# BOX HILL NORTH

## WATER BALANCE SUMMARY REPORT

27 SEPTEMBER 2019

FINAL

PREPARED BY KINESIS FOR FLOW SYSTEMS

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Gables Draft Masterplan

**Note: This report is provided subject to some important assumptions and qualifications:**

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy, water and greenhouse consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

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# EXECUTIVE SUMMARY

Box Hill North is an urban release area close to Richmond, NSW. The scheme proposes to provide recycled water to 4,800 houses on 330 ha of land, approximately 30 ha of which are comprised of sporting fields, neighbourhood parks and other public open spaces that either require irrigation or are able to be irrigated with recycled water. In addition, the recycled water system is proposed to establish connections with customers on the fringe of the Box Hill North urban release area for irrigation.

The Box Hill Water system for the development will operate a recycled water scheme that incorporates a membrane bioreactor system with associated recycled water storage. The system will take inflows from all grey and black waste water in the precinct and provide recycled water for:

- Toilets
- Washing Machines (cold only)
- Car washing
- Hardstand cleaning
- Dust suppression
- Street cleaning
- Irrigation
- Water features

## BOX HILL NORTH WATER SYSTEM

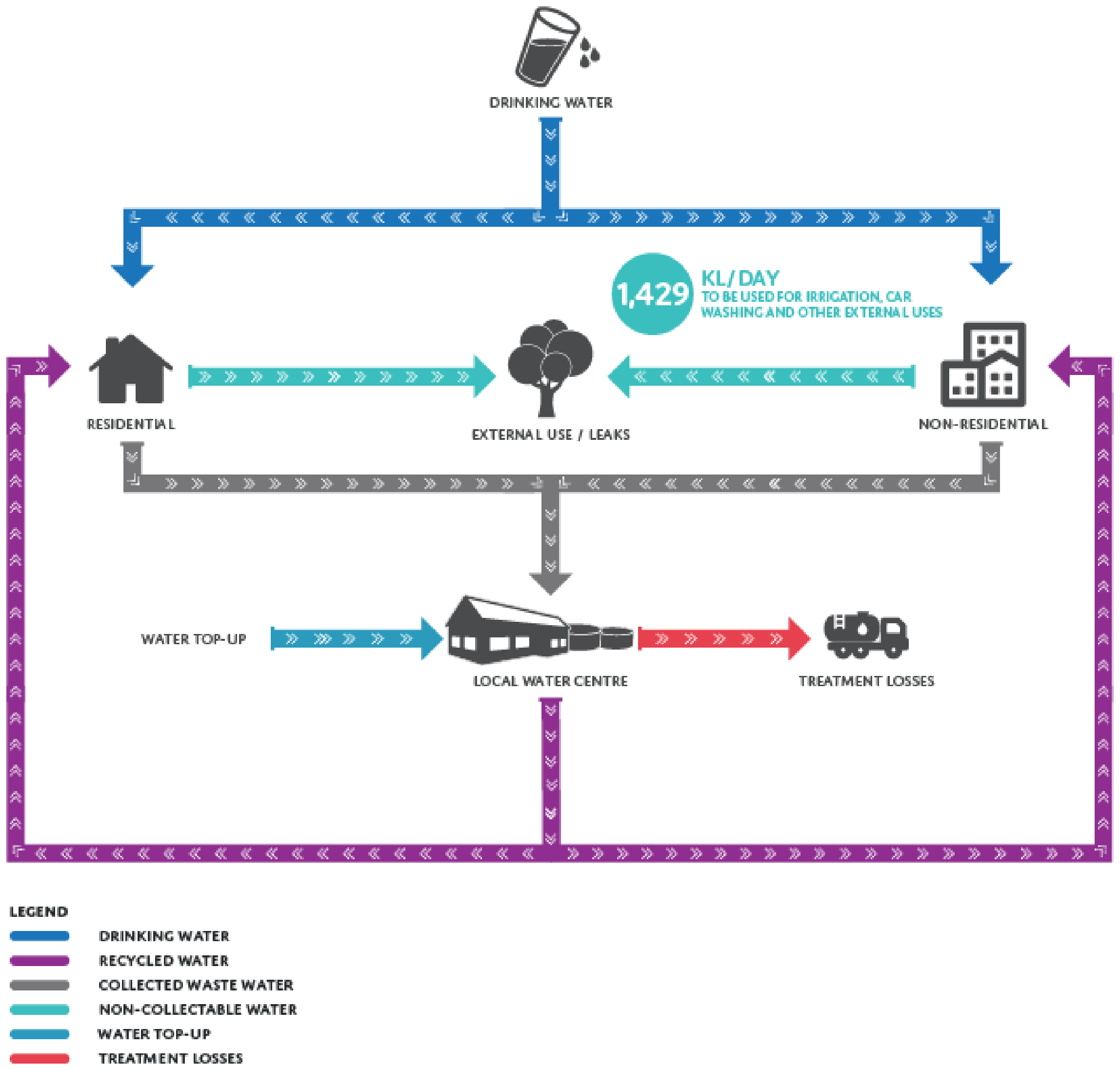


Figure 1: Box Hill Water System

Note: External use includes irrigation, car washing & other external uses such as hardstand cleaning.

* Other uses may be external customers or other internal uses such as cooling towers top-up with appropriate treatment.

# 1. PROJECT DETAILS

This report documents the water balance analysis of Box Hill North urban release area development in order to inform the delivery of a recycled water scheme. Box Hill urban release area is a residential development at Box Hill North close to Richmond, NSW. Ultimately it will comprise of **4,800 dwellings** on **330 ha** of land and include approximately **30 ha** of sporting fields, neighbourhood parks and other public open spaces that either require irrigation or are able to be irrigated with recycled water.

Analysis in this report outlines the results and performance outcomes for Box Hill North. This analysis is undertaken based on development figures provided by Flow Systems (see Figure 2 and Table 1) using Kinesis's CCAP Precinct modelling tool. CCAP Precinct is a land use and planning tool that models key environmental, economic, social and infrastructure implications and requirements for precinct-scale development projects.

The report is structured as follows:

- Water Demands
- Source Water Production
- Recycled Water System Performance

Recycled water irrigation areas as categorised into Essential, Highly Preferable, Non-essential and Not to be irrigation as per Figure 2.

| Land Use | Area/Number |
|---|---|
| **Total Development Area** | **330 ha** |
| **Public Space (Irrigation)** | |
| Essential Irrigation | 7.9 ha |
| Highly Preferable | 2.9 ha |
| **Total public space** | **10.8 ha** |
| **Non-residential** | |
| Retail | 7,900 m$^2$ |
| Commerce/Office | 500 m$^2$ |
| Entertainment | 1,150 m$^2$ |
| Day clinic | 450 m$^2$ |
| Primary & Secondary School | 25,000 m$^2$ (1,920 students) |
| Fringe Customers | 330 ha |
| **Residential Dwellings** | |
| Standard house lots (>240 m$^2$) | 2,793 |
| Integrated house lots (<240 m$^2$) | 355 |
| Large lots (>2,000 m$^2$) | 86 |
| Apartments | 866 |
| Dwellings by Third Party Developers | 700 |
| **Total dwellings** | **4,800** |

Table 1: Dwelling yield and floor space for Box Hill North urban release area.

## MASTER PLAN

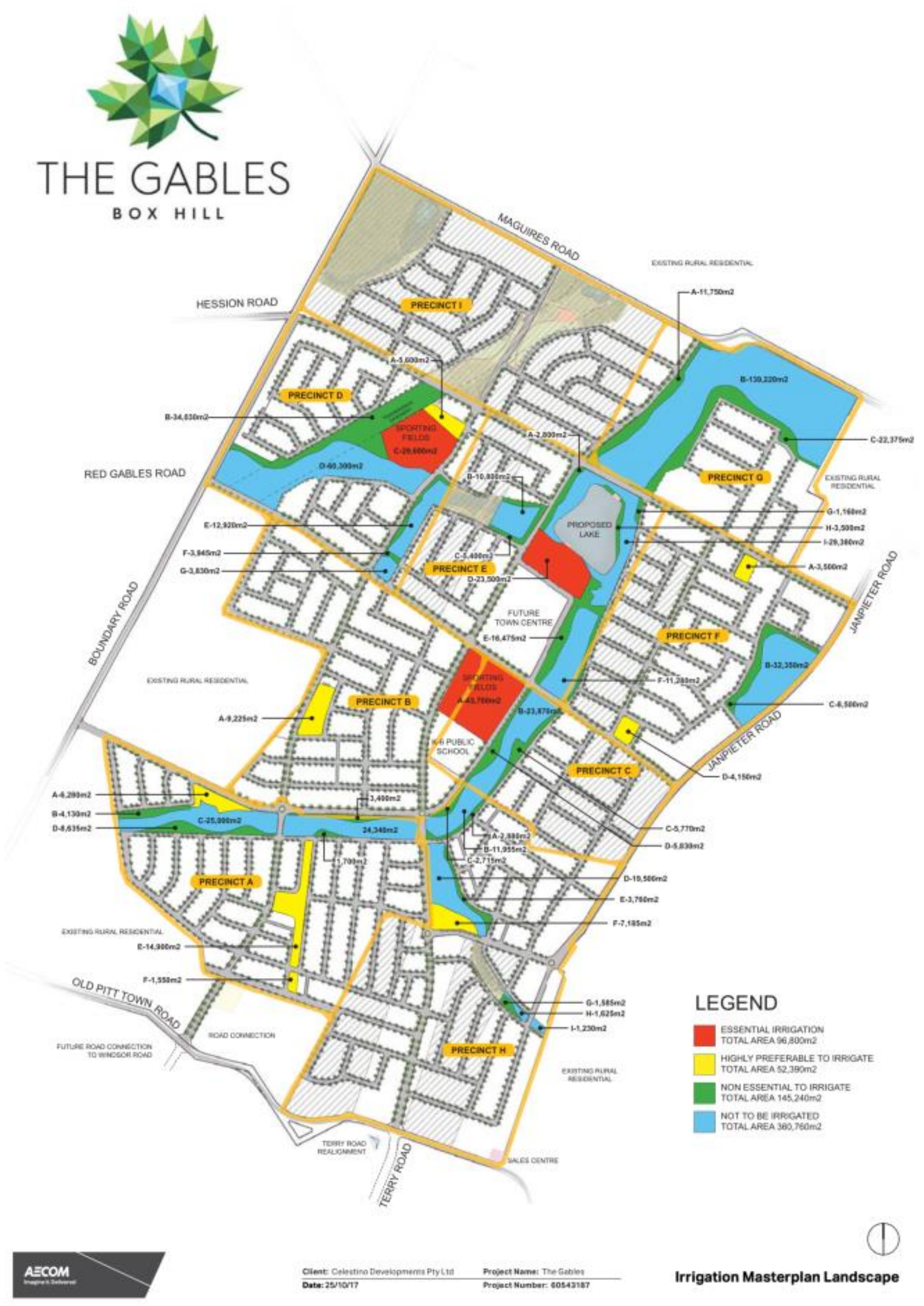


Figure 2: Development Master Plan

# 2. WATER DEMANDS

## 2.1 RESIDENTIAL WATER DEMANDS

Residential water demands were calculated based on the specific residential building types proposed for The Box Hill North urban release area. A water balance for an average Box Hill North dwelling, with a specific focus on water quality, is outlined in Figure 3. The details of the dwelling type configuration for modelling are outlined in Table 2. Figure 4 and Figure 5 display historical dry-bulb temperature and rainfall data from the local climate zone that was used to model the development water demand. Table 3 outlines the technology assumptions and associated demands that was used in the modelling process. Monthly total and daily average residential water demands by end use are outlined in Figure 6 and 7. Month to month variation is evident due to changes to irrigation water demands based on rainfall and evaporation profiles. Monthly internal total demands vary slightly due to differences in the number of days per month.

### AVERAGE BOX HILL NORTH DAILY WATER BALANCE (PER DWELLING)

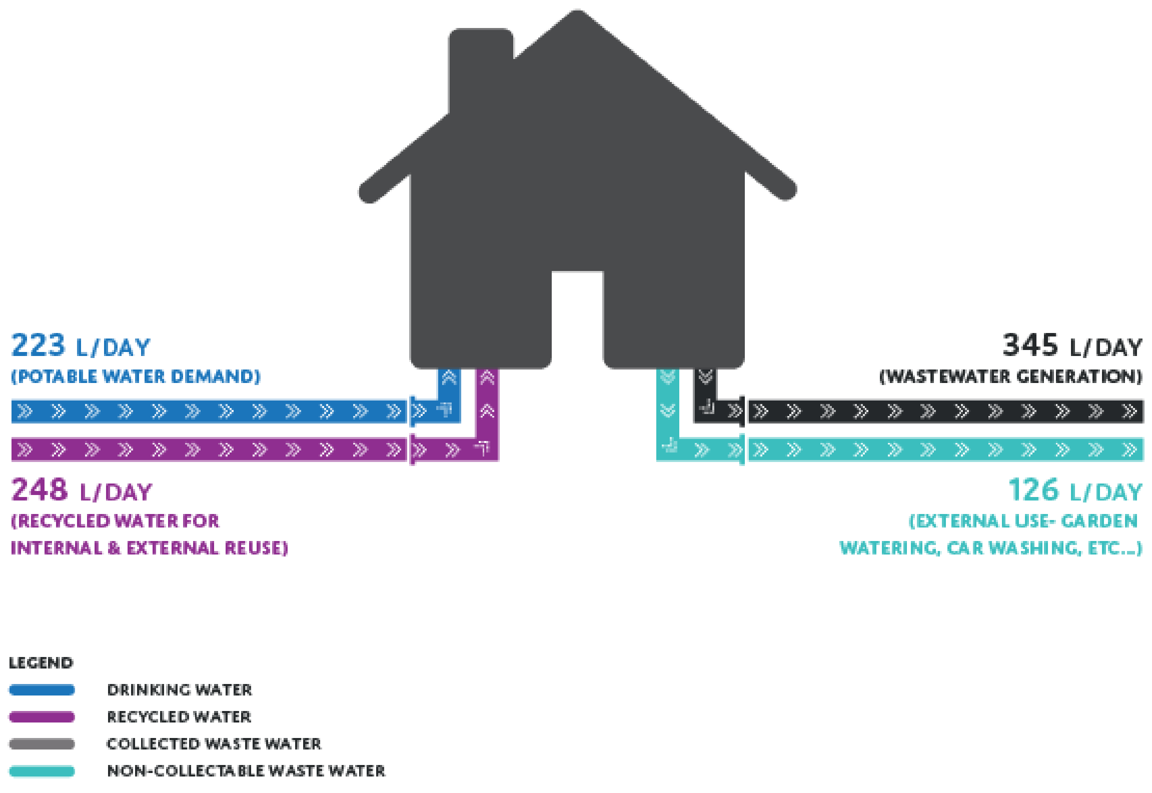


Figure 3: Schematic showing an average dwelling in The Box Hill North (including detached dwelling and apartments) expected daily drinking and recycled water consumption, including common area and irrigation demands.

