B.5 Water Availability for SRAIP: Provision of Sufficient Supply & Reliability for Proposed Subdivision

Edited by Epic Environmental and OD Hydrology on 14/08/2023.

MEMO

Date: 22 June 2022
To: Office of Coordinator General
From: RPS

Regarding: SRAIP – Water Availability

Water Availability for SRAIP:
Provision of Sufficient Supply & Reliability for Proposed Subdivision

1. Executive Summary

Three key pieces of research have been undertaken to quantify the demand, availability and reliability of water to the SRAIP in response to the water availability items within the IAR Information Request.

1. Demand – Kalfresh calculation of annual water usage -summary of anticipated water demand for each lot within the Precinct. Based on known demand and standard anticipated industrial demand.
2. Availability – SRAIP Groundwater Source Report by Randall Cox. Incorporating water supply and availability investigations and monitoring to quantify the quantity of water currently available to the subject site.
3. Reliability – OD Hydrology undertook a hydrological assessment of the availability and reliability of water for the development and long-term operation of the SRAIP to determine whether the reliability of the supply was equivalent to the urban standard required to justify approval of an industrial subdivision in this location.

The combined findings of this research have been that at the current time there is at least **371ML annually of water available to the SRAIP** project with reliability equivalent to or better than the High Priority A Group water allocation detailed in the Moreton Water Plan (~~being an **urban standard of security/reliability**~~ which is equivalent to the typical reliability of allocations held by urban water supply providers).371ML is **sufficient water** to accommodate standard industrial demand for water **across all lots within the SRAIP**, plus provide for the additional demand associated with known tenants/land uses within the Precinct.

Therefore there is an appropriate level of supply to all industrial lots within the SRAIP with reliability equivalent to an urban standard of security /reliability under the Moreton Water Plan – meaning that the requirement for sufficient and reliable water supply to the precinct has been met.

It is proposed to allocate and manage the water distribution within the precinct by way of the Community Management Scheme (CMS) using mechanisms within this document to facilitate the metering of water usage and to use commercial means at time of purchase of a lot to place the onus on purchasers to identify their water requirements and obtain a suitable allocation for their needs from within the available allocations within the CMS.

It is noted that there are potential future users who may wish to locate in the Precinct, for whom additional water would be required. There is also potential that post 2025 the Moreton Water Plan will be amended and further water will be available to the SRAIP. At the time of purchase of their site all users will need to confirm that there is sufficient water allocated to their lot, and if they are users with high water demand they may not locate in the precinct until such time that additional water has been secured. This will be managed by the requirements within the CMS to identify water requirements of the proposed use and secure the required allocation within the CMS at the time of purchase of the lot.

2. Information Request Item

The information request item from the Office of Coordinator General relating to water availability is as follows:

> **Water**
>
> **Water availability**
>
> Approvals for reconfiguration of a lot and development permits will not be possible without water secured for that part of that stage of development. Water licences and allocations under the *Water Act 2000* cannot be issued as part of the IAR process and are being progressed separately with DNRME and commercial agreements with Seqwater. Accordingly, the following additional information is required.
>
> 34. Confirm water availability for stage 1 including a detailed description of how that water will be sourced, any approvals required, detailed concept plans and predicted timing for attaining water access and servicing the required allotments. CPD understands stage 1 will involve construction of two processing facilities - proponent to confirm.
>
> 35. Provide details of the available pathway/s to attain water supply for the SRAIP industrial precinct subdivision including quantity required, likelihood of options proceeding, approvals required and predicted timeframes and staging requirements / sequencing.

In addition to the above items following confirmation of water availability, the Department of Regional Development Manufacturing and Water advised that modelling should be undertaken to demonstrate the reliability of the supply, benchmarked against the standard applied to the supply of water in towns (eg urban reliability).

3. Confirmation of water availability

The attached, Groundwater Source Assessment (prepared by Randall Cox – Refer Appendix A) and Water Supply Assessment (undertaken by ODHydrology – Refer Appendix B) have established the security performance of sources of water available to the SRAIP and the associated quantities. ODHydrology have undertaken detailed hydrological reporting to assess the projected water supply system using two modelling tools. The water supply system concept comprises utilization of the existing water sources, with addition of on-*site storage as required to maintain the required supply performance under increasing demand. The Assessment outcomes demonstrate credible and practical immediate options for up to approximately 371 ML/a at a very high security performance*. Table 1 below depicts the resulting outcomes of the performance tests:

Table 1: Performance results

Water Requirement	Demand (ML/a)	On-site storage (ML)	% of months with 100% of demand met	% of months with at least 85% of demand met
Low	270	5	100.0%	100.0%
High	371	55	96.8%	100.0%

The attached plan – Appendix C illustrates the location of the proposed 55ML water storage dam on the subject site. This will be a lined turkeys nest dam that does not capture overland flow. The plan also illustrates the offtake point on Warrill Creek for water purchased from the Warrill Valley Water Supply Scheme and the proposed route of the water pipeline along which the water will be pumped to the on site storage dam.

