GWE
CONSULTING ENGINEERS

BEACHLANDS SOUTH
WATER SUPPLY CONCEPT DESIGN

110 Jack Lachlan Drive
Beachlands South

BEACHLANDS SOUTH LIMITED PARTNERSHIP

March 2022 | Final

Creative Thinking | Better Environments

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EXECUTIVE SUMMARY

Beachlands South Limited Partnership (BSLP) has engaged GWE Consulting Limited (GWE) to develop a concept design for the required water supply to service the proposed Beachlands South Private Plan Change (PPC) area which will rezone approximately 307 hectares of land from Rural Countryside Living to a series of live urban zones, and an area of future urban zone.

As part of the process, GWE undertook a number of analyses and investigated a number of key factors to determine the most viable infrastructure solutions from raw water supply to treatment and distribution. The key factors and analysis include:

- Supply-demand balance analysis.
- Hydrogeology beneath the site, unallocated and available groundwater and supply options.
- Raw water quality data analysis.
- General site topography and land requirements.
- Development philosophy.
- Staging requirements.
- Operational complexity and reliability.
- Ease of construction.
- Use of technologies that are common within NZ context and consistent with current and emerging technologies.

Based on the identified key factors, raw water quality data available and site-specific conditions, the PPC can be viably serviced for water throughout the different stages of development (Live Zone and Future Urban Zone) through the ground water take solutions identified in this report. There is no apparent reason that the land is not suitable for urbanisation. The development will progress at an estimated rate of 250 Household Unit Equivalent (HUE) per year starting off using the existing consented sources of supply at Formosa golf club and Pine Harbour Living Limited (PHLL). There will be a large surplus of water for the first 8 years of growing population, allowing the development to go as fast as demand requires.

GWE has determined the following:

Live Zoned Land – Demand = between 1,245 m^3/day (150 l/day/person) to 1,424 m^3/day (175 l/person/day)

This will be met through the following ground water supply sources:

- Water supply agreement with Pine Harbour Living Limited (PHLL) = 765 m^3/day
- The existing Formosa water take permit = 300 m^3/day
- The proposed water take permit from the existing 620 Whitford Maraetai Road test bore = 250 m^3/day
- A proposed water take permit from an additional bore at 620 Whitford Maraetai Road = 250 m^3/day

This equates to 1,565m^3/day and meets the above demand requirements with a reasonable margin of comfort.

It is therefore considered that sufficient potable water can be supplied to the live zoned part of the site. In any case, the PPC includes a standard (I.7.4) that requires adequate water supply be provided at the time of subdivision or development. This will ensure development does not occur without sufficient potable water to meet the needs of future occupants. In addition, water usage is expected to be lower as the PPC includes a rule that requires rainwater harvesting from residential developments for non-potable water uses and the use of water efficient fixtures.

Further, water management forms part of the Beachlands South Sustainability Strategy for the PPC. Specifically, the reduction of water use/demand is included as a particular focus area of the Sustainability Strategy and development in the precinct requiring resource consent will be assessed against this strategy and the extent to which it achieves the outcomes. Adherence to this Sustainability Strategy and the proposed rule/standard is expected to lower per capita water usage to an average of 150 litres per person per day, or less (1,245m^3/day). In any case, this assessment has also modelled a higher average daily per capita water usage figure of 175 litres per day per person to allow for daily water usage variations.

Future Urban Zoned Land – Demand = between 482 m^3/day (150 l/person/day) to 563 m^3/day (175 l/person/day)

This will be met through the following ground water supply sources, in addition to the sources outlined above:

- Proposed water take permits from additional bores at 620 Whitford Maraetai Road = 500 m^3/day

This meets the required demand for the Future Urban Zone land, when combined with the Live Zoned land water supply (refer table below). In addition, the same water supply standard (outlined above) and rainwater harvesting/water efficient fixture rule will apply to this part of the site and will therefore ensure sufficient potable and non-potable water is available to meet the needs of future occupants. It is considered the implementation of the Sustainability Strategy recommendations combined with the proposed rules will lower the Future Urban Zoned Land water supply requirements to 482 m^3/day or less.

Associated Matters

- Water sourced from these bores will require treatment. The most suitable groundwater treatment option, similar to the treatment process at the PHLL water treatment plant, is likely Ion Exchange (IEX) followed by cartridge filtration, UV and Chlorine dosing. IEX has the potential to reduce iron, manganese and hardness in a much lower safety risk compared with other iron removal systems. Chlorine dosing provides the additional disinfection step to make sure there is no bacteria growth in the storage tanks and enable to meet the requirements of the Drinking Water Standards for New Zealand 2021 (DWSNZ). No technology should be excluded from design options until further water quality data of all the water supply bores are available.
- The bores and water treatment plant will need to be consented and built in the southern part of the site to service the future urban zoned land. This is where the bore field will provide the additional supply and therefore it is good practice for the water treatment plant to be located in the vicinity. Under current Auckland-wide provisions of the AUP, new bores

for purposes not otherwise specified (i.e. for water take) outside the management area overlays specified is provided for as a controlled activity, or restricted discretionary activity where the relevant controlled activity standards are not met.

- Reservoir storage of 4,500 m^3 split across two tanks should be installed at the north-east corner of the site to service the Live Zone and benefit from gravity flow as well as provide emergency and firefighting supply.
- The proposed infrastructure options and solutions will be able to service the projected number of dwellings and area within the PPC area for both the Live Zone and Future Urban Zone.

The following table summarises the infrastructure required to service the live zoned area versus the future urban zoned land.

	LIVE ZONE	FUTURE URBAN ZONE	TOTAL LZ + FUZ
Water Requirements			
150 litres/person/day	**1,245 m^3/day**	**482 m^3/day**	**1,727 m^3/day**
175 litres/person/day	**1,424 m^3/day**	**563 m^3/day**	**1,987 m^3/day**
Sources			
PHLL	765 m^3/day		765 m^3/day
Formosa Bore*	300 m^3/day		300 m^3/day
"620 bore''	250 m^3/day		250 m^3/day
Southern bores	250 m^3/day	500 m3/day	750 m^3/day
TOTAL	**1,565 m^3/day**	**500 m^3/day**	**2,065 m^3/day**
Treatment	PHLL & Formosa upgraded to treat additional capacity		At the new WTP near the Southern bore field or alternatively near or at PHLL
Service Reservoir	4,500 m^3 72 hours storage Split between 2 reservoirs for adequate turnover	2,000 m^3 72 hours storage Split between 2 reservoirs for adequate turnover	6,500 m^3 72 hours storage Split between 4 reservoirs for adequate turnover

**the Formosa bore will go from 0 to 300 m^3/day over the course of the LZ as the golf course gets decommissioned.*

1 INTRODUCTION

This report has been prepared in support of the proposed Private Plan Change (PPC) by Beachlands South Limited Partnership (BSLP) to rezone approximately 307 hectares of Rural Countryside Living to a series of live urban zones and an area of future urban zone for the Beachlands South area.

The part of the PPC area owned and controlled by BSLP comprises of approximately 255 hectares of coastal land made up of the Formosa Golf Resort (110 Jack Lachlan Drive) and rural-residential properties (620 and 712 Whitford-Maraetai Road). The area is currently serviced by treated water from a consented bore at PHLL.

The development is proposed to be undertaken in seven stages, with the final design horizon (including the area to be zoned future urban) understood to be 3,810 housing unit equivalents (HUEs), with additional minor commercial, community, employment areas, schools, a hotel and mixed-use developments.

Beachlands South Limited Partnership (BSLP) has engaged GWE Consulting Limited (GWE) to develop a drinking water and wastewater treatment infrastructure concept design to service the proposed Beachlands South PPC area.

The purpose of this report is to outline a concept design for the required water supply to support the preparation of a PPC to guide the development of the area for future, urban growth. The water treatment plant concept design is based on available water quality data and conventional treatment processes using established treatment technologies. Further design stages will confirm process unit sizing and plant layout, all of which will support the separate preparation of the groundwater take consent application and Assessment of Environmental Effects (AEE). The concept design is based on compliance with the Drinking Water Standards for New Zealand 2021 (DWSNZ), as well as firefighting supply in compliance with the New Zealand Fire Service Fighting Water Supplies Code of Practice SNZ PAS 4509:2008.

2 EXISTING ENVIRONMENT

2.1 Project Location

The Beachlands South PPC area comprises of approximately 307 hectares of Rural Countryside Living land largely made up of the Formosa Golf Resort (110 Jack Lachlan Drive) and rural-residential properties (620 and 712 Whitford-Maraetai Road). The other properties within the private plan change area are generally rural blocks with single residential dwellings.

The PPC area is located on the southern side of Jack Lachlan Drive and adjoins the thriving community of Beachlands, to the north. Refer to Figure 1 for a locality plan.

Topography across the site is variable but generally slopes towards the coastal edge before sloping steeply, over a low scarp, towards the CMA. The overall Beachlands South PPC area catchment contains a number of tributaries which generally flow towards the coastline.

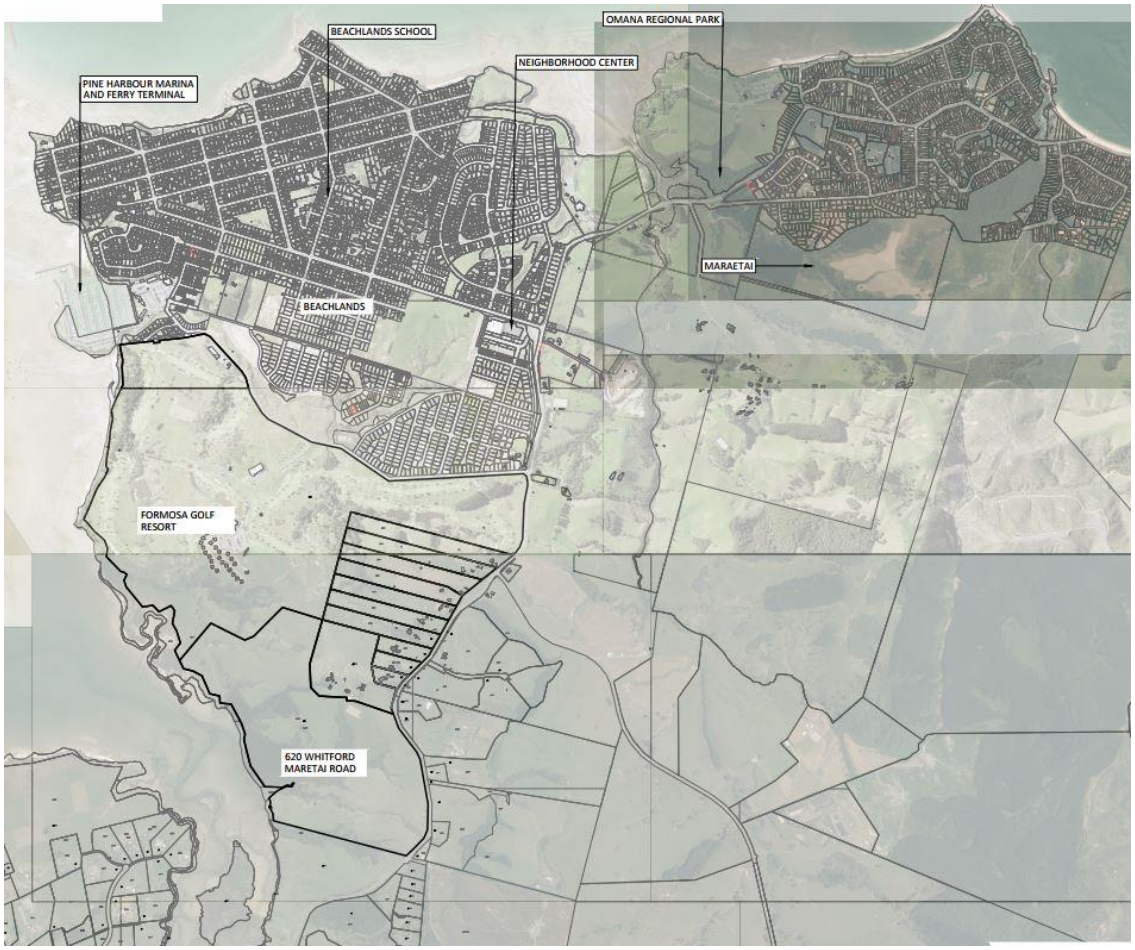


Figure 1: Locality Plan – Beachlands South Overall Plan Change Area

2.2 Surrounding Area

The wider environment covers the Beachlands and Maraetai areas.

Beachlands is a coastal village located east of the existing Manukau urban areas and was established in the 1920s. Development in the area increased in the ensuing years due to its proximity to several beaches and bays.

Maraetai is a town located to the east of Beachlands and is similar in nature to the Beachlands Village area in terms of its coastal context.

Historical developments in the Beachlands area are largely characterised by grid-based roading layouts, low-density character with typically rectangular shaped allotments and minimal rear site development. Water has been supplied by a combination of bores, rainwater harvesting from roof collection systems, supplemented by top up from water tanker contractors.

A more recent development in the area includes the Beachlands 1 Precinct development (covering 122 ha of land between the Beachlands Village area and Jack Lachlan Drive).

Potable water has been predominantly supplied by a reticulated network supplied from an aquifer managed and operated by Pine Harbour Living Ltd (PHLL). Beachlands South Limited Partnership has a supply agreement with PHLL, to service the PPC area.

3 PROPOSED DEVELOPMENT

3.1 Site Plan and Description

The development of the PPC area will proceed in multiple stages. Each Stage is detailed in the structure and precinct plans prepared by JASMAX[1] provided in Appendix A. The PPC provides for the live zoning and future urban zoning.