### RESIDENTIAL DWELLING SPECIFICATIONS

| Dwelling Type | Number | Bedrooms | Occupancy | Est. Population |
|---|---|---|---|---|
| 7 Bedroom Detached Houses; 2000 $m^2$ lots | 101 | 7 | 5.3 | |
| 5 Bedroom Detached Houses; 700 $m^2$ lots | 142 | 5 | 4.0 | |
| 4 Bedroom Detached Houses; 700 $m^2$ lots | 142 | 4 | 3.4 | |
| 5 Bedroom Detached Houses; 450 $m^2$ lots | 1,079 | 5 | 4.0 | |
| 4 Bedroom Detached Houses; 450 $m^2$ lots | 1,078 | 4 | 3.4 | |
| 5 Bedroom Detached Houses; 240 $m^2$ lots | 165 | 5 | 4.0 | |
| 4 Bedroom Detached Houses; 240 $m^2$ lots | 496 | 4 | 3.4 | |
| 3 Bedroom Detached Houses; 240 $m^2$ lots | 167 | 3 | 2.7 | |
| 5 Bedroom Attached Houses; 240 $m^2$ lots | 59 | 5 | 3.9 | |
| 4 Bedroom Attached Houses; 240 $m^2$ lots | 240 | 4 | 3.5 | |
| 3 Bedroom Attached Houses; 240 $m^2$ lots | 117 | 3 | 2.6 | |
| 4 Bedroom Multi Apartment | 254 | 4 | 3.2 | |
| 3 Bedroom Multi Apartment | 507 | 3 | 2.6 | |
| 2 Bedroom Multi Apartment | 253 | 2 | 2.0 | |
| **TOTAL** | **4,800** | | **-** | **16,474** |
| **AVE. DWELLING** | | **4** | **3.4** | |

Table 2: Residential dwelling specifications used in the analysis

### DRY-BULB TEMPERATURE AT BOX HILL NORTH

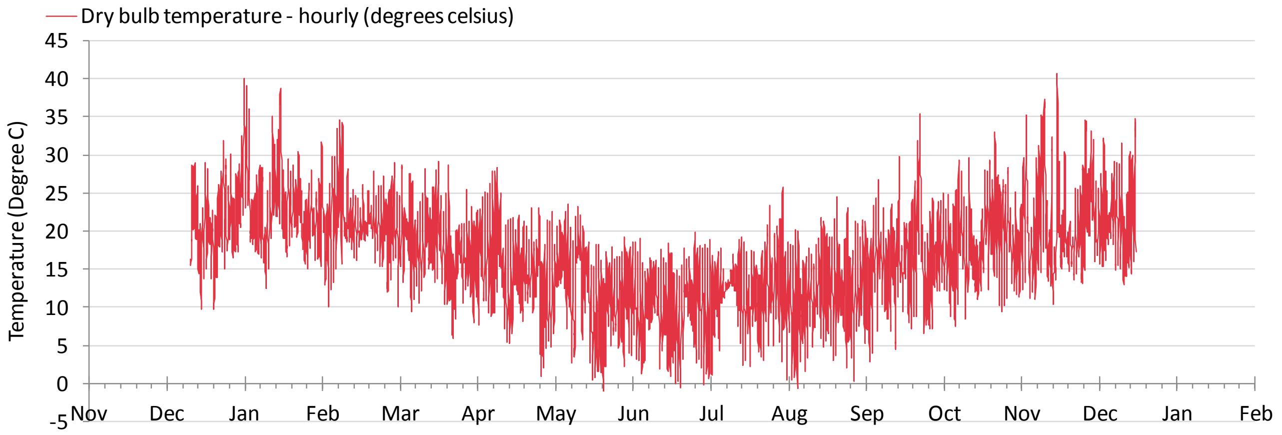


Figure 4: Dry-bulb temperature for local climate zone.

## RAINFALL AT BOX HILL NORTH

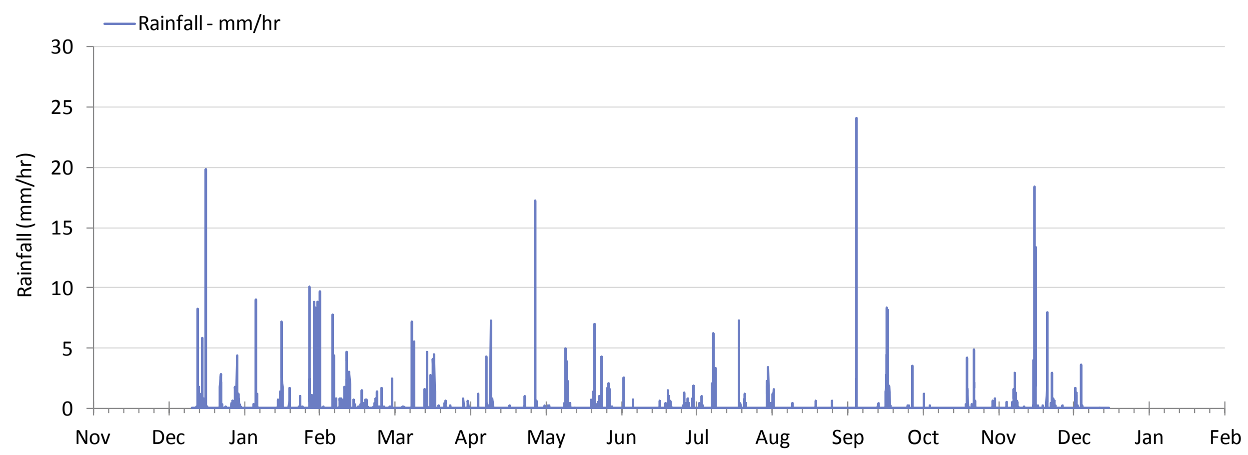


Figure 5: Historic average rainfall for local climate zone.

## RESIDENTIAL END USE SPECIFICATIONS AND AVERAGE DEMANDS

| Water End Use | Technology | Per Person Demand (L/day) | | | Average Development Demand (kL/day) | | |
|---|---|---|---|---|---|---|---|
| | | DW | RW | Total | DW | RW | Total |
| Shower | 4 Star WELS | 28.5 | - | 28.5 | 468.7 | - | 468.7 |
| Kitchen sink | 4 Star WELS | 7.5 | - | 7.5 | 124.3 | - | 124.3 |
| Bathroom basin | 4 Star WELS | 2.6 | - | 2.6 | 43.0 | - | 43.0 |
| Dishwasher | 4 Star WELS | 2.3 | - | 2.3 | 37.9 | - | 37.9 |
| Laundry trough | - | 5.0 | - | 5.0 | 82.4 | - | 82.4 |
| Bath | - | 8.7 | - | 8.7 | 143.3 | - | 143.3 |
| Fire testing* | - | 1.5 | - | 1.5 | 24.7 | - | 24.7 |
| Toilet | 4 Star WELS | - | 17.5 | 17.5 | - | 288.8 | 288.8 |
| Washing machine | 4 Star WELS | 4.1 | 23.0 | 27.0 | 66.7 | 378.1 | 444.8 |
| Car washing | - | - | 0.7 | 0.7 | - | 10.7 | 10.7 |
| Leaks (DW and RW grade) | - | 4.7 | 5.5 | 10.2 | 77.0 | 90.6 | 167.6 |
| Other external** | | - | 4.0 | 4.0 | - | 65.9 | 65.9 |
| Irrigation*** | - | - | 21.5 | 21.5 | - | 354.9 | 354.9 |
| **TOTAL** | **-** | **64.8** | **72.2** | **137.0** | **1,068.0** | **1,189.0** | **2,257.0** |
| **AVE. DWELLING** | | **222.5** | **247.7** | **470.2** | | | |

Table 3: Residential dwelling end use specifications and average per person daily demands used in the analysis

(DW = Drinking water demand, RW = Recycled water demand)

*Estimated using the proportion of Box Hill North residents in apartment dwellings and fire test water use as per BASIX

** Other external includes hose down, household cleaning, etc.

*** Irrigation areas estimated for dwellings based on lot area. Irrigation demand calculated as a product of this area and applied irrigation rate of approx. 0.3 kL per sqm per year derived from Department of Planning Industry and Environment, BASIX data.

## TOTAL RESIDENTIAL WATER DEMANDS

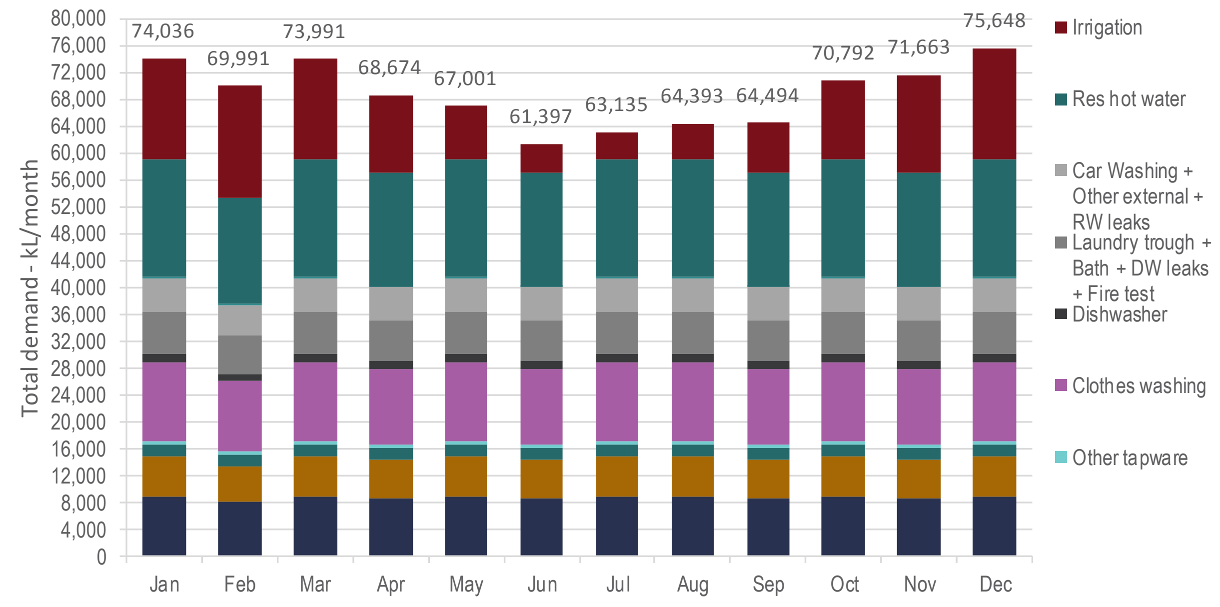


Figure 6: Total residential total water demands by end use, by month

## AVERAGE DAILY RESIDENTIAL WATER DEMANDS

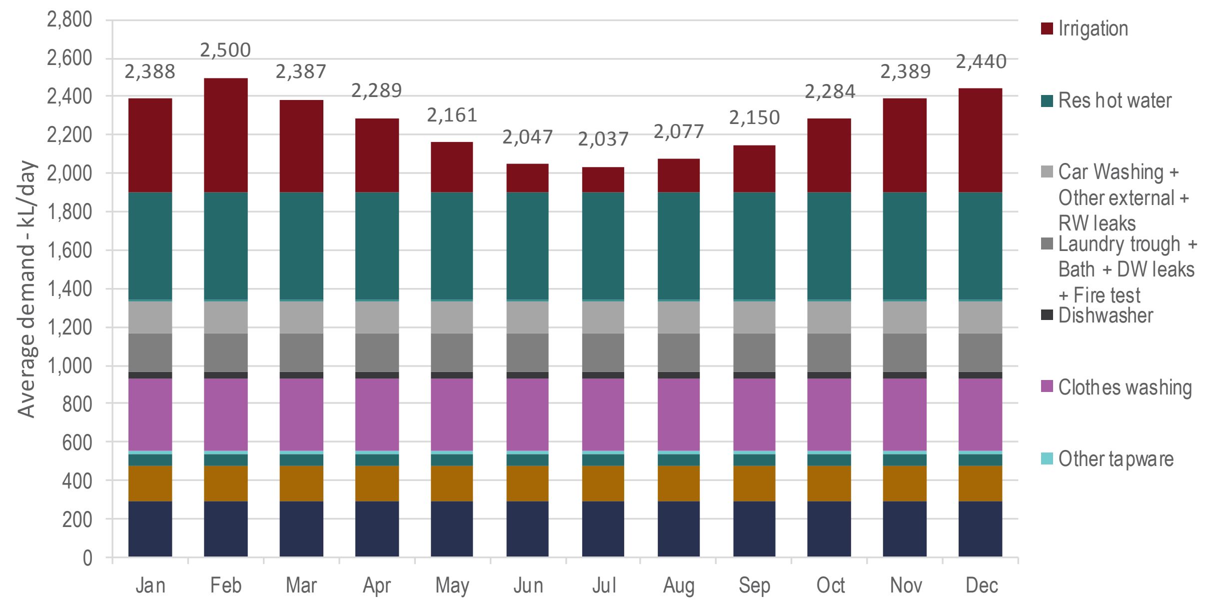


Figure 7: Average daily residential water demands by end use, by month

**Note:** Other external includes hose down, household cleaning, etc.

## 2.2 NON-RESIDENTIAL WATER DEMANDS

Non-Residential water demand was calculated based on the retail, commercial, community and open space areas proposed. Details of the building and open space configuration are outlined in Table 4. It should be noted that non-residential water demand modelling only considered public open spaces for which irrigation is deemed either essential or highly preferable in the HydroPlan *Irrigation Strategy Master Plan* document for Box Hill North urban release area.

