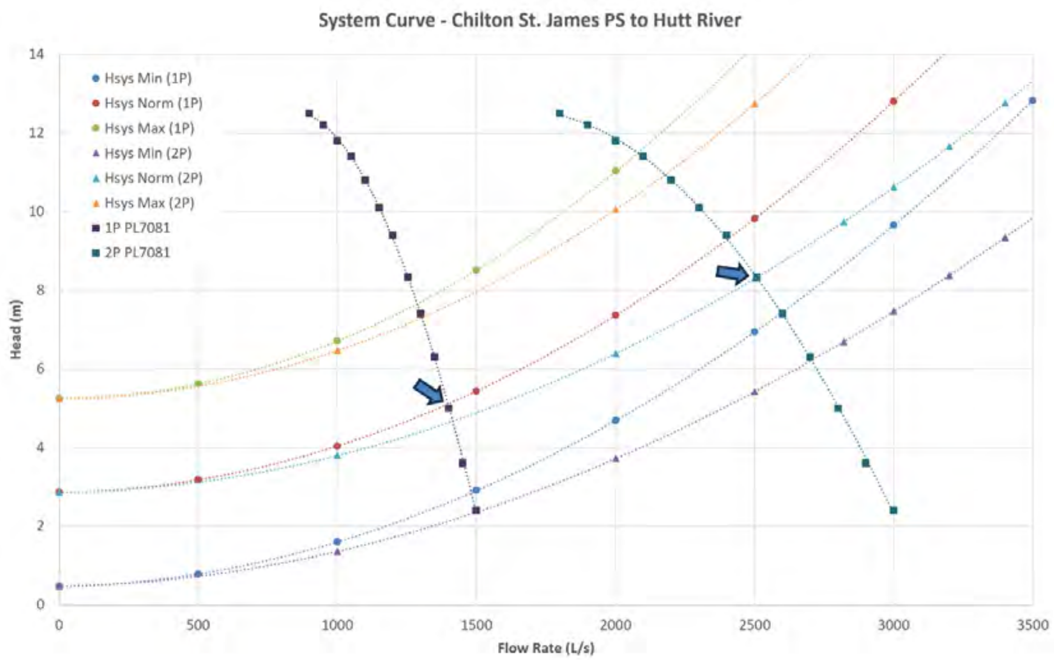

Figure 4 System curve- Chilton St. James Pump Station to Hutt River

<u>4.2 Riddiford Gardens</u>

The pump system curve in Figure 5 illustrates the pump selection for one pump delivering 1575 l/s at 6.2m head and two pumps delivering 2970 l/s at 8.0m at average water levels for the Riddiford Gardens Pump Station.

The pump wetwell dimensions are depicted on drawing HCC-WIG-DRW-CD-SW-006. The minimum submergence of the pumps is 2.3m above the sump floor level of the pump wetwell.

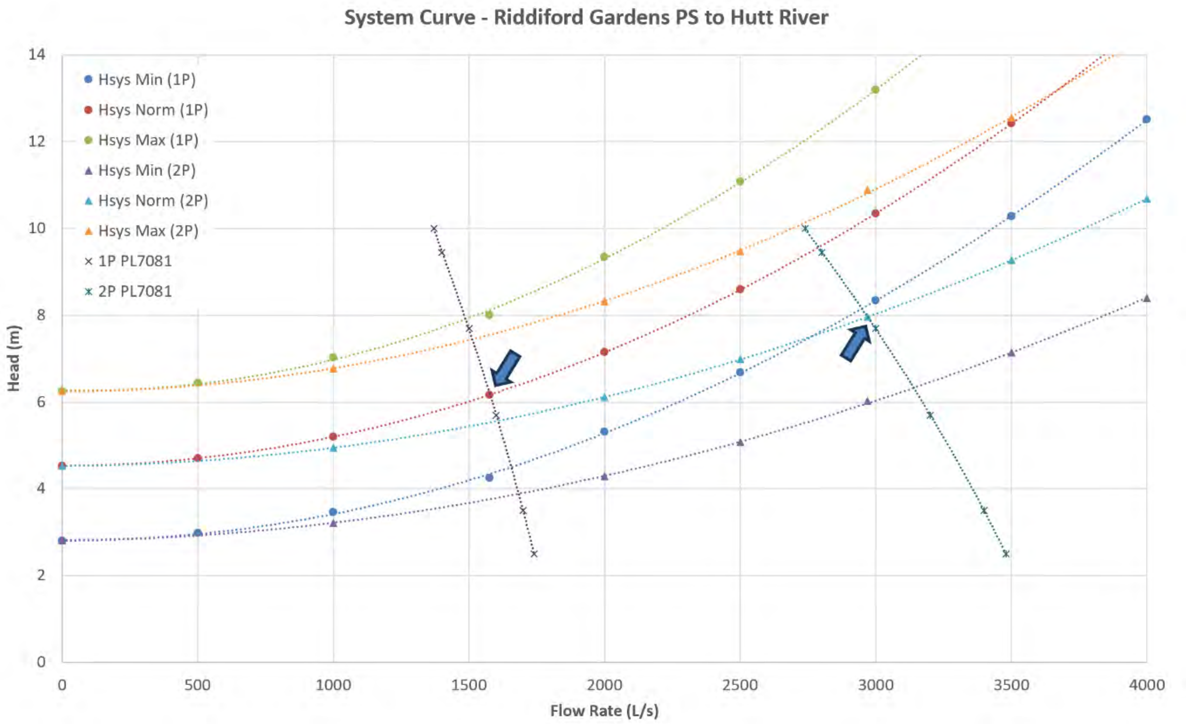

Figure 5 Riddiford Gardens Pump Station

5. Hutt Recreation Ground

The pump system curve in Figure 6 depicts one pump operating to deliver 1675 l/s at 6.8m head and two pumps operating to deliver 3090 l/s at 9.1m head.

The pump wetwell dimensions are depicted on drawing HCC-WIG-DRW-CD-SW-008. The minimum submergence of the pumps is 2.25m above the sump floor level of the pump wetwell.

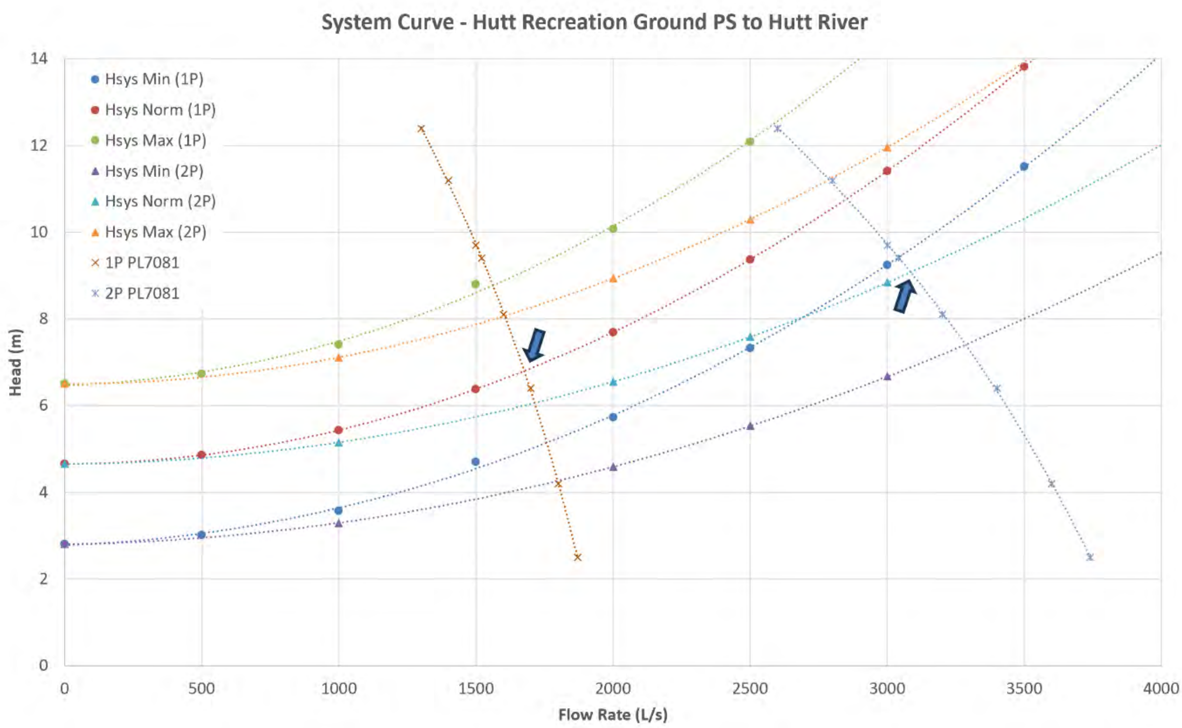

Figure 6 *Hutt Recreation Ground Pump Station*

Buildings and Ancillary systems

Provision has been made for the following items required to support the operation and maintenance of each pump station. These are to be located in the "Valve Chamber and Operations Room" footprints indicated on the drawings. The buildings are based at this stage in the design on the Opahu Pump Station site as shown in Figure 7. These are specified as follows:

- A single storey, concrete blockwork building with 3.0m stud height and monopitch timber framed coloursteel roof, containing three rooms as follows:
  - A 25m^2 MCC and control room, which houses the electrical distribution and controls infrastructure. This room is to be fitted with a suspended plywood floor above the reinforced concrete floor, to provide a void space for the entry / exit of cables from the room. The room is to have a double exterior door.
  - A 35m^2 transformer room. The room is to have a double exterior door.
  - A 10m^2 store and washroom. The room is to be fitted with a wash basin, small table, storage shelving and have a single personnel access door.
- Allowance is to be made for paving for heavy vehicle access into the site, of 300m^2 total area with a double road entry crossing.
- A 1.8m high galvanised stanchion and mesh fence, with manual double gate entry.
- Site lighting attached at two points to the aforementioned building.
- Two hose points fed from a water supply connection not the site.

Architectural and Engineering design of these structures has not been undertaken and a spatial allowance on the site footprint is the only detail provided at this stage in the design.

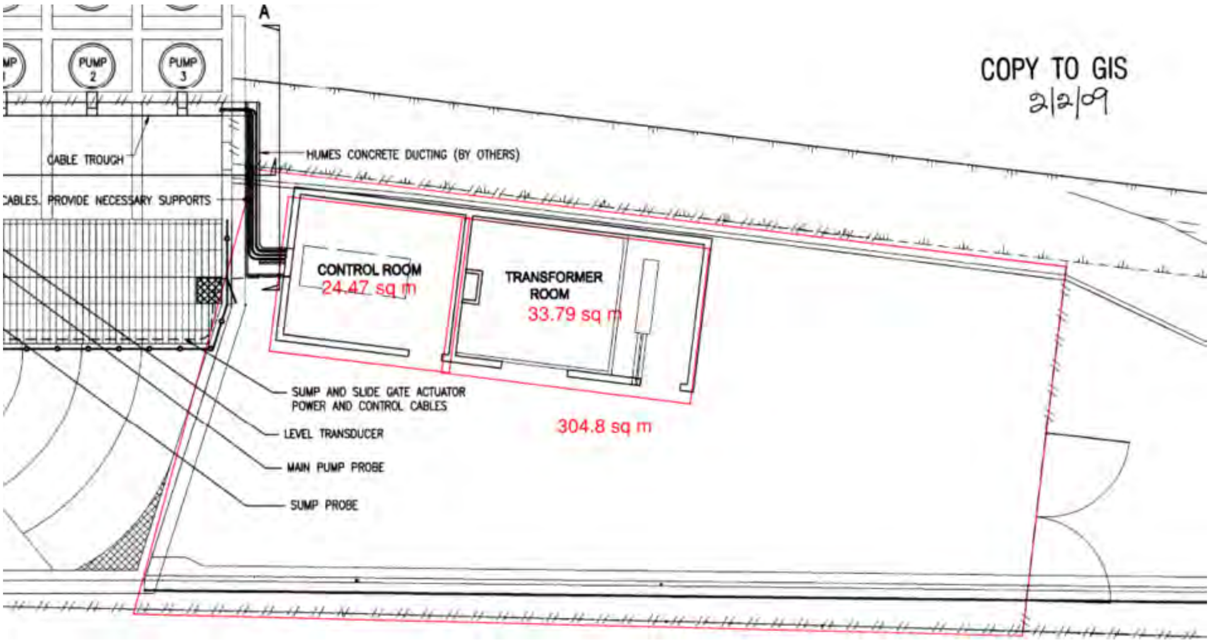

Figure 7 Opahu Pump Station buildings

Opportunities

The following opportunities for refinement of the design and potential cost savings have been identified at this stage of the project and should be reviewed further as the design is developed:

- Review WWL standard requirement for 8 pump cycles per hour
- Review of overflows and drains to either the stream or to existing stormwater systems depending on terrain and flooding scenarios.

Summary

In summary, the design has been conducted based on currently available hydraulic and hydrology information obtained from Tonkin & Taylor. Further investigations and hydraulic modelling, which may include CFD modelling, will be carried out to enable detailed design. This will include confirmation of the discharge point locations and hydraulics (i.e. the flood water level in the Hutt River) and will enable performance assessments and sensitivity analysis for various hydraulic and hydrologic scenarios.

Appendix C- Stormwater planning meeting minutes

Minutes

Stormwater Planning Meeting

Date:	30th June 2023	**Time:**	10:00am – 12:00pm
Location:	TEAMS / T&T Wellington	**Room:**	WLG Red Rocks
Chair:	[redacted]	**Mtg No:**	3
Attendees	[redacted] Minute Taker: [redacted]		
Apologies	[redacted]		
Subject	HCC IAF CBD Wellington Water Stormwater Discussions		

	Item	By whom
Introduction	**Project Induction – Brief overview on what is trying to be achieve / minimum requirements throughout the project.** • Status = Gap Analysis Stage **Personal Induction - Round table style with a brief introduction of what each person will bring to the project**	**All**
Action	• Flush out agreement on the design concept for the stormwater pipelines	**All**
Project Success Factors	**Wastewater** • Design solution has been well defined and will not be discussed in this meeting. **Stormwater** • Existing flooding issues in urban catchments between Opahu Stream and the Hutt River **Discussion:** around the current flooding problems • The work done by Stantec in 2022 has determined three main causes of flooding - primarily relating to tailwater levels in the Hutt River and Opahu Stream • **2022 Preferred Stormwater Option** - Two main pump stations to Hutt River - Three diversions out of Opahu Stream	

	- Each diversion will have the ability to convey 10% AEP - Pump stations to the Hutt River to convey 1% AEP - Currently the Opahu Stream diversions are only modelled for 10% AEP (following the Regional Standard) **What are we trying to achieve and how far should we go?** • Reduce the incidence of flooding / flood damage to the surrounding roads / assets and properties • Protect existing floor levels to 1%AEP where possible • Reduce frequency of flooding to access routes to properties • Not all existing properties can be protected to this standard. • The flood problem should not become worse under future scenarios • The 2022 work does not spell out what flooding outcomes the proposed option will deliver. Project to define what can be achieved for new and existing properties. • Design horizon is 2070 **Other Discussions** The scope will take current design as starting point and outline alternative options to identify best opportunity. • [redacted] Future risk with transfer to new water entity, that projects deemed less affordable may be dropped or deferred. [redacted] Confirmed that funding is secured: [redacted] IAF and [redacted] HCC.	
Action	• Further discussion to be had around level of service and achievability • Confirm through modelling, what flood benefits the 10% AEP diversions deliver and consider what more could be achieved from other options. Discussion on funding risk from Three Waters Reform and need to stage options was parked for future meetings Circulate / meet once confirmation on what will be delivered to understand the risk impact. • [redacted] to confirm critical roads and access points to be protected	
Uncertainty / Risk Assessment and management	**Sea Level Rise (SLR)** • The assumption of 1 m SLR by 2130 is on the lower side of current projections. A range of reasonable scenarios gives approx. 1 m to 2.2 m relative SLR. There is reasonable certainty over the next 50 years but uncertainty grows markedly beyond that. • Joint probability. The downstream boundary is actually the Hutt River, not the coast. It has been modelled with a 10% AEP when the stormwater model has a 1% AEP event. WWL has had a joint probability study done. • Existing modelling assumes hydraulic neutrality similar to WWL acceptable standards 70% upper limit for impermeable surfaces and rainwater tanks installed in residential developments. Full hydraulic neutrality is optimistic and doesn't reflect the range of uncertainty. The hydrology itself is also uncertain. The point is not whether the number is right or	

	wrong, it's more the question of should you be representing uncertain variables as a single value. • One way to address the uncertainty is to consider a range of values to give design envelopes. Then design for adaptability. **Iwi and Stakeholders** • Iwi engagement is just starting and may impact design options. **Funding and investment** • Boundaries and Funding /Investment risks are actively being tracked within the project risk register **Climate change** • WWL are aware that the climate change projections in the regional standards need to be updated – this is ongoing with WWL and GWRC. **Stress Testing** • Agreed to assume the current standard and stress test the model at the end of August to understand impacts. This will need to be in line with GWRC projections for the Hutt model.	

Action	• Looking into SLR range / difference over time • [redacted] is working with WCC and Greater Wellington to get the Climate change projections updated – before end of August • WWL to provide the joint probability report • Design to address uncertainties through sensitivity analyses and design envelopes • Assumptions will be clearly notedConsider adaptive design/staging/conservative sizing of key elements	
Residual flood risk	• Flood levels in the flood maps are based on the existing Opahu Stream pumps operating (not the proposed). There is LTP funding for adding generator to existing downstream PS. • The existing maps allow for a 20% increase in rainfall intensity and 1 m of SLR. • Confirmed that allowance is 10% AEP in Hutt River. This has also been aligned with Riverlink. • Existing flood maps do not allow for future developments • Not recommended for future 1% AEP flood extent for planning controls to include new pump stations, but can be modelled. • Installing generators at key pump stations is being considered - Big standby cost, supply of diesel during an event if only on standby. Planning controls will still be needed. Many uncertainties and risk of pump failure.	
Action	• Check whether Hutt River and Opahu reached 100% in the 2004 flood event. • Stress test 50% increase in rainfall	

Relevant design standards	• Existing houses should be protected to 1% AEP where possible. • Roads and access to houses should also be protected to 1% AEP ideally • Full hydraulic neutrality is not required by the District Plan. WWL standards require roof water to be retained. - All new houses should be built above 1% AEP water level + freeboard	
Action	• Look into different pump station failure modes and failure scenarios (under the assumption all three pumps have gone out of action)	

Appendix D- Constraints assessment – Hydrogeology

Memorandum

To	Hutt City Council
cc	
From	[redacted]
Date	29 April 2024
Subject	HCC IAF Upgrades – Constraints Assessment - Hydrogeology
Reference	1091097.TT.2100.PRW.ME.EN.18.Constraints Assessment_Hydrogeology Assessment_Hydrogeology_Rev02.docx

1 Introduction

1.1 Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the wastewater pipeline upgrade required to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options", prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass", prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.2 Current project stage and purposes of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility (this stage) is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this document is to identify key constraints and fatal flaws relevant to Hydrogeology which will inform further option development.

1.3 Description of IAF options

1.3.1 Stormwater

A site walkover and brainstorming session has been carried out by the design team at the start of this stage. Various options have been identified to form a “long list” of possible options. Through further option development, the long list will be reduced down to a short list and then ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is included in Appendix A. Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stop banks provide flood protection from Hutt River flooding to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to high flows in the Hutt River.

2 Constraints Assessment

2.1 Introduction/Overview

The potential hydrogeological constraints associated with the construction of the stormwater upgrade options comprising pipelines, pump stations and detention features include effects associated with high groundwater levels. The removal of groundwater (i.e. dewatering of excavations) to allow construction in dry or near dry conditions has the potential to result in groundwater drawdowns beyond the excavation extents. Groundwater inflows to, and removal from, excavations can result in large volumes of water needing to be managed and discharged. Determination of these flows are based on the understanding of the hydrogeological conceptual model.

This report presents the findings of a high level desktop review. This qualitative assessment is based on review of readily available information describing the local ground conditions in the Lower Hutt Valley and ground conditions along the pipeline alignments. These ground conditions are represented in three geological cross sections based on the available investigation data.

This updated version of the report incudes additional information following Wellington water's review in September 2023. Refer to Section 6.

2.2 Scope of work

A review of available relevant source data for the site including:

- Geotechnical Desktop Assessment (Riverlink Wastewater Trunk CBD Bypass)[1].
- Available T+T Geotechnical Reports and the New Zealand Geotechnical Database (NZGD).
- Bore and Well reference data from Greater Wellington Regional Council (GWRC) to identify potential groundwater users in the local area.
- Readily available public report on the Lower Hutt Aquifer Model (HAM3)[2].

Develop a conceptual hydrogeological model to establish the likely shallow groundwater levels within the general areas of the proposed excavation (based on the three selected pipeline alignments and indicative cross sections) and selection of representative hydraulic conductivity values.

Undertake selected dewatering assessments to determine the groundwater inflows into the excavations, indicative radius of influence from the dewatering activities and the potential constraints from the assessment findings.

2.3 Proposed works

Various options have been identified to form a "long list" of possible options of which three geological cross sections have been generated, as shown in Figure 2.1. These cross section alignments; north (A-A'), middle (B-B'), south (C-C') comprise a mix of different options as follows:

- North (A-A') – Option 7 and Option 5
- Middle (B-B') – Part Option 6 and Part Option 8
- South (C-C') – Option 2B and Option 3B

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[1] Holmes Consulting (6 July 2022) Riverlink Wastewater Trunk CBD Bypass – Geotechnical Desktop Assessment. Project No. 144418.50. Included as Appendix A in Hutt CBD Sewer Bypass Optioneering and Concept Design Report 06/04/2023 Project No. OPC101481.

[2] Gyopari, M. (June 2014) Lower Hutt Aquifer Model Revision (HAM3): Sustainable Management of the Waiwhetu Aquifer. Prepared for Greater Wellington Regional Council.

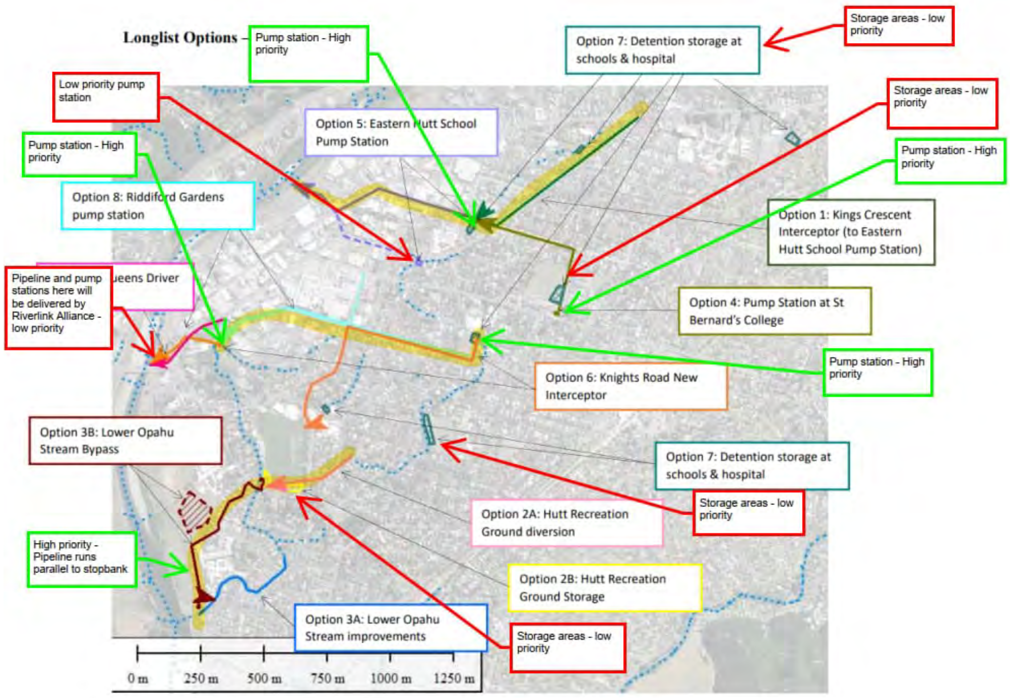

Figure 2.1 - Site plan showing selected pipeline alignment options.

For this high level assessment, the proposed excavations have been assessed based on the indicative dimensions for each type of infrastructure and the anticipated duration of the excavation being open, and thus requiring dewatering. These details are presented in Table 2.1.

Table 2.1: Indicative excavation details used in the dewatering assessment

Infrastructure type	Depth of excavation (m)	Width of excavation (m)	Length of excavation open at one time (m)	Estimated duration of excavation open (days)
Pressurised pipelines (PE) - 900 mm and 1500 mm Ø pipe	3.4 – 4.0	1.9 - 2.5	12	4-6
Gravity pipelines (concrete) - 1350 mm and 1800 mm Ø pipe	5.85 – 6.3	2.35 – 2.8	6	5-10
Stormwater Pump Stations	8.0	15	30	90
Notes: Pipeline excavation dimensions are based on an allowance of 0.5 m each side of the pipe, 0.5 m below pipe invert level, a minimum 2 m cover for smaller diameter pipes (PE) and a minimum 4 m cover for larger diameter pipes (concrete). Pump station excavation width includes a batter and working space based on a pump station structure width of 15 m				

It is assumed that most excavations require trench supports during the construction works. The effects of the trench supports are not considered on the dewatering inflow rates, but the potential for the driven sheet piles to result in breaches of the aquitard are considered. The stability of the excavations and options to support the excavations are beyond the scope of this assessment. It is noted that some installations may be trenchless[3]. These are not considered in this assessment since dewatering activities are assumed to be unlikely for this type of pipeline installation.

[3] Discussions with T+T project team based on their understanding with the Contractor.

3 Hydrogeological conceptual model

3.1 Environmental setting

The proposed alignments are located in the Lower Hutt Valley, on the true left (eastern side) of the Hutt River and inland of the coastline at Petone. The local area is low lying ground at an elevation ranging between approximately 0 m and 6 m above mean sea level (m amsl) with the proposed pipeline alignments typically in areas with a ground elevation of between 4 m and 6 m amsl.

3.2 Local geology

Lower Hutt and the site are located in the fault-bounded basin of the Hutt Valley. This basin has been infilled with Quaternary unconsolidated sediments comprising gravel rich horizons in a thick sequence of alluvial and glacial outwash sediments which have infilled the basin[2].

Locally the sequence of Holocene age deposits above the Waiwhetu gravel aquifer comprise the Taita Alluvium, Melling Peat, and Petone Marine Beds. The Taita Alluvium consists of variable gravel deposits derived from river and fan environments, but also includes sand, silt, and clay deposited from flooding and over-bank deposits of the Hutt River[2]. An average thickness of the Taita Alluvium is 12 m with deposits dipping down valley toward the southwest. Melling Peat underlies the Taita Alluvium[2] although recent work by Begg[4] indicates that over Hutt Valley, stratigraphic location of Melling Peat may be more variable than indicated by the HAM3 report. The Petone Marine Beds, dominated by clays, shelly silts, and sandy silts underlie the peat deposits. These sediments overlie the Waiwhetu gravel aquifer which is encountered at depths of around 15 to 20 m in the local area and around 20 m – 30 m at the coastline[2]. The soil group in the area is identified as predominantly Waikanae silt loam, where these soils have not been disturbed by urbanisation. A typical cross section of the ground conditions likely to be encountered at a pump station excavation is shown in Figure 3.1. The depth to shallow groundwater is expected to be encountered within 1 m of surface. Further detail on the geological sections is provided below.

[4] Begg, J. (June 2020) The Lower Hutt – Wellington Harbour (Te Whanganui a Tara) Geological Model. J Begg Geo Ltd.

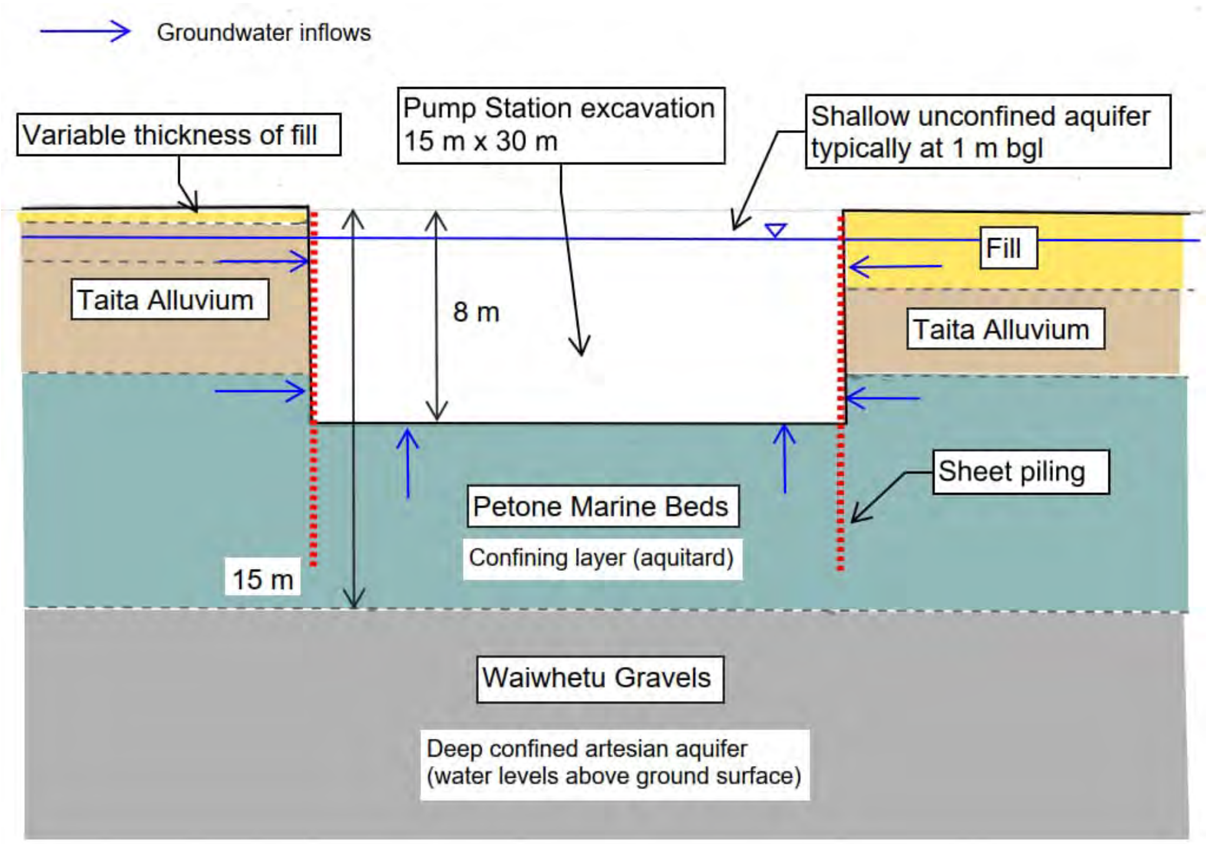

Figure 3.1 - Sketch of pump station excavation and expect ground conditions encountered.

3.2.1 Geological sections

Site investigations along the proposed pipeline alignments have not been undertaken to date. Therefore, information on the anticipated ground conditions in the vicinity of the pipeline alignments has been obtained from bore logs recorded in the NZGD to create three geological cross sections using a cross section generator tool. All available bore logs on or close to (i.e. within 70 m) the pipeline alignment have been used to develop these sections, which inform the hydrogeological conceptual model as described in Section 4.3. Interpolation of the geology from these bog logs has been undertaken to determine the indicative depths of the underlying geological units. Groundwater depths were estimated based on recorded water levels in the boreholes, and inference of the hydraulic connection between the shallow groundwater at nearby surface waters. The cross sections are provided in Figures 3.2, 3.3 and 3.4, with full size sections and the maps showing the locations included in Appendix B.

In the following summaries, the range of depths reflect the collective depths from the available bore logs. The level of detail described in the summaries are based on the detail described on the bore logs with our interpretation on the formation type. It is noted that the recorded shallow ground conditions are highly heterogenous across short distances (< 15 m) where multiple records of investigations are reported[5] and the indicative sections and model may differ to that described in this report.

[5] Bore logs obtained from NZGD.

3.2.1.1 Section 1 - Option 7 and Option 5

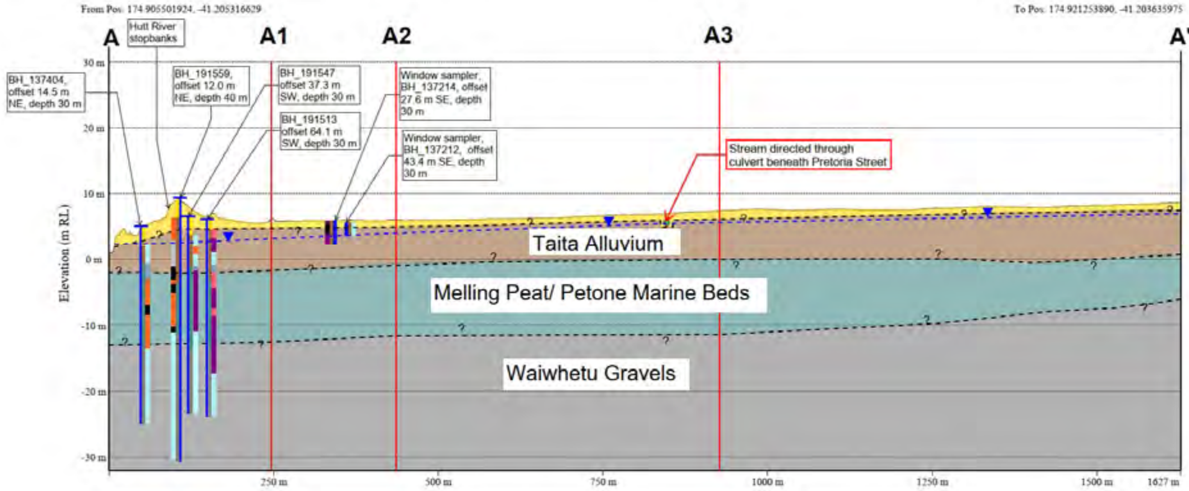

Figure 3.2 - Geological cross section 1: A - A' (North) – Option 7 and Option 5

- Based on the available bore logs[6] on or close to the pipeline alignment, as shown on Section 1 (A-A'), the indicative ground conditions at the western end are shown to comprise:
- Fill to depths of 1.5 m to 2.85 m
- Occasional strata of clayey silt (1.3 m thick), silty fine sand to sand, fine to coarse gravel at depths of 2.8 m to 7.45 m, one bore recording gravel to 10.2 m (Taita Alluvium),
- Peat at depths of 6 m to 9 m (Melling Peat)
- Fine to medium sand at depths of 8.6 m to 12 m (Petone Marine Beds)
- Predominantly silty sand and sandy silt with some gravel strata at depths of 12 m to 19.6 m (Petone Marine Beds)
- Predominantly fine to coarse gravel at depths > 18.6 m (Waiwhetu Gravels)
- Ground conditions[7] at the eastern end of Section 1 (A-A') from bores more distant from the pipeline alignment (and not shown on the section) show increased silt and clay content within the Taita Alluvium.

[6] Obtained from bore logs on NZGD; BH_191560, BH_191513, BH_191547, BH_191559 between Hutt River & Rutherford Street.
[7] Obtained from bore logs on NZGD; BH_114687 & BH_114688 at Hutt Hospital.

3.2.1.2 Section 2 - Part Option 6 and Part Option 8

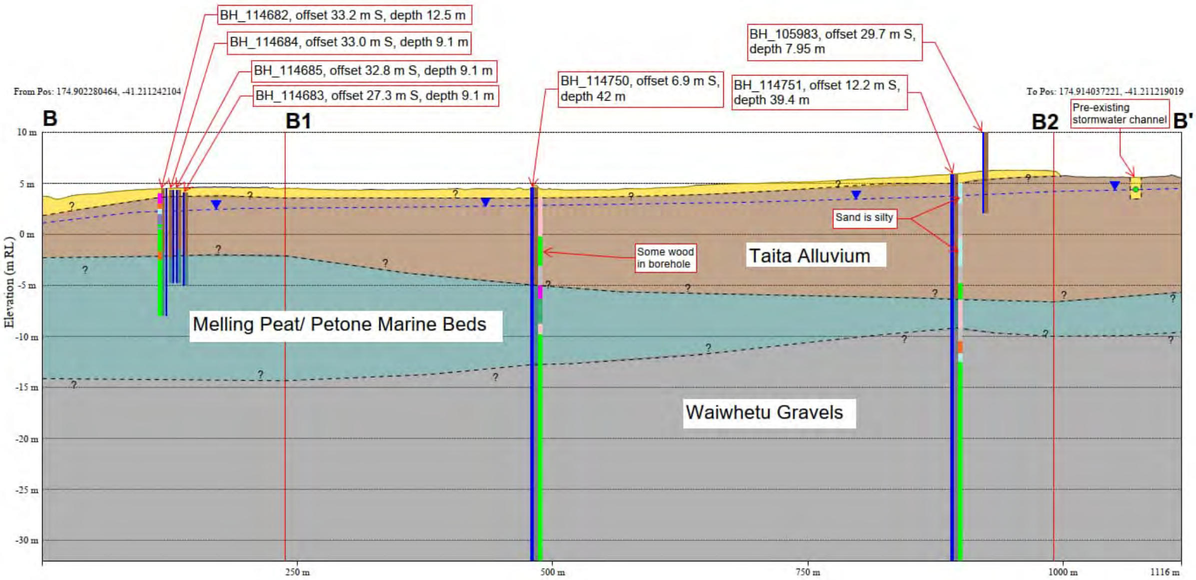

Figure 3.3 - Geological cross section 2- B to B' (Middle) – Part Option 6 and Part Option 8

This section has the greatest amount of available bore data in close proximity to the pipeline alignment. It is not possible to "group together" the ground conditions for the entire pipeline alignment due to a large heterogeneity in depth of the alluvial deposits between the locations, therefore, the descriptions have been based on the three "groupings" of the available bore data.

Based on the available bore logs[8] on or close to the pipeline alignment, as shown on Section 2 (B-B'), the indicative ground conditions at the western end are shown to comprise:

- Topsoil and/or Fill to depths of 3.8 m
- Silt clay, sand at depths of 0.4 m to 2.1 m
- Clayey silt, sandy fine to coarse gravel with peat strata in some bores up to 1.8 m at depths of 3.8 m to 6.2 m (Taita Alluvium)
- Fine to med sand, some gravel at depths of 6.2 m to 8.5 m (Petone Marine Beds)
- Sandy Silt, & silty fine sand, sand at depths of 8.5 m to 15 m (Petone Marine Beds)
- Gravel with sand and silt at depths of 15 m to 17 m (Petone Marine Beds)
- Gravel at depths of 18.5 m (Waiwhetu Gravels)
- Based on the available bore log[9] on the pipeline alignment, the indicative ground conditions at the mid-way chainage of the alignment is shown to comprise:
- Fill to a depth of 0.8 m
- Clay at a depth of 0.8 m to 4.9 m (Taita Alluvium)
- Gravel, clay, wood at a depth of 4.9 m to 7.8 m (Taita Alluvium)
- Gravel at a depth of 7.8 m to 9.8 m (Taita Alluvium)
- Silt, gravel, clay at a depth of 9.8 to >18 m (Petone Marine Beds)

[8] Obtained from bore logs on NZGD; BH_113222, BH_114766, BH_114768, BH_114769, BH_114682, BH_114683, BH_114684, BH_114685 between Laings Road & the western end of Knights Road.

[9] Obtained from bore logs on NZGD; BH_114750 at Bloomfield Terrace.

Based on the available bore logs[10] close to the pipeline alignment, the indicative ground conditions at the eastern end of the alignment are shown to comprise:

- Fill to a depth of 1 m
- Gravel and silty sand at a depth of 1 m to 3 m (Taita Alluvium)
- Gravel at a depth of 3 m to 6.1 m (Taita Alluvium)
- Gravel, silty sand, silty gravel at a depth of 6.1 m to 12.2 m (Taita Alluvium)
- Clay at a depth of 12.2 m to 15.1 m (Petone Marine Beds)
- Ground conditions[11] at the far eastern end of Section 2 (not included on the cross section) show limited gravel at shallow depth (i.e. < 5 m) and a thick stratum of sandy gravel between 8.5 to 12 m depth. Interbedded coarse sand, gravel, sandy silt extend below this depth with Waiwhetu gravels encountered at 21 m.

3.2.1.3 Section 3 - Option 2B and Option 3B

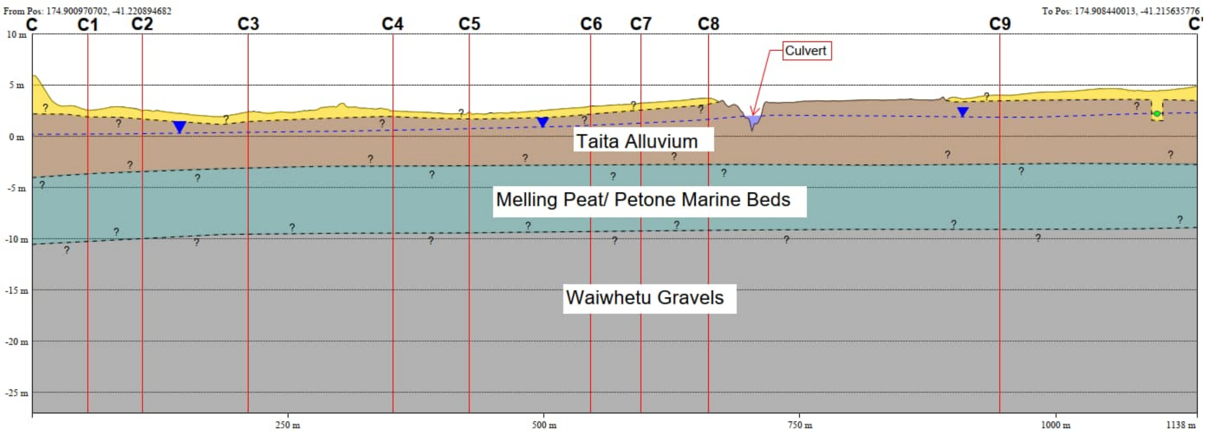

Figure 3.4 Geological cross section 3- C to C' (South) – Option 2B and Option 3B

There are no available bore logs on or close to the pipeline alignment for Option 2B and Option 3B and the indicative ground conditions for Section 3 South (C-C') are based on an overview of the wider Lower Hutt geology which are inferred to comprise:

- Taita Alluvium (underlying topsoil and/or fill) to typical depths of 7 m to 8 m
- Melling Peat (where present) and Petone Marine Beds at typical depths of between 7 m to 15 m
- Waiwhetu Gravels at depths typically > 15

3.3 Hydrogeology

3.3.1 Shallow groundwater

The local groundwater conditions comprise an extensive shallow water table (unconfined) aquifer within the Taita Alluvium underlain by the confined Waiwhetu Artesian aquifer. Based on a general understanding of the groundwater resources, there is likely to be limited groundwater use (locally) within the shallow unconfined aquifer.

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[10] Obtained from bore logs on NZGD; BH_114751, BH105983 at Penrose Street.

[11] Obtained from bore logs on NZGD; BH_105980 at Willoughby Street.

Based on the bore logs, there are limited records and observations of the depth to groundwater in the local area. The reported range varies between 0.4 m to 1.8 m bgl. The geological cross sections present a simplified hydrogeological model with a groundwater level typically at 1 m below ground level (bgl) in the Taita Alluvium.

Groundwater levels in the Taita Alluvium are strongly influenced by recharge from the Hutt River upstream of Kennedy Good Bridge (Boulcott) to the Taita Gorge, where the river loses water to the aquifers. Variations in groundwater levels, both long-term and short-term are directly related to level in these reaches of the Hutt River in close proximity. This means that seasonal effects on river flows are observed in the groundwater levels with a summer low in the unconfined aquifer corresponding to low river levels and low rainfall. Groundwater variation between the summer lows and winter highs is approximately 1 m to 2 m at close proximity to the Hutt River[2]. Therefore, excavations at the western end in the Boulcott area (e.g. Section 1 (A-A') Option 7 and Option 5 are likely to experience a greater range in groundwater levels (when encountered). Further away from the river, groundwater levels in the Taita Alluvium will exhibit a more attenuated and lagged response to river level changes[2]. Downstream of Kennedy Good Bridge (Boulcott) toward the coast the Hutt River is generally a gaining reach, which receives groundwater. Therefore, excavations at the western end and southern end of the pipeline alignments close to the Hutt River are more likely to discharge water from the shallow groundwater to the river.

Rainfall is a source of recharge to the shallow unconfined aquifer. The dewatering assessment (described in Section 4) relies on a rainfall recharge input for the model. Therefore, data from "*…a single climate square near Avalon (square 80_132)…to represent the entire the [Lower Hutt] valley..*"[2] has been used whereby an average rainfall recharge of 425 mm is calculated for the Waikanae silt loam. Some discharge from the unconfined aquifer occurs as baseflow to the local surface waters of the Opahu Stream, the Hutt River (down gradient of Kennedy Good Bridge) and more distant; Waiwhetu Stream. Other discharges from the aquifer are likely to occur at the coastline.

There is limited testing to derive aquifer parameters for the Taita Alluvium. Only one reliable pumping test, relatively close to the Hutt River, has been performed in the shallow gravel in the Taita Alluvium. This reports[2] a wide range in transmissivity values (2,700 m^2/d to 52,700 m^2/d) which equates to a hydraulic conductivity of 1,000 m/day in the Avalon Studios area. Given that the range of distances of the pipeline from the Hutt River varies from the Hutt Valley side of the stop banks to 1,000 m, it is assessed that the range in hydraulic conductivity is likely to be significantly less at many locations along the pipeline alignments. Therefore, other published data have also been used to estimate the hydraulic conductivity across the sites and applied to the dewatering assessments.

3.3.2 Deeper groundwater

Groundwater in the deeper Waiwhetu Artesian aquifer in the Waiwhetu Gravels is primarily confined by the overlying low permeability sediments of the Petone Marine beds. The Waiwhetu Gravels are a highly productive confined, and in places semi-confined, artesian aquifer which provide a water source for the wider Wellington region. The top of the Waiwhetu aquifer is typically encountered at depths of between 15 m to 20 m in the local area and excavations for the shallow pipeline alignments are not likely to encounter the Waiwhetu Gravels.

Whilst groundwater levels in the Waiwhetu aquifer are artesian (above ground level), the confining layer is identified to be semi-confined ("leaky") in places within Lower Hutt. The unconfined-confined boundary of the Waiwhetu Aquifer is in the area between Melling Bridge and Kennedy Good Bridge (Hutt Golf Course/Boulcott area). Therefore, the proposed northern pipeline alignments are likely situated in an area where the Waiwhetu Aquifer is unconfined to semi-confined. In other areas of the proposed pipeline alignments, semi-confined aquifer conditions could prevail. This is evident from bore records, where obvious confining strata overlying the gravel such as thick sequences of low permeability silt, which form an aquitard, are limited. This may have implications on the excavations and the driving of sheet piling (where required), and effects of the dewatering from deep excavations such as at pump stations (described in Section 3.0). However, the very nature that the confined Waiwhetu Aquifer is artesian (groundwater levels above the surface), demonstrates that the overlying strata have sufficiently low permeabilities to confine the aquifer.

The Waiwhetu aquifer is reported[2] to become deeper and more confined toward the coastline (to the south) meaning that there is a greater thickness of, and lower permeability of, strata forming the aquitard. Accordingly, the southern-most proposed pipeline alignments are likely to be situated over the confined artesian aquifer. However, if deep sheet piles are required for excavation support, it is possible that these piles could penetrate the upper Waiwhetu aquifer depending on the target depth. Reported aquifer properties[2] of the Petone Marine Beds where they form an aquitard provide hydraulic conductivities of between 0.1 m/day to 0.001 m/day, with a mean value also at 0.001 m/day.

Pumping tests on the upper Waiwhetu Aquifer report[2] a mean transmissivity value of 28,000 m^2/d, locally increasing to 35,000 m^2/d to 40,000 m^2/d at the Wellington Water public water supply bores at Waterloo. Based on an assumed 20 m thickness of the upper gravels, this equates to a hydraulic conductivity of 1,400 m/day. A storage coefficient of between 3×10^{-4} to 1×10^{-3} has been derived from the pumping tests[2].

3.4 Hydrology

The nearest surface water is the Opahu Stream, which is crossed by, and adjacent to, part of the Section 3 (C-C’) – Option 2B and Option 3B pipeline alignment.

Both of the western-most ends of the Section 1 (A-A’) – Option 7 and Option 5 and Section 3 (C-C’) – Option 2B and Option 3B pipeline alignments are adjacent to the Hutt River (at its stop banks). The Waiwhetu stream (tributary of the Hutt River) is located approximately 1.3 km to the southeast of the pipeline alignment Section 2 (B-B’) – Part Option 6 and Part Option 8. The Hutt River is tidal up to Ewen Bridge, and is located approximately 300 m west of Section 2 (B-B’) – Part Option 6 and Part Option 8.

3.5 Surrounding groundwater users

There are 444 bores identified on the GWRC “Wells and Bores” open data map[12] within an approximate buffer of 500 m within all nine options encompassing the three selected pipeline alignment options. Considering the high level nature of this assessment, no further details have been obtained to verify whether these bores are actively used and/or have current groundwater take consents. It is expected that not all of these bores exist. However, it is reasonable to expect that most of the bores finished to 15 m depth or less penetrate the Taita Alluvium, Melling Peat, and/or Petone Marine Beds and these bores are likely to be for investigation purposes rather than groundwater takes.

Of these 444 bores, there are 92 bores with depths recorded between 15 m and 42 m which are likely to intercept the Waiwhetu aquifer. There are seven bores with unrecorded depths. A summary of these bores is presented in Table 3.1 with the general locations of the bores shown in Figure 3.5.

[12] GWRC open data “Wells and Bores” layer https://data-gwrc.opendata.arcgis.com/datasets/wells-and-bores/explore

Table 3.1: Summary of well and bores within a 500 m buffer of the pipeline alignments.

Bore depth range (m)	No. of bores
0.5 to 5	67
5.1 to 10	128
10.1 to 15	149
15.1 to 42	92
>42	1

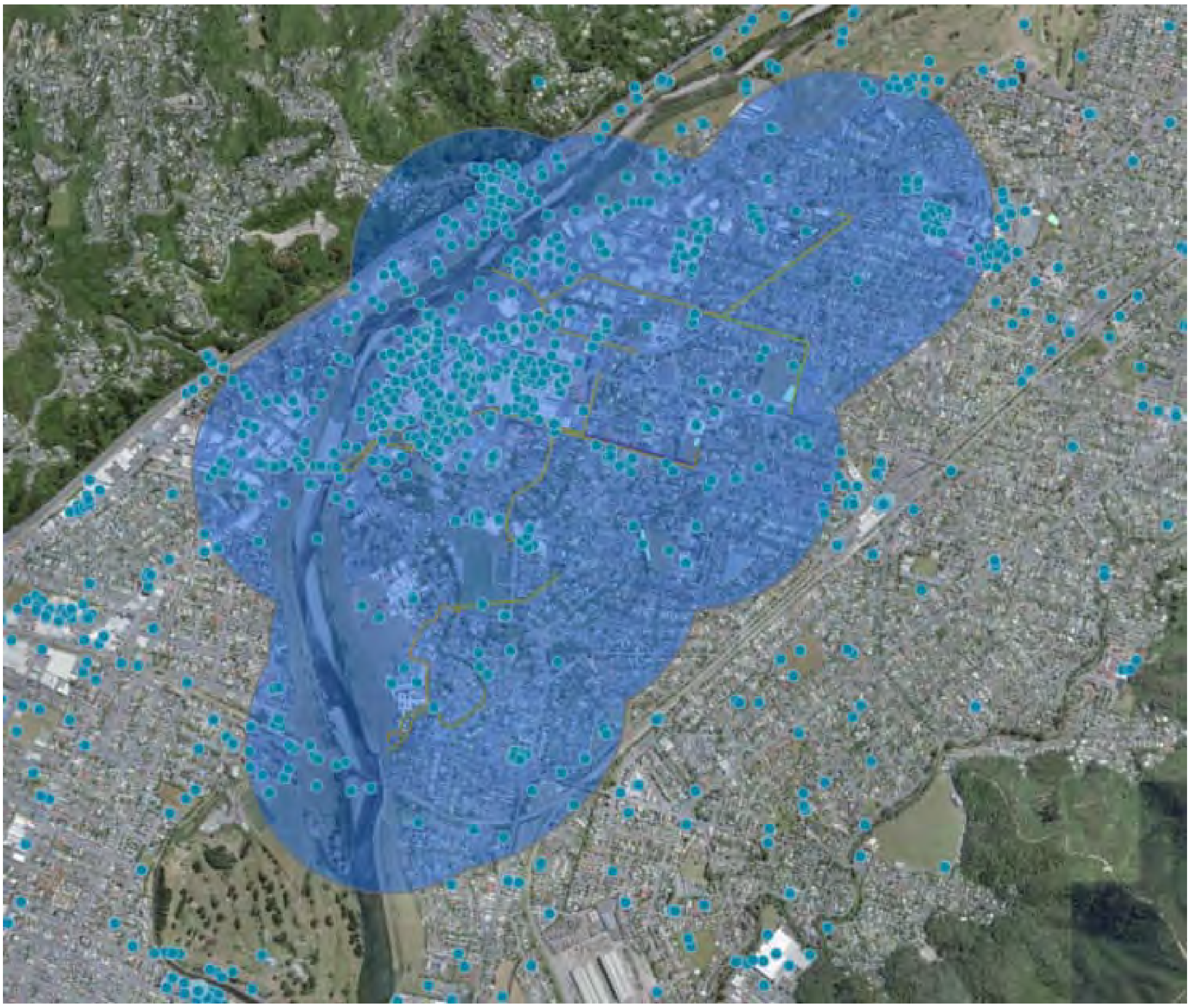


Figure 3.5 Wells and Bores within a 500 m buffer of the nine pipeline options.

4 High level estimates of groundwater inflows

4.1 Method of assessment

High-level dewatering assessments (scenarios) have been undertaken to determine steady state dewatering volumes and the groundwater drawdowns induced beyond the proposed excavations by the dewatering activities.

The adopted method of assessment is based on groundwater inflows presented by Marinelli (2000)[13]. This method has been used to determine the potential groundwater inflow volumes and the resulting potential drawdown effects during the construction dewatering. The calculations are based on steady state conditions i.e. once the groundwater levels and flows have stabilised after the initial removal of groundwater from the excavations.

The dewatering assessments are based on the excavation dimensions as described in Section 2.3 which results in five scenarios, as shown in Table 4.1. The adopted duration of the dewatering is a maximum of 10 days for the pipeline excavations and 90 days (3 months) for pump station excavations. The assessments are also based on selected ground conditions to represent an indicative range of conditions that could be encountered across the pipeline alignments.

Table 4.1: Excavation dimensions for dewatering assessment

Infrastructure type & Scenario assessment	Excavation dimensions (m)			Estimated duration of excavation open (days)
	Width	Length*	Depth	
Pressurised pipelines (PE) - 900 mm and 1500 mm Ø pipe				
Scenario 1a	1.9	12	3.4	4-6
Scenario 1b	2.5	12	4	4-6
Gravity pipelines (concrete) - 1350 mm and 1800 mm Ø pipe				
Scenario 2a	2.35	6	5.85	5-10
Scenario 2b	2.8	6	6.3	5-10
Pump Stations				
Scenario 3a	15	30	8	90
*length of excavation open at one time.				

4.2 Model input parameters

To calculate groundwater inflow, the parameter values shown in Table 4.2 have been adopted. Based on the ground conditions described in Section 3.3, three geology scenarios (i), (ii) and (iii) have been selected to represent the range of expected ground conditions identified at specific locations on or close to the pipeline alignments. These scenarios have been selected to represent typical low, medium and high permeability within the upper 10 m of the soil profile and have been applied to the main infrastructure scenarios described in Table 4.1.

Published hydraulic conductivity values have been adopted in absence of site specific data, and as such the material descriptions for the published values differ slightly to the actual ground conditions described on the bore records. The overall selected range is wide and is expected to reflect the typical variation in the ground conditions along the pipeline alignments i.e. occurrences of minor silt

[13] https://www.researchgate.net/profile/Walter-Niccoli/publication/249469020_Simple_Analytical_Equations_for_Estimating_Ground_Water_Inflow_to_a_Mine_Pit/links/5a450f21aca272d2945d983d/Simple-Analytical-Equations-for-Estimating-Ground-Water-Inflow-to-a-Mine-Pit.pdf

(lower permeability) and sandy gravel strata (high permeability) within the Taita Alluvium. However, the individual assessments do not take into account a mix of ground conditions through the excavation profile. Each scenario is further subdivided and modelled with a groundwater level at the surface and at 1 m bgl.

Table 4.2: Input parameters for dewatering assessment

Parameter	Value	Source
Hydraulic conductivity range (K)		
Ground condition scenario (i) typically "silty sand, silt, clay, peat"	0.000864 to 0.864 m/d	Published values[14] selected for sandy silts, very silty fine sands and laminated or mixed strata of silt/sand/ clay.
Ground condition scenario (ii) typically "fine to medium sands"	8.64 to 43.2 m/d	Published values[14] selected for fine to medium sands
Ground condition scenario (iii) typically "silty gravel".	43.2 to 86.4 m/d	Published values[14] selected for clean sand and sand/gravel mixtures
Depth to groundwater		
Within 200 m of the Hutt River	0 m	Conservative, indicative estimate and distance from river.
Beyond 200 m from the Hutt River	1.0 m	Typical expected conditions across most of the area.
Rainfall recharge	0.001 m/d	HAM3 modelled rainfall recharge (425 mm/yr).

4.3 Model assumptions

The method of assessment is based on assumptions described in Marinelli (2000)[13] and is based on steady state groundwater conditions. This means that the length of dewatering is not needed for this method. Whilst steady state conditions may not be experienced for the short duration (4 to 10 days) of the proposed construction works for the pipeline alignments, the assessment provides a high level result for the groundwater inflows and resultant potential effects of lowering groundwater level (drawdown) on the surrounding environment. It is likely that steady state conditions will be experienced for the longer duration (90 days/3 months[15]) of the proposed construction works for the pump stations.

The model does not account for the presence of any trench supports, such as sheet piling or trench shields. For these assessments, the trench supports (if used) are assumed as being solely for the retention of the soils and stability of the excavations.

The hydrogeological conceptual model and assessments are based on one geological unit of uniform thickness with the same aquifer parameters throughout for each pipeline alignment, represented by the three cross sections. This assumption may be more applicable to the shallow excavations, once below the depth of the fill and/or topsoil layers, where ground conditions could be similar through the shallow depth (over short lateral distances). However, the deeper excavations and in particular, the pump stations are likely to be excavated into multiple geological unit (e.g. silt, sandy gravel, sand

[14] Cashman, P. & Preene, M. (2012) Groundwater Lowering in Construction: A Practical Guide to Dewatering. 3rd Ed. Applied Geotechnics Series. CRC Press

[15] Amount of time that the excavation is expected to be open and requiring dewatering. The remainder of the construction time up to 90 days (3 months) is estimated for completion of the pump station.

etc). However, the scenarios developed provide a range of results to assist with this constraints evaluation.

Due to the variation in elevation across the wider site area, the modelled assessment has assumed that the base of the excavation is at 0 m. The initial static groundwater level has been set at a nominal height above the base of the excavation to reflect a groundwater level at either surface or 1 m below ground level.

The duration of works is based on an estimate which ranges between 4 days and 10 days for pipeline construction. This duration allows for excavation, dewatering and pipe installation as well as an allowance for any delay associated with poor weather conditions. The duration of works for the pump stations is based on an estimate of 90 days which allows for the part of the works that requires dewatering activities with an allowance for any delay associated with poor weather conditions.

4.4 Results

4.4.1 Groundwater inflows

The results of the dewatering assessment, based on steady state conditions, show estimated groundwater inflow rates range widely between approximately < 1 L/s to 217 L/s (equivalent to <1 m^3/d to 18,800 m^3/d).

This range in results is based on the lower end hydraulic conductivity values (i.e. representing silt-rich material) and the upper end hydraulic conductivity values (representing gravel-rich material) used in the model for the pipeline alignments and the intermediate (representing fine to medium sand) hydraulic conductivity values used for the pump station excavations. Table 4.3 provides a summary of the results and the detailed results are presented in Appendix C.

The results are based on the high level assessment and any variations in the input parameters i.e. deviations from the modelled ground conditions and depth to groundwater, will vary the results of the assessment. The results presented are once steady state conditions have been achieved. The range of results for the pipeline alignments are summarised as follows:

- For pressurised pipelines **Scenario 1i** with low permeability ground conditions, the groundwater inflows range between approximately **0.001 L/s to 0.68 L/s** (< 1m^3/d to 60 m^3/d).
- For pressurised pipelines **Scenario 1iii** with high permeability ground conditions, the groundwater inflows range between approximately **15.2 L/s to 60.2 L/s** (1315 m^3/d to 5,200 m^3/d).
- For gravity pipelines **Scenario 2i** with low permeability ground conditions, the groundwater inflows range between approximately **0.002 L/s to 0.96 L/s** (< 1 m^3/d to 83 m^3/d).
- For gravity pipelines **Scenario 2iii** with high permeability ground conditions, the groundwater inflows range between approximately **28.2 L/s to 81.7 L/s** (2,436 m^3/d to 7,060 m^3/d).

The results presented below for the pump station scenario 3 are based on excavation of a single geological unit. However, due to the large size of the proposed excavations (i.e. 15 m x 30 m by 8 m depth) and the observed heterogeneity of the ground conditions within the upper 10 m of soil, it is very unlikely that one geological unit will be encountered. The range of hydraulic conductivity values across the entire pump station excavation are likely to be better represented by scenario (3ii) with the intermediate range (or lower bound value) in hydraulic conductivity for fine to medium sands.

Therefore, once steady state conditions have been achieved the range of results at pump station excavations are summarised as follows:

- For the pump station **Scenario 3ii** with intermediate permeability ground conditions, the groundwater inflows range between approximately **39 L/s to 217L/s** (3,370 m^3/d to 18,800 m^3/d).

Table 4.3: Summary of predicted groundwater inflows in litres per second (L/s) after steady state conditions have been reached.

Scenario	Max/Min adopted K value (m/d) for each scenario	Groundwater levels at:			
		Surface (0) m bgl		1m bgl	
		L/s (maximum)	L/s (minimum)	L/s (maximum)	L/s (minimum)
Scenario 1a Excavations 3.4 m deep	Scenario (i) 0.864 to 0.000864	0.50	**0.001**	0.34	0.0008
	Scenario (ii) 43 to 8.64	22.4	5	15.1	3.1
	Scenario (iii) 86.4 to 43.2	44.4	22.5	30	**15.2**
Scenario 1b Excavations 4 m deep	Scenario (i) 0.864 to 0.000864	**0.68**	0.002	0.49	0.001
	Scenario (ii) 43 to 8.64	30.3	6.3	21.9	4.5
	Scenario (iii) 86.4 to 43.2	**60.2**	30.5	43.5	22.0
Scenario 2a Excavations 5.85 m deep	Scenario (i) 0.864 to 0.000864	0.82	**0.002**	0.64	**0.002**
	Scenario (ii) 43 to 8.64	35.3	7.5	28.0	5.9
	Scenario (iii) 86.4 to 43.2	69.6	35.5	55.4	**28.2**
Scenario 2b Excavations 6.3 m deep	Scenario (i) 0.864 to 0.000864	**0.96**	0.002	0.77	0.002
	Scenario (ii) 43 to 8.64	41.3	8.7	33.43	7.04
	Scenario (iii) 86.4 to 43.2	**81.7**	41.5	66.0	33.6
Scenario 3 Excavations 8 m deep	Scenario (i) 0.864 to 0.000864	5.0	**0.01**	4.1	**0.01**
	Scenario (ii) 43 to 8.64	**217**	45	188	39
	Scenario (iii) 86.4 to 43.2	432	218	374	189

Notes:
Bold denotes min and max values for the three main scenarios at both groundwater conditions.
Scenario 1a & b Pressurised pipelines, Scenario 2a & b Gravity pipelines, Scenario 3 Pump Stations.
Scenarios (i) silty sand, clay, peat, (ii) fine to med sand, (iii) silty gravel

Until steady state conditions are established, pumping rates are likely to be higher as the dewatering commences and water stored in the excavation is removed. However, this removal rate will need to be controlled by the dewatering method, such as the use of dewatering spears or well point excavation. The capacity and number of pumps will need to be selected according to the size of the excavation and the timeframe allowed for the dewatering of the excavation, therefore the rate at which dewatering will occur will be constrained by the pump size.

For the short duration of the dewatering at the pipeline alignments, it is unlikely that steady state conditions will be met. However, for the dewatering at the pump stations, given the duration of the works, steady state conditions are likely to be established. Based on the assumed use of trench support (e.g. sheet piles) as the construction works progress, and the excavation becomes sealed at the sides, inflow volumes may reduce and may be lower than those calculated. The presence of deep sheet piles may result in additional groundwater inflows if the confining layer (aquitard) overlying the Waiwhetu aquifer is compromised and upward artesian flows occur between the sheet and the surrounding ground. This is further described in Section 5.

As identified in Table 4.3, the depth to groundwater level also influences the groundwater inflows, with a lower (deeper) static water level resulting in lower groundwater inflows. Close to the Hutt River, in the Boulcott area/Kennedy Good Bridge, shallow groundwater levels in the Taita Alluvium are strongly influenced by recharge (leakage) from the river. Therefore, excavations at the western end of Section 1 (A-A') Option 7 and Option 5 of the pipeline alignment close to the Hutt River is likely to experience higher groundwater inflows with a higher static water level. For this assessment, we have inferred a nominal distance of 200 m from the river where groundwater levels could be at the surface. However, this scenario would depend on the ground elevation, location of the excavation and ground conditions.

Based on the long list of options, it appears that all of the high priority pump stations are located at distances greater than 200 m from the Hutt River. If pump stations were designated at sites close to the Hutt River in the Boulcott area and any other surface waters, groundwater inflows may be greater than calculated if the surface water is acting as a recharge boundary.

During periods of high rainfall and surface water flooding excavations more distant from the river may experience higher groundwater levels as a result of the higher flows in the river. Further investigation and assessment is required to determine the extent (distance) from the river at which this may occur. Generally, further away from the Hutt River, groundwater levels in the Taita Alluvium will exhibit a more attenuated and lagged response to river level changes[2]. A higher localised groundwater levels may also exist in the vicinity of the Opahu Stream.

4.4.2 Groundwater drawdowns

Based on the modelling and results described in Section 4.4, predicted drawdown effects (radius of influence) can be calculated based on the groundwater inflows when steady state conditions have been reached. This means when the groundwater volume has been removed and the groundwater levels in the excavation are taken to be at the base of the excavation. The predicted radius of influence (i.e. where the drawdown is zero) for each scenario is presented in Table 4.4 and the detailed results are presented in Appendix C. The results are likely to vary at different excavations depending on the ground conditions.

For the pipeline excavations, the results show the predicted radius of influence extends up to approximately 800 m from the edge of the excavations. These results are calculated after dewatering has induced a localised drawdown effect into the excavation. Given the short duration of the construction works for the pipeline alignment, the radius of influence may be less than predicted due to steady state conditions not being reached. In addition to this, the heterogeneity of the ground conditions may result in a smaller (or larger) radius of influence.

For the larger pump station excavations, based on the intermediate range (scenario ii) in hydraulic conductivity for fine to medium sands, the results show the predicted radius of influence extends up to approximately 855 m from excavations. Due to the expected duration (90 days) of the construction dewatering works, this radius of influence may be longer lasting as the dewatering would be expected to be maintained for some time. However, the influence of the sheet piling has not been considered in this assessment and this would be most likely to reduce the lateral extend of the drawdown effects.

The results presented are once steady state conditions have been achieved. The range of results for the pipeline alignments are summarised as follows:

- For pressurised pipelines **Scenario 1i** with low permeability ground conditions, the radius of influence ranges between approximately **5 m to 543 m**.
- For pressurised pipelines **Scenario 1iii** with high permeability ground conditions, the radius of influence ranges between approximately **72 m to 249 m**.

- For gravity pipelines **Scenario 2i** with low permeability ground conditions, the radius of influence ranges between approximately **6 m to 102 m**.
- For gravity pipelines **Scenario 2iii** with high permeability ground conditions, the radius of influence ranges between approximately **458 m to 802 m**.

Once steady state conditions have been achieved, which is most likely, the range of results at pump station excavations are summarised as follows:

- For the pump station **Scenario 3ii** with intermediate permeability ground conditions, the radius of influence ranges between approximately **425 m to 855 m**.

Table 4.4: Summary of predicted radius of influence (distance away from the edge of the excavation) in metres (m) after steady state conditions have been reached.

Scenario	Max/Min adopted K value (m/d) for each scenario	Groundwater levels at:			
		Surface (0) m bgl		1m bgl	
		m (maximum)	m (minimum)	m (maximum)	m (minimum)
Scenario 1a Excavations 3.4 m deep	Scenario (i) 0.864 to 0.000864	62	6	46	**5**
	Scenario (ii) 43 to 8.64	339	166	248	123
	Scenario (iii) 86.4 to 43.2	463	340	339	**249**
Scenario 1b Excavations 4 m deep	Scenario (i) 0.864 to 0.000864	**72**	6	57	6
	Scenario (ii) 43 to 8.64	397	195	307	151
	Scenario (iii) 86.4 to 43.2	**543**	398	420	308
Scenario 2a Excavations 5.85 m deep	Scenario (i) 0.864 to 0.000864	95	7	80	**6**
	Scenario (ii) 43 to 8.64	540	262	456	221
	Scenario (iii) 86.4 to 43.2	742	542	627	**458**
Scenario 2b Excavations 6.3 m deep	Scenario (i) 0.864 to 0.000864	**102**	7	88	6
	Scenario (ii) 43 to 8.64	582	282	498	242
	Scenario (iii) 86.4 to 43.2	**802**	582	682	500
Scenario 3 Excavations 8 m deep	Scenario (i) 0.864 to 0.000864	162	19	145	**18**
	Scenario (ii) 43 to 8.64	855	425	759	379
	Scenario (iii) 86.4 to 43.2	**1167**	857	1032	762
Notes: **Bold** denotes min and max values for the three main scenarios at both groundwater conditions. Scenario 1a & b Pressurised pipelines, Scenario 2a & b Gravity pipelines, Scenario 3 Pump Stations. Scenarios (i) silty sand, clay, peat, (ii) fine to med sand, (iii) silty gravel					

As identified in Table 4.4, the depth to the initial groundwater level is expected to change the extent of the radius of influence, with a lower (deeper) static water level resulting in a smaller radius. For pipeline alignments close to the Hutt River, where shallow groundwater levels are influenced by recharge (leakage) from the river, Section 1 (A-A') Option 7 and Option 5, it is likely that the radius of influence will be smaller than calculated because the river will be acting as a recharge boundary.

As described in Section 4.3, we have inferred a nominal distance of 200 m from the river where groundwater levels could be at the surface and thus receiving recharge from the river. However, this scenario would depend on the ground elevation, location of the excavation and ground conditions. For pipeline alignments close to the Opahu Stream, it is also possible that the radius of influence could be smaller than calculated, however, given the size of this surface water, the presence of the stream acting as a recharge boundary is not known.

5 Potential hydrogeological constraints associated with construction

5.1 Overview

The potential hydrogeological constraints associated with construction of the pipeline alignments and the pump stations arise from the potentially large groundwater inflows that will require removal by dewatering to allow for construction of the infrastructure. Removal of large groundwater volumes may result in effects on features beyond the excavation.

Due to the heterogenous nature of the ground conditions, specific sections of the pipeline alignments and individual pump station locations cannot be identified as 'favourable' or 'unfavourable' locations for the proposed works without further hydrogeological (such as permeability testing) investigations to refine the model. However, it is noted that the depth to the Waiwhetu aquifer is likely to be shallowest at the northern end of the pipeline options. This area coincides with the indicative boundary between the unconfined and confined aquifers, and/or in an area where the aquitard is thin meaning that deep excavations and driven sheet piling could have the potential to breach the Waiwhetu Aquifer. Whilst the Waiwhetu Aquifer becomes more confined and deeper toward the south, the risk of penetration by sheet piling and potential influences by groundwater sourced from the Waiwhetu Aquifer still exist.

This high level assessment focusses on the depth of the excavations and the range of the typical hydraulic conductivities (permeability) for the selected ground condition scenarios.

The key issues that have been identified are around the potentially large groundwater inflows, localised groundwater drawdowns and effect of river levels (referred to as effect on groundwater recharge) which are discussed in this Section. The effects of sheet piling extending toward the depth of the Waiwhetu Aquifer and the presence of buried structures are also considered. Further investigation, assessments, and mitigation will be required during the detailed design phase to address these risks. It is envisaged that the detailed design phase should also consider (but not limited to):

- Management of high groundwater inflows and potential flooding of excavations
- Control of the discharge rates and discharge quality.
- Identify method of discharge disposal

A summary of these risks and recommendations are tabulated in Section 7.

5.2 Large groundwater inflows

The results of the dewatering assessment estimate large groundwater inflow rates up to 250 L/s (21,500 m^3/d) depending on the ground conditions and the depth of the excavation. Generally, groundwater inflows will increase with the depth of excavation in uniform ground conditions with the greatest inflows encountered in deep excavation with highly permeable sediments e.g. clean gravels. These rates are based on steady state conditions which means that the initial pumping rates required to achieve a dry excavation would be greater than pumping during steady state. Some of these dewatering rates may be difficult to achieve and manage without mitigation. Further investigation and assessment is required to confirm the rates at specific locations based on the ground conditions encountered.

The presence of trench supports such as welded sheet piling will reduce lateral groundwater inflows into excavations, but these initial calculations do not take into account these barriers. The presence of these structures can be assessed using numerical dewatering models which can simulate both steady state and transient groundwater conditions. Whilst the presence of sheet piling may reduce lateral groundwater inflows into the excavation, depending on the depth of the sheet piling and the depth to the Waiwhetu Aquifer, the installation of sheet piles has the potential to breach the aquitard and intercept the Waiwhetu Aquifer. This may result in large uncontrollable vertical inflows into the excavations, for example, by artesian groundwater tracking up the sides of the sheet piles. If this were to occur, most groundwater would be expected to track up the inside of the sheet pile and enter into the excavation. However, this may also occur on the outside of the excavations resulting in hidden effects potentially causing erosion and piping in the overlying sediments.

Unexpected, buried structures such as historic bores, which are potentially numerous in the Lower Hutt Valley prior to the provision of water reticulation, could also act as conduits for groundwater to flow vertically into excavations if disturbed. Given the locations of the pipeline alignments being typically in the road corridor, it is unlikely that these buried structures will be encountered during the pipeline excavations, but they could be encountered during the pump station excavations. Decommissioned boreholes and CPT holes that penetrate the Waiwhetu Aquifer may also act as conduits if disturbed and if the seal in these features is broken, resulted in unexpected inflows to the excavation.

The duration of dewatering required to reach and maintain steady state is subjective, but likely to be most quickly achieved where low permeability sediments are encountered in the excavations.

The constraints of large groundwater inflows and the subsequent removal of large volumes are likely to be most significant on the Waiwhetu artesian aquifer due to the high use of groundwater in this aquifer. These issues are:

- Potential heaving of the underlying strata, resulting in possible collapse of the aquitard overlying the Waiwhetu aquifer. This would increase the amount of leakage between the shallow and deeper aquifers, resulting in artesian water discharging into the excavation.
- There is the potential for pathways (piping) to occur from the removal of fines in the aquitard and reduction of water pressure at the base of the excavation.

5.3 Large groundwater drawdowns

Based on the predicted groundwater inflows and dewatering rates, this high level assessment has identified that groundwater drawdown effects may extend up to approximately 870 m from the edge of the excavations.

It is assessed that the predicted drawdown effects caused by dewatering pipeline excavations may be less than identified above due to steady state conditions not being reached and due to the short durations of the excavation (dewatering) works. However, the predicted drawdown effects at the larger pump station excavations have the potential to impact on the surrounding water environment for example by:

- Lowering groundwater levels for surrounding groundwater users who access water in the Taita Alluvium and/or Melling Peat
- Potentially damaging the overlying aquitard above the Waiwhetu aquifer unless suitable mitigation measures are adopted e.g. site specific investigations, assessment for potential heave, controlling flows through the base of the excavation, and/or keeping a suitable water head in excavations if required.
- Impact on surface waters through stream depletion

The induced drawdown of the surrounding groundwater adjacent and beyond the excavations has the potential to impact on groundwater users. It is not expected that there are many groundwater users (if any) within the Taita Alluvium shallow aquifer. However, the Waiwhetu Aquifer is heavily used by Wellington Water and further assessment should be made to determine if there is potential for the deeper excavations, such as at pump stations to impact on groundwater users such as public water supply bores. The areas of greatest potential risk for drawdown effects in the deeper confined Waiwhetu Aquifer is if the confining layer (aquitard) is compromised and/or in areas where the confining layer is thin or absent and aquifer conditions are artesian e.g. in the vicinity of the northern-most pipeline alignments.

There is the potential for stream depletion effects to occur during the dewatering of the larger pump stations close to surface waters such as at the Opahu Stream, where the radius of drawdown influence could extend to the stream within the Taita Alluvium. However, given the size of this stream, it is unclear if it may act as a recharge or discharge boundary or show any effect of the dewatering. Our recommendation is that further assessment is required to determine the potential hydraulic connection between the stream and aquifer system. Similarly, where pipeline alignments are close to the Opahu Stream, although dewatering is expected to be of short duration, there is the risk of impact to this surface water.

5.4 Impacts from localised groundwater recharge

Higher groundwater inflows have been identified where a higher static groundwater level is likely to occur (i.e. groundwater at surface). In particular, this means that excavations at the western end and southern end of the pipeline alignments close to the Hutt River may need additional dewatering capacity to manage potential for potentially large dewatering volumes. Where shallow groundwater levels are influenced or maintained by Hutt River water levels, these elevated groundwater levels may result in higher dewatering volumes than calculated. Recharge of groundwater from the Hutt River, occurs in the Boulcott area and upstream of Kennedy Good Bridge. Under these conditions, steady state conditions are likely to quickly establish but further evaluation may be required to confirm detailed construction aspects such as dewatering methods and excavation retention to manage potential inflows.

Close to the Hutt River shallow groundwater is likely in direct hydraulic continuity with the river, and groundwater level changes are likely to be matched by/similar to changes in the river levels e.g. during periods of high rainfall (flooding) or conversely during summer low-flow conditions. Therefore, the opportunity to complete construction works located close to the Hutt River during low-flow conditions would be advantageous.

Levels in the Hutt River are tidally influenced at least up to Ewen Bridge. Groundwater levels in excavations at the southern-most pipeline alignment close to the river are likely to be affected by these diurnal changes. Pumping may need to controlled as far as possible to mitigate potential effects of saline intrusion, should a saline wedge be present in the river in the vicinity of the proposed dewatering

Given the environmental setting of the local area, periods of high intensity rainfall and surface water flooding may result in excavations more distant from the river becoming flooded or experiencing high groundwater levels with greater groundwater inflows occurring during these rainfall events.

6 Wellington Water Review

Wellington Water completed a review[16] of this original report dated 21 September 2023 and identified the absence of assessment with regards to the source water protection. Information on the Waiwhetū Aquifer has become publicly available since the date of the original report and this has been included in this section of the report to respond to the questions raised by Wellington Water (which are shown in italics).

[16] Wellington Water (20 March 2024) Hutt Growth Projects Review – Stormwater Projects

6.1 Question 1

S2.2 - Scope of work is to "develop a conceptual hydrogeological model to establish the likely shallow groundwater levels within the general areas of the proposed excavation" - consideration of source water protection not within scope of the memo.

Response – This is acknowledged and responded to in Qu 3. where we provide consideration to the source protection areas and the vulnerability of the confined aquifer in the vicinity of the Waterloo Wellfield.

6.2 Question 2

Appendix A – "Long list of options" was missing from the provided document and could not be reviewed.

Response – This is now included in Appendix A.

6.3 Question 3

Source water protection measures were not within the scope of the memo and not considered as part of that assessment. However, such measures are likely to be a constraint as some of the pump station locations that require deep excavations are likely to be located within the source water risk management area of the Waterloo Wellfield, particularly Option 6. Deep excavations and any associated deeper penetrations (e.g. piling) represent an acute risk to the Upper Waiwhetū aquifer and Waterloo Wellfield operated by Wellington Water (refer to Waiwhetū Aquifer: Source water risk management implications report[17]). Any disturbance to the Petone Marine Beds, which acts as an aquitard, confining the Upper Waiwhetū aquifer below, should be avoided or minimised. The risk to the groundwater source is even greater in the area around the Waterloo Wellfield (i.e., Option 6 pump station, Option 4 pump station) as subsurface disturbances in that area can lead to rapid increases in turbidity of the source water requiring abstraction wells and treatment plant shutdowns, threatening the continuity of water supply to the Wellington region.

Response – We have reviewed the Waiwhetū Aquifer: Source water risk management implications report[17] which became available after the issue of our assessment. We acknowledge that the confined aquifer in the vicinity of the Waterloo Wellfield is vulnerable to surface influences and there is *"a greater risk from contaminants being able to migrate downwards into the aquifer/bores from the surface"*[17]. The east-west alignment of Option 6 and the Chilton St James Pump Station (Option 6) is in the vicinity of the Waterloo Wellfield, where five of the eight public water supply bores are located along Knights Road.

In this area, the confining layer of the Petone Marine Beds is relatively thin and permeable[17], and the overlying Taita Alluvium is only approximately 3 m thick. Wellington Water has identified that in some areas excavations deeper than 3 m could increase the contamination risks to the aquifer due to the thin confining layer (aquitard). Source protection zone 1 (SPZ1) extends up to 170 m from the Waterloo Wellfield water supply bores. Wellington Water has further delineated a source protection zone 2a (SPZ2a) which considers the potential for groundwater contamination based on aquifer vulnerability mapping and national and international guidance and practise within the context of the Waiwhetū aquifer[17].

[17] *Waiwhetū Aquifer: Source water risk management implications, Wellington Water Ltd, 22 March 2023, provided to HCC IAF, 3 November 2023 in II028.*

Figure 6.1 shows the location of SPZ1 and SPZ2a in relation to the pipeline alignment options and pump stations. This figure is reproduced at A4 in Appendix D.

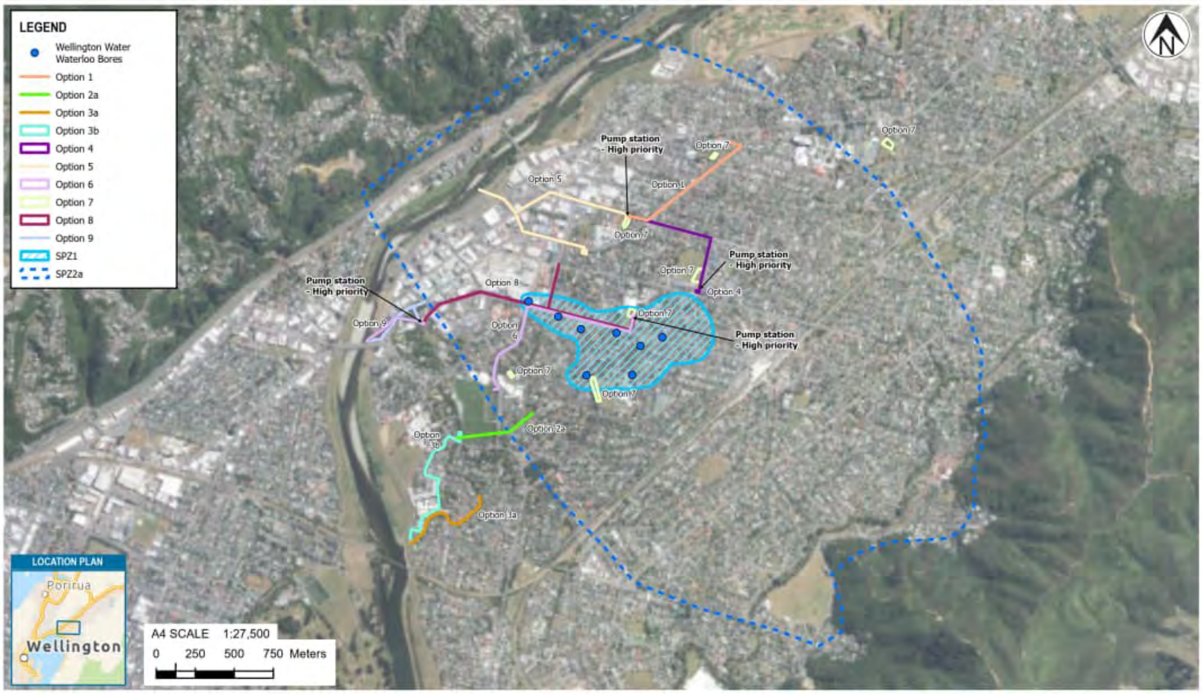


Figure 6.1: Longlist options showing the location of the Waterloo Wellfield bores and the source protection zone 1 and 2a

Based on this proposed infrastructure, we identify the following high priority sites located in SPZ1 of the Waterloo Wellfield:

- Option 6 - Chilton St James Pump Station
- Part of Option 6 - Knights Road New Interceptor located between Chilton St James Pump Station and Bloomfield Tce (east-west alignment)
- Part of Option 8 – Riddiford Gardens (same as Option 6)

In addition, although not within the SPZ1, Option 4 Pump Station at St Bernard's College is acknowledged as being located marginally outside the fringe of SPZ1 and so has also been considered.

In ground activities, such as deep excavations, i.e. > 3 m, and piling within SPZ1 have the potential to increase the risk to the public water supply bores by:

- creating potential pathways for contamination from surface sources (including sediment – turbidity) to migrate toward the bores;
- reducing the aquifer pressures due to breaching the aquitard; and
- exacerbation of saline intrusion combined with summer public water supply demands.

The impacts of these activities need to be mitigated to ensure that the water supply bores are not affected by the proposed work and disruption to the supply does not occur. A construction management plan (CMP) will be prepared during the detailed design stage. The CMP will document the vulnerability of the Waiwhetū aquifer and key source water risks identified by Wellington Water. This plan will involve input from the appointed contractor to ensure that all management solutions and monitoring are workable and clearly understood. The CMP will identify activities where there is a potential:

- contaminant source to the aquifer;
- creation of pathways and compromise of the aquitard (Petone Marine Beds); and
- impact on water availability.

At this high level assessment stage, the CMMP will include plans for the management of the effects such as:

- high sedimentation and turbidity;
- Deep excavations (> 3 m depth);
- Excavation vibrations; and
- Effects of temporarily lowering the groundwater level (dewatering).

Whilst the risks of the in ground activities on the public water supply bores within SPZ2a Wellfield are likely to be reduced compared with SPZ1, the CMP will include consideration of the same management processes (as in SPZ1) to mitigate the effects of those activities. The high priority sites located in SPZ2a of the Waterloo Wellfield are:

- Part of Option 6 – remaining length of Knights Road New Interceptor (north-south alignment)
- Option 4 - Pump Station at St Bernard's College.
- Option 5 – Eastern Hutt School Pump Station
- Option 1 – Kings Crescent Interceptor
- Option 8 - Riddiford Gardens Pump Station
- Part of Option 8 – Riddiford Gardens (western end)
- Part of Option 2A – Hutt Recreation Ground diversion

7 Recommendations and Summary

Based on the discussion in Section 4, the following Table 7.1 provides a high level summary of the constraints on the pipeline alignments and pump stations.

Table 7.1: Summary of results

<table>
<tr><th>Infrastructure type</th><th>Constraints</th><th>Recommendations</th></tr>
<tr><td rowspan="2">Pipeline alignments
(Typically shallow excavations open for short durations)</td><td>Potentially large groundwater inflows resulting in:
• Large groundwater volumes to be removed, treated, and discharged (there may be practical limits on pumps/sizes, treatment and disposal options, etc.).
• Potential for ground settlement to occur in compressible ground conditions.
Expected higher groundwater levels and potential higher inflows at excavations close to the Hutt River and potentially adjacent to Opahu Stream.</td><td>Further geotechnical investigation along the selected pipeline alignments to confirm ground conditions (e.g. CPT, BH, HA) and to confirm:
• Hydraulic conductivity parameters at each (strategic) location.
• Compressibility of sediments and potential for settlement[1].
• Depth to groundwater.
Detailed dewatering modelling to confirm if mitigation is required to reduce risks in relation to groundwater management and/or if geotechnical investigations show complex ground conditions.</td></tr>
<tr><td>Radial effects (drawdown) extending to sensitive locations:
• Localised stream depletion effects in high permeability sediments adjacent to the Opahu Stream.
• Potential well interference effects on shallow groundwater users and the Waterloo Wellfield bores.
• Potential for settlement effects at sensitive locations.</td><td>Further assessment to:
• Identify surrounding groundwater users in the Taita Alluvium including the Waterloo Wellfield bores and determine the well interference effects at these bores.
• Calculate potential stream depletion effects for short-term dewatering.
• Provide drawdown information for geotechnical assessment of settlement.</td></tr>
<tr><td>Pump Station excavations
(Typically deep excavations open for long duration)</td><td>Potentially very large groundwater inflows resulting in:
• Large groundwater volumes to be removed (limits on pumps/sizes etc)
• Potential for ground settlement to occur in compressible ground conditions.
• Potential for heave and piping in the base of the excavations.</td><td>Further geotechnical investigation at each pump station locations to confirm ground conditions (e.g.CPT, BH, HA) and to confirm:
• Hydraulic conductivity parameters at each (strategic) location.
• Compressibility of sediments and potential for settlement[1].
• Depth to groundwater.
Detailed dewatering modelling to:</td></tr>
</table>

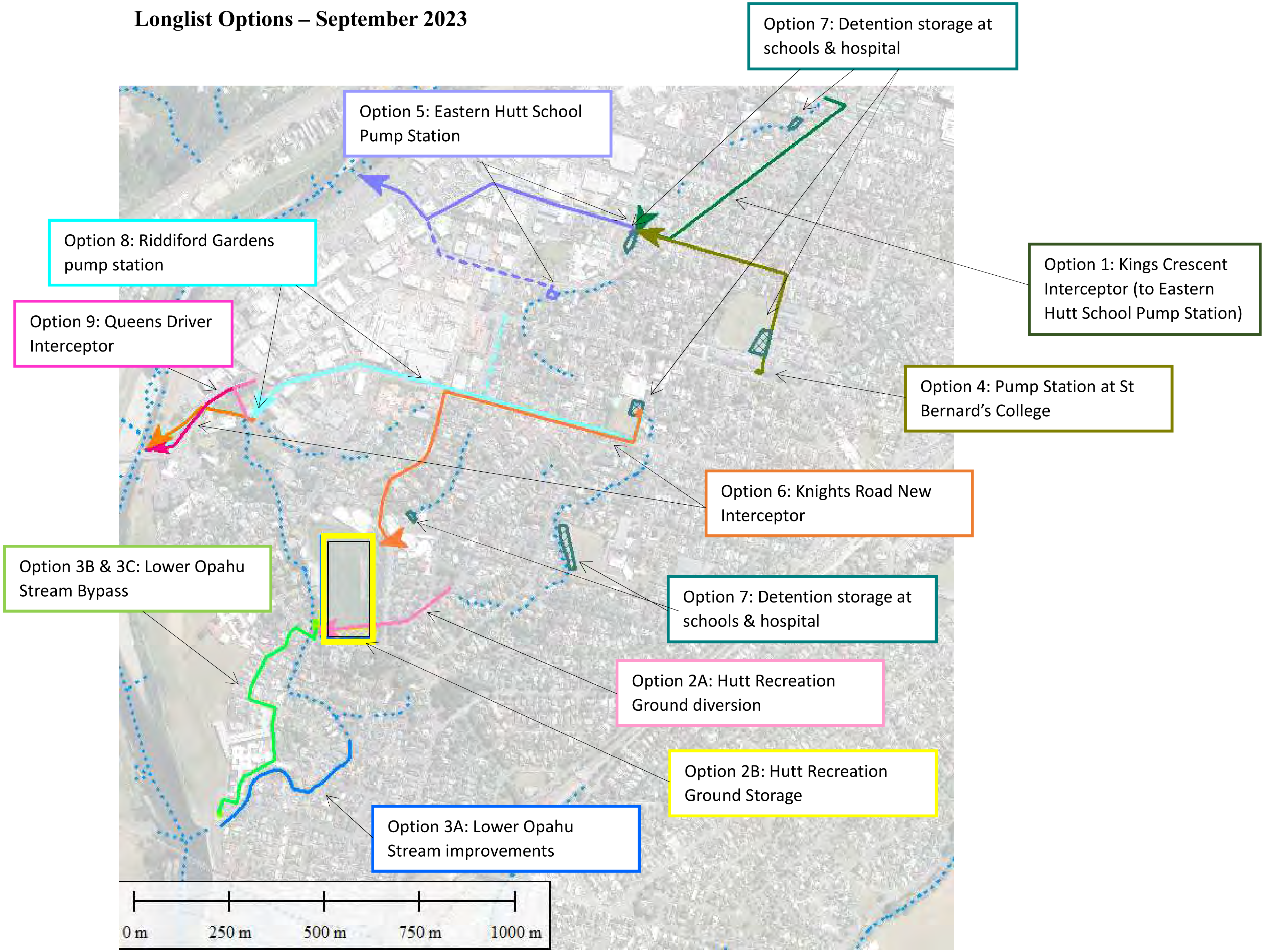
<table>
<tr><th>Infrastructure type</th><th>Constraints</th><th>Recommendations</th></tr>
<tr><td rowspan="2"></td><td>Potential for compromise of the confining layer over the Waiwhetū aquifer, particularly for deep excavations north of Melling Bridge (Boulcott area) and within SPZ1 of the Waterloo Wellfield.
Potential for compromise of the confining layer and the Waiwhetū Aquifer by the presence of deep driven sheet piles, particularly within SPZ1 of the Waterloo Wellfield.
Potential to encounter buried structures (e.g. bores and CPTs) which when disturbed result in additional inflows into the excavations.
Expected higher groundwater levels and potential higher inflows at excavations close to the Hutt River and potentially adjacent to Opahu Stream.</td><td>Include transient groundwater conditions.
Gain greater understanding on potential inflows.
Determine the extent of drawdowns based on excavation dimensions and the potential effects on the Waterloo Wellfield bores.
Assess potential settlement effects.
Detailed design to:
Select sites to avoid deep excavations into areas of clean gravel.
Design excavation supports to restrict lateral groundwater inflows.
Design sheet piling depth to avoid penetration into the Waiwhetū Aquifer.
Manage and mitigate heave and piping in base of excavations.
Manage and mitigate the occurrence of high turbidity groundwater during the dewatering.</td></tr>
<tr><td>Radial effects (drawdown) extending to sensitive locations:
Stream depletion effects from removal of large groundwater volumes for a long duration.
Potential well interference effects on groundwater users e.g. greatest risk is to users in the Taita Alluvium and the Waterloo Wellfield bores.
Potential for saline intrusion to occur as a result of drawdown effects over longer durations of dewatering at locations close to the Hutt River.</td><td>Further assessment to:
Identify surrounding groundwater users in the Taita Alluvium and Waiwhetū Aquifer including the Waterloo Wellfield bores and determine the well interference effects at these bores.
Calculate potential stream depletion effects.
Assess potential for saline intrusion to occur.</td></tr>
</table>

Notes:

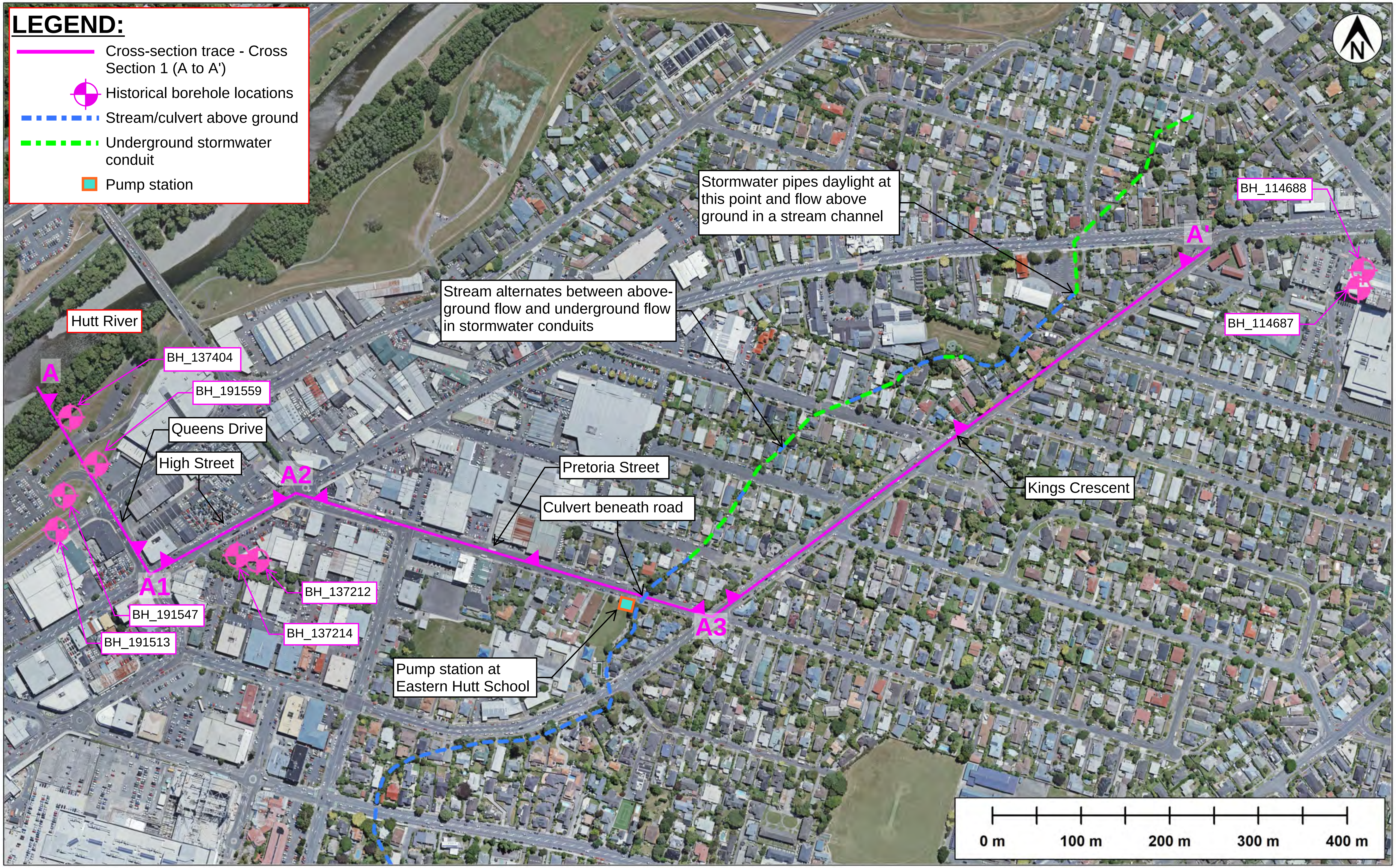
1. Settlement calculations to be undertaken by Geotechnical.

Appendix A- Long list of options

Longlist Options – September 2023



Appendix B - Geology cross sections & maps



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NOTES
- Aerial imagery is 0.075 m aerial photography (2021) from Land Information New Zealand.
- The displayed borehole appellations are the borehole identification numbers for each investigation in the New Zealand Geotechnical Database.
- Positions of underground stormwater conduits are estimated from Wellington Water GIS service maps

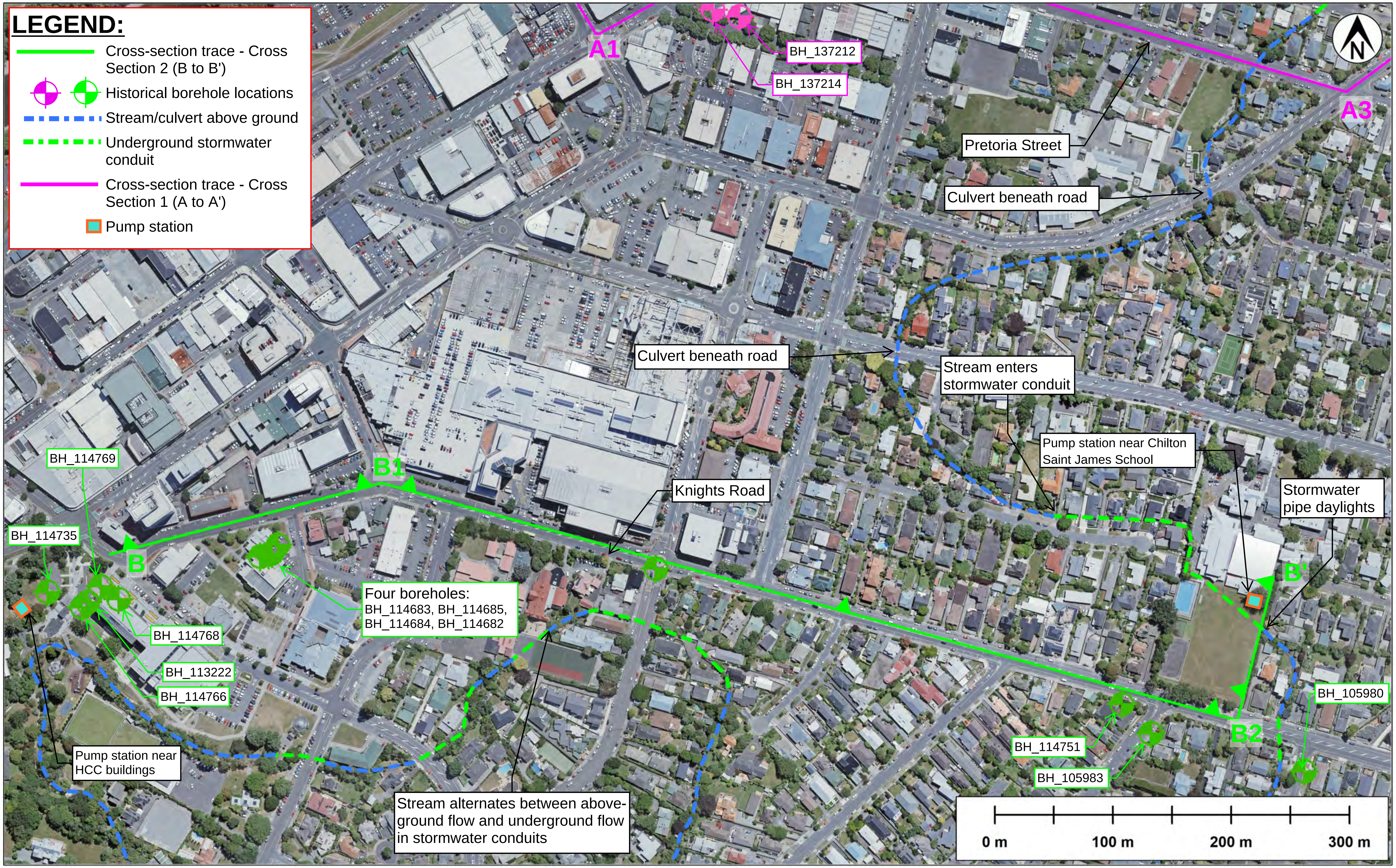
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE **Cross Section 1: A to A'**
SCALE (A3) 1:4000
REV

COPYRIGHT ON THIS DRAWING IS RESERVED   DO NOT SCALE FROM THIS DRAWING - IF IN DOUBT, ASK.



NOTES
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- Positions of underground stormwater conduits are estimated from Wellington Water GIS service maps

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	31/08/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT Hutt City Council

PROJECT HCC IAF Stormwater/Wastewater Upgrades

TITLE **Cross Section 2: B to B'**

SCALE (A3) 1:3000

REV

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- Positions of underground stormwater conduits are estimated from Wellington Water GIS service maps

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	31/08/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT Hutt City Council

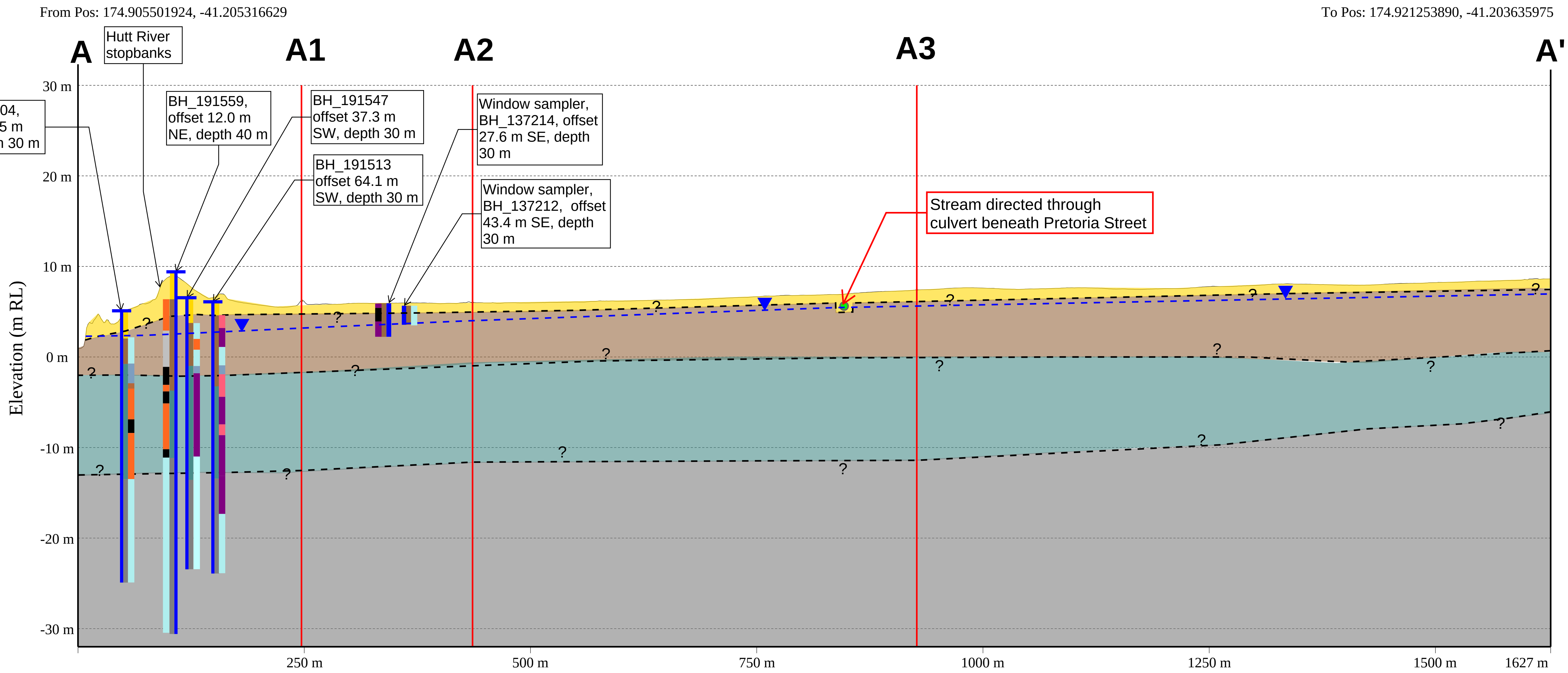
PROJECT HCC IAF Stormwater/Wastewater Upgrades

TITLE **Cross Section 3: C to C'**

SCALE (A3) 1:3000

REV

Cross Section 1 - A to A'



LEGEND

- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:5000H
10x Vertical Exaggeration (1:500V)

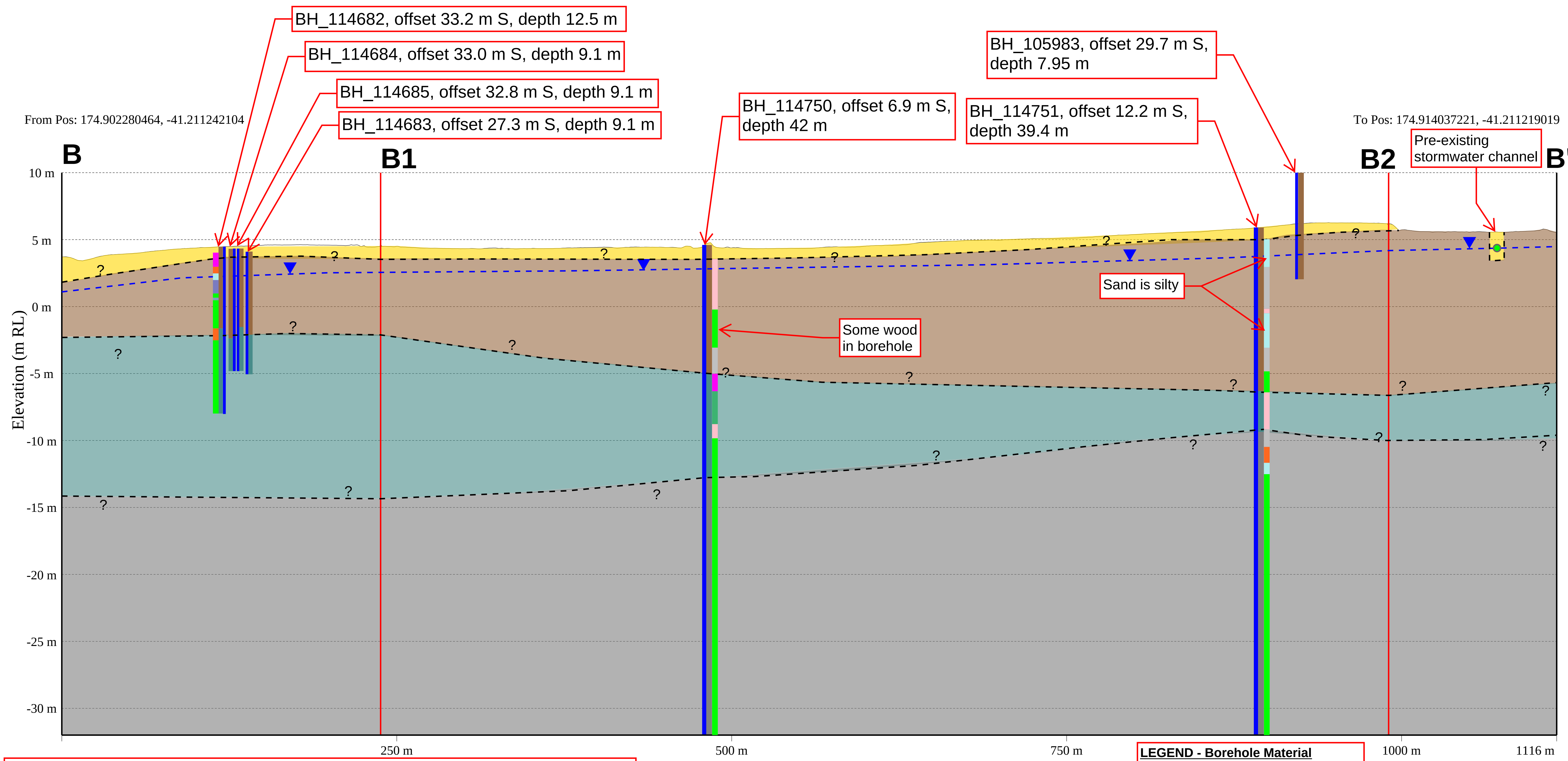
NOTES:

- It must be appreciated that subsurface conditions may vary from those inferred in this cross section.
- The ground conditions presented in this cross section are based on pre-existing geotechnical data derived from limited historical borehole locations.
- The geological model away from these locations is inferred and should be considered approximate only.

LEGEND - Borehole Material

- SILT
- SILT AND CLAY
- ORGANIC SILT
- CLAY
- CLAY AND WOOD/VEGETATION
- GRAVEL
- GRAVEL AND SAND
- GRAVEL AND SILT
- GRAVEL AND CLAY
- SAND
- SAND AND SILT
- VEGETATION/WOOD/PEAT

Cross Section 2 - B to B'



LEGEND

- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:5000H
10x Vertical Exaggeration (1:500V)

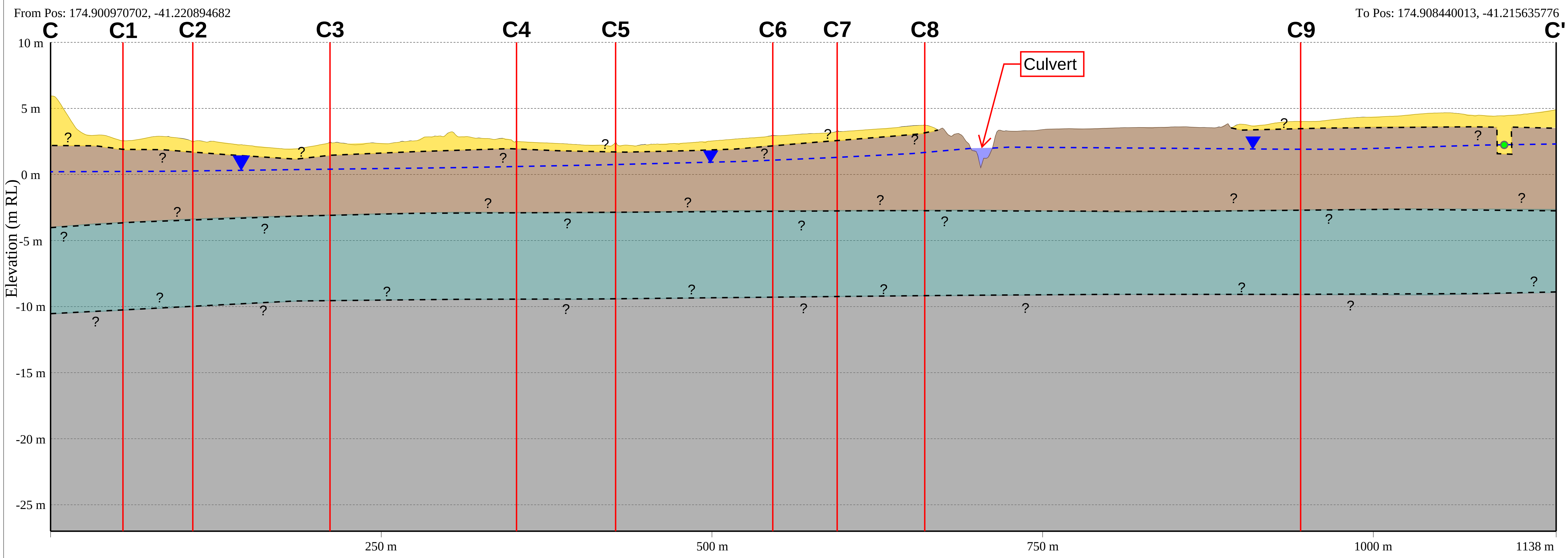
NOTES:

- It must be appreciated that subsurface conditions may vary from those inferred in this cross section.
- The ground conditions presented in this cross section are based on pre-existing geotechnical data derived from limited historical borehole locations
- The geological model away from these locations is inferred and should be considered approximate only.

LEGEND - Borehole Material

- SILT
- SILT AND CLAY
- ORGANIC SILT
- CLAY
- CLAY AND WOOD/VEGETATION
- GRAVEL
- GRAVEL AND SAND
- GRAVEL AND SILT
- GRAVEL AND CLAY
- SAND
- SAND AND SILT
- VEGETATION/WOOD/PEAT

Cross Section 3 - C to C'



LEGEND

- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:3000H
10x Vertical Exaggeration (1:300V)

NOTES:

- It must be appreciated that subsurface conditions may vary from those inferred in this cross section.
- The ground conditions presented in this cross section are based on pre-existing geotechnical data derived from limited historical borehole locations.
- The geological model away from these locations is inferred and should be considered approximate only.

Appendix C – Results of dewatering assessments

Summary of dewatering results

based on Marinelli (2000) calc

Description of standard inputs		GW at 0 m Excavation parameters for 900 mm dia pipe			GW at 1 m bgl Excavation parameters for 900 mm dia pipe		Source
base of excavation (assume 0 mRL)	p0	0	m	p0	0	m	Proposed excavations, height of water column represents diff. depths
initial head in m above base of pit	p1	3.4	m	p1	2.4	m	Max GWL at surface & GWL at 1 m bgl
rainfall recharge	W	1.00E-03	m/d	W	1.00E-03	m/d	HAM3 modelled rainfall recharge (425 mm/yr)
of excavation	Length	12	m	Length	12	m	Length of pipeline worked on at one time
of excavation	Width	1.9	m	Width	1.9	m	900 mm diam pipe with 0.5 m each side
of excavation	Area	22.8	m2	Area	22.8	m2	Calculated
representative radius	r_p	2.694	m	r_p	2.694	m	Calculated
initial head above base of pit	h0	3.4	m	h0	2.4	m	Calculated
no water in base of pit	h_p	0	m	h_p	0	m	Calculated
depth of water in pit	d	0	m	d	0	m	Calculated
vertical hydraulic conductivity anisotropy	m	1		m	1		Assumed

Scenario 1a GW at 0 m

		900 dia Press.Pipe Silt Min	900 dia Press.Pipe Silt Max	900 dia Press.Pipe Sand Min	900 dia Press.Pipe Sand Max	900 dia Press.Pipe Gravel Min	900 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E+01	8.64E+01	8.64E+01	8.64E+01	8.64E+01	8.64E+01
radius of influence (calculated)	r0	462.69	462.69	462.69	462.69	462.69	462.69
inflow from pit walls	Q1	7.2E-02	7.2E-02	8.6E+01	3.6E+02	3.6E+02	6.7E+02
inflow through pit base	Q2	3.2E-02	3.2E-02	3.2E+02	1.6E+03	1.6E+03	3.2E+03
total inflow (steady-state)	**Q_total**	**1.0E-01**	**1.0E-01**	**4.0E+02**	**1.9E+03**	**1.9E+03**	**3.8E+03**

Scenario 1a GW at 1 m bgl

		900 dia Press.Pipe Silt Min	900 dia Press.Pipe Silt Max	900 dia Press.Pipe Sand Min	900 dia Press.Pipe Sand Max	900 dia Press.Pipe Gravel Min	900 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	4.32E+01
radius of influence (calculated)	r0	4.65	46.19	122.69	247.69	248.69	248.69
inflow from pit walls	Q1	4.5E-02	6.7E+00	4.7E+01	1.9E+02	1.9E+02	1.9E+02
inflow through pit base	Q2	2.2E-02	2.2E+01	2.2E+02	1.1E+03	1.1E+03	1.1E+03
total inflow (steady-state)	**Q_total**	**6.7E-02**	**2.9E+01**	**2.7E+02**	**1.3E+03**	**1.3E+03**	**1.3E+03**

Summary of dewatering results

based on Marinelli (2000) calc

Description of standard inputs		**GW at 0 m** **Excavation parameters for 1500 mm dia pipe**			**GW at 1 m bgl** **Excavation parameters for 1500 mm dia pipe**		**Source**
base of excavation (assume 0 mRL)	p0	0	m	p0	0	m	Proposed excavations, height of water column represents diff. depths
initial head in m above base of pit	p1	4	m	p1	3	m	Max GWL at surface & GWL at 1 m bgl
rainfall recharge	W	1.00E-03	m/d	W	1.00E-03	m/d	HAM3 modelled rainfall recharge (425 mm/yr)
of excavation	Length	12	m	Length	12	m	Length of pipeline worked on at one time
of excavation	Width	2.5	m	Width	2.5	m	1500 mm diam pipe with 0.5 m each side
of excavation	Area	30	m2	Area	30	m2	Calculated
representative radius	r_p	3.090	m	r_p	3.090	m	Calculated
initial head above base of pit	h0	4	m	h0	3	m	Calculated
no water in base of pit	h_p	0	m	h_p	0	m	Calculated
depth of water in pit	d	0	m	d	0	m	Calculated
vertical hydraulic conductivity anisotropy	m	1		m	1		Assumed

Scenario 1b GW at 0 m

		1500 dia Press.Pipe Silt Min	**1500 dia Press.Pipe Silt Max**	**1500 dia Press.Pipe Sand Min**	**1500 dia Press.Pipe Sand Max**	**1500 dia Press.Pipe Gravel Min**	**1500 dia Press.Pipe Gravel Max**
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	6.37	72.09	195.09	397.09	398.09	543.09
inflow from pit walls	Q1	9.7E-02	1.6E+01	1.2E+02	5.0E+02	5.0E+02	9.3E+02
inflow through pit base	Q2	4.3E-02	4.3E+01	4.3E+02	2.1E+03	2.1E+03	4.3E+03
total inflow (steady-state)	**Q_total**	**1.4E-01**	**5.9E+01**	**5.5E+02**	**2.6E+03**	**2.6E+03**	**5.2E+03**

Scenario 1b GW at 1 m bgl

		1500 dia Press.Pipe Silt Min	**1500 dia Press.Pipe Silt Max**	**1500 dia Press.Pipe Sand Min**	**1500 dia Press.Pipe Sand Max**	**1500 dia Press.Pipe Gravel Min**	**1500 dia Press.Pipe Gravel Max**
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	5.61	56.59	151.09	307.09	308.09	420.09
inflow from pit walls	Q1	6.9E-02	1.0E+01	7.2E+01	3.0E+02	3.0E+02	5.5E+02
inflow through pit base	Q2	3.2E-02	3.2E+01	3.2E+02	1.6E+03	1.6E+03	3.2E+03
total inflow (steady-state)	**Q_total**	**1.0E-01**	**4.2E+01**	**3.9E+02**	**1.9E+03**	**1.9E+03**	**3.8E+03**

Summary of dewatering results

based on Marinelli (2000) calc

Description of standard inputs		GW at 0 m Excavation parameters for 1350 mm dia pipe			GW at 1 m bgl Excavation parameters for 1350 mm dia pipe		Source
base of excavation (assume 0 mRL)	p0	0	m	p0	0	m	Proposed excavations, height of water column represents diff. depths
initial head in m above base of pit	p1	5.85	m	p1	4.85	m	Max GWL at surface & GWL at 1 m bgl
rainfall recharge	W	1.00E-03	m/d	W	1.00E-03	m/d	HAM3 modelled rainfall recharge (425 mm/yr)
of excavation	Length	6	m	Length	6	m	Length of pipeline worked on at one time
of excavation	Width	2.35	m	Width	2.35	m	1350 mm diam pipe with 0.5 m each side
of excavation	Area	14.1	m2	Area	14.1	m2	Calculated
representative radius	r_p	2.119	m	r_p	2.119	m	Calculated
initial head above base of pit	h0	5.85	m	h0	4.85	m	Calculated
no water in base of pit	h_p	0	m	h_p	0	m	Calculated
depth of water in pit	d	0	m	d	0	m	Calculated
vertical hydraulic conductivity anisotropy	m	1		m	1		Assumed

Scenario 2a GW at 0 m

		1350 dia Press.Pipe Silt Min	1350 dia Press.Pipe Silt Max	1350 dia Press.Pipe Sand Min	1350 dia Press.Pipe Sand Max	1350 dia Press.Pipe Gravel Min	1350 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	6.57	95.12	262.12	540.12	542.12	742.12
inflow from pit walls	Q1	1.2E-01	2.8E+01	2.2E+02	9.2E+02	9.2E+02	1.7E+03
inflow through pit base	Q2	4.3E-02	4.3E+01	4.3E+02	2.1E+03	2.1E+03	4.3E+03
total inflow (steady-state)	**Q_total**	**1.6E-01**	**7.1E+01**	**6.4E+02**	**3.0E+03**	**3.1E+03**	**6.0E+03**

Scenario 2a GW at 1 m bgl

		1350 dia Press.Pipe Silt Min	1350 dia Press.Pipe Silt Max	1350 dia Press.Pipe Sand Min	1350 dia Press.Pipe Sand Max	1350 dia Press.Pipe Gravel Min	1350 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	5.89	80.12	221.12	456.12	458.12	627.12
inflow from pit walls	Q1	9.5E-02	2.0E+01	1.5E+02	6.5E+02	6.6E+02	1.2E+03
inflow through pit base	Q2	3.6E-02	3.6E+01	3.6E+02	1.8E+03	1.8E+03	3.6E+03
total inflow (steady-state)	**Q_total**	**1.3E-01**	**5.6E+01**	**5.1E+02**	**2.4E+03**	**2.4E+03**	**4.8E+03**

Summary of dewatering results

based on Marinelli (2000) calc

Description of standard inputs		GW at 0 m Excavation parameters for 1800 mm dia pipe			GW at 1 m bgl Excavation parameters for 1800 mm dia pipe		Source
base of excavation (assume 0 mRL)	p0	0	m	p0	0	m	Proposed excavations, height of water column represents diff. depths
initial head in m above base of pit	p1	6.3	m	p1	5.3	m	Max GWL at surface & GWL at 1 m bgl
rainfall recharge	W	1.00E-03	m/d	W	1.00E-03	m/d	HAM3 modelled rainfall recharge (425 mm/yr)
of excavation	Length	6	m	Length	6	m	Length of pipeline worked on at one time
of excavation	Width	2.8	m	Width	2.8	m	1800 mm diam pipe with 0.5 m each side
of excavation	Area	16.8	m2	Area	16.8	m2	Calculated
representative radius	r_p	2.312	m	r_p	2.312	m	Calculated
initial head above base of pit	h0	6.3	m	h0	5.3	m	Calculated
no water in base of pit	h_p	0	m	h_p	0	m	Calculated
depth of water in pit	d	0	m	d	0	m	Calculated
vertical hydraulic conductivity anisotropy	m	1		m	1		Assumed

Scenario 2b GW at 0 m

		1800 dia Press.Pipe Silt Min	1800 dia Press.Pipe Silt Max	1800 dia Press.Pipe Sand Min	1800 dia Press.Pipe Sand Max	1800 dia Press.Pipe Gravel Min	1800 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	7.11	102.31	282.31	582.31	582.31	802.31
inflow from pit walls	Q1	1.4E-01	3.3E+01	2.5E+02	1.1E+03	1.1E+03	2.0E+03
inflow through pit base	Q2	5.0E-02	5.0E+01	5.0E+02	2.5E+03	2.5E+03	5.0E+03
total inflow (steady-state)	**Q_total**	**1.9E-01**	**8.3E+01**	**7.5E+02**	**3.6E+03**	**3.6E+03**	**7.1E+03**

Scenario 2b GW at 1 m bgl

		1800 dia Press.Pipe Silt Min	1800 dia Press.Pipe Silt Max	1800 dia Press.Pipe Sand Min	1800 dia Press.Pipe Sand Max	1800 dia Press.Pipe Gravel Min	1800 dia Press.Pipe Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	6.43	88.31	242.31	498.31	500.31	682.31
inflow from pit walls	Q1	1.1E-01	2.4E+01	1.8E+02	7.8E+02	7.9E+02	1.5E+03
inflow through pit base	Q2	4.2E-02	4.2E+01	4.2E+02	2.1E+03	2.1E+03	4.2E+03
total inflow (steady-state)	**Q_total**	**1.6E-01**	**6.7E+01**	**6.1E+02**	**2.9E+03**	**2.9E+03**	**5.7E+03**

Summary of dewatering results

based on Marinelli (2000) calc

Description of standard inputs		GW at 0 m Excavation parameters for Pump Station			GW at 1 m bgl Excavation parameters for Pump Station		Source
base of excavation (assume 0 mRL)	p0	0	m	p0	0	m	Proposed excavations, height of water column to represent different excavation depths
initial head in m above base of pit	p1	8	m	p1	7	m	Max GWL at surface & GWL at 1 m bgl
rainfall recharge	W	1.00E-03	m/d	W	1.00E-03	m/d	HAM3 modelled rainfall recharge (425 mm/yr)
of excavation	Length	30	m	Length	30	m	Expected dimensions
of excavation	Width	15	m	Width	15	m	Pump station includes a batter and working space based on PS structure width of 15 m
of excavation	Area	450	m2	Area	450	m2	Calculated
representative radius	r_p	11.968	m	r_p	11.968	m	Calculated
initial head above base of pit	h0	8	m	h0	7	m	Calculated
no water in base of pit	h_p	0	m	h_p	0	m	Calculated
depth of water in pit	d	0	m	d	0	m	Calculated
vertical hydraulic conductivity anisotropy	m	1		m	1		Assumed

Scenario 3a GW at 0 m

		Pump Station Silt Min	Pump Station Silt Max	Pump Station Sand Min	Pump Station Sand Max	Pump Station Gravel Min	Pump Station Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	18.85	161.97	424.97	854.97	856.97	1166.97
inflow from pit walls	Q1	6.7E-01	8.2E+01	5.7E+02	2.3E+03	2.3E+03	4.3E+03
inflow through pit base	Q2	3.3E-01	3.3E+02	3.3E+03	1.6E+04	1.7E+04	3.3E+04
total inflow (steady-state)	**Q_total**	**1.0E+00**	**4.1E+02**	**3.9E+03**	**1.9E+04**	**1.9E+04**	**3.7E+04**

Scenario 3a GW at 1 m bgl

		Pump Station Silt Min	Pump Station Silt Max	Pump Station Sand Min	Pump Station Sand Max	Pump Station Gravel Min	Pump Station Gravel Max
horizontal hydraulic conductivity	Kh1	8.64E-04	8.64E-01	8.64E+00	4.30E+01	4.32E+01	8.64E+01
radius of influence (calculated)	r0	18.03	144.97	378.97	758.97	761.97	1031.97
inflow from pit walls	Q1	5.7E-01	6.6E+01	4.5E+02	1.8E+03	1.8E+03	3.3E+03
inflow through pit base	Q2	2.9E-01	2.9E+02	2.9E+03	1.4E+04	1.4E+04	2.9E+04
total inflow (steady-state)	**Q_total**	**8.6E-01**	**3.6E+02**	**3.3E+03**	**1.6E+04**	**1.6E+04**	**3.2E+04**

Appendix D – Figure showing the location of the Waterloo Wellfield bores and SPZ1 and SPZ2a

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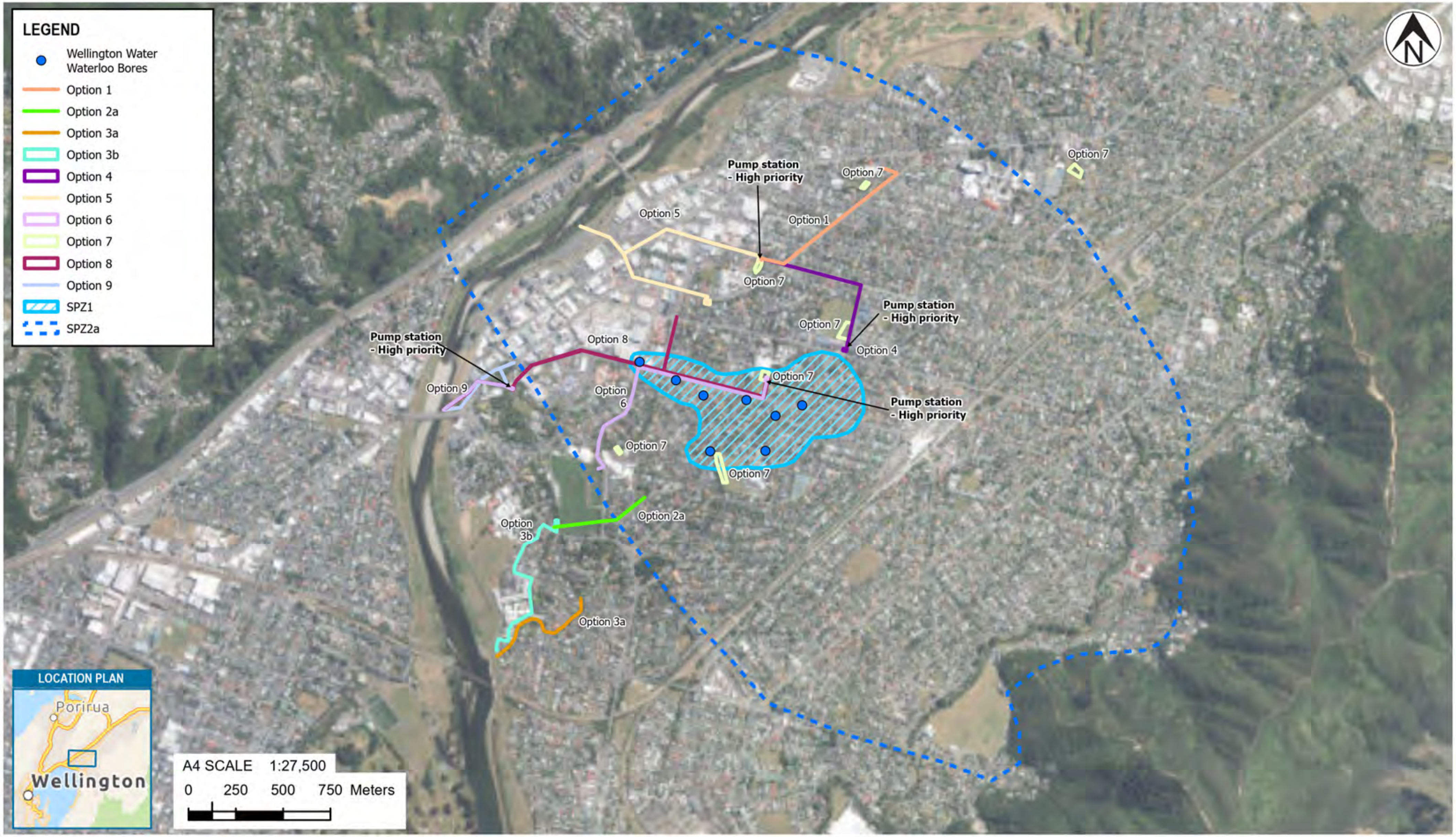
T:\Wellington\TT Projects\1091097\WorkingMaterial\GIS\HCC Hydrogeology\WWBoresAndSPZs.aprx Layout: Longlist Options 2024-Apr-29 9:31 am Drawn by DSMI



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NZ Navigation Map: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors. NZ Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors	First version (17/04/24)	0	DSMI

PROJECT No.	1091097	
DESIGNED	DSMI	APR.24
DRAWN	DSMI	APR.24
CHECKED	CHSA	APR.24
APPROVED	DATE	

CLIENT HUTT CITY COUNCIL

PROJECT HCC IAF STORMWATER/WASTEWATER UPGRADES

TITLE LONGLIST OPTIONS SHOWING LOCATION OF WATERLOO WELLFIELD BORES AND SOURCE PROTECTION ZONE 1 AND 2A

SCALE (A4) 1:27,500   FIG No. FIGURE 1.   REV 0

Appendix E- Constraints assessment – Contamination

Memorandum

To	**Hutt City Council**
cc	
From	**Tonkin & Taylor Ltd**
Date	**17 April 2024**
Subject	**HCC IAF Upgrades – Constraints Assessment - Contamination**
Reference	**IAFHCC.1091097.2000.MR.TM.PRW.XXXX.Constraints Assessment_Contamination.docx**

1. Introduction

1.1. Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the wastewater pipeline upgrade required to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options," prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass," prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.2. Current project stage and purposes of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility, is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this memo is to identify key constraints and fatal flaws relevant to contamination which will inform further option development. This contamination constraints assessment is for the stormwater upgrades only and excludes the wastewater upgrades.

1.3. Description of IAF options

1.3.1. Stormwater

A site walkover and brainstorming session was carried out by the design team at the start of this stage. Various options have been identified to form a "long list" of possible options. Through further option development, the long list will be reduced to a short list and then ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is included in **Appendix A**. Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stopbanks provide flood protection to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to high flows in the Hutt River.

1.3.2. Wastewater

The concept wastewater design option is presented in the Holmes Report. A copy of the Concept Design Drawings is included in **Appendix B**.

The option comprises gravity pipes, cut into the existing network, to divert flows to an offline storage tank and pump station. A rising main then runs from the pump station on Pretoria Street across the Hutt River and connecting to the existing network on the western side of the river.

Based on the Holmes Report, the pump station and storage tank can be located anywhere along Pretoria Street.

Contamination constraints assessment

1.4. Introduction/Overview

Tonkin & Taylor Ltd (T+T) has been commissioned by HCC to undertake a contamination constraints assessment specifically for the stormwater upgrades, which will facilitate the construction of new houses in the Lower Hutt Valley.

As stated above, the purpose of this assessment is to identify key contamination constraints and fatal flaws which will inform further option development. The persons undertaking, managing reviewing, and certifying this investigation are suitably qualified and experienced practitioners (SQEP), as required by the NESCS and defined in the NESCS Users' Guide (April 2012).

1.5. Scope of work

We have undertaken an initial review of potentially contaminated sites that may result in constraints to the construction of the proposed stormwater infrastructure, within the 'Project Area'. The Project Area extends from Kennedy Good Bridge to Ewen Bridge in central Lower Hut We will address the construction of the physical stormwater pipeline structures only at this stage, to inform the early

The scope of work for this assessment comprised:

Identification of potentially contaminated sites in the vicinity of possible stormwater route options, as identified in the City of Lower Hutt District Plan (District Plan) and Greater Wellington Selected Land User Register (SLUR).

- Identification of sites that will require detailed site investigations prior to the earthworks commencing.

Preparation of a summary of any identified high-risk sites that will likely require remedial, or management works that may influence the development of route or construction methodologies.

- Identification of possible contaminated land requirements for the construction of the proposed stormwater pipelines under the following RMA documents:
  - GWRC's Proposed Natural Resources Plan
  - Hutt City Council's District Plan
  - Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

Items (1) and (2) listed below have not been considered as part of this assessment, as they do not form part of the route and construction methodology options assessment. These will however be addressed in the consenting strategy.

1. Construction of outfalls of any other structures within the bed of the Hutt River. We understand that outfalls have already been consented as part of the RiverLink package. Any other earthworks within potentially contaminated sites within the adjacent RiverLink work areas.
2. The presence of contamination not related to activities listed on the MfE Hazardous Activities and Industries List (HAIL).

2. HAIL activities identified

Greater Wellington Regional Council holds the Selected Land Use Register (SLUR), on behalf of the local authorities. The SLUR is a record of potentially contaminated and contaminated sites within the Wellington Region. The SLUR and identified HAIL sites within the Project Area, as well as the implications on this project, including whether further investigations will be required, has been included in Table 2.1 below. Figure 1 presents the identified SLUR and HAIL sites within the Project Area.

Table 2.1: HAIL activities within Project Area

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
Stanley R & Muriel J Goodright SLUR ID: SN/03/230/02 SLUR Category IV: Contamination Acceptable, Managed/Remediated.	• 28 Downer Street	• HAIL F7: Service stations including retail or commercial refuelling facilities.	• SLUR Comments: This site was formerly a service station. One underground storage tank (containing hydrocarbons) was removed in May 2002. Impacted soil was removed from the site. A tank pull report found that two samples collected from the tank pit exceeded the Guideline Acceptance Criteria for the Protection of Groundwater Quality (based on BTEX concentrations). All other sample results complied with the applicable Oil Industry Guidelines for commercial/industrial land-use. Groundwater is not used in the area.	Currently outside of works area. Further assessment required if area to be disturbed during works.
TAB Lower Hutt SLUR ID: SN/03/099/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	• 252-256 High Street	• HAIL F7: Service stations including retail or commercial refuelling facilities.	• SLUR Comments: 2007: This site was a service station pre-1940. Photos show hydrocarbons migrating from the site during a dig under an adjacent footpath. Underground storage tanks which were on site have been removed. It is unknown if the contaminated soil was remediated. No detailed site assessment has been undertaken for this site.	Currently outside of works area. Further assessment required if area, or immediately surrounding area, to be disturbed during works.
Hutt Hospital SLUR ID: SN/03/176/02. SLUR Category IV: Contamination Acceptable, Managed/Remediated.	• 638 High Street	HAIL A17: Storage tanks or drums for fuel, chemicals, or liquid waste.	SLUR Comments: Three underground storage tanks containing hydrocarbons were removed from this site. Significant contamination of the soil was discovered and removed. The soil remaining was found to be within guidelines for both commercial/industrial and residential use. The site has been classified as a remediated site.	Currently outside of works area. Site previously remediated.
Ex Naenae Bowling Club SLUR ID: SN/03/788/02 SLUR Category IV: Contamination Acceptable, Managed/Remediated.	135 Witako Street	HAIL A10: Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.	SLUR Comments: This site meets the Ministry for the Environment Hazardous Activity and Industry List (HAIL) classification for Category A - Chemical manufacture, application and bulk storage, Activity 10 - Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds. Evidence of the HAIL activity was confirmed by reviewing historical aerial images 1971-2017. The full details of the listing are in a file note held by the Greater Wellington Regional Council [Ref: CLMG-9-1011] and were confirmed as a Verified HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2011) requirements. The DSI undertaken by PDP [CNMG-9-1468] recommended further soil testing should the site be subdivided for residential use. Further testing is attributable to a soil sample exceeding the relevant standards for residential. As a result of a district plan change, the Hutt City Council engaged PDP to reinterpret the DSI in the context of a commercial/industrial property [CNMG-9-1467]. The change in classification was confirmed by a suitably qualified and experienced practitioner, considering the risk to groundwater. The details of the reclassification can be found in a file note [CNMG-9-1479].	Currently outside of works area. Site previously investigated.
Caltex VIC SLUR ID: SN/03/157/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	514-516 High Street	HAIL F7: Service stations including retail or commercial refuelling facilities. HAIL F4: Motor vehicle workshops.	SLUR Comments: The site has been a service station and workshop. Petroleum hydrocarbons were stored in 4 underground storage tanks (UST's), and an above ground waste oil tank is also on site. A 'Take Charge Assessment' conducted in 2003 found that with the exception of the hydrocarbon-stained stormwater drain, there was no evidence of environmental pollution or contamination associated with infrastructure at this site. Information received (URS, 2010) shows that the underground petroleum storage system containing 4 USTs were removed from the site. At the time of the UST removals, samples were collected and analysed to determine any residual contamination. The report states that all samples representative of soil remaining on site comply with corresponding Oil Industry Guidelines Tier 1 soil acceptance criteria for commercial/industrial land use. No information is available on potential contamination from the waste oil tank or workshop facilities.	Currently outside of works area. Further assessment required if area to be disturbed during works.

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
Mobil Lower Hutt SLUR ID: SN/03/158/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	659 High Street	HAIL F7: Service stations including retail or commercial refuelling facilities.	SLUR Comments: Service station with the bulk storage of hydrocarbons. Three double skinned fibre glass underground storage tanks are on site, stored within a concrete bund. An above ground storage tank LPG tank is also on site. There had been no significant contamination or spills according to a Greater Wellington 2003 'Take Charge Assessment'. August 2015: A report commissioned by Mobil "Mobil Lower Hutt - Phase 2 Environmental Site Assessment" was received in August 2015. Mobil have indicated that this report is commercially sensitive, please contact the GWRC for further information on the details of the report. The electronic copy of this report is held on OurSpace, document ID ENAR-12-55730. April 2019: Notification received from PDP regarding the removal and upgrade to the current Underground Petroleum Storage System (1x diesel and 3x petrol 40,000 L UST's). See OurSpace document CNMG-9-1290 for full details.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Hutt Intermediate SLUR ID: SN/03/149/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	7 Kauri Street **Note: Site location appears to be residential properties on the western boundary of the Intermediate. The correct address is assumed to be 44-48 Penrose Street**	HAIL G3: Landfill sites.	SLUR Comments: While our files note that this site was a landfill, no further information is available. The site is currently used as an intermediate school. Former landfill on SLUR at Hutt Intermediate School – no evidence of landfill observed in aerials (1940-current). Area appears to be in pasture prior to the development of the school in the later 1940s.	Yes - limited investigation to assess whether there is waste present in the development.
Kaycote Laminations Ltd / Total Tabs Ltd SLUR ID: SN/03/126/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	24 Downer Street **Note: Site location appears to also cover 26 Downer Street**	HAIL A2: Chemical manufacture, formulation, or bulk storage.	SLUR Comments: Ex BASF NZ Ltd occupied this site from 1986 until at least 1994. Agricultural and industrial chemicals were stored on site. In 2003 the site was occupied by Kaycote Laminations Limited and Total Tabs Limited. No detailed site investigation was undertaken so therefore the level of contamination, if any, is unknown.	Currently outside of works area. Further assessment required if area to be disturbed during works.
McLennan J & D Ltd SLUR ID: SN/03/110/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	2-12 Rutherford Street	HAIL D5: Engineering workshops with metal fabrication.	SLUR Comments: June 2015: This site has been occupied by J & D McLennan Ltd, an engineering company, since 1945. This activity meets the Ministry for the Environment Hazardous Activity and Industry List classification for category - D Metal extraction, refining and reprocessing, storage and use, activity- 5 Engineering workshops with metal fabrication.	Currently outside of works area. Further assessment required if area to be disturbed during works.
BP Melling SLUR ID: SN/03/155/02 SLUR Category III: Contamination Confirmed.	17 Melling Road	HAIL F7: Service stations including retail or commercial refuelling facilities.	SLUR Comments: BP service station and therefore hydrocarbons are stored in bulk on this site. Previous investigations have been carried out in response to fuel losses. Groundwater contamination (particularly of benzene) was noted and groundwater in the area has been regularly monitored since 1997. In 1998 six underground storage tanks were removed and an LPG tank was installed. The sampling indicated some level of groundwater contamination. In 1998 the level of detected BTEX (Benzene, toluene, ethyl benzene and xylene) and TPH (total petrochemical hydrocarbons) were below Oil Guideline values except for one sampling site where TPH levels were exceeded. The results in general suggest contaminants appeared to be fluctuating at a fairly constant level. In July 2000, all BTEX concentrations were below the applicable guidelines. A further round of monitoring was proposed for 2001, although it is not known whether this monitoring was undertaken A 'Take Charge Assessment' in 2003 found that there was no evidence of significant environmental pollution or contamination associated with the current infrastructure or operations at this site. March-May 2022-partial UPSS decommissioning, removal and upgrade works were completed, and a tank pull report was prepared by AECOM. The dispensers, dispensing lines, remote fill points and vents were removed from site during the decommissioning works. Thirty-four soil samples were collected during the upgrade works. Seventeen of the soil samples were submitted for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, xylene, and naphthalene (BTEXN) analysis. Two soil samples were also	Currently outside of works area. Further assessment required if area to be disturbed during works.

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
			submitted for heavy metal analysis. Soil remaining on site complied with the Oil Industry Guidelines Soil Tier 1 Soil Acceptance Criteria for Commercial / Industrial Land Use. Approx 202 tonnes of material was removed from site and disposed of at Wellington City Council Southern Landfill, Wellington.	
Lower Hutt Fire Station SLUR ID: SN/03/201/02 SLUR Category IV: Contamination Acceptable, Managed/Remediated. **Note: Also includes the Lower Hutt Fire Station Apartments**	1 John Reynolds Square	HAIL A17: Storage tanks or drums for fuel, chemicals, or liquid waste.	SLUR Comments: Two underground storage tanks containing hydrocarbons were removed in May 2001 from concrete lined pits. The pipework was not removed. The URS report indicates that all soil samples taken on removal were below the Oil Industry Guideline Tier 1 Acceptance Criteria for commercial/industrial land use. For full details see URS (2001) Underground Petroleum Storage System Removal Report (CNMG-9-414). It is thought that other underground tanks onsite have also been removed however Greater Wellington does not hold a tank pull report to confirm this.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Stevens Motors Ltd SLUR ID: SN/03/224/02 SLUR Category I: Verified History of Hazardous Activity or Industry. **Note: Stevens Motors Ltd no longer occupies the site. Instead Captial City Motors currently appears to occupy the site.**	434 High Street	HAIL F7: Service stations including retail or commercial refuelling facilities. HAIL F4: Motor vehicle workshops.	SLUR Comments: The site has been used for the bulk storage of hydrocarbons and for the maintenance of motor vehicles. No detailed site investigation has been undertaken by Greater Wellington and therefore the level of contamination, if any, is unknown. It is unknown if underground storage tanks remain on site.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Harvey Norman SLUR ID: SN/03/223/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	28-36 Rutherford Street	HAIL F7: Service stations including retail or commercial refuelling facilities. HAIL F4: Motor vehicle workshops.	SLUR Comments: The site has previously been used by a service station and motor vehicle workshops. The underground fuel tanks have been removed. The residual hydrocarbon contamination has been shown to be below the Tier 1 acceptance criteria (Guidelines for Assessing and Managing Hydrocarbon Contaminated Sites in New Zealand, Ministry for the Environment 1997). Greater Wellington holds no record of environmental investigations being undertaken to assess what, if any, contamination has resulted the workshop activities.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Ex Lithographic Service Ltd. SLUR ID: SN/03/237/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	22 Downer Street	HAIL A15: Printing including commercial printing using metal type, inks, dyes, or solvents (excluding photocopy shops).	SLUR Comments: 2007: In 1986 a small-scale printing business operated from this site. Potential contamination includes solvents, acids, alkalis, and heavy metals. No detailed site assessment was undertaken and therefore the level of contamination, if any, is unknown. It is unclear when the business moved off-site.	Currently outside of works area. Further assessment required if area to be disturbed during works.
13/13A Connolly Street SLUR ID: SN/03/365/02 SLUR Category IV: Contamination Acceptable, Managed/Remediated.	15A Connolly Street	HAIL A10: Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.	SLUR Comments: The site was previously used to produce flowers. Several glasshouses were located on the site. The site was investigated in 2005/06 and significantly elevated concentrations of lead, arsenic and DDT were found in the surface soils. Groundwater was also found to be contaminated with copper and arsenic. The site was remediated in August 2006, when the contaminated soil was removed to Silverstream Landfill. Following the excavation, the site was validated which indicated that the level of the contaminants remaining on the site were at or slightly above background levels.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Hutt City Council SLUR ID: SN/03/363/02 SLUR Category IV: Contamination Acceptable, Managed/Remediated.	22-34 Laings Road	HAIL A17: Storage tanks or drums for fuel, chemicals, or liquid waste. HAIL E1: Asbestos products manufacture or disposal including sites with buildings containing asbestos products known to be in a deteriorated condition.	SLUR Comments: 2010: The site has two underground storage tanks that have been used to store fuel. One is located behind the southeast wall of the town hall boiler room, and the other is located at the southern end of the horticultural hall. 2010: Information received (ERMA, 2008) shows that ERMA has given approval for the two underground tanks to be slurry filled and remain at the site given their locations within building structures, which the owners of the site have. Asbestos was found at one of the tank	Yes (in area of former buildings at 26 Laings Road) – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the pipework

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
			locations, and it is presumed there would be more asbestos throughout the building. 2014: Information received (#1412422) from PDP prepared for Hutt City Council regarding the removal, in August 2008, of one of the three underground storage tanks (UST)on site. Tank location and images of removal are included in the above report held by Greater Wellington Regional Council. The report indicated that the 4,500L diesel UST and associated pipework were removed; a short section of pipework has been capped and is still in place due to its proximity to suspected underground gas line. Soil samples were taken to detect petroleum hydrocarbon concentrations, detection was below laboratory reporting limits. Once the tank had been removed all bedding material was returned. • Former buildings have been identified in historic aerial images* (1941-2013) available on the HCC Map Viewer. A residential dwelling was present in this area in the 1941 image which was replaced by the larger council office building from 1958 until the 2013 image. The building was then replaced with the current council office buildings.	for 'Option 8 - Collecting from Chilton St James School PSI'. SLUR Site, at 32-34 Laings Road, currently outside of works area. Further assessment required if area to be disturbed during works.
Midas Car Care, 10 Pretoria St SLUR ID: SN/03/681/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	10 Pretoria Street	HAIL F4: Motor vehicle workshops.	SLUR Comments: September 2014: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle refuelling, service and repair, activity 4 - Motor vehicle workshops. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the company website, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1405321] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2012) requirements.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Pit Stop, 15 Rutherford St SLUR ID: SN/03/683/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	13-15 Rutherford Street	HAIL F4: Motor vehicle workshops.	SLUR Comments: September 2014: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle refuelling, service and repair, activity 4 - Motor vehicle workshops. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the company website, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1405388] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2011) requirements.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Pak 'n Save Fuel, Corner Brunswick, and High Street SLUR ID: SN/03/697/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	20 Brunswick Street	HAIL F7: Service stations including retail or commercial refuelling facilities.	SLUR Comments: 2014: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle Refuelling, Service and Repair, activity 7 - Service stations including retail or commercial refuelling facilities. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the company website, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1418907] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2011) requirements.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Z VIC Corner, 545-555 High Street SLUR ID: SN/03/637/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	547-555 High Street	HAIL F7: Service stations including retail or commercial refuelling facilities.	SLUR Comments: 2014: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle Refuelling, Service and Repair, activity 7 - Service stations including retail or commercial refuelling facilities. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the company webpage, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council	Currently outside of works area. Further assessment required if area to be disturbed during works.

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
			[WGN document #1419183] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2012) requirements.	
417 and 419 High Street, Hutt City SLUR ID: SN/03/482/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	421 High Street	HAIL F4: Motor vehicle workshops.	SLUR Comments: 2014: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle refuelling, repair and service, activity 4 - Motor vehicle workshops. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listings from both companies' webpages, and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1431844] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2012) requirements. Note: This site refers to 417 and 419 High Street.	Currently outside of works area. Further assessment required if area to be disturbed during works.
GRC Automotive SLUR ID: SN/03/726/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	25 Brunswick Street	HAIL F4: Motor vehicle workshops.	SLUR Comments: July 2015: This site meets the Ministry for the Environment Hazardous Activity and Industry List classification for category F - Vehicle refuelling, service and repair, activity 4 - Motor vehicle workshops. Evidence of the HAIL activity was confirmed from aerial photographs, online directory listing from the Gopher website and Google Earth Street View photographs. The full details of the listing are in the file note held by the Greater Wellington Regional Council [WGN document #1504283] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NES (2011) requirements.	Currently outside of works area. Further assessment required if area to be disturbed during works.
1 Pretoria Street SLUR ID: SN/03/2043/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	1 Pretoria Street	HAIL A17: Storage tanks or drums for fuel, chemicals, or liquid waste. HAIL F4: Motor vehicle workshops.	SLUR Comments: This site meets the Ministry for the Environment Hazardous Activity and Industry List (HAIL) classification for Category A – Chemical manufacture, application, and bulk storage; Activity – 17 Storage tanks or drums for fuel, chemicals or liquid waste, and Category F – Vehicle refuelling, service, and repair; Activity 4 – Motor vehicle workshops. Evidence of the HAIL activity was confirmed after Pattle Delamore Partners advised Greater Wellington Regional Council that 4 USTs were being removed from the site. The full details of the listing are in a file note held by the Greater Wellington Regional Council [OurSpace document CLMG-6-273] and were confirmed as a HAIL site by a suitably qualified and experienced practitioner in accordance with NESCS (2012) requirements.	Currently outside of works area. Further assessment required if area to be disturbed during works.
Mobil Gas SLUR ID: SN/03/2051/02 SLUR Category I: Verified History of Hazardous Activity or Industry.	• PT ASS 16081/999 SOUTH BLOCK • **Note: This site does not have an exact street address. It is located in the grassed area, on the stopbank, to the north-west of the Queens/Ewen/Woburn round-about.**	HAIL F7: Service stations including retail or commercial refuelling facilities.	SLUR Comments: In 2021, Tonkin + Taylor undertook a Contaminated Land Technical Assessment for the Riverlink project and identified historical HAIL activities. A Mobil gas sign was identified in a 1956 Oblique image viewed from Whites Aviation Ltd, which is present near the roundabout off Ewan Bridge. The Mobil Gas building was present at least from 1939-1950. It was removed or demolished, and the stopbanks/road have been realigned.	Yes – Investigation will be required in the area where soil disturbance is to be undertaken for installing the outfall pipework.
Additional Sites for Consideration				
Bernard's College Proposed detention storage	183 Waterloo Road	HAIL A10: Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.	Market gardening activities have been identified in an historic aerial image (1941) available on the HCC Map Viewer. Subsequent historic aerial images (from 1958 onwards) show the school being present and market gardening activities ceased.	Yes - Investigation will be required in the area where soil disturbance is necessary for installing the detention storage structure.
Former dwellings at Hutt Recreation Grounds, from Woburn Road, extending along Bellevue Road to Huia Street.	135 Woburn Road	Potential HAIL I: Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment.	Previous buildings and structures have the potential to contain asbestos building materials and lead-based paints. Previous dwellings have been identified in historic aerial images (1941, 1958 and 1969) available on the HCC Map Viewer. All but one of the dwellings had been removed by the 1969 image and by the 1977 historic aerial images, all dwellings had been removed.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the detention

Site and SLUR Status	Location	HAIL Activities	Comments	Requires Further Investigation
				storage structure is recommended.
Former building/s	River end of Whites Line West, on stopbank.	Potential HAIL I: Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment.	Previous buildings and structures have the potential to contain asbestos building materials and lead-based paints. A former building has been identified in historic aerial images* (1958, 1969 and 1977) available on the HCC Map Viewer. By the 1988 image, the building was no longer present, and the area appears to have been used for stockpiling of flood protection materials (concrete blocks).	Further assessment required if area to be disturbed during works as prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils.
	Queens Drive Slip Road, adjacent to 36 High Street		A former building has been identified in an historic aerial image* (1941) available on the HCC Map Viewer. Subsequent historic aerial images* (from 1958 onwards) show the building is no longer present and the current Queens Drive Slip Road present in its place.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the pipework for the 'Option 9 – CBD Interceptor', 'Option 6 – Riddiford Garden to Outlet 24' and 'Option 8 - Pumping from Riddiford Gardens to Outlet 24'.
	Bloomfield Terrace between Knights Road and Waterloo Road		Former residential dwellings have been identified in historic aerial images* between 1941 and 1969, available on the HCC Map Viewer. Bloomfield terrace in under construction in the 1969 aerial image. An additional dwelling was removed from the corner of Bloomfield Terrace and Kings Crescent in 1971 aerial photo.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the pipework for 'Option 8 - Collecting Cornwall St gravity Interceptor'.
	2 Kings Crescent		Former buildings have been identified in historic aerial images* (1941 and 1958) available on the HCC Map Viewer. A residential dwelling and commercial building were present in this area in the 1941 image which was replaced by a section of Queens Drive that intersects with Kings Crescent in 1969 aerial photo.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the pipework for 'Option 5: Alternative PS to outfall'.
	48 Kings Crescent		A former building (appears to be a small shed) has been identified from the 1941 historic aerial image* available on the HCC Map Viewer. Subsequent historic aerial images* (from 1958 onwards) show the building is no longer present and from 1977 the current residential dwellings are present.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the 'Option 5 - Alternative PS Kings Cres'.
	Eastern Hutt School, 53 Kings Crescent, Pretoria Street portion.		A former building has been identified in an historic aerial image* (1941) available on the HCC Map Viewer. Subsequent historic aerial images* (from 1958 onwards) show the building is no longer present and the site vacant until the 1969 image when the area is incorporated into the school grounds.	Yes – prior demolition activities have the potential to disburse contaminants from dwellings in to surrounding soils. Investigation prior to installing the 'Option 7 – Eastern Hutt School Detention Storage'.

