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Report

DRAFT: Huia Site Options Constructability Comparison

Prepared for Watercare Services Ltd

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Executive Summary

This report provides an overview of the constructability considerations for each of the shortlisted options for the replacement of the Huia Water Treatment Plant. It is intended to be used to allow comparison between the short-listed sites and therefore should be read in its entirety to appreciate the relative differences between sites.

Each site option is reviewed with consideration of the sub-components of the scheme; raw water pipelines, tunnel, treatment plant and treated water pipelines. For each sub-component the construction methodology and timeframes have been described.

The final section on each site outlines a high-level construction programme that incorporates the timeframes and interdependencies for each scheme. The construction programmes proposed for all four sites are between 3 and 4 years, although there are a number of risks and uncertainties that could affect this.

The key messages from this assessment are described below for each site.

Parker North and South

The construction of the treated watermain from the proposed site at Parker Road sites faces some constraints associated with the width of the road. This includes:

- The live lane will need to be used intermittently by construction vehicles during the pipe laying and backfilling process
- As a result of this the contractor will need to actively manage traffic with onsite TMS presence for much of the time
- Two sections of Parker Road will need to be widened within the existing road corridor to provide sufficient space for pipe installation.

These constraints associated with the treated watermain construction mean that it is unlikely to be able to proceed in parallel with the treatment plant construction.

The report also provides detail on the construction of the raw water tunnel at Mackies Rest. This work is also at a constrained site and therefore the construction work will need careful programming to minimise disruption and inefficiencies.

Existing Site

Construction on the existing site is constrained by the presence of the existing treatment plant and will be dependent on the how this is taken out of service and demolished. The site is constrained and the contractor's laydown area is likely to be located off site; either over the road or on the Manuka Road site up the road. The installation of the Muddy Creek overflow pipeline will only add to constraints on this site if this is installed during the same construction period. The partial closure of Woodlands Park Road would aid the construction process and minimise risks to the public.

The other issue affecting the existing site option is the timing associated with the construction of the tunnel and the treated water reservoirs on the same site. Due to the restricted nature of this area, we have proposed that these two construction activities do not overlap. It would be possible to commission the new plant with one of the two reservoirs being completed.

The construction of the treated watermain is constrained in the section immediately downstream of the tunnel, in Shetland Street and Phillip Avenue. This is a built-up residential area and the traffic management and trenching methodology that is implemented will need to consider the impact on local residents.

Manuka Road

The site at Manuka Road is affected by many of the same issues as construction on the existing site. The key differences are:

- The additional raw and treated watermain in Woodlands Park Road
- The Upper Nihotupu Raw Watermain extension along Exhibition Drive
- The off-spec water management

As with the existing site, there would be significant benefits from closing or minimising through traffic in Woodlands Park Road. This will be most relevant during the 6 month period while the watermain is being installed.

Further investigation will be needed to determine the most appropriate installation technique and route for the Upper Nihotupu Raw Watermain. This will need to consider disruption to the walkers and cyclists using Exhibition Drive as well as the impact on the wider construction works.

The lagoon at the existing plant will need to be extended to meet the off-spec discharge requirements. This may need to occur after commissioning of the new plant to prevent disruption to operation of the existing plant. This will present an operational risk until this work is completed.

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1 Introduction

This report provides an overview of the constructability considerations for each of the shortlisted options for the replacement of the Huia Water Treatment Plant. It was prepared with input from a senior design engineer with experience monitoring large diameter watermain construction projects. It does not include input from contractors or traffic assessments. It should be read in conjunction with the Shortlist Site Development Report (GHD, September 2016) and the Ancillary Structures Report (CH2M Beca, October 2016). The sites reviewed are:

- Parker North
- Parker South
- The Existing Site
- Manuka Road

Each site option is reviewed with consideration for the sub-components of the scheme; raw water pipelines, tunnel, treatment plant and treated water pipelines. For each sub-component the construction methodology and timeframes have been described. In the case of Parker North, which is described first, a more comprehensive description is provided to provide a benchmark for comparison against the other sites. The review for Parker North includes:

- Construction process
- Site footprint and construction site
- Access
- Traffic implications
- Shutdowns
- Timeframes
- Interdependencies
- Risks and uncertainties

The final section on each site outlines a high-level construction programme that incorporates the timeframes and interdependencies for each scheme.

2 Parker North

An overview plan of the Parker North site and the components of that scheme is provided in Appendix A1. The sections below describe the constructability considerations for that scheme.

2.1 Raw Water Tunnel

2.1.1 Construction Process

The exact tunnelling methodology will be determined by the contractor but it is envisaged that a single shield tunnel boring machine (TBM) would be used. The machine could either be leased or purchased outright and then sold upon completion of the work.

The machine would be lowered down a 10m deep shaft, which would be located at Mackies Rest. Refer to the Mackies Rest site layout (Appendix C1) for an indication of the shaft size. Water and chemicals would need to be pumped to the tunnelling face and a conveyor system would be required to remove the slurry that results from the excavated material. This would be managed via the access shaft at Mackies Rest. The slurry would need to be transported away from the worksite for disposal. The sludge landfill for the current Huia

WTP is located adjacent to the Mackies Rest access track and it is possible that it could be used for the disposal of the slurry.

The tunnel is likely to be lined with reinforced concrete, which would be installed by pipe jacking. This would require the pipes to be transported to the work site at Mackies Rest.

The tunnel length is 2.1km to the Parker North site and needs a bend to avoid daylighting the tunnel in Parker valley (Refer Appendix B1). Therefore it is anticipated that an intermediate access shaft will be required at the head of the Parker valley. This is shown on the tunnel route figure for Parker North (Appendix B1) and the overview of the intermediate access shaft (Appendix B2). It may be possible to avoid the need for this intermediate shaft if the final construction technique allows the tunnel alignment to be curved at a tight enough radius.

Upon completion of the tunnel the jacking shaft will be used as the inlet chamber at the start of the tunnel. Allowance will therefore be made for the three raw watermains to connect into the top of this chamber.

2.1.2 Site Footprint and Construction Site

The minimum site footprint for the tunnel jacking location is 700m² although a larger area would increase productivity and reduce the health and safety risks associated with working on such a constrained site. The preferred site layout for Mackies Rest (Appendix C1) shows a footprint of 1500m² which will require the removal of some secondary vegetation and retaining of the surrounding slopes to increase the available flat working area.

Additional work area will be needed for the storage of pipes, equipment and machinery. This may be possible at the existing treatment plant landfill at the start of the Mackies Rest access track and some site preparation will be needed if this is used.

The Huia and Lower Nihotupu raw watermains pass through the site (refer to Appendix C1) and are required to provide supply to the existing water treatment plant. Watercare has indicated that the precise location of these mains as shown on the GIS is not likely to be correct and therefore it is recommended that a survey be carried out prior to any further design. If the jacking shaft is obstructed by the raw watermains it could be possible to restrict the width at the top of the shaft, provided the pipelines are appropriately protected and supported. In the worst case scenario, one of the watermains would need to be rerouted or taken out of service for the duration of the works. The Huia Water Treatment Plant has operated with one of the raw watermains out of service for significant periods of time in the past.

A reduced site footprint will be needed for the intermediate jacking shaft. This is indicatively shown on the site layout in Appendix C2.

2.1.3 Access

Access to Mackies Rest is restricted due to the narrow access track and the steep slope up to the construction site. The access track is approximately 4m wide and 825m long after leaving the intersection of Huia Road and Exhibition Drive. This road will require upgrading to cater for the construction traffic, such as a crawler crane. This may include the laying of a more durable surface and localised widening of the track. Widening would require some vegetation removal and the retaining of existing batters and appropriate environmental controls would need to be put in place.

The access immediately prior to the work site is via a steep slope, up which an access road would need to be built. The Huia Raw Watermain passes up this slope and its depth will need to be confirmed to determine if additional protection is needed during the construction period.

Access to the intermediate access shaft will be via Parker Road and then a side access track from the top of Parker Road. The top of the road and the track are relatively narrow but the amount of construction traffic required at this location is low because the tunnel spoil will be conveyed to Mackies Rest or the treatment plant site. Some localised access improvements may be needed depending on the final location of the shaft.

2.1.4 Traffic Implications

The construction traffic will access the Mackies Rest site via Huia Road. The volume of traffic is dependent of whether the slurry material needs to be transported for disposal elsewhere. If this was the case then there would be approximately 1,800 truckloads of slurry (based on 50% water, 50% substrate), which would equate to approximately 15 to 20 truck movements a day. On top of this would be the transport of equipment and materials to site. Therefore there could be up to 30 truck movements per day to Mackies Rest.