Monthly total and daily average non-residential water demands by end use are outlined in Figures 8 and

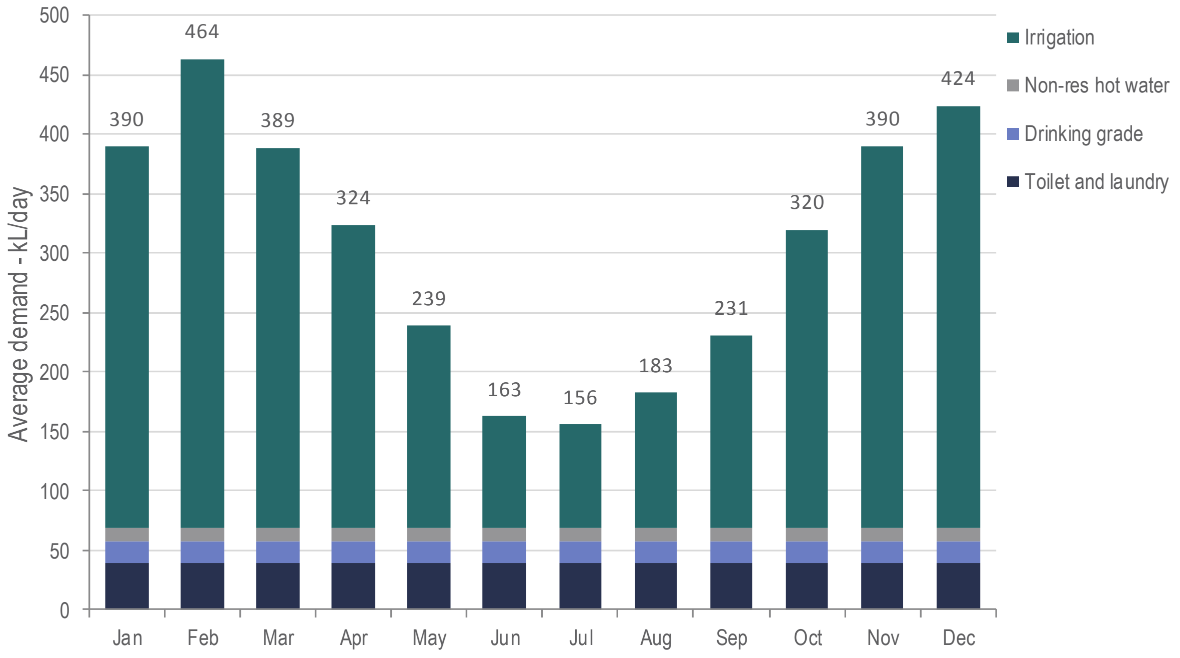


Figure 9. Monthly internal total demands vary due to differences in the number of days per month. Month to month variation is only evident in changes to irrigation water demand based on rainfall and evaporation profiles.

### NON-RESIDENTIAL SPECIFICATIONS – TOTAL

| Demand Hierarchy | Water End Use | Area ($m^2$) | Per $m^2$ demand (L/day) | | | Development Demand (kL/day) | | |
|---|---|---|---|---|---|---|---|---|
| | | | DW | RW | Total | DW | RW | Total |
| 1 | Retail | 7,900 | 1.4 | 0.5 | 1.9 | 10.7 | 3.7 | 14.4 |
| 1 | Commercial | 500 | 0.5 | 2.2 | 2.7 | 0.2 | 1.1 | 1.3 |
| 1 | Entertainment | 1,150 | 3.4 | 0.8 | 4.2 | 3.8 | 0.9 | 4.7 |
| | **Commercial Total** | **9,550** | | | | **14.7** | **5.7** | **20.4** |
| | | | | | | | | |
| 1 | Education | 27,000 ** (1,920 students) | 5.8 | 17.3 | 23.0 | 11.1 | 33.2 | 44.2 |
| 1 | Day clinic | 450 | 9.6 | 0.6 | 10.2 | 4.3 | 0.3 | 4.6 |
| | **Community Total** | **4,850** | | | | **15.4** | **33.5** | **48.8** |
| | | | | | | | | |
| 2 | Open Space Irrigation (Essential + High Preferable) | 107,948 | - | 1.3* | 1.3* | - | 141.1 | 141.1 |
| 3 | On lot irrigation of non-residential buildings | 7,125 | - | 1.3* | 1.3* | - | 9.3 | 9.3 |
| | **Public Open Space Total** | **115,073** | | | | - | **150.4** | **150.4** |
| | | | | | | | | |
| 4 | **Fringe customers** | **330,000 *** ** | - | **2.0 ******* | **2.0 ******* | **-** | **679.1** | **679.1** |
| | **TOTAL** | | | | | **30.1** | **868.7** | **898.8** |

Table 4: Non-Residential specifications and average annual demands used in the analysis

DW = Drinking water demand, RW = Recycled water demand

*1.3 L/$m^2$ per day is the irrigation rate based on the HydropPlan Irrigation Strategy's calculated irrigation depths of 0.477m in an average year

** 25,000 $m^2$ land area and 2,000 students are assumed for the Santa Sophia Catholic College.

*** Irrigation demands from fringe customers assumed to be approximately 10% of total area identified

**** 2 L/m2 per day irrigation rate based on the Whitehead & Associates Environmental Consultants' local Land Capability Assessment for Recycled Water

## TOTAL NON-RESIDENTIAL WATER DEMANDS

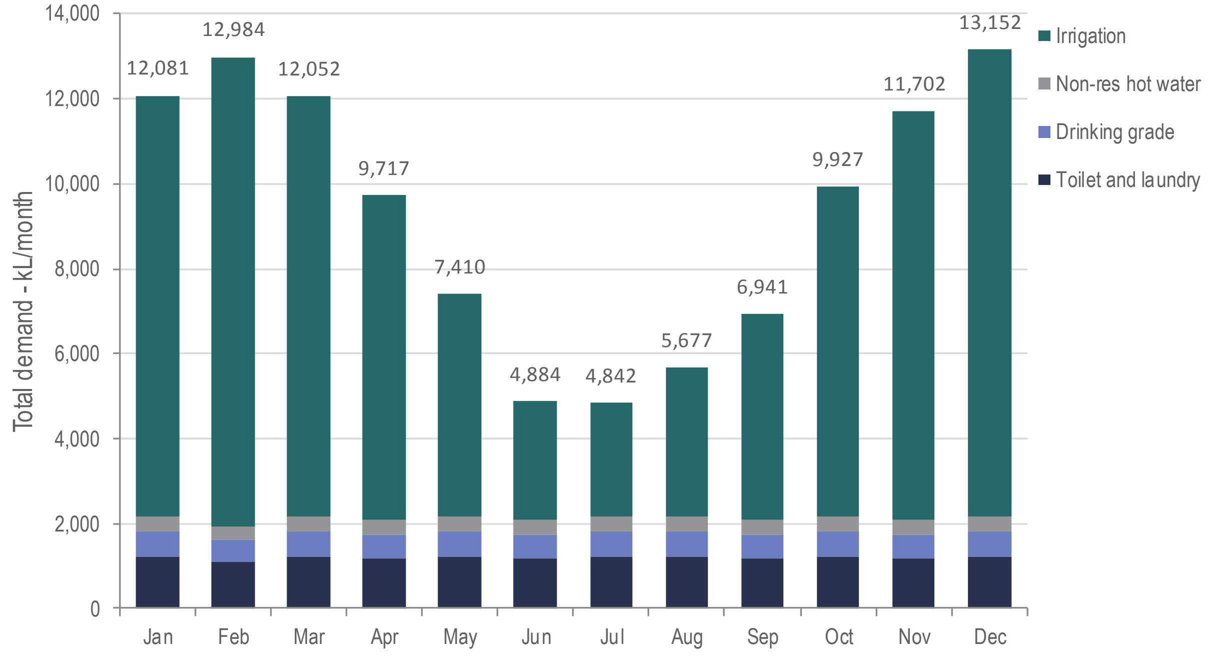


Figure 8: Non-Residential total water demands by end use, by month

## AVERAGE DAILY NON-RESIDENTIAL WATER DEMANDS

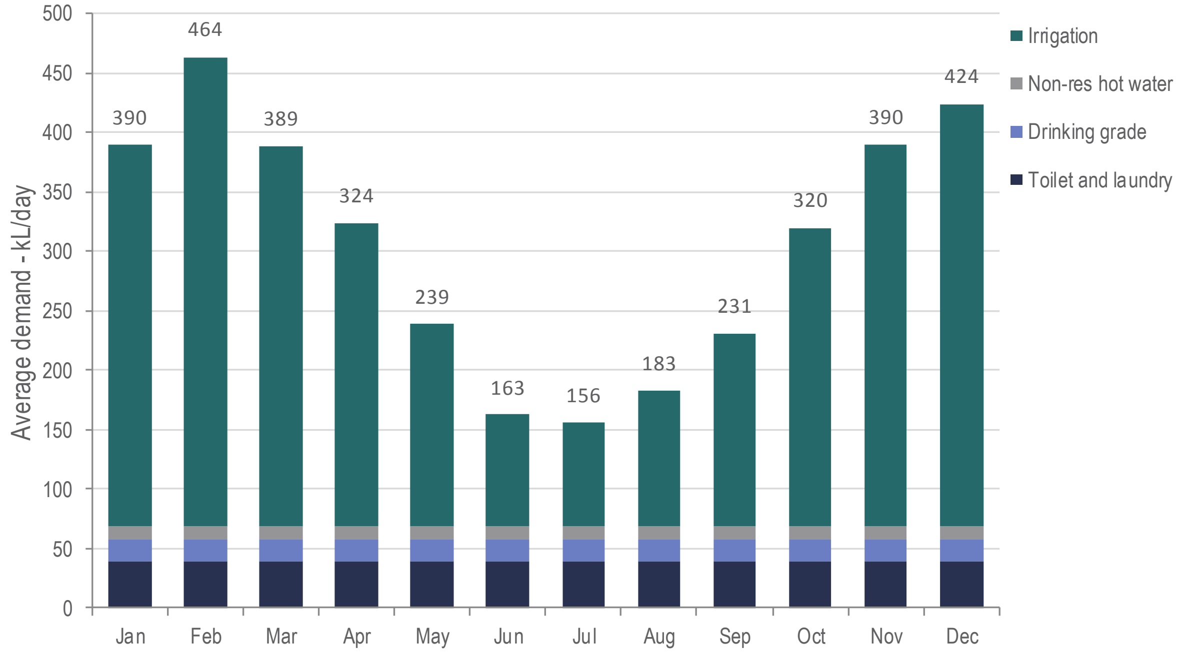


Figure 9: Average daily Non-Residential water demands by end use, by month

## 2.3 TOTAL AND PEAK WATER DEMANDS

Total water consumption, drinking water demand and recycled water demands are outlined in Tables 5 to 7. These tables show both total and peak demands for each use.

**Total water demands** are outlined in Figures 10 to 12 (monthly totals) and Figures 13 to 15 (daily average), summarising the results of the residential and non-residential demands for both drinking and recycled water demands.

As with the individual residential and non-residential demands, month to month variation is predominantly due to changes in irrigation demands. The irrigation demand analysis takes into account hourly rainfall data and cumulative period since the last rain event and irrigation to predict the time and water use of the next irrigation event. Predictions are also calibrated against real irrigation data for better alignment and accuracy (see *Key Data Sources* in Appendix).

**Peak water demand** (kilolitres per hour) for each month is provided in Figure 16. Peak demands for drinking and recycled water are also shown separately in Figures 17 and 18. The peak demand was determined based on the hourly maximum demand for each month, calculated based on the following variables:

- Hourly internal water demands based on a standard hourly internal water demand profile for each end use and building type.
- Hourly irrigation demands based on the irrigation area and local hourly rainfall and evaporation rates.

Due to the fact that internal water demand is relatively consistent over time, in all cases, outdoor irrigation demand is the key contributor towards peak water demands. It should also be noted that peak demands for drinking water and recycled water (Figures 17 and 18) do not necessarily add up to the total peak demand (Figure 16) as the individual peak demands may occur at different times.

### TOTAL WATER DEMAND PROFILE

| FACTOR | RESIDENTIAL | NON-RESIDENTIAL | TOTAL |
|---|---|---|---|
| Average Daily Demand (kL/day) | 2,259 | 305 | 2,564 |
| Peak day (kL/day) | 3,406 | 652 | 3,942 |
| Peak hour (kL/hr) | 345 | 56 | 394 |

Table 5: Demand profile for Box Hill North urban release area.

### DRINKING WATER DEMAND PROFILE

| FACTOR | RESIDENTIAL | NON-RESIDENTIAL | TOTAL |
|---|---|---|---|
| Average Daily Demand (kL/day) | 1,070 | 30 | 1,101 |
| Peak day (kL/day) | 1,563 | 44 | 1,608 |
| Peak hour (kL/hr) | 164 | 5 | 169 |

Table 6: Demand profile for Box Hill North urban release area.

### RECYCLED WATER DEMAND PROFILE

| FACTOR | RESIDENTIAL | NON-RESIDENTIAL | TOTAL |
|---|---|---|---|
| Average Daily Demand (kL/day) | 1,189 | 275 | 1,464 |
| Peak day (kL/day) | 1,884 | 615 | 2,499 |
| Peak hour (kL/hr) | 184 | 53 | 228 |

Table 7: Demand profile for Box Hill North urban release area.