The development will comprise a mix of housing types including 5/6-storey apartments, 3-storey walk-up apartments, 2-storey terraced housing (narrow, large and detached), stand-alone houses (medium, large and extra-large), live-work units, retirement villas and apartments as well as light industrial development. In addition, there will be a school, hotel, golf, commercial offices and retail. The details for both the live and future urban zone are provided in the table below and typical footprint / roof areas presented as the information is used for supply-demand calculations.

Table 1: Development Details

HOUSE TYPE	UNITARY PLAN ZONE	HOUSEHOLD UNIT EQUIVALENT (HUE) LIVE ZONE (TOTAL)	HOUSEHOLD UNIT EQUIVALENT (HUE) FUTURE URBAN ZONE (CUMULATIVE TOTAL)**	TYPICAL FOOTPRINT / ROOF AREA (m2)
5/6-storey lifted apartments	THAB	1,139	1,139	936
3-storey walk-up apartments	Mixed Housing Urban	432	452	528
2-storey terraced housing – narrow lots	Mixed Housing Urban	223	223	49.5
2-storey terraced housing – larger lots	Mixed Housing Urban	334	409	78
2-storey zero-lot or duplex housing	Mixed Housing Urban	328	565	96
Standalone houses – medium	Mixed housing Urban	191	386	120
Standalone houses – large	Mixed housing Urban	77	404	180
Standalone houses – extra large	Large Lot	-	38	300
Live-work units		28	28	49.5
Retirement villas		71	71	180
Retirement apartments		25	2	528

[1] Structure & Precinct Plans

HOUSE TYPE	UNITARY PLAN ZONE	HOUSEHOLD UNIT EQUIVALENT (HUE) LIVE ZONE (TOTAL)	HOUSEHOLD UNIT EQUIVALENT (HUE) FUTURE URBAN ZONE (CUMULATIVE TOTAL)**	TYPICAL FOOTPRINT / ROOF AREA (m2)
Light industrial (112m2)		70	70	*
HUE's Total		**2,918**	**3,810**	
Other Uses				
Golf (100 people)				*
Hotel (300 guests, 30 staff)				*
School (1000 students, 150 teachers)				3,000
F&B (micro-brewery, restaurant, wine bar, multi-purpose pavilion)				1,810
Retail				2,515
Metromarket				1,800
Innovation Hub and Commercial				5,095
Service / Light Industry (600 people)				*

Note:

**water demand based on persons/rooms, not roof area*

***The HUE's totals are cumulative with the Live Zone, therefore there are no additional 5/6 storey lifted apartments within the Future Urban Zone, only 20 3-storey walk ups, etc.*

3.2 Water Supply Philosophy

The water supply for the development is based on a philosophy of self-sufficiency and independence. Already available information on the water supply sources was gathered by Tonkin & Taylor[2], provided in Appendix B, and used in our conceptual design.

The source of water for the PPC area will be from groundwater (the Beachlands Waitemata and the Whitford Waitemata aquifers) and can be supplemented by rainwater harvesting for non-potable demand.

Groundwater will be the sole source of a potable supply. The resource will comprise a supply agreement with PHLL for the supply of up to 765 m^3/day (or greater) supplemented by the existing Formosa Golf Club bore (300 m^3/day or greater) and the existing southern test bore on the 620 site (to be consented). The groundwater will be pumped to the PHLL treatment plant where it will be treated and supplied to the PPC area, along with the water supplied under a supply agreement with PHLL.

[2] Tonkin & Taylor Water Supply Sources Report '20210827 Production Well Locations'

In addition, a proposed bore field in the southern area of the PPC, comprised of an additional 3 bores as per Tonkin & Taylor's report[2], will supplement the required demand. One test bore has already been developed on site (620 bore above mentioned) and has been used to provide water quality data for concept treatment plant design purposes.

The proposed groundwater sources will come on stream as detailed in the following table. The Formosa bore will progressively send water to PHLL for treatment as development expands and the golf course reduces in size.

Table 2: Groundwater Supply Source Summary

SOURCE NAME	SUPPLY YIELD	COMMENTS
PHLL BORE	765 m^3/day	Supply Agreement with PHLL Optional – Increase supply for contingency
FORMOSA GOLF CLUB BORE	300 m^3/day	Step 1 – Using available volume from existing golf club Step 2 – Using available volume from golf club reduced to 9 holes Step 3 – Using all of Formosa bore from decommissioned golf club Step 4 (contingency) – Increase consented take from Formosa or bring the '620' bore consent forward or increase take from PHLL
SOUTHERN BORE FIELD	250 m^3/day 250 m^3/day 500 m^3/day	Step 1 – 620 test bore yielding 250 m^3/day Step 2 – Additional southern bore yielding 250 m^3/day Step 3 - Additional 2 bores yielding 250 m^3/day each
TOTAL BORE WATER	**2,065 m^3/day**	

Consistent with the Sustainability Strategy developed for Beachlands South, it is recommended that each new dwelling (excluding apartments) and the school have a rainwater harvesting collection system used for non-potable supply. (toilets, laundry and gardens). The PPC includes a rule that requires this as well as the use of water efficient fixtures. The proposed PPC rule is outlined below.

"Non-potable Water Supply Efficiency

Purpose: ensure new dwellings adopt minimum energy efficiency measures to provide cost, comfort and health benefits to their occupants, and sustainability benefits to the wider community.

(1) *All new dwellings are designed to have non-potable water requirements (for toilets, laundry and gardens) supplied by rainwater tanks (or bladders) sized in accordance with the table below. Rain tank/bladder capacity for attached housing and apartment typologies can be provided in either individual or as communal rainwater systems; and*

(2) *All new dwellings are fitted with water efficient fixtures, to a minimum 3 Star standard (under the Water Efficiency Labelling Scheme (WELS)).*

(3) *The minimum sizes for rainwater tanks (or bladders) in Table I605.6.4.9.1 and Table I605.6.4.9.2 apply to detached and attached housing in all sub-precincts.*

Table 1: All dwellings except apartments

Dwelling type	***Minimum tank (or bladder)***
1 bedroom (includes Studio)	*1000L*
2 bedroom	*2000L*
3 bedroom	*3000L**
4 bedroom	*5000L (roof area up to 110m^2), or 3000L (roof area greater than 110m^2)*
5 bedroom	*5000L*

** All attached houses to be 3000L max*

Table 2: Apartments

Dwelling type	***Minimum tank (or bladder)***
1 bedroom (includes Studio)	*1000L*
2 bedroom	*2000L*
3 bedroom	*1500L*
4 bedroom	*2000L*
5 bedroom	*2500L"*

All dwellings, businesses and institutional buildings are therefore recommended to install water conserving plumbing fixtures and appliances, to a minimum 3 Star Standard (under the Water Efficiency Labelling Scheme (WELS)).

Development in the Beachlands South precinct requiring resource consent will also be assessed against the Sustainability Strategy which includes reduced water use/demand as a key focus area and is included as a matter of discretion and assessment criteria in the precinct provisions.

Overall, the proposed rainwater harvesting standard is supported as well as the water efficient fixture standard. These provisions will reduce the demand for water within the precinct and ensure potable water is not used inefficiently for non-potable purposes. They are considered to be the most appropriate provisions to address the water supply requirements for development within Beachlands South.

4 WATER DEMAND

4.1 Supply Demand Balance

A water supply demand analysis was undertaken to assess water supply needs and issues for the PPC area and how these can be addressed. The model is provided in Appendix C.

The supply demand assumptions are summarised in the table below.

Table 3: Supply-Demand Balance Assumptions

PARAMETER	ASSUMPTION	COMMENT
Groundwater treatment and network losses[3]	13.2%	
Groundwater availability[4]	Total of 2,065m^3/day made of:	
	• Up to 765 m^3/day (or greater for contingency) from PHLL (Beachlands Waitemata aquifer)	• Supply agreement with PHLL
	• Up to 300 m^3/day from the Formosa Golf Club bore (Beachlands Waitemata aquifer)	• Refer to Table 2 for Staging
	• Up to 1,000 m^3/day from the southern bore field (Whitford and Beachlands Waitemata aquifers) including the 620 bore and 3 further bores.	• Unallocated, available for BSLP in the Beachlands Waitemata and the Whitford Waitemata aquifers. To be consented.

The supply vs demand balance looked at three water consumption rates (130, 150 and 175 litres/person/day), and two stages of development:

- Live Zone
- Future Urban Zone (Full Development)

The groundwater available for the development stages is proposed as per table below and illustrated in Figure 3:

Table 4: Groundwater Supply Source Staging

	LIVE ZONE	FUTURE URBAN ZONE	TOTAL LZ + FUZ
Water Requirements			
150 litres/person/day	**1,245 m^3/day**	**482 m^3/day**	**1,727 m^3/day**
175 litres/person/day	**1,424 m^3/day**	**563 m^3/day**	**1,987 m^3/day**
Sources			
PHLL	765 m^3/day		765 m^3/day
Formosa Bore*	300 m^3/day		300 m^3/day
''620 bore''	250 m^3/day		250 m^3/day
Southern bores	250 m^3/day	500 m3/day	750 m^3/day
TOTAL	**1,565 m^3/day**	**500 m^3/day**	**2,065 m^3/day**

The various groundwater sources will provide supply as staged in Table 4.

[3] Water NZ Waterloss Guidelines
[4] Tonkin & Taylor Water Supply Sources Report '20210827 Production Well Locations'

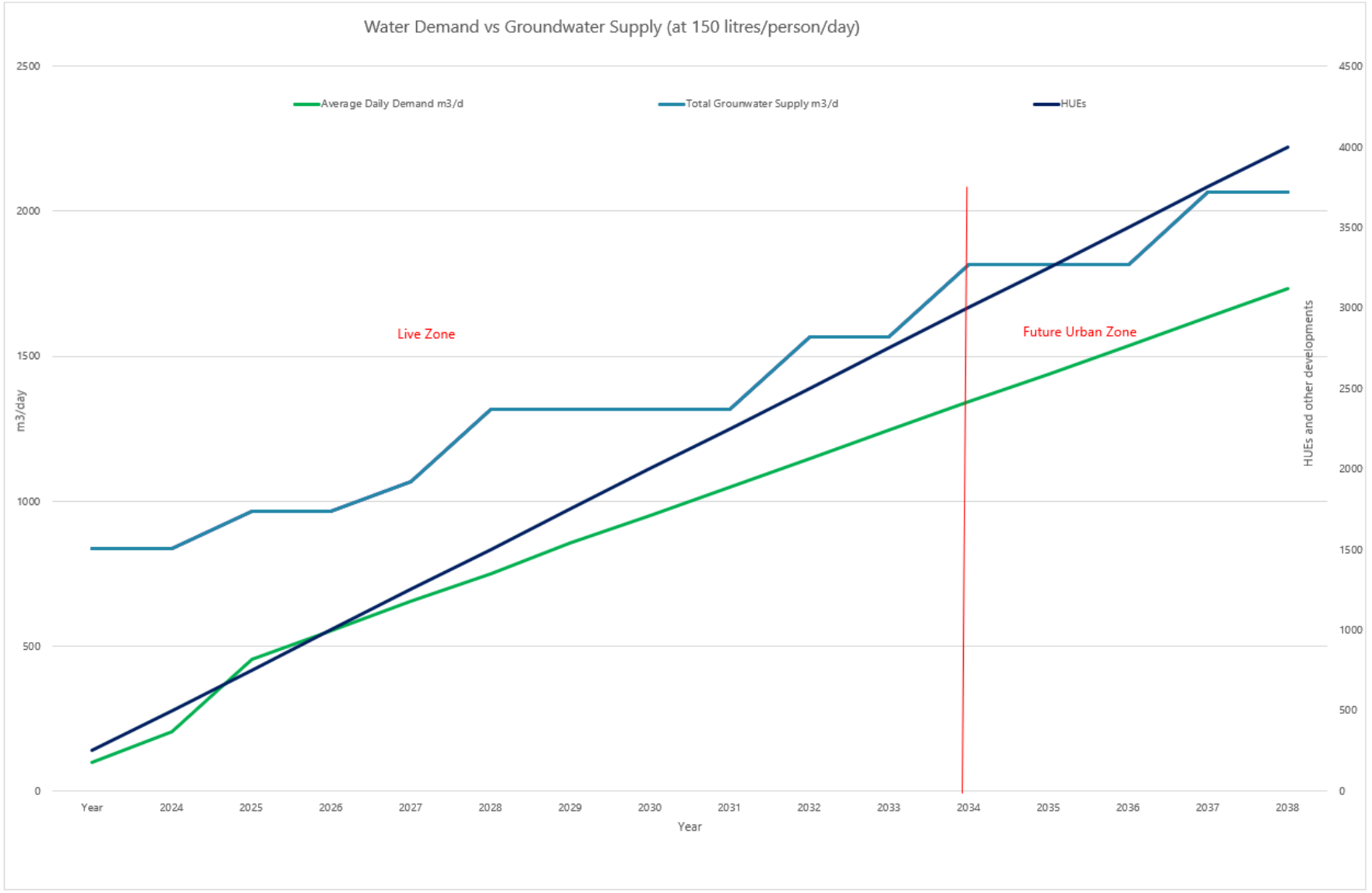
The results of the water supply vs demand analysis for the Live Zone and the Future Urban Zone (FUZ) are summarised in the table below.

Table 5: Supply-Demand Balance Summary

WATER CONSUMPTION RATE (L/PP/DAY)	TOTAL DEMAND (m^3/DAY) LIVE ZONE	TOTAL SUPPLY (m^3/DAY) LIVE ZONE	SHORTFALL/SURPLUS (m^3/DAY) LIVE ZONE	TOTAL DEMAND (m^3/DAY) FUZ	TOTAL SUPPLY (m^3/DAY) FUZ	SHORTFALL/SURPLUS (m^3/DAY) FUZ
175	1,424	1,565	+141	1,987	2,065	+78
150	1,245	1,565	+320	1,727	2,065	+338
130	1,102	1,565	+463	1,520	2,065	+545

The analysis shows that there is no water shortfall throughout the different stages of the development. At the time the Live zone and future urban zone lands are developed, provided the necessary consents have been obtained to take water from the southern bore field, there will be a surplus of water available regardless of the water consumption rate.