*Historic aerial images are included in Appendix D.

3. Sites requiring remediation

No sites, at this stage, require remediation. If further investigations find elevated levels of contamination, above relevant human health, and environmental criteria, then remedial works will likely be required prior to the project works.

4. Regulatory Implications

The rules and associated assessment criteria relating to the control of contaminated sites in the Wellington and Horizons regions are specified in the following documents:

National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS)[1];

The Greater Wellington Regional Council's Natural Resources Plan [2];

The Hutt City Council's City of Lower Hutt District Plan [3].

The NESCS and District Plans consider issues relating to land use and the protection of human health while the Regional Plans have regard to issues relating to the protection of the general environment, including ecological receptors. Contamination related resource consents for the works associated with the stormwater upgrade has been evaluated against these regulatory requirements.

4.1. NESCS

4.1.1. Applicability

The NESCS came into effect on 1 January 2012. This legislation sets out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health. As a result, the NESCS prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NESCS.

The NESCS applies to specific activities on land where a HAIL activity has, or is more likely than not, to have occurred. Activities covered under the NESCS include soil disturbance, soil sampling, fuel systems removal, subdivision, and land use change.

Table 4.1 below, as provided in the NESCS Users Guide (April 2012), confirms the NESCS applies to pieces of land within the Project Area.

Table 4.1: NESCS checklist

NESCS Requirement	Applicable to site?
Is an activity described on the HAIL currently being undertaken on the piece of land to which this application applies?	Yes
Has an activity described on the HAIL ever been undertaken on the piece of land to which this application applies?	Yes
Is it more likely than not that an activity described on HAIL is being or has been undertaken on the piece of land to which this application applies?	Yes
If 'Yes' to any of the above, then the NESCS may apply.	

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

[2] Greater Wellington Regional Council, 2023. Natural Resources Plan for the Wellington Region.

[3] Hutt City Council, 2004. City of Lower Hutt District Plan.

NESCS Requirement	Applicable to site?
The five activities to which the NES applies are:	
Is the activity you propose to undertake removing or replacing a fuel storage system or parts of it?	No
Is the activity you propose to undertake sampling soil?	No
Is the activity you propose to undertake disturbing soil?	Yes
Is the activity you propose to undertake subdividing land?	No
Is the activity you propose to undertake changing the use of the land?	No
Conclusion: The NESCS applies to the HCC SW development.	

The NESCS applies to 'pieces of land' within the Project Area where the proposed upgrades to the stormwater network are to be located, as defined in Table 4.1 above. The sites that have been identified as requiring further investigation, i.e. to assess the presence or level of contaminants present, are detailed in Table 4.1.

4.2. Greater Wellington Regional Council's Natural Resources Plan

GWRC is responsible for the management of discharges of contaminants to land, air, and water. This includes the discharge of contaminants from existing contaminated land.

The GWRC Operative Natural Resources Plan (NRP) contains Rules R81-R83 that relate to contaminated land and hazardous substances.

Section 5.2.12 – Rules R81-82 relate to contaminated land and hazardous substances permitted activity status. Permitted activity status under these rules can be met so long as:

- Any future detailed site investigation reports are provided to the GWRC within 2 months of completion;
- The site is not classified as SLUR 'Category III – Contamination Confirmed' land; and
- The results of the detailed site investigations indicate that the discharge does not pose an unacceptable risk to human health or the environment, on-site or off-site.

Although there is currently one SLUR Category III site recorded to be within the Project Area on the GWRC's SLUR, the BP Service Station at Melling, we understand that no development will be completed within or surrounding this site.

A resource consent under rules relating to soil disturbance and discharges from contaminated sites under the PNRP will be required for the redevelopment works if further investigations confirm that there are contaminated sites within the area to be disturbed by development.

4.3. District Plan Applicability

The Hutt City Council's District Plan became operative in 2003 and is currently under review. The NESCS now prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NESCS. The rules in the District Plan do not deal with any effects that are not dealt with in the NESCS, with respect to managing contaminants in soil to protect human health. Therefore, the provisions of the District Plan have not been considered further in this assessment.

5. Summary and Conclusions

Tonkin & Taylor Ltd (T+T) has been commissioned by HCC to undertake a contamination constraints assessment within the Project Area, extending from Kennedy Good Bridge to Ewen Bridge in Lower Hutt, for the purposes of a stormwater network upgrade.

A summary of the findings is below:

There have been several historic and current HAIL activities identified across the Project Area that have the potential to result in soil and groundwater contamination. Activities include horticulture, motor vehicle workshops, use and disposal of fuels and other associated substances; and

It is likely that lead-based paint and asbestos have also been used in the construction of a number of buildings and structures within the Project Area. Wear and maintenance of the buildings may have resulted in soil contamination around the buildings and structures. It is likely that building materials from historic buildings and structures have been buried in areas along the stopbanks and berms.

- A summary of potential regulatory implications for future development of the Project Area is below:

The NESCS will apply to the proposed work and a resource consent will be required to undertake development activities, including; soil disturbance and changes to land uses, within the Project Area;

Further investigation, i.e. Detailed Site Investigations (DSIs), of some HAIL sites may be required within the Project Area, to determine the presence and potential risks to human health and the environment from soil contaminants, particularly where soil disturbance is proposed;

Asbestos is also likely to be present in some of the current and prior buildings within the Project Area. The Asbestos Regulations are likely to apply if works that will disturb these structures are proposed; and

Rules related to discharge of contaminants to land and water in the Greater Wellington Regional Council’s Natural Resources Plan will apply to the proposed works.

Appendix A: Stormwater Options

Appendix B: Concept Design Drawing

Appendix C: Figures

Appendix D: Historic Aerial Photos

River end of Whites Line West, on stopbank.	1958	
	1969	
	1977	

	1988	
Queens Drive Slip Road, adjacent to 36 High Street	1941	
	1958	

22-34 Laings Road	1941	
	1958	
	2013	

Bloomfield Terrace between Knights Road and Waterloo Road	1941	
	1969	
	1971	

2 Kings Crescent	1941	
	1958	
	1969	

48 Kings Crescent	1941	
	1958	
	1977	

53 Kings Crescent	1941	
	1958	
	1969	

Appendix F- Constraints assessment – Planning

Memorandum

To	**Hutt City Council**
cc	
From	[redacted], **Principal Planner**
Date	**16 August 2023**
Subject	**HCC IAF Upgrades – Constraints Assessment - Planning**
Reference	**1091097.TT.2100.PRW.ME.EN.23.Constraints Assessment Planning.docx**

1 Introduction

1.1 Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the wastewater pipeline upgrade required to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options", prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass", prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.2 Current project stage and purpose of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this document is to identify key constraints and fatal flaws relevant to planning, including consenting, which will inform further option development.

1.3 Description of IAF options

1.3.1 Stormwater

A site walkover and brainstorming session has been carried out by the design team at the start of this stage. Various options have been identified to form a "long list" of possible options. Through further option development, the long list will be reduced down to a short list and then ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is included in Appendix A. Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stopbanks provide flood protection to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to high flows in the Hutt River.

1.3.2 Wastewater

The concept wastewater design option is presented in the Holmes Report. A copy of the Concept Design Drawings is included in 0.

The option comprises gravity pipes, cut into the existing network, to divert flows to an offline storage tank and pump station. A rising main then runs from the pump station on Pretoria Street across the Hutt River and connecting to the existing network on the western side of the river.

Based on the Holmes Report, the pump station and storage tank can be located anywhere along Pretoria Street.

The concept design seeks to achieve the following level of service:

- No dry weather overflows for the projected 2070 population and proposed land use.
- Uncontrolled spilling to not exceed an average of one spill per year wet weather overflow frequency (1yr event).
- Overflows at engineered overflow points to not exceed an average of two spills per year wet weather overflow frequency (6-month event).

Wastewater overflows would be directly to Te Awa Kairangi, with the overflow discharge point likely to be located adjacent to the north of Melling Bridge.

2 Constraints Assessment

2.1 Introduction/Overview

This preliminary planning assessment considers the potential consenting requirements and policy framework that would apply to the construction and operation of stormwater and wastewater infrastructure, including pipelines, pump stations and stormwater detention features.

We have considered the implications of a potential overflow discharge of wastewater into Te Awa Kairangi with respect to the District Plan and Natural Resources Plan at a very high level in this assessment and will address other non-statutory implications of this discharge in the consenting strategy.

We have considered the District Plan and Natural Resources Plan only in this assessment. The consenting strategy will more thoroughly address other relevant plans and policies (including the Wellington Regional Policy Statement), consider possible consenting pathways, interactions with other projects (e.g. Riverlink, Wellington Water network discharge consent renewals), technical assessments and engagement and consultation requirements required to support any consent applications.

We understand that the stormwater discharges to Te Awa Kairangi would be covered by Wellington Water's network discharge consents and that outlets discharging stormwater from this catchment are consented as part of the Riverlink project. We have therefore not considered these aspects of the stormwater upgrade any further in this assessment.

In addition to the policy framework summarised in the constraints assessment below, the National Policy Statement for Freshwater 2020 (NPS Freshwater) is of key relevance to the project. The NPS Freshwater sets out objectives and policies for freshwater management and sets out a hierarchy that prioritises the health and wellbeing of water bodies and freshwater ecosystems, the health needs of people, and the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future (Objective 1). Importantly, the NPS Freshwater requires that freshwater is managed in a way that gives effect to Te Mana o te Wai (Policy 1), and that tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for (Policy 2). The NPS Freshwater and mana whenua considerations will be comprehensively addressed through the consenting strategy.

2.2 District Plan assessment

2.2.1 Background

The City of Lower Hutt District Plan (District Plan) applies to the entire project area. The District Plan set out provisions for managing land use, subdivision and development. The District Plan is subject to some significant changes at present and in the near future. Plan Change 56 is HCC's Intensification Planning Instrument, providing for greater housing density in Hutt City. The hearing panel has made recommendations on Plan Change 56, and these were accepted by HCC on 30 August. These changes will be formally adopted in late September.

In addition to this, HCC is currently undertaking a full District Plan review and expects to release a draft plan in October 2023. The proposed plan will likely be released in 2024. It is unclear whether the proposed plan will be released prior to any resource consent applications for this project being lodged, and whether any relevant proposed plan provisions would have immediate effect (and therefore apply to this project).

We will canvass this further in the consenting strategy and as the project progresses and note that the planning framework is in a state of flux at the moment which presents an additional layer of complexity, and any future changes to the district plan framework might present risks or opportunities to the project.

Chapter 13 of the Hutt City District Plan provides a framework for managing network utilities, including stormwater and wastewater infrastructure. This chapter applies district-wide and the underlying zones are not relevant (unless specifically stated in a provision).

The definition for '*regionally significant network utilities*' includes '*the local authority wastewater and stormwater network, systems and wastewater treatment plants*'. This project is covered by this definition, and therefore the provisions of Chapter 13 apply to the works.

2.2.2 Policy framework

The Policy framework in Chapter 13 is generally supportive of the development of regionally significant network utilities. In particular, the objectives and policies in 13.1.3 and 13.1.4 recognise and provide for network utilities and seek to manage their adverse effects from design, location, operation, upgrading and maintenance of network utilities.

The District Plan policies do not present any significant constraints to the project. However they also do not offer much to differentiate between the various longlist options, as most of the options will be generally consistent with the direction in these policies. For example, the new infrastructure would be located almost entirely underground and options that utilise road corridors are preferred, consistent with the direction of the policies in 13.1.4.

2.2.3 Rule framework

The relevant rules that could apply to construction, upgrade or removal of network utilities are provided in Table 1 below.

Table 1: District Plan rule framework

Rule	Provision	Activity status	Relevant standards
Rule 13.3.1.1	The removal of existing network utilities, including any existing associated structures.	Permitted	Earthworks: 13.3.2.5.1 Vegetation: 13.3.2.6 Noise: 13.3.2.7
Rule 13.3.1.4	The upgrading of existing network utilities, excluding: • Electricity and telecommunication lines; • Gas distribution and transmission pipelines at a pressure exceeding 2000 kilopascals.	Permitted	Health and Safety: 13.3.2.1 Earthworks: 13.3.2.5 Vegetation: 13.3.2.6 Noise: 13.3.2.7
Rule 13.3.1.14	Aerial crossings necessary for network utilities, located on or within existing bridges and structures or across watercourses, and including regulator stations but not compressor stations.	Permitted	Health and Safety: 13.3.2.1 Earthworks: 13.3.2.5
Rule 13.3.1.15	All network utilities that are not otherwise listed as a permitted, controlled, restricted discretionary or non-complying activity.	**Discretionary**	Health and Safety: 13.3.2.1
Rule 13.3.1.17	The construction, installation and development, of new underground network utilities, except for: • Electricity transmission lines above 110kV; and	Permitted	Health and Safety: 13.3.2.1 Earthworks: 13.3.2.5 Vegetation: 13.3.2.6

Rule	Provision	Activity status	Relevant standards
	• Gas distribution and transmission pipelines at a pressure exceeding 2000 kilopascals.		

In summary, new underground network utilities and the upgrade or removal of any existing aboveground or underground utilities is a *permitted activity*. New aboveground network utilities and any network utilities that cannot meet the relevant permitted activity standards would require resource consent as a *discretionary activity*.

The standards referenced above are summarised as follows:

- Health and safety standard 13.3.2.1 relates to radiofrequency and electric and magnetic fields and is therefore not relevant to this project.
- Earthworks standards do not apply to trenching in the road reserve or rail corridor. For all other activities, earthworks must be on a slope of less than 45°, less than 1.5m in height or depth, and limited to a total area that varies by zone e.g. 100m² in residential and recreation zones and 500m² in most other zones relevant to the project.
- Noise generated by the activity must not exceed the relevant noise standards for the underlying zone.

The Natural Hazards chapter, revised as part of Plan Change 56, generally seeks that development is undertaken in a way that reduces the vulnerability of people and their property in hazard prone areas. There are no specific provisions in the District Plan that relate to the upgrading of stormwater infrastructure networks and any resultant reduction in flood vulnerability.

2.3 Natural Resources Plan assessment

2.3.1 Background

Greater Wellington Regional Council's Natural Resources Plan (NRP) was made operative on 28 July 2023. The NRP manages natural and physical resources in the region, including water, air, soil, land and the coastal marine area.

The NRP also includes whaitua chapters. Chapter 8 is the Wellington Harbour and Hutt Valley Whaitua and currently only contains provisions relating to water quantity. Te Whanganui-a-tara Whaitua Committee's implementation programme[1] indicates that plan changes and network discharge consents are some of the tools that will be used to implement its strategy.

We understand that a plan change to the NRP is being drafted by GWRC that addresses three waters. The content and timing of the plan change is not yet known but may change our assessment below. We will address this further in the consenting strategy and will update the strategy as more information becomes available. Our assessment below is based on the current NRP provisions.

The NRP definition for '*regionally significant infrastructure*' includes '*the local authority wastewater and stormwater networks and systems, including treatment plants and storage and discharge facilities*'.

A summary of the relevant NRP plan notations is set out in Table 2 below.

[1] https://www.gw.govt.nz/environment/freshwater/protecting-the-waters-of-your-area/whaitua-te-whanganui-a-tara/whaitua-implementation-programme-recommendations/

Table 2: Planning map notations

Notation	Location	Implications
Schedule B: Ngā Taonga Nui a Kiwa: Te Awa Kairangi (Hutt River) *Mana whenua*: Ngāti Toa Rangatira		Waterbody identified as taonga by Ngāti Toa Rangatira
Schedule C4: Sites of significance to Taranaki Whānui ki te Upoko o te Ika a Maui - Maraenuku pā *Values*: wāhi tapu (battle site), mahinga kai	Within the bed of Te Awa Kairangi, north of Melling Bridge	Located adjacent to or within the location of the proposed wastewater overflow point
Schedule F1: Rivers and lakes with significant indigenous ecosystems - Habitat for indigenous fish species of conservation interest Habitat for 6 or more migratory indigenous fish species	Entire length of Te Awa Kairangi	Effects of wastewater discharges into Te Awa Kairangi on indigenous species must be considered.
Schedule F1b: Inanga spawning habitat	The lower reaches and estuary of Te Awa Kairangi	This is not within the area directly affected by the project, but implications of wastewater discharges to Te Awa Kairangi on this area should be considered further.
Schedule H1: Regionally significant primary contact recreation: Hutt River / Te Awa Kairangi	Entire length of Te Awa Kairangai	Effects of wastewater discharges into Te Awa Kairangi on contact recreation must be considered.
Drinking Water Groundwater Protection Area	Applies to flat land within Hutt Valley	Unlikely to have implications unless aquifer is intercepted.

2.3.2 Policy framework

The NRP includes objectives and policies that are supportive of the development of regionally significant infrastructure, which includes stormwater and wastewater infrastructure[2]. The NRP policies do not appear to include any particular constraints to the construction of the infrastructure.

The NRP contains a large number of policies that are relevant to the wastewater discharge. Objectives and policies relating to freshwater[3] generally seek to improve the quality of water bodies, particularly those identified in Schedules B, C and H (all of which apply to Te Awa Kairangi). They also seek to improve Māori relationships with freshwater[4], to preserve and protect natural character[5] and to protect ecosystems, biodiversity and mahinga kai[6].

The NRP also includes policies that seek to avoid 'significant' or 'more than minor' adverse effects on the following:

- Indigenous fish species in Schedule F1 waterbodies (Policy P43)
- Sites with significant mana whenua values (Policy P48).

Most relevant are the policies relating to discharge of wastewater to water. These are listed below:

---

[2] Objectives O9, O10, Policies P11, P13
[3] Including (but not limited to) Objective
[4] Policies P18 – P22
[5] Policies P23 and P24
[6] Policies P31 and P32

Policy P82: Avoiding inappropriate discharges to water

Discharges to fresh and coastal water of:

a) *untreated wastewater, except as a result of heavy rainfall event overflows, and*
b) *animal effluent from an animal effluent storage facility or from an area where animals are confined, and*
c) *untreated industrial or trade waste, and*
d) *untreated organic waste or leachate from storage of organic material,*

shall be avoided.

Policy P94: Avoiding new wastewater discharges to fresh water

New wastewater discharges to fresh water are avoided.

It is unclear whether Policy P82 would apply to new wastewater discharges. The interaction of the various policy provisions, the respective weighting that should be applied, and the respective definitions of existing and new wastewater discharges should be tested further. We also note that there is some recent case law[7] on 'avoid' policies and will address this in the consenting strategy.

While there is some nuance to the policy framework that is not considered in this high-level constraints assessment, our preliminary view is that it would be very difficult to demonstrate consistency with a number of individual policies (including some 'avoid' type policies) and with the policy direction in the NRP as a whole.

Most critically, the interaction and weighting to be applied to Policies P82 and P94 must be further investigated, particularly as Policy P94 presents a significant constraint and potential fatal flaw to the wastewater discharge.

2.3.3 Rule framework

The construction of infrastructure may trigger rules under the NRP for earthworks, vegetation clearance and/or discharges from contaminated land. A detailed assessment of potential resource consent requirements will be undertaken in the consenting strategy and will be informed by the findings of the other constraints assessments, particularly the contaminated land and ecology assessments. We do not expect any significant constraints in the NRP rules for the construction of the project.

Rule R66 of the NRP provides for new wastewater discharges into freshwater as a *non-complying activity*.

It appears that there are no prohibited activity rules that apply. We note that there may be other resource consent requirements under the NRP but Rule R66 has the most stringent activity status and therefore any other rules would not present any greater constraint to the project.

2.4 Relevant RMA considerations

2.4.1 Section 105 RMA

There are a number of additional tests that may apply to the project, and particularly to any wastewater discharges. Section 105 of the Resource Management Act 1991 (RMA) requires that any application for a discharge permit must:

'have regard to—

[7] Port Otago Limited v Environmental Defence Society Incorporated [2023] NZSC 112 (24 August 2023)

a) *the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
b) *the applicant's reasons for the proposed choice; and*
c) *any possible alternative methods of discharge, including discharge into any other receiving environment'.*

For this project, (c) above would require a robust assessment of alternatives for the wastewater overflow discharge and would likely be subject to careful scrutiny to confirm that it is the most appropriate option. We understand that an MCA process was undertaken by Holmes during concept design for the wastewater system, and that initial legal advice was obtained. Further consideration of the robustness of this process to confirm the concept design will be required.

2.4.2 Section 104D RMA

Section 104D of the RMA sets out the 'gateway tests' and requires that a consent authority only grant resource consent if it is satisfied that:

- the adverse effects of the activity on the environment will be minor; or
- the application is for an activity that will not be contrary to the objectives and policies of a relevant plan or proposed plan.

The gateway tests would apply to an application for resource consent under Rule R66 of the NRP and would require that at least one of the above tests is met. Our preliminary view is that it may be challenging for the wastewater discharge to meet the first test, and depending on the application of Policies P82 and P94, along with other 'avoid' type policies in the NRP, the wastewater discharge may not be able to pass the second test.

3 Summary and conclusions

3.1.1 Construction of stormwater and wastewater infrastructure

The District Plan and NRP frameworks are generally supportive of infrastructure upgrade and development. Resource consent would likely be required for the construction or upgrade of new infrastructure, but *our preliminary view is that there are no particular constraints or fatal flaws to construction of stormwater or wastewater infrastructure for this project*. Robust alternatives assessments that demonstrate the appropriateness of the selected development options would be required to support the consenting process.

3.1.2 Wastewater discharge

The NRP presents some significant constraints for the wastewater discharge into Te Awa Kairangi. The NRP identifies Te Awa Kairangi as a river with significant indigenous ecosystem and contact recreation values; as a taonga to Ngāti Toa, and the area near the possible wastewater overflow point as a site of significance to Taranaki Whānui.

Policy P94 of the NRP presents a significant constraint, and possibly a fatal flaw to the wastewater discharge.

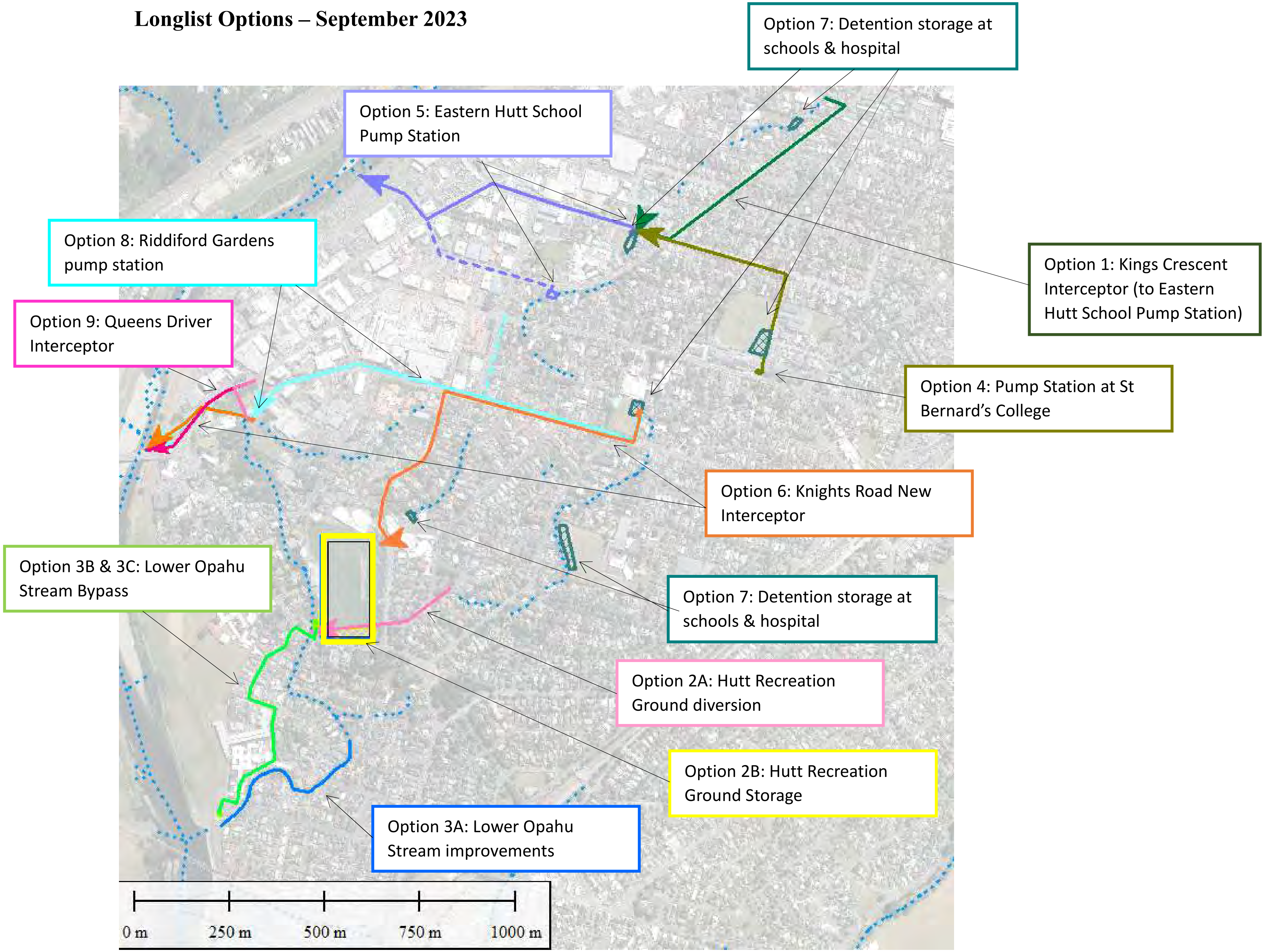
We recommend that given the uncertainty in the application of Policies P82 and P94, legal advice is sought to support the consenting strategy and to assist in identifying any further constraints or fatal flaws at this early stage of the project.

We note that the impending plan change to the NRP may change the findings of this assessment, but we do not have visibility of the content or timing for this plan change.

Early engagement with mana whenua will also be critical so that the project team can consider any further constraints or fatal flaws from a mana whenua perspective.

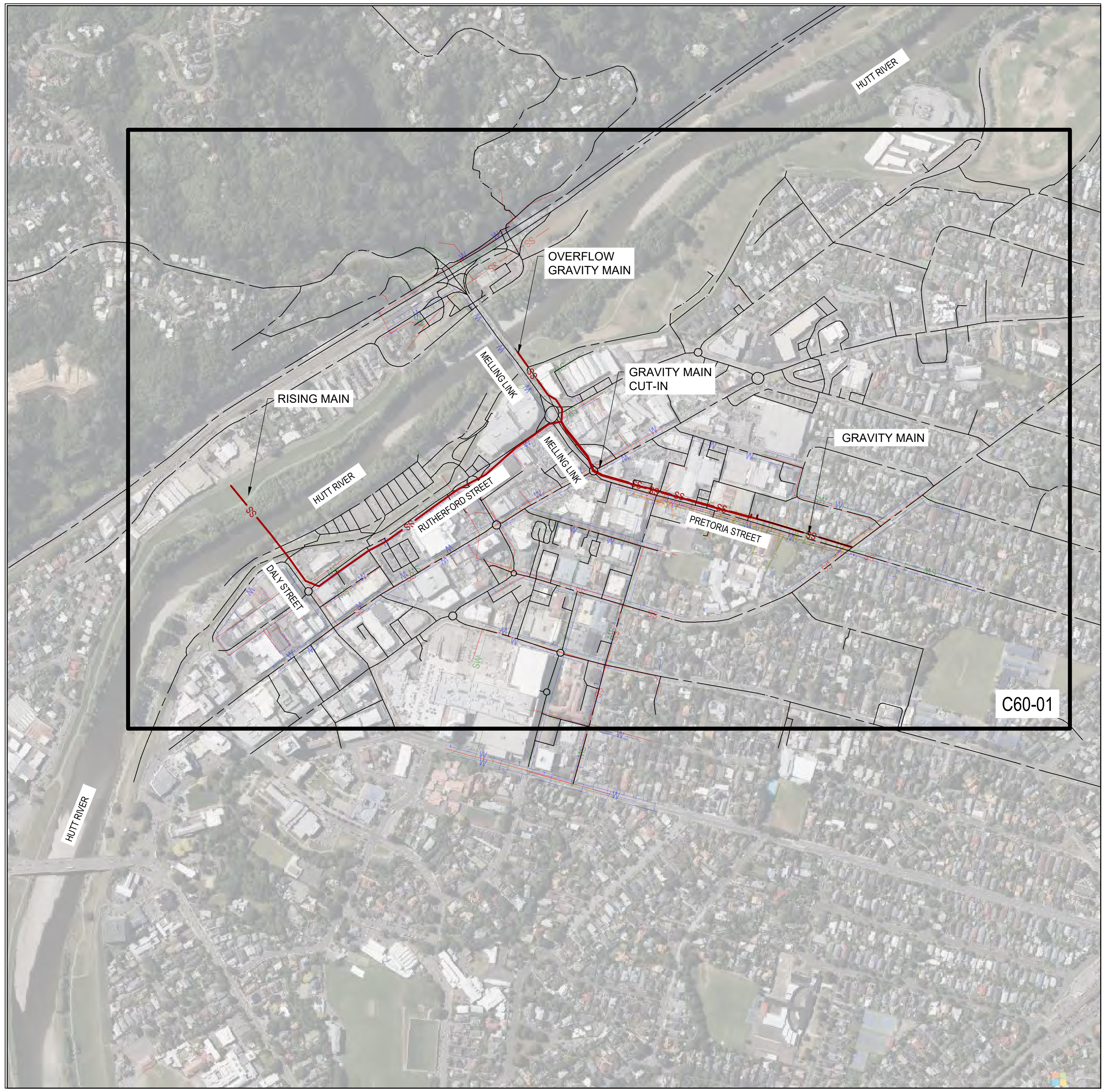
Appendix A: Longlist Options

Longlist Options – September 2023



Appendix B: Wastewater Concept Design Drawings

RIVERLINK WASTEWATER TRUNK CBD BYPASS



LOCALITY PLAN

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0 2.5 5 7.5 10 12.5m

SCALE 1:250 AT ORIGINAL SIZE

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

DRAWING REGISTER, DISTRIBUTION AND TRANSMITTAL

CLIENT	WELLINGTON WATER LTD								
CONTRACTOR									
DRAWING ISSUE STATUS OPTIONS: FOR INFORMATION ONLY; FOR APPROVAL; FOR TENDER ONLY; NOT FOR CONSTRUTION; ISSUED FOT CONSTRUCTION; AS BUILT (CONSTRUCTION RECORD)	ISSUE STATUS	FOR INFORMATION ONLY	CLIENT REVIEW	-	-	-	-	-	-
	DRAWING PRINT SIZE	A3	A3						
	DD	6	14						
CAD FILE REFERENCE: 144418.50 M-P Cover page and Location 144418.50 M-P-Gravity Main 144418.50 M-P-Rising Main 144418.50 M-P-Gravity Main Cut-In 144418.50 M-P-Overflow Gravity Main	MM	3	4						
	YY	23	23						
DRAWING NUMBER	DRAWING TITLE	1	A						
C00-00	COVER SHEET AND DRAWING INDEX	1	A						
C00-01	PROJECT INFORMATION	1	A						
C60-01	PROPOSED WASTEWATER KEY PLAN	1	A						
C61-01	PROPOSED WASTEWATER GRAVITY MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-02	PROPOSED WASTEWATER GRAVITY MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-03	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-04	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-05	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-06	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-07	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-08	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-09	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-10	PROPOSED WASTEWATER RISING MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-11	PROPOSED WASTEWATER GRAVITY MAIN CUT-IN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-12	PROPOSED WASTEWATER GRAVITY MAIN CUT-IN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-13	PROPOSED WASTEWATER OVERFLOW GRAVITY MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C61-14	PROPOSED WASTEWATER OVERFLOW GRAVITY MAIN PLAN AND LONGITUDINAL SECTIONS	1	A						
C63-01	PROPOSED PUMPSTATION PLAN VIEW	1	A						
C63-02	PROPOSED PUMSTATION LONGITUDINAL SECTIONS	1	A						

ORIGINAL DRAWING IN COLOUR

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A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: COVER SHEET AND DRAWING INDEX

Discipline: CIVIL

Drawing No. C00-00

Rev. A

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Document No. 144418.50 M-P COVER PAGE AND LOCATION.DWG

GENERAL NOTES

1. SURVEY MARKS SHOWN ARE FROM LINZ DATA SERVICES AND ARE APPROXIMATE ONLY.

SURVEY NOTES

1. COORDINATES ARE IN TERMS OF NZTM 2000.
2. HEIGHT SHALL BE IN TERMS OF NZVD 2016.

Structure Schedule: GRAVITY MAIN

Name	Levels	Coordinates	Type	Comments
MH01	LL: 7.579 D: 4.526 IL out = 3.053	E: 1760529.347 N: 5436443.792	1,050 dia Concrete Manhole Sump Depth 0.000	
MH02	LL: 7.444 D: 4.787 IL in = 2.657 IL out = 2.657	E: 1760445.525 N: 5436466.930	1,050 dia Concrete Manhole Sump Depth 0.000	
MH03	LL: 7.828 D: 5.458 IL in = 2.370 IL out = 2.370	E: 1760383.192 N: 5436485.807	1,050 dia Concrete Manhole Sump Depth 0.000	
MH04	LL: 8.255 D: 5.985 IL in = 2.270 IL out = 2.270	E: 1760365.558 N: 5436490.594	1,050 dia Concrete Manhole Sump Depth 0.000	
MH05	LL: 8.445 D: 7.245 IL in = 2.210 IL out = 1.200	E: 1760368.486 N: 5436500.999	1,800 dia Concrete Manhole Sump Depth 1.010	

Structure Schedule: PROPOSED GRAVITY MAIN CUT IN

Name	Levels	Coordinates	Type	Comments
MH06	LL: 7.318 D: 3.683 IL out = 3.666 IL out = 3.666	E: 1760064.865 N: 5436586.168	1,050 dia Concrete Manhole Sump Depth 0.031	
MH07	LL: 7.536 D: 3.987 IL in = 3.580 IL out = 3.580	E: 1760079.911 N: 5436573.834	1,050 dia Concrete Manhole Sump Depth 1.921	
MH08	LL: 6.935 D: 3.782 IL in = 3.184 IL out = 3.184	E: 1760166.216 N: 5436549.206	1,050 dia Concrete Manhole Sump Depth 1.921	
MH09	LL: 7.037 D: 4.258 IL in = 2.810 IL out = 2.810	E: 1760247.785 N: 5436525.630	1,050 dia Concrete Manhole Sump Depth 1.921	
MH10	LL: 7.944 D: 5.547 IL in = 2.427 IL out = 2.427	E: 1760331.663 N: 5436502.435	1,050 dia Concrete Manhole Sump Depth 1.921	
MH11	LL: 7.092 D: 3.353 IL in = 3.800	E: 1760072.227 N: 5436598.074	1,050 dia Concrete Manhole Sump Depth 0.000	

Structure Schedule: PROPOSED OVERFLOW GRAVITY MAIN

Name	Levels	Coordinates	Type	Comments
MH12	LL: 6.456 D: 2.503 IL in = 3.953 IL out = 3.956	E: 1760054.606 N: 5436611.524	1,050 dia Concrete Manhole Sump Depth 0.000	
MH13	LL: 5.988 D: 2.303 IL in = 3.686 IL out = 3.685	E: 1760017.301 N: 5436658.176	1,050 dia Concrete Manhole Sump Depth 0.000	
MH14	LL: 5.702 D: 2.140 IL in = 3.562 IL out = 3.562	E: 1760006.952 N: 5436674.709	1,050 dia Concrete Manhole Sump Depth 0.000	
MH15	LL: 5.271 D: 2.011 IL in = 3.260 IL out = 3.262	E: 1759982.322 N: 5436722.942	1,050 dia Concrete Manhole Sump Depth 0.000	
MH16	LL: 5.590 D: 2.662 IL in = 2.927 IL out = 2.927	E: 1759943.527 N: 5436777.476	1,050 dia Concrete Manhole Sump Depth 0.000	

A1 REPRODUCTION SCALE

A3 REPRODUCTION SCALE

PIPE MATERIAL

CODE	DESCRIPTION	SUPERSEDED CODE
ABS	ACRYLONITRITE BUTADIENE STYRENE	
AC	ASBESTOS CEMENT	
AC-E	ASBESTOS CEMENT EVERITE	
AC-I	ASBESTOS CEMENT ITALITE	
AL	ALUMINIUM	
CI	CAST IRON	
CU	COPPER	
DI	DUCTILE IRON	
EW	EARTHEN WARE	
GI	GALVANISED IRON	
LBST	LOCKBAR STEEL	
MPVC	MODIFIED POLYVINYL CHLORIDE	
PE100	POLYETHYLENE HDPE	
PE80	POLYETHYLENE MDPE	
PVC	POLYVINYL CHLORIDE	
RC	REINFORCED CONCRETE	CC
SS	STAINLESS STEEL	
ST	MILD STEEL	
UNK	UNKNOWN	
UPVC	UNPLASTICISED POLYVINYL CHLORIDE	

PIPE LINING

CODE	DESCRIPTION	SUPERSEDED CODE
BL	BITUMEN	
CL	CONCRETE	
CML	CEMENT MORTAR	
CTL	COAL TAR ENAMEL	EL, CTE
EL	EPOXY	PL
NL	NO LINING	
TEL	COAL TAR EPOXY	CTE
UL	UNKNOWN LINING (use UL when not specified)	

PIPE COATING

CODE	DESCRIPTION	SUPERSEDED CODE
BC	BITUMEN	
CTE	COAL TAR ENAMEL, PITCH ENAMEL, ENAMEL	MC, EC
DC	DIMET (EPOXY)	
EC	EPOXY	
GC	GUNITE	
NC	NO COATING	
PC	POLYETHYLENE, POLYKEN TAPE	TC
PW	POLYETHYLENE WRAP (polyethylene sleeve on DI pipe)	
UC	UNKNOWN COATING (use UC when not specified)	KC

SERVICES LEGEND

NEW WATER MAIN — W
EXISTING WATER MAIN — W
NEW STORMWATER — SW
EXISTING STORMWATER — SW
NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR
EXISTING WASTEWATER — SS
ABANDONED SERVICE — X — X — X
PRIVATE WATER
PRIVATE STORMWATER
PRIVATE WASTEWATER
KERBS
CONTOURS MAJOR
CONTOURS MINOR
PARCEL BOUNDARY
VALVE NEW OR EX. / REDUNDANT — V V
BOUNDARY VALVE
HYDRANT NEW OR EX. / REDUNDANT — FH FH
MANIFOLD NEW / EXISTING
EXISTING TOBY
PUMP
NEW SS/SW MANHOLE
EXISTING SS/SW MANHOLE
EXISTING SS/SW LHCE
EXISTING SW SUMP
PROPERTY NUMBER — 1

UTILITIES LEGEND

GAS - POWERCO — G
GAS - NOVA — NG
U/G POWER — UP
400V U/G POWER — 400V
11kV U/G POWER — 11kV
33kV U/G POWER — 33kV
O/H POWER / TROLLEY WIRE — OH
TELECOMMS / CHORUS — T
OVERHEAD TELECOMMS — OH
VODAFONE — V
FIBRE OPTIC — FO
CITYLINK BROADBAND — B
VECTOR COMMS — VC
OIL — OIL
LINZ SURVEY MARK — SM
POLE

MISCELLANEOUS

FENCE LINE — //
EXISTING FENCE — //
SECURITY FENCE

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*Dwg Check			Date

*Name Produced through Projectwise Signoff

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Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROJECT INFORMATION

Discipline: CIVIL

Drawing No.: C00-01

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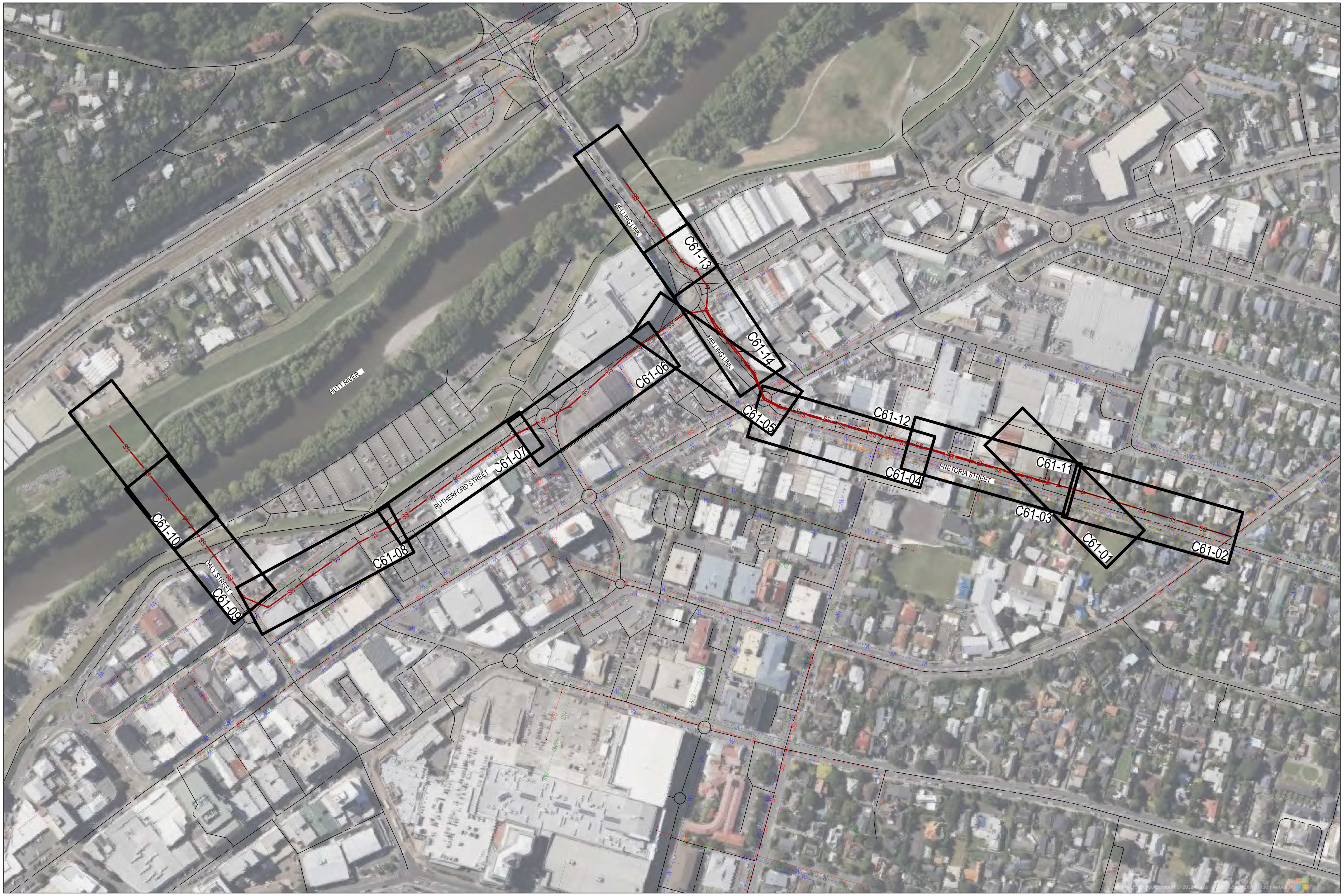

PROPOSED WASTEWATER KEY PLAN

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0 20 40 60 80 100m

SCALE 1:2000 AT ORIGINAL SIZE

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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Title: PROPOSED WASTEWATER KEY PLAN

Discipline: CIVIL

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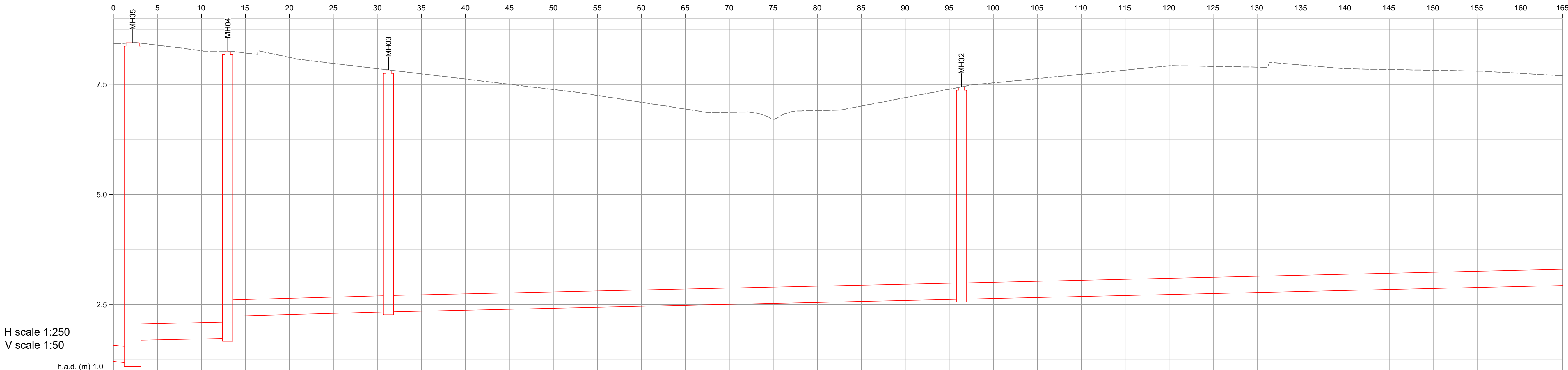
PLAN VIEW - PROPOSED WW GRAVITY MAIN (OPEN CUT CONSTRUTION)

1:250



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LID LEVEL	8.445, 8.255, 7.828, 7.444
COVER TO PIPE	6.84, 6.39, 5.65, 5.12, 4.45
PIPE DATA	300 NB RCRRJ CLASS 4 -1:50 (-2.00%); 300 NB RCRRJ CLASS 4 1:227 (0.44%); 300 NB RCRRJ CLASS 4 1:183 (0.55%); 300 NB RCRRJ CLASS 4 1:227 (0.44%); 300 NB RCRRJ CLASS 4 1:220 (0.46%)
INVERT LEVEL	1.244, 1.200, 1.722, 1.770, 2.270, 2.370, 2.370, 2.657, 2.657, 3.053
MH CHAINAGE	2.191, 13.000, 31.272, 96.400

LONGITUDINAL SECTION GRAVITY MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS

NEW WASTEWATER RISING MAIN — WWR

ORIGINAL DRAWING IN COLOUR

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0 2.5 5 7.5 10 12.5m SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m

HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

No.	Revision	By	Chk	Appd	Date
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Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED GRAVITY MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-01 Rev. A

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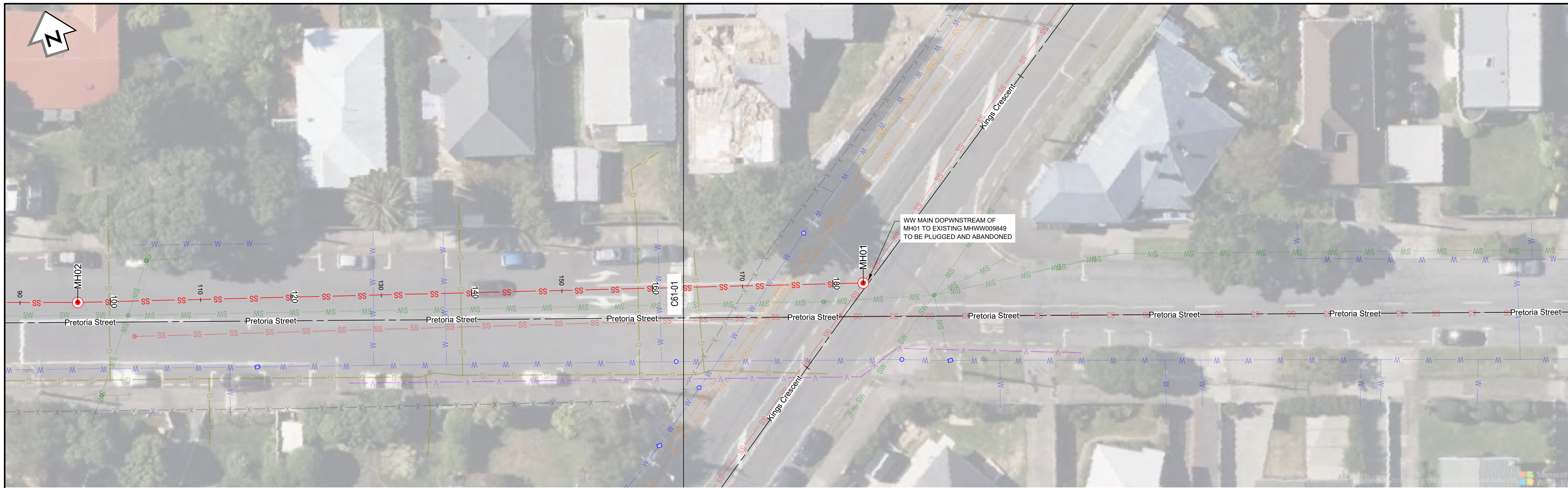
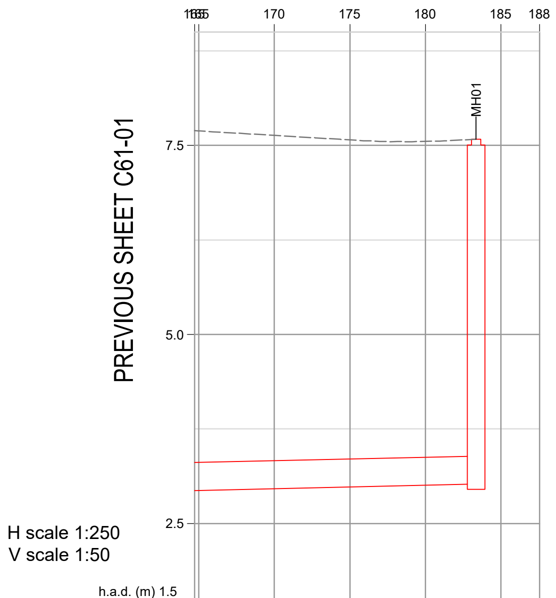


PLAN VIEW - PROPOSED WW GRAVITY MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	7.632	7.573 / 7.554
LID LEVEL		7.579
COVER TO PIPE	4.45	
PIPE DATA	300 NB RCRRJ CLASS 4 1:220 (0.46%)	
INVERT LEVEL	2.657	3.053
MH CHAINAGE		183.357

LONGITUDINAL SECTION GRAVITY MAIN ALIGNMENT

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

SCALE 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

VERTICAL 1:50 AT ORIGINAL SIZE (0 0.5 1 1.5 2 2.5m)

HORIZONTAL 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes — Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) / Reduced Scale (A3): AS SHOWN

Design	EG	06-03-2023
Drawn	JR	06-03-2023
*Dsg Verifier	PB	14-04-2023
*Dwg Check		

*Approved — Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED GRAVITY MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-02 — Rev. A

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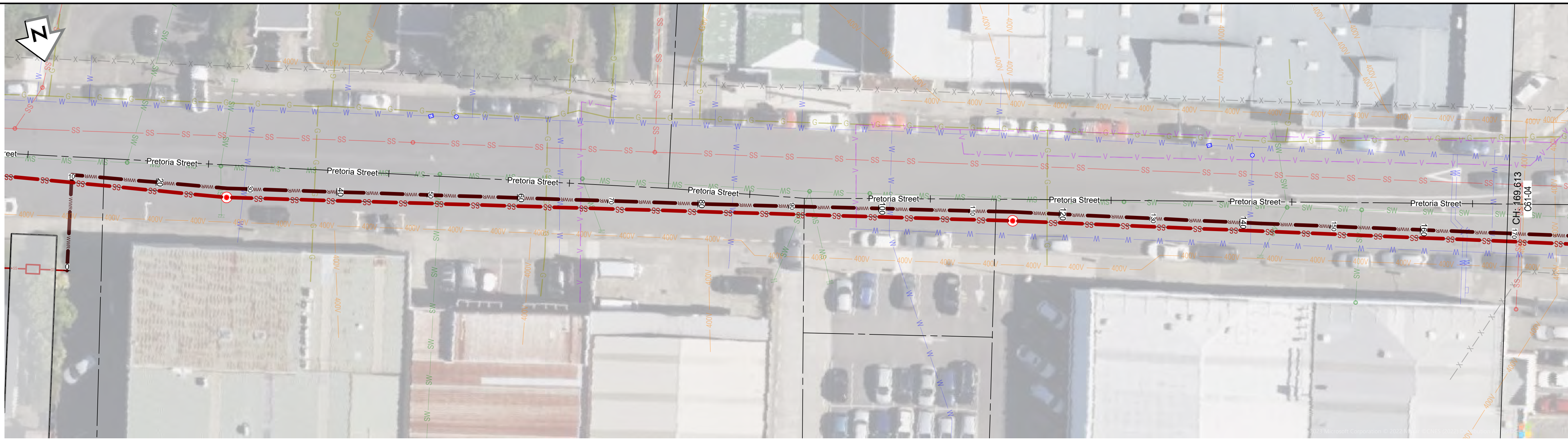
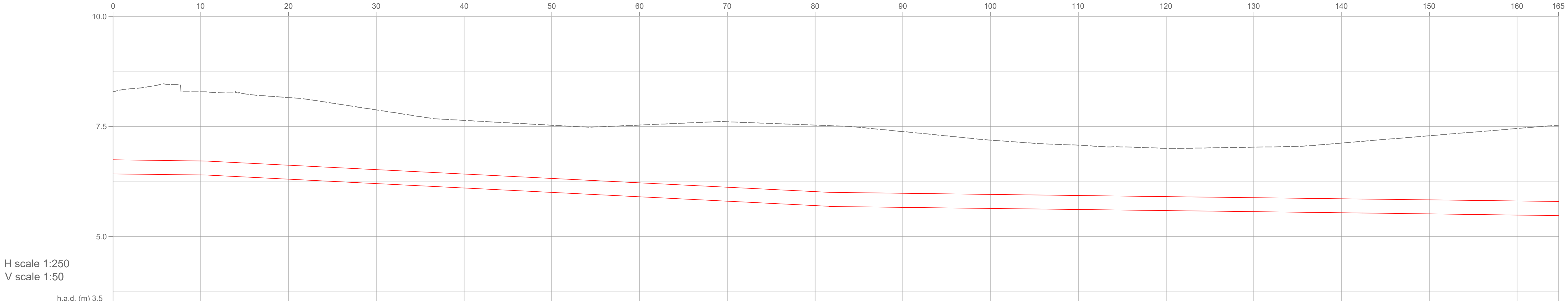
Document No. 144418.50 M-P-GRAVITY MAIN-3.DWG



PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



CONTINUES SHEET C61-04

EXISTING GL																	
8.295	8.288	8.159	7.879	7.640	7.529	7.534	7.607	7.533	7.385	7.191	7.077	7.003	7.031	7.125	7.290	7.455	7.533

LID LEVEL	7.204	6.731	6.558	6.019	5.936	5.867	
COVER TO PIPE	1.55	1.57	1.40	1.52	1.12	1.31	
PIPE DATA	315 NB PE100 PN16 1:378 (0.26%)	315 NB PE100 PN16 1:100 (1.00%)	315 NB PE100 PN16 1:100 (1.00%)	315 NB PE100 PN16 1:400 (0.25%)	315 NB PE100 PN16 1:400 (0.25%)	315 NB PE100 PN16 1:400 (0.25%)	
INVERT LEVEL	6.455	6.427 6.427	6.254 6.254	5.715 5.715	5.632 5.632	5.563 5.563	5.312
CHAINAGE	0.000	10.618	27.885	81.639	114.879	142.399	

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS

NEW WASTEWATER RISING MAIN — WWR

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

SCALE 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

VERTICAL 1:50 AT ORIGINAL SIZE (0 0.5 1 1.5 2 2.5m)

HORIZONTAL 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) | Reduced Scale (A3) 1/2 SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-03

Rev. A

Plotted By Johan Rosendo

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Drawing Plotted 14 Apr 2023 3:42 PM

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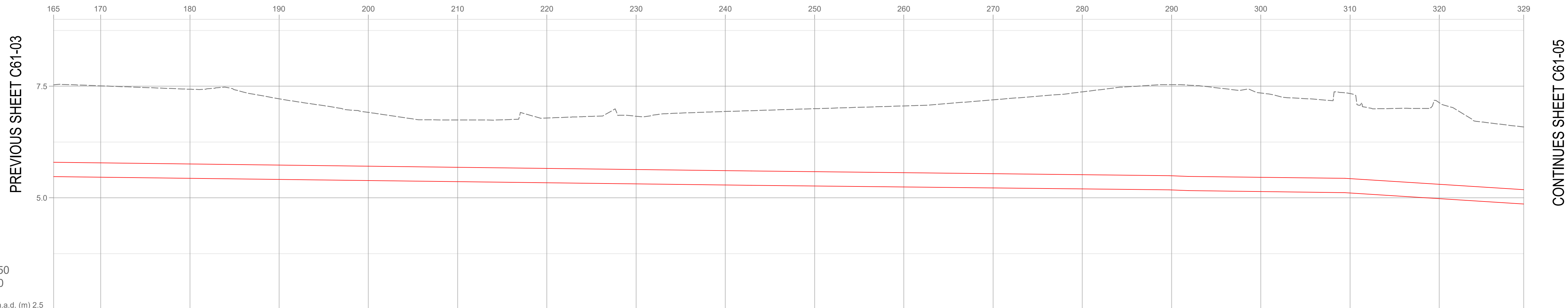
Document No. 144418.50 M-P-RISING MAIN-3.DWG

PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



H scale 1:250
V scale 1:50

EXISTING GL	7.533, 7.509, 7.434, 7.218, 6.916, 6.745, 6.788, 6.829, 6.934, 6.997, 7.060, 7.196, 7.375, 7.536, 7.349, 7.339, 7.132, 6.590
LID LEVEL	5.616, 5.512, 5.497, 5.452
COVER TO PIPE	1.31, 1.35, 2.04, 2.04, 1.92
PIPE DATA	315 NB PE100 PN16 1:400 (0.25%); 315 NB PE100 PN16 1:452 (0.22%); 315 NB PE100 PN16 1:142 (0.71%); 315 NB PE100 PN16 1:392 (0.25%); 315 NB PE100 PN16 1:79 (1.27%)
INVERT LEVEL	5.563, 5.312, 5.312, 5.208, 5.208, 5.193, 5.193, 5.148, 5.148, 4.804
CHAINAGE	242.895, 289.732, 291.898, 309.438

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS —
NEW WASTEWATER RISING MAIN

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) | Reduced Scale (A3) 1/2 SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-04 Rev. A

Plotted By Johan Rosendo

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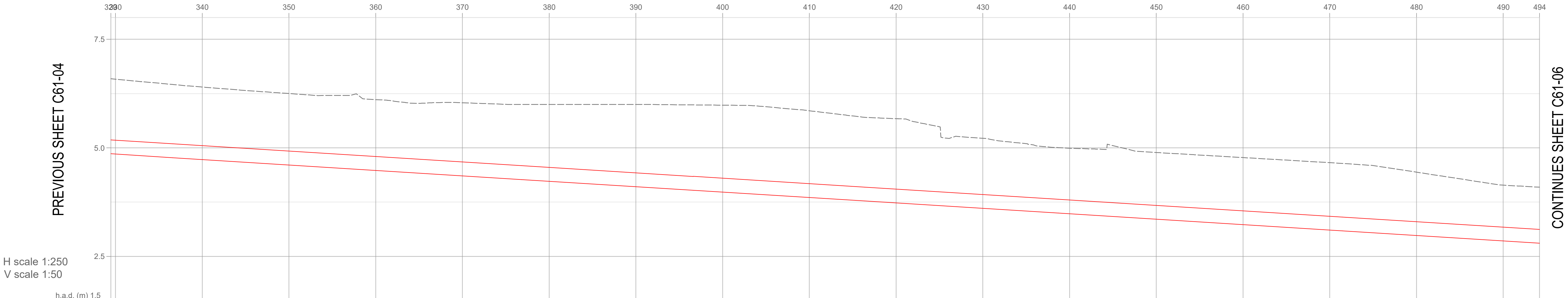
Document No. 144418.50 M-P-RISING MAIN-3.DWG

PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	6.590, 6.580, 6.400, 6.250, 6.110, 6.037, 6.000, 6.000, 5.983, 5.854, 5.672, 5.221, 4.989, 4.893, 4.775, 4.658, 4.440, 4.140, 4.094
LID LEVEL	5.585, 4.871, 4.772, 4.475, 4.028, 3.704
COVER TO PIPE	1.92, 1.37, 1.41, 1.65, 1.61, 1.19, 1.24
PIPE DATA	315 NB PE100 PN16 1:79 (1.27%); 315 NB PE100 PN16 1:80 (1.25%); 315 NB PE100 PN16 1:80 (1.25%); 315 NB PE100 PN16 1:80 (1.25%); 315 NB PE100 PN16 1:80 (1.25%); 315 NB PE100 PN16 1:80 (1.25%); 315 NB PE100 PN16 1:80 (1.25%)
INVERT LEVEL	5.148, 4.804, 4.804, 4.301, 4.301, 4.054, 4.054, 3.807, 3.807, 3.528, 3.528, 3.118, 3.118, 2.618
CHAINAGE	336.595, 376.829, 396.594, 416.362, 438.714, 471.477

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

SCALE 1:250 AT ORIGINAL SIZE: 0 2.5 5 7.5 10 12.5m

VERTICAL 1:50 AT ORIGINAL SIZE: 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE: 0 2.5 5 7.5 10 12.5m

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) | Reduced Scale (A3) 1/2 SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No.: C61-05 | Rev.: A

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Document No. 144418.50 M-P-RISING MAIN-3.DWG

Plotted By Johan Rosendo

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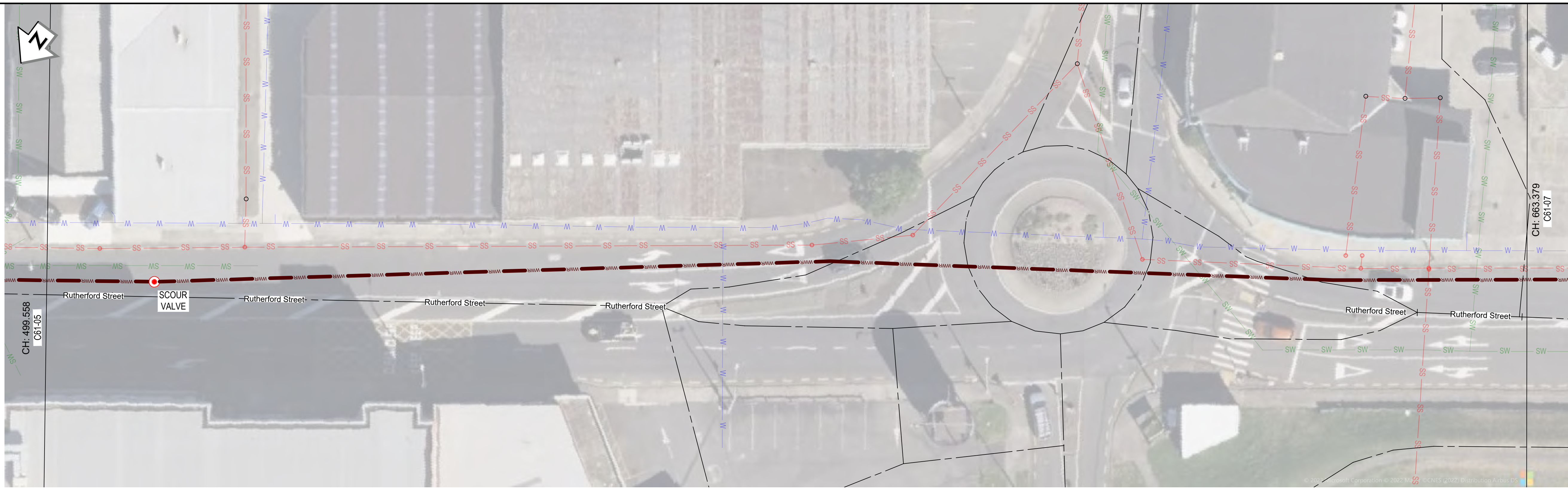
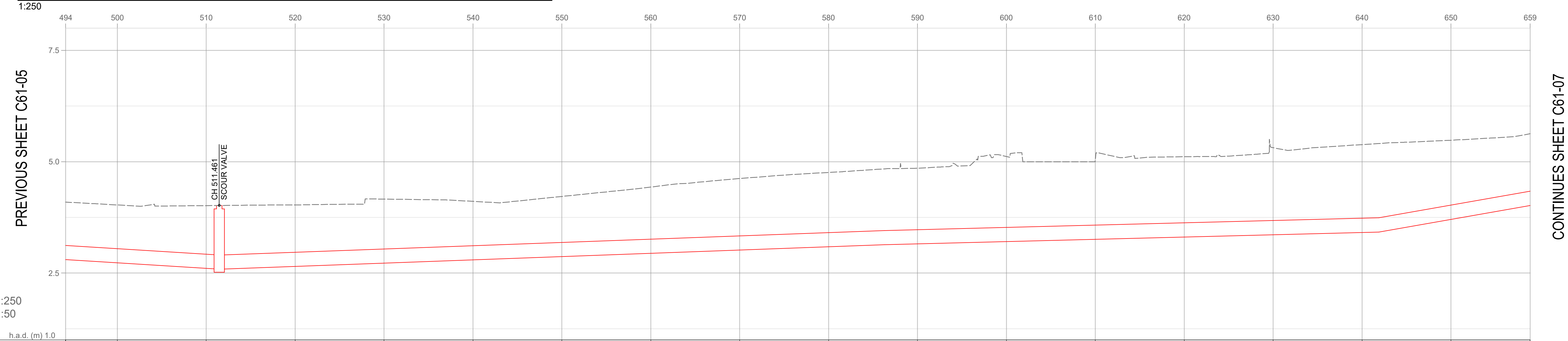
Drawing Plotted 14 Apr 2023 3:43 PM



PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	4.094	4.029	4.015	4.028	4.161	4.110	4.220	4.431	4.622	4.759	4.854	5.116	5.047	5.112	5.315	5.385	5.482	5.629

LID LEVEL		4.018	3.472	3.757
COVER TO PIPE	1.24	1.11	1.38	1.67
PIPE DATA	315 NB PE100 PN16 1:80 (1.25%)	315 NB PE100 PN16 -1:136 (-0.73%)	315 NB PE100 PN16 -1:195 (-0.51%)	315 NB PE100 PN16 -1:29 (-3.50%)
INVERT LEVEL	3.118	2.618 / 2.618	3.168 / 3.168	3.453 / 3.453	6.930
CHAINAGE		511.461	586.270	641.901

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

SCALE 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

VERTICAL 1:50 AT ORIGINAL SIZE (0 0.5 1 1.5 2 2.5m)
HORIZONTAL 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) | Reduced Scale (A3) 1/2 SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-06 Rev. A

Plotted By: Johan Rosendo

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Drawing Plotted 14 Apr 2023 3:43 PM

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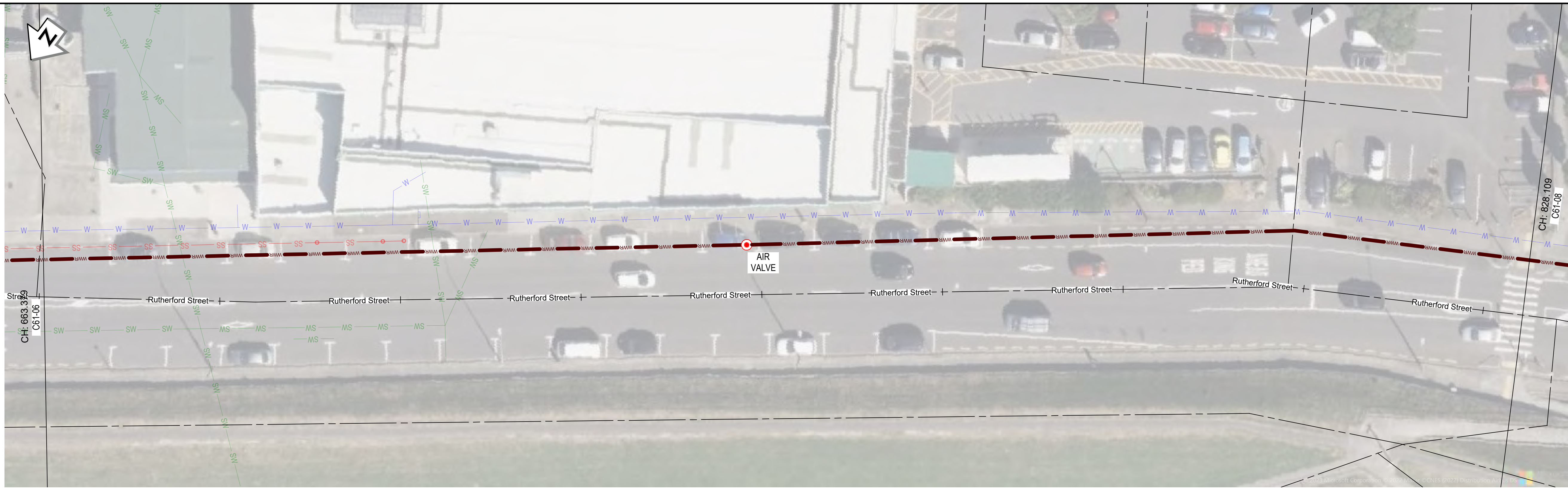
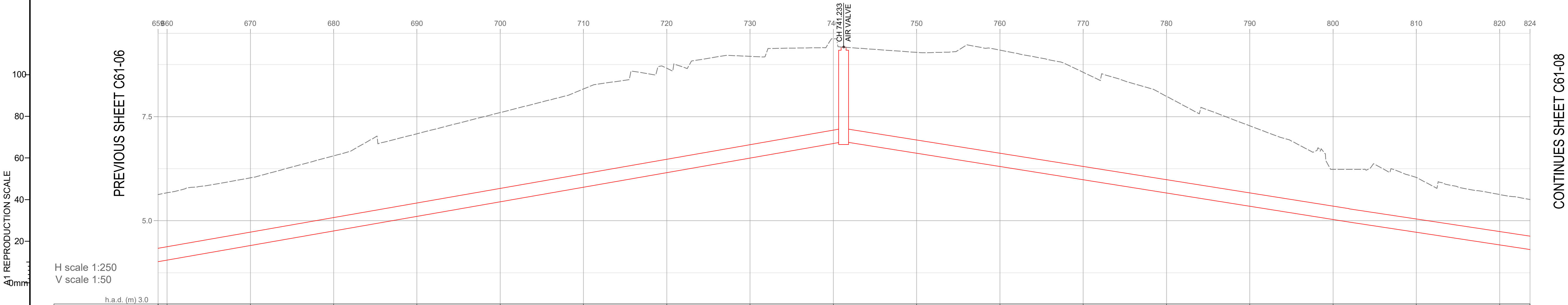
Document No. 144418.50 M-P-RISING MAIN-3.DWG



PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	5.629, 5.669, 6.029, 6.558, 7.088, 7.597, 8.163, 8.660, 8.947, 9.369, 9.043, 9.095, 8.565, 7.987, 7.278, 6.232, 6.039, 5.629, 5.508		
LID LEVEL	9.168	5.304	
COVER TO PIPE	1.67	1.95	0.94
PIPE DATA	315 NB PE100 PN16 -1:29 (-3.50%)	315 NB PE100 PN16 1:31 (3.18%)	315 NB PE100 PN16 1:33 (3.03%)
INVERT LEVEL	3.453	6.930 6.930	4.999 4.999 / 3.926
CHAINAGE		741.232	801.902

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

SCALE 1:250 AT ORIGINAL SIZE: 0 2.5 5 7.5 10 12.5m

VERTICAL 1:50 AT ORIGINAL SIZE / HORIZONTAL 1:250 AT ORIGINAL SIZE: 0 0.5 1 1.5 2 2.5m / 0 2.5 5 7.5 10 12.5m

A1 REPRODUCTION SCALE / A3 REPRODUCTION SCALE

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) / Reduced Scale (A3): AS SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-07 Rev. A

Plotted By Johan Rosendo

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Drawing Plotted 14 Apr 2023 3:43 PM

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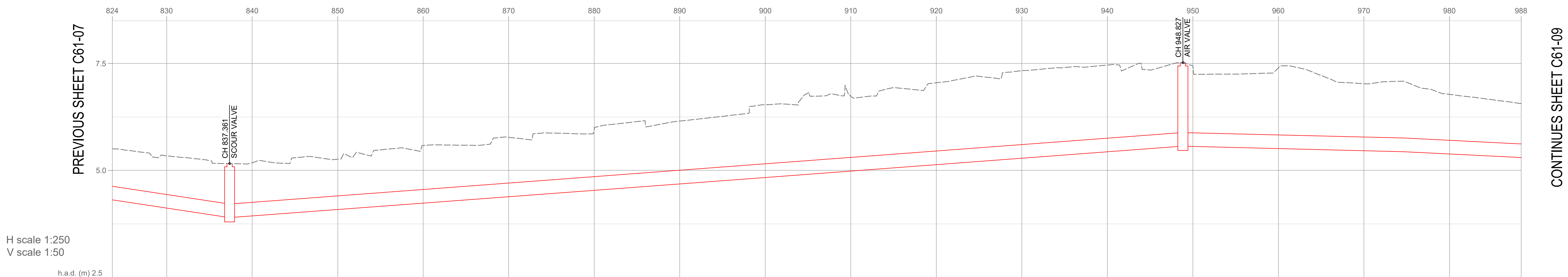
Document No. 144418.50 M-P-RISING MAIN-3.DWG

PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)
1:250



EXISTING GL																		
	5.508	5.339	5.180	5.261	5.579	5.776	5.955	6.155	6.536	6.729	7.049	7.332	7.463	7.441	7.399	7.028	6.779	6.564

	Start					End
LID LEVEL		5.159	5.058	7.517	5.773	
COVER TO PIPE	0.94	0.94	1.17	1.63	1.33	
PIPE DATA	315 NB PE100 PN16 1:33 (3.03%)	315 NB PE100 PN16 -1:67 (-1.50%)	315 NB PE100 PN16 -1:67 (-1.50%)	315 NB PE100 PN16 1:200 (0.50%)	315 NB PE100 PN16 1:100 (1.00%)	
INVERT LEVEL	4.999	3.926 3.926	4.754 4.754	5.598 5.598	5.469 5.469	4.961
CHAINAGE		837.361	892.564	948.827	974.658	

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

CHECK PRINT
DRG: 144418.50 M-P-Rising Main-3.dwg
DATE: 14 Apr 2023 3:43 PM
PROJECTNAME: ----

DISTRIBUTION	SIGN	DATE
ORIGINATOR		
DRAFTER		
CHECKER		

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Holmes

Drawing Originator
Holmes NZ LP
12 Madden Street
Auckland 1010
New Zealand
Holmesgroup.com
T: +64 9 965 4789

Original Scale (A1)
Reduced Scale (A3) AS SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-08

Rev. A

Plotted By Johan Rosendo

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Drawing Plotted 14 Apr 2023 3:43 PM

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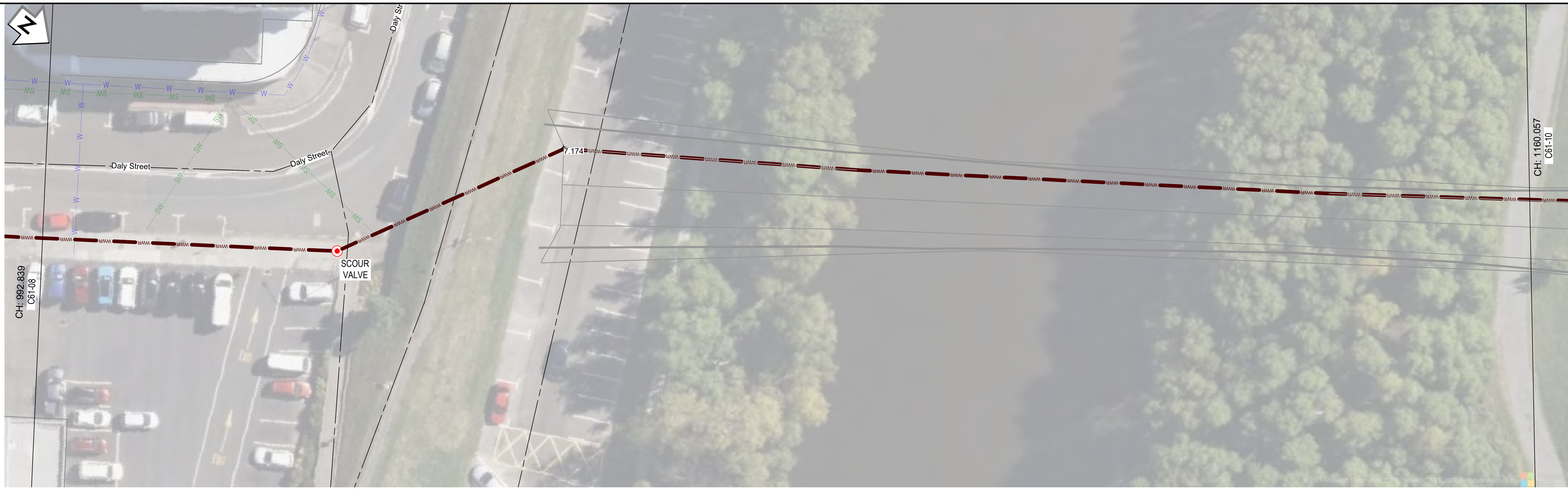
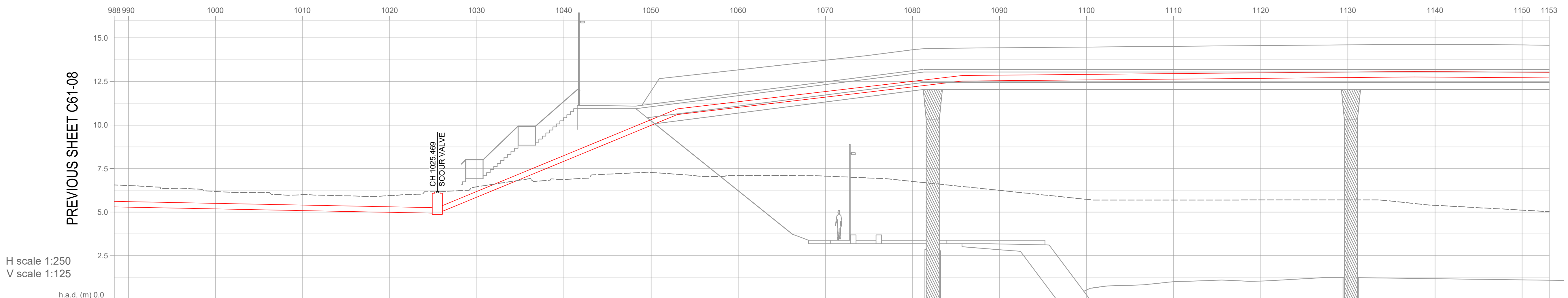
Document No. 144418.50 M-P-RISING MAIN-3.DWG



PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	6.564 6.525 6.185 6.000 5.950 6.455 6.876 7.280 7.107 7.064 6.763 6.249 5.733 5.693 5.698 5.702 5.390 5.116 5.031				
LID LEVEL	6.161	10.940	12.864	13.091	
COVER TO PIPE	1.33	0.91	-3.75	-6.38	-7.58
PIPE DATA	315 NB PE100 PN16 1:100 (1.00%)	315 NB PE100 PN16 -1:5 (-20.61%)	315 NB PE100 PN16 -1:17 (-5.88%)	315 NB PE100 PN16 -1:228 (-0.44%)	315 NB PE100 PN16 1:299 (0.33%)
INVERT LEVEL	5.469	4.961 4.961	10.636 10.636	12.560 12.560	12.788 12.788 12.652
CHAINAGE		1025.469	1053.007	1085.730	1137.643

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED
4. BRIDGE AND ALIGNMENT IS INDICATIVE ONLY AND SUBJECT TO CHANGE

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

A1 REPRODUCTION SCALE 100 80 60 40 20 0mm
A3 REPRODUCTION SCALE 50 40 30 20 10 0mm

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

Drawing Originator: Holmes NZ LP, 12 Madden Street, Auckland 1010, New Zealand, Holmesgroup.com, T: +64 9 965 4789

Original Scale (A1) — Reduced Scale (A3) AS SHOWN

Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-09

Rev. A

Plotted By:Johan Rosendo

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Drawing Plotted14 Apr 2023 3:43 PM

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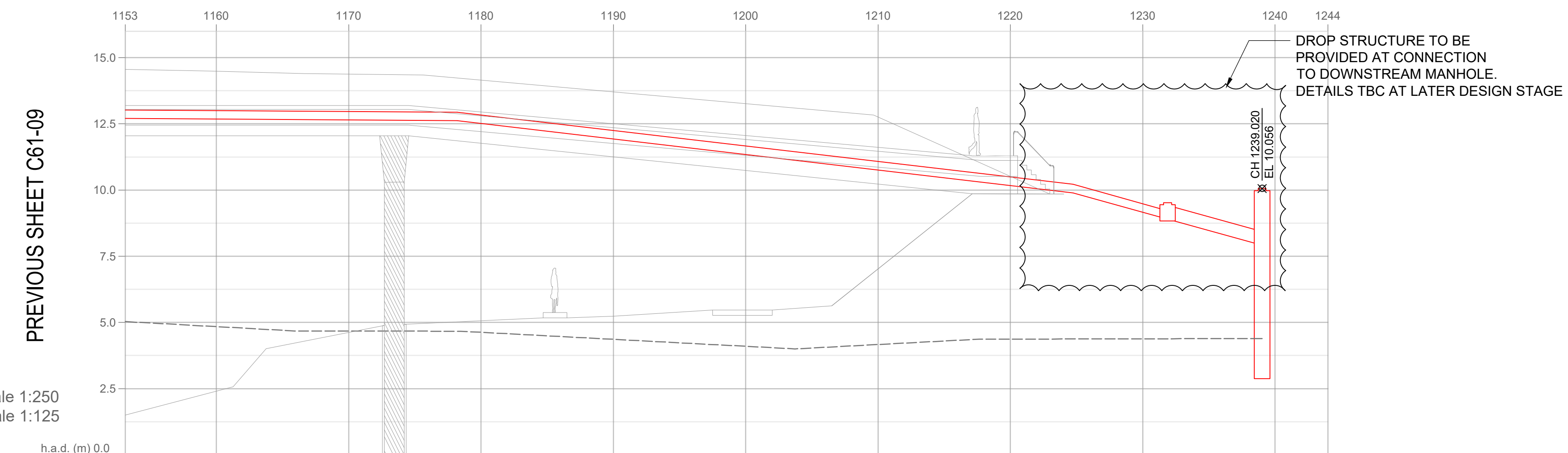
Document No. 144418.50 M-P-RISING MAIN-3.DWG

PLAN VIEW - PROPOSED WW RISING MAIN (OPEN CUT CONSTRUTION)

1:250



H scale 1:250
V scale 1:125

EXISTING GL	5.031	4.842	4.676	4.627	4.363	4.098	4.166	4.371	4.381	
LID LEVEL		12.956		10.230	9.522	10.056				
COVER TO PIPE	-7.58	-8.26	-5.84	-5.04						
PIPE DATA	315 NB PE100 PN16 1:299 (0.33%)	315 NB PE100 PN16 1:17 (5.86%)	315 NB PE100 PN16 1:7 (13.90%)	475 NB UPVC SN16 1:7 (13.90%)						
INVERT LEVEL	12.788	12.652 / 12.652	9.926 / 9.926	8.934 / 8.934	7.942					
CHAINAGE		1178.203	1224.740	1231.880	1239.020					

LONGITUDINAL SECTION RISING MAIN ALIGNMENT

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED
4. BRIDGE AND ALIGNMENT IS INDICATIVE ONLY AND SUBJECT TO CHANGE

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100
A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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Design	EG	06-03-2023	*Approved
Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED RISING MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL
Drawing No.: C61-10
Rev.: A

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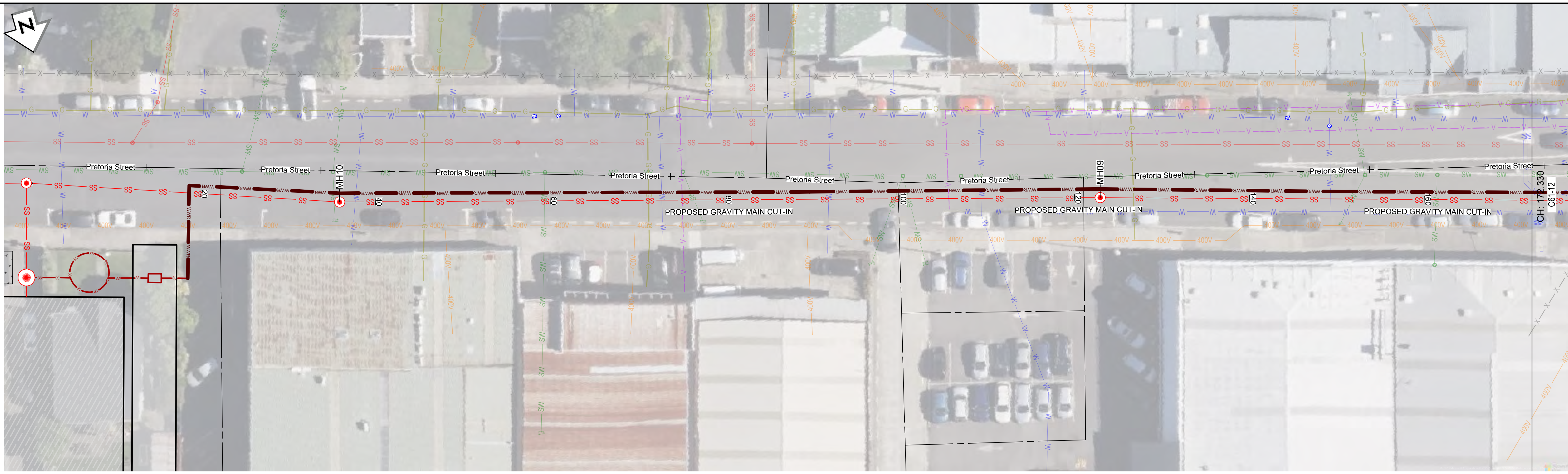
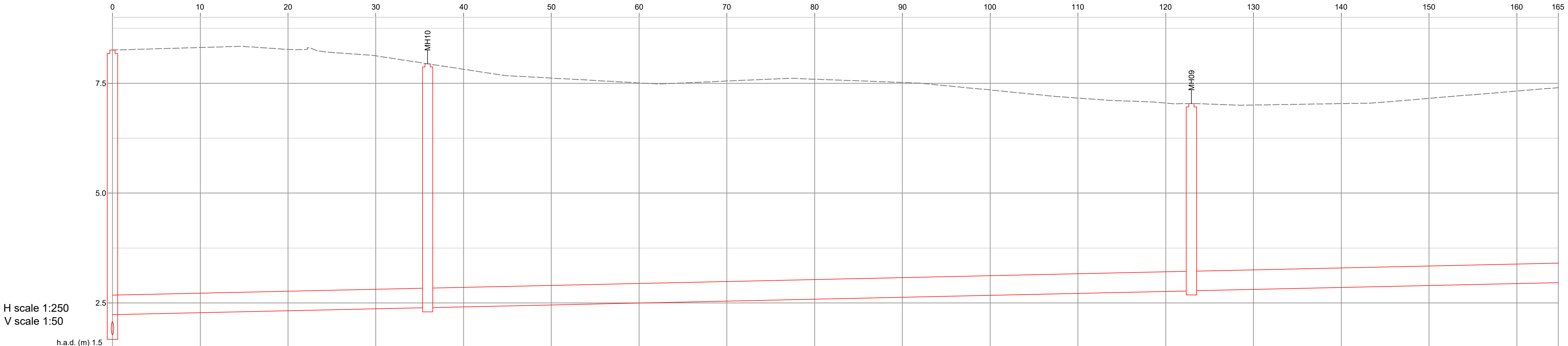


PLAN VIEW - PROPOSED WW GRAVITY MAIN CUT-IN (OPEN CUT CONSTRUTION)

1:250



CONTINUE SHEET C61-12

EXISTING GL	8.255	8.314	8.271	8.124	7.819	7.618	7.508	7.551	7.593	7.518	7.350	7.163	7.050	7.005	7.037	7.157	7.322	7.400

	Ch 0	MH10	MH09	End
LID LEVEL		7.944	7.037	
COVER TO PIPE	5.58	5.11	3.82	
PIPE DATA	375 NB RCRRJ CLASS 4 1:227 (0.44%)	375 NB RCRRJ CLASS 4 1:227 (0.44%)	375 NB RCRRJ CLASS 4 1:227 (0.44%)	
INVERT LEVEL	2.269	2.427 / 2.427	2.810 / 2.810	3.184
MH CHAINAGE		35.904	122.930	

LONGITUDINAL SECTION PROPOSED GRAVITY MAIN CUT-IN ALIGNMENT

SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE

HORIZONTAL 1:250 AT ORIGINAL SIZE

A1 REPRODUCTION SCALE

A3 REPRODUCTION SCALE

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS

NEW WASTEWATER RISING MAIN — WWR

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

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Reduced Scale (A3) AS SHOWN

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*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED GRAVITY MAIN CUT IN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-11

Rev. A

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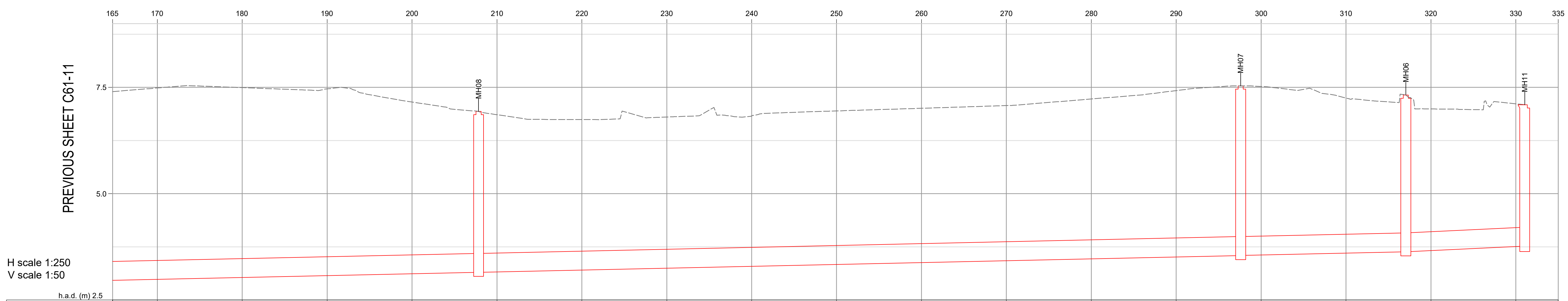
Document No. 144418.50 M-P-GRAVITY MAIN CUT-IN-3.DWG

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

PLAN VIEW - PROPOSED WW GRAVITY MAIN CUT IN (OPEN CUT CONSTRUTION)

1:250



Chainage	165	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330
EXISTING GL	7.400	7.487	7.495	7.464	7.156	6.858	6.743	6.803	6.829	6.946	7.009	7.072	7.228	7.424	7.521	7.250	6.993	7.114

	Start	MH08	MH07	MH06	MH11
LID LEVEL		6.935	7.536	7.318	7.092
COVER TO PIPE	3.82	3.34	3.55	3.24	
INVERT LEVEL	2.810	3.184 / 3.184	3.580 / 3.580	3.666 / 3.666	3.800
MH CHAINAGE		207.838	297.587	317.043	331.044

PIPE DATA:
- Start to MH08: 375 NB RCRRJ CLASS 4, 1:227 (0.44%)
- MH08 to MH07: 375 NB RCRRJ CLASS 4, 1:227 (0.44%)
- MH07 to MH06: 375 NB RCRRJ CLASS 4, 1:227 (0.44%)
- MH06 to MH11: 375 NB RCRRJ CLASS 4, -1:104 (-0.96%)

LONGITUDINAL SECTION PROPOSED GRAVITY MAIN CUT-IN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

SCALE 1:250 AT ORIGINAL SIZE: 0 2.5 5 7.5 10 12.5m

VERTICAL 1:50 AT ORIGINAL SIZE: 0 0.5 1 1.5 2 2.5m

HORIZONTAL 1:250 AT ORIGINAL SIZE: 0 2.5 5 7.5 10 12.5m

PROPOSED SERVICES LEGEND

- NEW WASTEWATER — SS
- NEW WASTEWATER RISING MAIN — WWR

ORIGINAL DRAWING IN COLOUR

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A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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		Date
Design	EG	06-03-2023
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*Dsg Verifier	PB	14-04-2023
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Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED GRAVITY MAIN CUT IN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-12

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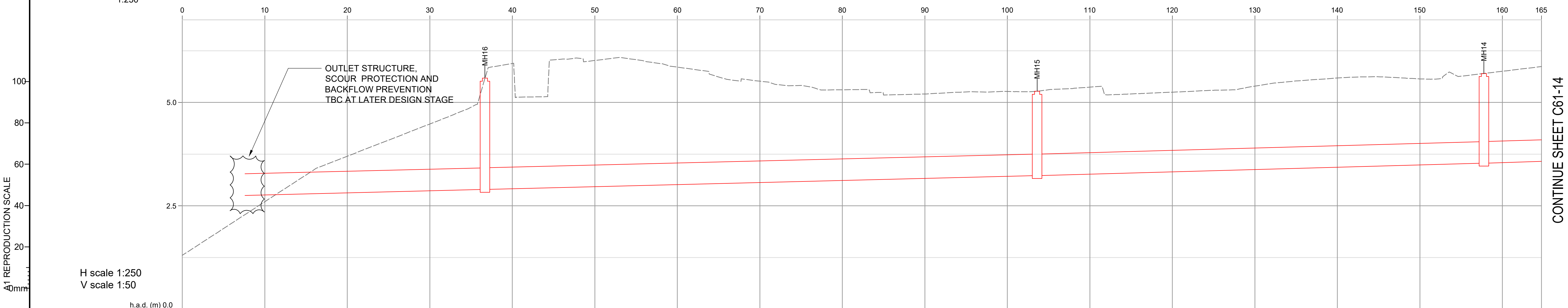
PLAN VIEW - PROPOSED WW OVERFLOW GRAVITY MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	1.303, 2.600, 3.700, 4.480, 5.945, 6.017, 5.855, 5.515, 5.307, 5.205, 5.268, 5.372, 5.250, 5.394, 5.592, 5.570, 5.755, 5.869
LID LEVEL	5.590, 5.271, 5.702
COVER TO PIPE	-0.99, 2.17, 1.52, 1.65
PIPE DATA	475 NB UPVC SN16 1:200 (0.50%); 475 NB UPVC SN16 1:200 (0.50%); 475 NB UPVC SN16 1:179 (0.56%); 475 NB U 1:158 (C
INVERT LEVEL	2.782, 2.927, 2.927, 3.262, 3.260, 3.562, 3.562, 3.685
MH CHAINAGE	36.680, 103.605, 157.764

LONGITUDINAL SECTION PROPOSED OVERFLOW GRAVITY MAIN ALIGNMENT

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS
NEW WASTEWATER RISING MAIN — WWR

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
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SCALE 1:250 AT ORIGINAL SIZE
VERTICAL 1:50 AT ORIGINAL SIZE
HORIZONTAL 1:250 AT ORIGINAL SIZE

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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Drawn	JR	06-03-2023	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

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Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED OVERFLOW GRAVITY MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No.: C61-13 Rev.: A

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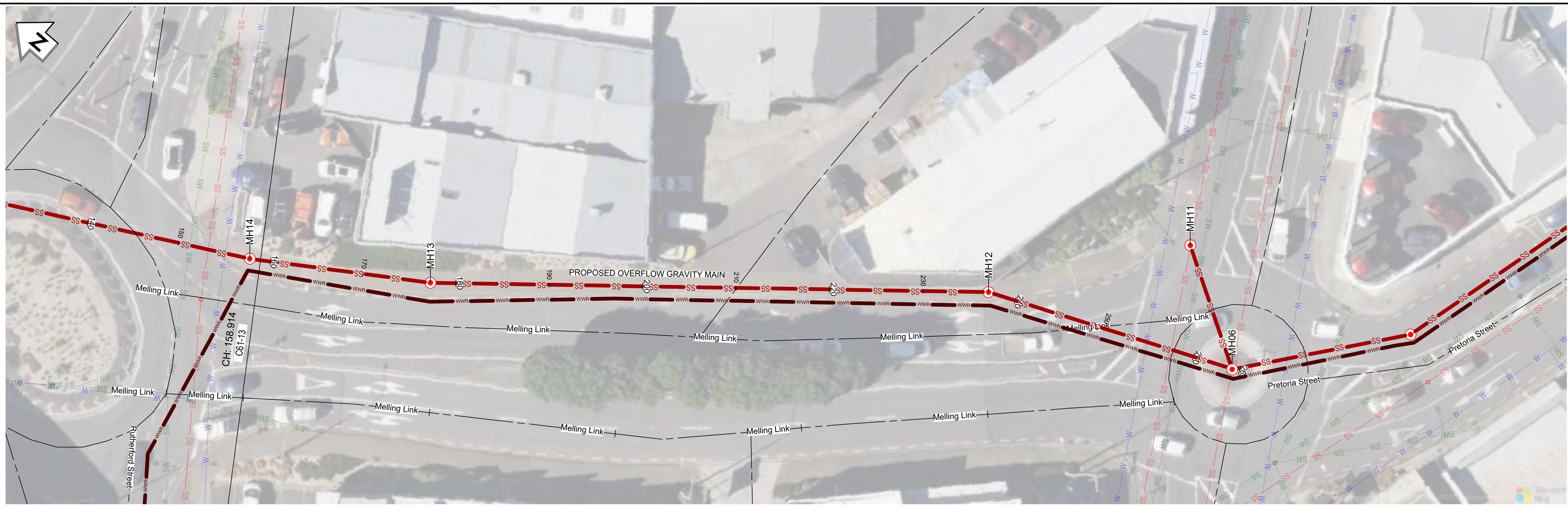
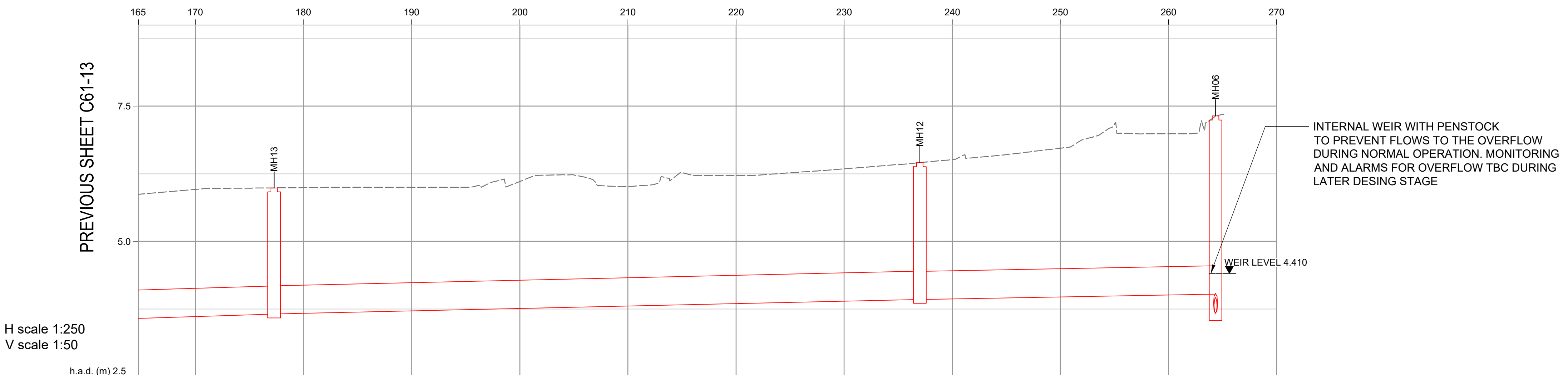
Document No. 144418.50 M-P-OVERFLOW GRAVITY MAIN-2.DWG



PLAN VIEW - PROPOSED WW OVERFLOW GRAVITY MAIN (OPEN CUT CONSTRUTION)

1:250



EXISTING GL	5.869	5.962	5.994	6.000	6.107	6.013	6.218	6.340	6.511	6.723	6.989
LID LEVEL	5.988	6.456									
COVER TO PIPE	1.65	1.81	2.01								
PIPE DATA	475 NB UPVC SN16 1:158 (0.63%)	475 NB UPVC SN16 1:221 (0.45%)	475 NB UPVC SN16 1:270 (0.37%)								
INVERT LEVEL	3.562	3.685 3.686	3.956 3.953	4.054							
MH CHAINAGE	177.268	237.002									

LONGITUDINAL SECTION PROPOSED OVERFLOW GRAVITY MAIN ALIGNMENT

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

PROPOSED SERVICES LEGEND

NEW WASTEWATER — SS

NEW WASTEWATER RISING MAIN — WWR

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. PIPE SIZE TO BE CONFIRMED

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
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0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

VERTICAL 1:50 AT ORIGINAL SIZE 0 0.5 1 1.5 2 2.5m
HORIZONTAL 1:250 AT ORIGINAL SIZE 0 2.5 5 7.5 10 12.5m

No.	Revision	By	Chk	Appd	Date
A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023

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Reduced Scale (A3)	*Dsg Verifier	PB	14-04-2023	
AS SHOWN	*Dwg Check			Date
	*Name Produced through Projectwise Signoff			

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED OVERFLOW GRAVITY MAIN PLAN AND PROFILE SECTION

Discipline: CIVIL

Drawing No. C61-14

Rev. A

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Document No. 144418.50 M-P-OVERFLOW GRAVITY MAIN-2.DWG

[redacted]

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. REFER TO GENERAL AND STANDARD NOTES AND LEGENDS ON DRAWING C00-01.
3. FENCING OF PUMP STATION AND ACCESS HATCHES REQUIRED
   - EXTENT ON FENCING DEPENDANT ON LONG TERM USE OF SITE
   - TBC DURING LATER STAGES OF DESIGN WITH HCC
4. SECURITY AND MAINTENANCE LIGHTING TBC WITH HCC DURING LATER DESIGN STAGES
5. WASH DOWN FACILITIES REQUIRED - DETAILS TBC DURING LATER DESIGN STAGES
6. CONNECTION FOR EMERGENCY GENERATOR TO BE INCLUDE

PROPERTY BOUNDARIES
PUMPSTATION BOUNDARIES
SS PROPOSED GRAVITY MAIN
WWR PROPOSED RISING MAIN

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

A1 REPRODUCTION SCALE 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

0 4.5 9 Meters

A	FOR CLIENT REVIEW	JR	EG	PB	14-04-2023
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Drawn	JR	06-03-2022	
*Dsg Verifier	PB	14-04-2023	
*Dwg Check			Date

*Name Produced through Projectwise Signoff

Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED PUMPSTATION PLAN VIEW

Discipline: CIVIL

Drawing No.: C63-01

Rev.: A

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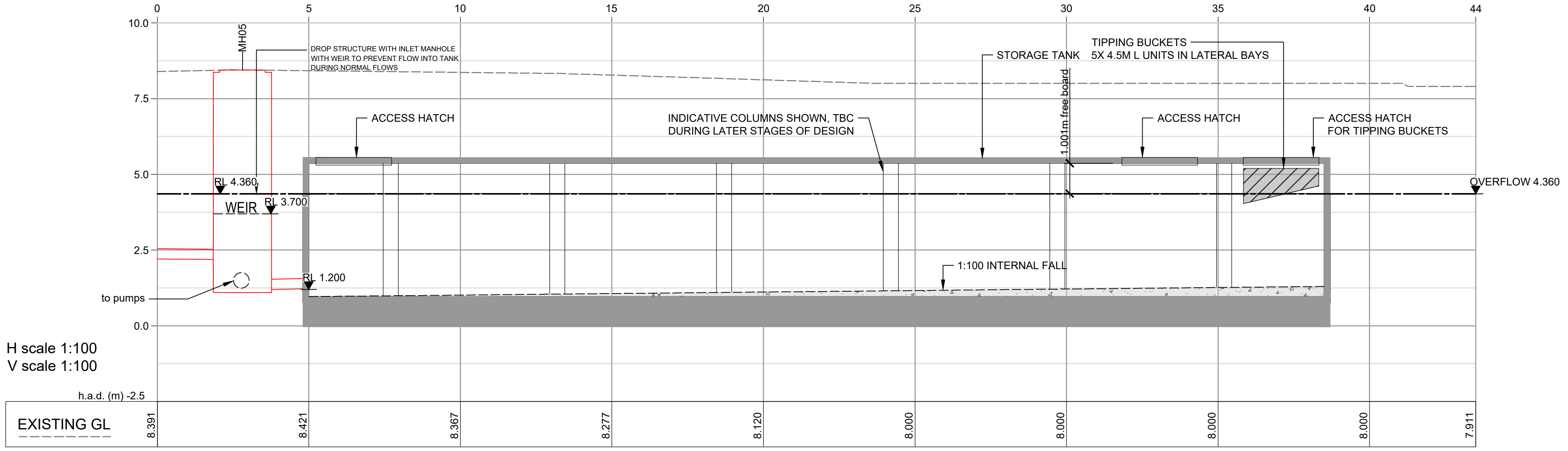
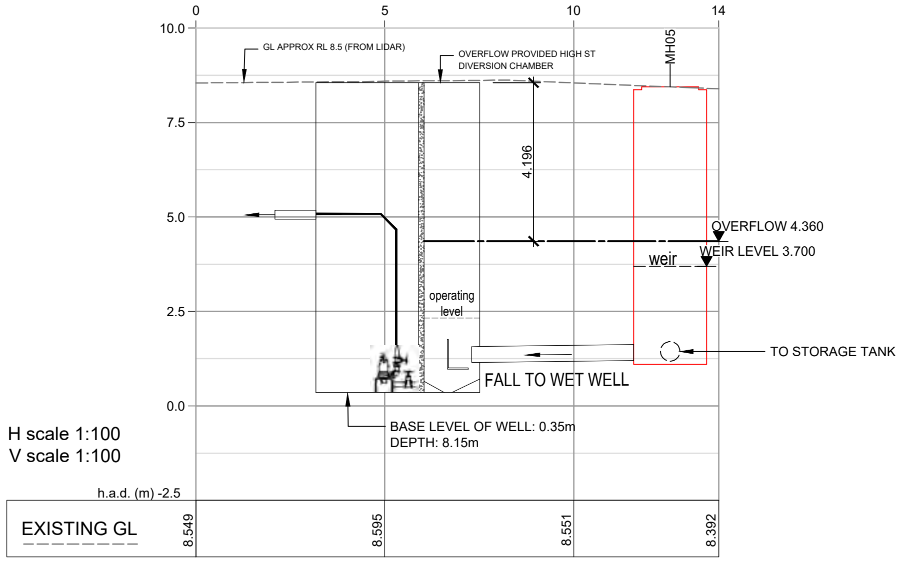


SECTION A -LONGITUDINAL SECTION



SECTION B -LONGITUDINAL SECTION

A1 REPRODUCTION SCALE

A3 REPRODUCTION SCALE

SCALE 1:100 AT ORIGINAL SIZE

ORIGINAL DRAWING IN COLOUR

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No.	Revision	By	Chk	Appd	Date
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*Dwg Check			Date

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Client: Wellington Water

Project: RIVERLINK WASTEWATER TRUNK CBD BYPASS

Title: PROPOSED PUMPSTATION LONGITUDINAL SECTIONS

Discipline: CIVIL

Drawing No.: C63-02

Rev.: A

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Document No. 144418.50 M-P PUMPSTATION.DWG

Appendix G- Constraints assessment – Ecology

Memorandum

To	**Hutt City Council**
cc	
From	[redacted], **Tonkin & Taylor Ltd**
Date	**16 August 2023**
Subject	**HCC IAF Upgrades – Constraints Assessment – Ecology**
Reference	**1091097.TT.2100.PRW.ME.EN.21.Constraints Assessment_Ecology.docx**

1 Introduction

1.1 Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed funding for wastewater pipeline upgrades to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options", prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass", prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.2 Current project stage and purposes of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this memorandum is to identify key constraints and fatal flaws relevant to Ecology which will inform further option development.

1.3 Description of IAF options

1.3.1 Stormwater

At the start of Stage 1, the engineering design team carried out a site walkover and brainstorming session to identify a "long list" of possible options. Through a further option development process, the long list will be reduced to a short list, and ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is detailed in **Table** *3.1* below, and is displayed in **Appendix A**. Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stopbanks provide flood protection to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to base flows in Te Awa Kairangi.

2 Constraints Assessment

2.1 Ecological context and site description

Opahu Stream is located within the Lower Hutt suburbs of Boulcott, Melling, Waterloo West and Woburn. Opahu Stream is a small urban stream that broadly flows in a southwest direction before its confluence with Te Awa Kairangi approximately 80 m upstream from the Wairarapa Line rail bridge over the river (**Figure 2.1**).

At the time of writing this memorandum, a site assessment has not been undertaken, and limited information on the ecological characteristics and values of the Opahu Stream are available. From a review of the photographs the engineering design team collected, the Opahu Stream can be described as a stream modified by the urban development within the catchment and the stream bed itself. The headwater open channels appeared to be intermittent, with large sections dry or stagnant. Large sections had the stream banks lined with artificial materials ranging from timber, rock wall and concrete. Long culverts and/ or piped network sections connect the open stream channels. We also understand that there are regular complaints from the public regarding odour issues from stagnant and dry sections of the Opahu Stream[1]. Flood control gates control the outfall of Opahu Stream with the confluence with Te Awa Kairangi. Taylor & Marshall (2016) noted that the gates appeared to provide fish passage due to the presence of inanga (Galaxias maculatus) upstream from the gates[2].

[1] Personal Communication [redacted], 15 August 2023.

[2] Taylor, M., & Marshall, W. (2016). Inanga Spawning Habitat Quality, Remediation and Management in the Wellington Region. Prepared for Greater Wellington Regional Council, Waiarapa Moana Wetlands Group, Porirua City Council, and Wellington City Council. Published by Aquatic Ecology Ltd.

Opahu Stream is highly indicative of experiencing the urban stream syndrome (Walsh et al. 2005[3]), where urban alterations to stream catchments and inputs lead to significant modifications in the stream's characteristics. This includes shifts in hydrological input through increased areas of pavement and direct channelling of flows to the stream, ultimately leading to changes in channel morphology marked by increased channel size. Consequently, this prompts modifications to the stream banks as a preventive measure against erosion. These changes combined may lead to a reduction in fauna biodiversity within the stream.

According to available records, a single entry in the New Zealand freshwater fish database[4] notes the capture of an unidentified galaxiid species within the stream. However, abundant numbers of inanga (*Galaxias maculatus*) and common bullies (*Gobiomorphus cotidianus*) have been observed at the lower extents of Opahu Stream[2]. INaturalist[5] also have a record of a shortfin eel (*Anguilla australis*) within the upper extents of the Opahu Stream. Opahu Stream provides little to no spawning habitat downstream of Wai-iti Street, mainly due to the lack of suitable intertidal vegetation[2].

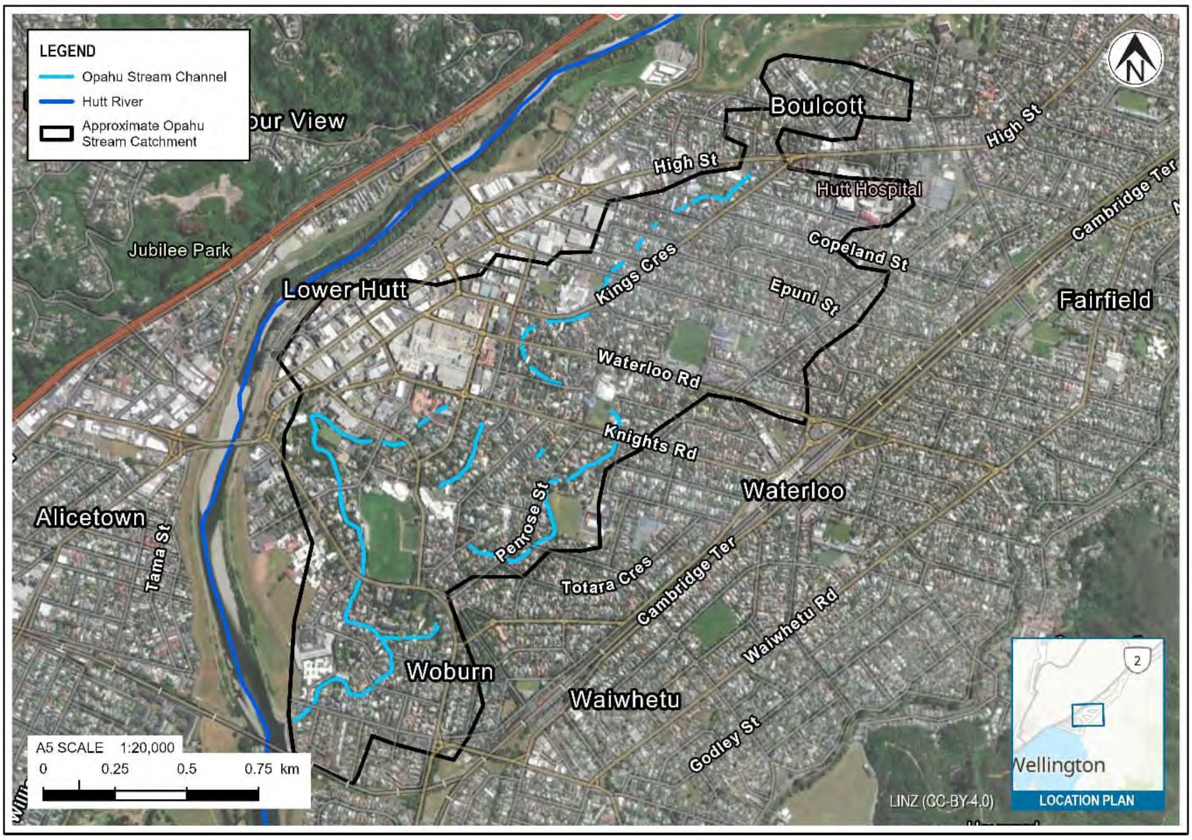


Figure 2.1: Opahu Stream Catchment

The riparian margin of the Opahu Stream primarily consists of gardens or urban parks with varying levels of native and exotic vegetation providing varying levels of shade to the stream channel. A

[3] Walsh, C. J., Roy, A. H., Feminella, J. W., Cottingham, P. D., Groffman, P. M., & Morgan, R. P. (2005). The urban stream syndrome: current knowledge and the search for a cure. Journal of the North American Benthological Society, 24(3), 706-723.

[4] NIWA. (n.d.). New Zealand freshwater fish database. Retrieved June 13, 2023, from https://niwa.co.nz/information-services/nz-freshwater-fish-database

[5] iNaturalist. (n.d.). Retrieved August 24, 2023, from https://www.inaturalist.org/

search of relevant fauna databases[5,6] indicates that a number of indigenous fauna are potentially present within the wider Opahu Stream Catchment (**Table 22.1**). The native short tailed bat (*Mystacina tuberculate*) is also present within a wider 30 km radius of the Opahu Stream Catchment[7]. However, short tailed bats are a forest-dwelling species and will not be present in the urban area.

Table 22.1: Indigenous fauna potentially present within the Opahu Stream Catchment and threat status[8,9]

Lizards	Indigenous birds
Northern grass skink (*Oligosoma polychrome*) – Not Threatened	White-faced heron (*Egretta novaehollandiae*) – Not Threatened
Raukawa gecko (Woodworthia maculate) – Not Threatened	Kererū (Hemiphaga novaeseelandiae) – Not Threatened
Copper skink (Oligosoma aeneum) – At Risk – Declining	Red-billed Gull (*Chroicocephalus novaehollandiae*) – At Risk – Declining
Northern spotted skink (*Oligosoma kokowai*)	Southern Black-backed Gull (Larus dominicanus) – Not Threatened
-	Swamp Harrier (*Circus approximans*) – Not Threatened
-	Tui (*Prosthemadera novaeseelandiae*) – Not Threatened

3 Ecological constraints and opportunities

Overall, the eleven stormwater options can be summarised into four main ecological constraints that need to be considered through the design and consenting phases of the project. The four constraints are listed below and are detailed against each option in **Table** *3.1*.

Interception of base flows: A number of the stormwater options revolve around capturing peak inflows into Opahu Stream from a number of pipe stormwater catchments and diverting flow either to Te Awa Kairangi or further down Opahu Stream. When redirecting peak stream flow, careful design is required to enable baseflows to continue flowing down the natural Opahu Stream channel. It has already been noted that the sections of Opahu Stream suffer from stagnant flows during low flow periods, leading to odour issues. If the interception captures baseflows or smaller flushing flood events, interception may worsen the situation. Flushing flows are essential in the ecology of intermittent streams and, therefore, should be maintained[10].

The interception of peak flows also provides an opportunity to provide more natural flood flows, which may benefit stream ecosystem function by removing the peak flows during flood events.

[6] Department of Conservation (DOC). (n.d.). Atlas of the amphibians and reptiles of New Zealand. Retrieved January 10, 2023, from https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution/atlas/
[7] Department of Conservation. (n.d.). Bat database. Retrieved May 8, 2023.
[8] Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. D., Miskelly, C. M., O'Donnell, C. F. J., Sagar, P. M., Scofield, R. P., Taylor, G. A., & Michel, P. (2021). Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation.
[9] Hitchmough, R., Barr, B., Knox, C., Lettink, M., Monks, J. M., Patterson, G. B., Reardon, J. T., van Winkel, D., Rolfe, J., & Michel, P. (2021). Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35. Department of Conservation.
[10] Vorste, R. V., Corti, R., Sagouis, A., & Datry, T. (2016). Invertebrate communities in gravel-bed, braided rivers are highly resilient to flow intermittence. Freshwater Science, 35(1), 164-177.

If the intercepted flow is to be discharged directly into the Opahu Stream or Te Awa Kairangi, then a resource consent authorising the discharge may be required. Refer to the consenting strategy for further information.

Works in open green space: A number of coastal sea birds (Red-billed Gull, Southern Black-backed Gull[5]) are present within the wider Opahu Stream catchment. These birds may utilise open spaces, such as grass sports fields, as high tide roosts to rest during high tide periods or to feed within the open space and return to the coastal foreshore to feed during low tide. Most indigenous bird species are protected under the Wildlife Act 1953, and harming or killing them is an offence. If coastal sea birds are present in the works area, work may have to be postponed until they naturally leave, which may occur frequently in places like grass sports fields.

Direct freshwater works within Opahu Stream: Option 3a proposes improving channel conveyance in the lower Opahu Stream, which may have significant ecological effects. The National Policy Statement for Freshwater Management (NPS-FM) objectives and policy aims to prioritise the health and well-being of water bodies and freshwater ecosystems, prevent the loss of river values, and protect habitats for indigenous freshwater species. This will prevent the creation of a truly engineered stream channel that prioritises peak flows.

There is an opportunity to provide nature-based solutions that incorporate channel naturalisation and improve inanga spawning while allowing for higher peak flows that address risks around ecological effects on Opahu Stream.

Option 6 may require diverting peak flows in Opahu Stream to an interception pipe at Riddiford Gardens. To divert peak flows into a new interception pipe, a weir may be necessary within the Opahu Stream to divert peak flows. Poorly designed weirs can act as barriers to native fish as they migrate upstream. The construction of a weir would trigger regulation 72 or 73 under National Environment Standards for Freshwater (NES-F), and fish passage requirements would need consideration during the project's design and resource consenting stages.

Vegetation clearance: Consideration of the potential impact on native fauna is needed when clearing vegetation for stormwater works. Native lizards may be present within this vegetation, particularly overgrown vegetation along the riparian margin of Opahu Stream. In addition, native birds may use this vegetation to nest during nesting season.

All native lizards and most indigenous bird species are protected under the Wildlife Act 1953. To avoid causing harm to lizards, a survey to determine the presence of geckos and skinks within the site's footprint should be undertaken during the consenting stage of the project. If geckos or skinks are found, an application for a Wildlife Act Authority (WAA) to enable the relocation of lizards should be prepared and submitted. There is potential for a six-month delay in obtaining these authorisations due to delays at the Department of Conservation.

To avoid harm to indigenous birds, vegetation clearance should be undertaken outside of nesting season (September to January, inclusive). Alternatively, vegetation can be inspected by ecologists immediately prior to clearance. Outside of the nesting season, indigenous birds should relocate naturally immediately prior to disturbance/clearance.

Table 3.1: Ecology risks and opportunities applying to each stormwater options

Option	Risks
Option 1: Kings Cres. interceptor	Interception of base flows
Option 2a: Hutt Recreation Ground diversion	Interception of base flows and works in open green space
Option 2B: Hutt Recreation Ground Storage	Works in open green spaces
Option 3A: Lower Opahu Stream improvements	Direct freshwater works within Opahu Stream and vegetation clearance.
Option 3B: Lower Opahu Stream Bypass	Interception of base flows and vegetation clearance
Option 4: Pump Station at St Bernard's College	Interception of base flows
Option 5: Eastern Hutt School Pump Station	Interception of base flows
Option 6: Knights Road New Interceptor	Interception of base flows, direct freshwater works within Opahu Stream and vegetation clearance.
Option 7: Detention storage at schools & hospital	Work in open green spaces
Option 8: Riddiford Gardens pump station	Interception of base flows
Option 9: CBD Interceptor	Interception of base flows

Overall, each option's ecological risks can be addressed through good design and undertaking best practice fauna management during construction. Ecological surveys to understand the characteristics and values of the Opahu Stream and the potential fauna present within the catchment would be required to inform an ecological impact assessment. The intensity of ecological surveys will depend on what options proceed.

4 Next steps

After narrowing down the list of options, it's essential to assess the ecological impact of the preferred option. This will help determine the necessary level of investigation for an ecological impact assessment during the project's consenting phase. The ecological investigation will likely involve a site assessment of the Opahu Stream to confirm its ecological value through conducting surveys of the macroinvertebrate and fish communities; and stream habitat. If naturalising the channel stream or instream structures is among the shortlisted options, seeking design advice from an ecologist and fluvial geomorphologist is advisable to avoid and minimise any adverse effects.

5 Summary

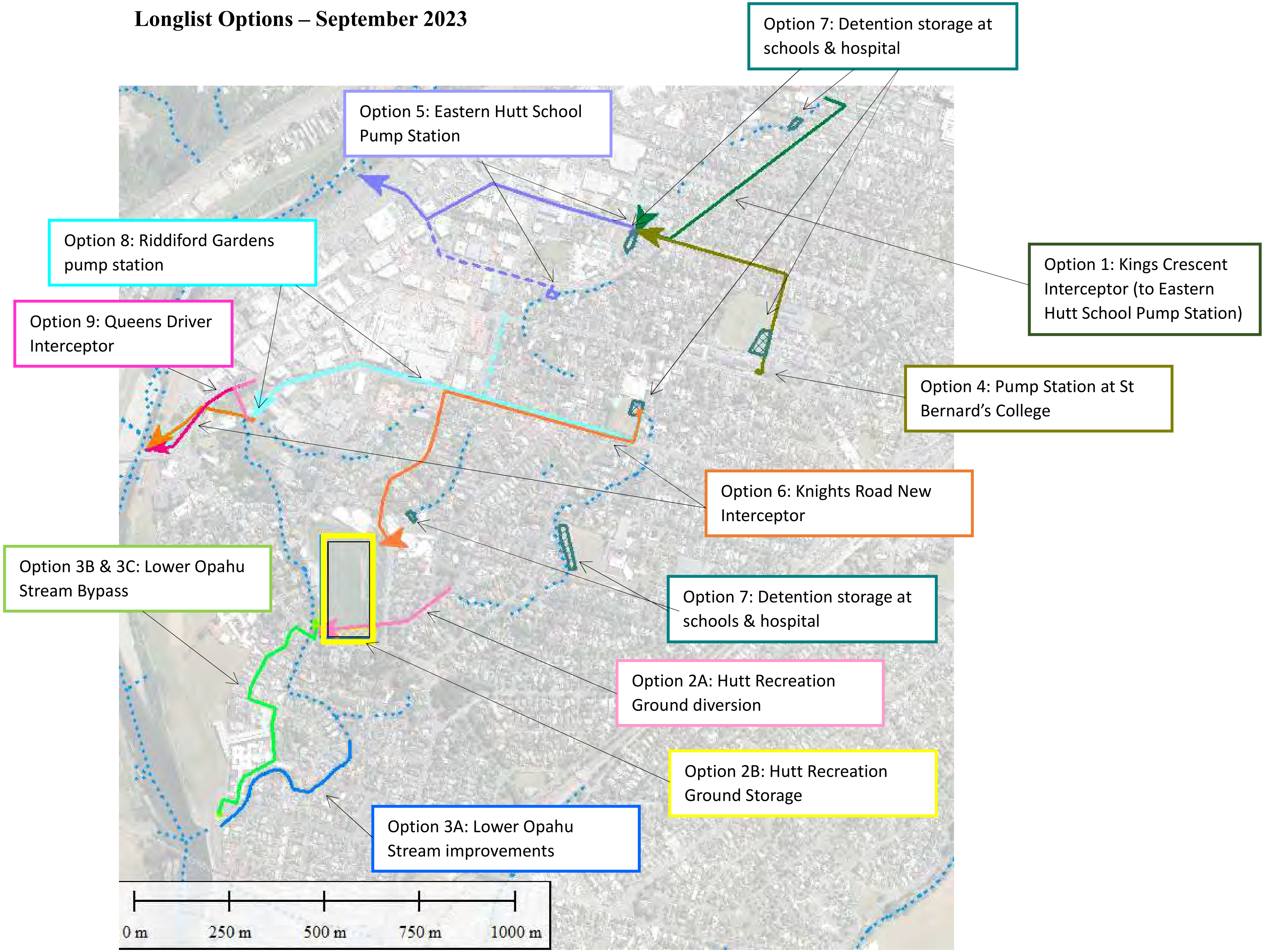
Hutt City Council (HCC) and Kainga Ora are looking to undertake upgrades of the stormwater networks within the Opahu Stream Catchment to facilitate the building of new houses. The longlist of current options will be reduced to a preferred solution that may be implemented as a combination of the different options or a single option.

Opahu Stream is a small urban stream located in the suburbs of Lower Hutt. It is heavily modified with intermittent open channels and artificial materials lining the banks. The stream characteristics are likely typical of an urban stream and are impacted by what is referred to as the urban stream syndrome. This is where the modification of the stream catchment results in alterations in the stream's characteristics, which impacts taxa biodiversity. However, three fish species have been recorded. The riparian margin consists of gardens and urban parks with native and exotic vegetation. Potentially, several indigenous fauna are present within the wider Opahu Stream Catchment.

The longlist of eleven stormwater options for the Opahu Stream project can be summarised into four ecological constraints: interception of base flows, works in open green space, direct freshwater works within Opahu Stream, and vegetation clearance. These constraints need to be considered during the design and consenting phases to avoid and minimise ecological effects and to provide a consenting pathway. Overall, the ecological risks associated with each option can be addressed through good design and undertaking best practice fauna management during construction.

Appendix A: Longlist Options

Longlist Options – September 2023



Appendix H- Constraints assessment – Dry Services

Memorandum

To	**Hutt City Council**
cc	
From	[redacted]
Date	**16 August 2023**
Subject	**HCC IAF Upgrades – Constraints Assessment – Dry Services**
Reference	**1091097.TT.2100.PRW.ME.EN.20.Constraints Assessment_Dry Services.docx**

1 Introduction

1.1 Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the wastewater pipeline upgrade required to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options", prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass", prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.2 Current project stage and purposes of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this document is to identify key constraints and fatal flaws relevant to Dry Services which will inform further option development.

1.3 Description of IAF options

1.3.1 Stormwater

A site walkover and brainstorming session has been carried out by the design team at the start of this stage. Various options have been identified to form a "long list" of possible options. Through further option development, the long list will be reduced down to a short list and then ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is included in **Appendix A**. Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stopbanks provide flood protection to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to high flows in the Hutt River.

2 Dry Services Constraints Assessment

2.1 Introduction/Overview

The dry services scope of works was outlined in our engagement letter titled HCC IAF Upgrades LOE Stage 1 – Feasibility dated 21 July 2023.

This includes collecting, reviewing, and summarising the available dry utilities information from B4Udig, T+T files, site investigations, information from HCC and from 3rd party asset owners. Additionally, the electricity network provider will be contacted to determine if sufficient capacity in the transmission lines to provide the estimated power consumption of a pump station.

The dry services that were identified within the proposed options area are natural gas, electricity, fibre optic network, telecommunications, and geodetic markers. The following companies detailed below were identified as the assess owners of these dry utilities. Each assets owner was contacted to identify:

- Design constraints including offsets and potential clash resolution
- Construction constrains such as stand over requirements

Each assets owners information is detailed in the following sections and summarised in Appendix A attached.

2.2 Dry services asset owners

2.2.1 Chorus

Chorus owns telecommunications networks in the Hutt. This network consists of residential fibre cables, metro fibre rings and older 'copper' telephone/broadband lines. Chorus offsets are outlined in their service document titled New Property Technical Requirements - General Fibre Network (Volume 1) Section 3.2 (Mar 2023) section 3.4 stating for the three waters the following clearances are required:

- The vertical and horizonal clearances are 300 mm.

Chorus was contacted to confirm these separation requirements were correct and were applicable to this project which they confirmed via email on 18th of August and the 6th of September 2023. Chorus also stated that their assets can be relocated as chargeable works if the IAF upgrade requires it. There is no ongoing disbandment of copper broadband so in the instant of a clash, the asset would be required to be relocated to maintain the existing capacity even if the system is no longer in use but was in use at some point in time. In the case that a duct is required to be moved, Chorus needs to be notified at least 4 weeks before works start.

The Chorus New Property Technical Requirements – General Fibre Network (Volume 1) is attached in Appendix B.

2.2.2 LINZ

Land Infrastructure New Zealand (LINZ) owns the survey marks across New Zealand. The geodetic markers (of varying importance) are located throughout the Hutt, some of which may be below ground level. The location of the geodetic markers in New Zealand can be found through LINZ data services website. In the event that the IAF work disturbs a survey marker the following requirements should be followed:

- LINZ should be notified prior to work commencing.
- The survey marks will need to be protected, replaced, or relocated by a Licensed Surveyor.

It is preferred that the replacement mark is added before the original mark is destroyed.

LINZ outlined and confirmed these requirements via email on 22 August 2023.

2.2.3 One NZ (formally Vodafone)

One NZ owns a buried telecommunications network in the Hutt. Most of the suggested locations for potential stormwater/wastewater pipes have a One NZ Hybrid fibre-coaxial (HFC) network. One NZ fibre also has metro fibre rings which may conflict with the proposed alignment. Queens Dr has a higher level of important links, refer to Appendix C1 for One NZ most critical metro fibre rings.

- One New Zealand require clearances from 3 waters infrastructure for their assets to be in accordance with the Regional Specification for Water Services – December 2021, these are outlined in Table 6.6;
  - Vertical clearances are 150 mm.
  - Horizontal clearances for a non-bulk water main is 300 mm and for a bulk water main is 600 mm.

One NZ also requires stand over when mechanical excavation is undertaken near their assets, refer to Appendix C2 for One NZ excavation matrix. In the instance of a clash, One NZ's procedure is a site-specific discussion with the Access DevOPs Engineer.

One NZ has confirmed these requires as current and applicable for this location via email on 22nd of August 2023 and a phone call on the 1st of September 2023.

The Metro Fibre Ring is a critical asset for One NZ, requiring the most challenging clash resolution works if this asset were in the path of the new stormwater infrastructure. The Metro Fibre Ring has been identified to run through the streets listed below and shown in Appendix C1.

- Queens Dr.
- High St.
- Rutherford Dr.
- Melling Link.
- Kings Cres.
- Cornwall St.
- Pretoria St.
- Knights Rd.

2.2.4 Wellington Electricity

The electricity network in the locations under investigation for the IAF upgrade are owned by Wellington Electricity (WE). This consists of above and below ground infrastructure. Wellington Electricity confirmed that there are strategic assets on Kings Crescent between Pretoria Street and High Street. Wellington Electricity construction constraints are detailed in the New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001) which are attached in Appendix D. The following requirements are to be taken:

- If construction work is occurring within 4 m of overhead lines or digging within 5 m of a power pole, a Close Approach Consent must be lodged.
- The exact location of the underground cables must be found using a cable locator before breaking ground.
- Digging within 1.5 m of critical underground cables will require supervision for the extraction as per the Wellington Electricity Safety page on their website.
- Offsets for buried cables are 500 mm for 33 kV cables and 300 mm for 11 kV and LV Distribution cables.
- A close approach consent for buried power ducts is only required if they are strategic, 33 kV and pilot cables.
- In the instance of a clash, communication with W.E is required as the procedure is site specific.

Wellington Electricity confirmed this information in an email on the 31st of August and 11th of September 2023.

The 33 kV electrical supply cable is a strategic asset for WE, requiring the most challenging clash resolution works if this asset were in the path of the new stormwater infrastructure. The active 33kV powerline has been identified to run through:

- Potomaru St.
- Kings Crescent.
- Epuni St.
- Between Rutherford St and the stop bank.

2.2.5 PowerCo

PowerCo owns buried gas lines in the potential affected area of the Hutt. The PowerCo "Works Agreement Issue and Management" standard detail some of the processes required when working near PowerCo gas lines attached in Appendix E. The following requirements are to be taken:

- If works are in close proximity to PowerCo gas lines, PowerCo is to mark out the network. Potholing must be completed to confirm the asbuilt and mark outs are correct. Stand overs may be required at this point.
- Where works are in close proximity a "Works agreement" must be completed. Within the "Works agreement" the following details get confirmed:
  - Timeframes for standover notifications and standover requirements, if required.
  - Mechanical excavation around gas network.
  - Hand excavation around gas networks.
  - Backfill/bedding material for gas network.
  - Note: Where Markout/standover contractor deems suitable, Works agreement may not be required IE; for smaller, non-strategic pipelines.
  - Clearances for gas networks.
- Offsets for Yellow Jacket Steel pipe / Intermediate pressure pipes are 300 mm.
- Offsets for Polyethylene pipes / Medium pressure pipes are 250 mm.

PowerCo confirmed this information in an email on the 3rd of October 2023.

PowerCo. has strategic pipes that have additional risk to the public and would require the most challenging clash resolution works if this asset were in the path of the new stormwater infrastructure. Strategic pipes are defined by the following criteria.

- Pipes with a MAOP > 420kPa.
- Pipe with a diameter of > 100NB.
- Pipe located in high community use areas (CBD).

PowerCo. has indicated that strategic pipes are located around High St, Brunswick St, and Kings Cres.

3 Power Demand

Several of the potential options require a pump station for stormwater and wastewater, these locations have been summarised in the aerial attached in Appendix F1. The potential power demand of these pump stations was provided by MOTS, which have been summarised in Appendix F2. Wellington Electricity has supplied snips from their GIS data base at the approximate locations of the proposed pump stations (Refer to Appendix F3). Wellington Electricity were engaged to conduct Powerflow analysis to determine available power capacity to the potential pump station location and feasibility of pump stations from a power demand perspective. The provided a feasibility letter for the proposed pump stations with an indicative cost require to upgrade the power supply to these locations attached in Appendix F4.

Wellington Electricity has noted that their current network would be unable to supply power concurrently to both proposed pump stations at Myrtle St and Laings Rd with the proposed pump station demands provided to them, Refer WE letter in Appendix F4 for further details.

4 Summary and Conclusions

The dry utilities that were investigated for the IAF HCC stormwater and wastewater improvements are Electricity, Natural Gas, Fibre optic network, Communications, and Geodetic Markers. A summary sheet of these constraints is attached in Appendix A.

Many of the dry services can be relocated through a clash resolution process.

Appendix A: Summary Table of Dry Services Constraints

Asset Owner - Required Clearances								
Asset Owner	**Service Type**	**Service to Clear**	**Vertical Clearance at Intersections (mm)**		**Horizontal Clearances on Parallel Runs (mm)**		**Notes**	**Source**
			Without Protection	**With Protection**	**Without Protection / Non-bulk Main**	**With Protection / Bulk Main**		
Chorus	Communication	3 Waters	300		300		There is no fixed clearance standards but this is the general standard	Chorus - New Property Technical Requirements - General Fibre Network (Volume 1) Section 3.2 (Mar 2023)
One NZ	Communication	3 waters	150		300	600	Standovers are required when excavating within 0.3 m and between 0.3 and 0.1 of a network service.	Confirmed via email as no public online specification - To local authority requirement - Regional Specification for Water Services
Linz	Geodetic Markers	Geodetic Markers	If your work is likely to disturb / destroy these survey marks, then you are required to arrange for them to be replaced and a survey plan and deliverables showing this work forwarded to LINZ. New marks do not need to be located in exactly the same location as an existing mark but be placed in a safe usable location which serves the same purpose as the existing mark. Survey marks in these areas are of different order and depending on this order various specifications apply to their renewal. The ideal method of replacing marks where required is to do this before the original mark is destroyed so that a tie can be made from the new mark to the old one.				Once we know - send to Linz contact in order of works to get all Geodetic Marker details	Confirmed via email as no public online specification
PowerCo	Gas (Yellow Jacket Steel Pipes/ Intermediate Pressure)	3 Waters	300				Standovers may be required. PowerCo has free service to have the network marked out.	Confirmed via email. Document from PowerCo: 394S010 Gas Operations - Works Agreement Issue and Management
PowerCo	Gas (Polyethylene Pipes/Medium Pressure)	3 Waters	250				Standovers may be required. PowerCo has free service to have the network marked out.	Confirmed via email. Document from PowerCo: 394S010 Gas Operations - Works Agreement Issue and Management
Wellington Electricity	Power (33kV)	3 Waters	500		500		Distances closer will need to be approved by W.E	Confirmed via email as no specification in New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001)
Wellington Electricity	Power (11kV)	3 Waters	300		300		Distances closer will need to be approved by W.E	Confirmed via email as no specification in New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001)
Wellington Electricity	Power (LV Distribution)	3 Waters	300		300		Distances closer will need to be approved by W.E	Confirmed via email as no specification in New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001)

Appendix B: Chorus Off-set Document

New Property Technical Requirements – General Fibre Network (Volume 1)

Network Deployment Standard

Publication Date: 27 March 2023
Document Number: ND0629 V4.0 (Volume 1)

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Tables List

1. Introduction

1.1.1. Objectives of Manual

The objective of this Manual is to provide the design and deployment standards for developers for new property developments or subdivisions within Chorus' UFB areas and areas with existing Chorus fibre or copper infrastructure. This document is separated into four volumes which covers different topics of the network.

1.1.1.1. Volume 1 – General Fibre Network Guidelines

Topics covered under Volume 1 includes:

The selection criteria for the type of network to be deployed (fibre or copper)

- Overview of the Chorus UFB network
- The lead-in infrastructure from the boundary to the premises
- Infrastructure compliance for separation of utilities
- Overview of installation of the copper network where applicable

Note: Property refurbishment is not covered in this document. Developers or property owners undergoing building refurbishment must contact their respective ISP for fibre cabling from the boundary to the premises.

1.1.1.2. Volume 2 - SDU and ROW Greenfield Development

Topics covered under Volume 2 includes:

- Single Dwelling Unit (SDU) and Rights of Way (ROW) infrastructure deployment
- The pathway from the lead-in External Termination Point (ETP) to the Home Distributor Hub

1.1.1.3. Volume 3 - MDU Fibre In-Building Distribution Network Design and Installation

Topics covered under Volume 3 includes:

- Multi Dwelling Unit (MDU) In-Building Distribution Network design
- MDU fibre network cable and terminal description
- MDU fibre network deployment scope of responsibility

1.1.1.4. Volume 4 - Premises Wiring Minimum Requirement Recommendation

Topics covered under Volume 4 includes:

- The recommended minimum requirement for general premises internal cabling from the Home Distributor Hub to all outlets.

1.1.2. Artefact Constraints

This Process and Procedure is constrained by the Design Rules OR Deployment Standard in the following Chorus internal artefacts. These documents will not be publicly available and only to be referenced by Chorus personnel and their contracted partners.

Document No.	Document Title
ND0545	UFB Network Design Rules
ND0574	UFB MDU Design and Installation
ND0563	NGA Provisioning and Assure Task Handbook
ND0625	UFB Fixed Fibre Aerial Design Guide
ND0635	UFB MDU Cable and Terminals Installation Handbook
ND0588	UFB Premise Boundary Deployment Standards
ND13006	UFB Aerial Road Crossing, RoW and Infill Technical Guide
ND13159	Network Depth and Separations
ND13161	Electric Lines Safety

1.1.3. Intended Audience

The intended audience of this document are Chorus, service companies' personnel, service providers, builders, property developers and their contractors involved with the design and installation of optical fibre networks in new properties or property subdivision. Where developer is listed, this can mean their agents e.g. builder, electrician or anyone acting on their behalf.

1.1.4. Chorus Network Specified Product (CNSP)

CNSP is an assessment and approval pathway for particular types of product and test equipment to ensure that a product meets criteria for:

- Whole of life performance
- Longevity, and
- Durability

Where a product is listed within the CNSP process, Chorus service companies must use that product from the approved supplier.

1.1.5. Contractual Reference

This document may be provided to Chorus partners, service companies, Chorus customers and 3rd party service providers for use alongside the relevant contracts for service or the relevant Standard Terms Determination.

Throughout this document, Chorus New Zealand is referred to as Chorus.

This document does not, in any way, vary the terms of the main contract between Chorus and the service company. If there is any conflict between the relevant contract and statements made in this document, the terms of the relevant contract shall prevail.

This document does not, in any way, vary the terms of the main contract between Chorus and the Service Company, developers or any other parties.

1.2. Related Reference Material

It is the responsibility of the contractor to research, understand and abide by the relevant national or local compliance standard as applicable to the location and tasks. The table below lists the national and international standards that may be associated or referenced within this standard. This list is not exhaustive and is not in place of the Building Code Compliance.

Document No.	Document Title
AS/NZS 1367	Coaxial cable and optical fibre systems or the RF distribution of analogue and digital television and sound signals in single and multiple dwelling installations
AS/NZS 3000	Electrical Installations
AS/NZS 11801.1:2019	Information technology - Generic cabling for customer premises Part 1: General requirements (ISO/IEC 11801-1:2017, MOD)
ANZS3084-2003	Telecommunications Installations standard
AS/NZS 3085	Telecommunications installations - Basic requirements
AS/NZS 3086	Telecommunications installations – Integrated telecommunications cabling systems for small office/home office premises
AS/NZS 3808	Insulating and Sheathing Materials for Electric Cables
AS/NZS 3112	Approval and test specification - Plugs and socket-outlets
AS/NZS ISO / IEC 15018	Information technology - Generic cabling for homes
AS/NZS ISCO / IEC 24702	Telecommunications installations - Generic cabling - Industrial premises
IEEE 802.3 2012	Power over Ethernet
ECP 34	Electrical Code of Practice for Electrical Safe Distances (ECP 34:2001)
	TCF Premises Wiring Guide – tcf.org.nz
ND13148	Chorus As Built Requirements
ND13005	Chorus Service Provider Health & Safety Plan

1.3. Glossary of Terms Used

The following list describes some of the terms used in this document:

Term	Description
ABF	Air Blown Fibre Refers to an installation method where a fibre cable is blown into a microduct
ABFFP	Air Blown Fibre Flexibility Point An enclosure which is installed in an underground pit. The enclosure houses an optical fibre splitter which acts as a flexible fibre network connectivity point.
ABFU	Air Blown Fibre Unit A small bundle of fibre that is installed through a 5/3.5mm microduct by using the air blown method. Chorus deploys a 2-fibre and a 12-fibre ABFU in the fibre network.
ATA	Analog Telephone Adapter A device that connects regular telephones to a broadband network for voice over IP (VoIP) service. The ATA delivers dial-tone, manages the call setup and provides the conversion between voice signals from an analogue telephone and IP packets.
BDD	Buried Distribution System An oval underground pit which provides a storage and connectivity point for microducts or FATs
BUDI I-FFP	Building Distribution Internal Fibre Flexibility Point A wall-mounted enclosure which houses optical fibre splitters which acts as a flexible fibre network connectivity point. Typically used for MDU with up to 48 premises.
CCA	Copper Clad Aluminium A type of sub-standard wire used in Ethernet cable that is NOT recommended by Chorus. Such cable type will not achieve the performance requirements for high speed broadband.
CNSP	Chorus Network Specified Product A list of products which are technically approved by Chorus to ensure network compatibility and reliability.
CO	Central Office An exchange building which houses Chorus transmission equipment
Drop Cable	A 2 fibre (2F) cable installed from the FFP or FAT in the Chorus distribution network. This is typically also referred to as the Service Lead.
Ducting	The green PVC pipe we use to get a route from A to B. It can be called duct, pipe, or conduit. It comes in a range of sizes, most commonly 20mm, 50mm, 100mm or microduct.
ETP	External Termination Point An outdoor enclosure mounted on the side of a premise which provides a point of connectivity from the service lead cable and the premises cable. This unit stops water ingress into the building and allows Chorus access for maintenance.
FAT	Fibre Access Terminal An enclosure which provides breakout access of Chorus' cables to the lead-in cables into premises.
FFP	Fibre Flexibility Point An enclosure which provides a connectivity point between the feeder fibres from the CO to the distribution fibre to premises.
FTTP	Fibre To The Premise Optical fibre network constructed pursuant to the UFB Initiative
GPON	Gigabit Passive Optical Network A type of telecommunications network that uses a point-to-multipoint FTTP which uses unpowered optical splitters to enable a single feeder optical fibre to serve multiple premises.
GPX I-FFP	GPX Internal Fibre Flexibility Point A wall-mounted enclosure which houses optical fibre splitters which acts as a flexible fibre network connectivity point. Typically used for MDU with more than 48 premises.
Hand hole	A small pit that is installed at the premises boundary as the location where the lead-in pipe into the premises is terminated. It is also used as a location to join microducts.
Home Distributor Hub	An in-wall networking cabinet that houses Chorus, ISP and home owner devices for connecting the incoming signal from the broadband provider to the internal network. This is usually where the ONT is installed, and needs to be non-metallic for modem transmission.

Term	Description
IBDN	In Building Distribution Network The optical fibre distribution network within a building premise.
ID	Internal Diameter
I-FFP	Internal Fibre Flexibility Point An FFP which is installed indoors, typically in a TER
IFDB	Internal Fibre Distribution Box, a fibre management access terminal used by Chorus to connect between 2 and 6 customers down a RoW. It is housed in a light green rectangular pillar adjacent to the communal driveway.
Infill	A new property where the address is created after UFB roll-out in the street and requires a new connection e.g. 1 existing lot subdivided into 2.
Internal Cables	All cables installed by the developer from the Home Distributor Hub, Comms Room, or similar, within a premises. These must be Low Smoke Zero Halogen (LSZH) and are not suitable for use outside.
ISAM	Intelligent Services Access Manager A node equipment that provides access services such as DSL and GPON.
ISP	Internet Service Provider Communication companies who use Chorus' optical network to create retail services which are sold to residents, businesses, schools and health premises.
ITP	Internal Termination Point An indoor enclosure installed in the HDH or on a wall which provides a point of connectivity from the service lead fibre to the ONT.
Lead-in Pipe	A dedicated green service lead-in pipe from the premises boundary to the dwelling. Specifically, when a 20mm internal diameter green lead-in pipe is used, it is for a single lead-in to an SDU, not for multiple connection lead-ins.
LFC	Local Fibre Company The operator of the local optical fibre network
LSZH	Low Smoke Zero Halogen A type of plastic used in cable jacketing. This material produces minimal smoke and has low toxicity when exposed to fire, which is suitable for installation inside buildings.
MDCC	Microduct Clamp Closure A type of closure that is used to drop off one or more 1-way ruggedized microduct service lead from a microduct bundle
MDU	Multi Dwelling Unit A building which has two or more premises such as an apartment building. This can be horizontal or vertical and generally has one lead-in which then feeds the various tenancies
Microduct	A small specially manufactured tube that is used for fibre installation through the blowing technique.
Micronet	A Hexatronic System consisting of microducts and cables used by Chorus for the optical fibre distribution network.
NPD	New Property Development also known as Greenfield or subdivision
NZCCPTS	New Zealand Committee for the Co-ordination of Power and Telecommunication Systems
OD	Outer Diameter
OFDF	Optical Fibre Distribution Frame An optical fibre distribution frame installed in the CO to provide connectivity between the Chorus active transmission equipment to the outside network.
OLT	Optical Line Terminal A GPON Access Node installed in Chorus' CO that provides for the delivery of UFB services. The GPON OLT is installed in Chorus exchange buildings
ONT	Optical Network Terminal A GPON network equipment installed in the customer premise that provides for the delivery of UFB services.
PE	Poly Ethylene
RLG	R.L. Grant, a Post Office engineer who designed the telecoms copper distribution network
RGW	Residential Gateway Equipment installed in the premise connected to the ONT which is used to centralise communications.
RoW	Rights of Way

Term	Description
	More than one premises with separate ownership sharing a common access to the public roads.
Ribbonet	A Hexatronic System consisting of microducts and cables used by Chorus for the optical fibre distribution network.
SDU	Single Dwelling Unit A premises which has a single customer connection. This can include a single, or multiple detached or attached dwelling(s)
Service Lead	A Service Lead is a cable that connects from the Chorus distribution network to the ETP/ITP.
TER	Telecoms Equipment Room (also known as Comms Room / Utilities Room) A location in an MDU where the lead-in cable terminates into an I-FFP and where the IBDN converges.
TV	Television
UFB	Ultra-Fast Broadband FTTP broadband service providing high speed internet connectivity.
UPS	Uninterrupted Power Supply Battery pack which provides backup power supply to keep critical devices powered in the event of a power outage.
UTP	Unshielded Twisted Pair A type of twisted pair copper cabling used for carrying transmission signals
VOD	Video On Demand Video service where the end user is able to order videos on demand.
VoIP	Voice Over IP A methodology for the delivery of voice communication over IP network such as the internet.

2. General Information for Chorus Network Installation

2.1. Chorus Network Overview

The Chorus network can be based on a pit and pipe system, a microduct system or a combination of both. The material to be installed can be a combination of the following:

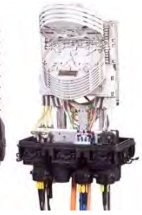
- Chorus branded Green PVC ducting (20mm 50mm and 100mm internal diameters)
- Microducts of various sizes for air blown optical fibre cables and ABFU
- Aluminium joint pits with one, two or four lids
- Plastic joint pits, Channell manufactured
- Hand holes for service lead connections (usually sited on alternate boundaries with the power service box or pits

  NOTE: see Section 6 for copper cable installations

The material used for the Chorus network must be approved under the Chorus Network Specified Product (CNSP) to ensure compliance, compatibility and performance. The table below shows some of the network components.

<table>
<tr><th>Network Element</th><th>Description</th><th>Example Photos</th></tr>
<tr><td>Green ducting</td><td>Green 20mm, 50mm and 100mm <u>internal</u> diameter pipes used in the Chorus network for external use only
Note: The green ducting used must be a Chorus Network Specified Product supplied by Chorus and/or Chorus' approved distributors/manufacturers
<table>
<tr><th rowspan="2">Pipe Type</th><th colspan="2">Nominal Sizes (mm)</th></tr>
<tr><th>OD</th><th>ID</th></tr>
<tr><td>100mm Green pipe</td><td>110.2</td><td>103.0</td></tr>
<tr><td>50mm Green pipe</td><td>60.3</td><td>55.1</td></tr>
<tr><td>20mm Green pipe</td><td>26.7</td><td>22.5</td></tr>
</table></td><td></td></tr>
<tr><td>Microducts</td><td>Microducts with green Chorus marked outer sheath. Microducts consists of a bundle of tubes that are used for blowing optical fibre cable and ABFU through to premises.</td><td></td></tr>
<tr><td>Plastic pit</td><td>Plastic pits that are manufactured by Channell. Pits come in three different sizes which are:

Bulk 2 – L559mm x W324mm x D476mm
Used as in-line cable hauling point or as distribution pits in ROWs with 4 or more premises.
Bulk 3 – L762 x W432 x D609mm
Used as turning pit and for FFP or FAT installation
Bulk 4 – L914 x W609 x D609mm
In situations where a larger than Bulk 3 is required
Note: This is a Class B pit and is only suitable for installation in footpaths and is not roadway rated.</td><td></td></tr>
<tr><td>Hand holes</td><td>Access pits usually installed at premises boundaries for service lead connections.
Note: This MUST NOT be installed in a location where vehicular traffic is expected.</td><td> </td></tr>
</table>

Network Element	Description	Example Photos
Mini Marker Post	Mini marker post to be installed at the premises boundary to indicate the location of service leads buried underground. Note: Only to be installed in soft surfaces for premises with pre-built fibre	
Large Marker Post	Large marker post to be installed at the premises boundary to indicate the location of service leads buried underground. Note: Only to be installed in soft surfaces for premises without pre-built fibre	
Internal Fibre Flexibility Point (I-FFP)	Wall-mounted termination box or cabinet that is usually installed in a comms room in a medium to large Multi Dwelling Unit (MDU). The I-FFP acts as the central point where the optical fibre lead-in cable and distribution cables are terminated.	
Fibre Access Terminal (FAT)	A FAT functions as a distribution point to branch off optical fibres from distribution cables to multiple drop cables to separate premises. For outdoor installation, the FAT can be installed underground in a pit, in a pedestal, wall-mounted or on a pole. Specific FATs are used in different install scenarios. For indoor installation, the FAT is installed as wall-mounted box usually in the comms room or in risers.	   
External Termination Pont (ETP)	A termination box that is usually wall-mounted on the external wall. It functions as a termination point to connect an external lead-in cable to the internal cabling.	
Composite Cable	A 6mm diameter composite two fibre and a four pair Cat5e cable.	
Internal 2F Flat White Cable	A two-fibre cable that is installed internally to connect the ETP or FAT to the ONT.	
Optical Network Terminal (ONT)	A wall-mounted equipment at the end of the Chorus network where the optical fibre is terminated. This is usually installed in the home distributor hub or in the lounge by the TV location. This unit is modem capable and needs to be installed in a non-metal box. This equipment needs to be powered by a 230V AC power source.	

Network Element	Description	Example Photos
Residential Gateway (RGW)	Depending on the Internet Service Provider (ISP), an RGW is provided to be connected to the Chorus ONT to provide broadband service and Wi-Fi.	
Internal Termination Point (ITP)	An indoor enclosure installed in the Home Distributor Hub or on a wall which provides a point of connectivity from the service lead fibre to the ONT.	

Table 1. Examples of Chorus Network Components

2.2. Minimum Cover for Buried Network

The following rules apply to all new installations and maintenance of ducts, microducts for both fibre optic and copper cables where those cables or ducts are to be installed below ground level.

2.2.1. Minimum Cover

The minimum ground cover for all new Chorus network (ducts, microducts and cables) is:

Situation – Network Plant outside of private property	Minimum Cover
Existing ducts	450mm
All buried plant alongside non kerbed roads (i.e. where there is a possibility of road reforming or grading of the road edge)	600mm
All buried plant in stable well-formed suburban areas when the lay is between the kerb and the boundary	450mm
All buried plant in suburban roadways	600mm
All buried plant in state highways	1000mm

Table 2. Minimum Cover Network Plant

Statutory compliance must be sought and confirmed at time of design Situation: Chorus Lead-in and Customer Service Lead on private property	Minimum Cover
20mm green Lead-in pipe and direct buried copper service lead	450mm
20mm green lead-in pipe and direct buried copper cable under permanent material such as concrete driveway	200mm
Duct other than 20mm green lead-in pipe	450mm
Microduct assemblies other than ruggedised single way	450mm
Ruggedised single way Microduct	Preferably 450mm No less than 200mm
Ruggedised Fixed Fibre service lead	

Table 3. Minimum Cover Lead-in and Service Lead (on private property)

2.2.2. Maximum Cover

Maximum cover for Chorus plant that requires physical access is 1.5m.

Work in any pit, shaft, trench or other excavation in which any person is required to work in a space more than 1.5m deep and having a depth greater than the horizontal width at the top is notifiable hazardous work under regulation 24 of the Health and Safety in Employment Regulations 1995.

2.3. Chorus Network Installation Inside the Development

A Chorus representative will supervise the installation of our network, as required. Any instruction given by that representative, either in the first instance or to correct a problem, must be followed.

Chorus prefers the telecoms service point to utilise the same trench as power services, however it is dependent on the final positions that will be confirmed in the final design specification. For more information on the telecoms service point, please refer to Volumes 2 & 3.

Road reserve: The installation will involve laying of the Chorus network in the main trench in the road reserve area and lateral ducting to Chorus pit positions near the section boundary line. Wherever possible, the telecommunication ducting needs to be laid furthest from the boundary in the road to be vested to the Council.

2.4. Chorus Network Installation Outside the Development

When a trench is to be provided (typically open cut) by the developers contractor on Council or Waka Kotahi NZTA land, the appropriate written permission from the Council or Waka Kotahi NZTA via a CAR (Corridor Access Request) must be obtained by the developers contractor prior to the commencement of any works. Chorus network must not be installed prior to this permission being viewed by the Chorus Service Company Representative.

Developers will not carry out simple single isolated road thrusts for Chorus network in rural situations - this work will be carried out by the Chorus Service Company.

Traffic Management Plans must be submitted by the developers contractor and approved by the Local Roading Authority before any Chorus network is installed.

The developer′s contractor is responsible to ensure that all other existing services (including Chorus′) are located prior to excavation. The cost of repair to any service will be the responsibility of the developer or their sub-contractor. To arrange location of existing Chorus services phone 0800 248 344 or see the website https://www.chorus.co.nz/our-network/before-you-dig

3. General Infrastructure Compliance

3.1. Overview

It is very important that telecommunications infrastructure is sufficiently protected and maintains a minimum separation from other utilities such as power, gas, water, storm water and sewage.

This is to ensure the health & safety of the installer and Chorus network, as well as prevent accidental damage to any other utility infrastructure.

This is based on the New Zealand Committee for the Co-ordination of Power and Telecommunication Systems (NZCCPTS) Cable Separation Guide.

3.2. Power Network Clearance

A guideline on the minimum separation between the Chorus network and a power network is as outlined. Refer to the NZCCPTS Cable Separation Guide for more details.