### TOTAL WATER DEMAND

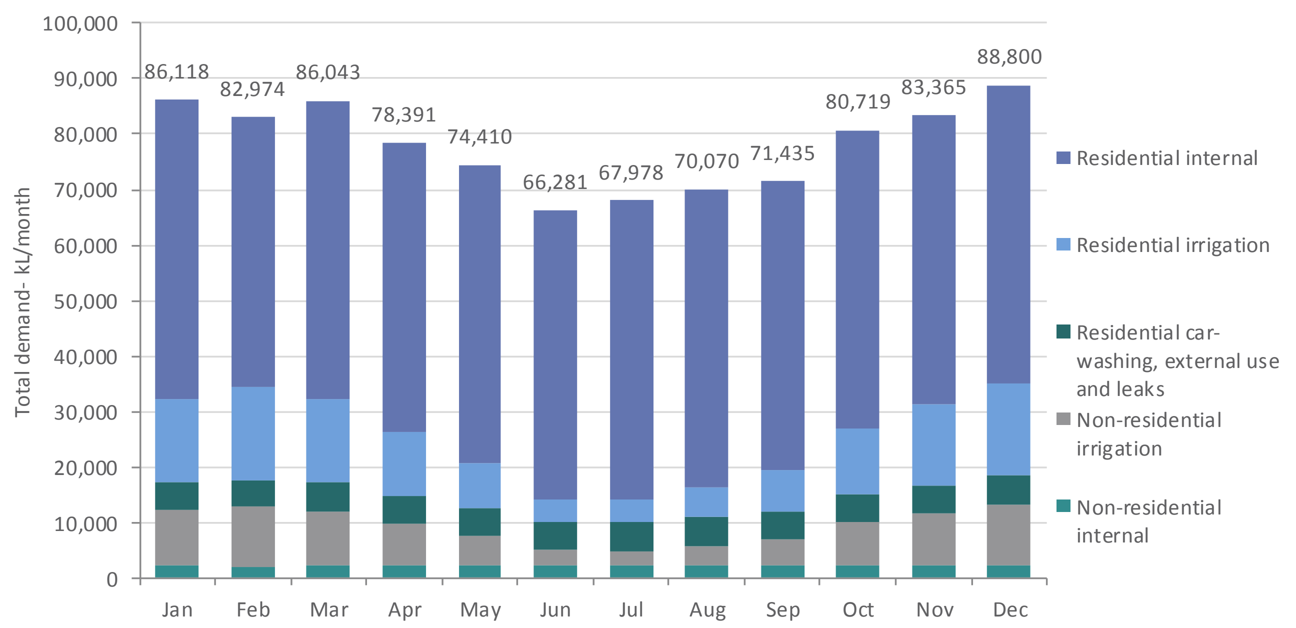


Figure 10: Total water demand by month

## TOTAL DRINKING WATER DEMAND

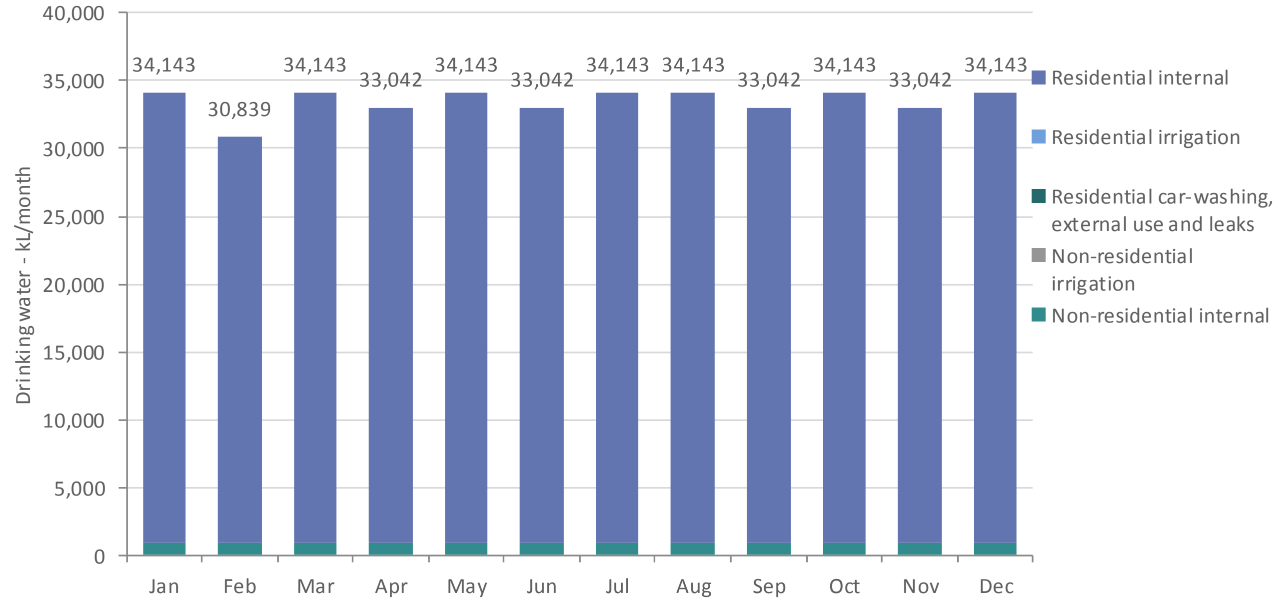


Figure 11: Total drinking water demand by month

## DAILY AVERAGE WATER DEMAND

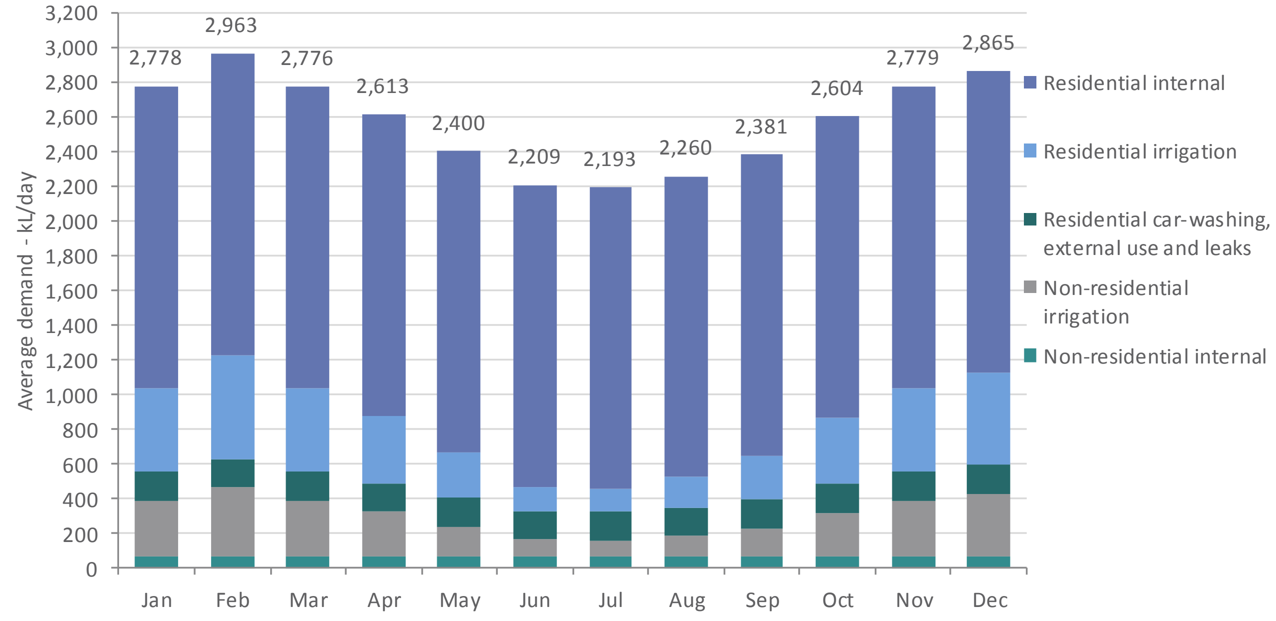


Figure 13: Daily average total water demands by month

## TOTAL RECYCLED WATER DEMAND

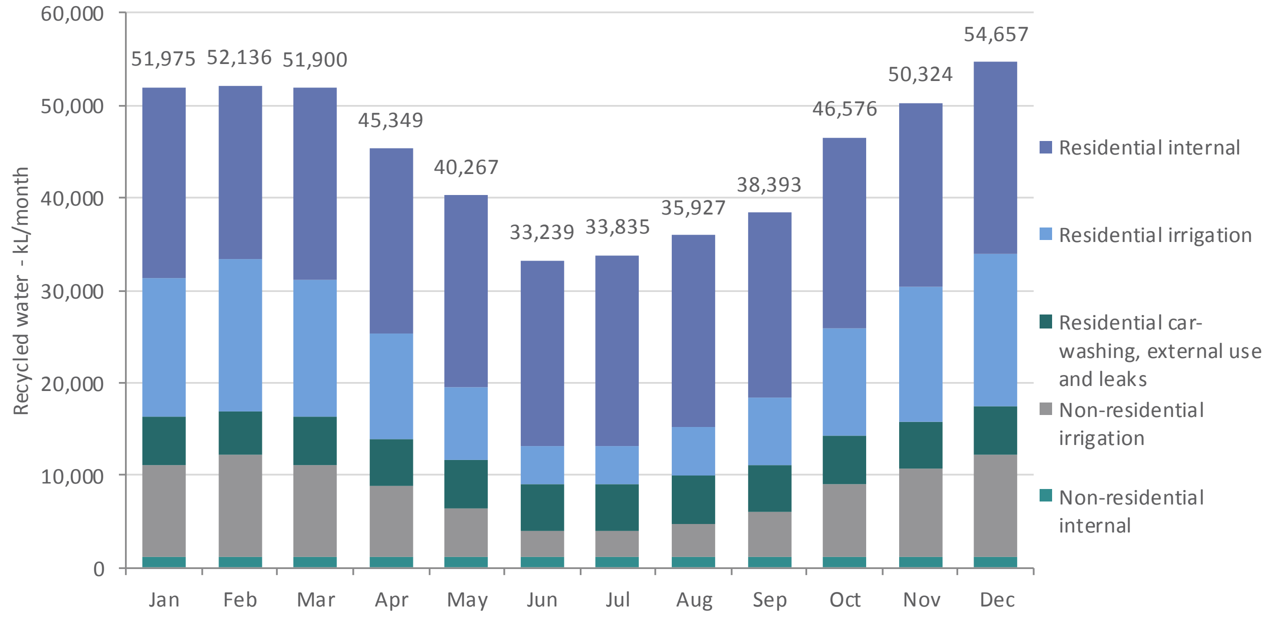


Figure 12: Total recycled water demands by month

## DAILY AVERAGE DRINKING WATER DEMAND

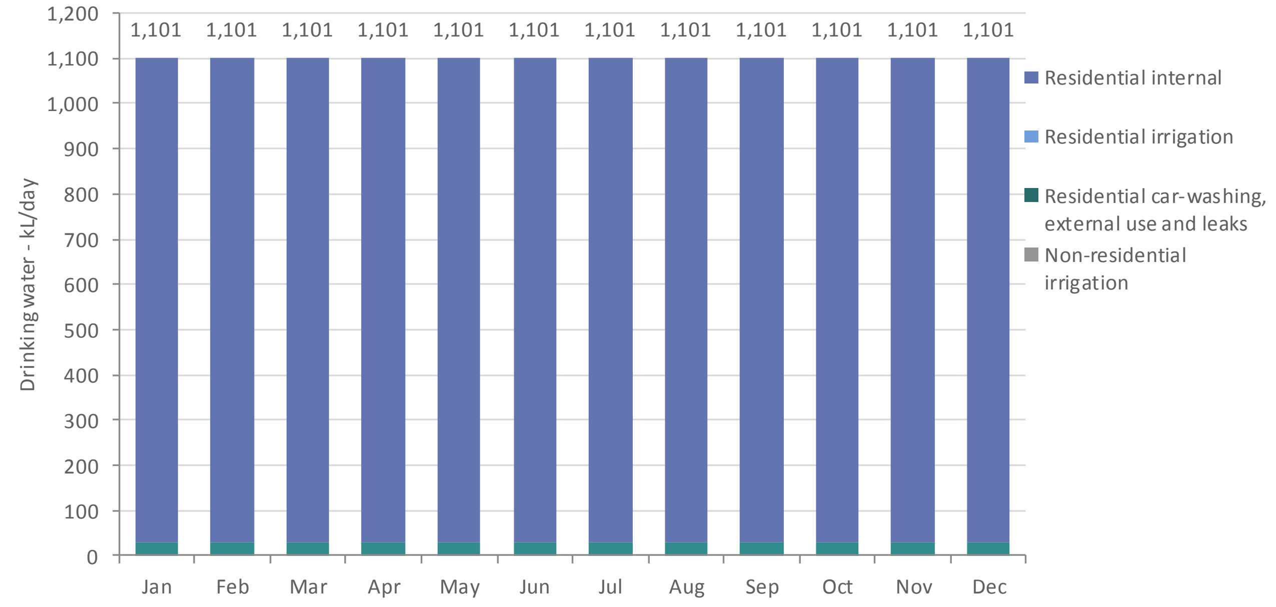


Figure 14: Daily average drinking water demand by month

## DAILY AVERAGE RECYCLED WATER DEMANDS

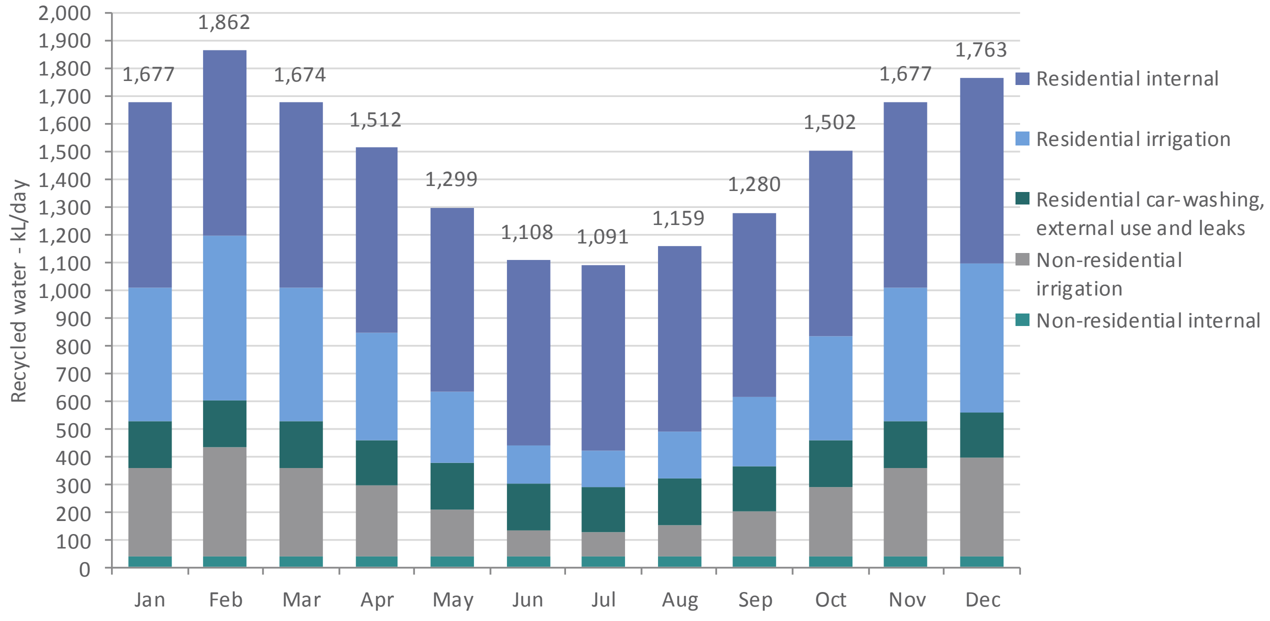


Figure 15: Daily average recycled water demand by month

## PEAK DRINKING WATER DEMANDS

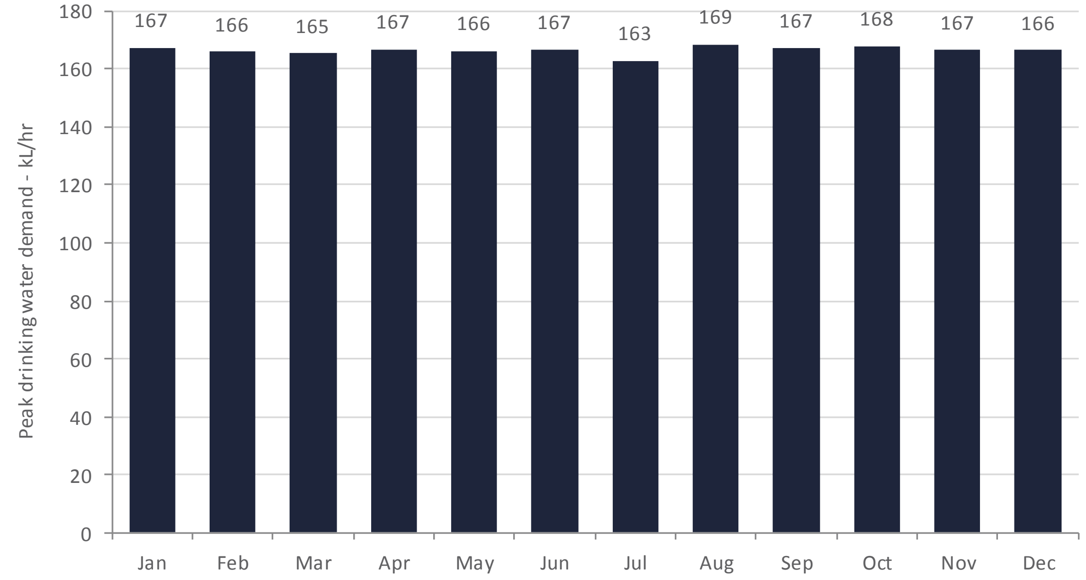


Figure 17: Peak drinking water demands by month

## PEAK TOTAL WATER DEMANDS

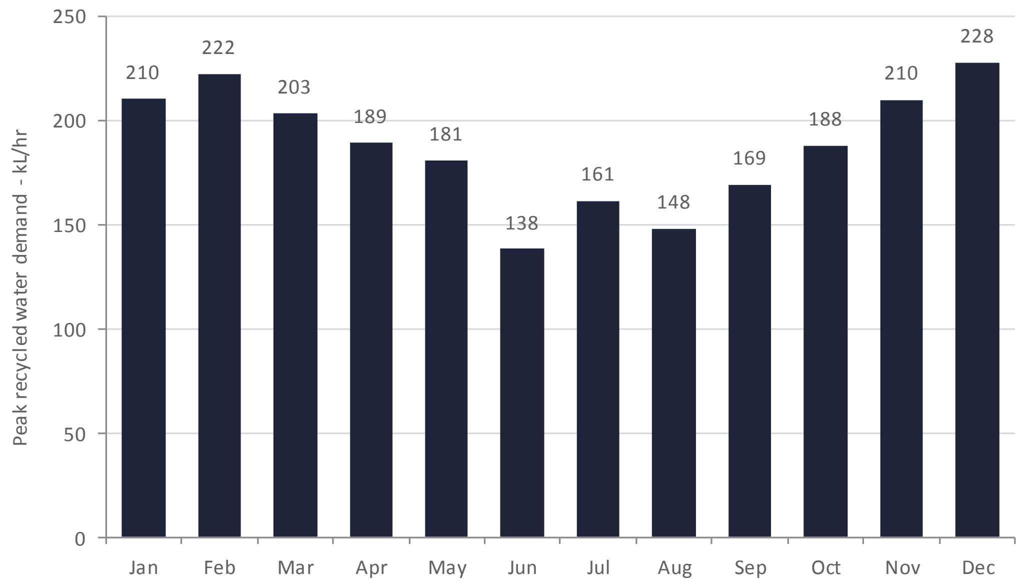


Figure 16: Peak total water demand by month

## PEAK RECYCLED WATER DEMANDS

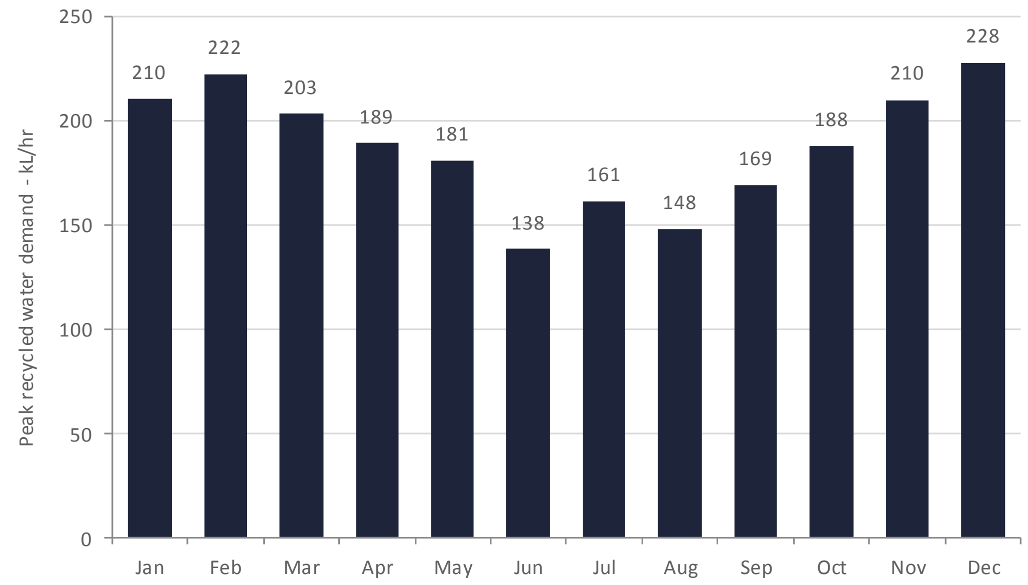


Figure 18: Peak recycled water demand by month

**NOTE:** Peak demands for drinking water and recycled water (Figures 17 and 18) do not necessarily add up to the total peak demand (Figure 16) as the individual peak demands may occur at different times.

# 3. SOURCE WATER PRODUCTION

## 3.1 SOURCE WATER PRODUCTION

Source water for the recycled water scheme is sourced from sewage production. Residential and non-residential sewage production is calculated based on the specific building types proposed for Box Hill North urban release area (as shown previously in Tables 3 and 4).

Table 10 outlines the average daily and peak sewer production for the residential and non-residential components of the development. Source water production from the residential and non-residential buildings is broken down further in Tables 8 and 9.

### RESIDENTIAL SEWAGE PRODUCTION

| Water End Use | Per Person Sewage Production (L/day) | Development Sewage Production (kL/day) |
|---|---|---|
| Shower | 28.5 | 469.8 |
| Kitchen sink | 7.5 | 124.6 |
| Bathroom basin | 2.6 | 43.1 |
| Dishwasher | 2.3 | 38.0 |
| Laundry trough | 5.0 | 82.6 |
| Bath | 8.7 | 143.6 |
| Fire testing* | 1.5 | 24.8 |
| Toilet | 17.5 | 289.5 |
| Washing machine | 27.0 | 445.9 |
| Car washing | - | - |
| Leaks (RW & DW grade) | - | - |
| Other external ** | - | - |
| Irrigation | - | - |
| **TOTAL** | 100.6 | **1,661.9** |
| **AVE. DWELLING** | **345.4** | |

Table 8: Residential dwelling end use specifications and per person daily sewage production used in the analysis