From a design point of view, rainwater harvesting for non-potable water use as much as practicable, water conserving plumbing fixtures and appliances in every household and sufficient service reservoir storage will provide resilience and buffer for the system. As noted in the previous tables, it is also recommended that a contingency plan is available to provide resilience for the system.


Water Demand vs Groundwater Supply (at 150 litres/person/day)
Average Daily Demand m3/d
Total Grounwater Supply m3/d
HUEs
Live Zone
Future Urban Zone
m3/day
HUEs and other developments
Year
2500
2000
1500
1000
500
0
4500
4000
3500
3000
2500
2000
1500
1000
500
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Year
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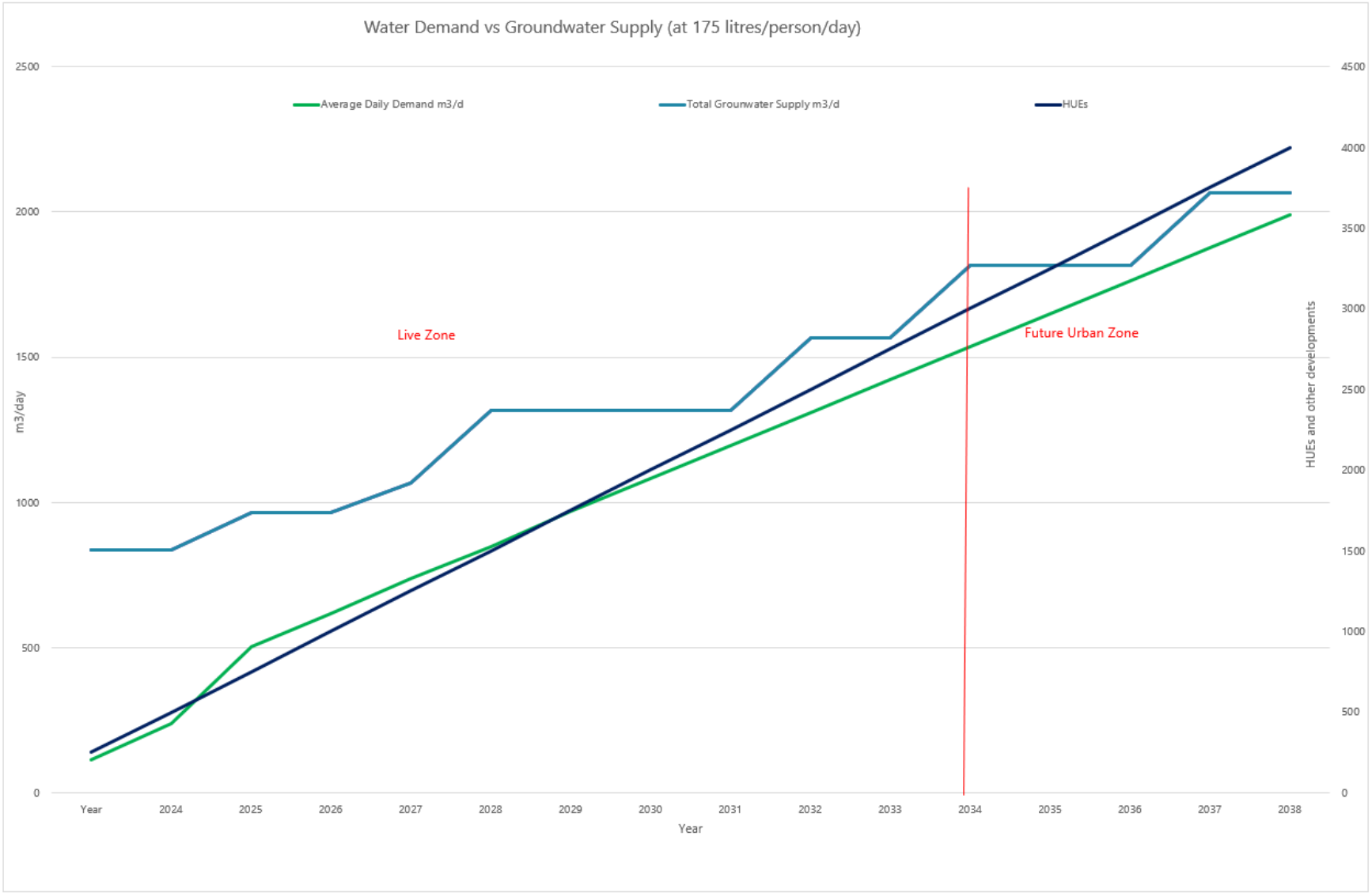


Figure 2: Illustrative Water Supply Demand Balance Diagrams at 150 and 175 litres/person/day

4.2 Demand Management

Demand management may need to be implemented for a couple of months during summer periods or at times of higher consumption.

Smart metering with increasing tariff above 130 litres/person/day usage can be implemented to encourage further water conservation.

During high demand periods, water conservation campaigns will be run, similar to campaigns run by Watercare; however, tailored to the supply demand requirements of the PPC area. This will include requests for people to flush wisely, no hose for irrigation, garden watering, car/house wash, proactive leak detection, etc.

An innovative and resilient three waters management strategy to ensure long-term benefit to the development, the wider community and surrounding natural environment is a key focus area of the Beachlands South Sustainability Strategy. This strategy is referenced in the assessment criteria of the precinct provisions for development in the precinct but will also be developer-led for long term implementation and to ensure successful demand management.

5 WATER SUPPLY INFRASTRUCTURE

5.1 Raw Water Quality Data

The water quality data available are as follows:

- PHLL supply bores, which inform the likely water quality of the Whitford Waitemata aquifer
- "620 bore", which is a test bore that informs the characteristics of the Whitford Waitemata aquifer and the safe yield for the Southern bore-field production bores
- Formosa Golf Club Bore, provided by Russell Property Group, supplements the "620 bore" to inform the water quality of the Beachlands Waitemata aquifer

The water quality data from these sources is summarised in the table below.

Table 6: Groundwater Sources Water Quality Data

PARAMETER	UNIT	FORMOSA GOLF CLUB BORE JAN 2020	FORMOSA GOLF CLUB BORE JUN 2020	PHLL BORE APR 2000	PHLL BORE APR 2008	'620'BORE DEC 2008	DWSNZ GUIDELINE VALUE	DWSNZ MAXIMUM ACCEPTABLE VALUE
Alkalinity (Total)	g/m^3 as $CaCO_3$	200	210		210	150	-	-
Aluminium	g/m^3				<0.0030		<0.10	
Ammonia-N	g/m^3			0.19	0.04		<1.5	
Apparent Colour (Total)	Hazen Units		40				<10	
Arsenic (Total)	g/m^3		<0.0001		<0.0010		-	0.01
Boron (Total)	g/m^3	0.025	0.026	0.13	0.032	0.028	-	1.4
Cadmium	g/m^3				<0.000050		-	0.004
Calcium (Total)	g/m^3	59	56		57	30	-	-
Chloride	g/m^3	30		31	37	38	<250	-
Chromium	g/m^3				<0.00050		-	0.05
Cobalt	g/m^3				<0.00020		-	
Conductivity (at 25 °C)	mS/m	49.1	49.7			49.1	-	-
Conductivity Electrical (EC)	mS/m	49.1			50	39.9		
Copper (Total)	g/m^3	<0.00053	<0.0002	<0.05	<0.00050	<0.00053	<1	2
Escherichia Coli	MPN/100 mL	<1	<1		<2	<1	-	<1
Free Carbon Dioxide	g/m^3 as 25°C	8.7			260		-	-
Hardness (Total)	g/m^3 as $CaCO_3$	186	180	230	180	100	200 100-300 (taste)	-
Iron (Total)	g/m^3	0.97	1.8	0.69	0.48	0.054	0.2	-
Lead (Total)	Mg/L		0.0026		<0.00010		-	0.01
Lithium	g/m^3				0.030		-	-
Magnesium (Total)	g/m^3	9.4	9.0	8.0	9.6	6.1	-	-

PARAMETER	UNIT	FORMOSA GOLF CLUB BORE JAN 2020	FORMOSA GOLF CLUB BORE JUN 2020	PHLL BORE APR 2000	PHLL BORE APR 2008	'620'BORE DEC 2008	DWSNZ GUIDELINE VALUE	DWSNZ MAXIMUM ACCEPTABLE VALUE
Manganese (Total)	g/m^3	0.107	0.099	0.12	0.094	0.0088	<0.04 (staining) <0.1 (taste)	0.4
Molybdenum	g/m^3				<0.00020		-	0.07
Nickel	g/m^3				<0.0050		-	0.08
Nitrate-N	g/m^3	<0.05	0.0032	0.07	<0.0020	<0.050	-	50
Nitrite-N	g/m^3				<0.0020		-	0.2
Nitrite (N) +Nitrate (N)	g/m^3		0.0067		0.0038		-	-
pH	pH Units	7.7	7.6	7.06	7.7	8.0	7.0-8.5	-
Phosphorus (Total)	g/m^3				0.046		-	-
Potassium (Total)	g/m^3	2.3		4	2.3	1.9	-	-
Sodium (Total)	g/m^3	30		35	36	44	<200	-
Sulphate	g/m^3	5.5		13	6.6	4.7	<250	-
Tin	g/m^3				<0.00050		-	-
Total Coliforms	MPN/100 mL		<1		2		-	-
Total Dissolved Solids	Mg/L		330		<3.0	270	<1000	-
Total Organic Carbon (TOC)	g/m^3				1.2		-	-
Total Phenols	g/m^3				<0.0020		<1	-
Turbidity	NTU		9.3		3.1		2.5	-
Vanadium	g/m^3				<0.0010			-
Zinc (Total)	g/m^3	0.0017		<0.05	0.053	0.0054	<1.5	-

The analytical results of the water quality available show overall good water quality. The Iron, Manganese and Hardness results for the Beachlands Waitemata aquifer indicate that treatment for these parameters will likely be required if the southern bore field in the Whitford Waitemata aquifer shows similar water quality results

- Elevated Iron above the DWSNZ Guideline Value of 0.2 mg/L
  - 0.69 and 0.48 mg/L from the PHLL bore
  - 0.97 and 1.8 mg/L from the Formosa bore
- Elevated Hardness (230 g/m^3 as $CaCO_3$ from the PHLL bore) above the DWSNZ Guideline Value of 200 g/m^3 as $CaCO_3$), suggesting likely softening treatment by PHLL.
- Turbidity measurements of 3.1NTU in the BHW bore and 9.3 in the Formosa bore, that seem elevated for groundwater, which are most likely a result of oxidised iron/manganese.

In summary, frequent samples taken from all bores from the bore field are likely to show variable levels of Iron, Manganese and hardness, indicating that treatment for these parameters will be required.

The groundwater treatment concept design is based on this information, in line with the treatment currently in operation at PHLL water treatment plant. Detailed treatment process design will require actual samples to be taken from all the bores of the bore field.

5.2 Bore Field

The bore field will comprise of four bores, yielding a total of 1,000 m^3/day, in the Whitford Waitemata (3) and Beachlands Waitemata (1) aquifers as described in the section above. The 620 test bore will yield 250 m^3/day out of the 1,000 m^3/day once fully developed and consented. Three additional bores will be required for the 750 m^3/day balance. Consent will be applied for the Live Zone and FUZ ahead of time to secure this available capacity in the aquifer.

The bores will be constructed as per standard engineering practices and standards to comply with the sanitary bore requirements of the most recent DWSNZ as specified in the Drinking Water Quality Assurance Rules 2021.

The bore heads will be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of surface water to shallow groundwater. Animals must be excluded from within 5 metres of the bore head. It is recommended that fencing 10m x 10m is built around each bore head to prevent accidental damage by construction or any other activities in the live zone or future urban zone.

The bore construction will comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism.

The bore heads will need to be inspected and maintained regularly as required by the drilling contractor.

The controlled activity standards under Chapter E7 of the AUP for the drilling of new bores not otherwise provided for is set out in the Table 7 below and we have commented against each standard:

Table 7: Summary of controlled activity standards for the drilling of new bores

STANDARDS E7.6.2.3. DRILLING AND USE OF HOLES AND BORES – NEW BORES NOT OTHERWISE SPECIFIED		COMMENT
1.	The bore must not be in a Wetland Management Areas Overlay	The AUP Geomaps viewer confirms the sites are not located within this overlay.
2.	The drilling of the hole or bore must not destroy, damage or modify any places scheduled in the Historic Heritage Overlay.	The AUP Geomaps viewer confirms there are no historic heritage overlays that apply to any of the site.
3.	The bore must be constructed to avoid contaminants entering the aquifer penetrated by the bore.	The bore will be drilled by a qualified contractor following the New Zealand Standards and best practices.
4.	The bore must be constructed to avoid a hydraulic connection between penetrated aquifers with different pressures, water quality or temperature.	The bore will be drilled by a qualified contractor following the New Zealand Standards and best practices.
5.	The bore must be operated and maintained to avoid the leakage of groundwater to waste	The bore will be operated and maintained following the DWSNZ 2021 and associated best practices.
6.	The drilling and construction of the bore must comply with section 1, 2, 3 and 4 of "New Zealand Standards - NZS 4411:2001 Environmental Standard for Drilling of Soil and Rock"	The bore will be drilled by a qualified contractor following the New Zealand Standards and best practices.
7.	The records required under section 4 of "New Zealand Standards - NZS 4411:2001 Environmental Standard for Drilling of Soil and Rock" must be kept and forwarded to the Council no later than one month after the bore is drilled.	BSLP will ensure the records are forwarded to Council as per NZS 4411:2001 requirements.

