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## **Wastewater Servicing Options – Southern Area Growth**

Prepared for Watercare Services Limited

August 2013

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## Executive Summary

This report covers initial preliminary high level scoping assessment of bulk wastewater infrastructure likely to be required to service development in the area around Drury and Pukekohe as proposed by the draft Auckland Unitary Plan (March 2013 version). While the Auckland Plan identified broad areas of growth and projected populations for the next 30 years, the draft Unitary Plan provided more detail by identifying a Rural Urban Boundary (RUB) within which this growth would be focussed. The basis of this study is the proposed growth within the southern RUB.

The study area lies generally between Papakura and Pokeno and it includes:

- Growth Areas identified in the draft Auckland Unitary Plan
- existing areas serviced for wastewater as part of the infrastructure network for Pukekohe and surrounding areas
- proposed commercial and industrial development south of Drury being progressed by way of a private plan change, known as Drury South Business Development
- the future development of Pokeno and Tuakau (located within Waikato District) already proposed to be serviced by extension of the Pukekohe wastewater treatment plant.

Information on projected urban growth in the study area was obtained from Auckland Council and by review of planning documents for the former Franklin District area. The assessed potential growth is shown in the following table. This data is grouped by the three sectors adopted for the structure of bulk wastewater infrastructure.

Sector	Growth Area	Growth in Household Numbers (no.)	Commercial/Industrial Area (ha)
Drury	Drury Opaheke 13	8,506	56.125
	Drury Opaheke 15	1,524	
	Karaka South 12	5,324	126.875
	Karaka South 17	6,110	3.25
	Drury South Business Area		223
	<i>Sector Total</i>		<i>21,464</i>
Paerata	Paerata	10,595	83.875
	Karaka Village	234	
	<i>Sector total</i>	<i>10,829</i>	<i>83.875</i>
Pukekohe	Pukekohe Existing		
	Pukekohe Infill	7,585	142
	Extension 4	2,000	1.625
	Extension 5	6,000	1.625
	Extension 6	1,000	1.625
	Belmont 35	800	
	Patumahoe	248	
	Pokeno	2,407	84
	Tuakau	684	27
	<i>Sector Total</i>		<i>20,724</i>
<b>STUDY AREA TOTAL</b>		<b>53,017</b>	<b>751</b>

Existing wastewater systems in the study area are structured around the following facilities:

- Wastewater treatment plant to the west of Tuakau discharging to the Waikato River, and serving a reticulated wastewater system for Pukekohe, Tuakau and Patumahoe - known as the Pukekohe WWTP
- Pump station at Hingaia, collecting wastewater from the Drury area and pumping to Mangere WWTP – this pump station is on the site of a decommissioned wastewater treatment plant.

The potential areas of growth are dispersed over the study area, and can be viewed in three main localities, or Sectors:

1. New urban Growth Areas around Drury
2. Pukekohe and new urban Growth Areas surrounding it
3. Paerata, located between Drury and Pukekohe.

Concepts for the trunk wastewater network and for treatment and disposal sites were therefore identified using a framework based on these three sectors. The following options for the bulk wastewater infrastructure to service the Southern RUB were identified:

- Option 1A – Single Sector Approach: using Pukekohe WWTP as the site for treating all waste, with trunk reticulation following State Highway 22, and temporarily diverting the existing Hingaia Pump Station to the new system to provide adequate initial pipe flows in the early years
- Option 1B – Single Sector Approach: using Pukekohe WWTP as the site for treating all waste, with trunk reticulation connecting the Drury South Business Development to Pukekohe urban area, and temporarily diverting the existing Hingaia Pump Station to the new system to provide adequate pipe flows in the early years
- Option 2A – Dual Sector Approach: using two treatment sites (Pukekohe and Hingaia), with Paerata discharging to Pukekohe
- Option 2B – Dual Sector Approach: using two treatment sites (Pukekohe and Hingaia), with Paerata discharging to Hingaia)
- Option 3 – Dual Sector Approach: using two treatment sites (Pukekohe and a land treatment and disposal site near Karaka)
- Option 4 – Tri Sector Approach: using three treatment sites (Pukekohe, Hingaia and a land treatment and disposal site near Karaka).

Indicative estimates of capital costs have been derived from the high-level concepts for the bulk wastewater infrastructure, excluding reticulation and local conveyance infrastructure. These estimates should be considered as order-of-magnitude estimates with a high level of uncertainty.

	Option 1A Single Sector Approach \$	Option 1B Single Sector Approach \$	Option 2A Dual Sector Approach \$	Option 2B Dual Sector Approach \$	Option 3 Land Application Approach – Dual Sector \$	Option 4 Land Application Approach – Tri Sector \$
<b>Treatment Costs</b>						
- Pukekohe WWTP	142,500,000	142,500,000	101,260,000	80,140,000	80,140,000	80,140,000
- Drury WWTP			86,380,000	106,650,000		86,380,000
- Land Application WWTP					106,650,000	51,390,000
<b>Disposal Costs</b>						
- Land					166,430,000	56,240,000
- Waikato Outfall	16,860,000	16,860,000	13,660,000	11,760,000	11,760,000	11,760,000
- Long Harbour Outfall			31,170,000	41,590,000		31,170,000
- Tidal Harbour Outfall			6,980,000	9,980,000		6,980,000
<b>Consenting</b>	1,500,000	1,500,000	3,500,000	3,500,000	3,750,000	5,000,000
<b>Pump Stations</b>	63,910,000	63,910,000	37,510,000	48,620,000	63,910,000	37,510,000
<b>Pipelines</b>	155,510,000	185,050,000	120,700,000	102,590,000	118,680,000	103,960,000
<b>TOTAL COST</b>	\$380 million	\$410 million	\$390 million <i>(long harbour outfall)</i>	\$390 million <i>(long harbour outfall)</i>	\$550 million	\$460 million <i>(long harbour outfall)</i>
			\$370 million <i>(tidal harbour outfall)</i>	\$360 million <i>(tidal harbour outfall)</i>		\$440 million <i>(tidal harbour outfall)</i>

The overall indicative capital costs for the bulk infrastructure are in the range of \$360 – 550million. If land disposal options are not considered then the overall indicative capital costs for the bulk infrastructure are in the range of \$360-410million.

A framework was developed for assessing options for staging development of the bulk wastewater system including bulk conveyance, treatment and disposal/discharge, based on financial net present value (NPV) of the following alternative staging sequences over 30 years:

- Servicing urban development sequenced from Pukekohe WWTP towards Drury, or
- Servicing progressive urban development in all areas, or
- Servicing urban development sequenced from Drury towards Pukekohe.

A brief comparative assessment was made of the potential costs to convey wastewater to more distant sites for treatment and/or disposal. An additional \$515million capital cost is required to convey the wastewater to Mangere WWTP for treatment and disposal. Options for disposal to a coastal outfall to the Tasman Sea were estimated to cost an additional \$600-850million. Detailed assessment was outside the brief.

Operating and maintenance cost estimates have not been developed for this report. For the purposes of comparing options at this time, relative operating and maintenance costs can be taken to be proportional to capital costs in most instances.

The key findings of this assessment are:

- The indicative capital cost for establishing bulk wastewater infrastructure to service possible growth in the Southern RUB is in the range of \$360-550million, depending on the option adopted. The configuration of the bulk wastewater network does not significantly affect the likely capital cost of the infrastructure.
- The higher range costs are for options using land disposal, as a result of the additional cost for land purchase. If land disposal is not considered then the indicative capital cost for establishing bulk wastewater infrastructure to service possible growth in the Southern RUB is in the range of \$360-410million. It should be noted that there is also a significant risk of the costs of land purchase being higher than estimated as a result of changed market conditions.
- The indicative capital costs for all options for disposal of wastewater to water are similar, with approximately 10% variation in capital cost across the range of options.
- If a tidal discharge to Manukau Harbour is able to be consented, the option with the lowest indicative capital cost involves treatment of wastewater at two sites (the Pukekohe WWTP with discharge to the Waikato River, and a new WWTP near Drury with discharge to Manukau Harbour). If a tidal discharge to Manukau Harbour is not able to be consented, the option with the lowest indicative capital cost is for treatment of all wastewater at the site of the Pukekohe WWTP, and discharge to the Waikato River. There is a higher risk associated with gaining consents for a new WWTP and harbour discharge.
- The lowest NPV for staged development is for an option involving treatment of wastewater at two sites – the Pukekohe WWTP with discharge to the Waikato River, and a new WWTP near Drury with discharge to Manukau Harbour. However, this is only marginally lower in NPV cost than the option to treat all wastewater at Pukekohe WWTP.
- The lowest NPV for each option is achieved if the development of wastewater infrastructure is sequenced from the location of the WWTP towards more distant serviced areas
- The method of staging does not have a significant effect on NPV. Variation in NPV is only 10% across the range of staging options considered, and all staging options give a similar benefit of approximately 15-20% discount from the capital costs of constructing all infrastructure at the beginning of the development.

# Watercare Services Limited

## Wastewater Servicing Options - Southern Area Growth

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## GLOSSARY

ADWF	Average dry weather flow of wastewater
BNR	Biological nutrient removal
GIS	Geographic information system
ha	hectares (a measure of area) (1ha = 10,000m <sup>2</sup> )
l	Litre (a measure of volume)
LIDAR	Light Detection and Ranging (a mapping technology)
m <sup>2</sup>	Square metres (a measure of area)
m <sup>3</sup>	Cubic metres (a measure of volume) (1m <sup>3</sup> = 1000L)
MWH	MWH New Zealand Ltd (Consultants who prepared the report)
NPV	Net Present Value
PDWF	Peak dry weather flow of wastewater
PWWF	Peak wet weather flow of wastewater
RUB	Rural urban boundary
SBR	Sequencing batch reactor
TBD	To be determined
Watercare	Watercare Services Limited (Commissioners of this study)
WWTP	Wastewater treatment plant

# 1 Purpose, Scope and Approach

## 1.1 Purpose of Project

In 2012 the Auckland Council published the Auckland Plan, a visioning document for Auckland's growth and development over 30 years. In 2013 the Council released for discussion the draft Unitary Plan, which outlines the proposed planning provisions for brownfield intensification and Greenfield development in Auckland.

The Drury, Karaka, Paerata and Pukekohe areas of Auckland have been identified as areas with significant areas of Greenfield land which could potentially be urbanised and developed to accommodate future population growth.

In order to inform Auckland Council's planning, Watercare commissioned this report on the options available from a wastewater perspective to service growth in these areas – collectively known as the Southern Greenfield Areas for Investigation.

The primary objective of the investigation is to identify (at a high level) the viable wastewater servicing options and indicative capital costs for a single growth scenario being that enabled by the draft Unitary Plan, located within the Southern Greenfield Areas for Investigation, as identified in the Auckland Plan.

## 1.2 Scope of Project

This report covers an initial high level scoping assessment of bulk wastewater infrastructure likely to be required to service development in the area around Drury and Pukekohe as proposed under the draft Unitary Plan. This report is limited to consideration of bulk services likely to be required to be implemented by Watercare, comprising trunk systems to convey wastewater from the areas of development to sites for treatment, wastewater treatment plants and outfalls of land disposal areas. It does not consider local wastewater collection and conveyance systems within the new urban areas that would be expected to be constructed by other parties undertaking the land development.

This report does not cover all potential configurations and systems for bulk wastewater infrastructure, particularly for interim development. Further investigation of alternatives would be required in planning any actual urban development, leading up to resource consents and further conceptual design, and then detailed design. Concepts and cost estimates described in this report should be taken as only indicative of the nature and scale of infrastructure likely to be required.

This assessment is based on limited data provided by Auckland Council on the scale of development being used for planning of the Southern Rural Urban Boundary (RUB). Information from previous planning documents has also been used for growth projections for areas outside the Auckland Council boundaries which are connected to the wastewater system. The primary focus of this project is future growth over the next 30 years rather than total projections. The 30 year timeframe is to match the Auckland Plan horizon.

Assumptions and approximations were required to estimate wastewater quantities for the purposes of this early high-level planning. Key assumptions have been agreed with Watercare for the purposes of this assessment. These are discussed separately throughout this report, and are not repeated here.

### 1.3 Study Area

The study area lies generally between Papakura and Pokeno and includes:

- Growth Areas identified in the draft Unitary Plan
- existing areas serviced for wastewater as part of the infrastructure network for Pukekohe and surrounding areas
- proposed commercial and industrial development south of Drury, known as Drury South Business Development
- areas of Pokeno and Tuakau (within Waikato District) already proposed to be serviced by extension of the Pukekohe wastewater treatment plant.

The boundaries of the study area were agreed in discussion with Watercare and Auckland Council in the course of this investigation. These are shown in the following figure (note that the individual areas proposed for new urban development within the study area are referred to as “Growth Areas” in this report).

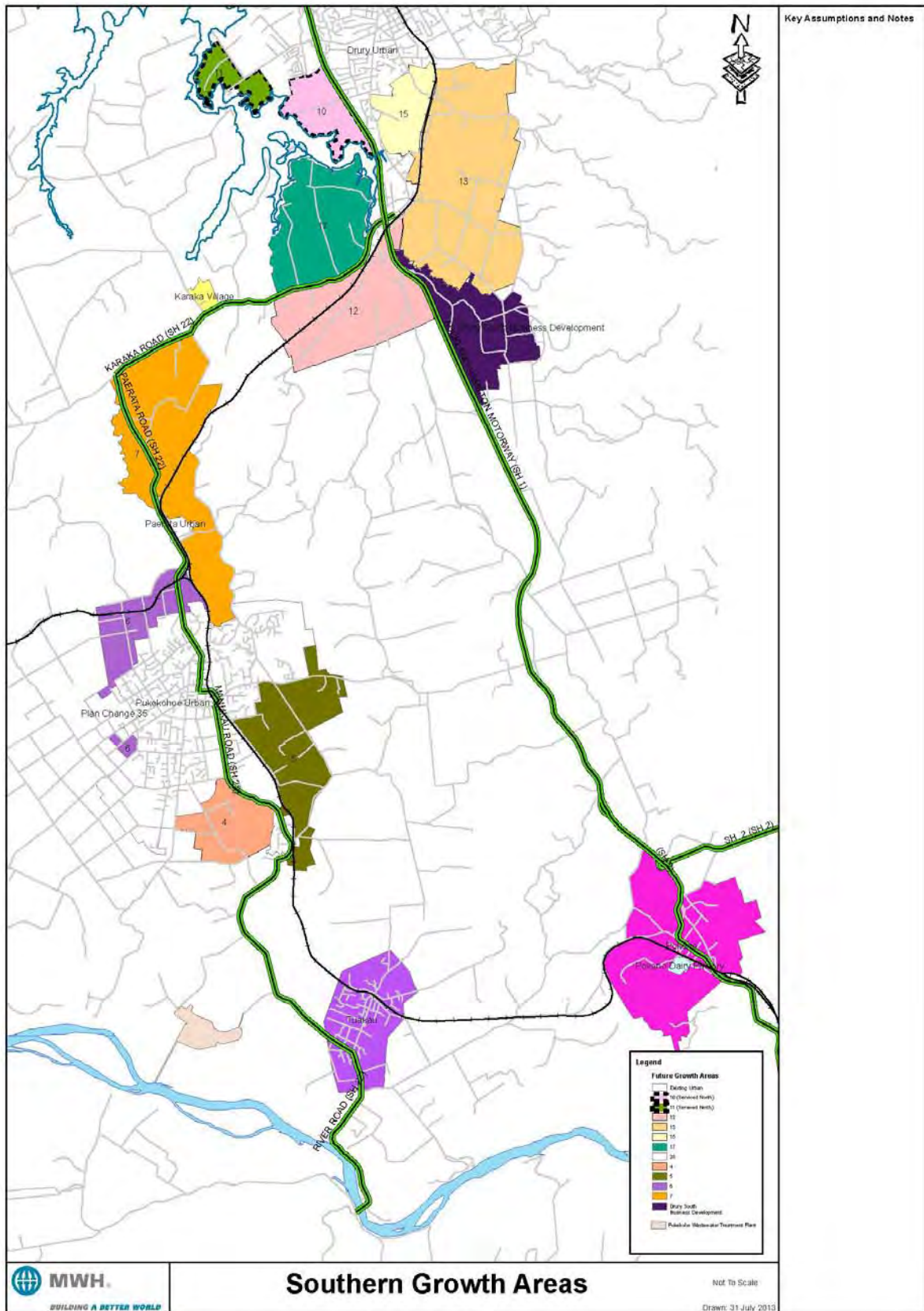


Figure 1-1: Location of the Southern Growth Areas  
(A3 version found in Appendix B)

## 1.4 Methodology

The methodology followed is outlined below:

1. Identify and quantify the existing development and wastewater infrastructure
2. Estimate the potential development under the draft Unitary Plan areas comprising Pukekohe, Karaka, Drury and Paerata / Whangapouri
3. Identify any excess wastewater conveyance and treatment capacity or shortfall in providing services for existing or potential development
4. Determine core options for servicing each development area
5. Formulate and assess scenarios for combinations of wastewater systems for the southern area.

The methodology was progressively defined through meetings and communications with Watercare and Auckland Council. A methodology diagram showing the key steps is provided in Appendix A.

## 2 Growth Projections – Population Business and Industry

### 2.1 Planning for Growth

The Auckland legacy councils were combined to form Auckland Council, with the former Franklin District being split between Auckland Council and Waikato District Council jurisdiction. However, the services of Watercare span both council jurisdictions and the purpose of this assessment is to understand the projected future growth of the area between Papakura (Auckland Council) and Pokeno (Waikato District Council) and how this could be serviced for reticulated wastewater.

The basis of the investigation is the estimated growth of urban areas over the next 30-years, in accordance with the Auckland Plan horizon. It should be noted that this investigation is concerned with growth rates as opposed to total population predictions.

The planning of growth in the former Franklin District has been undertaken at a variety of scales and through a number of different processes. In 2007, the former Franklin District Council developed the Franklin District Growth Strategy which established a high level non statutory blueprint for growth for the next 50 years. This strategy was intended to set the framework for future district plans by:

- Estimating growth projections
- Outlining where the future population of Franklin will live, work and play
- Identifying sufficient land to accommodate a projected population of 108,000 people by 2051 (doubling of the population)
- Setting out a staging plan for the establishment of any new development areas
- Guiding infrastructure planning including roading, water supply and wastewater.

The strategy was proactive, recognising that there are economic, social, environmental and cultural benefits to be gained from managing growth, rather than adopting a laissez faire approach allowing ad hoc development across the District.

The Franklin District Growth Strategy 2007 has been superceded in the Auckland Council jurisdiction by the Auckland Plan. Waikato District Council is similarly re-assessing the growth within their council boundaries although their planning is not perhaps as advanced as that undertaken by Auckland Council.

All the growth projections used in the report for the areas within the Auckland Council jurisdiction have been supplied by Auckland Council. The growth projections for the areas within Waikato Council have been derived from either the Franklin District Growth Strategy or the Franklin District Plan.

### 2.2 Auckland Growth Projections

The Auckland Plan sets the long-term strategic direction for Auckland. Section 79 of the Local Government (Auckland Council) Act 2009 requires Auckland Council to prepare a spatial plan (the Auckland Plan). The purpose of the plan is to:

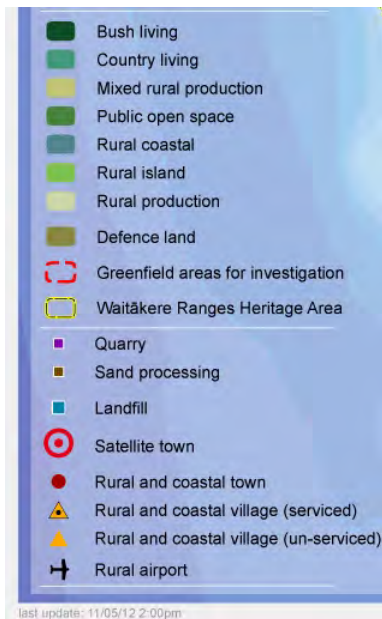
*Contribute to Auckland's social, economic, environmental, and cultural well-being through a comprehensive and effective long-term (20- to 30-year) strategy for Auckland's growth and development.*

Amongst other things, the Auckland Plan provides a development strategy for the region, including how growth in the southern rural parts of Auckland is to be managed.

The Auckland Plan contains a Development Strategy which outlines a broad strategy for the future, showing the current urban footprint and areas that are in various stages of preparation for development (illustrated on our Figure 2-1 ). It also shows 'areas for investigation' for future Greenfields development for new housing and employment – future urban land. Chapter 9 directs future population and business growth in rural areas to two significant satellite towns (of which Pukekohe is one) and, to a lesser extent, rural and coastal towns. Some limited and scale-appropriate growth will, over time, also occur in smaller rural and coastal villages where it benefits those communities.



Figure 2-1: Auckland’s Rural Strategy (Source: Figure 9.1 Auckland Plan)

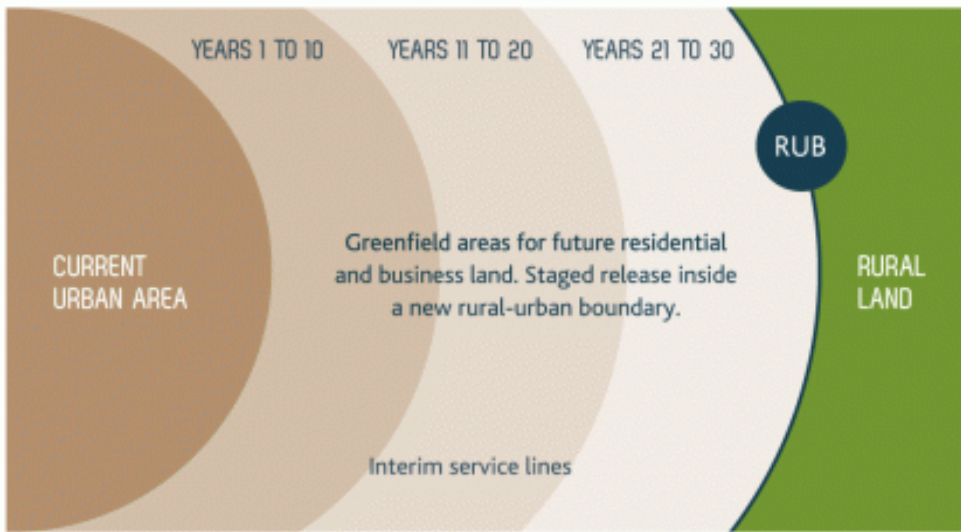


The Auckland Plan identifies growth to be managed by way of a RUB that will define the maximum extent of urban development to 2040 in the form of a permanent rural-urban interface. The main mechanism for enabling growth is the Unitary Plan through the RUB and urban zoning. The Auckland Plan requires that Auckland Council undertake a process of identifying a proposed RUB for identified Greenfields areas for investigation. The Unitary Plan process will confirm a 2040 RUB which will be illustrated on the Proposed Unitary Plan maps which will be publicly notified in September 2013. All land within the RUB being identified for future urban use in stages.

Following the investigation of Greenfields land and the establishment of the RUB, staged and managed land release will occur in approximately ten-year steps. This will ensure that there is at all times 20 years’ forward supply of development capacity, and an average of 7 years (with a minimum of 5 and



maximum of 10 years) of unconstrained, 'ready to go' land supply. This means operative zoning and bulk services infrastructure are in place.



**Figure 2-2: Staged release of land inside a 2040 rural urban boundary**

Based on the directives contained in the Auckland Plan for growth, the Spatial Strategy Team from Auckland Council has undertaken analyses of the identified Greenfield areas for investigation. The Spatial Strategy Team has divided up the southern area for investigation into Growth Areas based on geographic areas and calculated the growth for each specific Growth Area in terms of the number of households, commercial and industrial land.

The Growth Areas within the Southern study area are shown in Figure 1-1.

Based on advice from Watercare, the two Hingaia Growth Areas (10 and 11) are excluded from further consideration as the wastewater will be conveyed from the present Hingaia wastewater pumping station through the conveyance network to the Mangere WWTP.

## 2.3 Waikato District Considerations

Although they lie within Waikato District Council jurisdiction, Tuakau and Pokeno are both serviced for reticulated wastewater by Watercare and are included in this project. The wastewater from Tuakau is conveyed to the Pukekohe WWTP.

Pokeno currently has a population of approximately 600 (based on the 2006 Census), but a recent plan change (Plan Change 24) enables significant growth for Pokeno. Plan Change 24 included a significant level of residential growth but also 81 hectares of industrial land and a small amount of additional commercial land. Pokeno is not currently serviced for reticulated wastewater but funding for a connection to the Pukekohe WWTP is provided in the Waikato District Council Annual Plan. All properties in Pokeno will be connected to the Pukekohe WWTP by way of a pipeline following Whangarata Road. The future growth enabled for Pokeno by Plan Change 24 plus the existing urban development is used as a basis for estimating wastewater inputs to the WWTP.

Waikato District Council is in the early stages of developing a structure plan for Tuakau and re-examining the future level of growth appropriate for Pokeno. However this exercise is at the stage of consultation and has not yet proposed likely growth numbers. In the absence of this detailed planning assessment, the future growth identified in the Franklin District Growth Strategy for Tuakau has been used. The Franklin District Growth Strategy had a 50 year planning horizon so the growth is proportioned for 30 years to match the 30-year planning horizon for the Auckland Plan.

## 2.4 Growth Assessment

### 2.4.1 Households

The Spatial Strategy Team from Auckland Council provided the expected additional dwelling numbers for 4 main sectors of new development (east of Drury, Paerata North, Karaka South, Pukekohe). Numbers were also provided for the small area of Karaka Village. A total of 42,360 new dwellings are estimated. This excludes the Hingaia areas, which if included would bring the total number of new dwellings to 45,226.

The additional dwelling numbers developed by Auckland Council were based on a gross density ranging from 6.7 to 14.3 dwellings per hectare and make allowances for infrastructure provision and areas unsuitable for development due to flooding. The calculations provided by Council for population growth outline two scenarios – one higher density and the other low density. On Watercare's advice, this project has used the high scenario. This approach ensures any wastewater options will accommodate the maximum level of predicted development.