2.1.5 Shutdowns

Upon completion of the tunnel the existing raw watermains will need to be connected to the tunnel inlet chamber. This could be undertaken in a staged manner to allow commissioning of the new treatment plant while also maintaining a supply to the existing plant.

Upon completion of the works the current Mackies Rest inlet chamber and tunnel will be decommissioned.

2.1.6 Timeframes

The procurement timeframe of the TBM will be dependent on whether there is an existing machine available that can be used for the work. An allowance of 6 months should be sufficient for fabrication and shipping of the machine, assuming the majority of components are available from existing machines.

The site preparation and access improvement will need to be undertaken prior to tunnelling works starting on site. This work would take approximately 3 months.

The main tunnelling period will be dependent on the geology of the tunnelling route. Tunnelling rates of 10m/day should be achievable which would mean that the tunnel could be installed over a 12 month period, however geological conditions have yet to be determined and therefore it is recommended that 15 months be allowed in the programme.

The connections to the raw watermains will be dependent on the phasing of the overall plant commissioning but could occur over a 6 week period. This also applies to the commissioning of the tunnel, which would take approximately 2 months but will tie in with other works (see below).

2.1.7 Interdependencies

The second half of the proposed route for the Upper Nihotupu Raw Watermain connection follows the Mackies Rest access track. This will therefore need to be installed either after or before the tunnelling works takes place to avoid conflict with the tunnelling operations. It has been assumed that this will be done prior to the tunnelling as an advanced activity as the access track can then be upgraded at the same time. This can also occur while the TBM is being procured.

The water treatment plant will need the tunnel to be complete to provide a water supply to allow commissioning to commence.

2.1.8 Risks and Uncertainties

The geology of the area is sandstone, which is a substrate that is normally amenable to tunnelling. However, the exact geology of the route is unknown and localised changes in material or fault-lines could disrupt the tunnelling process and extend the construction timeframe. A geotechnical assessment has not yet been undertaken on the tunnel route or shaft locations.

The access to Mackies Rest is restricted and the extent of the access improvements and size of the site footprint will directly affect tunnel production rates.

2.2 Upper Nihotupu Raw Watermain Extension

2.2.1 Construction Process

The Upper Nihotupu Raw Watermain will be connected to the tunnel inlet via an extension along Exhibition Drive and Mackies Rest Access Track (refer to Appendix A1). This watermain will be approximately 500mm in diameter and will probably be installed by trenching. There may be an option to install sections by directional drilling if there are benefits at specific locations.

The final section of watermain will need to follow a steep slope up to Mackies Rest. This could take a similar alignment to the Lower Nihotupu raw watermain or as the Huia Raw Watermain. Installation over this short section will require specialist installation methods for steep terrain, such as those employed on Watercare's Cosseys Raw Watermain project.

A possible alternative to this pipeline route would be to connect the Upper Nihotupu pipeline to the tunnel by drilling from the vicinity of Jacobson's portal. The feasibility of this is dependent on the final tunnel alignment and access to drilling location.

2.2.2 Site Footprint and Construction Site

The trench would be 1m to 1.5m wide and the worksite would need to be wide enough to position an excavator and a truck alongside for spoil disposal. The work site would be at least 50m in length and ideally longer to allow excavation, pipe-laying and backfilling to occur in parallel. If the terrain is steep then the amount of open trench will have to be restricted to avoid concentration of overland flows.

The affected sections of Exhibition Drive may need to be closed to the walkers and cyclists for the duration of the construction works although a narrow public walkway could possibly be maintained adjacent to the work site.

2.2.3 Access

Ideally access to the site will be from both the Shaw Road intersection with Exhibition Drive as well as the Huia Road intersection to allow access from both ends of the work site. If this is not possible the construction timeframe would be extended.

The section along Mackies Rest access track will require careful planning to allow work to progress at either end of the trench.

2.2.4 Traffic Implications

This work is almost entirely on non-trafficked roads. The exception is access to the Pipeline Track car park from Huia Road and the six properties that are accessed from Huia Road. The car park will need to be closed during this phase of the works. The contractor will need to work closely with the residents when

trenching in the vicinity of these properties and vehicle access may need to be restricted for a short period of time.

During the construction phase there would be approximately 20 truck movements per day, depending on productivity.

2.2.5 Shutdowns

There will need to be a connection to the existing raw watermain at the end of Jacobson's portal. This will take place just prior to the main being commissioned. There may be option to install a temporary tee at this location to supply the new main for commissioning purposes while also maintaining supply to the existing treatment plant.

2.2.6 Timeframes

The width of the construction site will restrict progress with the installation of this pipeline. Installation rates of at least 10m a day should be achievable and it is 1.5km in length so the construction timeframe is approximately 6 months allowing for some contingency

2.2.7 Interdependencies

Refer to the Raw Water Tunnel interdependencies regarding the construction works. The Upper Nihotupu raw water pipeline extension can be commissioned at any time during the construction works, provided there is a supply from one of the raw water sources to the new plant.

2.2.8 Risks and Uncertainties

Requirements to maintain access to Exhibition Drive for cyclists and walkers will reduce the site footprint and increase construction timeframes.

2.3 Water Treatment Plant and Reservoirs

2.3.1 Construction Process

The construction of the treatment plant and reservoirs will begin with a site preparation and earthworks phase. This will be followed by the bulk of the civil/mechanical construction works. There will then be a phase completing electrical, instrument and controls before commissioning of the plant can progress.

Refer to the Shortlist Site Development Report (GHD, September 2016) for more details on the water treatment plant construction process.

The off-spec water management on this site involves the lagoon and the overflow pipeline to the adjacent creek. These will be constructed as part of the water treatment plant construction phase and do not appear to present significant construction challenges.

2.3.2 Site Footprint and Construction Site

The site footprint and construction work sites are presented in the work undertaken by GHD. Refer to the Shortlist Site Development report.

2.3.3 Access

Access to the site is via Parker Road, there is no alternative practical access route.

2.3.4 Traffic Implications

The volume of traffic movements is likely to be greatest during the earthworks phase when fill will need to be imported to site and some excavated material exported. This will be dependent on how much material can be reused on site. It's been assumed that the amount of material cut to waste and the fill imported aligns with that detailed in the cost estimate schedule. This equates to approximately 12,000 truck movements during this phase which equates to approximately 100 truck movements per day.

2.3.5 Shutdowns

There are no specific shutdown requirements for these works.

2.3.6 Timeframes

- The initial earthworks and mobilisation phase should be achievable in a 6 month period and therefore over one earthworks season.
- The bulk of the construction works will take approximately 1.5 years.
- The commissioning phase will last approximately 3 months and this will be followed by a proving period.

2.3.7 Interdependencies

The raw water tunnel will need to have been commissioned to provide water to allow commissioning of the treatment plant to progress.

The treated watermain will also need to be completed to allow full commissioning and proving to take place. It may be possible to undertake some initial commissioning activity prior to completion of the treated watermain by running the processed water into the lagoon and then recirculating to the head of the works.

2.4 Treated Watermain

2.4.1 Construction Process

The treated watermain will be constructed using trenching and the installation of 1200/1500mm concrete lined steel (CLS) pipes. At any one time the following activities will be taking place:

- Excavation of the trench
- Installation of shoring
- Pipe laying and welding
- Backfilling
- Resurfacing

The treatment plant will also need a connection to the wastewater network. This small diameter pipeline could be installed in the same trench as the water pipeline or as a separate activity by directional drilling.

2.4.2 Site Footprint and Construction Site

The minimum site footprint is shown in Appendix D1, indicating a possible typical layout for pipeline construction activity in Parker Road. The site will be 200m long at any one time to allow space for all the activities detailed above. Appendix D1 shows a 4.6m wide site plus a 3m wide traffic lane running adjacent to

it. The live lane will also need to be used intermittently by construction vehicles during the pipe laying and backfilling process, temporarily blocking the passage of other vehicles

There are two sections of Parker Road where the road width does not meet this minimum requirement and therefore the road will need to be widened prior to installation of the watermain. This is shown for one of the two sections in Appendix D1. The other section affected is outside number 60 to 72 Parker Road. The parcel boundaries indicate that this widening can progress within the existing road boundaries. There are a couple of alternatives to road widening and trenching for the construction process at these restricted sections:

- Trenchless techniques such as pipe-jacking would reduce the surface footprint for construction. However, there is limited space for a sheet-piled launch pit and crawler crane at either end of the works. This would also be a time consuming process and therefore it is deemed to be unlikely to be preferable.
- Trenching with a full road closure would allow pipeline installation within the existing road corridor. This would involve the residents parking on the northern side of the works. The contractor would provide a “walking bus” to allow residents to safely traverse the site during work hours and a path for non-work hours. This plan could include a taxi service or similar (available 24 hours/day) for Parker Road residents on the south side of the works during this period of construction

Where the road is wider, the construction site will also be widened to maximise the rate of progress. An example of this layout is shown in Appendix D2 for a section of the route on West Coast Road.