Based on the assessment in Table 7 above, the controlled activity standards for new bores are expected to be met for securing the controlled activity status associated with the new bores for water take and the necessary water supply to service the PPC area. On this basis, while a separate application will need to be submitted for the new bores, we do not expect any issues with securing this consent.

5.3 Rainwater Harvesting

As noted in Section 3.2, rainwater harvesting will be used to supplement the groundwater supply for non-potable use. Even though not necessary for the proposed demand, it can provide additional capacity and redundancy for the system. The proposed rainwater harvesting standard is supported as well as the water efficient fixture standard. These provisions will reduce the demand for water within the precinct and ensure potable water is not used inefficiently for non-potable purposes.

The proposed rainwater harvesting standard outlines the storage requirements for each type of residential dwelling/unit.

Water treatment would be required if the harvested rainwater is used for both potable and non-potable uses, however it is understood that it is not proposed for potable uses.

5.4 Groundwater Treatment

Initially the existing treatment plants at PHLL and at Formosa will treat the water required for the Live Zone. Longer term, the treatment plant could be expanded and a new southern bore field treatment plant will be built near the 620 site.

The southern bore field treatment plant design is based on a maximum groundwater abstraction peak flowrate of 1,500 m^3/day (annual average of 1,000m3/day). This abstraction rate is supported by Auckland Council's aquifer study. There is no requirement nor advantages in staging the treatment plant. However, the design can be sized to suit the exact peak and instantaneous demand/flows when the relevant consent application is prepared.

This treatment process is based on the expected raw water quality data described in section 4.1 and to meet the requirements of the DWSNZ.

Detailed water quality of groundwater from all the bores will be essential to progress the design further. The water treatment plant is proposed to be designed for the lowest water quality, in line with the current and future treatment process at PHLL, but parameters such as level of hardness and dissolved metals will inform the proposed process in the next stages of design to ensure it is suitable, cost effective and low maintenance for the proposed water quality and flow.

The proposed treatment is summarised in the following figure.

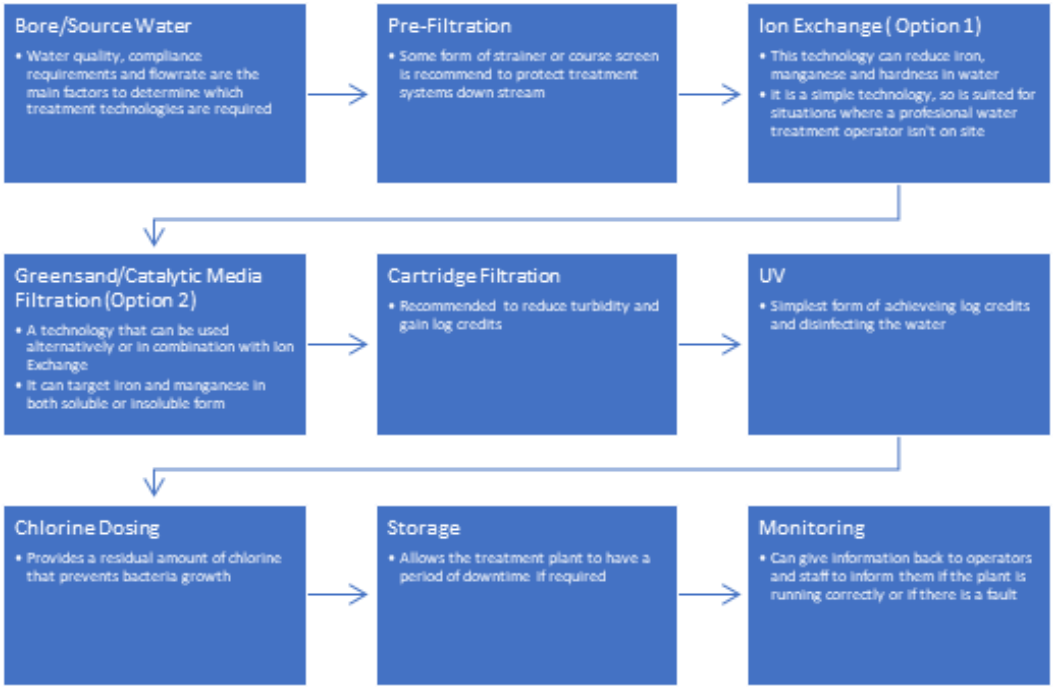


Figure 3: Proposed Water Treatment Process Flow Diagram

The four bores will be pumped to a raw water reservoir of approximately 500 m^3 (12 hours of storage for average demand), which forms part of the water treatment plant in the southern part of the site by the "620 bore".

The water treatment process is based on Ion Exchange which works best when the iron and manganese are in a soluble state. The proposed alternative treatment process would be greensand or catalytic media filtration (DMI65) if the iron and manganese are insoluble and the hardness is lower than expected, which can be assessed with additional water quality data.

If the raw water quality of one of the bores is significantly different to the others, an additional localised containerised and movable water treatment plant can be considered to enable a smaller more cost-effective treatment for the combined bores. This will be looked at after the bores are developed.

The proposed treatment process parameters are summarised in the table below.

Table 8: Water Treatment Process Design Information

TREATMENT PROCESS	KEY PARAMETER	NOTE
Raw Water Abstraction	Grundfos pump	Pump will be sized with knowledge of bore depth and distance to pump.
Prefiltration	Sati System – will provide screening for large sediment or sand to protect the downstream treatment processes.	Screen will be sized based on size of sand of sediment present in the raw water.
Ion Exchange	Dow ion exchange rhythm provider Waterco vessels	Flowrate, hardness level, iron and manganese data are essential for further design.

TREATMENT PROCESS	KEY PARAMETER	NOTE
		Pilot trial on site recommended to choose best system parameters. Alternative option for greensand process available depending on water quality.
Cartridge	3 cartridges Maximum flow 79.5m3/hr Absolute rating recommended down to 5 and 1 microns	
UV	Validated dose 40mJ/cm2 UVT Range 70-98% 3 lamps Automatic wiping system	Refer to online datasheet UV Trojan D03 for control panel details, sensor instrumentation, photos, etc
Chlorine Dosing	Grundfos DDA or DDE model Evoqua MFC-Depolox 5 Multi-function controller	Small dosing pump – will be sized with dose range requirements / network size.

As detailed in the previous sections, the following land allowances shall be made to enable the water supply infrastructure to be built and fenced.

- 10 m x 10 m area for each bore.
- 20 m x 25 m for the water treatment plant.
- 25 m x 40 m for the service reservoirs (Live Zone).

The proposed water supply footprint and location is detailed in the following figure.

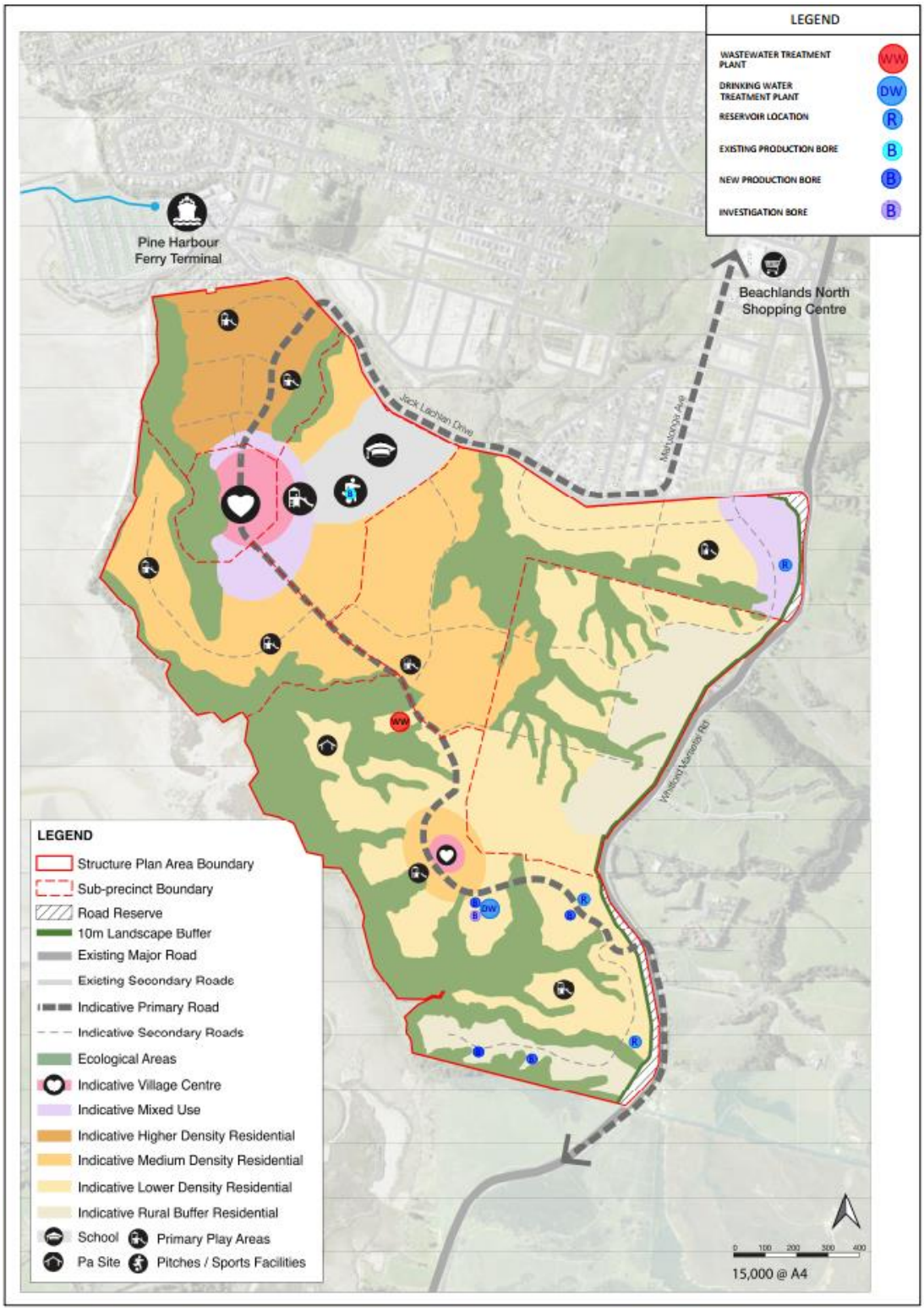


Figure 4: Water and Wastewater Infrastructure Concept Plan

6 TREATED WATER STORAGE AND DISTRIBUTION

6.1 Groundwater Storage

A preliminary assessment of three sites for the location of the service reservoirs, (based on topography only) are shown in Figure 6: Water and Wastewater Infrastructure Concept Plan

For the Live Zone, the service reservoirs shall be placed in the north-east corner of the site. This will service the Live Zone without developing additional access roading infrastructure too early in the development stages. Even though this is not the highest elevation of the development, the site is still elevated (approximately RL55 m), which will enable gravity flow to the community. Pressure boosting will be required to provide adequate pressure for water conserving plumbing fittings and appliances in dwellings above RL15m and for fire-fighting demands. This is subject to detailed water supply network modelling during the preliminary and detailed design phases.

The reservoir volume is proposed to be approximately 4,500 m3, which corresponds to 72 hours of effective storage for the maximum total average daily demand of the Live Zone (1,424m^3/day). This provides sufficient storage plus fire-fighting supply. This should be supplied from two reservoirs to enable sufficient turnover and ease of servicing and maintenance.

The reservoirs are proposed to be custom steel tanks and would each be approximately 8 metre high by 18 metre diameter.

When the PPC area is fully developed, reservoir storage will be provided in one of the proposed reservoir locations 2 or 3 in the south area of the site, as shown in the Concept Plan. This will service the remaining demand of the Future Urban Zone.

The Future Urban Zone reservoir volume is proposed to be approximately 2,000 m^3, which corresponds to 72 hours of effective storage for the total remaining daily demand of the Future Urban Zone (563 m^3/day).

6.2 Distribution

Treated water will be distributed from the service reservoirs to the community through a conventional treated water network. The network will be designed as the housing plans get developed to:

- Establish suitable pressure zones.
- Provide appropriate firefighting flows in compliance with the New Zealand Fire Service Fighting Water Supplies Code of Practice SNZ PAS 4509:2008.
- Prevent risk of backflow as per the Health Act 1956.
- Provide appropriate quality and quantity of water to the community in compliance with the Drinking Water Standards for New Zealand 2005, Revised 2018.

7 LAND REQUIREMENTS

As detailed in the previous sections, the following land allowances shall be made to enable the water supply infrastructure to be built and fenced.

- 10 m x 10 m area for each bore.
- 20 m x 25 m for the water treatment plant.

25 m x 40 m for the service reservoirs (one location in the Live Zone and one location only on the 620 site (2 options shown)).

8 CONCLUSION

GWE has undertaken a high-level concept design of key water infrastructure solutions to service the proposed Beachlands PPC area.

Based on the identified key factors, raw water quality data available and site-specific conditions, the PPC can be viably serviced for water throughout the different stages of development (Live Zone and Future Urban Zone) through the ground water take solutions identified in this report. There is no apparent reason that the land is not suitable for urbanisation. The development will progress at an estimated rate of 250 Household Unit Equivalent (HUE) per year starting off using the existing consented sources of supply at Formosa golf club and Pine Harbour Living Limited (PHLL). There will be a large surplus of water for the first 8 years of growing population, allowing the development to go as fast as demand requires.

GWE has determined the following:

Live Zoned Land – Demand = between 1,245 m^3/day (150 l/day/person) to 1,424 m^3/day (175 l/person/day)

This will be met through the following ground water supply sources:

- Water supply agreement with Pine Harbour Living Limited (PHLL) = 765 m^3/day
- The existing Formosa water take permit = 300 m^3/day
- The proposed water take permit from the existing 620 Whitford Maraetai Road test bore = 250 m^3/day
- A proposed water take permit from an additional bore at 620 Whitford Maraetai Road = 250 m^3/day

This equates to 1,565m^3/day and meets the above demand requirements with a reasonable margin of comfort.