**Table 2-1: Projected Number of Dwellings and Densities for Each Growth Area**

(Source: Spatial Strategy Team, Auckland Council)

	Number of Dwellings		Gross Density		Land Area (ha)
	Lower Density	Higher Density	Lower Density	Higher Density	
Drury Opaheke (including Hingaia)	9,346	12,574	6.7	9.0	1,399
Paerata North	8,755	10,595	11.8	14.3	743
Karaka South	9,090	11,434	9.6	12.0	951
Pukekohe	8,020	10,390	7.7	10.0	1,035
Karaka Village	208	234	8.0	9.0	26
<b>South RUB</b>	<b>35,418</b>	<b>45,226</b>	<b>8.5</b>	<b>10.9</b>	<b>4,154</b>

The future household figures supplied by the Spatial Strategy Team of Auckland Council were provided as an amalgamated figure for the two Hingaia Growth Areas and two Opaheke Growth Areas. The growth figure for the two Growth Areas comprising Karaka South was also amalgamated. In order to address each Growth Area making up those sectors, MWH has proportioned the number of households to each Growth Area based on the land area of each Growth Area.

Pukekohe is identified as a location to accommodate a significant level of future growth. The Planning - South, Regional and Local Planning team from Auckland Council provided approximate additional household numbers for proposed extensions to Pukekohe urban area. These numbers were for discrete extensions to the current Pukekohe urban footprint and included Proposed Plan Change 35 (Belmont). Although this was withdrawn as a plan change prior to a hearing being held, it will be included as a live zone in the notified version of the Unitary Plan.

Infill in the existing Pukekohe urban area was estimated based on the zoning of each site as contained in the Draft Unitary Plan (March 2013 version). The area attribute of each site was generated using GIS and the subdivision potential of each site was calculated. The subdivision potential was calculated using the minimum lot size for a vacant lot as contained in the Draft Unitary Plan as follows:

**Table 2-2: Minimum Vacant Lot Size Standards**

(Source: Draft Unitary Plan March 2013)

Zone <i>(as illustrated in the Draft Unitary Plan March 2013 version)</i>	Minimum vacant lot size (m <sup>2</sup> )
Large Lot	4,000
Single House	500
Mixed House	300
Terraced House and Apartment Building	250

The lots zoned as Large Lot were discounted for the purposes of this assessment as they are at the perimeter of the urban development and are considered large enough to provide wastewater treatment and disposal on-site.

It is accepted that not every landowner will wish to develop, and not every site is capable of developing due to constraints such as the location of the current dwelling, slope, access, trees etc. In addition, the larger sites will need to provide infrastructure such as roads and reserves which further reduces the potential development yield. Based on experience and advice from Watercare, an allowance of 45% was made to reflect a more realistic subdivision yield.

Given that Patumahoe is already serviced for wastewater as part of the existing Pukekohe wastewater system, it was considered prudent to include this rural village. The number of current lots was calculated using a count of titles zoned as residential. The infill was calculated using the zoning as contained in the Draft Unitary Plan and associated minimum vacant lot rules for Single House zone. Patumahoe has an overlay in the Draft Unitary Plan which increases the minimum vacant lot to 800m<sup>2</sup>. For consistency, a 45% allowance for infrastructure and other constraints was used to recognise that not all sites can subdivide to their maximum potential.

Private Plan Change 37 proposes an additional 70 residential lots on the western edge of Patumahoe which have been included in the future household numbers for Patumahoe. This plan change will be considered at a hearing in early September and is likely to be accepted.

As outlined above, Pokeno is not currently serviced for wastewater but funding has been identified in the Waikato Annual Plan for a connection to the Pukekohe WWTP. Based on the Pokeno Structure Plan and district plan provisions, Pokeno is projected to grow by 5,500 people. As at the 2006 Census, there were approximately 600 people in Pokeno. The projected growth of Pokeno has been estimated to a total of 6,100 to allow for possible growth since 2006. This has been converted into households by dividing by 2.7 which is the Census average household density for New Zealand. The whole of Pokeno has been included as it is currently not serviced but is anticipated to be serviced for wastewater shortly.

Due to the early stages of planning for Tuakau, the projected household growth for Tuakau outlined in the Franklin District Growth Strategy has been proportioned to 30 years.

## 2.4.2 Commercial

The Spatial Strategy Team from Auckland Council provided the expected additional land area for commercial in each of the Growth Areas.

**Table 2-3: Proposed Commercial Form for Each Growth Area**

(Source: Spatial Strategy Team, Auckland Council)

Growth Areas	Proposed Commercial forms
Drury Opaheke	1 x Town Centre and 4 x Local Centres
Paerata North	1 x Major Centre and 1 x Local Centre
Karaka South	1 x Major Centre and 3 x Local Centres
Pukekohe	3 x Local Centres
Karaka Village	No Centres
<b>Southern RUB - Total</b>	<b>2 x Major Centres, 1 x Town Centre and 11 x Local Centres</b>

The Franklin District Growth Strategy identifies 4 additional hectares of commercial land for Tuakau. The total commercial land for Pokeno was obtained from the Pokeno Structure Plan and Business zoned land as contained in the Waikato District Plan maps.

### 2.4.3 Industrial

The Spatial Strategy Team from Auckland Council provided the expected additional land area for industrial in each of the Growth Areas. The industrial land projections were provided for sites in Pukekohe (around the existing racetrack), north of Paerata, south of Drury interchange and south of Boundary Road in Papakura. Where possible, the Spatial Strategy Team indicated whether the proposed land was likely to be light or heavy industry.

A significant private plan change is proposed for land south of Drury (commonly referred to as the Stevenson's Plan Change). This is currently before a Hearings Panel; however given the significant nature of the plan change and potential wastewater / trade waste generation, it has been included to ensure that any wastewater options will accommodate the development should it be accepted by Council. The business, light industry and heavy industry land projections were acquired from the wastewater management report prepared by Beca ("Drury Stevenson Quarry Development - Wastewater Characterisation and Staging Assessment" dated 14 March 2012).

The Franklin District Growth Strategy identified future industrial land uses for Tuakau so this has been proportioned to 30 years.

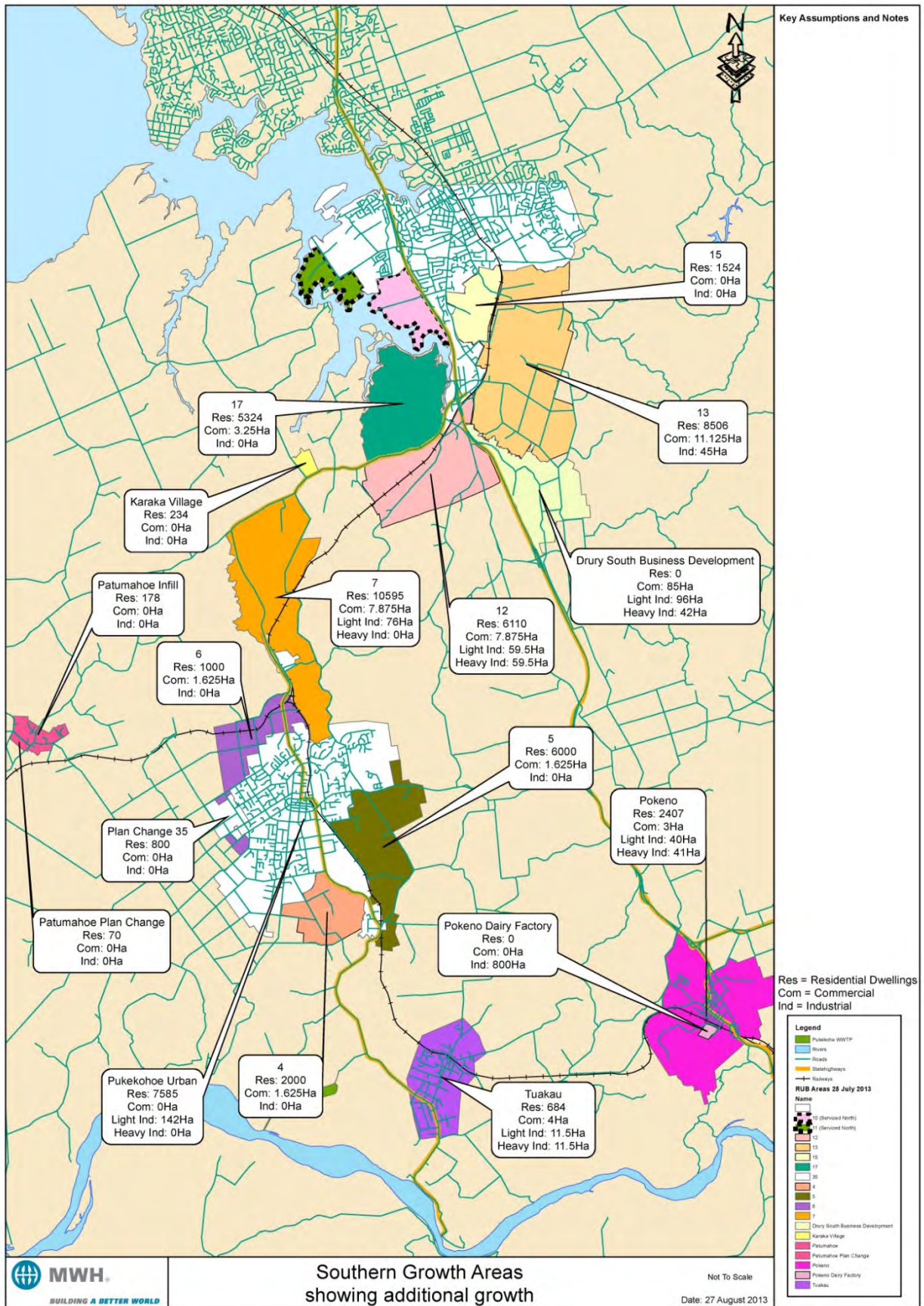
Based on the Pokeno Structure Plan and district plan provisions, Pokeno will have 81 hectares of industrial zoned land – both heavy and light. For the purposes of this assessment, the 81 hectares has been split evenly into land for heavy and light industry. A large dairy factory is proposed to be located in the Pokeno industrial land. Although this is currently being progressed through the resource consent process, the additional load likely to be contributed by the proposed Pokeno dairy factory has been included to ensure that any wastewater options will accommodate the development should the consent be granted by the Waikato District Council. The proposed dairy factory is estimated to contribute 800m<sup>3</sup> trade waste per day.

## 2.4.4 Summary of Total Growth

The assessment of existing development and potential growth is then summarised in the following table and Figure 2-3.

**Table 2-4: Summary of Total Growth**

Growth Area		Area	Households	Population (for the purposes of wastewater generation)	Commercial (hectares)	Light Industry	Heavy Industry
<b>Pukekohe</b>							
	Pukekohe existing		6,635	19,722			
	Pukekohe infill		7,585	20,480		142	
4	Pukekohe extension	231	2,000	5,400	1.625		
5	Pukekohe extension	464	6,000	16,200	1.625		
6	Pukekohe extension	248	1,000	2,700	1.625		
35	Belmont		800	2,160			
<b>Patumahoe</b>							
	Patumahoe existing		269	726			
	Patumahoe infill		178	937			
	Patumahoe Plan Change		70	189			
<b>Pokeno</b>							
	Pokeno		2,407	6,500	3	40	41
	Pokeno Dairy Factory						
<b>Tuakau</b>							
	Tuakau Existing		1742	4,704			
	Tuakau Growth		684	1,847	4	11.5	11.5
<b>Paerata</b>							
7	Paerata	752	10,595	28,607	7.875	76	
<b>Greenfield Growth Areas</b>							
17	Karaka South	460	5,324	15,972	3.25		
12	Karaka South	528	6,110	18,330	7.875	59.5	59.5
	Karaka Village	26	234	632			
13	Drury Opaheke	943	8,506	23,099	11.125	45	
15	Drury Opaheke	169	1,524	4,140			
	Drury South Business Area				85	96	42
<b>Totals</b>		<b>3,821</b>	<b>61,663</b>	<b>172,345</b>	<b>127</b>	<b>470</b>	<b>154</b>



**Figure 2-3: Southern Growth Areas**  
(Note: A3 sized schematic available in Appendix B)

## 2.5 Future Changes to Growth Projections

The growth projections used in this assessment are best available as of the time of writing the report, and are based on data provided for this assessment by Auckland Council up to 15 August 2013. However it is likely that the growth projections will change over time and it is recommended that the wastewater options be re-assessed as the growth projections change over time.

It is anticipated that the densities enabled by the Unitary Plan will change when it is formally notified in October 2013 and the potential infill will need to be re-calculated. This may be due to submissions seeking removal or addition of property to the RUB or changes to the subdivision requirements.

This report has factored in two private plan changes being the Drury South business land (also known as the Stevenson's Plan Change) and the Patumahoe Plan Change (Proposed Plan Change 37). Depending on the outcome of the hearings for these plan changes, the wastewater and trade waste contributions may need to be recalculated.

Other growth initiatives are currently being progressed. A decision on the Kingseat Plan Change has recently been notified and the plan change has been accepted. However Kingseat may be targeted for a significant level of new growth over and above that enabled by the plan change.

In addition, the growth projection work currently being undertaken by Waikato District Council may provide more definite growth numbers for Pokeno and Tuakau. Any growth additional to that calculated in this report will generate additional load for the Pukekohe WWTP and will need to be factored in.

## 3 Approach and Assumptions

### 3.1 Base Information

#### 3.1.1 Watercare

Watercare provided a CD containing the following information which was used as base information:

- Beca memorandums and file notes regarding the Drury Stevenson's Quarry Development
- Pukekohe District Growth Strategy
- AWT Pukekohe and Paerata wastewater sewer system reports
- AWT report on the Pukekohe Trunk Sewer for infrastructure planning
- Watercare Services Limited Southern Interceptor Upgrade Investigation
- AECOM 2011 Update of Unit Rate Cost Models
- Watercare Pump Station Operating Cost Summary
- Beca Auckland Region WWTP Unit Cost Curves 2006
- SKM Southern Wastewater Treatment Plants Options Study 2011
- Watercare Services Limited Three Waters Project – Rosedale WWTP Expansion Options Report.

Other Watercare documents held by MWH:

- The Watercare Water and Wastewater Code of Practice for Land Development and Subdivision Version 1.1 June 2011.

#### 3.1.2 Other Industry Base Information

MWH knowledge and resources provided background information for the following:

- MWH cost data on wastewater treatment and discharge
- MWH land application scheme cost estimate
- Franklin District planning information and growth strategy from a previous project advising on the development of the growth strategy
- MWH conveyance network data
- Auckland region LIDAR data.

Auckland Council online resources provided the following information:

- Auckland Council GIS data
- Wastewater Treatment Plant site designations for Pukekohe and Hingaia sites.

### 3.2 Sector Based Options Approach

Existing wastewater systems in the study area are structured around the following facilities:

- Wastewater treatment plant to the west of Tuakau discharging to the Waikato River, and serving a reticulated wastewater system for Pukekohe and Patumahoe, known as the Pukekohe WWTP
- Pump station at Hingaia, collecting wastewater from the Drury area and pumping to Mangere WWTP – this pump station is on the site of a decommissioned wastewater treatment plant. The site is still designated for sewage treatment.

The topography in the study area is rolling hill country, with ground generally falling north and south from the northern side of Pukekohe. The area around Drury and Paerata drains north to the Manukau Harbour estuary, while the area around Pukekohe drains south to the Waikato River.

It is recognised that the sequence of development in these dispersed areas is not known, and may be determined by factors other than wastewater servicing, including transport, land ownership and market preference.



The potential areas of growth are dispersed over the study area, and can be viewed in three main localities, or Sectors:

1. New urban Growth Areas around Drury
2. Pukekohe and new urban Growth Areas surrounding it
3. Paerata, located between Drury and Pukekohe.

Concepts for the trunk wastewater network and for treatment and disposal sites were therefore identified using a framework based on these three sectors. Six alternative concepts are described in Section 4.

### 3.3 Wastewater Generation

Assumptions and approximations were required to estimate wastewater quantities for the purposes of this preliminary high-level planning project.

The assumptions and approximations discussed in Section 2 provided a domestic population which was then used to estimate domestic wastewater quantities using parameters from the Watercare Code of Practice (3 persons per dwelling, 225l/head/day ADWF, peaking factor for dry weather 3, PWWF 1,500l/head/day).

The commercial and industrial areas discussed in Section 2 were used to estimate peak commercial and industrial wastewater quantities, using parameters in Table 5.1 of the Watercare Code of Practice. Equivalent estimates of average (ADWF) and peak dry weather flows (PWWF) were then made by adjustment according to the peaking factors for domestic wastewater in the Watercare Code of Practice. This flow estimate was comparable to typical proportions of trade waste in the range of 10-20% in other towns in New Zealand.

Previous reporting on wastewater (Beca) from the proposed South Drury Business Area was used to identify 3 land use types equivalent to “light”, “medium” and “heavy” water use. A “light” water use was included for this area because planning is more advanced for the land use here. However, the flow estimates undertaken by Beca were not adopted here as a significant area had been assessed as generating no wastewater. Instead, the land areas were classified according to assessed categories of water use in terms of the Watercare Code of Practice. This resulted in a higher estimate of wastewater quantities than that calculated by Beca, but is more consistent with the approach over the whole study area.

All commercial/industrial land in the residential Growth Areas was categorised as “medium” water use, based on information provided by Auckland Council that only land in the South Drury area was suitable for heavy industry, and direction from Watercare to only use “medium” or “heavy” water use categories.

On advice from Watercare, the two Growth Areas in Hingaia are excluded from further consideration as the wastewater will be conveyed to the Mangere WWTP.

The resultant flows are shown in Table 3-1 below.

**Table 3-1: Flowrates Adopted for Study**

Sectors	Cores	Estimated Flows								
		Residential			Commercial/Industrial			Total Wastewater		
		ADWF	PDWF	PWWF	ADWF	PDWF	PWWF	ADWF	PDWF	PWWF
		(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)	(m <sup>3</sup> /day)
Pukekohe	Existing Urban Area	4,479	13,436	29,858	0	0	0	4,479	13,436	29,858
	Infill	5,120	15,360	34,133	1,288	3,865	8,588	6,408	19,224	42,721
	Plan Change 35	540	1,620	3,600	0	0	0	540	1,620	3,600
	Purple 1 (Big)	629	1,887	4,194	8	25	56	638	1,913	4,250
	Purple 2 (Small)	46	138	306	0	0	0	46	138	306
	Dark Orange	1,350	4,050	9,000	8	25	56	1,358	4,075	9,056
	Khaki	4,050	12,150	27,000	8	25	56	4,058	12,175	27,056
	Existing Urban Area	182	545	1,211	0	0	0	182	545	1,211
Patumahoe	Infill	120	360	801	0	0	0	120	360	801
	Private Plan Change	47	142	315	0	0	0	47	142	315
	Drury Business Area (Quarry)	0	0	0	2,019	6,058	13,461	2,019	6,058	13,461
	Drury									
Drury	Dark Yellow	5,742	17,225	38,277	466	1,398	3,106	6,207	18,622	41,383
	Light Yellow	1,029	3,086	6,858	0	0	0	1,029	3,086	6,858
	Dark Green	3,594	10,781	23,958	17	51	112	3,611	10,832	24,070
Karakā South	Red	4,124	12,373	27,495	1,583	4,749	10,554	5,707	17,122	38,049
	Karakā Village	158	474	1,053	0	0	0	158	474	1,053
Paraeta North	Orange	7,152	21,455	47,678	730	2,191	4,869	7,882	23,646	52,546
Pokeno	Existing Area	1,463	4,388	9,750	1,069	3,208	7,128	2,532	7,595	16,878
	Dairy Factory	0	0	0	778	2,333	5,184	778	2,333	5,184
Tuakau	Existing Area	1,176	3,528	7,839	319	956	2,125	1,495	4,484	9,964
	Infill	462	1,385	3,078	0	0	0	462	1,385	3,078
	TOTAL	41,460	124,381	276,402	8,294	24,883	55,296	49,755	149,264	331,698

## 3.4 Reticulation and Conveyance

### 3.4.1 Local Reticulation and Local Conveyance

Local wastewater collection infrastructure (i.e. local wastewater collection and conveyance systems within the new urban areas that would be expected to be constructed by other parties undertaking the land development) is not included in this study, because funding is generally provided by the developer as opposed to Watercare. Trunk infrastructure inside Growth Areas is similarly not included in this study.

Consideration of conveyance is limited to bulk conveyance systems (of gravity sewers and pump systems) from the Growth Areas to sites for treatment and disposal/discharge.

### 3.4.2 Network Conveyance

The infrastructure required for network conveyance between Growth Areas and wastewater treatment plants has been assessed using the following approach.

- Concepts for new bulk conveyance sewers based on topography allow for gravity pipelines to collect wastewater and discharge in the general direction of falling ground levels (typically to the north or south from a watershed on the northern side of Pukekohe), and providing pumping systems for flow in the direction of rising ground levels.
- Rising mains follow road alignments. Gravity sewers follow falling topography (i.e. are not restricted to road corridors).
- Design concepts for wastewater systems are based on Watercare Services Ltd "Water and Wastewater Code of Practice for Land Development and Subdivision" Chapter 5.
- Estimated pipe capacities are based on pipes at minimum grade of 0.25% provided in "Water and Wastewater Code of Practice for Land Development and Subdivision" Chapter 5.
- Pipe capacities are calculated by the Colebrook-White Formula.
- Flows from the existing Hingaia pump station can be diverted to the southern trunk system in the short term, if required to provide minimum and flushing flows in the new trunk network pipelines.

The initial conveyance pipe sizing was based on:

- a maximum rising main length of 8km
- restriction of friction pumping head to approximately 60m
- twin rising mains to assist with staging of development.

Detailed analysis of the hydraulic capacity of the existing systems is beyond the scope of this project. Existing reticulation sewers and pumping systems are assumed to be at full capacity. Where additional bulk conveyance pipelines are required to service new areas, these are assessed as independent pipelines and no allowance is then made for residual capacity in existing pipelines.

## 3.5 Wastewater Treatment and Discharge

More detailed information on the assessment of wastewater treatment and disposal methods is in Section 6.

### 3.5.1 Wastewater Treatment

The approach used for estimating treatment requirements has been based on the existing sequencing batch reactor (SBR) type of biological nutrient removal (BNR) treatment process and treatment standards at the Pukekohe WWTP.

Potential locations for wastewater facilities were assumed to be:

- the existing Pukekohe WWTP adjacent to Parker Lane, south of Pukekohe as a potential site for the expansion of wastewater treatment capacity
- a new Drury WWTP sited on the existing land designated in the Papakura District Plan and Draft Auckland Unitary Plan as a Sewage Treatment Plant
- in the vicinity of possible land disposal site in rural land to the west of Karaka.

Sludge treatment has been allowed for at each of the WWTP sites included in the options. There are however some alternative options, particularly for a new Drury WWTP in that a liquid only plant could be established with the sludge (in the form of waste activated sludge) discharged from the existing Hingaia pump station back into the Mangere network for subsequent removal and treatment at the Mangere WWTP.

Key assumptions made when considering the new WWTPs and upgrades to Pukekohe WWTP included:

- There is sufficient available and designated land at the Pukekohe WWTP to accommodate an expanded treatment process to service the entire study area. Previous geotechnical studies have shown issues with the ground conditions at the site which would need to be overcome for the expansion of the plant.

- The former Hingaia treatment plant site (current site of the Hingaia pump station) is taken as the potential site for any new/temporary treatment plant to serve the study area around Drury.

It is noted that resource consent for a discharge in this location may be difficult to obtain (refer Section 4.5 and Section 7), however the land is already designated as a sewage treatment facility.

### **3.5.2 Discharge and Disposal of Treated Wastewater**

Options for discharge or disposal of treated wastewater to water or land were selected to suit the system configuration.

Options for discharge of well treated wastewater to water in the Waikato River or the Manukau Harbour have been included. It is assumed that all locations for discharge to water are able to be consented at the standard of discharge achievable from a modern and well operated BNR process. The environmental effects assessment of this is however beyond the scope of this project.

An option for disposal of wastewater to land was assessed, using a notional location for the discharge site. Data used for the land application (disposal) indicative sizing and cost estimates are a combination of data from MWH Waikato region wastewater projects, estimates for treatment at Kingseat by Beca, and the NIWA Waikato River Scoping Report information. It is assumed that disposal to land is a suitable option that is able to be consented at the standard of discharge achievable from a BNR process together with UV disinfection, but assessment of this is beyond the scope of this project.

The discharge / disposal of treated wastewater from the Pukekohe WWTP to land has not been considered in any option. Discharge of treated wastewater from the Pukekohe WWTP is assumed to continue to be to the Waikato River.