* Estimated using the proportion of Box Hill North residents in apartment dwellings and fire test water use as per BASIX

** Other external includes hose down, hardstand cleaning.

### NON-RESIDENTIAL SEWAGE PRODUCTION

| Water End Use | Sewage Production (L/m²/day) | Development Sewage Production (kL/day) |
|---|---|---|
| Retail | 1.8 | 13.9 |
| Commercial | 1.8 | 0.9 |
| Entertainment | 4.1 | 4.7 |
| Education | 1.6 | 43.9 |
| Day clinic | 10.2 | 4.6 |
| **TOTAL** | | **68.0** |

Table 9: Non-residential specifications and average annual demands used in the analysis. It should be noted that an estimated 1.1 kL/day is assumed to be lost through evaporative cooling in non-residential buildings.

### SEWAGE PRODUCTION PROFILE

| FACTOR | RESIDENTIAL | NON-RESIDENTIAL | TOTAL |
|---|---|---|---|
| Average Daily Production - kL/d | 1,661 | 68 | 1,729 |
| Peak day - kL/d | 2,426 | 100 | 2,525 |
| Peak hour – kL/hr | 254 | 10 | 265 |

Table 10: Demand profile for Box Hill North urban release area

# 4. RECYCLED WATER SYSTEM PERFORMANCE

## 4.1 RECYCLED WATER SYSTEM CONFIGURATION

The recycled water system for Box Hill North urban release area was configured as follows:

- Connection to all dwellings for toilet and washing machine (cold tap) and garden irrigation
- Connection to open spaces deemed either essential or highly preferable to irrigate in the HydroPlan *Irrigation Strategy Master* Plan document for the Gables development
- Total recycled water storage capacity of 7.5 ML
- Volume losses of 2% are considered for the membrane bioreactor process

## 4.2 WATER BALANCE

The average daily performance of the recycled water system at full build out is outlined Figure 20 and the key water results are shown in Table 11.

| Water Source | ML/year | kL/day |
|---|---|---|
| Total Precinct Water Demand | 937 | 2,564 |
| Sewage Production | 631 | 1,729 |
| Recycled Water Demand | 535 | 1,464 |
| Recycled Water Demand Met | 533 | 1,459 |
| Water top-up for Recycled Water Use | 2 | 5 |
| Drinking Water Demand | 402 | 1,101 |
| Water available for surplus irrigation | 85 | 234 |

Table 11: Estimated development average water balance with recycled water system at full build out

**Water Import for Recycled Water Use**

The model shows that, at full build out, on average, 2 ML per year water top-up (stormwater/ rainwater or potable water import) will be required to service non-drinking water uses (see Figure 19). This is because sewage production and storage are sufficient to meet recycled water demand (on average), although peak demands will require additional top-up.