Power Cable Voltage	Power Cable Type	With Mechanical Protection Installed	Minimum Separation
Low voltage – Exceeding 50v AC or 120v ripple free DC but not exceeding 1000v AC or 1500v DC	Neutral screened or armoured	No	150mm crossing 300mm parallel
		Yes	50mm
	Other than neutral screened or armoured	No	450mm
		Yes	50mm Crossing 450mm parallel
High voltage – Any voltage exceeding 1000v AC or 1500v DC	Single core or Multi core	No	450mm
		Yes	150mm crossing 450mm parallel (2.4km maximum parallel length)

Table 4. Clearances between Power and Telecommunication

Mechanical protection is generally installed to give protection to the power cable from any future digging activity. Examples of such mechanical protection are concrete slabs, PE mag slabs or ground contact treated timber. Refer to the AS/NZS 3000 standard for more information.

- Concrete slab: Minimum 50mm thickness
- Ground contact treated timber: Minimum 25mm thickness
- Tough plastic slab minimum dimension: 10mm thick x 150mm wide x 750mm long

3.2.1. Cable Crossing Separation

Following are diagrams showing cable separation between the different utilities to the ground level. Some examples of special protection are timber or mag slabs.

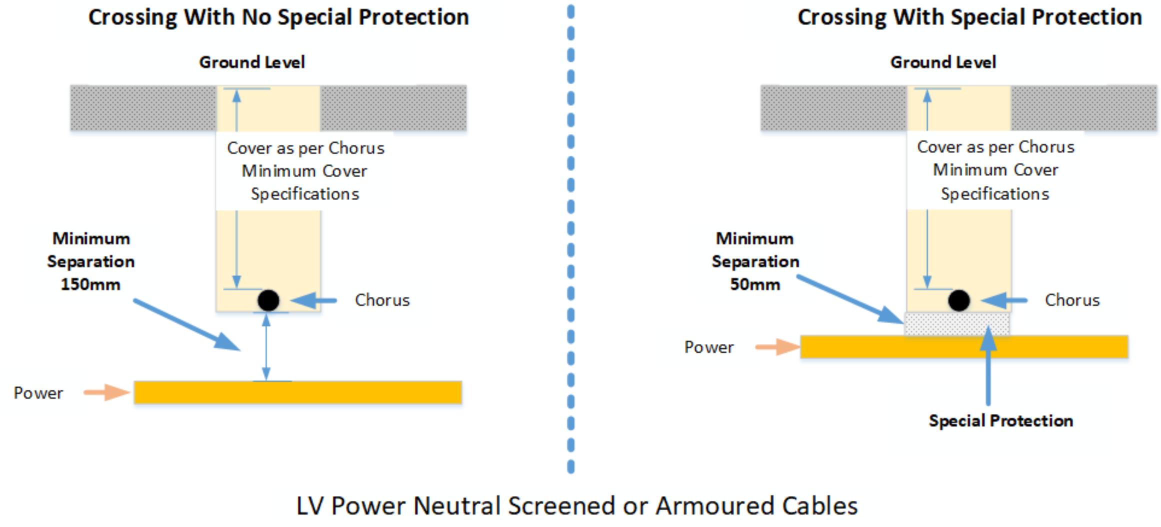


Figure 1. Crossing Separation – LV Neutral Screened or Armoured

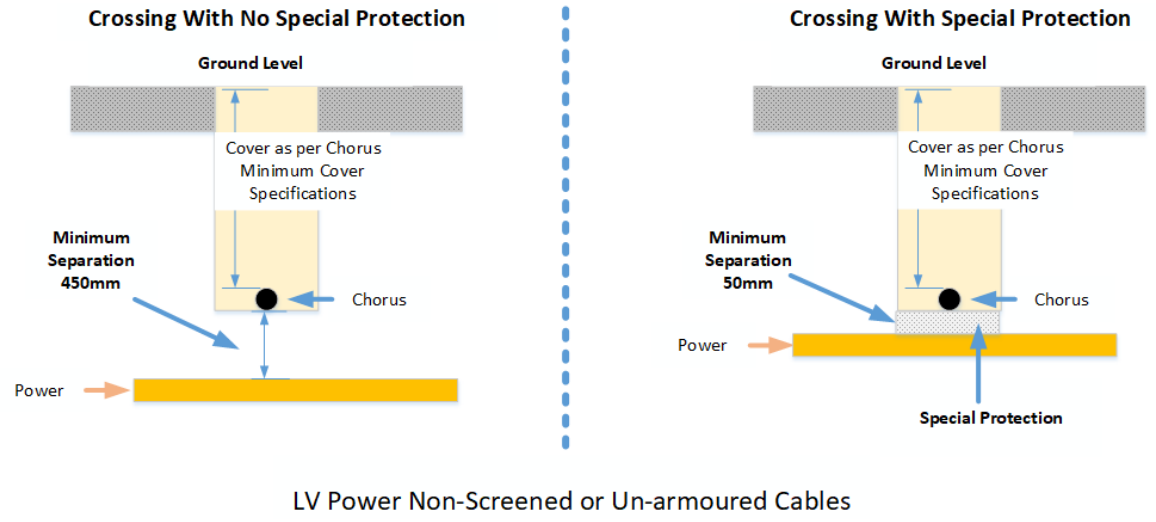


Figure 2. Crossing Separation – LV Non-Screened or Un-Armoured

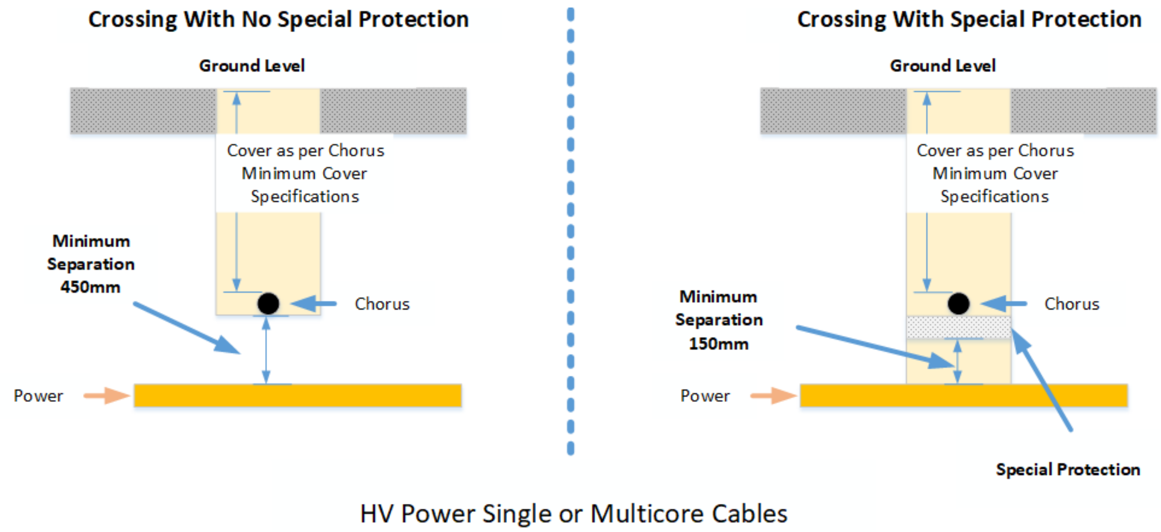


Figure 3. Crossing Separation – HV Single or Multicore

3.2.2. Cable Parallel Separation

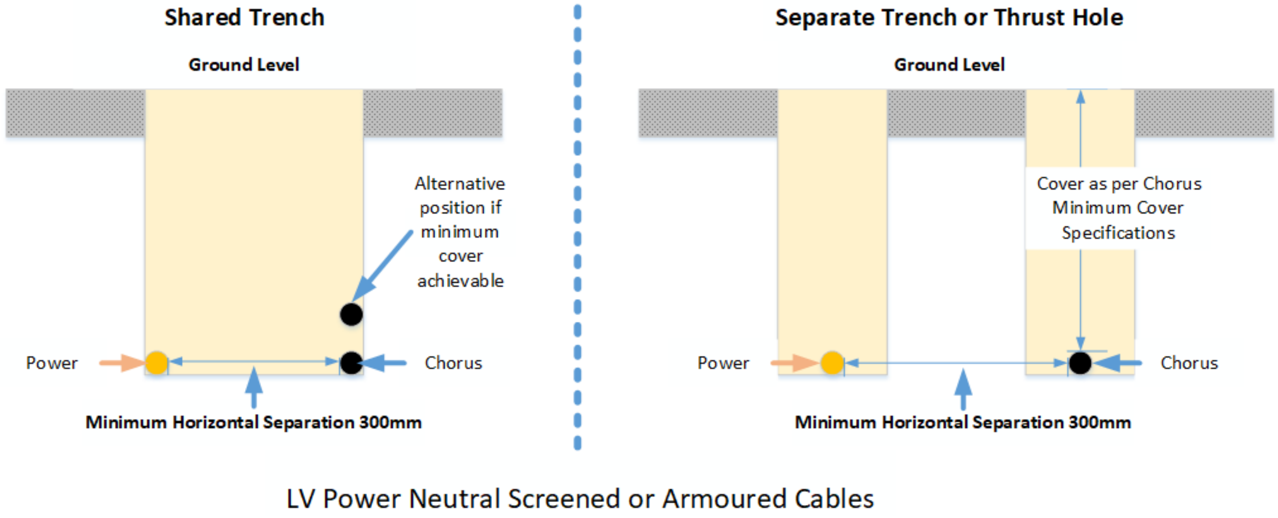


Figure 4. Parallel Separation – LV Neutral Screened or Armoured

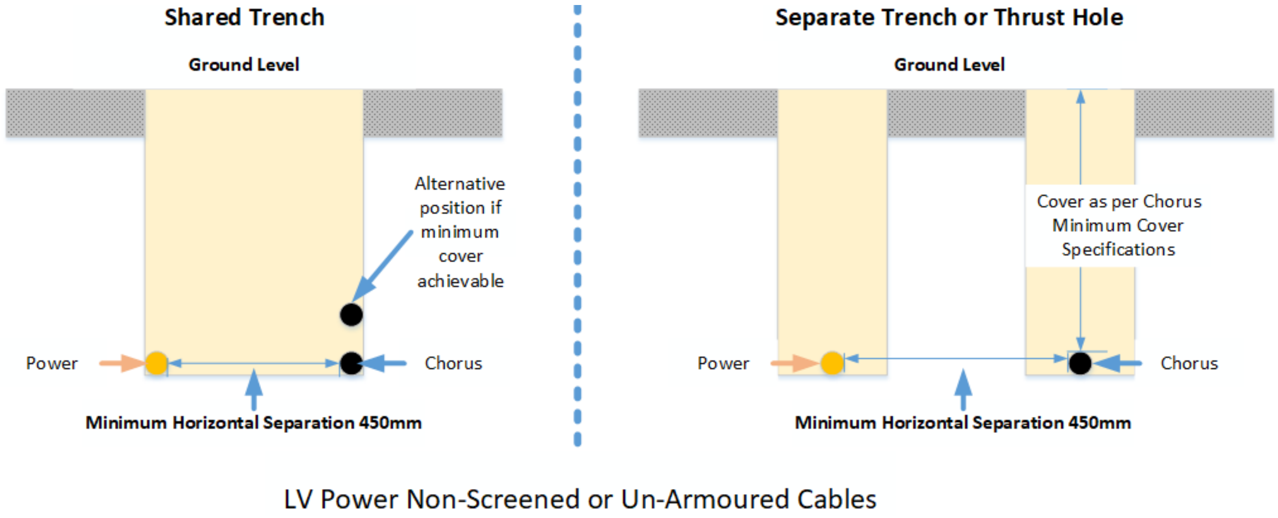


Figure 5. Parallel Separation – LV Non-Screened or Un-Armoured

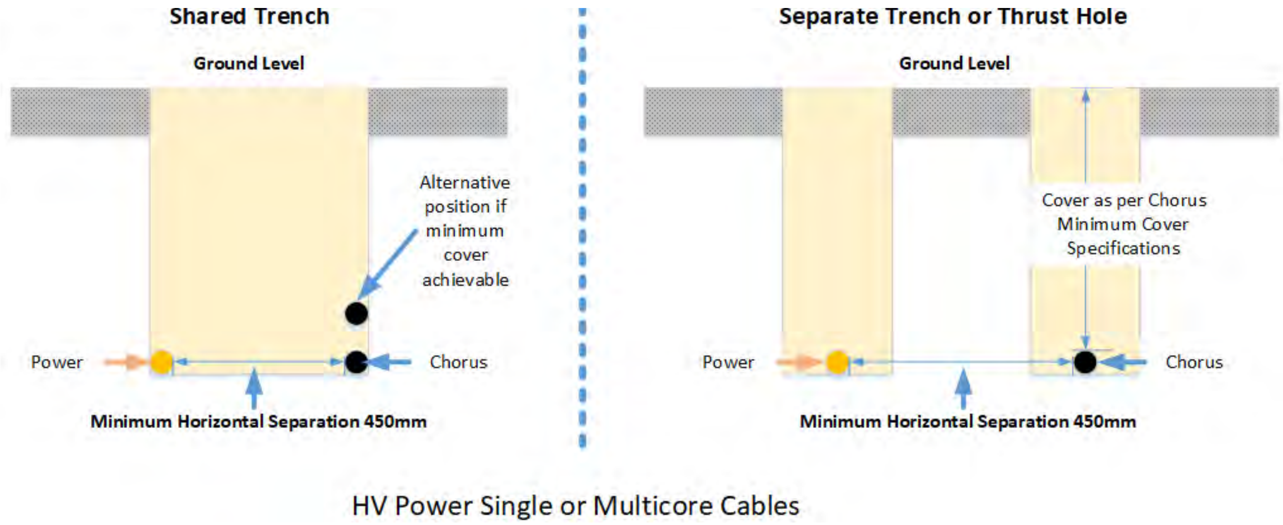


Figure 6. Parallel Separation – HV Single or Multicore Cable

3.3. Gas Network Clearance

3.3.1. Natural Gas Pressures

Description of operating pressures:

Operating pressures	Pipeline pressures
Low pressure	Up to 7 kPa
Medium pressure	Greater than 7 kpa but not exceeding 420 kPa.
Intermediate pressure	Greater than 420 kPa but not exceeding 2000 kPa.
High pressure	Systems operating above 2000 kPa.

Table 5. Natural Gas Pipeline Operating Pressures

3.3.2. Separations

Separations from pipelines operating at pressures.

Operating Pressure	Situation	Minimum Separation
Low pressure	Crossing	150mm
Low pressure	Parallel	150mm
Medium pressure	Crossing	150mm
Medium pressure	Parallel	150mm
Intermediate pressure	Crossing	300mm
Intermediate pressure	Parallel	450mm minimum (measured horizontally) Horizontal separation is required in the case of parallel cable to guard against damage which could occur in the event of a blowout in the gas pipe.
High pressure	Crossing	600mm minimum (greater if specified by the Pipe Line Inspector.
High pressure	Parallel	Not permitted within the easement

Table 6. Gas Separations

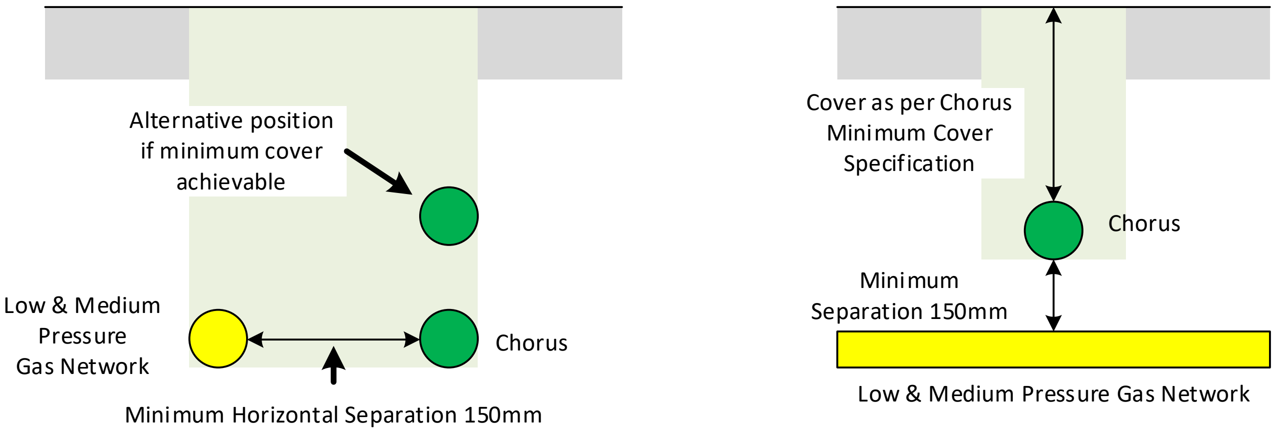


Figure 7. Parallel & Crossing Separation – Low & Medium Pressure Gas Pipe

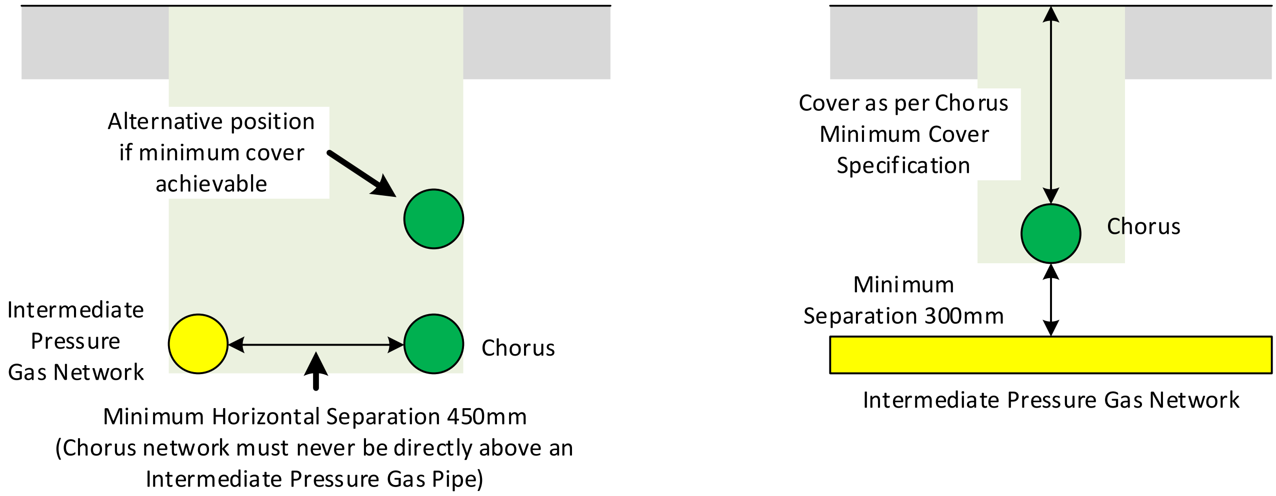


Figure 8. Parallel & Crossing Separation – Intermediate Pressure Gas Pipe

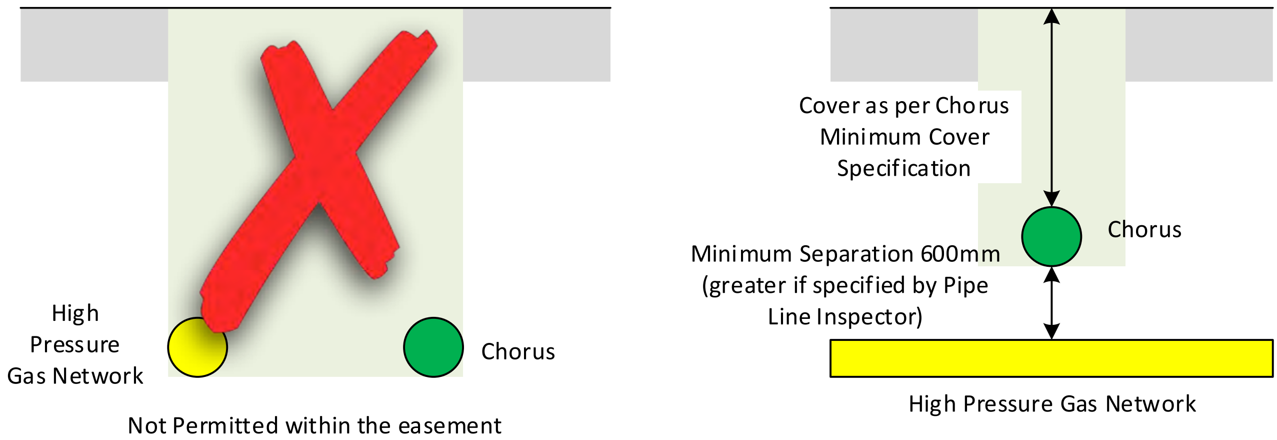


Figure 9. Parallel & Crossing Separation – High Pressure Gas Pipe

3.4. Other Services Clearance

There are no fixed clearance standards for other services, but in general a clearance of 300mm should be observed between Chorus network and water mains, storm water drains or sewer lines.

4. Communal Infrastructure

4.1. Civil Works

All Chorus cables, ducting, manholes and turning pits are to be installed at the correct level relative to the finished ground level. Pits that house FFP closures are installed by Chorus service companies.

The Chorus service company will provide all cables, ducting, manholes and turning pits including internal shutters. The manholes are to be installed in the locations as per the lay plan.

All cables and ducting are to be installed as per the supplied design plans after manholes and turning pits have been installed. Duct penetration into manholes and turning pit must be flush in concrete manholes and protrude by 50mm in Aluminium or plastic pits. All clearances from power and gas are to be maintained as per this document. Clearance from any other services is to be 300mm.

Trenches will need to be extended to the boundary locations from the main communal network for service lateral connections.

For a pit & pipe network 20mm or 50mm ducting can be teed off from a main pipe or pit to a Channell hand hole on the boundary located beside the power service box.

For a microduct network, lead-in microduct is tapped off from the main microduct to a Channell hand hole on the boundary located beside the power service box.

For copper cable installation, see Section 6.

Chorus network should not be installed until:

- berm levels have reached their final levels;
- kerb-lines and footpaths (where applicable) are in place (ducting may be placed under footpaths to facilitate the installation of service laterals at a later stage);
- boundary positions are accurately marked (final pegs do not necessarily have to be in place, but their final position must be accurately known);
- the installation of any other underground services, that may affect our network, has been completed.

4.2. Microduct Installation

Microducts are flexible, lightweight, durable and easy to handle tubes. They have a low friction inner surface that enables optical fibre cables to be blown into them on a stream of air. To facilitate installation microducts are supplied in multi-duct bundles where several microducts are bound together in an outer sheath.

In greenfield deployments, the direct buried type microduct is usually used where it can be installed similar to conventional PVC pipe. The common microduct bundle has a 26-way configuration that has 26x 5/3.5mm tubes and 1x 12/10mm tube. Care must be taking during installation to prevent any kinking of the microduct as it will impede the blowing of optical fibre through to the premises. Microduct must be installed with direction arrow on sheath pointing away from the FFP and towards the customer premises.

Drop off from the microduct bundle to each premises is done by using a microduct clamp closure where a ruggedized microduct is joint and installed into a hand hole at the boundary. All microduct jointing and lateral drop off to the hand hole at the premises boundary is to be done by Chorus. Developer to provide access to microduct and supply all required trenching between microduct and boundary. Access points must be kept open for microduct jointing and testing.

- All ends of ducting must be protected with multi-duct end cap (SRS 1016 17+) whilst on the drum.
- All ends of ducting must be protected with a heatshrink end cap during installation and after installation.
- Ensure that adequate length is left at each joint location.
- Ensure that minimum bend radius and maximum hauling tension requirements are met when installing the ducting.

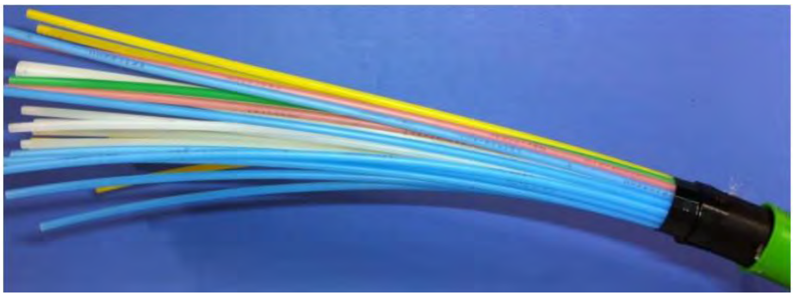


Figure 10. Direct Buried Microduct

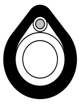
Microduct Type	Outer Sheath Diameter (mm)	Weight (g/m)	Minimum Bending Radius (mm)	Max Pulling Force (N)
 26-way DB Microduct	40.0	770	380	2400
 1-way Ruggedized Microduct	7.3 – 8.6	100	100	300

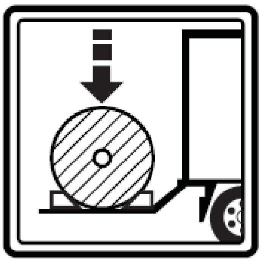
Table 7. Microduct Specification

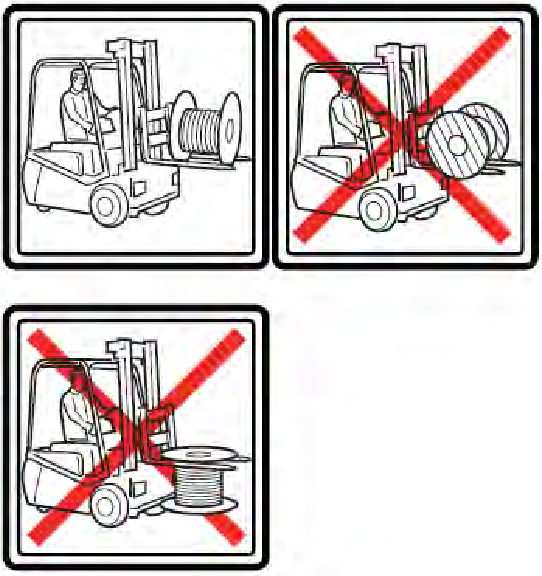
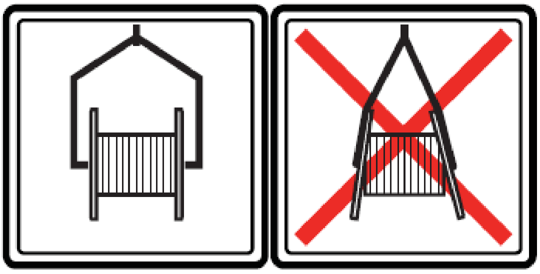
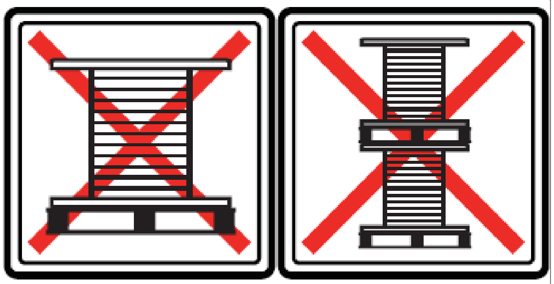
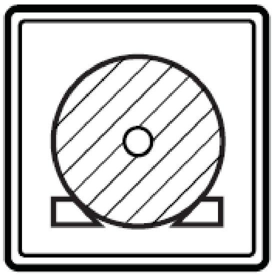
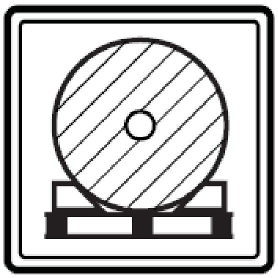
4.2.1. Handling of Drums

Fibre cable and multi-duct drums must be handled with care. Improper drum handling may cause damage to the cable or the duct. Cable or multi-duct drums must be transported on a jinker or suitable A-frame, capable of supporting the drum size and weight of up to 1000kg's.

Note: The multi-ducts may be supplied in wooden drums or steel drums. With steel drums, they may move around more when it is on a forklift or truck decks. Ensure that the drums are secured by using chocking blocks or straps.

The rules around handling drums are described below.

When loading or unloading drums use a forklift or lift the drum through the centre hole	
Never try to roll the drum off a truck, a ramp or similar	

When using a forklift, the fork is only allowed to lift the drum from the flange side. Make sure that the fork grips both flanges of the drum, and that the fork never touches the duct or cable. Otherwise, the fork may damage the duct or cable.	
When lifting with a crane through the centre hole, make sure the lifting wires are kept with a distance using a rod or an axle spreader to avoid lateral pressure on the flanges.	
Never place the drum on the side. Always keep it standing upright.	
Make sure that the drum is secured both when stored and during transportation. Especially on site, this is extremely important, due to liability issues, if the drum rolls away.	
When storing the drum outside, make sure that the ground is firm and well drained.	

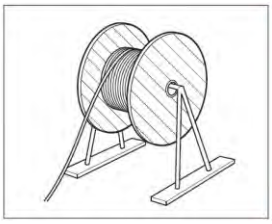
Do not store the drum in direct sunlight, and do not expose it for extreme temperatures. Store under cover in an upright position. Leave enough room between the drums to facilitate removing (at least 600mm)	
Always roll the drum in the direction of the arrow indicated on the drum. This will make sure that the duct or cable do not uncoil during the transportation.	
When rolling the duct or the cable off a drum, always roll it from the top side of the drum.	 
Always use a drum stand or jinker. Do not lift the drum up on one side and coil the duct off the drum, this will cause the duct to be twisted and undulate in the trench or conduit. A twisted duct will cause problems when blowing a cable.	

Table 8. Drum Handling

4.2.2. Microduct Installation Reference Guide

There is a difference in the installation direction of the microduct product. Care must be taken to ensure that installers are aware of the differences in the direction of installation.

Note: The rules shown below are mandatory and must be adhered to

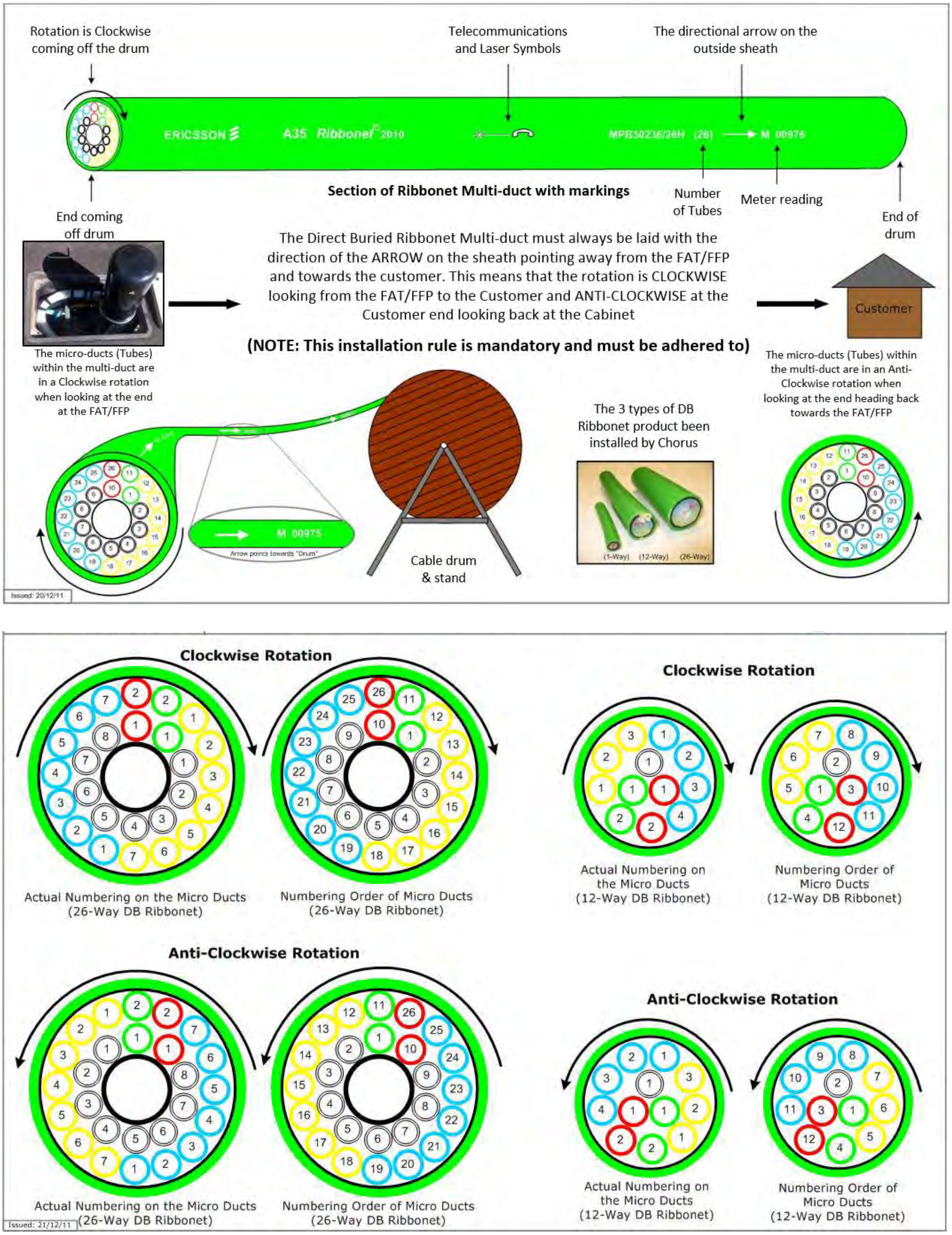


Figure 11. Microduct Installation Reference Guide

4.3. Duct 'T' Installation

100mm or 50mm duct that will have the Duct 'T' installed must always be on the property boundary side of any other Chorus ducting in the same trench to allow easy access to install a Duct 'T' and to ensure the Duct 'T' is installed onto the correct duct in the correct direction from the FFP/FAT to customer premises.

Duct 'T' installation must be installed to a very high standard using PVC glue and cable ties. The Duct 'T' must be installed correctly so no air escapes during the blowing in of fibre cables by the Chorus service companies.

There is a protruding locating knob on the inside of the duct 'T'. It is important to drill a small hole in the duct for this to sit in to ensure that the duct 'T' will seal and not twist when the PVC glue is setting in.

No trenches are to be back filled until the Duct 'T' are installed. The reason for this is to ensure that the Duct 'T' installation is on the correct duct when there are multiple ducts in the trench.

Figure 12. **Duct 'T'**

4.4. Road-Crossings

In cases where the network design requires road-crossings, and where the roads will be formed before the service trenches are opened, Chorus will provide 100mm PVC ducts to be installed at the road-crossing points before the roads are formed to allow the cables to be pulled through later. These road-crossing points will be indicated in the final design specification provided by the Chorus service company representative.

4.5. Hand Hole at Boundary

The Channell hand hole is 305mm deep and 362mm in diameter at the bottom. The installation of the hand hole in hard surfaces must follow the following rules.

Note: In some instances, a heavy duty hand hole may be required

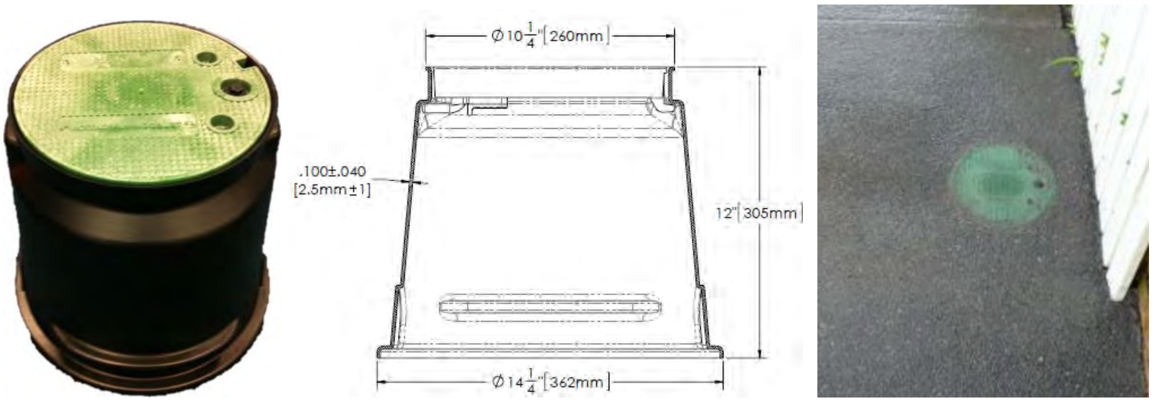
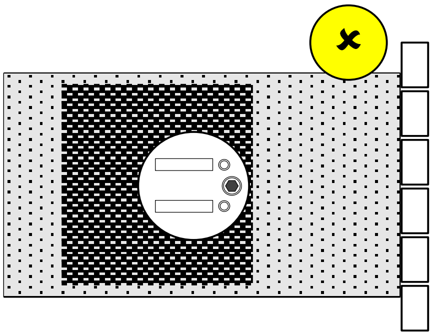
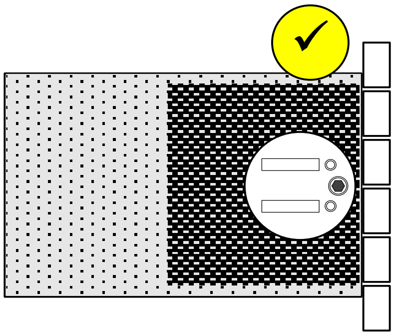


Figure 13. Channell Hand hole

1. Whenever possible, the hand hole shall be installed as close as possible to the customer boundary such that it is easily accessible from the customer side during provisioning.

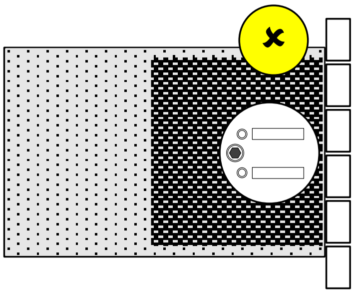


Too far from customer boundary

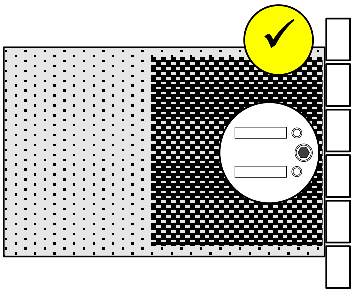


Close to customer boundary

2. The orientation of the top cover shall have the lock facing the boundary. This is to ensure the lid lifting hole is on the boundary side to prevent it from being a trip hazard.

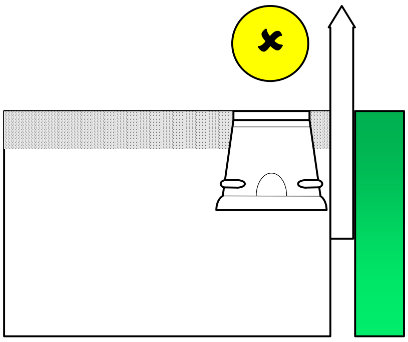


Wrong HEX lock orientation

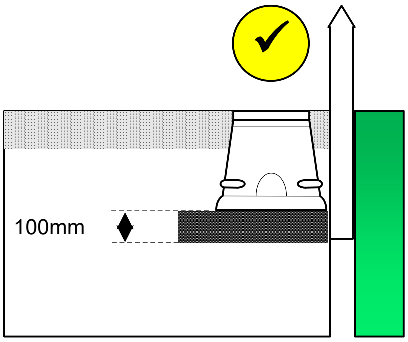


HEX lock facing customer boundary

3. There must be a min of 100mm compacted gravel below the Hand Hole.

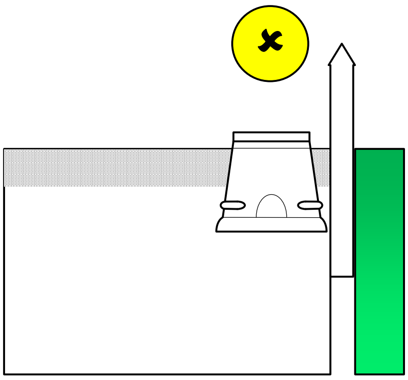


No gravel below pit

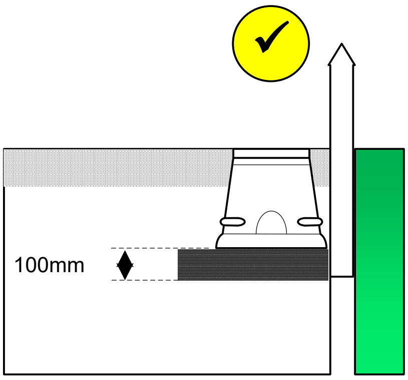


100mm Compacted Gravel below pit

4. The top cover of the pit shall be level with the reinstated ground.



Pit above ground level



Pit is at the same level as ground

4.6. Marker Post at Boundary

The Mini Marker Post and Large Marker Posts are installed into a soft surface at the customer boundary to indicate the location of service leads buried underground. At the boundary, microducts allocated to premises are labelled, capped and heat shrunk. These microducts are brought up above ground level and secured to the marker post by using cable ties.

Mini Marker Post

Deployed if Pre-Built Fibre (PBF) is agreed for the greenfields development. The Mini Marker Post is 500mm long and is to be buried at a 300mm depth with 200mm above ground. It has slots at the top and bottom to enable microducts to be secured by using cable ties.

Large Marker Post

Deployed if there is no PBF agreed for the greenfields development. The Large Marker Post is 1.4m long and is to be buried at a 400mm depth with 1m above ground. Holes are to be drilled into the Large Marker Post to enable microducts to be secured by using cable ties.

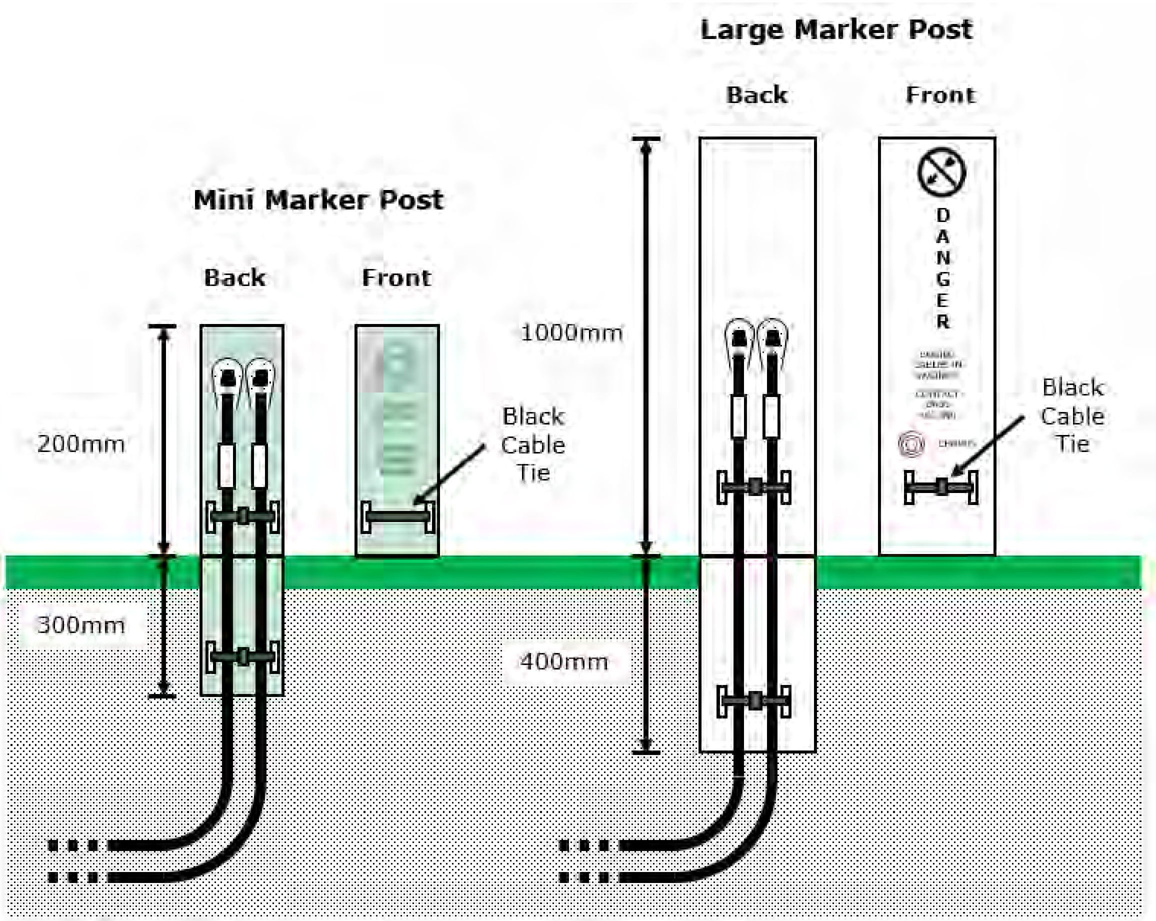


Figure 14. Marker Post at Boundary

4.7. Service Layout Examples

4.7.1. Typical Air Blown Microduct Boundary Layout

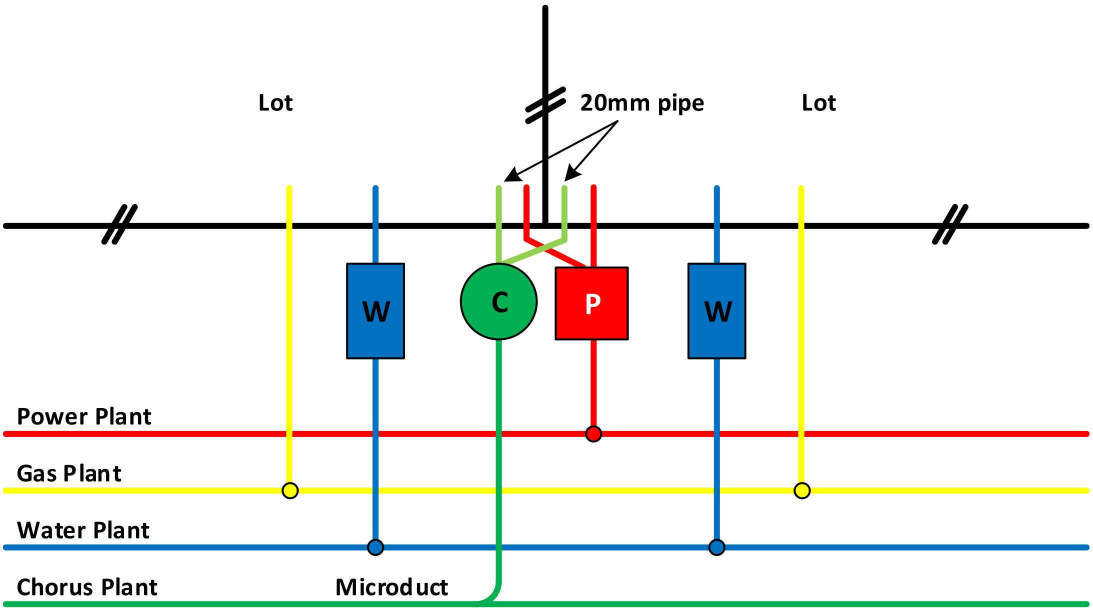


Figure 15. Typical Air Blown Microduct Boundary Layout

4.7.2. Typical Pit & Pipe Boundary Layout

The diagram below shows a typical pit & pipe boundary layout. Depending on the type of building, the boundary hand hole and the service lead-in pipe/duct size may differ.

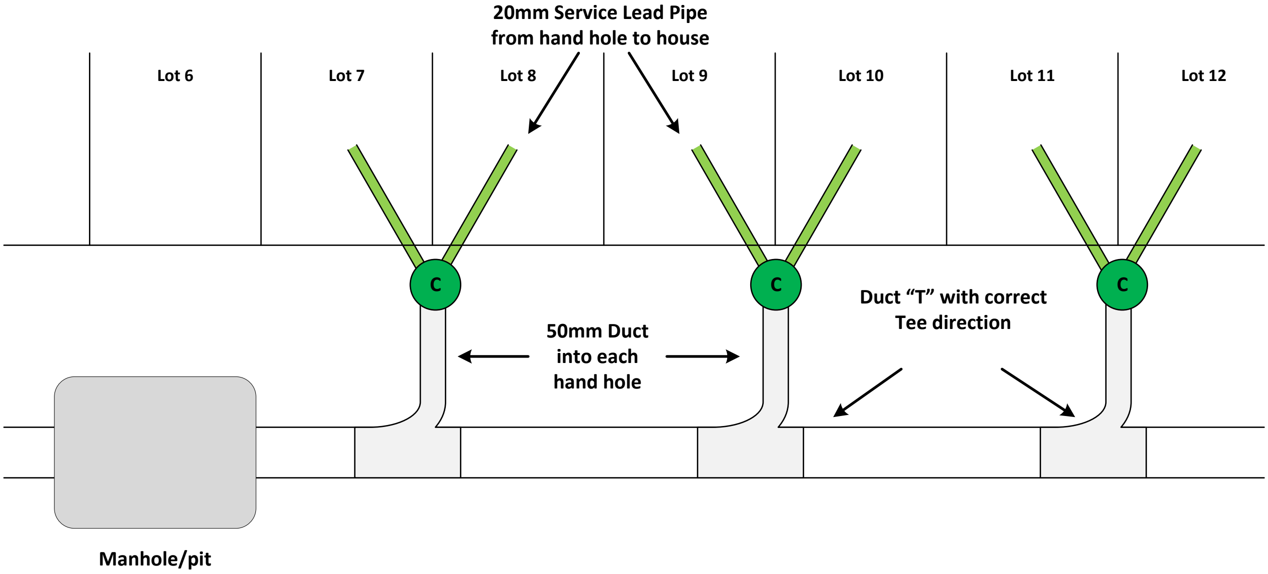


Figure 16. Typical Pit and Pipe Boundary Layout

4.7.3. Typical Copper Only Network Boundary Layout

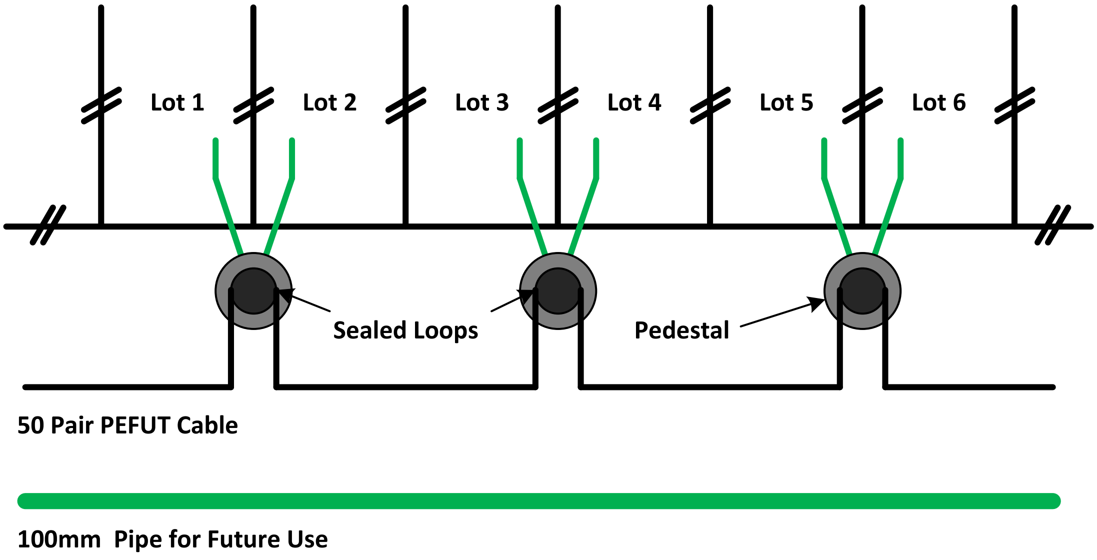


Figure 17. Typical Copper Only Network Boundary Layout

4.7.4. Service Lead Pipe Installation

A 20mm green lead-in pipe is to be installed from the pit or pedestal to the side of the house where the ETP is to be mounted. If there is no dwelling at time of subdivision communal network build, then a 20mm pipe is installed from the handhole, pit or pedestal to 600mm inside the property with 500mm showing above ground.

The 20mm green lead-in pipe must be installed below the finished ground level as outlined in document ND0629 Volume 2.

5. Chorus Communal Fibre Distribution Network

5.1. Overview

Chorus is actively building New Zealand's UFB fibre future by deploying optical fibre in the communal network.

In line with the UFB initiative, Chorus is producing this design guideline for property developers to ensure new properties, subdivisions and renovations are completed in such a way to ensure fibre readiness for connection to the Chorus UFB network.

There are three types of Communal Distribution Networks which are the:

- Microduct system using air blown technology
- A pit & pipe system using conventional fibre cable
- An aerial distribution cable.

Chorus typically deploys an underground air blown microduct system in new greenfield development areas, however, in locations such as in a CBD area where there is a higher possibility for network change, a pit & pipe system is the preferred network type.

5.1.1. Services Through UFB

There is a myriad of services that can potentially be provided through the UFB network. The most common services are High Speed Internet Service, VoIP Telephone Service, Broadcast TV, Video on Demand (VOD) and others. All these services can be provided through a port out of an ONT or an RGW, depending on the Internet Service Provider selling the service.

In order to future proof for the provision of these multiple services, optical fibre must be installed into the home distributor hub where the ONT is to be placed. This is important because there are 4x Ethernet ports and 1x ATA ports on the (current) ONT and different services may be provided through separate ports which can be connected to the Cat6 cabling throughout the premise.

5.2. Chorus UFB Network

The Chorus fibre network is based on a GPON deployment with a centralised passive splitting architecture. The diagram below shows the typical Chorus communal network design.

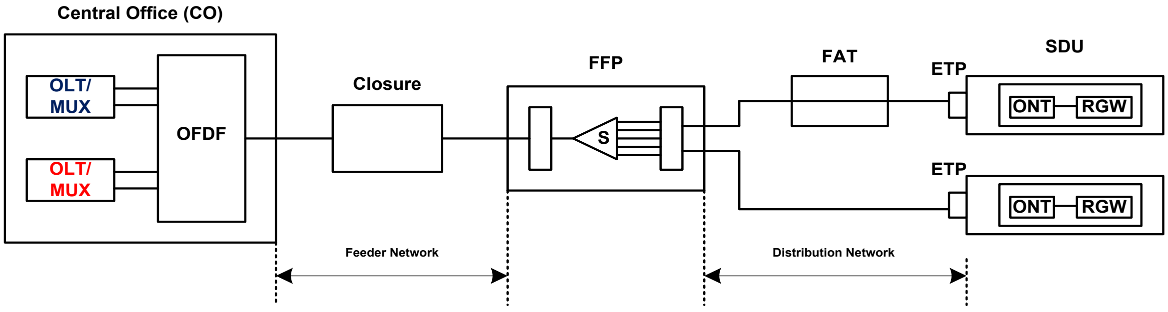


Figure 18. Typical Chorus UFB Network for SDU

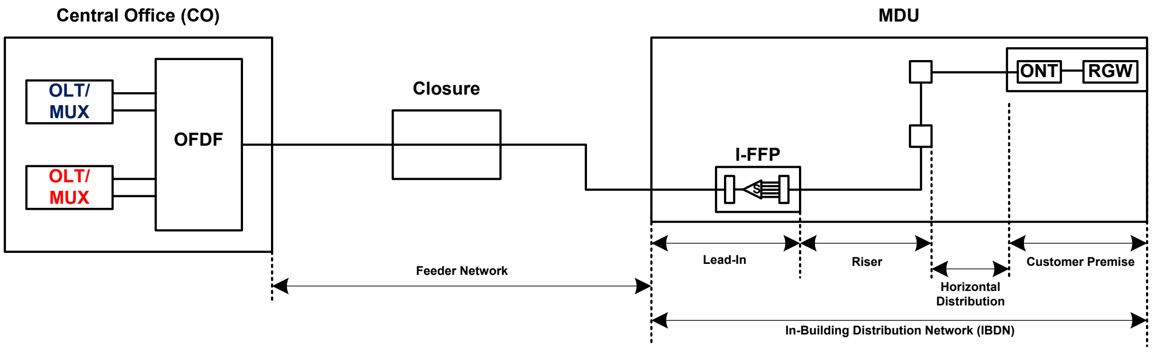


Figure 19. Typical Chorus UFB Network for MDU

6. Chorus Communal Copper Distribution Network

6.1. Overview

In areas that are not covered under the Chorus UFB network or within an area that cannot be connected to a Chorus fibre network, copper distribution will be installed to the development area. If the network is a copper only network, it will be based on the Sealed Loop RLG architecture as outlined in this section.

6.2. Chorus Sealed Loop RLG Architecture

The Chorus Sealed Loop RLG architecture uses a direct buried copper cable, with the cable looped through pillars/pedestals located on the boundaries (to coincide with power boundary box positions where possible). In a standard system, a 50 pair cable will be laid to serve 30 premises.

6.2.1. Cable Installation

Refer to Sections 3 and 5 for the trench and civils works requirements.

A pillar/pedestal will normally be situated adjacent to the premises boundary. The pillar/pedestal is to be installed at the finished ground level at the required boundary

The cable is to be looped at each pillar/pedestal such that there is 1m to 1.2m of cable above the ground to form a loop <u>without kinking the cable</u>.

A 20mm green lead-in pipe is to be installed from the pillar/pedestal to the side of the house where the ETP is to be mounted. If there is no building at time of build, then a 20mm green lead-in pipe is installed from the pillar/pedestals to 600mm inside the lots with 500mm showing above ground. All buried pipe must have the joints glued.

Cable on drums must be transported on a cable jinker or suitable A-frame, capable of supporting the drum size and weight of up to 1,000kgs.

6.2.2. Pipe Installation

On occasion a 50mm or 100mm lead-in pipe may be laid instead of direct buried cable.

For road crossings, please refer to Section 4.

6.2.3. Pipe for Future Use

In addition to the installation of the cable, a 50mm or 100mm pipe may also be installed with the cable along the road reserve trenches, in designated subdivision areas – this is for feeding future stages where applicable, or used to convert to fibre in the future.

Where these pipes terminate underground, they must be sealed with an endcap.

Any pipe, on completion of installation, may be subject to a pull-through test.

6.2.4. Jointing Cable

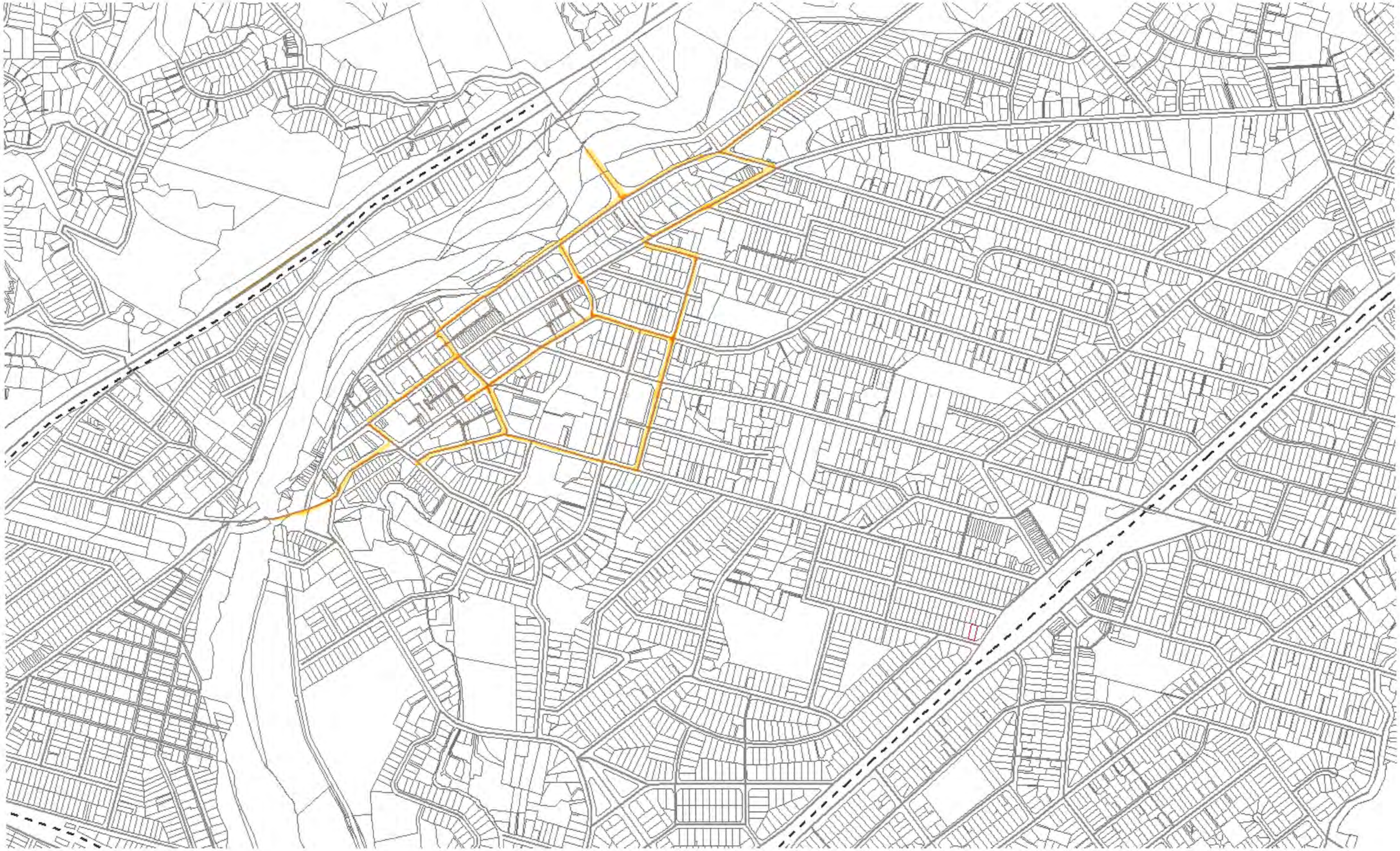
Cable joint positions are to be kept open until jointing is completed.

Consultation between the Chorus service company representative and the developer will be required to ensure that the cable jointing is completed prior to the completion of footpaths and berms.

Appendix C: One NZ

C1 Location of One NZ critical metro fibre rings

C2 One NZ Excavation Matrix



Risk Assessment Matrix for Excavations

Activity	Network Service	Location	Risk of Damage	Mitigation
Excavating > 1.0m from a network service	Ducts	Daylighted	low	not required
	Ducts	Buried detectable	low	not required
	Ducts	Buried non-detectable	low	not required
	Cables	Daylighted	low	not required
	Cables	Buried detectable	low	not required
	Cables	Buried non-detectable	low	not required
Excavating between 0.3 amd 1.0m of a network service	Ducts	Daylighted	low	not required
	Ducts	Buried detectable	medium	Standover
	Ducts	Buried non-detectable	high	Standover risk mitigation
	Cables	Daylighted	High	Standover risk mitigation
	Cables	Buried detectable	High	Standover risk mitigation
	Cables	Buried non-detectable	high	Standover risk mitigation
Excavating within 0.3m of a network service	Ducts	Daylighted	high	Standover risk
	Ducts	Buried detectable	high	Standover risk mitigation
	Ducts	Buried non-detectable	high	Standover risk mitigation
	Cables	Daylighted	high	Standover risk mitigation
	Cables	Buried detectable	high	Standover risk mitigation
	Cables	Buried non-detectable	high	Standover risk mitigation

Appendix D Wellington Electricity Construction Constraints

NZECP 34:2001 ISSN 0114-0663

NEW ZEALAND ELECTRICAL

CODE OF PRACTICE

for

ELECTRICAL SAFE DISTANCES

NZECP 34:2001

NEW ZEALAND ELECTRICAL CODE OF PRACTICE

for

ELECTRICAL SAFE DISTANCES

Issued by:
Manager, Standards and Safety,
Ministry of Consumer Affairs,
Wellington, New Zealand

THE ELECTRICITY ACT 1992

Approval of the New Zealand Electrical Code for Practice for Electrical Safe Distances 2001 *(NZECP 34:2001)* and the revocation of the New Zealand Electrical Code of Practice for Electrical Safety Distances 1993 *(NZECP 34:1993)*

Pursuant to section 38 of the Electricity Act 1992, I hereby revoke the New Zealand Electrical Code of Practice for Electrical Safety Distances 1993 *(NZECP 34:1993)* and approve the New Zealand Electrical Code of Practice for Electrical Safe Distances 2001 *(NZECP 34:2001)*.

The New Zealand Electrical Code of Practice for Electrical Safe Distances 2001 *(NZECP 34:2001* was published by the Manager, Standards and Safety, Ministry of Consumer Affairs, acting under delegated authority *(pursuant to section 41 of the State Sector Act 1988)* from the Chief Executive, Ministry of Economic Development on the 3rd day of August 2001.

Dated this 21st day of December 2001.

[redacted]

Minister of Energy

COMMITTEE REPRESENTATION

This Code of Practice was prepared by the Ministry of Consumer Affairs, in consultation with the following:

The Building Industry Authority
Transpower New Zealand Ltd
Electricity Engineers' Association of NZ (Inc)
Institution of Professional Engineers NZ
Tranz Rail Ltd
Telecom NZ Ltd
Telstra Saturn

REVIEW

This Code of Practice will be revised as occasions arise. Suggestions for improvements of this Code are welcome. They should be sent to the Manager, Standards and Safety, Ministry of Consumer Affairs, PO Box 1473, Wellington.

CONTENTS

TABLES

FIGURES

INTRODUCTION

This Electrical Code of Practice (Code) sets minimum safe electrical distance requirements for overhead electric line installations and other works associated with the supply of electricity from generating stations to end users.

The minimum safe distances have been set primarily to protect persons, property, vehicles and mobile plant from harm or damage from electrical hazards. The minimum distances are also a guide for the design of electrical works within substations, generating stations or similar areas where electrical equipment and fittings have to be operated and maintained.

The Code has been designed to include, in its various sections, requirements that were previously contained in the Electricity Regulations 1997 (the Regulations). Compliance with this Code is mandatory.

- **Section 1** is a general section, including this Code's scope, interpretation and glossary.
- **Sections 2** and **3** cover the safe distance requirements for building works and excavation near overhead electric line support structures. It also covers the construction of buildings and other structures near conductors and the installation of conductors near existing buildings and similar structures.
- **Section 4** covers the requirements for maintaining safe distances between conductors and the ground and water, including restrictions on material being deposited under or near conductors.
- **Section 5** covers the responsibilities of parties who work or operate mobile plant near overhead electric lines and other electrical works.
- **Sections 6 – 8** cover the requirements for safe design and installation of overhead electric and telecommunications systems and other electrical works and controls on access to conductors.
- **Section 9** covers minimum safe approach distance requirements for persons working near exposed live parts.
- **Section 10** covers the responsibilities of owners of electricity supply works for inspection and maintaining records.

SECTION 1
SCOPE, INTERPRETATION, GLOSSARY AND GENERAL

1.1. SCOPE

1.1.1 This Code covers safety issues, in so far as they relate to safe distances to overhead electric lines, telecommunication lines, line equipment and fittings, and personnel working on or near to such lines equipment.

1.1.2 This Code sets out minimum requirements in respect of the following matters:

(a) Excavations or construction near overhead electric line supports;

(b) Limits for construction near conductors;

(c) Limits for the installation of conductors near existing buildings and similar structures;

(d) The separation and height of conductors above ground etc;

(e) The separation of overhead telecommunications lines and conductors;

(f) Overhead electric line access, supports and stays;

(g) Limits on material deposited or placed under or near an overhead electric line;

(h) Operation of mobile plant near conductors;

(i) Safe distances for the design of substations, switchyards and switchboards;

(j) Minimum approach distances to exposed live parts; and

(k) Inspection and records.

1.1.3 The content of this Code does not exempt any person from compliance with any statutory requirements in respect of the matters in clause 1.1.2.

1.1.4 This Code does not apply to:

(a) Distance limits for large loads (e. g. buildings and over-dimension loads) travelling down roads.

(b) Optical fibre ground wire or optical fibre cables that are contained in or wrapped around any conductor.

(c) Hazards from trees.

1.2. INTERPRETATION

The Electricity Act 1992 and the Electricity Regulations 1997 contain definitions that are to be used in conjunction with this Code. These include: associated equipment; direct contact; electrically safe; exposed conductive part; fittings; high voltage; indirect contact; insulated; live or alive; live part; low voltage, and works.

In this Code, unless the context otherwise requires:

1.2.1 **Bare conductor** - means a conductor without covering or not insulated.

1.2.2 **Competent employee** – means an employee who can demonstrate to their employer, at any time, that they have the necessary knowledge, skills and experience to carry out electrical or telecommunications work in the vicinity of overhead electric lines, or exposed live metal, safely and to the standards used by the employer.

1.2.3 **Conductor** – means a wire, cable or form of metal designed for carrying electric current but does not include the wire of an electric fence.

1.2.4 **Distance** (for conductors) - unless otherwise specified, means the distance under the worst case combination of maximum sag, load current, solar radiation, climatic conditions, etc, and in which the conductor creep process is complete (in the case of a line crossing another line, the worst case is that which results in the minimum spacing between the two lines).

1.2.5 **Mobile plant -** means cranes, elevating work platforms, tip trucks or similar plant, irrigation booms, any equipment fitted with a jib or boom and any device capable of being raised and lowered.

1.2.6 **Overhead electric line** – means conductors and support structures.

1.2.7 **Telecommunication line -** means any overhead wire or wires or conductors of any kind (including a fibre optic cable) used or intended to be used for the transmission or reception of signs, signals, impulses, writing, sounds or intelligence of any nature by means of any electromagnetic system. It includes any pole, insulator, casing, fixture, or other equipment used or intended to be used for supporting, enclosing, surrounding, or protecting any such wire or conductor; and also includes any part of a line.

1.2.8 **Traction systems -** means any overhead conductor or fitting for any train, locomotive, tram, trolley bus or electric overhead travelling crane.

1.3. GLOSSARY OF ABBREVIATIONS USED IN THIS CODE

a.c.	Alternating current
d.c.	Direct current
LV	Low voltage
kV	Kilovolts
m	Metres
mm	Millimetres
V	Volts

SECTION 2
MINIMUM SAFE DISTANCES FOR EXCAVATION AND CONSTRUCTION NEAR OVERHEAD ELECTRIC LINE SUPPORTS

2.1 GENERAL

2.1.1 This section outlines the requirements for building or excavation near overhead electric line support structures (towers, poles and stay wires). The minimum safe distances are designed to limit the chance of damage or hazards being created by the building or excavation. The minimum distances also ensure that the support structures can be accessed for inspection and maintenance.

2.1.2 Excavations and other works near overhead electric line supports can compromise the structural integrity of the overhead electric line.

2.1.3 Metallic or conducting paths near overhead electric line supports can transfer voltage potentials that could create step and touch currents during earth fault conditions.

2.1.4 Any consent and associated conditions given under this section shall be reasonable, and shall not be unreasonably withheld.

2.2 EXCAVATION NEAR OVERHEAD ELECTRIC LINE SUPPORTS

2.2.1 Subject to clause 2.2.2, prior written consent of the pole owner shall be obtained for any excavation or other interference with the land near any pole or stay wire of an overhead electric line where the work:

(a) is at a greater depth than 300mm within 2.2 m of the pole or stay wire of the line; or

(b) is at a greater depth than 750 mm between 2.2 m and 5 m of the pole or stay wire; or

(c) creates an unstable batter.

2.2.2 Clause 2.2.1 does not apply to vertical holes, not exceeding 500 mm diameter, beyond 1.5 m from a pole or stay wire.

2.2.3 Prior written consent of the tower owner shall be obtained for any excavation or other interference with the land near any tower supporting an overhead electric line where the work:

(a) is at a greater depth than 300 mm within 6 m of the outer edge of the visible foundation of the tower; or

(b) is at a greater depth than 3 m between 6 m and 12 m of the outer edge of the visible foundation of the tower; or

(c) creates an unstable batter.

2.2.4 Nothing in clauses 2.2.1 - 2.2.3 applies in respect of normal agricultural cultivation or the repair, sealing, or resealing of the existing surface of any road, footpath, or driveway.

2.2.5 Figures 1 and 2 provide a quick reference to the minimum safe distances for excavation near overhead electric line supports.

2.3 INSTALLATION OF CONDUCTIVE FENCES NEAR OVERHEAD ELECTRIC LINE SUPPORTS

2.3.1 Fences of conductive materials shall not be attached to any tower or conductive pole of a high voltage overhead electric line.

2.3.2 Fences of conductive materials should not be constructed within 2.2 m of any tower or conductive pole of a high voltage overhead electric line between 1 kV - 50 kV.

2.3.3 Except with the prior written consent of the overhead electric line owner, fences of conductive materials shall not be constructed within 5 m of any tower or conductive pole of a high voltage overhead electric line of 66 kV or greater. As part of the consent, the overhead electric line owner may prescribe the design of any such fence to be constructed within this 5 m distance.

2.3.4 Where the construction of an overhead electric line would cause a contravention of the principles of clause 2.3.3, the line owner shall, at the line owner's cost, carry out an engineering study and undertake such remedial work as is necessary to maintain electrical safety.

2.3.5 Figures 1 and 2 provide a quick reference to the minimum safe distances for installation/ construction of conductive fences near overhead electric line supports.

2.4 CONSTRUCTION OF BUILDINGS AND SIMILAR STRUCTURES NEAR OVERHEAD ELECTRIC LINE SUPPORTS

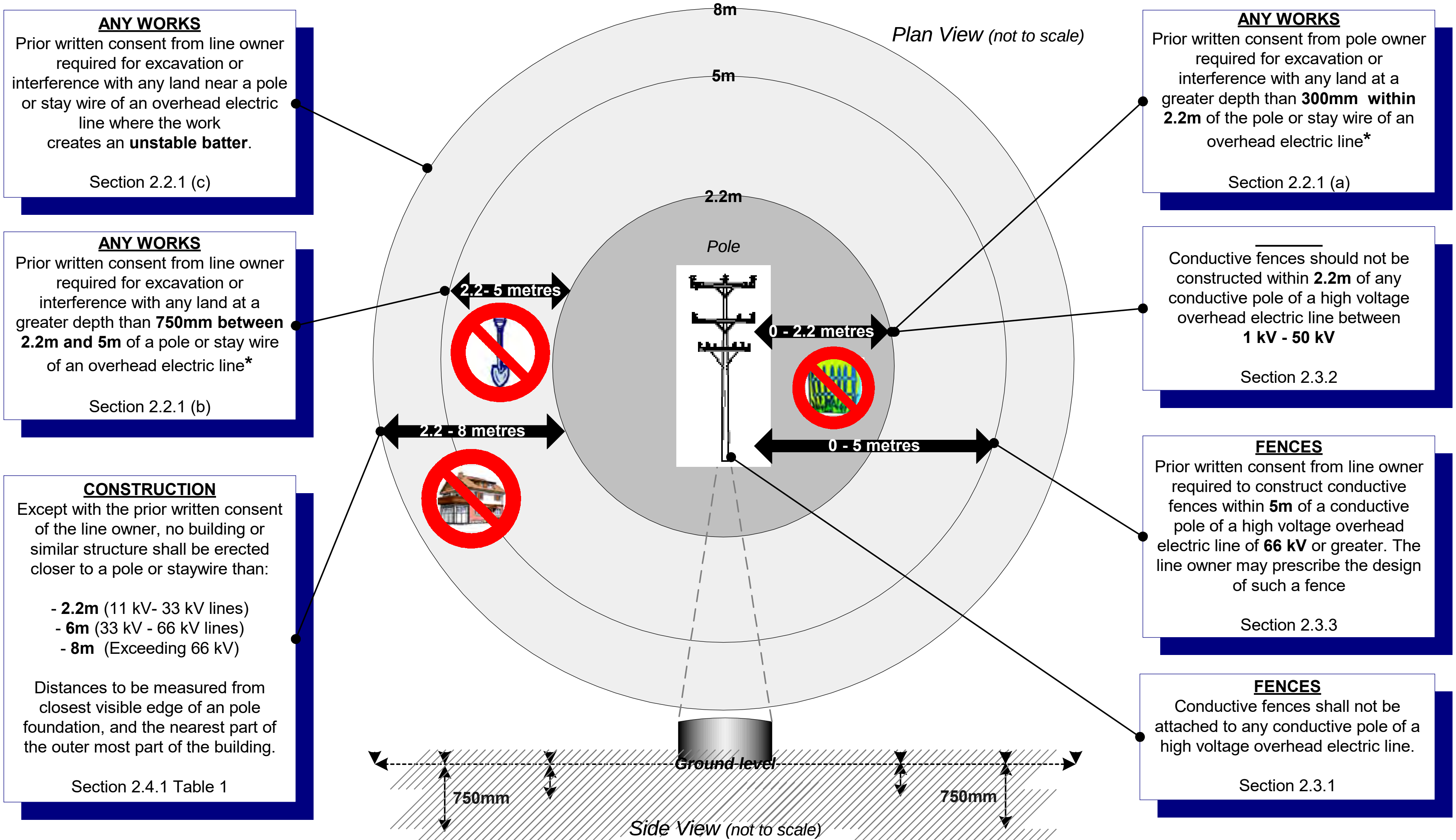
2.4.1 Except with the prior written consent of the overhead electric line owner, no building or similar structure shall be erected closer to a high voltage overhead electric line support structure than the distances specified in Table 1. The distances in Table 1 are to be measured from the closest visible edge of the overhead electric line support foundation, and the nearest part of the outermost part of the building. Refer to section 3 of this code for minimum safe distances between buildings (and other structures) and conductors.

TABLE 1 MINIMUM SAFE DISTANCES BETWEEN BUILDINGS AND OVERHEAD ELECTRIC LINE SUPPORT STRUCTURES

Circuit Voltage	Pole	Tower (pylon)
11 kV to 33 kV	2 m	6 m
Exceeding 33 kV to 66 kV	6 m	9 m
Exceeding 66 kV	8 m	12 m

2.4.2 Figures 1 and 2 provide a quick reference to the minimum safe distance requirements for the construction of buildings and other structures near overhead electric line supports.

FIGURE 1 MINIMUM SAFE DISTANCES FOR EXCAVATION AND CONSTRUCTION NEAR POLES OR STAY WIRES



Notes

- **This diagram is for quick reference only. Please refer to Section 2 for the complete safe distance requirements.**
- Nothing in clauses 2.2.1 - 2.2.3 applies in respect of normal agricultural cultivation or the repair, sealing, or resealing of the existing surface of any road, footpath, or driveway (Section 2.2.4).

* Clause 2.2.1 does not apply to vertical holes, not exceeding 500 mm diameter, beyond 1.5m from the pole or stay wire.

FIGURE 2 MINIMUM SAFE DISTANCES FOR EXCAVATION AND CONSTRUCTION NEAR TOWERS

ANY WORKS
Prior written consent from tower owner required for excavation or interference with any land near any tower supporting an overhead electric line where the work is at a greater depth than **300mm** within **6m** of the outer edge of the visible foundation of the tower

Section 2.2.3(a)

ANY WORKS
Prior written consent of the tower owner required for any excavation or other interference with the land near any tower supporting an overhead electric line where the work is at a greater depth than **3m**, between **6 - 12m** of the outer edge of the visible foundation of the tower

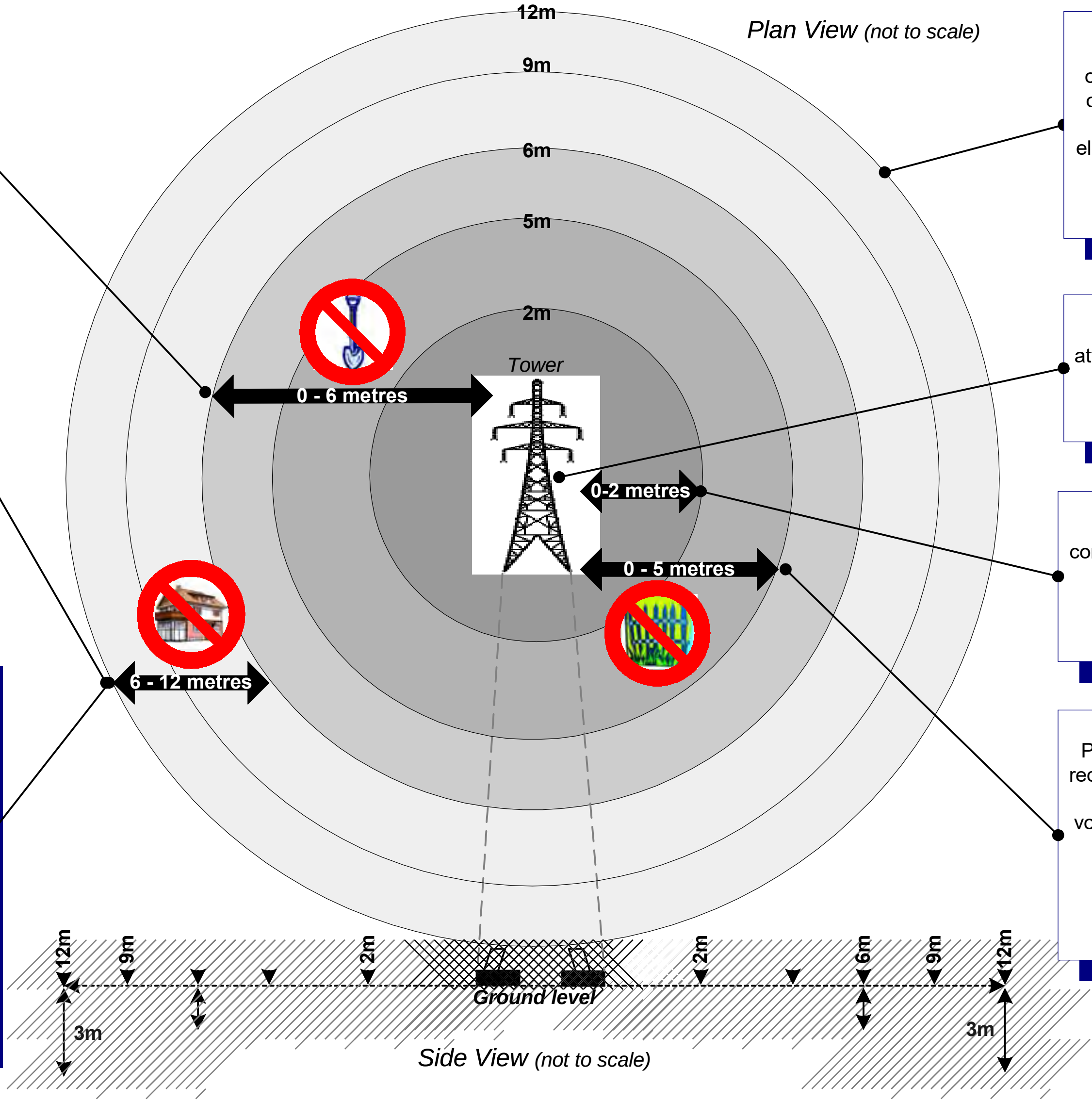
Section 2.2.3(b)

CONSTRUCTION
Except with the prior written consent of the line owner, no building or similar structure shall be erected closer to a tower of an overhead electric line than:

- **6m** (11 - 33 kV lines)
- **9m** (33 - 66 kV lines)
- **12m** (Exceeding 66 kV)

Distances to be measured from the closest visible edge of a tower, and the nearest part of the outermost part of the building

Section 2.4.1 Table 1



ANY WORKS
Prior written consent of the tower owner required for any excavation or other interference with the land near any tower supporting an overhead electric line where the work creates an **unstable batter**

Section 2.2.3(c)

FENCES
Conductive fences shall not be attached to any tower of a high voltage overhead electric line

Section 2.3.1

FENCES
Conductive fences should not be constructed within **2m** of any tower of a high voltage overhead electric line between **1 kV - 66 kV**

Section 2.3.2

FENCES
Prior written consent from line owner required to construct conductive fences within **5m** of any tower of a high voltage overhead electric line of **66 kV or greater.**
The line owner may prescribe the design of such a fence

Section 2.3.3

- **This diagram is for quick reference only. Please refer to Section 2 for the complete safe distance requirements.**
- Nothing in clauses 2.2.1 - 2.2.3 applies in respect of normal agricultural cultivation or the repair, sealing, or resealing of the existing surface of any road, footpath, or driveway (Section 2.2.4).

SECTION 3
SAFE DISTANCE REQUIREMENTS BETWEEN CONDUCTORS AND BUILDINGS (AND OTHER STRUCTURES)

3.1 GENERAL

3.1.1 This section sets safe distance requirements for the construction of buildings and other structures near existing conductors, to prevent inadvertent contact with or close approach to conductors. At higher voltages, contact may be made via a power discharge across the gap.

3.1.2 This section also sets safe distance requirements for the location and construction of conductors near existing buildings and other structures.

3.1.3 The construction of buildings, scaffolding and other structures shall be in accordance with the Building Code.

3.1.4 This section does not apply to telecommunications lines.

3.2 PROCESS FOR ESTABLISHING SAFE DISTANCES

3.2.1 Prior to any planned construction, the following process must be undertaken to comply with the Code. The landowner/ building owner shall:

3.2.1.1 Establish, if necessary with the assistance of the overhead electric line owner, whether the proposed building/structure is at a greater distance from the conductor than the recommended distances for new buildings from conductors under normal conditions specified in Table 2.

3.2.1.2 If the proposed building/structure is at a greater distance, then no further action is required by the building owner to comply with this section of the Code with regard to conductor distances.

3.2.1.3 If the proposed building/structure does not (or may not) comply with the requirements of Table 2, then the overhead electric line owner shall be consulted. A specific engineering study must be carried out by a competent person, to establish actual distances in accordance with the requirements of Table 3 (refer section 3.3). Table 3 sets out the minimum safe distances (which are closer than those specified in Table 2) under worst case conditions.

3.2.1.4 Based on the outcome of the engineering study, which shall be provided by the landowner/building owner, the overhead electric line owner will advise whether:-

(i) the proposed building/structure complies with Table 3 and construction can proceed without restriction; or

(ii) temporary arrangements during building construction need to be made, with the written agreement of the overhead electric line owner, to restrain conductor movement or to provide suitable insulation that will allow closer approach to conductors than those specified in Table 2. As part of the written agreement, the overhead electric line owner may prescribe reasonable conditions for the temporary arrangements; or

(iii) the proposed building/structure does not comply with Table 3 requirements, and therefore construction is prohibited.

3.2.2 For any overhead electric line owner planning to build a new conductor near to an existing building, a similar process to that set out in clause 3.2.1 must be followed, the costs of any necessary engineering study being borne by the line owner.

3.3 SAFE DISTANCES FROM CONDUCTORS WITHOUT ENGINEERING ADVICE

3.3.1 Table 2 sets out the safe distances from conductors under normal conditions without engineering advice for conductor spans up to 375 m with supporting structures at equal elevation.

TABLE 2 SAFE DISTANCES FROM CONDUCTORS WITHOUT ENGINEERING ADVICE

Circuit voltage	Maximum span length (m)	Minimum distance beneath conductors under normal conditions (m)	Minimum distance to the side of conductors under normal conditions (m)
Not exceeding 1 kV	50	4	3.5
Exceeding 1 kV but not exceeding 11kV	80	5.5	5
Exceeding 11 kV but not exceeding 33 kV	125	7	8.5
Exceeding 33 kV but not exceeding 110 kV	125	7.5	9.5
Exceeding 110 kV but not exceeding 220 kV	125	8.5	11
275 kV d.c. & 350 kV d.c.	125	8.5	7.5
Not exceeding 33 kV	250	8	12
Exceeding 33 kV but not exceeding 110 kV	250	8.5	12.5
Exceeding 110 kV but not exceeding 220 kV	250	10	14
275 kV d.c. & 350 kV d.c.	250	10	11
Not exceeding 33 kV	375	9.5	20.5
Exceeding 33 kV but not exceeding 110 kV	375	10	21
Exceeding 110 kV but not exceeding 220 kV	375	11	22.5
275 kV d.c. & 350 kV d.c.	375	10.5	18
For all other spans		Engineering advice required	

(voltages are a.c. except where specified as d.c.)

NOTES

(a) Observance of potential conductor motion is required to ensure safe distances during construction.

(b) Where supporting structures are not located on equal elevations, a specific engineering study may be required to ensure distances are in accordance with Table 3.

3.4 MINIMUM SAFE DISTANCES OF CONDUCTORS FROM BUILDINGS AND OTHER STRUCTURES WITH SPECIFIC ENGINEERING ADVICE

3.4.1 Table 3 sets out the minimum safe distance of distances for conductors from buildings and other structures where a detailed engineering assessment has been carried out.

3.4.2 The minimum safe distances from a conductor of an overhead electric line to any structure, building or line support *(other than a support for the line under consideration or any line crossing the line under consideration)* shall not be less than those specified in Table 3.

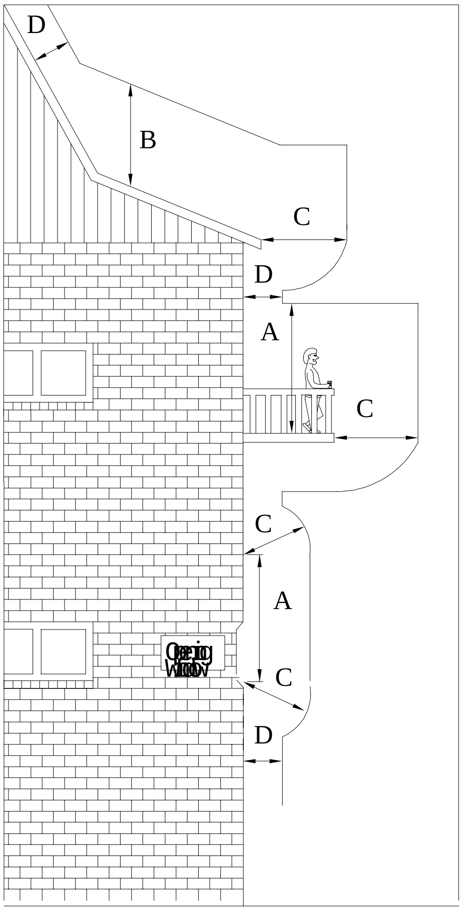
3.4.3 The Table 3 distances do not apply to insulated conductors or cables supported along the façade of a structure or building.

3.4.4 Figures 3 and 4 illustrate the application of the Table 3 to a particular building. The letters A to D refer to the distances A to D as set out in Table 3.

3.4.5 The distances specified in A and B of Table 3 shall also be maintained above an imaginary horizontal line extending outward for the distance specified in C.

3.4.6 For Figure 4, the greater distance of either A, or B (from Table 3) plus the height of the balcony, shall apply, as this latter calculation may result in a distance greater than A.

FIGURES 3 AND 4 BUILDING ELEVATION AND BALCONY SECTION



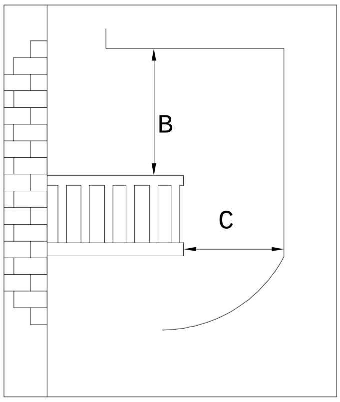


TABLE 3 MINIMUM SAFE DISTANCES OF CONDUCTORS FROM BUILDINGS AND OTHER STRUCTURES WHERE SPECIFIC CALCULATION OF CONDUCTOR MOVEMENT HAS BEEN CARRIED OUT

Safe distance conditions	Not exceeding 1 kV			Exceeding 1 kV		Exceeding 1 kV but not exceeding 33 kV	Exceeding 33 kV but not exceeding 110 kV	Exceeding 110 kV but not exceeding 220 kV	Exceeding 220 kV a.c. or d.c.
	Insulated m	Bare neutral m	Bare active m	Insulated with earthed screen m	Insulated without earthed screen m	Bare or covered m	Bare m	Bare m	Bare m
A Vertically above those parts of any structure normally accessible to persons	2.7	2.7	3.7	2.7	3.7	4.5	5	6.5	7
B Vertically above those parts of any structure not normally accessible to persons but on which a person can stand	0.1	2.7	2.7	0.1	2.7	3.7	4.5	6	6.5
C In any direction (other than vertically above) from those parts of any structure normally accessible to persons, or from any part not normally accessible to persons but on which a person can stand	0.1	0.9	1.5	0.1	1.5	2.1	3	4.5	5
D In any direction from those parts of any structure not normally accessible to persons	0.1*	0.3*	0.6*	0.1	0.6	1.5	2.5	3.5	4
E In any direction from the ground	Refer to Table 4								

* This distance can be further reduced to allow for termination at the point of attachment

SECTION 4
SAFE DISTANCES OF CONDUCTORS FROM THE GROUND AND WATER

4.1 GENERAL

4.1.1 This section sets the minimum safe clearance distances for conductors from the ground and water, including minimum safe distances for any excavations or other alterations.

4.1.2 Unless specifically identified, the requirements of this section do not apply to traction system conductors or to telecommunications lines, substations and generating stations.

4.2 MINIMUM SAFE DISTANCES OF CONDUCTORS FROM THE GROUND AND POOLS

4.2.1 Conductors of any overhead electric line, including any switching connections and transformer connections mounted on poles or structures, shall have distances from the ground not less than specified in Table 4.

4.2.2 Table 4 does not apply to existing overhead electric line conductors, or their replacement, where those conductors complied with the Regulations in existence at the time of their installation.

4.2.3 Conductors shall not be installed less than 5 m above the water level of any swimming pool.

4.3 MATERIAL DEPOSITED UNDER OR NEAR OVERHEAD ELECTRIC LINES

4.3.1 No material shall be deposited under or near an overhead electric line so as to reduce the conductor distance to ground to less than the distances required by Table 4 of this Code.

TABLE 4 MINIMUM SAFE DISTANCES OF CONDUCTORS FROM THE GROUND

Circuit voltage	**Vertical distance to ground (m)**			**Radial distance (m)**
	Across or along roads or driveways	Any other land traversable by vehicles (including mobile plant) but excluding across or along roads or driveways	Any land not traversable by vehicles (including mobile plant) due to its inaccessibility (e.g. steepness or swampiness)	In any direction other than vertical on all land
Not Exceeding 1 kV and insulated	5.5	4.0	2.7	2
Not Exceeding 1 kV	5.5	5.0	4.5	2
Exceeding 1 kV but not exceeding 33 kV	6.5	5.5	4.5	2
Exceeding 33 kV but not exceeding 110 kV	6.5	6.5	5.5	3
Exceeding 110 kV but not exceeding 220 kV	7.5	7.5	6.0	4.5
Exceeding 220 kV a.c. or d.c.	8.0	8.0	6.5	5

NOTES:

(a) Voltages are a.c. except where specified as d.c.

(b) The term ground includes any unroofed elevated area accessible to plant or vehicles.

(c) Distances specified in Table 4 are for conductors that have fully undergone mechanical creep (permanent elongation). This is deemed to have occurred after 10 years in service.

4.4 SAFE DISTANCES OF CONDUCTORS OVER NAVIGABLE WATERWAYS AND BOAT RAMPS

4.4.1 The height of conductors over a navigable waterway shall be determined in consultation with the Maritime Safety Authority of New Zealand (MSA). The booklet titled “New Zealand System of Buoys and Beacons”, produced by MSA, shall be used as a guide.

4.4.2 Where conductors are installed over a boat ramp, suitable notices shall be provided on either side of the ramp, to provide a warning of the conductors’ presence and an indication of the conductors’ height and voltage.

4.4.3 No overhead conductors shall be installed within 9 m in any direction of a boat ramp.

4.4.4 Overhead conductors installed between 9 and 12 m of a boat ramp shall be insulated.

4.4.5 No boat ramp shall be constructed within 9 m in any direction of an overhead electric line without prior written consent of the electric line owner.

4.5 SAFE DISTANCES OF CONDUCTORS OVER RAILWAY TRACKS

4.5.1 The safe distances above rail level at the crossing of the railway for all overhead electric line conductors, when at maximum sag, shall not be less than those specified in Table 5. Where electric traction is in use, refer also to clause 6.2.2.

TABLE 5 MINIMUM DISTANCES VERTICALLY ABOVE RAILWAY TRACKS

Conductors	**Distance (m)**
Earthed conductors	5.5
Stay wires	5.5
Conductors up to and including 33 kV	6.5
Conductors above 33 kV but not exceeding 220 kV	7.5
Conductors above 220 kV a.c. or d.c.	8

SECTION 5
SAFE DISTANCES FOR THE OPERATION OF MOBILE PLANT NEAR CONDUCTORS

5.1 GENERAL

5.1.1 This section does not apply to live line work or to any conductor forming part of the mobile plant or any collector wire, insulated cable, or flexible cord used for the purpose of supplying electricity to the mobile plant.

5.1.2 Mobile plant working near an electric overhead electric lines can damage the line and be hazardous for the plant operator, the mobile plant and people in the vicinity.

5.1.3 Conductors can be displaced from their normal position by wind or temperature change. This requires special consideration by mobile plant operators.

5.1.4 This section does not apply while mobile plant is in transit on a road and the relevant requirements of the Traffic Regulations 1976 are observed.

5.2 MINIMUM APPROACH DISTANCE

5.2.1 The distance between any live overhead electric line and any part of any mobile plant or load carried shall be **“AT LEAST 4.0 METRES”**, unless the operator has received written consent from the overhead electric line owner allowing a reduced distance.

5.2.2 When an approval has been obtained pursuant to clause 5.2.1, and subject to clause 5.5.1, the minimum approach distance between a conductor and any mobile plant shall not be less than specified in Table 6.

5.2.3 Figure 5 provides a quick reference guide to the minimum safe distances for use of mobile plant near conductors of overhead electric lines.

5.3 WORKING ABOVE OVERHEAD ELECTRIC LINES

5.3.1 Mobile plant or any load carried shall not operate above the conductors of any overhead electric line unless the operator has received written consent from the overhead electric line owner to work above the overhead electric line.

5.3.2 The use of helicopters above overhead electric lines is governed by the Civil Aviation Rules.

5.4 CONSENT FOR REDUCED MINIMUM APPROACH DISTANCES

5.4.1 The application for written consent from the overhead electric line owner shall be made with reasonable notice.

5.4.2 The overhead electric line owner’s written consent shall advise:

(a) The voltage of the overhead electric line and the minimum approach distance to be observed, which shall not be less than the requirements of Table 6; and

(b) Any other reasonable conditions to be observed while working in proximity to, or above, the overhead electric line.

(c) The section of line to which the consent applies.

TABLE 6 REDUCED MINIMUM APPROACH DISTANCES
(where written consent has been obtained)

Circuit voltage	Minimum approach distance (m)
Not exceeding 1 kV – insulated conductor	0.15
Not exceeding 1 kV – conductor not insulated	1.0
Exceeding 1 kV but not exceeding 66 kV	1.0
Exceeding 66 kV but not exceeding 110 kV a.c. or d.c.	1.5
Exceeding 110 kV but not exceeding 220 kV a.c. or d.c.	2.2
Exceeding 220 kV d.c. but not exceeding 270 kV d.c.	2.3
Exceeding 270 kV d.c. but not exceeding 350 kV d.c.	2.8
Exceeding 350 kV d.c. or 220 kV a.c.	4

5.5 REDUCED MINIMUM APPROACH DISTANCES FOR COMPETENT EMPLOYEES

5.5.1 Where the operator of any mobile plant is a competent employee working on, or in the proximity of, an overhead electric line, the approach distances may be reduced in accordance with the safety practices determined by the overhead electric line owner.

5.5.2 Direct contact of insulated elevating work platform with live conductors shall be acceptable only under approved live working procedures. Whenever a special reduced minimum approach distance is applied, the maximum practicable clearance from conductors shall be maintained.

5.6 OTHER REQUIREMENTS

5.6.1 Where any mobile plant is likely to be used at any time in the proximity of overhead electric lines, the owner or operator of such device shall affix an approved warning notice in a conspicuous place as near as practicable to the operator's position. The notice shall be maintained in a legible condition and shall state:

"WARNING, KEEP CLEAR OF POWER LINES".

5.6.2 Any mechanically operated hedge cutter used under or in close proximity to any overhead electric line shall be operated to prevent hedge clippings or other material being thrown into contact with the conductors or creating any other hazard.

FIGURE 5 MINIMUM SAFE DISTANCES FOR THE OPERATION OF MOBILE PLANT NEAR CONDUCTORS

ALL WORKS
The distance between any live overhead electric line and any mobile plant or load carried shall be **at least 4m**, unless the operator has written consent from the overhead electric line owner

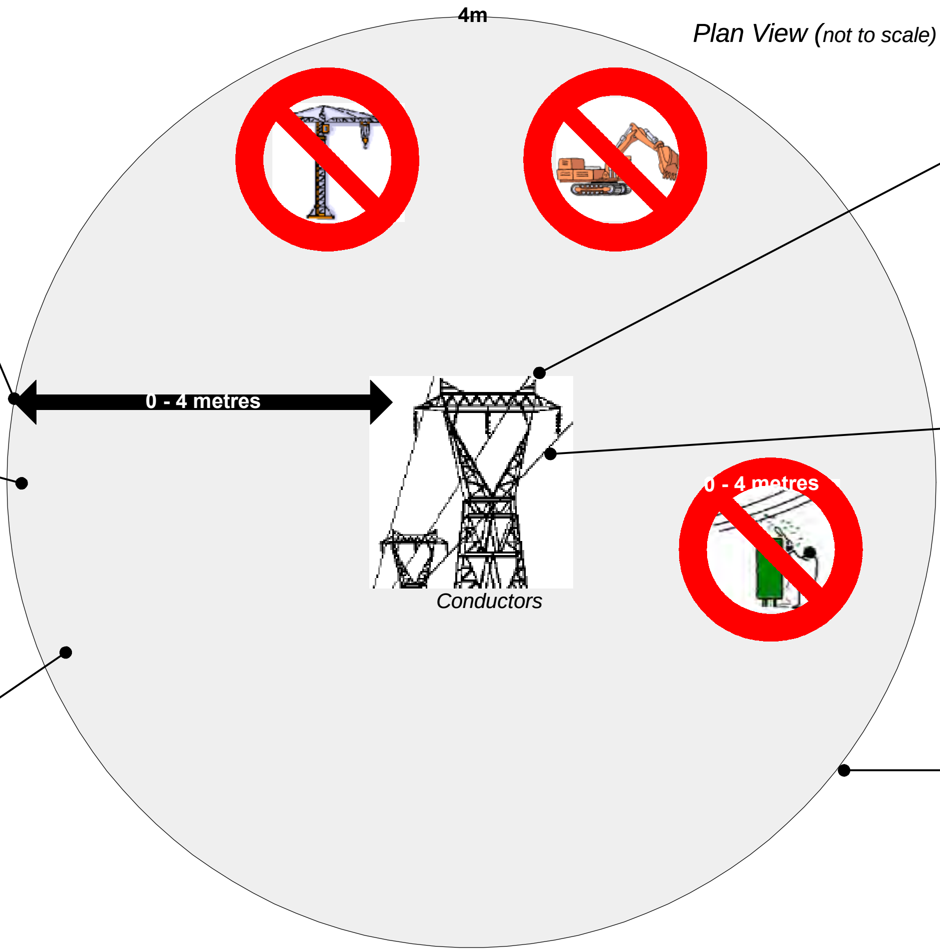
Section 5.2.1

ALL WORKS - REDUCED DISTANCES
When approval is obtained pursuant to clause 5.2.1, and subject to clause 5.5.1, the minimum approach distance between a conductor and any mobile plant shall not be less than specified in Table 6

Section 5.2.2

REDUCED DISTANCES FOR COMPETENT EMPLOYEES
Where the operator of any mobile plant is a competent employee working on, or near, an overhead electric line, approach distances may be reduced in accordance with safety practices determined by the electric line owner

Section 5.5.1



WORKING ABOVE OVERHEAD LINES
Written consent from line owner required for the operation of mobile plant or any load carried **above** the overhead electric line

Section 5.3.1

HEDGE CUTTERS
Mechanically operated hedge cutters used in close proximity to overhead lines shall be operated to prevent hedge clippings or other material from being thrown into contact with the conductors or creating any other hazard

Section 5.6.2

WARNING NOTICE
Where mobile plant is likely to be used close to overhead electric lines, the owner or operator of such device shall affix a warning notice in a conspicuous place as near as practicable to the operator's position, stating:

'WARNING, KEEP CLEAR OF POWER LINES'

Section 5.6.1

Notes

- **This diagram is for quick reference only. Please refer to Section 5 for the complete minimum safe distance requirements.**
- Mobile Plant includes cranes, loaders, excavators, drilling or pile driving equipment or other similar device.
- The provisions of Section 5 do not apply to live line work or to any conductor forming part of the mobile plant or any collector wire, insulated cable, or flexible cord used for the purpose of supplying electricity to the mobile plant (section 5.1.1) or while mobile plant is in transit on a road and the relevant requirements of the Traffic Regulations 1976 are observed (section 5.1.4).

SECTION 6

MINIMUM SAFE DISTANCES BETWEEN CONDUCTORS OF DIFFERENT CIRCUITS, TELECOMMUNICATION LINES AND STAY WIRES

6.1 GENERAL

6.1.1 This section sets minimum safe distances for overhead electric lines to prevent conductors contacting other conductors, or stay wires, or approaching sufficiently close to cause a fault condition. This section also applies to telecommunications lines.

6.1.2 The requirements of this section do not apply to substations and generating stations and unless specifically identified, traction system conductors.

6.1.3 The distances specified in Table 7 do not apply where the conductors of all relevant circuits are insulated. In the case of any of the insulated conductors operating at a voltage in excess of 1 kV, the conductor, or bundle of conductors, shall include an earth screen.

6.1.4 Where two circuits of different voltage cross each other, are attached to the same support, or share spans, the conductors of the higher voltage circuit should be placed above those of the lower voltage circuit. Earth wires may be above power circuits.

6.1.5 Telecommunications lines shall always be below power circuits.

6.2 CONDUCTORS OF DIFFERENT CIRCUITS ON DIFFERENT SUPPORTS *(UNATTACHED CROSSINGS)*

6.2.1 Under still air conditions, the vertical distance between any conductor or telecommunications line of the lower circuit at minimum sag and any point to which a higher circuit conductor may sag under the influence of short time overload current and solar radiation shall not be less than specified in Table 7.

6.2.2 The minimum vertical distance to a traction system is 2 m.

TABLE 7 MINIMUM VERTICAL DISTANCES BETWEEN CONDUCTORS *(unattached crossings)*

Higher voltage of either circuit	Minimum distance between conductors (unattached crossing) (m)
Below 1 kV a.c.	0.6
1 kV to 33 kV a.c.	1.2
Exceeding 33 kV but not exceeding 66 kV a.c.	1.8
110 kV a.c.	2.4
220 kV and 270 kV d.c.	2.8
350 kV d.c.	4

6.3 CONDUCTORS *(SAME OR DIFFERENT CIRCUITS)* ON THE SAME SUPPORT *(ATTACHED CROSSINGS)* INCLUDING SHARED SPANS

6.3.1 Where a detailed engineering study of the over-voltages and the conductor motion has not been undertaken, the distances between conductors of different circuits at any point on the same support under normal working conditions shall not be less than specified in Table 8.

TABLE 8 MINIMUM SAFE DISTANCES BETWEEN CONDUCTORS
(attached crossings)

Higher voltage of either circuit	Lower voltage of either circuit	Distance between circuits (m)
Not exceeding 33 kV a.c.	Less than 1 kV	1.0
	Greater than 1 kV	1.2
Exceeding 33 kV but not exceeding 110 kV a.c.	Less than 1 kV	1.5
	Greater than 1 kV	2.0
Exceeding 110 kV a.c. or d.c.	All	2.5

6.3.2 The distances in Table 8 may be reduced if a detailed engineering study of the maximum probable over-voltages and conductor motion establishes that there will be no adverse effects from a shorter distance.

6.3.3 Where lines operate at less than 1 kV, adequate measures should be taken to protect against unacceptable voltage rise between the lower voltage line and any structure energised due to the occurrence of a fault on the higher voltage line.

6.3.4 Where conductors are taken down a pole or other support to or from a transformer or other fittings, the distance between any conductors *(not being insulated to full working voltage)* shall be not less than the following:

(a) 600 mm between any line of low voltage and a line of 11 kV.

(b) 750 mm between any line of low voltage and a line of 22 kV.

(c) 900 mm between any line of low voltage and a line of 33 kV.

6.3.5 A reduced distance may be used at or near the terminals of any such transformer or other fittings where those terminals have a lesser distance between them than the minimum distance specified.

6.4 TELECOMMUNICATION LINES NEAR CONDUCTORS AND STAY WIRES

6.4.1 Subject to clauses 6.4.2 and 6.4.3, the minimum distance at any time between any telecommunication line *(including traction communication lines or signal wires)* and a conductor or stay wire shall not be less than the distances specified in Table 7.

6.4.2 Notwithstanding the distance specified in Table 7, at a shared support, the minimum distance of:

(a) a telecommunications line from a high voltage conductor that is not insulated shall not be less than 1.6 m; and

(b) a bare telecommunications line from a bare low voltage conductor shall not be less than 1.2 m.

(c) a covered telecommunications line from a bare low voltage conductor shall not be less than 0.6 m.

(d) For insulated conductors, and/or covered low voltage conductors, and covered telecommunications conductors, the distance shall not be less than 300 mm. This distance also applies to shared spans.

6.4.3 The minimum distance requirements specified in Table 7 between conductors and telecommunication lines do not apply to fibre optic cables that are:

(a) bound to a live conductor for support; or

(b) contained inside the lightning protection or earth conductor.

6.4.4 A bare catenary wire supporting a telecommunication line is deemed not to be bare for the purpose of this sub-section if the catenary is earthed at not less than every 10th pole in straight runs and at every pole when a cross-over or tee junction occurs.

SECTION 7

DESIGN AND INSTALLATION REQUIREMENTS FOR SUPPORTS AND STAY WIRES OF OVERHEAD ELECTRIC LINES, AND CONTROL OF ACCESS

7.1 SUPPORTS

7.1.1 All supports *(including stay wires, stay anchors, and other supporting equipment)* for conductors shall be so located as to avoid undue obstruction to pedestrian or vehicular traffic.

7.1.2 Poles or other supports shall not be erected closer than 4 m to the centre of the nearest railway track *(being measured horizontally from the centre of the nearest two rails to the nearest face of the pole or other support)* unless by agreement with the owner of the railway.

7.1.3 Live conductive parts less than 4.5 m above ground level, and attached to any pole or other support, shall be protected in such a manner as to prevent any accidental contact in reasonably foreseeable circumstances.

7.1.4 Any metal attached to a pole or other support, that is placed less than 2.5 m above ground level and that could become accidentally charged, shall be in direct contact with the earth, earthed or else adequately protected to prevent human contact.

7.2 STAY WIRES

7.2.1 Any stay wire less than 2.5 m from the ground in any direction that is likely to be a hazard shall be conspicuously marked.

7.2.2 Stay wires that are less than 2.5 m from the ground shall be earthed unless they are in direct contact with the earth. Alternatively, an insulator having a wet flashover value not less than that of the overhead electric line shall be inserted in the stay in a suitable position.

7.2.3 Stay wires that are erected across the part of any public road used by vehicular traffic shall have a minimum vertical distance above the ground of 5.5 m.

7.2.4 Stay wires shall not be less than 300 mm from any bare telecommunications line.

7.3 CONTROL OF ACCESS

7.3.1 Every conductor of an overhead electric line shall be so erected that it is not readily accessible to any person without the use of a climbing device.

7.3.2 Climbing steps on overhead electric line support structures shall not be placed at a height of less than 3 m above ground level.

SECTION 8
SAFE DISTANCES FOR THE DESIGN OF SUBSTATIONS, GENERATING STATIONS, SWITCHYARDS AND SWITCHROOMS

8.1 GENERAL

8.1.1 Safe distances in substations, generating stations, switchyards and switch-rooms where access to electricity supply works is required for operation, maintenance and installation activities, undertaken by competent employees, shall be suitable for the activities being undertaken and shall allow safe and unobstructed egress in emergency situations.

8.2 METALCLAD SWITCHGEAR

8.2.1 At the front of any low voltage and high voltage metalclad switchgear, there shall be a clear and unobstructed passageway at least 1 m wide and 2.5 m high.

8.2.2 Where frequent access is required for work at the sides or rear of any metalclad switchgear, there shall be clear and unobstructed passageways at least wide 1 m wide and 2.2 m high.

8.3 BARE CONDUCTORS WITHIN EARTHED ENCLOSURES

8.3.1 This subsection does not apply to bare conductors on or within panels or within fenced enclosures within buildings.

8.3.2 Any passageway at the side of or under any earthed enclosure containing bare conductors shall be clear and unobstructed and at least 800 mm wide and 2.2 m high.

8.4 BARE CONDUCTORS IN SUBSTATIONS, SWITCHYARDS, GENERATING STATION BUILDINGS AND OTHER LOCATIONS

8.4.1 In substations, switchyards, generating station buildings and other locations where there are bare conductors, the design and layout of the conductors shall be such that persons can carry out work without hazard.

8.4.2 Safety to persons shall be maintained by the provision of adequate distances to live parts for maintenance, vehicular access and pedestrian access, and if necessary to barriers or fences.

8.4.3 In fenced or other enclosed areas where access is restricted to situations where all conductive parts have been de-energised, distances may be reduced below those required by clauses 8.4.1 and 8.4.2, in accordance with a specific engineering design.

8.4.4 The distance from any bare conductor to any boundary fence or wall or similar enclosure boundary shall not be less than specified in Table 3.

8.4.5 The distances specified in Table 3 are generally applicable for bare conductors adjacent to substation buildings or other structures. These distances do not apply for situations where conductors are supported on buildings or other structures and may be reduced with a specific engineering design.

SECTION 9
MINIMUM SAFE APPROACH DISTANCE LIMITS FOR PERSONS WORKING NEAR EXPOSED LIVE PARTS

9.1 GENERAL

9.1.1 This section sets out minimum safe approach distances limits for persons working near exposed live parts.

9.1.2 Minimum safe distances limits are provided for non-competent persons. Reduced safe distances are provided for where;

(a) the owner of the live parts gives written permission; and

(b) competent employees are working near exposed live parts.

9.1.3 Minimum safe distances from exposed live parts shall be maintained at all times. Where necessary, insulating barriers shall be used to maintain minimum safe approach distances.

9.1.4 This section does not apply to work near conductors of extra-low voltage, or live line or live substation work.

9.1.5 Figure 6 illustrates the measurement of minimum safe approach distances from exposed live parts.

9.2 MINIMUM APPROACH DISTANCE LIMITS FOR NON-COMPETENT PERSONS WORKING NEAR EXPOSED LIVE PARTS

9.2.1 For non-competent persons working near exposed live parts, where written consent from the owner of the live parts has not been obtained, the minimum safe approach distances limits are:

(a) For circuit voltages 110 kV and below - 4 m.

(b) For circuit voltages above 110 kV - 6 m.

9.2.2 Where written consent from the owner of the live parts has been obtained, the minimum safe approach distance limits for non-competent persons working near exposed live parts shall not be less than those specified in Table 9.

TABLE 9 MINIMUM SAFE APPROACH DISTANCE LIMITS FOR PERSONS FROM EXPOSED LIVE PARTS (*Where consent from the owner of the live parts has been obtained)*

Circuit Voltage	Distance Limits (m)
Below 1 kV	0.5
11 kV	1.5
22 kV	2.0
33 kV	2.5
66 kV	3.0
110 kV	4.0
220 kV and above	6.0

9.3 MINIMUM SAFE APPROACH DISTANCE LIMITS FOR COMPETENT EMPLOYEES FROM EXPOSED LIVE PARTS

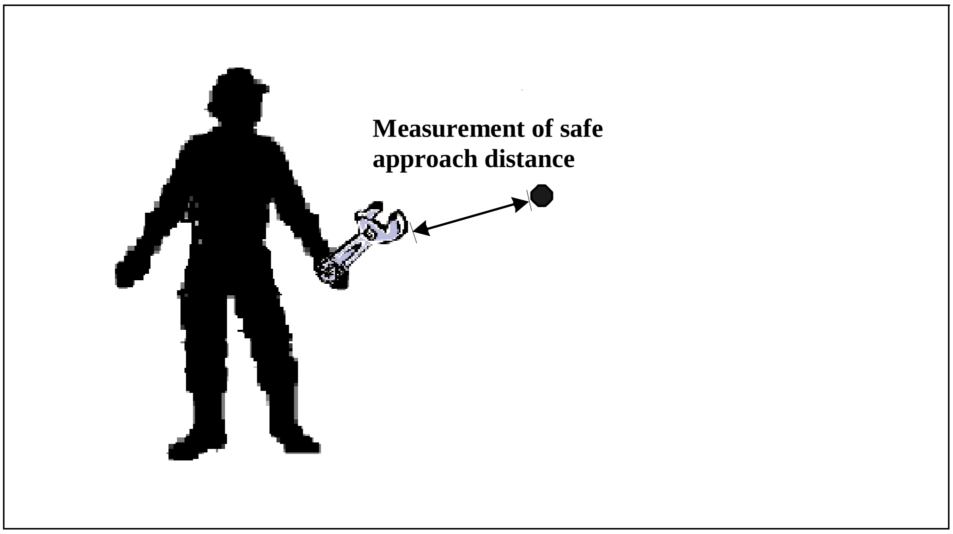
9.3.1 The minimum safe approach distance limits for competent employees carrying out electrical or telecommunications work near exposed live parts shall not be less than those set out in Table 10.

9.3.2 The minimum safe approach distance for competent employees shall be maintained by keeping all parts of the body, clothing and any hand held tools (except those tools designed for contact with live parts) beyond the safe distances set out in Table 10.

TABLE 10 MINIMUM SAFE APPROACH DISTANCE LIMITS FOR COMPETENT EMPLOYEES FROM EXPOSED LIVE PARTS

Nominal Voltage	Distance Limits (m)
Not exceeding 1 kV a.c. or d.c.	0.15
Exceeding 1 kV but not exceeding 6.6 kV a.c. or d.c.	0.25
Exceeding 6.6 kV but not exceeding 11 kV a.c. or d.c.	0.3
Exceeding 11 kV but not exceeding 22 kV a.c. or d.c.	0.45
Exceeding 22 kV but not exceeding 33 kV a.c. or d.c.	0.6
Exceeding 33 kV but not exceeding 50 kV a.c. or d.c.	0.75
Exceeding 50 kV but not exceeding 66 kV a.c. or d.c.	1
Exceeding 66 kV but not exceeding 110 kV a.c. or d.c.	1.5
Exceeding 110 kV but not exceeding 220 kV a.c. or d.c.	2.2
Exceeding 220 kV d.c. but not exceeding 270 kV d.c.	2.3
Exceeding 270 kV d.c. but not exceeding 350 kV d.c.	2.8
Exceeding 220 kV a.c or 350 kV d.c.	4

FIGURE 6 MEASUREMENT OF MINIMUM SAFE APPROACH DISTANCES



SECTION 10
REQUIREMENTS FOR INSPECTION AND RECORDS

10.1 INSPECTION

10.1.1 The owners of electrical works shall inspect and review overhead electric line installations at intervals not exceeding five years to ensure that the requirements of sections 2 to 8 have not been compromised by changed circumstances.

10.2 RECORDS

10.2.1 The following records shall be maintained to ensure that safe minimum distances are not compromised and to provide information to other parties:

(a) Asset register;

(b) Results of periodic inspections; and

(c) Dispensations or justifications for reduced distances (where applicable).

Appendix E: PowerCo Works Agreement Issue and Management

GAS OPERATIONS – WORKS AGREEMENT ISSUE AND MANAGEMENT

1 GENERAL

1.1 Scope

This Standard is part of a set of issued Standards designed to offer protection to Powerco's underground gas assets and to reduce reactive maintenance associated with third party damage. The focus of this Standard is to apply an appropriate level of management to:

- Contractors excavating in close proximity to Powerco's strategic gas assets, and provide these contractors with the right level of support to work safety when working in the vicinity of underground gas assets
- Situations where location of a pipe cannot be validated on site, when pot-holed
- Carry out evaluation of third parties performance
- The notification process between parties associated with asset location/mark out and support on site
- Filing of Works Agreements

1.2 Application

This standard applies to Powerco and Service Providers.

1.3 Objective of this Standard

The objective of this standard is to ensure processes are in place to:

- Set clear notification pathways between parties involved in on site locate/mark-out, and site management
- Set time between the issue of plans covering strategic assets and request for site support
- Achieve agreement between Powerco and third parties on controls and the level of support required from Powerco's representative for the third party to excavate in close proximity to Powerco strategic gas assets
- Promote positive dialog between Powerco and third parties working in close proximity underground gas assets
- Set requirements for the collection and archiving of issued Works Agreements

1.4 Standard Abbreviations

The following abbreviations are used in this document: -

nnnSnnn	Powerco standard specification.
NZS	Standard Specification of the Standards Association of New Zealand
AS	Standard Specification of the Standards Association of Australia
AS/NZS	Joint Australian /New Zealand Standard

Unless otherwise stipulated, reference to a standard specification refers to the current edition, including any amendments.

In the event of any ambiguity or contradiction between this specification and any of the standard specifications, this document will take precedence.

1.5 Referenced Documents

1.5.1 Legislation

Gas Act 1992

Gas (Safety and Measurement) Regulations

Health and Safety at Work Act 2015

National Code of Practice for Utility Operators' Access to Transport Corridors

1.5.2 Industry Rules and Standards

AS/NZS 4645.1	Gas Distribution Networks – Part 1: Network management
NZS 7901	Electricity and gas industries safety management systems for public safety

1.5.3 Powerco Documents

100R001	Risk Management Charter
310S108	Safety and Operating Plan
310S035	Environmental Management Plan
GOS-MSS-01	Gas Operations Standard Mains and Services – Part 6 Operations and Maintenance
140S004	Environmental Management Non-negotiables
140S009	Gas Network Environmental Plan
392S002	Health And Safety Requirements For Contractors
392S016	Clearance Plan Issuing & Locating Assets

1.6 Definitions

Term	Means
Gas site support	Generally observing the performance of excavation work(s) or providing support to a third party, to ensure works do not conflict with safety, and clearance requirements for a strategic pipe, or other identified gas pipes
GFSA	Gas Field Services Agreement
GIS	Geographical information System – a system used to capture, store, manipulate, analyse, manage, and present spatial geographic data.
GPR	Ground penetrating radar
High Density Community Use (CBD)	Area of community where the consequence of leakage may be much greater than "normal": ▪ CBD – as defined in local authority district plans ▪ Schools (>100 students – as listed on the ministry of education directory). Includes Preschool through to Tertiary ▪ Hospitals ▪ Airports – as defined in local authority district plans

ISN	External health and safety approval system
Service Provider	A contractor approved by Powerco through a GFSA, or other contractor engagement documentation. ISN approval will form part of this documentation
SPA	Service provider application
Spotter	A person positioned to observe the location of mechanical excavation equipment within, and/or above a trench line, to minimize the risk of damage to the pipe, and/or accidents or injuries
Strategic pipe (Critical pipe)	A gas pipe identified by way of supply criticality of gas into/or within Powerco's gas network/or a gas pipe presenting additional risk to the public, requiring additional procedural protection, and/or physical onsite support. The following pipes have been identified as meeting this criteria ▪ Pipe with an MAOP >420kPa ▪ Pipe with a diameter ≥100NB ▪ Pipe located in a High Community Use Area (CBD) – as defined in GIS
Third party	Any party intending to or performing excavation works in the vicinity of Powerco gas network assets

1.7 Health and Safety Hazard Identification and Management

The Health and Safety of Powerco workers, contractors and the public is paramount.

Health and Safety is a key driver throughout the lifecycle of assets, including: design; material & component selection; fabrication & construction; testing & commissioning; operations & maintenance and decommissioning. This Standard is focused on operations and maintenance of the gas networks.

All work in relation to the issue of Works Agreements shall comply with the Health and Safety at Work Act, Powerco Health and Safety Policy and relevant statutory requirements.

All activities associated with this Standard shall comply with the Powerco Health Safety and Environmental Management System 392S002, in particular the Formal Safety Assessment (FSA) and Safety and Operating Plan (SAOP) to ensure the safety of employees, contractors and public is managed.

All incidents shall be reported to Powerco and relevant authorities immediately.

Hazard assessment shall be conducted prior to commencing field activities and all hazards shall be managed.

1.8 Environmental Considerations

Protecting and managing the environment is a key commitment throughout the lifecycle of assets, including: design material and component selection, fabrication and construction, testing and commissioning, operations and maintenance and decommissioning.

A key element is designing environmental measures into assets to ensure it is integrated throughout the asset lifecycle.

All work on Powerco's gas networks shall comply with the Resource Management Act (RMA), Powerco Environment Policy, Powerco Environmental Management System and relevant statutory requirements.

All activities shall be conducted to minimise the impact on the environment by reducing waste, eliminating contamination and sustainably using resources and the environment.

Disposal of waste, hazardous substances and contaminated material shall comply with the requirements of the relevant Territorial Authority.

All breaches shall be reported to Powerco and relevant authorities immediately.

1.9 Copyright

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1.10 Enquiries Regarding this Document

Contact Person: Principal Engineer (Gas)

2 PROCESS

This part of the Standard details the process in place to manage excavation work in close proximity to Powerco's underground gas assets.

Exclusions from this Standard

Service Providers engaged by Powerco to undertake work on/or in close proximity to its underground assets are excluded from the Works Agreement process. This exclusion does not remove the requirement for risks associated with excavating in close proximity to underground gas assets to be included in the service providers risk assessment, and the management and control of the work site.

2.1 Notification of proposed third party work

Third parties intending to excavate in the road corridor are required under the "National Code of Practice for Utility Operators' Access to Transport Corridors" and the "Guide for Safety with Underground Services" to identify utility assets.

This process is managed by Powerco through the 'Clearance Plan Issuing & Locating Underground Assets Standard'. This stage of the process identifies strategic pipes and the requirement to have these located/marked out on site by Powerco's representative. It also covers subsequent issuing of a Works Agreements that maybe required to manage and/or provide support to the third party.

2.2 Works Agreement issuing

The following sets criteria where a Works Agreement may need to be issued. The specific conditions a Works Agreement is issued will be confirmed on site after assessment of planned works with the third party. These conditions will be documented in the Works Agreement as a protection to both Powerco, and the third party completing the excavation works.

The following situations will require a Works Agreement to be issued:

- Where excavation work is planned in a road corridor identified as having a strategic pipe (critical pipe) within the boundary of the road corridor
- Where excavation work is planned in private property identified as having a strategic pipe (critical pipe) route crossing or running through the private property, and the excavation work may encroach on the pipes alignment
- Where a main or service pipe cannot be positively identified by a third party using plans issued by Powerco

2.2.1 Works Agreement conditions

If the proposed works are likely to cause problems for Powerco, or the third party requires support, then Powerco's representative will add specific conditions in the Works Agreement to minimise the effects of the proposed works on Powerco's assets, and to clearly articulate options the third party should follow – refer to section 2.2.1.2 below.

These may include a requirement for Powerco's representative to be present on site throughout the duration of the work(s).

It is important the conditions recorded in a Works Agreement are accurate and unambiguous, as in the event of incident there may be a requirement to present these to Work Safe and/or a Court of Law.

The Works Agreement documents Powerco requirements, and the agreement of these by the third party. This agreement may be completed manually in writing reference Appendix 1 - Works Agreement example, or electronically, in each instance the agreement shall be signed by both parties.

Signing a Works Agreement does not absolve the third party of their obligations set out in Statute and/or Regulation.

2.2.1.1 Example of Works Agreement conditions

The following list provides examples of conditions/hold points that may be applied where excavation work is planned in close proximity to strategic pipes, and/or where a network asset cannot be positively identified on site. This list is not exhaustive, and can be amended where required to manage identified risk. The intent is for relevant conditions/hold points listed to be used where required along with other identified conditions.

For the protection of Powerco and the third party, the agreed conditions must be recorded on the "Works Agreement" under "Conditions of Agreement".

Scenarios	Conditions
Unable to positively identify a pipe through (pot-holing) where Powerco plans indicate the pipe position	▪ Utilise GPR to assist in determining pipe position ▪ Prove location through hand dig on the location GPT indicates the pipes positon, or ▪ Complete excavation using non-destructive excavation technology e.g. (hydro excavation)
Working in close proximity to, or crossing over a strategic pipe	▪ Positively identify strategic pipes by pot-holing before excavation works commence ▪ Machine digging, including drilling, is not permitted closer than 1 metre from a strategic pipe ▪ All gas pipes within 2 metres of the proposed route shall be pot-holed by hand digging before any type of digging machine or drilling commences ▪ All gas pipes must be pot-holed at every point where the proposed route meets or crosses the pipe(s) ▪ Non-destructive excavation technology may be used closer than 1 metre of a strategic pipe where hand digging is not practical ▪ Report any accidental damage to the pipe coating to the Powerco representative. This is to allow early repair of the damage and avoid later reactive maintenance ▪ Spotter required
Working parallel to a strategic pipe	▪ Choose the appropriate conditions from above and add the following ▪ Powerco representative to positively locate the pipeline route through direct connection of pipe locating equipment to a steel pipe, or to the tracer wire where the pipe is constructed using polyethylene ▪ Mark pipe route in the vicinity of excavation works as detailed in section 4.2.1 of 392S016 Clearance Plan Issuing and Locating Underground Assets Standard

Hold points/onsite support/observation	▪ The following hold points or on site presence may apply, these will be subject to the level of confidence Powerco's representative has in the third party carrying out excavation works – refer to 2.2.1.2 - Presence on site at all times excavation work is being carried out - Presence on site during uncovering and/or covering - Presence on site to allow pipe locating equipment to be attached to the pipe or tracer wire - Presence on site where temporary supports are being installed - Presence on site to interpret plans

2.2.1.2 Gas site support

In all instances where excavation works are planned in close proximity to a strategic pipe, a degree of support will be required by a Powerco representative, and determined as follows:

- Third party competence and experience
- Past performance of the third party
- Extent of work planned
- Site conditions

There are other locations where a pipe not classified as strategic may require site support, e.g. where the pipe is not able to be positively located on site.

The extent of support will be confirmed on site and documented in the "Works Agreement".

2.2.1.3 Incident contingency planning

To manage risk to the public and the third party, Powerco's representative will identify isolation points upstream and downstream of the planned works where there is residual risk of the asset being damaged.

2.2.1.4 Positioning of adjacent assets

In the interests of safety and accessibility for all assets owners to their assets, no services shall be laid closer than specified below, or directly above a gas pipe:

Minimum Distance from Pipe	Gas Pipe Operating Pressure
300mm	Intermediate Pressure Gas Pipes
250mm	Medium Pressure and Low Pressure Gas Pipes (designated in the GIS as being strategic)
250mm	Medium Pressure and Low Pressure Gas Pipes

2.2.2 Work agreement information

The following criteria shall be included in a Works Agreement.

Fields	Description
Person issuing Works Agreement	Person responsible for issuing the Works Agreement
Operator name	Name of person responsible for the excavation site
Company name	Company or organisation(s) completing the works
Address	Address of Company completing the works
Length of work agreement	Start time/date and finish time/date of works
Location of work	Full street address or land mark (must include street name and City/town
Enquiry number	Underground Gas Enquiry Sheet enquiry number
Work description	Brief but specific explanation of work
Authority working for	Company engaging the excavation contractor – (e.g. Council, Electricity, Telco etc…)
Conditions of agreement	Any special conditions outside of those already published or made available by way of requesting plans from Powerco - e.g. agreed method of excavation, hold points (time to inspection)
Site support	Yes or No
Extent of supervision	Where require specify the extent of supervision e.g. “Continuous” or “Hold Points” (when pipe exposed, backfilling trench etc…)
Acknowledgement of agreement	Signatories to the agreement – Issuer and receiver

2.3 Notification

Where a Works Agreement is required, and the person locating the assets on site will not be the same person issuing the Works Agreement, notification shall be maintained between these parties to manage risk to Powerco’s assets and to the third party.

The above will be managed through the Powerco “Underground Location Database” with a requirement for a copy of the Works Agreement to be loaded in the “Underground Locations Database”.

Database methods shall be developed to allow notification to the Powerco representative, where a period of two days has elapsed from the time the Works Agreement requirement was logged. Refer to Figure 1.

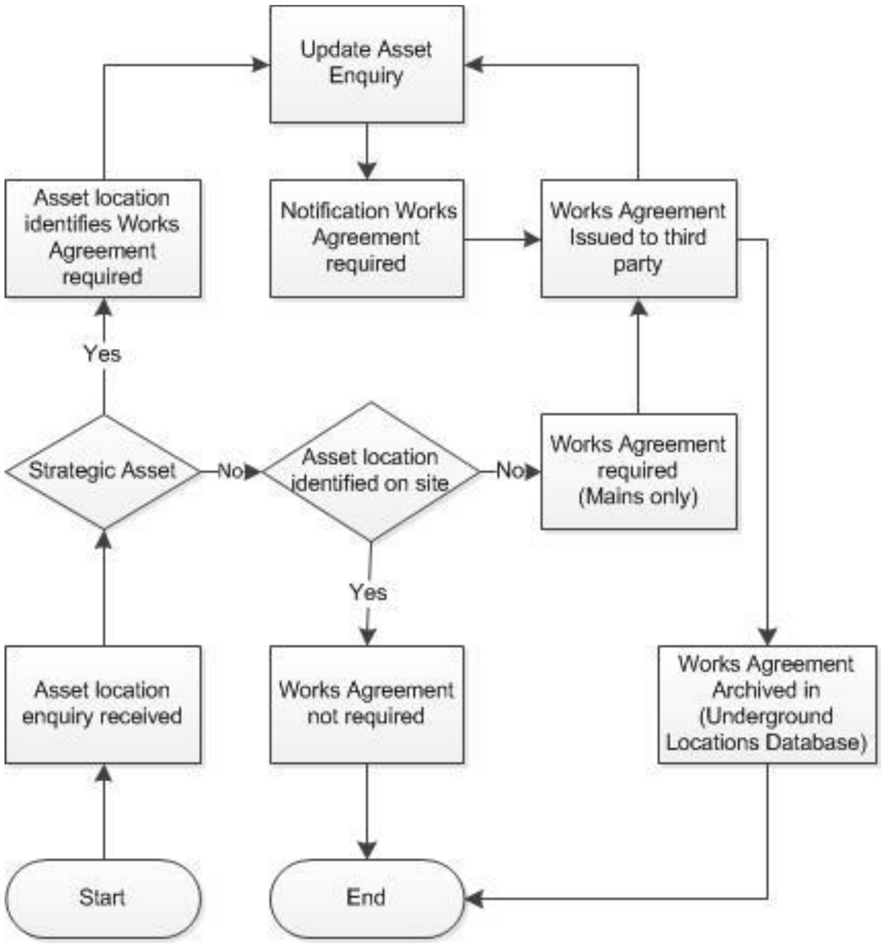


Figure 1

3 FILING

Copy of all Works Agreements shall be archived in the "Underground Location Database" against the relevant enquiry number, and be retrievable using metadata:

- Works address, or
- Third party name, or
- Work agreement number

Filing of Works Agreements will require the Works Agreement to be linked to the relevant enquiry number in the 'Underground Location Database'. This can be done by scanning the hard copy of the Works Agreement and loading against the enquiry number, or electronically linked to the enquiry number.

APPENDIX 1 - WORKS AGREEMENT EXAMPLE

Gas Works Agreement			No: 00001
Agreement issued by:	Name: Company: Contact number:		
Agreement issued to:	Site supervisors name: Excavation company: Address:		
Agreement valid from: Date [ ] Time [ ]		Agreement valid to:	Date [ ] Time [ ]
Location of work:			
Work description:			
Authority working for:	Authority name:		
Conditions of agreement: 1. 2.			
Site supervision required:		Yes	No
Extent of supervision: Detail supervision where other is specified:		Continuous	Other
All works and conditions specified in this agreement must be agreed to by Powerco prior to the commencement of the works.			Enquiry No:
Signed: For and on behalf of excavation company	Signed: On behalf of Powerco;		
In an emergency phone **0800 111 848 or 111**			

4 DOCUMENT REVIEW HISTORY:

Version Number	Reviewed By.	Issue Date	Reason
1			First issue of document into Powerco's BMS
2	B Parsons	4/8/2003	Scheduled review
3	B. Monk	18/09/2017	Extensive rewrite since first issued 2003 ▪ Title updated to "Gas Operations – Works Agreement Issue and Management" ▪ Expanded to include; - Level of contractor management - Criteria where Works Agreements may be required to be issued - Notification process - Management and filing of Works Agreement ▪ Updated referenced documents ▪ Added definitions –note **'Gas Site Support'** has replaced **'Standover'** as a term used to monitor third party work ▪ Add examples of Works Agreement conditions ▪ Added contingency planning ▪ Added positioning of assets adjacent to gas assets ▪ Added notification requirements where the asset locator is not the same person issuing a Works Agreement ▪ Added filing section to collect issued Works Agreements

5 POWERCO STANDARD - DOCUMENT CHANGE REQUEST

Memo to: **Principal Engineer (Gas)**
Powerco Gas
Grey Street
Wellington

Change Details:
(Attach separate sheets as necessary).

Paragraphs Affected:

Priority: **Urgent** (Within 1 week) **Routine** (Within 12 months) **Low** (Next Review)

Submitted By (Print Name)	**Date**

Document Change Request - Acknowledgement

Dear ……………………………

Thank you for your suggestion regarding changes to the above mentioned document.

Your request has been noted and added to our works program. Should we require any additional information regarding your notification then we will be in contact with you.
Thank you for your contribution to improving the quality of Powerco's documentation.
Regards,

……………………………… ………………………………..
Principal Engineering (Gas) **Date**

Appendix F: Pump station locations and Power Demand

F1 Pump Station location

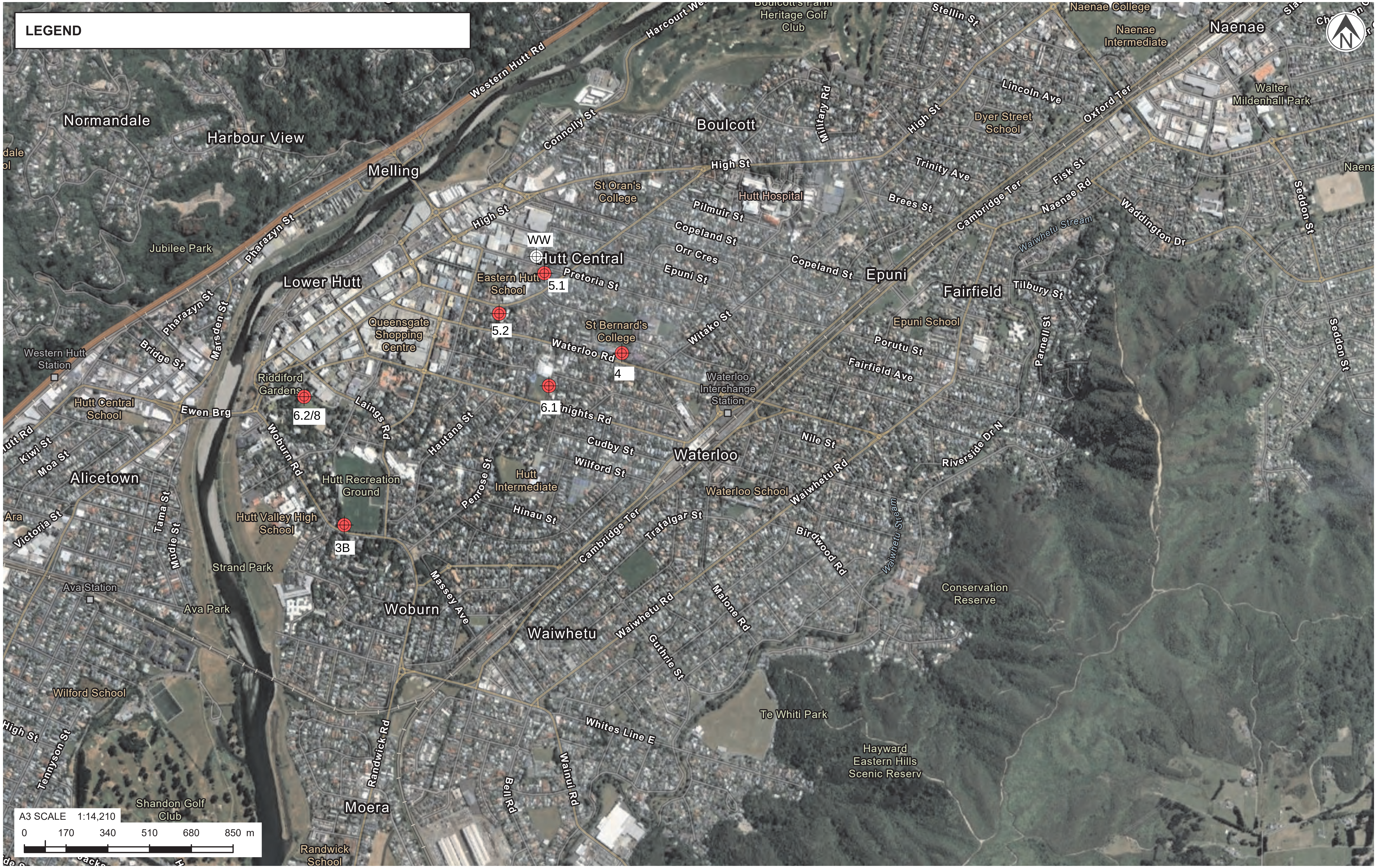
F2 Pump Station Power Demand

F3 Wellington Electricity GIS Layer Snips

F4 Wellington Electricity Pump Station feasibility letter

F5 Wellington Electricity current capacity for proposed Pump Stations

Source: Tonkin + Taylor Map Viewer (NZ) Date: 17/08/2023 11:40 AM



LOCATION PLAN

Tonkin+Taylor

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NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Stats NZ, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS, Maxar

PROJECT No.		
DESIGNED	XXXX	AUG.23
DRAWN	-WEB-	AUG.23
CHECKED		
APPROVED		DATE

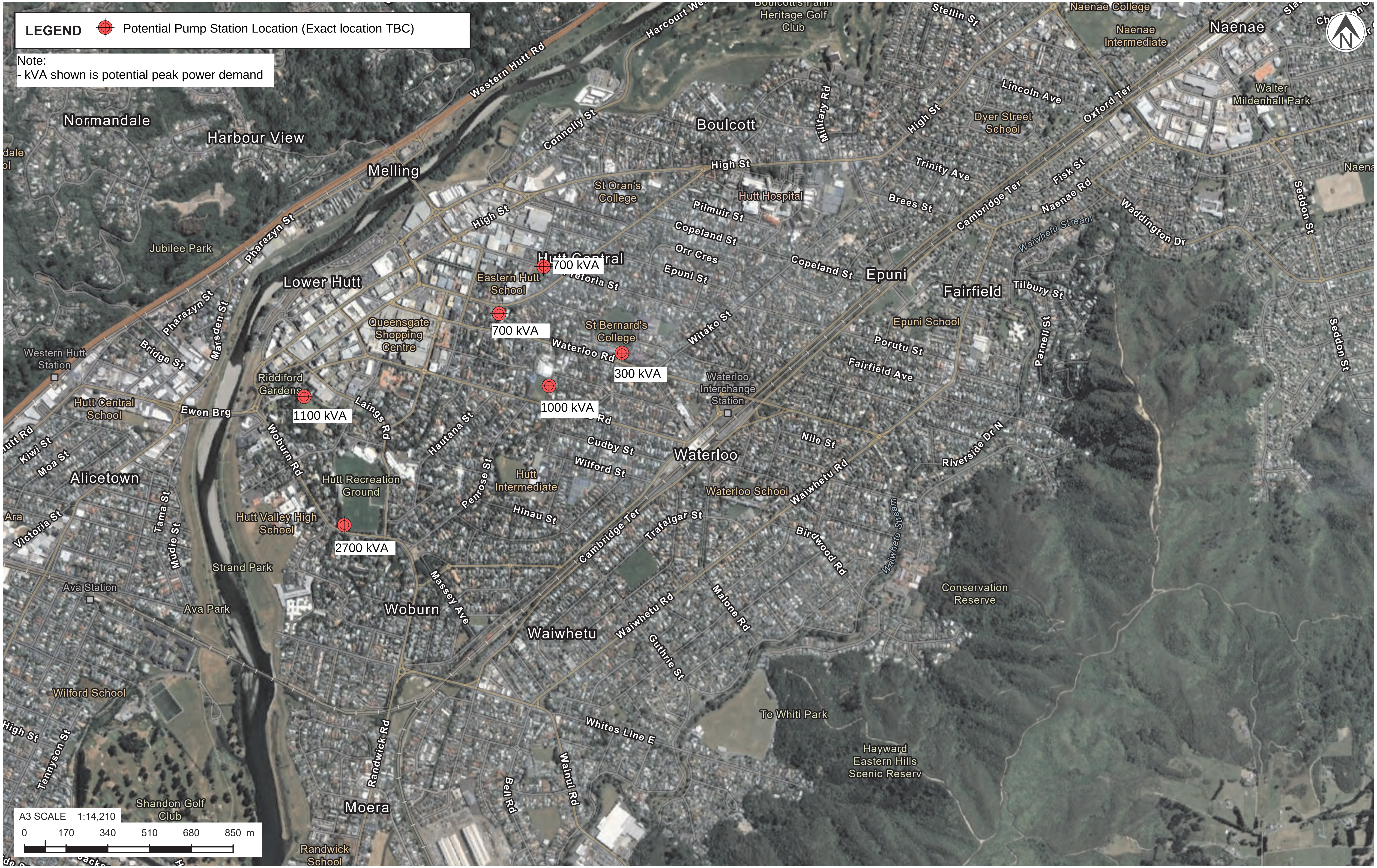
CLIENT

PROJECT

TITLE TT MAP VIEWER PRINT
Approx Pump Location

SCALE (A3) 1:14,210 FIG No. FIGURE 1. REV 0

Source: Tonkin + Taylor Map Viewer (NZ) Date: 17/08/2023 11:40 AM



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NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Stats NZ, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS, Maxar

LOCATION PLAN

PROJECT No.		
DESIGNED	XXXX	AUG.23
DRAWN	-WEB-	AUG.23
CHECKED		
APPROVED		DATE

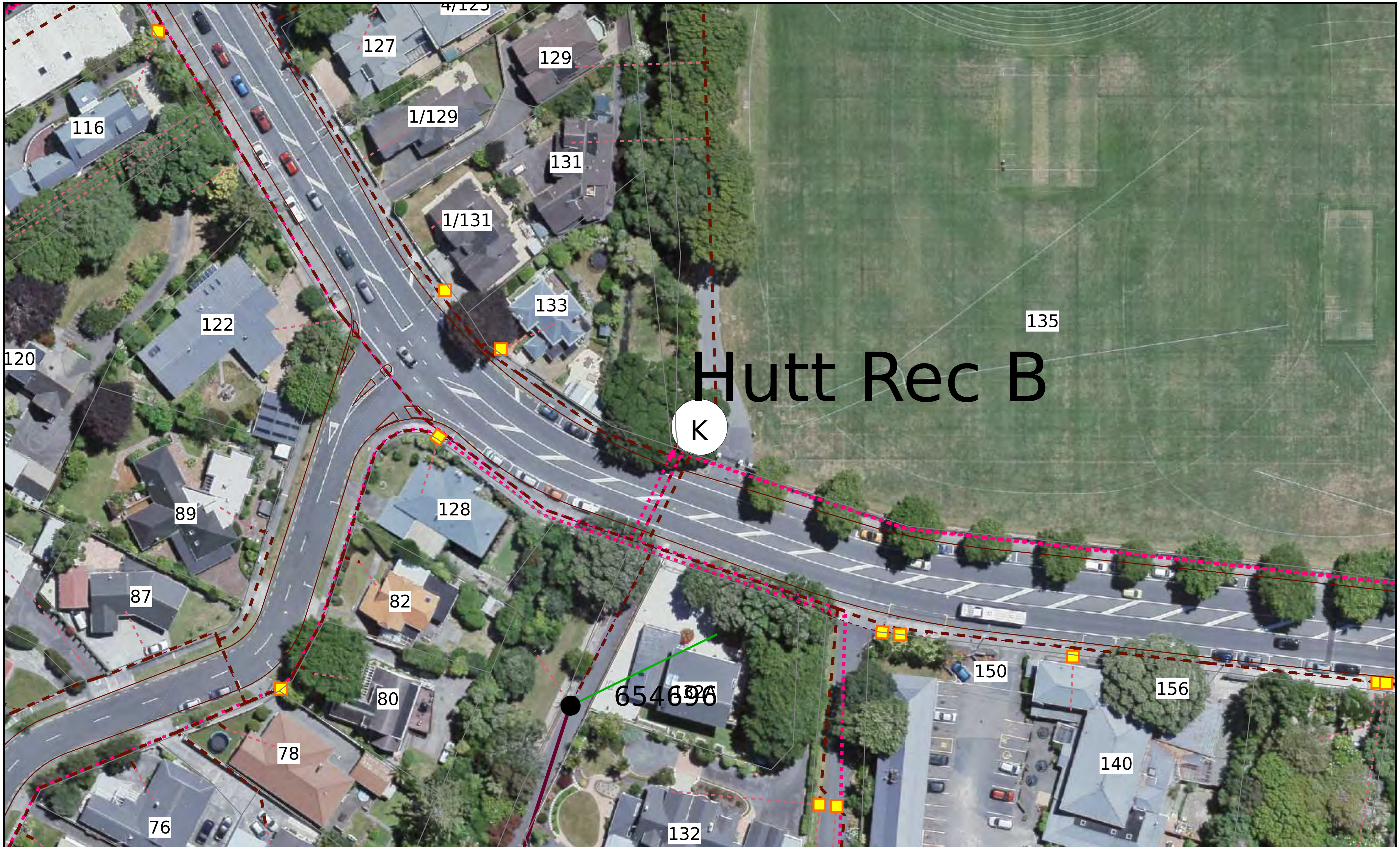
CLIENT

PROJECT

TITLE TT MAP VIEWER PRINT

Approx Pump Location

SCALE (A3) 1:14,210 FIG No. FIGURE 1. REV 0



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For underground service locations and obstruction plan requests call us on 0800 248 288. If you hit an electricity cable or overhead line call us immediately on 0800 248 148.
If you hit any gas pipeline call the Fire Service on 111.

THIS PLAN IS FOR DESIGN PURPOSES ONLY

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A4 ELECTRICITY DESIGN PLAN

Title:

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A4 ELECTRICITY DESIGN PLAN

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A4 ELECTRICITY DESIGN PLAN

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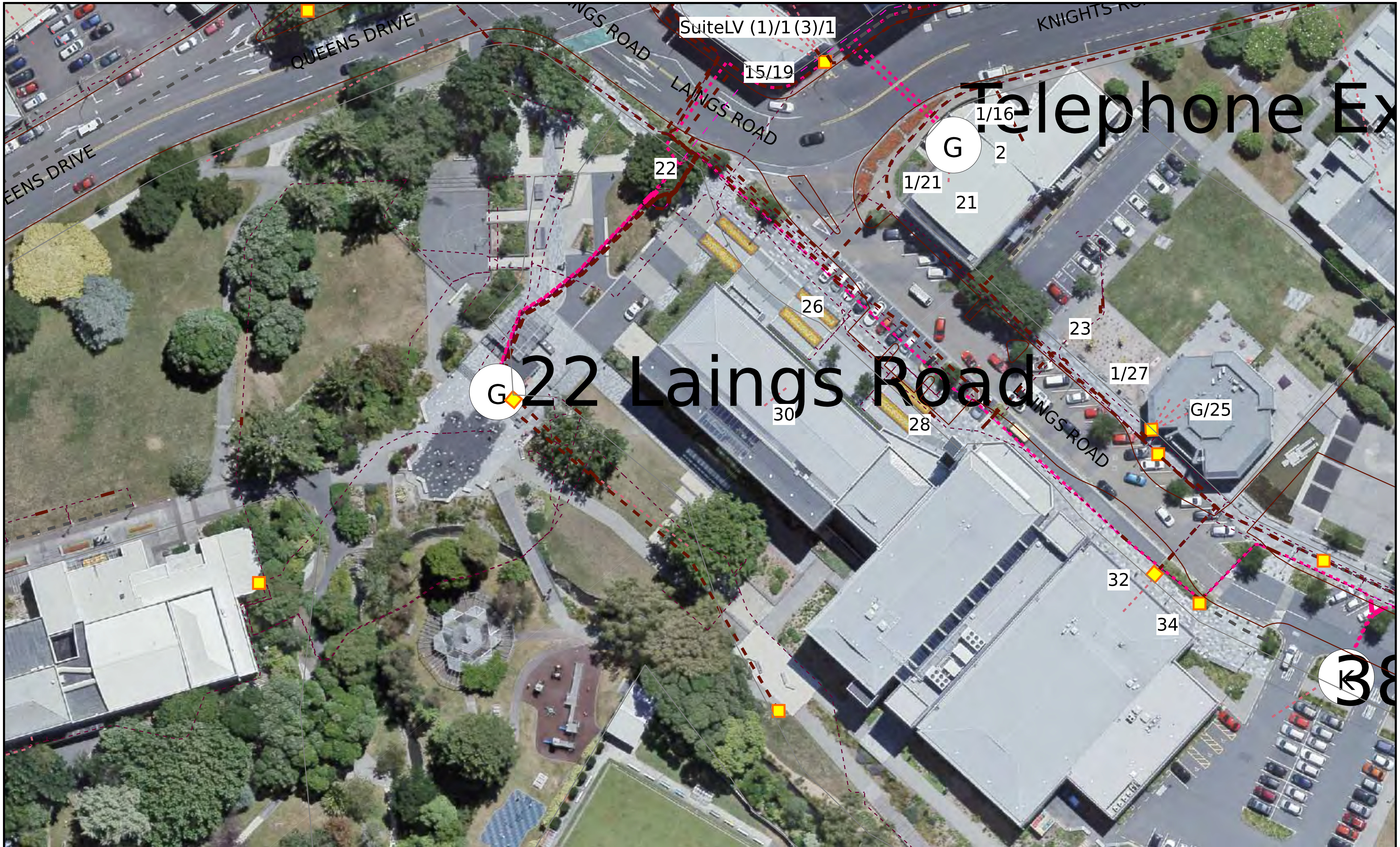

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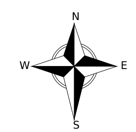

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wellington electricity

Wellington Electricity
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IISC is a service provider to we*

Tonkin + Taylor
L4, 265 Wakefield Street
Wellington, 6011
New Zealand

Dear [redacted]

Re: New Lower Hutt Pumping Stations with Indicative Project Costs

This letter is in response to an enquiry about Wellington Electricity's (WELL) network capacity for four potential new pump stations in the Lower Hutt region. The four new locations were presented by Tonkin and Taylor as three options Option 1B, Option 4, and Option 5.

WELL can confirm that at present there is adequate 11 kV capacity nearby to the provided locations for the pump stations. Indicative costs for connecting these loads are as follows:

Option Number:	Approximate Location:	Size (kVA):	Indicative Cost:
Option 1B	Pretoria Street	700	[redacted]
Option 4	Laings Road	1100	[redacted]
Option 4	Knights Road	1000	[redacted]
Option 5	Myrtle Street	1100	[redacted]

While all these sites are viable individually, at present, only three out of the four could potentially be connected and run concurrently. There are two scenarios in which this is possible:

Scenario	Locations
1	Pretoria Street, Laings Road, Knights Road
2	Pretoria Street, Knights Road, Myrtle Street

There is a concern, however, around reliability and resilience when connecting both the Pump stations at Myrtle Street and Laings Road at the same time. We would need to have a wider discussion around resilience to consider an option with all four pump stations operating concurrently.

Please be aware that these costs are an estimation based on the information presented at the time of writing this letter, these costs are likely to change with further information and more time to develop and understand the requirements of the project. All new customer connections will be aligned with WELL's customer contribution policy and our relevant technical standards.

Again, please note that WELL does not reserve capacity on its networks and is allocated on a first-come first-serve basis.

Happy to discuss further or provide clarification to any of the comments as outlined.

Kind regards

[redacted]

[redacted]
Graduate Engineer
Wellington Electricity

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IISC is a service provider to **we***

Tonkin + Taylor
L4, 265 Wakefield Street
Wellington, 6011
New Zealand

Dear [redacted]

Re: New Lower Hutt Pumping Stations

This letter is written in response to an enquiry about Wellington Electricity's (WELL) network capacity for six potential new pump stations in the Lower Hutt region.

WELL can confirm that at present there is adequate 11 kV capacity to supply the following pump stations, and have all the loads active at the same time:

Location	Size (kVA)
Waterloo Road	300
Kings Crescent	700
Pretoria Street	700

At present, the remaining three sites, listed below, would cause the 11 kV network to exceed its security criteria.

Location	Size (kVA)
Chilton Grove	1000
Laings Road	1100
Woburn Road	2700

As per our Asset Management Plan 2023, there are a number of 11 kV network upgrades planned for this area. We would be interested in working with you to develop a solution that would enable this capacity and meet the reliability requirements of such infrastructure.

All new customer connections will be aligned with WELL's customer contribution policy and our relevant technical standards.

Please note that WELL does not reserve capacity on its networks and that this is allocated on a first-come first-serve basis.

Happy to discuss further or provide clarification to any of the comments as outlined.

Kind regards

[redacted]

[redacted]
Graduate Engineer
Wellington Electricity

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W www.welectricity.co.nz

Appendix I- Constraints assessment – Geotechnical

Memorandum

To	**Hutt City Council**
cc	
From	[redacted]
Date	**04 September 2023**
Subject	**HCC IAF Upgrades – Constraints Assessment - Geotechnical**
Reference	**1091097.TT.2100.PRW.ME.EN.22.Constraints Assessment_Geotechnical.docx**

1 Introduction

1.0 Project background

Hutt City Council (HCC) and Kainga Ora, through the Infrastructure Acceleration Fund (IAF), have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the wastewater pipeline upgrade required to support this additional growth.

Tonkin and Taylor Ltd (T+T), with subconsultants Mott MacDonald (MM), have been engaged by Hutt City Council (HCC) to provide technical advice and design for the upgrades.

Previous work has been carried out by Stantec and Holmes Consulting to identify possible stormwater and wastewater upgrade options, respectively. The relevant reports are:

- The report produced by Stantec titled "Waiwhetu Growth – Stormwater Servicing Options", prepared for Wellington Water Ltd dated October 2021 ("Stantec Report").
- The report produced by Holmes Consulting titled "Optioneering and Concept Design Report, Hutt CBD Sewer Bypass", prepared for Wellington Water Ltd (WWL) dated 06/04/2023 ("Holmes Report").

1.1 Current project stage and purposes of this memorandum

The overall IAF upgrade programme comprises five stages:

- Stage 0 – Discovery phase (gap analysis), which is now complete.
- Stage 1 – Feasibility – current project stage.
- Stage 2 – Pre-implementation (detailed design).
- Stage 3 – Implementation (construction).
- Stage 4 – Practical completion.

The purpose of Stage 1 – Feasibility is to be in a position at the end of the phase to understand the feasibility of each project with associated cost and programme and go to market to procure a contractor for Early Contractor Involvement (ECI) for the preliminary design and consenting phases of the project.