It is therefore considered that sufficient potable water can be supplied to the live zoned part of the site. In any case, the PPC includes a standard (I.7.4) that requires adequate water supply be provided at the time of subdivision or development. This will ensure development does not occur without sufficient potable water to meet the needs of future occupants. In addition, water usage is expected to be lower as the PPC includes a rule that requires rainwater harvesting from residential developments for non-potable water uses and the use of water efficient fixtures.

Further, water management forms part of the Beachlands South Sustainability Strategy for the PPC. Specifically, the reduction of water use/demand is included as a particular focus area of the Sustainability Strategy and development in the precinct requiring resource consent will be assessed against this strategy and the extent to which it achieves the outcomes. Adherence to this Sustainability Strategy and the proposed rule/standard is expected to lower per capita water usage to an average of 150 litres per person per day, or less (1,245m^3/day). In any case, this assessment has also modelled a higher average daily per capita water usage figure of 175 litres per day per person to allow for daily water usage variations.

Future Urban Zoned Land – Demand = between 482 m^3/day (150 l/person/day) to 563 m^3/day (175 l/person/day)

This will be met through the following ground water supply sources, in addition to the sources outlined above:

- Proposed water take permits from additional bores at 620 Whitford Maraetai Road = 500 m^3/day

This meets the required demand for the Future Urban Zone land, when combined with the Live Zoned land water supply (refer table below). In addition, the same water supply standard (outlined above) and rainwater harvesting/water efficient fixture rule will apply to this part of the site and will therefore ensure sufficient potable and non-potable water is available to meet the needs of future occupants. It is considered the implementation of the Sustainability Strategy recommendations combined with the proposed rules will lower the Future Urban Zoned Land water supply requirements to 482 m^3/day or less.

Associated Matters

- Water sourced from these bores will require treatment. The most suitable groundwater treatment option, similar to the treatment process at the PHLL water treatment plant, is likely Ion Exchange (IEX) followed by cartridge filtration, UV and Chlorine dosing. IEX has the potential to reduce iron, manganese and hardness in a much lower safety risk compared with other iron removal systems. Chlorine dosing provides the additional disinfection step to make sure there is no bacteria growth in the storage tanks and enable to meet the requirements of the Drinking Water Standards for New Zealand 2021 (DWSNZ). No technology should be excluded from design options until further water quality data of all the water supply bores are available.
- The bores and water treatment plant will need to be consented and built in the southern part of the site to service the future urban zoned land. This is where the bore field will provide the additional supply and therefore it is good practice for the water treatment plant to be located in the vicinity. Under current Auckland-wide provisions of the AUP, new bores for purposes not otherwise specified (i.e. for water take) outside the management area overlays specified is provided for as a controlled activity, or restricted discretionary activity where the relevant controlled activity standards are not met.

- Reservoir storage of 4,500 m^3 split across two tanks should be installed at the north-east corner of the site to service the Live Zone and benefit from gravity flow as well as provide emergency and firefighting supply.
- The proposed infrastructure options and solutions will be able to service the projected number of dwellings and area within the PPC area for both the Live Zone and Future Urban Zone.

The following table summarises the infrastructure required to service the live zoned area versus the future urban zoned land.

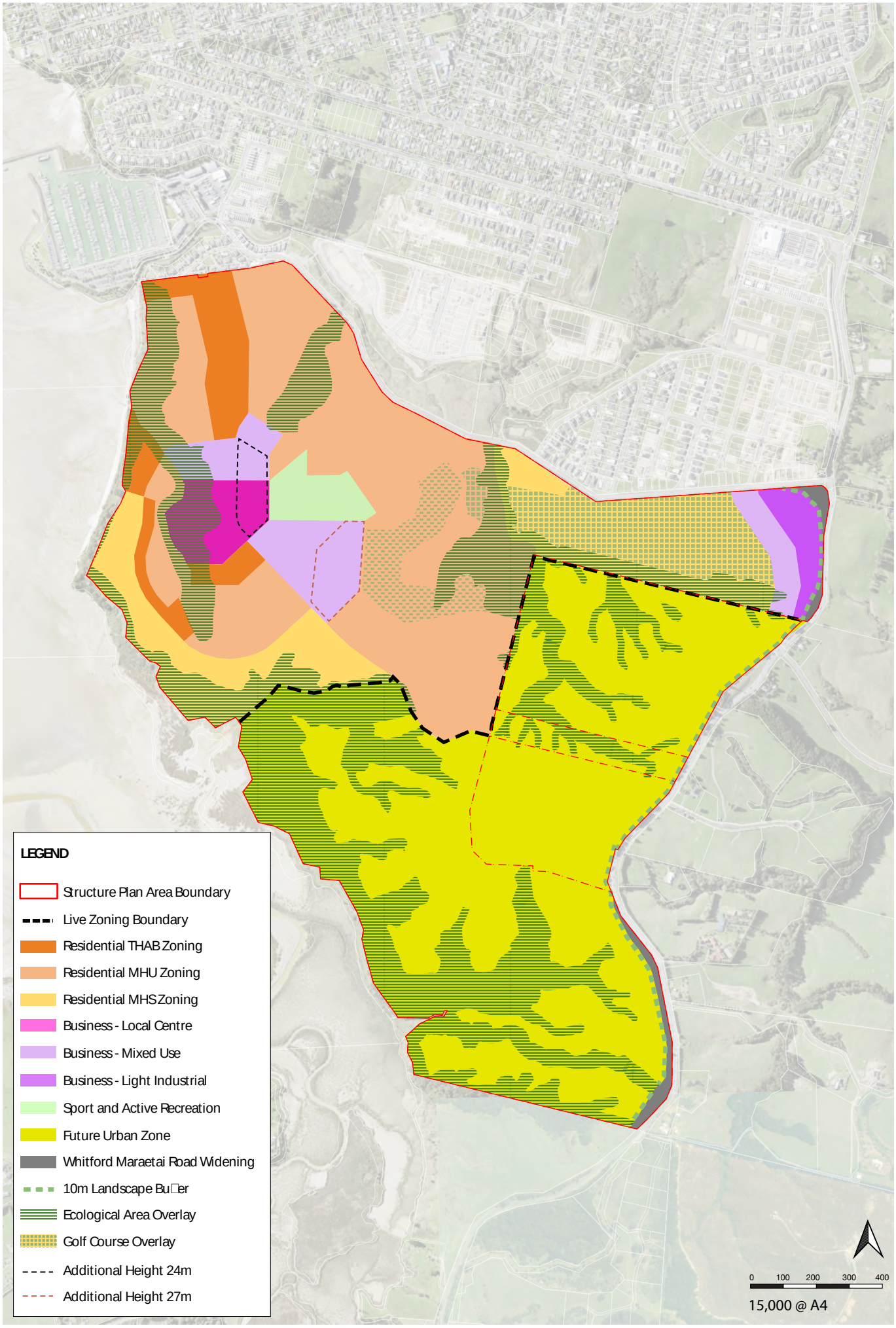
	LIVE ZONE	FUTURE URBAN ZONE	TOTAL LZ + FUZ
Water Requirements			
150 litres/person/day	**1,245 m^3/day**	**482 m^3/day**	**1,727 m^3/day**
175 litres/person/day	**1,424 m^3/day**	**563 m^3/day**	**1,987 m^3/day**
Sources			
PHLL	765 m^3/day		765 m^3/day
Formosa Bore*	300 m^3/day		300 m^3/day
"620 bore''	250 m^3/day		250 m^3/day
Southern bores	250 m^3/day	500 m3/day	750 m^3/day
TOTAL	**1,565 m^3/day**	**500 m^3/day**	**2,065 m^3/day**
Treatment	PHLL & Formosa upgraded to treat additional capacity		At the new WTP near the Southern bore field or alternatively near or at PHLL
Service Reservoir	4,500 m^3 72 hours storage Split between 2 reservoirs for adequate turnover	2,000 m^3 72 hours storage Split between 2 reservoirs for adequate turnover	6,500 m^3 72 hours storage Split between 4 reservoirs for adequate turnover

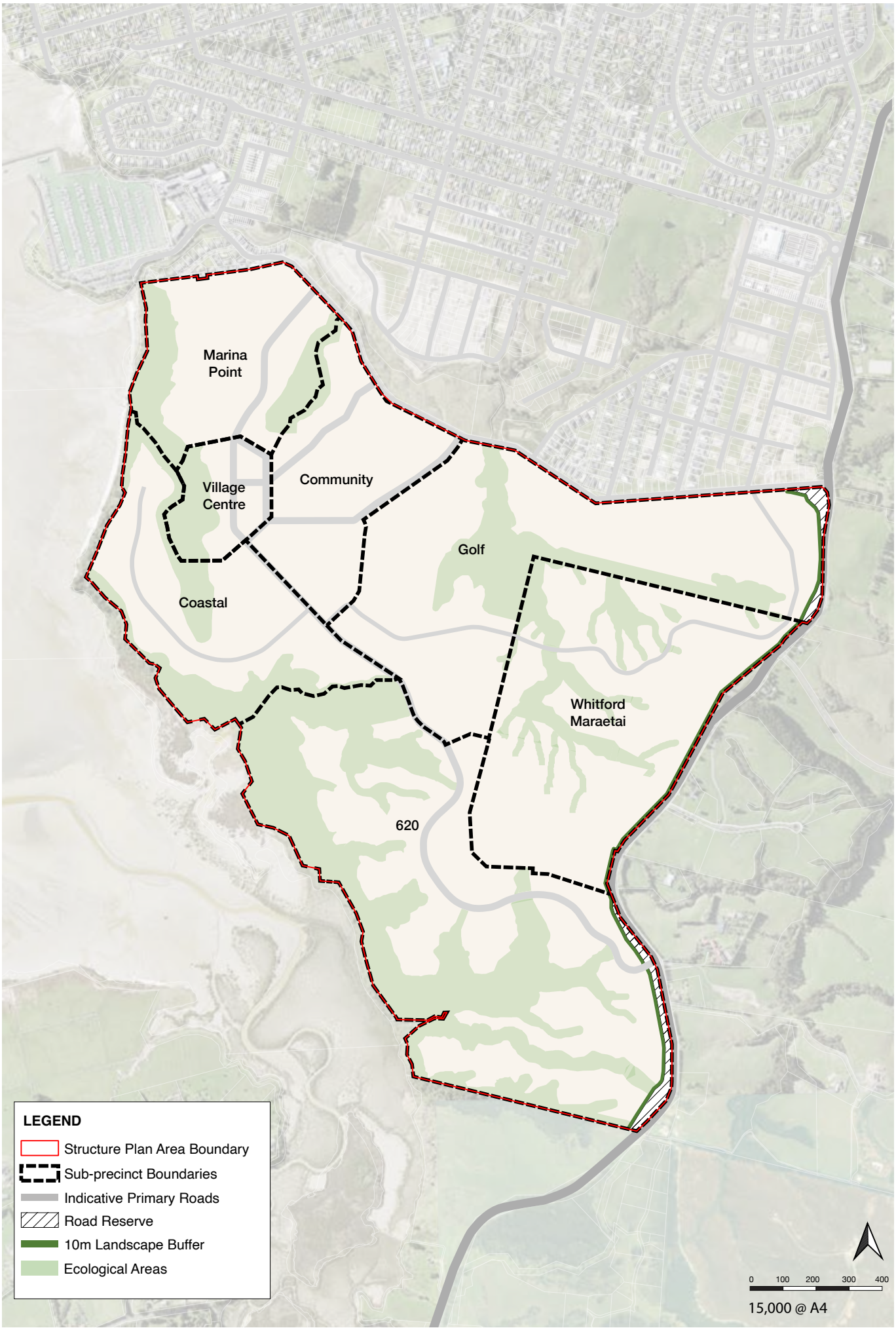
**the Formosa bore will go from 0 to 300 m^3/day over the course of the LZ as the golf course gets decommissioned.*