## RECYCLED WATER SYSTEM PERFORMANCE AT FULL BUILD OUT

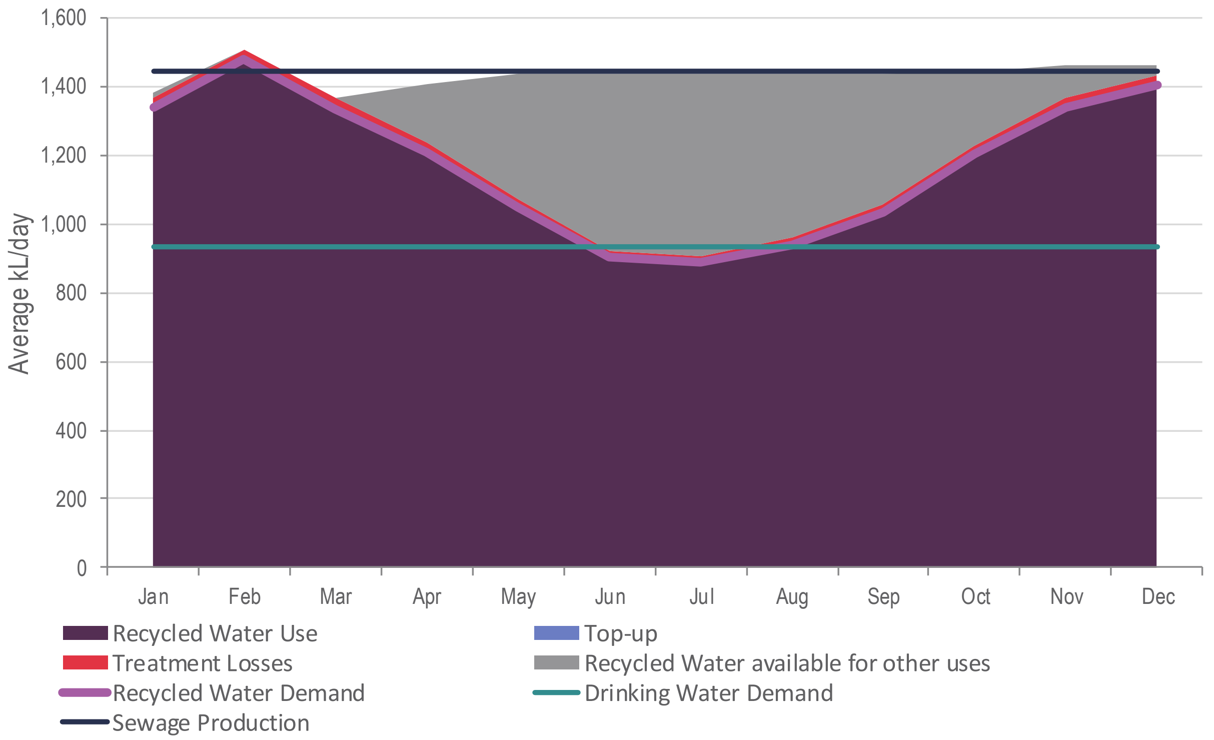


Figure 19: Recycled water system performance showing monthly recycled water use, demand and surplus that can be used to irrigate additional public open space areas. Note that daily averages have been calculated for each month. As such, daily variation in sewage production that results in the availability of recycled water for irrigation in summer is not apparent in this figure

## ANNUAL AVERAGE DAILY FLOWS IN KL/DAY

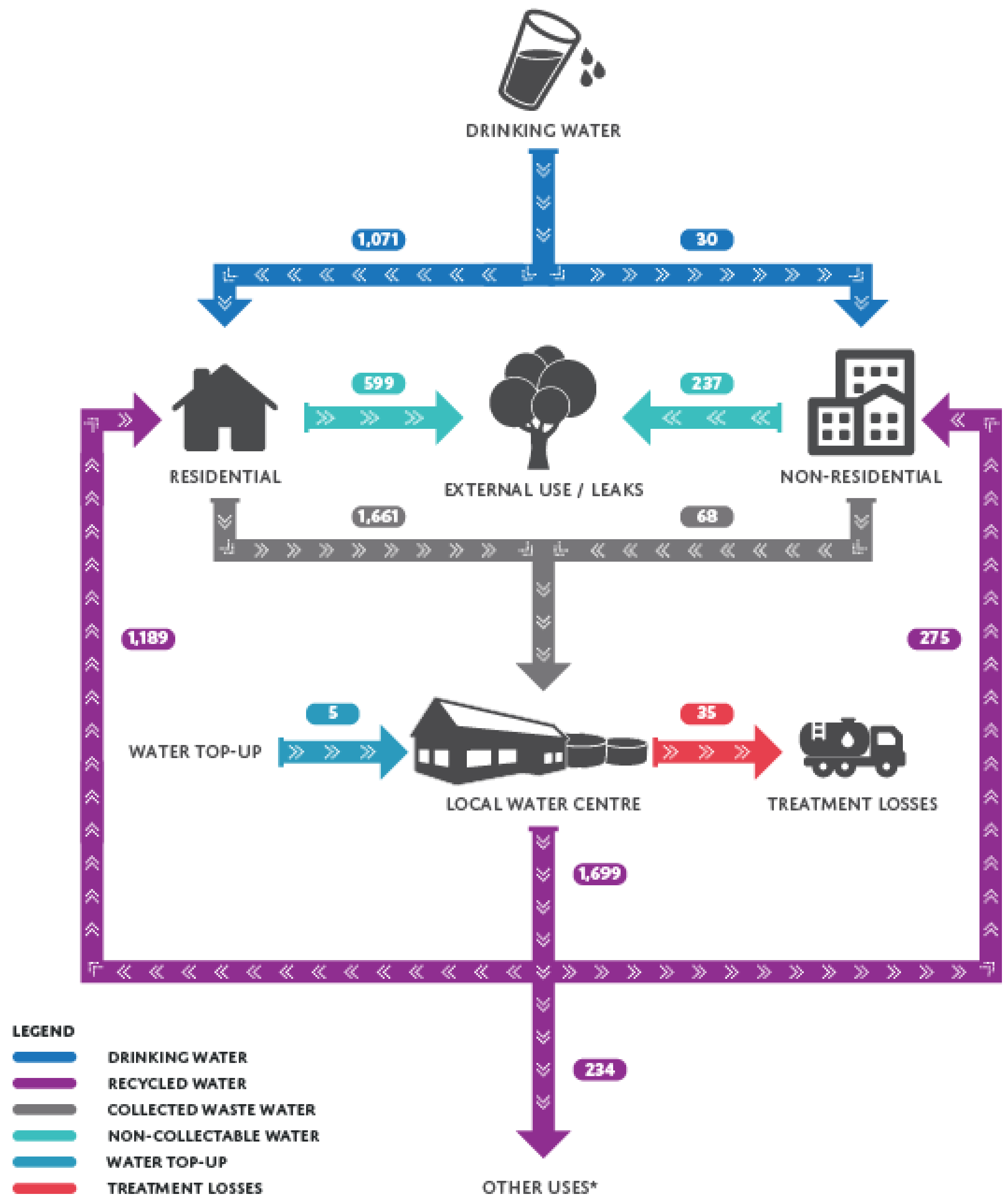


Figure 20: Schematic of the recycled water system showing annual average daily flows and treatment losses in kL/day.

**Note** - The sum of monthly recycled water use and discharge to sewerage does not always equal the total sewage production, due to the hourly analysis run by CCAP Precinct and the storage tank actively accepting and supplying water in order to minimize top-up, e.g. sewage production in excess of the recycled water demand is kept in the flow balance or recycled water is kept in the recycled water storage tanks, for periods where sewage production cannot meet the recycled water demand. External use includes irrigation, car washing & other external uses such as hose down.
* Other Uses may be external customers.

## 4.2 ADDITIONAL IRRIGATION RECYCLED WATER CONNECTIONS FOR OTHER USE

There are 38 additional lots on the fringe of the development with large open areas that require irrigation. If connections are established with the fringe customers on irrigation, a fully balanced, self-sustainable recycled water system could be achieved where all the treated water would be utilized and any 'other use' is fully accommodated.

Figure 21 and Figure 22 outline the recycled water system performance of the fully balanced system, visualizing the outcome of an established connection between the fringe customers and the development water network. The fringe customers will utilize the available other use recycled water for their irrigation purposes, at a rate of 2 mm/day suggested by Whitehead & Associates Environmental Consultants' *Land Capability Assessment for Recycled Water Management Scheme at Proposed Box Hill North Master Plan Development, Box Hill, NSW*. It is estimated that a total of 30.2 ha of land is required from fringe customers to fully utilize the 'other use' portion in the recycled water plant. However, it is also worth noting that, during summer periods, the connections from fringe customers will require sizable water top-up, increasing the annual top-up of the development to be 363 kL per day, or 133 ML per year.

### RECYCLED WATER SYSTEM PERFORMANCE UTILIZING OTHER USE FOR IRRIGATION

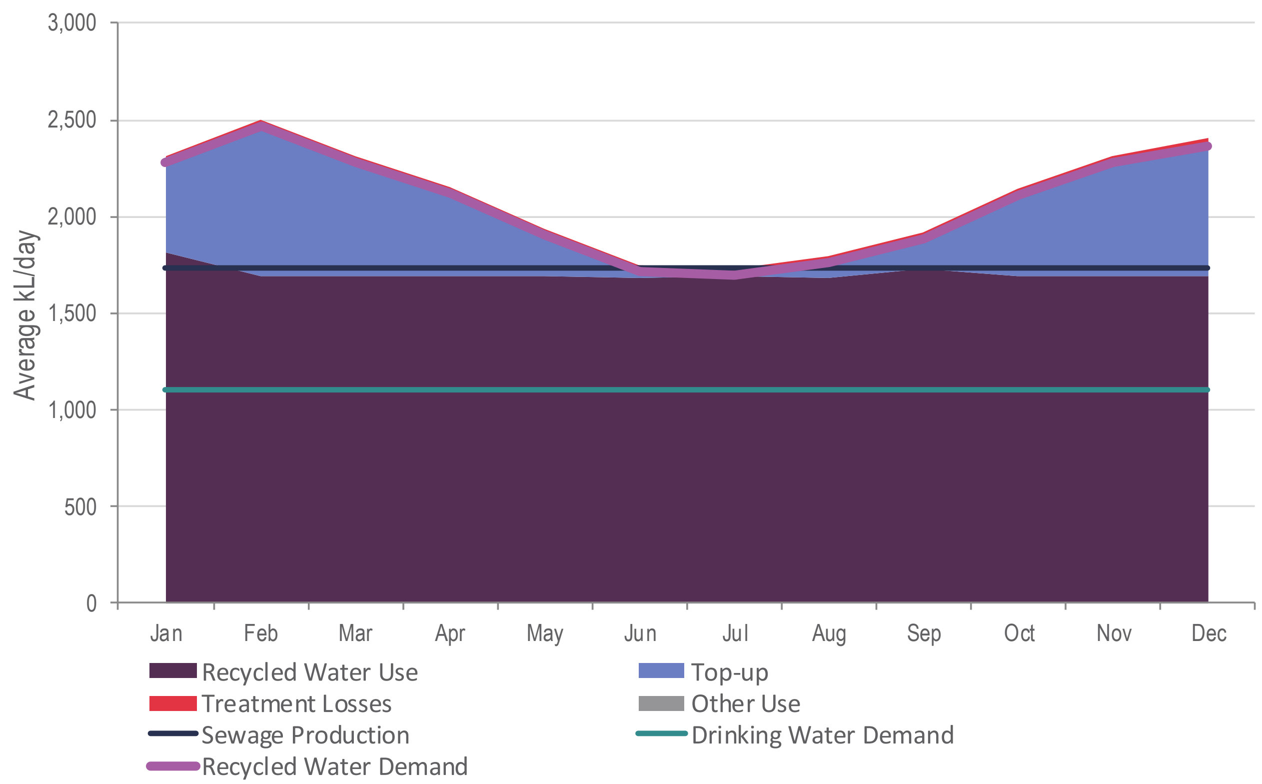


Figure 21: Recycled water system performance showing monthly recycled water use and demand, with additional irrigation connection to the fringe of the development to fully utilize the available recycled water for other uses.

### ANNUAL AVERAGE DAILY FLOWS IN KL/DAY WITH FRINGE CUSTOMERS

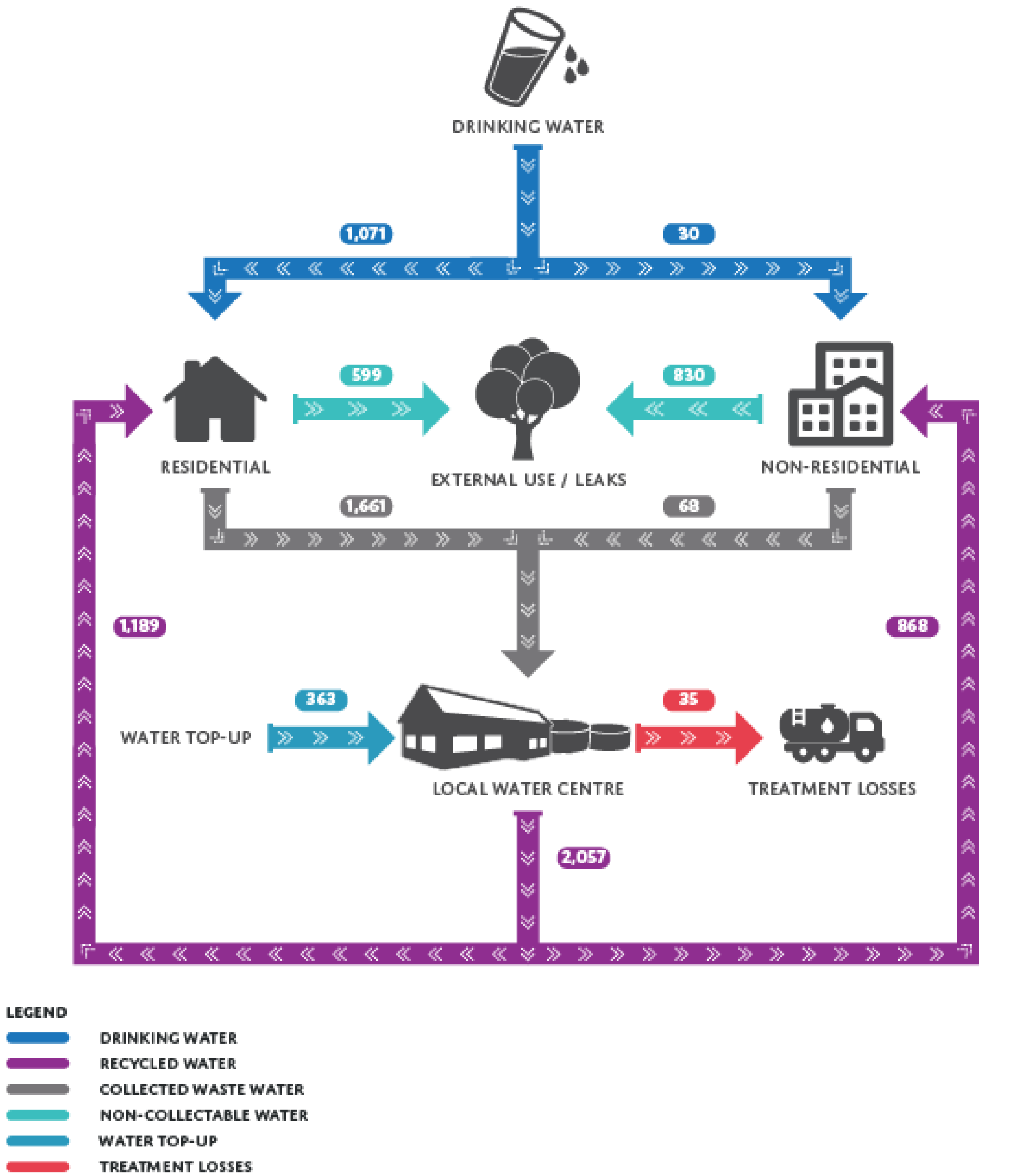


Figure 22: Schematic of the recycled water system with fringe customers, showing annual average daily flows and treatment losses in kL/day

# APPENDIX

## KEY DATA SOURCES

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data (station 040842 – Richmond RAAF, 10 km Northwest from development, synthesized RMY)
  - Data is from the representative weather station for the local climate zone (NatHERS zone 10)
  - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia. The total rainfall and evaporation for this climate zone is:
    - Annual rainfall (mm) - 881
    - Annual evaporation (mm) – 1,738
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Kinesis 2014, Additional water end use breakdowns derived from first principle analysis of residential and non-residential building types.
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra.
- Whitehead & Associates Environmental Consultants, 2014, Land Capability Assessment for Recycled Water Management Scheme at Proposed Box Hill North Master Plan Development, Box Hill, NSW
- Hydroplan, 2017, Irrigation Strategy Master Plan – The Gables

## DOCUMENT CHANGE LOG

| Date | Version No. |
|---|---|
| 24/03/2017 | 0.1 |
| 28/03/2017 | 0.2 |
| 04/04/2017 | 0.3 |
| 12/04/2017 | 0.4 |
| 1/05/2017 | 0.5 |
| 12/03/2018 | 1 |
| 19/03/2018 | 2 |
| 05/04/2018 | 3 |
| 26/09/2019 | 4.0 |
| 27/09/2019 | 5.0 |

# Preliminary Risk Assessment Summary for Box Hill

## Purpose

The purpose of undertaking the preliminary risk assessment was to:

- Identify potential risks that may impact the safe and reliable operation of the facility (and associated components), specifically focused on risks associated with the following:
  - Potential impacts to public health and/or water quality
  - Environmental impacts including noise, odour and general environmental impacts
  - Operational reliability and process performance
  - Financial viability
  - Customer service
- Identify early, potential risk mitigation/control measures that can be incorporated into the design, construction and operation of the facility to sufficiently mitigate these risks
- Facilitate further dialogue with all key stakeholders to ensure all key risks associate with the project are identified and effectively controlled.