The purpose of this document is to identify key constraints and fatal flaws relevant to the geotechnical aspect which will inform further option development.

1.2 Description of IAF options

1.2.1 Stormwater

A site walkover and brainstorming session has been carried out by the design team at the start of this stage. Various options have been identified to form a "long list" of possible options. Through further option development, the long list will be reduced down to a short list and then ultimately a preferred option will be identified by the end of this stage.

A summary of the long list stormwater options, current at the time of writing, is included in **Appendix A.** Included among these are the Woburn and Melling preferred stormwater options identified in the Stantec Report.

The objective of the stormwater upgrade options is to divert peak flows from the Opahu Stream to Te Awa Kairangi (The Hutt River), where stopbanks provide flood protection to adjacent developed areas.

The options generally comprise one or more pipelines, pump stations, and detention features. Both gravity and pumped systems are being considered at this stage, although it is likely that a pumped system will at least in part be required due to high flows in the Hutt River.

2 Constraints assessment

2.0 Introduction/overview

This report discusses the geotechnical considerations associated with the alignment options and associated structures. This report presents:

- A summary of findings of a desktop assessment;
- Likely soil/rock profile and groundwater level;
- A summary of the seismic hazard at the site;
- The potential for liquefaction at the site and associated consequences;
- A summary of geotechnical issues/challenges along the proposed alignment options and structures associated with the alignment options; and
- Options for specific site investigations to inform identified geotechnical issues.

2.1 Proposed works

Various options have been identified to form a "long list" of possible options of which three geological and hydrogeological cross-sections have been generated. These sections: north, middle, south comprise a mix of different options as follows:

- North – Option 7 and Option 5
- Middle – Part Option 6 and Part Option 8
- South - Option 2B and Option 3B

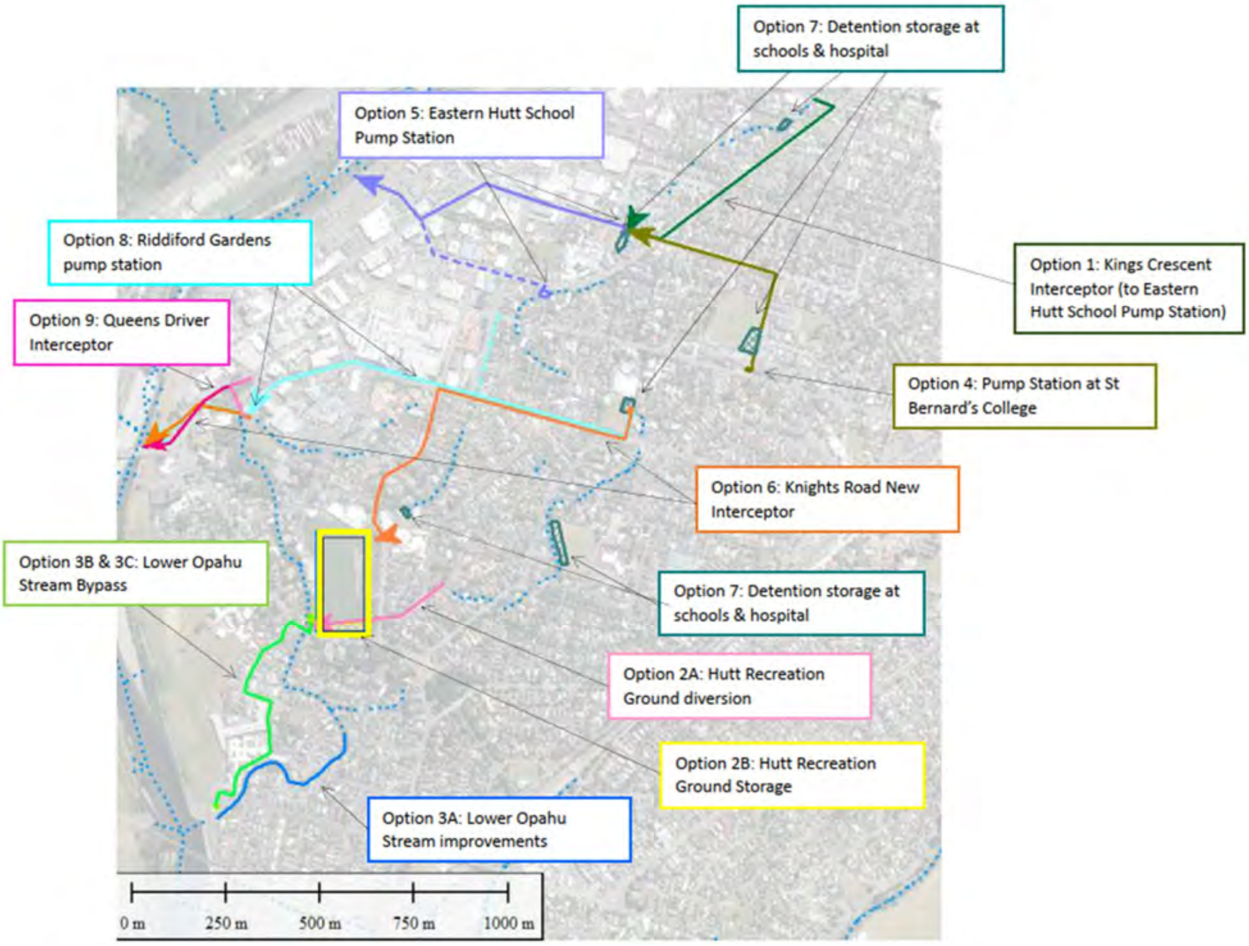

Figure 2.1: Alignment Options.

The geotechnical assessment has been based on the indicative dimensions for each type of infrastructure/structure. These details are presented in Table 2.1.

Table 2.1: Indicative dimensions for each type of infrastructure/structure

Infrastructure type	Depth of excavation (m)	Width of excavation (m)	Length of excavation open at one time (m)	Assumed construction Method
Pressurised pipelines - 900 mm and 1500 mm Ø pipe	3.4 – 4.0	1.9 - 2.5	12	Trench excavation with shoring
Gravity pipelines - 1350 mm and 1800 mm Ø pipe	5.85 – 6.3	2.35 – 2.8	6	Trench excavation with shoring/trenchless technology
Pump Stations	8.0	20	30	Sheet piling/Shoring

2.2 Available information

Data available for this assessment was sourced from:

- Stantec Limited (October 2021). Waiwhetu Growth – Stormwater Servicing Options. Prepared for Wellington Water Limited. Revision 2.

- Wellington Water Limited (April 2023). Optioneering and Concept Design Report. Hutt CBD Sewer Bypass. OPC101481.
- Holmes Consulting Limited (April 2023). Riverlink Wastewater Trunk CBD Bypass Civil Drawing Set. Revision A.
- Tonkin & Taylor Limited (June 2023). HCC IAF – Gap Analysis Memo. Reference no. 1091097.New Zealand Geotechnical Database.
- Historic aerial photographs sourced from Retrolens and licenced under the Creative Commons Attribution 4.0 New Zealand Licence[1]. Refer to **Appendix C**.

2.3 Site description

The project site encompasses the entire Hutt Central and extends southward to Whites Line W, including Totara Crescent to the East. To the west, it is bounded by the Te Awa Kairangi/Hutt River. The Te Awa Kairangi/Hutt River in this area follows a southwest course, traversing a low-lying basin known as the Lower Hutt Basin, flanked by steep hill country to the northwest, referred to as the Western Escarpment. The site plan is included in **Appendix B**.

Currently, there are ten proposed stormwater pipeline alignment options within the project site, as per Figure 2.1. It is important to note that all these pipeline alignments are planned to pass through the Hutt City Road Reserve. The topography of the project site is predominantly flat, with minimal variations in ground elevation.

The proposed pipeline alignments will cross a number of existing culverts and underground stormwater conduits along the Waiwhetu Stream (Refer **Appendix C**).

2.4 Geology

Published geological information, particularly by Stevens (1956)[2] and Begg (1996)[3] indicate that the Lower Hutt Basis comprise interbedded Quaternary age marginal marine, alluvium and beach deposits. The varied deposits reflect a complex geological history of climate change, global sea level rise, fault driven subsidence and sediment inputs into the basin. These deposits are collectively termed the Hutt Formation and have infilled the basis, butting against the Wellington Fault bound hill country to the west. The basin deepens towards the Wellington Fault and south towards Wellington Harbour to depths of greater than 300 m. The hill country is comprised of Rakaia Terrane sandstone and mudstone rock sequences.

The Hutt Formation deposits are further subdivided into specific Members (Stevens, Stratigraphy of the Hutt Valley, New Zealand 1956), and those relevant to the Riverlink site include Taita Alluvium overlying Petone Marine Beds and Melling Peat. Beneath these layers are the Waiwhetu Artesian Gravels which form a regionally significant aquifer.

The extent of the Petone Marine Beds has been inferred by others to extend approximately to the Melling Bridge. The Melling Peat was initially identified by Stevens (circa 1956) in a then heavily eroded section of the Hutt Riverbank near Melling Bridge.

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[1] Retrolens website accessed on 8 September 2023. https://retrolens.co.nz.

[2] Stevens, G.R. 1956. "Stratigraphy of the Hutt Valley, New Zealand." New Zealand Journal of Geosciences 38 (3): 201-235.

[3] Begg, J.G., Mazengarb, C. 1996. Geology of the Wellington area, scale 1:50 000, geological map 22. Lower Hutt: Institute of Geological & Nuclear Sciences.

The following sub-sections provide a summary of each of the six geologic units which are expected to underlie the site.

2.4.1 Fill (existing)

The existing fill material is typically 0.5 m – 1.5 m thick across the project area (and Hutt Valley), except at stopbank and infilled stream channel locations where fill thicknesses greater than 2.5 m have been observed (fill thickness >2.5 m is expected to be present in some infilled stream locations).

The existing fill is typically fine to coarse sand with gravel and cobbles. Such fill is loosely packed, sub-rounded to sub-angular and well graded.

The infilled stream channels northwest of the Hutt River are variously/occasionally logged as colluvium. There is insufficient detail available at this stage to robustly map the extent of the infilled stream areas.

Historically fill material has been dredged / excavated from the Hutt River, but silt and clay layers up to 3 m thick have been reported in the stopbanks. The stopbanks have been modified many times since their original construction during the 1900s. Quarry strippings were used to raise the stopbanks in 1960/61 and these will likely comprise low permeability residual soil and weathered greywacke.

2.4.2 Taita Alluvium

Taita Alluvium materials are present throughout the project footprint and generally underlies the existing fill. The Taita Alluvium material consists of cobbles and gravels, mixed with sands, silts and clays. The Taita Alluvium material is exposed in some locations along the existing Hutt Riverbed.

The silty fine sand layers in the Taita Alluvium material are typically medium dense and are encountered at variable depths.

2.4.3 Melling Peat

The Melling Peat layer is described by Stevens[4] as a 'fossil forest and associated beds of woods debris'. And 'the roots penetrate into a brown clay layer, rich in rootlets, representing the former forest floor'. The age of the Melling Peat is estimated to be approximately 4,300 years before present time (B.P.). The Melling Peat is occasionally logged in some boreholes as organic layers in the Taita Alluvium, in particular in the vicinity and south of Melling Link Bridge.

2.4.4 Petone Marine Beds

The Petone Marine Beds materials are described by Stevens as interbedded silts and clays which are over-consolidated consistent with approximately 30 m overburden. The Petone Marine Beds are reported to extend from the Petone shoreline to the Melling Bridge area.

2.4.5 Waiwhetu Alluvium

The Waiwhetu Alluvium material is typically reported as a sandy, fine to coarse gravel. Sub-rounded to sub-angular. Dense to very dense with uncorrected SPT N values typically greater than 50. The Waiwhetu Alluvium material was deposited in a braided high energy fluvial environment during the last glacial period (approximately 10,000 – 70,000 years ago). It forms the principal aquifer in the

[4] Stratigraphy of the Hutt Valley, New Zealand. G.R. Stevens. Geology Department, Victoria University College (1956).

Lower Hutt Valley, and it is usually confined by the younger Petone Marine Beds and Melling Peat material.

2.5 Ground and groundwater conditions

The ground model developed for the site is based on available site investigations and published geotechnical information from New Zealand Geotechnical Database. The geology was divided into different geological units. The geological units are summarised in Table 2.2 and form the basis for the geotechnical sections presented in **Appendix B**.

Table 2.2: Ground model summary

Geological unit	Description	Extent	Depth to top of layer (m)	Thickness (m)
Fill	Gravel and sand with localised areas of silt and clay. Variable strength	Existing stopbanks, and possibly widespread across the project site.	0	1 to >5 m
Taita Alluvium	Sand and Gravel with localised layers of clay, silt, and organics. M. dense to very dense	Widespread across most of the site.	0 to 5	2 to >15
Petone Marine Beds/Melling Peat	Silt, clay, and silty sand. Beds of organic silt, wood and peat. Firm to stiff	Extends from Wellington Harbour and inferred to terminate north of Melling Bridge (exact extent unknown)	5 to 20	>5 to >15
Waiwhetu Gravels	Sand Gravel. Medium. Dense to v. dense	Widespread across the site at depth.	15	> 15

The groundwater is likely to be encountered within the Taita Alluvium at relatively shallow depths approximately 1.0 m below ground level.

2.6 Faults

The project area is located in the Wellington Region, an area of high seismicity. The region has a number of major active faults and a subduction zone capable of producing large earthquake of Richter Magnitude 8 or greater. A number of active faults are located in the vicinity of the site and are summarised in Table 2.3.

Table 2.3: Summary of nearby known Active Faults

Active Fault	Recurrence Interval of Rupture	Characteristic Magnitude	Distance from Site Area (km)
Wellington Fault	840	7.5	~0.8
Ohariu Fault	2,200	7.5	~10
Wairarapa Fault	1,500	8.1	~15
Pukerua – Shepherds Gully Fault	3,500	7.4	~17
Otaki Fault	4000	7.4	~ 6.5

Published information maps the Wellington fault between the true right bank of the Te Awa Kairangi/Hutt River and the Western Escarpment.

A characteristic rupture of the Wellington Fault could give single event displacements of the order of 4 m horizontal and 1 m vertical. These values follow recent available research by Saunders, et al. (2016)[5] and Little, et al. (2010)[6] and are greater than those presented in the Hutt City District Plan, Chapter 14H 1.1.1 (4 m horizontal displacement and 0.5 m vertical displacement).

Faulting in the wider region has resulted in regional uplift and subsidence. A recent example is the 1855 Wairarapa Fault earthquake which resulted in uplift of the Hutt Valley/Petone area in the order of 1.2-1.5 m (Townsend, et al. 2015). While regional contour changes in elevation are a relevant hazard for the Hutt Valley which could cause changes to river flow and flood height, they are extremely difficult to predict and are not expected to be considered in the design.

2.7 Seismic subsoil class

Ground investigations along the Te Awa Kairangi/Hutt River and surrounding project area did not encounter bed rock. Boon[7] suggested that Greywacke bedrock is likely to lie at depths in excess of 210 m below ground level across the site. On this basis, the site subsoil is assessed to be Class D – Deep soil site for structural design purpose, as outline in the design standard (NZS 1170.5: 2004 2016).

2.8 Seismic shaking hazard

The seismic hazard in terms of peak ground acceleration (PGA) and magnitude (M) for the site has been assessed based on MBIE/NZGS Earthquake Geotechnical Engineering Practice Module 1 (2021): Overview of the Guidelines, Section 5, Method 1. Table 2.4 presents the return periods for earthquakes with various 'unweighted' peak ground accelerations (PGA) with a corresponding earthquake magnitude. The derived PGA and earthquake magnitude have been used to determine the liquefaction potential at the site.

The proposed stormwater pipeline and associated structure shall be designed as seismically resilient in accordance with Clause 3.7 – Seismic Resilience of the Wellington Water Regional Standard for Water Services (December 2021). The design criteria for a stormwater pipeline and associated structure shall be in accordance with Table 3.2 – Design criteria for new structures of the Standard.

Table 2.4: Ground seismic hazard

NZS 1170.5 Limit State	Importance Level	PGA (g)	Magnitude, M	Return period (years)
Ultimate limit state (ULS_{IL4})	IL4	1.27	7.7	2500
Serviceability limit state (SLS)	IL4	0.13	6.5	25

[5] Saunders, W.S.A., J.E. Mathieson, J. Lawrence, R.J. Van Dissen, G.D. Dellow, W.L. Power, W.F. Ries, and D.B. Townsend. 2016. Review of hazard information for Hutt City, Report Reference 2016/74. Lower Hutt: GNS Science.

[6] Little, T.A., R. Van Dissen, U. Rieser, E.G.C. Smith, and R. Langridge. 2010. "Co-seismic strike-slip at a point during the last four earthquakes on the Wellington fault near Wellington, New Zealand." Journal of Geophysical Research 115, (B05403).

[7] Boon, D., N.D. Perrin, G.D. Dellow, R. Van Dissen, and B. Lukovic. 2011. "NZS1170.5:2004 Site Subsoil Classification of Lower Hutt." Auckland: Proceedings of the Ninth Pacific Conference on Earthquake Engineering.

2.9 Liquefaction assessment

2.9.1 General

The site geology includes alluvial and marine deposits comprising predominantly gravel, sand, and silt layers. A recent regional study (Dellow, Perrin and Ries 2018)[8] has indicated soils within the project area to have between a moderate to high susceptibility (potential) to liquefy and therefore we have further assessed the liquefaction risk and consequence of the site.

Indicative values of free field settlement (FS), cyclic displacement (CD), and lateral spread displacement (LSD) for the project site are presented in **Appendix D**.

2.9.2 Historical liquefaction events

In the past, land damage was observed along the river during the Wairarapa earthquake in 1855. During this earthquake, large fissures were formed along banks of rivers and streams within the Hutt Valley, and a bridge across the Te Awa Kairangi/Hutt River was destroyed when the abutments sank (the location of this bridge is not clear). This damage has been attributed to earthquake ground shaking resulting in liquefaction and lateral spreading (Townend, Langridge and Jones 2005)[9].

The historic evidence of the 1855 Wairarapa earthquake shows that liquefaction and lateral spreading has occurred in the Hutt Valley, presumably, including the Project area. However, it should be noted that this event is estimated to have been a magnitude 8.2 Mw (Townend, Langridge and Jones 2005) which is significantly greater than the ULS design earthquakes presented in Section 2.8.

2.9.3 Liquefaction trigger

Soils that are susceptible to liquefaction require a certain level of earthquake shaking (trigger) to cause them to liquefy. Denser soils require more intense and/or longer duration of shaking (higher trigger) than less dense soil.

The trigger for each soil layer identified as being susceptible to liquefaction has been assessed by the method proposed by Idriss and Boulanger (2014). This method is based on an empirical relationship with the SPT 'N'/CPT "q_c" and fines content.

The results of the assessment are summarised in Section 2.9.8.

2.9.4 Liquefaction-induced free-field settlement

Liquefaction-induced free-field settlement at the site has been assessed using the method of Zhang, Robertson and Brachman[10].

2.9.5 Cyclic softening susceptibility

Saturated silts and clays which are not susceptible to liquefaction have the potential to undergo cyclic softening (some strength loss). The potential for cyclic softening to occur, and the associated cyclic strength has been evaluated using the Boulanger and Idriss (2007)[11] method.

[8] Dellow, G.D., N.D. Perrin, and W.F. Ries. 2018. Liquefaction hazard in the Wellington Region. (GNS Science report; 2014/16), Lower Hutt (NZ): GNS Science, 71 p. doi:10.21420/G28S8J.
[9] Townsend, D.B., J.G. Begg, R.J. Van Dissen, D.A. Rhoades, W.S.A. Saunders, and T.A. Little. 2015. Estimating co-seismic subsidence in the Hutt Valley associated with rupture of the Wellington Fault. Lower Hutt: GNS Science.
[10] Zhang, G., Robertson, P.K., and Brachman, R.W.I. (2002). "Estimating liquefaction-induced ground settlements from CPT for level ground". Canadian Geotechnical Journal, 2002, 39(5).
[11] Boulanger, R.W. and Idriss I.M. (2007). "Evaluation of cyclic softening in silts and clays. Journal of Geotechnical and Geoenvironmental Engineering, 133(6), 641-652.

2.9.6 Cyclic displacement

Cyclic displacement at the site has been assessed in accordance with the Bridge Manual using the procedure proposed by Tokimatsu and Asaka[12].

2.9.7 Lateral spreading

Lateral spreading is the movement of ground downslope or toward a free edge (e.g. the Te Awa Kairangi/Hutt River) as a result of shearing of weak liquefied ground under seismic and/or gravity forces. Lateral spreading of the land adjacent the Te Awa Kairangi/Hutt River following earthquake shaking has been assessed for the Project.

Potentially continuous layers that have been assessed to be liquefiable using borehole and CPT results have been identified. These continuous layers of liquefiable material could result in lateral spread.

Lateral spreading at the site has been assessed in accordance with the Bridge Manual using empirical methods proposed by Zhang et al. (2004)[13].

2.9.8 Liquefaction potential

Liquefaction susceptibility and trigger have been assessed as described in Sections 2.9.1 and 2.9.3 The conclusions are summarised below.

Table 2.5: Liquefaction potential

Geological unit	Description	Depth to top of layer (m)	Layer thickness (m)	Liquefaction Potential
Fill	Gravel and sand with localised areas of silt and clay. Variable strength	0	1 to 5+	<u>Above groundwater table:</u> Not expected to liquefy above the groundwater table. <u>Below groundwater table:</u> Local liquefaction of the Fill at the site could be triggered at a PGA of 0.16g, Magnitude 7.7 earthquake event or greater (13% ULS). Widespread liquefaction of the Fill could be triggered at a PGA of 0.22g, Mw 7.7 earthquake event or greater (17% ULS). This widespread liquefaction could result in lateral spread.
Taita Alluvium	Sand and Gravel with localised layers of clay, silt, and organics. Medium dense to very. Dense	0 to 5	0 to 15	<u>Above groundwater table:</u> Not expected to liquefy above the groundwater table. <u>Below groundwater table:</u> Local liquefaction of the Taita Alluvium at the site could be

[12] Tokimatsu, K. and Asaka, Y. (1998). "Effects of liquefaction-induced ground displacements on pile performance in the 1995 Hyogoken-Nambu earthquake. Soils and Foundations, Special Issue no. 2, September 1998: 163-177 pp.
[13] Zhang G, Robertson PK and Brachman RWI (2004) Estimating liquefactioninduced lateral displacements using the standard penetration test or cone penetration test. Journal of Geotechnical and Geoenvironmental Engineering, 130(8), 861-871.

				triggered at a PGA of 0.16g, Magnitude 7.7 earthquake event or greater (13% ULS). Widespread liquefaction of the Fill could be triggered at a PGA of 0.22g, Mw 7.7 earthquake event or greater (17% ULS). This widespread liquefaction could result in lateral spread.
Petone Marine Beds/Melling Peat	Silt, clay, and silty sand. Beds of organic silt, wood and peat. Firm to stiff	0 to 15	O to 15	Material is highly plastic and not susceptible to liquefaction but may exhibit cyclic softening under ULS shaking.
Waiwhetu Gravels	Sandy Gravel. Dense to very dense	15	> 15	Data from the previous investigations indicate the Waiwhetu gravels are too dense to liquefy.
Rakaia Terrane	Moderately weathered, grey, sandstone Moderately strong	> 200	Unknown	Not expected to liquefy under a ULS shaking.

2.9.9 Liquefaction consequences

Considering the potential for liquefaction described in Table 2.5, the consequences of liquefaction at the site have been identified as listed in Table 2.6.

Table 2.6: Liquefaction consequences

ID	Issue	Comments
1	Post-liquefaction ground settlement	• Total free-field settlement at ULS shaking is estimated to be in the order of 100 m to 200 mm. Could be more or less in some areas. • Could be a problem for the stormwater pipes, manholes, and shallow foundations. • Foundation piles will experience negative skin friction (NSF) as a consequence of the above settlement and should be accounted for in the vertical foundation design.
2	Sand boils	• Possible in areas with thin non-liquefied surface crust (e.g. less than 2 – 3 m) with shallow widespread liquefaction below the crust. • Could result in vertical settlement in addition to the post-liquefaction ground settlement.
3	Cyclic displacement	• Cyclic displacement (ground lurch) at ULS shaking is estimated to be in the order of 100 to 300 mm. • This will cause increased lateral earth pressures against the basement walls, foundations, and any substructure. • Cyclic displacement (ground lurch) should be considered in the design of pump station basement, foundation, and manhole and pipelines.
4	Lateral spread	• Lateral spread displacements at ULS shaking are estimated to be: – North Option 5 and 7: Expected to be between 500 mm to 1600 mm along the stopbanks, and decreases further away from the Hutt River.

		– Middle Option 5 and 7: Expected to be 150 mm to 650 mm along the stopbanks and decreases further away from the Hutt River. – South Part Option 2B and 3B: Expected to be 500 mm to 900 mm along the stopbanks and decreases further away from the Hutt River. • Refer to the displacement profile included in Appendix B. • This will cause increased lateral earth pressures against the pump station basement walls, foundations, and any substructure. • This will cause pipe stretching or differential movement depending on the direction of lateral spread relative to the pipeline route. • Lateral spread should be considered in the design of pump station basement, foundation, manhole and pipelines. • Recommended mitigation comprises the use of ground improvement surrounding and beneath the pump station to reduce lateral spread deformation. Potentially feasible solutions include: – Ground improvement with stone columns around and beneath the pump station, but may not be effective for silts and clays; – In-situ cement stabilisation of soil under and around the pump station by mass stabilisation, or deep soil mix columns; or – Piled foundations to achieve high vertical and lateral capacities. The suitability of improvements would need to be verified through site-specific geotechnical investigations. • Use of flexible connections on all connecting pipes and utilities is recommended to accommodate lateral deformation and differential settlement, to limit potential for damage. • Use of pipe materials that exhibit a high level of seismic resilience.
5	Reduced soil strength and stiffness	• Liquefied soils will experience a reduction in strength and stiffness. • Weak clay-like soils may experience softening or strength degradation. • This results in reduced lateral and vertical support to foundations and substructure.
6	Uplift pressure	Any buried structures below the groundwater level will be subjected to hydrostatic and additional liquefaction-induced uplift pressures. Uplift pressure should be considered in the design of the pipe support, manhole, pump station, and any substructure. Pump stations/manholes should be designed to mitigate the potential for uplift from generation of excess pore pressure and bearing failure of the structure. Extending the base of the foundation laterally outside the footprint of the station may be a cost-effective measure of mitigation against uplift.
7	Differential Settlement along pipe alignments	Differential liquefaction-induced settlement is likely along the pipeline routes as the liquefaction potential varies across the entire project site. Differential movement should be considered in the pipe design. The use of flexible pipe materials and fittings is recommended.
8	Dynamic Structural Damage	The pump station structure and connecting pipe network will experience different seismic responses during ground shaking. The effect of this has not been analysed as part of this assessment. However it is important to highlight this as a potential cause of damage that may render the pump stations unserviceable, due to pipe and/or connection and structural breakage.

2.10 Geotechnical issues identified

Geotechnical issues associated with the site have been identified and are discussed below. These could impact the proposed pipeline options and associated structures and should be considered in the selection of the preferred alignment. All alignment options may have similar geotechnical constraints with the exception of lateral spreading, which varies depending on the location and distance from the Hutt River.

Table 2.7: Geotechnical issues identified.

ID	Issue	Comments
1	Liquefaction	Refer Section 2.9.9.
2	Geotechnical issues associated with construction	Refer to Sections 2.10.1 and 2.10.2.

2.10.1 Pipelines and manholes

Identified geotechnical issues for the construction of pipelines and manholes comprise the following:

- **In-ground obstruction:** Potential obstruction requiring removal for trenching, and delays for directional drilling.
- **Existing underground services:** Potential clash with other existing underground services.
- **Stability of trench excavation:** The stability of the trench excavation is likely to be variable along the pipeline routes.
- **Temporary trench support:** A temporary trench support may be required for excavation greater than 1.5 meters.
- **Excavation within the Melling Peat:** Excavation within the Melling Peat is unlikely to stand unsupported. It is also possible that for excavations supported by trench shields, an up-welling from the bottom of the excavation may occur. Up-welling from the bottom of the excavation should be considered in the temporary works design.
- **In-flow of water and dewatering:** Groundwater levels and inflows will vary along the pipeline route depending on the ground condition encountered and the seasonal rainfall. The requirement for dewatering should be considered in the temporary works design.
- **Ground Settlement:** Ground settlement due to the excavation wall movement, dewatering, and vibration is possible. Assessment of these effects should be considered in the temporary works design.
- **Secondary Compression of Melling Peat:** An ongoing secondary compression of the underlying Melling Peat may be possible. The amount of compression could vary depending on the type and thickness of the peat material. The effect of the secondary compression of peat should be considered in the design.
- **Directional Drilling:** Adequate overburden thickness will be required to mitigate potential for ground heave, and fracking of drilling fluids to the ground surface. Identification of appropriate trenchless technology would be required during detailed design.
- **Existing culverts/underground conduits:** The proposed pipeline alignment options will cross a number of existing culverts and underground stormwater conduits along the Waiwhetu Stream (Refer Appendix A and Appendix C). This should be considered in the detailed design.

2.10.2 Pump station

Identified geotechnical issues for the construction of pump stations comprise the following:

- **Shoring:** A temporary shoring would be required for deep excavations.
- **In-ground obstruction:** To support an excavation down to 8 meters below ground level, sheet pilling needs to be embedded into a competent material. Sheet pilling into dense gravels may be challenging. CFA piles or contiguous bored piles may be an option.
- **Vibration of surrounding soils:** Sheet pilling installation may cause vibration to the surrounding soils leading to potential ground settlement.
- **In-flow of water and dewatering:** Groundwater levels and inflows will vary depending on the ground condition encountered and the seasonal rainfall. The requirement for dewatering should be considered in the temporary works design.

3 Applicability

This report has been prepared for the exclusive use of our Wellington Water, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

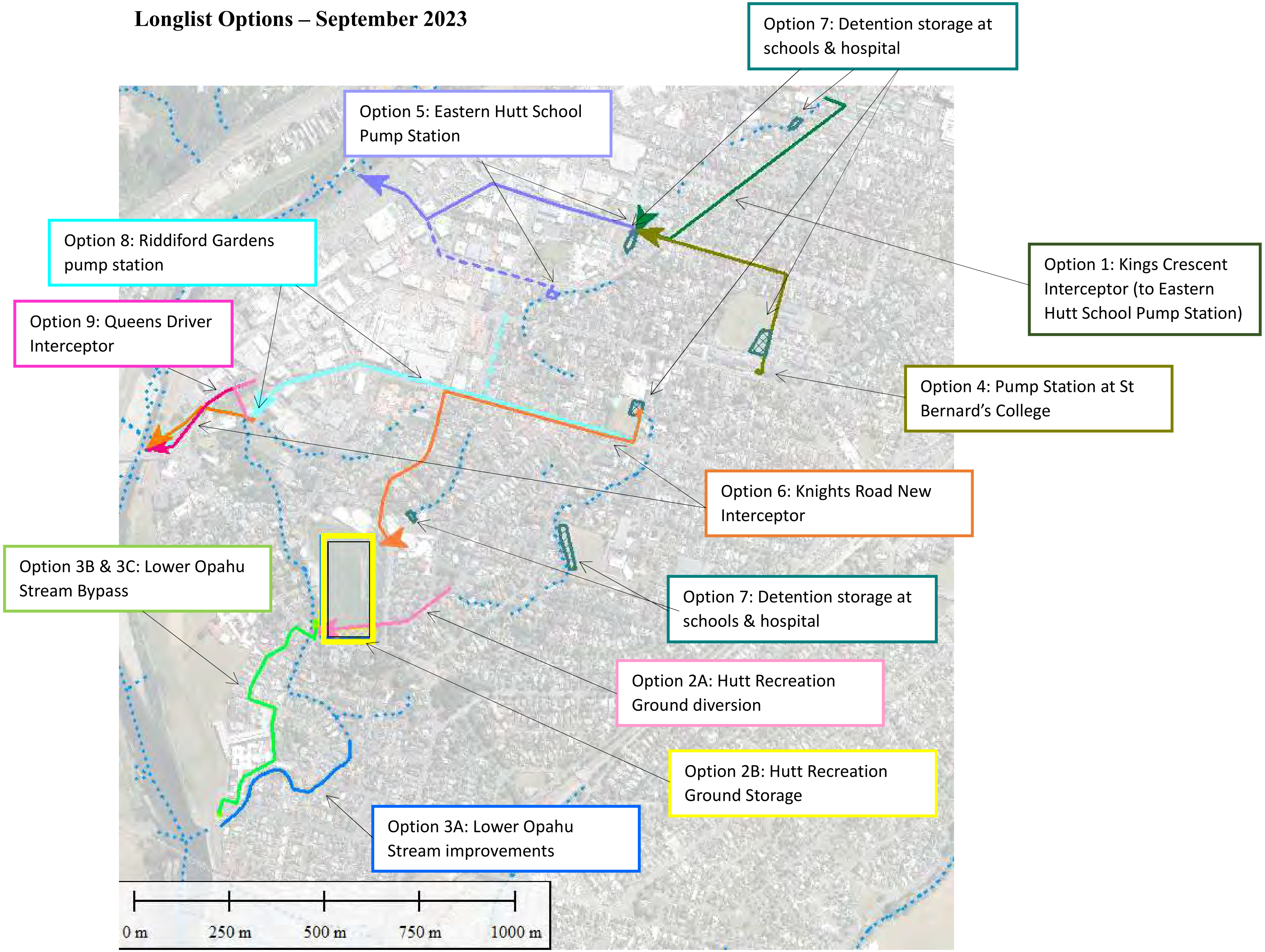
Recommendations and opinions in this report are based on existing limited ground investigation data. The nature and continuity of subsoil away from the ground investigation test locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

Report reviewed by:

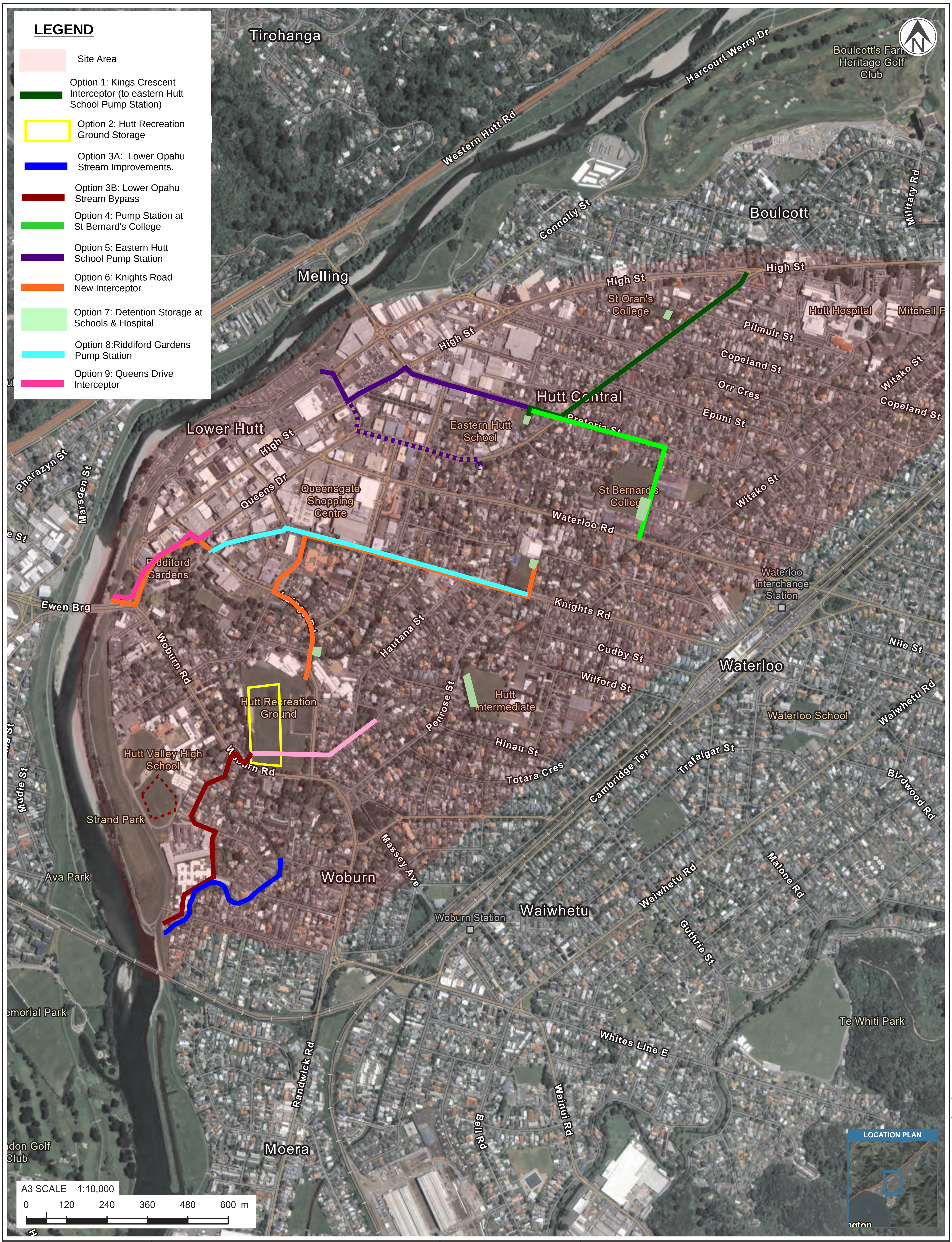
[redacted] Technical Director

Appendix A: Stormwater alignment options plan

Longlist Options – September 2023



Appendix B: Plan and sections



Source: Tonkin + Taylor Map Viewer (NZ) Date: 5/09/2023 9:32 AM

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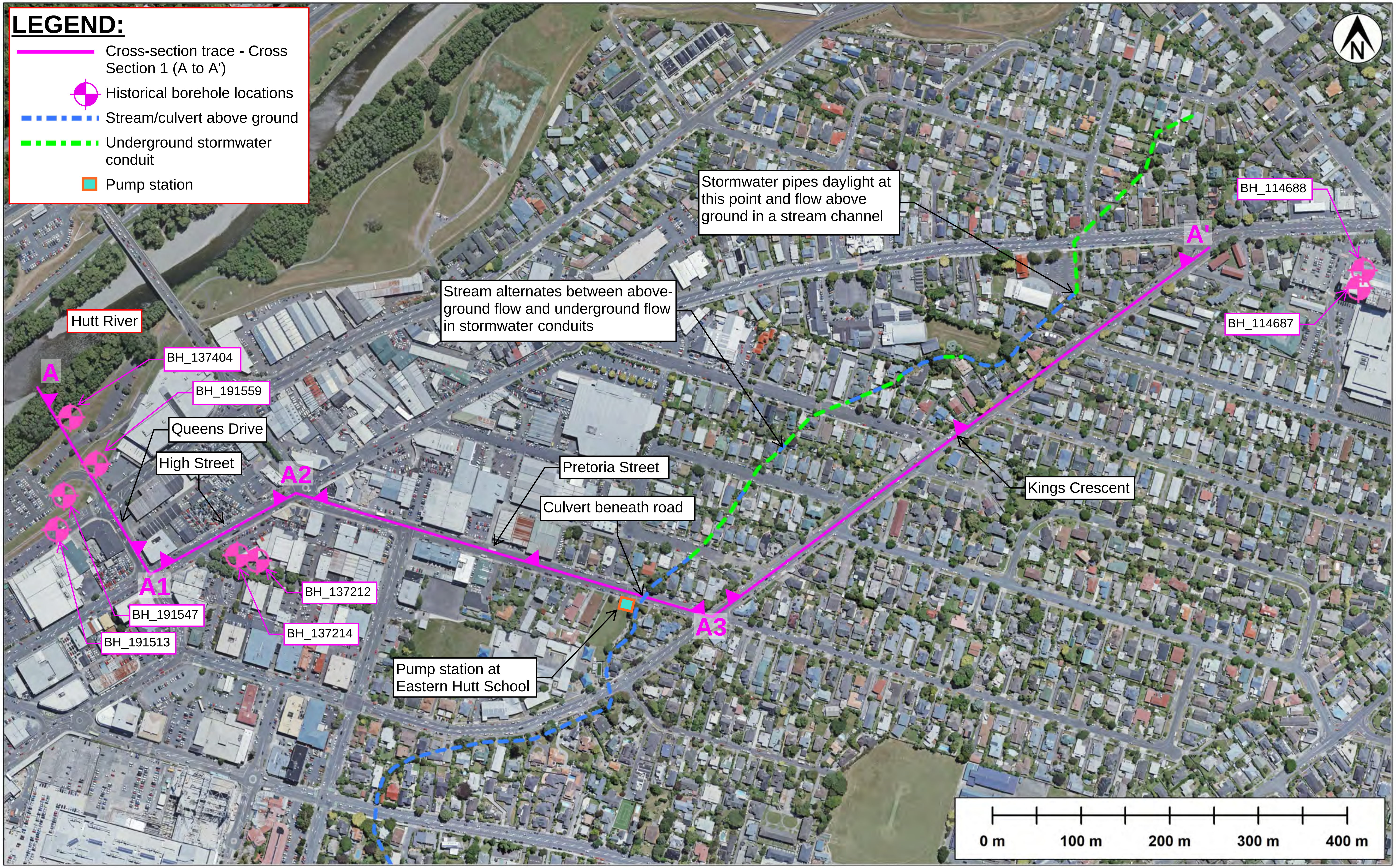
NOTES: Stormwater Alignment Options	PROJECT No.	1091097		CLIENT: **HUTT CITY COUNCIL**
	DESIGNED	DEVM	SEP.23	PROJECT: **HCC - IAF STORMWATER UPGRADE**
	DRAWN	-WEB-	SEP.23	TITLE: SITE PLAN_ALIGNMENT OPTIONS
	CHECKED			
CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Stats NZ, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS, Maxar	APPROVED	DATE		SCALE (A3) 1:10,000 FIG No. FIGURE 1. SITE PLAN REV 0



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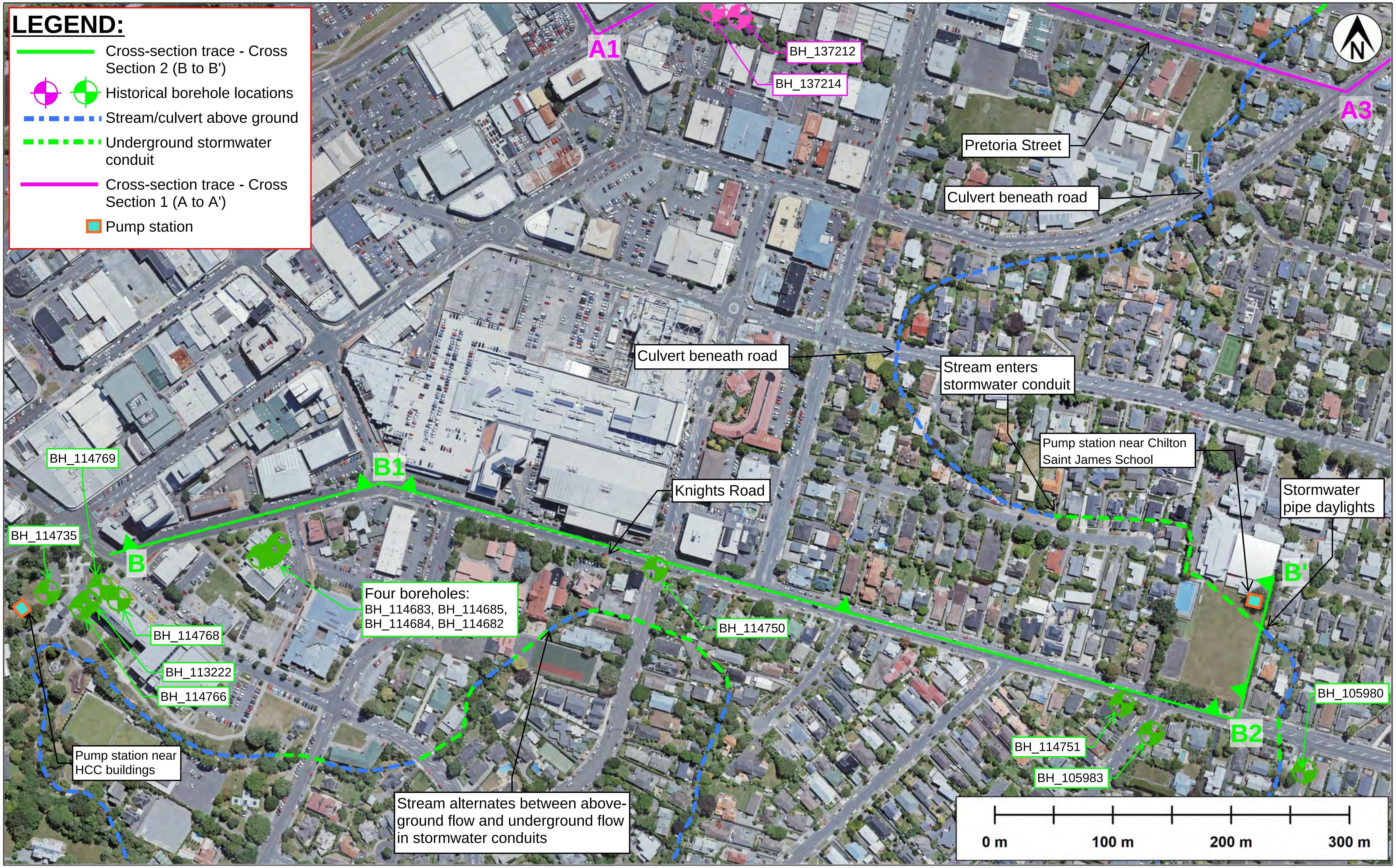
NOTES
- Aerial imagery is 0.075 m aerial photography (2021) from Land Information New Zealand.
- The displayed borehole appellations are the borehole identification numbers for each investigation in the New Zealand Geotechnical Database.
- Positions of underground stormwater conduits are estimated from Wellington Water GIS service maps

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE **Cross Section 1: A to A'**
SCALE (A3) 1:4000
REV



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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 31/08/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT **Hutt City Council**
PROJECT **HCC IAF Stormwater/Wastewater Upgrades**
TITLE **Cross Section 2: B to B'**
SCALE (A3) **1:3000**
REV

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NOTES
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- Positions of underground stormwater conduits are estimated from Wellington Water GIS service maps

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

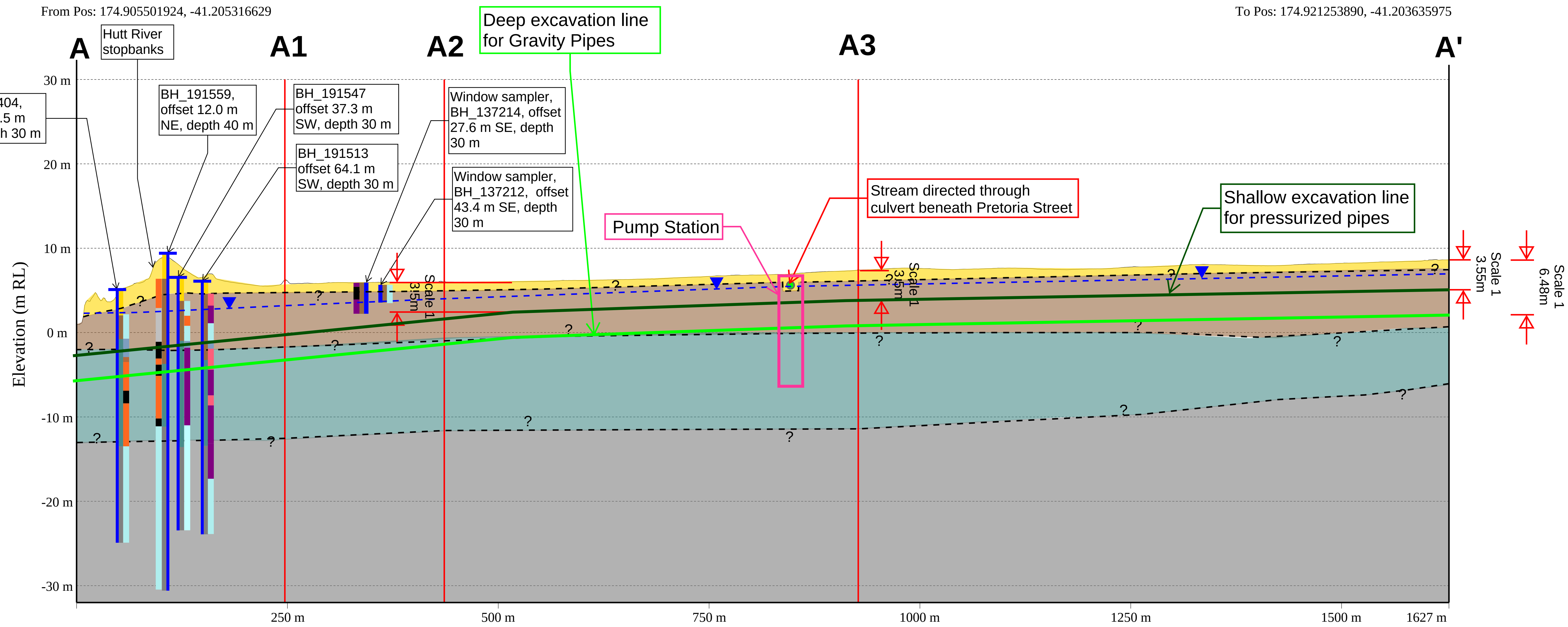
DESIGNED		
DRAWN	DAHE	31/08/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE **Cross Section 3: C to C'**
SCALE (A3) 1:3000
REV

Cross Section 1 - A to A'



LEGEND

- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:5000H
10x Vertical Exaggeration (1:500V)

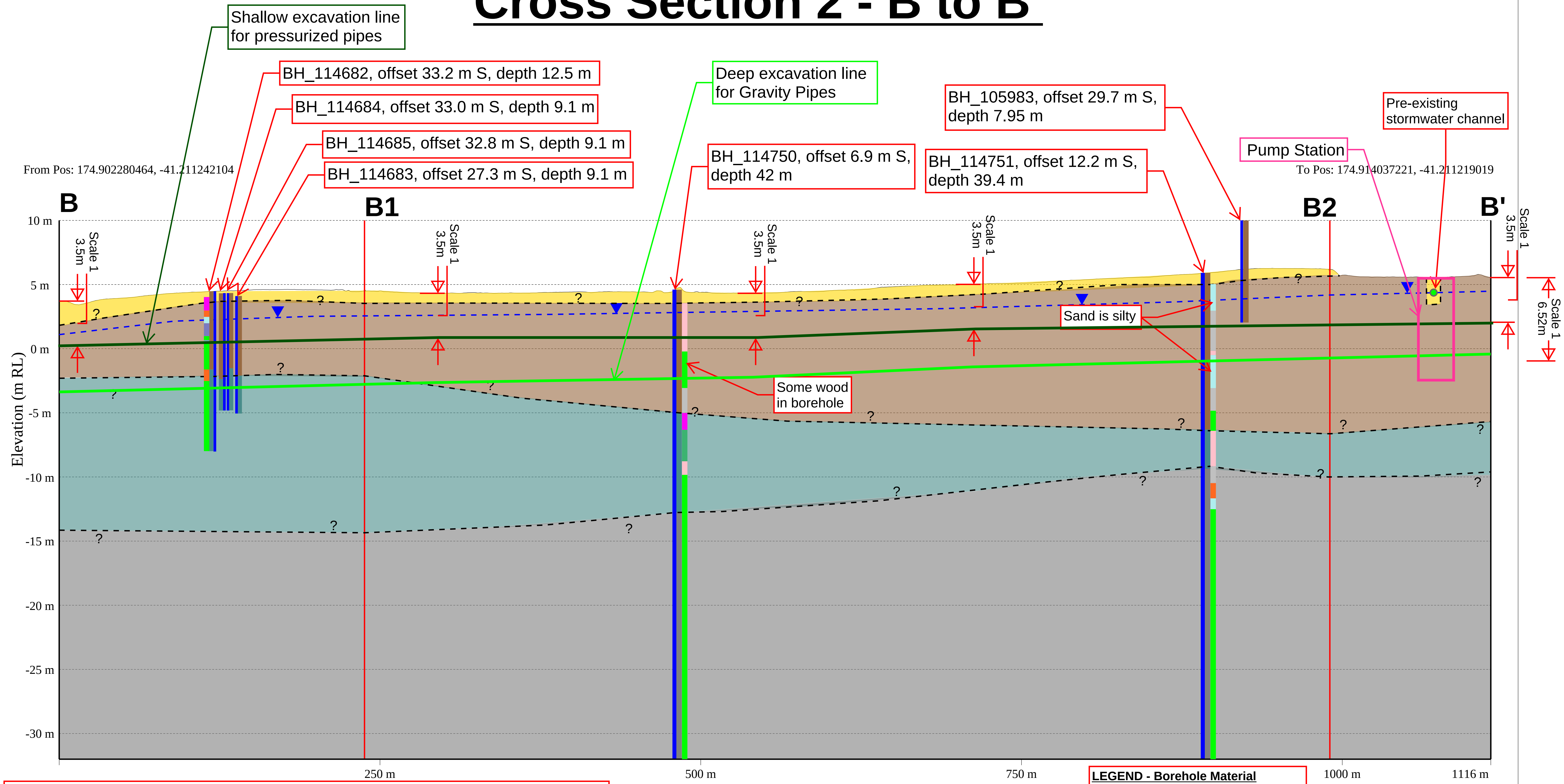
NOTES:

- It must be appreciated that subsurface conditions may vary from those inferred in this cross section.
- The ground conditions presented in this cross section are based on pre-existing geotechnical data derived from limited historical borehole locations.
- The geological model away from these locations is inferred and should be considered approximate only.

LEGEND - Borehole Material

- SILT
- SILT AND CLAY
- ORGANIC SILT
- CLAY
- CLAY AND WOOD/VEGETATION
- GRAVEL
- GRAVEL AND SAND
- GRAVEL AND SILT
- GRAVEL AND CLAY
- SAND
- SAND AND SILT
- VEGETATION/WOOD/PEAT

Cross Section 2 - B to B'



LEGEND

- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:5000H
10x Vertical Exaggeration (1:500V)

NOTES:

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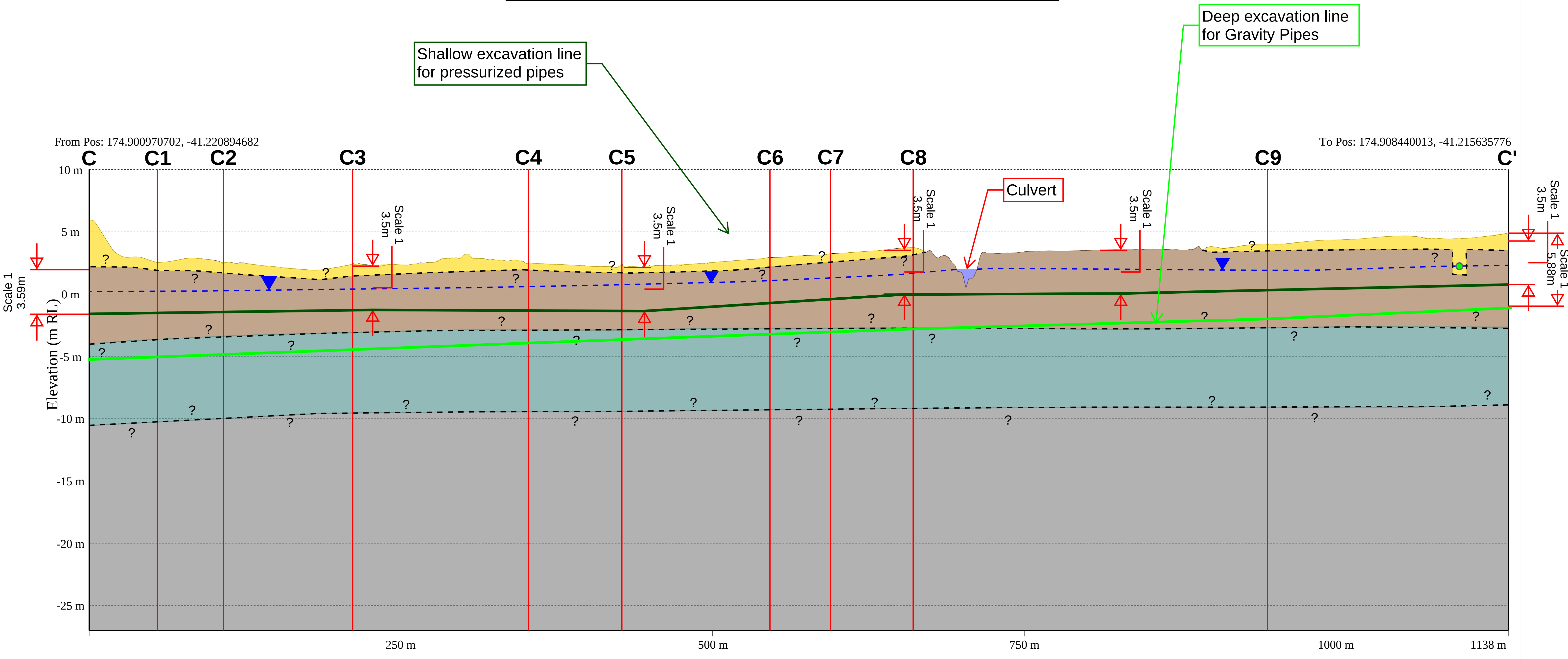
- The geological model away from these locations is inferred and should be considered approximate only.

LEGEND - Borehole Material

- SILT
- SILT AND CLAY
- ORGANIC SILT
- CLAY
- CLAY AND WOOD/VEGETATION
- GRAVEL
- GRAVEL AND SAND
- GRAVEL AND SILT
- GRAVEL AND CLAY
- SAND
- SAND AND SILT
- VEGETATION/WOOD/PEAT

Cross Section 3 - C to C'



LEGEND

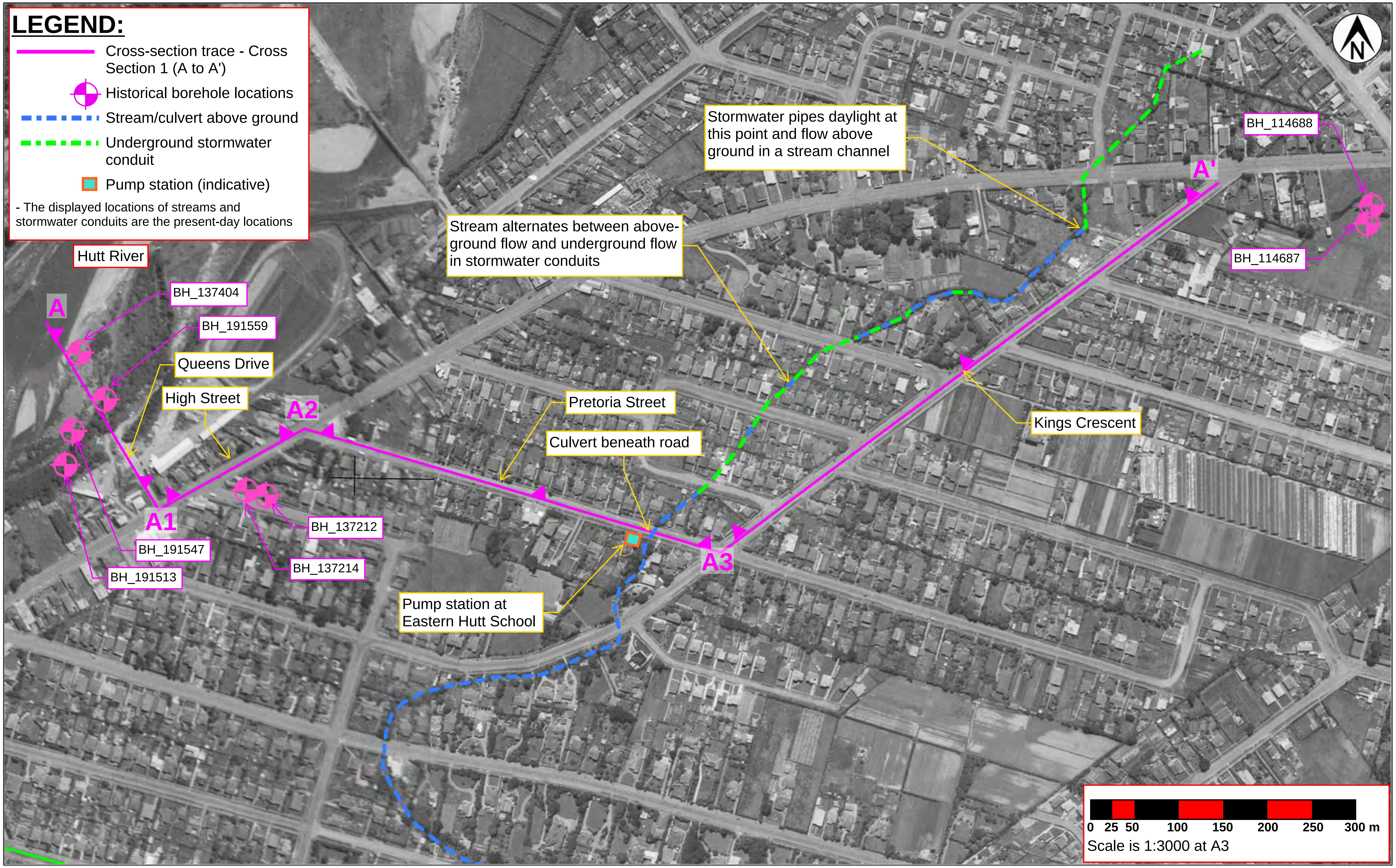
- Inferred Groundwater Table
- Fill materials
- Taita alluvium - Undifferentiated alluvium. Interbedded loose-dense, sandy gravel and, organic, L-H plasticity, soft-stiff sandy silt/clay
- Melling Peat/Petone Marine Deposits - Distinct layers of organic silt and peat, interbedded with silt, clay, sand and gravel. Wood and shell fragments often present. Low plasticity, stiff.
- Waiwhetu Gravels - Sandy Gravel. Medium dense to very dense.
- Change in Direction of Cross Section
- Inferred Geological Unit Boundary
- Historical Borehole

Scale: 1:3000H
10x Vertical Exaggeration (1:300V)

NOTES:

- It must be appreciated that subsurface conditions may vary from those inferred in this cross section.
- The ground conditions presented in this cross section are based on pre-existing geotechnical data derived from limited historical borehole locations.
- The geological model away from these locations is inferred and should be considered approximate only.

Appendix C: Historic plans



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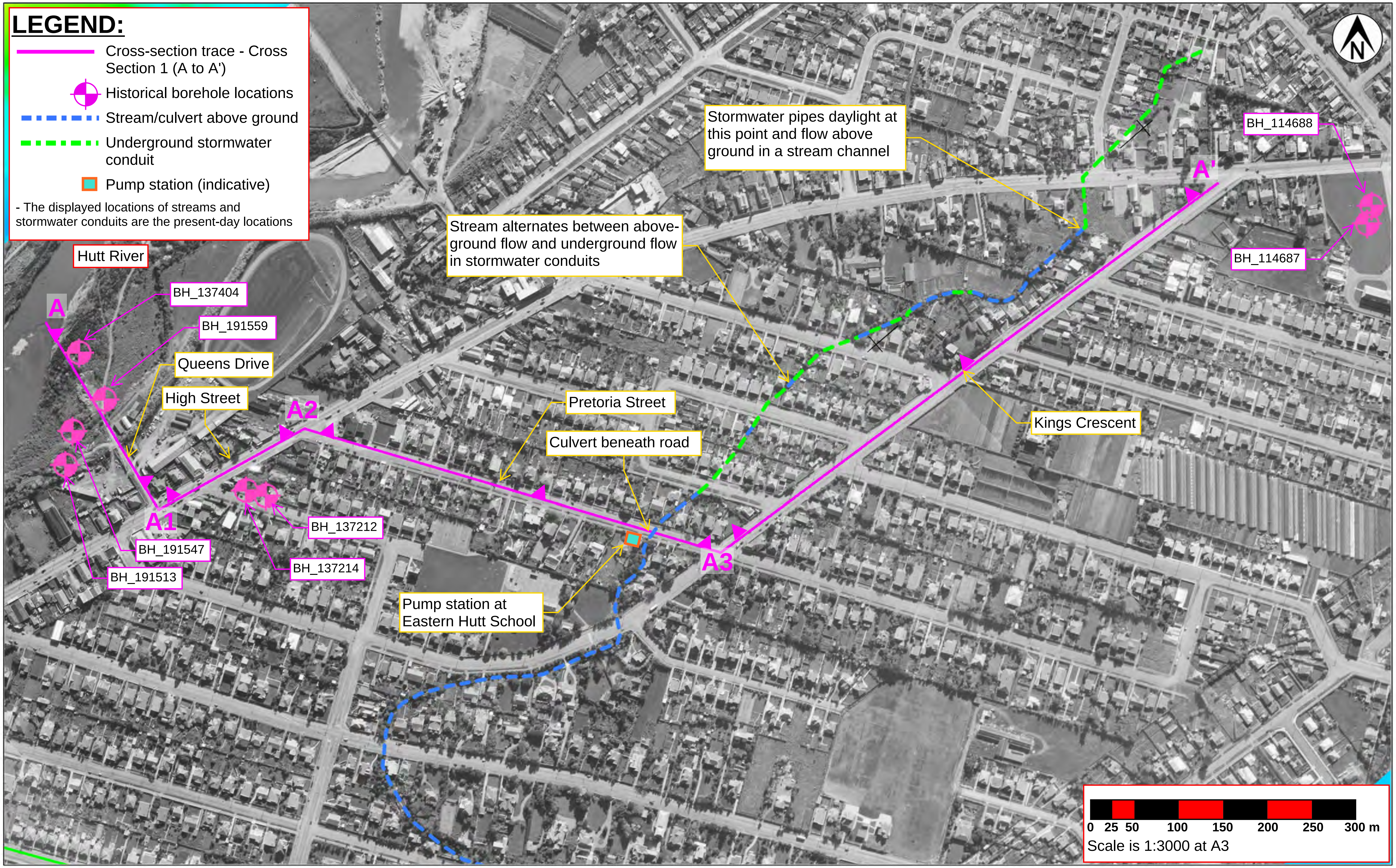
NOTES
- Aerial imagery was sourced from Retrolens
- The sourced aerial imagery was not georeferenced and was rectified manually
- Manual rectification may result in some discrepancies at the boundaries of the aerial photographs.

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE **Cross Section 1: A to A'**
Historical Aerial Imagery - 1941
SCALE (A3) 1:4000
REV



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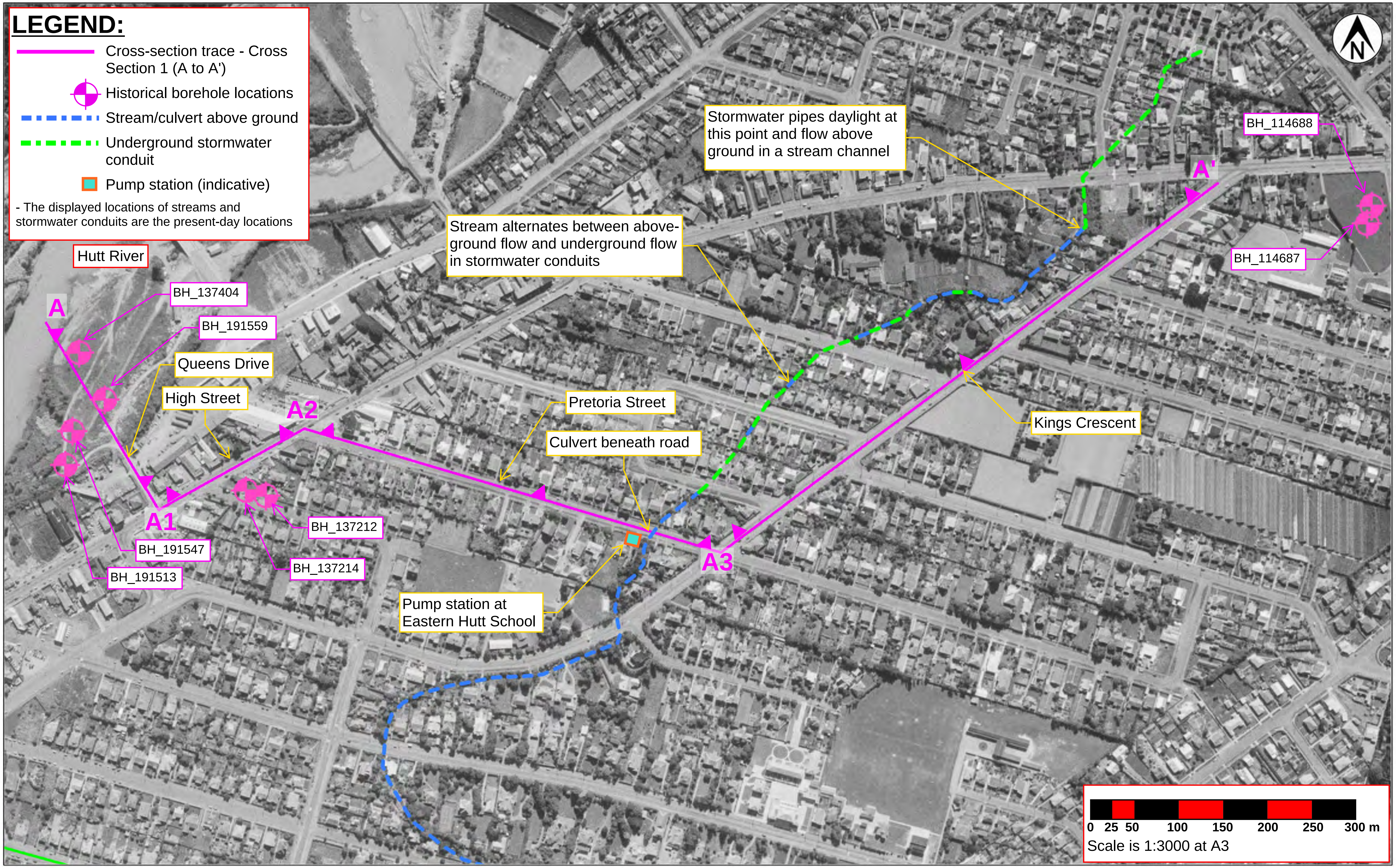
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE Cross Section 1: A to A'
Historical Aerial Imagery - 1951
SCALE (A3) 1:4000
REV



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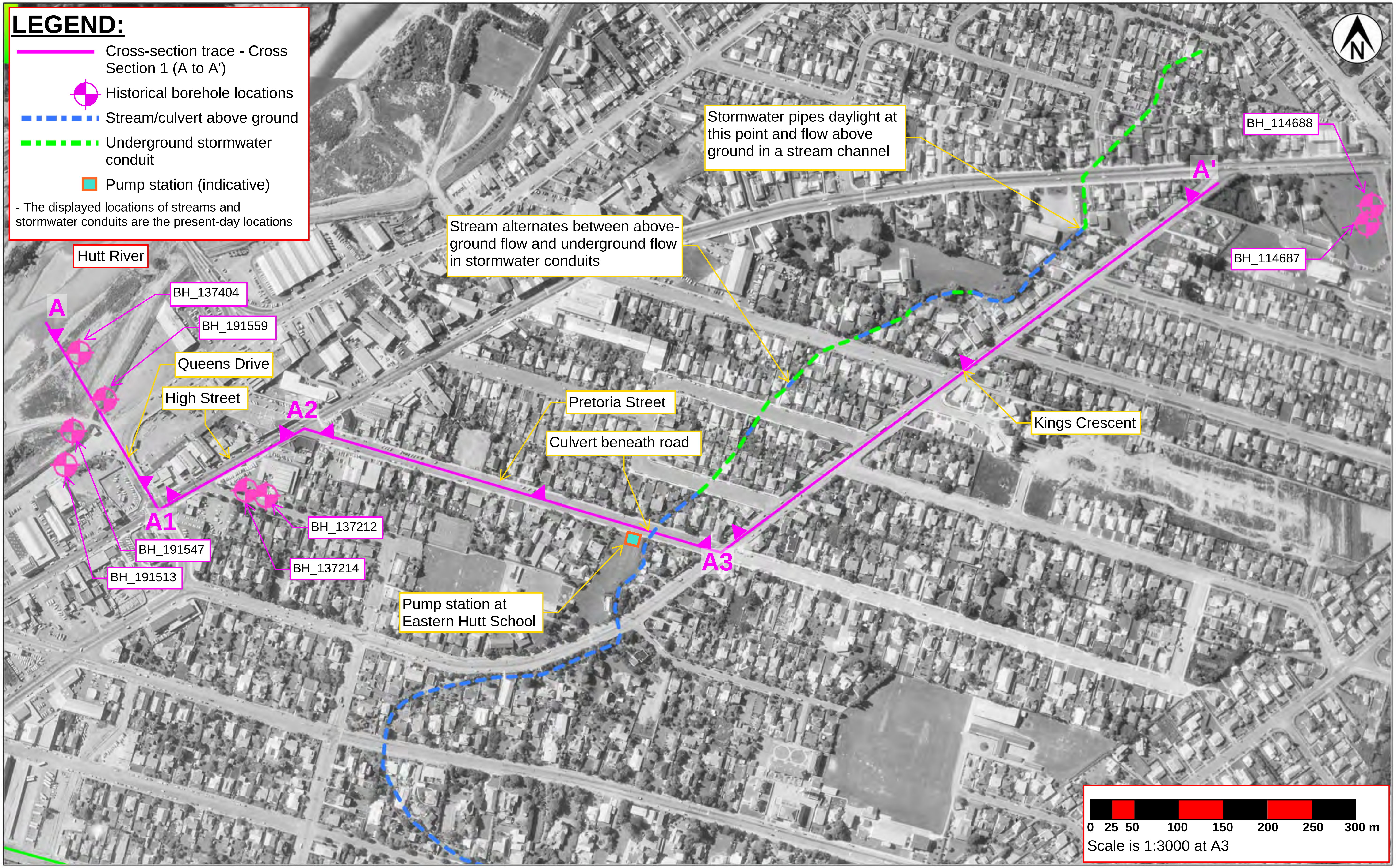
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE Cross Section 1: A to A'
Historical Aerial Imagery - 1957
SCALE (A3) 1:4000
REV



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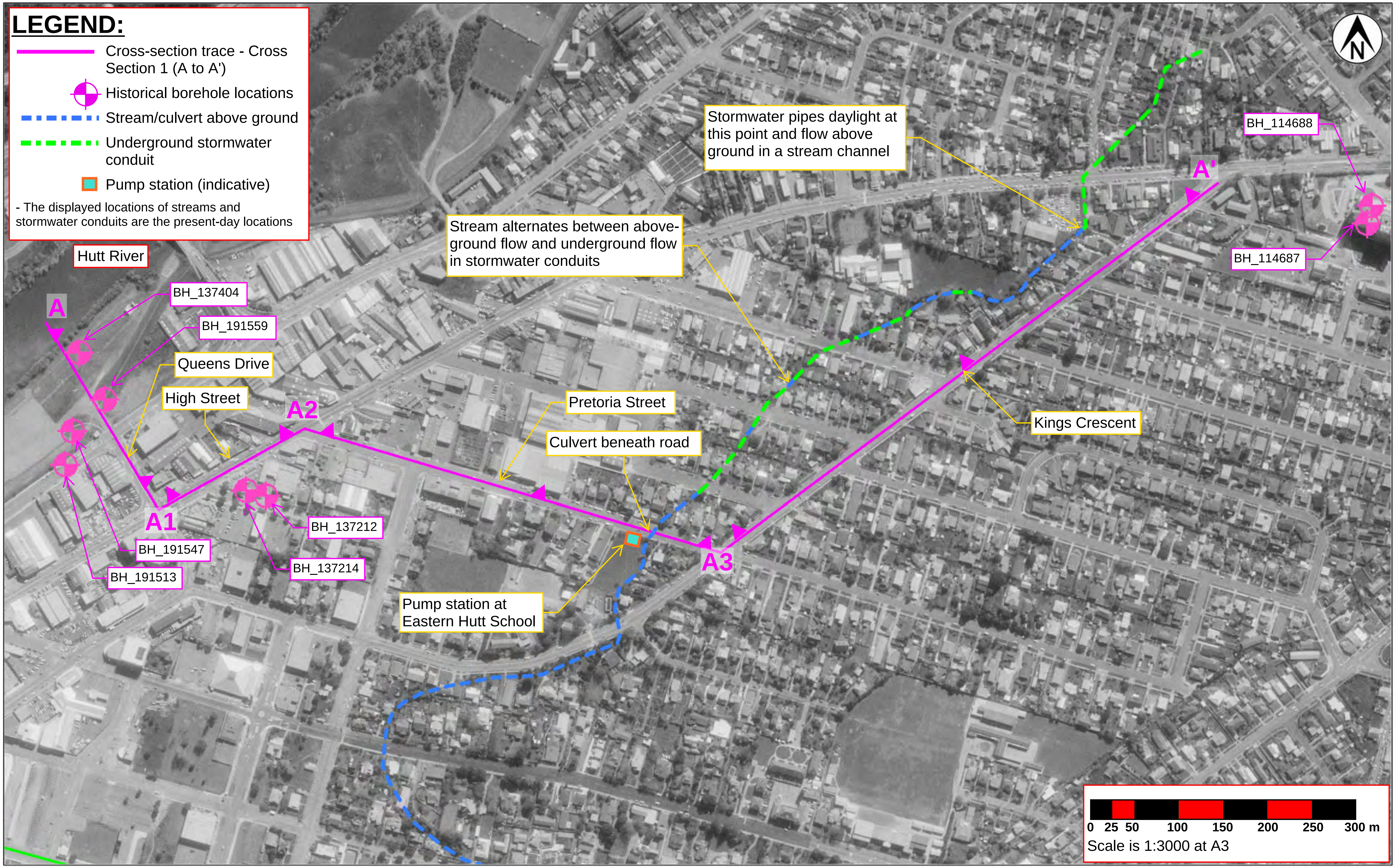
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT **Hutt City Council**
PROJECT **HCC IAF Stormwater/Wastewater Upgrades**
TITLE **Cross Section 1: A to A' Historical Aerial Imagery - 1966**
SCALE (A3) **1:4000**
REV



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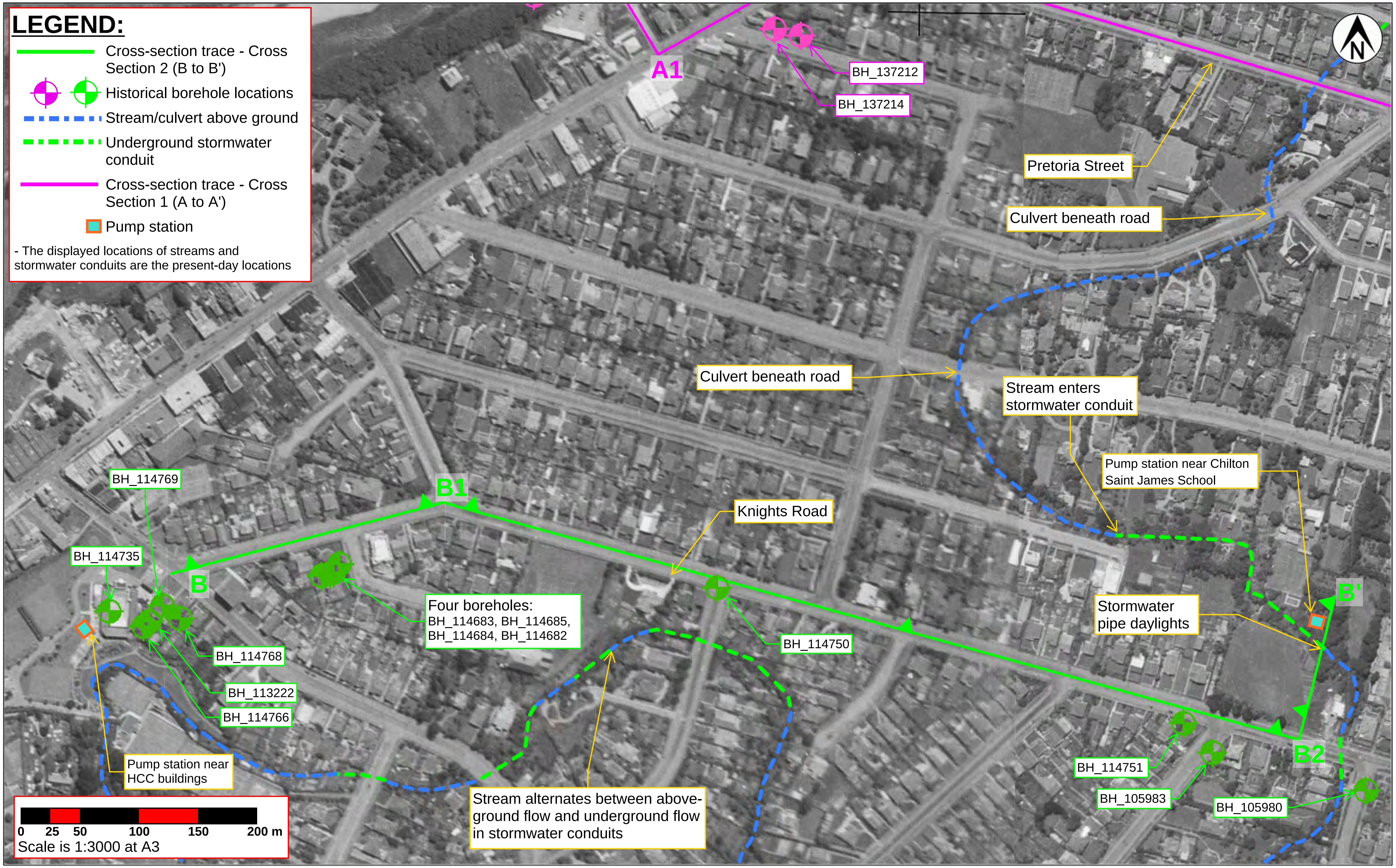
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED
FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE Cross Section 1: A to A' Historical Aerial Imagery - 1980
SCALE (A3) 1:4000
REV



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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT **Hutt City Council**
PROJECT **HCC IAF Stormwater/Wastewater Upgrades**
TITLE **Cross Section 2: B to B' Historical Aerial Imagery - 1941**
SCALE (A3) **1:3000**
REV

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	08/09/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

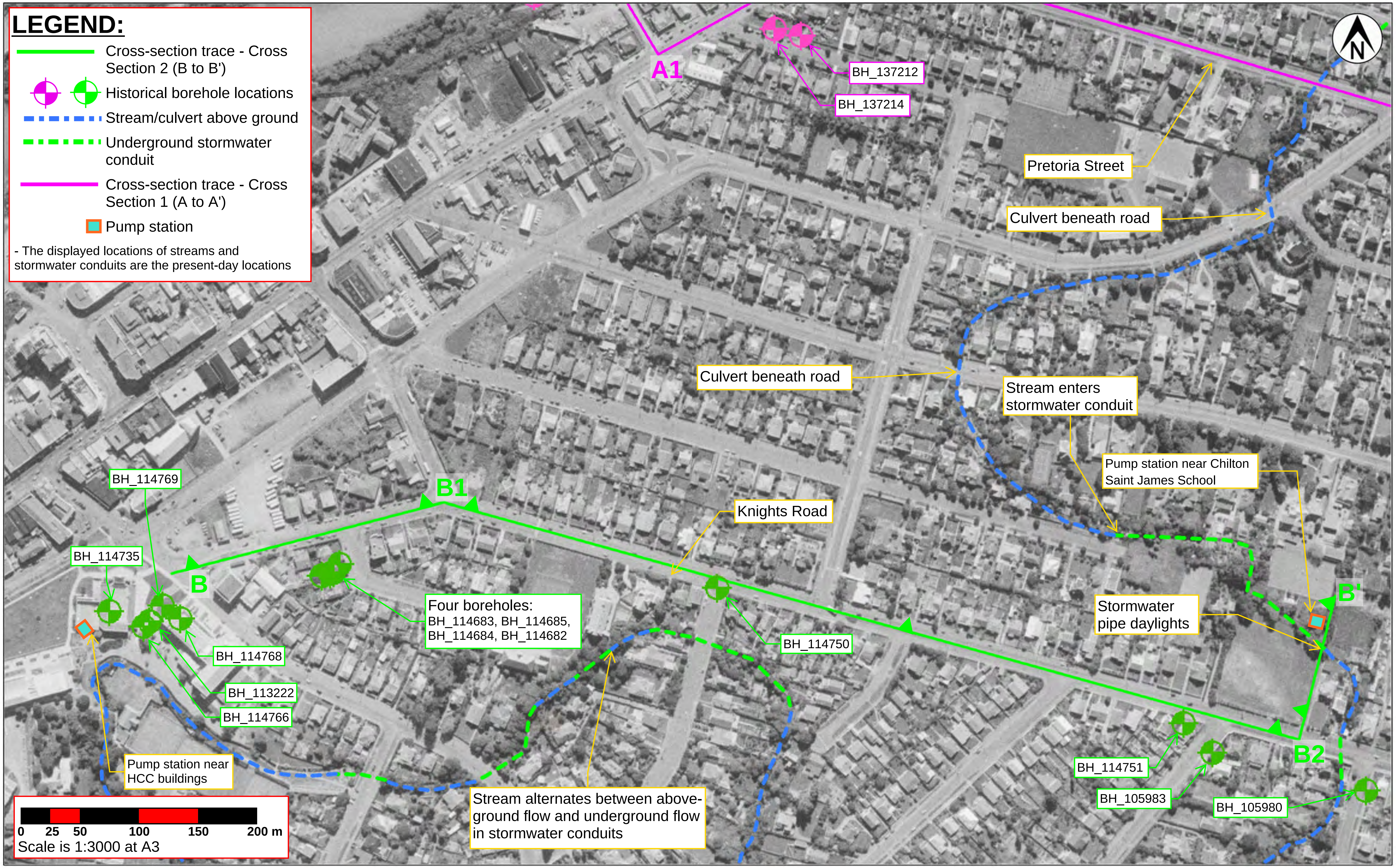
PROJECT PHASE

CLIENT Hutt City Council

PROJECT HCC IAF Stormwater/Wastewater Upgrades

TITLE **Cross Section 2: B to B' Historical Aerial Imagery - 1951**

SCALE (A3) 1:3000   REV



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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	08/09/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT **Hutt City Council**

PROJECT **HCC IAF Stormwater/Wastewater Upgrades**

TITLE **Cross Section 2: B to B' Historical Aerial Imagery - 1957**

SCALE (A3) **1:3000** REV

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NOTES
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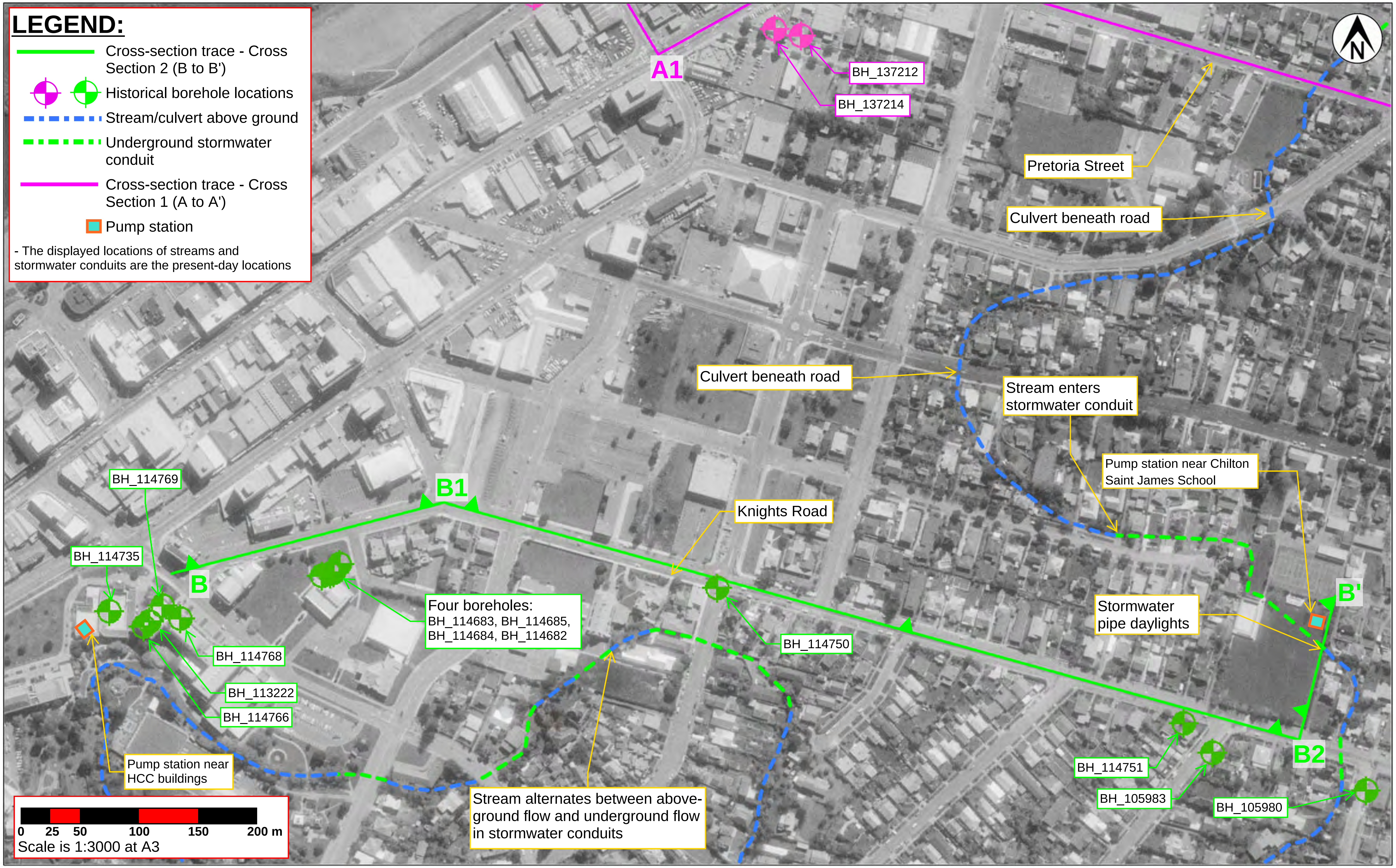
- Manual rectification may result in some discrepancies at the boundaries of the aerial photographs.

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED
FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE Cross Section 2: B to B'
Historical Aerial Imagery - 1966
SCALE (A3) 1:3000
REV



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- Manual rectification may result in some discrepancies at the boundaries of the aerial photographs.

REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED
FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE Cross Section 2: B to B' Historical Aerial Imagery - 1980
SCALE (A3) 1:3000
REV

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NOTES
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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	08/09/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT Hutt City Council

PROJECT HCC IAF Stormwater/Wastewater Upgrades

TITLE Cross Section 3: C to C' Historical Aerial Imagery - 1941

SCALE (A3) 1:3000

REV

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NOTES
- Aerial imagery was sourced from Retrolens
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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	08/09/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT **Hutt City Council**

PROJECT **HCC IAF Stormwater/Wastewater Upgrades**

TITLE **Cross Section 3: C to C' Historical Aerial Imagery - 1951**

SCALE (A3) **1:3000**

REV

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NOTES
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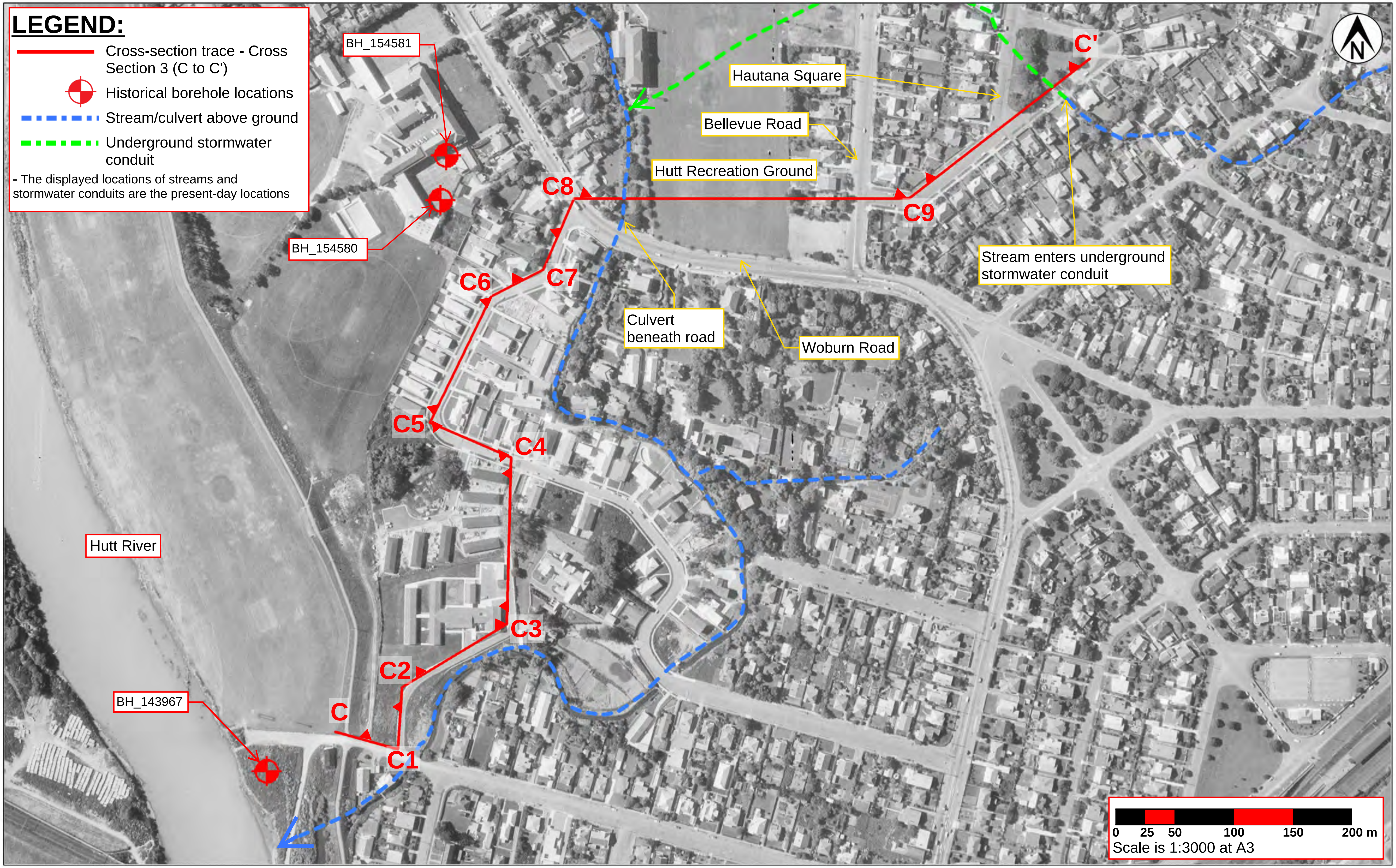
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT Hutt City Council
PROJECT HCC IAF Stormwater/Wastewater Upgrades
TITLE **Cross Section 3: C to C' Historical Aerial Imagery - 1957**
SCALE (A3) 1:3000
REV



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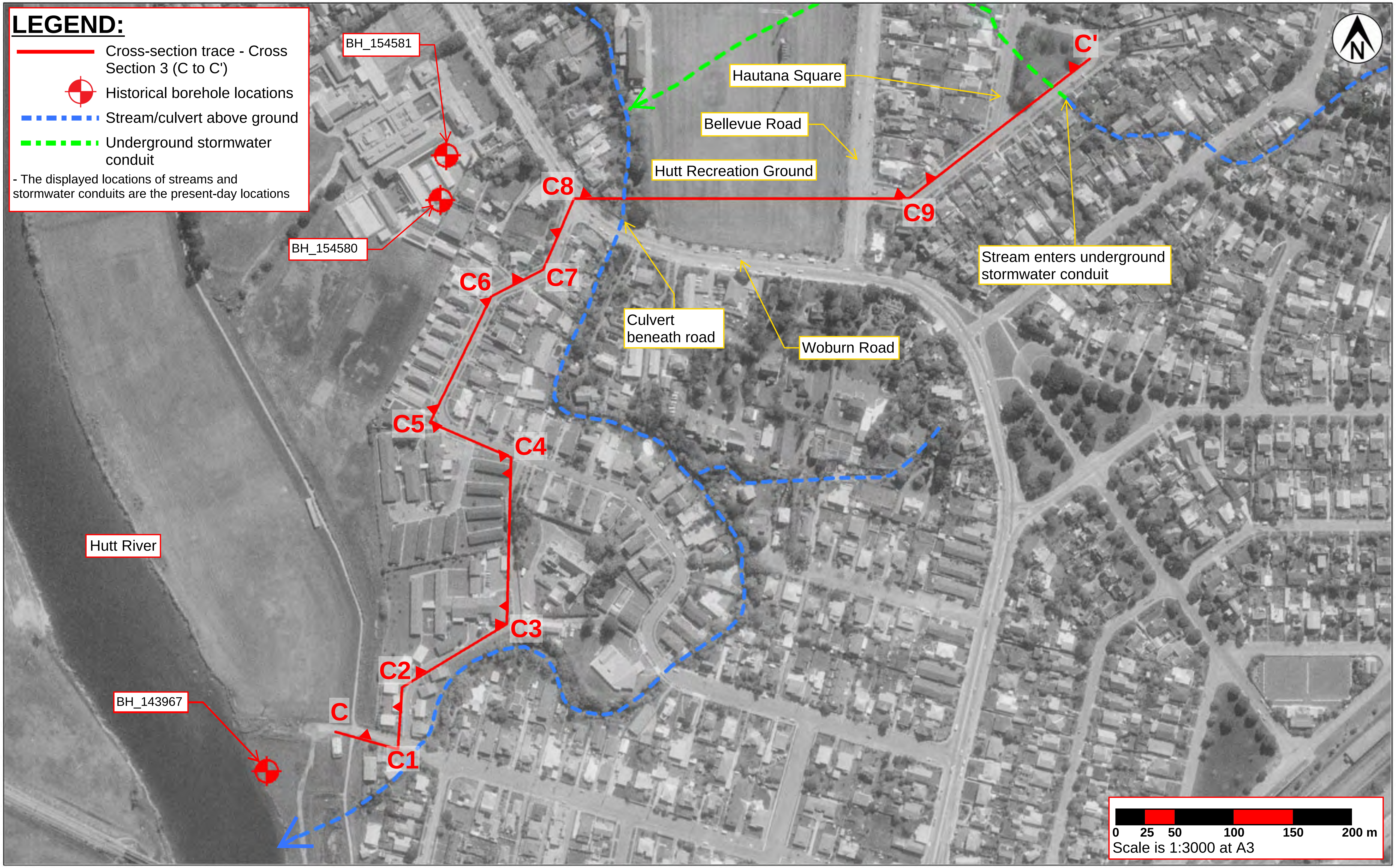
REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED
DRAWN DAHE 08/09/23
DESIGN CHECKED
FORMAT CHECKED

FIGURE STATUS
PROJECT PHASE

CLIENT **Hutt City Council**
PROJECT **HCC IAF Stormwater/Wastewater Upgrades**
TITLE **Cross Section 3: C to C' Historical Aerial Imagery - 1966**
SCALE (A3) **1:3000**
REV



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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE

DESIGNED		
DRAWN	DAHE	08/09/23
DESIGN CHECKED		
FORMAT CHECKED		

FIGURE STATUS

PROJECT PHASE

CLIENT Hutt City Council

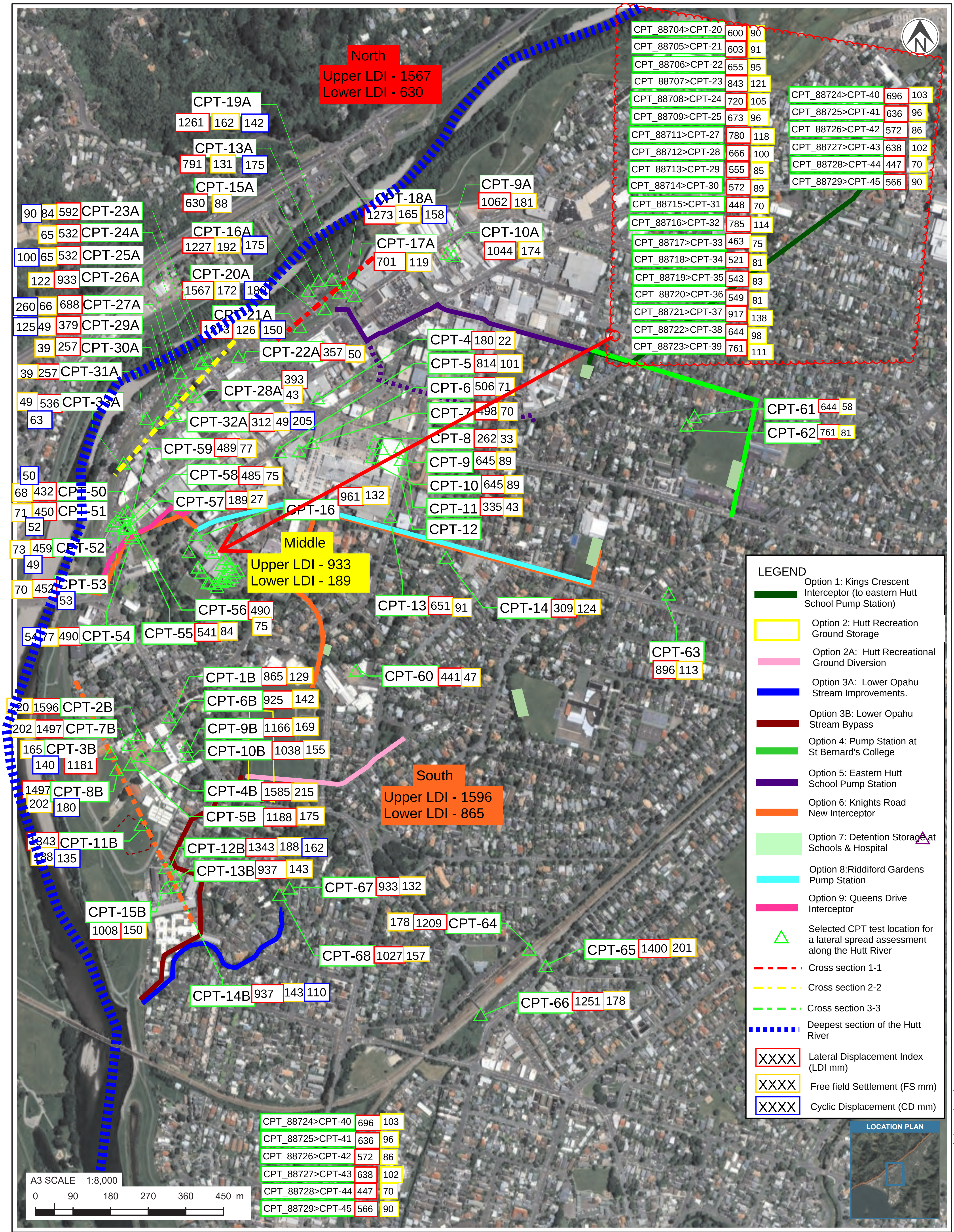
PROJECT HCC IAF Stormwater/Wastewater Upgrades

TITLE Cross Section 3: C to C' Historical Aerial Imagery - 1980

SCALE (A3) 1:3000

REV

Appendix D: Liquefaction assessment plans and plots



DO NOT SCALE FROM THIS FIGURE.

Source: Tonkin + Taylor Map Viewer (NZ)

Date: 7/09/2023 8:51 AM

Tonkin+Taylor

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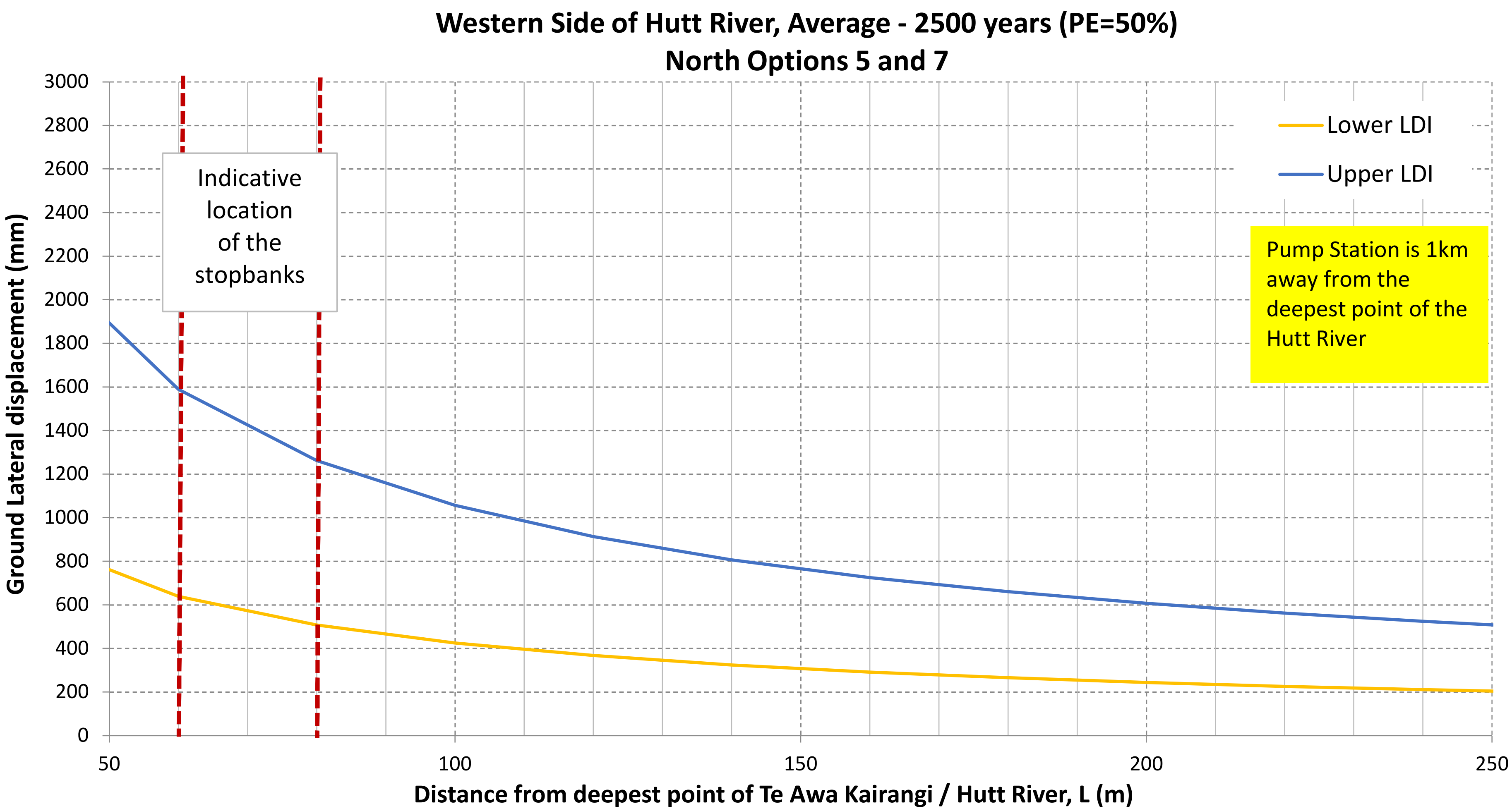
NOTES:

This plan is prepared for a preliminary assessment

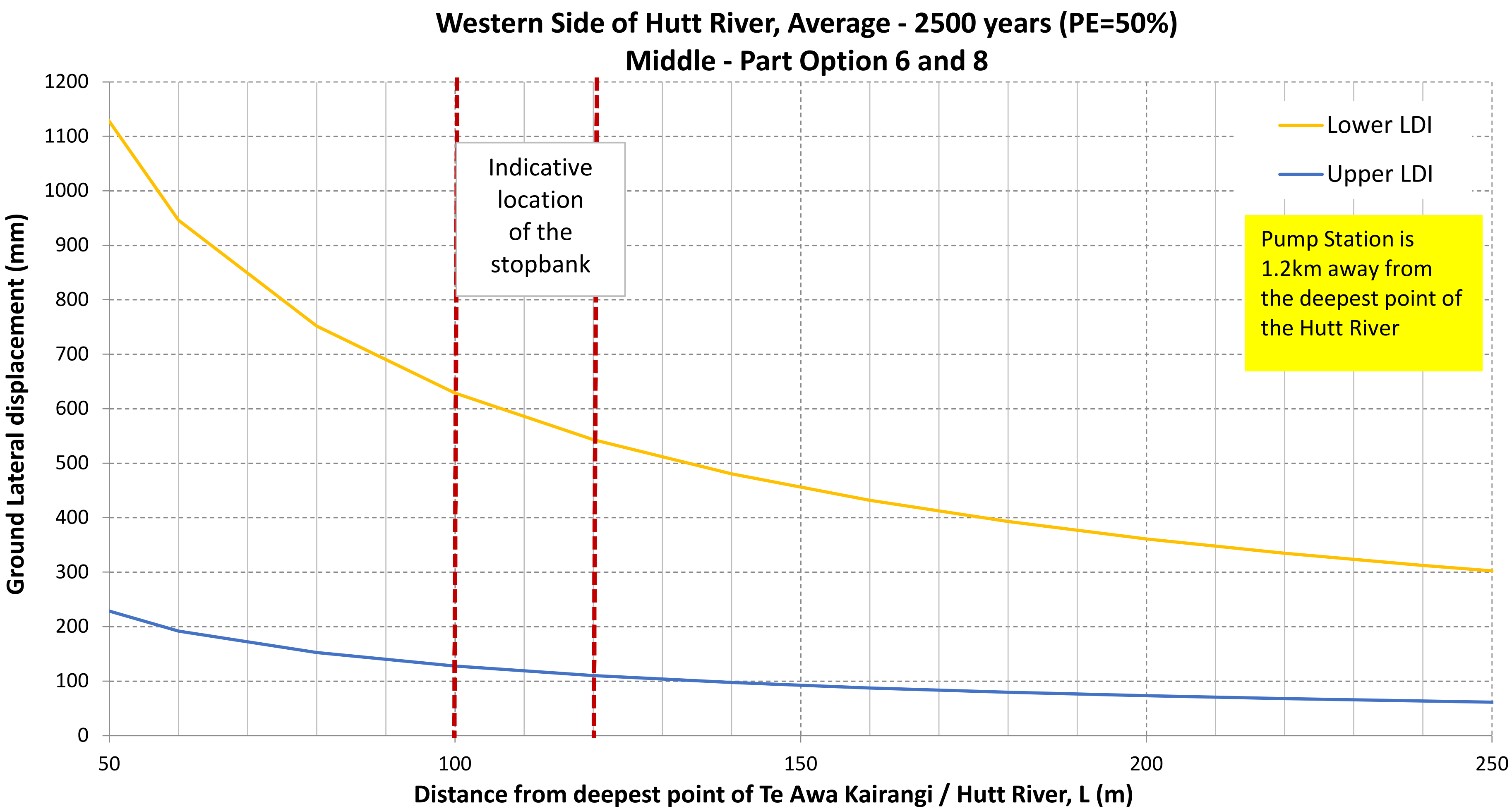
CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Stats NZ, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS, Maxar

PROJECT No.	1091097	
DESIGNED	DEVM	SEP.23
DRAWN	-WEB-	SEP.23
CHECKED		
APPROVED	DATE	

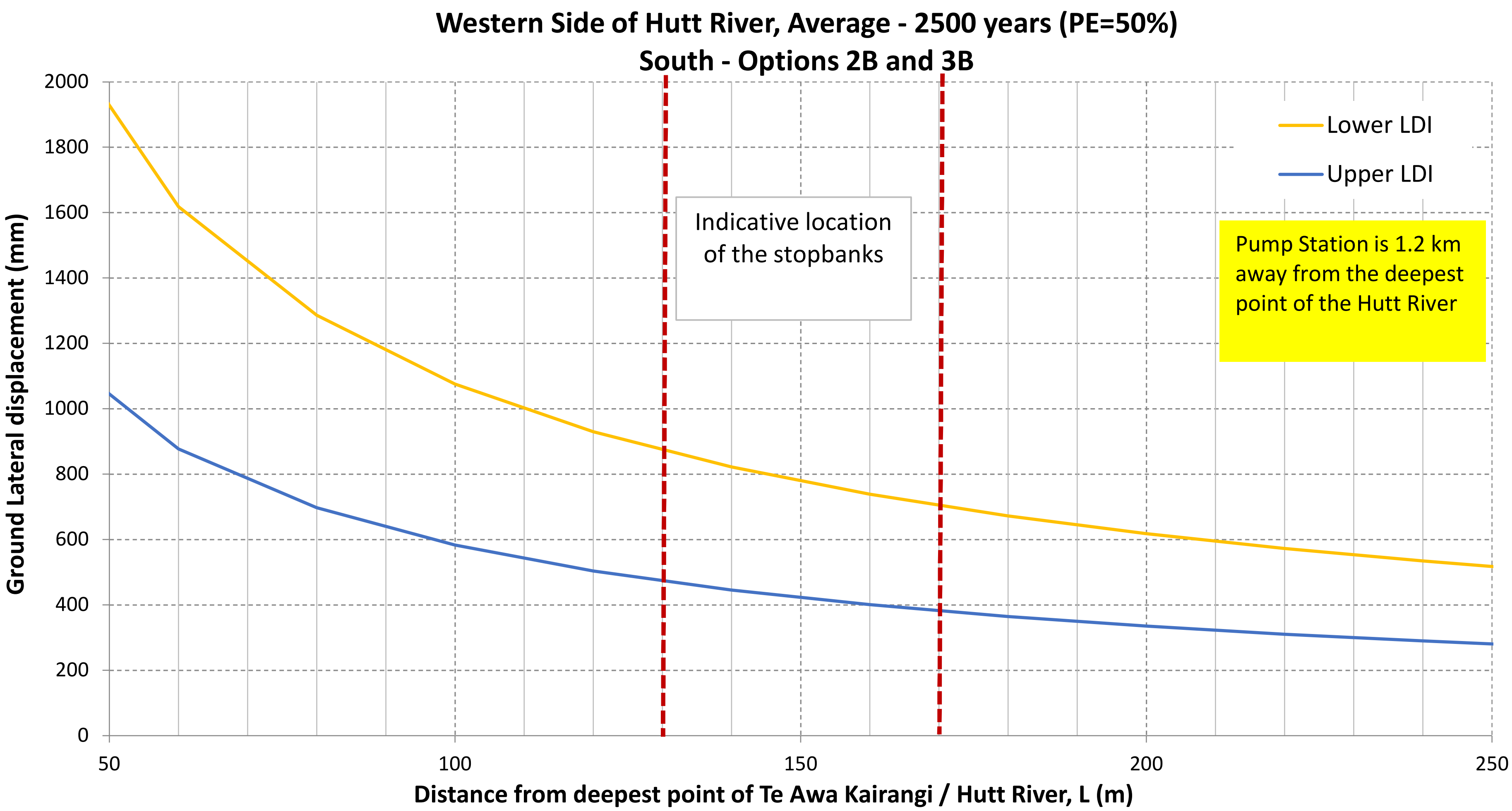
CLIENT	HUTT CITY COUNCIL
PROJECT	HCC - IAF STORMWATER UPGRADE
TITLE	PROPOSED SITE INVESTIGATION PLAN
SCALE (A3)	1:8,000
FIG No.	FIGURE 2. SIP
REV	0



Western Side of Hutt River, Average - 2500 years (PE=50%)
North Options 5 and 7
Ground Lateral displacement (mm)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
50
100
150
200
250
Distance from deepest point of Te Awa Kairangi / Hutt River, L (m)
Indicative location of the stopbanks
Lower LDI
Upper LDI
Pump Station is 1km away from the deepest point of the Hutt River

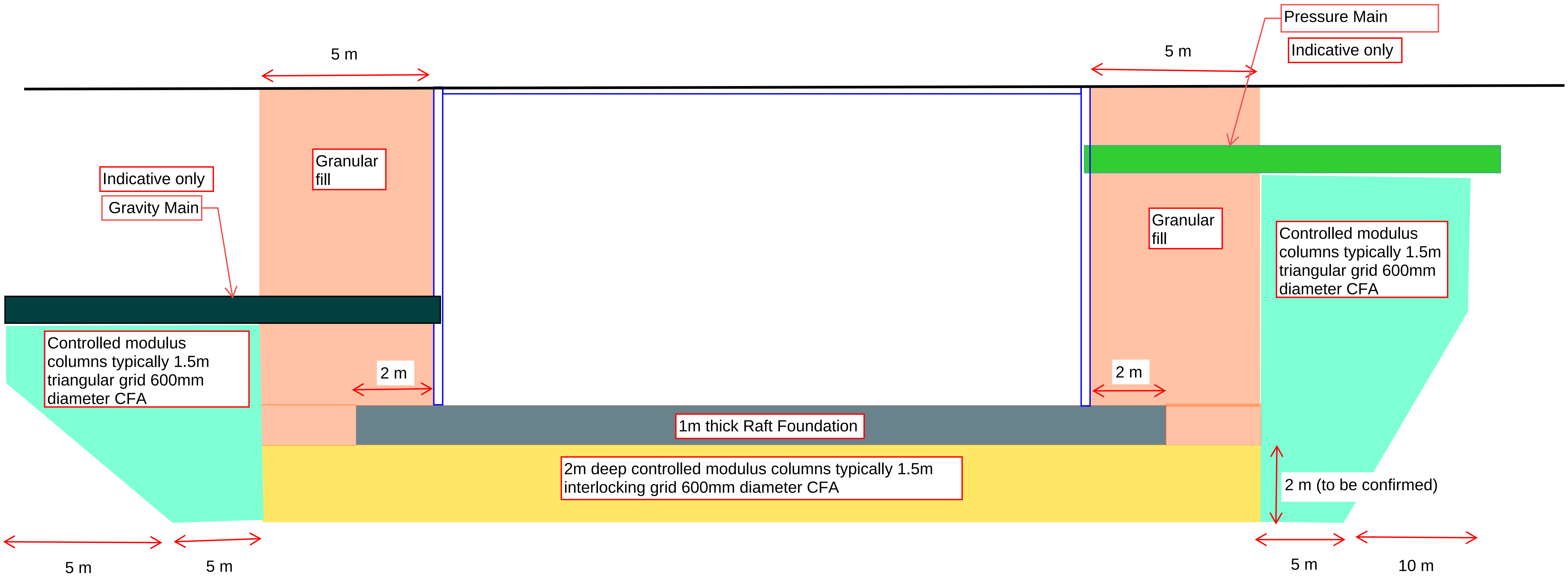


Western Side of Hutt River, Average - 2500 years (PE=50%)
Middle - Part Option 6 and 8
Ground Lateral displacement (mm)
Distance from deepest point of Te Awa Kairangi / Hutt River, L (m)
Indicative location of the stopbank
Lower LDI
Upper LDI
Pump Station is 1.2km away from the deepest point of the Hutt River
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
50
100
150
200
250



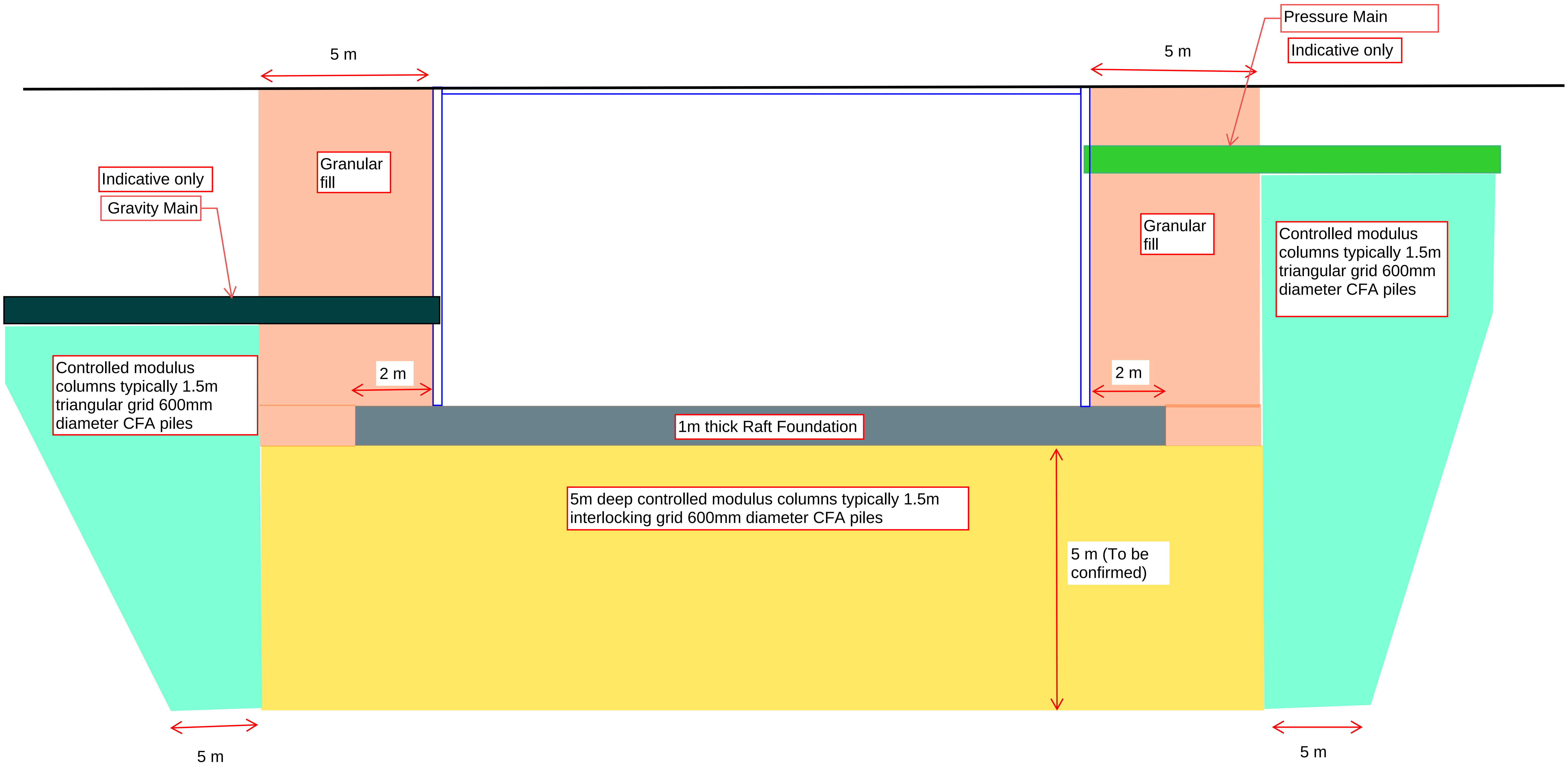
Western Side of Hutt River, Average - 2500 years (PE=50%)
South - Options 2B and 3B
Ground Lateral displacement (mm)
Distance from deepest point of Te Awa Kairangi / Hutt River, L (m)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
50
100
150
200
250
Indicative location of the stopbanks
Lower LDI
Upper LDI
Pump Station is 1.2 km away from the deepest point of the Hutt River

Appendix J- Pump station foundation concept



OPTION A - PUMP STATION FOUNDATION ON PETONE MARINE BEDS AND SHALLOW WAIWHETU GRAVELS

[redacted]



OPTION B - PUMP STATION FOUNDATION ON TAITA ALLUVIUM AND DEEP WAIWHETU GRAVELS

[redacted]

Appendix K- Longlist discontinued options

Memorandum

To	Scorers of longlist options
cc	
From	[redacted] Tonkin + Taylor
Date	9 May 2024
Subject	Discontinued options
Reference	1091097.TT.2100.PRW.ME.CV.27.Options not included on longlist.docx

The following options were initially considered as part of the optioneering process, but were not further developed to costing and were not included in the longlist for scoring.

1 Lower Opahu stream conveyance improvements/Lower Opahu Stream Bypass

These options were both based on the idea of increasing the amount of water able to flow to the existing Opahu Pump Station, either by widening the stream or by constructing a separate bypass pipeline from Hutt Rec Ground to the existing PS.

These two sub-options have been discounted, because:

- Initially it was thought that there may be spare capacity at the existing Opahu pump station that could be utilised. The pump station was built in 2008 and only two out of the three pumps have ever run, including during major storms in 2014[1] and 2016[2]. However, examination of the 1% AEP +CC model results shows all three pumps running, ie. the pump station is modelled to be at capacity.
- In the case of a gravity bypass pipeline, the route would be circuitous and would end up being too deep to connect to the existing pump station.

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[1] AEP unknown

[2] Assessed as being a 10%AEP event in the neighbouring Waiwhetu Stm. Stantec, 2022. *Eastern Lower Hutt Stormwater Model Build Report*.

Options for increasing flow to Opahu PS

2 Detention storage at multiple schools adjacent to the stream.

This option would have involved using school sites adjacent to the stream to create detention storage within the catchment. This would involve a combination of lowering playing fields and constructing bunds, along with inlet and outlet controls. The three largest stream-adjacent schools are Eastern Hutt, Hutt Intermediate and Chilton St James. Only two of these are public schools. The total 2D volume in a 1%AEP + CC flood is approximately 110,000 m^3. The total detention volume (assuming 1 m storage depth) available at these three schools is approx. 20,000 m^3.

This has been discounted, because:

- A larger amount (approximately 36,000 m^3) is available at a single site at Hutt Rec Ground. This site lies within a loop of the stream so is also considered hydraulically more feasible to get water into and out of. See Option 3a.
- It would be difficult to manage hydraulically – both in terms of arranging the storage at three different sites to function effectively, and also the challenge of getting water both into and

out of the storage while still providing a meaningful depth of storage (and not causing drainage problems on the playing fields).

- The complexity of delivering and managing the storage across three sites (one of which is a private school), compared to the small benefit in flood reduction delivered.

Storage sites on schools

3 CBD Interceptor

The thinking with this option was to reduce the size of intake required on the Opahu Stream at Riddiford Gardens, by intercepting 2-3 m^3/s out of the stormwater network immediately upstream of the network outlets into Opahu Stream and taking it either to the Riddiford PS or the originally proposed Outlet 24 PS. This option has been discounted because:

- Hydraulically, it would intercept a smaller range of flows and potentially have less impact than taking water out of the stream, compared to nearby options. We are focusing mainly on options that allow the drainage network to better drain to the Opahu Stream in order to achieve improvements over a wider area. It likely in some scenarios that (depending on storm duration, intensity etc) flows in the Opahu Stream are high but the peak has already passed in the local stormwater network, rendering this option less useful, or effective over shorter durations.

- The original thinking was predicated on there being a local network pump station for Outlet 24 (provided under Riverlink), to which this option would drain. This pump station is no longer being built so this opportunity no longer exists.
- If we want to capture additional flows directly from the stormwater network to the Riddiford Gardens pump station (in order to take less water through an inlet on the Opahu Stream), this can be considered during the further development of the Riddiford Gardens PS. It is not a standalone option in that case.

CBD interceptor

Appendix L- Longlist MCA briefing notes

Tonkin+Taylor

Memo

To:	Technical specialists scoring MCA criteria	**Job No:**	1090967
From:	[redacted]	**Date:**	29 September 2023
cc:	[redacted]		
Subject:	IAF Upgrades - Specialist briefing for stormwater options multi-criteria analysis workshop		

1 Purpose

This memorandum describes the site options and assessment approach for the Infrastructure Acceleration Fund (IAF) stormwater upgrades to facilitate the construction of up to 3,520 new houses in the Lower Hutt Valley.

This information is presented ahead of a multi-criteria analysis (MCA) workshop on **11 October 2023** for analysis by experts prior to that workshop. The workshop forms part of the alternatives assessment process to consider the stormwater upgrades longlist options.

2 Background - Alternatives assessment and MCA

Under the Resource Management Act 1991 (RMA), an assessment of alternatives is required in the following circumstances:

- When seeking a Notice of Requirement (NoR) for a designation and the Requiring Authority does not have an interest in the land sufficient for undertaking the work, or the work is likely to have a significant adverse effect on the environment (section 171(1)(b)).
- When seeking resource consent for projects with the potential to have significant adverse effects on the environment (section 6(1)(a) of Schedule 4).
- In the case of a resource application to discharge a contaminant, the application is required to include a description of any possible alternative methods of discharge (section 105(1); section 6(1)(d) of Schedule 4).

An assessment of alternatives is also required to support a compulsory property acquisition process under the Public Works Act 1981.

The alternatives assessment process is a fundamental building block used to support future decision making. Key considerations when undertaking an alternatives assessment include the following[1]:

- While a requiring authority cannot act arbitrarily or only give cursory consideration to alternatives, it is not required to eliminate every possible option, or even demonstrate that it is pursuing the "best" option.

[1] While this is derived from case law that relates to NoR processes, it provides useful guidance for a resource consent process.

- A thorough, although not exhaustive assessment of alternatives is required with the focus on the process, not the outcome.
- The process needs to be well documented, transparent and replicable in order to make an informed and defendable decision.

A multi-criteria analysis (MCA) is commonly applied to infrastructure projects where there are several sites or options to choose between and where there are numerous complex considerations involved. MCA assists in assessing the relative merits and constraints of an option and making the trade-offs between competing matters more transparent. The purpose of the MCA is to rank sites in a robust and transparent manner, in order that the process of finding a preferred option can be clearly demonstrated at a later date, including during the resource consent process.

3 MCA workshop

The workshop will take place at **1:30pm on 11 October 2023**, via Teams and in person. The purpose of the workshop is to test and confirm scoring for each of the stormwater upgrade options. Prior to this workshop, specialists are expected to:

- Review this memorandum and the attached information.
- Confirm their criterion and matters to consider within the criterion. Criteria and draft matters to consider have been provided in Appendix C.
- Develop an understanding of each option.
- Score each of the options on the MCA criteria and record reasons for scoring as per the template.
- Return your draft scores and assessment memo to [redacted] by **5pm on Friday 6 October**.

The reasons provided for scoring are anticipated to be high level only for the purposes of the workshop. A short summary of reasons for scoring each option should be provided alongside the scores.

Additional HCC and WWL representatives may attend the workshop as observers and to contribute to the workshop moderation session in their particular area of expertise.

4 Information provided

The following documents are provided to inform technical specialists during the scoring process and workshop:

Appendix A: Overall plan showing longlist stormwater upgrade options

Appendix B: Description of option

Appendix C: MCA criteria and specialists

Appendix D: Summary memo template, including MCA recording and scoring

5 Methodology for criteria development and scoring

Nine criteria have been developed: Cultural, ecology, constructability, operations, flooding reduction, risk and resilience, community effects, property and planning/consentability.

The effects of each option in relation to these criteria will be scored by the relevant specialists. The memo template, which includes the scoring and recording table, is attached in Appendix D.

When scoring, please note the following:

- The specialist is responsible for completing the scoring and template. The specialist is encouraged to seek input from the relevant people, including but not limited to those identified in Appendix C.
- Some of the criteria include a list of issues to consider. These are not sub-criteria and should be considered as part of the overall score for each criterion.
- The draft criteria have been circulated for feedback and updated to reflect this feedback. However specialists may amend or clarify their criterion and/or issues to be considered should this be required.
- Scoring is based on the following assumptions:
  - Scores are based on the level of effects (adverse or positive) of each option for each specialist criteria.
  - One score will be provided for every criterion.
  - Reasons for scoring will be recorded, including if there are particular components of the option which have a significant influence on the scoring.
- The final score for each option should include standard/expected mitigation (where relevant). Bespoke mitigation and offsetting should not be considered in the final score, however the potential for further mitigation / offsetting of identified effects should be recorded. Experts should record what mitigation they have factored into their scores (and what additional mitigation might be possible) to allow for those assumptions to be tested.
- All options should be scored on the 9-point (plus "fatal flaw") scale set out in Table 2 below, along with reasons for the given score. This scoring scale has been adopted partly in order to provide greater scope for differentiation between options. However, experts are instructed to score each option by applying their expertise and against the description of the scores provided below. Scoring should be carried out on an absolute rather than relative basis. In other words, experts should not seek to create an artificial distinction in scores between options.
- The scoring scale provides for a "fatal flaw" negative score. This score should be used where the expert considers that there are unacceptable adverse effects associated with the option – and that there is no reasonable way to appropriately avoid, remedy or mitigate those effects.

Scoring	Level of effect
F	Fatally flawed – unacceptable adverse effects, risks or challenges that cannot reasonably be appropriately avoided, remedied or mitigated.
- 4	Very high / very significant adverse effects, risks or challenges.
- 3	High / significant adverse effects, risks or challenges.
- 2	Moderate / medium adverse effects, risks or challenges.
- 1	Low / minor adverse effects, risks or challenges.
0	Neutral / no change
1	Low / minor positive effects, benefits or opportunities
2	Moderate / medium positive effects, benefits or opportunities
3	High / significant positive effects, benefits or opportunities
4	Very high / very significant positive effects, benefits or opportunities

6 Additional matters

6.1 Sensitivity analysis

In order to further analyse and test the ranking of the options and inform the overall decision making, sensitivity analysis will be undertaken to test the sensitivity of the scoring against different matters. A number of weighting systems could be applied (e.g. environmental effects; technical and engineering considerations i.e. constructability, operations, risk and resilience; provision of flooding reduction; property and planning risk etc). Potential weighting systems will be developed prior to the workshop and can be discussed at the workshop.

6.2 Cost

Cost estimates will be prepared at an appropriate level of detail for each stage of the process.

The construction and operation cost of each option is a key factor when considering alternative options. However cost is a quantum rather than a relative measure of value (or effect). For this reason, while cost will be identified in the MCA, it will be separated out from the other parameters and will not be combined into the overall score.

7 Reporting

Each specialist should provide a brief assessment memo in the assessment template provided in Appendix D. The memo should note:

- A description of any matters considered;
- Any assumptions applied when scoring; and
- Reasons for scoring of each option (this can be brief; bullet points for each option is fine).

The report should ensure that the reader understands the methodology and reasoning behind the scoring given to each option.

8 Other matters and conclusion

It is important that information is shared effectively between the experts, and with the project team. In particular:

- Please proactively ask any questions you have; and
- Please discuss your assessments with other experts as appropriate.

It is important to note that:

- The MCA is a decision support tool with the focus on the process rather than the outcome.
- There is no requirement to eliminate every option or demonstrate that the selected option is the 'best' option.
- The purpose of the workshop is to assist HCC to select options to proceed to the shortlisting stage. It is expected that HCC will need to balance a number of factors in selecting its preferred stormwater upgrade option(s), including cost (both CapEx and OpEx).

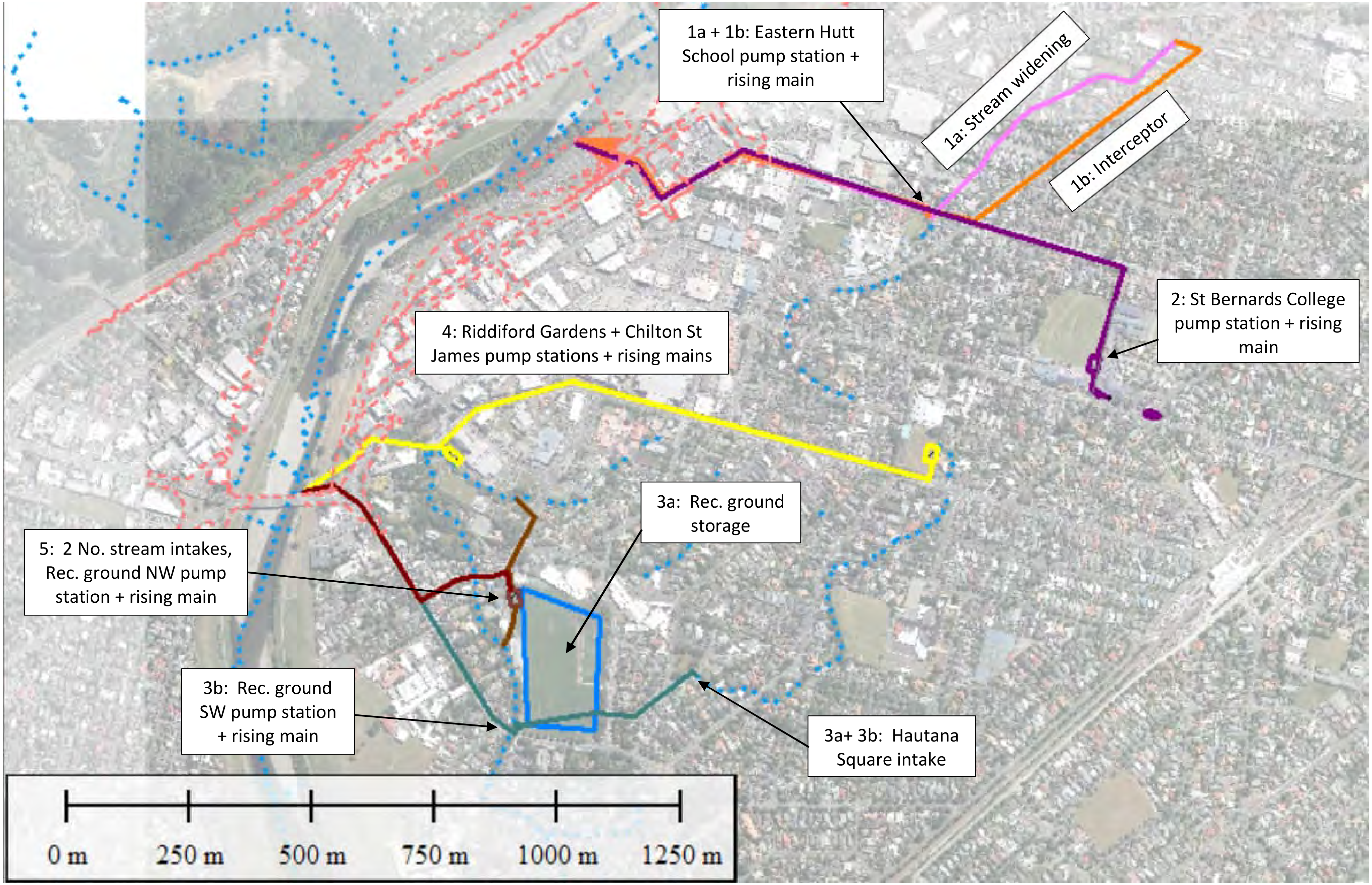
Where there is not agreement in the workshop on the options to proceed to the shortlist, or where there would be merit in more than three options proceeding to the shortlist, it is understood that [redacted] with assistance from [redacted] is empowered to make a call on behalf of HCC as to how to proceed, subject to endorsement of the Project Management Board (PMB). The Project Team will write up the results of the long list workshop and its recommended decision in a board paper to go to the board meeting on 20 October for endorsement by the PMB.

If you require any further information, please do not hesitate to contact me.

30-Sep-23

Appendix A Long list options

OPTION	DESCRIPTION
1a	Upper Opahu Stream Improvements + Eastern Hutt School Pump Station
1b	Eastern Hutt School Pump Station with Kings Crescent Interceptor
2	St Bernards School pump station
3a	Hautana Square intake to Hutt Rec Ground Storage
3b	Hautana Square intake to Hutt Rec Ground pump station
4	Chilton St James School and Riddiford Gardens pump stations
5	Hutt Rec Ground NW pump station with two stream inlets



1a + 1b: Eastern Hutt School pump station + rising main
1a: Stream widening
1b: Interceptor
2: St Bernards College pump station + rising main
4: Riddiford Gardens + Chilton St James pump stations + rising mains
3a: Rec. ground storage
5: 2 No. stream intakes, Rec. ground NW pump station + rising main
3b: Rec. ground SW pump station + rising main
3a+ 3b: Hautana Square intake
0 m
250 m
500 m
750 m
1000 m
1250 m

Appendix B Summary description of options

HCC IAF Stormwater Longlist Options

September 2023

Tonkin+Taylor

Wellington Water

HUTT CITY
TE AWA KAIRANGI

Stormwater Longlisting Option Assessment

Option	Option 1a
Description	Upper Opahu Stream Improvements + Eastern Hutt School Pump Station

Summary

This option includes the following:

- Increasing the conveyance capacity of the Opahu Stream along Kings Crescent from High Street to Pretoria Street (channel improvements and culvert upgrades).
- A stream intake structure and pump station with 2 m^3/s discharge capacity located at Eastern Hutt School.
- Rising main from pump station to outfall to Te Awa Kairangi (via Riverlink outlet 35), pipe to be laid within the road reserve.

High-level plans

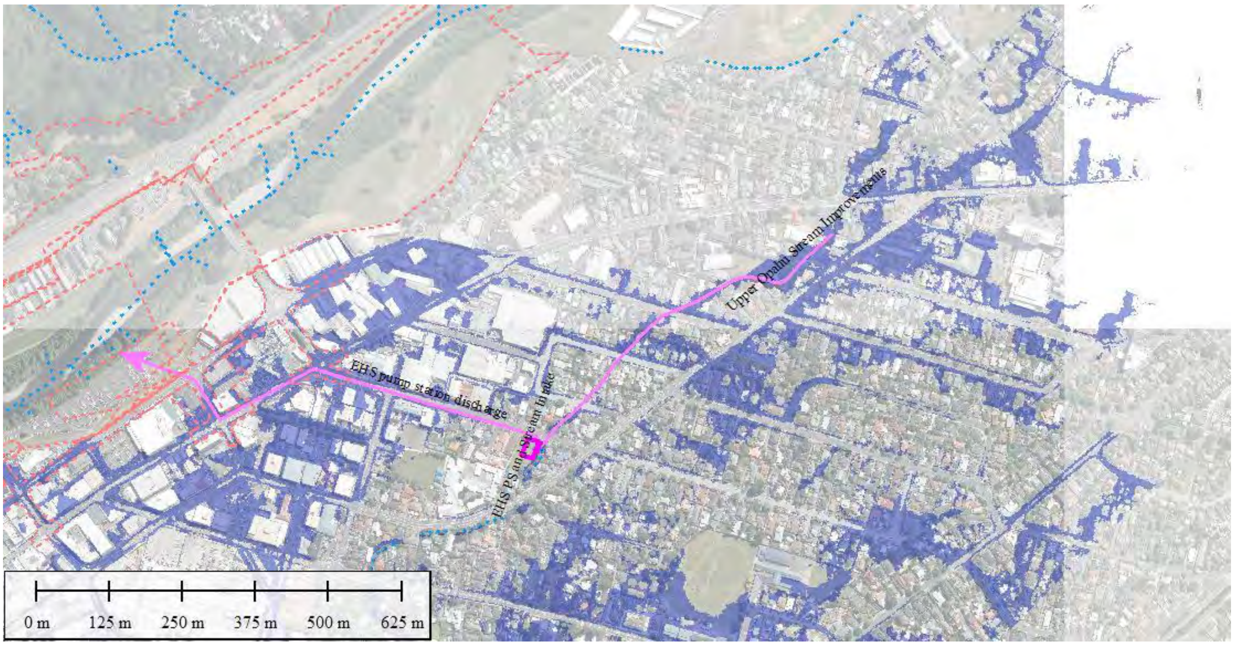


Figure 1 – Option 1A Overview

Figure 2 – Option 1A Pump Station and Stream Intake Structure Location Plan

Key details from preliminary sizing:

- Design flow 2 m3/s.
- Existing stream base width increased from 0.5m to 5m for design flow, side slopes from 1V:4H to 1V:1H with slope reinforcement.
- Existing culvert crossings upgraded to convey design flow.
- Stream intake structure is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir length 5m, wingwall span 13m, depth 2.4m.
- Pump station includes buried concrete inlet chamber (6.5m D x 6.6m W x 6.6m L), wet well (10.1m D x 8.6m W x 8.1m L) and valve chamber (5.1m D x 8.7m W x 10.5m L) and a 70 m^2 transformer/electrical building.
- Rising main 800mm dia.
- Targeting flooding around Kings Crescent and in the immediate stormwater network from the upstream reaches of the Opahu Stream, also thereby decreasing downstream flows. This approximate volume (from the 1%AEP + climate change existing model results) is around 30,000m^3. From preliminary inspection of the existing 1%AEP + CC hydrographs, this pump station would be expected to remove about this volume over approximately an 8-hour period at an average flow rate of 1 m^3/s, depending on other network flow constraints.
- Some of the targeted flooding is at some distance from the Opahu Stream and may be at least partly related to network capacity issues rather than directly associated with stream flows.

Key risks / opportunities:

- Depth of pump station structure relative to Waiwhetu aquifer.
- Agreement from school to pump station and rising main.
- Risk that pump station location is not compatible with adjacent services compound on EHS field.
- Several property purchases required to construct option.
- Opportunity to daylight existing culverts.

Stormwater Longlisting Option Assessment

Option	Option 1b
Description	Eastern Hutt School Pump Station with Kings Crescent Interceptor

Summary

This option includes the following:

- Intercept piped stormwater flows upstream of Opahu Stream via a new weir chamber and divert along Kings Crescent in a new gravity stormwater pipe.
- A stream intake structure and pump station with 2 m^3/s discharge capacity located at Eastern Hutt School.
- Rising main from pump station to outfall to Te Awa Kairangi (via Riverlink outlet 35), pipe to be laid within the road reserve.

High-level plans

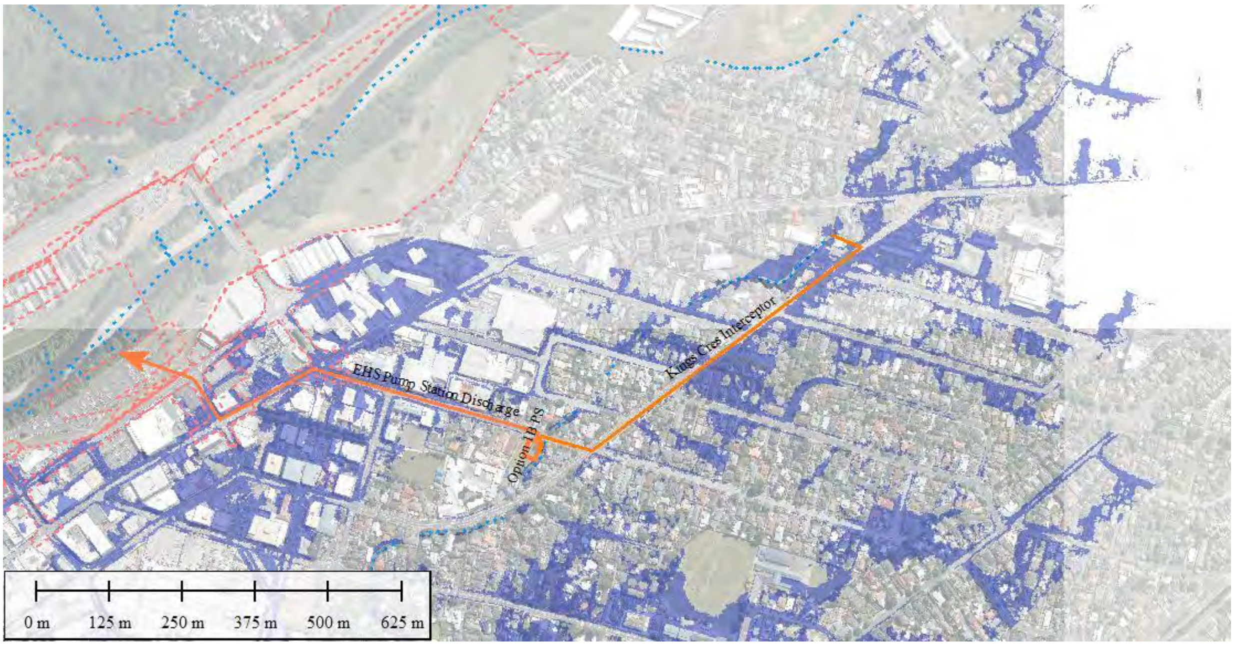


Figure 1 – Option 1B Overview

Figure 2 - Option 1B Pump Station and Stream Intake Structure Location Plan

Key details from preliminary sizing:

- Design flow 2 m3/s.
- Weir chamber on existing stormwater line to divert flows into an interceptor pipe. Weir chamber is a 2.4m dia x 2.5m deep manhole installed at the head of the interceptor pipe.
- 900mm diameter RCRRJ gravity interceptor pipe x 725m long x 4.5m average depth below ground level.
- Stream intake structure is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir length 5m, wingwall span 13m, depth 2.4m.
- Pump station includes buried concrete inlet chamber (6.5m D x 6.6m W x 6.6m L), wet well (10.1m D x 8.6m W x 8.1m L) and valve chamber (5.1m D x 8.7m W x 10.5m L) and a 70 m^2 transformer/electrical building.
- Rising main 800mm dia.
- Targeting flooding around Kings Crescent and in the immediate stormwater network from the upstream reaches of the Opahu Stream, also thereby decreasing downstream flows. This approximate volume (from the 1%AEP + climate change existing model results) is around 30,000m^3. From preliminary inspection of the existing 1%AEP + CC hydrographs, this pump station would be expected to remove about this volume over approximately an 8-hour period at an average flow rate of 1 m^3/s, depending on other network flow constraints.
- Some of the targeted flooding is at some distance from the Opahu Stream and may be at least partly related to network capacity issues rather than directly associated with stream flows.

Key risks / opportunities:

- Depth of pump station structure relative to Waiwhetu aquifer.
- Agreement from school to pump station and rising main.
- Risk that pump station location is not compatible with adjacent services compound on EHS field.
- Risk of exacerbating existing odour issues in upstream reach of Opahu Stream which occurs in low flows / dry conditions, due to removing flushing flows

Stormwater Longlisting Option Assessment

Option	Option 2
Description	St Bernards School Pump Station

Summary

This option includes the following:

- An intake from the existing stormwater pipelines (primary network) in Waterloo Road
- An intake to capture surface water on the northern side of Waterloo Road (secondary flows)
- A pump station on the grounds of St Bernards School
- A rising main along Pretoria St to Outlet 35

High-level plans

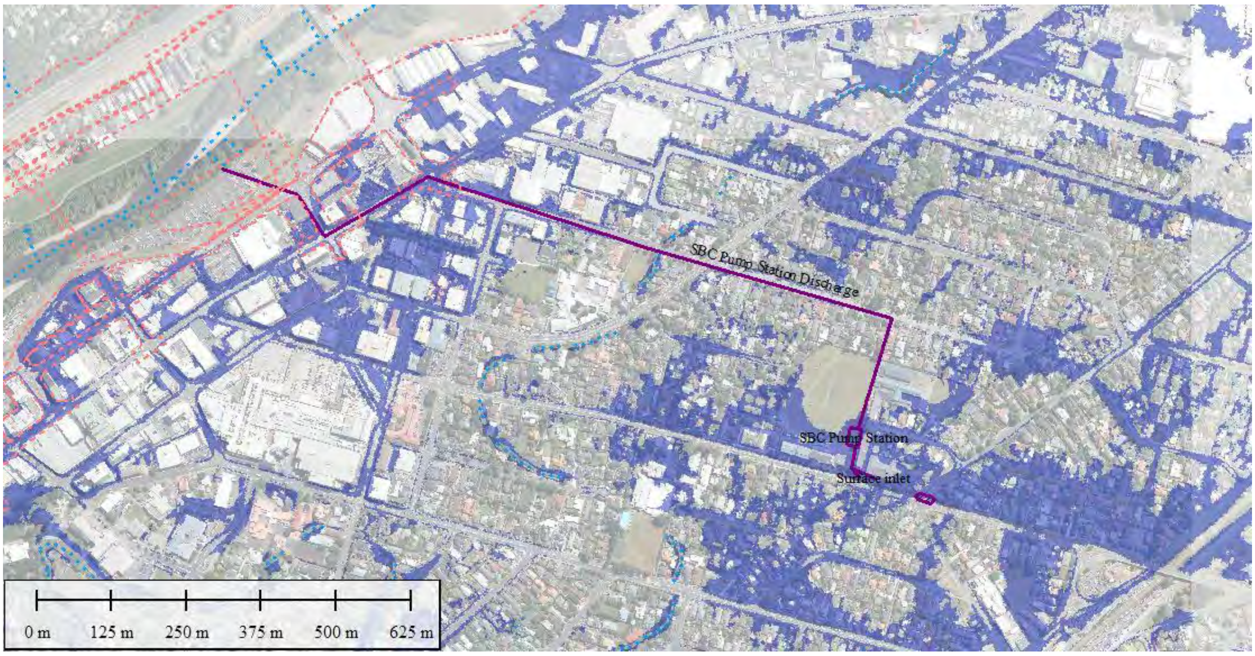


Figure 1 – Option Overview

Figure 2 - Pump Station and Intake Location

Key details from preliminary sizing:

- Design flow max 2 m^3/s.
- Dishing (lowering) of Witako St by about 200mm to allow the overflow path to flow to the west and alleviate ponding at this location.
- Pump station includes buried concrete inlet chamber (7m D x 7m W x 7m L), wet well (6m D x 9m W x 11m L), valve chamber (5m D x 9m W x 11m L) and a 70 m^2 transformer/electrical building.
- ~ 1,000mm diameter rising main of length 1,750m.
- Targeting flooding along Waterloo Road and in the immediate stormwater network from the northeast leading to the Opahu Stream, also thereby decreasing downstream flows. This approximate volume (from the 1%AEP + climate change existing model results) is around 25,000m^3. From preliminary inspection of the existing 1%AEP + CC hydrographs, this pump station would be expected to remove this volume over about a 6-hour period at an average flow rate of around 1 m^3/s.
- Targeted flooding is at some distance from the Opahu Stream and may be at least partly related to network capacity issues rather than directly associated with stream flows.

Key risks / opportunities:

- Depth of pump station structure relative to Waiwhetu aquifer.
- Agreement from school to pump station and rising main.
- Opportunity to combine the rising main with the Option 1a/1b rising main and/or lay it in the same trench as the wastewater interceptor.

Stormwater Longlisting Option Assessment

Option	Option 3a
Description	Hautana Square intake to Hutt Rec Ground Storage

Summary

This option includes the following:

- Intercept flows on a culverted section of Opahu Stream at Hautana Square and divert to a new open channel through Hutt Recreation Ground.
- New open channel in Hutt Recreation Ground to fall east to west and discharges into a downstream section of Opahu Stream.
- Ground levels within Hutt Recreation Ground lowered to provide temporary detention in flood events, with flows spilling out of bank from the new open channel.
- Flood detention to drain by gravity when water levels in Opahu Stream reduce.

High-level plans

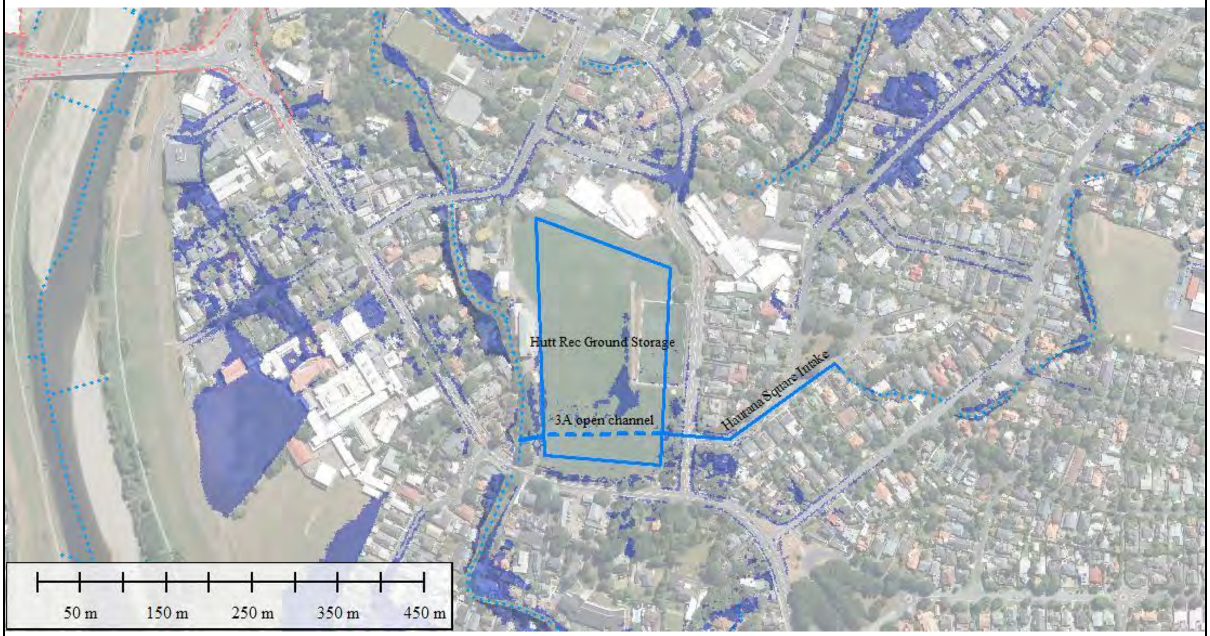


Figure 1 - Option 3A Overview

Key details from preliminary sizing:

- Design flow 2 m3/s.
- 4m dia x 3m deep concrete shaft with internal weir wall to divert flood flows.
- A flow diversion through a 1350mm dia gravity pipe discharging to a new open channel in Hutt Rec Ground.
- New open channel through Hutt Rec Ground discharging back into existing Opahu Stream on the western side of the Hutt Rec Ground.
- The levels of the Hutt Recreation Ground will be lowered by 1m over half the area, and raised by 1m over the other half, so that there is a cut/fill balance.
- The lowered portion of the Hutt Rec Ground will be used for flood storage. In flood events, water will overtop the open channel diversion and be stored within the playing field temporarily.
- A low permeability bund required around perimeter of lowered portion of site.
- Targeting to remove the peak flows from the oxbow section of Opahu Stream to provide additional conveyance capacity in CBD area. The approximate volume of detention provided is around 30,000m^3.

Key risks / opportunities:

- Agreement from landowner / users for flood detention in Hutt Rec Ground.
- Risk that a small package pump station may be required for local drainage.
- Option subject to a Dam Impact Assessment.

Stormwater Longlisting Option Assessment

Option	Option 3b
Description	Hautana Square intake to Hutt Rec Ground pump station

Summary

This option includes the following:

- Intercept flows on a culverted section of Opahu Stream at Hautana Square and divert to a new buried gravity pipe through Hutt Recreation Ground.
- New gravity pipe discharging to a new pump station in the Hutt Rec Ground (South Western corner).
- The pump station will then discharge through Woburn Road to Outlet 24 (in Riverlink designation).