4. Projections for water demand

Original estimations for projected water demand included in the IAR submission incorporated assumed demand for of a variety of prospective uses (some of which have assumed an extremely large demand for water). However the key consideration at this time relates to whether there is sufficient water supply available for an industrial subdivision at the anticipated base rate of demand for each lot. Revised calculations for water demand have been created which are based on the estimated water consumptions based on the SEQ Code for standard industrial uses.

Lot No.	Total Area (ha)	Industrial Water Use Guideline	Water Use (ML/year) Low Limit	Water Use (ML/year) High Limit
1	1.63	SEQ Code - 24 – 30 EP/Ha	3.71	4.64
2	2.16	SEQ Code - 24 – 30 EP/Ha	4.92	6.15
3	2	SEQ Code - 24 – 30 EP/Ha	4.56	5.69
4	1.99	SEQ Code - 24 – 30 EP/Ha	4.53	5.67
5	2	SEQ Code - 24 – 30 EP/Ha	4.56	5.69
6	1.75	SEQ Code - 24 – 30 EP/Ha	3.99	4.98
8	0.51	SEQ Code - 24 – 30 EP/Ha	1.16	1.45
9	4.98	SEQ Code - 24 – 30 EP/Ha	11.34	14.18
10	3.99	SEQ Code - 24 – 30 EP/Ha	9.09	11.36
11	5.00	SEQ Code - 24 – 30 EP/Ha	11.39	14.24
12	3.34	SEQ Code - 24 – 30 EP/Ha	7.61	9.51
13	3.00	SEQ Code - 24 – 30 EP/Ha	6.83	8.54
14	2.00	SEQ Code - 24 – 30 EP/Ha	4.56	5.69
15	2.00	SEQ Code - 24 – 30 EP/Ha	4.56	5.69
		TOTAL ML/PER YEAR	**82.79**	**103.49**

This calculation identifies that where each lot has access to the base rate of water supply required for an industrial land use that the demand is 103.49ML/year. This indicates that the 371ML/year available to the SRAIP is ample to service the water requirements of the fifteen industrial lots on the subject site, and to accommodate additional demand by some users in the 267.51ML/year remaining after the base allocation is made to the lots.

Further to this, a Demand management strategy within the Community Management Scheme is proposed to ensure that the available water is sufficient and is equitably distributed amongst users within the SRAIP and where additional allocations may be made available if and when they become available in the future. Refer to Section 6 for more details.

5. Continuity of Supply (Ensuring no shortfalls)

The modelling by ODHydrology within the attached report in Appendix B incorporates factors such as drought data from the past 130 years, Moogerah Dam storage behaviour and associated availability of high and medium priority allocations. The SRAIP source model incorporates catchment-wide climatic/hydrologic conditions and user behaviours in order to accurately model and consider factors potentially affecting water supply for the SRAIP Project.

The performance results in Section 2 account for potential water supply shortfalls and ensuring continuity of supply and finds that the water availability on site provides appropriate reliability and continuity of supply.

6. Future Additional Supply and Demand hikes

The reporting undertaken by ODHydrology (Appendix B) explores avenues for securing additional water supply in the future to accommodate demand for potential uses with very high water needs within the precinct. Assessment of estimated upper bound water requirements shows that credible options for maintaining the defined supply performance at these significantly higher potential water requirements exist, with augmentation via one or a combination of:

- Increased on-site storage.
- Precinct water-use efficiency (capture/re-use of disturb/hard-stand area runoff).
- Purchase of Medium Priority (MP) water allocations.
- Optimisation of SRAIP Project water supply operation – e.g. reduced use of volcanic aquifer under normal conditions with increased use during drought.
- Potential to increase the volcanic supply by increasing pumping rates and/or drilling additional bores with confirmation via assessment/monitoring program.

As well as potential options subject to water planning outcomes:

- Access water harvesting licences through trading;
- Increasing HP water allocation through further release processes;
- Access to Overland Flow.

7. Demand Management / Allocation of water to allotments

It is recommended that the development be conditioned to require that the cumulative projected demand for water of all of the users within the SRAIP must not exceed the total amount of water allocations available within the SRAIP CMS at any given time.