## Methodology

A risk assessment was conducted for provision of the following services:

- Sewage
- Recycled water

The assessment approach adopted for conducting the sewage and recycled water preliminary risk assessments was consistent with the recommendations in the Australian Guidelines for Water Recycling (AGWR). The assessment criteria are provided in Attachment A.

Business risks, or risks leading to a loss of service or complaints, were assessed using the Flow assessment criteria provided in Attachment B.

The preliminary risk assessment process included the following activities:

- **Risk Identification** – The identification of a range of risks related to the project (what might happen?)
- **Risk Categorisation** – The categorization of the risks into various types to aid understanding and to provide context.
- **Risk Assessment** – Determination of the likelihood and consequence of the unmitigated/uncontrolled risk (what is the likelihood and impact/consequence?)
- **Managing the Risk/Risk Mitigation** – the identification of appropriate controls to be further developed and implemented as appropriate should the project be approved to process (what can be done to stop it happening?)
- **Post Mitigation Risk Assessment** – the reassessment of the risk following implementation of appropriate controls to ensure that the risk is sufficiently mitigate (how effective do we anticipate the controls to be?)

### Controls

Controls modify the likelihood or the impact of the risk (i.e. both the likelihood and consequence of a risk).

- Preventive controls apply at the beginning of a risk's life, at or near the root causes(s). As a device, they often act as a barrier to "nip it (the risk) in the bud". They primarily reduce the likelihood of the risk occurring. Examples are system passwords, locked doors, machinery maintenance etc.
- Detective controls usually apply somewhere in the middle of the risk's life. Detective controls rely on the analysis of information in order to detect that a risk is "in motion". Detective controls that are "early" in the risk's life usually modify likelihood and those that are "late" in the life, usually modify impact. Examples are online monitoring, inspections, complaints and incident monitoring etc.
- Reactive controls (sometimes also called Responsive or Corrective), apply towards the end of a risk's life when the impact is imminent or being felt. They are focused on modifying impact. Examples are plant shutdown, drinking water top up, incident and emergency response processes.

### Risk rating before and after controls

The risk rating after controls is a risk assessment with controls in place. As explained above, controls can modify both the likelihood and consequence of a risk.

The qualitative descriptions for consequence or impact contained in the recommendations of the AGWR and ADWG (refer to Attachments A and B), use a combination of the scale of the impact and the size of population or ecosystem affected. If the controls can reduce the scale of the impact or size of the population or ecosystem affected, then the overall risk rating can be reduced.

Examples include:
Sewage – The risk of sewage overflow is mitigated by rapid response and isolation reducing the quantity of sewage released, and/or the flows to sensitive receiving environments being diverted, and therefore the scale and size of the ecosystems affected.
Recycled water - The risk of process failure is mitigated by a multi-barrier treatment approach and plant shutdown if critical control points are exceeded.

## Outcomes

**Sewage Risk Assessment**

In undertaking the preliminary risk assessment, risks were identified across the following areas:

| Area | Descriptions |
|---|---|
| The Catchment | Risks associated with the catchment area including consideration of items such as contamination, volume changes, public health incidents, storage requirements, illegal discharge to sewers etc. |
| The Sewer Network | Risks associate with the network itself including blockages, pipe or equipment failure, loss of power etc. |
| Management | General operation management issues risks that may impact operational reliability or supply surety. |

Risks have been summarise at Attachment C as the detailed preliminary risk assessment contains information that is commercial in confidence.

**Recycled Water Risk Assessment**

In undertaking the preliminary risk assessment, risks were identified across the following areas:

| Area | Descriptions |
|---|---|
| Local Water Centre | Consideration of the potential risk associated with the operation of the treatment facility including tank and/or equipment failure, odour, noise, process risks, capacity, power failure, telemetry, vandalism, operator error, flooding etc. |
| Recycled Water Reticulation and Use | Risks associated with the storage and distribution of recycled water to users and considered areas such as equipment failure, demand, unauthorized usage, water quality, security, power failure etc. |
| Management | General operation management issues risks that may impact operational reliability or supply surety. |

Risks have been summarise at Attachment D as the detailed preliminary risk assessment contains information that is commercial in confidence.

# Attachment A Qualitative Risk Assessment Criteria as per the AGWR

## Risk Matrix - Australian Guidelines for Water Recycling

| Likelihood | | | | | | |
|---|---|---|---|---|---|---|
| | A Almost certain | Low | Moderate | High | Very High | Very High |
| | B Likely | Low | Moderate | High | Very High | Very High |
| | C Possible | Low | Moderate | High | Very High | Very High |
| | D Unlikely | Low | Low | Moderate | High | Very High |
| | E Rare | Low | Low | Low | High | High |
| | | Insignificant 1 | Minor 2 | Moderate 3 | Major 4 | Catastrophic 5 |
| | | Consequence | | | | |

## Likelihood (qualitative measures)

| Level | Descriptor | Example description |
|---|---|---|
| **A** | **Almost certain** | Is expected to occur, with probability of multiple occurrences within a year. |
| **B** | **Likely** | Will probably occur within a 1-5 year period. |
| **C** | **Possible** | Might occur or should be expected to occur within 5-10 year period. |
| **D** | **Unlikley** | Could occur within 20 years or in unusual circumstances. |
| **E** | **Rare** | May occur in exceptional circumstances; may occur once in 100 years. |

## Consequence or impact (qualitative measures)

| Level | Descriptor | Example description |
|---|---|---|
| **1** | **Insignificant** | Insignificant impact or not detectable. |
| **2** | **Minor** | Health - minor impact for small population<br>Environment - potentially harmful to local ecosystem with local impacts contained to site. |
| **3** | **Moderate** | Health - minor impact for large population<br>Environment - potentially harmful to regional ecosystem with local impacts primarily contained on site. |
| **4** | **Major** | Health - major impact for small population<br>Environment - potentially lethal to local ecosystem. Predominantly local, but potential for off-site impacts. |
| **5** | **Catastrophic** | Health - major impact for large population<br>Environment - potentially lethal to regional ecosystem or threatened specias. Widespread on-site and off-site impacts. |

**Note:**
1. The levels used for "Likelihood" have been changed to be the same as the ADWG i.e. A = Almost certain. In the AGWR A = Rare

# Attachment B Flow's Qualitative Risk Assessment Criteria

Risk Matrix - Flow Systems

| Likelihood | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | Almost certain | | Low | Medium | High | Very High | Very High |
| B | Likely | | Low | Medium | High | Very High | Very High |
| C | Possible | | Minimal | Low | Medium | High | Very High |
| D | Unlikely | | Minimal | Minimal | Low | Medium | High |
| E | Rare | | Minimal | Minimal | Low | Medium | High |
| | | | Insignificant<br>1 | Minor<br>2 | Moderate<br>3 | Major<br>4 | Catastrophic<br>5 |
| | | | Consequence | | | | |

## Attachment B Flow's Qualitative Risk Assessment Criteria *cont.*

### Likelihood (qualitative measures)

| Level | Descriptor | Example description (Flow) |
|---|---|---|
| **A** | **Almost certain** | Expected to occur in most circumstances.<br>Greater than 90% chance of occurrence.<br>More than once per year. |
| **B** | **Likely** | Will probably occur in most circumstances.<br>65%-90% chance of occurrence<br>Once in 1-2 years |
| **C** | **Possible** | Might occur or should occur at some time.<br>35%-65% chance of occurrence<br>Once in 2-5 years |
| **D** | **Unlikley** | Could occur in unusual circumstances.<br>10%-35% chance of occurrence.<br>Once in 5- 20 years. |
| **E** | **Rare** | May occur only in exceptional circumstances.<br>Less than 10% chance of occurrence.<br>Once in 20 years |

### Consequence or impact (qualitative measures)

| Level | Descriptor | Example description |
|---|---|---|
| **1** | **Insignificant** | No material financial consequence to Flow<br>Cost <$10k<br>1-2 customers impacted.<br>Little disruption to normal operation, low increase in normal operation costs. |
| **2** | **Minor** | Some financial consequences to Flow<br>Cost $10k-100k.<br>2-10 customers or a whole street impacted.<br>May require notification but no other extraordinary activities.<br>Some manageable operation disruption, some increase in operating costs. |
| **3** | **Moderate** | Considerable financial consequences to Flow.<br>Cost $100k-$250k.<br>Subdivision of community or whole development stage impacted.<br>Significant negative consequences requiring additional actions to rectify.<br>Negative client / customer reaction but temporary.<br>Significant modification to normal operation but manageable, operation costs increased, increased monitoring. |
| **4** | **Major** | Material financial consequences to Flow<br>Cost $250k-$1 million.<br>Whole community impacted.<br>High likelihood of adverse client/ customer reaction (e.g. lawsuits).<br>May lose some clients / customers permanently.<br>Systems significantly compromised and abnormal operation if at all, high level of monitoring required. |
| **5** | **Catastrophic** | Such significant financial consequences to Flow that its ability to operate is threatened.<br>Cost > $1 million.<br>More than one community impacted.<br>Adverse client / customer reaction (e.g. lawsuits).<br>Permanent loss of multiple clients / customers.<br>Flow's key point of contact with IPART in the short term.<br>Complete failure of systems. |

## Attachment C – Preliminary Risk Assessment Summary - Sewage

| Risk ID | Component | Potential Risk | Pre-mitigation Risk | Controls | Post-mitigation Risk (or residual risk) |
|---|---|---|---|---|---|
| SW 1.1 | Whole of system | Failure of overarching sewer management plan | **Very High** | • Additional controls as listed for each individual risk below.<br>• **Preventive:**<br>• Business Management System (BMS) independently verified to the International Standards ISO 9001 for quality management, ISO 14001 for environmental management and ISO 45001 for safety management<br>• Regular audits by auditors from the regulator's (IPART) independent panel of auditors.<br>• Regular internal process and compliance audits are a component of the Flow BMS.<br>• Review of resource requirements as part of Flow's business planning and budgeting process.<br>• Annual review of BMS and water quality management plans.<br>• Regulator oversight and enforcement action.<br>• Skilled and trained operators.<br>• Competency based training system.<br>• **Detective:**<br>• Consumer complaints<br>• Operator inspections<br>• **Reactive:**<br>• Incident & Emergency Management Plan and associated processes to ensure a rapid and effective incident response and to prevent incident escalation.<br>• Incident Notification Protocol with NSW Health to ensure risks to public health are controlled quickly<br>• Qualified contractors engaged to provide rapid response to faults and emergencies including sewage overflows.<br>• Pollution incident notification as per POEO Act requirements | **Low** |
| SDW 1.1 | Delivery of developer works | Delays in construction and delivery of infrastructure by developer | **Very High** | • Compliance Certificate only issued when developer completes works<br>• If works delayed, developer pays bond to Flow and Flow will deliver infrastructure<br>• Early identification of contingency measures through modelling.<br>• Project management processes.<br>• Generators if delay related to connection to power.<br>• Other reactive contingency measures dependent on service i.e. : sewage tankering, drinking water tankering, deployment of extra pumps | **Low** |
| SDW 1.2 | Delivery of Local Water Centre | Delays in construction and delivery of Local Water Centre by Flow | **Very High** | • ISO 9001 certified project management processes to ensure timely delivery of infrastructure<br>• Early identification of contingency measures through modelling.<br>• Sewage tankering<br>• Provision of drinking water through recycled water network. | **Low** |
| SC1.1<br>SC1.2 | On lot plumbing and wastewater collection tanks | Overflow | **Very High** | • Office of Fair Trading Inspections<br>• Monitoring of pump operation through telemetry and data collection<br>• Alarms linked to telemetry<br>• Customer complaints<br>• Ability to isolate mains<br>• Qualified contractors to manage wastewater spills | **Low** |

| | | | | | |
|---|---|---|---|---|---|
| SC 1.3<br>SC 1.4 | Collection system (Sewer main) | Sewage escape from sewer main due to third party damage | **High** | • Dial Before You Dig (DBYD)<br>• Survey prior to invasive site work<br>• Physical and mechanical protection on mains<br>• Customer and community complaints and response process<br>• Customer communications | **Low** |
| SC1.5 | Collection system (Sewer main) | Low flows in initial development stages | **High** | • Design, production, installation and testing by qualified contractors and quality assurance to AS3735 Water Retaining Structures<br>• Customer Complaints Program<br>• Continuous monitoring and alarms | **Minimal** |
| SL 1.6<br>SL 1.10 | Local Water Centre (Flow Balance Tank) | Overflow from tank | **Very High** | • Design, production, installation and testing by qualified contractors and quality assurance to AS3735 Water Retaining Structures.<br>• Standby pumps and emergency alarms<br>• Storage within collection tanks<br>• Incident and Emergency Management Plan and associated processes to ensure rapid response and mitigation. | **Low** |
| SL 1.8<br>SL 1.9<br>SL 1.10 | Local Water Centre (Flow Balance Tank) | Operational failure | **Very High** | • Duty / standby of equipment<br>• Monitoring and controls<br>• Proactive maintenance regime<br>• Experienced operators<br>• Trade waste agreement<br>• Tankering company on emergency callout contract.<br>• Customer Complaints Program<br>• Continuous monitoring and alarms | **Low** |
| SL 1.11 | Local Water Centre | Inability to service customers | **Very High** | • Duty / standby of equipment<br>• Storage within the Flow Balance Tank<br>• Skilled operators<br>• Monitoring and controls<br>• Overflow relief<br>• Tankering company on emergency callout contract<br>• Drinking water top up to recycled water tanks. | **Low** |