High-level plans

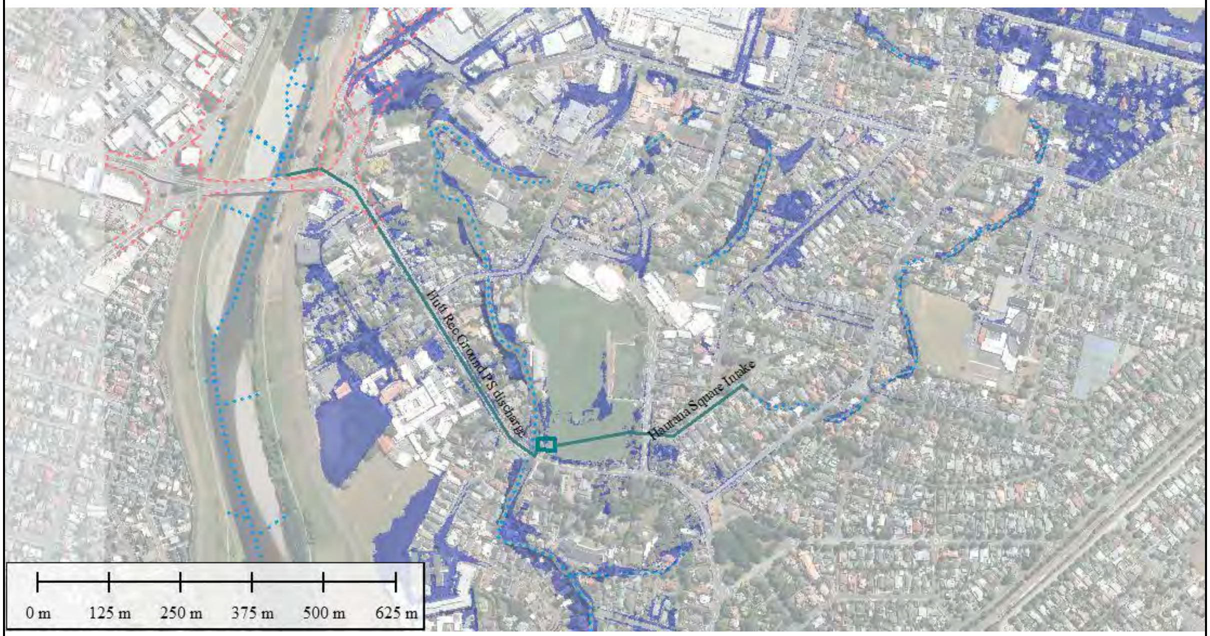


Figure 1- Option 3B Overview

Figure 2 – Option 3B Pump Station Location

Stormwater Longlisting Option Assessment

Option	Option 4
Description	Chilton St James School and Riddiford Gardens pump stations

Summary

This option includes the following:

- A stream intake and pump station with a capacity of max. 3m³/s at Chilton St James School
- A stream intake and pump station with a capacity of max. 3m³/s at Riddiford Gardens
- A rising main from Chilton St James PS along Knights Rd to Riddiford Gardens PS, and then a combined rising main along Queens Dr to Outlet 24.

High-level plans

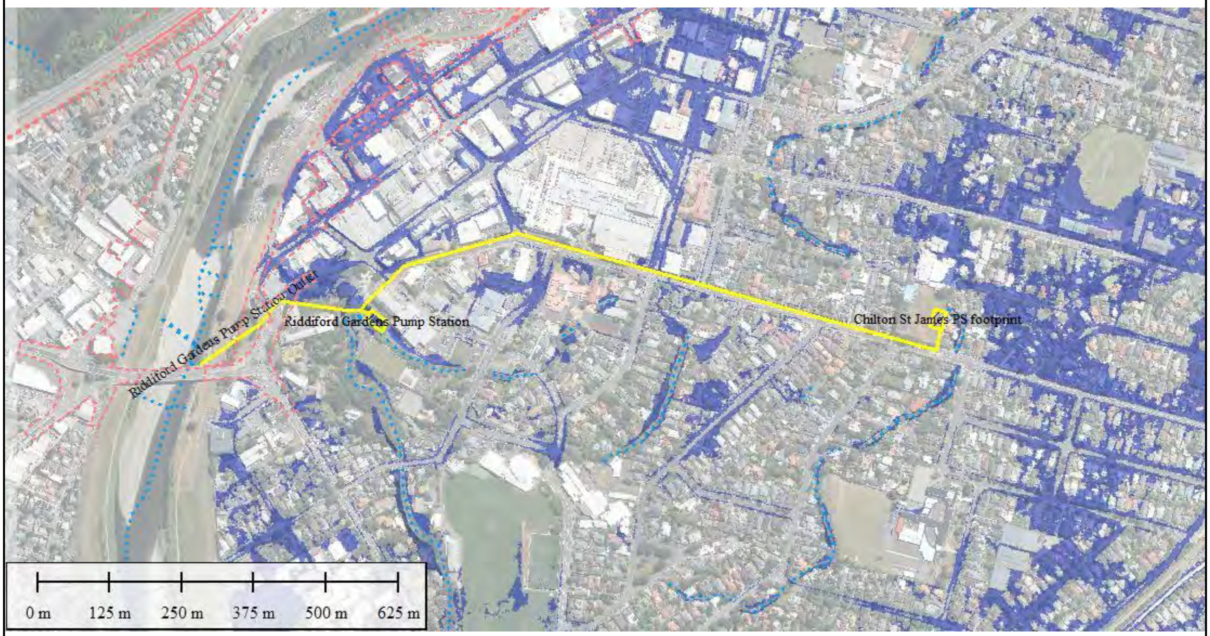


Figure 1 – Option Overview

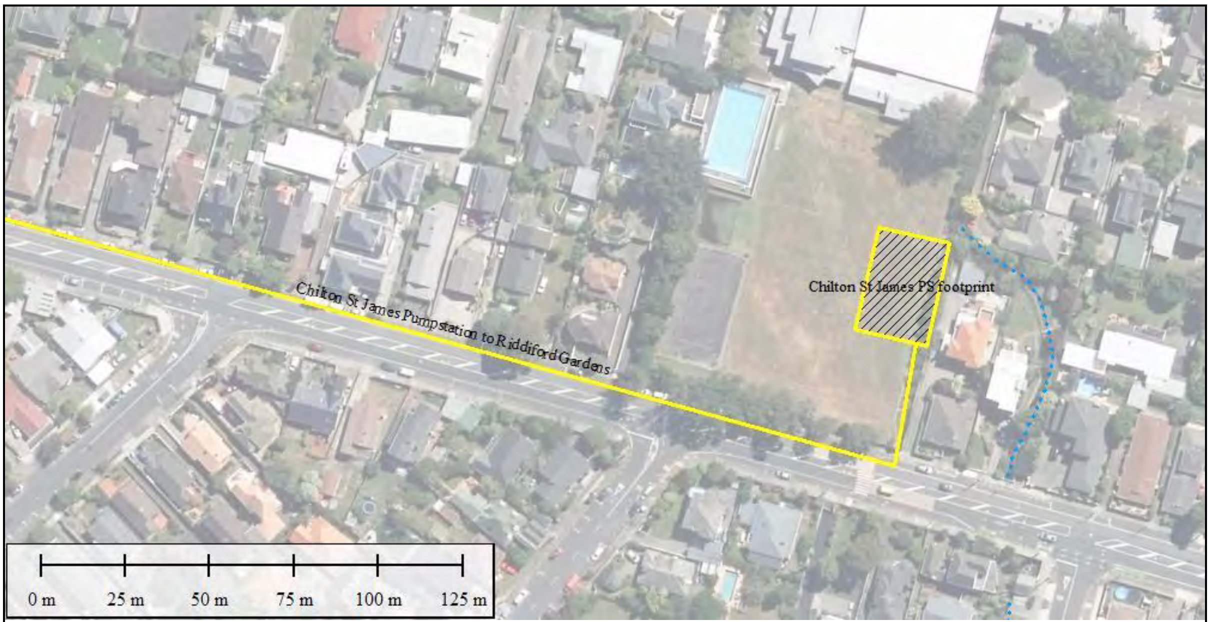


Figure 2 –Chilton St James pump station and intake location

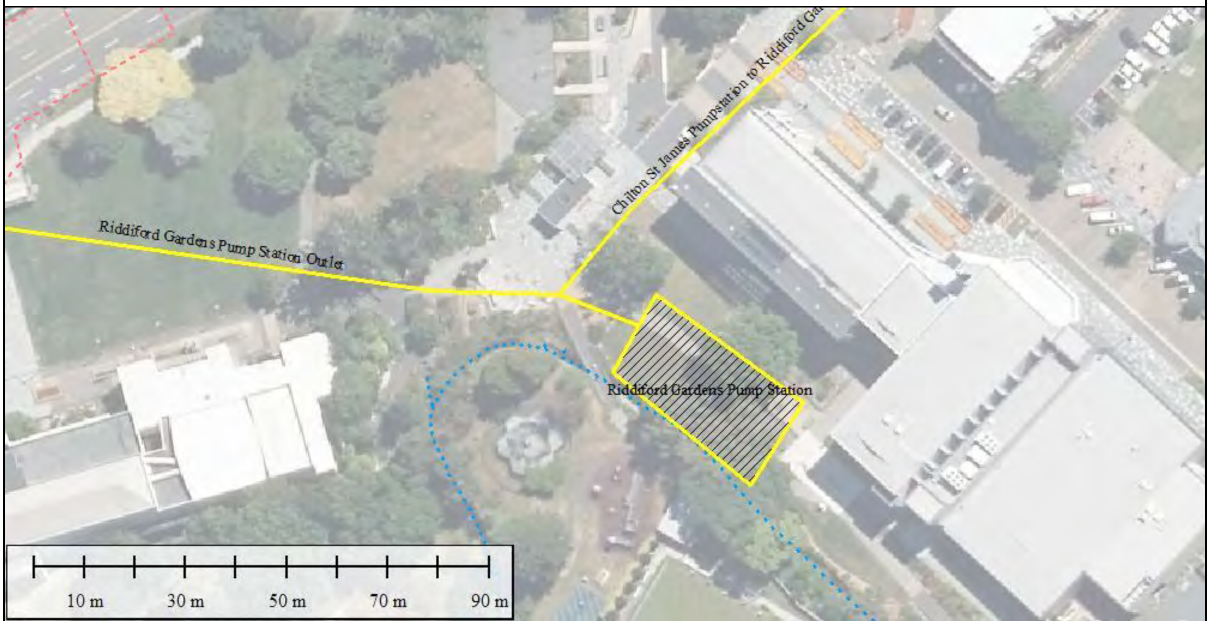


Figure 3 – Riddiford Gardens pump station and intake location

Key details from preliminary sizing:

- Total design flow maximum $6m^3/s$.
- Each stream inlet is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir length 5m, wingwall span 13m, depth 2.4m.
- Each pump station includes a buried concrete inlet chamber (7m D x 7m W x 7m L), wet well (7m D x 9m W x 10m L), valve chamber (5m D x 9m W x 11m L) and a 70 m^2 transformer/electrical building.
- ~ 1,100mm diameter rising main of length 1,150m from Chilton St James pump station to Riddiford Gardens pump station.
- ~ 1,600mm diameter rising main of length 320m carrying the combined flow from Riddiford Gardens pump station to Outlet 24.
- This option seeks to remove water from the Opahu Stream during flooding to allow the stormwater network in the broader catchment to function better. This is expected in particular to have benefits in the CBD and Knights Rd areas, although this will have to be confirmed via modelling. This option has the potential to remove about 70,000 m^3 of floodwater over the course of about 8 hours, at an average flow of 2.5 m^3/s, based on inspection of the existing 1%AEP + CC hydrographs.

Key risks / opportunities:

- Depth of pump station structures relative to Waiwhetu aquifer.
- Agreement from Chilton St James school to pump station and rising main.
- Existing services congestion in Queens Drive

Stormwater Longlisting Option Assessment

Option	Option 5
Description	Hutt Rec Ground NW pump station with two stream inlets

Summary

This option includes the following:

- A stream intake (Intake 1) with a capacity of max. 1.5m^3/s at Riddiford Gardens (Myrtle St)
- A stream intake (Intake 2) with a capacity of max. 1.5m^3/s at Hutt Rec Ground
- Gravity pipelines from each intake to the pump station
- A pump station with a capacity of 3m^3/s at the northwest corner of the Hutt Rec Ground
- A rising main along Myrtle St and Woburn Rd to Outlet 24.

High-level plans

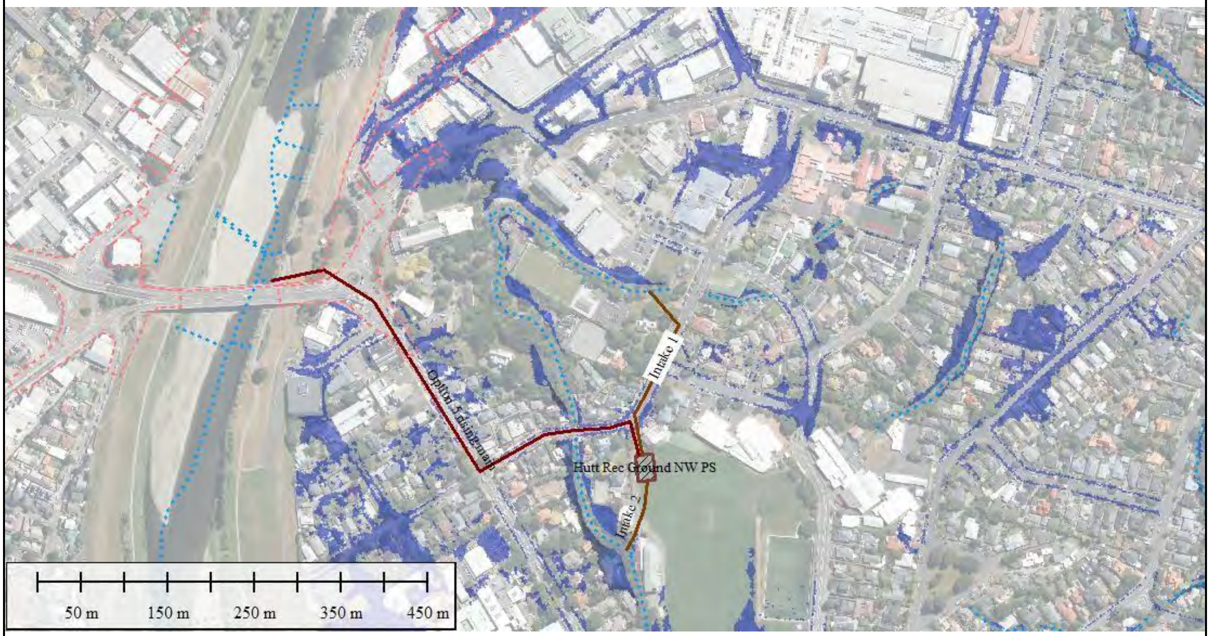


Figure 1 – Option Overview

Key details from preliminary sizing:

- Total design flow maximum $3m^3/s$.
- Each stream inlet is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir length 5m, wingwall span 13m, depth 2.4m.
- Gravity inline pipes ~900mm diameter and length of 220m (Intake 1) and 100m (Intake 2) to pump station.
- The pump station includes a buried concrete inlet chamber (7m D x 7m W x 7m L), wet well (7m D x 9m W x 8m L), valve chamber (5m D x 9m W x 11m L) and a 70 m^2 transformer/electrical building.
- ~ 1,100mm diameter rising main of length 570m from Hutt Rec Ground NW pump station to Outlet 24.
- This option seeks to remove water from the Opahu Stream during flooding to allow the stormwater network in the broader catchment to function better. This is expected in particular to have benefits in the CBD and Woburn areas, although this will have to be confirmed via modelling. This option has the potential to remove about 40 – 50,000 m^3 of floodwater over the course of around 8 hours, at an average flow of 1.5 m^3/s based on inspection of the existing 1%AEP + CC hydrographs.

Key risks / opportunities:

- Depth of pump station structures relative to Waiwhetu aquifer.
- Possible alternative location to the Riddiford Gardens PS, as such, could be combined with the Chilton St James PS.

Appendix C MCA criteria and specialists

Criteria (and matters to consider within each)[1]		Specialist	Input sought from:
Planning, environmental and cultural			

1.	Ecology
	[Some possible matters for your consideration in the criteria. TBC by the ecologist]
	- Terrestrial ecology
	  o Impacts on native vegetation
	- Freshwater ecology
	  o Impacts on wetlands or streams
	  o Potential changes to hydrology which impact on downstream ecosystems
	  o Fish passage implications
		[redacted] (T+T)	[redacted] (T+T)

2.	Cultural *[Some possible matters for your consideration in the criteria. TBC by the cultural specialist]* - Wāhi tapu - Ngāhere/rakau (important bush/trees) - Awa - Mauri - Ngā Taonga Nui a Kiwa / Sites of significance (pNRP schedules B and C)	[redacted] (HCC)	[redacted] (HCC)
3.	Planning and consenting complexity - Zones and overlays / any particular constraints - Potential consent requirements and activity status - Any major consenting impediments - Potential for notification	[redacted] (T+T)	[redacted] (WWL), [redacted] (T+T)
Engineering and technical considerations			
4.	Constructability *[Some possible matters for your consideration in the criteria. TBC by the specialist]* - Construction risks and general degree of difficulty - Depth/area of excavation - Access, health and safety - Disruption to existing services and utilities	[redacted] (T+T)	[redacted]T+T), contractor input, [redacted] (T+T)
5.	Infrastructure resilience and risk *[Some possible matters for your consideration in the criteria. TBC by specialist]* - Risks due to: infrastructure failure (e.g. pump failure), residual risks. - Resilience and adaptability of proposed option.	[redacted]	[redacted] / [redacted] (T+T)

	Criteria (and matters to consider within each)[1]	Specialist	Input sought from:
6.	Operation of infrastructure *[Some possible matters for your consideration in the criteria. TBC by the specialist]* - Ongoing operational and maintenance requirements - Access - Health and safety (asset owner)	[redacted] WWL)	[redacted] (WWL)
	Social		
7.	Provision of flooding reduction - Within the identified growth area of residential homes and access to houses, and arterial roads (primary focus) - To residential land adjacent to dwelling spaces or access or egress routes (secondary focus)	[redacted] (T+T)	[redacted] / [redacted] WWL)
8.	Property *[Some possible matters for your consideration in the criteria. TBC by the specialist]* - Ownership - No of private properties impacted - Complexity of land access and/or property purchase	[redacted]	
9.	Effects on community - Construction - Broadly more or less disruptive (taking into account duration and proximity to neighbours) - Operational o Effects on community assets and amenities (excludes flood reduction addressed above). o Noise effects associated with operation of infrastructure	[redacted] (T+T)	[redacted] (T+T), [redacted] (HCC), HCC Parks.

Notes

1. The draft criteria have been circulated for feedback and updated to reflect this feedback. However specialists may amend or clarify their criterion and/or issues to be considered should this be required.
2. The specialist is encouraged to seek input from the relevant people, including but not limited to those identified above.

Appendix D Summary memo template, including MCA recording and scoring

Memorandum

To:	[redacted]
From:	[Specialist name]
Date:	
Subject:	**Multi-criteria analysis - IAF stormwater upgrades options** [**Specialist criteria**]

1 Introduction

In June 2021, the New Zealand government announced the Infrastructure Acceleration Fund (IAF). The IAF is administered by Kainga Ora and is designed to allocate funding to new or upgraded infrastructure to unlock housing developments in the short-to-medium term and enable a meaningful contribution to housing outcomes in areas of need.

The Hutt City Council (HCC) has IAF funding support to deliver Enabling Infrastructure Projects to facilitate the construction of up to 3,520 new houses in the Lower Hutt Valley. This includes Related Enabling Infrastructure Projects such as the stormwater upgrades proposed to provide for flood management and protection works.

HCC is currently considering stormwater upgrade options to reduce flooding within the catchment of the Opahu Stream. The primary focus of these options is to reduce flooding within the identified growth area of residential homes (floor levels) and access to dwellings, and of arterial roads identified by HCC. The options are being considered via a multi-criteria analysis (MCA) process. Seven options have been considered as part of this process.

This report summarises the evaluation of the options under the [XXXXX] criterion, and records the scores assigned for each option under that criterion.

2 Background

Summary of context as relevant to criterion e.g. property agreements, ecology assessments, etc.

2-4 paragraphs max.

3 Methodology

- *Data/information used*
- *Matters considered*

4 Key assumptions

- *Key assumptions (further work required to address – where relevant)*
- *Mitigation assumptions*

- *What determines fatal flaws*
- *Approx. 1 page max.*

5 Scoring

See attached table. Include:

- Score (based on chart provided in briefing memo)
- Key reasons for score, including mitigation taken into account

Option	Name	Score	Reasons for score
		e.g. -3	*e.g. would have significant impact on a wetland of significant value* *key benefits / advantages or effects / risks*
1a	Upper Opahu Stream Improvements + Eastern Hutt School Pump Station		
1b	Eastern Hutt School Pump Station with Kings Crescent Interceptor		
2	St Bernards School pump station		
3a	Hautana Square intake to Hutt Rec Ground Storage		
3b	Hautana Square intake to Hutt Rec Ground pump station		
4	Chilton St James School and		

	Riddiford Gardens pump stations		
5	Hutt Rec Ground NW pump station with two stream inlets		

6 Additional matters

Any important matters not otherwise captured previously. If none, N/A

Regards

[Signature]

[First Name] [Surname]
[Position]

Appendix M- Longlist costs summary

NOT INCLUDED

Appendix N- Outcomes of shortlisting workshop

PMB Papers

To	Project Management Board (PMB)
cc	
From	[redacted]
Date	18 October 2023
Subject	Outcomes of shortlisting workshop
Reference	1091097.TT.2000.PRW.ME.GV.0013.PAPER_ Shortlisting results.docx

1 Decision Requested

Endorsement of the shortlisted options to be taken to the next stage of design development.

2 Background

A Multi Criteria Analysis (MCA) was undertaken to assess the short list of best practicable options to take forward for further consideration for stormwater projects. The workshop was held on 11 October 2023 to assess the seven longlist stormwater options. The seven longlist stormwater options are shown on Figure 1 in Appendix A.

The stormwater MCA considered the following criteria, each scored by relevant specialists:

1. Ecology
2. Cultural
3. Planning and consenting complexity
4. Constructability
5. Infrastructure resilience and risk
6. Operation of infrastructure
7. Provision of flooding reduction
8. Property
9. Effects on community

The purpose of the stormwater MCA and of the longlist/shortlist process more generally, is to meet the requirements under the Resource Management Act 1991 (RMA) to demonstrate a robust and transparent process for decision making to obtain the best practicable option. The proposed scope for feasibility studies did not consider an MCA process. However, when property acquisition of private properties was a feature of several of the options it was deemed necessary to undertake the MCA process in order to avoid the risk of revisiting the preferred option during consenting or any public works act process that might arise from property acquisition.

The costs of the various options were not scored as part of the MCA but were considered alongside the MCA scorings to decide the short list.

3 Discussion

3.1 Stormwater MCA results

Summary results of the MCA can be found in Appendix B. To assist the group in comparing the potential economic benefit of each option in the long list, an assessment was undertaken of the flooded area and flooded properties that were within the zone of influence to be improved by an option. This enabled a rough comparison between options based on the potential cost per property where flooding may be able to be improved.

- Option 1A scored poorly across several criteria, particularly for Consenting, Constructability, and Property. Option 1B addresses flooding in the same catchment area but had fewer identified constraints.
- Option 2 is similar to Option 4 but addresses a smaller area of flooding.
- Option 3A and Option 3B scored favourably in the MCA, however both options have a very high cost per property and was therefore considered to provide a lower value outcome.
- Option 5 scored favourably in both the MCA and the cost per property.

3.2 Costs

The total budget for the IAF project is [redacted], including both the stormwater and wastewater upgrades. Kainga Ora are contributing [redacted] towards the Stormwater projects. The latest cost estimate for the Wastewater project is [redacted], higher than the [redacted] Included in the HCC LTP. A further value engineering process is proposed for both the Wastewater and Stormwater projects. This may reduce the costs of projects. An updated estimate is expected at the end of November 2023.

A summary of the cost estimates for the stormwater options are shown in Table 1 below. The cost estimates for the stormwater options indicate that one or two options can be delivered within the current funding allocation.

Table 1: Stormwater Cost Estimate Summary

Option	P50 Estimate + Property ($m)	Expected Estimate Range ($m)		P95 Estimate +Property
		95%	130%	
1A	[redacted]			
1B	[redacted]			
2	[redacted]			
3A	[redacted]			
3B	[redacted]			
4	[redacted]			
5	[redacted]			

3.3 Flooding impacts

During the process of assessing the long list options it was determined that it will not be possible to target all flooding within the IAF growth area by means of just one or two of the options, due to the distributed nature of this flooding.

The area of flooding addressed / targeted by each option is shown spatially on Figure 1 in Appendix A and is numerically represented in Appendix B. Note this is based on high level assessment against Wellington Water 1% AEP CC flood hazard extents.

3.4 Shortlisted Options

On the basis of the MCA results and consideration of the value for money from the potential zone of influence for each option, the following options were chosen to progress to the shortlist for further consideration:

- Option 1B
- Option 4
- Option 5

During the shortlisting stage it is proposed to consider one round of optimisation for each of the shortlisted options in order to identify any cost savings within the feasibility level designs. E.g. reducing pump station depths for the options.

4 Recommendation

It is recommended that the PMB endorse the following shortlist stormwater options to progress to the next stage of design development:

- Option 1B
- Option 4
- Option 5

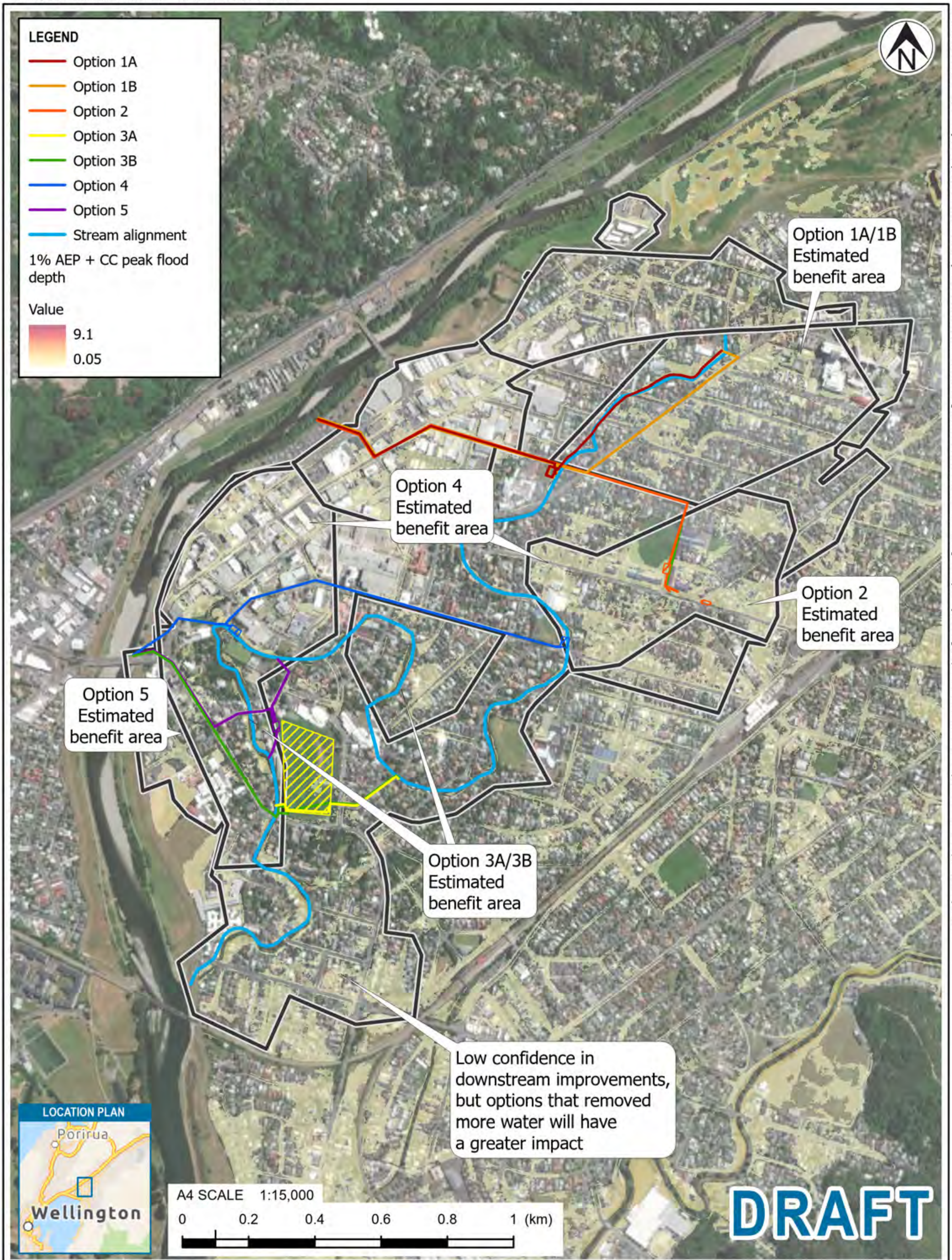
in parallel with Value Engineering being carried out for the wastewater concept design.

Resolution

Next Steps

Recommended By:	Name [redacted]	Signature [redacted]
Approval by the PAB:		
[redacted] (T+T) Chairperson	Name [redacted]	Signature [redacted]
[redacted] (HCC) Project Sponsor	Name [redacted]	Signature [redacted]
[redacted] (WWL) PMB Representative	Name [redacted]	Signature [redacted]

Appendix A – Longlist Options and Areas of Flood Benefit



C:\Users\reho\OneDrive - Tonkin + Taylor Group Ltd\Documents\ArcGIS\Projects\HCC SW areas of estimated flooding effect\HCC SW areas of estimated flooding effect.aprx Layout: Longlist options and estimated areas of impact 2023-Oct-16 5:04 pm Drawn by REHO

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PROJECT No.	1091097.2100		CLIENT	HUTT CITY COUNCIL
DESIGNED	REHO	OCT.23	PROJECT	HUTT CITY COUNCIL IAF
DRAWN	REHO	OCT.23	TITLE	LONGLIST OPTIONS AND ESTIMATED AREAS OF IMPACT
CHECKED				
APPROVED		DATE		
SCALE (A4)	1:15,000	FIG No.	FIGURE 1.	REV 0

Appendix B- Summary of MCA Results

IAF STORMWATER UPGRADE OPTIONS - MCA

[redacted] [redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	See above. Addresses the same area but with less constraints. Likely to proceed to shortlist.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	HCC Parks indicated significant constraints. Any constructed channel would need to be along boundary of park. No to a split level field (but would consider overall lowering of field but a number of requirements / challenges associated with this). Smaller volume of water. therefore reduction in flooding less than other options. Taken off long list for same reasons as 3b. Note: Costs updated to show lowering of full field and off-site disposal of material.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Costly option relative to flooding reduction. While the flood reduction is a high level assessment, this option is notably higher than all other options. Unlikely to proceed to short-list. Note: HCC Parks would not consider PS on pitch side but there are unused areas of land or existing buildings that could be repurposed / replaced.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Parks would not consider new PS building within Riddiford Gardens. However would consider repurposing of existing buildings. Option addresses two separate areas / good to cover range of areas.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Flood reduction includes commercially zoned land. However commercial zone encourages and provides for significant residential intensification.

[redacted]

redact

Appendix C- Costs table

		%	Option 1a; Eastern Hutt school PS with stream conveyance improvements	Option 1b; Eastern Hutt School PS with Kings Crescent Interceptor	Option 2; St Bernards College Pump Station and Rising Main to Outlet 35	Option 3a; Hautana Square Intake to Hutt Rec Ground Storage	Option 3b; Hautana Square intake to Hutt Rec Ground SW Pump Station	Option 4; Chilton St James PS + Riddiford Gardens PS	Option 5; Hutt Rec Ground NW Pump Station with two stream intakes
PHASE	**DESCRIPTION**		**TOTAL**	**TOTAL**	**TOTAL**	**TOTAL**	**TOTAL**	**TOTAL**	**TOTAL**
Design			[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Preliminary Design (% of Construction Works)	4%	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Design Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Base Estimate	Consenting Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Site Investigation Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Property & Utilities Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Project Specific Insurances Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Construction Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Base Estimate Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Known/Unknown Risk	40% Allowance	*40%*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Known / Unknown Risk Allocation Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Expected Estimate	Base Estimate		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
P50	Known / Unknown Risk - 40% Allowance		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Expected Estimate Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Property Acquisition & Demolition	Making good existing property		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Property Acquisition, including demolition		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Property Acquisition, including demolition. Risk Allowance (Additional Properties) is full cost at 50%		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	School Easement and Offset Property Purchase		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Property and School Land Acquisition (including demolition) Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Expected Estimate + Property Acquisition	**Expected Estimate + Property Acquisition, including Demolition**		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Expected Estimate Range	**95% Range**		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	130% Range		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Funding Risk (Additional Client Risk)	60% Allowance	*60%*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Funding Risk Total		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
95th Percentile Estimate P95	Expected Estimate + Property Acquisition		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Funding Risk		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	95th Percentile Estimate		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Appendix O- MCA workshop meeting notes

MCA workshop Meeting Notes

11 October 2023

Attendees: [redacted]

General:

- The 3500 lots affected stated in the IAF application came from a former employee in the HCC housing team and what they felt the potential might be [redacted]
- Cross reference to the District Plan which has changed in the last 6 months. When looking at the areas to develop, the central city catchment and Waterloo Station areas are good ones to be benefitting ([redacted]
- HCC has 400m and 800m walkable catchment maps, which [redacted] can share [done]. There is a general concentration of services/facilities on the western side and near to Waterloo Station, with a corresponding absence in the middle
- WWL is working with HCC on the District Plan so flood maps have been influencing the District Plan changes
- There is no appetite for moving forward with options over the limit
- Assess the area of flooding where it is above 200mm (assessing beyond just the number of properties affected) – for next stage
- Floor level data is not easily accessible/available
- [redacted] was a P80 for cost estimate (a P95 was conducted and then contingency was trimmed)
- Riddiford gardens will require high spec reinstatement
- Bowling Club often floods and could be a potential area for consideration
- Need to double check if commercial area is part of the residential intensification designation
- Look at map of areas of cultural significance
- [redacted] to test Riddiford Gardens and Hutt Rec Ground with Parks and Reserves team
- [redacted] to chat with urban Renewal Programme group on development areas

Construction:

- Has there been consideration of whether there are benefits and/or drawbacks of installing connections with the wastewater on Pretoria Street? If there are two very large pipes, this will impact that TMP as it may require full road closures. It could also cause community disruptions and introduce challenges with the interface between different contractors and sequencing

Operational:

- Pump station on school grounds not favourable – conflict between school autonomy and 24/7 operational needs.
- Not much land at CSJ so may be issues with acquiring land
- The bigger the pump station the hard it will be to get portable generation.
- Need to assess the access during flood conditions
- Have considerations been made for if the pump stations were to fail?

Resilience and risk:

- Frequency of PS being used – e.g. if not used for 10 years then could face mechanical issues when starting up

- Risks can be mitigated with standby power generation (onsite, not portable)
- Onsite generator for pump stations should be a given. Cannot rely on bringing a generator (availability, access). [redacted]

Cultural:

- Ensure stormwater is not mixed with fresh water, especially at sites of significance
- Need to consider the pump stations close to the Waiwhetu aquifer
- Spiritual H&S on the land needs to be considered when works begin
- Cultural values include ensuring Mana Whenua receive updates and that there is ample time for Mana Whenua to input into decisions.
- Mana Whenua are working with council to get the locations of significance mapped on GIS. There is currently a markup with the pinpoints (but doesn't show the extents)

Property purchase:

- Council approval needed for property purchase. Robust case required.

Planning:

- Diversion of water out of the Opahu Stream will need a consent from GWRC
- The Riddiford Gardens toilet block consent can be used as a comparable case as they are a fairly new construction.
- Ongoing regulatory requirements potential for Option 1A

ACTIONS SUMMARY

- The property scoring to be reviewed for option 1b and updated as required (complete)
- Ecology scoring for options 1a (to reflect stream restoration) and 3a (no pumpstation) to be reviewed and updated as required (by 12.10.23)
- Cultural scoring to be undertaken by 13.10.23. [redacted] and [redacted] will liaise with [redacted] and [redacted] where information on the options is needed.
- To relate the flooding reduction identified by [redacted] back to the DP level of intensification provided for, along with any information regarding walkable catchments ([redacted] by 12.10.23)
- Hutt Recreation Ground – implications of changing the levels across the park for cricket in particular and confirm whether or not this is a show stopper/fatal flaw – [redacted] by 12.10.23
- Riddiford Gardens – current thinking is that a PS within the gardens would be exceptionally challenging to consent due to heritage and amenity consideration. To clarify this with HCC – [redacted] by 12.10.23

Appendix P- Stormwater pivot paper

PMB Papers

To	Project Management Board (PMB)
cc	[redacted]
From	[redacted]
Date	10 November 2023
Subject	Stormwater Pivot
Reference	1091097.TT.2000.PRW.ME.GV.50.PAPER_Stormwater_pivot.docx

1 Decision Requested

Note the proposed approach to continuing shortlist development for the Stormwater options.

2 Background

The following options were selected for the stormwater project shortlist for further development. and are shown on the plan in Appendix A:

- Option 1B: pump station at Eastern Hutt School with a gravity interceptor in Kings Crescent.
- Option 4: pump stations at Chilton St James school and Riddiford Gardens.
- Option 5: pump station at the NW corner of the Hutt Rec Ground, with two intake pipelines.

Option 1B is similar to the original 'MEL_Option_2' but with the pump station located further upstream and the addition of the gravity interceptor. Option 4 is essentially the same concept as the original 'WOB_Option_2'.

The 2021 Stantec study[1] concluded that the primary driver of flooding in the Melling, Woburn and Waterloo West suburbs was high water levels in the Opahu Stream and/or Hutt River. The original options 'MEL_Option_2' and 'WOB_Option_2' were developed in line with that finding. In the absence of further modelling to date, T+T/MM has also developed the current longlist/shortlist options on that basis. The reliance on this previous finding was identified as a risk (RSK-0035).

Stantec has recently carried out initial modelling of the shortlisted options and these results are presented on the maps in Appendix B. These maps show the resulting peak flood depth (in shades of blue) and the reduction in flood depth due to the modelled option (in shades of red) for a 1% AEP +

[1] Stantec, 2021. *Waiwhetu Growth – Stormwater Servicing Options*. (Table 2)

CC [2] storm for each option. In all three cases, the proposed option has an impact on water levels adjacent to the stream, including a reach up- and downstream of the intake locations. However, the area of flood reduction does not extend as far from the stream as expected. This level of benefit alone is unlikely to be enough to justify the expected cost of this infrastructure investment.

Although the previous study concluded that the downstream water level in the Opahu Stream was driving the modelled flooding in this catchment, the most recent results indicate that network constraints also have a strong influence. These constraints are preventing the runoff from high intensity rainfall from reaching the stream as water runs overland and ponds in low areas where it is unable to rejoin the network to enter the stream. This result reflects that the level of service of the primary stormwater network is typically (at best) around 10% AEP.

Table 1, below, shows the number of residential and commercial lots that experience a reduction of flooding under each option.

Table 1 Number of lots with a flooding improvement under each option

Option	No. of residential lots	No. of commercial lots
Option 1B	313	16
Option 4	356	47
Option 5	135	36

Whilst the number of lots may seem high, the location of the lots is typically in a strip immediately adjacent to the stream where it is unlikely that HCC would wish to encourage further development. It should also be noted that this includes all lots that experience a flooding reduction – including those that had very little flooding to begin with, and those that have a very small reduction.

The current options mostly achieve further capacity within Opahu Stream. This is an important factor in reducing flooding as it provides an intermediate location that water could be channelled to before it reaches Te Awa Kairangi.

3 Discussion

We have considered two approaches for the shortlisting to reflect these findings.

3.1 Approach 1: proceed as originally planned

Under this approach, we proceed with the development of the three shortlisted options as they stand. The relatively modest flood benefits, however, will likely make the project costs difficult to justify to Kāinga Ora and to HCC councillors.

This approach has limited additional cost or programme implications (beyond the consideration of possible courses of action and the time the project has been paused while this matter was considered).

[2] 1% Annual Exceedence Probability (100-year) with an allowance for climate change

3.2 Approach 2: the 'pivot'

Under Approach 2, we work with Stantec to identify flooding 'clusters' that show the most promise to combine with each of the three shortlisted options, to look more closely at the model results for each of these to understand the mechanisms of flooding, and to develop high level solutions to reduce the flooding in these areas. We expect that these solutions would mostly involve modifying overland flow paths or short lengths of increased piped capacity because building primary (piped) infrastructure to cope with a 1% AEP + CC storm is unlikely to be cost effective or sustainable.

Due to the flat nature of the terrain, these clusters are likely to be those nearby but not directly adjacent to the stream. We would also look specifically at what might be possible in the Waterloo Road area, which lies further from the stream to investigate if draining any of this area to Opahu Stream is feasible. Finally, Stantec would remodel each of the three options with the associated cluster solutions for a 1% AEP + CC storm.

Following the pivot, the shortlist development and costing work would resume with the additional cluster solutions included.

3.2.1 Cost implications

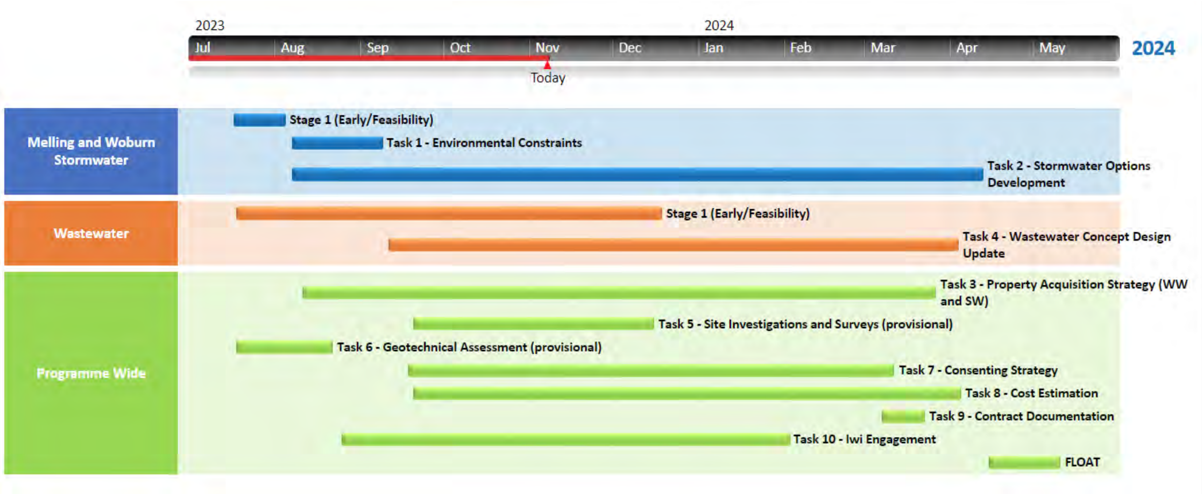
Approach 2 would have a cost implication of approximately [redacted] including an allowance of [redacted] for additional site investigations in the cluster areas. This comprises:

- T+T and Stantec time in planning the pivot
- Modelling and high level design work in developing solutions
- Additional time required for costing the three options due to the inclusion of the cluster solutions (more than just an update and refinement of the longlist options)
- Additional time required in the design of the preferred option and in reporting due to this additional design.

3.2.2 Programme implications

The pivot is expected to take around four weeks to carry out and merge back into the shortlist options development. This does not include the week the project has been paused while planning for the pivot was undertaken.

However, the programme will extend into early April as shown below. This is due to (1) there being less certainty around the final composition of the shortlist options meaning we are not able to run as many tasks concurrently, and (2) each stormwater option increasing in scale and complexity meaning more design effort is required.



4 Recommendation

That the PMB note the results that have been received from the modelled options and note the pivot of the stormwater options.

Resolution
Endorsed

Next Steps
Enact pivot

Recommended By:	Name [redacted]	Signatu[redacted]
Approval by the PAB:		
[redacted]T+T) **Chairperson**	Name [redacted]	Signatur[redacted]
[redacted](HCC) **Project Sponsor**	Name [redacted]	Signature [redacted]
[redacted]WWL) **PMB Representative**	Name [redacted]	Signatur[redacted]

Appendix A – Shortlist Options

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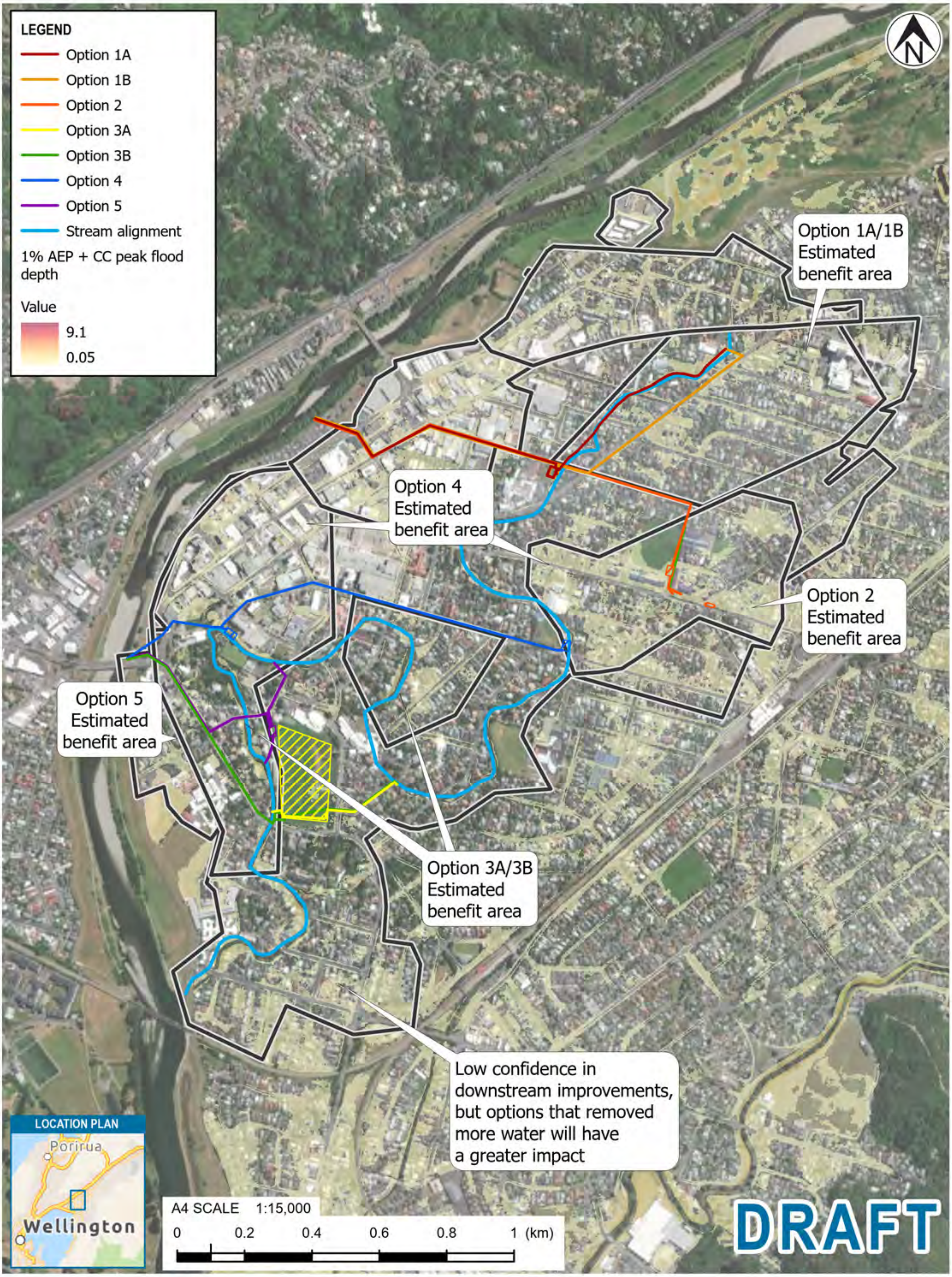

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PROJECT No.	1091097.2100		
DESIGNED	REHO	OCT.23	
DRAWN	REHO	OCT.23	
CHECKED			
APPROVED		DATE	

CLIENT HUTT CITY COUNCIL

PROJECT HUTT CITY COUNCIL IAF

TITLE LONGLIST OPTIONS AND ESTIMATED AREAS OF IMPACT

SCALE (A4) 1:15,000   FIG No. FIGURE 1.   REV 0

Appendix B– Flood maps for each option

IAF STORMWATER UPGRADE OPTIONS - MCA																						
		Planning, Environmental and Cultural			Engineering and Technical			Social														
OPTION	DESCRIPTION	Ecology	Cultural*	Planning & consenting complexity	Constructability	Operation of Infrastructure	Risk and resilience	Flooding Reduction	Property	Effects on community	Area of flooding (approx.)	Flood reduction - no of affected properties	Total -ve	Total +ve	TOTAL	RANK	High level approx. COST ($)	Per area	Per Property	Zoning devel potential	Comments / Notes
1a	Upper Opahu Stream Improvements + Eastern Hutt School Pump Station	1	-2	-3	-2	-2	0	3	-3	-3	56602	301	-15	4	-11	7	[redacted]			High (+ relatively large area)	Unlikely to proceed to short-list. Very challenging option to consent, construct and maintain. Significant property impacts/purchase and associated long term community effects (displacement). Option 1b addresses same area but with less identified constraints.
1b	Eastern Hutt School Pump Station with Kings Crescent Interceptor	-1	-2	-2	-2	1	-1	3	-2	-2	56602	301	-12	4	-8	5				High (+ relatively large area)	See above. Addresses the same area but with less constraints. Likely to proceed to shortlist.
2	St Bernards School pump station	0	-2	-1	-2	1	-1	2	-2	-2	76719	259	-10	3	-7	4				High (+ large area)	Addresses the same area as the Chilton component of Option 4. More challenging from a property perspective and flood reduction benefits of Option 4 greater. Therefore this option unlikely to proceed to shortlist.
3a	Hautana Square intake to Hutt Rec Ground Storage	-1	1	-2	-1	3	2	1	0	-1	15167	107	-5	7	2	1				High (but over small area)	HCC Parks indicated significant constraints. Any constructed channel would need to be along boundary of park. No to a split level field (but would consider overall lowering of field but a number of requirements / challenges associated with this). Smaller volume of water. therefore reduction in flooding less than other options. Taken off long list for same reasons as 3b. Note: Costs updated to show lowering of full field and off-site disposal of material.
3b	Hautana Square intake to Hutt Rec Ground pump station	-1	0	-1	-2	2	1	2	0	-2	15167	107	-6	5	-1	2				High (but over small area)	Costly option relative to flooding reduction. While the flood reduction is a high level assessment, this option is notably higher than all other options. Unlikely to proceed to short-list. Note: HCC Parks would not consider PS on pitch side but there are unused areas of land or existing buildings that could be repurposed / replaced.
4	Chilton St James School and Riddiford Gardens pump stations	-1	-1	-3	-3	-1	1	3	-1	-3	136114	442 Chilton 304 / Riddiford 138	-13	4	-9	6				High (Chilton) / Very high (Riddiford) (+ very large area)	Parks would not consider new PS building within Riddiford Gardens. However would consider repurposing of existing buildings. Option addresses two separate areas / good to cover range of areas.
5	Hutt Rec Ground NW pump station with two stream inlets	-1	-1	-2	-2	2	1	2	0	-2	59,394	517 Res 82 / Commercial 435	-8	5	-3	3				Very high (+ relatively large area)	Flood reduction includes commercially zoned land. However commercial zone encourages and provides for significant residential intensification.

* The **cultural assessment** assigned priority to the options from 1 (highest/best) to 7 (lowest/worst). Indicative scoring to reflect these priorities has been applied as follows:
Priority 1: Scored 1; Priority 2: Scored 0; Priorities 3-4: Scored -1; Priorities 5-7: Scored -2

Appendix Q- Update on stormwater pivot

Memorandum

To	HCC WIG Technical Advisory Group [redacted]
cc	[redacted]
From	[redacted] SW Lead. [redacted] Project Manager/Design Manager
Date	31/01/2024
Subject	For information: update on SW Pivot
Reference	1091097.TT.2100.PRW.ME.CV.70.TAG_Update on SW Pivot.docx

1 Situation

The project team identified six potential areas where low technology solution measures could be implemented to drain a cluster of flooded areas towards the trunk network. These conceptual interventions were then passed to Stantec to model for effectiveness.

Stantec has carried out high-level modelling of T+T's conceptual solutions to flooding in the six selected clusters. The solutions use measures such as:

- roadside swales;
- channels formed from depressing driveways;
- large scruffy dome inlets; and
- new pipe connections to the Opahu Stream

to capture surface flows and drain ponding areas impounded behind roads.

The clusters, along with the preferred development areas, provided by Urban Advisory for HCC, and the shortlisted options, are shown for reference in Figure 1.

The focus of the options development and assessment is on creating capacity in the trunk network to enable new dwellings without worsening flooding. The cluster solutions then identify specific areas where overflows can be enabled to get back to the trunk network. There is still uncertainty about exactly where and when new development will take place, although we have an indication of the preferred development areas identified by HCC/Urban Advisory. Future development within specific areas will need to additionally consider and make provision for flow of water from the developed areas back into the trunk network. The cluster solutions can support this outcome in the areas they impact.

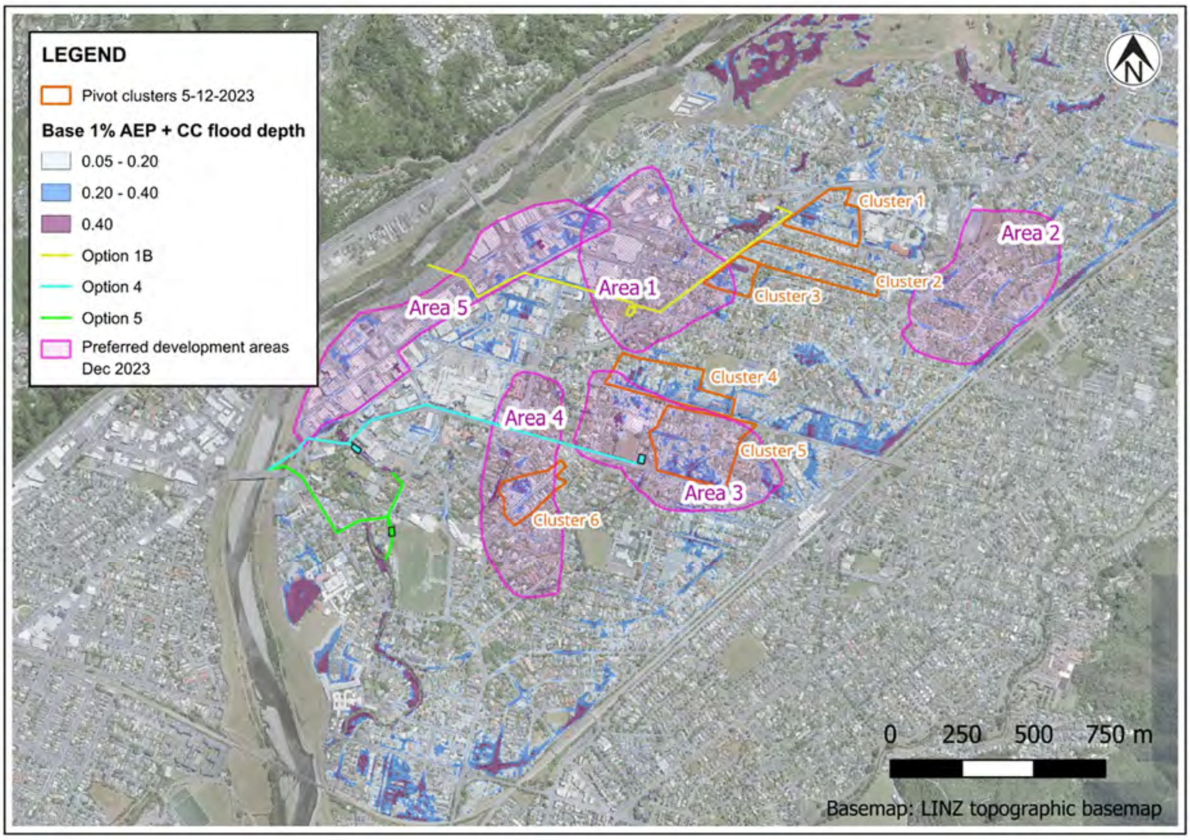

Figure 1. Overview of clusters, shortlist options and preferred development areas.

2 Results

The modelling results are promising. All of the six clusters show a reduction in flood depth and flood extent, to varying degrees. The area of land subject to flooding greater than 200 mm depth in each cluster is reduced by amounts ranging from 54% to 83%. Figure 2 and Figure 3 below show the example of Cluster 4. The colour scale for the flood depth is the same as in Figure 1 above.

Figure 2. Cluster 4 flood depths with shortlist Option 4 only.

Figure 3. Cluster 4 flood depths with Option 4 and cluster solutions.

3 Next steps

As Clusters 1, 2, 3 and 4, 5, 6 have been modelled together, we plan to carry out additional model runs to separate out the individual effects of Clusters 4 and 5. We also plan to isolate the effects of the Riddiford versus the Chilton St James pump stations (Option 4) on Clusters 4, 5 and 6. This is intended to de risk the possibility of the intervention either Cluster 4 or Cluster 5 carrying providing most of the benefit with the other intervention potentially having minimal effect. In addition, it will test the validity of potentially dropping the Riddiford Street Pump Station from further consideration if it is not contributing much to additional trunk capacity in or near the preferred development areas.

In addition to further modelling, we are developing high-level costs for the conceptual cluster solutions. We will combine this information with judgements around feasibility and expected impact/ benefits to choose some of the cluster solutions for integration into their associated shortlist options.

Figure 1 shows that Option 5 and potentially also the Riddiford Pump Station within Option 4 are not associated with any clusters, preferred development areas or significant existing flood hazard, considering that:

- Preferred Development Area 2 and most of Area 5 lie outside the area that is feasible to drain to the Opahu Stream; and
- The large area of flooding at the bottom of the catchment is not significantly affected by any of the shortlisted options.

We are considering whether the benefits are sufficient to take Option 5 (and possibly the Riddiford Pump Station part of Option 4) further through the shortlist development process.

Appendix R- Interim costs update

NOT INCLUDED

Appendix S- Proposal for use of 200 mm flood depth threshold

Memorandum

To	HCC WIG Technical Advisory Group [redacted] (HCC), [redacted] (WW), [redacted] (HCC), [redacted] (WW)
cc	[redacted] (WW)
From	[redacted] SW Lead.
Date	06/03/2024
Subject	For endorsement: proposed use of 200 mm flood depth threshold
Reference	1091097.TT.2100.PRW.ME.CV.81.TAG_Proposal to use 200mm threshold.docx

1 Situation

Tonkin & Taylor Ltd (T+T) needs to confirm an appropriate metric based on flood depth, that can be used to compare the shortlisted options and describe the project benefits. We would like to use this metric to compare both the number of existing buildings and the areas of land zoned for residential development, that would be affected by flooding.

The previous study carried out by Stantec in 2021[1] used thresholds of:

- 200 mm flood depth to compare the number of buildings subject to flooding in a 10% AEP flood event, and
- 400 mm flood depth to compare the number of buildings subject to flooding in a 1% AEP flood event.

These thresholds are in relation to the modelled flood depth rather than the "plus freeboard" depth used by WWL for flood mapping purposes.

WWL's flood maps are used by HCC for setting minimum floor levels, making decisions on building/subdivision consent applications and informing the hazard zones in the District Plan.

There is no firm guidance (either from WWL, HCC or nationally) in terms of what depth of flooding should be used in comparing flood reduction projects/options. Two relevant considerations for this project could be:

- The Building Act. As well as requiring floor levels to be set above the 50-year flood level, the Building Act E1/AS1 requires floor levels to be set 150 mm above either the road crown or the downhill property boundary, depending on whether the house sits above or below the road. For example, see Figure 1 below. The Building Act also has a range of ground clearance

[1] Stantec, 2021. *Waiwhetu Growth – Stormwater Servicing Options*

requirements that range from 100 mm to 450 mm but relate more to moisture ingress rather than drainage and flooding per se[2].

- WWL floor level requirements. WWL, in its Regional Standard for Water Services (December 2021) requires a 500 mm freeboard above a 1% AEP water level for habitable floor levels. The 1% AEP being referenced is not the 1% AEP straight from the model as we have used from Stantec in this study to date. The 1% AEP water level being referenced contains modelling freeboard, a variable amount added to the raw hydraulic model results via dynamic process and sometimes amounting to several hundred mm. It is not possible to estimate what the final "with freeboard" flooding extents and depths might be, based on the model results, without carrying out this process. The process of adding the freeboard and producing final flood maps is time consuming and iterative, as it first involves agreeing, running and assessing a number of sensitivity scenarios.

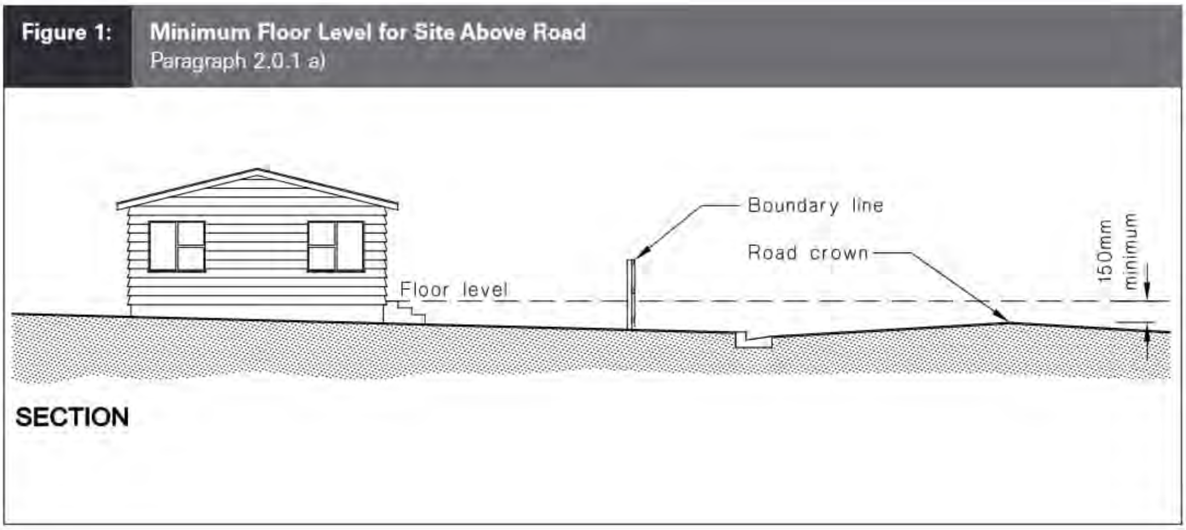

Figure 1. Example from Building Act E1/AS1 floor level requirements

2 Recommended approach for endorsement

Since the purpose of this project is to enable intensification of residential development, the selected metric(s) should give an indication of how a given option leads to a reduction in flood hazard so that more dwellings can be built. At this feasibility design stage, we are seeking a broad and practical metric that can be easily applied to different scenarios and options.

We propose to use a threshold value of 200 mm flood depth for reporting areas/buildings subject to flood hazard, because:

- It sits in the mid-range of values typically required under the Building Act and close to the value of 150 mm required by E1/AS1.
- It is consistent with one of the metrics adopted by Stantec in their 2021 report.
- Most of the flooding in the catchment is relatively shallow using model results without modelling freeboard applied to it. Adopting a deeper threshold (for example, 400 mm) against this raw data would underestimate the restrictions placed upon development from the deeper 'with freeboard' mapping. Using the 200 mm extents will more closely resemble the area over which the 400 mm flood extents would cover in the WWL flood model.

[2] https://www.weathertight.org.nz/new-buildings/detail-solutions/floor-levels-and-clearances/ has a good summary of these ground clearance requirements

3 Recommendation

Recommend that the TAG endorse the proposed approach.

Resolution
Endorsed
Next Steps
None Required.

Recommended By:	Name [redacted]	Signatur[redacted]
Approval by the TAG:		
[redacted] **(WWL)**	Name [redacted]	Signature [redacted]
[redacted]**(WWL)**	Name [redacted]	Signature [redacted]
[redacted]**(HCC)**	Name	Signature [redacted]

Appendix T- Briefing notes for shortlist MCA workshop

Memo

To:	Technical specialists scoring MCA criteria	**Job No:**	1090967
From:	[redacted]	**Date:**	28 March 2024
cc:	[redacted]		
Subject:	IAF Upgrades - Specialist briefing for stormwater options multi-criteria analysis shortlist workshop		

1 Purpose

This memorandum describes the site options and assessment approach for the Infrastructure Acceleration Fund (IAF) stormwater upgrades. This information is presented ahead of a multi-criteria analysis (MCA) workshop on **11 April 2024** for analysis by experts prior to that workshop. The workshop forms part of the alternatives assessment process to consider the stormwater upgrades shortlist options.

2 Project objectives

The overall objective of IAF stormwater upgrades is to facilitate and enable the construction of up to 3,520 new houses in the Lower Hutt Valley in a manner that meets the terms and conditions of the IAF Funding Agreement.

Initial options testing focused on the suburbs of Boulcott, Hutt Central, and Woburn (the 'Central Hutt Suburbs'). These suburbs border the Opahu Stream which has been identified by Hutt City Council (HCC) as the primary source of flooding in the area. Options to reduce flooding in the Opahu Stream catchment have been developed through a long list process, and are now subject to this shortlist MCA to support the identification of a preferred option. The specific objective through this shortlist process, subject to the overall objective set out above, is to "*create sufficient capacity in the stormwater trunk network to enable 3,520 dwellings on flood-free land, without making flooding worse in other locations*".[1]

3 Background - Alternatives assessment and MCA

Under the Resource Management Act 1991 (RMA), an assessment of alternatives is required in the following circumstances:

- When seeking a Notice of Requirement (NoR) for a designation and the Requiring Authority does not have an interest in the land sufficient for undertaking the work, or the work is likely to have a significant adverse effect on the environment (section 168(3)(b)).
- When seeking resource consent for projects with the potential to have significant adverse effects on the environment (section 6(1)(a) of Schedule 4).

[1] For the purpose of this objective, 'flood-free land' means land that is currently flood-free as identified through modelling undertaken for the HCC Water Infrastructure for Growth project.

- In the case of a resource application to discharge a contaminant, the application is required to include a description of any possible alternative methods of discharge (section 105(1); section 6(1)(d) of Schedule 4).

An assessment of alternatives is also required to support a compulsory property acquisition process under the Public Works Act 1981.

The alternatives assessment process is a fundamental building block used to support future decision making. Key considerations when undertaking an alternatives assessment include the following[2]:

- While a requiring authority cannot act arbitrarily or only give cursory consideration to alternatives, it is not required to eliminate every possible option, or even demonstrate that it is pursuing the "best" option.
- A thorough, although not exhaustive assessment of alternatives is required with the focus on the process, not the outcome.
- The process needs to be well documented, transparent and replicable in order to make an informed and defendable decision.

A multi-criteria analysis (MCA) is commonly applied to infrastructure projects where there are several sites or options to choose between and where there are numerous complex considerations involved. MCA assists in assessing the relative merits and constraints of an option and making the trade-offs between competing matters more transparent. The purpose of the MCA is to assess sites in a robust and transparent manner, in order that the process of finding a preferred option can be clearly demonstrated at a later date, including during the resource consent process.

4 MCA workshop

The shortlist workshop will take place at **1 pm on Thursday 11 April 2024**, via Teams and in person. The purpose of the workshop is to test and confirm scoring for each of the stormwater upgrade options. Prior to this workshop, specialists are expected to:

- Review this memorandum and the attached information.
- Confirm their criterion description and matters to consider within the criterion. Criteria and draft matters to consider have been provided in Appendix C.
- Develop an understanding of each option.
- Score each of the options on the MCA criteria and record reasons for scoring as per the template.
- Return your draft scores and assessment memo to [redacted]y **5pm on Tuesday 9 April**.

The reasons provided for scoring are anticipated to be high level only for the purposes of the workshop. A short summary of reasons for scoring each option should be provided alongside the scores.

Additional HCC and WWL representatives may attend the workshop as observers and to contribute to the workshop moderation session in their particular area of expertise.

Kāinga Ora – Homes and Communities representatives may also be attending the workshop in an observation capacity only.

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[2] While this is derived from case law that relates to NoR processes, it provides useful guidance for a resource consent process.

5 Information provided

The following documents are provided to inform technical specialists during the scoring process and workshop:

Appendix A: Overall plan showing shortlist stormwater upgrade options

Appendix B: Description of option

Appendix C: MCA criteria and specialists

Appendix D: Summary memo template, including MCA recording and scoring

6 Methodology for criteria development and scoring

Criteria development

Twelve criteria have been developed: Cultural, ecology, hydrogeology, constructability, operations, housing enablement (through flooding reduction), risk and resilience, community effects, property, planning/consenting complexity, sustainability and cost.

Cost estimates have been prepared at an appropriate level of detail for each stage of the process. The construction and operation cost of each option is a key factor when considering alternative options. While cost was not included as a criterion in the long list process, it was an important consideration and included in the MCA spreadsheet alongside the criteria that were scored. For the shortlist the MCA will be undertaken with and without cost included as a criterion.

The criteria for flooding reduction has been refined through the shortlist process to 'Enablement of housing development'. This reflects the more detailed information available through the shortlist process and responds directly to the project objective.

Hydrogeology has been included as a criterion at the shortlist stage. While this has been a consideration throughout the course of the project, further design detail on the depth of the pump stations available at the short list stage indicates this infrastructure is likely to be deeper than originally anticipated, at least for some of the options. Hydrogeology, in particular any potential implications for the underlying aquifer and source drinking water protection, has therefore been included as a criterion at the shortlist stage.

Sustainability has also been included as a criterion at the shortlist stage. Similar to the longlist, this is unlikely to be a key differentiator between options. However the project team determined to include this criterion so that the sustainability of each of the options in terms of embodied carbon is explicitly considered at the shortlist stage.

Scoring

The effects of each option in relation to these criteria will be scored by the relevant specialists. The memo template, which includes the scoring and recording table, is attached in Appendix D.

When scoring, please note the following:

- The specialist is responsible for completing the scoring and template. The specialist is encouraged to seek input from the relevant people, including but not limited to those identified in Appendix C.
- Some of the criteria include a list of issues to consider. These are not sub-criteria and should be considered as part of the overall score for each criterion.

- The draft criteria have been circulated for feedback and updated to reflect this feedback. **However specialists may amend or clarify their criterion and/or issues to be considered should this be required.**
- Scoring is based on the following assumptions:
  - Scores are based on the level of effects (adverse or positive) of each option for each specialist criteria.
  - One score will be provided for every criterion.
  - Reasons for scoring will be recorded, including if there are particular components of the option which have a significant influence on the scoring.
- The final score for each option should include standard/expected mitigation (where relevant). Bespoke mitigation and offsetting should not be considered in the final score, however the potential for further mitigation / offsetting of identified effects should be recorded. Experts should record what mitigation they have factored into their scores (and what additional mitigation might be possible) to allow for those assumptions to be tested. Where significant mitigation is included then this should be communicated to T+T to allow it to be factored into the cost criterion.
- All options should be scored on the 9-point (plus "fatal flaw") scale set out in Table 2 below, along with reasons for the given score. This scoring scale has been adopted partly in order to provide greater scope for differentiation between options. However, experts are instructed to score each option by applying their expertise and against the description of the scores provided below. Scoring should be carried out on an absolute rather than relative basis. In other words, experts should not seek to create an artificial distinction in scores between options.
- The scoring scale provides for a "fatal flaw" negative score. This score should be used where the expert considers that there are unacceptable adverse effects associated with the option – and that there is no reasonable way to appropriately avoid, remedy or mitigate those effects.

Scoring	Level of effect
F	Fatally flawed – unacceptable adverse effects, risks or challenges that cannot reasonably be appropriately avoided, remedied or mitigated.
- 4	Very high / very significant adverse effects, risks or challenges.
- 3	High / significant adverse effects, risks or challenges.
- 2	Moderate / medium adverse effects, risks or challenges.
- 1	Low / minor adverse effects, risks or challenges.
0	Neutral / no change
1	Low / minor positive effects, benefits or opportunities
2	Moderate / medium positive effects, benefits or opportunities
3	High / significant positive effects, benefits or opportunities
4	Very high / very significant positive effects, benefits or opportunities

7 Weighting and sensitivity analysis

In order to further analyse and test the ranking of the options and inform the overall decision making, sensitivity analysis will be undertaken to test the sensitivity of the scoring against different matters.

A number of weighting systems can also be applied (e.g. environmental effects; technical and engineering considerations i.e. constructability, operations, risk and resilience; project objectives (housing enablement and cost); property and planning risk etc). Potential weighting systems will be developed and confirmed prior to the workshop and can be discussed at the workshop.

8 Reporting

Each specialist should provide a brief assessment memo in the assessment template provided in Appendix D. The memo should note:

- A description of any matters considered;
- Any assumptions applied when scoring; and
- Reasons for scoring of each option (this can be brief; bullet points for each option is fine).

The report should ensure that the reader understands the methodology and reasoning behind the scoring given to each option.

9 Other matters and conclusion

It is important that information is shared effectively between the experts, and with the project team. In particular:

- Please proactively ask any questions you have; and
- Please discuss your assessments with other experts as appropriate.

It is important to note that:

- The MCA is a decision support tool with the focus on the process rather than the outcome.
- There is no requirement to eliminate every option or demonstrate that the selected option is the ‘best’ option.
- The purpose of the workshop is to assist HCC to select a preferred option. It is expected that HCC will need to balance a number of factors in selecting its preferred stormwater upgrade option(s), including cost (both CapEx and OpEx).

The Project Team will write up the results of the short list workshop and its recommended decision in a board paper to go to the board meeting in May 2024 for endorsement by the PMB.

If you require any further information, please do not hesitate to contact me.

28-Mar-24

Appendix A Short list options

Option	Option 1b
Description	Eastern Hutt School Pump Station with Kings Crescent Interceptor

Option	Option 4
Description	Chilton St James School and Riddiford Gardens (Bowling Club) pump stations

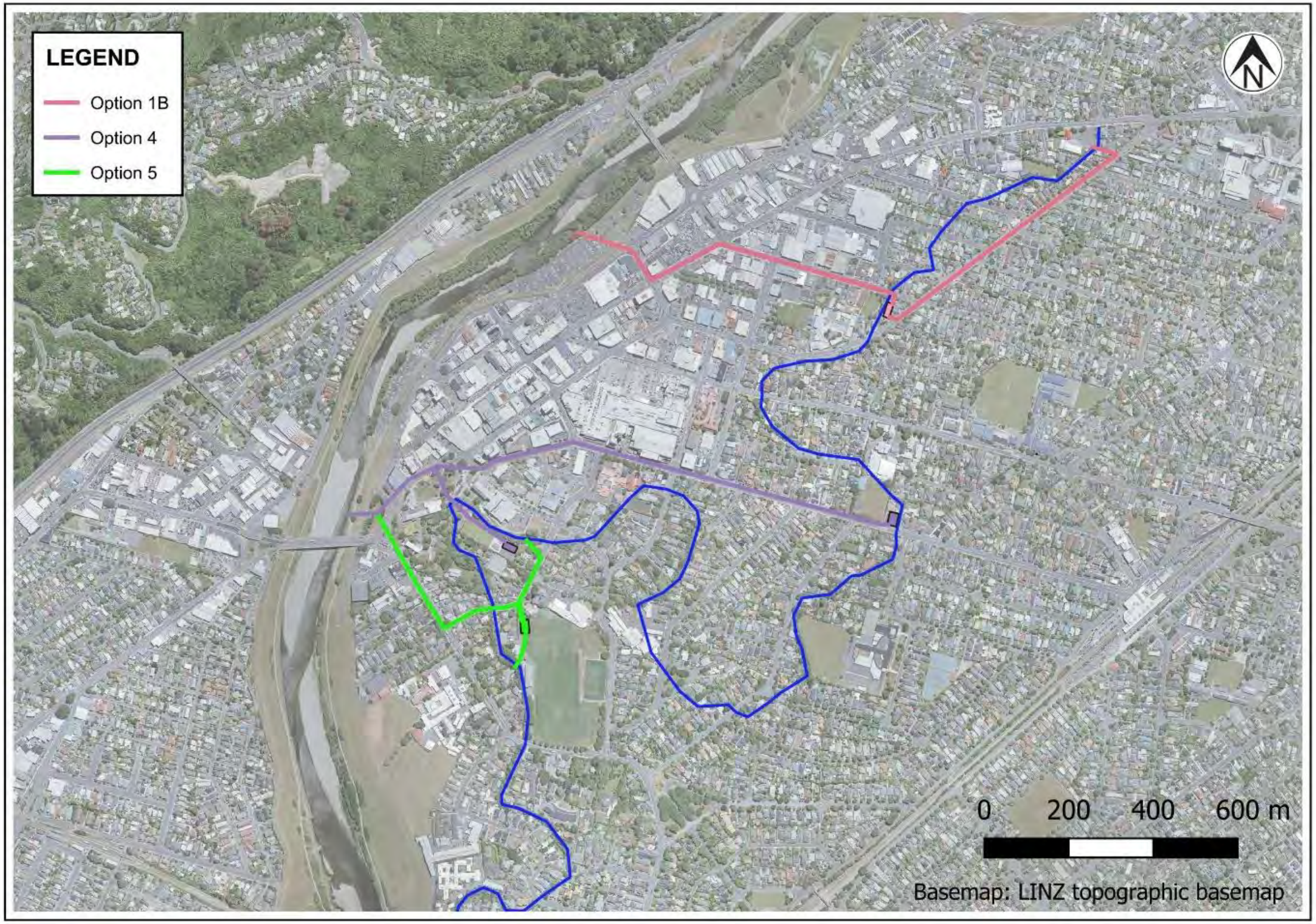
Option	Option 4B[3]
Description	Chilton St James School pump station only

Option	Option 5
Description	Hutt Rec Ground NW pump station with two stream inlets

[3] Due to the location of options along the Opahu Stream, only Option 4 can efficiently connect a rising main to a second pump station. The other options would require a significantly longer rising main.

Option 4B is included as an opportunity to assess this option with one pump station only, similar to the other options. It also reflects the fact that the area the Riddiford Gardens pump station serves i.e. mostly the Hutt CBD, is already built out and largely impervious. While there is significant potential for development through this area, this is unlikely to increase the level of imperviousness and associated run-off.

Tonkin+Taylor



Appendix B Summary description of short list options

Stormwater Longlisting Option Assessment

Option	Option 1b
Description	Eastern Hutt School Pump Station with Kings Crescent Interceptor

Summary

This option includes the following:

- Intercept piped stormwater flows upstream of Opahu Stream via a new weir chamber and divert along Kings Crescent in a new 900 mm diameter gravity stormwater pipe.
- A stream intake structure and pump station with up to 3 m^3/s discharge capacity located adjacent to Eastern Hutt School, including a hydraulic control structure in the stream downstream of the inlet
- Rising main from pump station along Pretoria St to outfall to Te Awa Kairangi (via Riverlink outlet 35), pipe to be laid within the road reserve.
- An outlet to be constructed through the stopbank being upgraded under the Riverlink project, combined with Riverlink Outlet 35

High-level plans

Figure 1 – Option 1B Overview

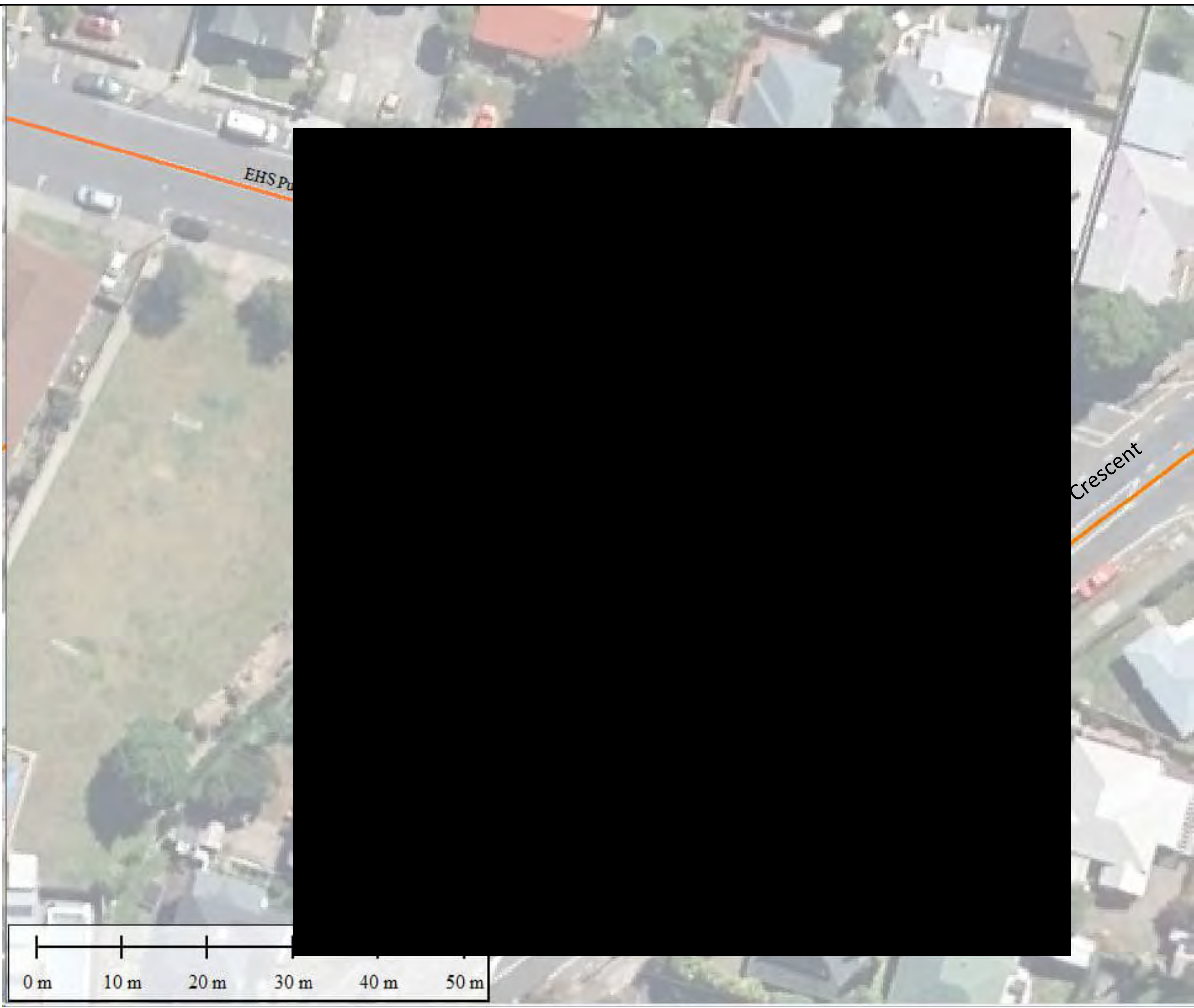


Figure 2 - Option 1B Pump Station Location Plan

Key details from preliminary sizing:

- Design flow 3 m3/s.
- Weir chamber on existing stormwater line to divert flows into an interceptor pipe. Weir chamber is a 2.4m dia x 2.5m deep manhole installed at the head of the interceptor pipe.
- 900mm diameter RCRRJ gravity interceptor pipe x 725m long x 4.5m average depth below ground level.
- Stream intake structure is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir intake bank length approximately 9 m narrowing to approximately 2 m weir width within structure, depth 3.0m.
- Pump station includes buried concrete inlet chamber (7.4m D x 6.6m W x 6.6m L), wet well (7.8m D x 7.6m W x 10.5m L) and valve chamber (4.8.8m D x 7.0m W x 5.0m L) and a 70 m^2 transformer/electrical building.
- Rising main 1200mm dia, length 855m.
- A permanent outlet consisting a 1200 mm pressure pipe within a box culvert (as a sleeve), to be combined with the Riverlink Outlet 35 stormwater pipe (also within the box culvert to avoid creating additional stopbank penetrations)
- Fixed backup generator

The layout drawings for the pump stations are attached.

Further details of the pump stations/pipelines can be provided by T+T on request to support options scoring.

Key risks / opportunities:

- Depth of pump station structure relative to Waiwhetu aquifer. The depth of the pump station wet well below ground is 9m. Below this is a further 1 m raft foundation and 5 m grout-filled screw piles (based on the high level foundation design) The top of the aquifer is expected to lie between 15 to 20 m below ground level. There may be the opportunity to reduce foundation depth following site investigations, and to reduce the pump station depth in the next stage of design.
- Risk that dewatering is much greater than anticipated for the pump station excavation, and potentially for the gravity interceptor.

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

CONCEPT DESIGN
STORMWATER PUMP STATIONS AND INTAKES SITE LAYOUT DRAWINGS

OPTION 1B FOR PRICING

Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. COORDINATES ARE IN TERMS OF NZTM2000
4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED DURING DETAILED DESIGN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)

LEGEND

- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
P3	03/24	HN	FOR REVIEW	MT	HE
P2	02/24	HN	FOR REVIEW	MT	HE

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Parnell, Auckland 1151
New Zealand

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W mottmac.com

Client

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

PROJECT OVERVIEW

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:3000	CONCEPT DESIGN	P4	

Drawing Number

HCC-WIG-DRW-CD-SW-001

[redacted]

Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. COORDINATES ARE IN TERMS OF NZTM2000
4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED DURING DETAILED DESIGN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

SITE DRAINAGE
SCOUR AND OVERFLOW
WATER SUPPLY
KERB LINE
OPTION 1B
OPTION 4
OPTION 5
RIDDIFORD GARDENS RISING MAIN
PROPERTY BOUNDARIES FROM LINZ
SW—SW— EXISTING STORMWATER MAIN
ABOVE GROUND RC STRUCTURE
BURIED RC STRUCTURE
GENERATOR / ELECTRICAL FITTINGS YARD
RIVERBANK PROTECTION / IMPROVEMENT
PLANTING

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
P3	03/24	HN	FOR REVIEW	MT	HE
P2	02/24	HN	FOR REVIEW	MT	HE

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Client

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

SITE LAYOUT ; OPTION 1B PUMP STATION (EASTERN HUTT SCHOOL)

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:150	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-004

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[redacted]

Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. COORDINATES ARE IN TERMS OF NZTM2000
4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
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10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
- SCOUR AND OVERFLOW
- WATER SUPPLY
- KERB LINE
- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN
- PROPERTY BOUNDARIES FROM LINZ
- SW—— SW—— EXISTING STORMWATER MAIN
- ABOVE GROUND RC STRUCTURE
- BURIED RC STRUCTURE
- GENERATOR / ELECTRICAL FITTINGS YARD
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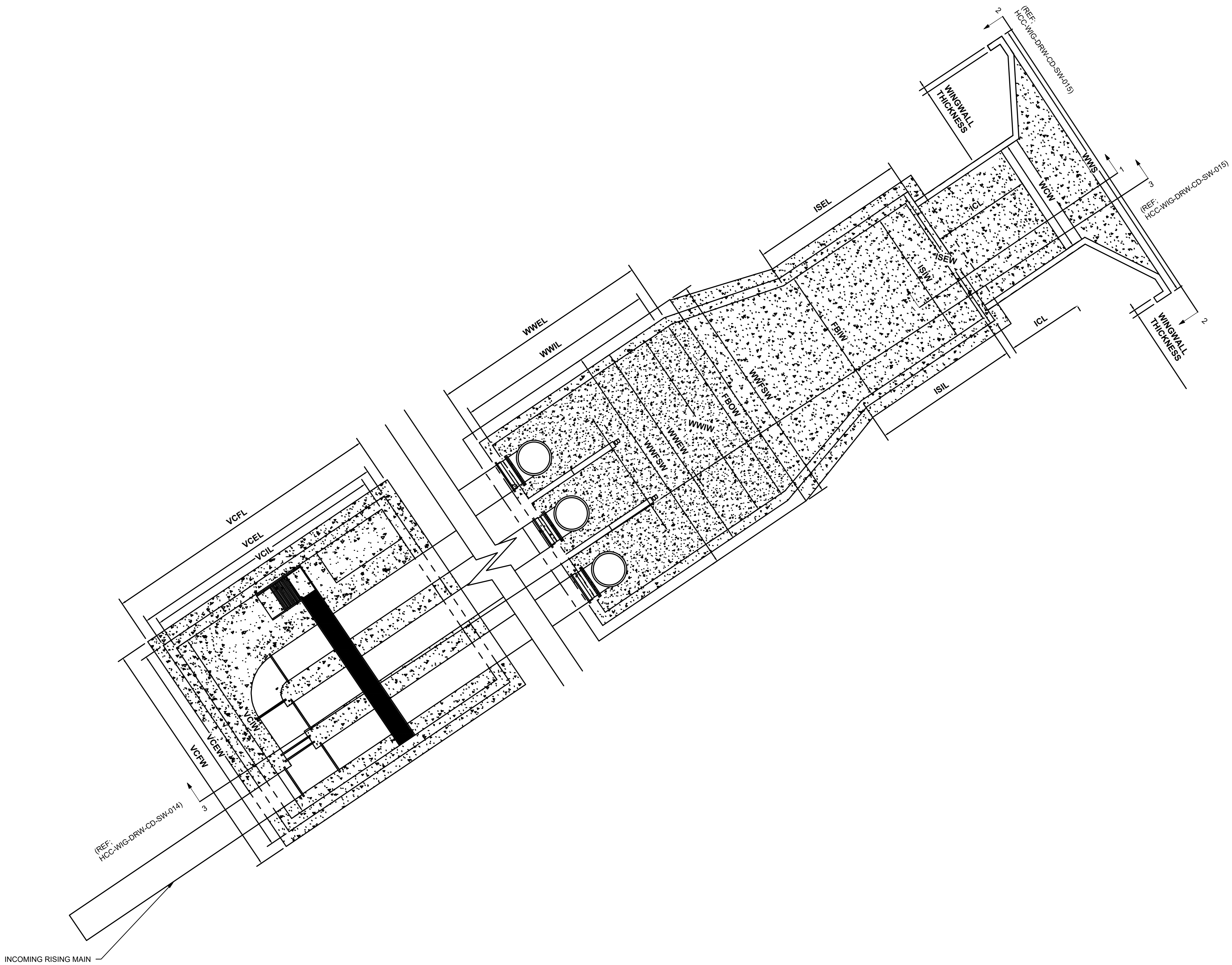
SITE LAYOUT ; OPTION 1B INTAKE SITE (EASTERN HUTT SCHOOL)

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:25	CONCEPT DESIGN	P4	

Drawing Number HCC-WIG-DRW-CD-SW-005



Notes

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4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
6. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
7. ACCESS LADDER INDICATIVE ONLY, TBC LATER IN DESIGN
8. STORMWATER AND PUMPSTATION INTERCONNECTION FOR CHILTON ST. JAMES DIMENSION DETAILS ARE AS ON LAYOUT PLAN
9. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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Title

TYPICAL PUMP STATION PLAN

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-013

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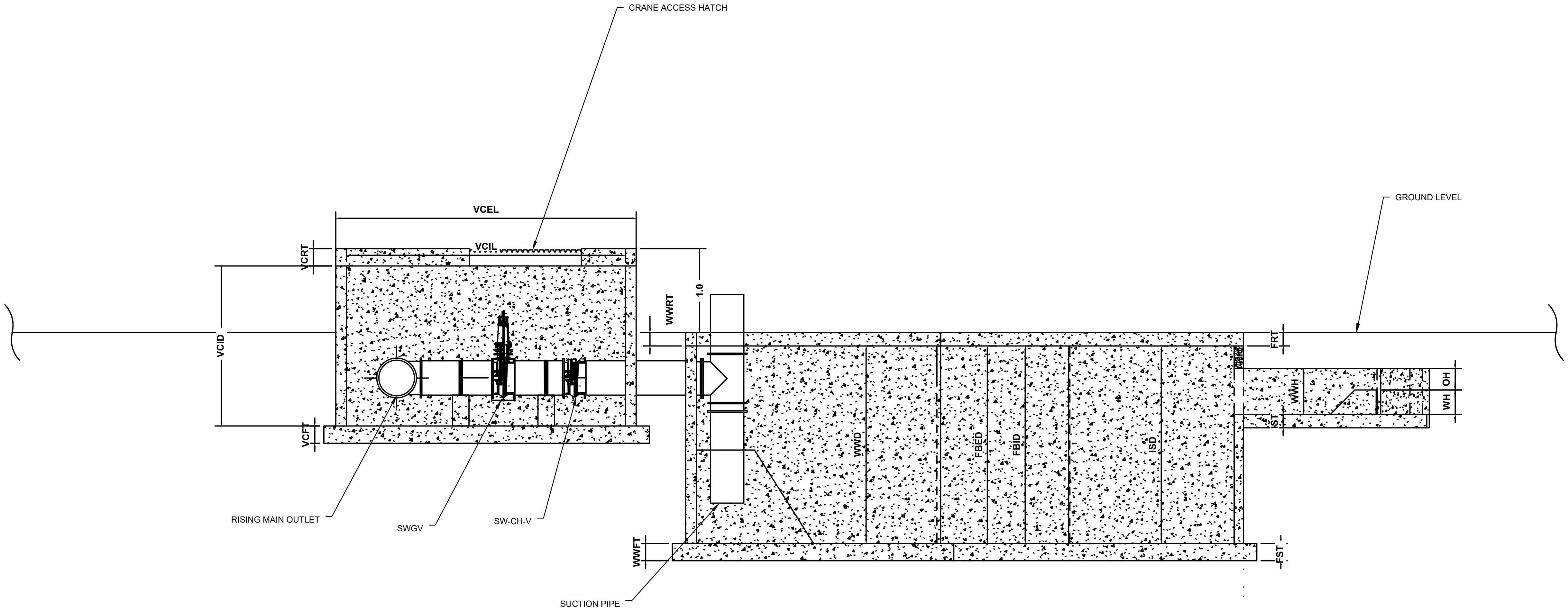

SECTION 3

Notes

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TYPICAL PUMP STATION SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
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Drawing Number
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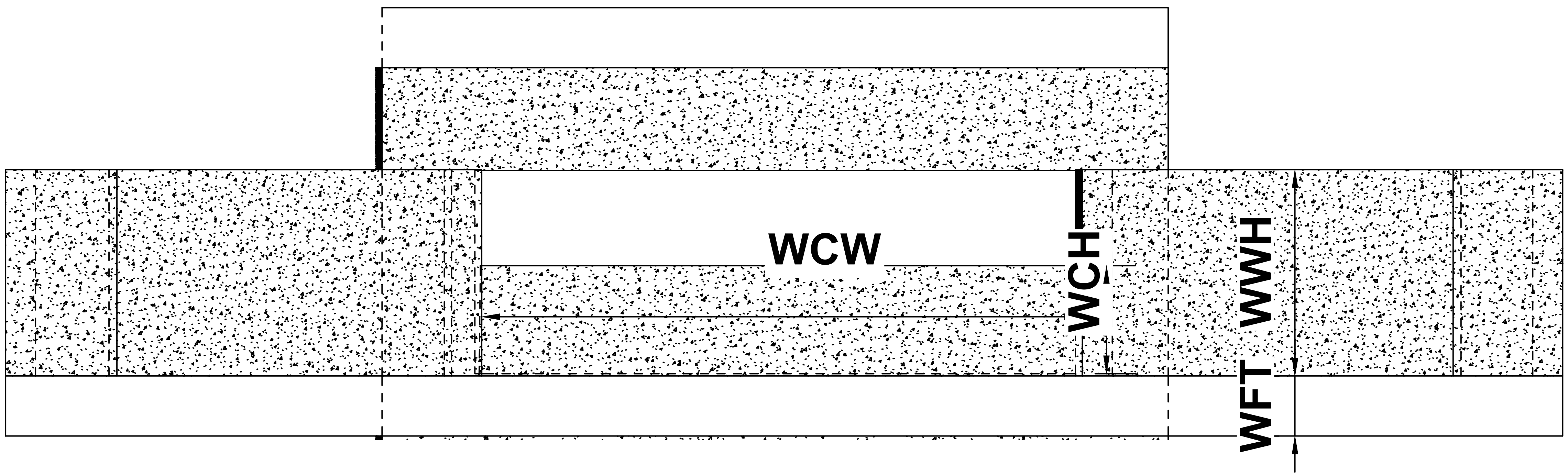
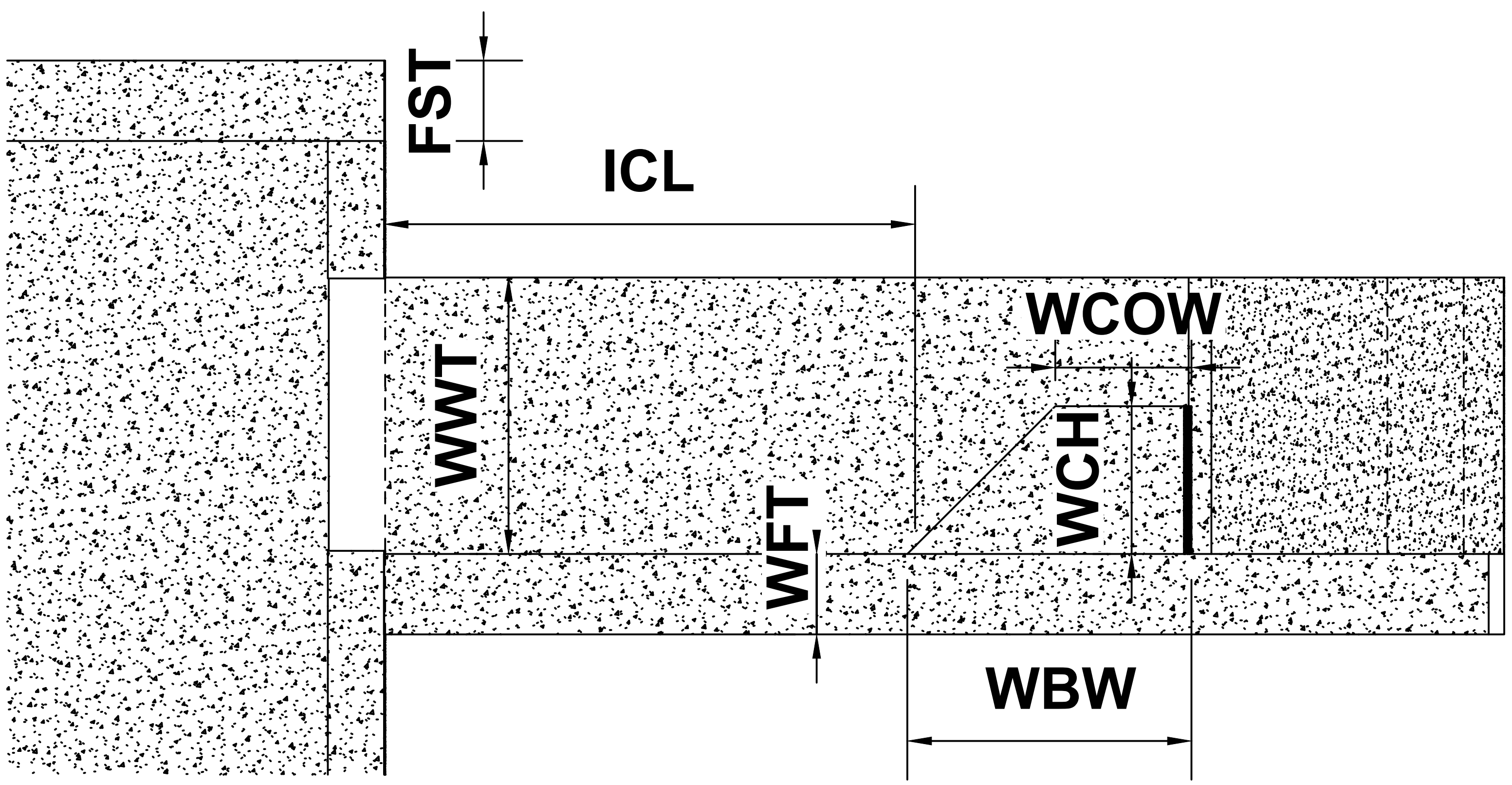


SECTION 2



SECTION 1

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9. TRASH RACKS TO BE INCLUDED IN DETAILED DESIGN
10. LATERAL STRUCTURES SHOWN IN SITE LAYOUT PLANS
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12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

TYPICAL WEIR SECTION

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Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-015

Option 1b costing

INTAKE SIZING			
			Eastern Hutt School
		ACRONYMS	**Shortlist**
	Weir Crest Width (m)	WCW	2.0
	Wingwall span (m)	WWS	8.7
	Weir Crest Overflow Width (m)	WCOW	0.8
	Weir Bottom Width (m)	WBW	1.0
	Wingwall heights (m)	WWH	1.5
	Intake weir height (m)	WCH	0.4
	Offtake chamber length (m)		3.2
	Offtake chamber width (m)		2.5
	Offtake chamber depth (m)		3.0
	Weir floor thickness	WFT	0.3
INLET CHAMBER SIZING (*For Costing purposes, assumed the same size for all cases*)			
	Internal Depth (m)	ISD	7.4
	External Width (m)	ISEW	6.6
	External Length (m)	ISEL	6.6
	Roof Slab thickness	FRT	0.7
	Floor slab thickness	FST	1.0
	Roof slab length	ISEL	6.6
	Roof slab width	ISEW	6.6
	Floor slab length	ISFL	7.6
	Floor slab width	ISFW	7.6
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		9.0
	Inlet Channel Length	ICL	3.5
	Internal Length(m)	ISIL	6.0
	Internal Width(m)	ISIW	6.0
FOREBAY INLET STRUCTURE			
	Forebay Inlet width	FBIW	6.0
	Forebay outlet width	FBOW	7.6
	Forebay roof thickness	FRT	0.7
	Forebay Floor slab thickness	FST	0.9
	Forebay internal depth	FBID	7.4
	Forebay external depth	FBED	9.0
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		9.0
WET WELL SIZING (Refer to Design Drawings for PS Schematic Details)			
Design inputs	Min Discharge(L/s)		-
	Max discharge(L/s)		2000.0
	Max discharge(L/s)		
	Intake-PS Pipe Diameter(mm)		I.D, 1500 (DI) + 900 (RCRRJ)
	Intake-PS Pipe Length (m)		12 + 725
	Rising Mains Length (m)		
	Rising main diameter(mm)	Internal Diameter	1200.0
	Pump Tube Height (m)		>7.5
Configuration and dimensions	No. pumps(Duty + Standby)		3(2d+1)
	INTER PUMP CL SPACING		2.5
	B (m)		7.6
	L (m)		5.1
	D (m)		1.2
	P(m)		1.5
	C (m)		0.6
	Minimum Internal Width (m)/	WWIW	7.6
	Minimum Internal Length(m)/	WWIL	10.5
	Internal Depth(m)	WWD	7.8
	Roof Slab Length (m)	WWEL	11.3
	Roof Slab Width (m)	WWEW	8.4
	Floor Slab Length (m)	WWFSL	12.3
	Wet Well Floor Slab Width (m)	WWFSW	9.4
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		9.0
	Wet well external width	WWEW	8.4
	Wet well external length	WWEL	11.3
	Wet well roof thickness	WWRT	0.5
	Wet well floor thickness	WWFT	0.7
	Pump		PL 7101/705 3~420N4
VALVE CHAMBER SIZING (m)			
	Internal Depth	VCID	4.8
	Internal Width	VCIW	7.0
	Internal Length	VCIL	5.0
	Roof Slab thickness	VCRT	0.7
	Floor slab thickness	VCFT	0.9
	Roof slab width	VCEW	7.8
	Roof slab length	VCEL	5.8
	Floor slab width	VCFW	8.8
	Floor slab length	VCFL	6.8
	Stormwater gate valve length	SW GV	0.9
	Stormwater check valve length	SW-CH-V	1.5
	Height of SW gate valve height	SW GV	3.8
	Valve chamber external length	VCEL	5.8
	Valve chamber external Width	VCEW	7.8
	Approximate height of roof slab above ground		1.0
	Approximate depth of structure below ground		5.3
	Total VC Height (Above GL+Below GL)		6.3

Stormwater Longlisting Option Assessment

Option	Option 4
Description	Chilton St James School and Riddiford Gardens (Bowling Club) pump stations

Summary

This option includes the following:

- A stream intake and pump station with a capacity of max. 2.5m³/s adjacent to Chilton St James School
- A stream intake and pump station with a capacity of max. 3m³/s at Hutt Bowling Club, including a hydraulic control structure in the stream downstream of the inlet.
- A rising main from Chilton St James PS along Knights Rd and Queens Dr to the outlet.
- A rising main from the Hutt Bowling Club Pump Station under the Opahu Stream and through Riddiford Gardens, then onward along Queens Dr to the outlet.
- Due to the stopbank at the outlet location no longer being upgraded as part of the Riverlink project, a temporary outlet will be constructed to use the existing Outlet 24, shared with local stormwater. A permanent outlet will be constructed later.

High-level plans

Figure 1 – Option Overview

Figure 2 –Chilton St James pump station and intake location

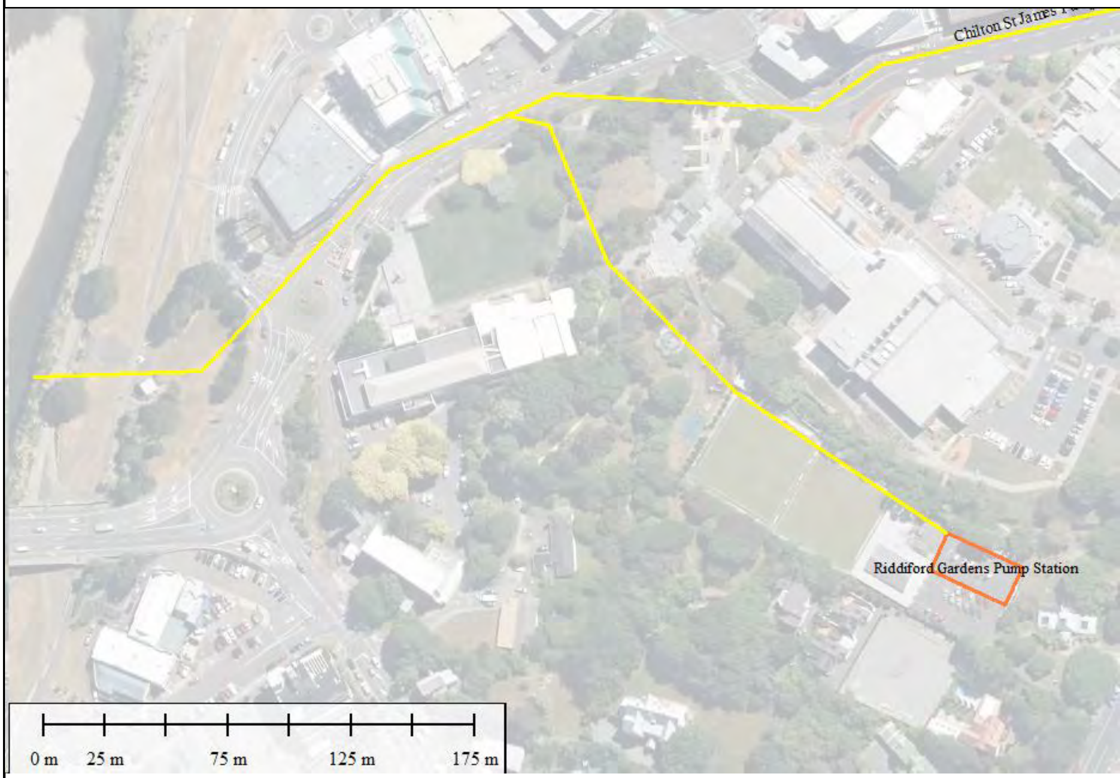

Figure 3 – Riddiford Gardens pump station and intake location

Key details from preliminary sizing:

- Total design flow maximum 5.5m^3/s.
- Each stream inlet is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir intake bank length approximately 9 m narrowing to approximately 3 m weir width within structure, depth 3.0m
- Each pump station includes a buried concrete inlet chamber (8m D x 3.2m W x 3.2m L for Chilton St James and 7.4m D x 5.5m W x 6.2m L for Riddiford Gardens), wet well (7.6m D x 6.4m W x 8.8m L for Chilton St James and 7.5m D x 7.1m W x 9.5m L for Riddiford Gardens), valve chamber (4.8m D x 7m W x 5m L both Chilton St James and Riddiford Gardens) and a 70 m^2 transformer/electrical building.
- Both pump stations to have fixed emergency generators
- The Riddiford/Bowling Club intake includes a hydraulic control structure in the stream bed downstream of the intake. The Chilton St James pump station will instead make use of minor modifications to an existing downstream culvert.
- ~ 1,200mm diameter rising main of length 1,380m from Chilton St James pump station to the outlet.
- ~ 1,200mm diameter rising main of length 525m carrying the combined flow from the Bowling Club pump station to the outlet.
- A temporary outlet, involving reuse of the existing 900 mm diameter Outlet 24 (shared with local stormwater)
- A permanent outlet consisting of twin 1200 mm pressure pipes within a box culvert (as a sleeve), to be constructed through the stopbank in the future when the stopbank is upgraded by others

Pump station layout drawings:

The layout drawings for the pump stations are attached.

Further details of the pump stations/pipelines can be provided by T+T on request to support options scoring.

Key risks / opportunities:

- Depth of pump station structures relative to Waiwhetu aquifer. The depth of the pump station wet well below ground is 9.3 m for the Chilton St James and 8.7 m for the Riddiford Gardens/Bowling Club pump station. Below this is a further 1 m raft foundation and 5 m grout-filled screw piles (based on the high level foundation design) The top of the aquifer is expected to lie between 15 to 20 m below ground level. There may be the opportunity to reduce foundation depth following site investigations, and to reduce the pump station depth in the next stage of design.
- Chilton St James pump station location in the vicinity of the Knights Road drinking water wellfield (source water protection area) may have major impacts during construction (dewatering), possibly requiring shutdown of the water supply wellfield during the works.
- Dewatering is much greater than anticipated, particularly for the Riddiford/Bowling Club pump station and for chambers associated with the temporary and permanent outlets.
- Risk of rejection of temporary outlet by HCC and/or WWL due to potential impacts on local stormwater system. This temporary arrangement will in any case greatly limit the capacity that the pump stations can run at until such time as the stopbank is upgraded and the permanent outlet constructed. If this stopbank upgrade and the construction of the permanent outlet is delayed long-term, climate change impacts and development intensification may exceed the reduced capacity of the pump stations.

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

CONCEPT DESIGN
STORMWATER PUMP STATIONS AND INTAKES SITE LAYOUT DRAWINGS

OPTION 4 FOR PRICING

Notes

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LEGEND

- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN

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PROJECT OVERVIEW

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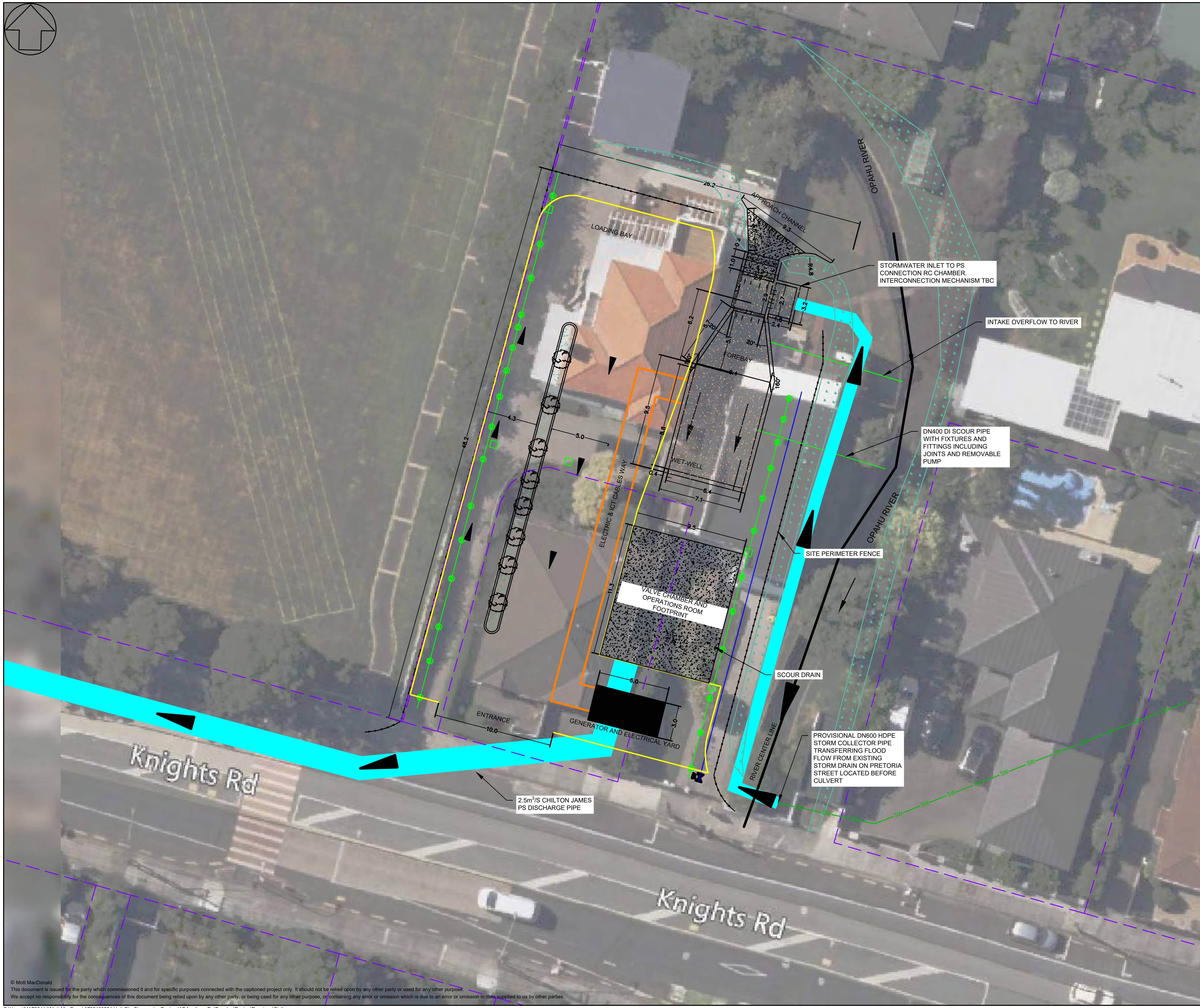
Scale at A1	Status	Rev	Security
1:3000	CONCEPT DESIGN	P4	

Drawing Number

HCC-WIG-DRW-CD-SW-001



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SITE LAYOUT ; OPTION 4 PUMP STATION (CHILTON ST. JAMES)

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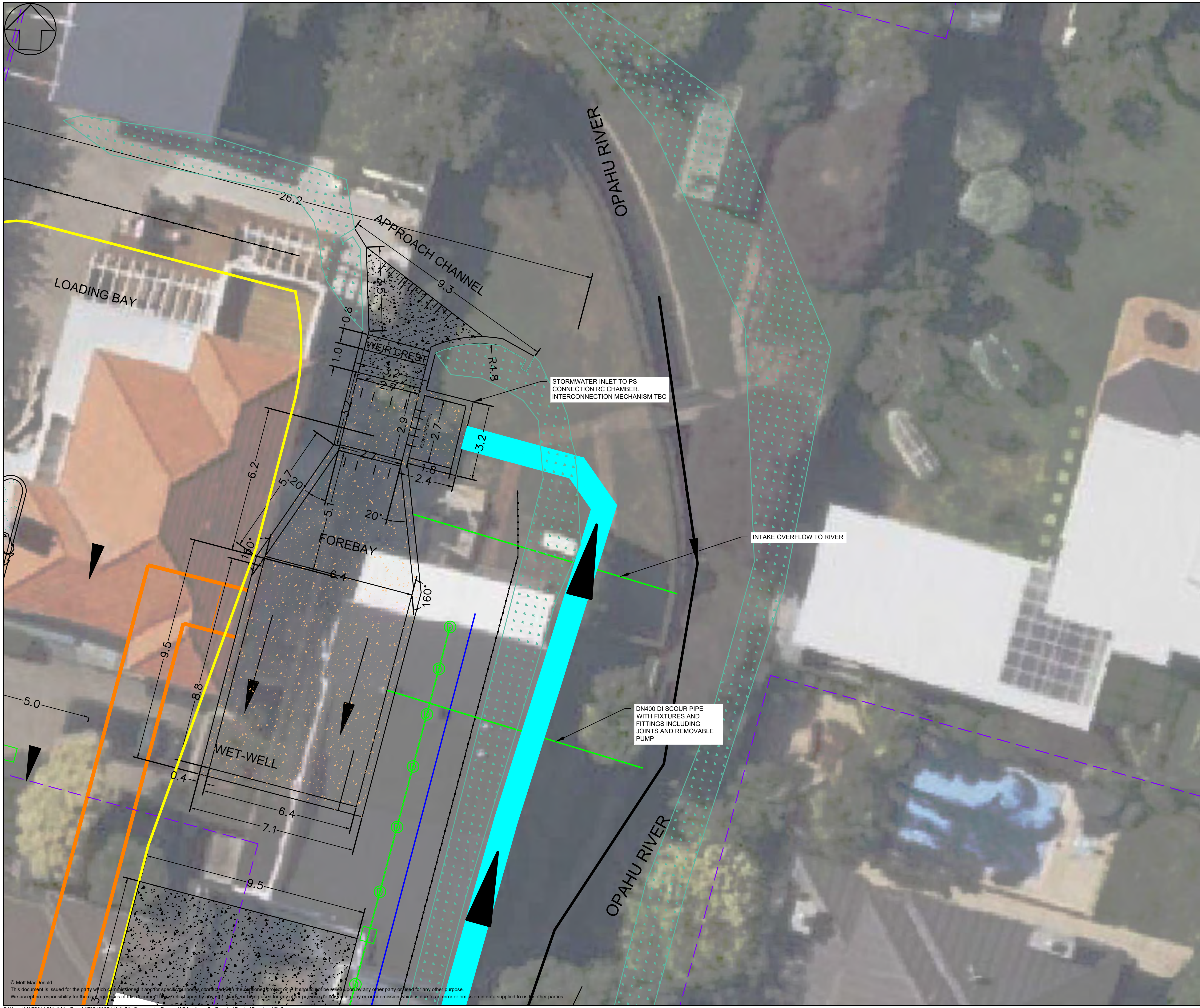
Scale at A1	Status	Rev	Security
1:150	CONCEPT DESIGN	P4	

Drawing Number

HCC-WIG-DRW-CD-SW-002



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4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED DURING DETAILED DESIGN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
- SCOUR AND OVERFLOW
- WATER SUPPLY
- KERB LINE
- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN
- PROPERTY BOUNDARIES FROM LINZ
- SW—SW EXISTING STORMWATER MAIN
- ABOVE GROUND RC STRUCTURE
- BURIED RC STRUCTURE
- GENERATOR / ELECTRICAL FITTINGS YARD
- RIVERBANK PROTECTION / IMPROVEMENT
- PLANTING

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
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Title

SITE LAYOUT ; OPTION 4 INTAKE (CHILTON ST. JAMES)

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024
Scale at A1 1:75	Status CONCEPT DESIGN		Rev P4	Security	

Drawing Number HCC-WIG-DRW-CD-SW-003

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Notes

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10. THE INTAKE SPAN FOR THE RIDDIFORD PUMPSTATION WILL BE 3.0m IF THE OPTION 5 PUMPSTATION IS NOT IMPLEMENTED
11. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
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Title

SITE LAYOUT ; RIDDIFORD GARDEN PUMP STATION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

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SITE LAYOUT ; RIDDIFORD GARDEN INTAKE

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Scale at A1 1:100	Status CONCEPT DESIGN	Rev P4	Security

Drawing Number
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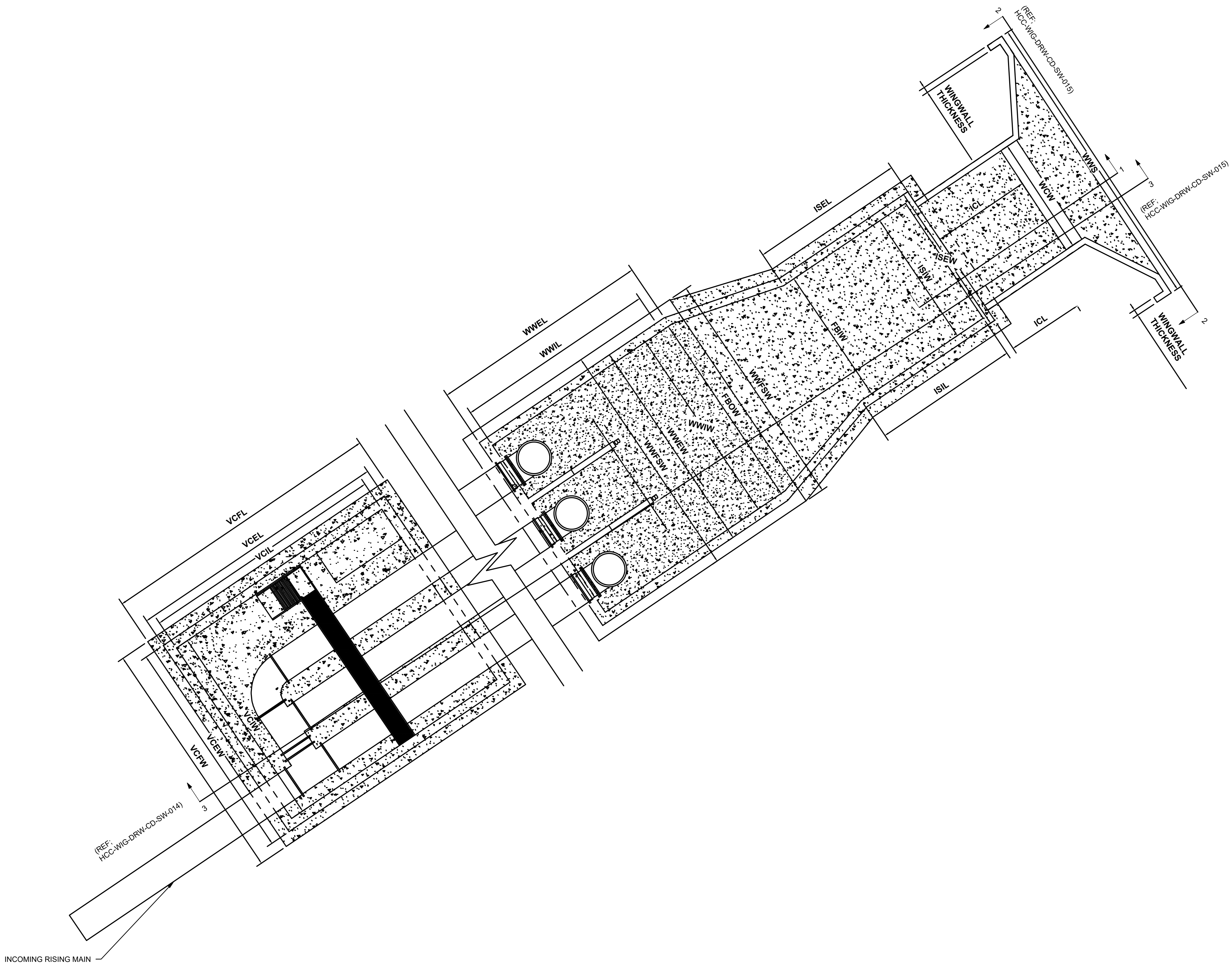

Notes

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4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
6. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
7. ACCESS LADDER INDICATIVE ONLY, TBC LATER IN DESIGN
8. STORMWATER AND PUMPSTATION INTERCONNECTION FOR CHILTON ST. JAMES DIMENSION DETAILS ARE AS ON LAYOUT PLAN
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Title

TYPICAL PUMP STATION PLAN

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-013

Notes

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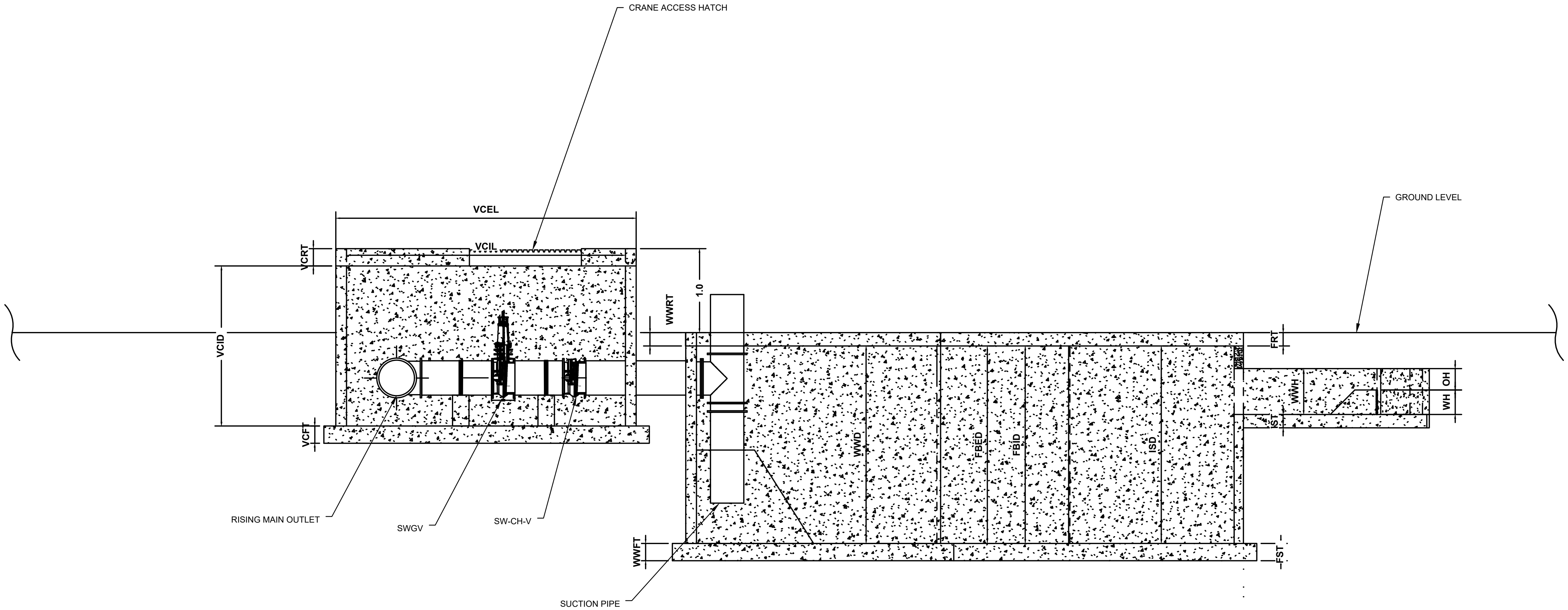
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS



SECTION 3

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
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Title

TYPICAL PUMP STATION SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
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Drawing Number
HCC-WIG-DRW-CD-SW-014

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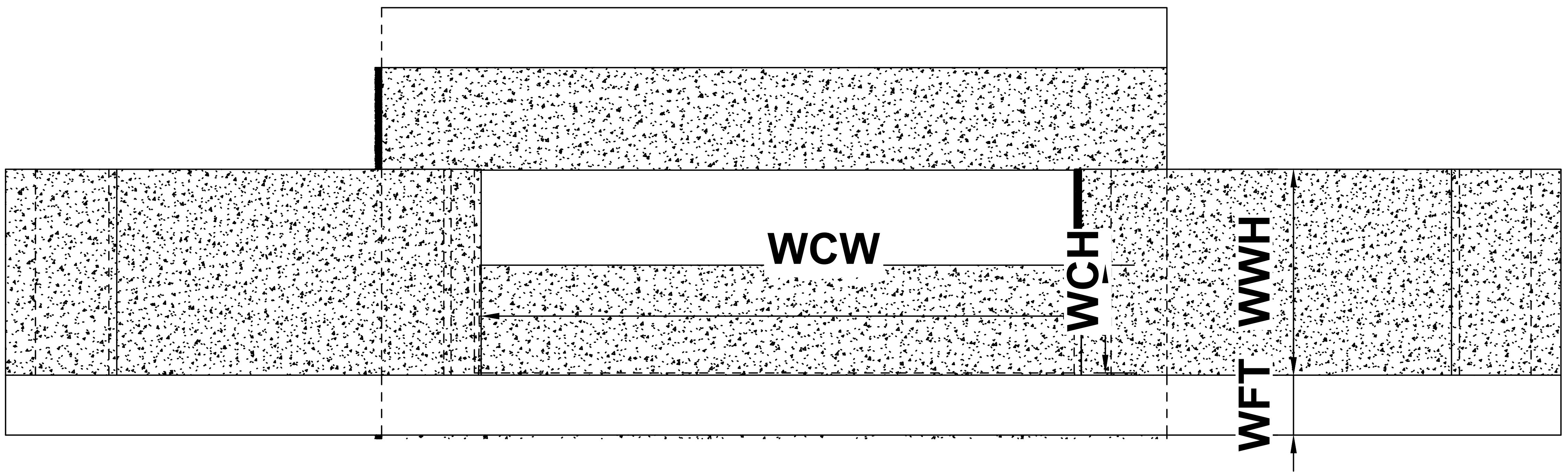
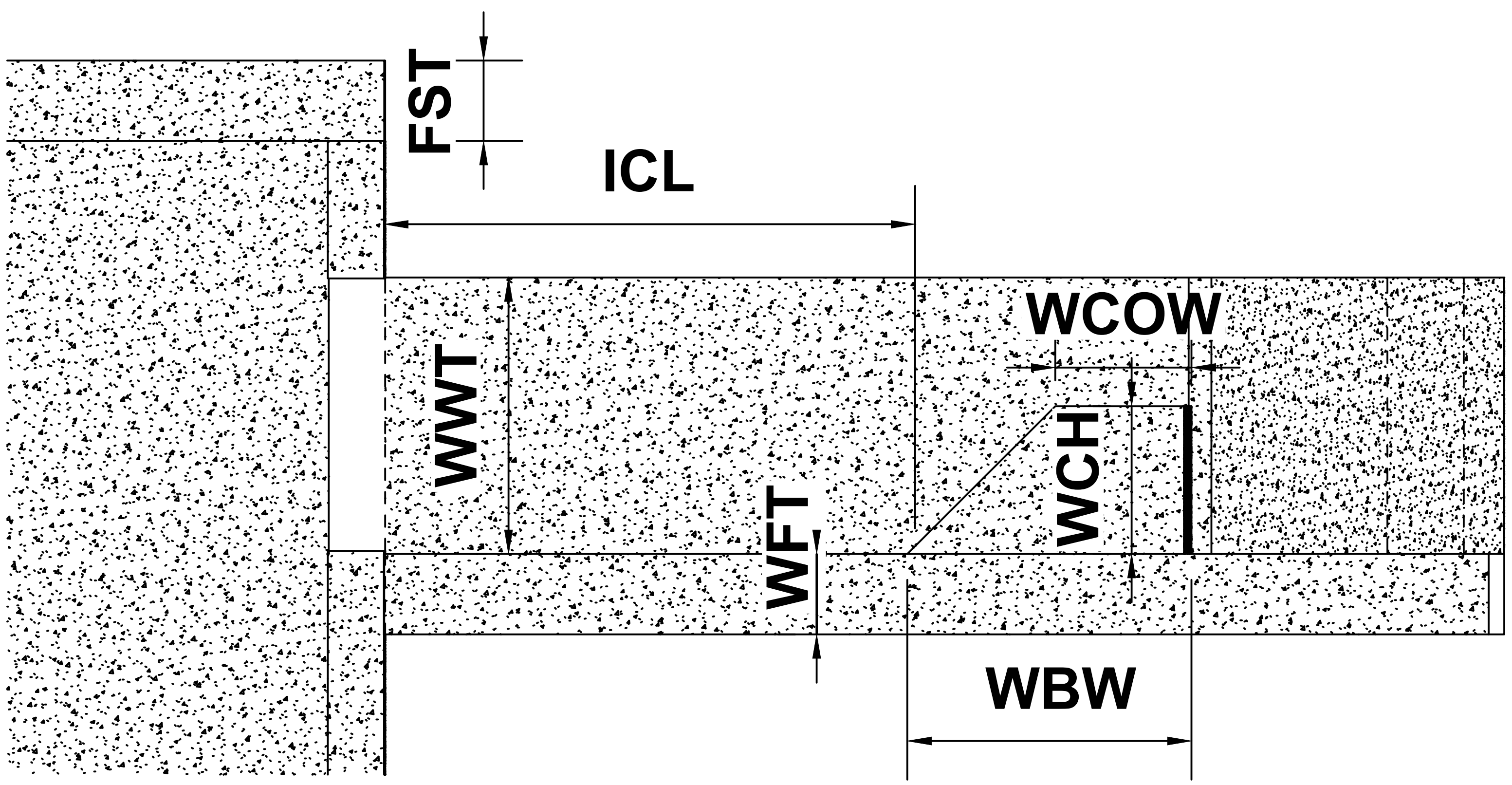


SECTION 2



SECTION 1

Notes

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7. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
8. FINAL DIMENSIONS TO BE BASED ON SETTING OUT DATA LATER IN DESIGN
9. TRASH RACKS TO BE INCLUDED IN DETAILED DESIGN
10. LATERAL STRUCTURES SHOWN IN SITE LAYOUT PLANS
11. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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Title

TYPICAL WEIR SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number

HCC-WIG-DRW-CD-SW-015

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Option 4 for costing

		ACRONYMS	Chilton St. James School Shortlist	Riddiford Gardens Shortlist
INTAKE SIZING				
	Weir Crest Width (m)	WCW	2.7	3.0
	Wingwall span (m)	WWS	9.3	11.3
	Weir Crest Overflow Width (m)	WCOW	0.2	0.3
	Weir Bottom Width (m)	WBW	1.0	1.0
	Wingwall heights (m)	WWH	1.5	1.6
	Intake weir height (m)	WCH	0.6	0.2
	Offtake chamber length (m)		3.2	3.2
	Offtake chamber width (m)		2.4	2.5
	Offtake chamber depth (m)		3.0	3.0
	Weir floor thickness	WFT	0.3	0.3
INLET CHAMBER SIZING				
	Internal Depth (m)	ISD	8.0	7.4
	External Width (m)	ISEW	3.2	5.5
	External Length (m)	ISEL	3.2	6.2
	Roof Slab thickness	FRT	0.7	0.5
	Floor slab thickness	FST	0.7	0.7
	Roof slab length	ISEL	3.2	5.5
	Roof slab width	ISEW	3.2	6.2
	Floor slab length	ISFL	4.4	7.3
	Floor slab width	ISFW	4.2	5.8
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.3	8.6
	Inlet Channel Length	ICL	1.0	3.5
	Internal Length(m)	ISIL	2.9	5.7
	Internal Width(m)	ISIW	2.7	4.8
FOREBAY INLET STRUCTURE				
	Forebay Inlet width	FBIW	2.7	4.8
	Forebay outlet width	FBOW	6.4	7.6
	Forebay roof thickness	FRT	0.7	0.5
	Forebay Floor slab thickness	FST	0.7	0.7
	Forebay internal depth	FBID	8.0	7.4
	Forebay external depth	FBED	9.4	8.6
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.4	8.6
WET WELL SIZING (Refer to Design Drawings for PS Schematic Details)				
Design inputs	Min Discharge(L/s)		-	-
	Max discharge(L/s)		2500.0	3000.0
	Max discharge(L/s)			
	Intake-PS Pipe Diameter(mm)		DN600 (HDPE)	DN1500(HDPE)
	Intake-PS Pipe Length (m)		50.0	35
	Rising Mains Length (m)		1383.0	521
	Rising main diameter(mm)	Internal Diameter	1200.0	1200.0
	Pump Tube Height (m)		>9	>8.5
Configuration and dimensions	No. pumps(Duty + Standby)		3(2d+1)	3(2d+1)
	INTER PUMP CL SPACING		2.1	2.5
	B (m)		6.4	6.4
	L (m)		4.3	4.3
	D (m)		1.0	1.0
	P(m)		1.4	1.5
	C (m)		0.5	0.5
	Minimum Internal Width (m)/	WWIW	6.4	6.4
	Minimum Internal Length(m)/	WWIL	8.8	8.8
	Internal Depth(m)	WWD	7.6	7.5
	Roof Slab Length (m)	WWEL	9.5	10.9
	Roof Slab Width (m)	WWEW	7.1	8.3
	Floor Slab Length (m)	WWFSL	10.5	11.5
	Wet Well Floor Slab Width (m)	WWFSW	8.1	9.3
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.3	8.7
	Wet well external width	WWEW	7.1	9.5
	Wet well external length	WWEL	9.5	7.1
	Wet well roof thickness	WWRT	0.7	0.5
	Wet well floor thickness	WWFT	1.0	0.7
	Pump		PL 7081/735 3~990N4	PL 7081/735 3~990N4
VALVE CHAMBER SIZING (m)				
	Internal Depth	VCID	4.8	4.8
	Internal Width	VCIW	7.0	7.0
	Internal Length	VCIL	5.0	5.0
	Roof Slab thickness	VCRT	0.7	0.7
	Floor slab thickness	VCFT	0.9	0.9
	Roof slab width	VCEW	7.8	7.8
	Roof slab length	VCEL	5.8	5.8
	Floor slab width	VCFW	8.8	8.8
	Floor slab length	VCFL	6.8	6.8
	Stormwater gate valve length	SW GV	0.9	0.9
	Stormwater check valve length	SW-CH-V	1.5	1.5
	Height of SW gate valve height	SW GV	3.8	3.8
	Valve chamber external length	VCEL	5.8	5.8
	Valve chamber external Width	VCEW	7.8	7.8
	Approximate height of roof slab above ground		1.0	1.0
	Approximate depth of structure below ground		5.3	5.3
	Total VC Height (Above GL+Below GL)		6.3	6.3

Stormwater Longlisting Option Assessment

Option	Option 4B
Description	Chilton St James School pump station only

Summary

This option includes the following:

- A stream intake and pump station with a capacity of max. 2.5m^3/s adjacent to Chilton St James School
- A rising main from Chilton St James PS along Knights Rd and Queens Dr to the outlet.
- Due to the stopbank at the outlet location no longer being upgraded as part of the Riverlink project, a temporary outlet will be constructed to use the existing Outlet 24, shared with local stormwater. A permanent outlet will be constructed later.

High-level plans

Figure 1 – Option Overview

Figure 2 –Chilton St James pump station and intake location

Key details from preliminary sizing:

- Total design flow maximum 2.5m^3/s.
- The stream inlet is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir intake bank length approximately 9 m narrowing to approximately 3 m weir width within structure, depth 3.0m.
- Pump station includes a buried concrete inlet chamber (8m D x 3.2m W x 3.2m L), wet well (7.6m D x 6.4m W x 8.8m L), valve chamber (4.8m D x 7m W x 5m L) and a 70 m^2 transformer/electrical building.
- Pump station to have fixed emergency generator
- The Chilton St James pump station will make use of minor modifications to an existing downstream culvert rather than requiring an in-channel hydraulic control structure.
- ~ 1,200mm diameter rising main of length 1,380m from Chilton St James pump station to the outlet.
- A temporary outlet, involving reuse of the existing 900 mm diameter Outlet 24 (shared with local stormwater)
- A permanent outlet consisting of a 1200 mm pressure pipe within a box culvert (as a sleeve), to be constructed through the stopbank in the future when the stopbank is upgraded by others

Pump station layout drawings:

The layout drawings for the pump stations are attached.

Further details of the pump stations/pipelines can be provided by T+T on request to support options scoring.

Key risks / opportunities:

- Depth of pump station structures relative to Waiwhetu aquifer. The depth of the pump station wet well below ground is 9.3m. Below this is a further 1 m raft foundation and 5 m grout-filled screw piles (based on the high level foundation design) The top of the aquifer is expected to lie between 15 to 20 m below ground level. There may be the opportunity to reduce foundation depth following site investigations, and to reduce the pump station depth in the next stage of design.
- Chilton St James pump station location in the vicinity of the Knights Road drinking water wellfield (source water protection area) may have major impacts during construction (dewatering), possibly requiring shutdown of the water supply wellfield during the works.
- Dewatering is much greater than anticipated for chambers associated with the temporary and permanent outlets.
- Risk of rejection of temporary outlet by HCC and/or WWL due to potential impacts on local stormwater system. This temporary arrangement will in any case greatly limit the capacity that the pump stations can run at until such time as the stopbank is upgraded and the permanent outlet constructed. If this stopbank upgrade and the construction of the permanent outlet is delayed long-term, climate change impacts and development intensification may exceed the reduced capacity of the pump stations.

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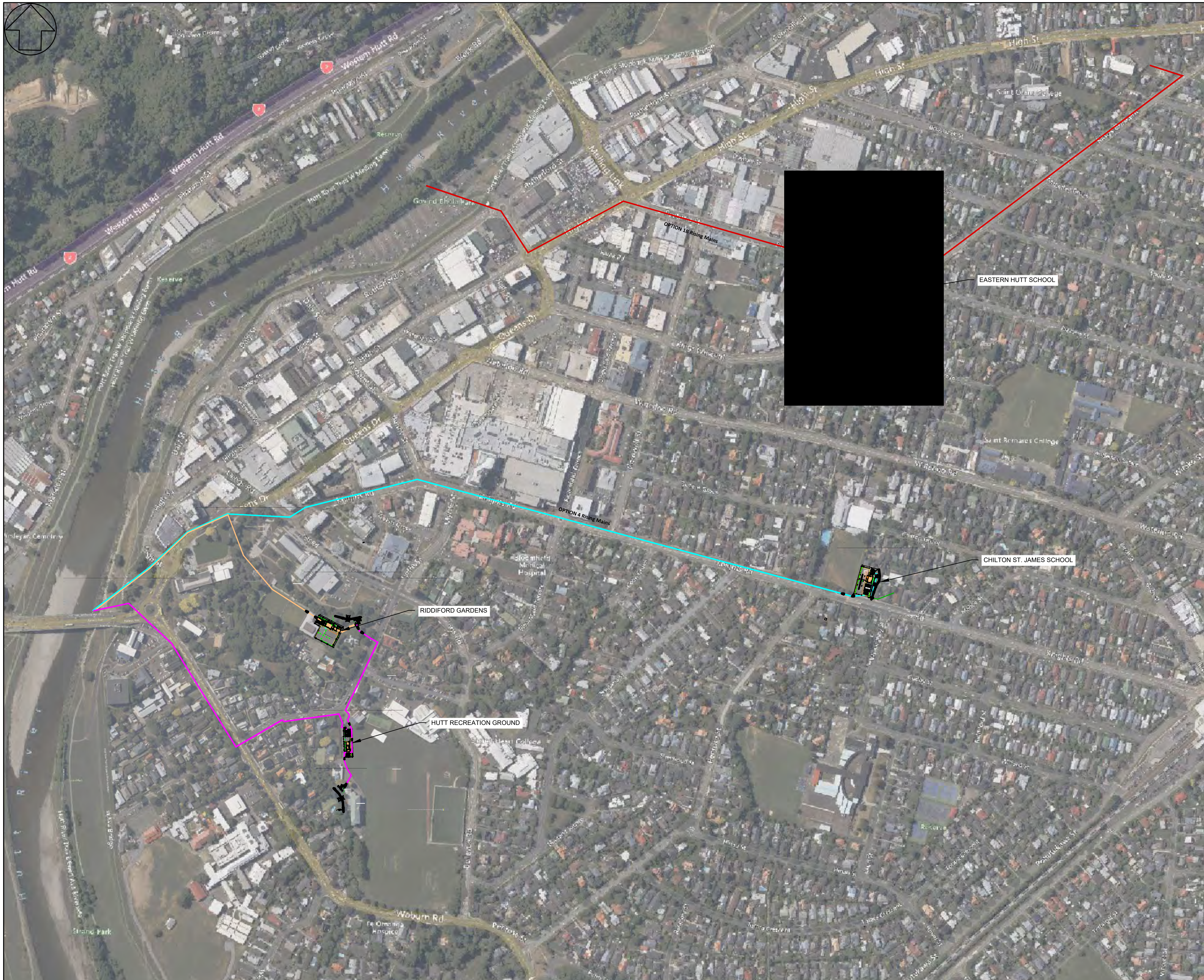
CONCEPT DESIGN
STORMWATER PUMP STATIONS AND INTAKES SITE LAYOUT DRAWINGS

OPTION 4 FOR PRICING



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LEGEND

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- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

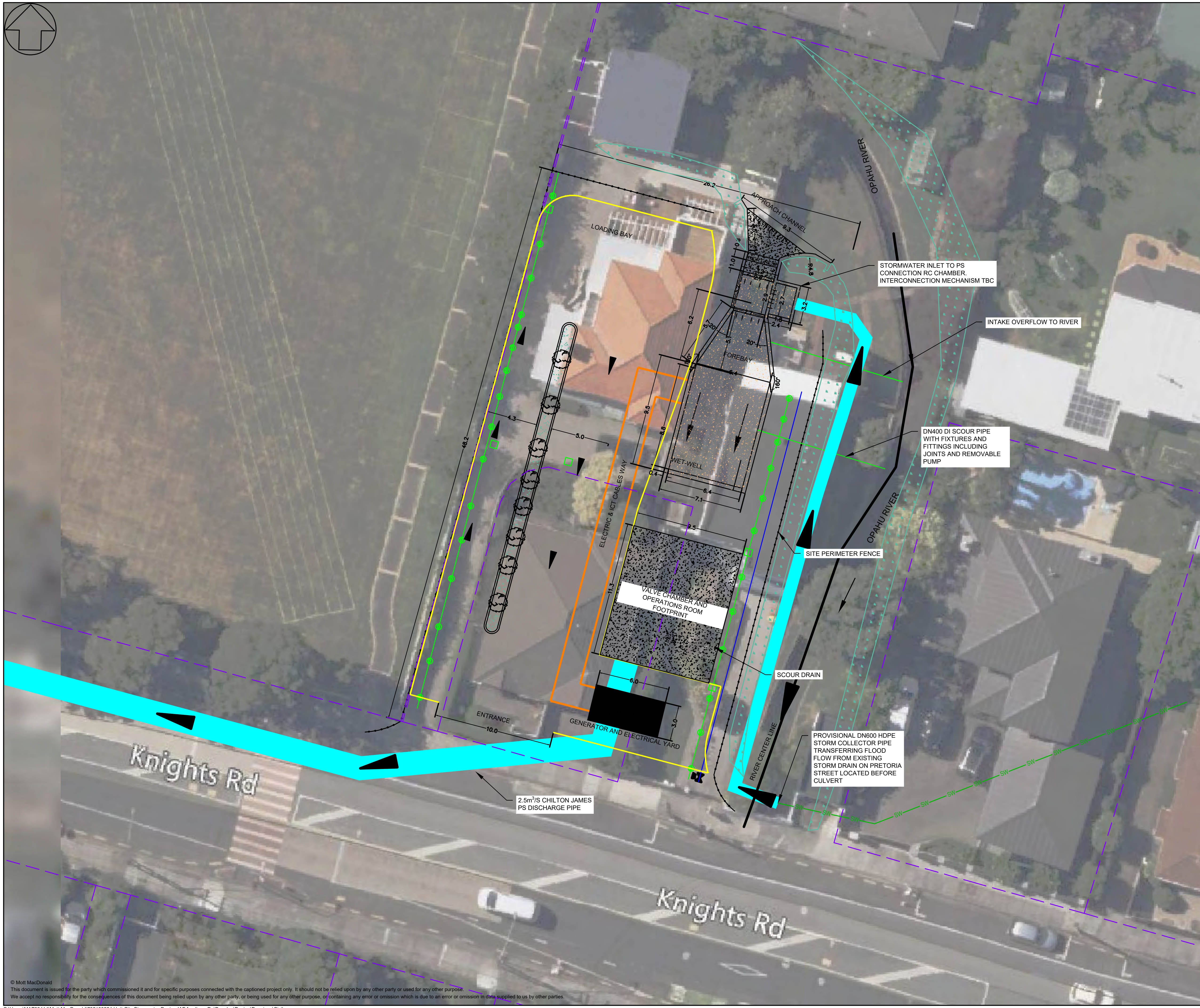
PROJECT OVERVIEW

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:3000	CONCEPT DESIGN	P4	

Drawing Number

HCC-WIG-DRW-CD-SW-001



Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. COORDINATES ARE IN TERMS OF NZTM2000
4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED DURING DETAILED DESIGN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
- SCOUR AND OVERFLOW
- WATER SUPPLY
- KERB LINE
- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN
- PROPERTY BOUNDARIES FROM LINZ
- SW—SW— EXISTING STORMWATER MAIN
- ABOVE GROUND RC STRUCTURE
- BURIED RC STRUCTURE
- GENERATOR / ELECTRICAL FITTINGS YARD
- RIVERBANK PROTECTION / IMPROVEMENT
- PLANTING

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
P3	03/24	HN	FOR REVIEW	MT	HE
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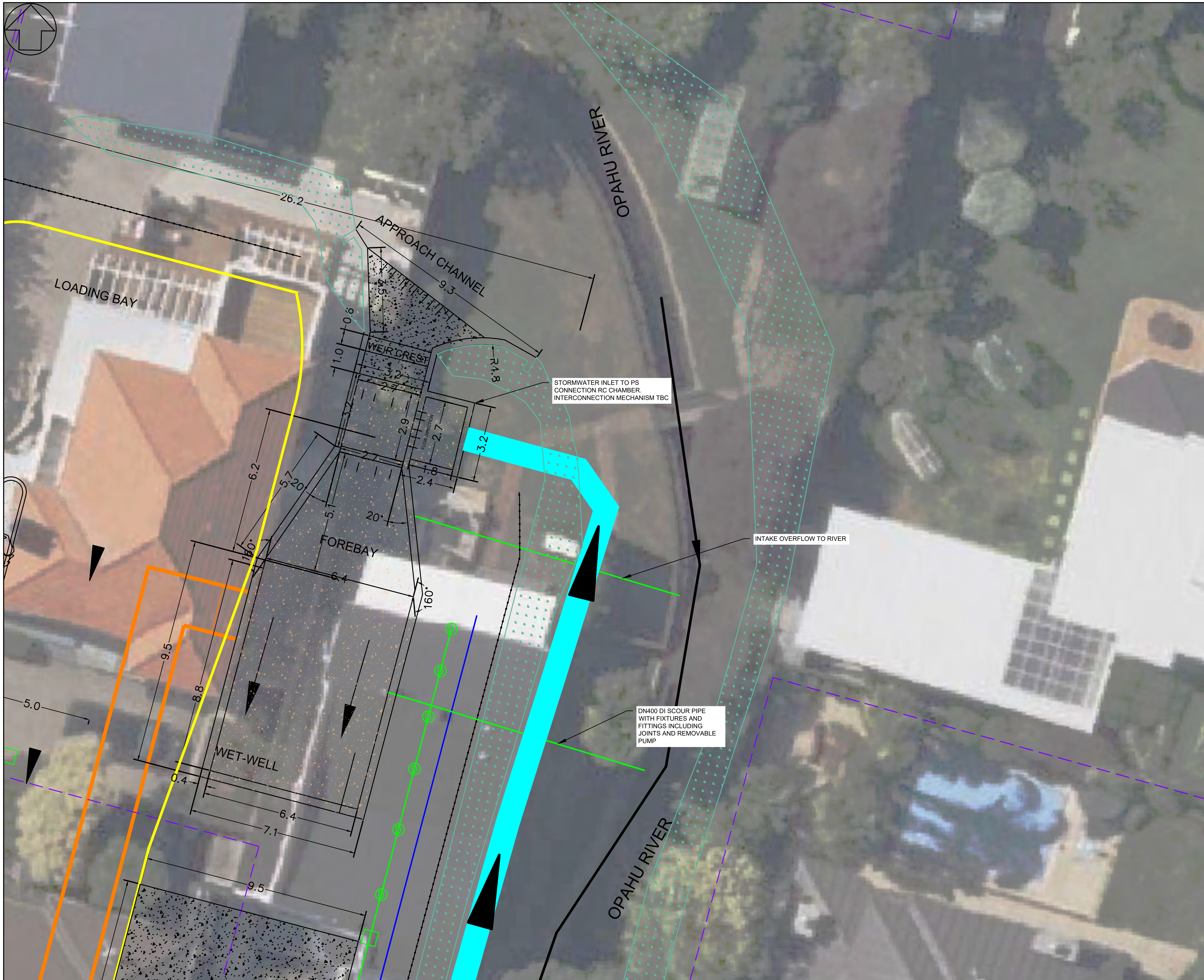
SITE LAYOUT ; OPTION 4 PUMP STATION (CHILTON ST. JAMES)

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:150	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-002



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SITE LAYOUT ; OPTION 4 INTAKE (CHILTON ST. JAMES)

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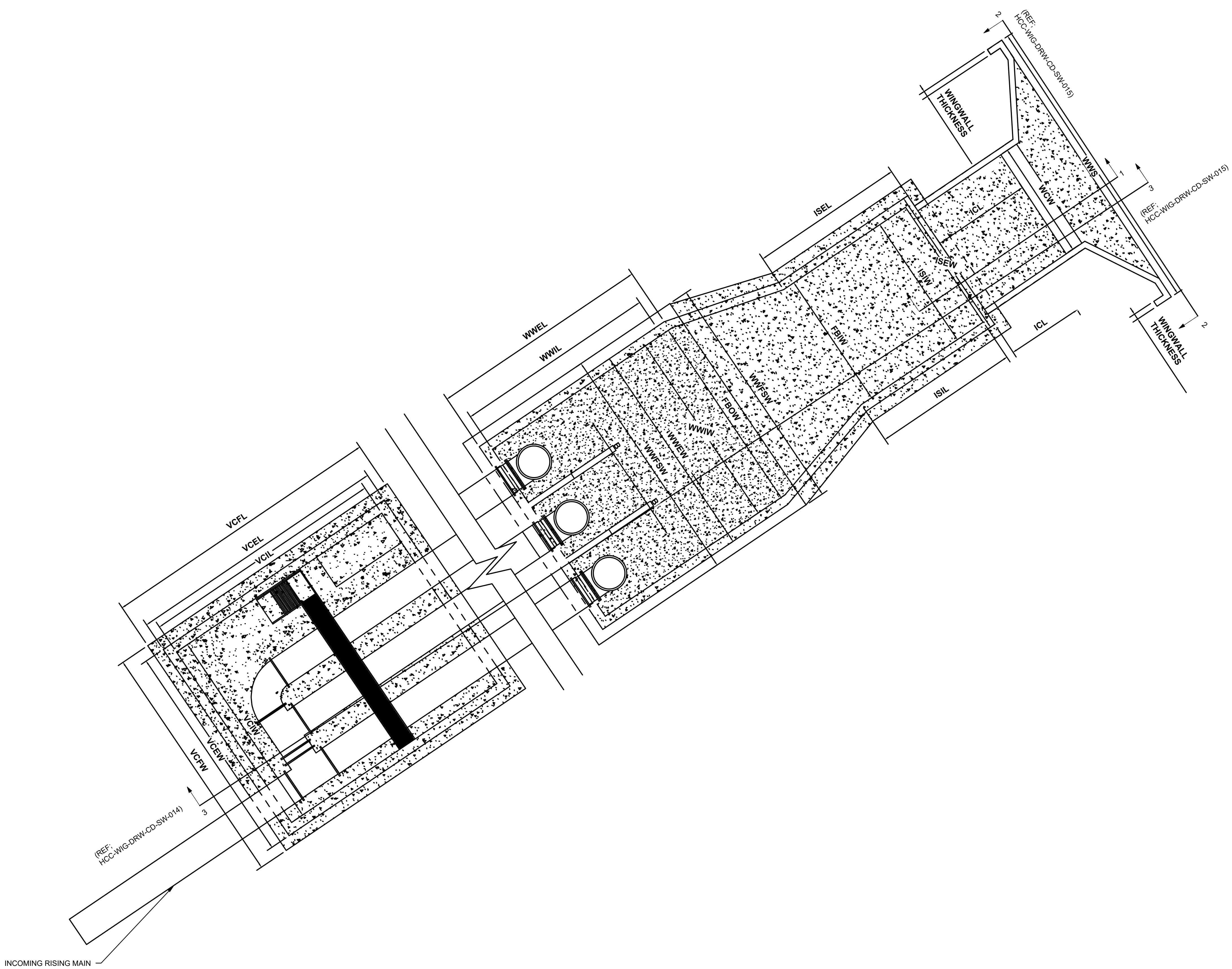
Scale at A1	Status	Rev	Security
1:75	CONCEPT DESIGN	P4	

Drawing Number HCC-WIG-DRW-CD-SW-003



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3. TO BE READ IN CONJUNTION WITH HCC-WIG-DRW-CD-SW-014 AND HCC-WIG-DRW-CD-SW-015
4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
6. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
7. ACCESS LADDER INDICATIVE ONLY, TBC LATER IN DESIGN
8. STORMWATER AND PUMPSTATION INTERCONNECTION FOR CHILTON ST. JAMES DIMENSION DETAILS ARE AS ON LAYOUT PLAN
9. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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P2	02/24	HN	FOR REVIEW	MT	HE

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

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TYPICAL PUMP STATION PLAN

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Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-013

Notes

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5. DEPTHS TBC LATER IN DESIGN
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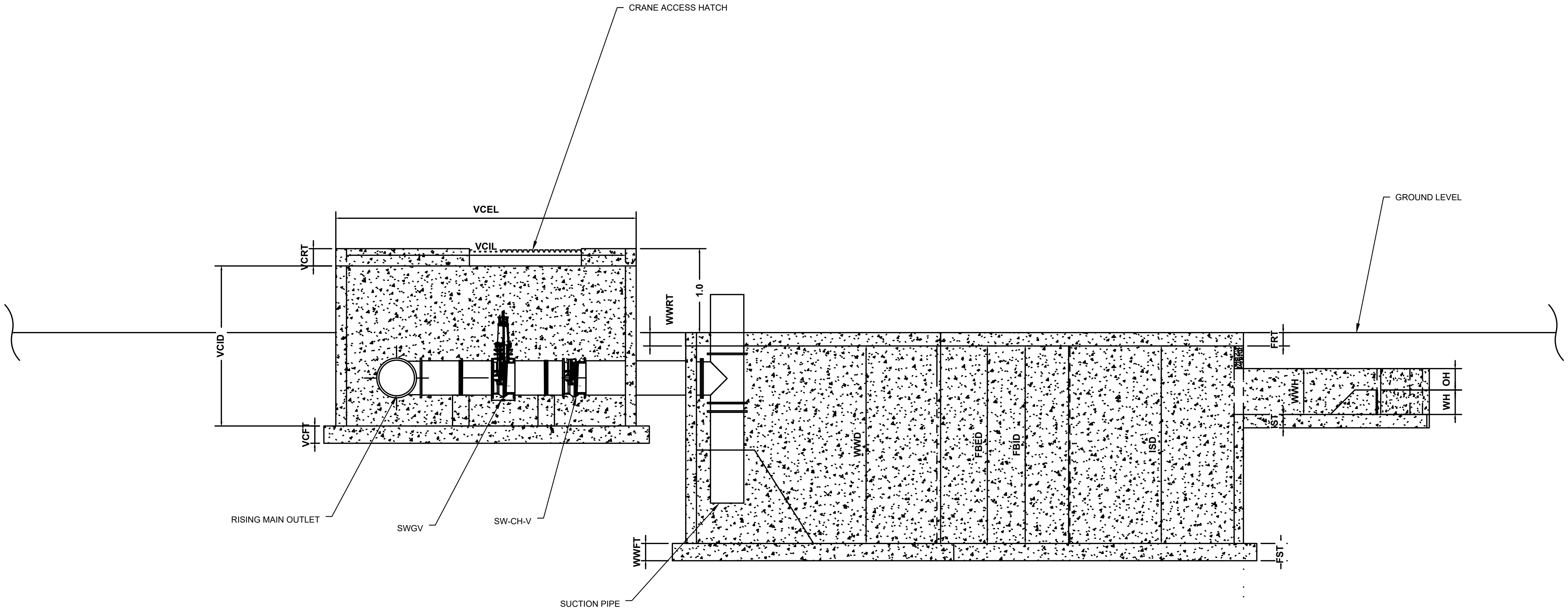
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS



SECTION 3

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
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Title

TYPICAL PUMP STATION SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
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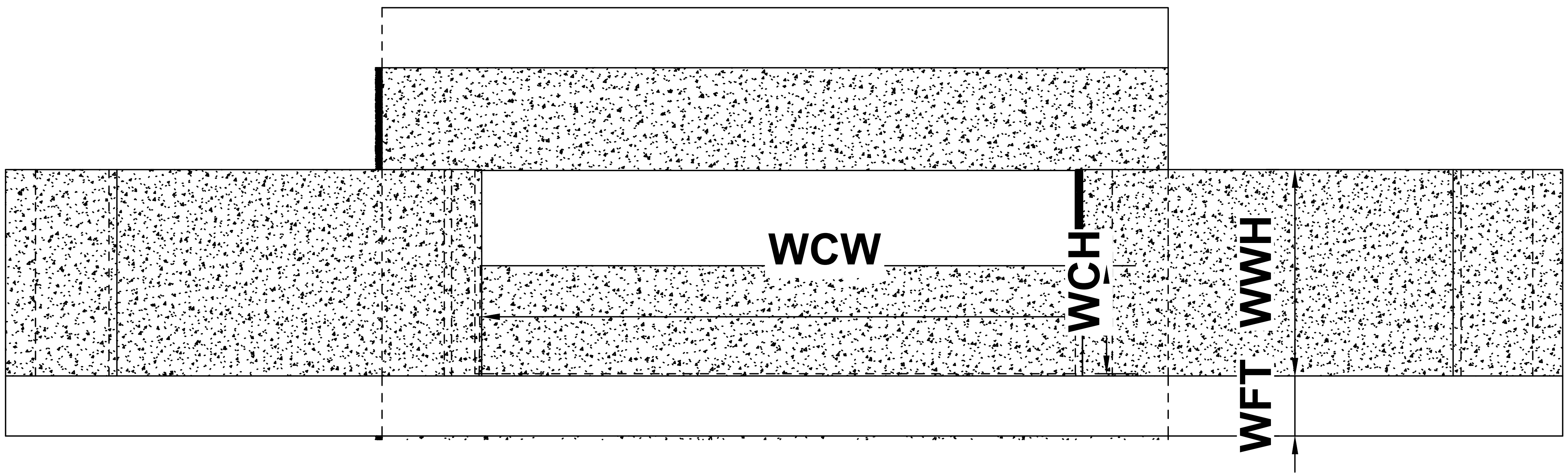
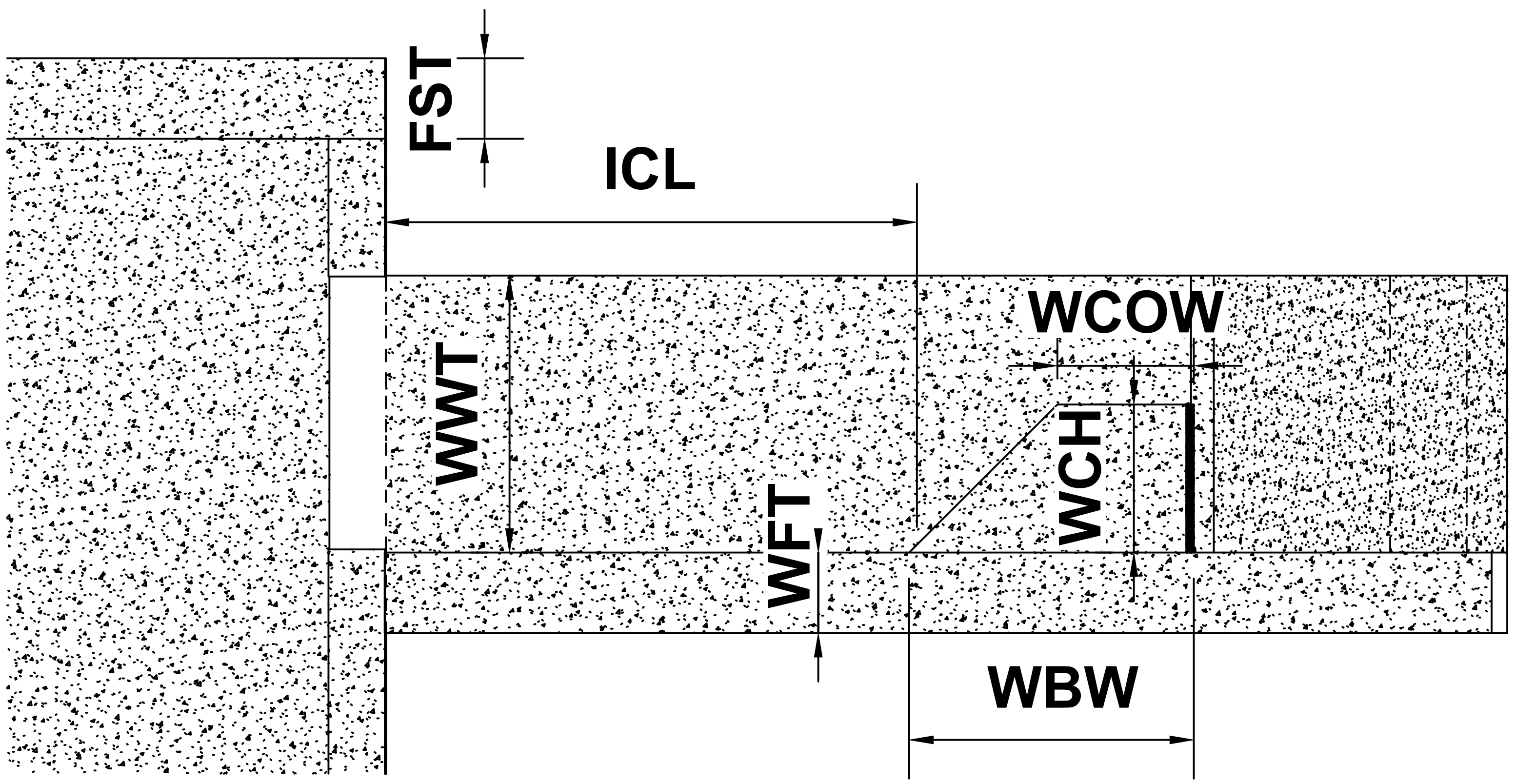
Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-014



SECTION 2



SECTION 1

Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. TO BE READ IN CONJUNTION WITH HCC-WIG-DRW-CD-SW-013
4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. DEPTHS TBC LATER IN DESIGN
6. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
7. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
8. FINAL DIMENSIONS TO BE BASED ON SETTING OUT DATA LATER IN DESIGN
9. TRASH RACKS TO BE INCLUDED IN DETAILED DESIGN
10. LATERAL STRUCTURES SHOWN IN SITE LAYOUT PLANS
11. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

TYPICAL WEIR SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
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Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-015

Option 4 for costing

		ACRONYMS	Chilton St. James School Shortlist	Riddiford Gardens Shortlist
INTAKE SIZING				
	Weir Crest Width (m)	WCW	2.7	3.0
	Wingwall span (m)	WWS	9.3	11.3
	Weir Crest Overflow Width (m)	WCOW	0.2	0.3
	Weir Bottom Width (m)	WBW	1.0	1.0
	Wingwall heights (m)	WWH	1.5	1.6
	Intake weir height (m)	WCH	0.6	0.2
	Offtake chamber length (m)		3.2	3.2
	Offtake chamber width (m)		2.4	2.5
	Offtake chamber depth (m)		3.0	3.0
	Weir floor thickness	WFT	0.3	0.3
INLET CHAMBER SIZING				
	Internal Depth (m)	ISD	8.0	7.4
	External Width (m)	ISEW	3.2	5.5
	External Length (m)	ISEL	3.2	6.2
	Roof Slab thickness	FRT	0.7	0.5
	Floor slab thickness	FST	0.7	0.7
	Roof slab length	ISEL	3.2	5.5
	Roof slab width	ISEW	3.2	6.2
	Floor slab length	ISFL	4.4	7.3
	Floor slab width	ISFW	4.2	5.8
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.3	8.6
	Inlet Channel Length	ICL	1.0	3.5
	Internal Length(m)	ISIL	2.9	5.7
	Internal Width(m)	ISIW	2.7	4.8
FOREBAY INLET STRUCTURE				
	Forebay Inlet width	FBIW	2.7	4.8
	Forebay outlet width	FBOW	6.4	7.6
	Forebay roof thickness	FRT	0.7	0.5
	Forebay Floor slab thickness	FST	0.7	0.7
	Forebay internal depth	FBID	8.0	7.4
	Forebay external depth	FBED	9.4	8.6
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.4	8.6
WET WELL SIZING (Refer to Design Drawings for PS Schematic Details)				
Design inputs	Min Discharge(L/s)		-	-
	Max discharge(L/s)		2500.0	3000.0
	Max discharge(L/s)			
	Intake-PS Pipe Diameter(mm)		DN600 (HDPE)	DN1500(HDPE)
	Intake-PS Pipe Length (m)		50.0	35
	Rising Mains Length (m)		1383.0	521
	Rising main diameter(mm)	Internal Diameter	1200.0	1200.0
	Pump Tube Height (m)		>9	>8.5
Configuration and dimensions	No. pumps(Duty + Standby)		3(2d+1)	3(2d+1)
	INTER PUMP CL SPACING		2.1	2.5
	B (m)		6.4	6.4
	L (m)		4.3	4.3
	D (m)		1.0	1.0
	P(m)		1.4	1.5
	C (m)		0.5	0.5
	Minimum Internal Width (m)/	WWIW	6.4	6.4
	Minimum Internal Length(m)/	WWIL	8.8	8.8
	Internal Depth(m)	WWD	7.6	7.5
	Roof Slab Length (m)	WWEL	9.5	10.9
	Roof Slab Width (m)	WWEW	7.1	8.3
	Floor Slab Length (m)	WWFSL	10.5	11.5
	Wet Well Floor Slab Width (m)	WWFSW	8.1	9.3
	Approximate height of roof slab above ground		0.0	0.0
	Approximate depth of structure below ground		9.3	8.7
	Wet well external width	WWEW	7.1	9.5
	Wet well external length	WWEL	9.5	7.1
	Wet well roof thickness	WWRT	0.7	0.5
	Wet well floor thickness	WWFT	1.0	0.7
	Pump		PL 7081/735 3~990N4	PL 7081/735 3~990N4
VALVE CHAMBER SIZING (m)				
	Internal Depth	VCID	4.8	4.8
	Internal Width	VCIW	7.0	7.0
	Internal Length	VCIL	5.0	5.0
	Roof Slab thickness	VCRT	0.7	0.7
	Floor slab thickness	VCFT	0.9	0.9
	Roof slab width	VCEW	7.8	7.8
	Roof slab length	VCEL	5.8	5.8
	Floor slab width	VCFW	8.8	8.8
	Floor slab length	VCFL	6.8	6.8
	Stormwater gate valve length	SW GV	0.9	0.9
	Stormwater check valve length	SW-CH-V	1.5	1.5
	Height of SW gate valve height	SW GV	3.8	3.8
	Valve chamber external length	VCEL	5.8	5.8
	Valve chamber external Width	VCEW	7.8	7.8
	Approximate height of roof slab above ground		1.0	1.0
	Approximate depth of structure below ground		5.3	5.3
	Total VC Height (Above GL+Below GL)		6.3	6.3

Stormwater Longlisting Option Assessment

Option	Option 5
Description	Hutt Rec Ground NW pump station with two stream inlets

Summary

This option includes the following:

- A stream intake (Intake 1) with a capacity of max. 1.5m³/s at Riddiford Gardens (Myrtle St)
- A stream intake (Intake 2) with a capacity of max. 1.5m³/s at Hutt Rec Ground
- Gravity pipelines from each intake to the pump station
- A pump station with a capacity of 3m³/s at the northwest corner of the Hutt Rec Ground
- Due to the stopbank at the outlet location no longer being upgraded as part of the Riverlink project, a temporary outlet will be constructed to use the existing Outlet 24, shared with local stormwater. A permanent outlet will be constructed later.