The contractor will require a laydown area in the vicinity of the construction works to manage pipelines and equipment during the work.

2.4.3 Access

Access to the site will be via Parker Road.

2.4.4 Traffic Implications

The width of Parker Road necessitates that during this phase of works the contractor will need to actively manage traffic with onsite TMS presence for much of the time. Road users will need to wait at either end of the work site while construction traffic is active in the live lane. During non-construction periods (i.e. at night) the traffic could be managed using traffic lights.

The greater space on West Coast Road should allow a continuous contraflow to be maintained with a speed restriction.

During the construction phase there would be approximately 20-40 truck movements per day, depending on pipeline laying rates.

2.4.5 Shutdowns

The shutdown requirements are associated with connections to the treated water transmission network. The connection the North Harbour No.1 Watermain will present significant risks due to the critical nature of this asset.

2.4.6 Timeframes

The watermain installation should progress at approximately 10m/day based on typical installation rates achieved on Watercare’s Hunua 4 Trunk Watermain project. It would therefore take 8 months for the 1600m section in Parker Road and 8 months in West Coast Road. The road widening in Parker Road will add additional time to this phase of approximately 1 month.

2.4.7 Interdependencies

The treated water pipeline will need to be completed to allow the treatment plant to be fully commissioned. Equally, the pipeline will need a sufficient water supply to allow pressure testing, chlorination and commissioning. The local network water supply to Parker Road may be sufficient for testing purposes but the treatment plant will need to be commissioned before the pipeline can be fully commissioned.

Pipeline installation in Parker Road is not likely to be feasible at the same time as significant vehicle movements are taking place for other phases of the works. This is most relevant to the bulk earthworks and main construction phase of the water treatment plant. It would therefore be beneficial to install this section of watermain as advanced works.

2.4.8 Risks and Uncertainties

Consenting and approvals for the road widening in Parker Road presents a risk and should be investigated further.

Parker Road is likely to need resurfacing following the completion of the construction works due to the volume of construction traffic. There is a risk if the pipeline is installed at the start of the project that two resurfacings will be required resulting in additional cost and disruption.

2.5 Programme

A high level programme has been developed based on the information outlined above. This is based on the assumption that all works will be delivered by the same contractor. The actual programme will be dependent on the procurement strategy for the project which has not yet been determined. It should be noted that there are a number of ways that a contractor may choose to deliver these works, and this programme and sequence of activity should be regarded as indicative. The programme indicates a construction period of 3 years plus a 3 month proving period. The critical path is the construction of the Parker Road section of the treated water main and the water treatment plant.

Year	1				2				3				4
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1
Raw Water Tunnel													
TBM Procurement													
Site and Access Road Preparation													
Tunnelling													
Connections and commissioning													
Upper Nihotupu Raw Watermain Extension													
Exhibition Drive Section													
Mackies Rest Section													
Water Treatment Plant and Reservoirs													
Initial Earthworks and mobilisation													
Bulk Construction Phase													
Commissioning													
Proving period													
Treated Watermain													
Parker Road													
West Coast Road													

3 Parker South

An overview plan of the Parker South site and the components of that scheme is provided in Appendix A2. The sections below describe the constructability considerations for that scheme.

3.1 Constructability Summary

The construction of the Parker South site is essentially similar to that described for Parker North, the main difference being a shorter tunnel and a longer treated watermain (refer to Appendix A2). This does not affect the construction methodology but has minor impacts on the construction programme as detailed below.

The treated watermain will be installed as described in section 2.4. The additional length of the main in Parker Road will extend the construction of the pipeline installation phase to approximately one year. There are no further narrow sections Parker Road between Parker North and Parker South that will require widening to facilitate pipe installation.

3.2 Programme

A high level programme for the Parker South site is provided below. The programme indicates a construction period of 3.5 years. The critical path is the construction of the Parker Road section of the treated water main and the water treatment plant.

Year	1				2				3				4	
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Raw Water Tunnel														
TBM Procurement	■	■												
Site and Access Road Preparation		■	■											
Tunnelling				■	■	■	■	■						
Connections and commissioning									■	■				
Upper Nihotupu Raw Watermain Extension														
Exhibition Drive Section			■											
Mackies Rest Section		■												
Water Treatment Plant and Reservoirs														
Initial Earthworks and mobilisation					■	■								
Bulk Construction Phase							■	■	■	■	■	■		
Commissioning													■	
Proving period														■
Treated Watermain														
Parker Road	■	■	■	■										
West Coast Road									■	■	■			

4 Existing Site

An overview plan of the option to build at the existing site in Woodlands Park Road and the components of that scheme is provided in Appendix A3. The sections below describe the constructability considerations for that scheme.

4.1 Water Treatment Plant and Reservoirs

4.1.1 Construction Summary

The construction of the treatment plant and reservoirs will begin with a site preparation and earthworks phase. This will be followed by the bulk of the civil/mechanical construction works. There will then be a phase completing electrical, instrument and controls before commissioning of the plant can progress.

Refer to the Shortlist Site Development Report (GHD, September 2016) for more details on the water treatment plant construction process.

The existing treatment plant is intended to be partially or fully demolished prior to the construction of the new plant. The practicality of restricting the treated water output of the existing plant on Auckland's water supply will need to be determined if this option is progressed.

The site area is relatively confined for the treatment plant and the reservoirs, which will affect the construction phasing. The contractor may choose to utilise a laydown area on one of the reservoir sites or up the road on the Manuka site. Due to the movement of construction traffic between these sites there would be significant benefits to diverting through traffic away from Woodlands Park Road for the course of the works.

4.1.2 Timeframes and Interdependencies

The construction of the treatment plant will be similar to that outlined for the Parker North site. However, the demolition of the existing plant is likely to extend the initial earthworks and mobilisation phase, which we have estimated would be another 3 months.

The constricted nature of the site is also likely to extend the bulk construction phase, which we have estimated would take an additional 6 months. This results in a construction period of three years plus a three month proving period.

The construction of the reservoirs is dependent on completion of the treated water tunnel, which will be installed from the same site. There is an opportunity to delay construction of one of the reservoirs until after the completion of the treatment plant, which will free up space for a laydown area.

4.2 Off-Spec Water

4.2.1 Construction Summary

Limited space on site means that a lagoon for storage of off-spec water is not practical and would need to be diverted to a new 900mm diameter overflow pipeline that discharges to the Manukau Harbour. The pipeline route options are detailed in the *Huia WTP Overflow and Off-spec waters diversion pipeline investigation* (MWH, 2010). This report details the constructability risks associated with the various options. The preferred option adopts the most direct route to the harbour via Little Muddy Creek and it will require installation via trenchless techniques along the majority of its length.

4.2.2 Timeframes and Interdependencies

The pipeline installation will take approximately 9 months based in an assumed installation rate of 10m/day.

It is likely that a construction site will need to be in place within the existing site area for the majority of the works. This will further restrict construction of the treatment plant. Due to the moderate site footprint requirements, we have assumed that this can happen in parallel to the main plant construction works.

The pipeline will need to be complete prior to commissioning of the treatment plant to allow it to be utilised through the commissioning phase.

4.3 Treated Watermain

4.3.1 Construction Summary

The treated watermain will be installed using similar techniques described for the Parker North site.

The treated water rising main to the reservoirs will mainly be installed within the footprint of the existing plant, or on the reservoir site. The exception is the Woodlands Park Road crossing to the reservoirs, which will have a short-term impact and will require appropriate traffic management.