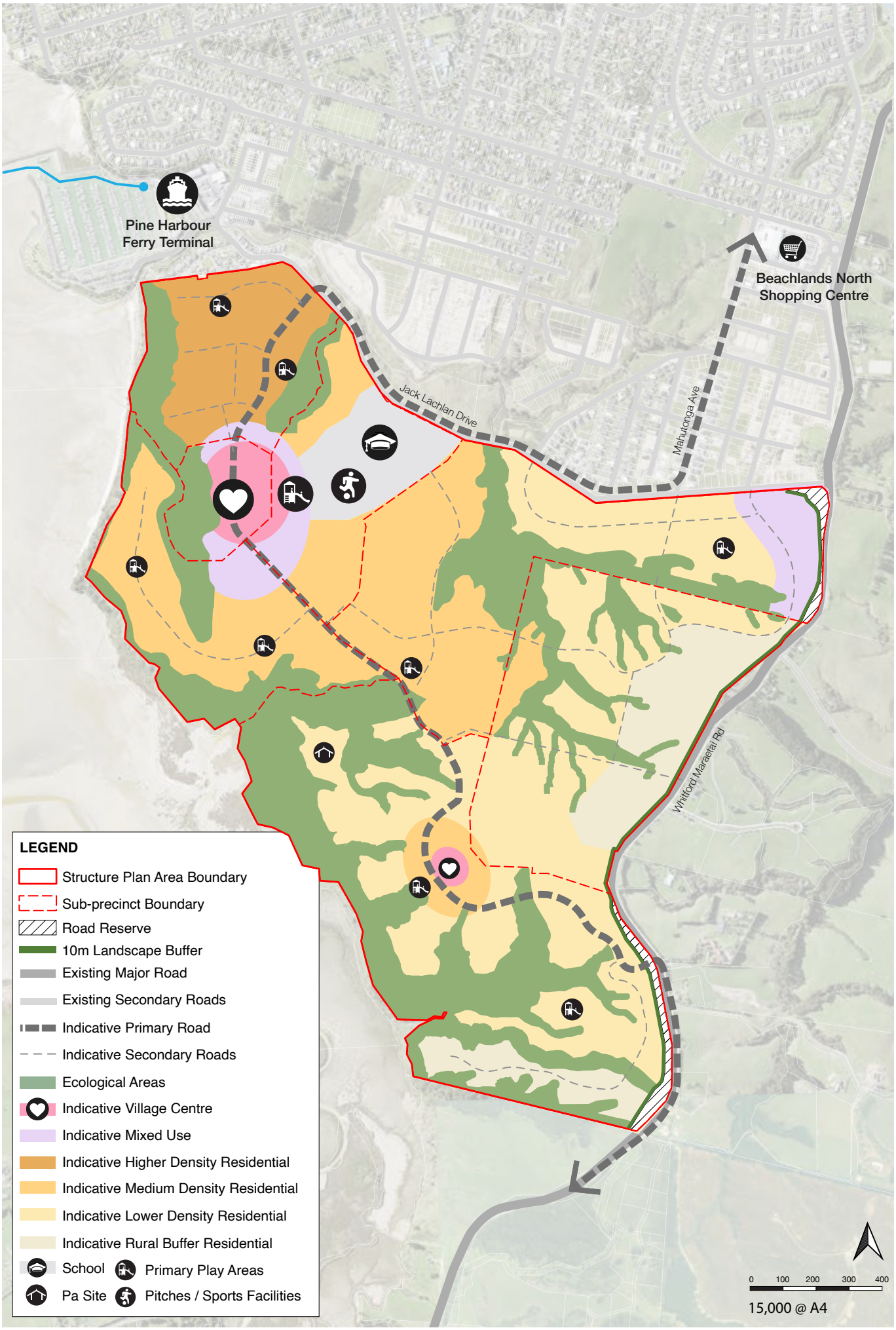
9 LIMITATIONS

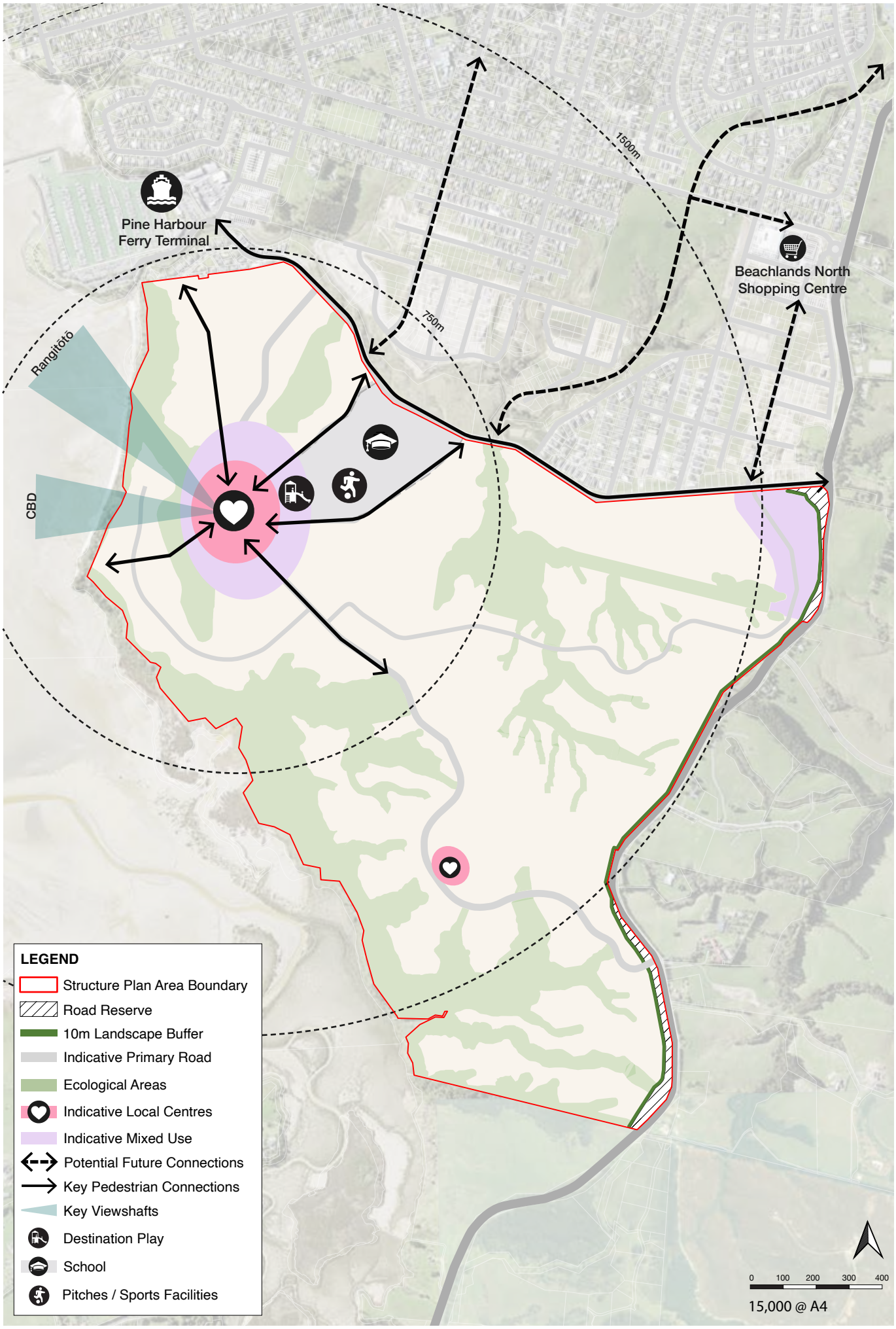
This report has been prepared for the sole benefit of **Beachlands South Limited Partnership** as our client, and their appointed representatives, according to their instructions, for the specific objectives described herein. It is not to be relied upon or used out of context by any other party for any other objective without reference to GWE Consulting Ltd. The reliance by other parties on the information or opinions contained in the report shall, without prior review and agreement in writing, be at such parties' sole risk.

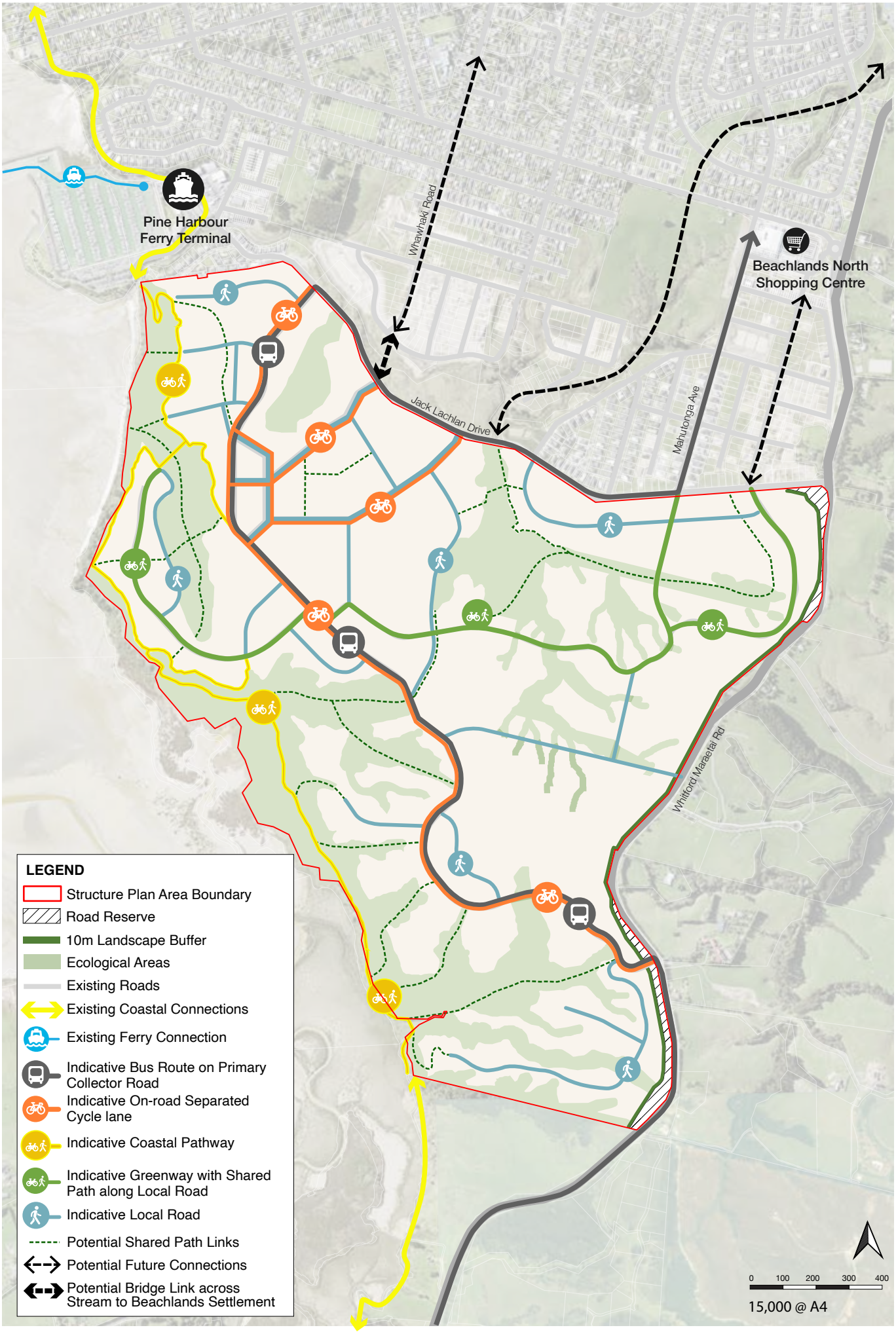
APPENDIX A
STRUCTURE & PRECINCT PLANS

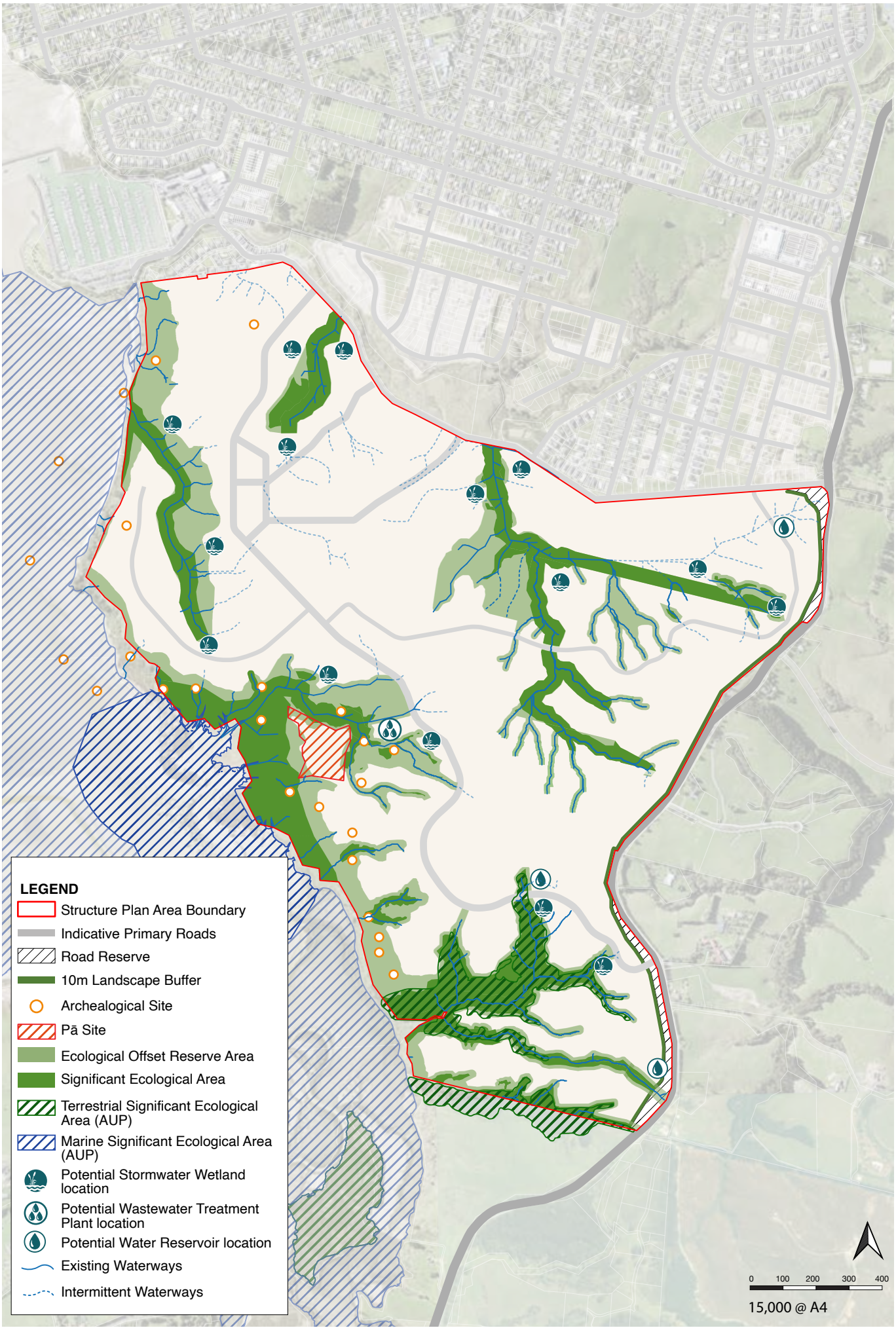

LEGEND
Structure Plan Area Boundary
Live Zoning Boundary
Residential THAB Zoning
Residential MHU Zoning
Residential MHS Zoning
Business - Local Centre
Business - Mixed Use
Business - Light Industrial
Sport and Active Recreation
Future Urban Zone
Whitford Maraetai Road Widening
10m Landscape Bu er
Ecological Area Overlay
Golf Course Overlay
Additional Height 24m
Additional Height 27m
0 100 200 300 400
15,000 @ A4