High-level plans

Figure 1 – Option Overview

Key details from preliminary sizing:

- Total design flow maximum 3m^3/s.
- Each stream inlet is a concrete side weir located within the stream bank and partially buried. Approximate dimensions of structure within stream banks: weir intake bank length approximately 10 m narrowing to approximately 2 m weir width within structure, depth 3.0m.
- Each intake includes a hydraulic control structure in the stream bed downstream of the intake
- Gravity inline pipes ~900mm diameter and length of 253m (Intake 1) and 65m (Intake 2) to pump station.
- The pump station includes a buried concrete inlet chamber (7.4m D x 6.6m W x 6.5m L), wet well (6.8m D x 9.6m W x 7.2m L), valve chamber (4.8m D x 7.8m W x 5.8m L) and a 70 m^2 transformer/electrical building.
- ~ 1,200mm diameter rising main of length 881m from Hutt Rec Ground NW pump station to the outlet.
- Pump station to have fixed emergency generator
- A temporary outlet, involving reuse of the existing 900 mm diameter Outlet 24 (shared with local stormwater)
- A permanent outlet consisting of a 1200 mm pressure pipe within a box culvert (as a sleeve), to be constructed through the stopbank in the future when the stopbank is upgraded by others

The layout drawings for the pump station are attached.

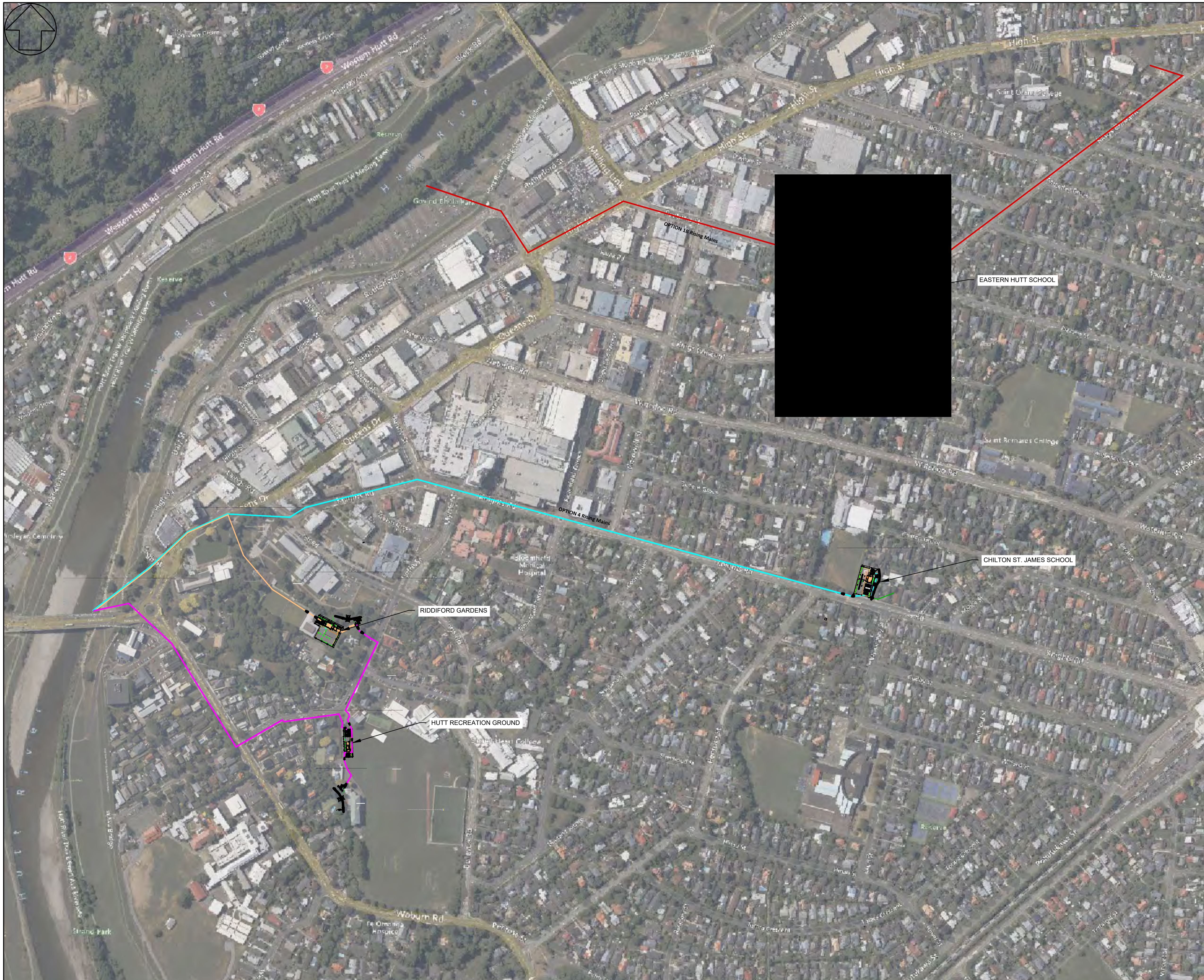
Key risks / opportunities:

- Depth of pump station structures relative to Waiwhetu aquifer. The depth of the pump station wet well below ground is 8.8m. Below this is a further 1 m raft foundation and 5 m grout-filled screw piles (based on the high-level foundation design) The top of the aquifer is expected to lie between 15 to 20 m below ground level. There may be the opportunity to reduce foundation depth following site investigations, and to reduce the pump station depth in the next stage of design.
- Dewatering is much greater than anticipated, particularly for the pump station excavation and for chambers associated with the temporary and permanent outlets.
- Risk of rejection of temporary outlet by HCC and/or WWL due to potential impacts on local stormwater system. This temporary arrangement will in any case greatly limit the capacity that the pump station can run at until such time as the stopbank is upgraded and the permanent outlet constructed. If this stopbank upgrade and the construction of the permanent outlet is delayed long-term, climate change impacts and development intensification may exceed the reduced capacity of the pump station.

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

CONCEPT DESIGN
STORMWATER PUMP STATIONS AND INTAKES SITE LAYOUT DRAWINGS

OPTION 5 FOR PRICING



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Drawing Number

HCC-WIG-DRW-CD-SW-001

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11. THE INTAKE SPAN FOR THE RIDDIFORD PUMPSTATION WILL BE 3.0m IF THE OPTION 5 PUMPSTATION IS NOT IMPLEMENTED
12. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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- OPTION 5
- RIDDIFORD GARDENS RISING MAIN
- PROPERTY BOUNDARIES FROM LINZ
- SW—SW EXISTING STORMWATER MAIN
- ABOVE GROUND RC STRUCTURE
- BURIED RC STRUCTURE
- GENERATOR / ELECTRICAL FITTINGS YARD
- RIVERBANK PROTECTION / IMPROVEMENT
- PLANTING

Rev	Date	Drawn	Description	Ch'k'd	App'd
P5	03/24	SM	FOR SHORTLIST PRICING	PT	HE
P4	03/24	HN	FOR REVIEW	MT	HE
P3	03/24	HN	FOR REVIEW	MT	HE
P2	02/24	HN	FOR REVIEW	MT	HE

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Client

HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

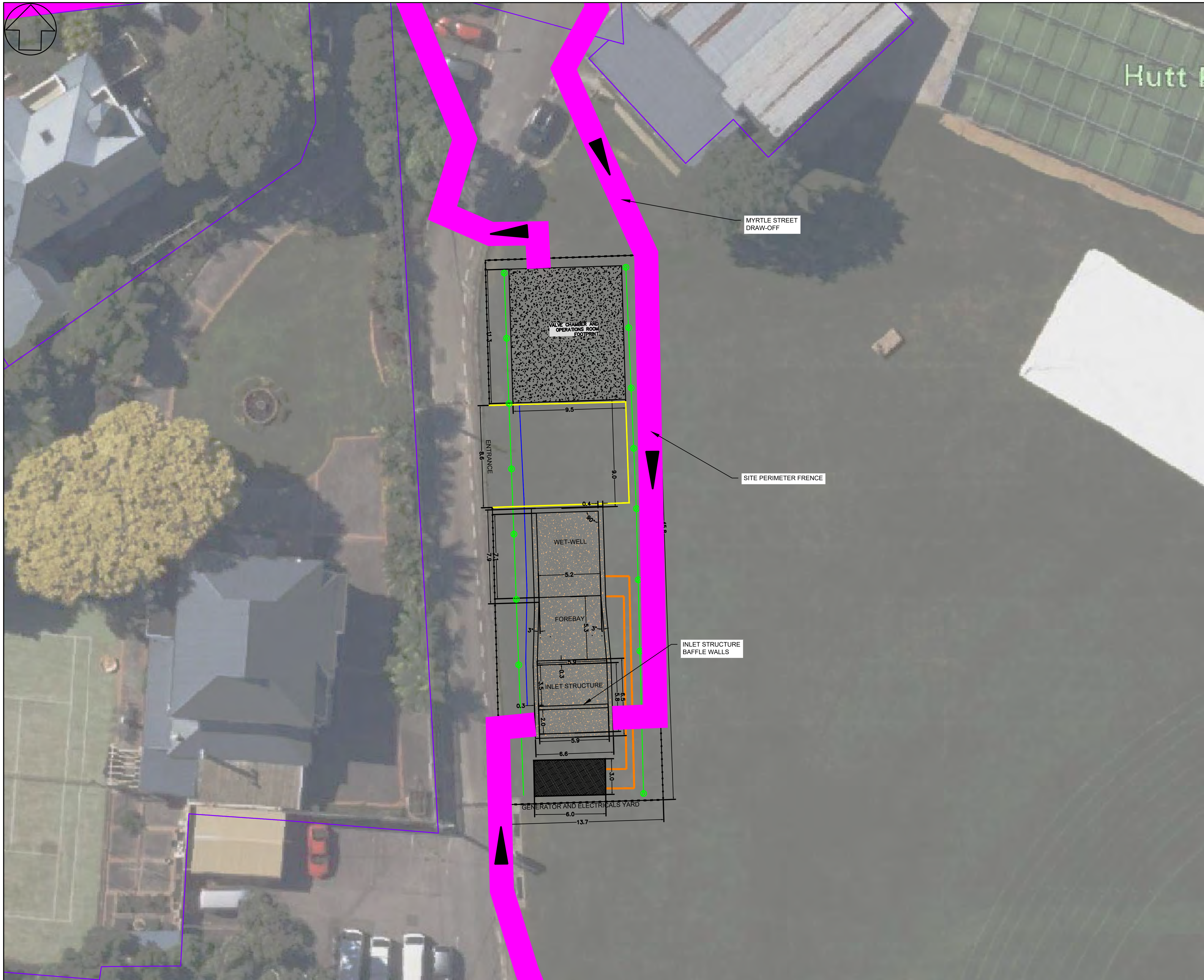
SITE LAYOUT ; OPTION 5 PUMP STATION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:750	CONCEPT DESIGN	P5	

Drawing Number

HCC-WIG-DRW-CD-SW-008



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Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. COORDINATES ARE IN TERMS OF NZTM2000
4. TOPOGRAPHY TAKEN FROM LINZ LIDAR
5. TOPOGRAPHY AND PROPERTY BOUNDARIES TO BE VERIFIED WITH TOPOGRAPHICAL SURVEY
6. FLOOD WATER LEVEL ASSUMED BASED ON HEC-RAS MODEL DEVELOPED FROM WWL OPAHU STREAM HYDROGRAPHS
7. BACKGROUND IMAGERY FROM CIVIL3D GEOMAPS
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED AT DETAILED DESIGN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
- SCOUR AND OVERFLOW
- WATER SUPPLY
- KERB LINE
- OPTION 1B
- OPTION 4
- OPTION 5
- RIDDIFORD GARDENS RISING MAIN
- PROPERTY BOUNDARIES FROM LINZ
- EXISTING STORMWATER MAIN
- ABOVE GROUND RC STRUCTURE
- BURIED RC STRUCTURE
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- PLANTING

REVISIONS

1. PUMP STATION LAYOUT REVISED

Rev	Date	Drawn	Description	Ch'k'd	App'd
P5	03/24	SM	FOR SHORTLIST PRICING	PT	HE
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P3	03/24	HN	FOR REVIEW	MT	HE
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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

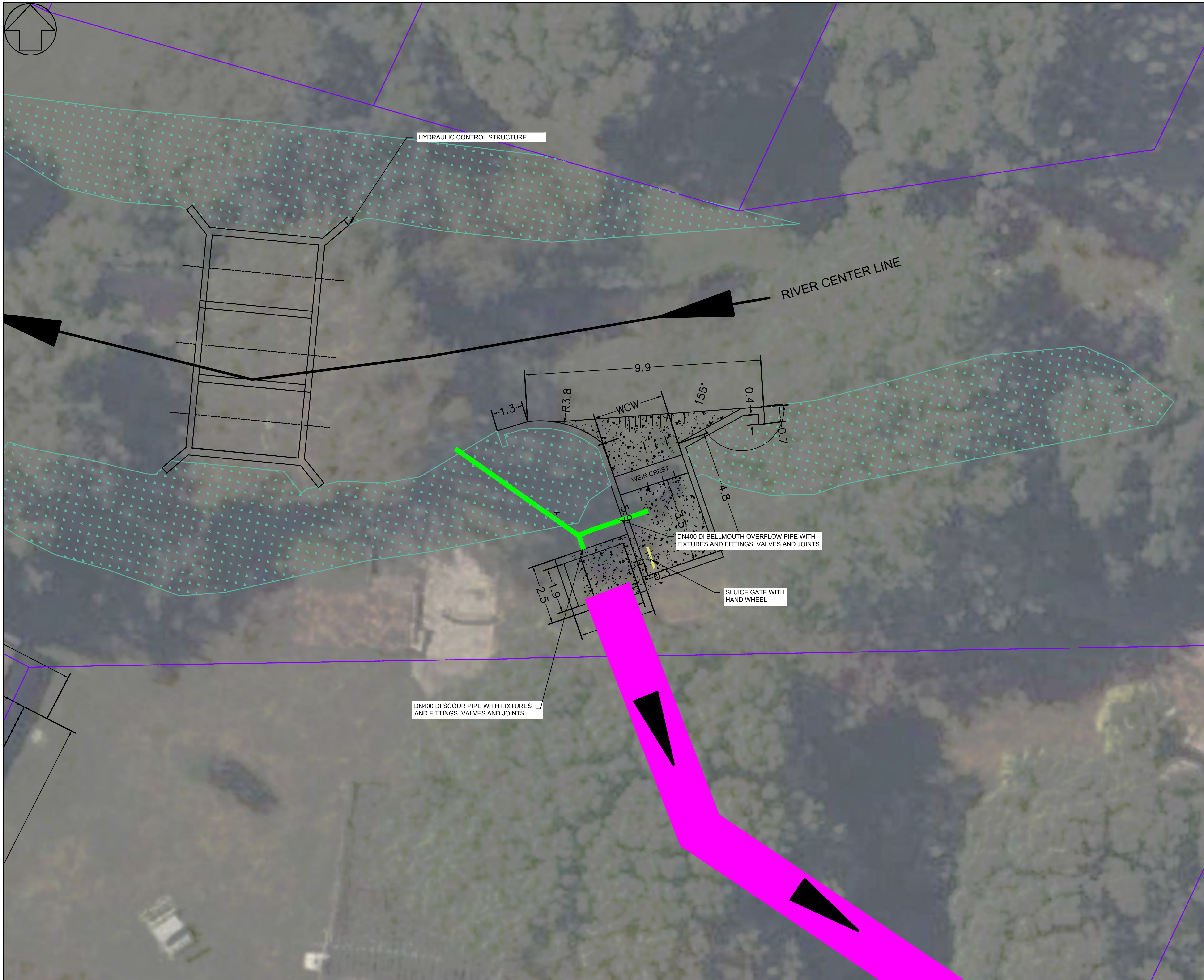
SITE LAYOUT ; OPTION 5 PUMP STATION and INTAKE LAYOUT

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:150	CONCEPT DESIGN	P5	

Drawing Number

HCC-WIG-DRW-CD-SW-009



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7. BACKGROUND IMAGERY FROM GOOGLE EARTH
8. INTERFACE WITH EXISTING UTILITIES TO BE CONFIRMED DURING DETAILED DESIGN
9. FINAL DIMENSIONS FOR PUMP STATIONS AND INTAKE TO BE DEVELOPED AT DETAILED DESIGN
10. WCW FOR OPTION 5 IS 2.25m AND FOR RIDDIFORD GARDENS OPTION IS 3.0m
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11. SCOUR AND OVERFLOW PIPES DISCHARGE TO STREAM
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
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P3	03/24	HN	FOR REVIEW	MT	HE
P2	02/24	HN	FOR REVIEW	MT	HE

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

SITE LAYOUT ; OPTION 5 INTAKE 1

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
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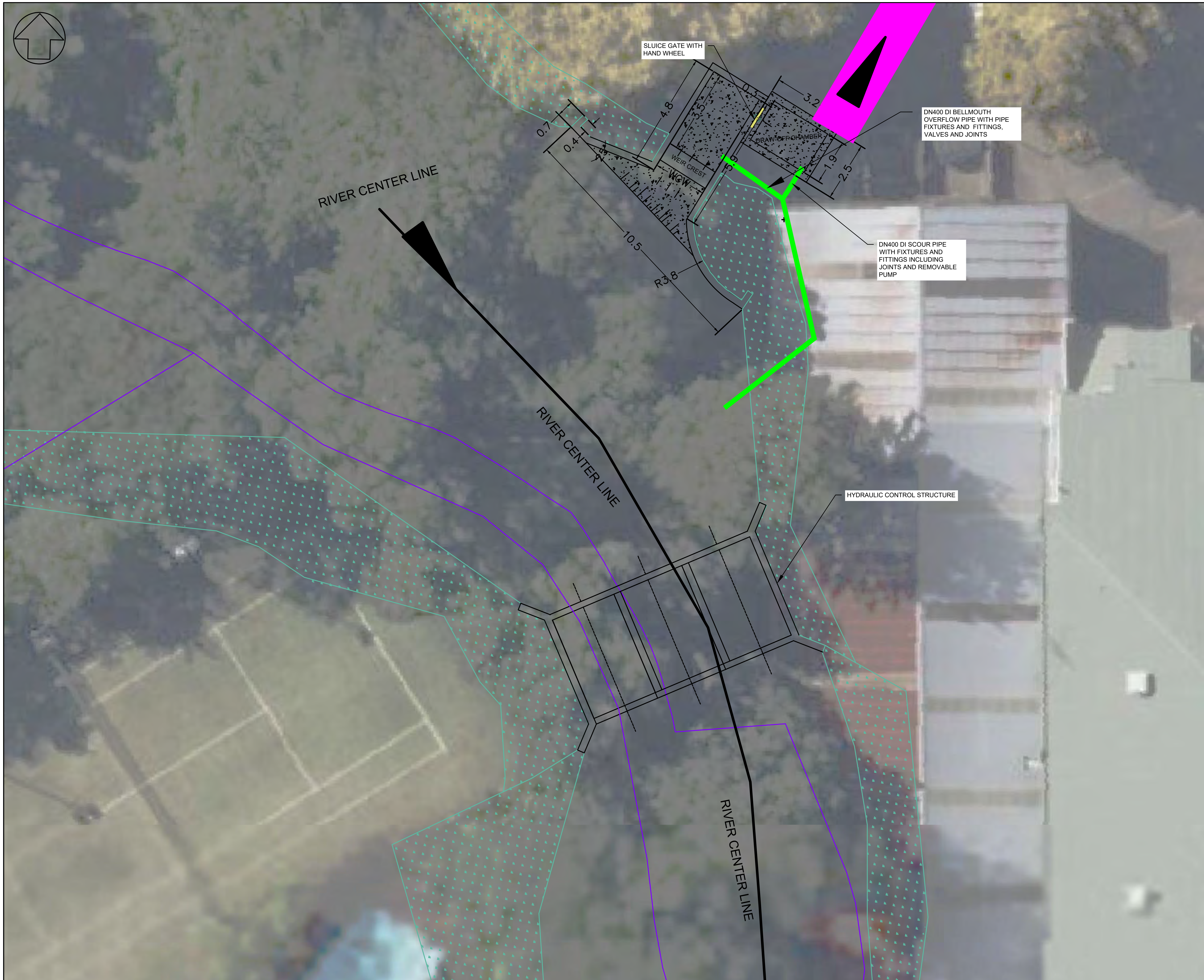
Drawing Number HCC-WIG-DRW-CD-SW-010



Notes

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12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

LEGEND

- SITE DRAINAGE
- SCOUR AND OVERFLOW
- WATER SUPPLY
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P3	03/24	HN	FOR REVIEW	MT	HE
P2	02/24	HN	FOR REVIEW	MT	HE

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

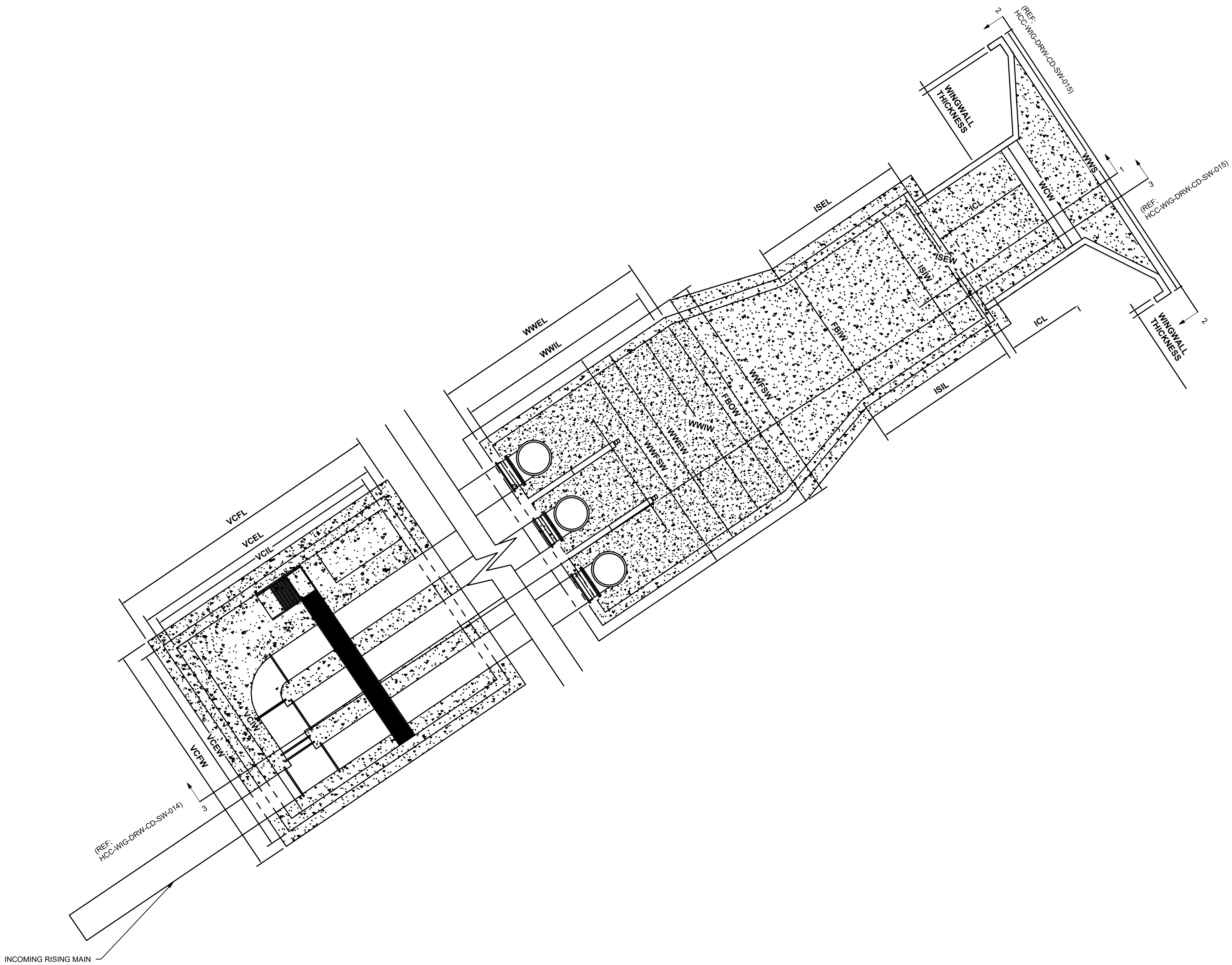
Title

SITE LAYOUT ; OPTION 5 INTAKE 2

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
1:75	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-011



Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. TO BE READ IN CONJUNTION WITH HCC-WIG-DRW-CD-SW-014 AND HCC-WIG-DRW-CD-SW-015
4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
6. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
7. ACCESS LADDER INDICATIVE ONLY, TBC LATER IN DESIGN
8. STORMWATER AND PUMPSTATION INTERCONNECTION FOR CHILTON ST. JAMES DIMENSION DETAILS ARE AS ON LAYOUT PLAN
9. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

Rev	Date	Drawn	Description	Ch'k'd	App'd
P4	03/24	SM	FOR SHORTLIST PRICING	PT	HE
P3	03/24	HN	FOR REVIEW	MT	HE
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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

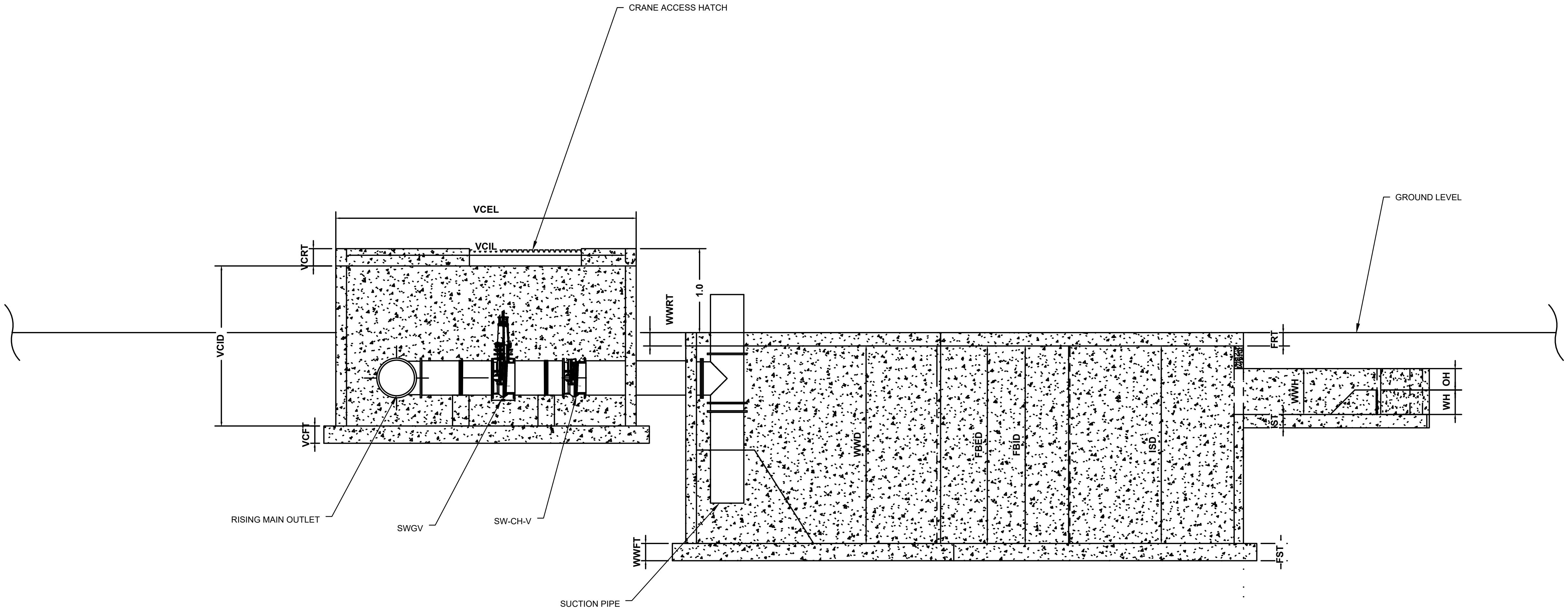
Title

TYPICAL PUMP STATION PLAN

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-013



SECTION 3

Notes

1. ALL DIMENSIONS GIVEN IN METRES (m)
2. DO NOT SCALE OFF DRAWINGS
3. TO BE READ IN CONJUNTION WITH HCC-WIG-DRW-CD-SW-013
4. REINFORCEMENT DIMENSIONS TBC AT LATER IN DESIGN AND AS ADVISED BY STRUCTURAL ENGINEER
5. DEPTHS TBC LATER IN DESIGN
6. ANY MANUFACTURER SPECIFIC INFORMATION TO BE OBTAINED FROM THE MANUFACTURER OR SUPPLIER
7. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
8. ACCESS LADDER INDICATIVE ONLY, TBC LATER IN DESIGN
9. STORMWATER AND PUMPSTATION INTERCONNECTION FOR CHILTON ST. JAMES DIMENSION DETAILS ARE AS ON LAYOUT PLAN
10. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

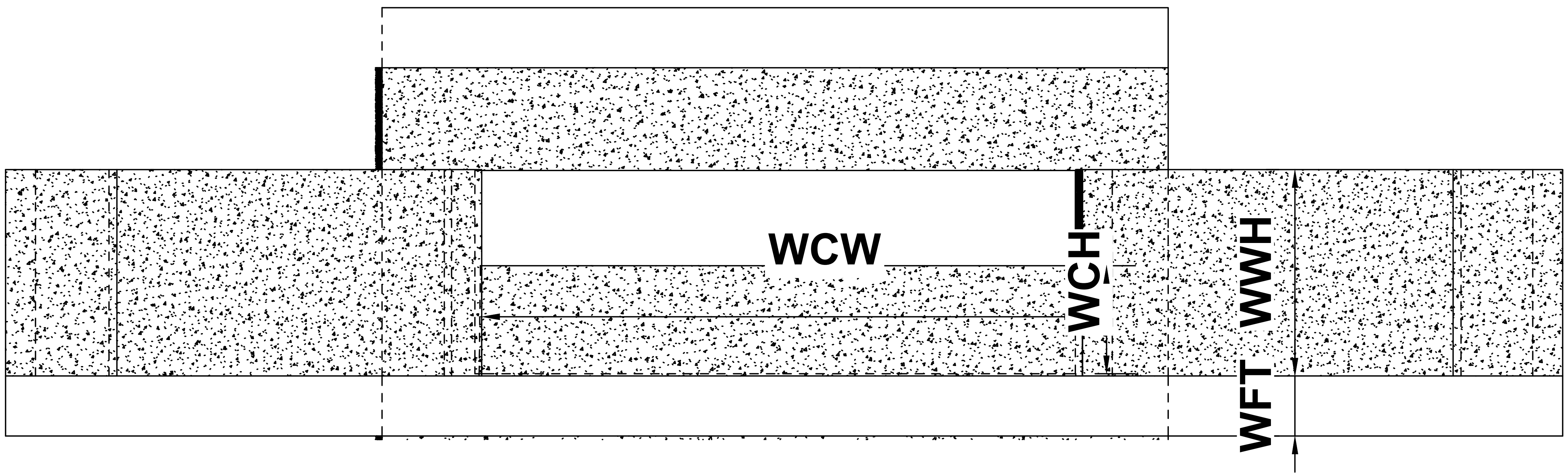
Title

TYPICAL PUMP STATION SECTION

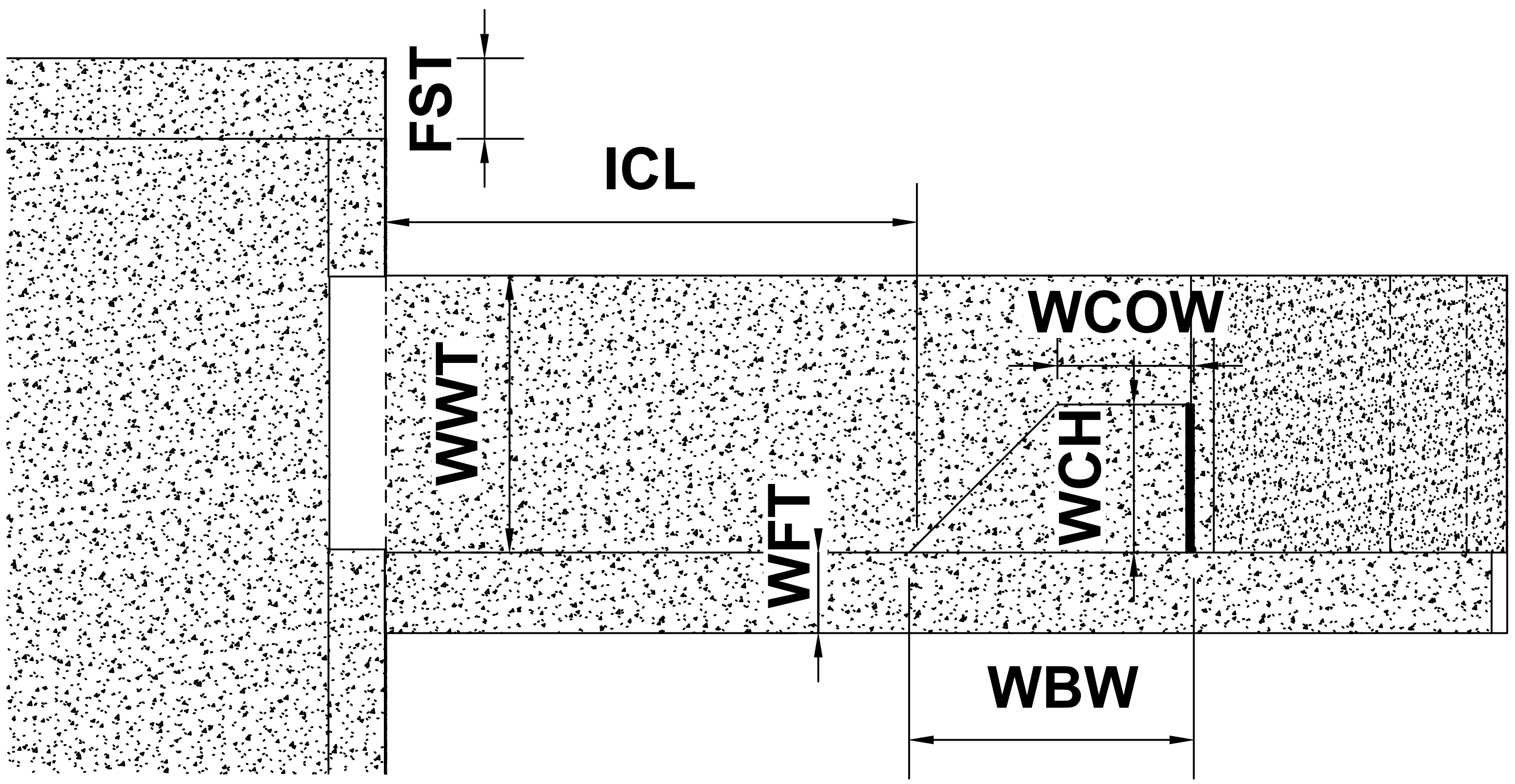
Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-014



SECTION 2



SECTION 1

Notes

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5. DEPTHS TBC LATER IN DESIGN
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7. INTERNAL BAFFLE WALLS TO BE READ FROM THE SITE SPECIFIC LAYOUT PLANS
8. FINAL DIMENSIONS TO BE BASED ON SETTING OUT DATA LATER IN DESIGN
9. TRASH RACKS TO BE INCLUDED IN DETAILED DESIGN
10. LATERAL STRUCTURES SHOWN IN SITE LAYOUT PLANS
11. BUILDING IMPORTANCE LEVEL OF 1 OR 3, RISK GROUP WB (NEW ZEALAND BUILDING CODE)
12. REFER TO TABLE ON HCC-WIG-DRW-CD-SW-012 FOR STRUCTURE DEPTHS AND DIMENSIONS

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HCC WIG - HUTT CITY COUNCIL WATER INFRASTRUCTURE FOR GROWTH PROJECT

Title

TYPICAL WEIR SECTION

Designed	H. NJUGUNA	02/2024	Eng check	M. TSEN	02/2024
Drawn	H. NJUGUNA	02/2024	Coordination	H. NJUGUNA	02/2024
Dwg check	S. MATEPARAE	02/2024	Approved	H. EDMOND	02/2024

Scale at A1	Status	Rev	Security
NTS	CONCEPT DESIGN	P4	

Drawing Number
HCC-WIG-DRW-CD-SW-015

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Option 5 for costing

			NW Hutt Rec Park
		ACRONYMS	**Shortlist**
INTAKE SIZING			
	Weir Crest Width (m)	WCW	2.3
	Wingwall span (m)	WWS	10.5
	Weir Crest Overflow Width (m)	WCOW	0.2
	Weir Bottom Width (m)	WBW	1.0
	Wingwall heights (m)	WWH	1.5
	Intake weir height (m)	WCH	0.4
	Offtake chamber length (m)		3.2
	Offtake chamber width (m)		2.5
	Offtake chamber depth (m)		3.0
	Weir floor thickness	WFT	0.3
INLET CHAMBER SIZING			
	Internal Depth (m)	ISD	7.4
	External Width (m)	ISEW	6.6
	External Length (m)	ISEL	6.5
	Roof Slab thickness	FRT	0.5
	Floor slab thickness	FST	0.9
	Roof slab length	ISEL	6.5
	Roof slab width	ISEW	6.6
	Floor slab length	ISFL	7.5
	Floor slab width	ISFW	7.6
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		8.8
	Inlet Channel Length	ICL	3.5
	Internal Length(m)	ISIL	5.8
	Internal Width(m)	ISIW	5.9
FOREBAY INLET STRUCTURE			
	Forebay Inlet width	FBIW	5.9
	Forebay outlet width	FBOW	5.2
	Forebay roof thickness	FRT	0.7
	Forebay Floor slab thickness	FST	0.7
	Forebay internal depth	FBID	7.4
	Forebay external depth	FBED	8.8
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		8.8
WET WELL SIZING (Refer to Design Drawings for PS Schematic Details)			
Design inputs	Min Discharge(L/s)		-
	Max discharge(L/s)		3000.0
	Max discharge(L/s)		
	Intake-PS Pipe Diameter(mm)		I.D, 2x900(RCRRJ)
	Intake-PS Pipe Length (m)		253 & 65
	Rising Mains Length (m)		585
	Rising main diameter(mm)	Internal Diameter	1200.0
	Pump Tube Height (m)		>8.3
Configuration and dimensions	No. pumps(Duty + Standby)		3(2d+1)
	INTER PUMP CL SPACING		1.7
	B (m)		6.4
	L (m)		4.5
	D (m)		1.0
	P(m)		1.5
	C (m)		0.5
	Minimum Internal Width (m)/	WWIW	6.4
	Minimum Internal Length(m)/	WWIL	8.8
	Internal Depth(m)	WWD	6.8
	Roof Slab Length (m)	WWEL	7.9
	Roof Slab Width (m)	WWEW	6.0
	Floor Slab Length (m)	WWFSL	8.9
	Wet Well Floor Slab Width (m)	WWFSW	7.0
	Approximate height of roof slab above ground		0.0
	Approximate depth of structure below ground		8.8
	Wet well external width	WWEW	9.6
	Wet well external length	WWEL	7.2
	Wet well roof thickness	WWRT	0.8
	Wet well floor thickness	WWFT	1.2
	Pump		PL 7081/765 3~990N4
VALVE CHAMBER SIZING (m)			
	Internal Depth	VCID	4.8
	Internal Width	VCIW	7.0
	Internal Length	VCIL	5.0
	Roof Slab thickness	VCRT	0.7
	Floor slab thickness	VCFT	0.9
	Roof slab width	VCEW	7.8
	Roof slab length	VCEL	5.8
	Floor slab width	VCFW	8.8
	Floor slab length	VCFL	6.8
	Stormwater gate valve length	SW GV	0.9
	Stormwater check valve length	SW-CH-V	1.5
	Height of SW gate valve height	SW GV	3.8
	Valve chamber external length	VCEL	5.8
	Valve chamber external Width	VCEW	7.8
	Approximate height of roof slab above ground		1.0
	Approximate depth of structure below ground		5.3
	Total VC Height (Above GL+Below GL)		6.3

Appendix C MCA criteria and specialists

	Criteria (and matters to consider within each)[1]	Specialist	Input sought from:	Relevant refinements from longlist stage (not exhaustive)
1.	**Ecology** *[Some matters for your consideration in the criteria. TBC by the ecologist / confirm in memo]* - Terrestrial/riparian ecology o Impacts on native vegetation - Freshwater ecology o Impacts on wetlands or streams o Potential changes to hydrology which impact on downstream ecosystems o Fish passage implications	[redacted] (T+T)	[redacted] (T+T)	Hydraulic structures in streambed now explicitly shown on drawings. Slight pump station location changes.
2.	**Cultural** *[Some matters for your consideration in the criteria. TBC by the cultural specialist]* - Wāhi tapu - Ngāhere/rakau (important bush/trees) - Awa - Mauri - Ngā Taonga Nui a Kiwa / Sites of significance (pNRP schedules B and C)	[redacted] (Hikoikoi Management)	[redacted] (HCC) [redacted] (HCC)	Slight PS location changes Form/appearance of pump stations now shown on site layouts More detail on river outlets
3.	**Hydrogeology** *[Some matters for your consideration in the criteria. TBC by the hydrogeologist/ confirm in memo]* - Risk to aquifer - Risk to drinking water source	[redacted] (T+T) (TBC)	[redacted] (T+T)	
4.	**Sustainability** - Embodied carbon	[redacted] (T+T) (TBC)	[redacted] (T+T) [redacted] (WWL)	
5.	**Planning and consenting complexity**	[redacted] (T+T)	[redacted] (WWL),	Pump station depth vs aquifer

Criteria (and matters to consider within each)[1]		Specialist	Input sought from:	Relevant refinements from longlist stage (not exhaustive)
	- Zones and overlays / any particular constraints - Potential consent requirements and activity status - Consenting complexity/challenge - Potential for notification		[redacted] (T+T)	Chilton St James PS vs drinking water protection area Slight PS location changes Form/appearance of pump stations now shown on site layouts Hydraulic structures in streambed now explicitly shown on drawings. More detail on river outlets
6.	**Constructability** *Some matters for consideration in the criteria. TBC by the specialist in their memo]* - Construction risks and general degree of difficulty - Depth/area of excavation - Access, health and safety - Disruption to existing services and utilities	[redacted] (T+T)	[redacted] (T+T) contractor input [redacted] (T+T)	Pump station depth vs aquifer. Slight PS location changes Form/appearance of pump stations now shown on site layouts More detail on river outlets More detail on potential service clashes
7.	**Infrastructure resilience and risk** *[Some matters for consideration in the criteria. TBC by specialist in their memo]* - Risks due to: infrastructure failure (e.g. pump failure), residual risks. - Resilience and adaptability of proposed option.	[redacted] (on behalf of WWL)	[redacted] (T+T)	New climate change flood mapping Areas of benefit estimated based on trunk capacity upgrade Outlet uncertainty/ difficulty Option 4/5 Information about cluster flooding
8.	**Operation of infrastructure** *(Some matters for consideration in the criteria. TBC by the specialist in their memo]* - Ongoing operational and maintenance requirements - Access - Health and safety (asset owner)	[redacted]	Paul Winstanley (WWL)	Outlet uncertainty/difficulty Option 4/5 Slight PS location changes Form/appearance of pump stations now shown on site layouts
9.	**Enablement of housing development**	[redacted] (HCC)	[redacted] (HCC)	Change from a flood reduction approach

	Criteria (and matters to consider within each)[1]	Specialist	Input sought from:	Relevant refinements from longlist stage (not exhaustive)
	- Area of residential land potentially served by an upgrade in trunk capacity - Degree of certainty or uncertainty in this benefit - Alignment with preferred development areas including zoning and developer-preferred areas		[redacted] (T+T)	targeting floor levels, access and roads, to a "trunk capacity" approach. Areas of benefit estimated based on trunk capacity upgrade
10.	**Property** *[Some matters for consideration in the criteria. TBC by the specialist in their memo]* - Ownership - No of private properties impacted - Complexity of land access and/or property purchase	[redacted]		Slight PS and pipeline location changes
11.	**Effects on community** - Temporary o Construction - Broadly more or less disruptive (taking into account duration and proximity to neighbours) - Permanent o Effects on community assets and amenities (excludes flood reduction addressed above). o Noise effects associated with operation of infrastructure	[redacted] (T+T)	[redacted] (T+T) [redacted] (HCC)	Slight PS location and rising main route changes Form/appearance of pump stations now shown on site layouts
12.	**Cost**	[redacted]	[redacted] (T+T) [redacted] (T+T)	

Notes

1. The draft criteria have been circulated for feedback and updated to reflect this feedback. **However specialists may amend or clarify their criterion and/or issues to be considered should this be required. This should be confirmed in the memo to be prepared by the specialist.**
2. The specialist is encouraged to seek input from the relevant people, including but not limited to those identified above.

Appendix D Summary memo template, including MCA recording and scoring

Memorandum

To:	[redacted]
From:	[Specialist name]
Date:	
Subject:	**Multi-criteria analysis - IAF stormwater upgrades options** [**Specialist criteria**]

1 Introduction

In June 2021, the New Zealand government announced the Infrastructure Acceleration Fund (IAF). The IAF is administered by Kainga Ora and is designed to allocate funding to new or upgraded infrastructure to unlock housing developments in the short-to-medium term and enable a meaningful contribution to housing outcomes in areas of need.

The Hutt City Council (HCC) has IAF funding support to deliver Enabling Infrastructure Projects to facilitate the construction of up to 3,520 new houses in the Lower Hutt Valley. This includes Related Enabling Infrastructure Projects such as the stormwater upgrades proposed to provide for flood management and protection works.

HCC is currently considering stormwater upgrade options to reduce flooding within the catchment of the Opahu Stream. The primary focus of these options is to reduce flooding within the identified growth area of residential homes (floor levels) and access to dwellings, and of arterial roads identified by HCC. The options are being considered via a multi-criteria analysis (MCA) process. Seven options have been considered as part of this process.

This report summarises the evaluation of the options under the [XXXXX] criterion, and records the scores assigned for each option under that criterion.

2 Background

Summary of context as relevant to criterion e.g. property agreements, ecology assessments, etc.

2-4 paragraphs max.

3 Methodology

- *Data/information used*
- *Matters considered*

4 Key assumptions

- *Key assumptions (further work required to address – where relevant)*
- *Mitigation assumptions*

- *What determines fatal flaws*
- *Approx. 1 page max.*

5 Scoring

See attached table. Include:

- Score (based on chart provided in briefing memo)
- Key reasons for score, including mitigation taken into account

Option	Name	Score	Reasons for score
		e.g. -3	*e.g. would have significant impact on a wetland of significant value* *key benefits / advantages or effects / risks*
1a	Upper Opahu Stream Improvements + Eastern Hutt School Pump Station		
1b	Eastern Hutt School Pump Station with Kings Crescent Interceptor		
2	St Bernards School pump station		
3a	Hautana Square intake to Hutt Rec Ground Storage		
3b	Hautana Square intake to Hutt Rec Ground pump station		
4	Chilton St James School and		

	Riddiford Gardens pump stations		
5	Hutt Rec Ground NW pump station with two stream inlets		

6 Additional matters

Any important matters not otherwise captured previously. If none, N/A

Regards

[Signature]

[First Name] [Surname]
[Position]

Appendix U- Shortlist option costings

NOT INCLUDED

Appendix V- Shortlist MCA workshop minutes

Minutes

Meeting:	HCC IAF Stormwater Upgrades Shortlist MCA Workshop		
Venue:	Tonkin + Taylor (Red Rocks) and Teams	**Date:**	11 April 2024
Job No:	1091097.00000	**Time:**	1pm
Present:	[redacted]		

	Agenda Item	**Owner**
1	**Purpose of workshop** The purpose of the workshop is to determine the strengths and benefits of each of the options. The MCA helps assess sites in a robust and transparent manner. The overall scoring will be used to help inform Hutt City Council (HCC) when selecting an option, and the MCA process and outcome will accompany and underpin an NOR process and/or RMA consent application. HCC will ultimately determine the preferred option and can consider the MCA but do not have to align their decision with the highest scoring option.	[redacted]
2	**Background to Project** Objectives, description of options (including questions / discussion), and scene setting. Difference between longlist and shortlist: - Riverlink design changes forced a change to the outlets. - Hydraulic modelling of the options. - Risk of pump stations being located on schools may have operational constraints. This has changed from the longlist to shortlist, and they are now proposed to be located on private property. - Additional utility and constructability input. Changes in approach: - Conceptual change to the approach.	[redacted]

	- Modelling results showed the areas where we are getting flooding reduction is quite modest. There wasn't a lot of impact very far from the stream because overland flow paths are often blocked by roads (a problem with flat catchments), the existing pipe network is under capacity, in addition in some areas it appears that inlet capacity is inadequate. This led to a different approach – "the Pivot". - The pivot involved identifying 6 cluster options, and conceptualising solutions to each of the clusters. - The conceptualised solutions reduced flooding but were not low cost. They represented good incremental value. $/ha compared to base option was good. But would not deliver enough flood free land for the development of 3500 houses. This could however be used for future HCC projects. - However, the project is providing capacity in the trunk network and without this capacity the positive benefits of any future stormwater improvement projects will be very locally limited and likely require extensive site-based infrastructure to reduce off site flows to predevelopment levels because the capacity in the trunk network will still be constrained. Therefore focussed on trunk capacity approach instead. - Hydraulic neutrality – 2-3 m^3/s pump station capacity design. Current Opahu pump station 9 m^3/s. Sensitivity analysis undertaken on the high level calculations to test different development scenarios Sensitivity analysis results 1-3 m^3/s. Clarification/Question: Improved trunk capacity – additional infrastructure works may be required on a development-by-development basis. However, the works will depend on the nature of the development proposals. In addition, without this work the development proposals would have to front up for this work themselves. Cost prohibitive for developers. On site development controls (rainwater tanks etc) will not achieve hydraulic neutrality. Question - Is there additional scope of work to enable development? Have to be careful that people don't interpret the purple area as "good to go" for development in the area of improved trunk capacity map. Response - Depends on where in the zone of influence development is proposed as to whether additional work may be required to enable consenting of the proposed development and whether that work is minor/major. Response - Nature of our modelling is high level. Riverlink designed outfalls are now proposed to be on a like-for-like basis, no extra capacity added. Challenge If HCC upgrade local network without undertaking any IAF upgrade, they would need to find an outlet to get water out of the system to Te Awa Kairangi.	
3	**Criteria – Community effects** Scores have remained relatively unchanged from the longlisting. The main change relative to this assessment criteria is the relocation of the pumpstation to private land (Options 1b, 4 and 4b). This has a significant effect on one or two individual's private property, but a lesser effect on the community than the previously proposed location. This wasn't enough to change the level of effect overall. Short term community effects for 1b and 4b. However, the long-term effects have been weighted greater than short term.	[redacted]
4	**Criteria – Sustainability** The scoring for the criteria was confined to be embodied carbon. Therefore, the options with more material components scored lower.	[redacted]

	Question: Were carbon emissions from operations included? This analysis looked at embodied carbon as that will be the biggest impact. Operational will be small in comparison due to hydropower and the relatively low frequency of operation of the pump station. In addition, Pump stations all relatively similar in size. Therefore, operational carbon not a differentiator.	
5	**Criteria – Ecological values** All designs are similar in terms of effects. The largest adverse effect is fish entrainment (i.e. fish are sucked into the pump station intakes). To mitigate this, fish friendly pump designs (fish screens or suitable pumps) to avoid fish getting chopped up by pumps could be procured. It is unknown whether these will be feasible and have assumed that these are not included. Other effects that have been considered include: - Base flows for the stream could be pumped out – the design currently will not allow that to happen. - Potential fish passage blockage as a result of the hydraulic control structures, but these can be designed to provide for fish passage. Question – Have you considered that option 4 has two pump stations, and would this have a greater effect compared to the other options? Answer - The intermittent use of the pump stations will not put it higher than the other options for now. But would require further investigations in the next stage.	[redacted]
6	**Criteria – Hydrogeology** - Brief description of the hydrogeological conditions in which the project is located. Options 4 and 4b Chilton St James pump station are located in close proximity to the Waterloo well abstraction bores. The criteriaon was scored based on both the protection to the Waiwhetu Aquifer and the risk to the drinking water source. - From a source water protection lens, Option 4 and 4B have fatal flaws. WWL have legal obligations to protect drinking water and have specified source water risk management areas to combat acute risks. This management area overlaps with Option 4 Chilton St James pump station, where the closest supply well field is 70 m. - However, there are opportunities for monitoring to see if there are any adverse effects from construction. - Anecdotal evidence that ground disturbances in the area causes turbidity spikes. - Piling/construction work to these depths may create contaminant pathways. - Option 5 has the lowest risk. It is down gradient from the well field, so it is unlikely to affect the well field. The wet well is also not as deep in this area. Questions/Answers/Discussion: Question: From an RMA/affected party point of view, would WWL sign off excavations at that depth in the zone (provided monitoring regimes were in place)? Answer: May be difficult to sign off from WWL and will be heavily scrutinised due to criticality of the water supply and vulnerability to ground disturbance. Additional investigations to show that the confining layer was thicker or the ground conditions were not as assumed then it may be possible.	[redacted]

	Question: If there is a chance that this may be possible, should it still be fatally flawed? Answer: Based on available information, I still consider the options to be fatally flawed. Question: Is there a construction method that could reduce the turbidity/disturbance? Answer: influenced by the wet well sizing (which would need to be shorter but then does not meet standards). Question: Can you stop works in case of turbidity problems and then resume bore operation in a few weeks? Answer: Risk of long term damage so likely not possible. Also, shutting the bores down for a period of weeks is likely not feasible operationally. Question: Is there any construction in the Lower Hutt area that is as deep that we can learn from? Answer: there has been some studies to support this and the high density work. This could be looked into further. Discussion on moving from fatally flawed to a -4 scoring. Flag and re-look at this if Options 4 and 4B would otherwise be in contention.	
7	**Criteria – Property** - As compared to the longlist, the shift to buying private properties has reduced risk, with the exception of option 4. This is mainly attributed to the bowling club (whether they would want to purchase another bowling club within the vicinity). It is an incorporated society, which might influence purchasing ability. If amalgamation with another club does happen then this could be an easier pathway. There is also a risk that if the bowling club were notified of the proposal then it might deter them to amalgamate with another club. - Another risk included the occupational agreements on the public grounds (Hutt Rec), i.e. there would need to be access arrangements etc. - Score for option 4 reflects if they change it to a high-density zoning as pricing per square meter will increase. Discussion around fast track consenting changes and whether the public works act is incorporated into the new fast track legislation (elements of it are, but not all of it). Furthermore, with regards to land acquisition, there hasn't been a history of designating pump stations in the Hutt, so that may set a precedent.	[redacted]
8	**Criteria – Cultural values** - There are no sites of significance in the area (no pā, ūrupa) - There is some evidence to support cultivation around Hutt Rec - Given the above two bullet points Iwi have more alignment with what is best for the ecology. Which option is going to cause the least amount of impact to the river (Te Awa Kairangi). - Anecdotally, people catch eels in the area by opening manhole covers in their backyard. The eels are in the pipes. - In the daylighted areas, you are more likely to find native species. - Trout, whitebait present in the southern areas. Question/Discussion	[redacted]

	Question: What is the likelihood of infiltration of wastewater into the scheme and the flow on effects into the river? Answer: Unknown. Scoring is closely aligned with ecology scoring for now, and noted that ecology scoring didn't consider impact on Te Awa Kairangi (because those effects are considered in the global stormwater consents).	
9	**Criteria – Constructability** Overall, the scoring hasn't changed significantly since the long listing, with very similar constraints. - Constraints include the right people, right gear and right location - A lane will be shut off regardless of diameter of the pipe. - Construction has been based on trenching (worst case) – could be improved through directional drilling or trenchless methods to speed things up. Until you know if you can directionally drill, it is difficult to understand where that can be. - Slow productivity due to the nature of the work (e.g. butt-welding PE pipes together). - Major risk includes the riverbank outlets and rising main levels - Ground improvement scheme has not changed since long list. - ECI period can mitigate many of the constructability risks. - Service clashes + upgrades for WE for the new pump stations. - Discussion on combining hydrogeological score with construction and changing to more novel methods for construction - Resourcing complexities (e.g. the number of crews) discussion – would be known further down the track when you know the programme. Question: Should there be alignment to hydrogeo scores? If we needed to amend construction method based on hydrogeo concerns would that effect your score? Answer: The ground improvement solution doesn't need to be piles, they are just there to spread the load. Therefore, changing the method due to hydrogeological concerns would not change the scoring. Although consent conditions could alter the way things are built, so consent conditions could have an influence on the scoring.	[redacted]
10	**Criteria – Operations** Overall the scores favour the pump stations, and therefore the positive scoring has been reflected in the options. - Pump stations sit on their own sites now (with the exception of Hutt Rec). - Hutt Rec may have issues with access and maintenance, will need to check the Reserve Act for rules about access for operations (but not seen to be a big issue). - Scoring reflects final outcome (and not temporary outlet).	[redacted]

11	**Criteria – Infrastructure resilience and risk** The scoring was based on what happens if something fails and what are we actually trying to achieve. - No major issues through each of the options in terms of failure. - Risk around the temporary outlet structure and if that it doesn't become the permanent one (this can be mitigated through forward planning). - Pumping concept is great for when the river is high. - Risk and resilience for the areas that were intended to be developed – more resilience for Option 1B (as it is at the head of the stream). The risk and uncertainty gets higher as you go downstream, therefore a better chance of delivering the desired outcomes at the upstream end. Question about the basic hydraulics: will development put the head room back where it is now? Answer - The calculated design capacity is higher than the Kāinga Ora capacity requirements.	[redacted]
12	**Criteria – Cost** Scores for this criteria were determined based off formula. Scores across the three formula remained pretty consistent. This type of cost scoring is not unique to this project and has been used in WWL projects before. - Cost of the permanent outlet are built in and so are the property acquisition costs. - Scores were determined by three methods, using formula to see how much each one differs from the median, highest cost etc. - Option 4 is the most expensive so has the highest score. - Total cost shown is P95, not the expected cost (which P50). - Scoring based on cost rather than value. What is the greatest ROI? - Appropriate to have a criteria that considers value for money – this is sitting outside the MCA process. - Need to be clear that these costs are p95 costs rather than total cost. Need to be clear that this relates to costs also to return on investment.	[redacted]
13	**Criteria – Enablement of housing development** Important to note that there is no science into the scoring for enabling housing development. - Council is contracted to support 3500 houses over 12 years – covers the entire Valley Floor but there are strategic reasons why we want to focus on the CBD area. - In the scorer's opinion, the full requirement of 3500 more homes will occur in this wider catchment in 10 years because developers will target opportunities that are economic for them, spread out across the full catchment. - Enabling housing in the context of this project is about enabling additional impervious surfaces without negatively impacting flooding elsewhere. Commercial areas already 100% hardstand therefore it was discounted from the benefits considerations for the purposes of this project. - From a strategic perspective, within the contract there are different housing outcomes being sought – density, public transport, etc - Urban advisory looked at the areas and came back with numbers for density – useful to consider but when you look at the capacity assessment it is more nuanced (e.g fragmentation of land, considering existing dwellings, economic feasibility)	[redacted]

	- Generally speaking each area is broadly similar. Each zone has been zoned High density residential. Indicating council believe it is already appropriate to be developed from an urban planning perspective. - Basically scored on the availability of residential land. Area of residential trunk capacity improvement. - The biggest challenge is the cost of development for developers – cost consideration is relevant to what can feasibly be developed.	
14	**Criteria – Planning and consenting complexity** Planning framework changes since the longlist include: - Plan Change 1 to the Natural Resources plan. Trenching is now not excluded by earthworks and consent could be required if earthworks exceed 3000 m^2 (interpreted as open at once). Unlikely to affect scoring. - HCC proposed plan draft. Unlikely to affect scoring. Being notified later on this year – depends when you apply. Consenting Risk: - Depth of pump station to aquifer and pump stations within Waterloo well field. - Pump stations close to residential dwellings (might get negative resident feedback) - Intake structures within heritage areas (Riddiford Garden) - Pumpstations in Open Space zoning. - Outlet 35 – if it is actioned under the Riverlink consent, it is still a change so will need to go through IGA (in general accordance) assessment, and may require a new consent. - Outlet 24 – May also need new consent if it cannot be done under the Riverlink consents. Discussion: - On the back of the hydrogeology scoring, options 4 and 4b need to be changed to -4. This is due to the consenting risk if WWL does not sign off as an affected party. HCC may end up in a notified/limited notified consent process. This increases the consenting risk significantly. - Although option 4 has more risk items from a planning sense, the weighting of the risk to the Waterloo Wellfield and the consenting risk that that presents is greater that the other risks, and for this reason, both options 4 and 4b score -4.	[redacted]
15	**Discussion, review of results, weightings** - Discussion of the weightings – looking at additional scenarios where we look at the optimistic, pessimistic views. As well as figuring out the tipping point where the costs flip results for Option 1B and 5 (to understand the impact of costs). - Derisking - Combination with WW project discussion. - Is there a more favourable developable area? - Need to take back to HCC to see appetite of risk between Option 1B and 5. - [redacted] to tidy up spreadsheet and tease out other weightings. Board meeting tomorrow afternoon – [redacted] to report back on today's workshop outcomes/discussions. Way forward – board making the decision. Council elect decision going forward. MCA report to go to Council for decisions.	[redacted] All

Appendix W- Outcome of shortlist MCA workshop memorandum

Memorandum

To	[redacted]
From	[redacted] Tonkin & Taylor Ltd
Date	02 May 2024
Subject	Outcome of Shortlist MCA Workshop Memorandum
Reference	1091097.TT.2000.PRW.ME.GV.100.MCA Workshop Outcome

1 Purpose

This memorandum describes the multi-criteria analysis (MCA) shortlist workshop held on 11 April 2024. The outcome of this workshop informed the decision on the preferred option for the Infrastructure Acceleration Fund (IAF) stormwater upgrade for Hutt City Council (HCC). The workshop formed part of the alternatives assessment process to consider the stormwater upgrades shortlist options.

1 Project objectives

The overall objective of IAF stormwater upgrades is to facilitate and enable the construction of up to 3,520 new houses in the Lower Hutt Valley in a manner that meets the terms and conditions of the IAF Funding Agreement.

Initial options testing focused on the suburbs of Boulcott, Hutt Central, and Woburn (the 'Central Hutt Suburbs'). These suburbs border the Opahu Stream, which had been identified by Stantec on behalf of Wellington Water in its 2021 report as the primary source of flooding in the area[1]. Options to reduce flooding in the Opahu Stream catchment were developed through a long list process and were then subject to a shortlist MCA to support the identification of a preferred option. The specific objective through the shortlist process, subject to the overall objective set out above, was to "*create sufficient capacity in the stormwater trunk network to enable 3,520 dwellings on flood-free land, without making flooding worse in other locations*".[2]

2 Shortlist MCA process

3.1 Purpose of MCA

An MCA is commonly applied to infrastructure projects where there are several sites or options to choose between and where there are numerous complex considerations involved. MCA assists in assessing the relative merits and constraints of an option and making the trade-offs between competing matters more transparent. The purpose of the MCA is to rank sites in a robust and

[1] "Waiwhetu Growth – Stormwater Servicing Options", prepared by Stantec for Wellington Water Ltd dated October 2021

[2] For the purpose of this objective, 'flood-free land' means land that is currently flood-free as identified through modelling undertaken for the HCC Water Infrastructure for Growth project.

transparent manner, in order that the process of finding a preferred option can be clearly demonstrated later, including through subsequent Resource Management Act 1991 (RMA) and/or Public Works Act 1981 (PWA) processes.

3.2 Shortlist MCA workshop

The shortlist MCA workshop took place on Thursday 11th April. The purpose of the workshop was to test and confirm scoring for each of the four shortlisted options, being Options 1B, 4, 4B and 5[3].

Option 4B, which was included in the MCA, is a modified version of Option 4 (i.e. with the Riddiford Pump Station removed). This was included to reflect a single pump station option that gives adequate trunk capacity in Opahu Stream between Option 1B in the north and Option 5 further south. This modified version provided for a more comparable version of Option 4 in that like Options 1B and 5, Option 4B comprised one pump station rather than the two pump stations associated with Option 4.

The methodology for criteria development and scoring is set out in the Specialist Briefing Memorandum dated 28 March 2024. Scores were developed prior to the workshop and confirmed at the workshop. The overall score for the options and their relative rank were not shared through the course of the workshop, but rather once the workshop had been completed.

3.3 Results of shortlist MCA

Please refer to **Appendix A** for scoring results. In summary:

- Option 5 emerged as the top ranked option, albeit only marginally ahead of Option 1B (i.e. they were separated by 1 point).
- When the cost criterion was removed from the scoring, Options 1B and 5 were ranked 1=.
- Options 4 and 4B consistently performed poorly in terms of the raw scores as well as the weighted scores. This was primarily due to the risk that the options presented to the integrity of the Hutt Valley Aquifer and effects that construction may have on the turbidity of the Waterloo Wellfield during construction.
- Both these options were considered to potentially be ‘fatally flawed’ in the hydrogeology criteria scoring. To ensure an overall score and ranking for these options was still provided, they were both assigned a placeholder score of -5, rather than ‘F’, for the hydrogeology criteria. It is relevant to note that amending the score up to -4 (which was available in the scoring template) for these two options did not have any impact on the relative ranking of these options from both a raw score and weighted score perspective.
- Option 1B outscored Option 5 by one point in the housing enablement criterion. This scoring was based on the preliminary analysis that Option 1B provided for approximately 40.2 hectares of residential land for development within the 'zone of influence’, whereas Option 5 provided for approximately 29.4 hectares (noting further analysis was undertaken post the workshop).

Only one point separated Options 1B and 5 (noting that excluding the cost criteria meant the options were ranked evenly/the same). Notable differences in scoring between the two options (i.e. >/=2 points) are canvassed in the table below.

[3] Refer Specialist briefing memo dated 28 March 2024.

Criteria	Option 1B	Option 5	Comment
Sustainability	-3	-1	Option 1B scored lower as the option has larger embodied carbon due to the longer length of pipes (gravity inlet and rising main).
Hydrogeology	-2	0	Option 5 has the lowest risk of contamination of aquifer source water as it is down gradient from the Waterloo Wellfield, and the aquifer is deeper in this area. Option 1B was considered far enough upstream of the Waterloo Wellfield for the risks to source water to be manageable.
Risk and Resilience	3	1	Option 1B appears technically sound and results in an area of improvement conducive for residential infill development objectives (reflected in the housing enablement scoring). The temporary outlet proposed by Option 5 poses risk if a permanent solution cannot be sought. A large part of the area of improvement for this option is 100% commercial usage now, so likely more difficult to develop and adapt for climate resilience going forward.

3.4 Weightings

The raw scoring from the MCA workshop was tested against different weightings systems developed prior to the workshop. The exceptions to this are weightings 6 (Project benefit/opportunities) and 7 (Project risk) which were suggested at the workshop and applied immediately after the workshop. One of the weightings was also removed in the final set of weightings applied on the basis that it was a duplication of Weighting 1.

Please refer to **Appendix B** for a breakdown of weighted scoring and results. In summary:

- Weightings 1 - 3 have a broad project objective lens which focus on housing enablement, cost, and cultural considerations (with weightings 2 and 3 applying a different weighting to cost to test the sensitivity of options to this criteria). This weighting system shows that Option 5 performs marginally better than Option 1B. However, when cost is taken out (i.e. weighted zero) then Option 1B performs better and is ranked first. Options 4 and 4B are consistently ranked 3rd and 4th through these weighting systems.
- The RMA weighting (Weighting 4) ranks Option 5 very marginally higher than Option 1B.
- When ecological and cultural effects are prioritised (Weighting 5), then Option 1B is favoured over Option 5.
- Weighting of project benefits and opportunities (Weighting 6) favours Option 1B over Option 5. Conversely, applying a weighting to project risks (Weighting 7) favours Option 5 over Option 1B.
- In the raw scores and with all weightings applied, Option 4 is ranked 4th and Option 4B is ranked 3rd. The only exception to this is Weighting 2 (Overall project outcome weighting with cost zero weighted) where Option 4 (with two pump stations) is ranked 3rd and Option 4B is ranked 4th.

3 Conclusion

The overall ranking and relative merits and constraints of each of the four options subject to this MCA shortlist assessment are summarised above and further detailed in the information accompanying the MCA and the appendices attached to this memorandum. The MCA is a decision support tool; HCC will need to balance several factors in selecting the preferred option.

The MCA process indicates that both Options 1B and 5 have positive attributes and constraints that counterbalance each other to the extent that the two options are more-or-less equal in terms of the raw score and weighting analysis results.

Following the conclusion of the MCA shortlist workshop, and given how closely Options 1B and 5 scored, a more detailed comparison between the two options regarding housing enablement was undertaken. This factor is central to Council's objective of ensuring that new housing actually occurs within a timeframe, and so consideration needs to be given not just to the number of new houses that might notionally be enabled, but to the economic feasibility of development in each of the zones of influence for the stormwater upgrades associated with Options 1B and 5, respectively.

This analysis was undertaken to further inform the HCC decision making process to select the preferred option and is presented in Appendix C. This analysis indicates that Option 1B has notable advantages from a housing enablement perspective.

Taking into consideration the results of the shortlist MCA and this further analysis, the project team has recommended that Option 1B should be the preferred option to take forward for design and consenting.

In view of the project risks associated with Option 1B, particularly the private property acquisition required for the pump station site and potential budget implications of this option, the project team has also recommended that Option 5 be maintained as a back-up option (i.e. if key risks associated with Option 1B are realised).

Attachment A: Shortlist MCA Scoring Table

OPTION	DESCRIPTION	Ecology	Hydro-geology	Sustain-ability	Cultural	Planning & consent complexity	Property	Effects on community	Constructability	Operation of Infrastructure	Risk and resilience	Enablement of housing development	Cost	TOTAL	RANK	[redacted]	RANK WITH OUT COST
1b	**Eastern Hutt School Pump Station with Kings Crescent Interceptor**	-1	-2	-3	-1	-1	-1	-2	-2	3	3	3	-2	**-6**	**2**	[redacted]	**1**
4	**Chilton St James School and Riddiford Gardens (Bowling Club) pump stations**	-2	-5	-4	-2	-4	-3	-3	-3	2	2	4	-4	**-22**	**4**	[redacted]	**4**
4B	**Chilton St James School pump station only**	-2	-5	-2	-2	-4	-1	-2	-2	3	2	3	-2	**-14**	**3**	[redacted]	**3**
5	**Hutt Rec Ground NW pump station with two stream inlets**	-2	0	-1	-2	-2	0	-2	-2	4	1	2	-1	**-5**	**1**	[redacted]	**1**

Attachment B: Shortlist MCA Weighting Results

Weighting 1 - Overall (Project outcome): Proj objective 20% + cost 20%; Cultural 10%
Weighting 2(1B) - Overall with Cost zero weighted
Weighting 3(1C) - Overall with Cost 50% weighted
Weighting 4 - RMA (env & cultural effects, consentability/ policy framework - 60%)
Weighting 5 - Ecol and cultural (60% each)
Weighting 6 - Project benefit/ opportunity (risk + resilience, operation, housing enablement - 20% each)
Weighting 7 - Project risk (Consenting, hydrogeo, constructability, Property - 20% each)

Results

OPTION RANK	Raw	W1	W2	W3	W4	W5	W6	W7
1B	2	2	1	2	2	1	1	2
4	4	4	3	4	4	4	4	4
4B	3	3	4	3	3	3	3	3
5	1	1	2	1	1	2	2	1

Attachment C: Housing Enablement Memo

MEMORANDUM

Date:	16 May 2024
To:	TBC
From:	[redacted], Housing & Development Lead
Subject:	**HOUSING ENABLEMENT – COMPARISON OF OPTION 1B AND 5**

SUMMARY

1. Council has completed a multi-criteria analysis (MCA) for a stormwater project to enable more housing in central Lower Hutt in accordance with the Infrastructure Acceleration Fund (IAF) grant.
2. Two options (Option 1A and Option 5) received similar scores in the MCA. Given the primary purpose of the project is to enable growth, I have been asked to more closely consider the two options form a housing supply perspective.
3. I consider that the key additional consideration is to look more closely at the likelihood of development occurring each area based on economic feasibility. This is consistent with other approaches such as the National Policy Statement on Urban Development. This considers not only the area of land, but feasibility of delivery.
4. There are limited means to consider feasibility and in this regard I have primarily relied on the ratio of improvements to land value (Improvements Ratio) to compare level of existing housing investment in each area. Using that information, I have considered the overall feasible area and number of dwellings enabled. I have also considered additional factors that could further differentiate between the two options: cost effectiveness, area of unbuilt land benefited, and the areas subject to a more permissive building height limit.
5. The outcome of the additional analysis is that Option 1B is superior. The original scoring for the housing enablement criterion for the MCA workshop was Option 1B – 3 and Option 5 – 2. If this further analysis was factored into the scoring, then using

the scoring template this would likely result on a score of 4 for Option 1B i.e. 'Very high / very significant positive effects, benefits or opportunities'.

BACKGROUND

6. I provided a memo on dated 10 April 2024 for the MCA workshop, assessing each option on housing supply.
7. Scoring of the 'housing supply' criterion was based on the overall area of residential land with each option's 'zone of influence' only. The outcomes were:
    a. Option 1b benefited 40.2 ha of residential land, and was scored +3, Option 5 benefited 29.4ha of residential land and was scored +2.
8. It was assumed for the purpose of the initial assessment that "the economic feasibility of re-developing sites in each area are broadly similar". This memo tests that assumption, and provides a more nuanced consideration beyond land area only.
9. In considering the potential for future housing supply, it is relevant to consider the likelihood of private development actually occurring.[1] On a city-wide level the Council undertakes a Housing and Business Capacity Assessment (HBA) to consider the likely feasible development potential.
10. The HBA is a specialist and time-consuming exercise. In lieu of such a modelling exercise, I have obtained high-level data that is indicative of development potential.
11. I have also considered other data that Council has access to that can provide an indication of the benefit from each project from a housing supply perspective.

LAND AREA

12. The 10 April 2024 memo looked at the total residential area of land excluding areas with a mapped flood hazard of 0.05m or more.
13. **The 'Total Residential Area'** determined as follows:
    a. Shapefiles of the area of benefit[2] for the two options were provided by Tonkin & Taylor and were used to select data by Council's GIS team.
    b. All non-residentially zoned land based on the City of Lower Hutt District Plan 2024 were excluded; and
    c. Land with designations (e.g. schools) were excluded.[3]

[1] The vast majority of housing supply is likely to be through private market delivery.
[2] The area that benefits from the potential stormwater upgrade.
[3] I also removed 61 Woburn Road (cemetery) from Option 1B as I consider this to be an outlier as while it is zoned residential, it contains a church and cemetery and is considered unlikely to be developed with housing.

IMPROVEMENT RATIOS

14. The HBA model considers a several variables including evidence and modelling on expected development revenue, likely housing typology and cost calculations including land.[4]
15. Of those variables, the data that is easily available is the land cost and improvement value from Council's rating database.
16. I have considered an **Improvement Ratio**, which is the ratio of the value of improvements relative to the land. A high Improvement Ratio indicates high capital investment in the land. A low Improvement Ratio indicates underutilisation of the land, and therefore better potential for re-development.
17. Of the Total Residential Area, Option 1B has an Improvement Ratio of 0.40 and Option 5 of 0.48. This indicates a greater average development potential in Option 1B, and therefore greater likelihood of development.

TOTAL FEASIBLE AREA AND TOTAL ENABLED UNITS

18. A Total Feasible Area was determined by excluding properties in the Total Residential Area where improvement values are equal to or exceed the land value (i.e. an Improvement Ratio of 1 or more).5 There is no set ratio where a property becomes feasible, but a ratio of 1 is used because at this point a developer purchasing a site is spending more than half of the funds on improvements which would be demolished. I have also tested this with an Improvement Ratio of 0.75 and 1.25.
19. The above methodology is considered to provide a sound basis for estimating housing enablement within the area of benefit of Options 1B and 5. Using the Total Feasible Area, I have considered the potential number of dwellings enabled.
20. To determine the number of residential units enabled, I have applied the permitted activity standards in the District Plan based on the Medium Density Residential Standards (MDRS). The key standard is building coverage, which is 50%. I have then considered development at a medium-density level which I've assumed is 75 square metres per unit at a townhouse typology.

[4] Appendix-2-Regional-Assessment-of-Feasibility-of-Development-Capacity-by-Property-Economics.pdf (wrlc.org.nz)

[5] There are also some properties that were excluded as there is no improvement value on file. This is likely due to new builds that have not been valued yet.

21. The Total Feasible Area and Total Units Enabled are shown in the table below, considering different trigger points for the Improvement Ratio. In each scenario, Option 1B would result in more units being enabled.

	Option 1B		**Option 5**	
	Area	**Units Enabled**	**Area**	**Units Enabled**
Total Feasible (IR <0.75)	49.68	3,312	30.73	2,049
Total Feasible (IR <1)	52.53	3,502	33.12	2,208
Total feasible (IR <1.25)	53.20	3,547	34.91	2,327

COST EFFECTIVENESS

22. By dividing the estimated project cost[6] by the Total Enabled Dwellings I have calculated a cost per Enabled Unit. I have also considered the cost per hectare of residential land and per hectare of feasible land in the table below.

	Option 1B	**Option 5**
Cost per enabled dwelling (IR<1)	[redacted]	[redacted]
Cost per hectare – Total Residential Area	[redacted]	[redacted]
Cost per feasible hectare (IR<1)	[redacted]	[redacted]

23. Option 1B is considered to be preferable as it is more cost effective on a per unit and per hectare basis.

OTHER INDICATORS

Unbuilt Area

24. I have also considered that the provision of stormwater does not necessarily equate to a certain number of dwellings enabled (unlike other infrastructure such as wastewater). Rather, improved stormwater enables additional impervious surfaces. As a further indicator of the enablement of the two options, I have used Council data to outline the **Total Unbuilt Area**, which provides an additional point of comparison.
25. The overall area of unbuilt land in Option 1B is approximately 8.7ha greater and is therefore preferable.

Lot size:

[6] P95 Estimate – Option 1B: $107.4M; Option 5: $76.35M.

26. Larger sites are easier to develop with medium density housing and are less likely to require purchasing multiple sites. I have included below various measures of lot sizes for comparison.
27. The lot size is on average greater in Option 5. However, there are a greater number of potential development sites that are over 800sqm and 1,000sqm in Option 1B. So on balance, I consider that there are more likely to be more potential development sites in the area of Option 1B.

	Option 1B	Option 5
Average lot size	706sqm	914sqm
Lots over 800sqm	194	143
Lots over 1,000sqm	104	56

Height Limit:

28. The residential land in both areas is zoned High Density Residential Zone, but there are precincts that also benefit from a more permissive height limit of 36m. Under the current market conditions, there are unlikely to be any buildings built to 36m in these areas, but the height limit gives an indication of where Council considers additional density to be strategically appropriate. I also consider that obtaining resource consent for higher density developments is likely to be easier in these area.
29. Option 1B has 26.92ha of land in the 36m-height limit area, and Option 5, 21.61ha. Therefore Option 1B is considered to be preferable.

CONCLUSION

30. On each measure considered above, Option 1B would result in a greater enablement of housing. It is also more cost effective.
31. Each of these data points are only an indicator and the volume of supply feasibly enabled will vary from this and will depend on numerous variables. Ultimately, the actual delivery is dependent on the individual site characteristics and the behaviour of the market.
32. Noting that whilst these indicators I have considered may provide a more nuanced analysis, I still consider that the primary factor is the overall land area. In this regard, Option 1B is superior. However, the analysis further emphasises the superiority of Option 1B, and accordingly, if this further analysis was factored into the scoring, then using the scoring template this would likely result on a score of 4 for Option 1B i.e. 'Very high / very significant positive effects, benefits or opportunities'.

APPENDIX

SUMMARY OF FIGURES

	Option 1B	Option 5
Total Residential Land Area	55.45ha	39.94ha
Total Feasible Area (IR<1)	52.53ha	33.12ha
Total Feasible Area (IR<0.75)	49.68ha	30.73ha
Total Feasible Area (IR<1.25)	53.20ha	34.91ha
Total Enabled Dwellings	3,502	2,208
Improvement Ratio	0.40	0.48
Cost per Enabled Unit	[redacted]	[redacted]
Cost per hectare (Total Residential Area)	[redacted]	[redacted]
Cost per feasible hectare	[redacted]	[redacted]
Unbuilt land	35.98ha	27.29ha
Average lot size	705sqm	914sqm
Lots over 800sqm	194	143
Lots over 1,000sqm	104	56
Total area 36m height limit	26.92ha	21.61ha

DETAILED METHOD

Indicator	Method
Total Residential Area	All land parcels in the Council's GIS database within the shapefile area. Exclude any land not zoned residential, or subject to a designation (e.g. schools) Manual exclusion of 61 Woburn Road (cemetery).
Improvement Ratio	Through the ratings data, Council has improvements value and land value. This is based on the QV valuations as of 1 September 2022, except for newly built or subdivided properties, which are valued upon completion.

	The ratio is the sum of the improvements value over the land value.
Total Feasible Area	Total Residential Area excluding parcels with an Improvement Ratio of 1 or more.
Dwellings Enabled	Assumptions: 1. All of the Total Feasible Land is re-developed at the maximum permitted building coverage of 50%. 2. Medium-density development occurs, assuming 75sqm per dwelling for a townhouse typology. (Total Residential Land Area÷2) ÷75
Unbuilt Area	1. Council's GIS database includes building footprints. The footprint area was deducted from the overall parcel area and totalled.

Appendix X- Drawings

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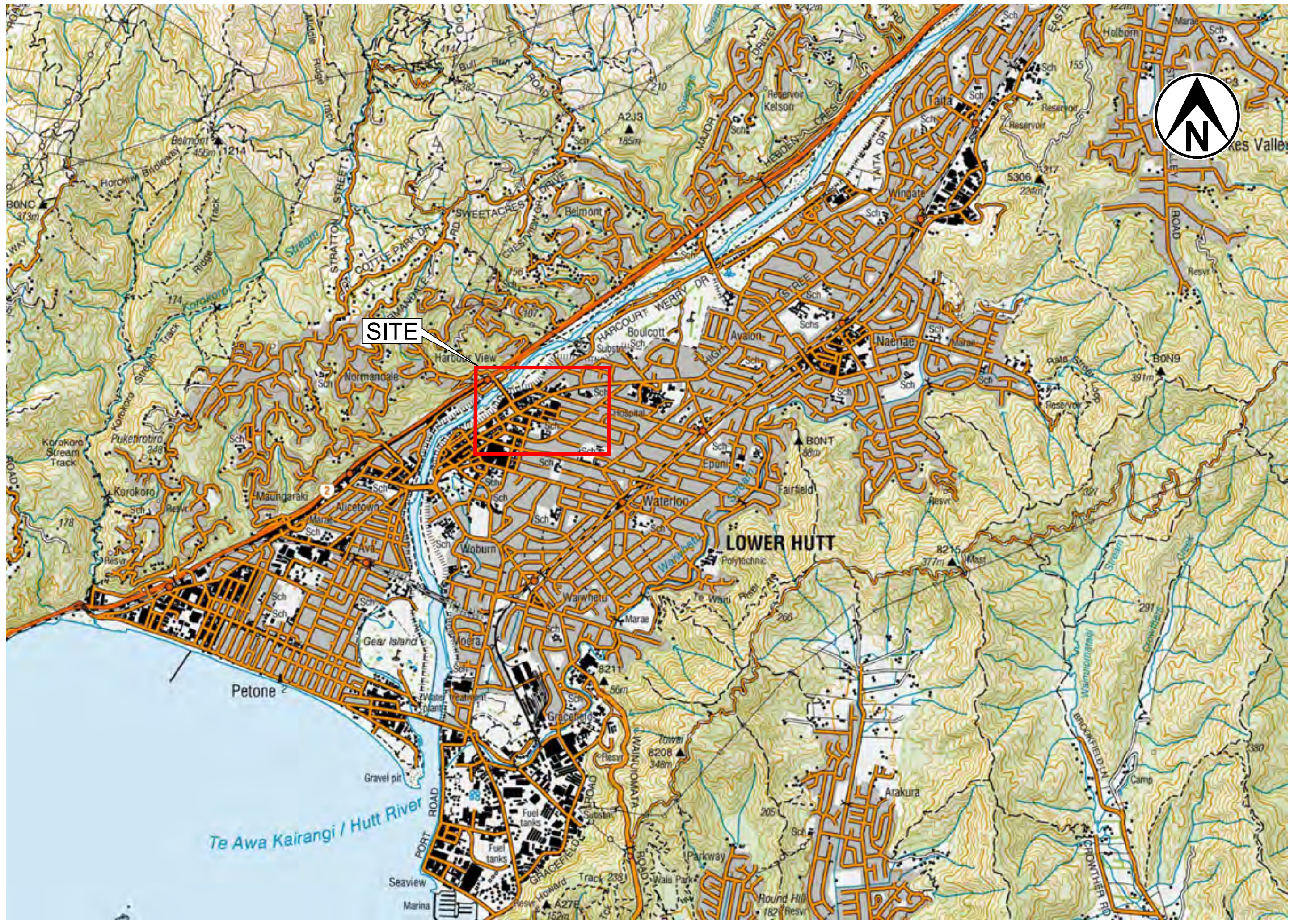
DRAWING LIST

		DRAWING NUMBER	REV	TITLE
		GENERAL		
1	✓	HCC-WIG-DRW-SW-200	1	DRAWING LIST AND LOCATION PLAN
2	✓	HCC-WIG-DRW-SW-201	1	GENERAL NOTES AND LEGEND
		GENERAL ARRANGEMENT (OPTION 1B)		
3	✓	HCC-WIG-DRW-SW-300	1	OVERALL LAYOUT PLAN
		PLAN AND LONGSECTIONS (OPTION 1B)		
4	✓	HCC-WIG-DRW-SW-301	1	PLAN AND LONGSECTIONS-SHEET 01
5	✓	HCC-WIG-DRW-SW-302	1	PLAN AND LONGSECTIONS-SHEET 02
6	✓	HCC-WIG-DRW-SW-303	1	PLAN AND LONGSECTIONS-SHEET 03
7	✓	HCC-WIG-DRW-SW-304	1	PLAN AND LONGSECTIONS-SHEET 04
8	✓	HCC-WIG-DRW-SW-305	1	PLAN AND LONGSECTIONS-SHEET 05
9	✓	HCC-WIG-DRW-SW-306	1	PLAN AND LONGSECTIONS-SHEET 06
10	✓	HCC-WIG-DRW-SW-307	1	PLAN AND LONGSECTIONS-SHEET 07
11	✓	HCC-WIG-DRW-SW-308	1	PLAN AND LONGSECTIONS-SHEET 08
12	✓	HCC-WIG-DRW-SW-309	1	PLAN AND LONGSECTIONS-SHEET 09
13	✓	HCC-WIG-DRW-SW-310	1	PLAN AND LONGSECTIONS-SHEET 10
14	✓	HCC-WIG-DRW-SW-311	1	PLAN AND LONGSECTIONS-SHEET 11
		DETAIL		
15	✓	HCC-WIG-DRW-SW-400	1	STOPBANK PENETRATION JOINT DETAIL
		PUMP STATION BY MOTT MACDONALD		
16	✓	HCC-WIG-DRW-SW-100	P1	OPTION 1B LAYOUT
17	✓	HCC-WIG-DRW-SW-004	P4	SITE LAYOUT; OPTION 1B PUMP STATION (EASTERN HUTT SCHOOL)
18	✓	HCC-WIG-DRW-SW-005	P4	SITE LAYOUT; OPTION 1B INTAKE SITE (EASTERN HUTT SCHOOL)
19	✓	HCC-WIG-DRW-SW-013	P4	TYPICAL PUMP STATION PLAN
20	✓	HCC-WIG-DRW-SW-014	P4	TYPICAL PUMP STATION SECTION
21	✓	HCC-WIG-DRW-SW-015	P4	TYPICAL WEIR SECTION
22	✓	HCC-WIG-DRW-SW-101	P1	OPTION 1B PUMP STATION DIMENSION TABLE
	✓	DENOTES DRAWINGS IN THIS ISSUE: 14/05/2024		



NOTE; TOPOMAP SOURCED FROM LAND INFORMATION NEW ZEALAND DATA (CROWN COPYRIGHT RESERVED)

LOCATION PLAN
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CLIENT **HUTT CITY COUNCIL**
PROJECT **HCC WIG PROGRAMME (STORMWATER)**
TITLE GENERAL
DRAWING LIST AND LOCATION PLAN
DRAFT
SCALE (A1) ASHOWN DWG No. HCC-WIG-DRW-SW-200 REV 1

GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.
2. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016.
4. SOLID WALLED PE PIPE DIAMETERS REFERRED TO BY OUTSIDE DIAMETERS (OD)
5. AERIAL PHOTO AND PROPERTY BOUNDARY SOURCED FROM LAND INFORMATION NEW ZEALAND DATA (CROWN COPYRIGHT RESERVED).
4. SURVEY STORMWATER AND WASTEWATER MANHOLES PROVIDED BY REVEAL DATED 20 DEC 2023.
5. STORMWATER, WASTEWATER AND WATER SOURCED FROM WELLINGTON WATER.
6. SERVICES LOCATIONS AND DEPTHS SHOWN ON THE DRAWINGS ARE INDICATIVE ONLY, UNLESS OTHERWISE NOTED. NOT ALL RELOCATIONS HAVE BEEN IDENTIFIED AND OTHER SERVICES MAY EXIST ON SITE. OVERHEAD LINES ARE NOT SHOWN. CONTRACTOR RESPONSIBLE FOR SERVICE LOCATES PRIOR TO EXCAVATION.
7. SOME EXISTING SERVICES LATERALS ARE NOT SHOWN FOR CLARITY. CONTRACTOR TO RECONNECT ALL IMPACTED LATERALS AS REQUIRED.
8. WELLINGTON WATER GIS DATA, TARGETED MANHOLE AND GPR SURVEYS, AND ESTIMATED PIPE COVER USED TO SET VERTICAL ALIGNMENT. ONLY KEY CROSSING SERVICES ARE SHOWN IN THE LONG SECTIONS.
9. WORKS TO BE IN ACCORDANCE WITH WELLINGTON WATER REGIONAL STANDARD FOR WATER SERVICES DECEMBER 2021 AND REGIONAL SPECIFICATION FOR WATER SERVICES - DECEMBER 2021
10. THE CONTRACTOR IS TO TAKE MEASURES TO PROTECT, RELOCATE OR DIVERT SERVICES AS NECESSARY TO SAFELY COMPLETE THE WORKS.
11. EXCAVATION IN THE VICINITY OF THE OTHER SERVICES TO BE UNDERTAKEN IN ACCORDANCE WITH THE RELEVANT SERVICE AUTHORITY WITH STANDOVER WHERE REQUIRED.
12. PRIOR TO COMMENCEMENT OF WORKS THE CONTRACTOR SHALL CONFIRM ON SITE THE LINES AND LEVELS FOR THE PROPOSED PIPE AND SHALL CONFIRM WITH THE MANUFACTURER THAT THE LINES AND LEVELS TO BE FORMED CAN BE ACHIEVED AND THE CONTRACTOR SHALL PROVIDE SUCH CONFIRMATION TO THE ENGINEER.
13. THE DESIGN AND INSTALLATION MUST COMPLY WITH RELEVANT NZS STANDARDS FOR PE PIPE.
14. FEASIBILITY STAGE DESIGN BASED ON OPEN CUT EXCAVATION. TRENCHLESS METHODOLOGY TO BE EXPLORED AT NEXT STAGES OF DESIGN.
15. PIPE TRENCHING TO BE CONDUCTED IN ACCORDANCE WITH NZS3725 and NZS2566.
16. ALL CONCRETE TO HAVE A MINIMUM CRUSHING STRENGTH OF 27.5MPa AFTER 28-DAYS.

LEGEND

	PROPERTY BOUNDARY
SW	PROPOSED STORMWATER LINE
	PROPOSED STORMWATER MANHOLE
SW	EXISTING STORMWATER LINE
	EXISTING STORMWATER MANHOLE
	EXISTING STORMWATER CATCHPIT
WW	EXISTING WASTEWATER LINE
	EXISTING WASTEWATER MANHOLE
WW	ABANDONED WASTEWATER LINE
WW	WASTEWATER FEASIBILITY DESIGN (HOLMES)
W	EXISTING WATER LINE
W	ABANDONED WATER LINE
CHORUS	EXISTING CHORUS LINE
UG/HV	EXISTING HIGH VOLTAGE ELECTRICAL LINE
UG/LV	EXISTING LOW VOLTAGE ELECTRICAL LINE
FIBRE	EXISTING FIBER ELECTRICAL LINE
DUCT	EXISTING DUCT/TRENCH ELECTRICAL LINE
PWR	ELECTRICAL CABLE NOT IN USE
VODA	EXISTING ONENZ CABLE LINE
FIBRE	EXISTING ONENZ FIBER CABLE LINE
GAS	EXISTING GAS LINE

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PROJECT **HCC WIG PROGRAMME (STORMWATER)**

TITLE GENERAL GENERAL NOTES AND LEGEND

DRAFT

SCALE (A1) AS SHOWN DWG No. HCC-WIG-DRW-SW-201 REV 1

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NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.

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CLIENT: **HUTT CITY COUNCIL**

PROJECT: **HCC WIG PROGRAMME (STORMWATER)**

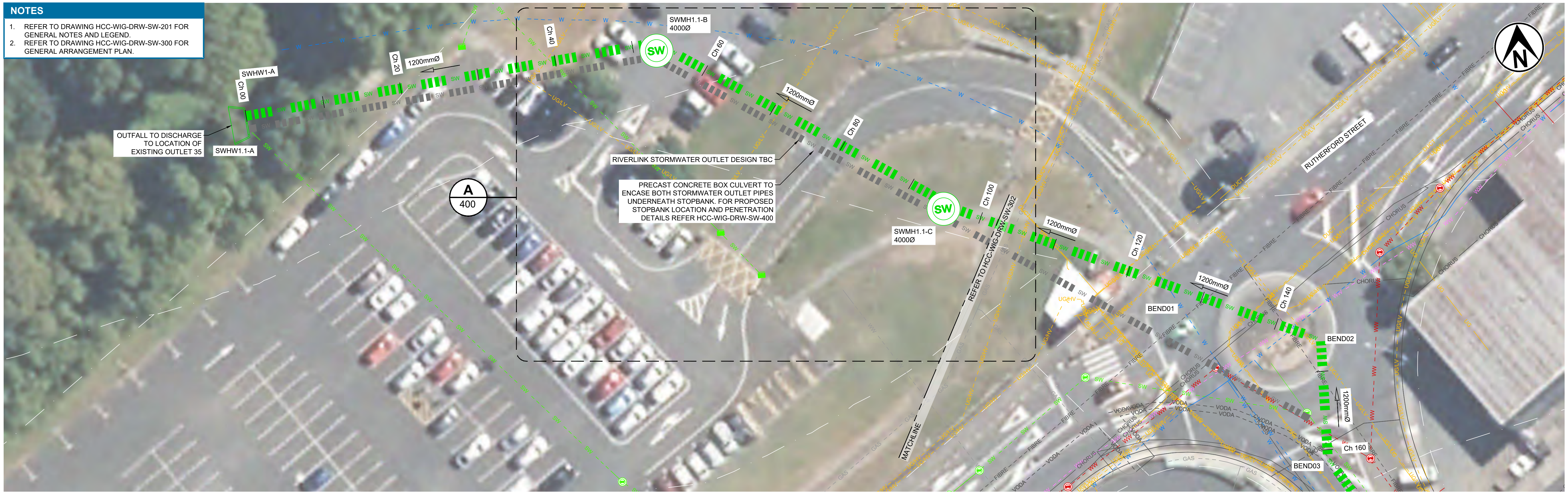
TITLE: GENERAL ARRANGEMENT (OPTION 1B) OVERALL LAYOUT PLAN

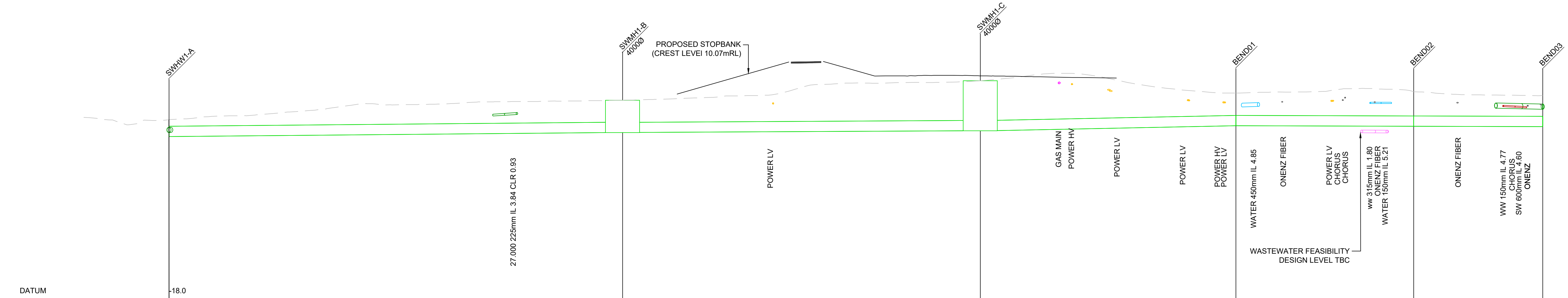
DRAFT

SCALE (A1): 1:2000 DWG No. HCC-WIG-DRW-SW-300 REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





	SWHW1-A		SWMH1-B		SWMH1-C		BEND01		BEND02		BEND03
EXISTING LEVEL (m)	3.32		5.60		7.88		6.45		6.60		6.14
LID LEVEL (m)			5.60		7.88						
INVERT LEVEL (m)	1.34 / 1.34		1.82 / 1.82		2.03 / 2.05		2.62 / 2.62		2.56 / 2.56		2.51
PIPE SIZE / GRADE		PE100 PN16 SDR11 DN1200 @ 0.89%		PE100 PN16 SDR11 DN1200 @ 0.50%		PE100 PN16 SDR11 DN1200 @ 1.90%		PE100 PN16 SDR11 DN1200 @ -0.29%		PE100 PN16 SDR11 DN1200 @ -0.29%	
CHAINAGE (m)	0.00	(53.19m)	53.19	(41.95m)	95.14	(29.98m)	125.12	(20.85m)	145.97	(15.12m)	161.09

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

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TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 01

DRAFT

SCALE (A1): 1:250 DWG No. HCC-WIG-DRW-SW-301 REV 1

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NOTES

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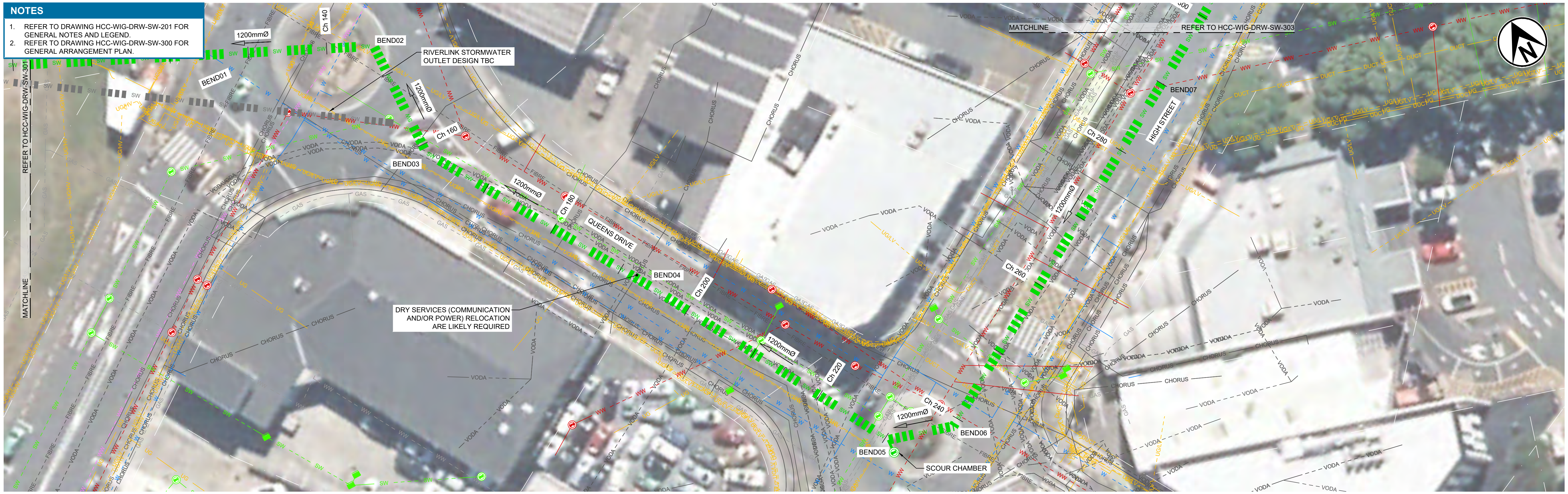
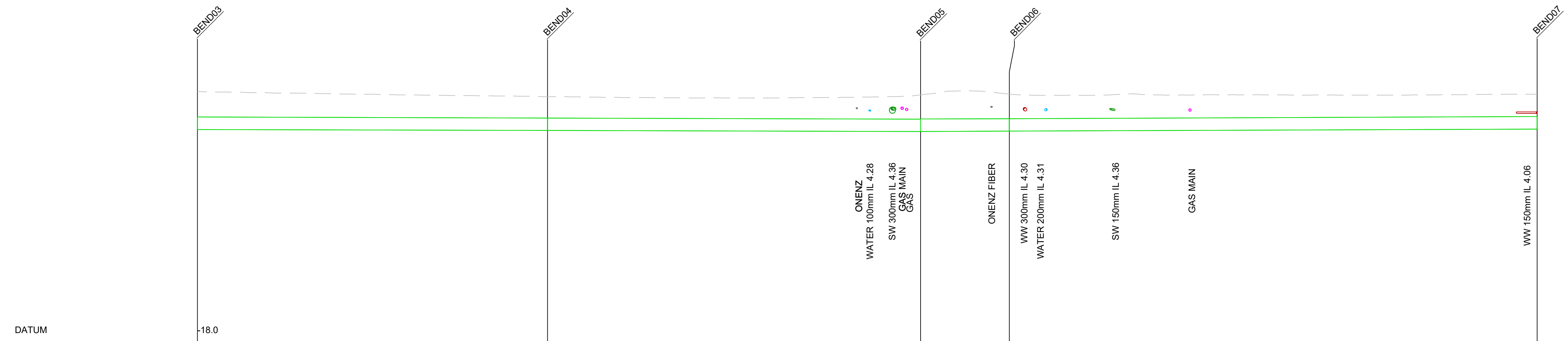
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





	BEND03		BEND04		BEND05		BEND06		BEND07
EXISTING LEVEL (m)	6.14		5.66		5.82		5.91		5.90
LID LEVEL (m)									
INVERT LEVEL (m)	2.51 / 2.51		2.41 / 2.41		2.31 / 2.32		2.35 / 2.35		2.55
PIPE SIZE / GRADE		PE100 PN16 SDR11 DN1200 @ -0.29%		PE100 PN16 SDR11 DN1200 @ -0.29%		PE100 PN16 SDR11 DN1200 @ 0.38%		PE100 PN16 SDR11 DN1200 @ 0.38%	
CHAINAGE (m)	161.09	(33.57m)	194.66	(35.77m)	230.43	(8.50m)	238.93	(50.61m)	289.55

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

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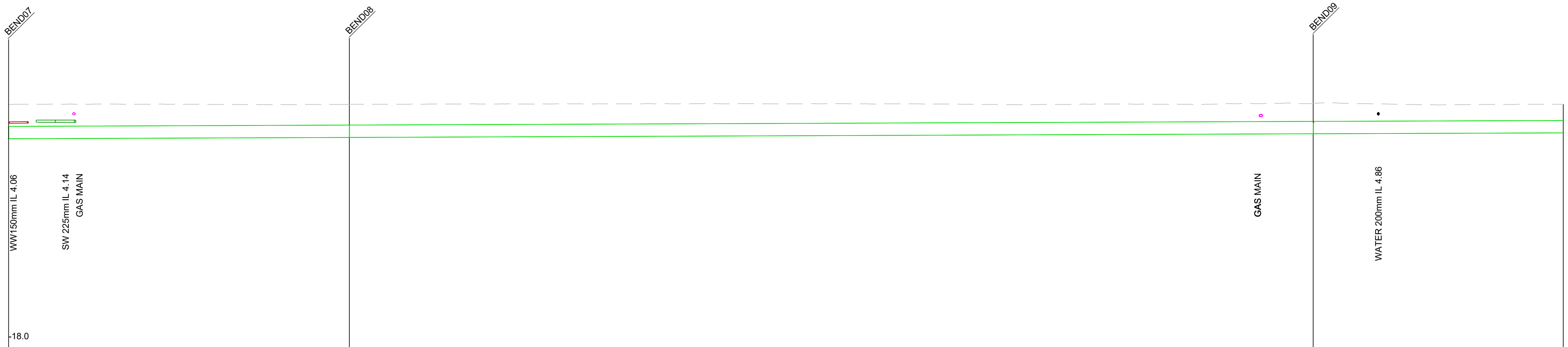
TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 02

DRAFT

SCALE (A1) 1:250   DWG No. HCC-WIG-DRW-SW-302   REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.



EXISTING LEVEL (m)	5.90		5.90		5.99		5.92
LID LEVEL (m)							
INVERT LEVEL (m)	2.55 / 2.55		2.67 / 2.67		3.03 / 3.03		3.13
PIPE SIZE / GRADE		PE100 PN16 SDR11 DN1200 @ 0.38%		PE100 PN16 SDR11 DN1200 @ 0.38%		PE100 PN16 SDR11 DN1200 @ 0.38%	
CHAINAGE (m)	289.55	(33.27m)	322.82	(94.06m)	416.88	(46.17m)	441.28

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

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CLIENT: HUTT CITY COUNCIL
PROJECT: HCC WIG PROGRAMME (STORMWATER)
TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 03

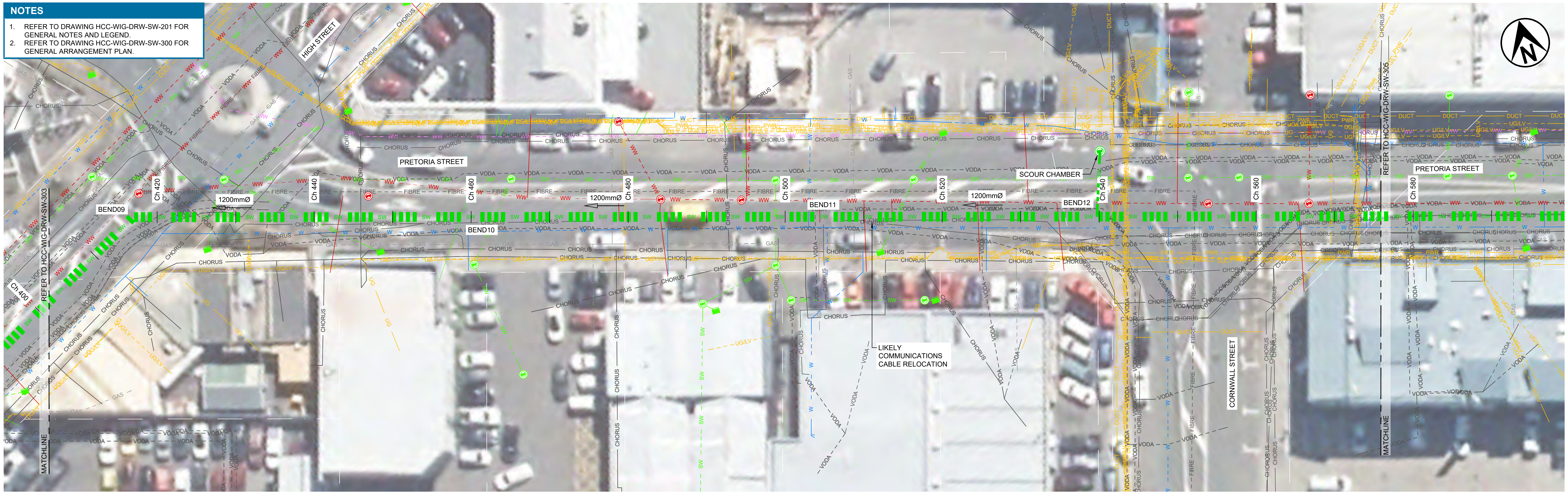
DRAFT

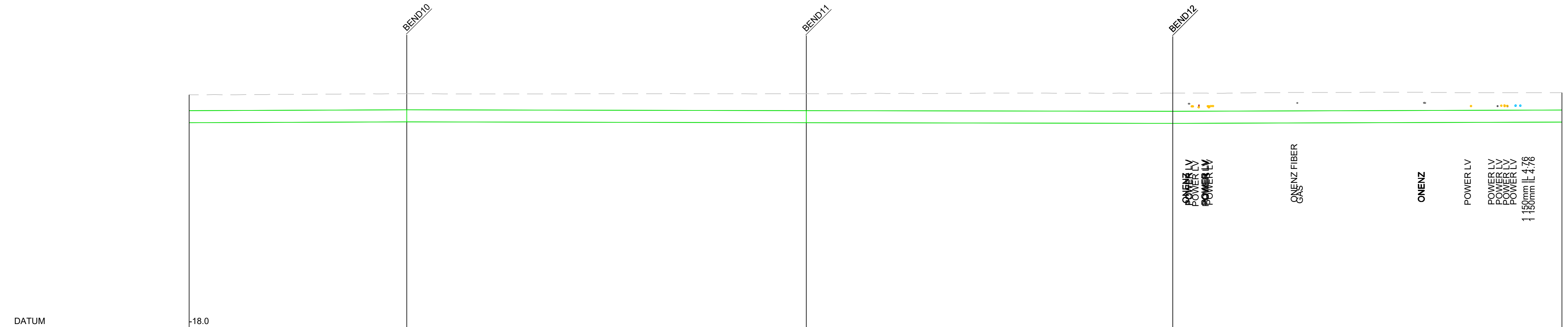
SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-303 REV 1

C:\12dSynergy\data\ALBTCAD\IAF_1425\01_WIP\200_Design\20_Documentation\22_Drawings\HCC-WIG-DRW-SW-301_312.dwg 2024-May-07 10:34:07 pm Plotted By: JC

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





EXISTING LEVEL (m)	5.92		6.02		6.02		6.08	6.13
LID LEVEL (m)								
INVERT LEVEL (m)	3.13 / 3.13		3.21 / 3.21		3.13 / 3.13		3.06 / 3.06	3.19
PIPE SIZE / GRADE		PE100 PN16 SDR11 DN1200 @ 0.38%		PE100 PN16 SDR11 DN1200 @ -0.20%		PE100 PN16 SDR11 DN1200 @ -0.19%	PE100 PN16 SDR11 DN1200 @ 0.33%	
CHAINAGE (m)	441.28	(46.17m)	463.05	(39.98m)	503.03	(36.69m)	539.72 (123.10m)	578.66

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	FOR INTERNAL REVIEW					

DESIGNED	MIME	Apr.24
DRAWN	JC	Apr.24
DESIGN CHECKED		
DRAWING CHECKED		

DRAWING STATUS
PRELIMINARY DRAFT
PROJECT PHASE
FEASIBILITY DESIGN

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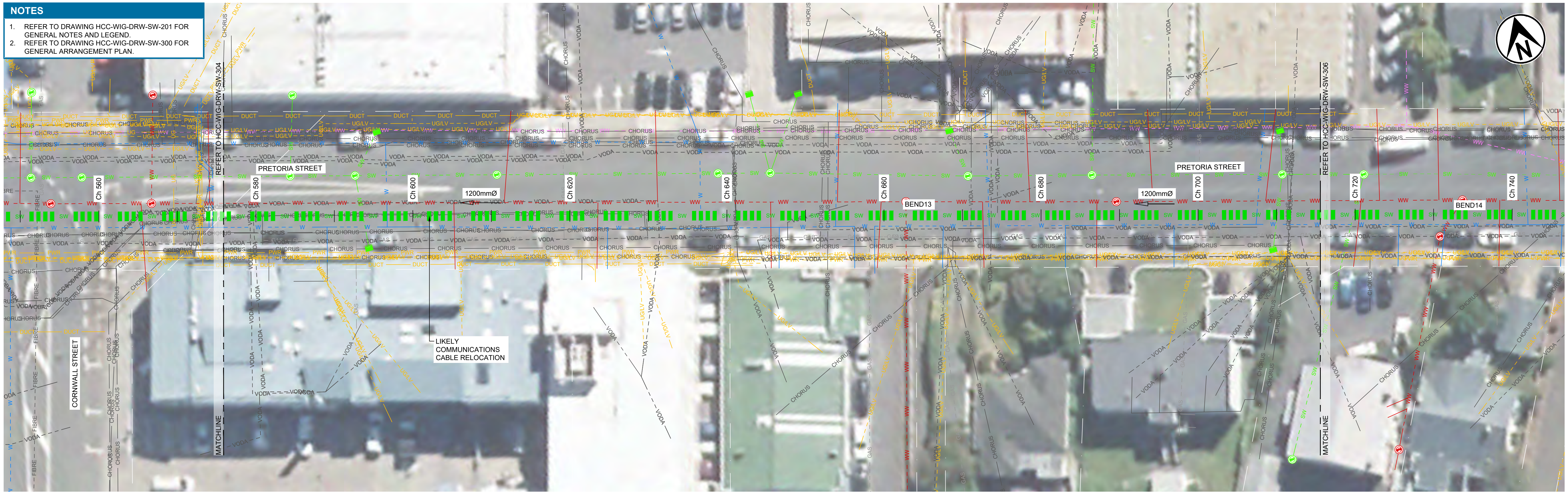
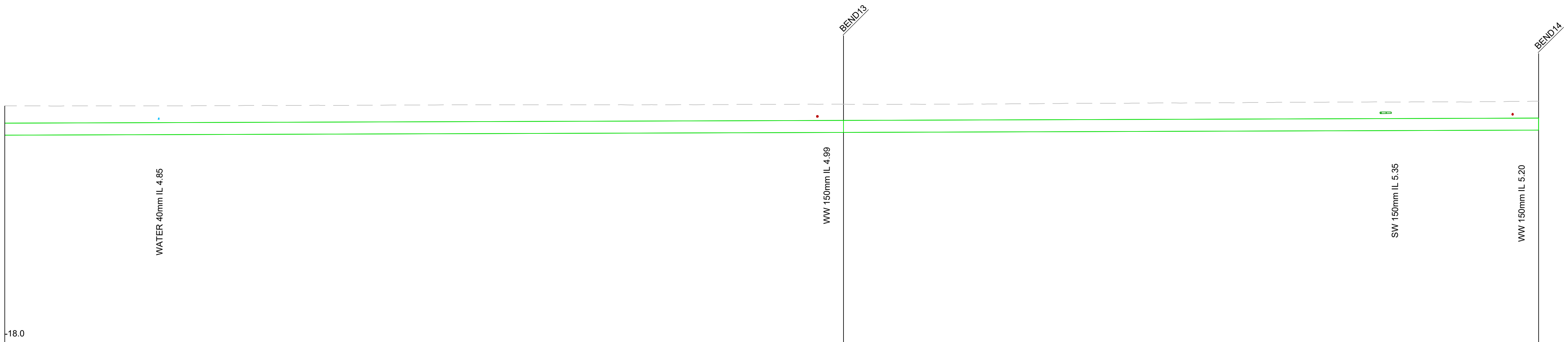
CLIENT HUTT CITY COUNCIL
PROJECT HCC WIG PROGRAMME (STORMWATER)
TITLE PLAN AND LONGSECTIONS (OPTION 1B)
SHEET 04
DRAFT
SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-304 REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





EXISTING LEVEL (m)	6.13	6.29	6.59
LID LEVEL (m)		4.67	4.90
INVERT LEVEL (m)	3.19	3.47 / 3.47	3.70
PIPE SIZE / GRADE	PE100 PN16 SDR11 DN1200 @ 0.33%		PE100 PN16 SDR11 DN1200 @ 0.33%
CHAINAGE (m)	578.66 (123.10m)	662.82 (69.74m)	732.56

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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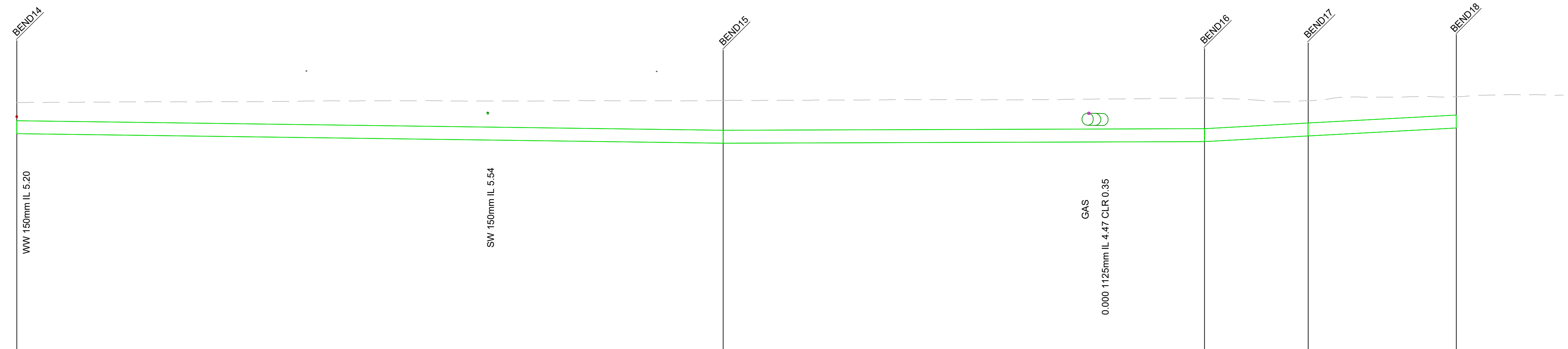
CLIENT **HUTT CITY COUNCIL**
PROJECT **HCC WIG PROGRAMME (STORMWATER)**
TITLE PLAN AND LONGSECTIONS (OPTION 1B) SHEET 05

DRAFT

SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-305 REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.
3. OVERHEAD SERVICES IN VICINITY OF THE PUMP STATION SITE.



DATUM 18.0

	BEND14		BEND15		BEND16		BEND17		BEND18
EXISTING LEVEL (m)	6.59		6.78		7.01		6.76		7.14
LID LEVEL (m)	4.90		4.01		4.15		4.68		5.43
INVERT LEVEL (m)	3.70 / 3.70		2.81 / 2.81		2.95 / 2.95		3.48 / 3.48		4.23
PIPE SIZE / GRADE		PE100 PN16 SDR11 DN1200 @ -1.35%		PE100 PN16 SDR11 DN1200 @ 0.33%		PE100 PN16 SDR11 DN1200 @ 5.43%		PE100 PN16 SDR11 DN1200 @ 5.43%	
CHAINAGE (m)	732.56	(65.92m)	798.49	(44.90m)	843.39	(9.67m)	853.06	(13.84m)	866.89

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

LONGITUDINAL SECTION RISING MAIN LINE 1 ALIGNMENT

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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DRAWING CHECKED		

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PRELIMINARY DRAFT
PROJECT PHASE
FEASIBILITY DESIGN

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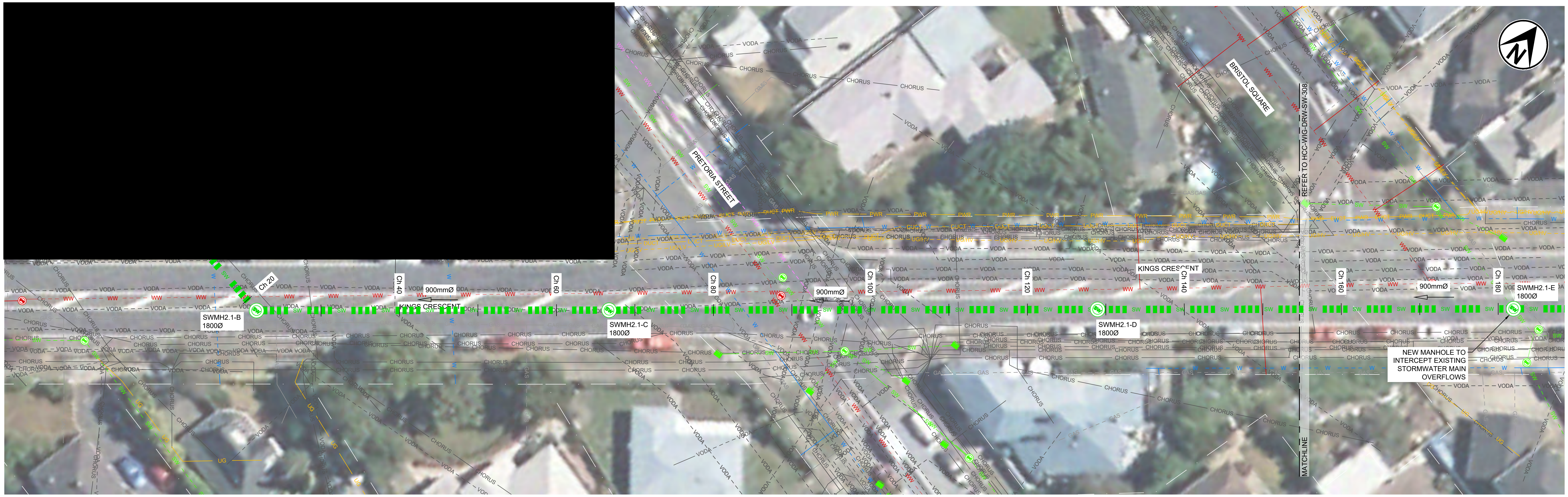
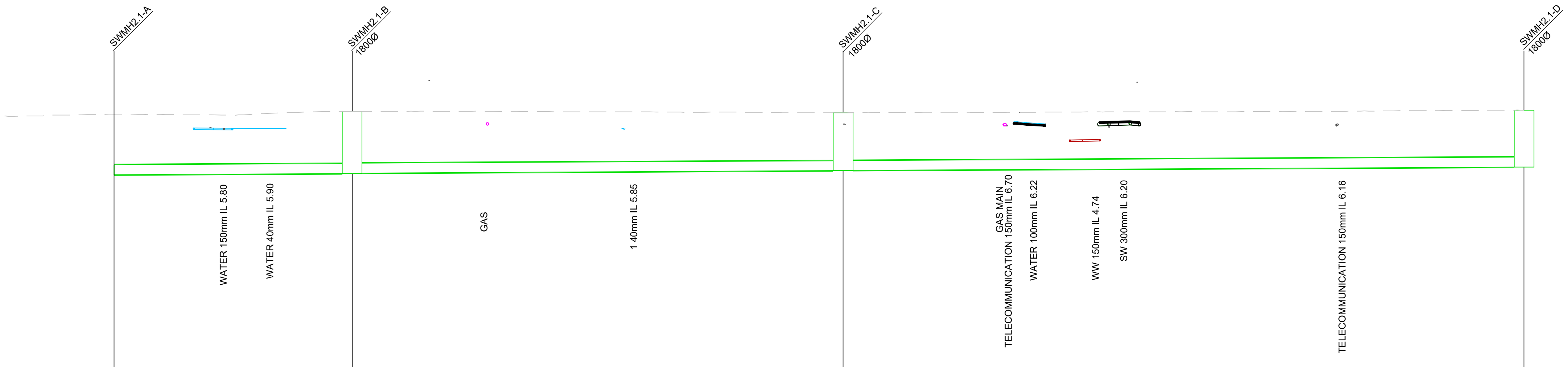
CLIENT **HUTT CITY COUNCIL**
PROJECT **HCC WIG PROGRAMME (STORMWATER)**
TITLE PLAN AND LONGSECTIONS (OPTION 1B) SHEET 06

DRAFT

SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-306 REV 1

[redacted]





DATUM 18.0

	SWMH2.1-A		SWMH2.1-B		SWMH2.1-C		SWMH2.1-D
EXISTING LEVEL (m)	7.17		7.48		7.35		7.58
LID LEVEL (m)	2.59		7.48		7.35		7.58
INVERT LEVEL (m)	1.69 / 1.69		1.79 / 1.83		2.06 / 2.08		2.39
PIPE SIZE / GRADE		RCRRJ CLASS 4 DN900 @ 0.50%		RCRRJ CLASS 4 DN900 @ 0.50%		RCRRJ CLASS 4 DN900 @ 0.50%	
CHAINAGE (m)	0.00	(21.78m)	21.78	(44.90m)	66.68	(62.27m)	128.95

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.1 ALIGNMENT

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	FOR INTERNAL REVIEW					

DESIGNED	MIME	Apr.24
DRAWN	JC	Apr.24
DESIGN CHECKED		
DRAWING CHECKED		

DRAWING STATUS
PRELIMINARY DRAFT
PROJECT PHASE
FEASIBILITY DESIGN

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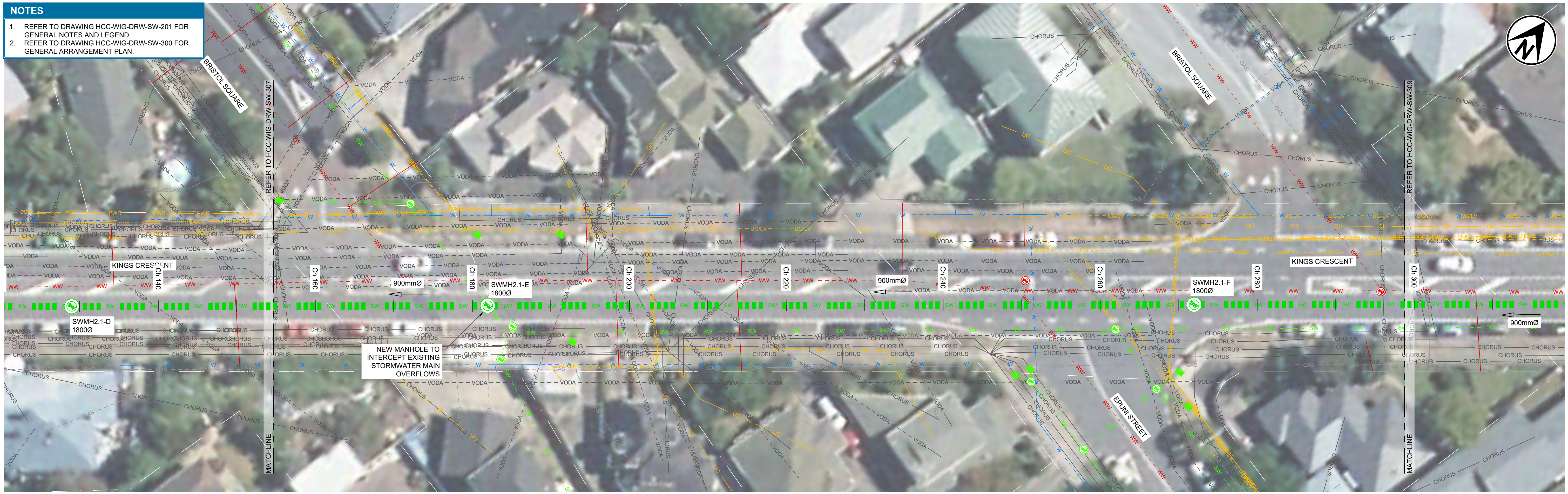
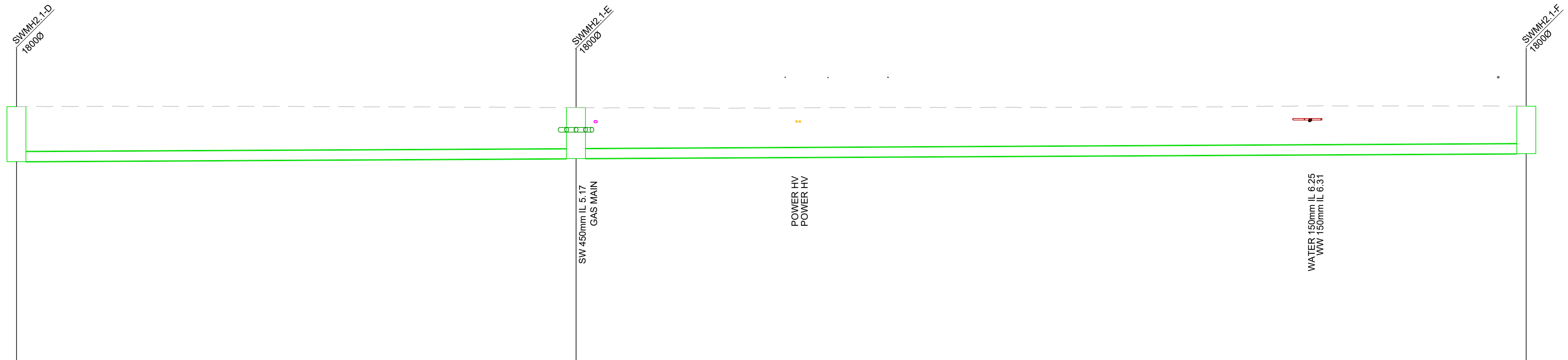
CLIENT HUTT CITY COUNCIL
PROJECT HCC WIG PROGRAMME (STORMWATER)
TITLE PLAN AND LONGSECTIONS (OPTION 1B)
SHEET 07
DRAFT
SCALE (A1) 1:250   DWG No. HCC-WIG-DRW-SW-307   REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





DATUM -18.0

EXISTING LEVEL (m)	7.58 … 7.49 … 7.63
LID LEVEL (m)	7.58 … 7.49 … 7.63
INVERT LEVEL (m)	2.39, 2.41, 2.67 … 2.67, 2.69, 2.67, 3.00, 3.00, 3.01, 3.01, 3.02, 3.02, 3.02, 3.02, 3.03, 3.03, 3.04, 3.04, 3.04, 3.05, 3.05, 3.05, 3.05, 3.06, 3.06, 3.13, 3.13, 3.13, 3.13, 3.14, 3.14 … 3.14
PIPE SIZE / GRADE	RCRRJ CLASS 4 DN900 @ 0.50% ; RCRRJ CLASS 4 DN900 @ 0.50%
CHAINAGE (m)	128.95, 53.00 (53.00m) … 181.95, 0.00, 60.62, 60.62, 63.19, 63.19, 63.91, 63.91, 64.52, 64.52, 67.13, 67.13, 69.05, 69.13, 69.13, 69.53, 69.53, 69.96, 69.96, 73.01, 73.01, 86.60, 86.60, 86.97, 86.97, 87.38, 87.38 (90.00m) … 271.95

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.1 ALIGNMENT

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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PROJECT PHASE: FEASIBILITY DESIGN

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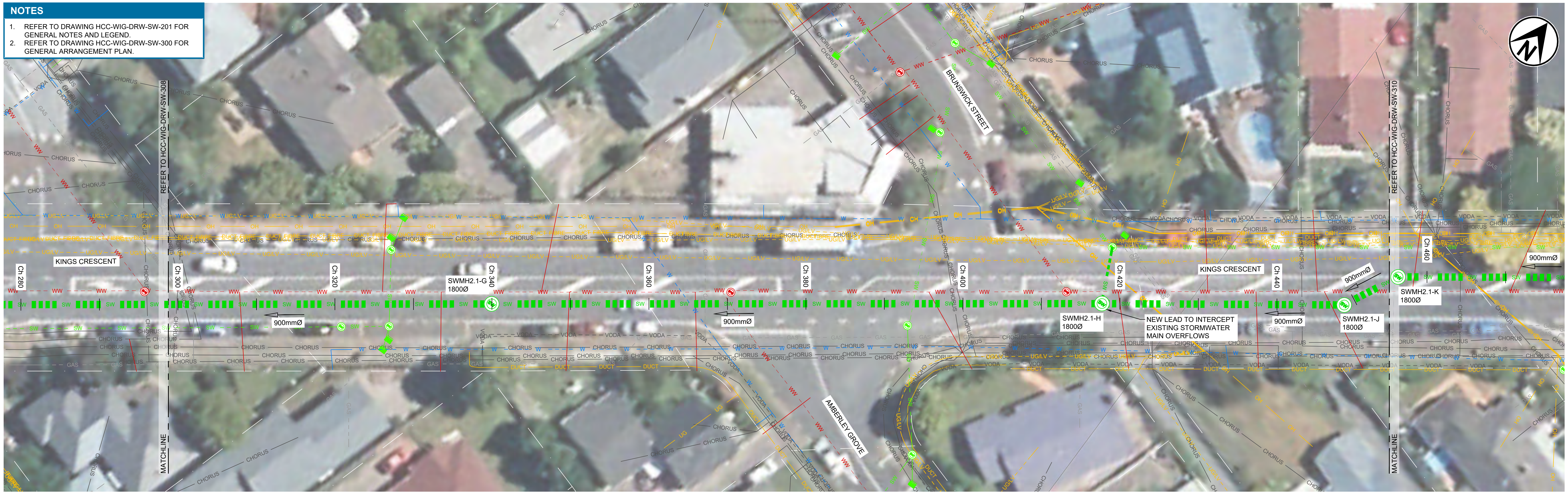
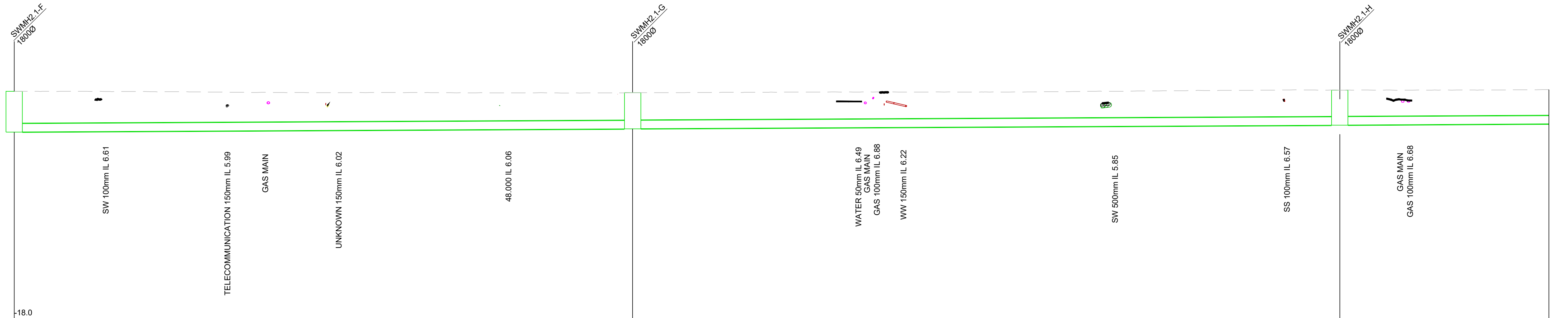
CLIENT: HUTT CITY COUNCIL
PROJECT: HCC WIG PROGRAMME (STORMWATER)
TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 08
DRAFT
SCALE (A1): 1:250
DWG No. HCC-WIG-DRW-SW-308
REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





	SWMH2.1-F		SWMH2.1-G		SWMH2.1-H		End
EXISTING LEVEL (m)	7.63		7.48		7.77		7.82
LID LEVEL (m)	7.63		7.48		7.77		
INVERT LEVEL (m)	3.14 / 3.16		3.50 / 3.52		3.91 / 3.93		4.05
PIPE SIZE / GRADE		RCRRJ CLASS 4 DN900 @ 0.50%		RCRRJ CLASS 4 DN900 @ 0.50%		RCRRJ CLASS 4 DN900 @ 0.50%	
CHAINAGE (m)	271.95	(68.00m)	55.02 / 339.95	(77.75m)	77.68 / 417.70	(30.85m)	440.70

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.1 ALIGNMENT

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
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DRAWN JC Apr.24
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DRAWING STATUS: PRELIMINARY DRAFT
PROJECT PHASE: FEASIBILITY DESIGN

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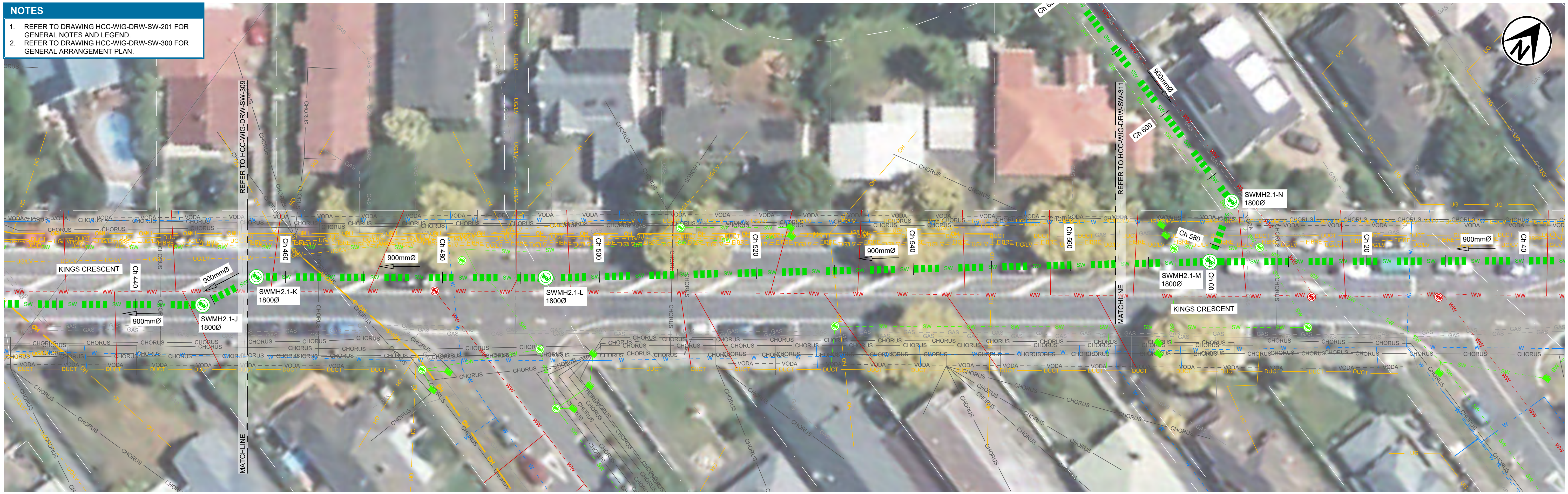
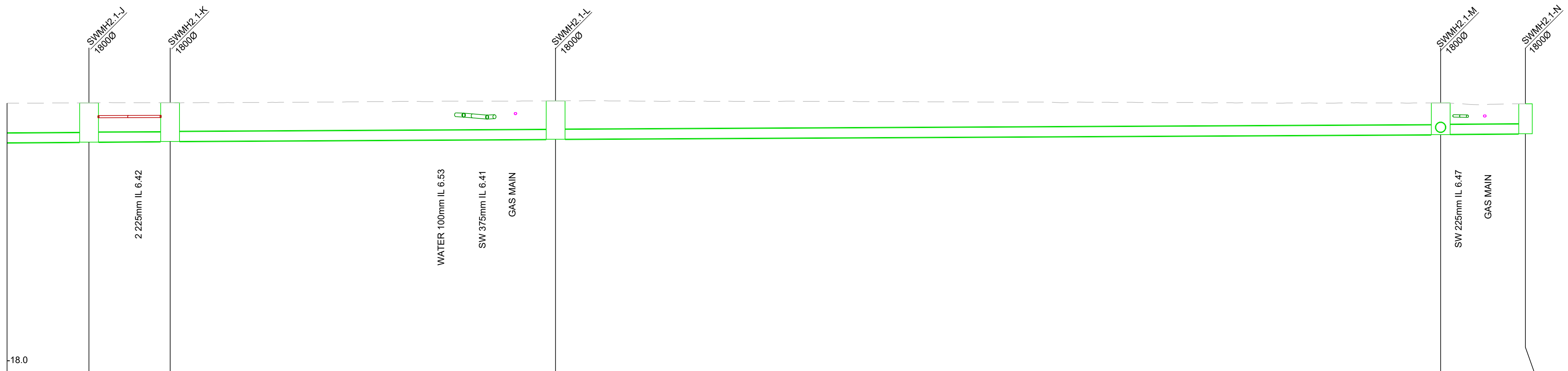
CLIENT: HUTT CITY COUNCIL
PROJECT: HCC WIG PROGRAMME (STORMWATER)
TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 09
DRAFT

SCALE (A1): 1:250
DWG No. HCC-WIG-DRW-SW-309
REV 1

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.





EXISTING LEVEL (m)	7.82	7.84	7.85	8.03	7.84	7.76
LID LEVEL (m)		7.84	7.85	8.03	7.84	7.76
INVERT LEVEL (m)	4.05	4.09 / 4.12	4.16 / 4.19	4.37 / 4.39 / 4.80	4.81 / 4.86	4.90
PIPE SIZE / GRADE	RCRRJ CLASS 4 DN900 @ 0.50%	RCRRJ CLASS 4 DN900 @ 0.50%	RCRRJ CLASS 4 DN900 @ 0.50%	RCRRJ CLASS 4 DN900 @ 0.50%	RCRRJ CLASS 4 DN900 @ 0.50%	
CHAINAGE (m)	440.70 (30.85m)	26.41 / 448.55 (7.75m)	456.30 (36.86m)	493.16 / 80.27 (84.64m)	577.80 (8.11m)	585.91

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.1 ALIGNMENT

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PROJECT PHASE: FEASIBILITY DESIGN

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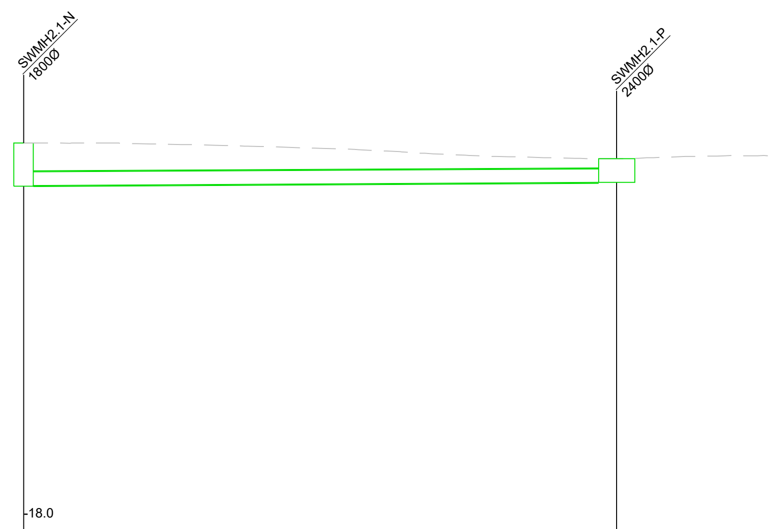
CLIENT: HUTT CITY COUNCIL
PROJECT: HCC WIG PROGRAMME (STORMWATER)
TITLE: PLAN AND LONGSECTIONS (OPTION 1B) SHEET 10

DRAFT

SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-310 REV 1

NOTES

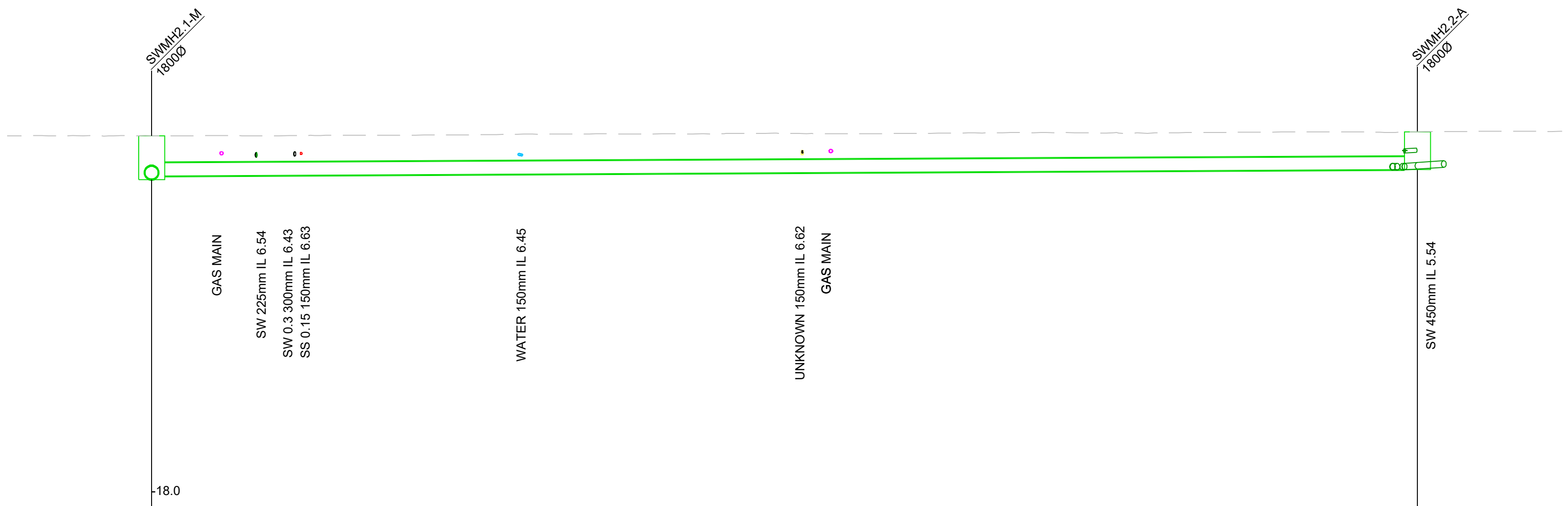
1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. REFER TO DRAWING HCC-WIG-DRW-SW-300 FOR GENERAL ARRANGEMENT PLAN.