The treated watermain on the outlet of the tunnel will pass down Shetland Street, Phillip Avenue and Glengarry Road before running down West Coast Road. The section along Shetland Street is relatively narrow and this is a dead-end road of residential properties. The construction site footprint is likely to be similar to that described for Parker Road in section 2.4.2 and shown in Appendix D1, although an initial review indicates that road widening should not be needed. The upper section of Shetland Street, which is the most narrow, has secondary access to the properties on the western side of the road and it is likely that this could be utilised to provide residents access. Phillip Avenue is also relatively narrow and construction will follow and similar methodology but this section does have the option to divert traffic via alternative routes.

In Glengarry Road there are options to divert residents via alternative routes to maximise the use of the road for construction purposes. The road is approximately 10m wide and a contraflow arrangement may be achievable, as per Appendix D2. If this is unachievable the pipeline may need to be installed using the shared live-lane method described for Parker Road and shown in Appendix D1.

Construction in West Coast Road will follow a similar methodology to that described for the Parker North site along West Coast Road (Appendix D2). Construction of this section will be highly disruptive to road users and alternative route options should be considered at the next stage of design. Alternative routes will be more feasible for the Existing Site and the Manuka Site than the Parker Road Sites because these sites will have a direct connection to Titirangi Reservoirs, therefore providing additional resilience.

4.3.2 Timeframes and Interdependencies

The treated watermain downstream of the tunnel will take approximately 18 months to install in Shetland Street and Glengarry Road. The section in West Coast Road will take a further 6 months to install.

Construction of the pipeline in Shetland Street may be restricted by construction of the treated water tunnel. The tunnel access will mainly be required from Woodlands Park Road but it is assumed that the watermain in Shetland Street and Glengarry Road cannot occur in parallel to the tunnelling phase.

4.4 Treated Water Tunnel

4.4.1 Construction Summary

The tunnelling methodology would be similar to that described for Parker North in section 2.1.1. The exception being that a pipe will be installed in the tunnel to transfer the treated water. This is needed because the pipeline will operate under significant pressure above the working capacity of the tunnel alone. This will require sections of pipe to be transported to site and welded together for installation.

The site preparation will be more straight-forward than at Mackies Rest for the Parker sites due to good access from Woodlands Park Road. This preparation can occur in parallel to the earthworks for the reservoirs, which may present some opportunities around minimising rework but will also present challenges due to the restricted nature of the site.

4.4.2 Timeframes and Interdependencies

The tunnel is much shorter than the Parker Road tunnel at 800m, which will reduce the main tunnelling phase to approximately a year. However, the pipe installation within the tunnel will extend this construction phase by approximately 3 months.

As discussed in section 4.1.2, the tunnelling will need to be completed prior to the construction of the reservoirs.

4.5 Programme

A high level programme has been developed based on the information outlined above. This is based on the assumption that all works will be delivered by the same contractor. The actual programme will be dependent on the procurement strategy for the project. It should be noted that there are a number of ways that a contractor may choose to deliver these works. The programme indicates a construction period of 3.5 years but construction of the second reservoir may continue after the commissioning of the plant. The critical path is the construction of the tunnel and the reservoirs. However, due to the confined nature of this site, there are likely to be a number of conflicting activities that will require careful planning and it is possible that the construction timeframe may increase.

Year	1				2				3				4	
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Water Treatment Plant														
Initial Earthworks and mobilisation														
Bulk Construction Phase														
Commissioning														
Proving period														
Off Spec Water														
Muddy Creek Pipeline														
Reservoirs														
Pre load Reservoir site														
Pre-cast concrete manufacture														
Reservoir Construction														
Treated Water Tunnel														
TBM Procurement														
Site Preparation														
Tunnelling														
Connections and commissioning														
Treated Watermain														
Shetland Street and Glengarry Road														
West Coast Road														

5 Manuka Road

An overview plan of the Manuka Road option and the components of that scheme is provided in Appendix A4. The sections below describe the constructability considerations for that scheme.

Construction on the Manuka Road site has many similarities to the Existing Site option. The differences arise from the pipeline infrastructure along Woodlands Park Road and Exhibition Drive, the off-spec discharge arrangement, and that the construction of the plant is on a greenfield site.

5.1 Raw Watermain Infrastructure

5.1.1 Construction Summary

The Manuka Road site is located approximately 350m along Woodlands Park Road from the end of the raw water aqueduct and will require a 1200mm-1500mm diameter raw watermain extension to be constructed. This will be installed by trenching as described for the Parker Road site. Woodlands Park Road is wider than Parker Road but not as wide as West Coast Road and the traffic management is likely to depend on the specific section of the works. Ideally the road would be closed to through traffic during the installation of this pipeline; this would also benefit the installation of the treated watermain to the reservoirs, which runs along the same route for much of its length. As some form of access will be needed into Manuka Road for residents, and for construction and operational traffic it is likely these two pipelines will be installed in sequence, rather than in parallel.

The other component of the raw water infrastructure needed for this scheme is a raw water pump station at the outlet of the existing raw water aqueduct. Some vegetation clearance will be needed for this work. Its construction, and particularly the commissioning will affect the supply to the existing treatment plant with some form of shutdown required. It is therefore anticipated that it will occur towards the end of the construction programme.

5.1.2 Timeframes and Interdependencies

As previously described, the construction of the raw watermain is closely related to the construction of the treated watermain in Woodlands Park Road. The installation of this pipeline will last approximately 3 months. The other consideration for the pipeline construction will be maintaining access for construction traffic to the tunnel and reservoir site. This would ideally be programmed to occur at a time where access for construction traffic is reduced.

The raw water pump station will need to be commissioned prior to the treatment plant commissioning. It is anticipated that this would take 6 months to construct.

5.2 Upper Nihotupu Raw Watermain

5.2.1 Construction Summary

The construction of the Upper Nihotupu raw watermain would mainly be along Exhibition Drive. With the exception of the final section that connects to the treatment plant. The installation method would be trenching as described in section 2.2.1 unless there is an option to rehabilitate or reline the abandoned watermain that currently follows this route. Ideally the track would be closed to cyclists and walkers between Shaw Road and Scenic Drive allowing construction traffic access from both these locations.

5.2.2 Timeframes and Interdependencies

The watermain would take between 6 and 9 months to install. The main interdependency occurs when it leaves Exhibition Drive; the current proposed route shows it crossing the reservoir site and along Woodlands Park Road. If this route was selected it would ideally occur at a time that does not disrupt the tunnelling and reservoir construction. The alternative would be to continue to the pipeline to the end of Exhibition Drive and connect directly to the plant, rather than connect to the new raw watermain in Woodlands Park Road. This route would minimise disruption to other components of the work and would offer an opportunity to commission the new plant on a supply directly from this source.

5.3 Water Treatment Plant and Reservoirs

5.3.1 Construction Summary

The construction of the treatment plant and reservoirs will begin with a site preparation and earthworks phase. This will be followed by the bulk of the civil/mechanical construction works. There will then be a phase completing electrical, instrument and controls before commissioning of the plant can progress.

Refer to the Shortlist Site Development Report (GHD, September 2016) for more details on the water treatment plant construction process.

The construction site is relatively confined, which will present challenges regarding phasing of the works and is anticipated to extend the construction time compared to the sites on Parker Road.

During the early phase of the construction works the overflow pipeline will need to be installed from the new site to the lagoon on the existing site as this will be needed for the commissioning phase of the works. The existing lagoon will need to be extended, probably with the installation of retaining walls to increase the available space.

5.3.2 Timeframes and Interdependencies

The constricted nature of the site is likely to extend the bulk construction phase, which we have assumed would take an additional 6 months on top of that allowed for the Parker Road sites. This results in a construction period of three years including a three month proving period. The extension of the existing lagoon may only be feasible once the existing plant has been decommissioned. This will mean operating the new plant for a period of time with reduced overflow storage. We have assumed that this demolition phase and lagoon extension will last 6 months following commissioning of the new plant.

As described for the existing site in section 4.1.2, the reservoir construction will be closely linked to the tunnelling phase with these two activities occurring on the same site.

5.4 Treated Water Tunnel and Watermain

5.4.1 Construction Summary

The construction methodology of the treated water tunnel and watermain will follow the same process as the existing site (refer to sections 4.3 and 4.4). The only difference is the section of treated watermain in Woodlands Park Road. This will be installed by trenching and will need to be managed with the installation of the raw watermain along the same section of road.

5.4.2 Timeframes and Interdependencies

The tunnelling phase will last approximately 15 months once the TBM has been brought to site. The treated watermain in Woodlands Park Road will take approximately 3 months to install and can occur at any time but probably will be aligned with the installation of the raw watermain.