## 4 Sector Based Wastewater Options

### 4.1 Wastewater Network Options

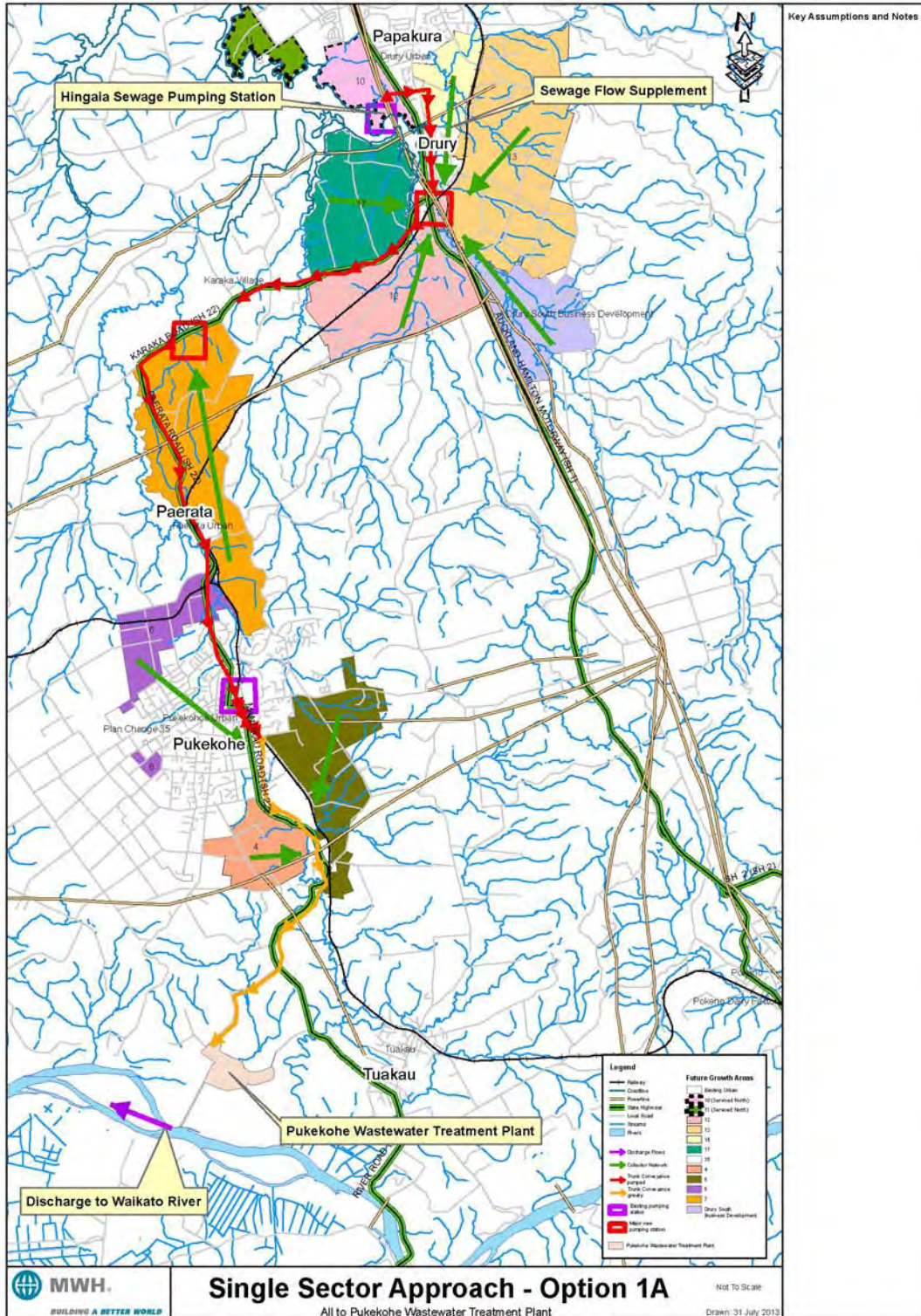
The following options for the bulk wastewater infrastructure to service the Southern RUB were identified:

- Option 1A – Single Sector Approach: using Pukekohe WWTP as the site for treating all waste, with trunk reticulation following State Highway 22, and temporarily diverting the existing Hingaia Pump Station to the new system to provide adequate initial pipe flows in the early years
- Option 1B – Single Sector Approach: using Pukekohe WWTP as the site for treating all waste, with trunk reticulation connecting the Drury South Business Development to Pukekohe urban area, and temporarily diverting the existing Hingaia Pump Station to the new system to provide adequate pipe flows in the early years
- Option 2A – Dual Sector Approach: using two treatment sites (Pukekohe and Hingaia), with Paerata discharging to Pukekohe
- Option 2B – Dual Sector Approach: using two treatment sites (Pukekohe and Hingaia), with Paerata discharging to Hingaia
- Option 3 – Dual Sector Approach: using two treatment sites (Pukekohe and a land treatment and disposal site near Karaka)
- Option 4 – Tri Sector Approach: using three treatment sites (Pukekohe, Hingaia and a land treatment and disposal site near Karaka).

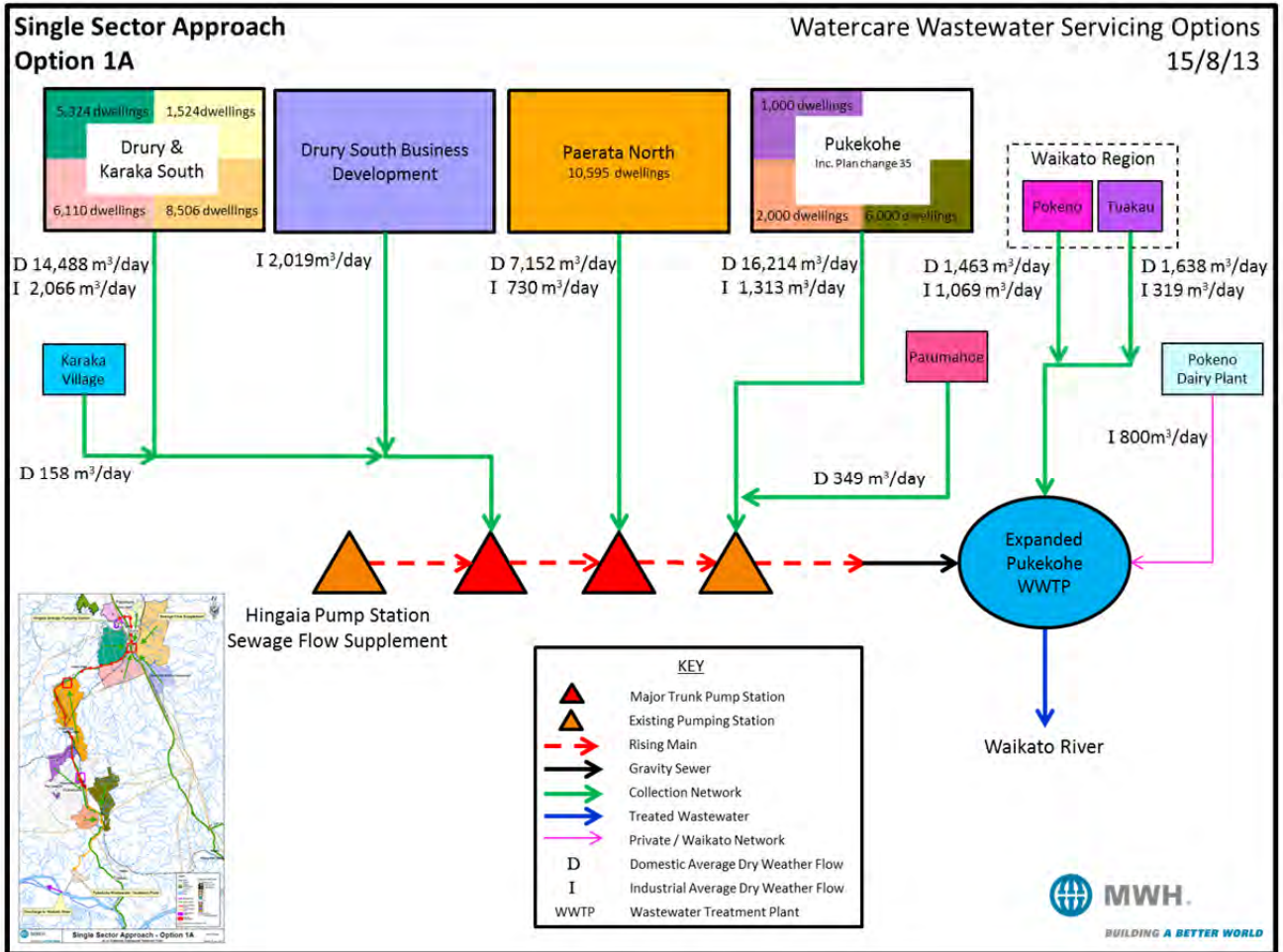
These options are described in the following maps and system diagrams.

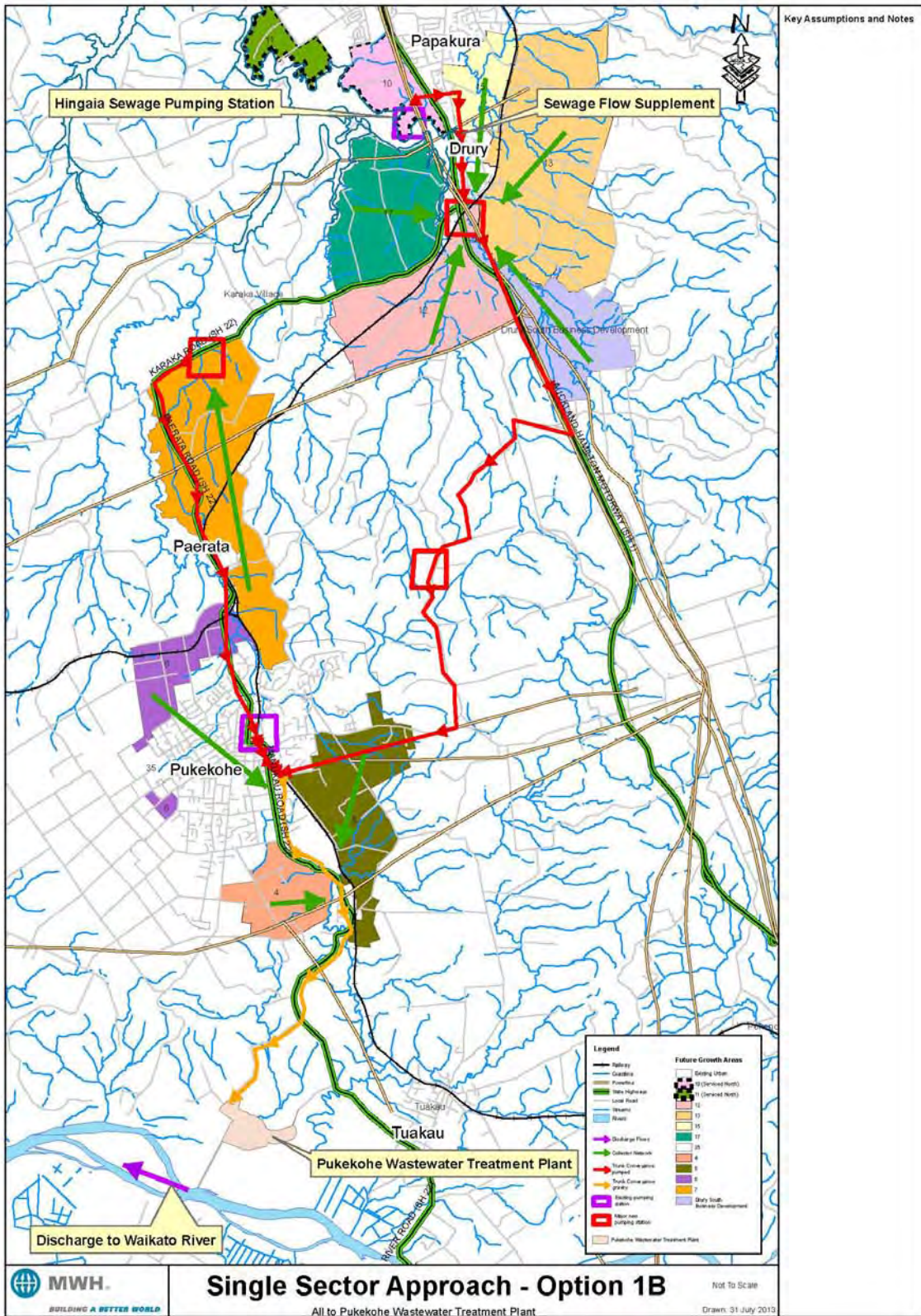
### 4.1.1 Single Sector Option 1A and 1B – Discharge to Waikato River

Single sector options 1A and 1B convey the flow from all Growth Areas to an upgraded Pukekohe WWTP. The difference between Option 1A and Option 1B is the conveyance route from Drury / Opaheke and Karaka Growth Areas to Pukekohe, as illustrated on the following option maps. The 'cross country' conveyance route in Option 1B would follow smaller roads and allow development of Drury / Opaheke and Karaka Growth Areas to precede development in Pukekohe and Paerata.



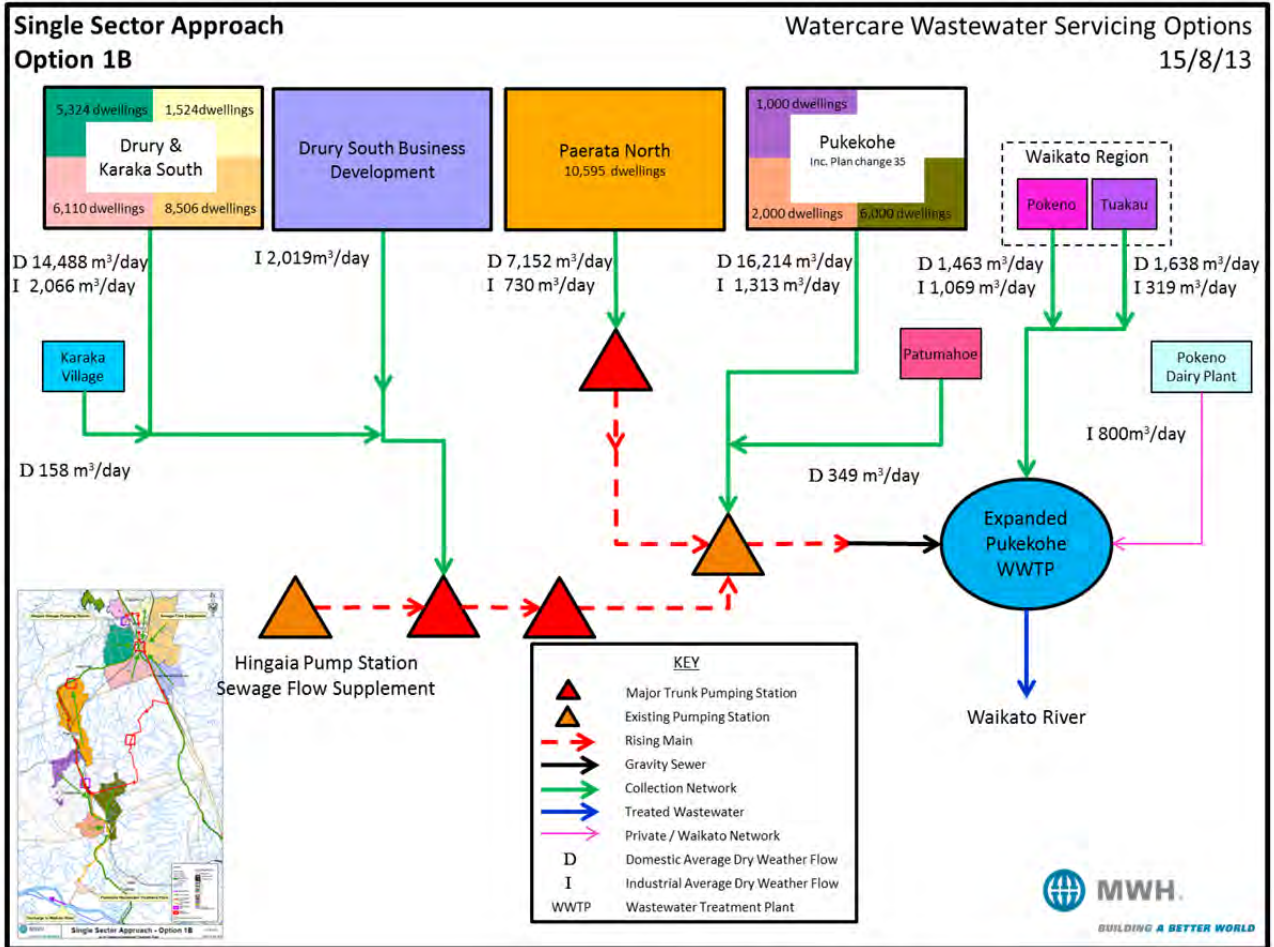
Note: A3 sized schematics available in Appendix G.





Note: A3 sized schematics available in Appendix G.

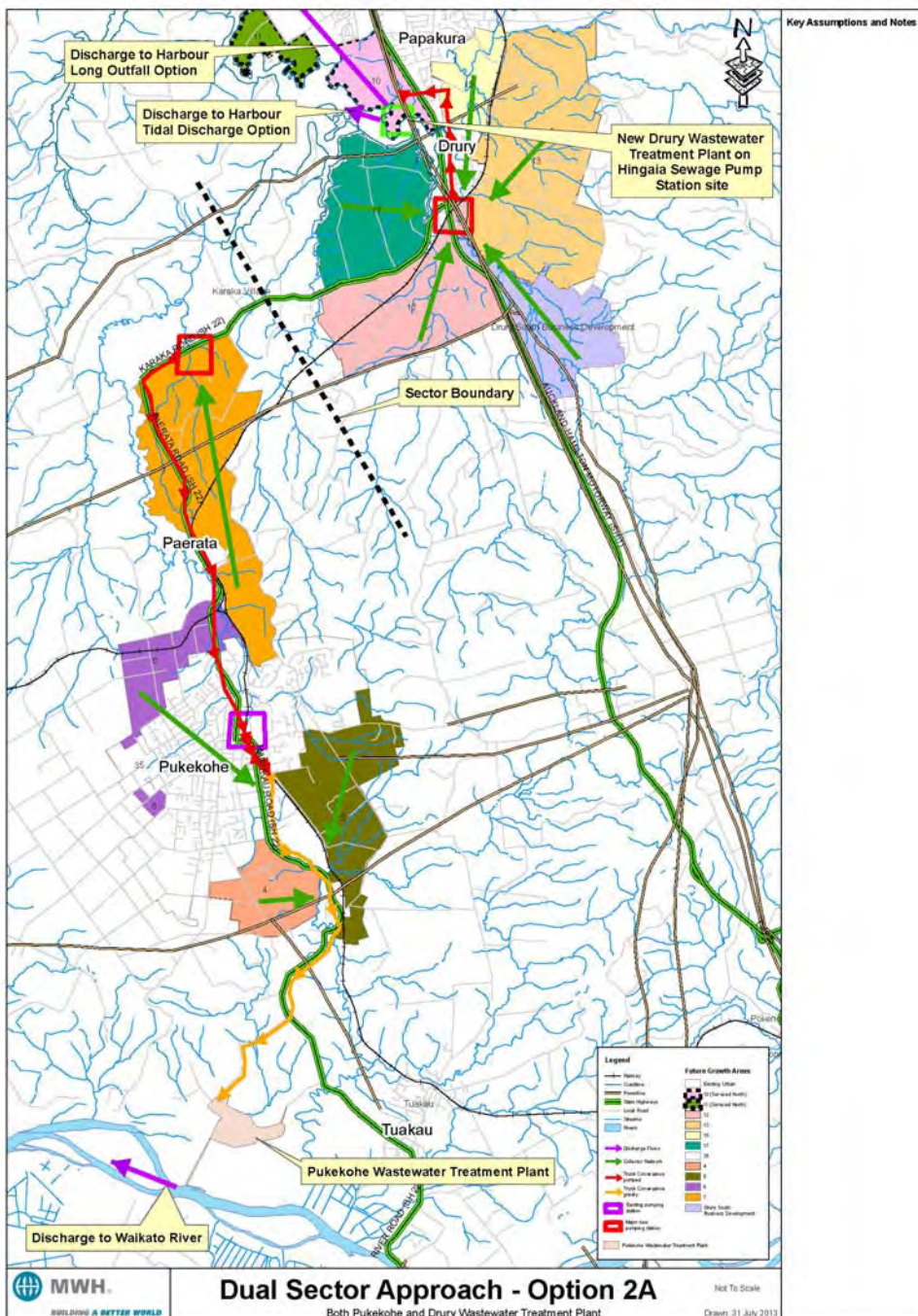




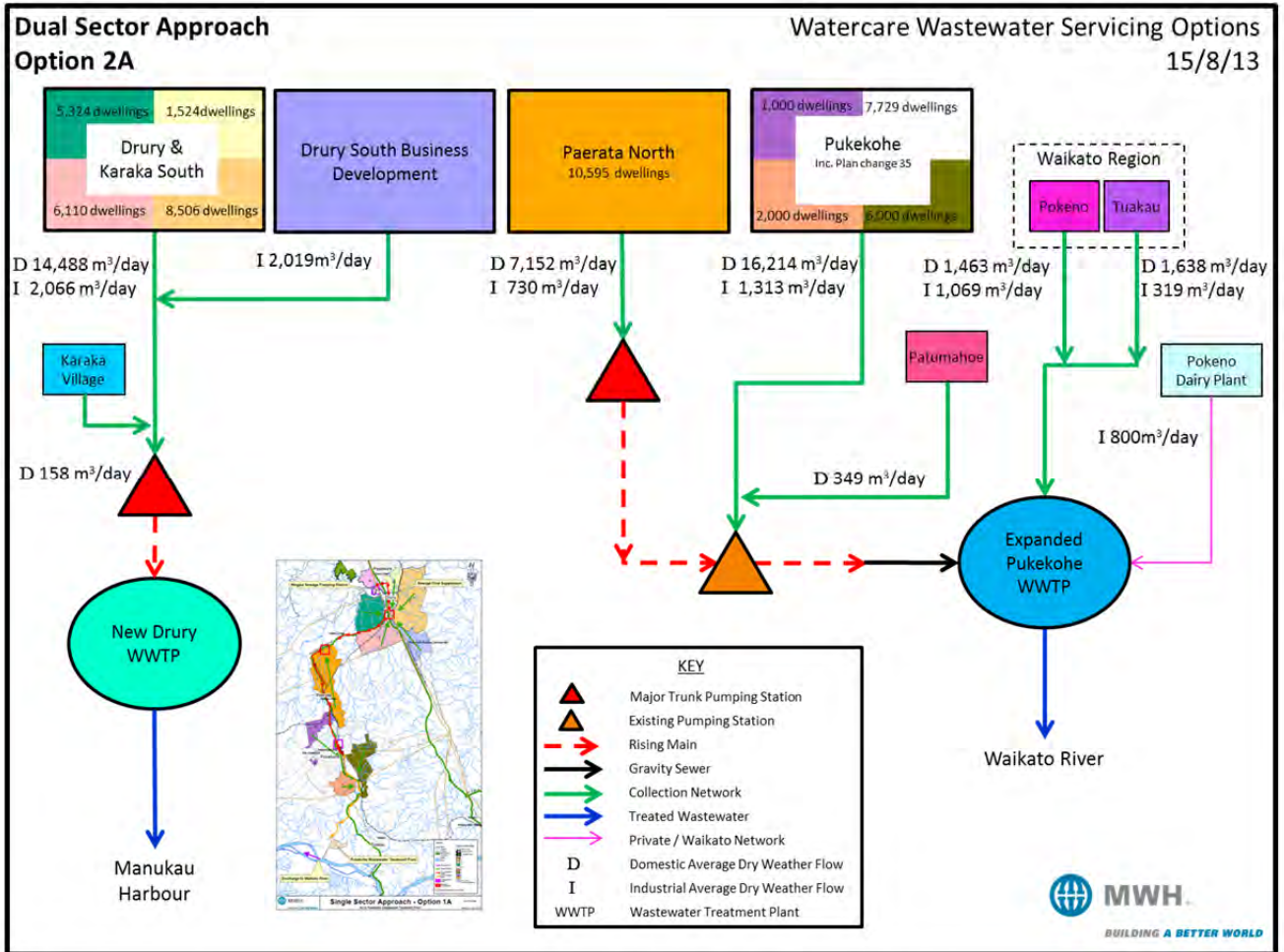
### 4.1.2 Dual Sector Options 2A and 2B – Discharge to Waikato River and Manukau Harbour

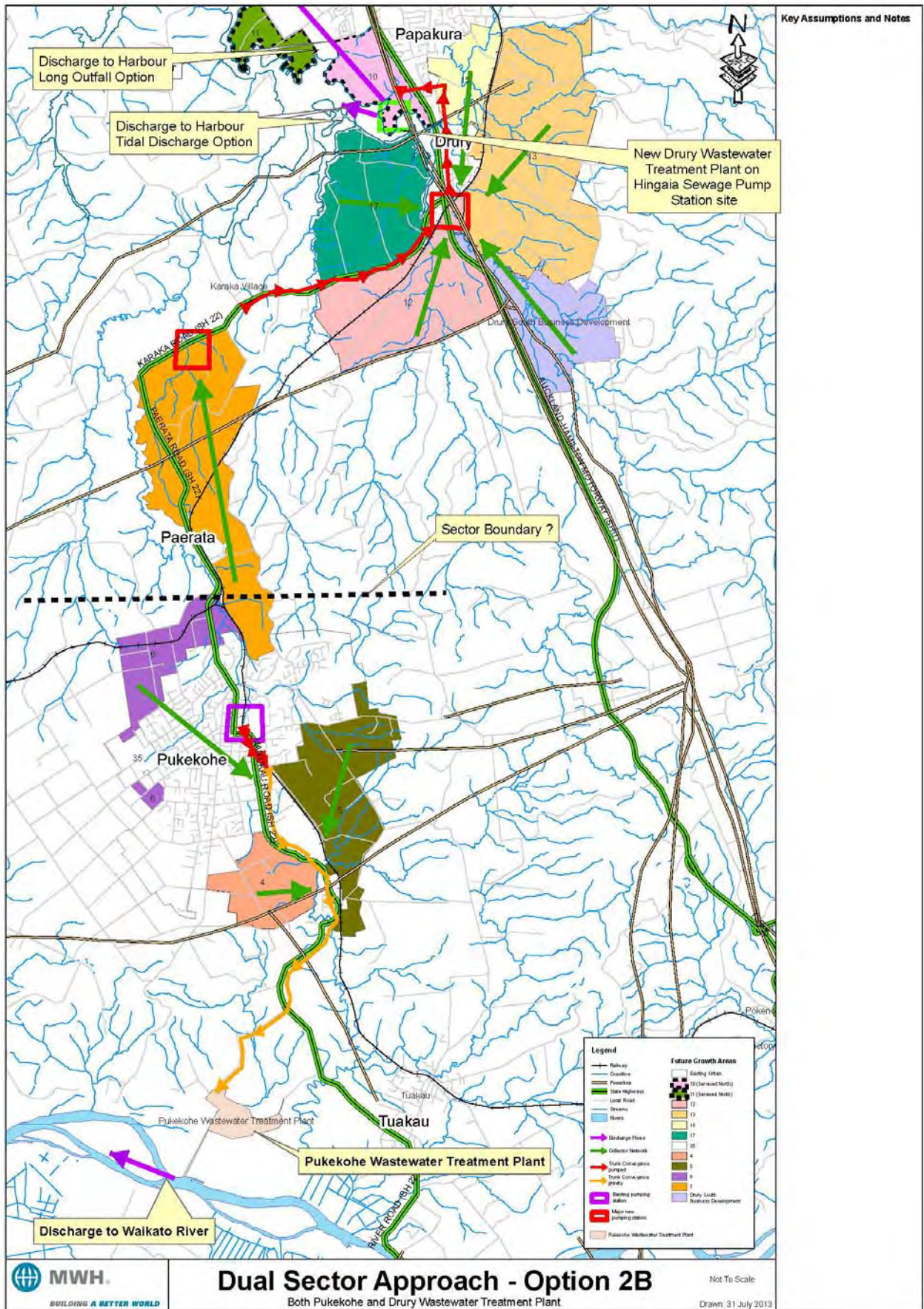
Dual sector options 2A and 2B split the flow from Growth Areas between an upgraded Pukekohe WWTP and a new WWTP on the “sewage treatment facility” designated land at the existing Hingaia Pump Station.