## Attachment D – Preliminary Risk Assessment Summary – Recycled Water

| Risk ID | Component | Potential Risk | Pre-mitigation Risk (or | Controls | Post-mitigation Risk (or residual risk) |
|---|---|---|---|---|---|
| RW 1.1 | Whole of system | Failure of overarching recycled water quality plan | **Very High** | • See SW1.1 | **Low** |
| RDW 1.1 | Delivery of developer works | Delays in construction and delivery of infrastructure by developer | **Very High** | • Compliance Certificate only issued when developer completes works<br>• If works delayed, developer pays bond to Flow and Flow will deliver infrastructure<br>• ISO 9001 certified project management processes including project meetings, program updates, and reporting.<br>• Generators if delay related to connection to power.<br>• Other reactive contingency measures dependent on service i.e. : sewage tankering, drinking water tankering, deployment of extra pumps | **Low** |
| RDW 1.2 | Delivery of Local Water Centre | Delays in construction and delivery of Local Water Centre by Flow | **Very High** | • ISO 9001 certified project management processes to ensure timely delivery of infrastructure<br>• Early identification of contingency measures through modelling.<br>• Sewage tankering<br>• Provision of drinking water through recycled water network. | **Low** |
| RC 1.2<br>RC 1.3 | Collection System | Raw sewage characteristics are outside of design influent parameters | **Very High** | • Design influent parameters based on industry guidelines for water efficient homes.<br>• Community education i.e. new owner information packs, newsletters, school experience programmes etc. used to inform the public on what can be disposed of down the sewer.<br>• Trade Waste Agreements with retail and commercial users<br>• Multiple treatment barrier approach<br>• Automatic plant shutdown when critical control points are breached.<br>• Ability to tanker from LWC balance tank or divert to public water utility sewer (if applicable)<br>Additional storage in wastewater collection tanks<br>• Incident and Emergency Management Plan and Processes<br>• Incident notification protocol with NSW Health | **Low** |
| RL 1.1<br>RL 1.6<br>RL 1.8<br>RL 1.13 | Local Water Centre | Process equipment damage / failure | **Very High** | • Duty / standby of equipment<br>• Spares of critical equipment on site<br>• Monitoring and controls<br>• Proactive maintenance regime<br>• Experienced operators<br>• Incident and Emergency Management Plan and associated processes to ensure rapid response and mitigation.<br>• Tankering company on emergency callout contract<br>• Drinking water top up. | **Low** |
| RL 1.2<br>RL 1. 4<br>RL 1. 7<br>RL 1. 9<br>RL 1.12 | Local Water Centre | Process performance outside operational parameters | **Very High** | • Duty / standby of equipment<br>• Multi-barrier treatment process<br>• Spares of critical equipment on site<br>• Monitoring and controls<br>• Proactive maintenance regime<br>• Experienced operators<br>• Incident and Emergency Management Plan and associated processes to ensure rapid response and mitigation<br>• Drinking water top up | **Low** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | • Tankering company on emergency callout contract. | |
| RL 1.3<br>RL 1.5 | Local Water Centre | Tank failure | **High** | • Design, production, installation and testing by qualified contractors and quality assurance to AS3735 Water Retaining Structures<br>• Level monitoring<br>• Incident and Emergency Management Plan and associated processes to ensure rapid response and mitigation<br>• Tankering company on emergency call out contract.<br>• Drinking water top up | **Low** |
| RL 1.11 | Local Water Centre | Supply of chemicals is exhausted or degraded/poor quality | **Very High** | • Tanks sized for adequate storage<br>• Chemical supply from a reputable supplier.<br>• Skilled operators with documented operational procedure<br>• Chemical storage tanks are fitted with level devices to ensure levels are continuously monitored. | **Low** |
| RL 1.15 | Local Water Centre | Chemical spill | **Very High** | • Chemicals stored within weatherproof, bunded area as per Australian standards<br>• Chemical loading area within bunded area<br>• Chemical delivery procedures<br>• Trained and inducted delivery drivers<br>• Operator inspections<br>• Spill response procedure<br>• Tankering company on emergency callout contract<br>• Incident and Emergency Management Plan and processes | **Low** |
| RL 1.16 | Local Water Centre | Incorrect chemical delivery | **Very High** | • Operators on site and supervise chemical deliveries<br>• Chemical supply agreements and operational procedures<br>• Chemical delivery procedures including signage and labelling<br>• Trained and inducted delivery drivers<br>• Tankering company on emergency callout contract<br>• Incident and Emergency Management Plan and processes<br>• Spill response procedure. | **Low** |
| RL 1.17<br>RL 1.18<br>RL 1.19<br>RL 1.20<br>RL 1.21 | Local Water Centre | Disaster Emergency such as fire, lightning, vandalism, theft, power failure | **Very High** | • In the event of power failure onsite back-up generator used to maintain key process units.<br>• Regular maintenance of back up generator<br>• Ability to source an offsite generator as a backup<br>• UPS system installed to ensure control and access to the plant is still maintained.<br>• Top-up with drinking water<br>• Firefighting system for the LWC<br>• Incident and Emergency Management Plan and processes | **Low** |
| RL 1.23<br>RL 1.24 | Local Water Centre | Poor aesthetics / Noise | **Very High** | • Local Water Centre has been designed to blend in with the local environment whilst not hiding its core activity.<br>• Building layout has been designed to facilitate scheduled visits from interested stakeholders.<br>• All odour generating equipment has been fitted with covers and odour treatment as required.<br>• Odour modelling has been undertaken to confirm that expected impact on surrounding stakeholders is negligible.<br>• All noise generating equipment has been fitted with acoustic covers. Further | **Minimal** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | • acoustic treatment has been provided on the Local Water Centre building.<br>• Noise modelling has been used to confirm that expected impact on surrounding stakeholders is negligible.<br>• Incident and Emergency Management Plan and processes | |
| RL 1.25 | Local Water Centre | PLC / SCADA failure | **Very High** | • Local Water Centre can continue operation in the event telemetry is lost.<br>• Automatic LWC shutdown on PLC failure<br>• Operating procedure to respond to PLC failure<br>• Data capture will continue on the local SCADA and PLC.<br>• Plant would shut down if parameters were out of specification.<br>• Top up with drinking water<br>• Software and hardware back up<br>• Supply agreement with telemetry with emergency response provision | **Low** |
| RD 1.1<br>RD 1.2 | Recycled Water Distribution | Tank overflow / failure | **Low** | • Design, production, installation and testing by qualified contractors and quality assurance<br>• Incident and Emergency Management Plan and associated processes to ensure rapid response and mitigation<br>• Tankering company on emergency callout contract | **Low** |
| RD 1.3<br>RD 1.4 | Recycled Water Distribution | Cross connection | **Very High** | • Recycled water kept at lower pressure than drinking water thereby mitigating recycled water entering the system<br>• Colour coded, different materials, labelled pipes and marker tape<br>• QA inspections of house plumbing by NSW Office of Trading prior to handover / operation<br>• Plumbing inspections triggered by DA process<br>• OFT inspection and Flow's cross-connection plumbing check pre-conditions to Flow's connection of sewerage<br>• QA checks on reticulation installation prior to handover to Flow (and Flow's issue of Certificate of Compliance)<br>• Home builder education (website, Builders Guide)<br>• Customer education (website, home owners guide, including translated services)<br>• Backflow prevention at each house connection<br>• Telemetry monitoring of drinking and recycled water usage to identify anomalous use | **Low** |
| RD 1.5 | Recycled Water Distribution | Recycled water is used for unauthorized purposes | **Very High** | • Colour coded, different materials, labelled pipes and marker tape<br>• Information packs will be supplied to householders on initial connection or with change of ownership. These information packs will clearly define the authorised uses for the recycled water.<br>• Community education on recycled water / website<br>• Signage on recycled water taps<br>• Monitoring of drinking and recycled water usage to identify anomalous use | **Low** |
| RD 1.6 | Recycled Water Distribution | Process equipment damage / failure | **Moderate** | • Pumps are installed duty / standby with automatic changeover.<br>• Maintenance contractor to be engaged under standard protocols to investigate cause of pump failure. | **Minimal** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | • Maintenance contractor to be engaged under emergency protocols to repair pump(s) or install temporary pump or repair leak.<br>• Preventive maintenance on pumps<br>• Reticulation pipe work will be provided with a number of valves enabling isolation of parts of the network<br>• Incident and Emergency Management Plan and processes. | |
| RD 1.7 | Recycled Water Distribution | Main break leading to discharge of recycled water | **Moderate** | • Reticulation pipe work will be provided with a number of valves enabling isolation of parts of the network.<br>• Maintenance contractor to be engaged under emergency protocols to repair leak.<br>• High quality recycled water<br>• Dial Before You Dig (DBYD)<br>• Automatic shut down on high flow<br>• Looped reticulation design and construction<br>• Highlighting of single supply mains as high priority on DBYD where looping not possible<br>• Pressure monitoring of the network for early alert of leaks<br>• Mechanical vehicle protection on storage tanks (height restrictions, bollards)<br>• Detectable marker tape over all mains | **Low** |
| RD 1.9 | Recycled Water Distribution | Demand exceeds supply | **Moderate** | • Recycled water storage sized at >5 days of average production.<br>• Drinking water used to maintain supply if the recycled water storage tank drops below a minimum level.<br>• Membrane tank over-sized to allow for the option of stormwater harvesting to supplement the source water supply. | **Minimal** |
| RD 1.10 | Recycled Water Distribution | Health impact from exposure to water features | **Very High** | • Signage indicating use of recycled water in water features and proper use<br>• High quality recycled water has low risk of health impact<br>• Information packs and community education<br>• Incident and Emergency Management Plan and processes | **Low** |
| RD 1.11 | Recycled Water Distribution | Supply exceeds demand | **Very High** | • Implement Integrated Water Cycle Management (IWCM) Policy and regularly review scheme specific IWCM Plan.<br>• Seek additional recycled water customers<br>• Monitor volumes, demands and trends and adjust operations to suit. | **Low** |
| RI 1.1<br>RI 1.2<br>RI 1.3<br>RI 1.4<br>RI 1.5<br>RI 1.6 | Recycled Water Irrigation in Designated Irrigation Zones | Increased flows to receiving waters from over-irrigation | **Moderate** | • Minimum 5m buffer area from waterways<br>• Monitoring soil and water quality<br>• Visual inspections<br>• Metered connections to Designated Irrigation Zones (DIZs)<br>• Water quality and flow monitoring. | **Low** |
| RI 1.7<br>RI 1.7a<br>RI 1.11 | Recycled Water Irrigation in Designated Irrigation Zones | Inappropriate irrigation | **High** | • Management in accordance with Recycled Water Irrigation Management Plan<br>• DIZ Site selection criteria<br>• Seasonal irrigation to meet water balance requirements<br>• Remote/in person monitoring of DIZs<br>• Visual inspection of DIZs<br>• Metered connections to DIZs<br>• Minimum 5m buffer area from waterways | **Low** |

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|---|---|---|---|---|---|
| RI 1.8<br>RI 1.9.<br>RI 1.10 | Recycled Water Irrigation in Designated Irrigation Zones | Increased salinity, pathogens and nutrients | **Moderate** | • Treatment process (LWC)<br>• DIZ Site selection<br>• Vegetation selection and maintenance<br>• Monitoring - water and soil quality | **Low** |
| EU 1.1<br>EU 1.2<br>EU 1.3<br>EU 1.5<br>EU 1.6<br>EU 1.7<br>EU 1.8<br>EU 1.9<br>EU 1.10 | End Uses | Health impact from exposure to recycled water through customer end uses | **High** | • Multiple barrier treatment process<br>• Regular audits by auditors from the regulator's (IPART) independent panel of auditors.<br>• Regular internal process and compliance audits are a component of the Flow BMS.<br>• Information packs will be supplied to householders on initial connection or with change of ownership. These information packs will clearly define the authorised uses for the recycled water.<br>• Community education on recycled water / website | **Low** |
| EU1.3<br>EU 1.8<br>EU1.9 | End Uses | Environmental impact from recycled water runoff | **High** | • Multiple barrier treatment process<br>• Regular audits by auditors from the regulator's (IPART) independent panel of auditors.<br>• Regular internal process and compliance audits are a component of the Flow BMS.<br>• Flow/customer agreements which allow Flow to communicate authorised purposes, associated health and environmental risks and required risk controls.<br>• Customer education for appropriate end uses (website, home owners guide, including translated services) | **Low** |

flow

# Drinking Water Quality Plan

(DWQP)

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# Recycled Water Quality Plan (RWQP)

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# Infrastructure Operating Plan (IOP)

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