	SWMH2.1-N		SWMH2.1-P
EXISTING LEVEL (m)	7.76		6.71
LID LEVEL (m)	7.76		6.71
INVERT LEVEL (m)	4.90 / 4.95		5.15
PIPE SIZE / GRADE		RCRRJ CLASS 4 DN900 @ 0.50%	
CHAINAGE (m)	585.91	(39.25m)	625.16

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.1 ALIGNMENT



	SWMH2.1-M		SWMH2.2-A
EXISTING LEVEL (m)	7.84		8.11
LID LEVEL (m)	7.84		8.11
INVERT LEVEL (m)	4.81 / 5.06		5.50
PIPE SIZE / GRADE		RCRRJ CLASS 4 DN900 @ 0.50%	
CHAINAGE (m)	0.00	(87.55m)	87.55

LONGITUDINAL SECTION GRAVITY MAIN LINE 2.2 ALIGNMENT

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PROJECT PHASE FEASIBILITY DESIGN

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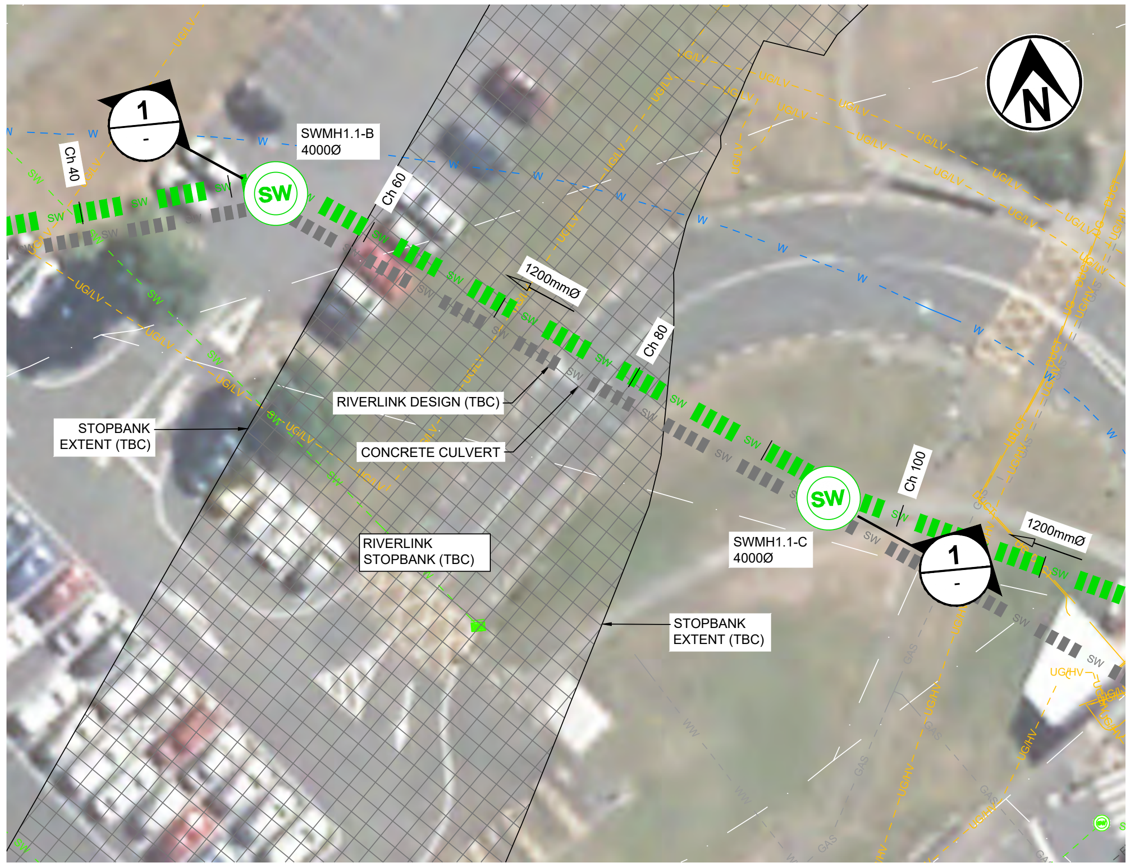
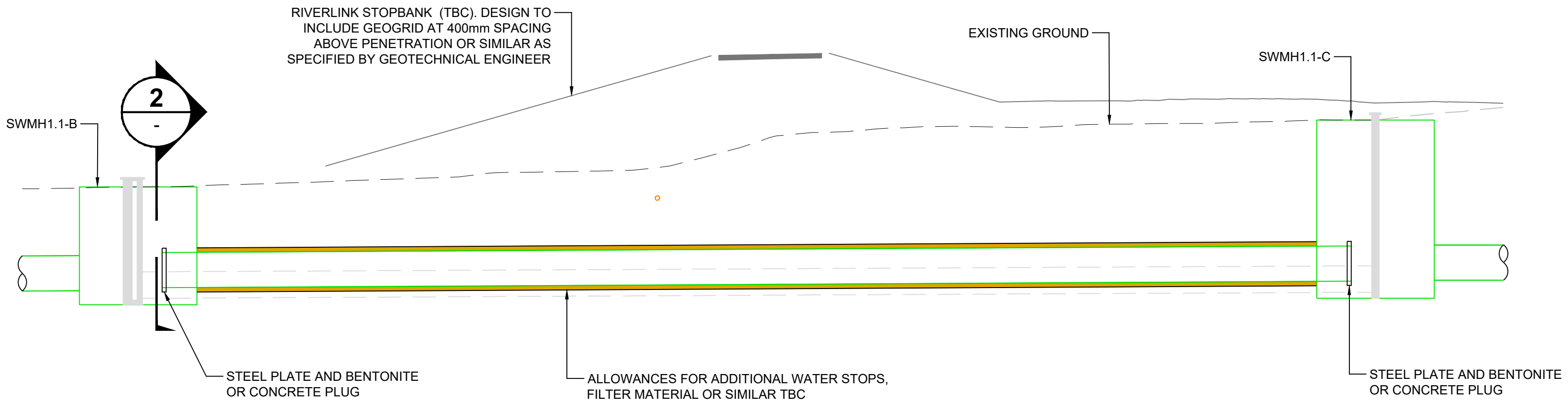
PROJECT HCC WIG PROGRAMME (STORMWATER)
TITLE PLAN AND LONGSECTIONS (OPTION 1B) SHEET 11
DRAFT

SCALE (A1) 1:250 DWG No. HCC-WIG-DRW-SW-311 REV 1



A 301 **PLAN**
SCALE 1:250



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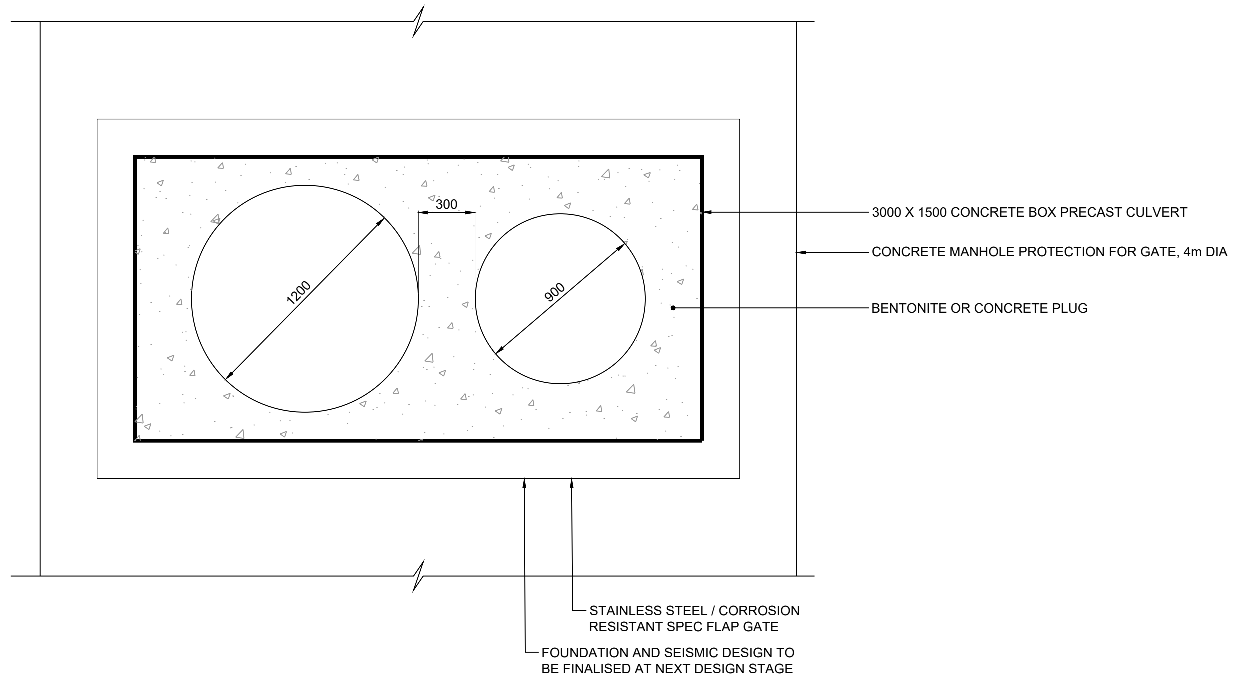
SCALE 1:125



2 - **SECTION**
SCALE 1:20

NOTES

1. REFER TO DRAWING HCC-WIG-DRW-SW-201 FOR GENERAL NOTES AND LEGEND.
2. GROUND INVESTIGATION REQUIRED DURING DETAILED DESIGN.
3. EXCAVATION NEAR STOPBANK TO BE MINIMUM 10m AWAY FROM TOE OF THE STOPBANK.

0 6.25 12.5 m 1:250 (A1) 1:500 (A3)

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PROJECT PHASE
PROJECT PHASE

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CLIENT **HUTT CITY COUNCIL**
PROJECT **HCC WIG PROGRAMME (STORMWATER)**
TITLE DETAIL
STOPBANK PENETRATION JOINT DETAIL
DRAFT
SCALE (A1) AS SHOWN DWG No. HCC-WIG-DRW-SW-400 REV 1

Appendix Y- Stantec modelling summary memo

Opahu Stream Modelling - PCN04

Report

13/05/2024

Ref: 310104084

PREPARED FOR:

[redacted]

Tonkin and Taylor

PREPARED BY:

[redacted]

Stantec

Revision Schedule

Revision No.	Date	Description	Prepared by	Quality Reviewer	Independent Reviewer	Project Manager Final Approval
1	13/05/2024	FINAL	[redacted]	[redacted]	[redacted]	[redacted]
2	17/05/2024	FINAL	[redacted]	[redacted]	[redacted]	[redacted]

Disclaimer

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Stantec has assumed all information received from the client and third parties in the preparation of the report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

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Contents

List of figures

List of Appendices

1. Background

Tonkin and Taylor (T+T) are investigating potential improvements to stormwater conveyance capacity along the Opahu Stream corridor, Hutt City. The Opahu Stream catchment is completely contained within the extent of the Wellington Water (WWL) Eastern Lower Hutt (ELH) stormwater model – as previously developed by Stantec in 2021. As a results, Stantec have been engaged by T+T to undertake hydraulic modelling of proposed upgrades as developed by the T+T design team. Modelling of the proposed T+T proposed upgrades was based on the WWL ELH stormwater model. Assessment by Stantec of the proposed upgrades can be separated into the following key stages:

- Initial Investigation.
- Clustered Stormwater Improvements.
- Preferred Scenario Sensitivity Testing.

These three stages are summarised in the sections below. The initial investigation presentation, summary email, cluster assessment report and T+T cluster modelling instructions are included as appendices.

This differs from the initial scope which is summarised as:

- Assessment of model suitability for longlist options.
- Preparation of a cut down model: WWL ELH stormwater model for Opahu Stream.
- Setup of three shortlist options in the model, followed by two design iterations. Includes provision of GIS outputs of model results, up to 30 model hydrographs and habitable floor GIS information. ***This was modified in PCN01/PCN02 to provide additional modelling and remove habitable floor GIS information from the required deliverables.***
- Draft technical memorandum summarising results. ***This was modified in PCN01 to cover the cluster flood mechanisms.***
- Preferred option and sensitivity assessment. ***No scope change but included in PCN04.***
- Final technical memorandum (this document). ***Reduced scope of the deliverable, covered in PCN04.***

1.1 Key Dates

As Stantec's scope and involvement in the project has seen considerable evolution following initial engagement by T+T. The key dates are as follows:

- 25/9/2023 – Stantec proposal signed by T+T.
- 27/9/2023 – provision of longlist options to Stantec by T+T.
- 9/10/2023 – email summary of model suitability for longlist options from Stantec to T+T.
- 13/10/2023 – confirmation by T+T of shortlist options for modelling.
- 27/10/2023 – results of shortlist options modelling discussion.

- 1/11/2023 – scrum workshop to discuss options pivot following shortlist options results.
- 23/11/2023 – agreement of scope pivot (PCN01).
- 6/12/2023 – provision of cluster locations by T+T to Stantec (PCN01).
- 11/12/2023 – Stantec issue Waterloo Road investigation model deliverables (PCN01).
- 21/12/2023 – Stantec issue cluster investigation report to T+T (PCN01).
- 16/01/2024 – confirmation of modelling instructions for clusters by T+T (PCN01).
- 26/01/2024 – provision of modelling outputs to T+T (PCN01).
- 31/01/2024 – additional modelling instructions provided by T+T (PCN02).
- 28/02/2024 – provision of modelling outputs to T+T (PCN02).
- 17/04/2024 – confirmation of preferred option by T+T (PCN04).
- 22/04/2024 – confirmation of sensitivity criteria by T+T (PCN04).
- 10/05/2024 – provision of summary memo and sensitivity results to T+T (PCN04).

2. Initial Investigation

The initial investigation by Stantec focussed on analysing the seven longlist options provided by T+T. A high-level suitability assessment of these options was prepared by Stantec, as shown in Figure 1. The email provided to T+T and associated assessment material are attached in the appendices.

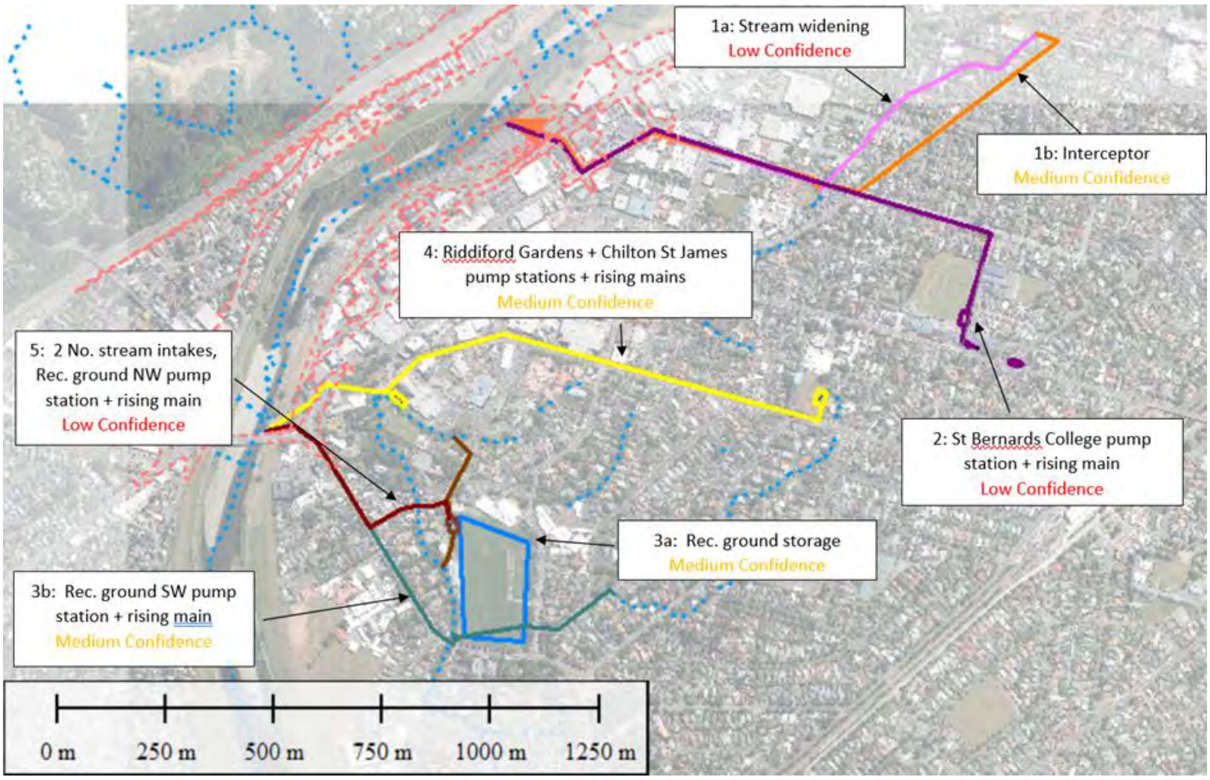


Figure 1: Initial assessment of longlist options as proposed by T+T.

Three of the seven long list options, Options 1B, 4 and 5 were then shortlisted by T+T for hydraulic modelling.

In preparation of receiving these short-listed options, Stantec developed a reduced extent of the full WWL, ELH stormwater model, focusing on the Opahu Stream catchment and predicted area of influence of the options. This extent was bounded to the east and south by the Hutt Valley railway line (Figure 2).

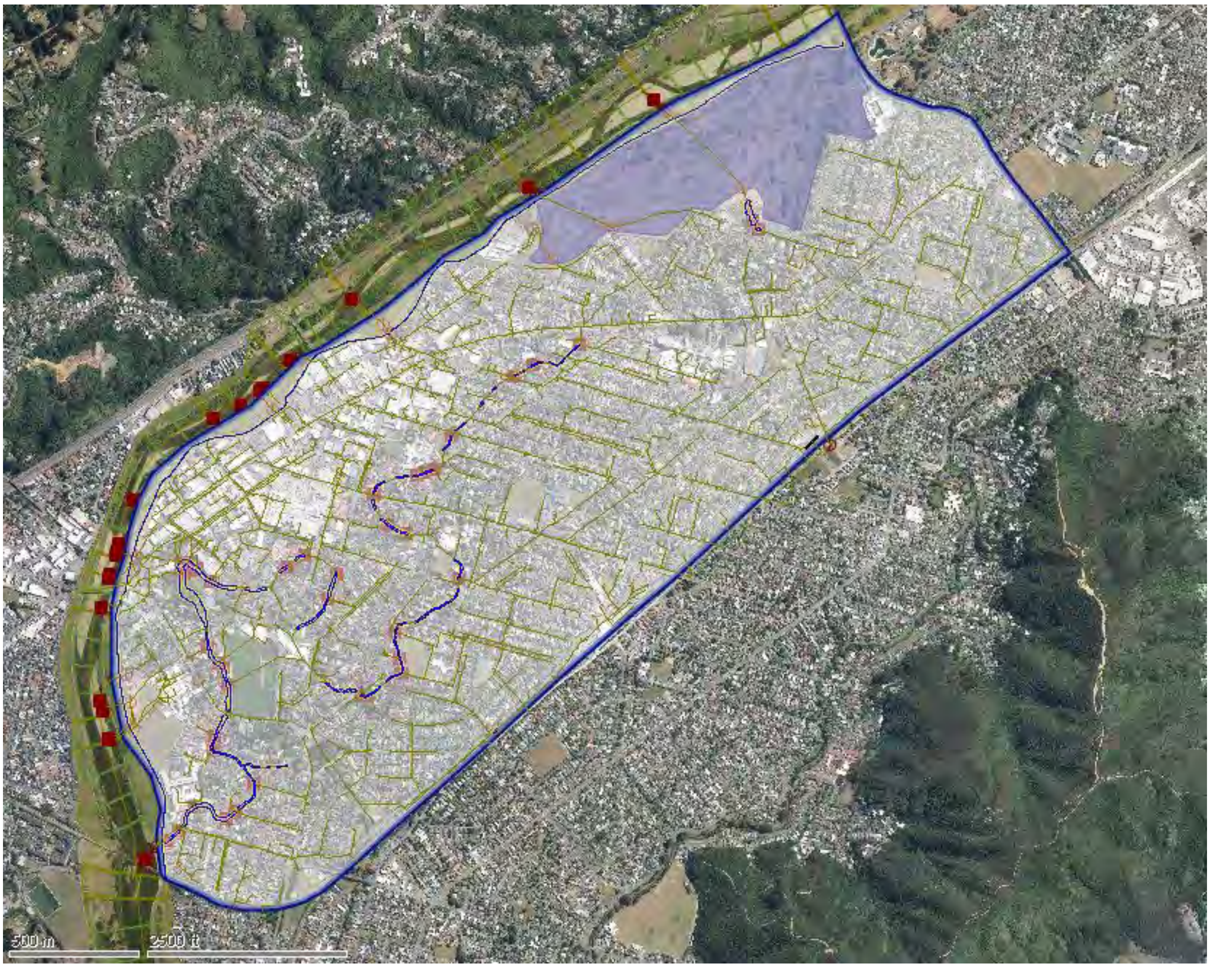


Figure 2: Opahu Stream model extent.

2.1 Shortlist Options

A simplified modelling approach to the pumps and gravity interceptor was selected for the shortlist options. This involved free outfalls connected to orifices set with a limiting discharge. Direct modelling of the gravity interceptor and rising mains was not required by T+T. Limitations are included in Section 0.

Modelling of the shortlist options is summarised as:

- Option 1B (Gravity interceptor and pump)
  - New 1 m^3/s capacity gravity interceptor, modelled assuming an equal flow of 0.25 m^3/s removed from four main connection points between Hutt Hospital and Eastern Hutt School
  - New 2 m^3/s capacity pump station at Eastern Hutt School, modelled assuming:
    - That the gravity interceptor is full (accounts for the first 1m^3/s pumped flow).
    - Second 1 m^3/s removed from the Opahu Stream at Eastern Hutt School.
- Option 4 (2 new pump stations)
  - 3 m^3/s flow removed from Opahu Stream at Knights Road.

-
    - $3\ m^3/s$ flow removed from Opahu Stream at Riddiford Gardens.
- Option 5 (Single pump with 2 inflows)
    - $1.5\ m^3/s$ flow removed from Opahu Stream at Hutt Valley Bowling Club.
    - $1.5\ m^3/s$ flow removed from Opahu Stream at Hutt District Cricket Club.

Modelling results were provided to T+T on the 27/10/2023. T+T interpretation of option benefits led to a follow-up workshop on 1/11/2023 and a redefinition of the modelling scope. This is change was covered by PCN01.

3. Clustered Stormwater Improvements

Following presentation of the initial modelling results for the three shortlisted options, T+T carried out a scope pivot to investigate clusters of stormwater improvements associated with each shortlisted option. The aim of this process was to increase the realised benefit of each shortlisted option. The modified scope was covered by PCN01 and included:

- High level assessment of sump leads upsized to 300mm. Raw results provided to T+T.
- Additional modelling of Waterloo Road to identify the scale of a potential solution using a high-capacity intake. Raw results provided to T+T.
- Investigation of flood mechanisms at each cluster location. Results provided to T+T in a report issued on 21/12/2023 and included in appendices.
- Modelling of proposed solutions as per T+T instructions (included in appendices).
- Provision of raw model results and hydrographs to T+T for assessment.

Additional modelling of the clusters was undertaken by Stantec, with raw results and hydrographs again provided directly to T+T for assessment. This additional scope was covered by PCN02. However, T+T have not progressed further with the cluster-based approach.

4. Preferred Scenario Sensitivity Testing

T+T have indicated that providing additional capacity in Opahu Stream is sufficient for their project goals, reducing the need to demonstrate wider improvements in stormwater network performance.

PCN04 covered the scope for Stantec to finalise the modelling of the preferred shortlist option. This was confirmed between Stantec and T+T by email as Option 1B on 17/04/2024. PCN04 includes sensitivity testing of Option 1B, preparation of this memo and project closeout. No assessment of model results has been undertaken by Stantec. As specified in PCN04, sensitivity scenarios include:

- Option 1B with no climate change (100yr ARI nested design storm).
- Option 1B with climate change sensitivity. 100yr ARI nested design storm uplifted by 20% (as per WWL approach to climate change uplift)[1], and then uplifted by a further 50% as per WWL standard sensitivity approach.
- Option 1B with a failure of the proposed pump near Eastern Hutt School (Figure 3):
  - o To represent the pump failure, while maintaining flow in the gravity main (initially modelled as controlled outfalls abstracting flow from the model), flow is conveyed directly to the Opahu Stream at Eastern Hutt School via newly added weirs.
  - o The 1 m^3/s flow abstraction at Eastern Hutt School was also removed.

Figure 3: Option 1B pump failure scenario. Direct connection from gravity interceptor locations to the Opahu Stream are shown in light blue.

This conservative approach was discussed with T+T and does not reflect practical design considerations for connecting the gravity interceptor to the proposed 2 m^3/s capacity pump station at Eastern Hutt School.

Raw model sensitivity results have been provided to T+T for assessment. Base results refer to Option 1B including climate change (RCP8.5 2100).

1. Reference Guide for Design Storm Hydrology, Wellington Water Limited (2023)

5. Model Limitations

Modelling limitations are summarised as follows:

- The Opahu Stream in the ELH model was developed without the support of survey data. All cross-sections of the Opahu Stream in the ELH model were automatically generated based on the ground model or site visit observations.
- The Opahu Stream has an approximate total length of 5,400m in the model, of which ~30% are modelled culverts and ~70% open channel i.e., the channel is heavily culverted in this area.
- The Manning's n value of the open channel sections is split into two categories. 20% has values of 0.03 n, and the other 80% values of 0.045 n. Therefore, the roughness of the channel has not been optimized beyond the initial model build assumptions.
- A comparison between the modelled open channel cross-section profile and ground model level (LiDAR flown 2019) revealed that the modelled levels were almost always below the LiDAR levels. It is therefore likely that the capacity of the stream is overestimated.
- Only a small portion of model data have "ABM" or "SITE" flags (As built information and measured on site values respectively). In the case of culvert widths (used for determining the capacity of the crossings), only 18% originate from measured data.
- Modelling of Option 1B does not include the gravity interceptor, rather, it assumes removal of 0.25m^3/s from four locations in the stormwater network to represent its impact. It is assumed that it can be designed to capture and deliver 1 m^3/s to the site of the proposed pump station at Eastern Hutt School. In addition, the proposed pump station has been modelled as a fixed 1 m^3/s abstraction and does not consider any pump curve. It is recommended that prior to construction, a more complete hydraulic representation of the proposed solution is developed.
- The approach to the Option 1B pump failure sensitivity scenario is conservative and assumes instantaneous and lossless conveyance along the gravity interceptor to Eastern Hutt School. It is recommended that this sensitivity assessment is repeated should a more complete hydraulic representation of the solution be developed.

Appendices

Appendix A Summary Email of Model Suitability

[redacted]

From: [redacted]
Sent: Monday, 9 October 2023 5:27 pm
To: [redacted]
Cc: [redacted]
Subject: Opahu Stream Stormwater Modelling Project - Email Summary of Model Suitability Review
Attachments: Opahu Stream Model Review Memo 231009.pdf

[redacted]

We have pulled together a summary of the points that were discussed at our meeting last week. Relevant screenshots and discussion points can be found in the attachment.

In summary:

- The existing Easten Lower Hutt (ELH) model includes most of the Lower Hutt township including the entire Opahu Stream. As discussed, the model will be trimmed down to cover a smaller area to enable faster runtimes. This cut-down model will be used in all the remaining modelling work for the options. We are currently working on this, aiming to have completed by Thursday this week.

- The Opahu Stream in the ELH model was developed without the support of survey data. All cross-sections of the Opahu Stream in the ELH model were automatically generated based on the ground model, bar a few cross-sections that were updated from site visit investigations and observations (but not from measured survey).

- The Opahu Stream has an approximate total length of 5,400m in the model, of which ~30% are modelled culverts and ~70% open channel i.e., the channel is heavily culverted in this area.

- The Opahu Stream has two distinct shapes in the ELH model: 40% of the open channel length has been represented with a rectangular shape with steep side slopes, and the remaining 60% with a 'V'-like shape channel. The rectangular sections follow site observations, whilst the 'V'-like shape is a default shape from UMM (the model construction tool used by WWL) which was automatically generated as part of the model build process. Further analysis from previous site walkovers and aerial imagery shows that the channel is mostly rectangular. Thus, we have a higher confidence in the rectangular shaped sections in the model.

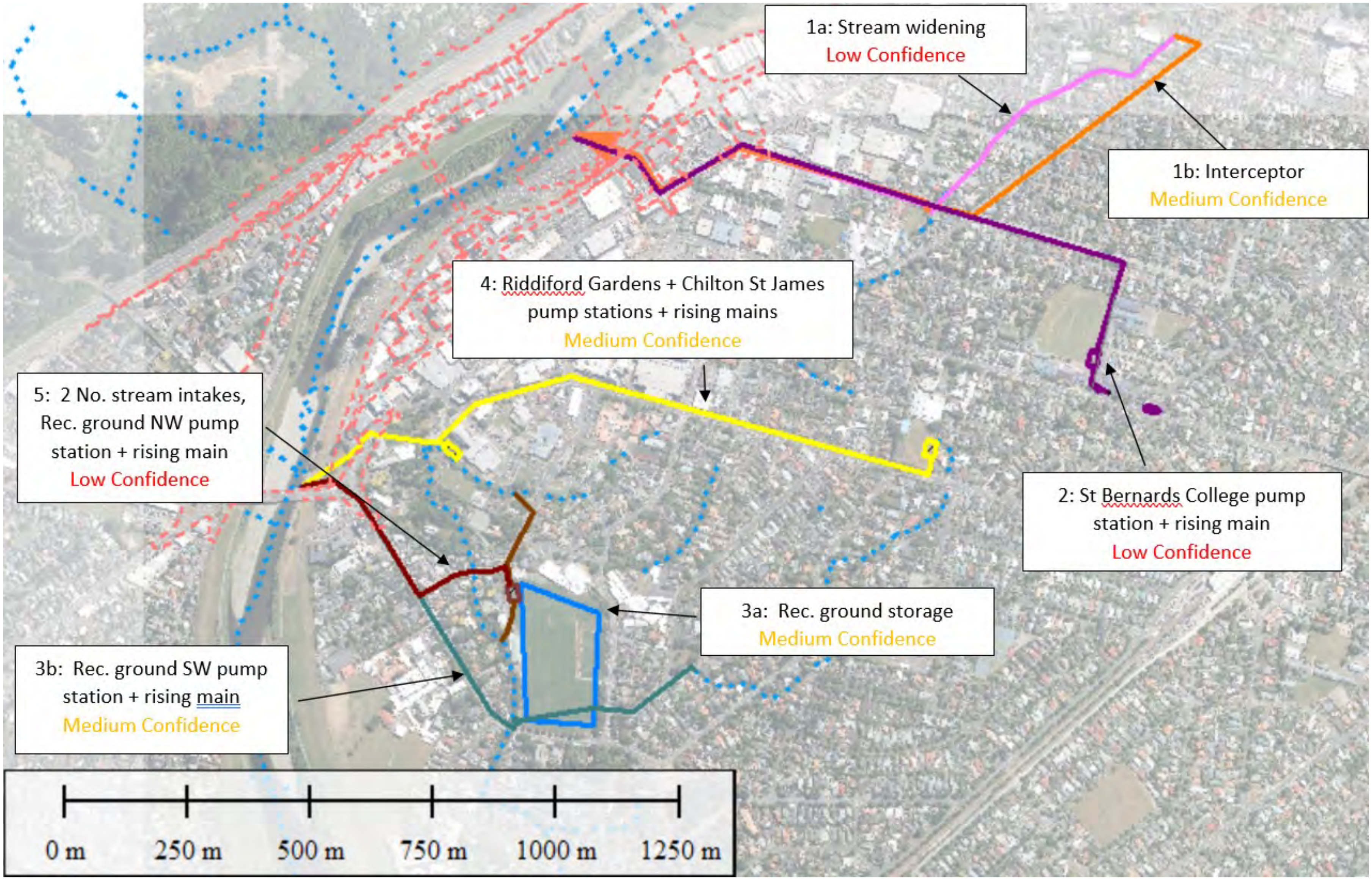
- The manning's n value of the open channel sections is also split into two categories. 20% has values of 0.03 n, and the other 80% values of 0.045 n. Thus, the roughness of the channel has not been optimized beyond the initial model build assumptions.

- A comparison between the modelled open channel cross-section profile and ground model level (LiDAR flown 2019) revealed that the modelled levels were almost always below the LiDAR levels. This difference is caused by the automated channel build process where the channel shape is "burned" into the terrain to try to pick up the bed under the water. As a shallow 'V'-like shape was used instead of a smaller cross-sectional rectangle, it is more likely the capacity of the stream is overestimated than underestimated.

- Various data sources were used in the model construction. Sources include from GIS database (moderate confidence), engineering judgement, interpolated information, and default values (low confidence). Most of the information is of a lower confidence. Only a small portion of data have "ABM" or "SITE" flags (As built information and measured on site respectively) which would generally give “higher” confidence values. In the case of culvert widths (used for determining the capacity of the crossings), only 18% originate from measured data.

- The option of reducing ground surface elevation for Option 2 is feasible in the model but the change may be too small to show any meaningful results.

- A high confidence score was not given to any of the options as we have limited confidence that the Opahu Stream is represented well in the model. Thus, the flow rates along the stream may be offset from reality. However, certain areas (and therefore options) had higher confidence values than others e.g., 1b, 3a, 3b, and 4.



Could you please confirm via reply that you are satisfied with the model review and limitations presented, and that we will be progressing to the options shortlist with no further model modifications or inclusion of additional survey data at this stage?

Kind regards,

[redacted]

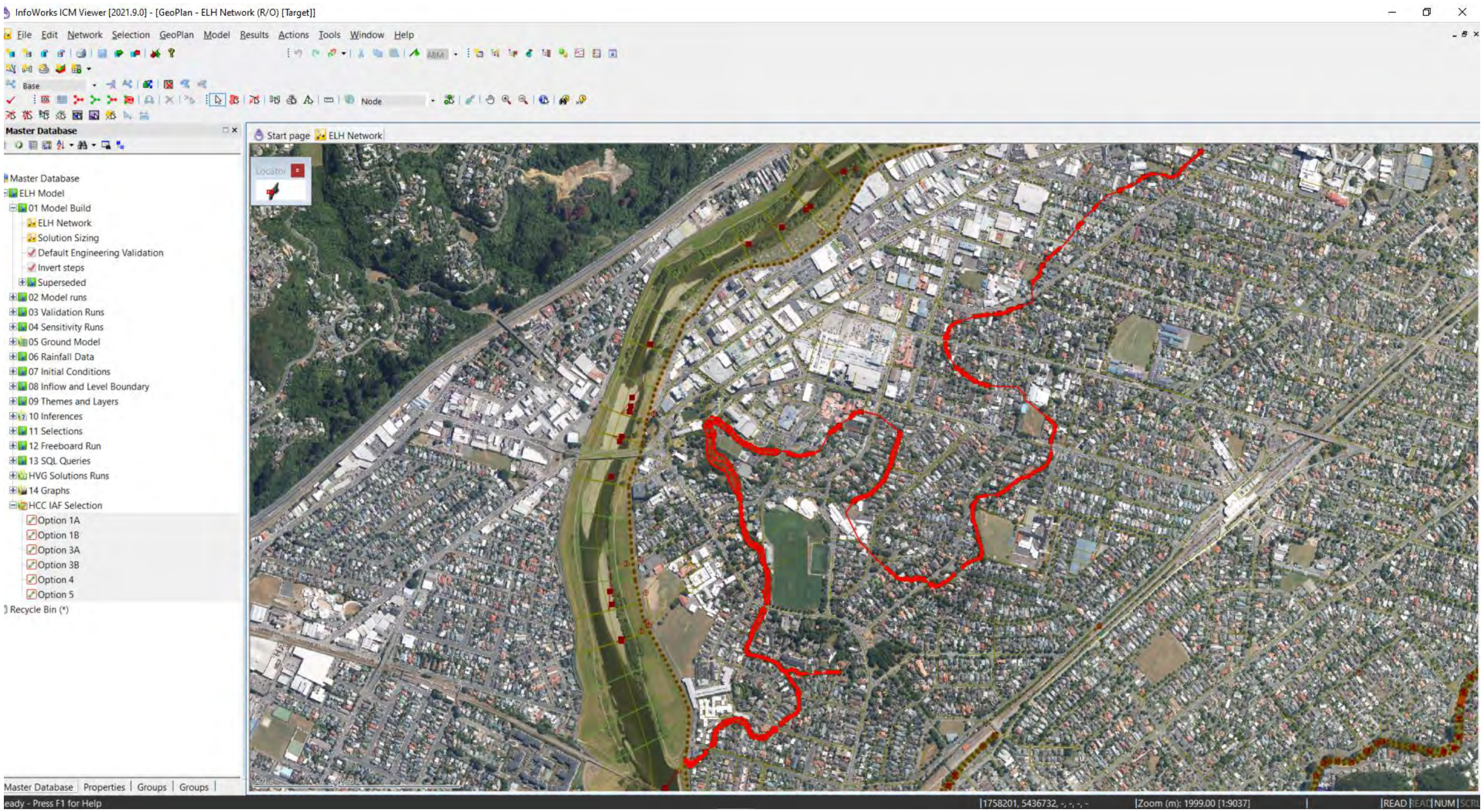
[redacted]

[redacted]

Stantec New Zealand
Level 15, 10 Brandon Street
Wellington Central, Wellington 6011 New Zealand

Appendix B Model Suitability Presentation

Opahu Stream



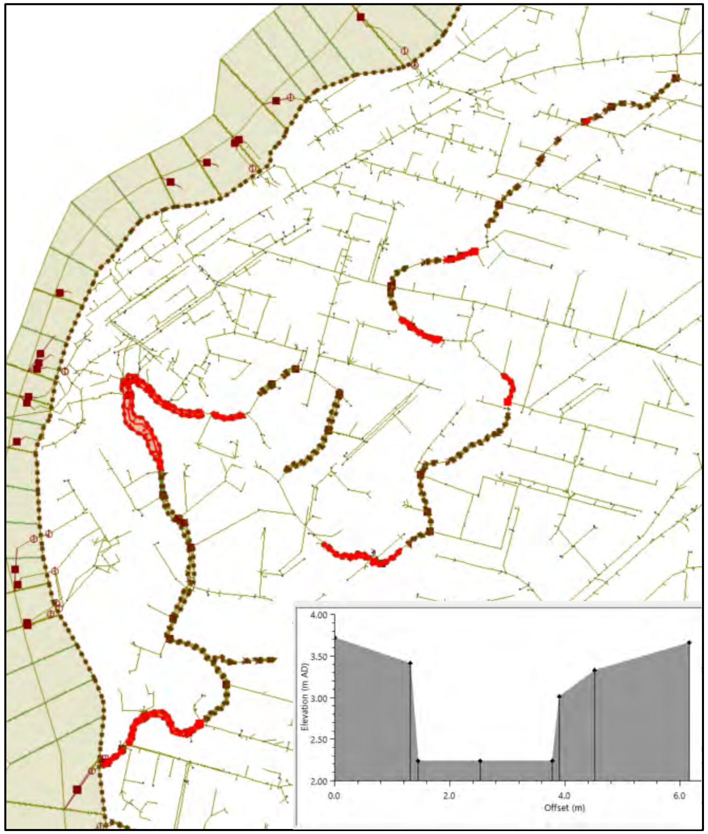
Opahu Stream
5300m

Culvert
1600m 30%

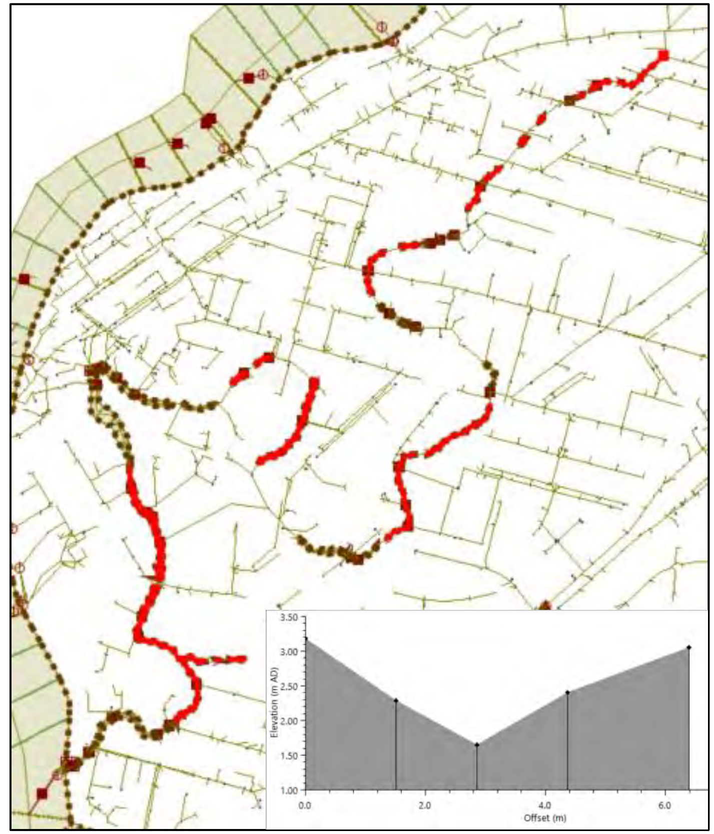
Open Channel
3700m 70%

The entire Opahu Stream model was developed without the any support of survey data. Most of the channel is modelled as a generic ‘V’-like shape that was “burned” into the LiDAR.

Medium Confidence Channels



Low Confidence Channels



Opahu Stream
5300m

Culvert
1600m 30%

Open Channel
3700m 70%

Medium Confidence
1400m 40%

Low Confidence
2300m 60%

0.03 **Manning's** n

700m of 0.03 n
20%

0.045 **Manning's** n

3000m of 0.045 n
80%

A comparison between the modelled open channel cross-section profile and ground model level (LiDAR flown 2019) revealed that the modelled levels were almost always below the LiDAR. This difference is caused by the automated channel build process where the channel shape is burned into the terrain to try to pick up the bed under the water. As a shallow 'V'-like shape was used for most of the channel instead of a smaller cross sectional rectangle the cut can be significant, the model it is more likely overestimating capacity than underestimating.

*As there is limited detail in the channels in the model, and because the stream alternates quickly between culvert to open channel, much of the river reaches only have two cross sections (at end points). The comparison shown is therefore done in locations where the LiDAR is not well represented in the channel (channel is near its end point at a road edge)

Model Flags

The sources of data in the model are various, and not all data is high confidence.

ABM		As Built
GIS		GIS Import
USER		Engineering judgement
UMM		UMM derived value - default applied
SITE		Confirmed on site
#D		System Default

An example of a portion of Opahu Stream culvert:

DS node ID	Length (m)	Shape ID	US invert level (m AD)	DS invert level (m AD)	Width (mm)	Height (mm)
HCC_SW026779	2.9	RECT	6.200	6.180	800	620
HCC_CH_OPAHU_08_upstream	7.1	CIRC	5.190	5.050	900	900
HCC_CH_OPAHU_02_upstream	1.0	RECT	6.157	6.150	800	620
HCC_SW026828	6.2	CIRC	5.263	5.258	900	900
HCC_SW026778	3.3	RECT	6.150	6.157	800	620
HCC_SW026802	6.4	CIRC	4.970	4.895	1125	1125
HCC_SW026701	21.0	CIRC	5.341	5.328	750	750
HCC_SW026809	8.7	CIRC	5.271	5.263	900	900
HCC_CH_OPAHU_07_upstream	10.0	CIRC	5.258	5.250	900	900
HCC_CH_OPAHU_10_upstream	12.5	CIRC	4.895	4.750	1125	1125
HCC_CH_OPAHU_06_upstream	48.0	CIRC	5.328	5.300	750	750
HCC_SW026806	17.4	CIRC	5.200	5.190	900	900
HCC_SW026829	35.3	CIRC	5.300	5.271	900	900
HCC_SW026800	3.4	CIRC	5.010	4.970	1125	1125
HCC_SW005321	16.0	RECT	5.350	5.341	750	750
HCC_CH_OPAHU_03_upstream	21.9	CIRC	6.110	5.900	750	750
HCC_CH_OPAHU_05_upstream	15.6	CIRC	5.400	5.350	750	750
HCC_CH_OPAHU_04_upstream	26.0	CIRC	5.600	5.400	750	750
HCC_SW026807	63.6	CIRC	5.200	5.200	900	900

ABM	As Built
GIS	GIS Import
USER	Engineering judgement
UMM	UMM derived value - default applied
SITE	Confirmed on site
#D	System Default

If we focus on Culvert Width, the composition of the data is shown below:

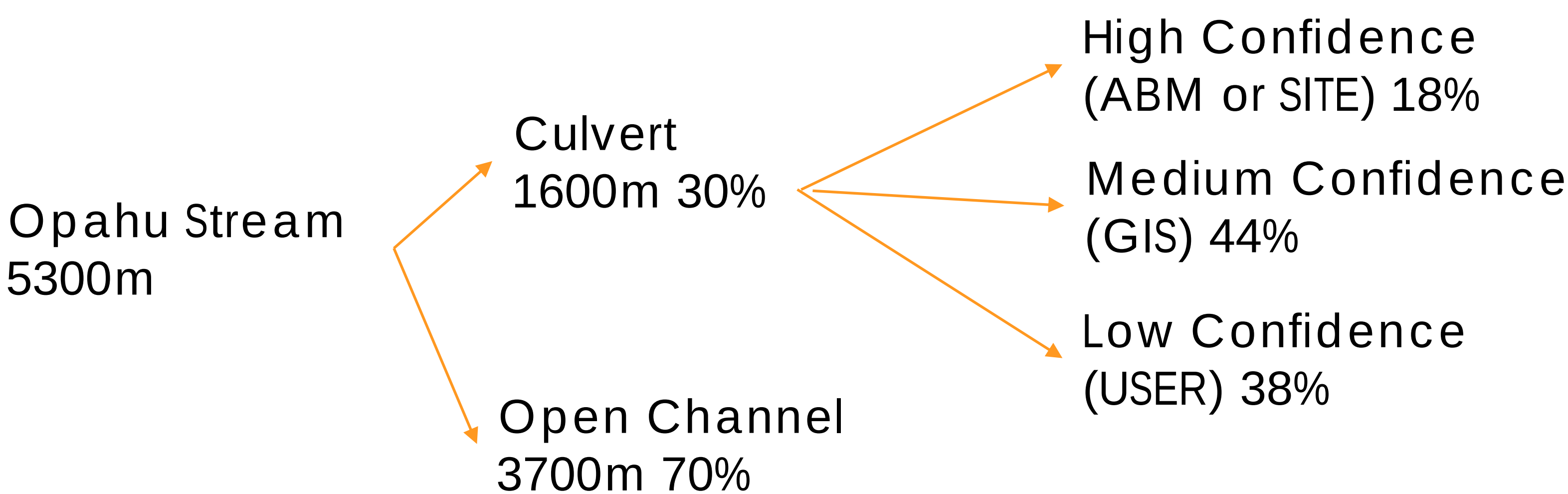


Figure 1 – Option Overview

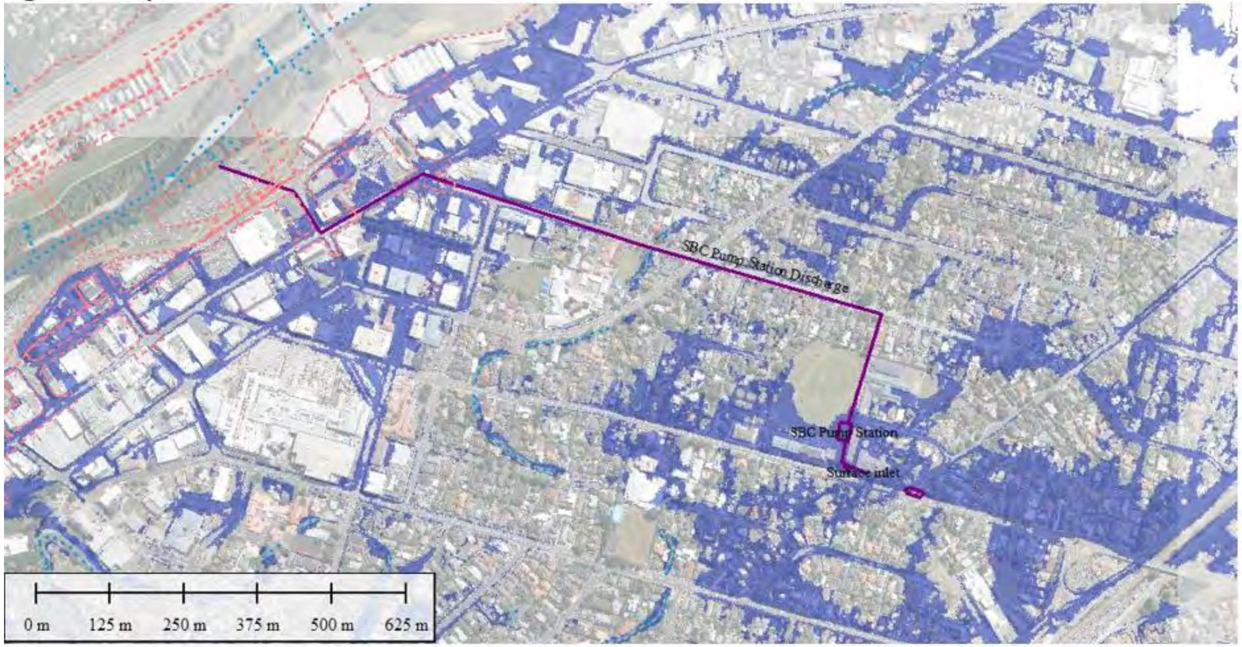
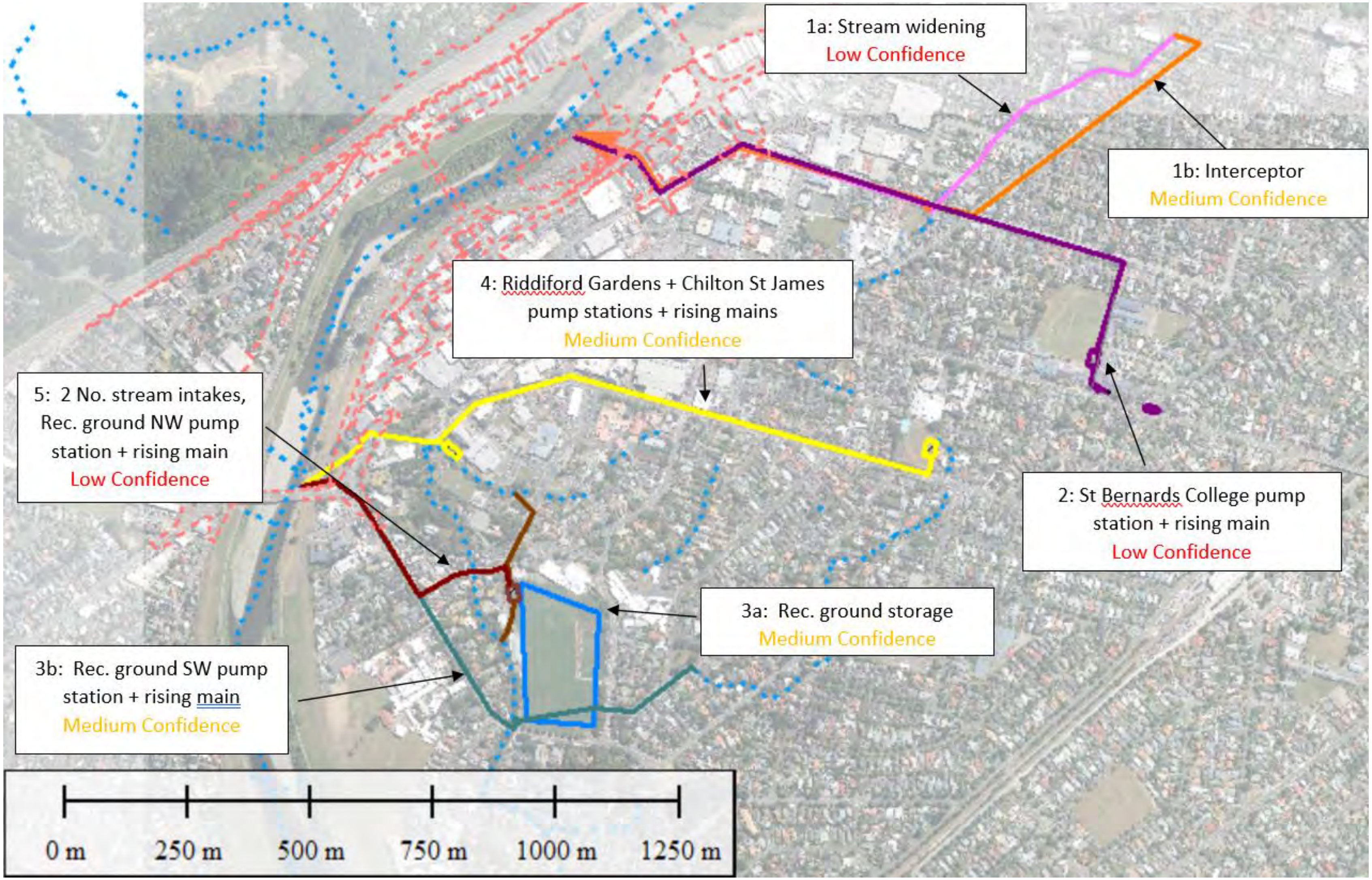


Figure 2 –Pump Station and Intake Location

The option of reducing ground surface elevation is feasible in the model but the change may be too small to show any meaningful results.

The purpose of lowering the ground level at the intersection in Option 2 is to allow ponding water from the east to flow westwards into the proposed inlets. However, due to the limitations of the accuracy of the LiDAR data, it is likely that changing only the ground level at the intersection will not significantly change the situation.

A high confidence score was not given to any of the options as we have limited confidence that the Opahu Stream is represented well in the model. Thus, the flow rates along the stream may be offset from reality. However, some areas are higher than others, and we'd have more confidence in model outputs for results near Option 1b, 3a, 3b and 4.



Appendix C Cluster Assessment Report

HUTT CITY WIG - CLUSTER INVESTIGATIONS

21 December 2023

Prepared for:
Tonkin + Taylor

Prepared by:
[redacted]

Project Number:
310104084

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
1.1	Draft – Cluster 1	[redacted]	12/12/2023	[redacted]	12/12/2023		
1.2	Final	[redacted]	14/12/2023	[redacted]	21/12/2023	[redacted]	21/12/2023

The conclusions in the Report titled Hutt City WIG - Cluster Investigations are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Prepared by: [redacted]

Signature

[redacted]

Printed Name

Reviewed by: [redacted]

Printed Name

Approved by: [redacted]

Printed Name

Table of Contents

LIST OF FIGURES

1 Introduction

This report covers Task 1.9 defined as part of the "scope pivot" agreed between Tonkin + Taylor (T+T) and Stantec on Wednesday 23rd November 2023; and following the "scrum workshop" held on Wednesday 1st November 2023.

A total of six clusters were provided to Stantec by T+T on Wednesday 6th December for detailed investigation using model results developed in earlier stages of the Water Infrastructure for Growth (WIG) project. The scope for each cluster was confirmed via email with T+T and is as follows:

1. Is there any "modelling" reason why see this flooding, that might not reflect reality?
2. Are the model results in this location of greater or lesser confidence than elsewhere?
3. Does the cluster correlate with previous work by Stantec, that we can draw on?
4. Surface water flow hydrographs at key locations provided by T+T to describe flow into/out of the area. ***Attached as appendix.***
5. Comments from knowledge of model/network, which options are more likely to be effective.

Scope item 3 is not covered in detail by this report as all relevant previous work by Stantec has already been provided to T+T. The focus of this assessment is results produced in earlier stage of the WIG project. There are similarities to a selection of the high-level solutions proposed as part of the Hutt Valley Growth Study (Stantec, 2021); however, Hutt Valley Growth was directed as a series of defined growth area, none of which overlap the cluster locations provided by T+T.

Model components and results used in the investigation of 1, 2, 4 and 5 by Stantec are summarised as:

a) Nodes where spill is considered likely to contribute to overland flow (generally those with cumulative spill volumes greater than $100m^3$), noting that this value is not based on any guidance or specification values and has been chosen using engineering judgement and is subjective.

b) Inflow, outflow and total volume contained within the cluster based on 2D model results.

c) Backflow from the primary stormwater network where applicable.

d) Subcatchments directly (primary network) and indirectly (overland flow) connected to the cluster.

e) Stormwater network long sections at key locations, as identified from engineering judgement.

Engineering judgment was used to identify locations of lower model confidence where model components as outlined above were not performing well relative to expected reality.

Stantec's assessment of the clusters is limited to potential improvements in network performance and reduction in ponding extents and depths. No specific level of service targets have been identified. This memo is intended as a summary of the cluster assessment carried out by Stantec with the T+T project team as the exclusive audience. As such, background information has not been provided on why each cluster has been selected, how they link together and how they interface with the options proposed in previous phases of work. It is assumed that the reader will have familiarity with the project, negating the need for documentation of background inputs in this memo given budget and programme constraints.

2 Cluster 1

Stantec's understanding of Cluster 1 (Figure 2-1) is based on is based on the figure provided and confirmatory discussions with T+T, and is as follows:

a) A swale constructed from the centre of the cluster to convey floodwater west towards Knights Crescent.
b) A piped crossing through Knights Crescent.
c) A swale constructed to connect pipe flow to the Opahu Stream.
d) A swale constructed on eastern side of Knights Crescent to convey flow southwest towards the piped crossing.
e) Cluster 1 is to be considered as an extension of Option 1B, and therefore should use Option 1B 100yr ARI RCP 8.5 2100+ model results.

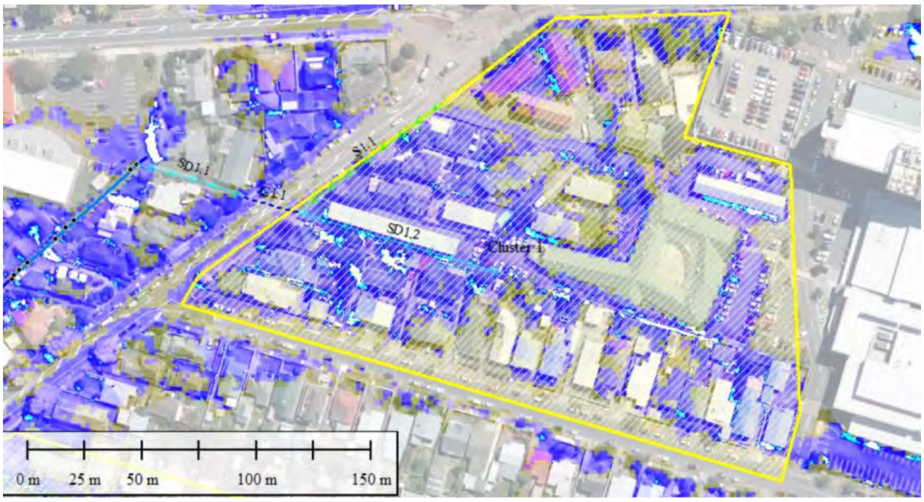


Figure 2-1 Screenshot of Cluster 1 as provided by T+T.

Stantec assessment of the proposed T+T solution and potential additional options is summarised as:

a) Adoption of a secondary flow path-based approach that aims to address surface ponding by allowing for overland flow is likely the only practical approach, given the volume of overland flow and ponding in the area.
b) Conveyance of surface water towards Opahu Stream make sense as this is the only available natural drainage path. However, it is likely that the tailwater effect of levels within the Opahu Stream will limit conveyance capacity of the proposed T+T solution. Timing of peaks and changes to attenuation time within Cluster 1 will need to be considered.
c) There is likely potential for adoption of sustainable urban drainage practices within the area contributing to Cluster 1. Model results indicate that surface runoff from the larger hospital subcatchments may be a significant contributor to surface ponding.

Additional detail is provided in the section below.

2.1 Detail

As shown in Figure 2-2, overland flow enters Cluster 1 from the southeast. At the peak of the design storm, overland flow rapidly ponds within the cluster due to capacity constraints within the shallow grade 450mm stormwater main proving primary drainage. This is exacerbated by inhibitors to overland flow towards the Opahu Stream such as buildings and Knights Crescent road levels. Once inundation reaches a critical level, this barrier to overland flow is overtopped at the intersection of Knights Crescent and Pilmuir Street.

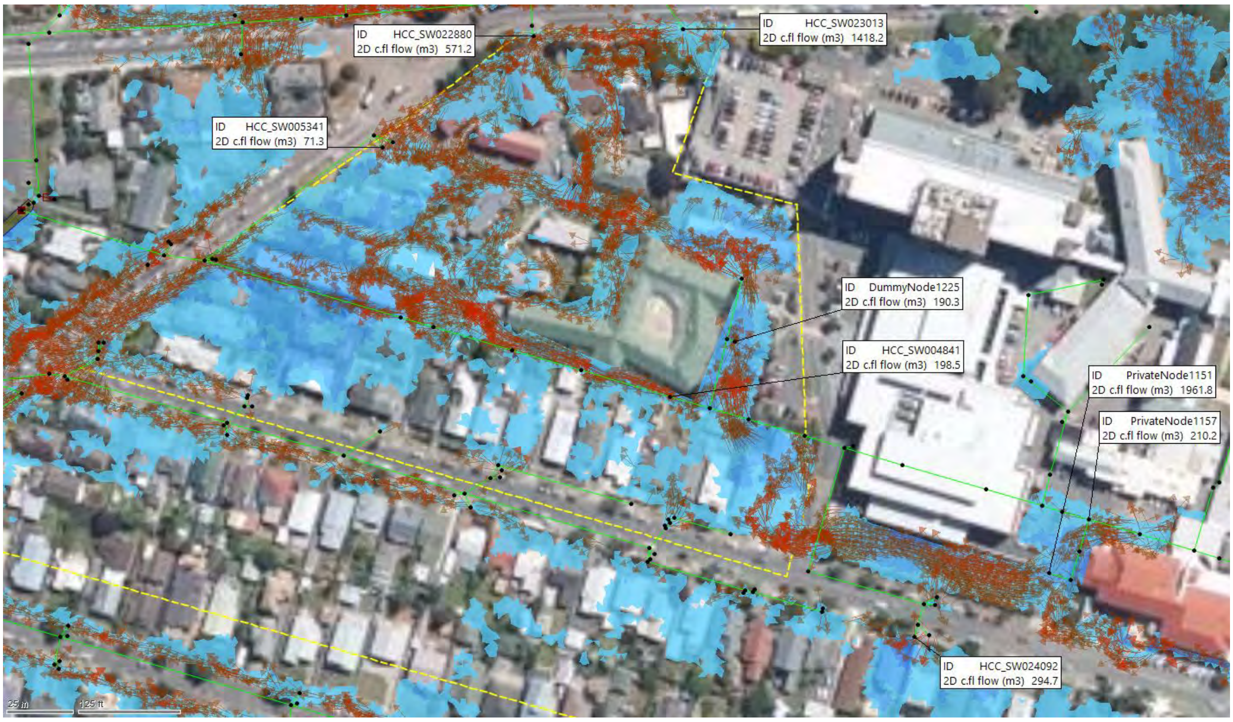


Figure 2-2: Option 1B Maxima. Key nodes labelled with cumulative flow onto the 2D zone.

As shown in Figure 2-3 and Figure 2-4, inflow and outflow peak at ~0.75m^3/s and 0.58m^3/s respectively. Surface volume contained within the cluster peaks at ~3,300m^3. A considerable volume of surface ponding results from surcharge occurring at manholes within the cluster area. The largest cumulative spill locations onto the 2D surface are labelled in Figure 2-2.

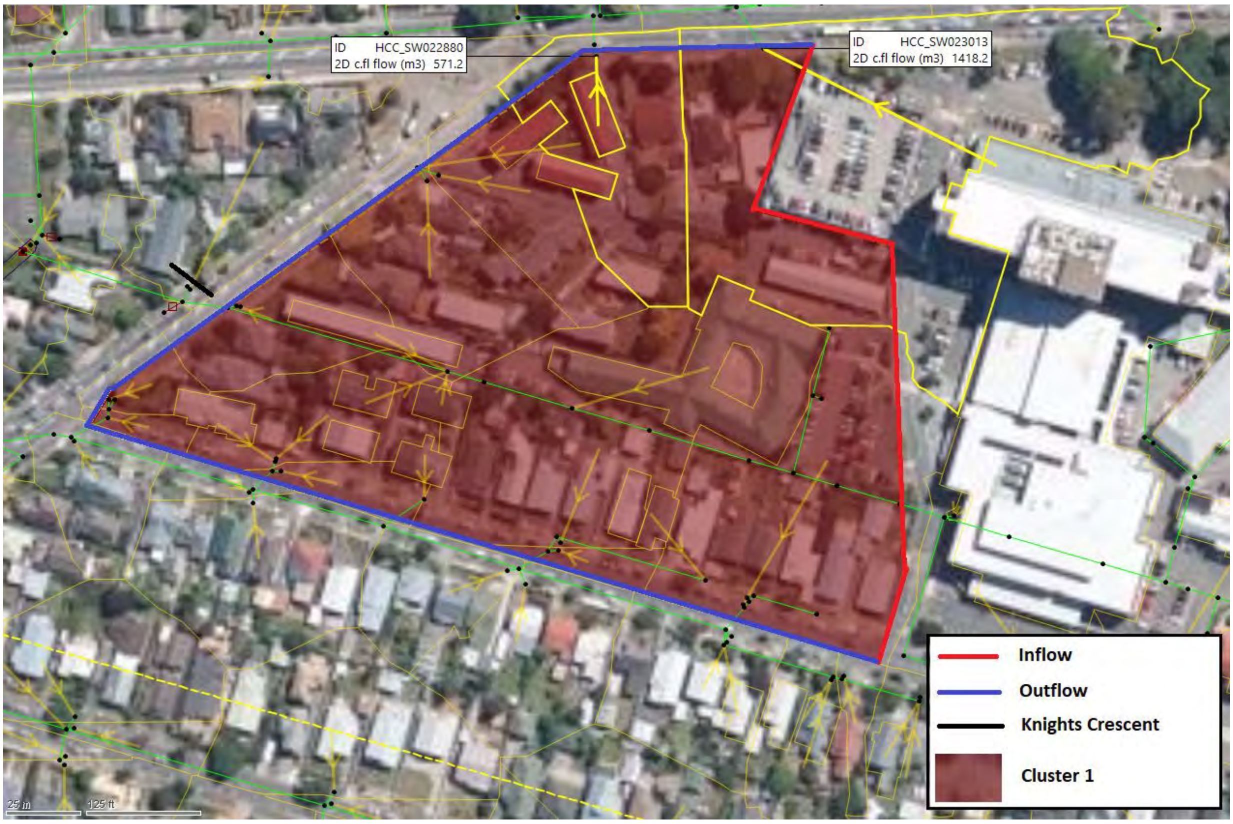
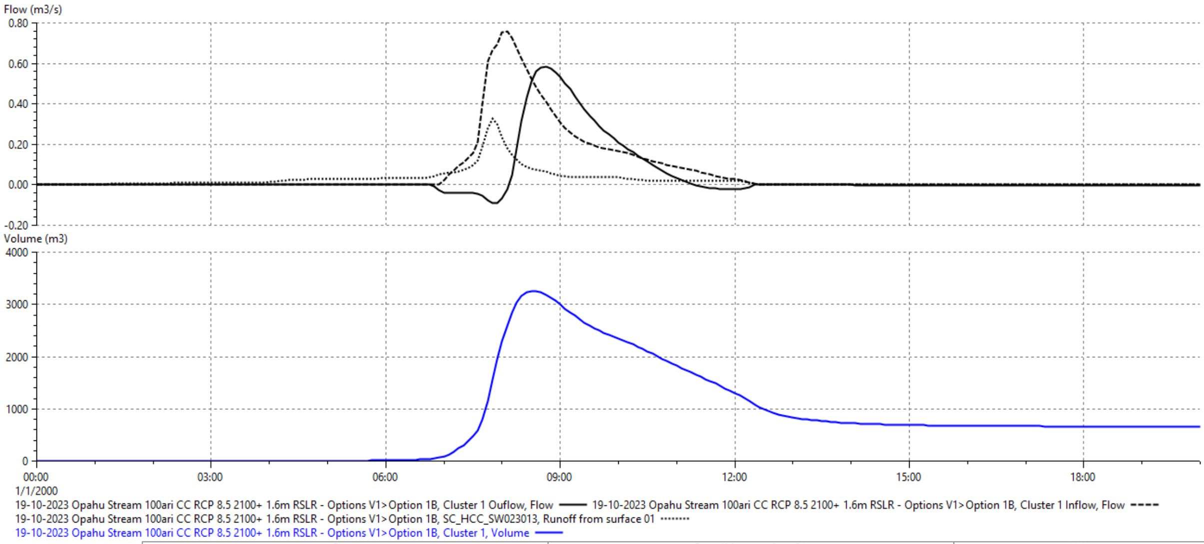


Figure 2-3: Hospital subcatchments connected away from Cluster 1 and ICM results polygons/lines. Red line – inflow, blue line – outflow, black line flow along western side of Knights Crescent (Figure 2-6).



	Flow			Runoff from surface 01			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
...tion 1B, Cluster 1 Ouflow	-0.089	0.584	2803.523					
...ption 1B, Cluster 1 Inflow	0.000	0.761	4481.469					
...n 1B, SC_HCC_SW023013				0.000	0.328	1664.952		
...s V1>Option 1B, Cluster 1							0.000	3262.052

Figure 2-4: Option 1B results line flows, results polygon volume and hospital subcatchment runoff.

As an example, runoff from the subcatchment connected to HCC_SW023013 is included in Figure 2-4. Runoff from this subcatchment is directed away from the Cluster 1 primary network (as shown in Figure 2-3; however, due to levels within the High Street stormwater network most of the runoff volume generated by this catchment surcharges from the manhole and ponds within Cluster 1. Flow, in conduits downstream of HCC_SW022880 and HCC_SW023013, is plotted in Figure 2-5. This demonstrates the tailwater effect of flows in the High Street stormwater network preventing discharge away from Cluster 1. Negative flow occurs within these conduits in the order of 200m^3 to 300m^3 over the duration of the storm – this additional volume will pond within Cluster 1.

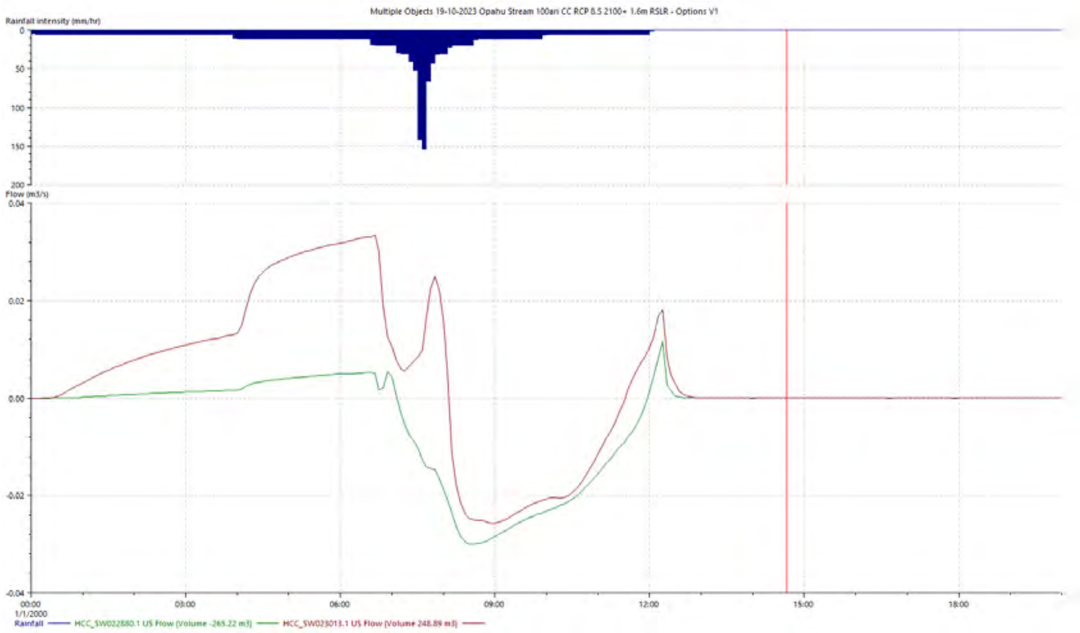


Figure 2-5: Flow in conduits downstream of subcatchments shown in Figure 2-3.

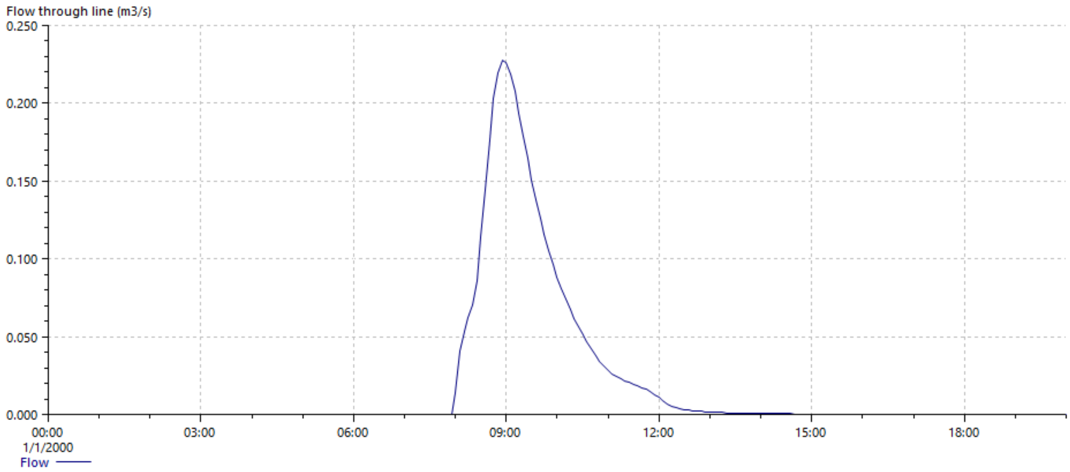


Figure 2-6: Overland flow along western side of Knights Crescent towards proposed swale connection to Opahu Stream.

Subcatchments directly and indirectly connected to Cluster 1 are shown in Figure 2-7 and Figure 2-8. The total connected area is ~8.4 ha and the total disconnected area contributing overland flow is ~5.8 ha. Any inconsistency between the drainage point of these subcatchments in the model and reality is likely to have limited impact on model results for this 100yr ARI RCP 8.5 2100+ event as the primary stormwater network is fully surcharged. Model results demonstrate overland flow path routing that is broadly consistent with expectations based on the topography.

If higher frequency design events are adopted in the future option development, it is recommended that subcatchment connection points are revisited.

Figure 2-7: Subcatchments connected directly to the primary stormwater network draining Cluster 1.

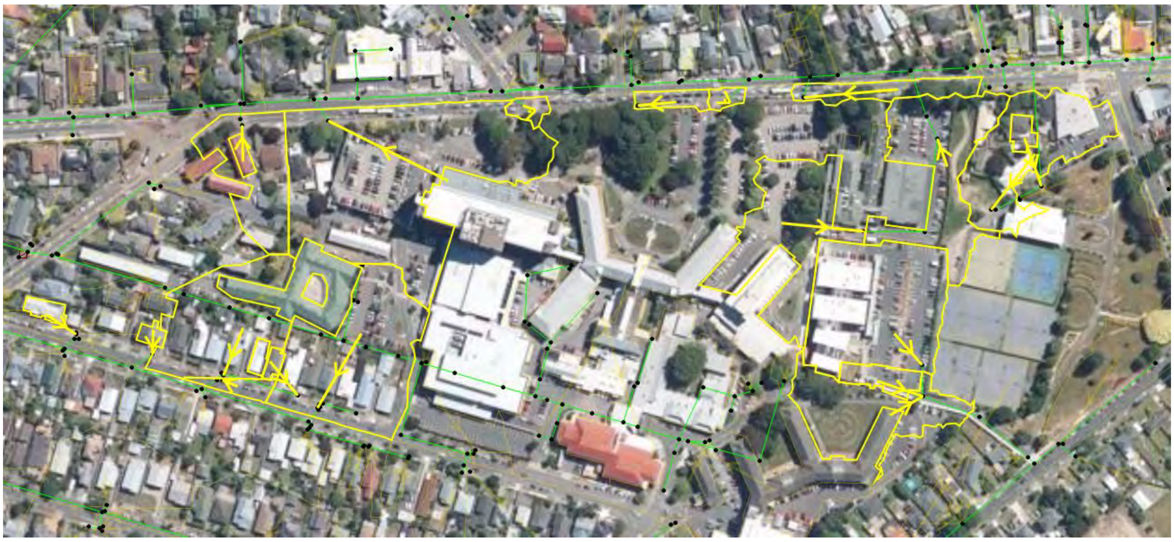


Figure 2-8: Subcatchments not connected directly to the primary stormwater network draining Cluster 1 but contributing to overland flow.

To demonstrate hydraulic connectivity between areas of ponding, three long sections have been extracted for the primary network draining through Cluster 1 (Figure 2-10, Figure 2-11 and Figure 2-12). Figure 2-12 shows that due to hydraulic grade, the primary network can link otherwise disconnected areas of surface ponding when the network is at capacity.

Figure 2-9: Long section location map.

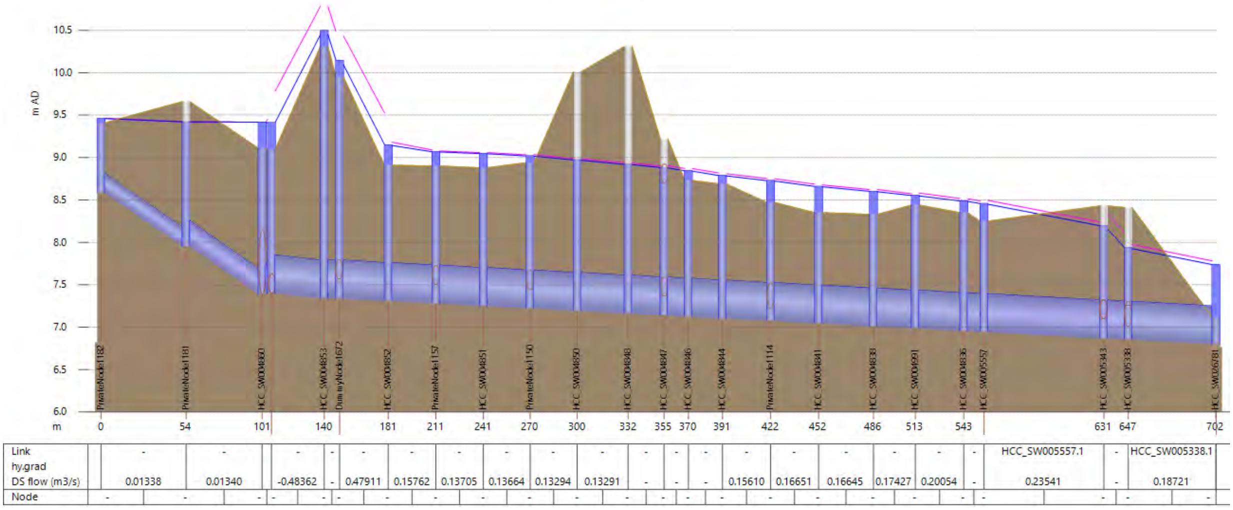


Figure 2-10: Long section A-C. Option 1B maxima.

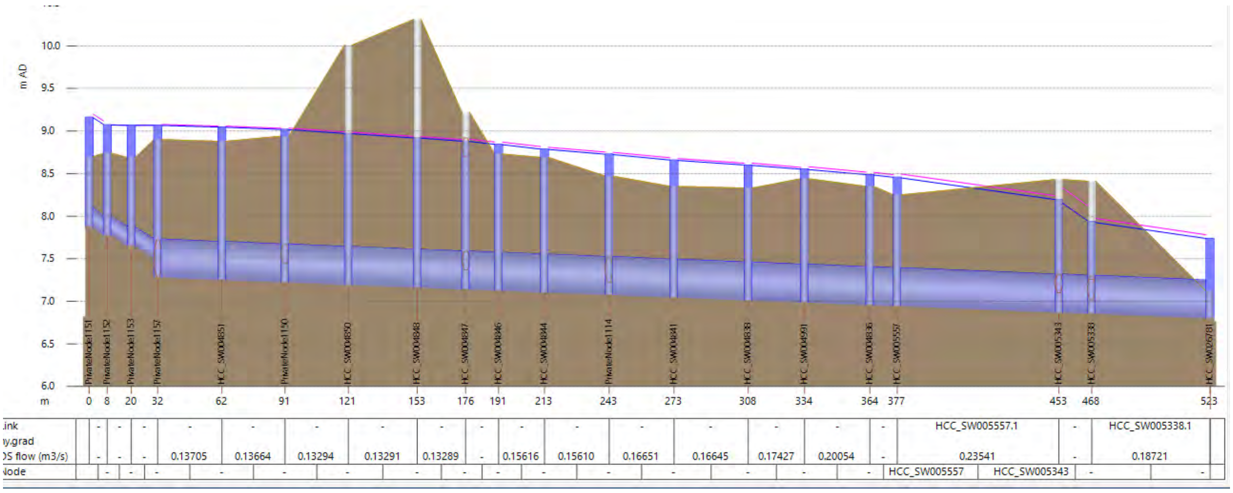


Figure 2-11: Long section B-C. Option 1B maxima.

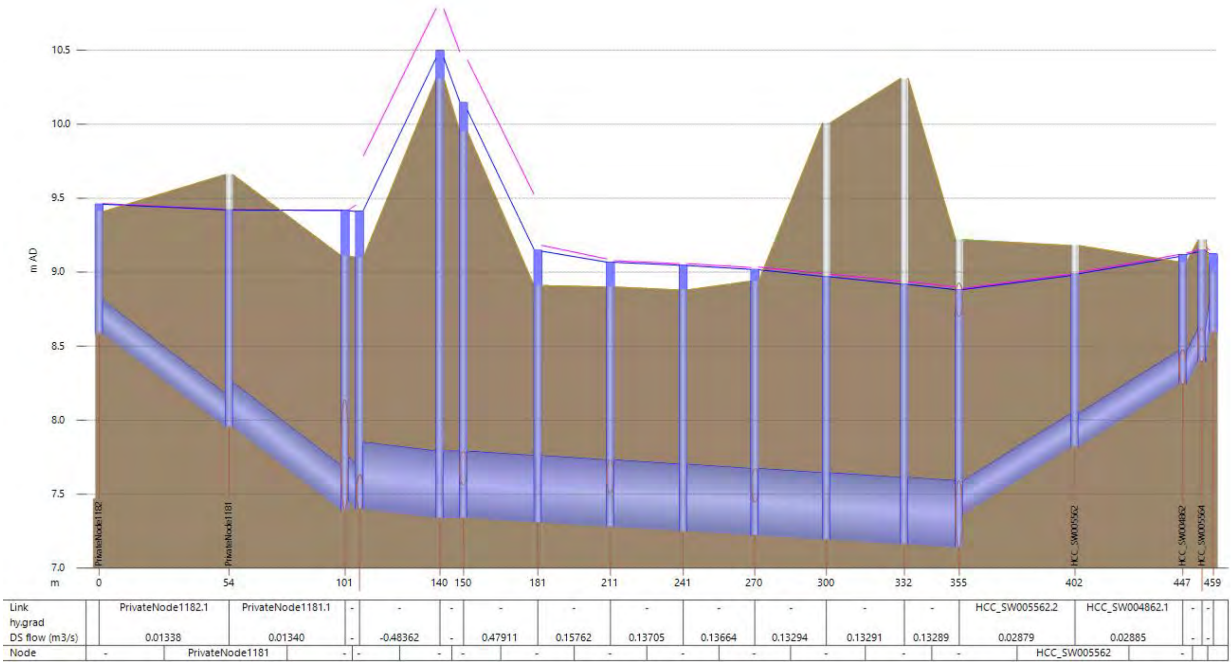


Figure 2-12: Long section A-B. Option 1B maxima.

3 Cluster 2

Stantec's understanding of Cluster 2 (Figure 3-1) is based on is based on the figure provided and confirmatory discussions with T+T, and is as follows:

a) Swales constructed along both sides of Copeland Street to convey water in a northwest direction.
b) A crossing southwest over Copeland Street.
c) A pipe crossing over Knights Crescent towards the Opahu Stream.
d) A swale constructed along Brunswick Road to connect pipe flow to the Opahu Stream.
e) Cluster 2 is to be considered as an extension of Option 1B, and therefore should use Option 1B 100yr ARI RCP 8.5 2100+ model results.

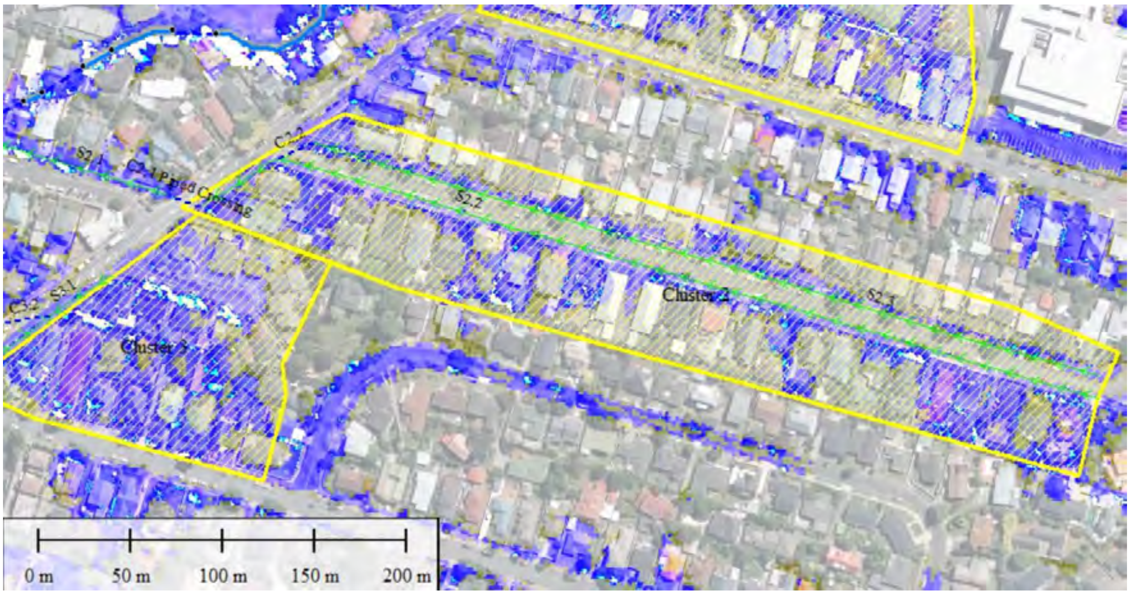


Figure 3-1: Screenshot of Cluster 2 as provided by T+T.

Stantec assessment of proposed T+T solution and potential additional options is summarised as:

a) Adoption of a secondary flow path-based approach is appropriate given the volumes of water and topographic constraints along Copeland Street.
b) Conveyance of surface water towards the Opahu Stream is likely to be challenging due to the tailwater effect of levels within the Opahu Stream - timing of peaks will need to be considered.
c) Construction of drainage swales along Copeland Street is likely to alleviate much of the surface ponding impacting properties within this cluster. There may be opportunity to manage flows within these swales to adjust timing of peaks and optimise capacity in the Opahu Stream and/or the proposed Option 1B solution.

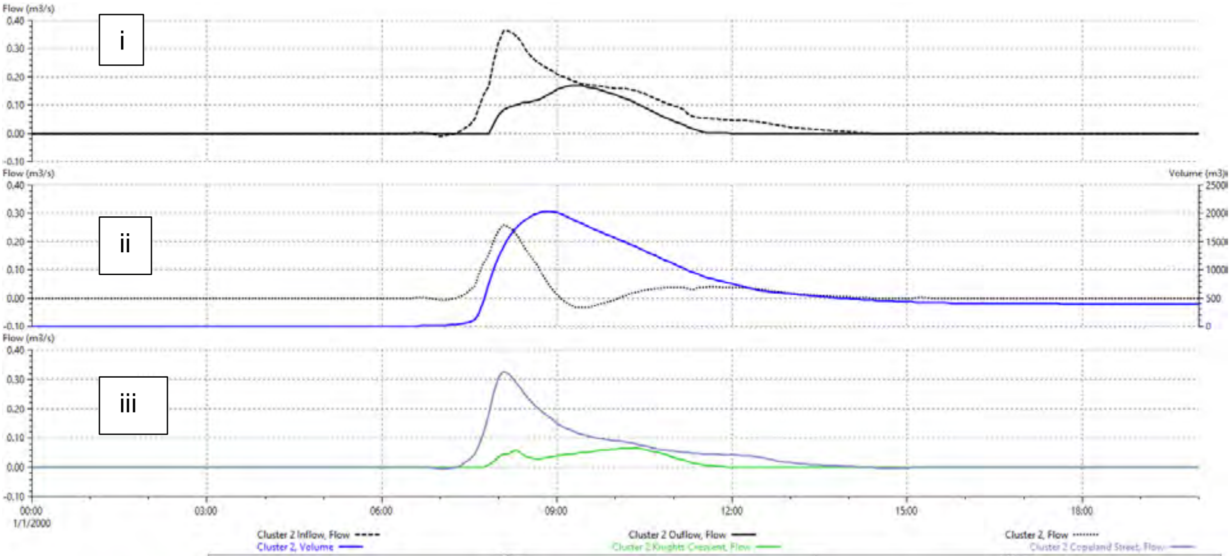
d) Overland flow along Copeland Street from the southwest is likely diverting a relatively minor volume of water away from the low point on Waterloo Road. There may be potential to increase overland flow diverted from Witako Street, potentially reducing volumes ponding close to Waterloo Station.

Additional detail is provided in the section below.

3.1 Detail

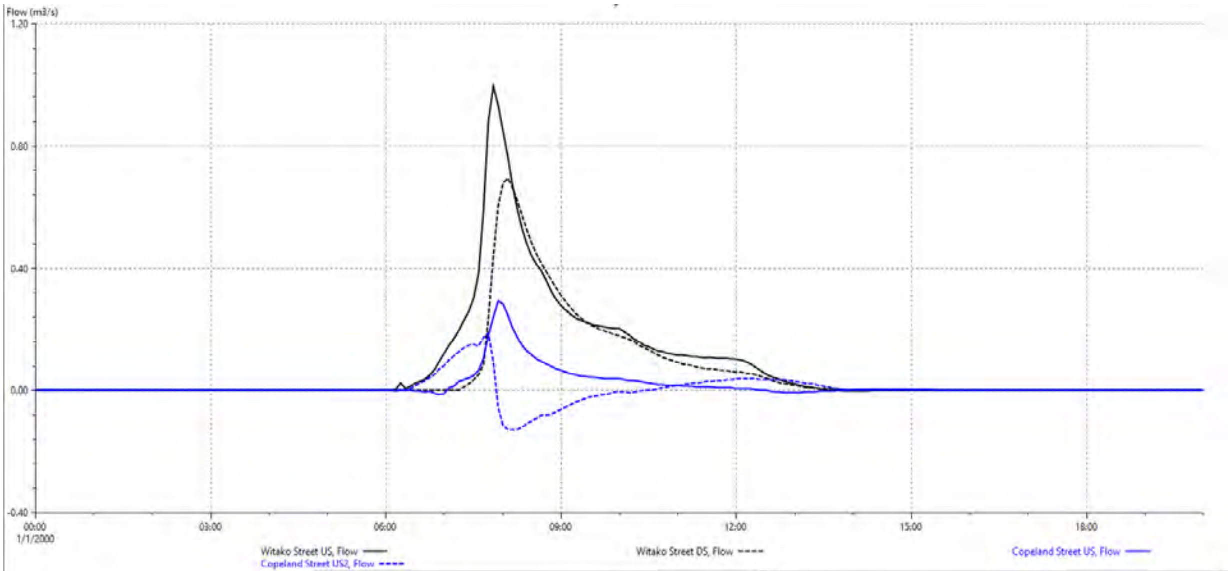
Overland flow results have been extracted from the modelled 2D surface to demonstrate key mechanisms driving flooding in Cluster 2. As shown in Figure 3-2 and Figure 3-3, the volume of surface flooding contained within Cluster 2 peaks at ~2,000m^3; with surface inflows peaking at 0.36m^3/s and outflows peaking at 0.17m^3/s. Overland flow occurs northeast to southwest along Kings Crescent, some of which enters the topographic low around the intersection of Kings Crescent and Copeland Street (downstream end of Cluster 2). However, the main contributor to overall volume within Cluster 2 is overland flow from the southeast along Copeland Street.

Figure 3-2: Overland flow results lines (letter labelling) and results polygon for Cluster 2 (maroon fill).



	Flow			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
Cluster 2 Inflow	-0.009	0.362	2851.314		
Cluster 2 Ouflow	-0.000	0.171	1371.265		
Cluster 2				0.000	2041.739
Cluster 2 Knights Crescent	-0.000	0.066	593.261		
Cluster 2 Copeland Street	-0.005	0.327	2126.394		

Figure 3-3: i) Cluster 2 inflow, outflow. ii) Combined flow and total volume. iii) Knights Crescent inflow and Copeland Street inflow (A and B in Figure 3-2).



	Flow		
	Min (m3/s)	Max (m3/s)	Volume (m3)
Witako Street US	-0.003	0.997	5510.471
Witako Street DS	0.000	0.694	4085.790
Copeland Street US	-0.013	0.293	1140.923
Copeland Street US2	-0.130	0.190	328.868

Figure 3-4: Flow around intersection of Copeland Street and Witako Street west of Cluster 2. Witako Street US, Witako Street DS, Copeland Street US and Copeland Street US2 correspond to C, D, E and F in Figure 3-2.

As shown in Figure 3-5, there is over 1,000m^3 of cumulative spill predicted from the primary network west of Cluster 2 on Copeland Street. However, levels in this location are only able to overcome a slight high point on Copeland Street due to a relatively large volume of overland flow northeast to southwest along Witako Street. Without this volume of flow originating a considerable distance from the Copeland Street/Witako Street junction, primary network spill west of Cluster 2 would likely drain the opposite direction. Figure 3-4 shows overland flow hydrographs extracted around the intersection of Witako Street and Copeland Road. Approximately 20% of the total volume is directed down Copeland Road towards Cluster 2, with 80% continuing down Witako Street towards the low point on Waterloo Road.

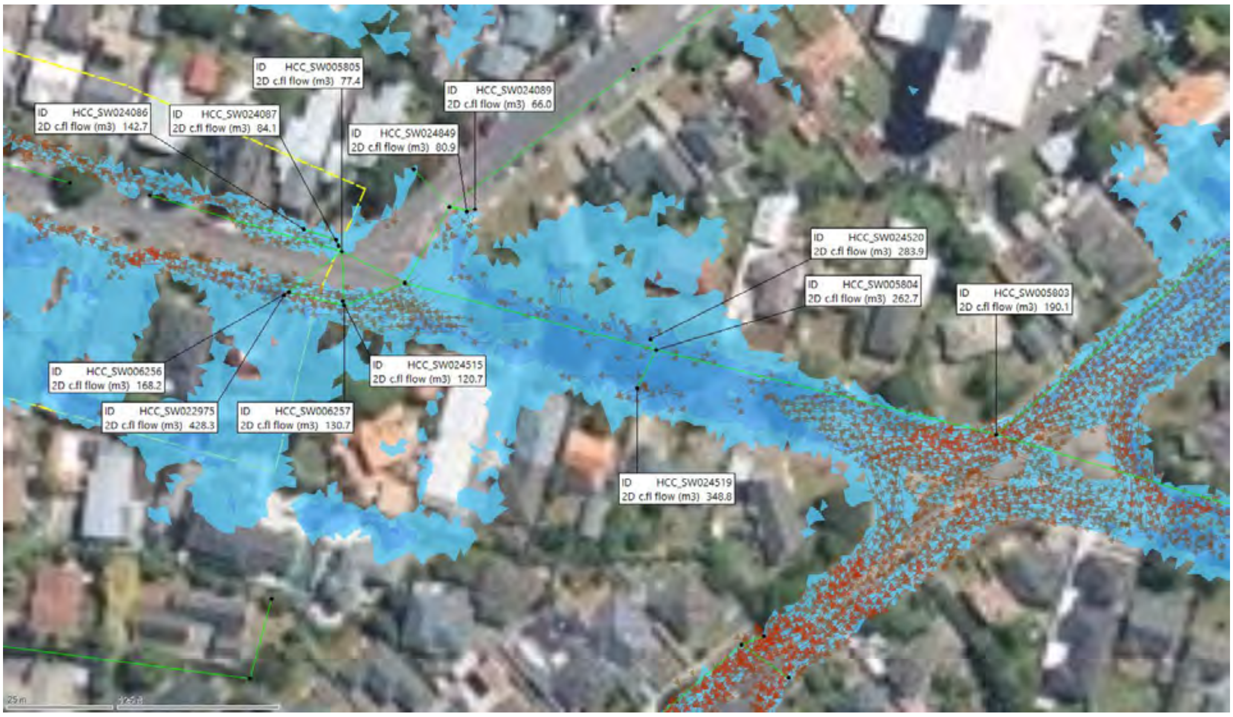
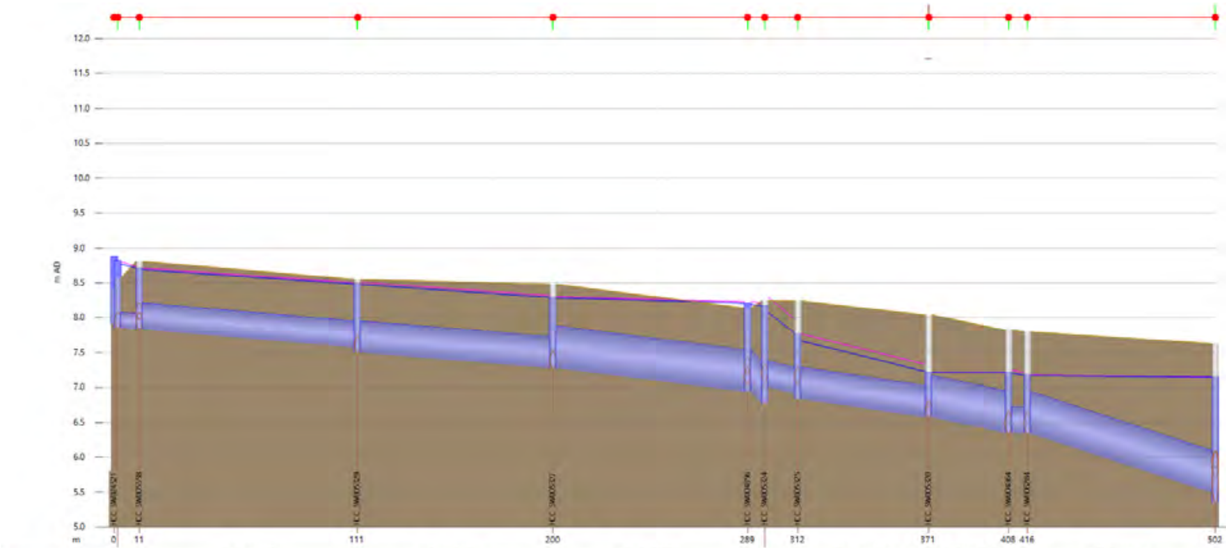


Figure 3-5: Option 1B Maxima. Key nodes labelled with cumulative flow onto the 2D zone around Copeland Street west of Cluster 2 (between Pilmuir Street and Witako Street).

A long section has been extracted from the primary network draining Cluster 2 towards the Opahu Stream, as shown in Figure 3-6 and Figure 3-7. Much of the network has sufficient cover to prevent spill onto the surface; however, a topographic low point along the edge of Copeland Street results in spill in the vicinity of property. Although cumulative volumes are relatively low (<300m^3, Figure 3-8), they are sufficient to result in ponding within property boundaries up to depths of ~0.25m as the road is generally forms a high point.

Figure 3-6: Example long section along the Cluster 2 primary network between a Copeland Street sump and the piped Opahu Stream underneath Brunswick Street.



Link	-	HCC_SW005558.1	HCC_SW005329.1	HCC_SW005327.1	-	-	HCC_SW005325.1	HCC_SW005320.1	-	HCC_SW006284.1
US depth (m)	-	0.854	0.977	1.006	-	1.074	0.829	0.641	-	0.831
US flow (m3/s)	-	0.09174	0.15399	0.21312	-	-	0.26099	0.08005	-	0.14266
us inv (m AD)	-	7.835	7.500	7.280	-	7.000	6.839	6.576	-	6.342
US total head (m AD)	-	8.712	8.508	8.304	-	8.294	7.770	7.218	-	7.180
DS depth (m)	-	0.907	1.011	1.269	-	0.864	0.654	0.865	-	1.658
DS flow (m3/s)	-	0.08508	0.15523	0.21308	-	-	0.26031	0.07890	-	0.14480
ds inv (m AD)	-	7.575	7.280	6.940	-	6.914	6.576	6.348	-	5.491
DS total head (m AD)	-	8.502	8.319	8.226	-	7.981	7.334	7.215	-	7.154

Node: HCC_SW005558 | HCC_SW005329 | HCC_SW005327 | HCC_SW004856 | - | HCC_SW005325 | HCC_SW005320 | - | HCC_SW006284 | HCC_SW005321

Figure 3-7: Long section of primary network highlighted in Figure 3-6. Option 1B maxima.

Figure 3-8: Option 1B Maxima. Key nodes labelled with cumulative flow onto the 2D zone within Cluster 2.

Figure 3-9 and Figure 3-10 show model subcatchments directly connected to the primary network draining Cluster 2 and those that contribute to overland flow that enters Cluster 2. These subcatchment boundaries and their connection locations appear to represent likely overland flow paths in Cluster 2. However, any inconsistency between the drainage point of these subcatchments in the model and reality is likely to have limited impact on results as the primary network is surcharged.

If higher frequency design events are adopted in the future, it is recommended that subcatchment connection points are revisited.

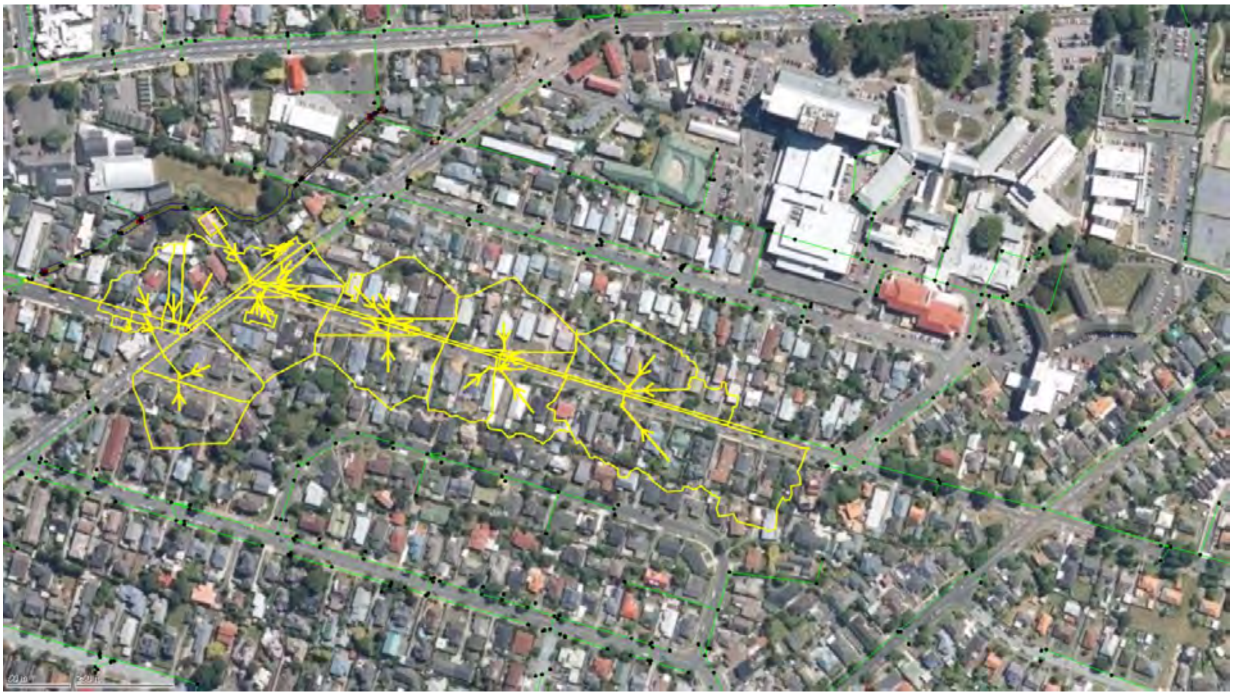


Figure 3-9: Subcatchments directly connected to the primary network draining Cluster 2 towards Opahu Stream.

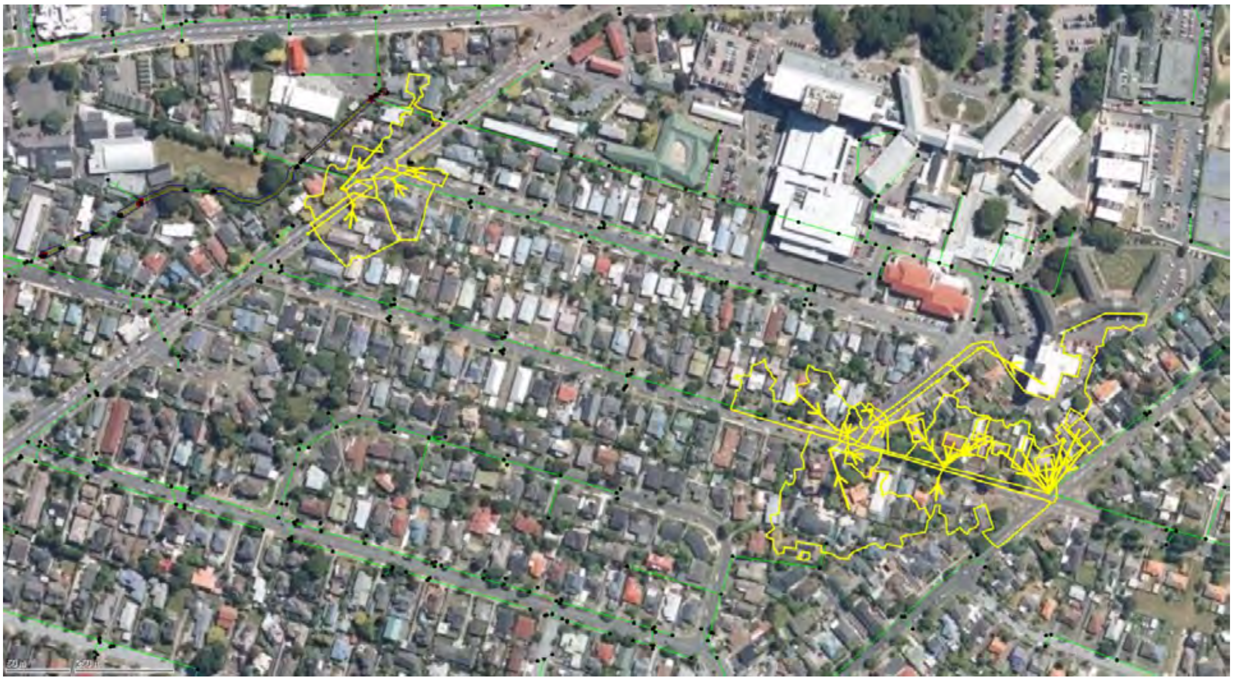


Figure 3-10: Subcatchments not directly connected to the primary network draining towards Opahu Stream but contributing to overland flow into Cluster 2.

4 Cluster 3

Stantec's understanding of Cluster 3 based on Figure 4-1 and discussion with T+T is as follows:

a) Swale constructed along Knights Crescent to convey flow towards crossing approximately 2/3rds of the way down the western boundary of Cluster 3.
b) Piped crossing through Knights Crescent.
c) Piped connection along Bristol Square to Opahu Stream.
d) Cluster 3 is to be considered as an extension of Option 1B, and therefore should use Option 1B 100yr ARI RCP 8.5 2100+ model results.

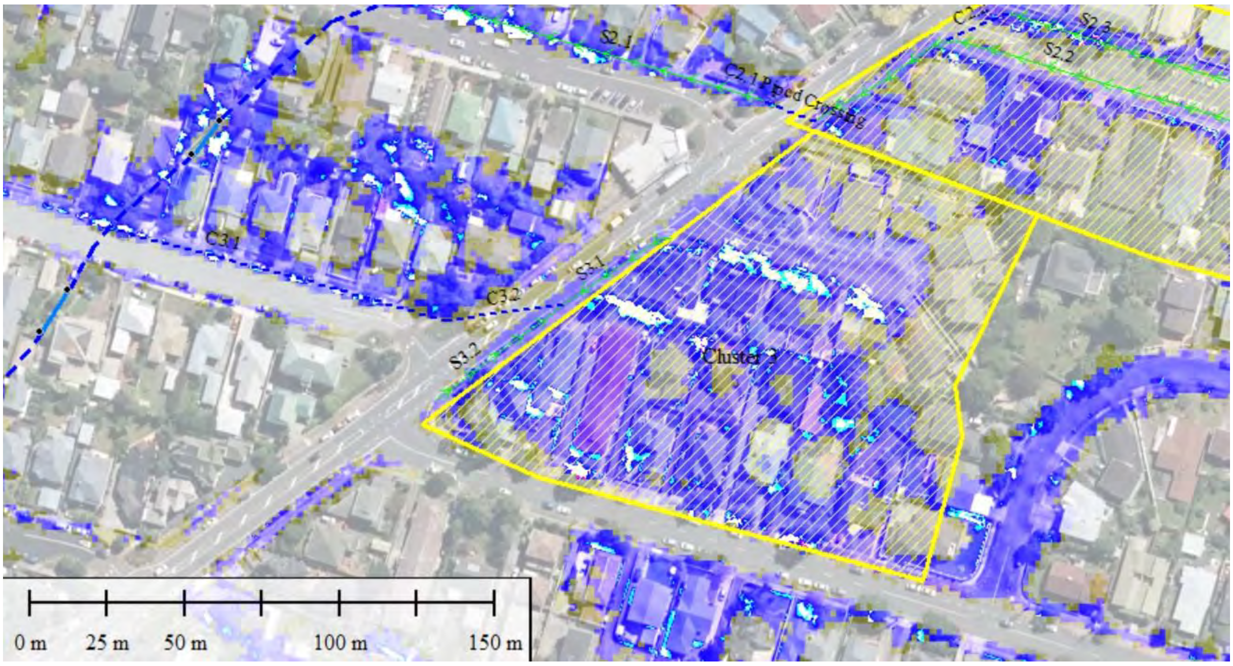


Figure 4-1: Screenshot of Cluster 3 as provided by T+T.

Stantec assessment of proposed T+T solution and potential additional options is summarised as:

a) The proposed option is likely to result in increased volumes passing through private property north of Epuni Street as conveyance capacity is increased. Topographic constraints in the vicinity of Cluster 3 don't appear to be suited to surface conveyance.
b) In addition, conveyance of surface water towards Opahu Stream will be challenging due to the limited hydraulic grade and tailwater effect of levels within Opahu Stream.
c) Construction of drainage swales at the proposed locations on Kings Crescent may encourage more flow through Cluster 3, however, this will not address high depths in the

Amberly Grove road reserve. These will likely buffer water surface elevation of the surrounding area, negating any potential reduction in flood level.

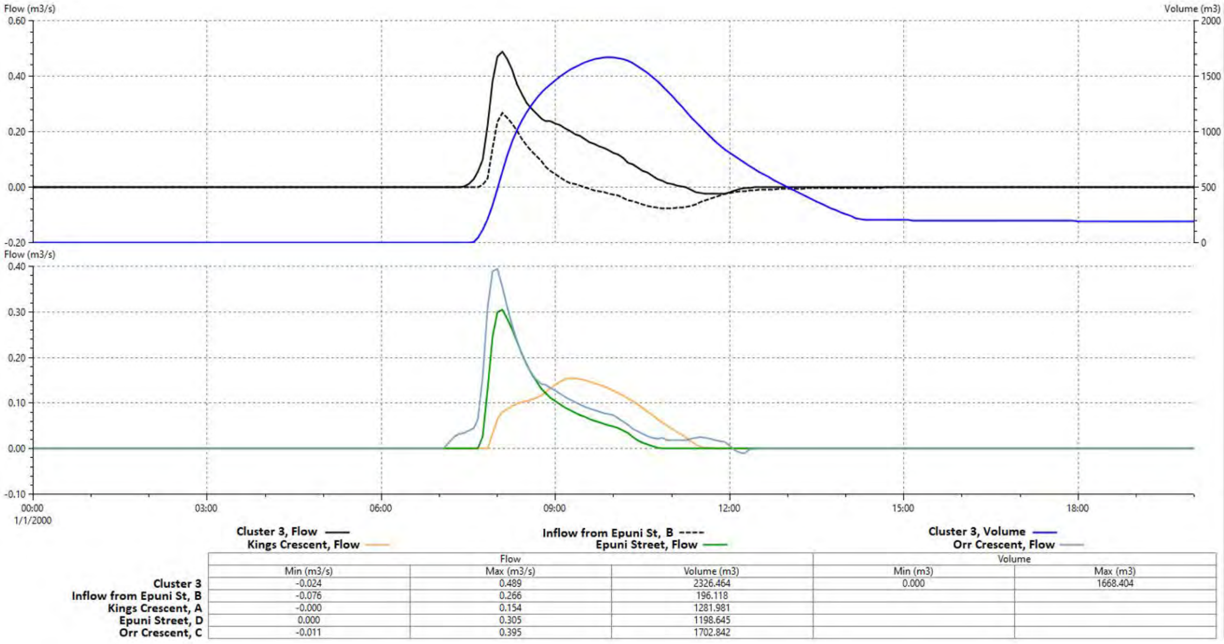
d) Any benefits are likely to be minor as private property inundation depths are relatively low and any reduction in property inundation levels is uncertain at this stage of assessment.

Additional detail is provided in the section below.

4.1 Detail

Results sections have been extracted from the model for key overland flow paths and a results polygon has been extracted for the Cluster 3 area (see Figure 4-2). As shown in Figure 4-3, a total volume of ~ 1,700m^3 is contained within Cluster 3. However, ~50% of this is within the Amberly Grove topographic low; unlike surrounding streets, properties on Amberly Grove are raised above the road reserve and can therefore accommodate more surface ponding without inundating private property. Minor spill (cumulative <100m^3) occurs from the primary network on Amberly Grove, with much of the ponding a result of overland flow southwest along Kings Crescent (section A and Figure 4-4). Additional surface water inflows into Cluster 2 are minor including a peak of 0.27m^3/s entering from the Epuni Road/Orr Crescent area. Aside from this flow, the comparatively large flows on Orr Crescent (C) and Epuni Street (D) are disconnected from inundation within Cluster 2.

Figure 4-2: Results sections for Kings Crescent (A), inflow from Epuni Street (B), Epuni Street (D) and Orr Crescent (C). The maroon fill represents the Cluster 3 results polygon.



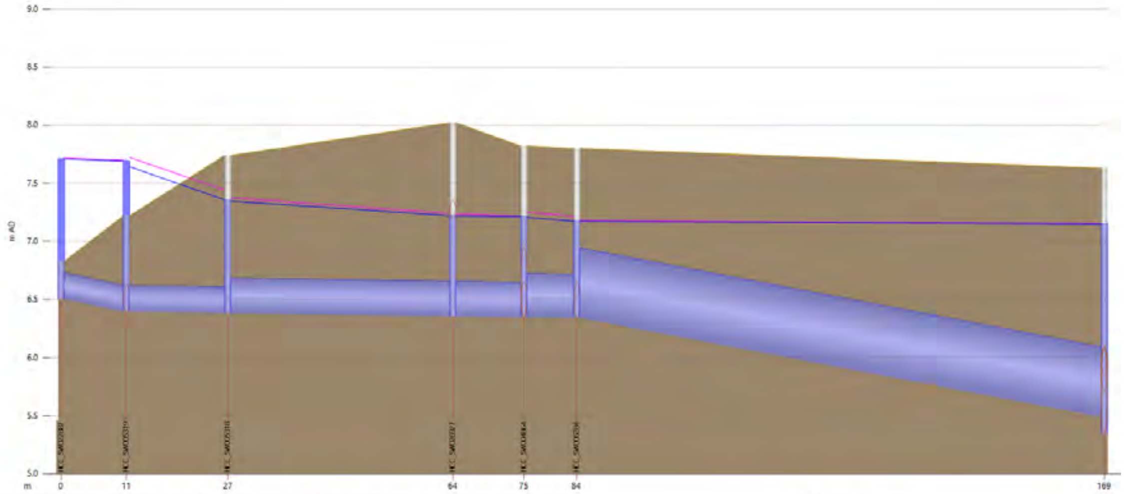
	Flow			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
Cluster 3	-0.024	0.489	2326.464	0.000	1668.404
Inflow from Epuni St, B	-0.076	0.266	196.118		
Kings Crescent, A	-0.000	0.154	1281.981		
Epuni Street, D	0.000	0.305	1198.645		
Orr Crescent, C	-0.011	0.395	1702.842		

Figure 4-3: Flow and volume results for the locations shown in Figure 4-2.

Figure 4-4: Option 1B maxima. Shows key overland flow paths.

A primary network long section is shown in Figure 4-5 and Figure 4-6. This highlights the Amberly Grove topographic low as a driver of network surcharge in this location. Hydraulic grade between Cluster 2 and the Opahu Stream is limited.

Figure 4-5: Long section of primary network connecting Cluster 2 to the piped Opahu Stream beneath Brunswick Street.



Link	-	HCC_SW005319.1	HCC_SW005318.1	-	-	HCC_SW006284.1
US depth (m)	1.205	1.248	0.964	0.863	0.858	0.831
US flow (m3/s)	0.02810	0.07146	0.07140	0.07148	0.14213	0.14266
us inv (m AD)	6.505	6.395	6.383	6.357	6.348	6.342
US total head (m AD)	7.717	7.723	7.375	7.237	7.250	7.180
DS depth (m)	1.297	0.975	0.864	0.866	0.833	1.658
DS flow (m3/s)	0.02809	0.07145	0.07141	0.07149	0.14238	0.14480
ds inv (m AD)	6.395	6.383	6.357	6.348	6.342	5.491
DS total head (m AD)	7.699	7.441	7.241	7.218	7.215	7.154

Node	-	HCC_SW005319	HCC_SW005318	HCC_SW026927	-	HCC_SW006284	HCC_SW005321

Figure 4-6: Long section of network highlighted in Figure 4-5. Option 1B maxima.

Figure 4-7 shows model subcatchment connections and highlights those directly connected to the primary network draining Cluster 3. Subcatchment boundaries and their connection locations appear to well represent likely overland flow paths in Cluster 3. However, as also identified in previous clusters, any inconsistency between the drainage point of these subcatchments in the model and reality is likely to have limited impact on results as the primary network is surcharged.

If higher frequency design events are adopted in the future, it is recommended that subcatchment connection points and delineations are revisited.

Figure 4-7: Subcatchment connections surrounding Cluster 3. Those connected directly to the network draining Cluster 3 are highlighted.

5 Cluster 4

Stantec's understanding of Cluster 4 based on Figure 5-1 and discussion with T+T is as follows:

a) Swale constructed along northern side of Waterloo Road to convey water northwest.
b) Swale constructed in St Bernards College to provide drainage to Waterloo Road.
c) Large culvert constructed to connect downstream end of Waterloo Road swale to a piped section of Opahu Stream.
d) Piped crossing under Waterloo Road at intersection of St Bernards College swale. This is intended to bridge the Waterloo Road overland flow path barrier.
e) Potential to utilise overland flow paths through Chilton Saint James' School.
f) Cluster 4 is to be considered as an extension of Option 4, and therefore should use Option 4 100yr ARI RCP 8.5 2100+ model results.

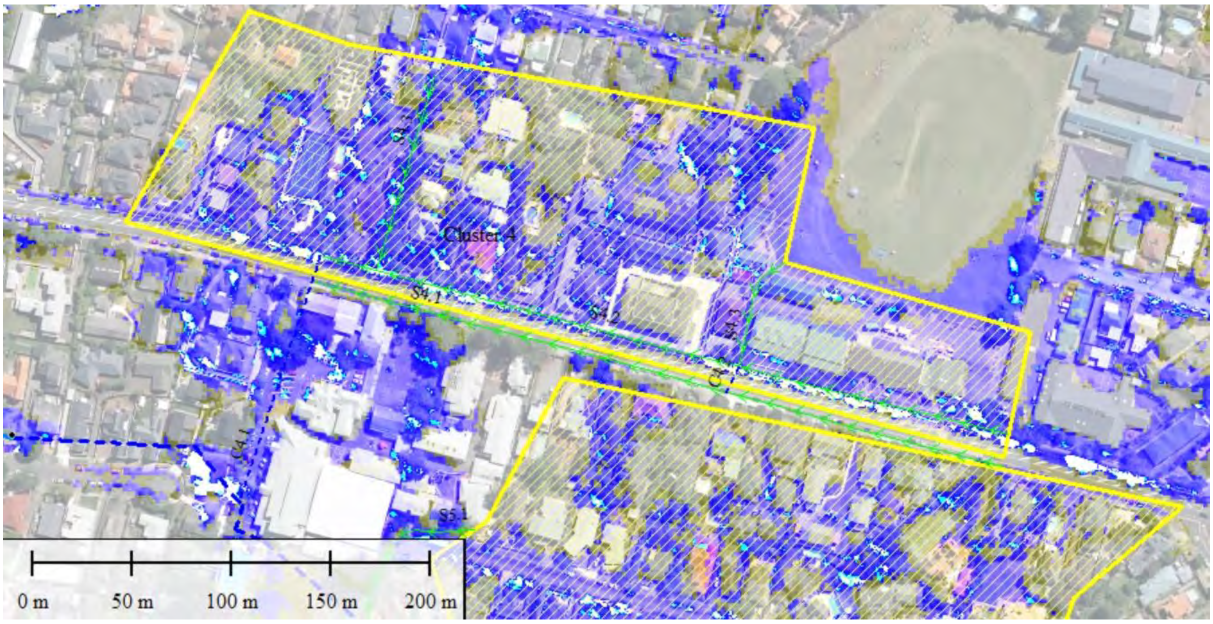


Figure 5-1: Screenshot of Cluster 4 as provided T+T.

Stantec assessment of proposed T+T solution and potential additional options is summarised as:

a) Cumulative flow volumes of ~12,000m^3 are likely to necessitate surface mitigation options. Improving capacity through the Waterloo Road topographic barrier will reduce flood levels to the north but is highly likely to increase levels to the south.
b) Much of the inundation volume drains through the primary network due to the flow restriction created by Waterloo Road. This large area of ponding provides storage until the primary network has sufficient capacity to allow drainage.
c) Although high levels in Opahu Stream are a factor in surcharge to the north, hydraulic gradient is available for conveyance south from Waterloo Road to Opahu Stream.

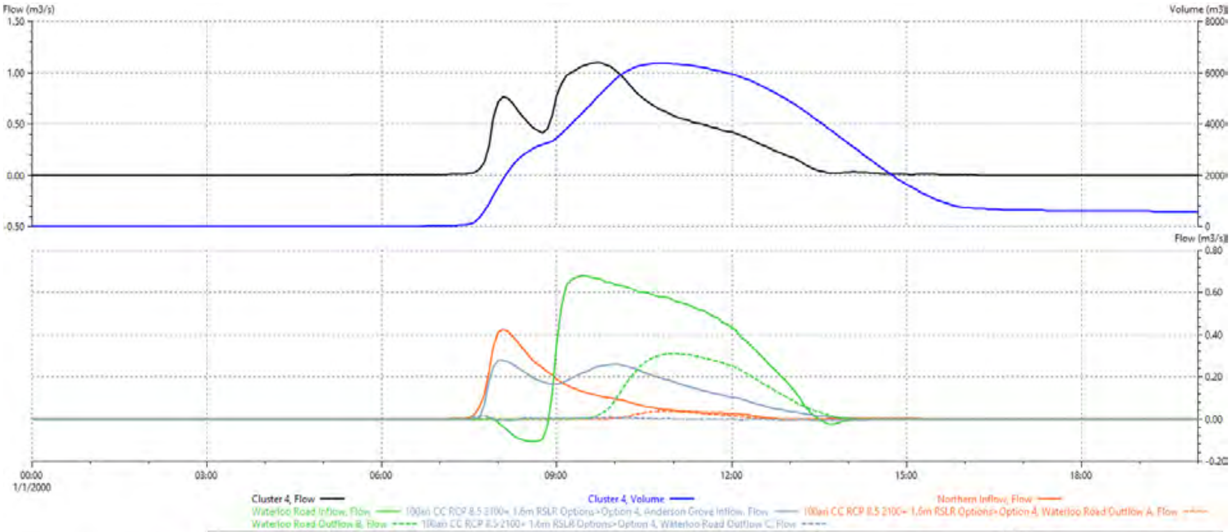
d) However, as most of the inundation volume already drains via the primary network, improved outcomes for the community may be better realised by development of purpose-built stormwater storage within St Bernard's College grounds. This would maintain the attenuating impact of the current ponding, limiting potential adverse impacts of more efficient conveyance downstream.

Additional detail is provided in the section below.

5.1 Detail

A series of result long sections in combination with a results polygon covering the Cluster 4 extent have been used to investigate flood mechanism. Figure 5-2 shows their locations with lines A, B and C used to demonstrate surface outflow and lines D, E and F used to demonstrate surface inflow. As the results in Figure 5-3 show, ~6,400m^3 of inundation volume accumulates within Cluster 4 on the northern side of Waterloo Road. Surface inflow (~13,000m^3) and surface outflow (~2,900m^3) balances indicate that much of the inundation volume ultimately drains through the primary network. Outflow over Waterloo Road at location B towards Chilton Saint James School peak at ~0.31m^3/s whereas inflows peak at ~1.10m^3/s.

Figure 5-2: Results sections at one inflow location along Waterloo Road (D), three outflow locations along Waterloo Road (A, B, C), Anderson Grove (E) and the northern inflow (F). The maroon fill represents the Cluster 4 results polygon.



	Flow			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
Cluster 4	-0.000	1.101	12240.621	0.000	6366.911
Northern Inflow	-0.001	0.428	2292.431		
Waterloo Road Inflow	-0.108	0.679	7306.946		
Anderson Grove Inflow	-0.000	0.279	3370.986		
Waterloo Road Outflow A	0.000	0.037	205.668		
Waterloo Road Outflow B	0.000	0.310	2730.030		
Waterloo Road Outflow C	-0.006	0.019	-0.646		

Figure 5-3: Flow and volume results for locations shown in Figure 5-2. Option 4 results.

Mechanisms driving these relatively large inflows are investigated in Figure 5-4, showing peak inundation depths, flow lines and cumulative spill from key nodes in the primary network. Spill from the primary network directly draining Cluster 4 is relatively minor, supporting the assumption that inundation within this area is mostly driven by surface inflows. Spill from nodes on Waterloo Road to the east of Cluster 4 is not labelled as the origin of these overland flow paths are not considered local to this cluster. However, overland flow from the north and from Anderson Grove originates from more localised primary network spill. This is particularly evident in the Marina Grove primary network with a total cumulative spill of ~2,500m^3 – total volume entering Cluster 4 from the north is ~2,300m^3. A long section of this network to Opahu Stream connection (highlighted yellow in Figure 5-4 and shown in Figure 5-5) indicates that the tailwater effect of high levels in Opahu Stream is likely a significant factor driving these spill volumes.

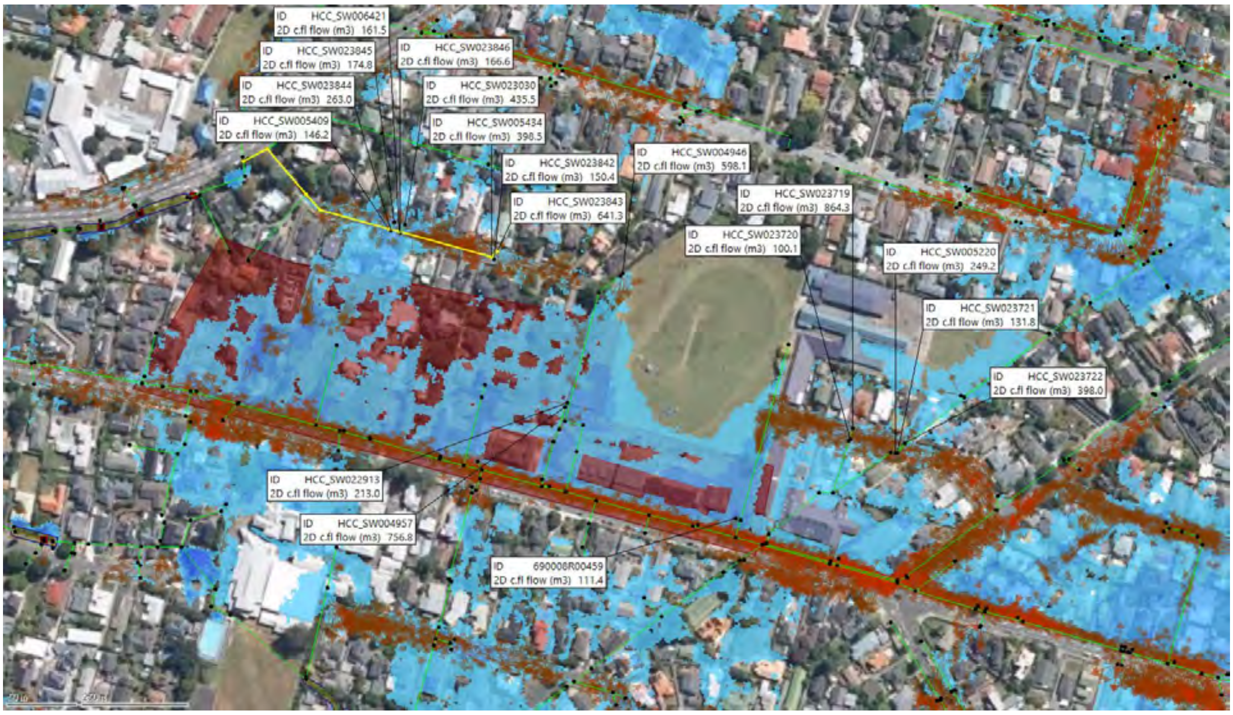


Figure 5-4: Nodes IDs and cumulative spill from the primary network. All nodes with cumulative spill >100m^3 within Cluster 4 are labelled, those outside are only labelled if considered to be significant in the context of overland flow. The primary network draining Marina Grove is highlighted in yellow. Option 4 results maxima shown.

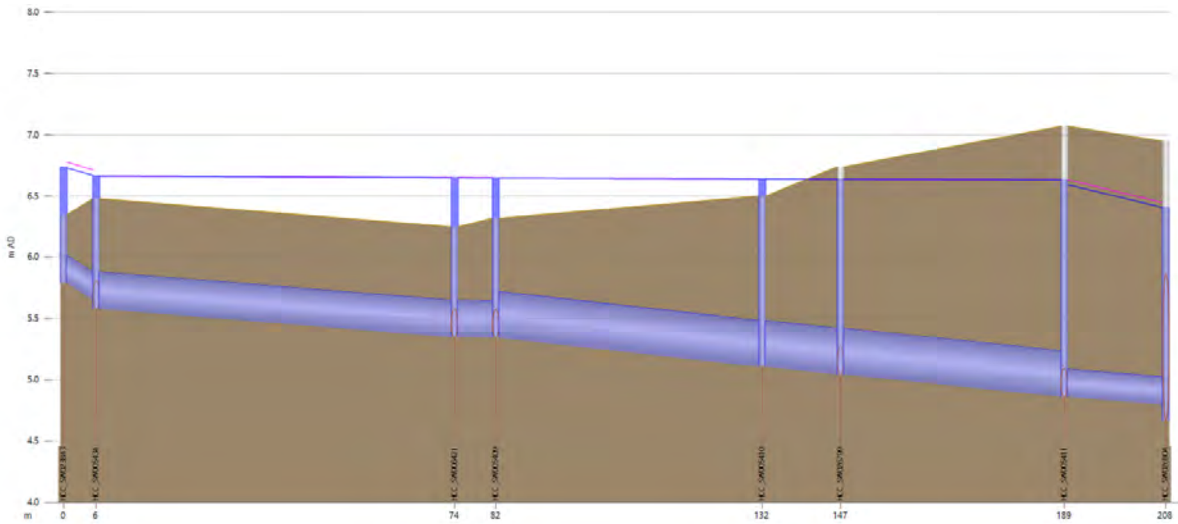


Figure 5-5: Long section of primary network connecting Marina Grove with Opahu Stream, as shown in Figure 5-4. Option 4 results maxima.

Investigation of subcatchments directly connect to Marina Grove indicates some inconsistency in model setup that may be contributing to the modelled spill volumes. As shown in Figure 5-6, the contributing area of these subcatchments extends north to Pretoria Street. Desktop information indicates that these subcatchment could be split and connected to the stormwater line between Marina Grove and Pretoria Street. Although capacity in the primary network is exceeded in the 100yr ARI RCP 8.5 2100+ event and spill is to be expected, subcatchment connection points will alter ponding locations and may influence overland flow path routing. Without confirmation of the current model setup, this reduces confidence in the modelled overland flow into Custer 4 from the north. However, the ~2,300m^3 total volume of this inflow is relatively minor compared to the total of ~13,000m^3.

Excluding potential issues around Marina Grove, subcatchment delineations and connection points are generally as expected based on local topography (as shown in Figure 5-7). However, if higher frequency events are considered in the future, it is recommended that subcatchment setup is revisited as it will become more important with increased reliance on the primary stormwater network.

Figure 5-6: Subcatchments directly connected to the Marina Grove primary network.

Figure 5-7: Subcatchment delineations and primary network connection locations.

As previously identified, much of the accumulated volume within Cluster 4 drains through the primary network. There are four potential routes in the primary network connecting this part of Waterloo Road to Opahu Stream. Figure 5-8 and Figure 5-9 highlight the shortest route as an example. Although relatively deep ponding is modelled above parts of the culverted Opahu Stream beneath Chilton Saint James School (Figure 5-8), hydraulic gradient (Figure 5-9) is present in the results maxima that will likely allow drainage towards Opahu Stream through capacity upgrades proposed by T+T.

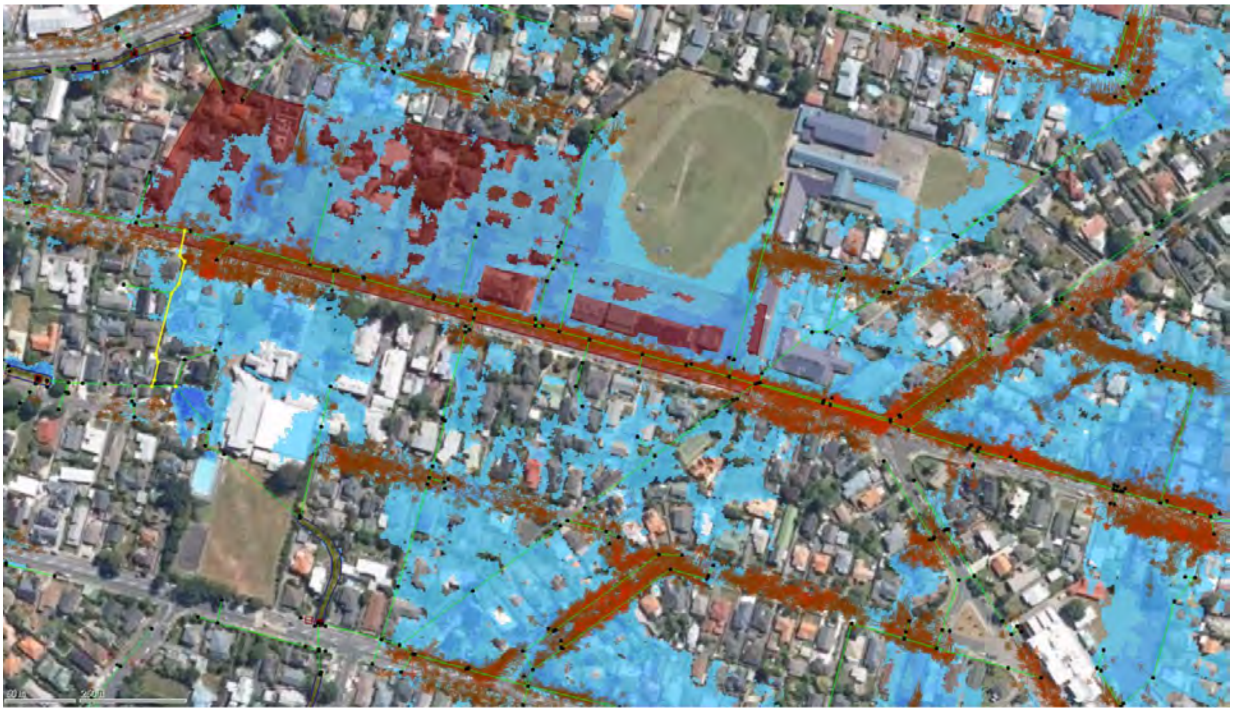


Figure 5-8: Plan view of shorted selected connection between Waterloo Road and the pipe section of Opahu Stream connecting Queens Grove with the reach upstream of Knights Road (beneath Chilton Saint James School). Option 4 results maxima.

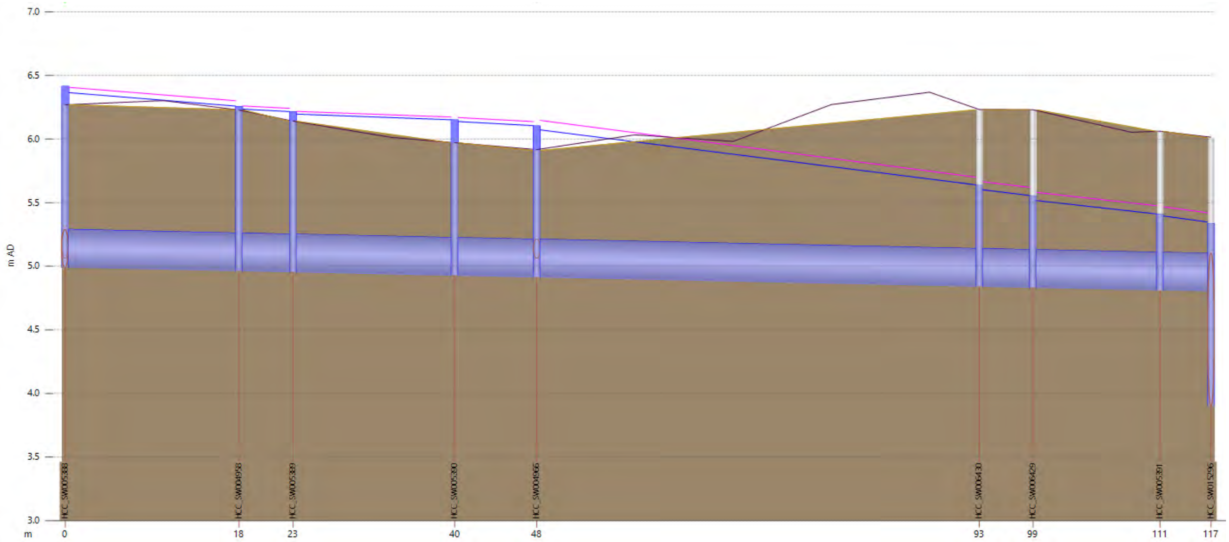


Figure 5-9: Long section of primary network connecting Waterloo Road to Opahu Stream, as shown in Figure 5-8. Option 4 results maxima.

6 Cluster 5

Stantec's understanding of Cluster 5 based on Figure 6-1 and discussion with T+T is as follows:

a) Two high-capacity "scruffy" dome style inlets at either side of Mahoe Street at intersection with Knights Road.
b) Pipe connection to Option 4 pump station constructed at upstream side of Opahu Stream crossing underneath Waterloo Road.
c) Swale constructed at western end of Chilton Grove to facilitate flow towards Opahu Stream.
d) Cluster 5 is to be considered as an extension of Option 4, and therefore should use Option 4 100yr ARI RCP 8.5 2100+ model results.

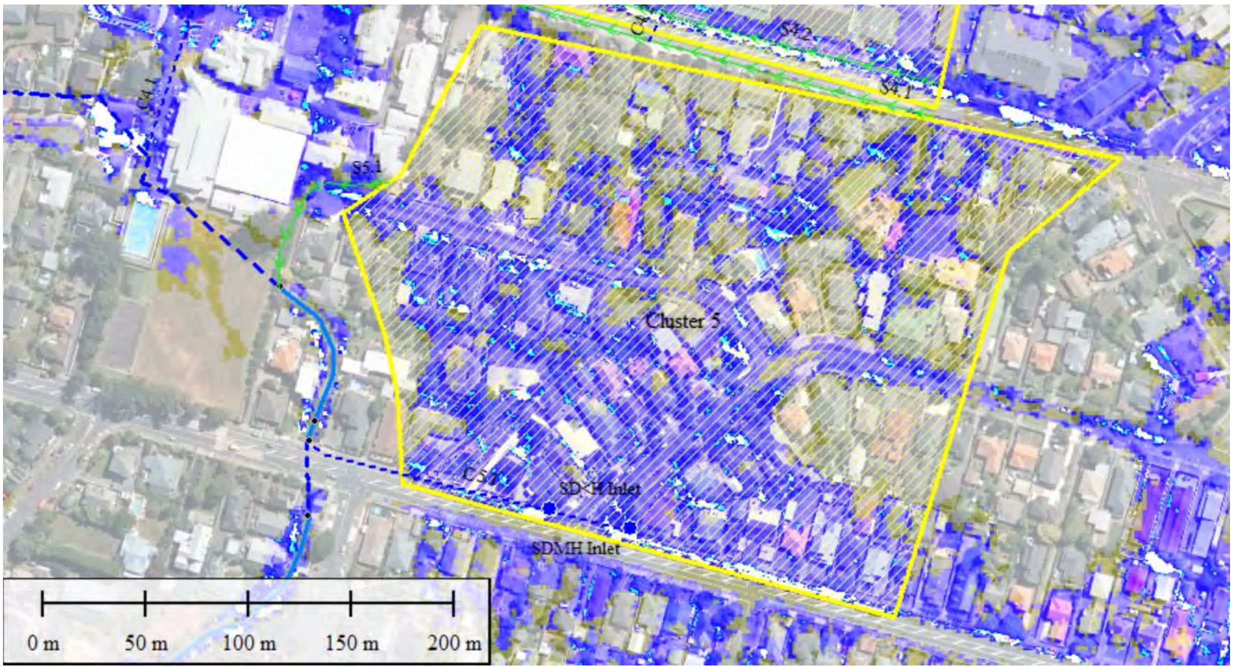


Figure 6-1: Screenshot of Cluster 5 as provided by T+T.

Stantec assessment of proposed T+T solution and potential additional options is summarised as:

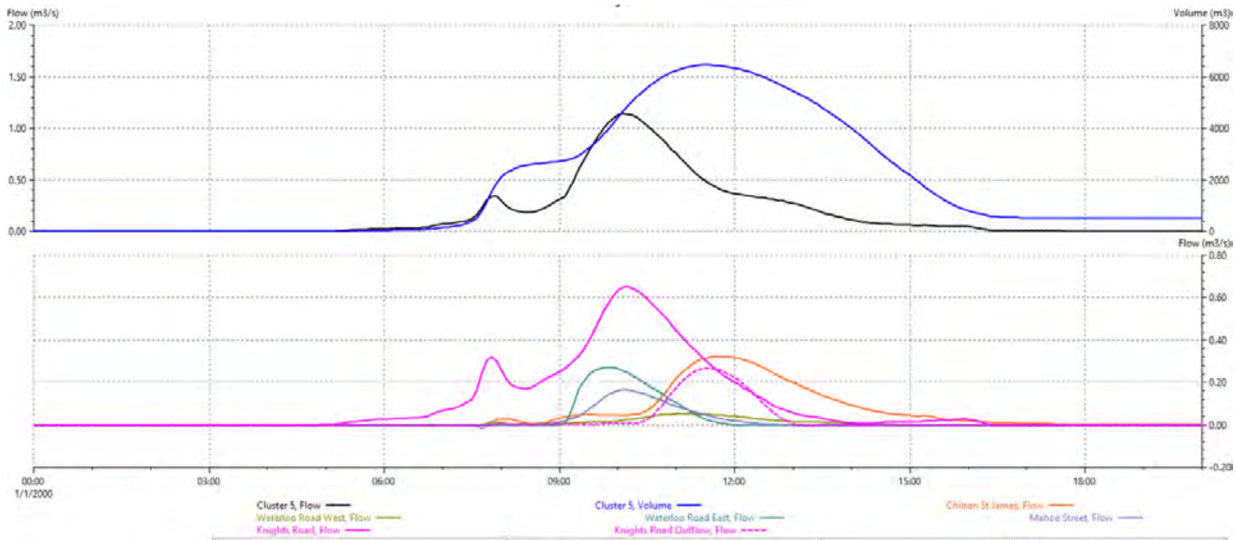
a) Additional inlet capacity upstream of the Knights Road topographic barrier with conveyance towards the Option 4 pump station will reduce flood levels to the north.
b) Much of the inundation volume drains through the primary network due to the Option 4 pump station; however, the impact of increase flows in Opahu Stream on known downstream flooding issues should be considered.
c) High levels in Opahu Stream are less relevant due to reliance on the Option 4 pump station.
d) There may be potential for stormwater attenuation in Chilton Saint James School rather than heavy reliance on pumping.

Additional detail is provided in the section below.

6.1 Detail

Results sections and a results polygon are presented in Figure 6-2, with flows and volumes presented in Figure 6-3. As shown in Figure 6-3, inundation volume in Cluster 5 peaks at ~6,500m^3, with a total inflow volume of ~13,400m^3 and peak flow of 1.14m^3/s. However, outflow volume across the Knights Road topographic barrier is only ~1,400m^3, with flow peaking at ~1.13m^3/s. Model results indicate that the primary network removes ~10,000m^3 from the 2D surface. Considerable volumes are drawn from Cluster 5 by the proposed pump station included in the Opahu Stream upstream of Knights Road (Option 4).

Figure 6-2: Results sections for inflows at Chilton Saint James School (A), Waterloo Road West (B), Waterloo Road East (C), Mahoe Street (D) and Knights Road (E). One outflow results section for flow to the south across Knights Road. The maroon fill represents the Cluster 5 results polygon.



	Flow			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
Cluster 5	-0.000	1.143	12171.720	0.000	6457.998
Chilton St James	0.000	0.323	3517.499		
Waterloo Road West	0.000	0.053	525.439		
Waterloo Road East	-0.002	0.273	1458.264		
Mahoe Street	-0.016	0.165	974.032		
Knights Road	-0.001	0.651	6905.423		
Knights Road Outflow	-0.004	0.269	1443.514		

Figure 6-3: Flow and volume results for locations shown in Figure 6-2. Option 4 results.

Figure 6-4 shows cumulative spill from the primary network at locations where it is greater than 100m^3. This indicates that in addition to considerable overland flow entering the cluster, spill from the primary network within Cluster 5 is a significant factor contributing to inundation extents.

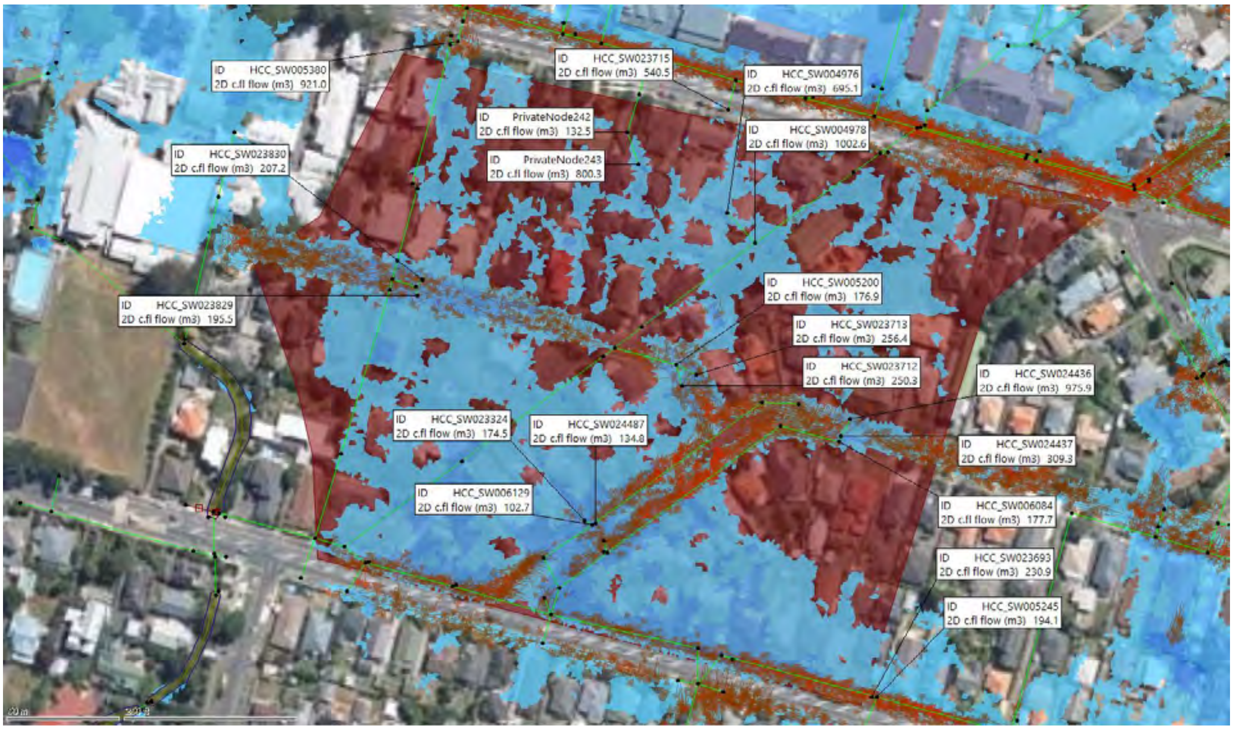


Figure 6-4: Nodes IDs and cumulative spill from the primary network. All nodes with cumulative spill >100m3 within Cluster 5 are labelled, those outside are only labelled if considered to be significant in the context of overland flow. Option 4 results maxima shown.

Two long sections have been extracted from the primary network for locations shown in Figure 6-5. Figure 6-6 is extracted along a large stormwater main terminating at the Opahu Stream pump station (Option 4) demonstrates that hydraulic gradient remains available even at the results maxima; however, cover is insufficient to prevent spill. Figure 6-7 is extracted on a smaller network branch that flows towards an alternative primary network route draining Cluster 5. This long section demonstrates reduced capacity for conveyance; although, it should be noted that this bifurcation drains towards the Awamutu Stream rather than the Opahu Stream.

Figure 6-5: Plan view of primary network long section A-B and C-D locations.

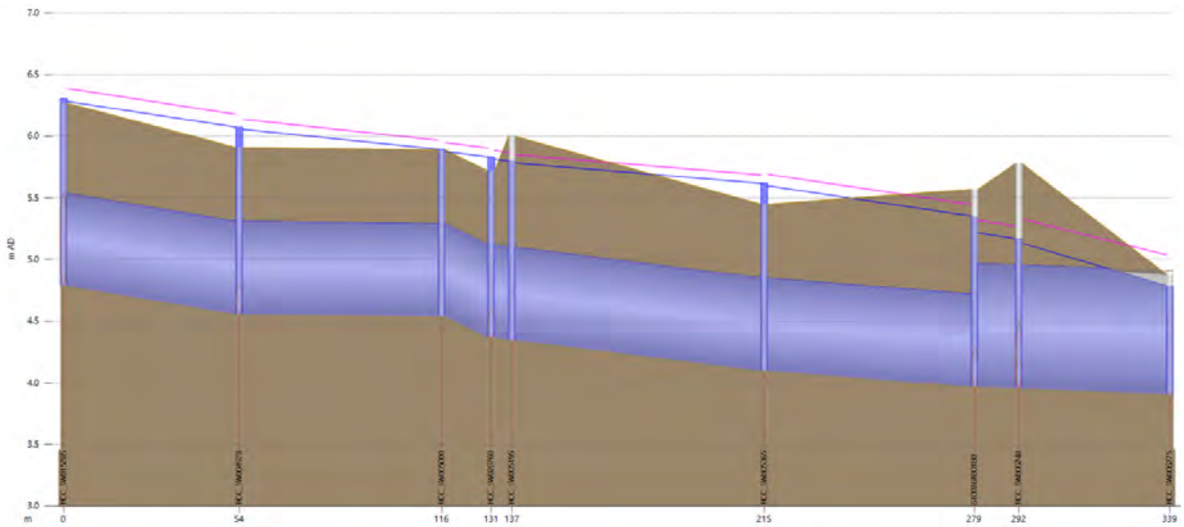


Figure 6-6: Option 4 maxima. Long section between A and B as shown in Figure 6-5.

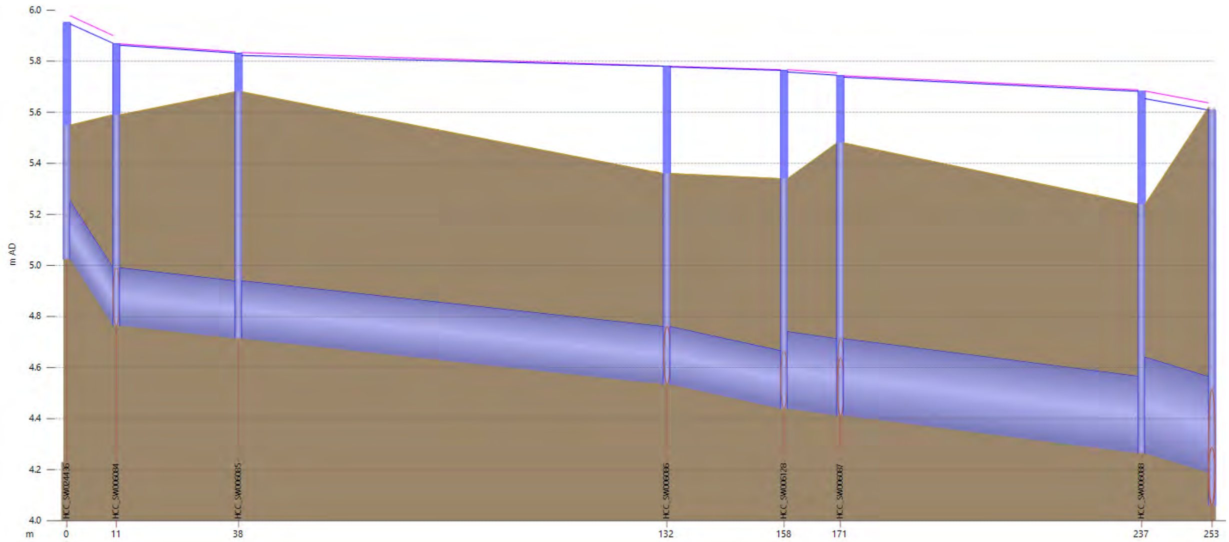


Figure 6-7: Option 4 maxima. Long section between C and D as shown in Figure 6-5.

Figure 6-8 Figure 4-7shows model subcatchment connections and delineations around Cluster 5 – these appear a reasonable representation of likely overland flow paths in Cluster 5. However, if higher frequency design events are adopted in the future, it is recommended that subcatchment connection points and delineations are revisited.

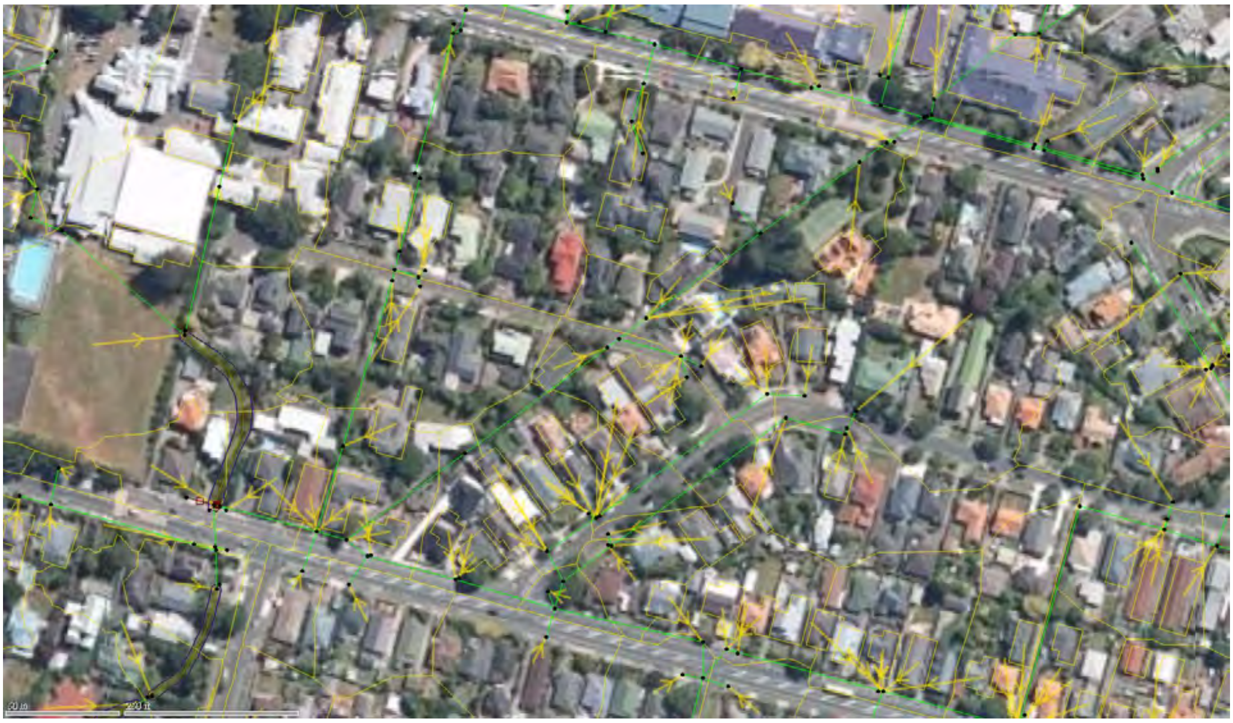


Figure 6-8: Model subcatchment delineations and connection points.