The difference between the options is the direction in which flow from Paerata is conveyed. Option 2A conveys flow from Paerata to Pukekohe and then on to Pukekohe WWTP, allowing for development in Drury / Opaheke and Karaka and the construction of a new WWTP at Hingaia to be delayed. Option 2B conveys flow from Paerata to a new WWTP at Hingaia. Option 2B will require the earlier construction of the Drury WWTP. The pumping station for Hingaia has been positioned north of Hingaia to allow for a predominantly gravity wastewater collection network.

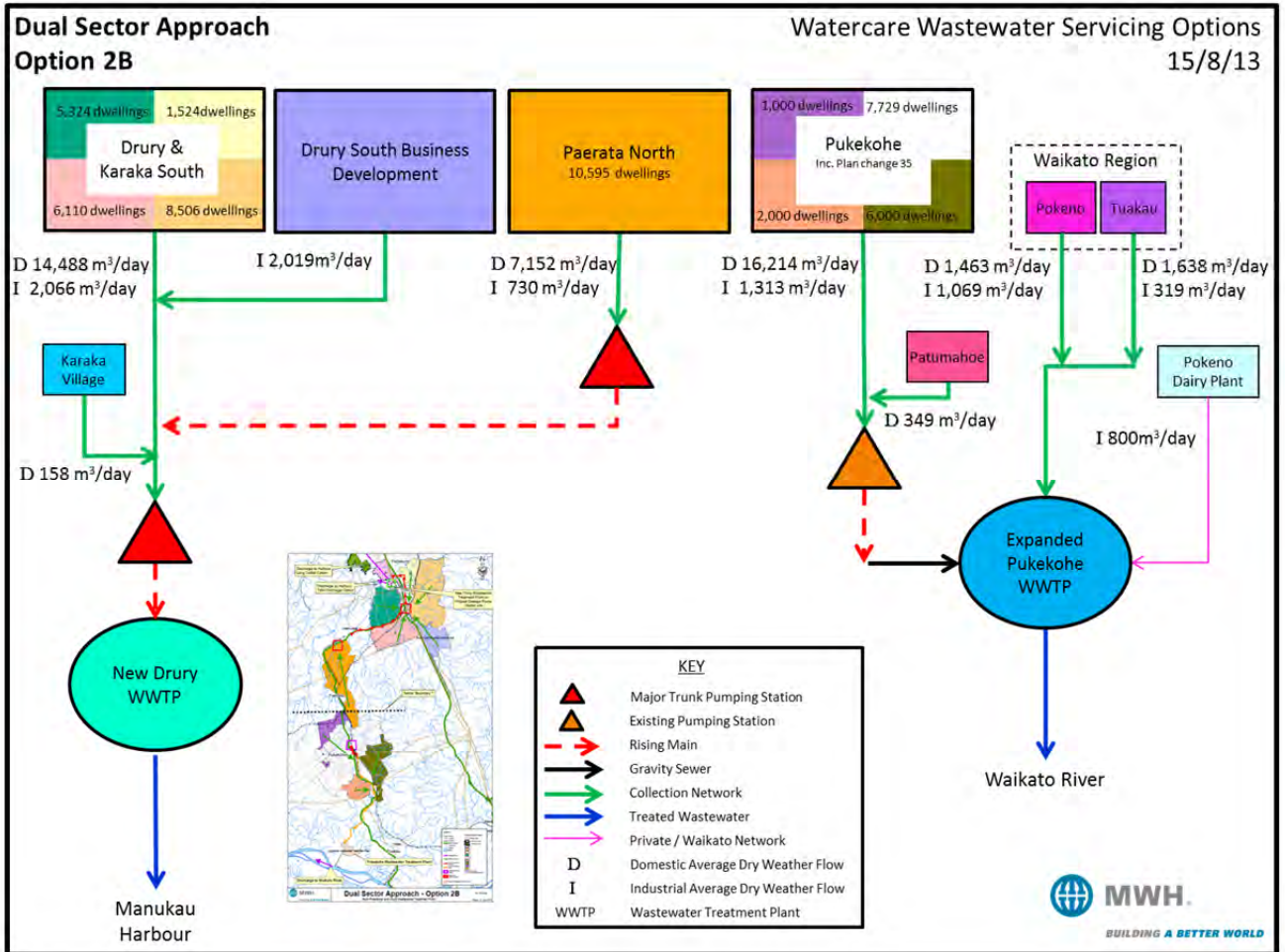


Note: A3 sized schematics available in Appendix G.



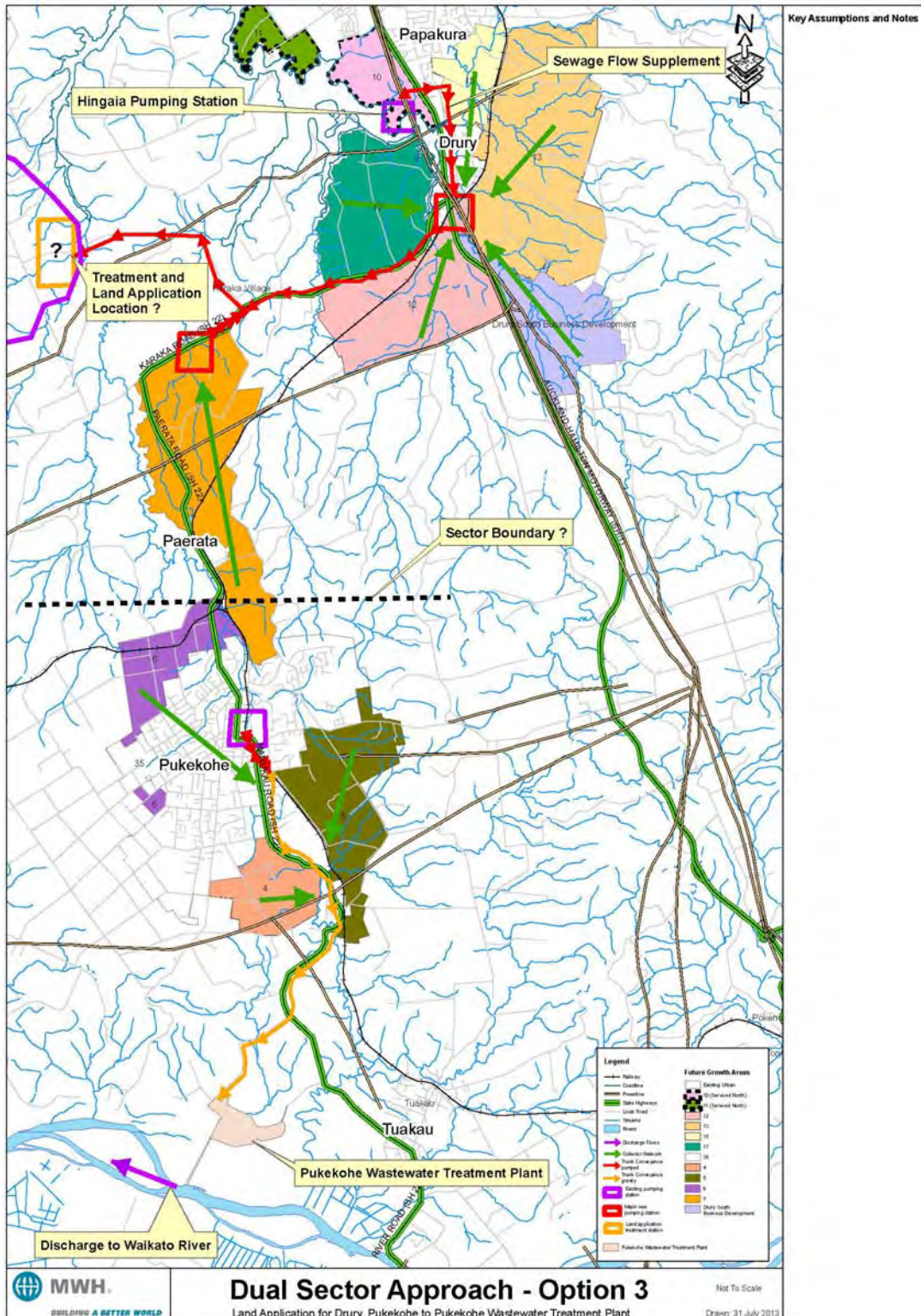


Note: A3 sized schematics available in Appendix G.

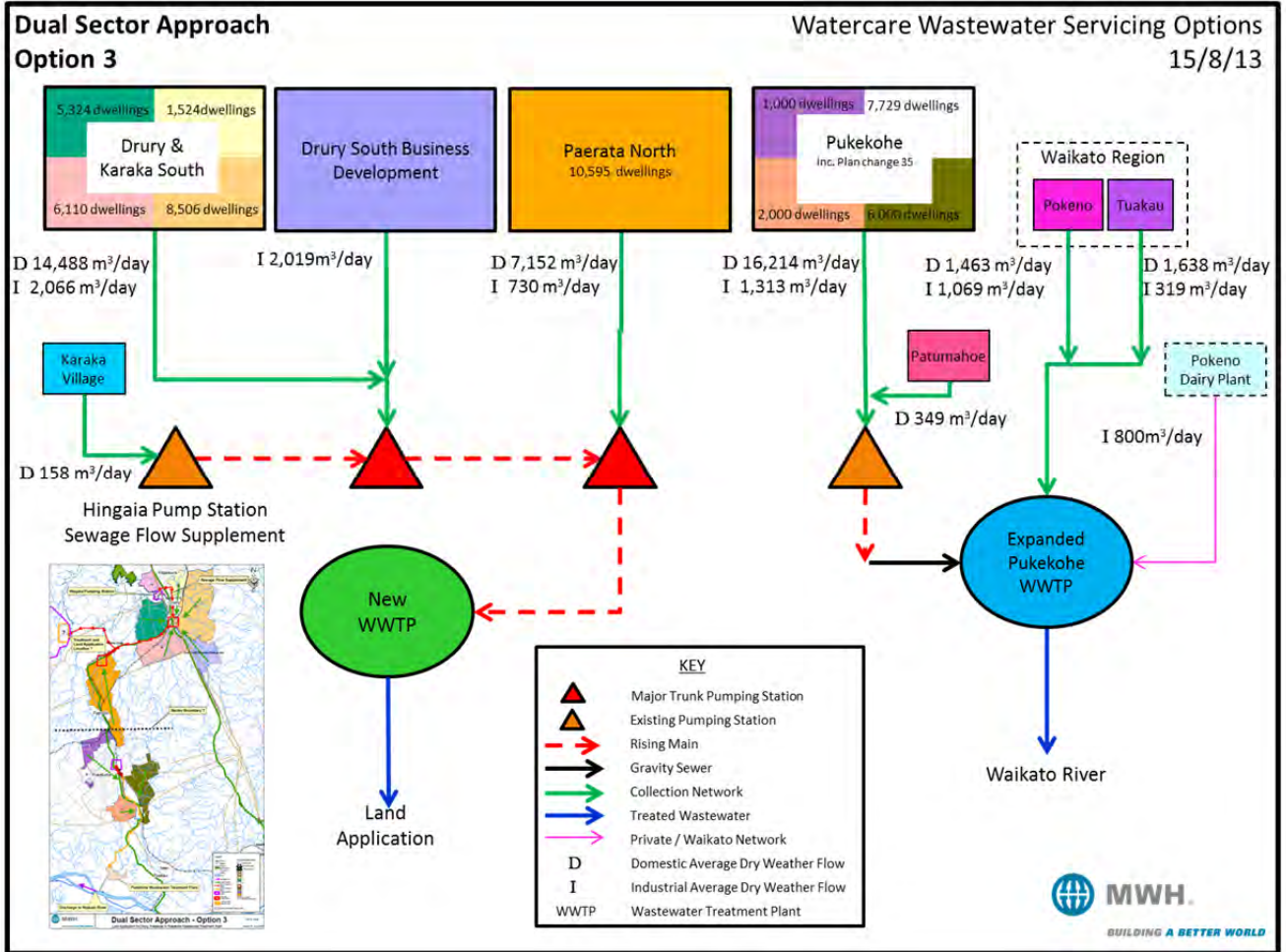


### 4.1.3 Dual Sector – Option 3 – Discharge to Waikato River and Disposal to Land

Dual sector Option 3 splits the flow from Growth Areas between an upgraded Pukekohe WWTP and a new WWTP to the north west of the Paerata Growth Area for the treatment of wastewater for land application. The sectors are split at the same point as in Option 2B with the wastewater from Drury / Opaheke, Karaka and Paerata Growth Areas treated at the new WWTP for land application and the flows from all Growth Areas south of Paerata treated at an upgraded Pukekohe WWTP.

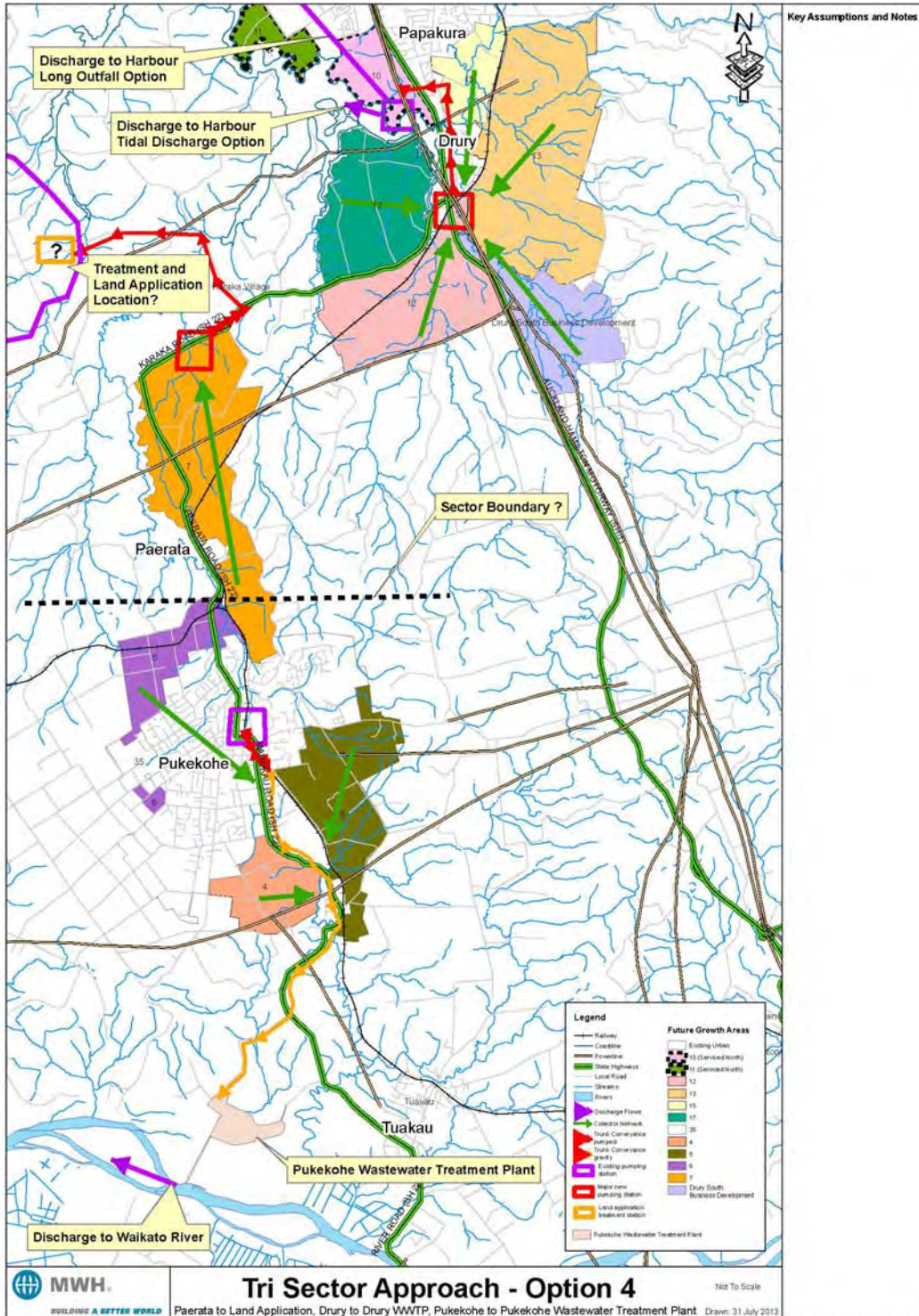


Note: A3 sized schematics available in Appendix G.



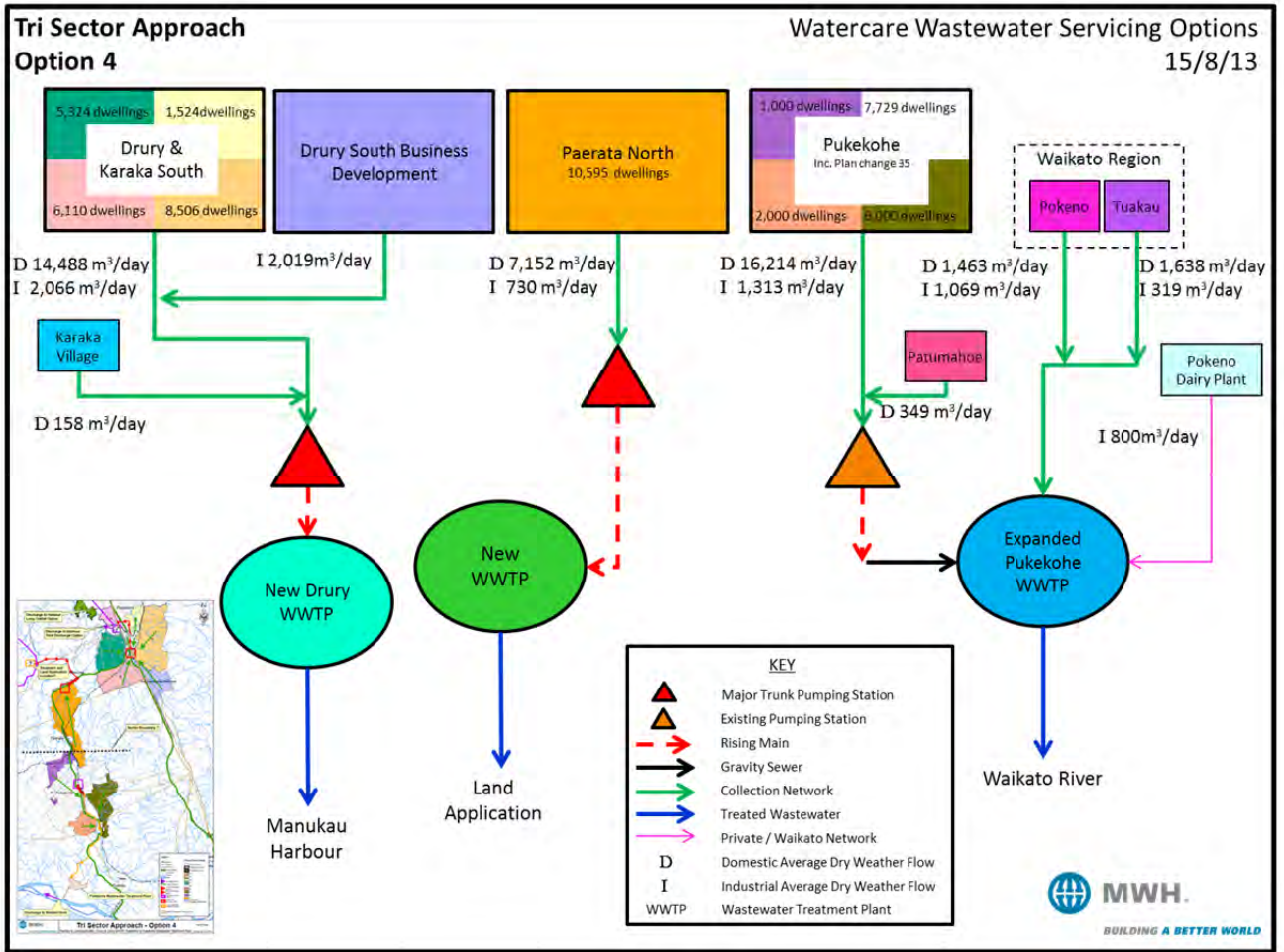
### 4.1.4 Tri Sector – Option 4 – Discharge to Waikato River, Manukau Harbour, Disposal to Land

Tri-sector Option 4 splits the flow from Growth Areas between an upgraded Pukekohe WWTP, a new WWTP on the “sewage treatment facility” designated land at the existing Hingaia Pump Station, and a new WWTP to the north west of the Paerata Growth Area for the treatment of wastewater for land application.



Note: A3 sized schematics available in Appendix G.





## 4.2 Indicative Capital Costs

Indicative estimates of capital costs have been derived from the high-level concepts for the bulk wastewater infrastructure. These estimates should be considered as order-of-magnitude estimates with a very high level of uncertainty.

Allowances have been included in the indicative estimates for risk and contingency items to recognise that there are considerable unknowns at this time. These risk and contingency items are a minimum prudent allowance at this time, and may not cover all potential variations from the assumptions used in assessing the required works and the indicative capital costs.

The indicative capital costs for construction of each option for the bulk wastewater infrastructure is summarised in the following table.

**Table 4-1: Summary of Indicative Capital Costs**

	Option 1A Single Sector Approach \$	Option 1B Single Sector Approach \$	Option 2A Dual Sector Approach \$	Option 2B Dual Sector Approach \$	Option 3 Land Application Approach – Dual Sector \$	Option 4 Land Application Approach – Tri Sector \$
<b>Treatment Costs</b>						
- Pukekohe WWTP	142,500,000	142,500,000	101,260,000	80,140,000	80,140,000	80,140,000
- Drury WWTP			86,380,000	106,650,000		86,380,000
- Land Application WWTP					106,650,000	51,390,000
<b>Disposal Costs</b>						
- Land					166,430,000	56,240,000
- Waikato Outfall	16,860,000	16,860,000	13,660,000	11,760,000	11,760,000	11,760,000
- Long Harbour Outfall			31,170,000	41,590,000		31,170,000
- Tidal Harbour Outfall			6,980,000	9,980,000		6,980,000
<b>Consenting</b>	1,500,000	1,500,000	3,500,000	3,500,000	3,750,000	5,000,000
<b>Pump Stations</b>	63,910,000	63,910,000	37,510,000	48,620,000	63,910,000	37,510,000
<b>Pipelines</b>	155,510,000	185,050,000	120,700,000	102,590,000	118,680,000	103,960,000
<b>TOTAL COST</b>	\$380 million	\$410 million	\$390 million <i>(long harbour outfall)</i>	\$390 million <i>(long harbour outfall)</i>	\$550 million	\$460 million <i>(long harbour outfall)</i>
			\$370 million <i>(tidal harbour outfall)</i>	\$360 million <i>(tidal harbour outfall)</i>		\$440 million <i>(tidal harbour outfall)</i>

These indicative cost estimates are based on the following.

- Indicative cost estimates for conveyance systems are based on Watercare Unit Rate Cost Models, as set out in the 2011 report “Update of Unit Rate Cost Models”, with escalations applied at the rate of the CGPI for 2 years. Rates used include 22% for design and management on-costs. Rates for construction in urban brownfield conditions were used for pipelines.
- Data used for the land application (and disposal) indicative sizing and cost estimates are a combination of data from MWH Waikato region projects, estimates for treatment at Kingseat by

Beca, and the NIWA Waikato River scoping report information. Indicative land purchase costs are included in these cost estimates.

- Indicative WWTP capital cost estimates are generally based on comparison to estimates and contract sums for similarly sized works and the recent AECOM cost estimate for the upgrade of the existing Pukekohe SBR plant. These include 15-20% for design and administration on-costs according to the size of the plant.
- Rates for contingency and risk for conveyance systems and land costs are included as follows:
  - unknown items 10%
  - design contingency 10%
  - market/cost contingency 10%
  - construction contingency 10%
- A provision of 10% for market/cost contingency was added to the WWTP capital costs. Other risk and contingency costs are included in the cost model used for WWTP capital costs.

Two options have been identified for discharge from a new Drury WWTP into the Manukau Harbour: a long harbour outfall and an outgoing tidal discharge outfall. The more expensive long outfall would be approximately 7.5km long, crossing approximately 5.7km of land before crossing the harbour for approximately 2km to a point in the harbour where the water is assumed to be sufficient for continuous discharge. The tidal outfall would be approximately 600m long and would require a tidal storage basin on the WWTP site.