Marina Point
Village Centre
Community
Golf
Coastal
Whitford Maraetai
620
LEGEND
Structure Plan Area Boundary
Sub-precinct Boundaries
Indicative Primary Roads
Road Reserve
10m Landscape Buffer
Ecological Areas
0 100 200 300 400
15,000 @ A4


Pine Harbour
Ferry Terminal
Beachlands North
Shopping Centre
Jack Lachlan Drive
Mahutonga Ave
Whitford Maraetai Rd
LEGEND
Structure Plan Area Boundary
Sub-precinct Boundary
Road Reserve
10m Landscape Buffer
Existing Major Road
Existing Secondary Roads
Indicative Primary Road
Indicative Secondary Roads
Ecological Areas
Indicative Village Centre
Indicative Mixed Use
Indicative Higher Density Residential
Indicative Medium Density Residential
Indicative Lower Density Residential
Indicative Rural Buffer Residential
School
Primary Play Areas
Pa Site
Pitches / Sports Facilities
0 100 200 300 400
15,000 @ A4


Pine Harbour
Ferry Terminal
1500m
750m
Beachlands North
Shopping Centre
Rangitōtō
CBD
LEGEND
Structure Plan Area Boundary
Road Reserve
10m Landscape Buffer
Indicative Primary Road
Ecological Areas
Indicative Local Centres
Indicative Mixed Use
Potential Future Connections
Key Pedestrian Connections
Key Viewshafts
Destination Play
School
Pitches / Sports Facilities
0 100 200 300 400
15,000 @ A4


Pine Harbour
Ferry Terminal
Whawhaki Road
Jack Lachlan Drive
Mahutonga Ave
Beachlands North
Shopping Centre
Whitford Maraetai Rd
LEGEND
Structure Plan Area Boundary
Road Reserve
10m Landscape Buffer
Ecological Areas
Existing Roads
Existing Coastal Connections
Existing Ferry Connection
Indicative Bus Route on Primary Collector Road
Indicative On-road Separated Cycle lane
Indicative Coastal Pathway
Indicative Greenway with Shared Path along Local Road
Indicative Local Road
Potential Shared Path Links
Potential Future Connections
Potential Bridge Link across Stream to Beachlands Settlement
0 100 200 300 400
15,000 @ A4


LEGEND
Structure Plan Area Boundary
Indicative Primary Roads
Road Reserve
10m Landscape Buffer
Archealogical Site
Pā Site
Ecological Offset Reserve Area
Significant Ecological Area
Terrestrial Significant Ecological Area (AUP)
Marine Significant Ecological Area (AUP)
Potential Stormwater Wetland location
Potential Wastewater Treatment Plant location
Potential Water Reservoir location
Existing Waterways
Intermittent Waterways
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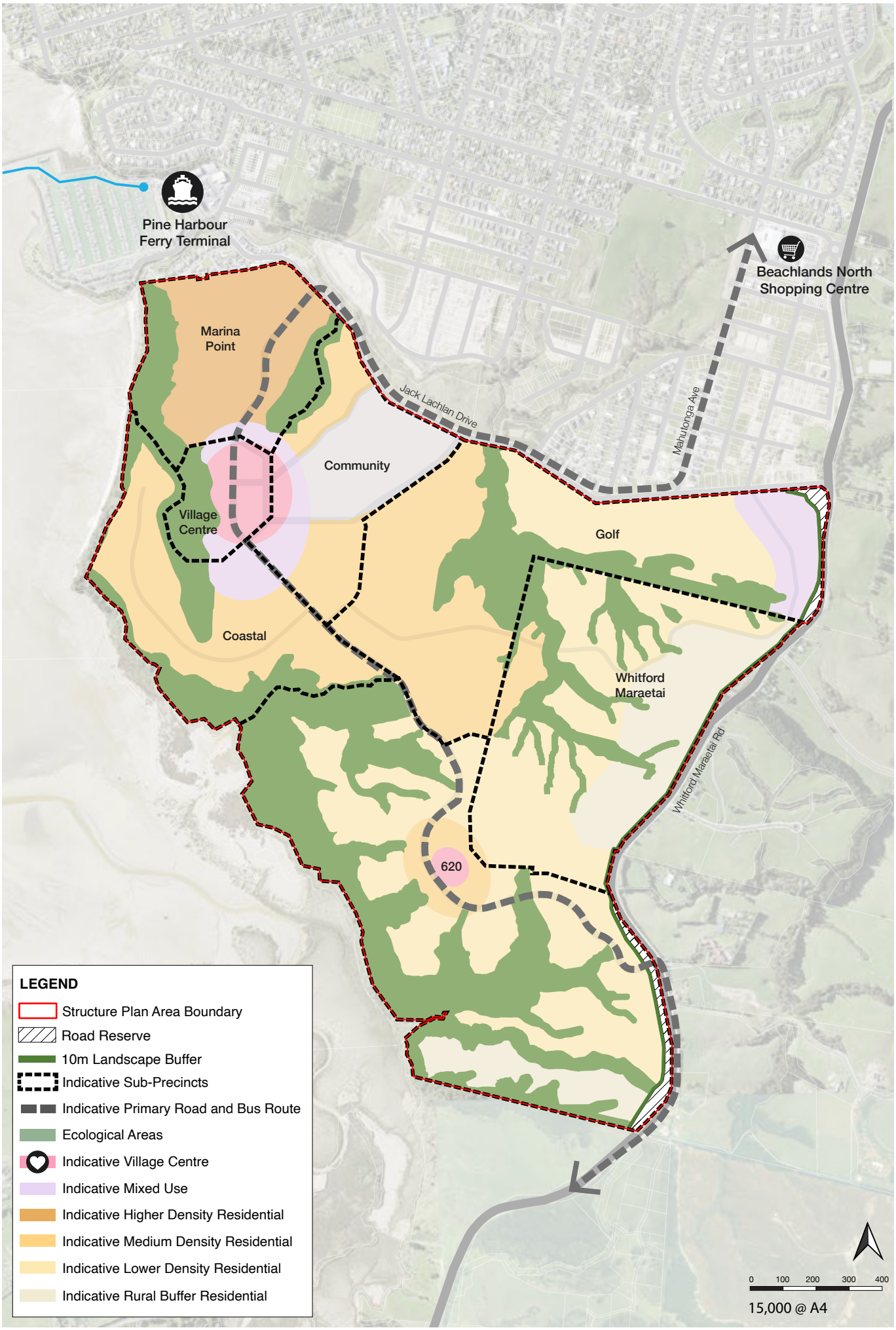
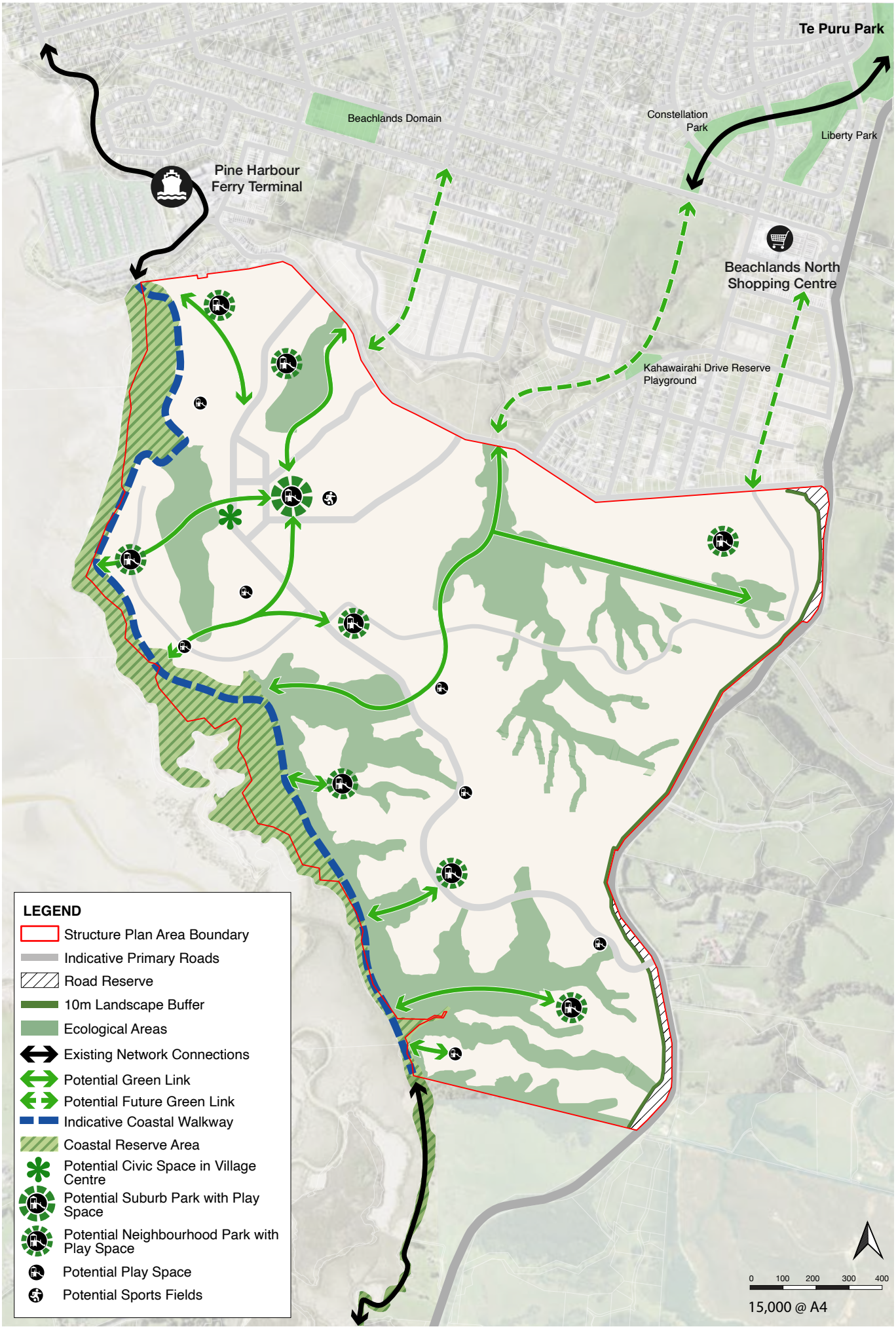
15,000 @ A4


Pine Harbour
Ferry Terminal
Beachlands North
Shopping Centre
Marina
Point
Jack Lachlan Drive
Mahutonga Ave
Community
Village
Centre
Golf
Coastal
Whitford
Maraetai
Whitford Maraetai Rd
620
LEGEND
Structure Plan Area Boundary
Road Reserve
10m Landscape Buffer
Indicative Sub-Precincts
Indicative Primary Road and Bus Route
Ecological Areas
Indicative Village Centre
Indicative Mixed Use
Indicative Higher Density Residential
Indicative Medium Density Residential
Indicative Lower Density Residential
Indicative Rural Buffer Residential
0
100
200
300
400
15,000 @ A4


Te Puru Park
Beachlands Domain
Constellation Park
Liberty Park
Pine Harbour Ferry Terminal
Beachlands North Shopping Centre
Kahawairahi Drive Reserve Playground
LEGEND
Structure Plan Area Boundary
Indicative Primary Roads
Road Reserve
10m Landscape Buffer
Ecological Areas
Existing Network Connections
Potential Green Link
Potential Future Green Link
Indicative Coastal Walkway
Coastal Reserve Area
Potential Civic Space in Village Centre
Potential Suburb Park with Play Space
Potential Neighbourhood Park with Play Space
Potential Play Space
Potential Sports Fields
0 100 200 300 400
15,000 @ A4

APPENDIX B

TONKIN & TAYLOR WATER SUPPLY SOURCES REPORT

Tonkin+Taylor

Job No: 1014358.2000
27 August 2021

Beachlands South Limited Partnership
c/- Russell Property Group
PO Box 17254
Greenlane
Auckland 1540

Attention: John Dobrowolski

Dear John

Beachlands production well locations - conceptual design

DRAFT

1 Introduction

Tonkin & Taylor Ltd (T+T) is pleased to provide proposed (and existing) production well locations to assist GWE Consulting Engineers with design for a potable supply using groundwater taken from the production wells. This work has been completed as an extension to our proposal dated 25 June 2020.

2 Background

Beachlands South Limited Partnership (the partnership) is seeking to re-zone an area of currently rural land in Beachlands. This re-zoning is across two land parcels, being the Formosa Golf Course at 110 Jack Lachlan Drive and the neighbouring property at 620 Whitford- Maraetai Road. We understand that there are two existing groundwater supply bores on the area to be re-zoned. The partnership wishes to identify the opportunities that may be available in relation to infrastructure and water supply for these properties.

3 Scope

Following a meeting with GWE (Monday 23 August via Teams) T+T has prepared this letter and a figure showing proposed production well locations to assist with conceptual design of the treatment system for providing a potable water supply. GWE have advised that the total groundwater supply required is up to a maximum rate of 1028 m^3/day. The locations have been selected based on site constraints (e.g. our knowledge of groundwater availability) and requirements for the water treatment plant(s) (which we understand may be centrally located adjacent to the new production wells)

Historical groundwater quality data for the Formosa and 620 Block production wells has been provided to GWE on 20 August.

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4 Proposed production wells

In addition to the existing production wells at the Formosa and 620 Block sites three new production wells are proposed to provide the required yield subject to requirements including testing and consenting. The number of wells required has been developed assuming that 250 m^3/day is available from each well. The well locations are tabulated below and shown on Figure 1, which is attached as Appendix A.