The treated watermain after the outlet of the tunnel can largely occur independently from the rest of the works but as discussed for the existing site, some consideration will be needed when phasing the work to minimise traffic disruption and maintain access requirements for the tunnel construction.

5.5 Programme

A high level programme has been developed based on the information outlined above. This is based on the assumption that all works will be delivered by the same contractor. The actual programme will be dependent on the procurement strategy for the project. It should be noted that there are a number of ways that a contractor may choose to deliver these works. The programme indicates a construction period of 3.5 years but construction of the second reservoir may continue after the commissioning of the plant. The critical path is the construction of the tunnel and the reservoirs. However, due to the confined nature of this site, there are likely to be a number of conflicting activities that will require careful planning and it is possible that the construction timeframe may increase. The extension of the existing overflow lagoon has been shown to occur following commissioning of the new treatment plant. This can then take place at the same time at the current plant being demolished.

Year	1				2				3				4			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Raw Water Infrastructure																
Raw Water Pump Station																
Raw Water Pipeline (Woodlands Park Rd)																
Upper Nihotupu Raw Watermain Extension																
Exhibition Drive Section																
Water Treatment Plant																
Initial Earthworks and mobilisation																
Bulk Construction Phase																
Commissioning																
Proving period																
Off spec Water																
Overflow pipeline to lagoon																
Lagoon Extension																
Reservoirs																
Pre load Reservoir site																
Pre-cast concrete manufacture																
Reservoir Construction																
Treated Water Tunnel																
TBM Procurement																
Site Preparation																
Tunnelling																
Connections and commissioning																
Treated Watermain																
Woodlands Park Road																
Shetland Street and Glengarry Road																
West Coast Road																

6 Summary

This report has outlined the constructability considerations for the four short-listed sites. The risks and challenges differ for each site, depending on its location and the specific requirements of each scheme.

The Parker Road sites benefit from large, relatively flat sites that facilitate construction of the treatment plant and reservoirs. In comparison, the Existing Site and Manuka Road site are both on small sites with difficult terrain that are further constrained by the presence of the operational site and native vegetation respectively. The reservoirs are located on a separate site to the treatment plant, which will also act as the treated water tunnel construction site. This is a significant interdependency in the construction programme and limits available laydown areas.

The Manuka Road site, and particularly the existing site, face challenges with the management of off-spec water compared to the Parker sites. This is another construction activity that needs to take place on the already constrained treatment plant sites.

The construction of the raw water tunnel to the Parker Road sites is more complex than the treated water tunnel for the other two sites. This is due to the narrow access track to Mackies Rest and the limited flat ground at that location. The existing raw water infrastructure will need to remain in service during the construction of the tunnel, further restricting available space. The contractor would need to consider the sequence of work and site preparation when planning this component of the scheme. The construction of the Upper Nihotupu Raw Watermain is another consideration in this constrained working area. The need to include a curve in the tunnel alignment adds complexity to the tunnel for the Parker Road sites, and may require the construction of a deep intermediate access shaft. In comparison, the tunnel required for the Existing Site and the Manuka Road site options is much shorter and access is relatively good. As previously mentioned, the main constructability consideration for these two sites is the programming of this work around the reservoir construction.

The construction methodology for the treated watermain is largely comparable across all the sites. All involve construction in busy roads and traffic disruption. However, Parker Road's restricted width presents particular challenges with this component of the work that will impact on local residents' access to their properties and the programme for the treatment plant construction. The road will need to be widened in a couple of locations to allow trenching to take place. The Manuka Road site requires the construction of pipelines in Woodlands Park Road, which will disrupt residents and affect access for construction traffic.

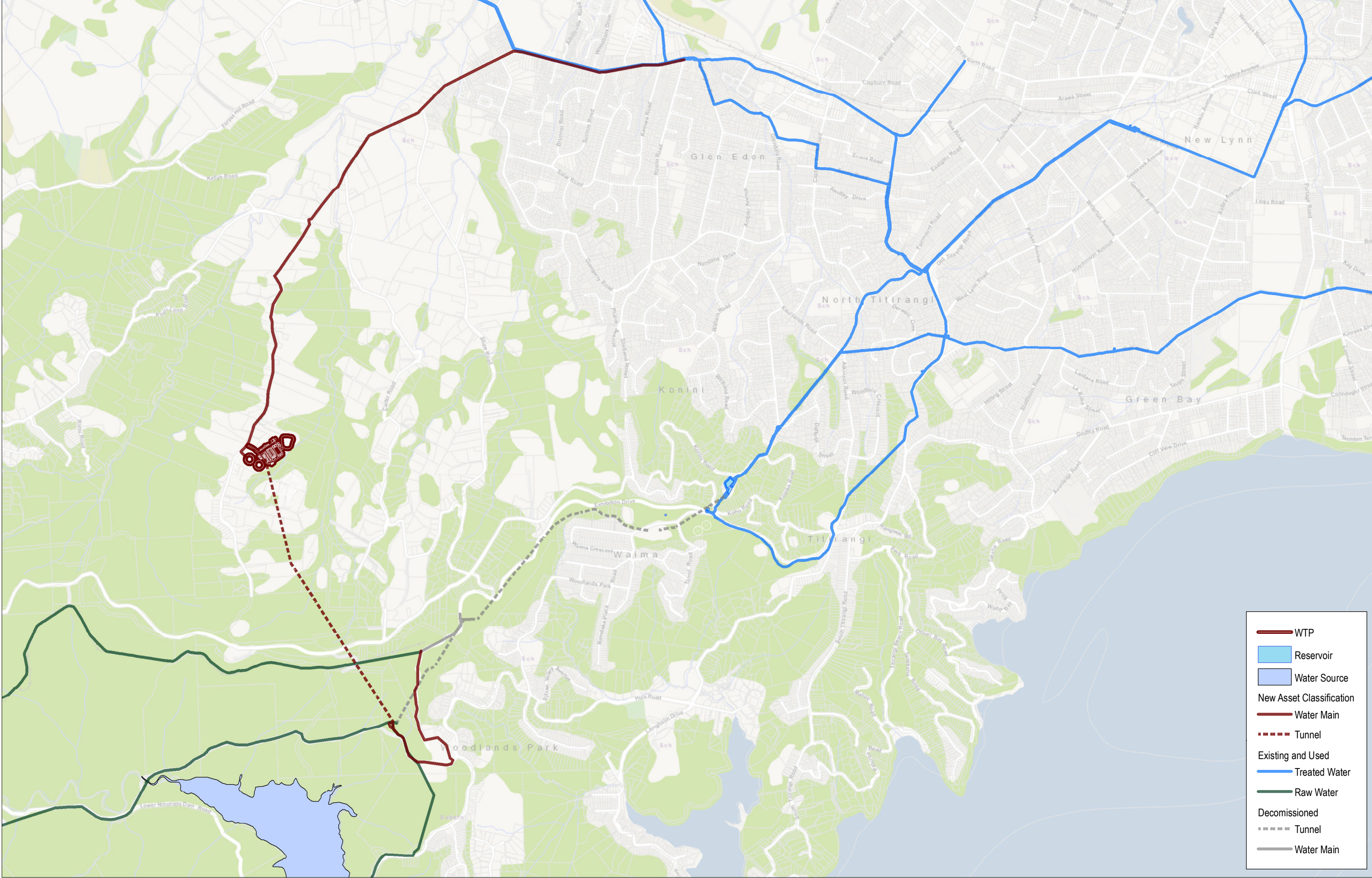
In summary, the main constructability constraints for the Parker Road sites is around the ancillary infrastructure, specifically the raw water tunnel and treated watermain. The construction challenges for the Existing Site and the Manuka Road site are due to the restricted site footprint for the treatment plant and reservoirs. This is likely to present a greater challenge to the construction of the overall scheme.