Comparison of the indicative capital costs for the options shows:

- The indicative capital costs for all options for disposal to water (Options 1A, 1B, 2A, 2B) are similar, with approximately 10% variation across the range).
- The relativity in capital costs between the single sector and dual sector approaches are determined by the type of harbour outfall from a treatment plant near Drury. If a short tidal outfall is able to be consented then the dual sector approach is lower cost. If a long harbour outfall is required, then Options 1A, 2A and 2B have similar capital costs.
- The costs for the options including land disposal (Options 3, 4) are higher, as a result of the additional cost for land purchase. It should be noted that there is also a significant risk of the costs of land purchase being higher than estimated as a result of changed market conditions.
- The indicative capital cost for the bulk wastewater infrastructure is in the range of \$360-410 million for the required infrastructure excluding any land purchase. The configuration of the bulk wastewater network does not significantly affect the capital cost of the infrastructure.

Indicative cost estimates given here are for all capital works at current rates. Information on potential staging of the works, and assessment of related NPV costs is in Section 5.

## 4.3 Other Options

A brief comparative assessment was made of the potential costs to convey wastewater to more distant sites for treatment and/or disposal. Detailed assessment was outside the brief.

### 4.3.1 Conveyance to Mangere Wastewater Treatment Plant

For comparison purposes the indicative cost of conveying all flows to Mangere WWTP via a new interceptor tunnel were assessed. Conveyance to Mangere would be in place of a new Drury WWTP or land application WWTP in options 2A, 2B, 3 and 4.

The tunnel has been estimated at 3.5m diameter to meet Watercare requirements for minimum size, and would be installed using a tunnel boring machine. The most direct route to Mangere WWTP from Hingaia pump station, where the flow for the growth areas of Paerata, Karaka and Drury / Opaheke would be collected, is approximately 20 kilometres long.

The indicative capital cost of such a tunnel is \$515 million. This is at an indicative rate of \$26,000 per metre including contingency and risk factors. This indicative cost estimate is based on Watercare Unit Rate Cost Models, as set out in the 2011 report "Update of Unit Rate Cost Models". This does not include costs for appurtenances and pumping stations.

In addition to the cost of the tunnel, Mangere WWTP would require upgrading to accommodate the additional wastewater volumes for treatment. In effect the cost of conveyance to Mangere can be compared to the cost of discharge to the Manukau Harbour from a Drury WWTP or disposal to land which cost between \$7,000,000 and \$167,000,000. There is therefore an additional capital cost of the order of \$350-500million to treat wastewater from the Southern RUB at Mangere WWTP.

### 4.3.2 Discharge to a New Tasman Sea Ocean Outfall

In the event that consent for discharge to the Manukau Harbour from a new Drury WWTP or an upgraded Pukekohe WWTP, discharge could be considered to the Tasman Sea via an ocean outfall 1-1.5km off shore.

The construction of an ocean outfall would require a tunnel with an estimated diameter of 3.5m to convey wastewater to the outfall location.

A tunnel following the most direct route to the West Coast from Drury WWTP would have an approximate length of 33km. At a rate of \$26,000 per metre for both the tunnel and outfall, including contingency and risk factors, the indicative cost of this alternative is \$850,000,000.

A tunnel following the most direct route to the West Coast from Pukekohe WWTP would have an approximate length of 23 km. At an indicative rate of \$26,000 per metre for both the tunnel and outfall, including contingency and risk factors, the indicative cost of the outfall is \$600,000,000.

These estimates do not include costs for appurtenances and pumping stations. These potential costs for both alternatives for discharge to an ocean outfall are additional to the indicative capital cost for the bulk wastewater options summarised in Section 4.2.

## 4.4 Operating and Maintenance Costs

This report addresses the viable wastewater servicing options and establishment costs for bulk wastewater infrastructure to service the potential urban growth. Operating and maintenance cost estimates have not been developed, as agreed with Watercare on the 2nd of August 2013.

While many of these costs will be similar between options, there will however be some significant differences. For the purposes of comparing options at this time, relative operating and maintenance costs can be taken to be proportional to capital costs in most instances.

Table 4-2 gives quantitative high level comments highlighting these key differences and how they would affect the NPV when annual operating as well as staged capital costs were included in a full (i.e. capital and operating and maintenance) NPV.

**Table 4-2: Annual Operating and Maintenance Cost Differences**

Component of Option	Indicative Difference Between Sector Options This will also depend on the strategy option for each sector option	Effect of the Differences on the full NPV
Within a Growth Area <ul style="list-style-type: none"> <li>Reticulation costs</li> <li>Conveyance costs</li> </ul>	Same / similar	No/little difference
Network conveyance	Option 1A – } Proportional to scale of Option 1B – } pumping and pipeline Option 2A – } length. Highest for Option 2B } Options 1A/1B. Lowest Option 3 – } for Options 2A/2B Option 4 – }	} No/little difference
Treatment including Sludge Management and Disposal/Reuse	<u>Options 1A &amp; 1B</u> Lowest cost options as only one Pukekohe WWTP plant to operate. This will also include efficiencies of scope of operating the existing WWTP on this site.	Lowest so least effect as NPV.
	<u>Option 2A &amp; 2B</u> Significantly greater than Options 1A and 1B as two WWTP's to operate, one being a completely new WWTP at the Hingaia site.	Significantly greater than Options 1A & 1B so more effect on NPV than those options.
	<u>Option 3</u> Similar to Options 2A and 2B.	Similar to Options 2A & 2B.
	<u>Option 4</u> Highest cost of the Options as three WWTP's to operate, two of which are new plants on new sites.	Highest so most effect on higher NPV.
Treated Wastewater Discharge / Disposal (includes monitoring costs)	<u>Options 1A &amp; 1B</u> With only a single Waikato River discharge this is clearly expected to be the lowest costs, although if a tidal discharge was required and not required for Option 2A costs could be similar to 2B and (2A?).	Lowest cost hence lowest effect on increasing the NPV.
	<u>Option 2A &amp; 2B</u> With two water discharges (Waikato River and Manukau Harbour) this would be a significantly higher cost than Option 1A and 1B.	
	<u>Option 3</u> Likely to be the highest of all options or similar to Option 4 depending to a large extent on the pumping (energy) and monitoring costs for a large land application area.	Highest hence most effect on producing a high NPV.
	<u>Option 4</u> Likely to be between Options 3 (highest) and Options 2A and 2B.	Effect on NPV. Between Option 3 and Option 2A & 2B.

## 4.5 Consenting and Approvals

Each option has a different consenting and approvals requirement. Experience shows consenting new wastewater discharges and land application areas, particularly for larger discharges into more confined areas as compared to the open sea for example, is usually a long and expensive process. Similar issues

apply to securing land for treatment plants and land application areas. Small areas for pumping stations and other infrastructure requirements can also be quite an involved and costly process.

In Section 7, Table 7-6 sets out a summary of the main consents and approvals likely to be needed for each option and compares, at a high level, the various options in terms of consent and approval needs and the possible comparative ease or difficulty in obtaining these consents and approvals. Land acquisition (or securing long term lease if that was acceptable, could be a (very) difficult activity with Public Works Act acquisition being necessary for some parcels of land.

## **4.6 Early and Interim Provision of Services for Individual Growth Areas**

Collection reticulation and trunk infrastructure inside Growth Areas is not included in this study, because it is funded by developers and does not require funding by Watercare.

Development of Growth Areas may proceed in a manner that interim systems are required. This may particularly apply where early development is at the outer limits of the Growth Areas. Temporary pump stations or pipelines may then be required to connect to the bulk wastewater services, to be replaced once other development proceeds. Package treatment plants and local disposal systems may be needed where areas of land are developed in advance of being able to connect to the bulk wastewater infrastructure. These interim systems would be funded by developers, and are excluded from the options and cost estimates included in this report.

## 5 Staging Assessment of Sector Based Options

### 5.1 Staging Framework

A framework was developed for assessing options for staging development of the bulk wastewater system including bulk conveyance, treatment and disposal/discharge, based on financial NPV of estimated capital costs. It is highlighted that the NPV calculations do not include for annual operating and maintenance costs as determination of these is outside the scope of this project.

This framework is based on alternative concepts for the pattern of wastewater infrastructure development, to assess whether there are significant differences between options. The assessed options are considered to cover the range of possible staging methods, between options that are most cost-effective for development of bulk wastewater infrastructure and others that are less cost-effective but would allow for alternative patterns of urban development. Actual infrastructure staging is likely to differ from these options, but this framework is intended to demonstrate potential differences in the cost-effectiveness of different approaches to staging.

The staging options are based on the following alternative approaches:

- servicing urban development sequenced from Pukekohe WWTP towards Drury, or
- servicing progressive urban development in all areas, or
- servicing urban development sequenced from Drury towards Pukekohe.

A base case is also included for comparison where the development of all infrastructure occurs at year 0.

Staging in up to 3 steps over a 30 year time period. Where feasible 10 year increments have been allowed for. In some cases, fewer steps are feasible or time increments cannot be matched to equal even 10 year time periods. Population growth and associated increase in wastewater flows are assumed to be at a constant rate over a 30 year development period.

Physical development of the main components of wastewater infrastructure is able to be staged as follows:

- Bulk conveyance – by individual components servicing different sectors (with timing of stages based on population increase at a constant rate, resulting in irregular time increments for stages).
- Treatment – by treatment modules according to increases in wastewater flows with population increase (7 additional treatment components are to be constructed, each comprising 2 SBR units). Modular SBR units are being used for this project. Actual WWTP implementation may differ as to the precise secondary biological treatment processes used.
- Disposal/Discharge – a single stage of developing outfalls was assumed, but land disposal was assumed to match the staging of treatment modules.

### 5.2 Capital Cost Estimates – Net Present Value Basis

#### 5.2.1 Capital Cost Estimates and NPV Assumptions

The NPV of each staging option was estimated based on the following assumptions:

- Indicative capital costs as identified in Section 4.2
- Construction of the staged works are assumed to occur in the financial year required for implementation – e.g. initial works are assumed to be constructed in Year 1
- Construction cost inflation at 5% per annum
- Financial discount rate at 8% per annum
- Population increase and land development occur at a constant rate over the 30 year development period
- A maximum of 3 stages for staging any component
- Staging of treatment and disposal infrastructure occurs in 3 steps at Year 1, Year 10 and Year 20 in proportion to the anticipated population increase over the subsequent 10 years

- Staging of conveyance systems occurs in 2 or 3 steps as needed to allow development in the areas for servicing
- Staging of land discharge or outfalls occurs in a single step at the time required for the initial treatment plant development
- A long harbour outfall is required for discharge from a new Drury WWTP into the Manukau Harbour – this assumption is made because obtaining consent for a tidal discharge is likely to be more difficult.

The following table summarises the NPV of the alternative approaches to staging each option.

For clarity and to aid comparison, indicative capital costs and NPVs are shown as rounded figures as follows:

- Indicative capital costs rounded to the nearest \$10million
- NPV rounded to the nearest \$1million.

**Table 5-1: Summary of Staging Costs**

Scenario					
Option No.	Description	Staging Option	Staging Approach	Indicative Capital Cost (2013)	Net Present Value for Staged Implementation
1A	Single Sector Approach – All treatment at Pukekohe WWTP	1A-1	Servicing sequenced development from Pukekohe WWTP towards Drury	\$380,000,000	\$314,000,000
		1A-2	Servicing progressive development in all areas		\$337,000,000
		1A-3	Servicing sequenced development from Drury towards Pukekohe		\$342,000,000
		1A-4	No staging		\$380,000,000
1B	Single Sector Approach – All treatment at Pukekohe WWTP	1B-1	Servicing sequenced development from Pukekohe WWTP towards Drury	\$410,000,000	\$330,000,000
		1B-2	Servicing progressive development in all areas		\$362,000,000
		1B-3	Servicing sequenced development from Drury towards Pukekohe		\$365,000,000
		1B-4	No staging		\$410,000,000
2A	Dual Sector Approach – Two treatment sites	2A-1	Servicing sequenced development from Pukekohe WWTP towards Drury	\$390,000,000	\$329,000,000
		2A-2	Servicing progressive development in all areas		\$344,000,000
		2A-3	Servicing sequenced development from Drury towards Pukekohe		\$311,000,000
		2A-4	No staging		\$390,000,000
2B	Dual Sector Approach – Two treatment sites	2B-1	Servicing sequenced development from Pukekohe WWTP towards Drury	\$390,000,000	\$325,000,000
		2B-2	Servicing progressive development in all areas		\$345,000,000
		2B-3	Servicing sequenced development from Drury towards Pukekohe		\$312,000,000
		2B-4	No staging		\$390,000,000
3	Dual Sector Approach – Two treatment sites, including land disposal	3-1	Servicing sequenced development from Pukekohe WWTP towards Drury	\$550,000,000	\$475,000,000
		3-2	Servicing progressive development in all areas		\$500,000,000
		3-3	Servicing sequenced development		\$475,000,000



Scenario					
Option No.	Description	Staging Option	Staging Approach	Indicative Capital Cost (2013)	Net Present Value for Staged Implementation
			from Drury towards Pukekohe		
		3-4	No staging		\$550,000,000
4	Tri Sector Approach – Three treatment sites	4-1A	Servicing sequenced development from Pukekohe WWTP towards Drury	\$460,000,000	\$390,000,000
		4-1B	Servicing sequenced development from Pukekohe WWTP towards Drury (Alternative)		\$389,000,000
		4-2	Servicing progressive development in all areas		\$407,000,000
		4-3	Servicing sequenced development from Drury towards Pukekohe		\$373,000,000
		4-4	No staging		\$460,000,000

### 5.3 Ranking of Options from an NPV Capital Cost Basis

Comparison of the indicative capital costs and the NPVs for the staged options shows:

- Although the indicative capital costs for all options for disposal to water (Options 1A, 1B, 2A, 2B) are similar, the lowest cost option is Option 1A as a single sector development for all treatment at Pukekohe WWTP
- The lowest NPV for staged development of the wastewater infrastructure is Option 2A for sequenced development from Drury towards Pukekohe – however, this is only marginally lower than alternative sequencing of both Option 2A and Option 1A from Pukekohe towards Drury
- The lowest NPV for each option is achieved if the development of wastewater infrastructure is staged from the location of the WWTP to more distant serviced areas
- The method of staging does not have a significant effect on NPV – the variation in NPV is only 10% across the range of staging options.

## 6 Wastewater Treatment and Discharge

### 6.1 Wastewater Treatment

#### 6.1.1 Approach

The approach used for estimating treatment requirements has been based on the existing sequencing batch reactor (SBR) biological nutrient removal (BNR) treatment process and treatment standards at Pukekohe WWTP. MWH experience and knowledge of the characteristics of treated wastewater from biological nutrient removal processes was used to create Table 6-1. Included for comparison in this table are typical characteristics for treated wastewater from other treatment systems types (natural systems and carbonaceous systems).

The quality of treated wastewater expected from a BNR is higher than the consent conditions in the existing Pukekohe WWTP and Mangere WWTP discharge consents, as shown in Table 6-1.

**Table 6-1: Typical Treated Wastewater Characteristics**

		Total Suspended Solids TSS	Biological Oxygen Demand cBOD5	Total Nitrogen TN Year Round	Total Ammonia	Dissolved Reactive Phosphorous DRP	Total Phosphorous TP	Dissolved Oxygen	Oil and Grease	Enterococci Bacteria	Faecal Coliforms FC (organisms/100 ml sample)	
		g/m <sup>3</sup>	g/m <sup>3</sup>	g/m <sup>3</sup>	g/m <sup>3</sup>	g/m <sup>3</sup>	g/m <sup>3</sup>	% Saturation	g/m <sup>3</sup>	Cfu/100ml	Without UV Disinfection	With UV Disinfection
Typical Raw Domestic Sewerage	Median	280	280	50		9	12				log 7	All can achieve log 2 UV dose varies
Natural System Treated Wastewater	Median	100	50	30		8	9				log 3	
Carbonaceous Treatment System Treated Wastewater	Median	10	10	40		6	8				log 5	
BNR Treatment System Treated Wastewater	Median	10	10	7		1	1.5				log 4	
Pukekohe WWTP (Current Consent to be confirmed)	90 percentile	18	12	10			8				1,000	
	Maximum	20	15	15			10				10,000	
Mangere WWTP (After tidal storage basin) (Current Consent to be confirmed)	Maximum Monthly Mean	15	15	Winter - 35 Summer - 9.5	Winter - 5 Summer - 3	9	Record Only	80	0.5	35	80	
	95th percentile over 3 months	30	30							100	250	
	Maximum		50		Winter - 15 Summer - 6							

The proposed upgrade to the Pukekohe WWTP is through the use of modular SBR cells, similar to existing. This upgrade approach has been the basis of a recent AECOM consultant's report investigating the indicative cost to upgrade the Pukekohe WWTP for stated projected flows. For consistency the same size modular approach has been used in this report but in practice a larger (less modules) and/or continuous inflow BNR treatment process would be preferable, as it would be expected to be of lower cost.

The modular approach taken is a conservative approach to estimating the indicative cost because, as stated above for larger WWTP's, the cell size of an SBR plant is likely to be increased or a continuous inflow BNR type treatment process or other secondary processes would be used.

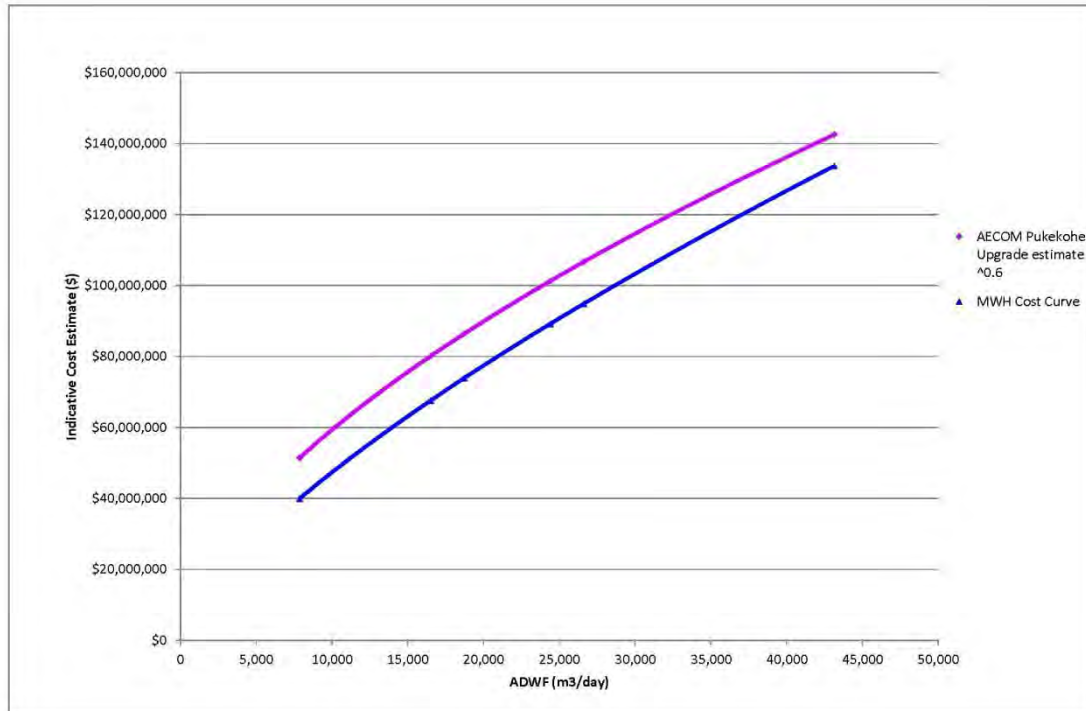
The existing two cell SBR system at Pukekohe WWTP is sized for an ADWF of approximately 6,000m<sup>3</sup>/day. This base was used to determine the number of cells required for each option. The flowrates are estimates only and for staging purposes the number of cells has been rounded to the nearest multiple of two, as shown in Table 6-2.

**Table 6-2: Number of Pukekohe equivalent SBR cells required to treat flow to treatment plant for each option**

Sector Option	Flowrate	Treatment		
	ADWF (m <sup>3</sup> /day)	Plant	Number of SBR	Assumed number of SBR cells (rounded)
1A	43,141	Pukekohe WWTP	14.4	14 cells
1B	43,141	Pukekohe WWTP	14.4	14 cells
2A	24,410	Pukekohe WWTP	8.1	8 cells
	18,731	Drury WWTP	6.2	6 cells
2B	16,528	Pukekohe WWTP	5.5	6 cells
	26,613	Drury WWTP	8.9	8 cells
3	16,528	Pukekohe WWTP	5.5	6 cells
	26,613	Land Application WWTP	8.9	8 cells
4	16,528	Pukekohe WWTP	5.5	6 cells
	7,882	Land Application WWTP	2.6	2 cells
	18,731	Drury WWTP	6.2	6 cells

When comparing the cost of wastewater treatment plants two sources of data were used, the MWH WWTP capital cost curve (as in Appendix C) and the recent AECOM Pukekohe WWTP Upgrade cost estimate. The industry standard for the scaling of WWTP costs to include scales of economy is a power law method using ADWF (volume) to the power of 0.6. The two approaches are compared as shown in Figure 6-1 using the AECOM Pukekohe Upgrade cost estimate and power law gives a higher indicative cost estimate than the MWH cost curve. This difference is likely due to the AECOM Pukekohe Upgrade cost estimate including extra geotechnical costs not usually seen at other wastewater treatment plants. As this is a high level assessment the higher indicative cost estimate produced by AECOM has been applied. Further geotechnical investigations may reduce the construction costs.

Figure 6-4 shows a 3D image of the location of the Drury WWTP site. This view shows the former Papakura WWTP oxidation pond that was on the site but has since been decommissioned. This image shows the sizable buffer zones to existing residential development. The site is still designated for sewage treatment purposes.



**Figure 6-1: Extrapolated AECOM Pukekohe Upgrade cost estimate in comparison to the MWH cost curve**

The existing Pukekohe WWTP (Figure 6-2) adjacent to Parker Lane, south of Pukekohe has been adopted as a potential site for the expansion of wastewater treatment capacity. This site (designation number 110) as shown in Appendix D is currently designated as a sewage treatment facility with an area of 58.07ha. An adjacent site with designation number 109 is designated as a contaminated site as it is a closed landfill.

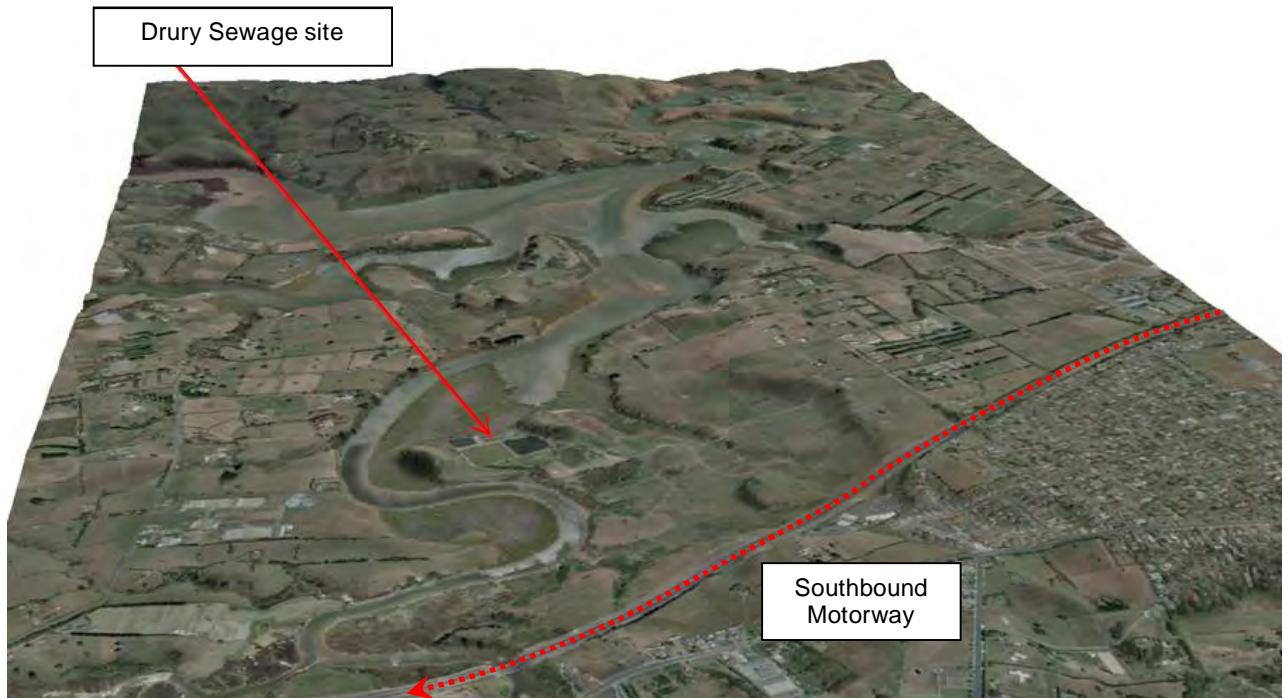


**Figure 6-2: Pukekohe WWTP site**

A new Drury WWTP (as included in Options 2A, 2B and 4) would be sited on the existing land designated in the Papakura District Plan and Draft Auckland Unitary Plan as a Sewage Treatment Plant, as shown in Appendix D. The proposed land is currently the site of the Hingaia pump station but was previously a wastewater treatment plant as shown in Figure 6-3. Figure 6-4 shows the elevation of the plant and the adequate separation from residential areas and other developments.



**Figure 6-3: Aerial image of Drury WWTP (2006)**



**Figure 6-4: 3D image of the location of the Drury WWTP with vertical exaggeration x3**

Sludge treatment has been allowed for at each of the WWTP sites included in the options. There are however some alternative options, particularly for a new Drury WWTP. A liquid only plant could be established with the sludge (in the form of waste activated sludge) discharged from the existing Hingaia pump station back into the Mangere network for subsequent removal and treatment at the Mangere WWTP. This type of approach is being used to an increasing extent in the USA and other countries with the centralisation of sludge facilities for (sub) regional plants.