Well Name	Description	Easting (NZTM)	Northing (NZTM)
Well 1	New Production Well 1	1778227	5912956
Well 2	New Production Well 2	1778390	5912903
Well 3	New Production Well 3	1778773	5913157
Formosa	Existing Production Well	1777853	5914738
620 Block	Existing Production Well	1778225	5913388

5 Applicability

This report has been prepared for the exclusive use of our client Beachlands South Limited Partnership, 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.

We have not made any attempt to allow for the impact of COVID-19 in this estimate and recommend you seek specialist economic advice on what budgetary allowances you should make for escalation and changed construction costs post COVID-19.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by: Authorised for Tonkin & Taylor Ltd by:

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Tony Reynolds
Senior Hydrogeologist

Peter Millar
Project Director

cc: Colin Cranfield, GWE Consulting Engineers

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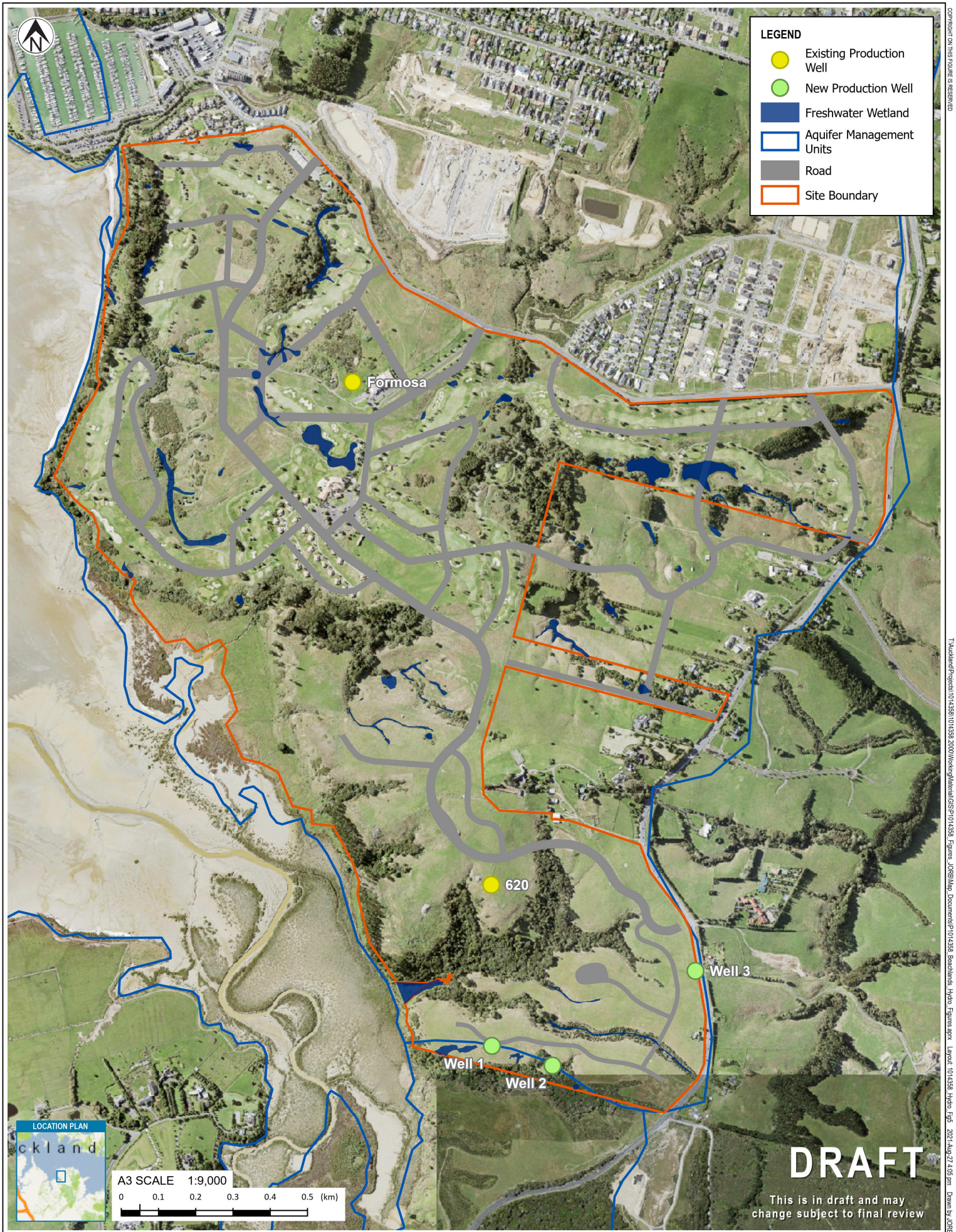
p:\1014358\1014358.2000\issueddocuments\20210827 production well locations.docx

Appendix A: Production well locations



T:\Auckland\Projects\1014358\1014358.2000\Working\Material\GIS\P1014358_Figures_JORB\Map_Documents\P1014358_Beachlands_Hydro_Figures.aprx Layout: 1014358_Hydro_Fig5 2021-Aug-27 4:05 pm Drawn by JORB

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Exceptional thinking together

NOTES: Basemap Generic/newzealand: Eagle Technology, Land Information New Zealand, Kiwi Rail, OpenStreetMap Community. NZ Imagery: Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence

REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE
0	First version	JORB	xxxx	20/08/21		

PROJECT No. 1014358.2000

DESIGNED	JORB	AUG.21
DRAWN	JORB	AUG.21
CHECKED	XXXX	AUG.21

CLIENT BEACHLANDS SOUTH LIMITED PARTNERSHIP
PROJECT BEACHLANDS PLAN CHANGE
TITLE PROPOSED PRODUCTION WELL LOCATIONS

SCALE (A3) 1:9,000 FIG No. FIGURE 1. REV 0

APPENDIX C
SUPPLY DEMAND BALANCE MODEL

Groundwater demand on a 250 dwellings per year basis

					Existing Consent 115m3/day														
Year	HUEs	Persons	Consumption Rate (m3/p/d)	Water Req (m3)	School	Consumption Rate (m3/p/d)	Water Req (m3)	Golf	Consumption Rate (m3/p/d)	Water Req (m3)	Hotel	Consumption Rate (m3/p/d)	Water Req (m3)	Dry Retails	Consumption Rate (m3/p/d)	Water Req (m3)	Wet Retails	Consumption Rate (m3/p/d)	Water Req (m3)
1	250	2.6	0.175	114															
2	500	2.6	0.175	228	150	0.05	7.5				30	0.05	1.5						
3	750	2.6	0.175	341	460	0.02	9.2	100	0.05	5	300	0.2	60	1026	0.065	58.1	121	0.015	27
4	1000	2.6	0.175	455	575	0.02	11.5			5			61.5			58.1			27
5	1250	2.6	0.175	569	805	0.02	16.1			5			61.5			58.1			27
6	1500	2.6	0.175	683	1000	0.02	12			5			61.5			58.1			27
7	1750	2.6	0.175	796			19.5			5			61.5			58.1			27
8	2000	2.6	0.175	910			19.5			5			61.5			58.1			27
9	2250	2.6	0.175	1024			19.5			5			61.5			58.1			27
10	2500	2.6	0.175	1138			19.5			5			61.5			58.1			27
11	2750	2.6	0.175	1251			19.5			5			61.5			58.1			27
12	3000	2.6	0.175	1365			19.5			5			61.5			58.1			27
13	3250	2.6	0.175	1479			19.5			5			61.5			58.1			27
14	3500	2.6	0.175	1593			19.5			5			61.5			58.1			27
15	3750	2.6	0.175	1706			19.5			5			61.5			58.1			27
16	4000	2.6	0.175	1820			19.5			5			61.5			58.1			27
										0									
Totals				**1820**			**19.5**			**5**			**61.5**			**58.1**			**27**

Stage	Year	New daily rate m3/d	Current and allocated m3/d	Spare m3/d (PHLL)	Beachlands South Demand m3/d	Southern Bores m3/d	Formosa Bore m3/d	Formosa and Southern Bores m3/d	Total Grounwater Supply m3/d	Rainwater harvesting m3/d	Water Supply (Groundwater) m3/d	Total Max Daily Demand m3/d
1a	2024	1300	535	765	114	0	70	70	835		835	215
1a	2025	1300	535	765	237	0	70	70	835		835	467
1b	2026	1300	535	765	501	0	200	200	965		965	1169
1b	2027	1300	535	765	618	0	200	200	965		965	1395
1c	2028	1300	535	765	737	0	300	300	1065		1065	1635
2a	2029	1300	535	765	846	250	300	550	1315		1315	1888
2a	2030	1300	535	765	968	250	300	550	1315		1315	2102
2a	2031	1300	535	765	1081	250	300	550	1315		1315	2317
2a	2032	1300	535	765	1195	250	300	550	1315		1315	2531
2b	2033	1300	535	765	1309	500	300	800	1565		1565	2746
2b	2034	1300	535	765	1423	500	300	800	1565		1565	2960
2c	2035	1300	535	765	1536	750	300	1050	1815		1815	3175
2c	2036	1300	535	765	1650	750	300	1050	1815		1815	3389
2c	2037	1300	535	765	1764	750	300	1050	1815		1815	3604
2d	2038	1300	535	765	1878	1000	300	1300	2065		2065	3818
3d	2039	1300	535	765	1991	1000	300	1300	2065		2065	4033

Table: Groundwater Sources and daily volumes

Stage	Groundwater Source	Daily Volume Available m3/day	Comment
-	PHLL Agreement	765	
-	Formosa Consent	300	120m3/day used for potable supply (Golf club peak demand 50m3/day) and 180m3/day for golf course irrigation (18 holes).
Stage 1a	Formosa Bore +	835	765m3/day PHLL agreement + 70m3/day from Formosa Bore only (based on current Formosa peak demand & 180m3/day to golf course irrigation)
Stage 1b	Formosa Bore +	965	765m3/day PHLL agreement + 200 m3/day from Formosa bore (base on golf club reduced to 9 holes therefore peak demand and irrigation reduced in half). 115 m3/day potable supply from Formosa is pumped to PHLL for treatm
Stage 1c	Formosa Bore +	1065	765m3/day PHLL agreement + 300 from Formosa Bore (based on Formosa Golf club fully decommissioned). 300m3/day potable supply from Formosa is pumped to PHLL for treatment.
Stage 2a	Stage 1 + 620 bore	1315	Stage 2 + 250m3/day from 620 bore
Stage 2b-d	Stage 2 + Southern	2065	based on additional 3 bores including the 620 bore yielding 250m3/day per bore

V9 GWE 25 March 2022

PROJECT TITLE: Beachlands South Water Supply

OBJECTIVE: Determine the number of houses the PPC area can support

PROJECT ASSUMPTION 13.2% Groundwater Treatment & network Losses / unaccounted for water

REFERENCES Source TP58 On-Site Wastewater Systems 2004 paper Fig 6.1
Water NZ Waterloss guidelines
BRANZ fact sheet
used 50 m2 per person for dry retail, 15 L per m2 of net floor area

input data
Demand
Groundwater

Table 1: Water demand and Development Capacity Check

HOUSING TYPOLOGY	NO. OF PEOPLE	AV ROOF AREA m^2	YIELD LZ Sc.1	YIELD FUZ Sc.2a	TOTAL AREA LZ Sc.1	TOTAL AREA FUZ Sc.2a	WATER CONSUMPION RATE (L/person/day)	Water Requirement LZ Sc.1 m3/day	Water Requirement FUZ Sc.2a
5/6-storey lifted apartments	2	936	1139	1139	21528	21528	150	342	342
3-storey walk-up apartments	2	528	432	452	6056	6336	150	130	136
2-storey terraced housing - narrow lots	2	49.5	223	223	11038.5	16979	150	67	67
2-storey terraced housing - larger lots	3	78	334	409	26052	77142	150	150	184
2-storey detached (or duplex) housing	3	96	328	565	31488	52800	150	148	254
Stand alone houses - Medium	4	120	191	386	22920	39480	150	115	232
Stand alone houses - Large	4	180	77	404	13860	89460	150	46	242
Stand alone houses - X-Large	4	300	0	38	0	25200	150	0	23
Live-work units	1	49.5	28	28	1386	1386	150	4	4
Retirement Villas	3	180	71	71	12780	12780	150	32	32
Retirements apartments	3	528	25	25	1584	1584	150	11	11
Light industrial (112sm)	196	112	70	70	7840	7840	150	29	29
Golf	100						50	5.0	5.0
Hotel (Guests)	300						200	60.0	60.0
Hotel (Staff)	30						50	1.5	1.5
School (student)	1000	3000			3000	3000	20	12.0	12.0
School (teacher)	150	3000			3000	3000	50	7.5	7.5
(micro brewery, restaurant, wine bar, multi-purpose pavilion) - wet	121	1810			1810	1810	15	27.2	27.2
Retail - dry	50	2515			2515	2515	65	3.3	3.3
Metromarket - dry	36	1800			1800	1800	65	2.3	2.3
Innovation Hub and Commercial - office and dry	340	5095			5095	5095	65	19.0	19.0
Service / light industry - office and dry	600	600			600	600	65	33.5	33.5
					174352	370335		**1,245**	**1727**
			2918	**3810**					
			HUE's	**HUE's**					

Table 2: Future Urban Zone Supply-Demand Summary

Water Consumption Rate (litres/person/day)	**175**	**150**	**130**
Total Demand (m3/day)	**1,987**	**1,727**	**1,520**
Groundwater available (m3/day)	**2,065**	**2,065**	**2,065**
Shortfall/Surplus (m3/day)	**78**	**338**	**545**

Table 3: Live Zone Supply-Demand Summary

Water Consumption Rate (litres/person/day)	**175**	**150**	**130**
Total Demand (m3/day)	**1,424**	**1,245**	**1,102**
Groundwater available (m3/day)	**1,565**	**1,565**	**1,565**
Shortfall/Surplus (m3/day)	**141**	**320**	**463**