Appendix A1

Parker North Scheme Overview

DRAFT

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Map Scale @ A3: 1:24,000

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Meters

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Revision	Author	Verified	Approved	Date	Title:
1	CP	JF	JB	13/03/2017	
1	CP	DRAFT	DRAFT	06/03/2017	

Parker Road North

Infrastructure Requirements

Client:

Watercare Services Ltd

Project:

Huia WTP Upgrade

Discipline:

GIS

Drawing No:

GIS-651164-090-01-02A

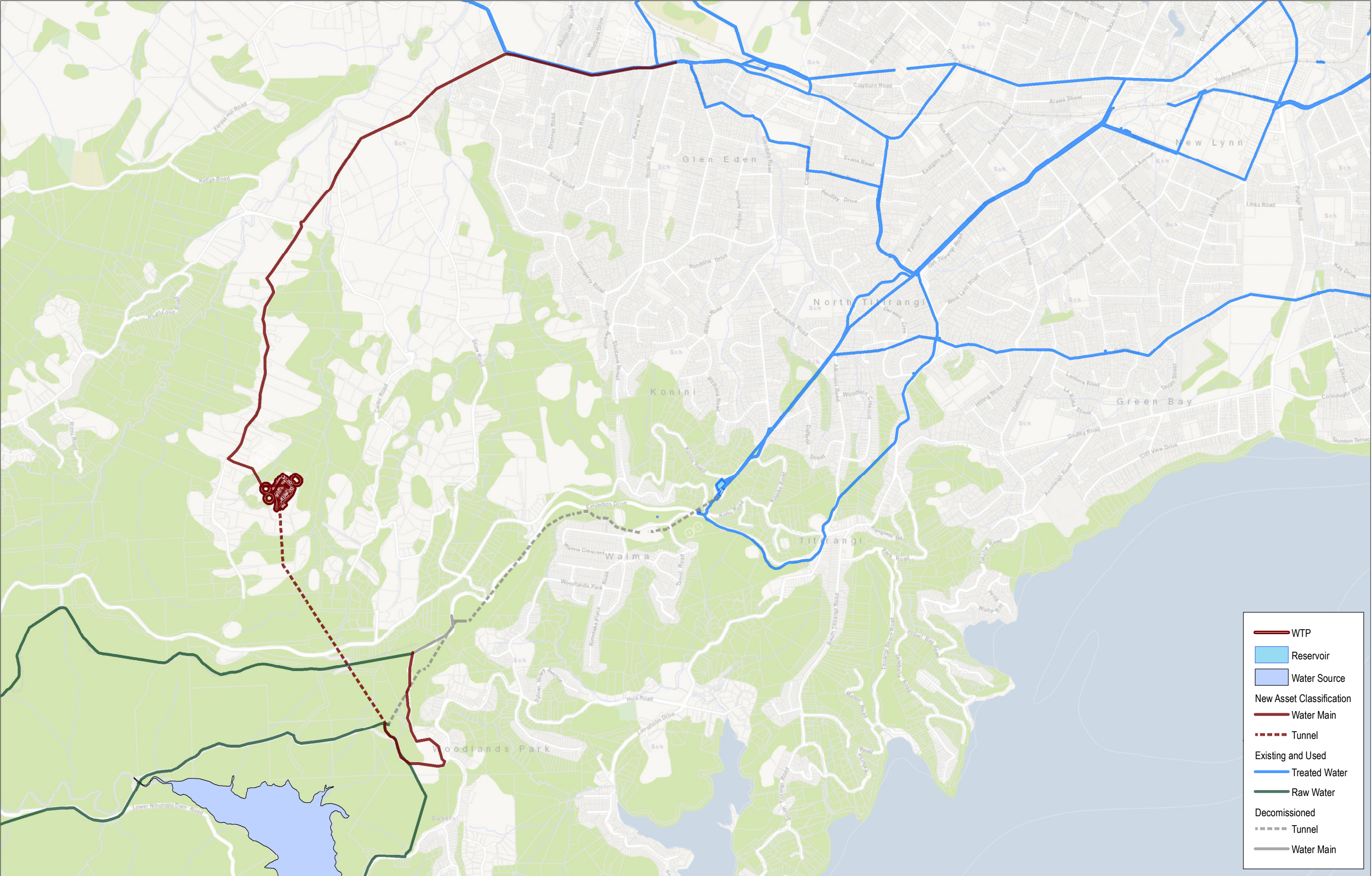
Appendix A2

Parker South-Scheme Overview

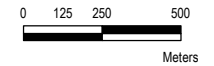
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1	CP	DRAFT	DRAFT	06/03/2017

Title:

Parker Road South Infrastructure Requirements

Client:

Watercare Services Ltd

Project:

Huia WTP Upgrade



Discipline:

GIS

Drawing No:

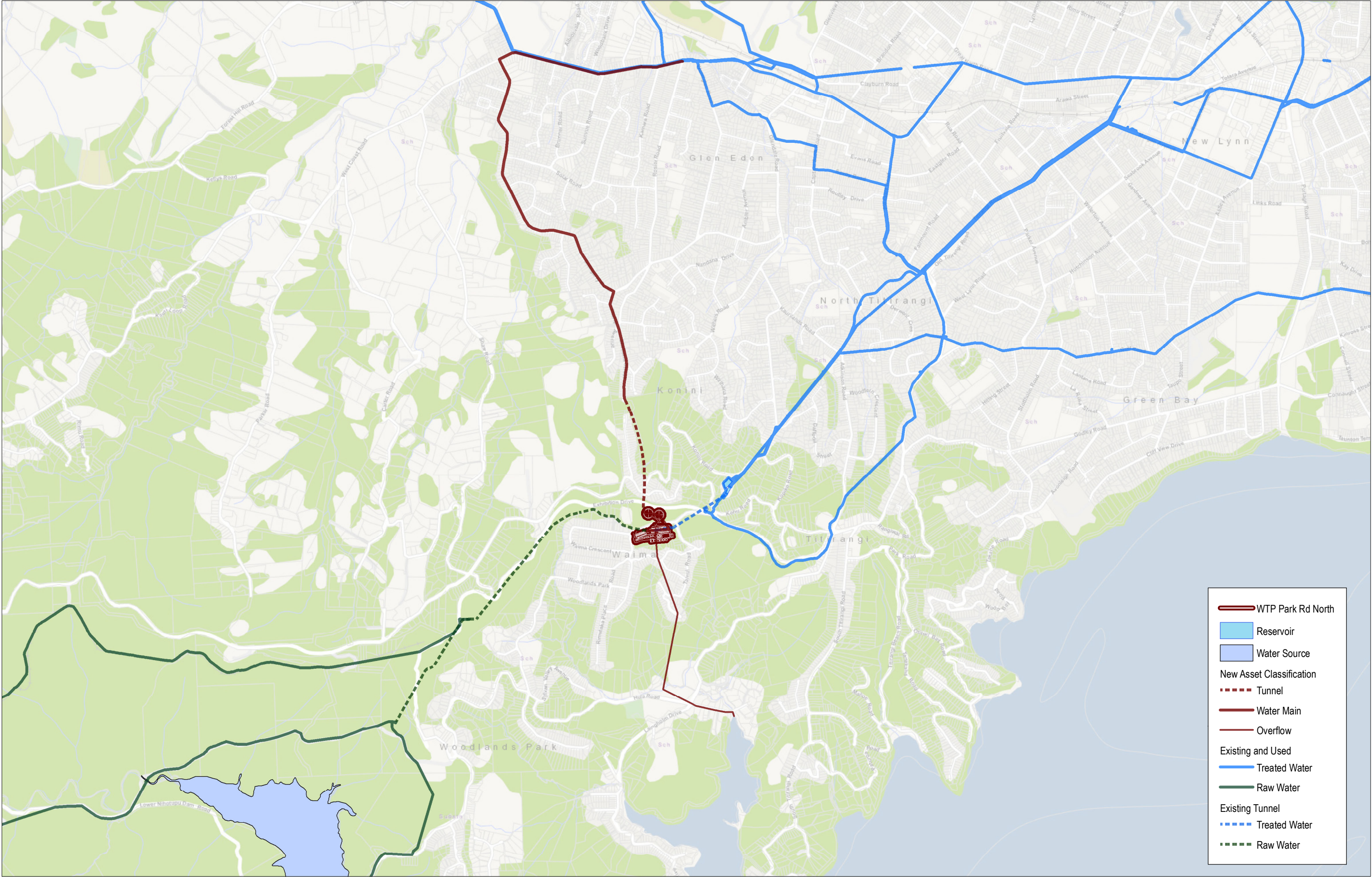
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Appendix A3

Existing Site- Scheme Overview

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1	CP	JF	JB	13/03/2017	
1	CP	DRAFT	DRAFT	06/03/2017	

Client:

Watercare Services Ltd

Project:

Huia WTP Upgrade

Discipline:

GIS

Drawing No:

GIS-651164-090-01-02C

Existing Site

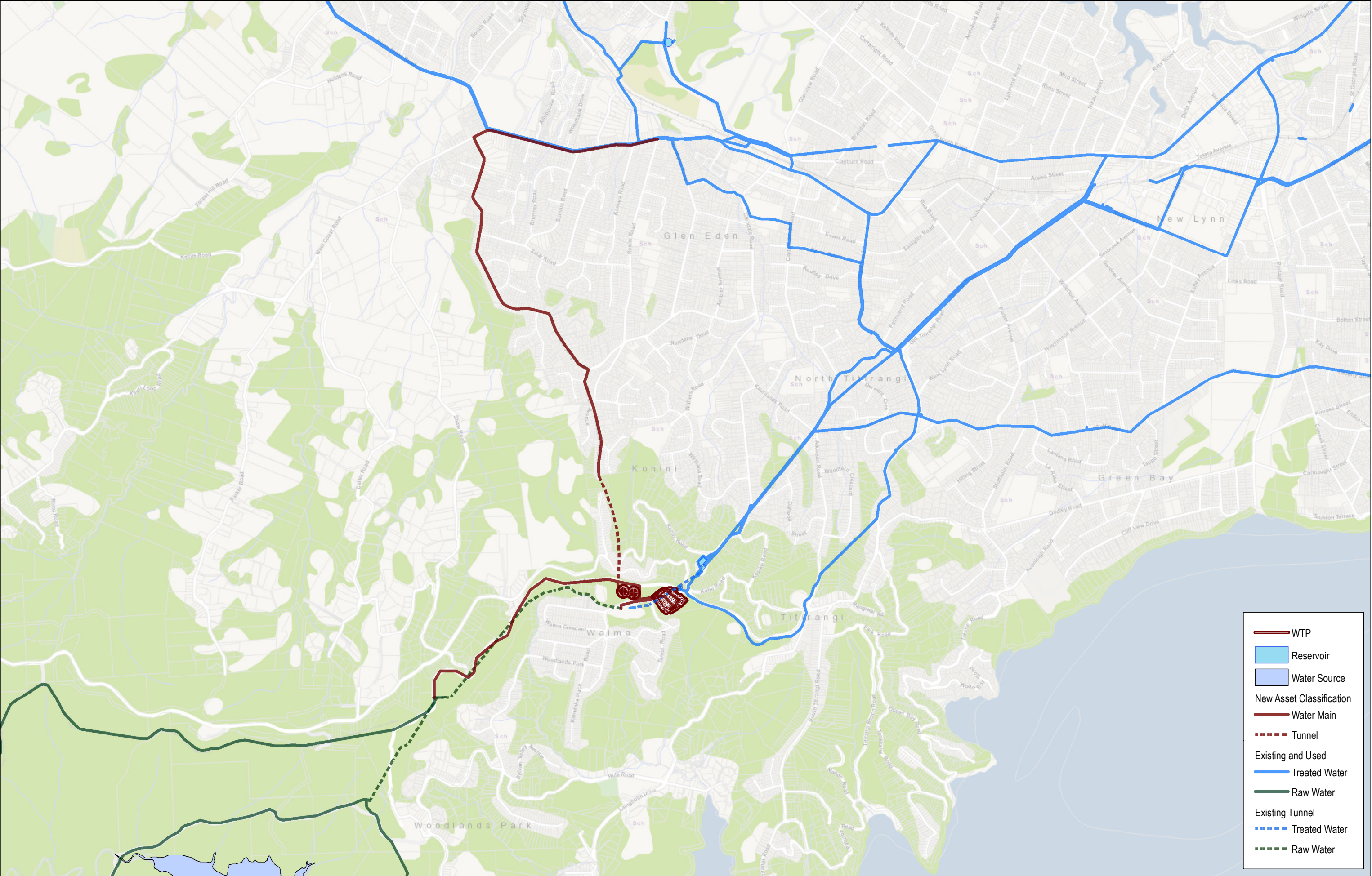
Infrastructure Requirements

Appendix A4

Manuka Road- Scheme Overview

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Revision	Author	Verified	Approved	Date	Title:
1	CP	JF	JB	13/03/2017	Manuka Site Infrastructure Requirements
1	CP	DRAFT	DRAFT	06/03/2017	

Client:

Watercare Services Ltd

Project:

Huia WTP Upgrade

Discipline:

GIS

Drawing No:

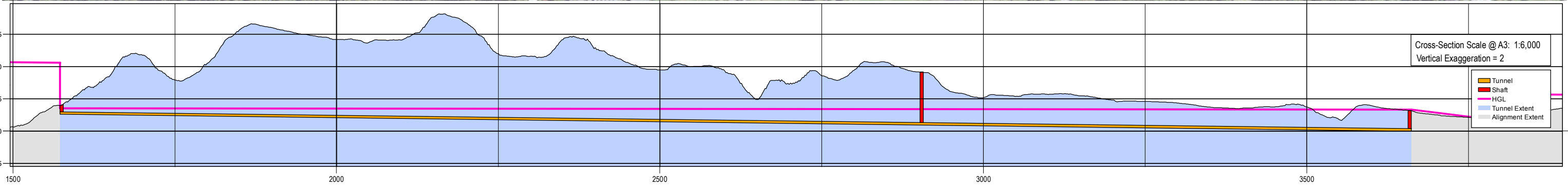
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Appendix B1

Parker North-Tunnel Overview

DRAFT

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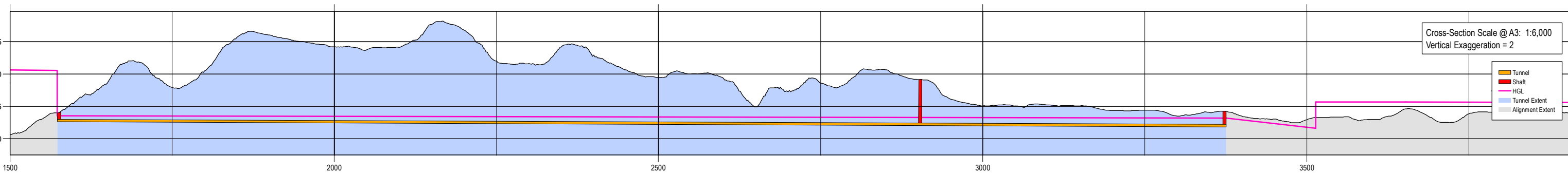
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									Drawing No: GIS-651164-033A-02
	1	CP	JF	JB	11/07/2016		Project: Huia WTP Upgrade		


Appendix B2

Parker South- Tunnel Overview

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	1	CP	JF	JB	7/07/2016				
							<p>Project:</p> <p>Huia WTP Upgrade</p>		<p>Drawing No:</p> <p>GIS-6511164-033B-02</p>