Similarly, if any temporary or interim package type plants were required in specific Growth Areas to cater for early development prior to the permanent Watercare servicing option was installed (refer Section 4.6) then similar type approaches may be appropriate for conveyance by pipe or (tanker or waste bin) truck of waste sludge to the Pukekohe WWTP and / or Mangere WWTP, or even a new Drury WWTP if it was in existence by then.

### 6.1.2 Assumptions

A number of assumptions have been made when considering the new WWTPs and upgrades to Pukekohe WWTP that form part of respective options.

- There is sufficient available and designated land at the Pukekohe WWTP to accommodate an expended treatment process to service the entire study area. Previous geotechnical studies have shown issues with the ground conditions at the site which would need to be overcome for the expansion of the plant. The estimated costs are considered sufficient to cover this situation.
- Flows from the existing Hingaia pump station can be diverted to the southern system in the short term, if required to provide minimum and flushing flows in the new trunk network pipelines.
- The former Hingaia treatment plant site (current site of the Hingaia pump station) is taken as the potential site for any new/temporary treatment plant to serve the study area around Drury. It is noted that resource consent for a discharge in this location may be difficult to obtain (refer Section 4.5 and Section 7), however the land is already designated as a sewage treatment facility.
- The conveyance of wastewater flow from Pukekohe Growth Areas 5, 6, and 7 to any wastewater treatment plant north of Pukekohe has not been considered in any option.

As these Growth Areas are an expansion of the existing Pukekohe area it is assumed that it will be most sensible and cost effective to join the Growth Areas to the existing Pukekohe wastewater network and therefore convey the flows to the Pukekohe WWTP.

- The proposed Drury South Business Area (also known as Stevenson's Quarry) is included in the Drury network area; the wastewater treatment plants have been sized to include this industrial flow at estimated quantities as set out in Section 3.
- The growth of Pokeno, Tuakau and Patumahoe has been included in the sizing of the Pukekohe WWTP.  
Despite being located in the Waikato Region Pokeno and Tuakau are to be serviced by Watercare at the Pukekohe WWTP.
- Patumahoe is currently connected to the Pukekohe wastewater network and growth is expected in the area.

## 6.2 Treated Wastewater Discharge to Water

### 6.2.1 Approach

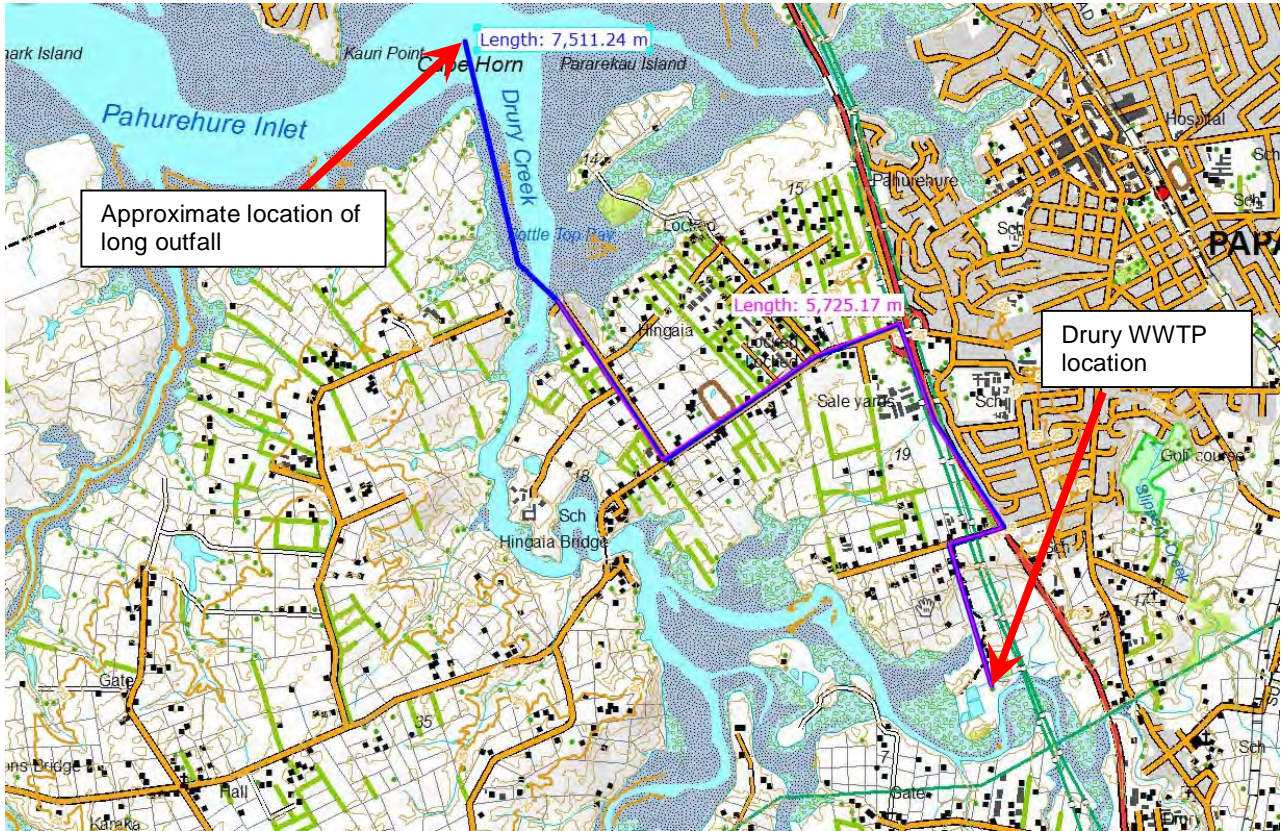
As discussed in Section 6.1 the treated wastewater discharge from WWTPs included in the options being developed is to a quality similar to the Pukekohe WWTP (Waikato River) and Mangere WWTP (Manukau Harbour). Based on this assumption, the treated wastewater from an upgraded Pukekohe WWTP would continue to be discharged to the Waikato River. The treated wastewater from a new Drury WWTP would be discharged to the Manukau Harbour.

Currently the Pukekohe WWTP discharges to the Waikato River via Parker Lane Stream as shown in Figure 6-2, for a substantially larger flow from a significantly expanded WWTP, a new outfall pipe and diffuser structure in the river would need to be constructed. This structure would comprise of a pipe from the WWTP to a multi-port diffuser in the river. The discharge of treated wastewater from the Pukekohe wastewater treatment plant to a tidal discharge in the Waikato has not been considered in any of the options but could be a feasible alternative as the tidal reach is within reasonable distance of the WWTP discharge point.

Two options have been identified for discharge from a new Drury WWTP into the Manukau Harbour; a long harbour outfall and an outgoing tidal discharge outfall. These locations have been assumed to be appropriate for discharge; no investigation has been made into the environmental effects or any other potential effects. The locations were selected on the assumption that with the appropriate treated water quality and discharge regime they are viable options for consenting.

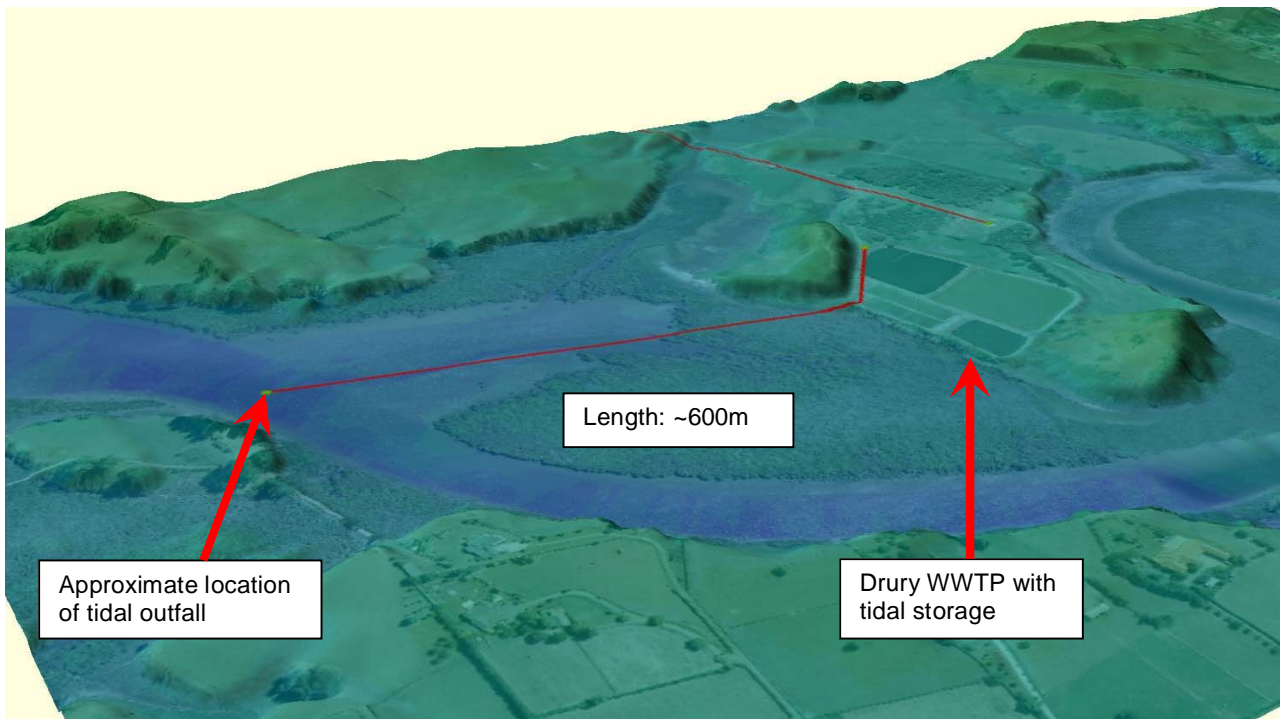
The long harbour outfall would be approximately 7.5km long, crossing approximately 5.7km of land before extending into the harbour for approximately 2km where the water is assumed to be sufficient for continuous discharge. This approximate location is shown in Figure 6-5.





**Figure 6-5: Approximate route of long outfall option from Drury WWTP to the Manukau Harbour**

The outgoing tidal outfall would be approximately 600m long and would require a tidal storage basin on the WWTP site. From inspection the designated WWTP site has adequate space to accommodate the tidal storage basin. From historical aerial photos it can be seen that the discharge point as shown in Figure 6-6 is tidal and supplemented by river flow.



**Figure 6-6: Approximate tidal outfall route from Drury WWTP to the Manukau Harbour**

### 6.2.1 Assumptions

It is assumed that all locations for discharge to water are able to be consented at the standard of discharge achievable from a modern and well operated BNR process. The environmental effects assessment of this is however beyond the scope of this project.

## 6.3 Treated Wastewater Application to Land

The cost of disposal of treated wastewater to land is highly dependent on the market cost of the large land take required. The cost estimate for this land is indicative only as it is based on 2013/2014 capital value obtained from the Auckland Council GIS viewer. It is to be expected that the capital value of the land in the area will fluctuate in the future and consequently this could have significant impacts on the overall cost of the disposal to land scheme.

### 6.3.1 Approach

Data used for the land application (disposal) indicative sizing and cost estimates are a combination of data from MWH Waikato region wastewater projects, estimates for treatment at Kingseat by Beca, and the NIWA Waikato River Scoping Report information.

The required land application is based on the following parameters:

Soil Type	Silty and Sandy Loams
Permeability	0.5 – 1.5 m/day
Design infiltration rate (DIR)	4 mm/day

These parameters are consistent with the Beca Kingseat wastewater land application assessment and MWH work undertaken on similar types of soils in the Waikato region. Extensive onsite investigations are required to establish appropriate hydraulics, and if governing, nutrient (nitrogen) loading requirements to more precisely establish land requirements. The MWH disposal to land information is included in Appendix E.

Buffer zones were estimated at 20% for Option 3 and 30% for the smaller area in Option 4. Option 3 has a significantly larger land area and therefore the buffer zone is a smaller percentage of the land. The indicative land area required is:

Option:	Average Daily Volume m <sup>3</sup>	Area Required -including Buffer (ha), rounded
<b>3</b> Dual Sector Approach – Discharge to Waikato River, disposal to land	26,613	800
<b>4</b> Tri Sector Approach – Discharge to Waikato River, Manukau Harbour, disposal to land	7,882	250

Note : The assessment used average daily flow, further assessment would be needed in respect to prolonged wet periods and the need, or otherwise, for a (extreme) wet weather treated wastewater discharge direct to water.

Figure 6-7 illustrates a representative rural area near Karaka. The area highlighted has been identified simply to provide base data for this evaluation. Further detailed site investigations will need to be undertaken to confirm whether this area is suitable for disposal to land.

Using Auckland Council GIS the area and capital cost of properties inside the highlighted area were identified and reviewed.

For simplicity the property size was rounded to the nearest hectare and properties less than 0.5ha in area were removed. This resulted in a table with the number of properties at each property size up to the largest at 216ha in area. The distribution of property sizes was graphed and is presented in Appendix F. A number of properties within the sample area were identified as having erroneous data; high CV data compared to the property area, or inaccurate areas. These properties were removed from the analysis.

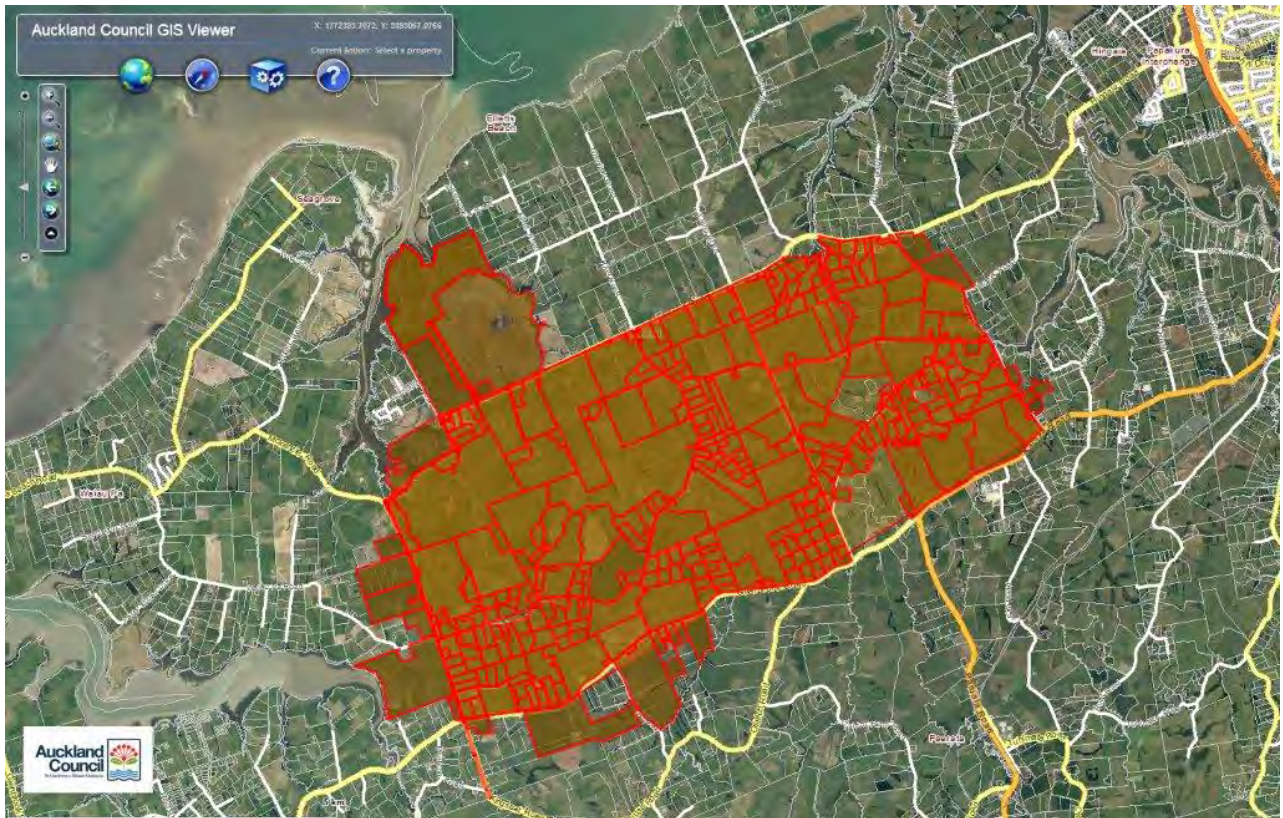
A likely cost per hectare of land was determined by the following method:

- The capital value of each property was converted to capital value per hectare then this was used to find the average capital value per hectare for a property size.
- The total capital value in the representative area was calculated, and used to calculate an average capital cost per hectare as the base cost for land purchase
- The number of properties likely to be required to be purchased for any disposal was estimated as a mix of property sizes in the same proportion as those in the selected area.
- A solatium payment of \$50,000 as per the Public Works Act 2013 amendment was applied to the number of properties thus expected to make up the required disposal site.

Risk and contingency allowance of 40% were added to the base cost and solatium payment, consisting of:

- Unknown items (10%)
- Design contingency (10%)
- Market / cost contingency (10%)
- Construction contingency (10%).

No other allowance has been made for future fluctuations in the market capital value of land. It is noted that land sales in this vicinity in the 3 months prior to this report have averaged 13% above capital value.



**Figure 6-7: Area used to estimate the cost of purchasing land for the application of treated wastewater**

Note: this is not the area required for land disposal, it is only an arbitrary area chosen to find the distribution of property sizes and capital value in the region.

### 6.3.2 Assumptions

It is assumed that disposal to land is able to be consented at the standard of discharge achievable from a BNR process together with UV disinfection, but assessment of this is beyond the scope of this project.

Areas identified for possible land application are only very indicative in their location, for the purposes of comparison against other treatment and discharge options. It is assumed that a site for land application

is technically feasible in the general vicinity of Karaka, but consenting assessment of this together with assessment of the long term secure availability of the land is beyond the scope of this project. Section 4.5 and Section 7 discuss consenting and approach matters as to how they are likely to compare between Options.

It is assumed that application of treated wastewater to land is a suitable technology, without investigation into the potential effects on ground water and surface waters which flow towards the Manukau Harbour, or the effect on bores for potable water, stock water and other water supply purposes. One significant potential issue will be long term nutrient build-up, particularly for nitrogen. The assessment of this is beyond the scope of this study.

## 7 Key Findings and Comparison of Options

### 7.1 Key Overall Findings

The key findings of this assessment are:

- The indicative capital cost for establishing bulk wastewater infrastructure to service possible growth in the Southern RUB is in the range of \$360-550million, depending on the option adopted. The configuration of the bulk wastewater network does not significantly affect the likely capital cost of the infrastructure.
- The higher range costs are for options using land disposal, as a result of the additional cost for land purchase. If land disposal is not considered then the indicative capital cost for establishing bulk wastewater infrastructure to service possible growth in the Southern RUB is in the range of \$360-410million. It should be noted that there is also a significant risk of the costs of land purchase being higher than estimated as a result of changed market conditions.
- The indicative capital costs for all options for disposal of wastewater to water are similar, with approximately 10% variation in capital cost across the range of options.
- If a tidal discharge to Manukau Harbour is able to be consented, the option with the lowest indicative capital cost involves treatment of wastewater at two sites (the Pukekohe WWTP with discharge to the Waikato River, and a new WWTP near Drury with discharge to Manukau Harbour). If a tidal discharge to Manukau Harbour is not able to be consented, the option with the lowest indicative capital cost is for treatment of all wastewater at the site of the Pukekohe WWTP, and discharge to the Waikato River. There is a higher risk associated with gaining consents for a new WWTP and harbour discharge.
- The lowest NPV for staged development is for an option involving treatment of wastewater at two sites – the Pukekohe WWTP with discharge to the Waikato River, and a new WWTP near Drury with discharge to Manukau Harbour. However, this is only marginally lower in NPV cost than the option to treat all wastewater at Pukekohe WWTP.
- The lowest NPV for each option is achieved if the development of wastewater infrastructure is sequenced from the location of the WWTP towards more distant serviced areas.
- The method of staging does not have a significant effect on NPV. Variation in NPV is only 10% across the range of staging options considered, and all staging options give a similar benefit of approximately 15-20% discount from the capital costs of constructing all infrastructure at the beginning of the development.

### 7.2 Summary Comparison of Options

The following tables cover other matters for reference in any future planning of wastewater infrastructure to service urban development in the Southern RUB study area.

**Table 7-1: Key Findings and Comparisons – Individual Options**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
Capital Cost		Lowest if short outfall not possible for Option 2B			Lowest if short outfall possible	Highest	High
Ease of consenting		Best	Best	More difficult than 1A and 1B	More difficult than 1A and 1B	More difficult than 1A and 1B	Most difficult – more consents needed than other options
Need for pumping		Greatest	Greatest	Least	Least	TBD	TBD
Early servicing of potential growth		Best	Best	Delays possible in obtaining consents	Delays possible in obtaining consents	Delays possible in obtaining consents	Delays possible in obtaining consents
Requirement for land purchase		Low	Low	Low	Low	Highest	High
Able to be staged		Similar	Similar	Similar	Similar	Similar	Similar

**Table 7-2: Key Findings and Comparisons – Option Staging**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
NPV for sequencing development from Pukekohe WWTP towards Drury		Lowest				Highest because of high capital cost	High because of high capital cost
NPV for sequencing development from Drury towards Pukekohe				Lowest	Lowest	Highest because of high capital cost	High because of high capital cost
NPV for sequencing progressive development in all areas		Lowest		Slightly higher than 1A	Slightly higher than 1A	Highest because of high capital cost	High because of high capital cost
Suitable for sequencing development from Pukekohe WWTP towards Drury		Good	Adequate	Adequate	Adequate	Adequate	Good
Suitable for sequencing development from Drury towards Pukekohe		Adequate	Adequate	Good	Good	Adequate	Good
Suitable for sequencing progressive development in all areas		Good	Adequate	Good	Good	Good	Good

**Table 7-3: Key Findings and Comparisons – Indicative Costs**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
Total Indicative Capital Cost relative to other options		Lowest if short outfall not possible for Option 2B			Lowest if short outfall possible	Highest	High
Pipelines Capital Cost relative to other options		Medium	Highest	Low	Lowest	Low	Lowest
Pumping Station Capital Cost relative to other options		Highest	Highest	Lowest	Medium	Highest	Lowest
Treatment Capital Cost relative to other options		Lowest	Lowest	High	High	High	Highest
Discharge/Disposal Capital Cost relative to other options		Lowest	Lowest	Medium	Medium	Highest because of land cost	High because of land cost
Land purchase cost relative to other options		Low	Low	Low	Low	Very High	High
Operating and maintenance cost		Lowest because single treatment site	Lowest because single treatment site	Higher because 2 treatment sites	Higher because 2 treatment sites	Higher because 2 treatment sites	Highest because 3 treatment sites



**Table 7-4: Key Findings and Comparisons – Environmental Type Considerations / Factors**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
<b>1) Construction and Operating of Infrastructure Adverse Effects</b>							
<ul style="list-style-type: none"> <li>• Disruption (Traffic/access etc)</li> </ul>		More	Lowest (pipeline )	More	More	More to most	Most
<ul style="list-style-type: none"> <li>• Traffic</li> </ul>		Low	Lowest	More	More	More	More to most
<ul style="list-style-type: none"> <li>• Noise</li> </ul>		Low	Lowest	More	More	Most similar to Option 4	Most similar
<ul style="list-style-type: none"> <li>• Dust Fumes etc</li> </ul>		Low	Lowest	More	More	Most	Between Options 2A & 2B and Option 3
<ul style="list-style-type: none"> <li>• Water Quality Effects</li> </ul>		Lowest	Lowest	More	More	More/most	More / most
<b>2) Built Infrastructure Adverse Effects</b>							
<ul style="list-style-type: none"> <li>• Visual effects (structures etc)</li> </ul>		Lowest	Lowest	More	More	Most	Between Options 2A & 2B and Option 3
<b>3) Treated Wastewater Discharge/Disposal Potential/Actual Adverse Effects</b>							
<ul style="list-style-type: none"> <li>• Effects on surface water quality/ecology</li> </ul>		Only on lower Waikato River.	Only on lower Waikato River.	Both on Waikato River and Manukau Harbour with possibly more for a tidal discharge to Manukau Harbour.	Both on Waikato River and Manukau Harbour with possibly more for a tidal discharge to Manukau Harbour.	On lower Waikato River and land application run off to surface water.	On lower Waikato River, Manukau Harbour and any run off to surface water from smaller land application.
<ul style="list-style-type: none"> <li>• Effects on groundwater quality (including water supplies)</li> </ul>		Minimal	Minimal	Minimal	Minimal	Potentially significant (large) from land application.	Some/significant from land application.

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
<ul style="list-style-type: none"> <li>Effects on land use</li> </ul>		Minimal	Minimal	Minimal except Drury WWTP site.	Minimal except Drury WWTP site.	Extensive from land application area.	Significant from (smaller) land application area.
<ul style="list-style-type: none"> <li>Effects on soils</li> </ul>		Minimal	Minimal	Minimal except Drury WWTP site.	Minimal except Drury WWTP site.	Could be significant over time in land application area.	Could be significant over time in land application area.
<ul style="list-style-type: none"> <li>Effects on recreation/commercial activities</li> </ul>		Probably lowest, could affect so usage in Waikato near discharge point.	Probably lowest, could affect so usage in Waikato near discharge point.	Some in Manukau Harbour and Waikato River.	Possibly more than Option 2A because of tidal discharge arrangement.	Potential loss of activities in Waikato River (and any) on the land application areas.	Potential loss on Waikato River (see Option 2A & 2B) plus some in Manukau Harbour and (any) on the smaller land application area.
<b>4) Contaminant (Odour Aerosol) Discharges to Air</b> <ul style="list-style-type: none"> <li>Potential/Actual Effect</li> </ul>		Lowest for odour.	Lowest for odour.	Low but two WWTP's.	Low but two WWTP's.	Significant especially for aerosol effects assuming spray irrigation at the land application area.	Significant (but less than Option 3) in terms of aerosol effects as less land area involved.