7 Cluster 6

Stantec's understanding of Cluster 6 based on Figure 7-1 and discussion with T+T is as follows:

a) Swales constructed either side of Hautana Street to convey water southwest and northeast towards the mid-point of Cluster 6.
b) Piped crossing through Hautana Street with a scruffy dome style inlet and a "bubble-up" outlet.
c) Swale constructed to connect pipe flow to Opahu Stream.
d) Cluster 6 is to be considered as an extension of Option 5, and therefore should use Option 4 100yr ARI RCP 8.5 2100+ model results.

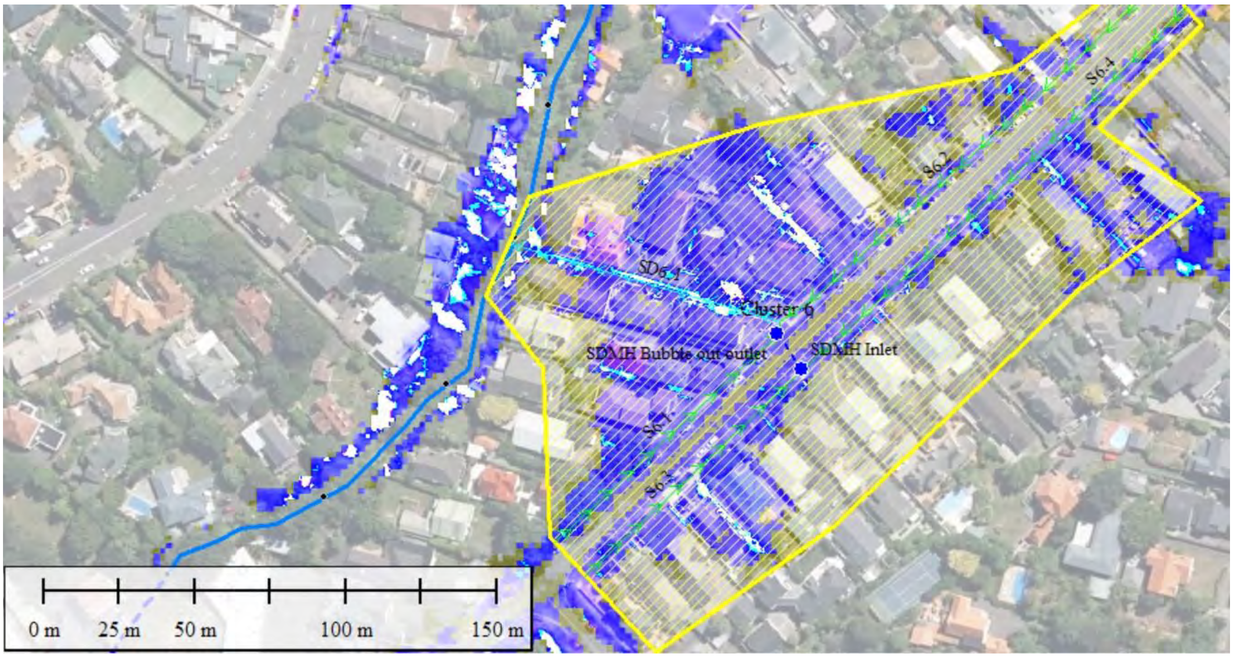


Figure 7-1: Screenshot of Cluster 6 as provided by T+T.

Stantec assessment of proposed T+T solution and potential additional options is summarised as:

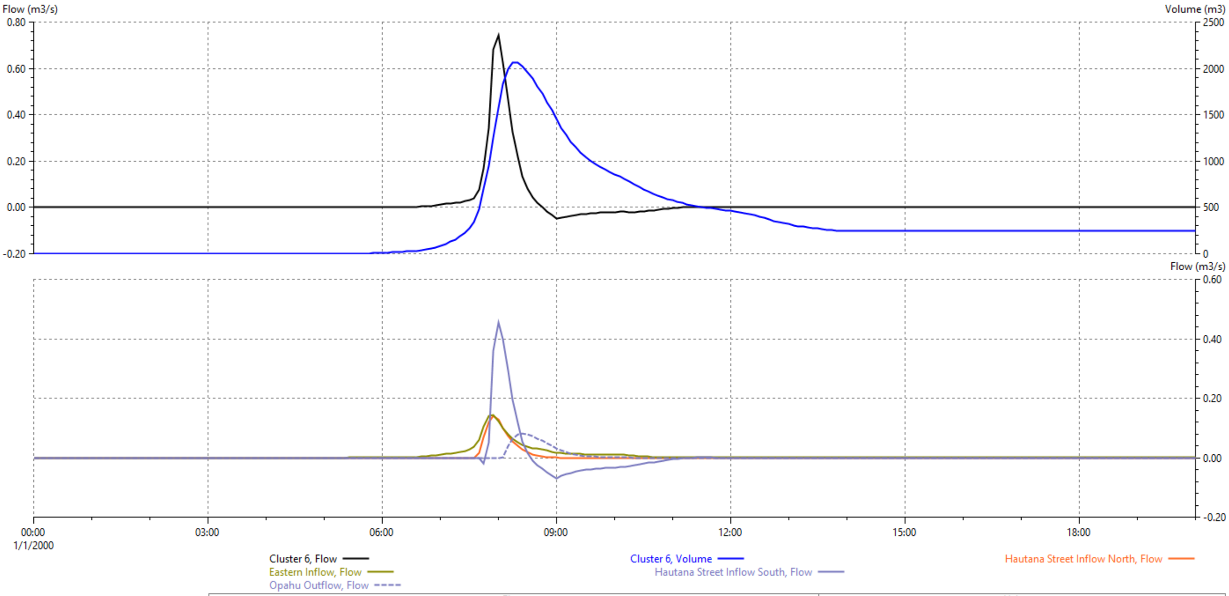
a) A predominately surface based approach is logical due to the large volumes and relatively small primary network catchment area.
b) Hydraulic grade should be available for overland conveyance towards Opahu Stream.
c) There may be an opportunity to capture additional overland flow on the southern side of Sherwood Street that flows south away from the proposed solution; however, these flows are relatively minor.

Additional detail is provided in the section below.

7.1 Detail

Figure 7-2 shows the location of results sections and polygons extracted for Cluster 6. Inflows to the cluster occur from the east (B) and along Hautana Street from the north (A) and south (C). Overland flow is discharged to Opahu Stream at section D – this is the same location that the primary network is also discharged. As shown in Figure 7-3, inundation volume peaks at ~2,000m^3 and inflow peaks at ~0.74m^3/s. Overland flow contributes ~50% of this by volume, the majority of which originates from the southern end of Hautana Street.

Figure 7-2: Results sections for inflows at Hautana Street North (A), the eastern inflow (B) and Hautana Street South (C). One outflow results section (D) capturing overland flow into Opahu Stream. The maroon fill represents the Cluster 6 results polygon.



	Flow			Volume	
	Min (m3/s)	Max (m3/s)	Volume (m3)	Min (m3)	Max (m3)
Cluster 6	-0.047	0.743	1071.111	0.000	2060.744
Hautana Street Inflow North	-0.000	0.140	229.941		
Eastern Inflow	0.000	0.145	464.445		
Hautana Street Inflow South	-0.069	0.455	274.914		
Opahu Outflow	-0.000	0.082	223.979		

Figure 7-3: Flow and volume results for locations shown in Figure 7-2. Option 4 results.

Approximately 50% of the inundation volume within Cluster 6 is spilled from the primary network within the cluster. Figure 7-4 shows cumulative spill totals from the primary network greater than 100m^3. Outside of the cluster local primary network spill is responsible for much of the overland flow volume.

Figure 7-4: Nodes IDs and cumulative spill from the primary network. All nodes with cumulative spill >100m3 within Cluster 6 are labelled, those outside are only labelled if considered to be significant in the context of overland flow. Option 4 results maxima shown.

As the primary network within Cluster 6 doesn't extend far beyond the boundary of the cluster, the full subcatchment contributing area is shown in Figure 7-5. Subcatchment delineation extend east to Penrose Street, which, without detailed investigation, appears likely to overestimate contributing area. However, this is unlikely to have a significant impact on results as the network is fully surcharged and overland flow from outside of the cluster is a large contributor to total volume.

If higher frequency design events are adopted in the future, it is recommended that subcatchment connection points and delineations are revisited. Results are likely to become more sensitive to subcatchment setup in smaller events due to the increased importance of primary network performance.

Figure 7-5: Model subcatchment delineations and connection points for those directly connected to the Cluster 6 primary network.

Long sections have been extracted from the primary network for locations shown in Figure 7-6. Figure 7-7 and Figure 7-8 demonstrate that although the network is fully surcharged, there is hydraulic gradient available at the results maxima for conveyance towards Opahu Stream.

Figure 7-6: Plan view of primary network long section A-B and C-D locations.

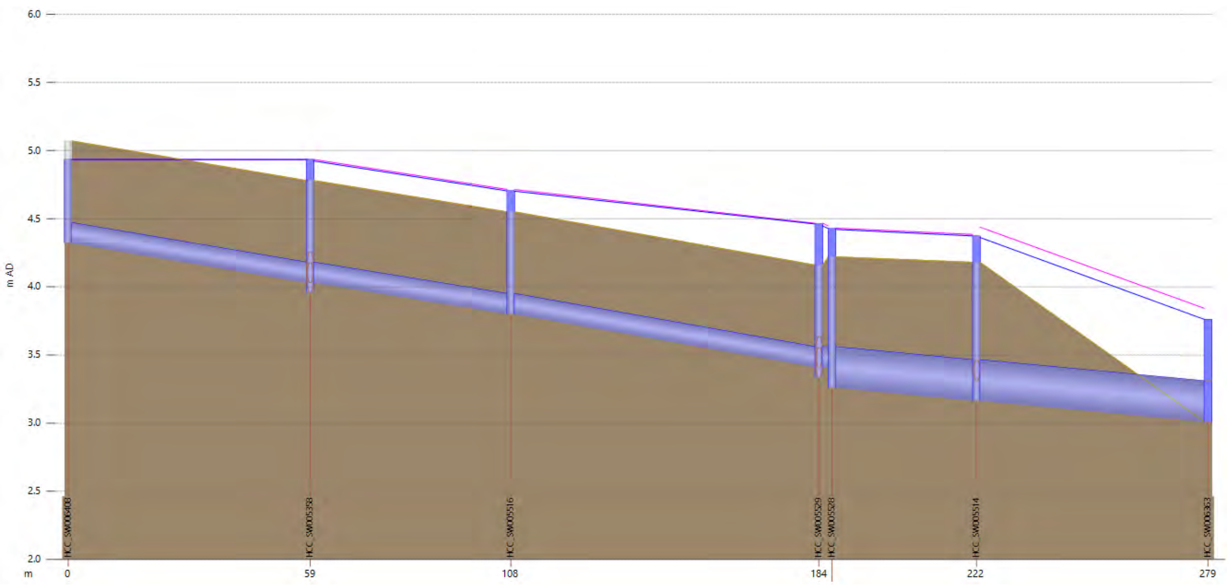


Figure 7-7: Option 4 maxima. Long section between A and B as shown in Figure 7-6.

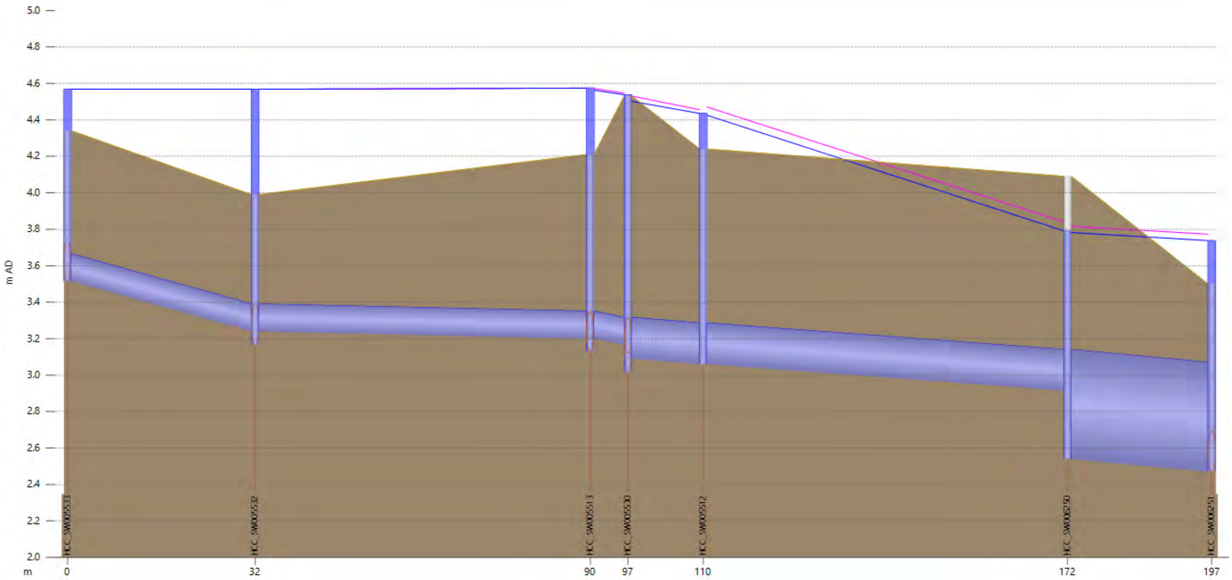


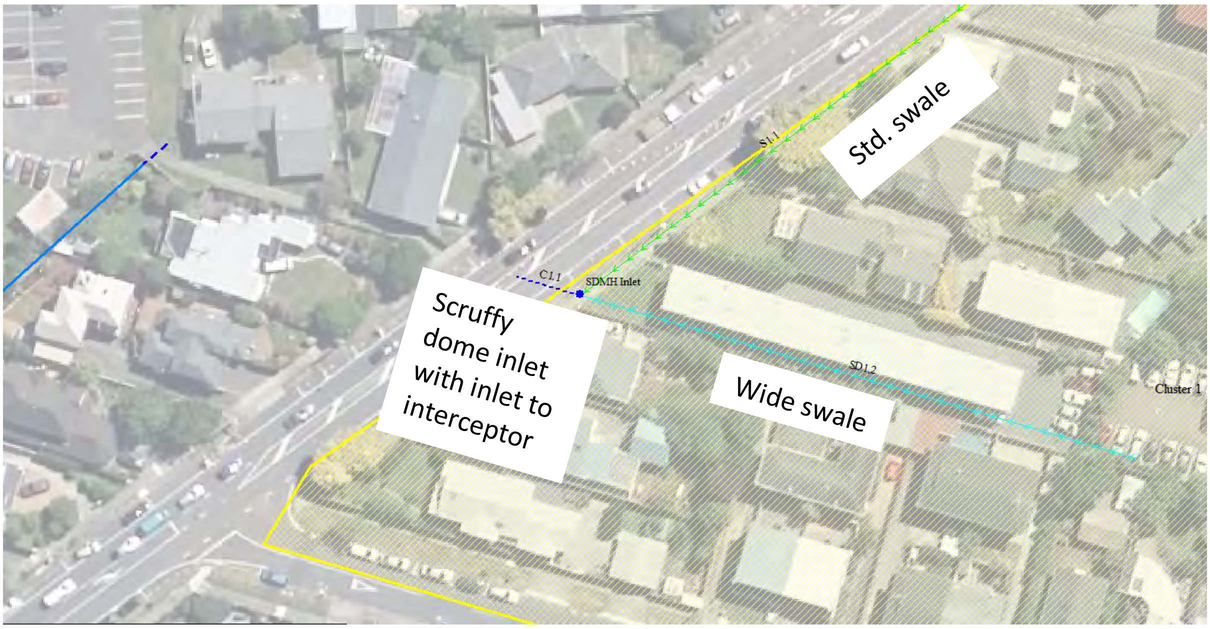
Figure 7-8: Option 4 maxima. Long section between A and B as shown in Figure 7-6.

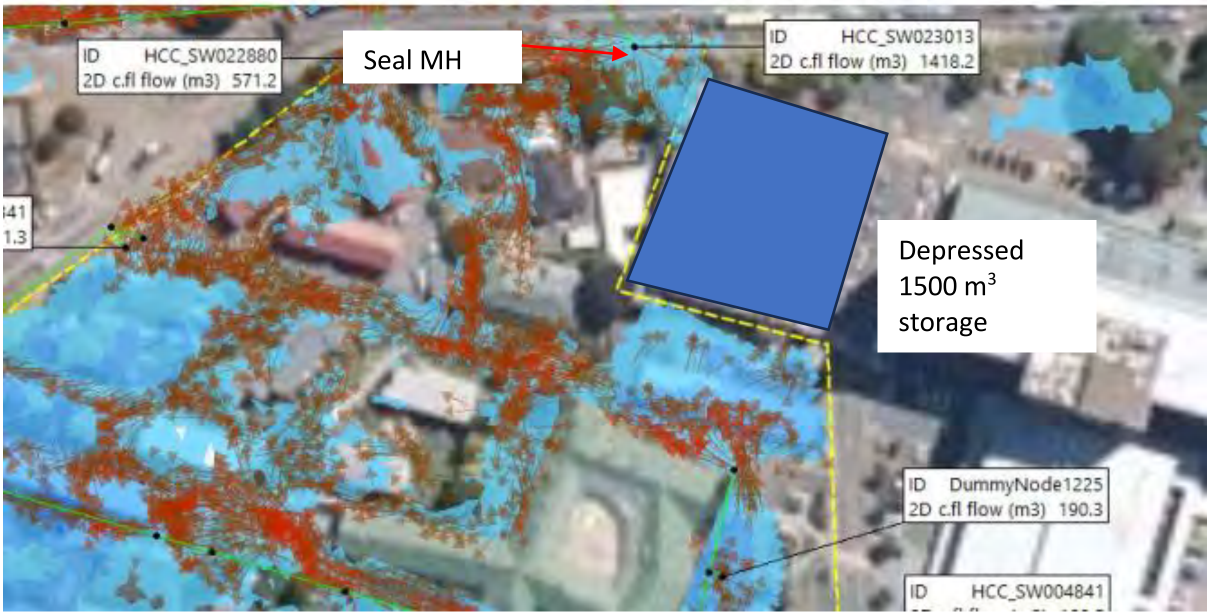
Appendix D Cluster Modelling Instructions

Directions for Stantec modelling of the six Pivot clusters, MARH 16/1/2023.

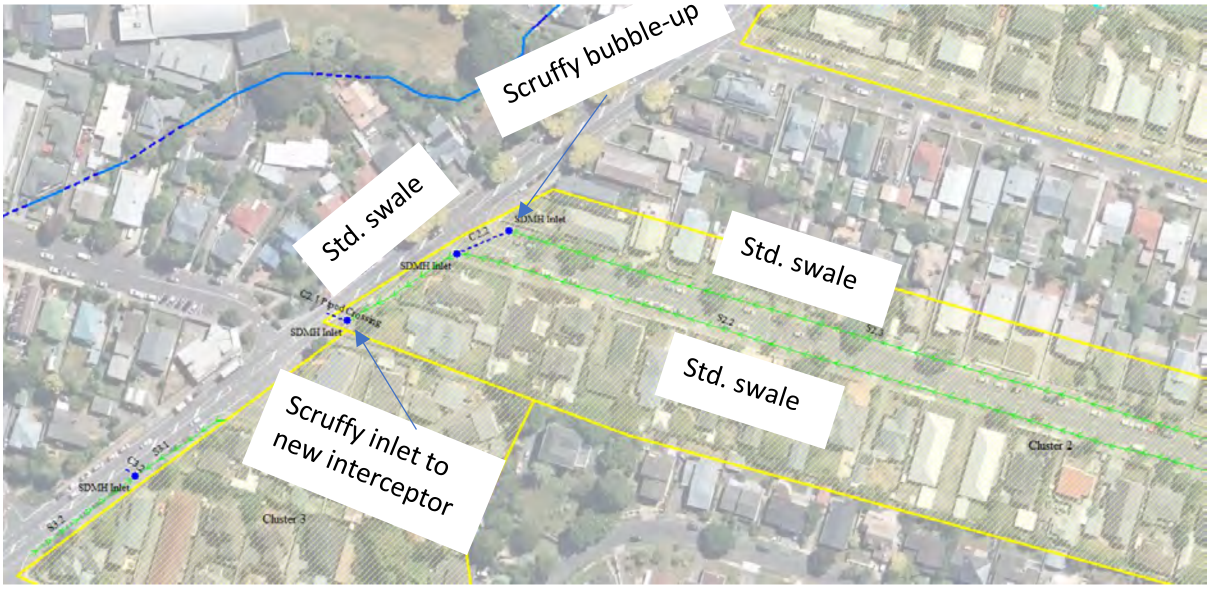
FINAL (supersedes draft from 15/01/2023)

1 Cluster 1





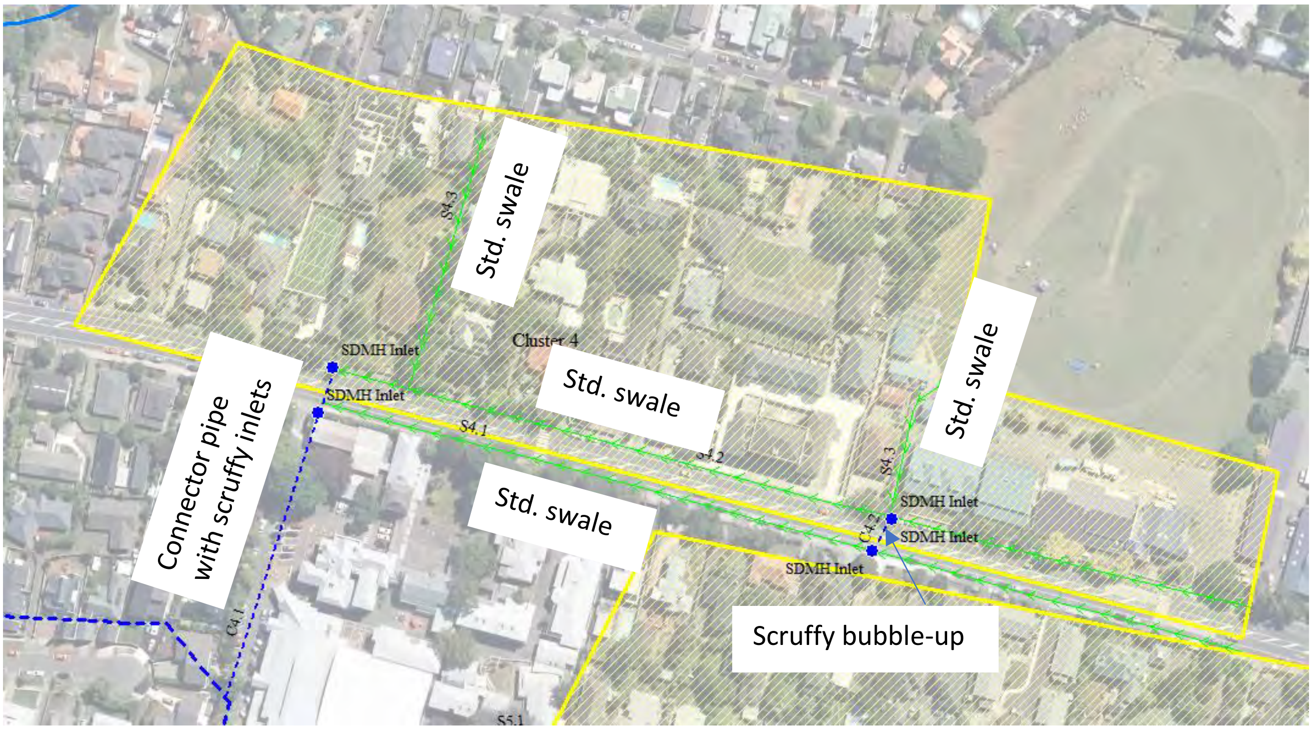
2 Cluster 2


Scruffy bubble-up
Std. swale
Std. swale
Std. swale
Scruffy inlet to new interceptor
SDMH Inlet
SDMH Inlet
SDMH Inlet
SDMH Inlet
Cluster 2
Cluster 3

3 Cluster 3

Connector pipe with scruffy inlet to new interceptor
SDMH Inlet
C2.2
SDMH Inlet
C2.1 Piped Crossing
SDMH Inlet
S2.2
S2.3
Std. swale
S3.1
SDMH Inlet
S3.2
Cluster 3
Std. swale

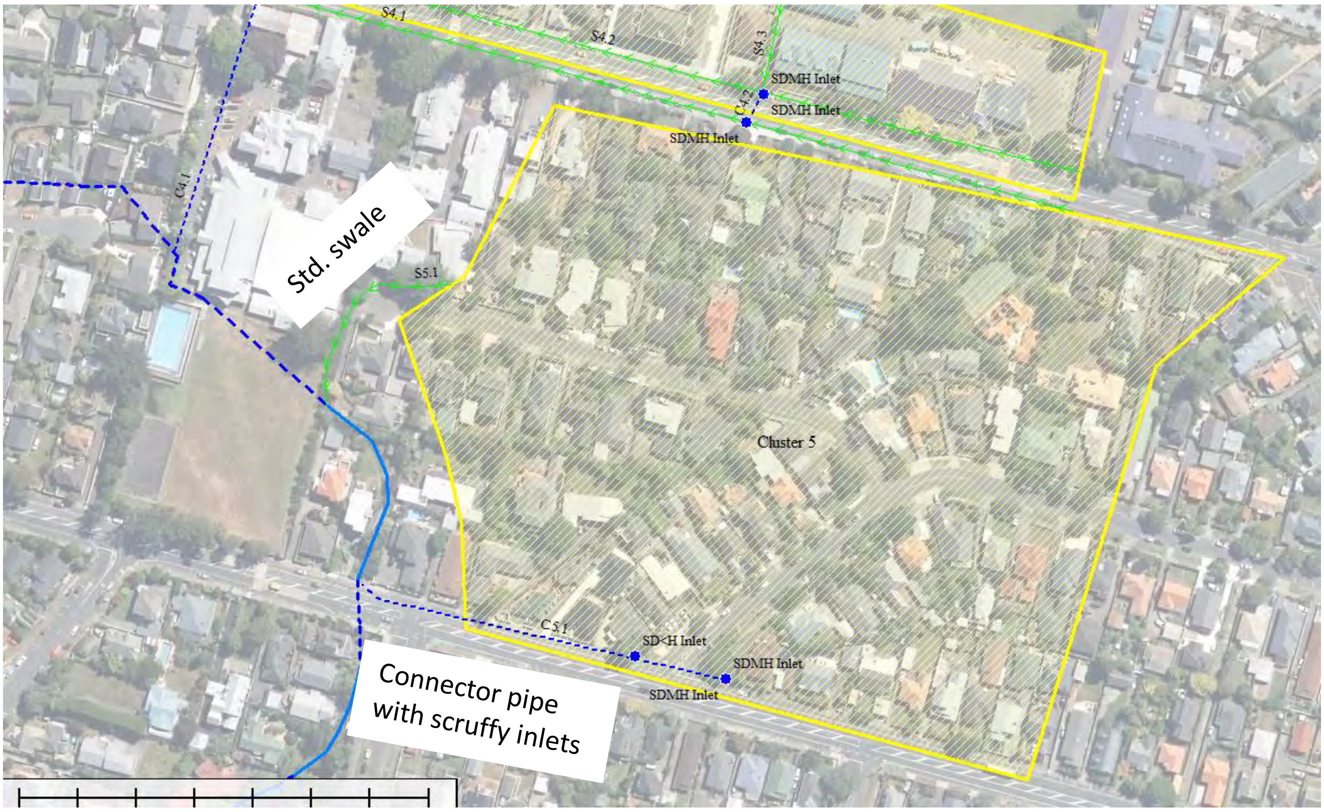
4 Cluster 4



(Note: we have decided not to proceed with modelling storage on the playing field at this stage)

The Chilton St James driveway culvert to the Opahu Stream should be modelled as 825 mm dia RCRRJ.

5 Cluster 5



Connector pipe size 375 mm dia RCRRJ

Stantec force swale from head of cul-de-sac at 0.5% grade to stream.

6 Cluster 6

Force wide swale at 0.5% longitudinal grade to stream.

Road swales at approx. existing grade.

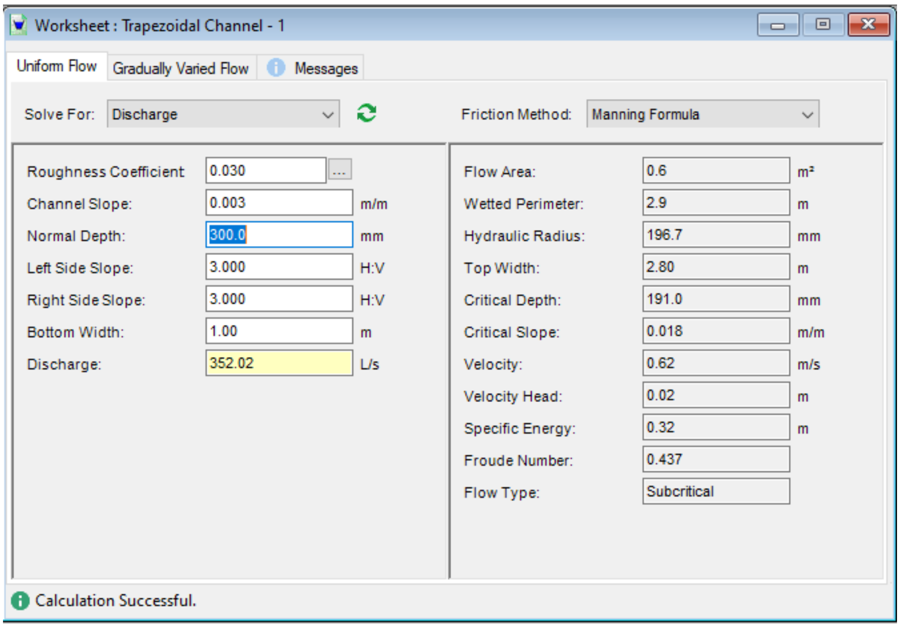
STANDARD COMPONENTS

Standard swale:

Trapezoidal grass swale with 3:1 side slopes and 1 m bottom width.

This will convey around 300 l/s at 0.25% and 450 l/s at 0.5%. I would ask them to model the swale at the approximate longitudinal grade available on that street. From [redacted] work using Copeland St as an example, a 3 m swale each side is about the best we could manage and would still result in loss of parking on one side and narrowing of the carriageway.

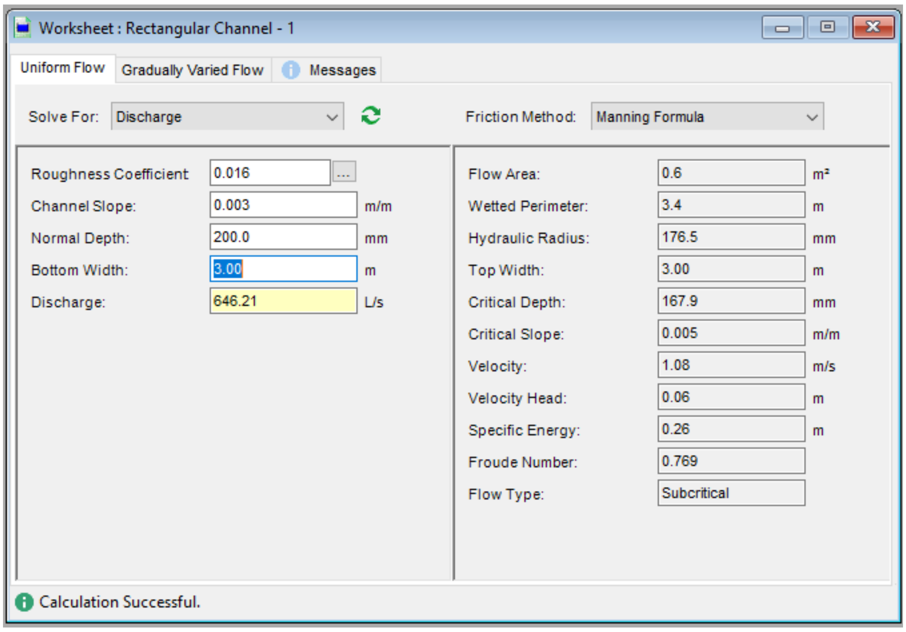
This will also need an underdrain intercepting house laterals and connecting to SW manholes but this plays no role in the flood modelling.



Wide swale

(sunken driveway – e.g. Clusters 1, 6)

3 m wide, 0.25% longitudinal grade, up to 200 mm flow depth, asphalt roughness. Conveys at least 600 l/s



<u>Scruffy domes (both bubble-up and pipe inlet):</u>

From WWL modelling guidelines. Note: set scruffy dome 200mm below existing ground level, to represent that it would be incorporated into a local swale or a small inlet basin. We don't want it to head up by 300mm in order to achieve a 500 l/s inlet capacity.

Scruffy Dome (1500mm)

Depth = 0.6m, Diameter = 1.5m

Q	H
1.24	0.5
0.89	0.4
0.58	0.3
0.31	0.2
0.11	0.1
0	0
-0.1	-0.02
-0.2	-0.03
-1	-0.04
-1.5	-0.045
-2	-0.05

Plot

Stantec New Zealand
Stantec Building, Level 15, 10 Brandon Street
Wellington 6011
PO Box 13-052, Armagh, Christchurch 8141
Tel +64 4 381 6700

Appendix Z- SiD hazard register

SAFETY IN DESIGN RISK REGISTER

Project	**HCC WIG Stormwater**
Project Number	**1091097**
Design Stage	**Feasibility (preferred option)**
Works Area/Location	**Various roads in Lower Hutt. Hutt River and stopbank. PS location adjacent Easter Hutt School (Kings Cresc)**

SID workshop held on 1/05/2023. Thoughts on key SID risks and mitigations were captured for the next design stage. Risk assessment has not been carried out at this stage as the design is still at a high level.
Attendees:
[redacted]

Date	1/05/2024
Revision	1

ID	Project Lifecycle	Hazard	Existing Controls	Risk Assessment C	Risk Assessment L	Risk Assessment Risk	Mitigation options	Residual Risk C	Residual Risk L	Residual Risk Risk	Considerations	Go?	Owner
R001	<Design>	Injury during site investigations	JSEA process										
R002		Damage to aquifer during investigations											
R003	<Construction>	Traffic	Compliance with all codes of practice, JSEA/H&S plans, permits, consents, standards. Detailed services investigations. Detailed site investigations incl geotechnical.										
R004		Fall from heights					Minimise depth. Consider opportunities for trenchless. Good coordination/communication with HCC, Riverlink and others on construction staging.						
R005		Risk of injury to members of public, adjacent school, neighbours											
R006		Risk of serious injury or death from underground service strikes											
R007		Above ground power											
R008		Working near/at stream.											
R009		Deep excavations - safety risk to workforce											
R010		Deep excavations - contamination of aquifer											
R011		Deep excavations - adjacent foundation/assets stability											
R012		Stopbank failure at outlet during construction	Coordination with Riverlink designers, consent conditions				Careful attention to construction staging, contingency plans, flood warning/forecasting, close liason with GWRC. Construct new stopbank section with existing in place?						

SAFETY IN DESIGN RISK REGISTER

Tonkin+Taylor

Project	**HCC WIG Stormwater**
Project Number	**1091097**
Design Stage	**Feasibility (preferred option)**
Works Area/Location	**Various roads in Lower Hutt. Hutt River and stopbank. PS location adjacent Easter Hutt School (Kings Cresc)**

SID workshop held on 1/05/2023. Thoughts on key SID risks and mitigations were captured for the next design stage. Risk assessment has not been carried out at this stage as the design is still at a high level.
Attendees:
[redacted]

Date	1/05/2024
Revision	1

R013	<Operation>	Public safety at outlet in operation e.g. kayakers					Fencing. Energy dissipation/stilling basin. Consider exact outlet location. Alarm.						
R014		Electrical failure causes flooding	Provision for generator				Consider in more detail during phase/permanent generator on site						
R015		Electrical safety incl. generator	Design to codes and Wellington Water standards, minimum electrical clearances,				Locate electricals inside closed building. Ventilated building. limit any exposed (outside) cables - use duct						
R016		Generator noise	Sound proofing Very occasional use, though typically tested once per month										
R017		Hazardous materials (diesel) near stream/groundwater	Double containment, location as far as possible from stream.				Consider bund additionally.						
R018		Clearing the screen. Operator safety and pump station performance.	Existing pump stations have two-stage screen with no automated provison, digger required on site.				Consider two-stage screening (coarse rack then automated screen). Provide enough room for vehicle access. Provide safe secondary access for manual cleaning. Alternative methods for monitoring blockage.						
R019		Draining of pipeline via scour chambers - mobile pump?	Locate chambers out of trafficable areas				Consider fixed submersible pump with generator connection kiosk						
R020		Falling from height - screen/intake area	Site fenced. Barrier for heights > 1m				Design out the need for regular access to the screen area.						
R021		Cleaning of wet well using sucker truck and two personnel	Fall prevention barriers, secure fixing points for portable ladders. Lighting. Use of sump pump to drain chamber. Full turning circle and access.				Consider whether a flushing system could reduce need for manual operation (though sucker truck operation v. likely still needed)						

Tonkin+Taylor

SAFETY IN DESIGN RISK REGISTER

Project	**HCC WIG Stormwater**
Project Number	**1091097**
Design Stage	**Feasibility (preferred option)**
Works Area/Location	**Various roads in Lower Hutt. Hutt River and stopbank. PS location adjacent Easter Hutt School (Kings Cresc)**

SID workshop held on 1/05/2023. Thoughts on key SID risks and mitigations were captured for the next design stage. Risk assessment has not been carried out at this stage as the design is still at a high level.
Attendees:
[redacted]

Date	1/05/2024
Revision	1

R022		Traffic	Room for vehicle access and parking on site.				Consider drive-through arrangement avoiding need for turning						
R023		Security - public access	Security fence and gate.				CCTV						
R024		Falling from height	Presence and options to be confirmed in next design stage Pump redundancy = less need for urgent works										
R025	<Maintenance>	Overhead power vs cranes	Confirm presence/location				Location of chambers vs overhead power. Relocate power.						
R026		Access to wet well for inspections, e.g. impellers	Fall prevention barriers, secure fixing points for portable ladders. Lighting.				Fall prevention grating for inspection.						
R027		Access to PS equipment for removal	Access through hatches, mobile crane										
R028	<Decommissioning/ Deconstruction>	Hazardous materials											

Appendix AA- Risk register

HCCIAF Risk Register Export 3 May 2024 - LIVE RISKS

												HCC Rating	HCC Rating							HCC Rating	HCC Rating
Risk ID	Sector	Element	Risk Title	Cause	Consequence	Risk Owner	Existing Controls	Control Effectiveness	Likelihood	Consequence	Inherent Rating (Project)	HCC Consequence Rating	Inherent Rating (HCC)	Status	Treatment Action	Action Owners	Residual Likelihood	Residual Consequence	Residual Rating (Project)	HCC Consequence Rating	Residual Rating (HCC)
RSK-0045	Stormwater Pipeline	Design	Unable to agree on stormwater outlet configuration through stopbank	Te Awa Kairangi Project partners (GW, WWL and HCC) cannot agree on Outlet configurations. e.g. through stop bank, over stop bank or under stop bank. Location and solutions could impact on outfall capacity. Riverlink Alliance is no longer pursuing this piece of work - HCC to progress.	Delay in preferred solution selection and further design iterations.	[redacted]	Working alongside RL Alliance Project Partner Leads and Alliance design team. Communication with WWL and GW around existing RL consents regarding infrastructure. April 24: Have engaged with GWRC environmental leadership team, and have had initial alignment on options for the outfall, and received some feedback.	Improvement Required	Likely (55% - 85%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	HIGH	Loss or increased cost of $500k to $5m	HIGH	Live - Treat	Further engagement with GWRC during Stage 2		Possible (30% - 55%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	MEDIUM	Loss or increased cost of $500k to $5m	MEDIUM
RSK-0075	Stormwater Pipeline	Design	Potential aquifer damage or contamination (stormwater)	Waiwhetu aquifer penetration or aquiclude damage during construction - deep foundations/wells for pump stations and/or deep lines. Also includes the low probability of contamination within the drawdown zone of the Knights Rd borefield.	Water supply contamination from Waterloo WTP. Release of water from aquifer. Up to 70% of water supply for Wellington affected with saltwater ingress.	[redacted]	Check aquifer depth and design structures to not penetrate aquiclude. MCA criteria to select preferred option with consideration of these risks.	Generally Sound	Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat	Further during stage 2: - Complete geotechnical site investigation to confirm aquifer and aquiclude depth - Consider depth of aquifer and aquiclude in design - Talk to GWRC about mitigation measures to protect aquifer - Obtain resource consent if needed and comply with consent conditions - Make all efforts to reduce pump station depth.	[redacted]	Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM
RSK-0079	Stormwater Pipeline	Planning	Study commissioned by HCC to consider properties with high development potential - impact on preferred option	HCC is commissioning a catchment study and highlighting areas for high development potential. This will influence preferred option and its intended benefits.	aaa	[redacted]	Initial view of study scope suggests not a risk to SW optioneering, as the outcome will provide further clarity to extent of overlap with the current SW study scope. Engagement with HCC urban planning to progress our design development for further engagement with developers. SW viable options are limited to 2 options - both will unlock development constraints.	Improvement Required	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH	Live - Treat	Continue to understand areas of preferred development and correlation with Stormwater pivot solutions, with consideration of investment cost versus return on yields. Potentially more flexibility with developable areas to cater for investment options. Improved resilience of infrastructure. Focusing on improving trunk capacity to allow conversations with developers which will result in focused areas. Recent change in HCC personnel, further alignment on growth areas - i.e. more commercial focus rather than aspirational perspective driven CURPs. Have had recent catch up with Urban Plus Ltd, who are a council led developer. Will involve them in shortlisting stage. Will involve new HCC housing lead in shortlisting stage and get him up to speed on options and objectives of both WW and SW Schemes	[redacted]	Rare (<5%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM
RSK-0094	Stormwater Pipeline	Design	Reduction in pump station and/or rising main dimensions	More detailed design in next stage may result in the ability to reduce pump station volume/depth, foundation depth, and/or rising main diameter. Review design parameters and potentially seek departures from Wellington Water.	Cost and programme savings. Lower risk to/from aquifer if depth reduced.	[redacted]	High level design at Feasibility stage. No ground investigations. Fairly conservative design. Ground investigations and further refinement of design in next stage. Focus on trying to reduce pump station volume/depth including seeking departure from WWL on number of pump starts per hour.	Generally Sound	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH	Live - Treat	Further design development in stage 2.		0	0			
RSK-0069	Stormwater Pipeline	Operations	Long lead time and insufficient budget for power supply for pump stations (if electrical)	Currently, there might be insufficient power supply for the anticipated pump stations and potential sites. This might not have been budgeted for. Have sized pump stations - understand requirements. Potential 4 stations. Power supply upgrades $1m-$2m per station - lead time > 2 years required after Council decision made (end of 2024). Station will likely run twice a year - doesn't favor W.E. cost recovery. vs $0.5m for diesel generators, but with more operational effort.	Need to identify and commission the installation of power supply or size pump station accordingly to constraints. Power supply upgrade if electrical will be critical path.	[redacted]	Diesel is key fall back as cheaper and shorter lead time alternative - but more ongoing operational cost and complexity long term.	Effective	Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat	Ongoing conversations with WW to discuss operational preference, develop cost estimate and complete MCA analysis.		Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH
RSK-0049	Stormwater Pipeline	Consenting	GWRC relitigates existing RiverLink stormwater outlet consent	Preferred stormwater solutions might trigger GWRC to relitigate existing approved RiverLink and/or WWL network discharge consents (i.e. more flows through existing approved outlets). Currently lack of clarity of flows which might trigger re-consenting risk, and/or exceeds existing approved limits.	Additional consenting timeframe and associated justification costs.	[redacted]	Maintain relationships with GWRC. Confirm that we have a viable option without increasing the size of consented outlets. Pre-application meeting 16 Oct 23 to engage GWRC planning and ongoing engagement.	Improvement Required	Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat	Future engagement in Phase 2.		Unlikely (5% - 30%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	MEDIUM	Loss or increased cost of $500k to $5m	MEDIUM
RSK-0046	Stormwater Pipeline	Consenting	Unforeseen or more than expected stormwater consent conditions and constraints	Some of the key consenting scope is engineering (for penetration through stopbanks), environmental, regulatory requirements and stakeholder effects to consider. Investigations and/or inability to undertake further investigations (i.e. archaeological property access) results in further consent conditions, constraints and/or increased offset requirements. (lizards, native birds, etc).	More cost for offset requirements. Ecological improvements with stream. More delivery restrictions and associated increased design/construction cost.	[redacted]	Constraints assessment for Ecology completed - key ecological risk are lizards but can be sourced. Consenting Strategy early to enable this to feed into early pricing. No change of risk status until Stage 2.	Generally Sound	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH	Live - Treat	Engage with GWRC during production of consenting strategy - due to be finalised end of May 2024.	[redacted]	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH
RSK-0036	Stormwater Pipeline	Design	Underestimating future growth and future impact on stormwater solutions - late input	There is no clear master plan and/or future development and growth strategy to guide the design solution and decision-making. This can impact hydraulic neutrality solutions, floor levels, dry access versus dry property lots, etc.	Late input into decision-making, further design considerations, under design of solution. Performance outcome is misaligned with stakeholder expectations.	[redacted]	Long list and shortlist workshops to guide decision-making with best available information from HCC planners. Balanced MCA evaluation will guide the decision-making. Funding constraint will limit amount of growth and options involved. Develop and seek stakeholder buy-in into design philosophy statement and ensure inputs from various stakeholders are captured.	Generally Sound	Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat	HCC is commissioning a study to understand potential high opportunity development areas. Change in HCC personnel providing different directive. Have had a recent catch up with Urbanplus LTd who are the Council led developer. Will provide initial SW impacts of options and will involve them as part of the shortlisting phase. Involving new Housing lead in shortlist MCA as well as Urban plus council led developers	[redacted]	Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM
RSK-0060	Stormwater Pipeline	Construction	Flooding impacts stormwater pipeline construction - Insurance + contingency	Stormwater solutions including pump stations are usually in flood prone area, and adjacent to stream - require temporary flood protection. Insurance premium might be high. Temporary measures will only be effective to certain levels/return period.	Higher cost than expected for temporary protection. If exceeds protection limits - significant delay to recover works and programme.	[redacted]			Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat			0	0			
RSK-0067	Stormwater Pipeline	Planning	Planning restrictions required to align with Concept of Operations are not implemented	Full flood protection requires design solution and planning restrictions. Planning restrictions not implemented due to loss of institutional knowledge or optimism bias/perception that 3 waters infrastructure has solved all flooding.	Requirements to increase pump capacity or seek buy-in into future planning constraints on floor levels.	[redacted]	Design Philosophy workshop at the outset of the project which included members from WWL and HCC Planning teams. This was documented and signed off by relevant personnel. Document communicated that the solution was a mix of engineering vs policy control	Generally Sound	Unlikely (5% - 30%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	HIGH	Loss or increased cost of $20m or greater	HIGH	Live - Treat	Document and communicate to both WWL/HCC planners. This Design philosophy documents the intent of the design.	[redacted]	Rare (<5%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM
RSK-0047	Stormwater Pipeline	Stakeholder	Opportunity to engage with Ministry of Education and Te Whatu Ora for onsite stormwater solutions	Many pump stations options potentially rely on school property. Opportunity to engage early and closely with MOE, Te Whatu Ora and private schools to test and progress solutions and offsets. Also an opportunity to discuss/consider future on-site detention of stormwater on-site for large contributors like schools - although this lies outside the current scope of design.	Beneficial solutions to all parties, i.e. playing fields as storage, access for construction. May be opportunities to combine with stream daylighting and/or improvement that delivers wider benefits.	[redacted]	Note that many of the schools in the project area are integrated or private schools. Some initial discussions with MoE. Significant opportunities at Hutt Hospital to manage run-offs.	Improvement Required	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH	Rejected	Early engagement with MoE and Te Whatu Ora at the longlisting stage. Identify key contacts Ongoing engagement as options develop and more detail is available.	[redacted]	Possible (30% - 55%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	HIGH	Loss or increased cost of $5m - $20m	HIGH
RSK-0068	Stormwater Pipeline	Operations	Sufficient water supply required during pump station commissioning testing	Pumps might require a certain volume of water to test commission pumps - and local supply might be insufficient.	Need to upgrade water supply or alternative approach to source required volume.	[redacted]	Robust commissioning planning and staging - able to source local main and/or divert creek to fill wells.	Effective	Unlikely (5% - 30%)	MINOR: $50k-$250k or 2wks -1mth or Local media coverage	LOW	Loss or increased cost of less than $250k	LOW	Live - Treat			0	0			
RSK-0085	Stormwater Pipeline	Design	Compromised stop bank integrity due to stormwater outlet penetration	Stormwater outlet needs to penetrate Hutt River stop bank. The outlet could result in stopbank failure during construction or subsequent operations (flooding).	Stopbank failure and property flooding risk. Significantly more costly solution required.	[redacted]	Close coordination of design development with Riverlink Alliance. Without clear understanding of current scope and design - whilst inherently effort to place to eliminate this risk, a design solution with sufficient safety margin can be reasonably developed. Close monitoring of construction and coordination with parties.	Generally Sound	Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM	Live - Treat			0	0			
RSK-0040	Stormwater Pipeline	Design	Insufficient operational consideration with stormwater design concept development	Not sufficiently engaging with WWL operational team to achieve desired operational solutions, and/or not understanding operational priority areas to focus on.	Poor operational outcomes - higher maintenance costs and not fulfilling design intent.	[redacted]	WWL including operations were involved in TAG group and options MCA workshops. Also SID workshop. WWL have many existing pump stations and have a good understanding of their operational requirements. Record any significant design issues/constraints/opportunities for later stages of design.	Generally Sound	Rare (<5%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM	Live - Treat	Ongoing engagement with operations as design development progresses on preferred option.	[redacted]	Rare (<5%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM
RSK-0052	Stormwater Pipeline	Design	Significant engineering issue impacts on viability of stormwater solution	Preferred option encounters unforeseen and significant engineering challenge that threatens technical and financial viability of project. Insufficient investigations or understanding of engineering constraints during earlier long list stages.	Significant redesign and alternative route or major engineering mitigation that threatens the financial viability. Revert back to consider other solutions. Significant delay.	[redacted]	Constraints investigations, use of 3D model with services included	Generally Sound	Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM	Live - Treat	Further investigations in Stage 2.		Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM
RSK-0095	Stormwater Pipeline	Design	Redesign of pump station layout avoids need to take one of three properties	Redesign of the pump station layout and access in the next design stage may be able to avoid the need to take [redacted] and just 2 is required.	Two properties only needed. Cost saving in the order of $1M.	[redacted]	High level design only to date. Redesign of pump station may become smaller or more compact. Site access "drive-through" may be possible rather than turning with single access on Kings Crescent - less width needed	Generally Sound	Unlikely (5% - 30%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM	Live - Treat	Further design development in Stage 2.		0	0			
RSK-0093	Stormwater Pipeline	Construction	Dewatering greater than expected due to high groundwater levels.	Pump station or pipeline construction requires much greater dewatering than expected. Particularly high risk at deep excavations (pump station and outlet chambers near river). Limited geotech assessment at this stage.	Productivity/programme delays. Increased dewatering costs. Possible changes to construction methodology.	[redacted]	Carry out site investigations to establish aquifer properties. Incorporate contingency in expected volumes/flows. Minimise pump station and pipeline depths. Constructability input	Generally Sound	Unlikely (5% - 30%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM	Live - Treat	Further investigations and design development during phase 2.		0	0			
RSK-0076	Stormwater Pipeline	Design	Flood levels exceeds design levels	Extreme hydrological event beyond modelled levels - climate change influence not yet fully understood.	Flood protection measures do not work as expected. Insufficient pump station capacity. Flooding and damage to properties.	[redacted]	Hydrologic and Hydraulic modelling is ongoing.	Improvement Required	Rare (<5%)	EXTREME: >$5m or >6 month delay/early or Sustained national media coverage	MEDIUM	Loss or increased cost of $20m or greater	MEDIUM	Live - Treat	Confirm return period design levels. Consider ideal flood protection mechanism at intake for exceedance.	[redacted]	0	0			
RSK-0066	Stormwater Pipeline	Operations	Insufficient resilience and redundancy considerations for pump station operations (SW)	Insufficient resilience and redundancy considerations for pump station (SW), e.g. risk of station flooding, pump failure, power outage, evacuation process, insufficient capacity, etc. This could dictate the design and concept of operations considerations for pump stations and locations.	If insufficient consideration given, this could result in significant additional pump station fit out costs and/or not achieving the functional requirements.	[redacted]	Early concept design has been updated with high levels redundancy, e.g. multiple pumps and spare pump. Unlikely for all 4 sites to fail - flooding damage constrained to specific site.	Generally Sound	Unlikely (5% - 30%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM	Live - Treat			0	0			
RSK-0081	Stormwater Pipeline	Interface	Riverlink SW renewal' works does not alleviate CBD flooding - reputational risk	Riverlink Alliance is renewing existing SW works (like-for-like) as part of their works, and the public might perceive that these works will alleviate SW flooding in the CBD - but it doesn't. HCCIAF works doesn't address all the CBD flooding issues.	Reputational risk to HCC as the public perceives the work would alleviate flooding.	[redacted]	HCCIAF current programme of works to alleviate Hutt CBD flooding as much as practicable.	Improvement Required	Unlikely (5% - 30%)	SEVERE: $1m-$5m or 2-6 months or Sustained media coverage (> 5days)	MEDIUM	Loss or increased cost of $5m - $20m	MEDIUM	Live - Treat			0	0			
RSK-0048	Stormwater Pipeline	Property	Difficulty engaging with property owners on stormwater solutions	Stormwater solution will potentially impact on existing properties (e.g. suboptimal flooding outcomes, or requires work in their properties) - and properties owners are not willing to engage.	More than expected effort to engage with property owners, redesign, negative media attention. If acquisition is not possible, additional cost with pump stations.	[redacted]	Engaged Property agent. Property agent has made initial contact with schools which are impacted by our long-list options.		Possible (30% - 55%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	MEDIUM	Loss or increased cost of $500k to $5m	MEDIUM	Live - Treat	Initial phone call with landowners. Acknowledgment letter sent. Trying to get an understanding around the viability of each option and getting a first pass sense around desire for property owners to collaborate.	[redacted]	Unlikely (5% - 30%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	MEDIUM	Loss or increased cost of $500k to $5m	MEDIUM
RSK-0065	Stormwater Pipeline	Design	Stormwater pump station location constraints (noise, etc) versus functional requirements	Various considerations - servicing access, proximity to residents, aesthetics, noise, odour, and close to location of outlets that need to be accessible / visible during storm events.	No viable locations, or preferred location does not meet servicing requirements, or property purchase required, or significant construction costs more than budgeted.	[redacted]	Currently a buffer of 15 meters has been proposed for PS sites. Regardless of location of the PS, the PS pump selection, design and installation will be optimised to reduce nuisance related to this risk. The civils designed to ensure no septic conditions that develop odour occur and also retention times are minimal near the PS	Generally Sound	Unlikely (5% - 30%)	MODERATE: $250k-$1m or 1-2months or Short term media coverage (<5 days)	MEDIUM	Loss or increased cost of $500k to $5m	MEDIUM	Live - Treat			0	0			

Appendix BB- Stage 0 Gap Analysis Memo

Tonkin+Taylor

Memo

To:	[redacted]	**Job No:**	1091097
From:	[redacted]	**Date:**	6 July 2023
cc:	[redacted]		
Subject:	HCC IAF – Gap Analysis Memo		

1 Background

Hutt City Council (HCC) and Kainga Ora through the Infrastructure Acceleration Fund (IAF) have jointly funded the stormwater upgrades required to facilitate building of up to 3,520 new houses in the Lower Hutt Valley. HCC has also committed to funding of the Wastewater pipeline upgrade required to support this additional growth.

The funding agreement between Kainga Ora and HCC includes several milestones that HCC will agree with Kainga Ora in advance. The first of these milestones is the completion of Stage 1 with the completion of Feasibility Activities. The funding agreement between both parties references completion of Stage 1 by 31st October 2023. However, it is noted that milestones can be adjusted by mutual agreement between both parties.

Wellington Water has progressed the wastewater pipeline design to the concept design stage and undertaken a growth study for HCC to inform the likely flows expected for the 2070 growth horizon. The growth study provided the stormwater flow information used to apply for IAF funding.

Wellington Water subsequently confirmed they did not have capacity to deliver the remainder of the wastewater project or the stormwater projects. HCC investigated a range of delivery options including via the recently procured Riverlink Alliance. A proposed procurement strategy was produced and approved by the HCC board and supported by Riverlink Programme Partners, Kainga Ora, WWL and HCC Stakeholders. The approved procurement strategy recommended Early Contractor Involvement (ECI) with HCC direct appointing T+T to be their Technical Advisor and support HCC with the development of the project. The procurement strategy also recommended a governance structure including a Project Management Board (PMB) made up of project partners and a Technical Advisory Group (TAG) made up of technical specialists from WWL and HCC.

T+T were engaged to complete an initial Discovery Stage (Funding Agreement Stage 0) to confirm the status of the Wastewater and Stormwater pipeline designs, identify gaps and confirm high level project milestones for delivery. This memo presents the results of these investigations.

2 Stage 0 – Discovery Stage

During the discovery stage T+T completed a stocktake of documents produced to date for the wastewater and stormwater projects. Several meetings were held with key stakeholders involved in one or both projects including:

- WWL modelling team
- WWL delivery team including [redacted] and [redacted]

- WWL Consenting team including [redacted]
- Holmes Consulting
- Stantec
- Riverlink Alliance team members
- [redacted] of Taranaki Whānui

From the meetings and the documents provided T+T and Mott MacDonald, our project partners for the pump station design, have determined where the gaps exist and mitigation tactics for completion of Stage 1 in a timely manner. We have also produced a high-level outline programme for project completion including suggested revised dates for milestones where applicable.

The minutes of meetings and document references are included in Appendix A to this memo.

The following sections discuss current status of each project and advise on how to achieve the project milestones in a timely way.

3 Current project Status

The following sections summarise the current projects status of wastewater and stormwater projects. The detailed gap analysis is included in Appendix B.

3.1 Wastewater Project Status

Several hydraulic modelling studies have identified Hutt Central as a priority area of Lower Hutt where there are currently capacity constraints. Modelling undertaking by Hydraulic Analysis Limited (HAL, 2021) has shown that there are currently no dry weather flow (DWF) spills within the Riverlink area. However, network capacity is predicted to become severely constrained under DWF conditions by 2040, meaning that dry weather overflows may occur in the future because of growth. This is due to a predicted maximum probable increase in population of 12,841 across Hutt Central by 2070 (from 4,439 to 17,280), including 4,550 in Riverlink brownfield development in the northern and southern Riverlink catchments (HAL, 2021).

A concept design incorporating an options assessment has been prepared by Holmes Consulting and Stantec on behalf of WWL (Optioneering and Concept Design Report, revision 4, 6 April 2023) to address these capacity constraints. The driver for the works is to achieve the following level of service:

- No dry weather overflows for the projected 2070 population and proposed land use.
- Uncontrolled spilling to not exceed an average of one spill per year wet weather overflow frequency (1yr event).
- Overflows at engineered overflow points to not exceed an average of two spill per year wet weather overflow frequency (6 month event).

The project consists of the following elements:

- Pump station with a duty capacity of 100L/s and an associated emergency storage tank with 2,000m^3 capacity. Located at [redacted]
- 1,240m long 315NB PE Rising main.
- Two sections of gravity sewer diversions consisting of a 330m long 375NB sewer and 180m long 300NB sewer.
- 475NB, 220m long Pump station overflow pipe.

Site investigations and engagement for the Concept Design have been limited to:

- A desktop review of the geology and the likely impact on construction. The geology has been assumed to be Holocene River Deposits comprising highly variable interbedded silt, sand, and gravel. General groundwater observations were that groundwater would be primarily associated with the unconfined Taitā Alluvium unit. As the pump station and storage tank consist of a large deep structure its price is very sensitive to the actual geology encountered. It would therefore be prudent to either take a conservative approach to the potential geology or procure a physical borehole at the proposed site to refine the requirements for this structure.

- A desktop review of archaeology was completed. This determined that the likelihood of inground archaeology being present in all areas of the project is high. It is recommended an Assessment of Archaeological Effects report be completed early in the consenting phase, with the likely requirement of obtaining an Archaeological Authority from Heritage New Zealand. As several of the recorded archaeological sites are of Māori origin it is recommended that consultation with relevant mana whenua is undertaken for the project in an early and meaningful way.
- A desktop review of the Selected Land Use Register (SLUR) sites identified several sites adjacent to the pipelines. Due to contamination creep, the project may require the excavation and disposal of contaminated material. It is recommended a contamination specialist is engaged during the next stage of design to understand the risk.
- Wellington Water have sought input from Taranaki Whānui as iwi with mana whenua status in the area. Taranaki Whānui stated that there is no inherent opposition to the provision of additional wastewater infrastructure at the early scoping phase. However, this engagement noted the potential for significant historical findings (see above) and their desire to be appropriately engaged during the investigation phase.

The wastewater design covers some of the elements required to progress the project to consenting and ECI procurement. There are however significant gaps to obtain more certainty on the delivery programme is required. The Concept Design has been priced using an appropriate level of detail and risk allowances for this stage of project development.

There are several areas that require more work before proceeding to the completion of Stage 1 in the funding agreement. These are;

- consenting strategy (for delivery),
- consenting strategy (for engineered overflow),
- scoping specialist advise needed to support design and consenting including, but not limited to:
    - Noise and vibration assessment
    - Assessment of Archaeological Effects
    - Land Contamination Preliminary site investigation (PSI)
    - Odour assessment
    - Review of flood hazard for the pump station site
- whether the proposed storage and pump station can be constructed without impacting the aquifer,
- confirmation of the strategy, timeline and costs for property acquisition,
- confirm the local power supply is sufficient for the proposed pump station demand,
- confirmation that the preferred pipeline alignment for the river crossing and how it will coordinate with the Riverlink project.

The optioneering and concept design included legal advice as to the approach for consenting the wastewater discharge, but a full consenting strategy was not produced. A consenting strategy will need to be produced and approved by the PMB before the project can proceed to consenting and ECI.

The Waiwhetu aquifer provides approximately 40% of drinking water for the Wellington region. Whilst the concept design endeavoured to keep infrastructure as shallow as possible, it did not specifically check for buoyancy and the interaction of the underground structures with the Aquifer and aquitard that sits above the aquifer.

The proposed concept design requires access to private properties for investigations associated with the pump station and storage tank; and these properties will need to be acquired and vacated before construction commences. The concept design process was not required to inform a construction programme timeline and hence did not need to confirm the likely timeline for property acquisition and mitigation strategies for extensions of this timeline.

Since the concept design for the wastewater line was produced, the Riverlink Alliance has been established. The preferred wastewater concept has the wastewater pipeline on the pedestrian bridge. This was largely preferred because at the time the option was being considered, the Melling bridge construction programme did not meet the funding milestone timeline for commissioning of the wastewater line. This may no longer be the case, and a shorter pipeline route may be more cost effective. In addition, the location of the wastewater line will impact the service diversion works required for Riverlink. Riverlink are currently preparing their pricing packs for the Target Outturn Cost. The wastewater line (within the Riverlink footprint) should be considered in the Riverlink service diversion pricing packs.

3.2 Stormwater Projects Status

In 2021 WWL undertook growth studies for several catchments identified as likely to be the target for residential housing growth in the short to medium term. The growth study also considered impediments to this growth. Flooding from the Opahu Stream and future increased flooding of this stream (due to climate change) was one of the impediments to housing growth in the region. Different climate change and growth scenarios, and implications on the design over time, have not yet been assessed.

Stantec were commissioned to undertake high level modelling to inform the case for funding of stormwater improvements to eliminate flooding in the proposed growth areas in HCC. This modelling formed the basis of the Melling and Woburn stormwater concepts described in the IAF agreement.

Very little has been done to date to confirm feasibility of the proposed stormwater options beyond the minimum that was required to inform the funding agreement. The proposed options have not been checked against the physical constraints of the surrounding terrain and environment. In addition, an options study option that would stand up to scrutiny through a consenting process has not been undertaken to determine a preferred option. No assessment of service diversions or the ability to provide power to pump stations has been carried out.

Due to the limited nature of the solution development to date, there is also no consenting strategy for the stormwater pipelines. The consenting process for Riverlink has benefited the stormwater projects in that the outlet pumpstations and discharge locations to Te Awa Kairangi were consented with the Riverlink consents. However, more work is required to confirm whether the consents cover the discharge volumes that will occur with the growth study catchment, and if any new consents are required, how they might interact with existing consents.

The most fundamental element of the stormwater projects that requires confirmation is the details of the housing development strategy that Kainga Ora proposes and to confirm that this strategy is compatible with the design requirements for the stormwater projects. The design philosophy and expectations for the project also need to be confirmed by the funding parties.

The Riverlink alliance are currently producing their pricing packs for the Target Outturn Cost process. The stormwater projects have an impact on the service diversions required within the project footprint. The location of stormwater lines should be considered in the Riverlink service diversion pricing packs.

3.3 Programme Risk

The existing project risk registers for the Stormwater and the Wastewater projects are appended to this document in Appendix C. We have undertaken a review of these and assessed the top 6 risks for the programme are as follows:

- Robustness of Housing Growth Development Strategy for Stormwater
- Gaining WWL departures in line with programme constraints
- Riverlink Interface
- Consenting for wastewater discharge
- Property acquisition for the wastewater project
- Creation of a new water entity causes delays in project approvals

We recommend commencing preparation of a consenting strategy for each of the projects as soon as possible, so that the specific risks and opportunities relating to consenting can be identified and managed.

We also recommend that early enquiries are made with regards to property acquisition for the proposed Wastewater storage location.

Given the context of 3 waters reform, the project has been set up as a staged approach to delivery to bear this issue in mind as we progress where we can stake stock of where the transfer process is at and plan the next stage accordingly.

T+T will develop the programme risk register throughout Stage 1 and review and update risk status for the PMB on a regular basis.

4 Proposed Plan – Stage 1

To go to market to procure ECI requires a Feasible Design where options with fatal flaws have been discarded, Draft Principal's Requirements and a consent that mitigates Constructor uncertainty over timelines but includes enough flexibility for the constructor to chase client value.

The feasible design needs to meet the design objectives and constraints, be constructable and consentable. Additionally, it must be affordable and continue to meet the requirements for the IAF co-funding agreement.

A consentable solution will have thoroughly explored alternatives and had early engagement with iwi, and with any critical stakeholders as part of the design process. A constructable design will have had input from contractors with expertise in construction of this nature and in these ground conditions. Additionally, physical constraints such as ground conditions and other services must have been adequately investigated to confirm the design feasibility. If it is identified that specialists have long lead items for effects assessments, we may need to engage them towards the end of this stage.

Any risks in construction, along with risks associated with design uncertainties such as climate change or growth assumptions, will be recognised in the design process, cost estimates and/or explicitly adaptive design.

Detailed hydraulic modelling will be carried out, considering a range of scenarios, to give confidence that the proposed solution meets the design objectives.

5 Proposed Programme for Project Completion

The following IAF funding agreement milestones are proposed based on the current status of projects and our assessment of the activities required to be undertaken;

IAF Funding Agreement Milestone	Melling Stormwater	Woburn Stormwater	Wastewater
Stage 1 – Early	31/12/2023	31/12/2023	31/12/2023
Stage 2 – Pre-Implementation	31/12/2024	31/12/2025	31/12/2024*
Stage 3 – Implementation	30/06/2026	31/12/2027	30/06/2026*
Stage 4 – Practical Completion	31/12/2026	30/06/2028	31/12/2026*

*note that property acquisition has the potential to put these dates at risk.

The milestone date in the IAF funding agreement for completion of Stage 1 is proposed to be renegotiated to be 31st December 2023 from the original IAF funding agreement date of 31st October 2023. This is to allow for sufficient time for feasibility studies to progress to undertake more robust flow modelling, Informed consideration of preferred option and initial site constraints investigations.

The other dates proposed in the IAF funding agreement remain the same. However, as noted above, the property acquisition for the Wastewater remains a risk to the delivery of the pre-implementation phase, as such this date should not be considered confirmed until further investigations have been undertaken regarding the property acquisition.

A high-level programme for meeting the above milestones is included in Appendix D.

6 Next Steps

When this memo is approved by the PMB, T+T and Mott MacDonald will develop an offer of Service for Stage one for HCC consideration. The key tasks in our offer of service will include the following:

6.1 General

- Workshop with HCC and WWL to confirm design objectives and project success factors.
- Prepare a consenting strategy as required by the IAF Funding Agreement. (See also 6.2 and 6.3)
- Engage a constructor for constructability advice.
- Develop RFP for ECI engagement and select contractor for ECI.
- Prepare an updated programme to construction.
- Confirm scope delineation between projects.
- Completion of the programme risk register, Riverlink interface risk register, stormwater projects risk register, wastewater projects risk register.
- Monthly updates for the PMB.
- Weekly interface meetings with the Riverlink team.
- Monthly TAG meetings
- Weekly interface meetings with Riverlink team including development of a shared risk register as part of ongoing meetings
- Complete QLB detailed utility model and targeted potholing ground investigations.

6.2 Stormwater

- Confirm Iwi views on the proposal and develop an understanding on the Tangata Whenua history in the project area.
- Agree the approach to uncertainties (especially climate change, growth and hydraulic neutrality) and the management of residual risk with HCC and WWL.
- Further hydraulic modelling in two stages:
  - Stage 1: rapid modelling to confirm the best locations and volumes for abstractions, and gravity/pumped options, as a key input to design.
  - Stage 2: as design progresses, in parallel run a range of scenarios to quantify risk and provide design envelopes for adaptation/staging of the works.
- Provide Riverlink with stormwater design parameters, solution options and pros and cons to allow for in Riverlink Pricing Packs.
- Undertake desktop constraints studies.
- Confirm consenting strategy.
- Information on underground services, including potholing/trenching at key locations to avoid fatal flaws.
- Establish a long list of feasible options.
- Undertake high level pricing of each option from the long list.
- Workshop to whittle the long list down to a short list.
- Update pricing of shortlist. Workshop for the shortlist based on updated pricing and site investigations/updated knowledge of constraints.
- Provide pricing updates for the HCC LTP Budget allocation process.
- Feasibility studies report to preferred option stage.
- Production of a project risk register and Safety in Design (SiD) Register.

6.3 Wastewater

- Confirm Iwi views on the proposal and develop an understanding on the Tangata Whenua history in the project area.
- Confirm that the proposed concept for storage and pump station designs are achievable without negatively impacting the Waiwhetu Aquifer.
- Commission an Assessment of Archaeological Effects report – If lead time is likely to impact the completion of the consenting stage.
- Undertake a land contamination study to a PSI level – If the lead time for completion of this study is likely to impact the programme for the consenting stage.
- Confirm power demand of pump station and ability of local power network to supply this demand.
- Confirm consenting strategy.
- Assess whether changes in the timing of Riverlink will change any part of the concept option.
- Provide a price estimate update for the Wastewater scheme up to the interface with the Riverlink project for the HCC LTP budget allocation process.
- Provide Riverlink with wastewater project options and pros and cons to allow for in Riverlink Pricing Packs.
- Confirm property acquisition strategy (including access for physical investigations) and timeline, noting that the pump station and storage location has some ability to move along Pretoria Street.

Appendices

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Appendix A Meeting Schedule and Minutes

Meeting Description	Date	Attendees
CBD Sewer Bypass	29 May 2023	[redacted]
IAF Three Waters Weekly Catchup	30 May 2023	[redacted]
HCC CBD Sewer bypass and IAF Stormwater projects	7 June 2023	[redacted]
IAF Stormwaters Project	8th June 2023	[redacted]
Wellington Water Planning Meeting	8th June 2023	[redacted]
HCC IAF - Scope alignment meeting for Feasibility Studies	12 June 2023	[redacted]
HCC IAF – Digital Data	14 June 2023	[redacted]
HCC - Gap Analysis Memo Drafting/Planning session	15 June 2023	[redacted]
RiverLink - IAF Kick Off Meeting	16 June 2023	[redacted]

Minutes

Stantec Meeting

Date:	16th May 2023	**Time:**	
Location:	TEAMS	**Room:**	N/A
Chair:		**Mtg No:**	
Attendees	[redacted]		
Apologies			
Subject	HCC IAF - Status of Existing model for stormwater flows		

	Item	By whom
	No geographic boundary for housing development. Only "Lower Hutt". Opahu Stream. - Restricted flows as it has been culverted in many sections. Modelling was done to get the flow rates. Not to check the hydraulics of the routes. Pipes are conceptual in the plan. The model is just taking water from the stream. There are no pipes modelled. e.g. no head losses or pump duties in the current model. It was a "modelling feasibility study" ie. quite loose. The proposed pipes themselves weren't modelled, just the abstractions from the stream. The pipe sizes were based on an assumption of target velocity eg. 1 m/s or 1.5 m/s. The pipe locations are quite close to the boreholes that extract water for the aquifer. [redacted] thoughts on moving forward: • Can we gravity feed hydraulically and practically? • Where are the Riverlink Stopbanks currently? Railway and then Opahu stream floods out in the locations where there are restrictions. Two locations that were outside of the geographic boundaries. [redacted] Discussion of the need for a Design Philosophy Review the project moving forward. Possibility of allowing for adaptive design, ie. design/size for a "no regrets" so that if eg. climate change, sea level rise, growth in flows are more than expected then larger pumps can be put it.	

	Flow assumptions for the modelling to date: • WWL standard approach for climate change impacts on flows (and sea level rise?) was used for the current modelling. • Hydraulic Neutrality for all future development was assumed. Dictated by WWL. Therefore assumption of no flow growth over time except for what is due to climate change. • WWL Modelling team set the expectations on Climate Change and flow rates. [redacted] - How do we make sure that we are not using assumptions for our basis of design that leave future generations worse off? To be answered offline of this conversation. Confirmation that the 2021 Stantec report was the only modelling report produced. Discussion of existing model overall: The model of the network itself is quite detailed although the modelling done for this project specifically was quite high level. Since 2021 there has been some work on sensitivity analyses to flow rates within the catchment but not for this purpose. Work required for GWRC. The model takes the fixed downstream level of Te Awa Kairangi as its boundary. The model takes into account the Riverlink levels. But not sure from what timeframe. **ACTION** Stantec to provide what the downstream conditions are for the model version used in the 2021 Report. The report says the pumps for Opahu stream were sized for 10% AEP stormflows. What does this mean. [redacted] confirmation that 10% of flow was extracted at each of the locations. Not 10% in total. No modelling of failures of the pump stations has been undertaken as yet. It would be important to understand the consequences of a failure of one or multiple pump stations, eg. district-wide power failure if they are electric. Discussion of redundancy of power failures etc. Need to check these assumptions during the design at some point. Initially need to understand what power supply status for the area is. [redacted] diesel pumps could be a good idea for resilience for very intermittent pump stations. [redacted]: Very short timeframes to do the IAF modelling therefore only time to take a lump sum of flow out of the streams. Did not model different splits of flow rates from each location. Figure of all the pipes that come in from the Opahu stream - ACTION - Stantec to provide if it not in report already. [redacted] to check. Stantec did look at where could bring connections across from the Opahu. Decisions on locations were driven by the road size and where there would be land for siting of a flow controlling structure near the	

	stream. Ie. not necessarily the most hydraulically optimal locations but where it seemed feasible. [redacted] suggested a modelling driven design envelope. E.g. Try an envelope in the model of pipe distance below ground and flow rates and see what pump station size this gives us. Note [redacted] assumption that Riverlink will definitely be doing the pump stations at the Te Awa Kairangi end. - Need to check this. For any further modelling need to use the latest version of the model from WWL because they might have done something to the model in the meantime. Suggestion - At the handover time from WWL is a good time to understand what the design criteria are from WWL. Stantec availability July/August time? Whilst there is availability this is not limitless. Need to work with Stantec to see what we can get in the time available. [redacted] – possibly two phases from Stantec. First phase quickly determine the basis for design from further development of the model based on existing assumptions. Second phase, explore sensitivities/design envelopes, refine design. Etc. Also to be aware of that the model can be unstable and takes a day or two days to do a run of the full model. Could downsize files from a 2D model to a 1D model for this case. [redacted] in order to get this design out in that timeframe, need to schedule at the start some key workshops throughout the design, at which we make decisions and keep things moving. Next Step = [redacted] gets in touch with [redacted] at Stantec around what is required of Stantec and for when.	
Action	Contact [redacted] at Stantec around what is required of Stantec and for when.	[redacted]
Action	Stantec to provide what the downstream conditions are for the model version used in the 2021 Report.	Stantec
Action	Stantec to provide if it not in report already. [redacted] to check.	[redacted]/Stantec

Minutes

Sewer Handover Meeting

Date:	29th May 2023	**Time:**	4:00pm
Location:	TEAMS/T&T office	**Room:**	
Attendees	[redacted]		
Apologies			
Subject	HCC IAF Sewer Handover Meeting		

	Item	By whom
Introduction	[redacted] suggested that we speak to this group about wastewater around the optioneering and concept designs done to date. At what level has the additional design be done, any risks, any gaps that you see, and methods of working. [redacted] has been working on resource plan for Riverlink and we might be able to tag onto this. [redacted] - Hutt City been granted as part of infrastructure fund to enable housing within the Hutt Region. Schemes in place to enable those housing projects to come about. Originally, we were going to procure these through Riverlink, but now developing as part of an ECI package. T&T helping with initial phase to progress to concept. [redacted] **- is there a delivery timeline on these projects?** [redacted] - yes high level programme for completion. Milestones are pretty flexible, the end date is not flexible 2027/28. [redacted] - complete feasibility studies by October if possible, but as long as there is a delivery plan this date is flexible. [redacted] **- who is involved?** T&T, HCC, [redacted] (Motts for the last pump station expertise), also [redacted] and [redacted] from Wellington Water. [redacted] - Discovery phase next 4 weeks, end of June.	
Earlier work team roles	[redacted] and [redacted] briefed the group on who played what role in the project. [redacted] - Chief Advisor Wastewater - light touch across the project [redacted] - Principal Engineer in the network engineering team in wastewater - technical direction provided by [redacted] and the	

	development and interactions with the team. [redacted] - reviewed work and gave feedback on options. [redacted] - Senior Project Engineer with Holmes - was the project lead that delivered the concept design with this. Then a design team within Holmes that did the work. Involved from the start of the optioneering.	
	[redacted] - What level of design has the project been completed to? • Concept design. In the Wellington Water process, completed Phase 3. Check list for this not all approved. **[redacted] - What has been done in terms of consenting?** • Planning design consent complete. We were still unsure on the delivery route, still things that need consent. Earthworks with storage tank, works in riverbank to construct EOP, assumed would be covered as part of Riverlink but if not will need its own consent. Not looked at impact of Waiwhetū aquafer, no proposal for piling into the aquafer, no flotation calculators done. Did an approximate storage tank size of what was appropriate. • [redacted] - tank currently near pump station, the reasons for trying to shift flows out of this area and locations we could do that. Where we pump flows and locations where one might do that and how it would work on the Western side. This was a significant shift of where we believe the optimal modelling was. The ideal was down the hotel end of the project. **[redacted] - What was the driver for the move?** • [redacted] - a lot of time on optioneering engineering. Short list of 5 and then did an MCA process on them. Further conversation with WW and with further feedback from Riverlink, when we could get access etc. the intention with proposed solution originally was the pump station would be on the access road on the existing Melling Bridge towards the end of the Riverlink project. Then Riverlink informed us on the differences between the IMF and the Riverlink deliverables programme and this was no longer going to be able to be done. So we looked at others areas where we could put the pump station. There was not really a lot else. Kairanga Ora and Riverlink is. [redacted] thinks Melling is still the best place for the pump station. Last caught up with them in March. • [redacted] attended the MCA workshop. It was a bit challenging as it was at the same time as they were getting to the really gritty bit of the tender for the Alliance. His input wavered. **[redacted] - If you were to tackle this again, how much do you think this is in it?** • [redacted] - believes we have nailed the key options.	

	• [redacted] - getting it across the new pedestrian bridge, part of the new infrastructure. • [redacted] - started with it on the new road bridge and again timing and the pedestrian bridge would be constructed earlier so we moved it onto this. • [redacted] - now the Alliance should be formed and have a plan and can interface with them. • [redacted] - we will interface with Riverlink, the construct boundaries Riverlink, outside this boundary team. **[redacted] - How resolved do you think the….** • This is basically to enable growth. The model shows (2017) quite significant spilling due to the growth. The options that were looked at were to divert flows North around the CBD, to current pump station or over the Western to other pump station. That frees up the network in the CBD for just Hutt CBD and future growth. They don't mitigate spilling in the wider network. • [redacted] - did out a modelling report pre this phase of the project. There is no reduction or increase in I&I (Infiltration and Inflow). [redacted] - unsure. [redacted] - we don't generally allow for a reduction in I&I. [redacted] - there is a standard assumption for deterioration. Often assumed it will get worse or already is as bad as it will get. • [redacted] - in project background there is references to modelling reports, that will have the information re I&I and growth figures. **[redacted] - quite new to this project, most keen to understand the fundamental drivers to the project. Going forward, starting from the right base line. Who should we be talking to get confidence that the initial modelling scenarios are still current, what is the chances they will change?** • [redacted] - growth scenarios change every year. • [redacted] **- are they variable for Hutt City?** [redacted] - fairly consistent over the 30 year horizon, 30% growth. [redacted] models themselves get calibrated every 5 years at the most, not sure there is any intention to re-calibrate the model. • [redacted] - started that process with the model in 2021 and then did the options for the IAF funding. • [redacted] **- safe to say high level of confidence that the design criteria are sound?** [redacted] - based off recent information. • [redacted] - HAL team continued to provide the support to the modelling team and worked with them through the development of this project through Holmes. The concept design has been run in the Hydraulics model with a long time series, so it shows that the concept designs still fit with the project objectives. • [redacted] - did the modelling from HAL. To rerun the model with the updated design would not be a huge	

	amount of work. They developed and designed the model, wouldn't be a big piece of work. **[redacted] - If you had to go to consenting tomorrow, what additional work would need to be done to feed into consenting?** • Options part is robust. [redacted] - we have a site, storage tank in commercial area of town and its currently showing under housing or commercial premises. That is one thing I pick up. No matter how big our storage tanks are there is an overflow and shows it is heading down to the Hutt River. • [redacted] - we didn't engage wit Hutt City or GW planners. We need engagement with the planning teams. 2nd - we have picked a location, but essentially it could be anywhere on Pretoria Street with changes to design. We haven't spoken to the residents about this, the EOP - the message that I got from RMA team is that structure would be constructed and there would be a valve on it. Any spillage would not be consented. Any spillage would have to be from the valve. Not sure that is still the approach they want to take. • [redacted] - just lodged for the Hutt City Councils for discharge wastewater to fresh water in heavy rain. They are not popular, and it is a headache under the new wastewater plan. **[redacted] - How often do you think emergency overflow needed to be utilised?** • [redacted] - one spill every 2 years. At the end of the design period, 2017. **[redacted] - where is the nearest existing spill?** • Silverstream - controlled - Stokes Valley catchment. Harbour Grove pump station. Ava Pumpstation (Wakefield St-western side) is behind a stock bank so we protect that. Various uncontrolled catchments. • [redacted] - on the consenting side. Concept shows the tank below ground. In terms of a tank this side 2mega litres, starting to push the boundary of a tank this side. Design suggests a dry well. Operations are pretty keen on a dry well. [redacted] - I think we went wet well/dry well as it is technically in the CBD. It's not like Taranaki St CBD, is there an opportunity around making it a wet well pump station. Wet Well only? We could still have a hut on top to get them out without a gantry train. The storage tank fills and drains by gravity, over the other side. Presents some challenges, the depth and dewatering. Maybe there is some consideration for the aquafer? The groundwater is pretty close to the surface. • [redacted] - reports to look at - modelling reports pre optioneering - it is summarised in main report. • Peer Review checklist on Woogle • Safety in design register and risk register on Woogle **[redacted] - What conditions does it flow down towards the tank?**	

	• It diverts all flows. Drawings about potentially what you want to do with that connection, keep option for it to continue downstream and bifurcation tank. It was to divert the dry weather flow. Wet weather flow didn't seem to work so well. It is an intercept down on Kings Crecent and always pumping them across to the other side, rather than just doing it in wet weather, allowing the flow to always go through the CBD. • Low flow continuation would be prime to blockage. • [redacted] - wasn't providing as much mitigation to uncontrolled spillage. Detailed what the cuttings look like, can continue downstream with pump failure. Manual intervention required. • [redacted] - would we required a standby generator - consenting issues around noise? Regional standards? • [redacted] - does not believe that they allowed for a generator. • [redacted] - currently believes the design is not varying from the regional standard. • [redacted] - at the end of the day the signoff of the designs go through the deign team, [redacted] and [redacted], Principal Engineer of Design Team. • [redacted] - early engagement around that philosophy will be important.	
Action	[redacted] (WW) will send through the additional files.	[redacted] (WW)
Action	Ask [redacted] (WW) who to be involved in the review process will be?	[redacted]

Minutes

Wellington Water Planning Meeting

Date:	8th June 2023	**Time:**	1:30pm -2pm
Location:	TEAMS	**Room:**	N/A
Attendees	[redacted]		
Apologies			
Subject	HCC Planning Meeting with Wellington Water		

No	Item	By Whom
	• Focus is on water quality not quantity for [redacted] work. • Physical infrastructure doesn't fall with [redacted]. But the discharges will fall under the stage 1 decision that will. • T+T to get the Stage 1 consent application and grant of consent. [redacted] • [redacted] Planner at Stantec for the wastewater	
Wastewater	• [redacted] would not try and seek a consent for a discharge for wastewater into a River at this point in time. • Whaitua process sets emergency events at 1 in 25 year. This is GWRC starting point. • [redacted] - When do we need a consent by? • [redacted] - Construction needs to be complete by 2027. • Suggestion from [redacted] - We could consent the building of the network but not consent the discharge • Then in 2027 get the discharge consent when the Plan change is accepted. WWL are having input into the HCC proposed plan change. • [redacted] - Mana Whenua's starting point is - No discharges to freshwater. DOC will also oppose and Mana Whenua will also oppose. And Forest and Bird will oppose. • Are we making the discharge better at other locations? This could also be a good argument for consenting.	
Discussion of plan rules	• Rule P82 - This provides for the exception of heavy rainfall events. Discussion of how this interacts with P94 - Avoiding overflows. • Discussion that this has not been tested yet so we could try and test it. Possibly if we could get mana whenua onboard then GWRC might be okay with going down this pathway. • If we do lodge a resource consent, then [redacted] would like to be aware of the conversation so she can understand how this might impact the WWL consenting programme or relationships.	

	• Plan change is due in November. Publicly saying August this year. • Should at least become a discretionary activity unless it is to a Schedule C site. Schedule F is biodiversity. Schedule C is cultural. • [redacted] should get a copy of the draft in August or September. • Also - Explore the option of not applying for a consent on the basis that a 1 in 2 year event is an emergency. [redacted] thinks that water care uses a twice a year standard as an emergency event.	
Next Meeting	• Meet again in mid July and update [redacted] on where we are at. [redacted] is back in the office from the 17th of July. Away all school holidays.	

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Minutes

Stormwater Planning Meeting

Date:	8th June 2023	**Time:**	12:00pm – 12:50pm
Location:	TEAMS	**Room:**	N/A
Chair:		**Mtg No:**	2
Attendees	[redacted]		
Apologies	[redacted] (WW) (sick)		
Subject	HCC IAF CBD Wellington Water Stormwater Discussions		

	Item	By whom
Introduction	[redacted] **started with a brief introduction of progress to date** • [redacted] - At this stage T&T are the designers working on gathering data. • Met with the Wastewater team to pass on the optioneering design • Met with [redacted] WW) to get the names of everyone involved to date on the project • Met with stormwater team to understand with what has been done to date.	
Roles in the process	[redacted] **from T&T** - Deliver a feasibility and confirmation of design by end of October. Role in project is called Pipes Lead. Will have a role working with the modelling. [redacted] **with Wellington Water (WW)** - in the modelling, will assist with questions around modelling and stormwater. [redacted] **WW) Growth Planning Manager** at Wellington Water, assisted by Hannah Hyde. [redacted] **– WW Stormwater Modeller** - familiar with Wellington stormwater models. [redacted] - Wellington Water interface contact. [redacted] **- Utilities team for Wellington Water** - pump station [redacted] **- T&T**	

	[redacted] T&T - have met with Stantec and have the growth report. We now have a number of questions to help us better understand where we are to date and gauge what the confidence levels are in the existing modelling. Stantec's feedback was that they didn't model a lot of different feasibility. Some scenario testing only. **What is the description of the model itself?** A) - It is a large model, Eastern Lower Hutt Model, Taita to Seaview, in Infoworks ICM, built to Wellington Water specification (all pipes model), lots of sub catchments draining to all the modelled sumps and the like. If you were to use it to the western side model its interfaced with the Hutt River. We represent the Hutt River very basically in the model, don't have it as a separate channel model. Not same detail as regional Council Hutt River model. If you use this model recommend cutting it down, delineation across the model would be the railway line. Just use the western side of model, would be more manageable. It includes the Opahu stream. Don't think any surveyed cross sections. Not sure how accurately the stream is, taken from Lidar rather than surveys. **Has it been calibrated with real events?** It has been validated, but only anecdotal reporting, e.g flooding photos. No measured results comparisons, no flow data. Overlaps with Waiwhetū stream. Was built for flood risk assessment. For Design need to make sure it is useful for that. Check that you are happy with how the stream is represented. The stream cross sections are not as critical for 100 year events. [redacted] - Not calibrated for measured information. It has been done on the Waiwhetū stream. [redacted] - not much point working out how much water we want to take out if it is escaping up stream [redacted] WW - Pump station - any monitoring of the discharge there? [redacted] – we can get monitoring data if we have dates and times. [redacted] - doesn't recall this in the model build phase, but could be done in the future. [redacted] - any additional data can be woven in. [redacted] **- What are the boundary conditions are in that part of the model?** [redacted] the downstream boundary is the Hutt River with a 10 year flow from GW Hutt River model. The Opahu Pump station is in the model [redacted] – can't remember how it is represented. [redacted] - since we are interested in taking water out of the stream and not coming out of the stream in other ways. Stantec suggested stripping it right down to a 1D model of the stream. [redacted] - Agree this is a sensible decision. Make sure in 1D flood risk is represented, in terms of flow may need to check against of 2D. [redacted] **- is the model unstable?**	

	[redacted] - No, it is just large and takes a long time to run. If you simplify down to just the channel, [redacted] reservations where the upstream network surcharges? That water potentially makes it to the stream across the surface. Guarantee all water from the network ended up in the stream allowing for secondary flow paths some how. [redacted] - wouldn't be confident with the water that surcharges the network disappears. **[redacted] - Stantec did the most recent work on the model and certainly looking at getting them to work on as part of the design. Any comments?** Stantec have been working on this model for Regional Council as well and a series of smaller events. Our events were 10 & 100 years for climate change. Stantec have done more scenarios. There are 2 versions of the model, still finalising the single version of the model. Different between the two models are the Waiwhetū stream. Everything west of railway line would be the same. [redacted] - they still ran the whole model for lower events. Changes are mainly around hydrology not the actual run off or the network. Just new hydrographs. **[redacted] - Is the work they did for Greater Wellington available?** Yes we believe it should be available, ask [redacted] at Regional Council. ([redacted] - we could shortcut this request by Stantec) **[redacted] - are there any other gaps in the modelling that we would need to address in the next phase to have confidence in the flows of the stream to assess the flood hazard?** [redacted] - make sure cross sections are reflected for the stream. Check the pumps. We haven't reviewed the options that Stantec have put in, for sensitivity be good to check what the risk is, does it work differently. [redacted] - Wgtn Water has fixed climate change allowances of 20% and fixed sea level response. This is OK for designing the primary network but in this case we would want to look at the uncertainties. [redacted] WW- any impact on sea level figure update? Wondered whether provision can be made depending on pump station capacity? can we add an additional pump or upgrade to take that into account. No point over designing it. At a later date designed so we can increase the flow. ([redacted] - adaptive response) [redacted] – we have not reviewed the options? Haven't looked at it in the model and questioned how it worked. Was no review of it. With climate change definitely would do an assessment around those higher levels. [redacted] = these will get taken over by Wgtn Water to manage, so we would at least meet current Wgtn Water design standards. Assumptions - future development is hydrology neutral. From roof runoff is less problematic. Would need to test rainfall and sea level. If building large infrastructure and investing for climate change to end of century. Def make sense to leave for another pump.	

[redacted] - in terms not having seen the options - Stantec went very quickly to these pipes (3 pipes) downstream, were any other options modelled upstream?
Taking peak out of hydrograph. [redacted] - from memory they didn't model a lot, such a short timeframe, more a concept around what needs to be done. [redacted] - doesn't know.
[redacted] - they had taken the 10 yr flow out of the stream. Divided by 3 locations? [redacted] - said took 10% of the flow at first place, then 10% next place at third place - then that worked.
[redacted] WW - 10% of what? Boundary conditions sounded like 100 year flow in Opahu, 10 year flow in Hutt City - base scenario for the modelling.
[redacted] - think it was 10% at each location. We def need to refine as how much water should come out of the stream. Do we need 3 pump stations.

[redacted] WW - what is the flow rate at those points?
The pump station will have limitations of what it will pump. They will work at different level of service, what is practical to achieve, need other controls in the catchment for protection of property.

[redacted] - how is the residual risk accounted for?
WW - even if had the pump stations, for new properties do you have a level as if the pump was not there. [redacted] - no one here from Hutt City that can speak to the goal. A project goal is to receive totally free of flooding, we still need to manage the residual risk. What does project success look like? It will still be indicated as a hazard until there is a plan change. [redacted] - do Hutt still want to keep it as a hazard.

[redacted] WW – the objective of the project needs to be clearly defined. What does betterment look like to them? Clear about current properties and new properties. Assuming pump stations operating or not?
[redacted] - to date this hasn't been explored. This is a gap.
- do we need pump stations are their options for gravity?
WW - how do you get that out of gravity in the Hutt Valley.
- gravity to a point then pump at the other end. [redacted] - you would have to have a pump station at the discharge end, Waiwhetū is not an option as it floods at the same time. All exiting is pump station.
[redacted] WW, could possibly design to have gravity discharge, and at the discharge end out controls, it can pump also.
[redacted] - current design has potentially as many as 5 pump stations.
WW - key question do you have the fall to get it across?
- downstream would be quite deep and big.

[redacted] - seems like at the moment only one thing trialled?
WW - they looked at storage in the catchment and raising the properties. No space to store it.

	[redacted] - Other than the Stantec report were the other options written down anywhere? NN - don't believe so, only Stantec report. (neither [redacted] or [redacted] were part of that project). [redacted] - they only spoke about options as a comment, not enough detail for resourcing consenting to name as an option we looked at and ruled it out. [redacted] - sounds like there was no time for anything. [redacted] WW - if there is not enough land, would need to build a dam on the river and this is not possible. Wasting their time. If Stantec had more information we could retrospectively write it down. [redacted] - said some workshop notes on this and why. **[redacted] – it is narrow from Taita up, are we confident that whatever flows are going in at Taita are accurate? River or stormwater?** [redacted] - fairly confident that the Northern end of the model doesn't receive external flows through it. It includes the northern extent of the Waiwhetū catchment. Fairly confident. No inflow in there, we try to keep it in one catchment. [redacted] will check the model. [redacted] - could find an area South of Taita where you could remove some of the Northern section of the model. Generally the network is flowing either east or west (either to the river or under the railway line to the Waiwhetū). There will be some overland flow South, but probably find a discreet boundary. [redacted] - downstream of the model - most up to date boundary - as in ocean or river. [redacted] - we have just had a joint probability study done - suggest that you test different flows to the river - it provides recommended (based on Monte Carlo approach) provides a series of different flows in the river that could be used for different events for different stormwater events. In the model we have a version of the river represented, you put the flow in at the top. GW could run it, or get hold of the model. Joint probability of water level included in that - no not yet. With the Opahu pump station - any works proposed on this pump, make it bigger? [redacted] - understanding probably not in terms of its capacity, 3 pumps there and never had to use all 3 at once. BH - few minor works e.g additional monitoring, nothing to impact the models. [redacted] side note - there are locations upstream of pump station where the velocity slows significantly and starts to back up naturally. Idea of channel improvements might be an option to be considered. [redacted] - was dismissed fairly quickly it is very close to properties. [redacted] it is a lot of peoples back yard. [redacted] - if you could buy 2or 3 properties and use that and don't use pump stations. Perhaps that does look like an economical solution? Perhaps touch base with [redacted] about where those areas are.	
Action	Check no flows from the north	[redacted]
Action	Provide the report on pump stations/boundaries	[redacted]

Action	Send through the model	[redacted]
Action	Send through the model report	[redacted]
Action	Contact GWRC about using the model	[redacted]
Action	Arrange a meeting with HCC, planners, Wellington Water (who will own the asset once finished) to confirm what the end objectives are. What defines a successful project?	[redacted]

Minutes

Riverlink IAF Kick Off Meeting

Date:	16th June 2023	**Time:**	9:30am
Location:	Level 7, Majestic Centre	**Room:**	Room 7.01
Attendees	[redacted]		
Apologies			
Subject	Riverlink IAF Kick Off Meeting		

No	Item	By Whom
Introduction	• [redacted] – started the meeting with an introduction • All participants introduced themselves	[redacted]/All

Objectives	• [redacted] – discussed the objectives of the meeting
	• Introduce the various teams and people that will need to interface to make this project a success
	• Discuss and understand:
	    o The key interfaces
	    o How will we work together?
	    o Who is who?
	    o Who needs to work with who?
	• Decision has been made to deliver the IAF project scope separately to the alliance or WWL. WWL indicated they did not have the delivery capacity (with existing commitments to deliver this additional scope) so this will be delivered by a different delivery vehicle.
	• Initial thinking is that design will be done by the IAF project team (T+T) and construction (only) in the Riverlink boundaries will be delivered by the Alliance.
		[redacted]

	Riverlink Alliance want to be clear on ownership of elements within the Riverlink site. This needs to be understood as there is likely a few fishhooks that will need to be addressed.	

	[redacted] want to know more about the IAF design programme. [redacted] and [redacted] provided an overview of the IAF project and its objectives. Noted that this IAF project makes up the largest single chunk of the IAF fund, being approx. 10% of the total funding. It is therefore important that it is delivered effectively. Key steps to get started are to: • line up the programmes (between Riverlink & IAF HCC) • Line up the design [redacted] – Riverlink programme is currently targeting final signing of the PAA with the TOC on 8th October 2023. This requires pricing packs by 4 August 2023. MK & MFT • for visual reasons Riverlink will be pushing very hard to put the W/W pipe on the new Melling Road bridge rather than the Pedestrian bridge. Ped bridge is likely to be a timber bridge. • The construction programme is still to be developed. So, they cannot say what order the bridges will be constructed. • Still trying to resolve how the road bridge will land on TLB. Riverlink are trying to land the bridge within the stop bank, rather than over it.	
Interfaces between Riverlink works and IAF Scope	**<u>ALL - General Discussion</u>** [redacted] – tabled a drawing that showed the Riverlink project area and the proposed 3 x IAF networks [redacted] – Driver for the IAF programme is deliver S/S improvement and be live by 2026. This is a key constraint for delivery. And was a key element in funding applications.	
Interface between the S/S crossing the bridges and different options	All – discussion about interface between the S/S crossing the bridges and different options. - Riverlink are currently not including the IAF elements in their scope or TOC build up. - If the bridge needs to be completed by 2026, and Riverlink are responsible for this, it needs to be identified ASAP and will need to be addressed in their scope/costs.	

	There was discussion about which elements are consented. [redacted] confirmed that the existing stormwater pump station locations and outfall locations are consented under Riverlink contents but IAF would need to consent an increase in the discharge.	
Interfacing & points of contact	[redacted] is the Riverlink utilities manager. Stantec will be delivering the 3 waters scope. [redacted] is undertaking Pump Station design. [redacted] will lead construction of these elements under [redacted] But need to have clear communications plan. All interface between IAF and Riverlink will initially go through [redacted] as OIM. Ok to copy in others. [redacted] will manage communications for the design team leads via [redacted]	
Action	Comms structure to be developed by IAF project and go through [redacted] This will start as a strawperson plan, confirm IAF communication channels to Riverlink and include escalation points.	
	Riverlink are doing a similar thing with Mill Street stop bank design team which could be used as a template. All - There was discussion on what elements should be included in Riverlink, whether these should be included in the TOC pricing exercise and what elements would benefit from Riverlink design. [redacted] – the pipelines will effectively be an exercise in utilities diversion – i.e. main planning and cost will be understanding, method and approach to utilities diversions. For that reason, it would make sense that Riverlink include the pipe locations and associated diversion in their design/costing scope. One option was for T+T to confirm a proposed corridor and pipe size/type/depth (gravity/pumped) and probable S/S crossing location and Riverlink could then include in the TOC design/costing. Noted that pump station outfall locations are consented and therefore will not be moving. There was general support for this approach however this approach would need to be confirmed by HCC ([redacted] and confirmed officially through the OIM ([redacted] T+T would need to do a very quick options selection to provide a preferred bridge crossing location (for the purposes of Riverlink TOC assumptions).	

Action	[redacted] to consider if HCC would like the Riverlink TOC scope to increase to include the detailed design and construct of 3 x IAF elements within the Riverlink zone of works.	
Action	If requested by HCC, OIM ([redacted] to instruct Riverlink to include the scope of the 3 x IAF elements in the TOC.	
Action	If requested by HCC, T+T to do fast options assessment and confirm (for purposes of Riverlink TOC assumptions) proposed alignments and overall dimension/type/depth of the 3 x IAF elements to be included in the Riverlink TOC scope.	
	[redacted] – it would make sense for Riverlink to take on the detailed design of the 2 x SW pump stations. This is because Riverlink will be designing a number of other structures so it would make sense that there are common design, procurement, operations, manuals etc across the new pump stations. [redacted] – on face value agree. [redacted] – Pointed out that the pump stations will all be similar already as they will all have to comply with WWL standards.	
Action	Action: HCC/EID and T+T to discuss pump station scope and communicate back to OIM.	
	[redacted] left approx. 10:25, meeting concluded approx. 10:35.	
Post meeting discussion with HCC/EID and T+T	Agreed it would be highly beneficial to include as much of the IAF scope within Riverlink boundaries so that it can be included in TOC.	
Action	T+T to develop high level plan for how this might work and what can be achieved by when.	

Tonkin+Taylor

Appendix B Gap Analysis Detail

1.1 Wastewater

Element	Current state	Desired state for completion of stage 1 – Feasibility Studies. December 31 2023	Recommendations
Overall design	Concept design completed in April 2023. • Pump station with a duty capacity of 100L/s and an associated emergency storage tank with 2,000m3 capacity. Located at [redacted] • 1,240m long 315NB PE Rising main • Two sections of gravity sewer diversions consisting of a 330m long 375NB sewer and 180m long 300NB sewer. • 475NB, 220m long Pump station overflow pipe	• Basis of design 3D model of layout, volumes and depths for all pump station and storage tank. • Adequate risk/s level assessed • Construction methodology and feasibility confirmed. • Structure importance level agreed • Confidence that this solution best meets the agreed objectives (see Flow modelling). • Consentable approach.	• Confirm design objectives and critical success factors with the client. • Design to "option confirmation" including results of specialist investigations. Consider space requirements and land ownership. • Concept Design using a 3-D approach to model the pipelines, PS and other services. • Include detailed constructability and costing input from specialist contractors. • Understand the consenting drivers and adapt design.
Flow modelling	• Detailed modelling of proposed solution undertaken with limited optimisation.	• Confirm the maximum pass forward flow possible in order to minimise the storage tank volume while meeting the overall catchment wide level of service outcomes.	• Further modelling required during feasibility design to test optimisation scenarios.
Climate change and other uncertainties	• Hydraulic modelling includes allowance for increase rainfall intensity. • No flooding resilience assessment undertaken	• Confirm level of service/resilience to be achieved by the pump station. • Understand the elevation of critical equipment.	• Review Wastewater flows from latest hydraulic model.

Element	Current state	Desired state for completion of stage 1 – Feasibility Studies. December 31 2023	Recommendations
		• Further detail and confirm Western trunk mains risks and upgrades requirements	• Assess interphase operational impacts between existing and proposed Wastewater systems
Site investigations/ground truthing	• Have not checked concept design against the level of the Waiwhetu Aquitard.	• Confirm river crossing options. This may require a review of loadings on existing structure. • Confirm the performance of the upgraded gravity collector trunk vs connecting laterals	• Check temporary works method to minimise groundwater ingress and possible settlement effects. • Potential ground water conditions and check buoyancy calcs with groundwater table for proposed pump station and storage
Iwi and stakeholder engagement	• Key partisan organisations engaged to the required level for concept design • External Stakeholder mapping not significantly done yet	• Internal and External stakeholder mapping and engagement plan drafted • Approval/acceptance of preferred option by iwi and key stakeholder organisations	• Optimise the concept design and get approval from contractual and stakeholder parties • Conduct aspects of social and community engagement
Pricing	• CAPEX - [redacted](Inclusive of Property Acquisition Costs) • OPEX - [redacted]	• Budget compliant design concept finalised	• Perform financial sensitivity for CAPEX and OPEX costs • Achieve sign-off on proposed budget • Optimise value for money

1.2 Stormwater

Element	Current state	Desired state for completion of stage 1 – Feasibility Studies. December 31 2023	Recommendations
Overall design	• 3x pipeline routes and pump station (PS) locations are indicated on large scale plans. • Ballpark pipeline sizing from basic hydraulic calcs • Formerly 2x Riverlink PS have preliminary layouts based on local stormwater catchments only. • No detailed consideration of route/PS location feasibility or existing services or other constraints. • (Other comments from Motts about PS design) • Design objectives/critical success factors not entirely clear • Not 100% clear on what basis the alternative options were discounted or whether they were rigorously considered (eg. to meet threshold for consenting)	• Confirmed pressure/gravity. • Diameter, material, alignment and preliminary long sections for all pipelines. • Plan layout, volumes and depths for all pump stations • Construction methodology and feasibility confirmed. • Residual flood risk eg. due to failure or over-design event considered and recommendations made. • Uncertainties well explored and approach agreed with client – possibly through elements of adaptive design. • Confidence that this solution best meets the agreed objectives. • Consentable approach.	• Confirm design objectives and critical success factors with the client. • Design to "option confirmation" (short of full conceptual design) including results of site/services investigations. Consider space requirements and land ownership. • Design using a 3-D approach to model the pipelines, PS and other services. • Include detailed constructability and costing input from specialist contractors. • Review complementary or wider catchment options to confirm whether they have a role to play.
Flow modelling	• Preliminary modelling to "options feasibility" level but no detailed modelling of the preferred option. • No sensitivity analysis. • Proposed pipes themselves not included in model, only abstractions from the stream. Pipe sizing was based on rule-of-thumb velocity assumptions. • No reporting beyond what was included in the growth study report. • Opahu Stream only represented simply in model. • Unsure how the existing Opahu PS is represented in the model. • Uncalibrated but validated against historical observations.	• Modelling to "conceptual design" level. • Proposed pipelines included. Model used to determine pump duty. • A range of flow rate scenarios examined in order to determine the optimal rate at each of the abstractions from the Opahu Stream. • Opahu Stream channel and the existing Opahu PS adequately represented • Sensitivity modelling of a range of uncertainties to establish envelopes for design.	• Clip to a smaller model region • Model a range of event sizes to understand performance across the whole spectrum. • Model gravity options, if these are selected for detailed analysis • Potentially improve stream representation • Confirm and update boundary conditions eg. representation of Opahu PS

Element	Current state	Desired state for completion of stage 1 – Feasibility Studies. December 31 2023	Recommendations
	• Model takes a long time to run	• Modelling of pump failure scenarios/surge analysis for pumped mains • Model documentation and reporting.	
Climate change and other uncertainties	A single scenario was modelled: • Rainfall + 20%? • Modelled Hutt River boundary condition with Sea Level Rise. However, sea level rise condition to be confirmed • Hydraulic neutrality of future growth • Unsure if this scenario considered the existing Opahu Pump Station to be in operation	• All major assumptions and uncertainties understood and documented, and the associated risks agreed with client. • Risks managed through design envelopes based on sensitivity analysis.	• Uncertainties and risks workshop with designers, WWL and HCC to inform sensitivity scenarios to be modelled. • Risks and uncertainties clearly communicated in design report. • Potentially an adaptive approach to design to allow for change over time
Site investigations/ ground truthing	None to date.	• Plan location of all services confirmed. • Depth of all major services or potential conflicts confirmed. • Potholing or trenching at critical bottlenecks. • All design constraints or risks identified.	Obtain services plans and GPR data, include in 3D model. Site and/or desktop investigations into: • Hydrogeology (aquifer) • Contaminated land • Planning • Stream ecology
Iwi and stakeholder engagement	None to date.	• Design constraints and any “no-go’s” identified. • Key relationships established and iwi/stakeholders engaged with the project. • Supportive iwi and key stakeholders. • Legal and consenting requirements satisfied.	

Element	Current state	Desired state for completion of stage 1 – Feasibility Studies. December 31 2023	Recommendations
Pricing	A cost estimate has been produced for the purposes of obtaining funding. However, the basis of the estimate is unconfirmed.	• High level cost estimate based upon the identified scope as detailed in the concept design information and specification to be developed incorporating allowances for escalation, risk and contingency.	An updated cost estimate shall be produced which will include quantities and rates for the purposes of confirming scope and tracking costs. Escalation shall be allowed for based upon the indicative construction programme and sequence. • A risk register shall be created capturing known/ unknown risk and a suitable contingency allowance shall be made.

Appendix C Existing Risk Registers

Risk Register

Any Cells with Red fill need urgent attention!!

Orange cells contain formula - DO NOT EDIT!

Project/Contract:	RiverLink - Hutt CBD Sewer Bypass	**Document Date:**		
Project/Contract ID:	OPC101481	**Supplier Lead:**	[redacted]	Holmes
WWL Lead:	[redacted]	**RM Specialist:**	[Enter data in '2 Project Information New']	[Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21	

										Current Exposure Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure Semi-Quantitative					
Rank	**RID**	**Risk Title**	**Description/ Cause/ Consequence**	**Risk Owner**	**Risk Owning Org**	**Date Raised (xx/xx/xxxx)**	**Risk Status**	**Phase**	**Established Controls**	**Consq.**	**Likelihood**	**Risk Score**	**Individual actions to be recorded in the Actions Register (Tab 4)**	**Consq.**	**Likelihood**	**Likely Cost ($M)**	**Likely Delay (Months)**	**Risk Score**	**Commentary & Closure Statement**
2	R01	Funding Envelope	Description: There is a threat that the project cost is above the current approved funding amount of [redacted] (rates and developer contributions) Cause: The cause of the threat is an underestimate of cost at budget setting stage and additional requirements and costs being identified during concept design Consequence: The consequence of the threat is insufficient funding to complete project resulting in project being cancelled and loss of funding or inability to meet project outcomes due to funding constraints	Project Manager	WWL	10/6/2022	Live - Treat	Construction	- Level 1 cost estimates undertaken by Alta as part of optioneering - MCA including capital cost + sensitivity testing on cost weighting - Cost estimate updated to Level 2 for concept design	High	very high	22	- Input updated expected cost into HCC annual plan review (October 2023) to increase project budget - Investigate and progress value for money ideas identified - Consider undertaking targetted value for money activities (workshop etc.)	High	Very Low	[redacted]	0.125	8	
3	R02	Riverlink Programme Tie-in	Description: There is an opportunity to hand the detailed design and construction of Hutt CBD Sewer to the Riverlink Alliance. Cause: The cause of the opportunity is the Riverlink Alliance, which includes HCC, is currently out to tender and the Hutt CBD Sewer can be incorporated in to the project scope Consequence: The consequence of the opportunity is coordinated scheduling of Riverlink works along with Hutt CBD Sewer project resulting in less disruption to the public and potential efficiencies (time and cost) in delivery	Project Manager	WWL	10/6/2022	Live - Treat	Design Development	- Ongoing engagement with HCC RiverLink project management - Hutt CBD sewer project timeframes aligning to RiverLink timeframes	Medium	High	17	- Present opportunity to RiverLink board to gain approval	Medium	Very High	[redacted]	6	18	
2	R03	Extent of Riverlink Designation	Description: There is a threat that the Hutt CBD Sewer project falls outside of the Riverlink consent designation. In particular the location and volume of the storage tank requires a separate consent. Cause: The cause of the threat is the Riverlink designation was obtained without the Hutt CBD Sewer project in frame Consequence: The consequence of the threat is Hutt CBD Sewer project will have to be consented separately, and that this will need to be done by WWL before passing to Riverlink Alliance. This could delay delivery of the project and ability to tie into main RiverLink works	Project Manager	WWL	10/6/2022	Live - Treat	Design Development	- Review possible consent triggers and highlight as part of optioneering - Complete planning assessment and include as part of concept design deliverables	High	very high	22	- Engage HCC and GWRC consenting teams with the project to understand requirements - Commence discussions with RiverLink on preferred approach - separate consenting vs changes to RiverLink consent designation	Medium	Low	[redacted]	0.5	11	
13	R04	IAF Funding Window	Description: There is a threat that the project cannot be delivered within the timeframe agreed with Kainga Ora - currently understood to be end of calendar year 2026. Cause: The cause of the threat is dependancies on to be constructed elements of the Riverlink works means the sewer bypass may be pushed to later stages by the Alliance Consequence: The consequence of the threat is that this could adversly effect HCC's reputation with Kainga Ora potentially putting at risk funding provided for other projects. This would require the shortfall to be found by HCC or the project cancelled due to insufficient funding	RiverLink Partner Lead	HCC	10/6/2022	Live - Parked	Detailed Design	- Options that utilised proposed Melling road bridge and/or existing Melling bridge stub updated to remove dependancies on those elements of the project - There is an opportunity to move the date as part of issuing of delivery plans - if the dates moved and there is justification this will probably be acceptable	medium	medium	15		medium	Medium	[redacted]	2	15	

redact name

Risk Register

Project/Contract:	RiverLink - Hutt CBD Sewer Bypass	**Document Date:**	
Project/Contract ID:	OPC101481	**Supplier Lead:**	[redacted] / Holmes
WWL Lead:	[redacted]	**RM Specialist:**	[Enter data in '2 Project Information New'] / [Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21

										Current Exposure – Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure – Semi-Quantitative					
Rank	**RID**	**Risk Title**	**Description/ Cause/ Consequence**	**Risk Owner**	**Risk Owning Org**	**Date Raised (xx/xx/xxxx)**	**Risk Status**	**Phase**	**Established Controls**	**Consq.**	**Likelihood**	**Risk Score**	**Individual actions to be recorded in the Actions Register (Tab 4)**	**Consq.**	**Likelihood**	**Likely Cost [redacted]**	**Likely Delay (Months)**	**Risk Score**	**Commentary & Closure Statement**
	R05	Western Trunk Main Sewer Capacity	Description: There is a threat that the western trunk sewer and terminal pump station (Ava) have current operational risks that would be made worse by adding extra flow from Hutt CBD Cause: The cause of the threat is additional flow being sent to Western Trunk / Ava from Hutt CBD via the bypass and pump station Consequence: The consequence of the threat is that possibly more flow will need to be restricted at Silverstream and bypassed to storage/EOP causing additional spilling of wastewater at Silverstream. This may also contribute to complexities in operating the Western Trunk main increasing the risk of uncontrolled spilling at Ava pump station	Lead Designer	Holmes	10/6/2022	Closed	Operation	- Review alternate options with COG - MCA including cost, risk and COG inputs - Develop options to mitigate operational risk - Gain COG endorsement prior to commencing concept design	Very high	High	24				#N/A	#N/A	0	Solution developed to not increase peak flow in Western Trunk Main and mitigate any increase in uncontrolled spilling downstream of bypass discharge point
9	R06	Engineered Overflow Point Consenting	Description: There is a threat that the engineered overflow point needs to be consented to be built Cause: The cause of the threat is the current approach is to not consent the EOP but install it with a control valve. The EOP will then only be used in an emergency event and a decision can be made to open the EOP valve. Use will be covered under the emergency works provisions of the RMA. Consequence: The consequence of the threat is that the consent authority deems that the emergency works provisions of the RMA do not apply and consent is required. This may result in delays to the project to obtain the required consent or EOP not being constructed resulting in the project not being able to be operated as intended.	Project Manager	WWL	10/6/2022	Live - Parked	Design Development	- Awaiting outcome of WWL's current network discharge consent application - Seeking legal advice - Consenting requirements for EOP covered in planning assessment	high	Medium	19		high	Medium	[redacted]	2	19	
	R07	Stakeholder Buy-in	Description: There is a threat that the project will stall because a decision cannot be reached. Cause: The cause of the threat is stakeholders have opposing views that cannot be easily resolved. Consequence: The consequence of the threat is project delay or preferring an option that is not the highest scoring through the MCA	Lead Designer	Holmes	10/6/2022	Closed	Optioneering	- MCA process with all stakeholders included - Risk workshop to highlight risks and mitigation measures - Further work identified to mitigate risks highlighted by stakeholders - 3WDMC to make a call	medium	Medium	15				#N/A	#N/A	0	Preferred option endorsed by 3WDMC prior to concept design
6	R08	Storage Volume	Description: There is an opportunity to increase overflow storage capacity in Hutt CBD Cause: The cause of the opportunity is building a new pump station provides opportunity for storage Consequence: The consequence of the opportunity is that a larger storage capacity could reduce the overall spilling amount from nearby EOPs including Barber Grove.	Project Manager	WWL	10/6/2022	Live - Parked	Design Development	- Network modelling outlining storage options to reduce overflows - Alternative project to look at storage options and costs	Medium	low	11		medium	Low	[redacted]	0.5	11	
	R09	EOP Gravel Inundation	Description: There is a threat that an EOP to Hutt River may be subject to gravel aggradation / blockage. This is worse south of Ewen Bridge (affects Option 4) Cause: The cause of the threat is the section of river south of Ewan bridge is known aggrade gravel Consequence: The consequence of the threat is that any EOP outlet structure south of Ewan bridge may required additional maintenance to keep operational	Lead Designer	Holmes	10/6/2022	Closed	Operation	- Review location of EOP in relation to known opeational issues / gravel aggredation sites / proposed river bed levels	high	Low	16				#N/A	#N/A	0	EOP structure proposed north of Melling Bridge in area that doesn't accumilate gravels

Risk Register

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WWL Lead:	[redacted]	**RM Specialist:**	[Enter data in '2 Project Information New']	[Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21	

										Current Exposure Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure Semi-Quantitative					
Rank	**RID**	**Risk Title**	**Description/ Cause/ Consequence**	**Risk Owner**	**Risk Owning Org**	**Date Raised (xx/xx/xxxx)**	**Risk Status**	**Phase**	**Established Controls**	**Consq.**	**Likelihood**	**Risk Score**	**Individual actions to be recorded in the Actions Register (Tab 4)**	**Consq.**	**Likelihood**	**Likely Cost ($M)**	**Likely Delay (Months)**	**Risk Score**	**Commentary & Closure Statement**
	R10	Uncontrolled vs. Overall Spill Reduction	Description: There is a threat of negative implications when considering network discharge consent. Cause: The cause of the threat is that although project addresses reduction in uncontrolled spills, these are effectively moved to a controlled spilling point which, in some instances, results in an increase in spilling out of an EOP Consequence: The consequence of the threat is if criteria is to address overall spilling there would be significant implications to required storage volume. High level modelling indicates approximately 3,600m3 of storage required for project to reduce overall spilling to nil.	Project Manager	WWL	10/6/2022	Closed	Design Development	- Understand wider network and aim of reducing overall spilling. '- Project based on assessment of reduction in uncontrolled spilling meets secondary service objective.	Medium	Medium	15				#N/A	#N/A	0	3WDMC endorsed preferred solution including consequence of increased controlles spilling
13	R11	Sequencing of Project in Riverlink Programme	Description: There is a threat that works will be difficult to sequence if not aligned with Riverlink Alliance programme Cause: The cause of the threat is not delivering the project through the Alliance Consequence: The consequence of the threat is potential project delays, increase in cost and increased disruption to the public	Project Manager	WWL	10/6/2022	Live - Treat	Design Development	- Ongoing engagement with HCC RiverLink Partner Lead - Hutt CBD sewer project timeframes aligning to RiverLink timeframes	Medium	Medium	15	- Present opportunity to RiverLink board to gain approval	Medium	Very Low	[redacted]	0.125	4	
7	R12	Optimisation of Design	Description: There is an opportunity to optimise the storage and pump station size Cause: The cause of the opportunity is the new pump station and storage facility in Hutt Central Consequence: The consequence of the opportunity is the ability for Wellington Water to either reduce wider network spilling or reduce project cost through design optimisation	Project Manager	WWL	10/25/2022	Live - Parked	Design Development	- Run parallel project with new activity brief to look at optimising storage and pump station sizing	Low	Medium	10		Low	Medium	[redacted]	2	10	
	R13	Interface with Other works	Description: There is a threat that the location pump station for option 4 coincides a new water supply bore. Cause: The cause of the threat is that there is a water supply bore located in south east corned of Hutt Recreation Ground. Consequence: The consequence of the threat is that the water supply bore will need to be removed or an alternative location for the pump station found.	Lead Designer	Holmes	10/27/2022	Closed	Design Development	- Obtain as-builts, carry out site investigations: geotech, topo & existing services surveys. - Check design against positions of all known services at design phase.	Medium	low	11				#N/A	#N/A	0	Option this affected is not being taken forward
5	R14	Operation of EOP	Description: There is a threat that the new EOP wouldn't operate under high river flow conditions. Cause: The cause of the threat is that central Hutt is very flat when in flood river levels are above surrounding ground level Consequence: The consequence of the threat is that emergency overflows would not operate under high river flows possibly leading to uncontroleld overflows.	Project Manager	WWL	10/27/2022	Live - Parked	Operation	- Review EOP discharge location and route during design development - Option to provide pumped overflow for high river flow conditions	Very High	Low	20		Very High	Low	[redacted]	0.5	20	
4	R15	Interface with Stormwater Project	Description: There is an opportunity to align some of the wastewater works with the stormwater. Cause: The cause of the opportunity is linking IAF projects for more efficient delivery Consequence: The consequence of the opportunity is cost savings for the project, reduced risk of delays and reduced impact on the public.	Project Manager	WWL	10/27/2022	Live - Treat	Construction	- Ongoing engagement with HCC RiverLink Partner Lead - Commence development of stormwater projects to increase likelihood of combining with this project	Low	Low	6	- Progress drafting of activity brief to kick-off stormwater projects	Low	Very high	[redacted]	6	14	
9	R16	Ground Conditions / Other Services	Description: There is a threat that unkown services or ground conditions will be encountered in construction Cause: The cause of the threat is existing or redundent services not surveyed / located and variations in ground conditions not identified / recorded. Consequence: The consequence of the threat is delays to project or unforseen costs.	Project Manager	WWL	10/27/2022	Live - Treat	Design Development		High	Medium	19	- Obtain as-builts, carry out site investigations: geotech, topo & existing services surveys. - Check design against positions of all known services at design phase.	High	Very Low	[redacted]	0.125	8	

Risk Register

Project/Contract:	RiverLink - Hutt CBD Sewer Bypass	**Document Date:**	
Project/Contract ID:	OPC101481	**Supplier Lead:**	[redacted] / Holmes
WWL Lead:	[redacted]	**RM Specialist:**	[Enter data in '2 Project Information New'] / [Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21

										Current Exposure			Treatment Strategy	Residual (Target) Exposure					
										Semi-Quantitative				Semi-Quantitative					
Rank	**RID**	**Risk Title**	**Description/ Cause/ Consequence**	**Risk Owner**	**Risk Owning Org**	**Date Raised (xx/xx/xxxx)**	**Risk Status**	**Phase**	**Established Controls**	**Consq.**	**Likelihood**	**Risk Score**	**Individual actions to be recorded in the Actions Register (Tab 4)**	**Consq.**	**Likelihood**	**Likely Cost ($M)**	**Likely Delay (Months)**	**Risk Score**	**Commentary & Closure Statement**
	R17	Alicetown Uncontrolled Spilling	Description: There is a threat that solutions connecting to the WHTM could have a knock-on effect downstream. Cause: The cause of the threat is connecting to WHTM and not addressing upgrade works inline with population growth. Consequence: The consequence of the threat is that uncontrolled spilling could occur in Alicetown or increased project costs to address knock-on effect.	Lead Designer	Holmes	10/31/2022	Closed	Operation	- Further work identified to understand immediate upgrades required to protect Alicetown and Ava pump station - Upgrade works for WHTM in HCC LTP - Solution developed to mitigate this risk	Very high	high	24				#N/A	#N/A	0	Solution developed so no longer increases uncontrolled spilling in Alicetown
2	R18	Availability of Resources	Description: There is a threat that HCC RiverLink Partner Lead has insufficient capacity to adequately support this project. Cause: The cause of the threat is this project is outside the original scope of the RiverLink project and is funded by IAF. Therefore, it hasn't been allowed for in the original resourcing plan. Consequence: The consequence of the threat is this project isn't adequately championed to the RiverLink board, and therefore doesn't become part of realising threat R11 and missing opportunity R02.	Project Manager	WWL	2/21/2023	Live - Treat	Procurement	- Continued engagement and pushing project with HCC RiverLink Partner Lead	High	Very High	22	- Continue to push agenda of this project with HCC RiverLink Partner Lead - Escalate within Wellington Water to enable escalation within HCC	Medium	Low	[redacted]	0.5	11	
1	R19	Groundwater Management	Description: There is a threat that the groundwater table needs to be drawn down to enable construction of the storage tank Cause: The cause of the threat is a high groundwater table and deep, buried storage tank. Consequence: The consequence of the threat is increase costs, potential programme delays and impacts on adjacent properties caused by settlement	Lead Designer	TBC	3/8/2023	Live - Treat	Construction		Very High	Medium	23	- Complete geotechnical site investigation including groundwater monitoring to confirm groundwater levels	Very High	Very Low	[redacted]	0.125	13	
11	R20	Consent Requirements	Description: There is a threat that resource consent for EOP will include additional requirements such as screening. Cause: The cause of the threat is the construction of a new EOP to the Hutt River and that conversations have not started with the consenting authority to understand their requirements Consequence: The consequence of the threat is additional capex and opex cost to install and maintain the additional infrastructure	Project Manager	WWL	3/7/2023	Live - Treat	Design Development		Medium	High	17	- Engage consenting authority on construction of new EOP to understand their requirements	Medium	Medium	[redacted]	2	15	
13	R21	Ground Conditions and high groundwater table	Description: There is a threat that the ground conditions are poor or will become consolidated and a high groundwater table Cause: The cause of the threat is unknown ground conditions and groundwater level being allowed for in the design of the storage tank Consequence: The consequence of the threat is the design of the storage tank will have to account for poor ground and/or settlement and high groundwater table	Lead Designer	TBC	3/8/2023	Live - Treat	Detailed Design		Medium	Medium	15	- Complete geotechnical site investigation to confirm ground conditions and groundwater table at location of storage tank	Low	Medium	[redacted]	2	10	
4	R22	Storage Tank Operation	Description: There is an opportunity to improve the operability and maintenance of the storage tank through designing out seals and including a bypass pipe to bypass the pump station Cause: The cause of the opportunity is early engagement of COG in the design of the storage tank Consequence: The consequence of the opportunity is reduction in operation and maintenance costs including need to overpump when accessing the pump station wet well	Lead Designer	TBC	3/8/2023	Live - Treat	Design Development		Low	Very Low	2	- Explore option to include as part of design development	Low	Very High	[redacted]	6	14	

Risk Register

Project/Contract:	RiverLink - Hutt CBD Sewer Bypass	**Document Date:**	
Project/Contract ID:	OPC101481	**Supplier Lead:**	[redacted] / Holmes
WWL Lead:	[redacted]	**RM Specialist:**	[Enter data in '2 Project Information New'] / [Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21

										Current Exposure Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure Semi-Quantitative					
Rank	**RID**	**Risk Title**	**Description/ Cause/ Consequence**	**Risk Owner**	**Risk Owning Org**	**Date Raised (xx/xx/xxxx)**	**Risk Status**	**Phase**	**Established Controls**	**Consq.**	**Likelihood**	**Risk Score**	**Individual actions to be recorded in the Actions Register (Tab 4)**	**Consq.**	**Likelihood**	**Likely Cost ($M)**	**Likely Delay (Months)**	**Risk Score**	**Commentary & Closure Statement**
5	R23	Private Property Purchase	Description: There is a threat that a suitable site cannot be purchased to locate the pump station and storage tank Cause: The cause of the threat is the need to purchase private property to locate the pump station and storage tank Consequence: The consequence of the threat is the project cannot progress	Project Manager	WWL	3/8/2023	Live - Treat	Design Development	- Engage HCC RiverLink Partner Lead to progress private property discussions	Very High	Low	20	- Commence discussions with property owners on Pretoria Street	Medium	Very Low	[redacted]	0.125	4	
1	R25	Private Property Purchase	Description: There is an opportunity to locate the pump station and storage tank on the Melling stub, which is HCC owned land or other land purchased as part of RiverLink Cause: The cause of the opportunity is the RiverLink project already purchasing land in Hutt CBD and the project creating new public spaces Consequence: The consequence of the opportunity is private property purchase will not be required for the project, removing threat R23	Project Manager	WWL	3/14/2023	Live - Treat	Design Development	- Engage HCC RiverLink Partner Lead to understand properties purchased and areas of new open space being created by RiverLink	Very High	Low	20	- Engage HCC RiverLink Partner Lead to understand requirements and flexibility with IAF timeframes - Progress investigation of alternative pump station and storage tank location based on available land	Very High	Very High	[redacted]	6	25	
2	R26	Wetwell Only Pump Station	Description: There is an opportunity for the pump station to be a wetwell only pump station with submersible pumps, instead of a wetwell drywell pump station Cause: The cause of the opportunity is the location of the proposed pump is outside of central Hutt CBD and modern pumps and washdown systems Consequence: The consequence of the opportunity is reduced construction cost and reduce consequence of threat R21	Lead Designer	TBC	3/14/2023	Live - Treat	Design Development		High	Medium	19	- Check with WWL Design Team if dispensation from Regional Standards for Water Services to enable this would be possible - Confirm with COG this would be an acceptable solution	High	Very High	[redacted]	6	22	
5	R27	Consenting of Project	Description: There is a threat that the project is unconsentible Cause: The cause of the threat is the project will trigger levels that require it to be consented under th District and Regional Plans Consequence: The consequence of the threat is the project will not be able to go ahead	Project Manager	WWL	3/14/2023	Live - Treat	Design Development	- Complete Planning Assessment to understand consenting risk	Very High	Low	20	- Engage with HCC and GWRC about project	Medium	Low	[redacted]	0.5	11	
13	R28	Uplift forces on storage tank	Description: There is a threat that the storage tank will float Cause: The cause of the threat is the high groundwater table and proposed large underground storage tank Consequence: The consequence of the threat is the storage tank floats and work needs to be done to mitigate this	Lead Designer	TBC	3/30/2023	Live - Treat	Operation		Medium	Medium	15	- Complete geotechnical site investigations to determine groundwater table at location of site - Design tank for floatation	Medium	Very Low	[redacted]	0.125	4	
17	R29	Stop Bank Integrity	Description: There is a threat that the integrity of the stopbank is compromised by the rising main or EOP Cause: The cause of the threat is the rising main and EOP routes crossing underneath the Hutt River stopbank Consequence: The consequence of the threat is failure of the stopbank and flooding of properties	Lead Designer	TBC	3/30/2023	Live - Treat	Operation		Very High	Very Low	13	- Assess impact of pipe penetrations on stopbank integrity	Medium	Very Low	[redacted]	0.125	4	
5	R30	Aquifer Contamination	Description: There is a threat that the aquifer becomes contaminated Cause: The cause of the threat is potential penetration of the Waiwhetu aquifer during construction or damage to the aquiclude creating a contamination pathway Consequence: The consequence of the threat is contamination of the water supply from Waterloo WTP	Lead Designer	TBC	3/30/2023	Live - Treat	Construction	- Check aquifer depth and design structures to not penetrate aquifer	Very High	Low	20	- Complete geotechnical site investigation to confirm aquifer and aquiclude depth - Consider depth of aquifer and aquiclude in design - Talk to GWRC about mitigation measures to protect aquifer	Very High	Very Low	[redacted]	0.125	13	

Risk Register

Project/Contract:	RiverLink - Hutt CBD Sewer Bypass	Document Date:	
Project/Contract ID:	OPC101481	Supplier Lead:	[redacted] / Holmes
WWL Lead:	[redacted]	RM Specialist:	[Enter data in '2 Project Information New'] / [Enter data in '2 Project Information New']
		Risk Tolerance Threshold:	21

										Current Exposure Semi-Quantitative			Treatment Strategy	Residual (Target) Exposure Semi-Quantitative					
Rank	RID	Risk Title	Description/ Cause/ Consequence	Risk Owner	Risk Owning Org	Date Raised (xx/xx/xxxx)	Risk Status	Phase	Established Controls	Consq.	Likelihood	Risk Score	Individual actions to be recorded in the Actions Register (Tab 4)	Consq.	Likelihood	Likely Cost ($M)	Likely Delay (Months)	Risk Score	Commentary & Closure Statement
11	R31	Settlement of surrounding properties	Description: There is a threat that the properties surrounding the proposed pump station and storage tank settle Cause: The cause of the threat is creating large excavations to enable construction of the storage tank and pump station Consequence: The consequence of the threat is work needs to be done on the neighbouring properties need to mitigate the effects of settlement	Project Manager	WWL	3/30/2023	Live - Treat	Construction	- Propose purchase of neighbouring properties to increase space between excavation and adjacent buildings - Consider site layout to increase distance between excavation and adjacent buildings	Medium	High	17	- Purchase sufficient land to enable safe construction of the proposed storage tank. Consider purchasing properties to enable construction with the intention to resell afterwareds - Consider construction methods to reduce settlement on adjacent buildings	Low	Low	[redacted]	0.5	6	
18	R32	Seismic Resilience of River Crossing	Description: There is a threat that the bridge carrying the rising main with fail during an earthquake Cause: The cause of the threat is the rising main crossing the Hutt River in an earthquake zone Consequence: The consequence of the threat is failure of the bypass causing uncontrolled overflows in Hutt CBD	Lead Designer	TBC	3/30/2023	Live - Parked	Operation	- Solution proposes to use new bridge for crossing with greater seismic resilience and desgn for inclusion of the rising main	High	Very Low	8		High	Very Low	[redacted]	0.125	8	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
												0		0		#N/A	#N/A	0	
																#N/A	#N/A		

Risk Status	
Draft	0
Live - Treat	19
Live - Parked	6
Impacted	0
Closed	6
Rejected	0
Blank	12
TOTAL	**43**

Current Risk Score	
Extreme	6
High	19
Moderate	5
Low	1
Zero	12
TOTAL	**43**

Residual Risk Score			
Extreme			2
High			9
Moderate			10
Low			4
Zero			12
TOTAL			**37**

Project Risk Register

Raw Risk Rating
(blank)

Residual Risk Rating
(blank)

Project Name:		Melling and Belmont Stormwater IAF projects	**Project Phase:**	Define	
Project Number:					

Project Manager:						
Risk Assessment Completed By:			**Date:**			
Risk Assessment Checked By:			**Date:**			
Reviewed By:			**Date:**			

Revision	Date	Reason for revision	Completed By			Reviewed By

Risk Identification

No	Risk Description	Risk Type: Harm to people	Risk Type: Reputation and organisation integrity	Risk Type: Harm to environment	Risk Type: Service delivery	Risk Type: Financial impact	Likelihood: Assessment	Consequences: Description	Consequences: Assessment	Raw Risk	Raw Risk Rating
1	There is a risk that WWL cannot resource the management of the projects		✓	✓	✓		4			x	
2	There is a risk that the expected timeframes cannot be met (due to design, property, consenting timeframes)				✓	✓				x	
3	There is a risk that the RiverLink Alliance design does not adequately future-proof for these projects					✓				x	
4	There is a risk that there will be cultural and consenting difficulties with changing the catchment of the stormwater		✓			✓				x	
5	There is an operational risk from stormwater pumps sitting idle for significant time periods	✓	✓	✓	✓					x	
6	There is a risk that the expected budget cannot be met (note that the IAF funding contingency was reduced from that provided by WWL)					✓				x	
7	There is a risk that RiverLink will not agree to design and deliver these projects									x	
8	There is a risk that WWL contractor costs are higher than expected and conditions are placed on their involvement					✓				x	
9	There is a risk that only HCC resource is focussed on RIverLink rather than IAF delviery		✓							x	
10	There is a risk that HCC / WLL do not understand the operational costs of these projects		✓			✓				x	
										x	
										x	
										x	
										x	
										x	
										x	

Risk Response Measures

No	Response Strategy	Response Measures/Control	Residual Consequence	Residual Likelihood	Residual risk	Residual Risk Rating
1					x	
2					x	
3					x	
4					x	
5					x	
6					x	
7					x	
8					x	
9					x	
10					x	
					x	
					x	
					x	
					x	
					x	
					x	

Actions/Monitoring

No	Risk Owner	Planned Actions	Action by Who	By When	Action Completed/Comments
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
										x	
1	There is a risk that WWL cannot resource the management of the projects		✓	✓	✓		4				
2	There is a risk that the expected timeframes cannot be met (due to design, property, consenting timeframes)				✓	✓					
3	There is a risk that the RiverLink Alliance design does not adequately future-proof for these projects					✓					
4	There is a risk that there will be cultural and consenting difficulties with changing the catchment of the stormwater		✓			✓					
5	There is an operational risk from stormwater pumps sitting idle for significant time periods	✓	✓	✓	✓						
6	There is a risk that the expected budget cannot be met (note that the IAF funding contingency was reduced from that provided by WWL)					✓					
7	There is a risk that RiverLink will not agree to design and deliver these projects										
8	There is a risk that WWL contractor costs are higher than expected and conditions are placed on their involvement					✓					
9	There is a risk that only HCC resource is focussed on RIverLink rather than IAF delviery		✓								

				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	
				x	

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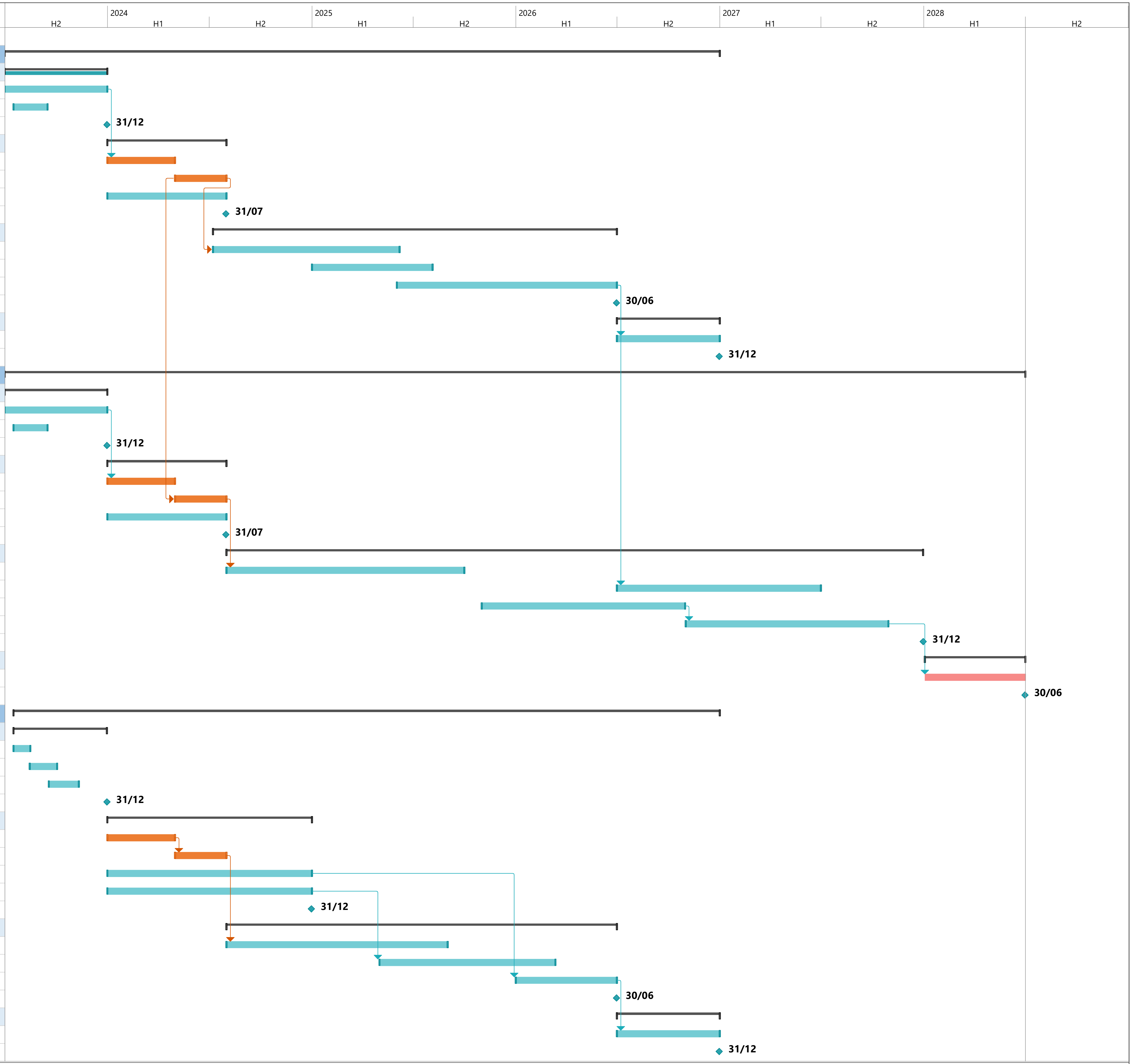
Appendix D Outline Delivery Programme and Funding Milestones

ID	Task Mode	Task Name	Start	Finish
1				
2		**Melling Stormwater**	**Sat 1/07/23**	**Thu 31/12/26**
3		**Stage 1 (Early/Feasibility)**	**Sat 1/07/23**	**Sun 31/12/23**
4		Feasibility Options Assessment	Sat 1/07/23	Sun 31/12/23
5		Consenting Strategy	Mon 17/07/23	Fri 15/09/23
6		Melling Feasilbility (Stage 1) Completion	Sun 31/12/23	Sun 31/12/23
7		**Stage 2 (Pre-Implementation/Consenting & Procuren**	**Mon 1/01/24**	**Wed 31/07/24**
8		Specimen Design & Principals Requirements	Mon 1/01/24	Tue 30/04/24
9		ECI Constructor Price Confirmation	Wed 1/05/24	Wed 31/07/24
10		Consenting	Mon 1/01/24	Wed 31/07/24
11		Melling Consenting (Stage 2) Completion	Wed 31/07/24	Wed 31/07/24
12		**Stage 3 (Implementation/Construction)**	**Mon 8/07/24**	**Tue 30/06/26**
13		Detailed Design	Mon 8/07/24	Fri 6/06/25
14		Melling Stormwater Pipeline	Wed 1/01/25	Mon 4/08/25
15		Melling Stormwater Inlet Pump Station	Mon 2/06/25	Tue 30/06/26
16		Melling Construction (Stage 3) Completion	Tue 30/06/26	Tue 30/06/26
17		**Stage 4 (Practical Completion)**	**Wed 1/07/26**	**Thu 31/12/26**
18		Melling Stormwater pump station commissioning	Wed 1/07/26	Thu 31/12/26
19		Melling Practical Completion (Stage 4) Completion	Thu 31/12/26	Thu 31/12/26
20		**Woburn Stormwater**	**Sat 1/07/23**	**Fri 30/06/28**
21		**Stage 1 (Early/Feasibility)**	**Sat 1/07/23**	**Sun 31/12/23**
22		Feasibility Options Assessment	Sat 1/07/23	Sun 31/12/23
23		Consenting Strategy	Mon 17/07/23	Fri 15/09/23
24		Woburn Feasibility (Stage 1) Completion	Sun 31/12/23	Sun 31/12/23
25		**Stage 2 (Pre-Implementation/Consenting & Procuren**	**Mon 1/01/24**	**Wed 31/07/24**
26		Specimen Design & Principals Requirements	Mon 1/01/24	Tue 30/04/24
27		ECI Constructor Price Confirmation	Wed 1/05/24	Wed 31/07/24
28		Consenting	Mon 1/01/24	Wed 31/07/24
29		Woburn (Stage 2) Completion	Wed 31/07/24	Wed 31/07/24
30		**Stage 3 (Implementation/Construction)**	**Thu 1/08/24**	**Fri 31/12/27**
31		Detailed Design	Thu 1/08/24	Wed 1/10/25
32		Woburn Stormwater Pipeline	Wed 1/07/26	Wed 30/06/27
33		Woburn Stormwater Pump Station 1	Sat 1/11/25	Fri 30/10/26
34		Woburn Stormwater Pump Station 2	Sun 1/11/26	Fri 29/10/27
35		Woburn Construction (Stage 3) Completion	Fri 31/12/27	Fri 31/12/27
36		**Stage 4 (Practical Completion)**	**Mon 3/01/28**	**Fri 30/06/28**
37		Woburn Stormwater pump stations commissioning	Mon 3/01/28	Fri 30/06/28
38		Woburn Practical Completion (Stage 4) Completion	Fri 30/06/28	Fri 30/06/28
39		**Wastewater**	**Mon 17/07/23**	**Thu 31/12/26**
40		**Stage 1 (Early/Feasibility)**	**Mon 17/07/23**	**Sun 31/12/23**
41		Option confirmation	Mon 17/07/23	Tue 15/08/23
42		Consenting Strategy	Tue 15/08/23	Mon 2/10/23
43		Property Procurement Strategy	Mon 18/09/23	Fri 10/11/23
44		Wastewater Feasibility (Stage 1) Completion	Sun 31/12/23	Sun 31/12/23
45		**Stage 2 (Pre-Implementation/Consenting & Procuren**	**Mon 1/01/24**	**Tue 31/12/24**
46		Specimen Design & Principals Requirements	Mon 1/01/24	Tue 30/04/24
47		ECI Constructor Price Confirmation	Wed 1/05/24	Wed 31/07/24
48		Property Acquisition	Mon 1/01/24	Tue 31/12/24
49		Consenting	Mon 1/01/24	Tue 31/12/24
50		Wastewater (Stage 2) Completion	Tue 31/12/24	Tue 31/12/24
51		**Stage 3 (Implementation/Construction)**	**Thu 1/08/24**	**Tue 30/06/26**
52		Detailed Design	Thu 1/08/24	Mon 1/09/25
53		Wastewater Pipelines	Fri 2/05/25	Thu 12/03/26
54		Wastewater Pump Station	Thu 1/01/26	Tue 30/06/26
55		Wastewater Construction (Phase 3) Completion	Tue 30/06/26	Tue 30/06/26
56		**Stage 4 (Practical Completion)**	**Wed 1/07/26**	**Thu 31/12/26**
57		Wastewater pump station commissioning	Wed 1/07/26	Thu 31/12/26
58		Wastewater Practical Completion (Phase 4) Comple	Thu 31/12/26	Thu 31/12/26



Project: Programme from White
Date: Fri 23/06/23

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Critical Split
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	Progress
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Critical	Manual Progress

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Appendix E Reference Documents

Document Name	Date	Author
BeforeUdig plans and related documents	-	HCC/WW
Appendix B Stormwater IAF Risk Register	-	
Lower Hutt Wastewater Network Options Assessment – prepared for Wellington Water	Sept 2022	Hydraulic Analysis Limited
Waiwhetu Growth – Stormwater Servicing Options	Oct 2021	Stantec
IAF – KO/HCC Funding Agreement 11/10/22	Oct 2022	KO/HCC
Riverlink – Hutt CBD Sewer Bypass Project Risk Register Concept Design Issue	Mar 2023	Stantec
Riverlink-Hutt CBD Sewer Bypass SID Risk Assessment Concept Design Issue	Mar 2023	Stantec
Activity Brief - Lower Hutt, Infrastructure Acceleration Fund Stormwater Upgrades for Lower Hutt Central and Opahu Stream	Mar 2023	Wellington Water
Taranaki Whānui ki Te Upoko o Te Ika feedback letter to Wellington Water – Hutt CBD WW pipe Ewen bridge 220322	Mar 2022	Taranaki Whānui ki Te Upoko o Te Ika
Eastern Lower Hutt Stormwater Model Build	Mar 2022	Stantec
Seaview Strategic Wastewater Model System Performance Assessment – prepared for Wellington Water	Jan 2022	Hydraulic Analysis Limited
Hutt City Council Three Waters Growth Study 2022	Aug 2022	Wellington Water and 3 Waters
Legal review of Optioneering and concept report	Apr 2023	Dentons
144418.50 Hutt CBD Sewer Bypass_Optioneering and Concept Design Report_Rev 4	Apr 2023	Stantec

Appendix CC- Memorandum: Housing Enablement

MEMORANDUM

Date:	19 June 2024
To:	TBC
From:	[redacted], Housing & Development Lead
Subject:	**HOUSING ENABLEMENT – COMPARISON OF OPTION 1B AND 5**

SUMMARY

1. Council has completed a multi-criteria analysis (MCA) for a stormwater project to enable more housing in central Lower Hutt in accordance with the Infrastructure Acceleration Fund (IAF) grant.
2. Two options (Option 1A and Option 5) received similar scores in the MCA. Given the primary purpose of the project is to enable growth, I have been asked to more closely consider the two options from a housing supply perspective.
3. I consider that the key additional consideration is to look more closely at the likelihood of development occurring in each area based on economic feasibility. This is consistent with other approaches such as the National Policy Statement on Urban Development. This considers not only the area of land, but feasibility of delivery.
4. There are limited means to consider feasibility and in this regard, I have primarily relied on the ratio of improvements to land value (**Improvements Ratio**) to compare level of existing housing investment in each area. Using that information, I have considered the overall feasible area. I have also considered additional factors that could further differentiate between the two options: lot sizes, cost effectiveness, and the areas subject to a more permissive building height limit.
5. The outcome of the additional analysis is that Option 1B is superior. The original scoring for the housing enablement criterion for the MCA workshop was Option 1B – 3 and Option 5 – 2. If this further analysis was factored into the scoring, then using the scoring template this would likely result in Option 1B scoring two points higher than Option 5, rather than only one point higher.

BACKGROUND

6. I provided a memo on dated 10 April 2024 for the MCA workshop, assessing each option on housing supply.
7. Scoring of the 'housing supply' criterion was based on the overall area of residential land with each option's 'zone of influence' only. The outcomes were:
   a. Option 1b benefited 40.2 ha of residential land, and was scored +3; and
   b. Option 5 benefited 29.4ha of residential land and was scored +2.
8. It was assumed for the purpose of the initial assessment that "the economic feasibility of re-developing sites in each area are broadly similar". This memo tests that assumption, and provides a more nuanced consideration beyond land area only.
9. In considering the potential for future housing supply, it is relevant to consider the likelihood of private development actually occurring.[1] On a city-wide level the Council undertakes a Housing and Business Capacity Assessment (HBA) to consider the likely feasible development potential.
10. The HBA is a specialist and time-consuming exercise. In lieu of such a modelling exercise, I have obtained high-level data that is indicative of development potential.
11. I have also considered other data that Council has access to that can provide an indication of the benefit from each project from a housing supply perspective.

LAND AREA

12. The 10 April 2024 memo looked at the total residential area .. [2]
13. For this exercise the **'Total Residential Area'** was determined as follows:
    a. Shapefiles of the zone of influence[3] for the two options were provided by Tonkin & Taylor and were used to select data by Council's GIS team.
    b. All non-residentially zoned land (including roads and open space) based on the City of Lower Hutt District Plan 2024 was excluded; and
    c. Land with designations (e.g. schools) was excluded.
    d. The flood hazard model prepared for the project was then applied by deducting the flood hazard area from each allotment. Any parcels with a remaining area of less than 200sqm were excluded. This number was used because it is considered that anything below 200sqm is unlikely to be a

[1] The vast majority of housing supply is likely to be through private market delivery.

[2] Although not noted in the 10 April memo, this land area excludes land that has a modelled flood hazard of 0.05m or more.

[3] The area that benefits from the potential stormwater upgrade.

sufficient size for medium density housing. Additionally, it was impractical to consider the placement of the flood hazards on the site. For example, a site with 200sqm of remaining section could have the non-hazard land fragmented across the site. Therefore, whilst a 150sqm area could conceivably accommodate a dwelling, a higher threshold has been used to take a more cautious approach.

14. The Total Residential Area is less than the area in the 10 April 2024 memo because this analysis excludes parcels that have less than 200sqm of land not modelled as being flood prone. Therefore, it excludes parts of parcels of land that are included in the original memo.

IMPROVEMENT RATIOS

15. The HBA model considers several variables including evidence and modelling on expected development revenue, likely housing typology and cost calculations including land.[4]
16. Of those variables, the data that is easily available are the land and improvement values from Council's rating database.
17. I have considered an **Improvement Ratio**, which is the ratio of the value of improvements relative to the value of the land. A high Improvement Ratio indicates high capital investment in the land. A low Improvement Ratio indicates underutilisation of the land, and therefore better potential for re-development.
18. Of the Total Residential Area, Option 1B has an Improvement Ratio of 0.34 and Option 5 of 0.49. This indicates a greater average development potential in Option 1B, and therefore greater feasibility of development in that area.
19. Total Feasible Area A **Total Feasible Area** was determined by excluding properties in the Total Residential Area for each Option where improvement values are equal to or exceed the land value (i.e. an Improvement Ratio of 1 or more).[5] [6] There is no set ratio where a property becomes feasible, but a ratio of 1 is used because at this point a developer purchasing a site is spending more than half of the funds on improvements which would be demolished. I have also tested this with an Improvement Ratio of 0.75 and 1.25.
20. The above methodology is considered to provide a sound basis for estimating housing enablement within the area of benefit of Options 1B and 5.

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[4] Appendix-2-Regional-Assessment-of-Feasibility-of-Development-Capacity-by-Property-Economics.pdf (wrlc.org.nz)

[5] There are also some properties that were excluded as there is no improvement value on file. This is likely due to new builds that have not been valued yet.

[6] For example, a newly developed site will have an improvement ratio exceeding 1.

21. The Total Feasible Area are shown in the table below, considering different trigger points for the Improvement Ratio. In each scenario, Option 1B would result in more feasible land being enabled.

	Option 1B **Total Feasible Area (ha)**	Option 5 **Total Feasible Area(ha)**
Total Feasible (IR <0.75)	37.30	27.90
Total Feasible (IR <1)	38.86	29.65
Total feasible (IR <1.25)	39.40	31.86

COST EFFECTIVENESS

22. By dividing the estimated project cost[7] by the Total Feasible Area, I have calculated a cost of each project option per feasible hectare:
    - Option 1B: [redacted]
    - Option 5[redacted]
23. Option 1B is considered to be preferable as it is more cost effective on a per feasible hectare basis.

OTHER INDICATORS

Lot size:

24. Larger sites are easier to develop with medium density housing and are less likely to require purchasing multiple sites. I have included below various measures of lot sizes for comparison. This is based on the Total Residential Area.

25. The lot size is on average greater in Option 5. However, there are a similar number of potential development sites that are over 800sqm and 1,000sqm in Option 1B. The Improvement Ratio is also higher for Option 5. So on balance, on the measure of lot size, both options are similar.

	Option 1B	**Option 5**
Average lot size	607sqm	849qm
Lots over 800sqm	123	121
Average IR of lots >800sqm	0.25	0.35
Lots over 1,000sqm	64	72
Average IR of lots >1,000sqm	0.23	0.35

Height Limit:

[7] P95 Estimate – Option 1B[redacted] Option 5: [redacted]

26. The residential land in both areas is zoned High Density Residential Zone, but there are precincts that also benefit from a more permissive height limit of 36m. Under the current market conditions, there are unlikely to be any buildings built to 36m in these areas, but the height limit gives an indication of where Council considers additional density to be strategically appropriate. I also consider that obtaining resource consent for higher density developments is likely to be easier in these areas.
27. Option 1B has 20.48 of land in the 36m-height limit area, and Option 5, 20ha. Therefore, both options are similar.

CONCLUSION

28. Option 1B would result in a greater enablement of housing because it has a larger Total Residential Area and on average has had less capital investment (i.e. has a lower Improvement Value). It is also more cost effective. On the measure of lot size and height limit, the two options are similar.
29. Each of these data points are only an indicator and the volume of supply feasibly enabled will vary from this and will depend on numerous variables. Ultimately, the actual delivery is dependent on the individual site characteristics and the behaviour of the market.
30. Noting that whilst these indicators I have considered may provide a more nuanced analysis, I still consider that the primary factor is the overall residential land area. In this regard, Option 1B is superior. However, the analysis further emphasises the superiority of Option 1B, and accordingly, If this further analysis was factored into the scoring, then using the scoring template this would likely result in Option 1B scoring two points higher than Option 5, rather than only one point higher.’.

APPENDIX

SUMMARY OF FIGURES

	Option 1B	Option 5
Total Residential Land Area (ha)	40.16	34.96
Total Feasible Area (IR<0.75)	37.30	27.90
Total Feasible Area (IR<1)	38.86	29.65
Total Feasible Area (IR<1.25)	39.40	31.86
Average Improvement Ratio	0.34	0.49
Cost per hectare (Total Residential Area)	[redacted]	[redacted]
Cost per feasible hectare	[redacted]	[redacted]
Average lot size	607sqm	849sqm
Lots over 800sqm	123	121
Lots over 1,000sqm	64	72
Total area 36m height limit	20.48ha	21.61ha

DETAILED METHOD

Indicator	Method
Total Residential Area	All land parcels in the Council's GIS database within the shapefile area. Exclude any land not zoned residential (including roads and open space), or subject to a designation (e.g. schools) Exclude parcels that are less than 200sqm in area after modelled flood areas have been deducted.
Improvement Ratio	Through the ratings data, Council has improvements value and land value. This is based on the QV valuations as of 1 September 2022, except for newly built or subdivided properties, which are valued upon completion. The ratio is the sum of the improvements value over the land value.

Total Feasible Area	Total Residential Area excluding parcels with an Improvement Ratio of 1 or more.