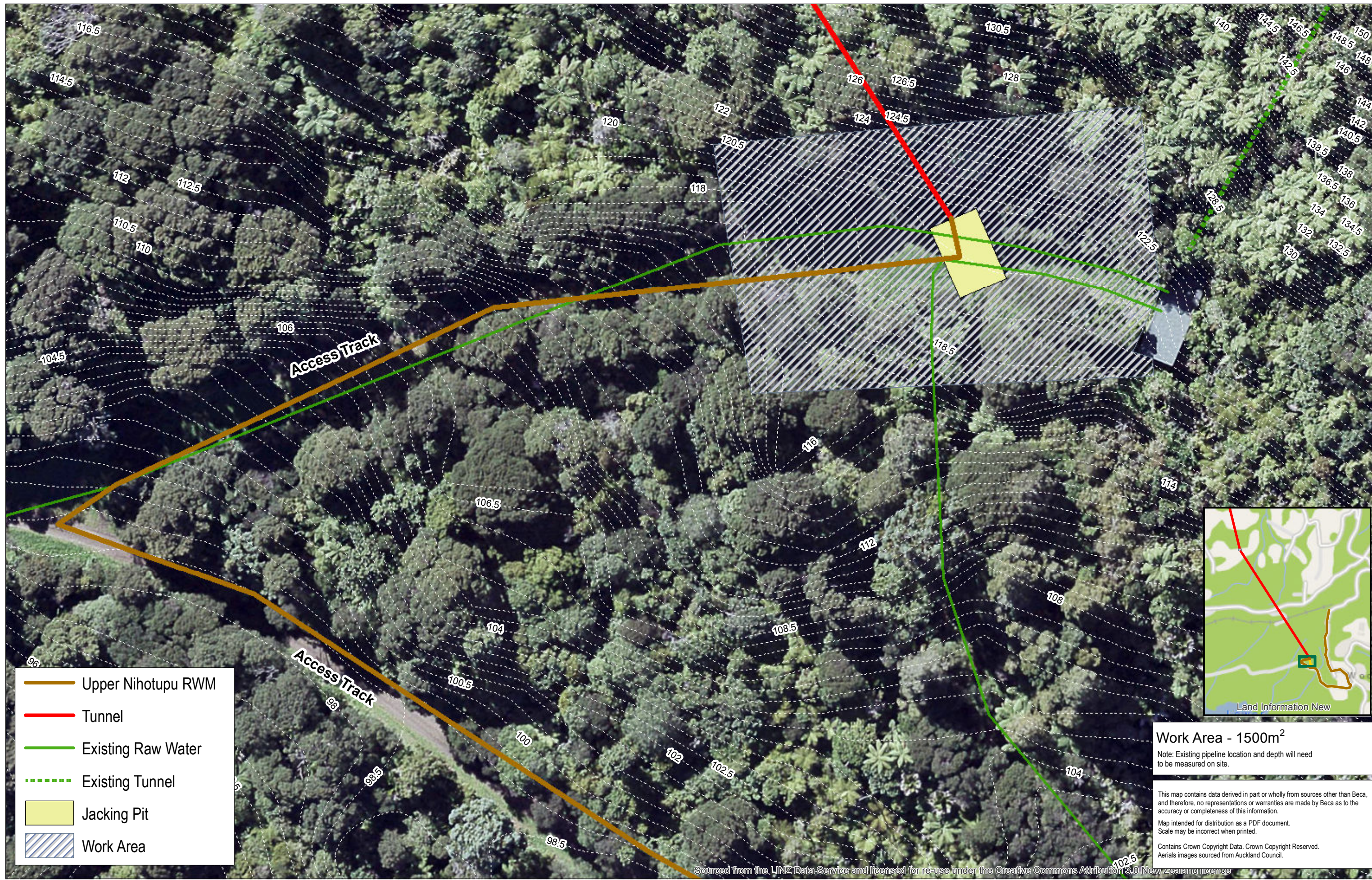
Appendix C1

Parker Road Sites- Mackies Rest Tunnel Jacking location

DRAFT

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GIS@beca.com
File: \\beca.net\projects\7777777-GIS-CH2M\651164 (Huia)\55_Workspaces\01_mxd\GIS-651164-033_03B_Mackies Rest.mxd Author: Beca GIS Date: 28/03/2017



Upper Nihotupu RWM

Tunnel

Existing Raw Water

Existing Tunnel

Jacking Pit

Work Area

Work Area - 1500m²
Note: Existing pipeline location and depth will need to be measured on site.

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Metres

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Revision	Author	Verified	Approved	Date
1	CP	JF	JB	13/03/2017
1	CP	JF	JB	08/07/2016

Parker - Work Area Detail
Mackies Rest

Client:
Watercare Services Ltd

Project:
Huia WTP Upgrade

Discipline:
GIS

Drawing No:
GIS-651164-033-03B

Appendix C2

Parker Road Sites- Intermediate tunnel shaft location

DRAFT

DRAFT

GIS@beca.com
Date: 28/03/2017
Author: Beca GIS
File: \\beca.net\projects\7771777-GIS-CHO-6511164 (Huia)\55_Workspaces\01_mxd\GIS-6511164-033_03A_IntermediateShaft.mxd



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Map Scale @ A3: 1:200

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Metres

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Revision	Author	Verified	Approved	Date
1	CP	JF	JB	13/03/2017
1	CP	JF	JB	08/07/2016

Parker - Work Area Detail Intermediate Shaft

Client: **Watercare Services Ltd**

Project: **Huia WTP Upgrade**

Discipline: **GIS**

Drawing No: **GIS-6511164-033-03A**

Appendix D1

Parker Sites- Parker Road
Treated Watermain Detail

DRAFT

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PRELIMINARY
NOT FOR CONSTRUCTION

A	PRELIMINARY		SVM	JRB	
No.	Revision	By	Chk	Appd	Date

Drawing Originator:



CH2M BECA www.ch2mbeqa.com

Original Scale (A1)	Design	JRB	08.03.17	Approved For Construction*
1:250	Drawn	KRR	08.03.17	Date
Reduced Scale (A3)	Design Check			
1:500	* Refer to Revision 1 for Original Signature			

Client:



Watercare
An Auckland Council Organisation

Project:

HUIA WTP
SITE SELECTION

Title:

PARKER ROAD
WATERMAIN TRENCHING
OVERVIEW

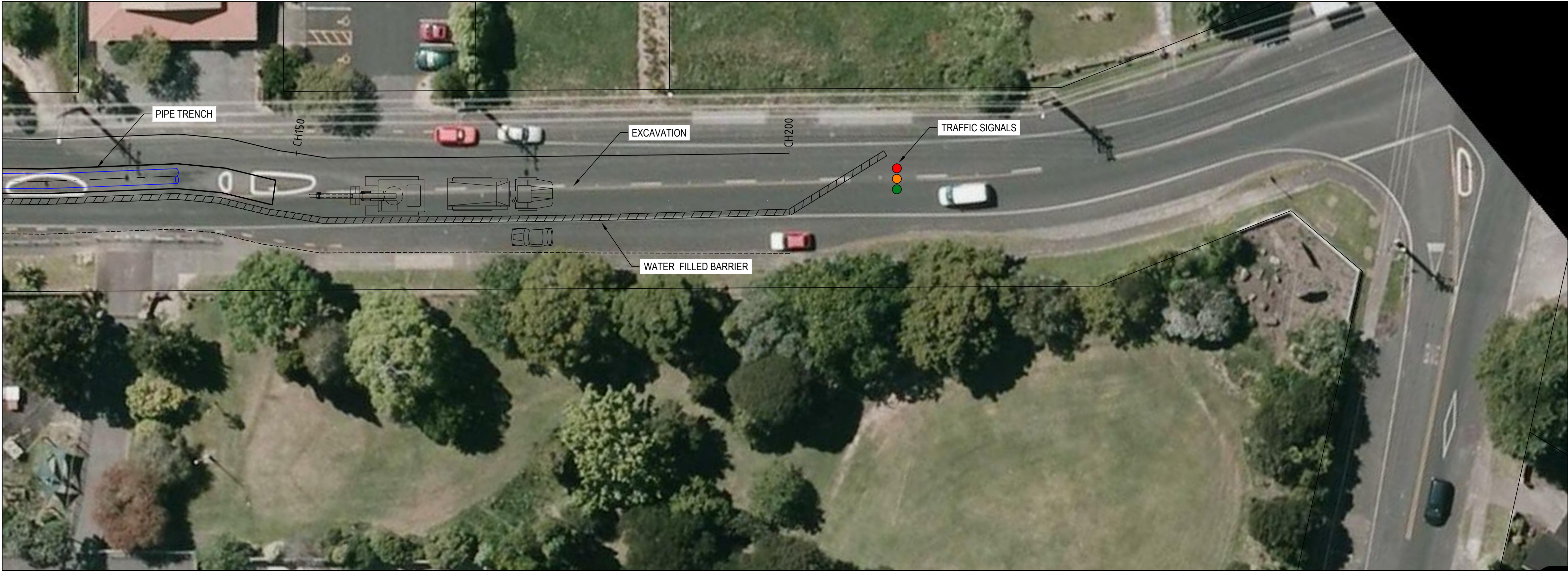
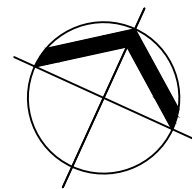
Discipline	CIVIL
Drawing No.	6511164-CK-100
Rev.	A

Appendix D2

Parker Sites- West Coast
Road Treated Watermain
Detail

DRAFT

DRAFT



No.	Revision	SVM	JRB	Appd	Date
A	PRELIMINARY				

Drawing Originator:



CH2M BECA www.ch2mbeqa.com

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1:250	Drawn	KRR	08.03.17	Date
Reduced Scale (A3)	Dag Verifier			
1:500	Dag Check			

* Refer to Revision 1 for Original Signature

Client:



Watercare
An Auckland Council Organisation

Project: **HUIA WTP
SITE SELECTION**

Title: **WEST COAST ROAD
WATERMAIN TRENCHING
OVERVIEW**

**PRELIMINARY
NOT FOR CONSTRUCTION**

Discipline	CIVIL
Drawing No.	6511164-CK-200
Rev.	A