**Table 7-5: Key Findings and Comparisons – Social and Maori Culture**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
<b>1) Social</b>							
<ul style="list-style-type: none"> <li>Adverse/Effect on individual property values</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<ul style="list-style-type: none"> <li>Perception and stigma</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<ul style="list-style-type: none"> <li>Potential adverse public health effects</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<ul style="list-style-type: none"> <li>Effects on (private) water supplies</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<ul style="list-style-type: none"> <li>Effects of food gathering</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<ul style="list-style-type: none"> <li>Loss of recreation</li> </ul>		Refer to Environmental Considerations					
<ul style="list-style-type: none"> <li>Socio-economic well-being</li> </ul>		TBD	TBD	TBD	TBD	TBD	TBD
<b>2) Maori Culture</b>							
To be advised by iwi and hapu in the area. Specific key matters/concerns could include:		TBD	TBD	TBD	TBD	TBD	TBD

**Table 7-6: Key Findings and Comparisons – Consents and Approvals**

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
<b>1) Consents Required</b>							
<ul style="list-style-type: none"> <li>Treated wastewater discharge/disposal to water</li> </ul>	For discharge to the Waikato River	For discharge to the Waikato River	For discharge to the Waikato River and discharge to the Manukau Harbour	For discharge to the Waikato River and discharge to the Manukau Harbour	For discharge to the Waikato River and disposal to land	For discharge to the Waikato River, discharge to the Manukau Harbour and disposal to land	
<ul style="list-style-type: none"> <li>Treated wastewater contingency/extreme wet weather discharge to water</li> </ul>	Existing consent at Pukekohe WWTP increased	Existing consent at Pukekohe WWTP increased	Existing consent at Pukekohe WWTP increased, new consent for Drury WWTP discharge to Manukau Harbour	Existing consent at Pukekohe WWTP increased, new consent for Drury WWTP discharge to Manukau Harbour	Existing consent at Pukekohe WWTP increased, extreme wet weather may have to be diverted or stored at the land disposal site	Existing consent at Pukekohe WWTP increased, new consent for Drury WWTP discharge to Manukau Harbour, extreme wet weather may have to be diverted or stored at the land disposal site	
<ul style="list-style-type: none"> <li>Air discharge of contaminants</li> </ul>	Existing consent for Pukekohe WWTP	Existing consent for Pukekohe WWTP	Existing consent for Pukekohe WWTP, new consent for Drury WWTP	Existing consent for Pukekohe WWTP, new consent for Drury WWTP	Existing consent for Pukekohe WWTP, new consent for the land disposal irrigation area of 800ha	Existing consent for Pukekohe WWTP, new consent for Drury WWTP, consent for a smaller land disposal area of 250ha	
<ul style="list-style-type: none"> <li>Occupy and use structures (namely outfalls) in the Waikato River Coastal Marine Area (CMA) of Manukau Harbour.</li> </ul>	For new Waikato River outfall assuming that is required.	For new Waikato River outfall assuming that is required.	For new Manukau Harbour outfall and new Waikato River outfall <u>if</u> the latter is required.	For new Manukau Harbour outfall and new Waikato River outfall <u>if</u> the latter is required.	For new Waikato River outfall if that is required.	Yes for new Waikato River outfall if that is required and the new Manukau Harbour outfall.	
<ul style="list-style-type: none"> <li>Disposal of treated wastewater to land</li> </ul>	No	No	No	No	Yes for large land application area of 800ha	Yes for smaller land application area Of 250ha	
<ul style="list-style-type: none"> <li>Construction activities including earthworks.</li> </ul>	TBD	TBD	TBD	TBD	TBD	TBD	
<ul style="list-style-type: none"> <li>Other - TBA</li> </ul>	TBD	TBD	TBD	TBD	TBD	TBD	

COMPARISON FACTORS	OPTION	OPTION 1 Single Sector – Discharge to Waikato River		OPTION 2 Dual Sector – Discharge to Waikato River and Manukau Harbour		OPTION 3 Discharge to Waikato River and Disposal to Land	OPTION 4 Discharge to Waikato River, Manukau Harbour, Disposal to Land
		Option 1A	Option 1B	Option 2A	Option 2B		
2) <b>Notice of Requirement (Designations) Required (or alternatively put in place Land Use consents)</b>		Only for new (major) pumping stations and conveyance pipelines.	For new Manukau Harbour outfall and new Waikato River outfall if the latter is required.	For new Manukau Harbour outfall and new Waikato River outfall if the latter is required.	For new Manukau Harbour outfall and new Waikato River outfall if the latter is required.		
3) <b>Land Acquisition Required</b>		Maybe for pump station.	Maybe for pump station.	Maybe for pump station.	Maybe for pump station.	Yes extensive for approximately 800 ha for land application area unless long term secure leases could be optioned should Watercare consider such option.	Yes for approximately 250 ha.
4) <b>Possible Key Issues/Matters in Obtaining Consents. So overall Consentability Comparison</b>		Possibly the less difficult to consent.		The long outfall option would probably be less difficult than the tidal outfall. Outfalls to the Manukau Harbour are expected to be significantly more difficult to consent than a new outfall to the Waikato River.		Obtaining the land application consents could be difficult (significantly more difficult than all other options) matter as it would also require acquiring 800ha of land unless long term leases were acceptable to Watercare.	Similar difficulties for obtaining land application consents as option 3 but for a smaller area of 250ha. Similar difficulties as for options 2A and 2B for discharge to the Manukau Harbour.

## 8 Further and Future Assessment

### 8.1 General

This report is an initial high level scoping assessment. More detailed analysis will be required through future stages of project development including feasibility and options development, concept design, developed design, consenting and detailed design.

This report relies on a number of assumptions as noted. It will be necessary to review those assumptions and to undertake more specific work to update or confirm them as part of any further planning or implementation process.

### 8.2 Changes in Growth Projections

As outlined in Section 2.5 of this report, it is likely the growth projections will change over time and it is recommended that the wastewater options be re-assessed as the growth projections become more certain. This is due to:

- Changes to the growth areas identified in the Proposed Auckland Unitary Plan. This is due for public notification at the end of September 2013.
- Changes to the location of the RUB as a result of submissions adding or removing sites
- Changes to the densities and subdivision rules in the Auckland Unitary Plan
- The outcome of the two private plan changes currently being processed (the Drury South Business Land and Patumahoe expansion)
- Growth projections of Tuakau and Pokeno
- Any other private plan changes that may be progressed.

### 8.3 Growth Timing Projections Match to Option Staging

The assessment of staging options in this report is based on a simple model for the pattern and rate of urban development. As the planning for urban growth progresses further it is expected that the rate and timing of the development of individual areas will become better defined. It is recommended that the means of staging the development of wastewater infrastructure are reviewed and updated to respond to this.

### 8.4 Integration with Wastewater Servicing for Other Growth Areas

In the same manner as growth was identified by the Auckland Plan in the southern areas for investigation, the Auckland Plan identifies other areas of growth. The northern area of growth includes Warkworth and Silverdale, while north-west includes Kumeu-Huapai and Whenuapai.

Pukekohe was identified as one of two satellite towns for accommodating growth. Warkworth is the other. Many of the towns and villages identified for growth in the draft Auckland Unitary Plan have considerable wastewater constraints and would benefit from a similar assessment of wastewater servicing options. Such assessment would also assist in comparative assessment of issues in the Southern area considered in this report. As the Auckland Unitary Plan is drawing closer to the date of notification, there is increasing certainty as to the areas that are likely to be zoned for urban purposes and the population that can be accommodated.

## 8.5 Risk Assessment and Assumptions Testing

In terms of further and future assessments it will be of paramount importance that risk categorisation and evaluation procedures are established and addressed as further planning phases take place. Watercare's established Risk Management procedures would form the basis of this activity.

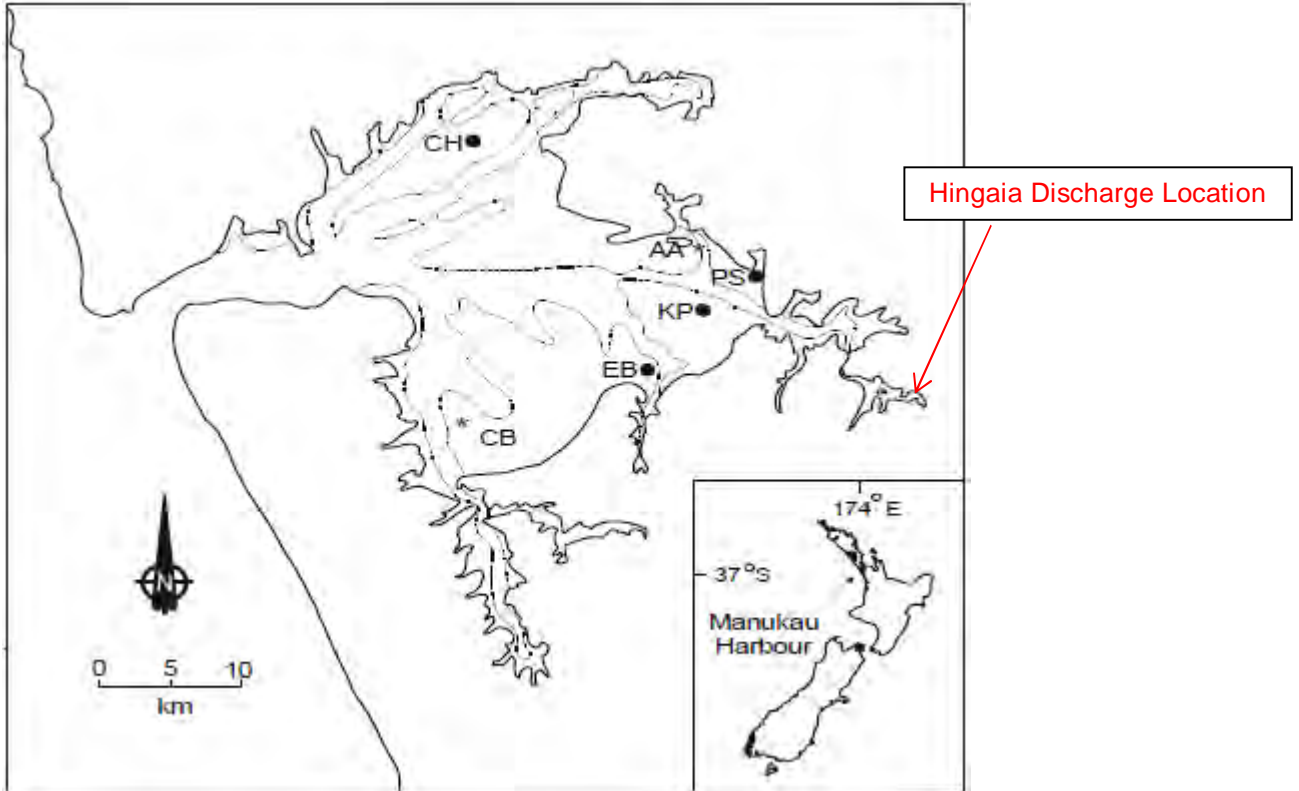
While it is outside the scope of this report to develop such procedures, it is important to raise this key future matter and based on the work included in the brief identify some key risk categories for further consideration. Such categories that have become evident to MWH while undertaking this project include:

- Actual growth not occurring at projected rates in relation to planned or constructed infrastructure. This further can result in operating difficulties such as the difficulties of low wastewater flows in new conveyance systems
- Waikato River Settlement Act and Co-Management procedures between Waikato Tainui and Waikato Regional Council, provide ever higher standard
- Land use challenges in the rural area such as for example possible increasing dairy in the vicinity of a land application area
- For the land application options (potential) groundwater contamination, particularly nitrogen, issues greater than may have been anticipated in early investigations.
- Environmental risks and impacts
- Financial risks and market variations
- Technology risks
- Design and construction risks
- Natural hazards
- Climate change impacts.

## 8.6 Environmental Investigations and State of Environment Reporting

The scope of this high level study (refer Section 1.2.above) does not include any specific environmental assessment of the three alternative treated wastewater receiving environments considered for treated wastewater discharge and disposal, namely Waikato River, Manukau Harbour and to land and also air contaminant discharges. Instead some key assumptions have been made in developing the Sector Based Options and in the staging of these, that the receiving environments could be acceptable with an appropriate degree of wastewater treated and air discharge, particularly odour, management and also with necessary attention to visual considerations of treatment plants and pumping stations and to operating factors such as traffic generation. As set out elsewhere in this report, discharge of treated wastewater to land may however be a more difficult option to consent and implement.

In view of the large size, scale and location of the growth being allowed for, it would be prudent for Watercare and Auckland Council to ensure all future environmental baseline monitoring in the vicinity of possible new treated wastewater discharges is tailored to provide sound information to input into future effects assessments that would be associated with new discharges. In this respect current monitoring under the Manukau Harbour Ecological Monitoring Programme (monitoring sites shown on Figure 8-1 below) which monitors sediment, water quality and certain living species with the aim of detecting detrimental effects on ecosystem health should provide an appropriate starting point for developing such a baseline monitoring programme.



**Figure 8-1: Map of Manukau Harbour showing Manukau Harbour Ecological Monitoring Programme monitoring sites**

Auckland Council also operates a water quality monitoring programme which monitors the following parameters at locations as shown on Figure 8-2:

- |                    |                          |                                |
|--------------------|--------------------------|--------------------------------|
| • Dissolved Oxygen | • Total Suspended Solids | • Soluble Reactive Phosphorous |
| • Temperature      | • Turbidity              | • Total Phosphorous            |
| • Salinity         | • Ammoniacal Nitrogen    | • Phytoplankton                |
| • Clarity          | • Nitrate Nitrogen       | • Enterococci                  |
| • pH               | • Nitrite Nitrogen       | • Faecal Coliforms.            |



**Figure 8-2: Auckland Council water quality monitoring programme monitoring points on the Manukau Harbour**

Additionally for the further consideration of land application options ground water, surface water and associated ecological baseline monitoring would be most appropriate in and down gradient of the locations under investigation.



Recreational and commercial activities in the general vicinity of possible new treated wastewater discharges should also be included in such baseline information collection.

## 8.7 Innovation and Future Changes in Wastewater Generation and Servicing

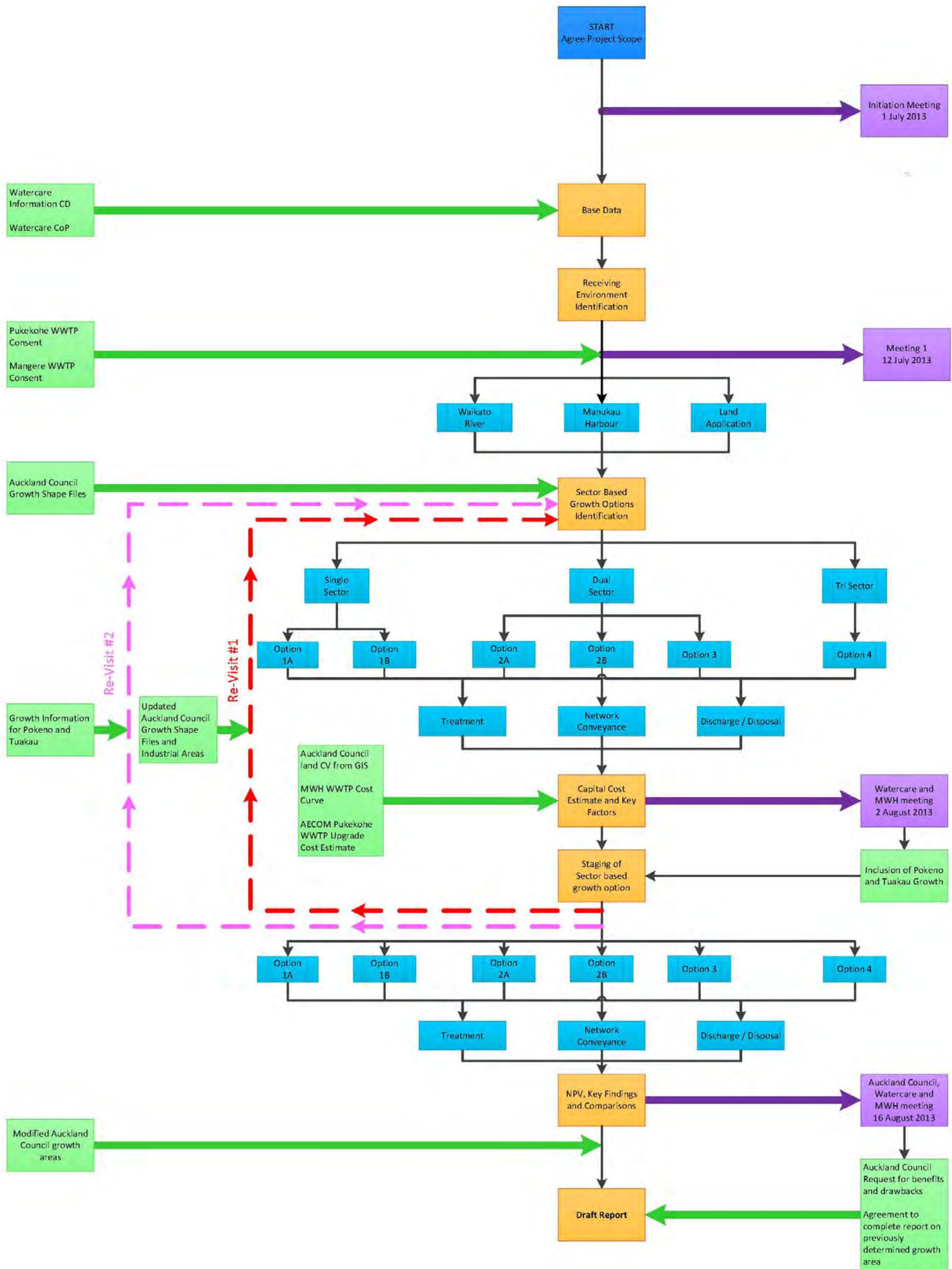
While this assessment of wastewater servicing options has been undertaken based on Watercare's best current practice and based on Watercare wastewater production figures and other Watercare and industry base information, it is both important and appropriate that in all future planning account is taken of innovation, new ways and changing trends. In this respect it is suggested that a 'living document' inventory of work is set up for these as part of future planning and assessment not only for this Southern Area of Auckland Council but also the North, West and other growth areas requiring new wastewater servicing.

This inventory would then be periodically reviewed and updated to incorporate new innovations and practices with the objective of having this information available for ongoing decision making input into future wastewater infrastructure planning and implementation, particularly in Greenfield development areas.

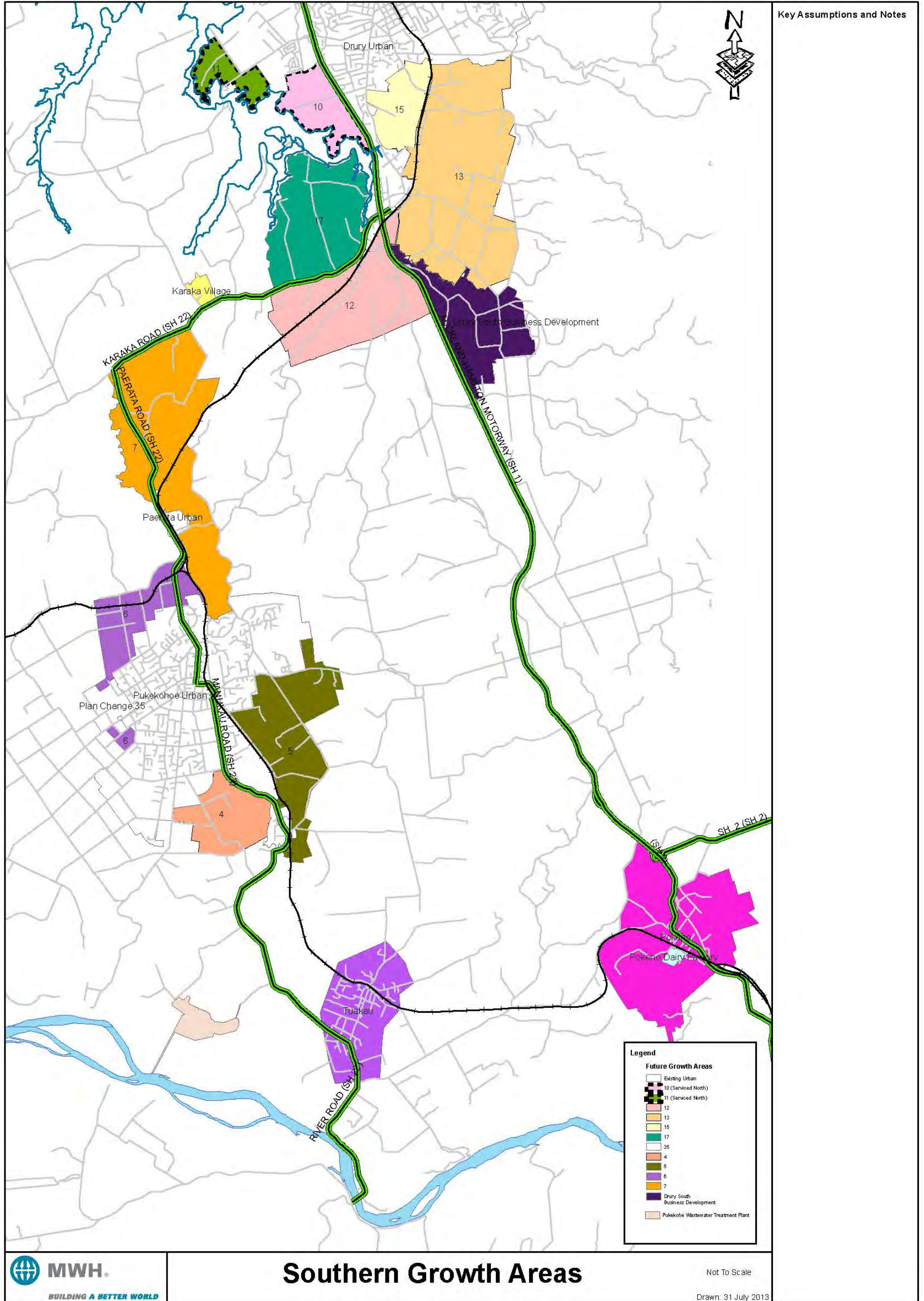
The following are some examples of matters that should/could be included on such an inventory:

- Watercare's own "Three Waters Strategy" and the progressive updating and implementation of this.
- Watercare's Water (Water Supply) Conservation and Demand Management Plan(s) and the implementation of these – from a wastewater reduction (per property) basis and business and industrial basis.
- Changes in trade waste management as implemented through Watercare's Trade Waste Bylaw and other procedures particularly for industry on site cleaner production and waste minimisation requirements.
- Progress and possible implementation of the re-use of highly treated wastewater as recycled (reclaimed or renovated) water for non-potable domestic and industry reuse using the 'third pipe' approach.
- Further development and implementation of alternative collection systems including pressure sewers (with the much lower wet weather flows than more conventional gravity systems) and other techniques.
- Waterless toilet and source (urine, faeces and grey water) separation systems.
- Others developments as arise in the international literature and New Zealand practice.

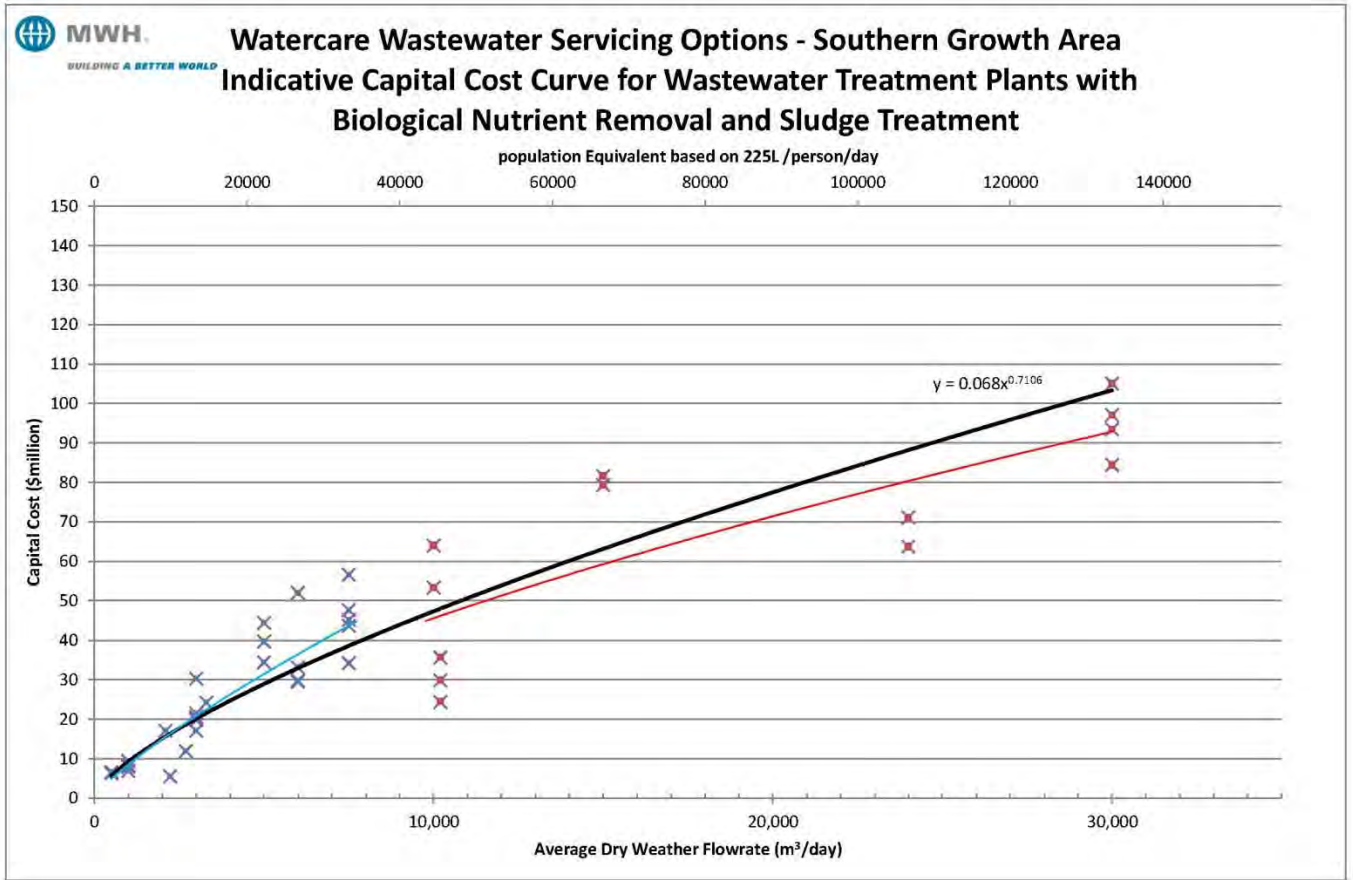
# Appendix A Methodology Diagram



## **Appendix B Map of Southern Growth Areas (Fig 2-3)**

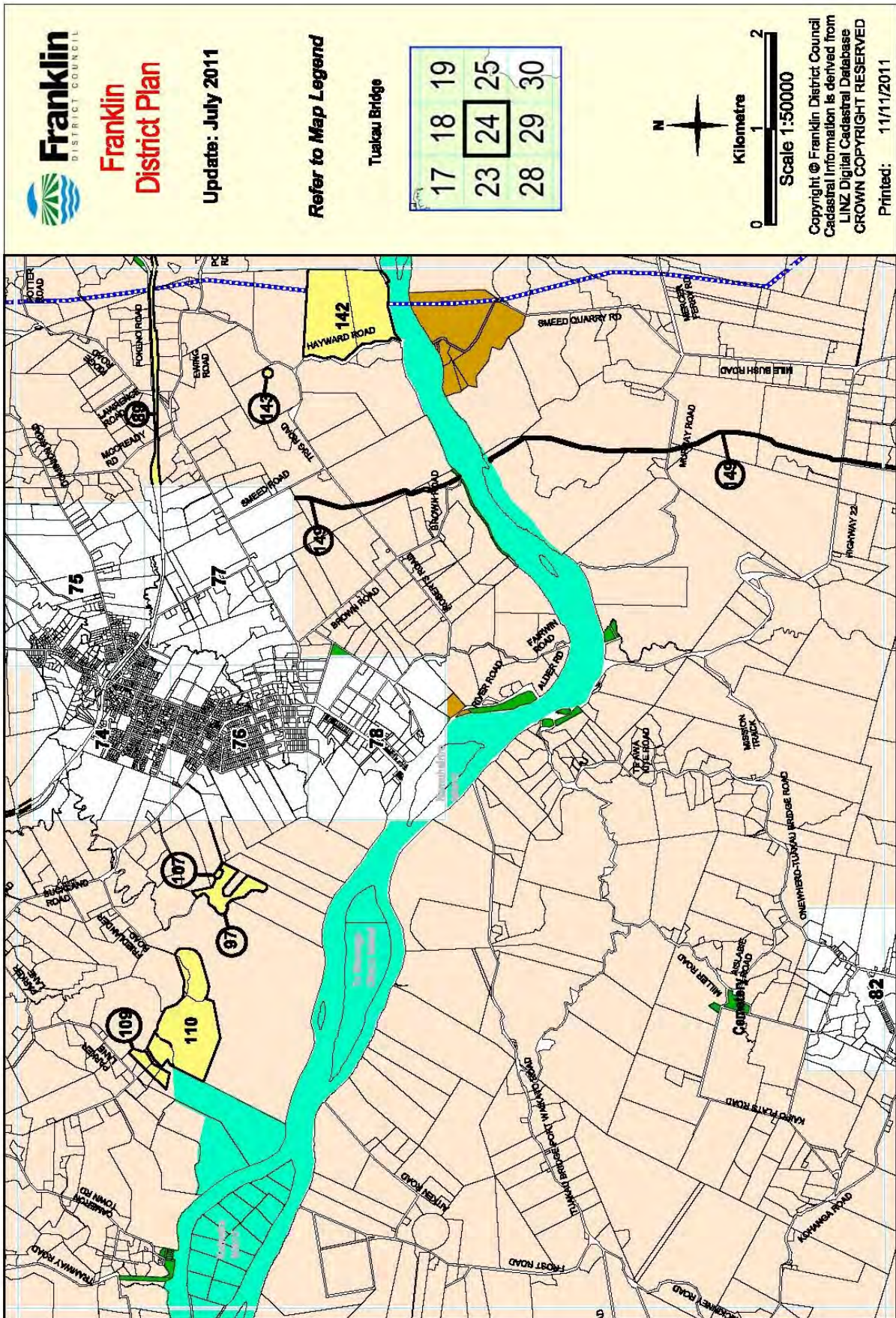







































## Appendix C WWTP Capital Cost Curve



## **Appendix D Site Designation Details**





	<b>Rural Zone</b>		<b>Structure Plan Area</b> (Refer Part 54)	 <p><b>Franklin District Plan</b></p> <p>Update: February 2012</p> <div style="border: 1px solid black; padding: 10px; text-align: center; margin: 20px 0;"> <p><b>MAP LEGEND</b></p> </div> <p>Copyright © Franklin District Council. Cadastral information is derived from LINZ Digital Cadastral Database. CROWN COPYRIGHT RESERVED</p> <p>Printed: 10/09/2012</p>
	<b>Business Zone</b>		<b>Village Overlay Plan</b> (Refer Part 55)	
	<b>Village Business Zone</b>		<b>Village Growth Area</b> (Refer Rule 22D.6)	
	<b>Recreation Zone</b>		<b>Concept Plan Required</b> (Refer Rule 22D.9)	
	<b>Residential Zone</b>		<b>Heritage</b> (Refer Part 8)	
	<b>Rural-Residential Zone</b>		<b>Proposed Tree</b> (Proposed Plan Change 39. Effective from 1 January 2012 Decision No (2011) NZEnvC 388)	
	<b>Village Zone</b>		<b>Designated Land/Sites</b> (Refer to Schedule at back of Plan)	
	<b>Industrial</b>		<b>Sites of Special Wildlife Interest</b> (Refer Schedule 6A and Map 103)	
	<b>Industrial Services</b>		<b>Coastal Marine Area</b>	
	<b>Wetland Conservation Zone</b>		<b>Kingsseat Special Zone</b> (Map 10)	
	<b>Aggregate Extraction &amp; Processing Zone</b>		<b>Timber Processing Zone</b> (Map 19)	
	<b>Forest Conservation Zone</b>		<b>Mauro Mining Zone</b> (Map 27)	
	<b>Proposed Esplanade Reserve</b>		<b>Iron and Steel Production Zone</b> (Map 18)	
	<b>Residential 2 Zone</b>		<b>Motorway Service Zone</b> (Map 18)	
	<b>Light Industrial Zone</b>		<b>Queens Radoubt Heritage Zone</b> (Map 67)	
	<b>Industrial 2 Zone</b>		<b>Local Authority Boundaries</b> (Auckland Waikato & Hauraki Councils from 01 Nov 2010)	
			<b>National Grid Transmission Lines</b> (Refer Parts 17B.6, 22.8, 22D.7, 22D.8, 26.4A.2(h), 27.A.2 & 27A.4)	
			<b>Pukekohe Hill Special Policy Area</b> (Map 64)	
			<b>Tutaenui Floodway Policy Area</b> (Map 63)	
			<b>Appeal Sites</b>	

**SCHEDULE OF DESIGNATIONS – FRANKLIN DISTRICT PLAN**

DESIGNATION NUMBER	PLAN MAP NUMBER	Date	DESIGNATING AUTHORITY	LEGAL DESCRIPTION	DESIGNATED PURPOSE	AREA (Ha)	UNDERLYING ZONE
100	5		Hauraki District Council	Part Wharekawa SC Block (CT 22C/1211)	Regional Parkland		Forest Conservation
100	5		Hauraki District Council	The water catchment land described in the schedule shown in (part CT 17A/877)	Regional Parkland		Forest Conservation
101	14 and 21		Department of Conservation	Part Lot 12 DP 17528 CT 809/287, CT 248/135, Lot 3 DP 48284, Part Lot 1 DP 48284, CT 4A/1248, Part Lot 2 and Lot 4 DP 48284 CT 4A/1249, Part Wharekawa 1G1 CT 14 B/305. Those lands that were previously shown as parts Wharekawa 1F3B block and Wharekawa 1G3 and being balance of lands in CT's 1130/206 and 1133/230. All severances and accretions not covered by Recreation, Reserve Gazette notice 1977 pg. 453 in SO 50856, Lot 1 DP 53345 CO 19A/1131, Lot 1 and 2 DP 182633, Lot 2 and 3 DP 211445, Lot 4 DP 199696 and Lot 1 DP 53345	Proposed Public Reserve		Rural
102	61		Auckland Council		Car park		Business
103		removed Mar 07					
104			[Does not exist]		[Does not exist]		
105		removed Mar 07					
106		uplifted Mar 07					
107	24, 76		Waikato District Council	Lot 1 DP 40257	Waterworks	1.1979	Rural
108	23		Waikato District Council	Lot 1, 3 DP 6951, Lot 2 DP 84027	Contaminated Site		Rural
109	24	altered Mar 07	Waikato District Council	Lot 1 DP 143271, Lot 1 DP 149792	Contaminated Site		Rural
110	24	altered Jan 09	Watercare Services Ltd	Lot 1 DP 86893, Part Lots 1, 2 DP 48497, Lot 2 143271	Sewage Treatment Facility	58.07	Rural
111	16		Auckland Council	Lot 1 DP 73307, Lot 1 DP 154681	Sewage Treatment Facility	17.4900	Rural
112	47		Auckland Council	Lot 8 DP 77055	Sewage Treatment Facility	2.9545	Recreation
113	17		Auckland Council	Lot 1 DP 107819	Sewage Treatment Facility	7.3040	Rural
114	89		Auckland Council	Lot 10 DP 134365 - Local Purpose Reserve	Sewage Treatment Facility	1.2569	Rural
115	10		Auckland Council	Lot 33 DP 145424 - Local Purpose Reserve	Sewage Treatment Facility	0.6100	Village
116	65		Auckland Council	Lot 1 DP 55095	Stock Pound	0.2977	Rural
117			has been uplifted				
118	71		Auckland Council	Lot 18 DP 119274	Depot and Transfer Station	0.9854	Business

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*Section Two, Part 6 – Objectives and Policies*

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that their effects can be assessed before consent is given for construction.

**Reasons for Policies**

The reasons for the policies are that public works are usually site specific and planning provision needs to be made both for the specific sites which are known to be required for public works and also for the eventuality that the public works requirement can be removed from time to time and that the Council needs to have made "underlying" provision for activities which may be appropriate on the land.

**Anticipated Results**

Public works will be provided for in a realistic and convenient manner.

**6.5 DESIGNATIONS**

Land which is required for a particular purpose by network utility operators, the Crown, or local authorities, is designated in the District Plan and the location of the land so designated is shown on the Planning Map. Where appropriate, details of designations are contained in the following schedule.

**6.5.1 Schedule of Designations**

MAP REF	DESCRIPTION	DESIGNATING AUTHORITY
<b>1</b>	<i>(Refer Section Three, Urban Papakura, Designation 235)</i>	
<b>2</b>	<b>Defence Purposes</b>	<b>Minister of Defence</b>
	Comprising approximately 671.2615 hectares and described as follows:	
	Allots 146, 147, 148, 149, 150, 151, 152 Opaheke Parish	
	Pt Allot 139, Opaheke Parish	1.1711
	Allot 153, Opaheke Parish	11.0277
	Allot 237, Opaheke Parish	13.7416
	Pt Allots 238 and 239, Opaheke Parish	9.8212
	Allot 235, Opaheke Parish	25.9454
	Allot 33, Pt N 171 Hunua Parish	84.9081
	Lot 1 DP15356	31.0799
	Lot 2 DP15356	18.6054
	Lot 3 DP15356	69.1886

*Section Two, Part 6 – Objectives and Policies*

MAP REF	DESCRIPTION		DESIGNATING AUTHORITY
	Lot 4 DP15356	34.6006	
	Pt Lot 5 DP15356	56.4916	
	Allot 137, 167, Hunua Parish	34.1454	
	Closed Road	0.0455	
	Closed Road	7.5879	
	Closed Road	4.1986	
	Pt Allot 32, Hunua Parish	33.0148	
	Pt Allot 32, Hunua Parish	)	
	Pt Allot 35, Hunua Parish	0.8229 )	
	Pt Allot 32, Hunua Parish	)	
	Pt Allot 32, Hunua Parish	0.1876	
	Closed Road	0.2555	
	Closed Road	1.2383	
	Pt Allot 32, Hunua Parish	1.3072	
	Pt Allot 32, Hunua Parish	0.7696	
	Pt Allot 8, Hunua Parish	2.3595	
	Pt Allot 32, Hunua Parish	0.2091	
	Pt Allot 35, Hunua Parish	12.3800	
	Pt Allot 8, Hunua Parish	2.5495	
	Pt Allot 8, Hunua Parish	8.2961	
	Pt Allot 77, Hunua Parish	12.3935	
<b>3</b>	<b>Defence Purposes</b> <i>(Refer Section Three, Urban Papakura, Designation 205)</i>		<b>Minister of Defence</b>
<b>4</b>	<b>Ardmore Primary School</b> Pt Allot 53 Parish of Papakura		<b>Minister of Education</b>
<b>5</b>	<b>Water Supply Purposes</b> on land at Hays Creek include a dam, spillways, impounded reservoir of water, intake and outlet structures, overhead power supply and telemetry, aeration equipment (including compressors), production forestry, noxious plant and pest control, and recreation plus utility services.		<b>Watercare Services Ltd</b>

*Section Two, Part 6 – Objectives and Policies*

MAP REF	DESCRIPTION	DESIGNATING AUTHORITY
	Part Allot 119 CT 4C/988, Part Allot 120 CT 4C/988, Part Allot 168 CT 89C/68, Part Allot 168 CT 30A/60, Part Allot N170 CT 4C/1298, Part Allot M170 CT 4C/988, Part Allot S 170 CT 89C/70, Part Allot 177 CT 1349/84, Part Allot 177 CT 13D/673, Part Allot SW 178 CT 89C/69 and Lots 1 and 9 DP30541 CT 14D/319, and Lots 1 and 2 DP65410 CT 30A/60.	
<b>6</b>	<b>Water Supply Purposes</b> on this land at Kaipara Road include a reservoir (tank) and pumping station plus utility services	<b>Watercare Services Ltd</b>
	Lot 1 DP79740 CT 36C/262	
<b>7</b>	<b>Water Supply Purposes</b> on this land at Hunua Gorge Road include a water treatment plant, stand-by power generation, depot and office, and water storage reservoir plus utility services	<b>Watercare Services Ltd</b>
	Lot 1 DP59100 CT 31A/842, Lot 1 DP43063 CT 31A/842, and Pt Lot 1 DP34331 CT 919/274	
<b>8</b>	<b>Water Supply Purposes</b> on this land at Creightons Road include a single residence on that parcel of land which is legally described as Part Lot 1 DP43534 and comprised in Certificate of Title 1302/14, and production forestry from the adjacent Ardmore Station on that parcel of land which is legally described as Part Lot 2 DP21088 and described in Gazette Notice 1977 Page 2193	<b>Watercare Services Ltd</b>
	Lot 2 DP21088 CT 1198/14 and Part Lot 1 DP 43534 CT 1302/14	
<b>9</b>	<b>Water Supply Purposes</b> on this land near the corner of Creightons and Jones Road include part of the Hays Creek reservoir	<b>Watercare Services Ltd</b>
	Part Allot 177 Hunua Parish, CT 35B/368 and road reserve	
<b>10</b>	<b>Electrical Works (substation)</b> Lot 1 DP39638	<b>Mercury Energy</b>
<b>11</b>	<b>Railway Purposes</b> North Island Main Trunk Railway	<b>New Zealand Railways Corporation</b>
<b>222</b>	<b>Ardmore Aerodrome</b> (refer Section 3 Part 12)	<b>Ardmore Airport Limited</b>
<b>13</b>	<b>Sewage Treatment Plant</b>	<b>Watercare Services Ltd</b>
<b>14</b>	<b>Rubbish Dump</b> Pt Allot 52, Hunua Parish	<b>Papakura District Council</b>

*Section Two, Part 6 – Objectives and Policies*

MAP REF	DESCRIPTION	DESIGNATING AUTHORITY
15	Rubbish Dump Lot 1 DP55769	Papakura District Council
16	Electrical Supply Substation Allot 301, Opaheke Parish; Section 1 Survey Office Plan 41081 (CT205324); Part of Section 1 Survey Office Plan 326417 (CT 231658)	Counties Power Ltd
17	State Highway One	Transit NZ
18	State Highway Twenty Two	Transit NZ
19	Alfriston Primary School Pt Allot 17 Parish of Papakura Pt Lot 1 DP 94453	Minister of Education
20	Drury Switchyard 261 Quarry Road, Drury and described as being Part Lot 1-2 DP 62333 contained within Certificate of Title NA86D/916	Transpower NZ Ltd
21	Primary School (Years 1 – 8) and Early Childhood Education Centre 171 Hingaia Road and described as Part Lot 2 DP 201220, Section 1 on SO 93559, CT: NA 129D/887	Minister of Education

**Conditions for Designation 16: Electrical Supply Substation**

**Sutton Road Future Road widening**

1. The Substation security fence shall be setback at least 14m from the Sutton Road/western boundary (being the location of this boundary as it existed in the Notice of Requirement).

**Advice Note:** *In future the Council may require up to 12m of the site to widen Sutton Road of which 4m can be landscaped. (Refer diagram Figure 1 prepared by Papakura District Council).*

**Noise**

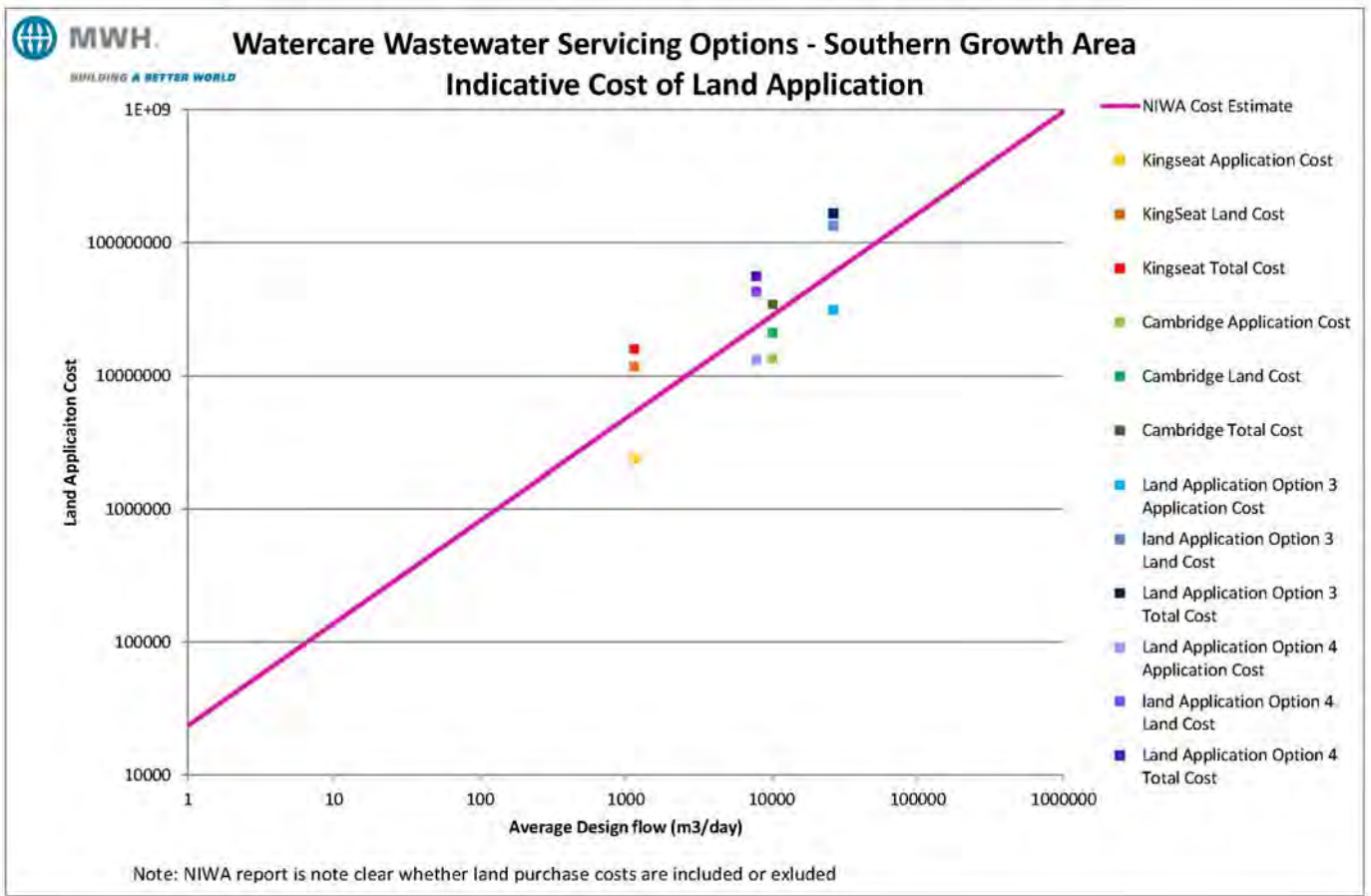
2. The substation must be operated in such a manner as to comply with the following noise emission standards. The noise level measured within the notional boundary of any existing dwelling shall not exceed the following limits:

Daytime	0700-2000	L10 = 50dBA
Night-time	2000-0700	L10 = 40dBA

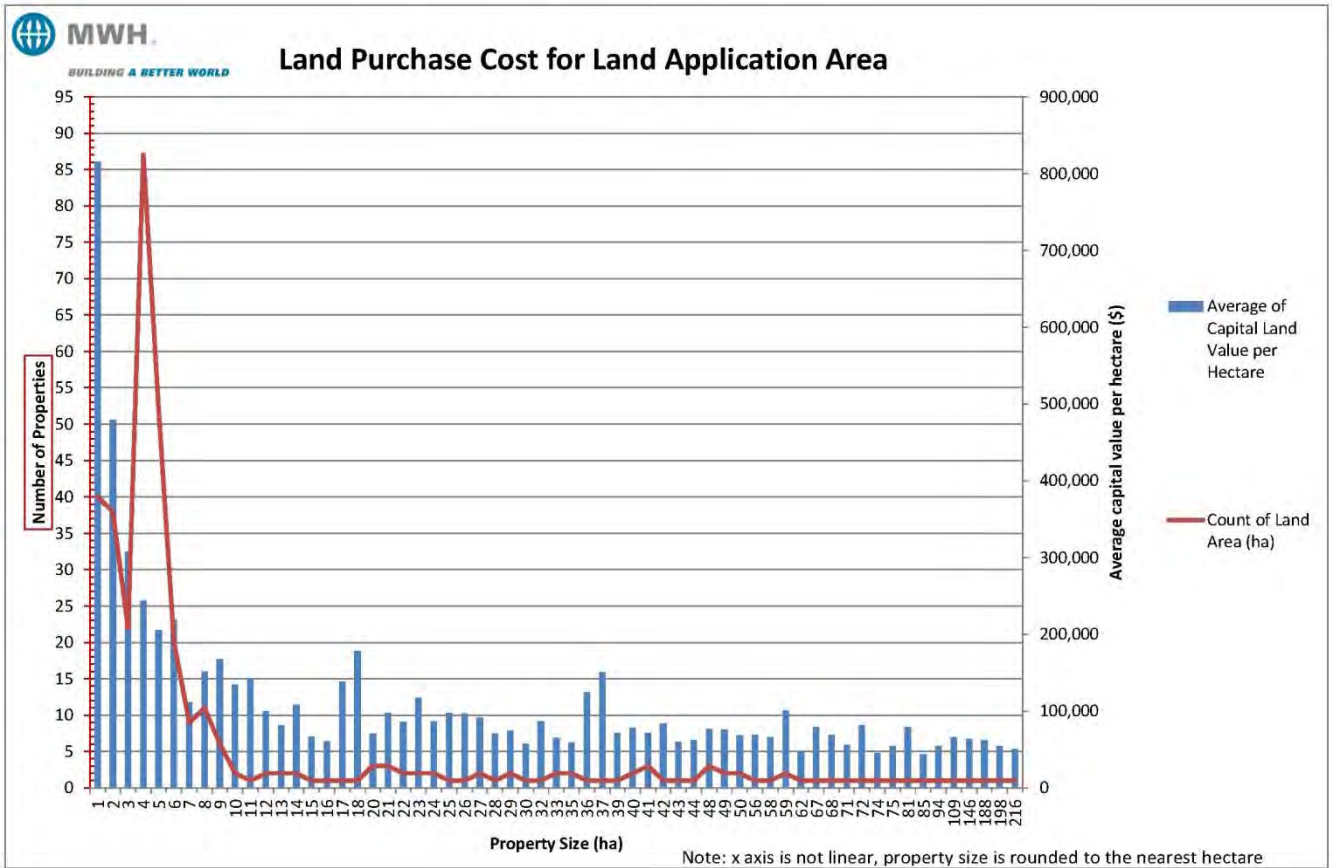
The noise levels must be measured and assessed in accordance with the requirements of NZ6801:1991 Measurement of Sound and NZS6802:1991 Assessment of Environmental Sound.

## **Appendix E MWH Disposal to Land Information**





## **Appendix F Land Purchase Cost for Land Application Area**



## Appendix G Wastewater Development Option Plans