A Demand management strategy mechanism is proposed to be implemented through the SRAIP Community Management Scheme (CMS). The CMS will be responsible for managing allocations of water between the 15 properties within the SRAIP project. A minimum allowance will be attached to each lot, based on lot size, and additional allocations will be made available to be acquired as necessary. The exact details of the CMS provisions and mechanism are still being determined (quantities, number of allocations, distribution policy etc.).

The aim of the Demand Management plan is to put the responsibility onto each tenant/buyer to understand what they need for their use, that there is a meter on their lot, and that they can't take more than their allocation. At such time when more water becomes available, it can be brought into the CMS as additional allocation which can be distributed and acquired by lot owners in the same way based on need. This approach ensures that the demand is limited to what is presently available and provides prospective purchasers with certainty regarding how much water they have available. Furthermore, the Demand Management plan gives the body corporate the means to accommodate extra water being available over time and also to control the amount of water each land owner in the SRAIP has access to.

Within the CMS the definitions/ interpretation of words will identify:

- The facilities management area – which is where utility infrastructure will be situated and operated from.
- Facilities management services – being the operation, maintenance, supply or delivery of services within the CMS including potable and non-potable water, re-use of stormwater and recycled water reticulation including filtration, storage, treatment and pumping. (It will also include the provision of other essential services to the precinct including but not limited to electricity and on site sewerage treatment).
- Facility Managers – being providers of facility management services
- Utility infrastructure – being infrastructure for provision of facilities management services

The body corporate enters into an agreement within the facilities manager/s to provide facility management services to the body corporate and/or occupiers. In this instance Kalfresh will be a facility manager for water infrastructure and service delivery and it will operate the utility infrastructure and facility management services, to provide the water under an agreement with the body corporate. Provisions within the CMS will nominate that a fair methodology for the selling price of facilities services (including water) is to be established with the body corporate and provides details with respect to issue of accounts for facilities management services. The CMS will also detail the process for connections and supply and use of the services, and that those services must be used responsibly.

The distribution of the base allocation of water to individual lots will be granted by way of the schedule of lot entitlements within the CMS and will be calculated based on the SEQ Code rates of demand for industrial land uses which are based on lot area. The base allocations will be fixed as permanent entitlements attached to each lot.

The balance of the currently available water will be divided into allocation parcels which may be secured from the body corporate as an additional entitlement at the time of purchase of the property. If deemed necessary by the Body Corporate an annual review of the additional entitlements may be scheduled which will allow lots within the body corporate to secure additional entitlements if available or relinquish additional entitlements not required for their premises.

Supporting Documents

The following documents are supplied in support of this submission:

- Appendix A: SRAIP Groundwater Source Assessment 18 June, 2022 – Randall Cox
- Appendix B: Kalfresh Water Supply Assessment SRAIP Project June 2022 - OD Hydrology Pty Ltd
- Appendix C: Water Supply Connection Map (Draft) Drawing No. 142489-16 - RPS

SRAIP

Groundwater Source Assessment

By Randall Cox

(Groundwater Strategy Consultant)

18 June 2022

CONTENTS

INTRODUCTION

The planned Scenic Rim Agricultural Industrial Precinct (SRAIP) will house new agricultural /industrial enterprises on the current KALFRESH site near Kalbar. Water supply for the SRAIP will comprise a portfolio of water sources. Currently held sources are high priority water allocation from the Warrill Valley Water Supply Scheme, alluvial groundwater and volcanic groundwater. This report sets out details about those sources.

GEOLOGIC SETTING

The oldest rocks in the area are the Walloon Coal Measures of the Mesozoic era. Volcanic rocks were intruded into Walloon Coal Measures during the Tertiary era. After a period of erosion of the old Mesozoic/ Tertiary surface, alluvium was deposited during the Quaternary along drainage lines.

The alluvium contains permeable sand and gravel horizons and is the primary aquifer for the district. It has been used as an irrigation supply by the local horticultural industry for many years and has supplied the Kalfresh factory since its inception.

The volcanic rocks are complex. Being resistant to weathering they occupy high topographic positions in the landscape and outcrop along the western margin of the SRAIP site. Throughout the district a range of individual volcanic intrusions have been mapped in outcrop areas. However, when volcanic rocks are encountered under the alluvium they are usually referred to as ‘undifferentiated’ volcanics. Throughout the district the volcanics are usually poor aquifers rarely yielding more than stock supplies. However, over the period 2002 to 2006 Kalfresh established three production bores in the volcanics for industrial and irrigation supply, with the largest operating since that time at a measured 8.0 l/sec. Clearly the deep volcanic rocks underlying the SRAIP site are, in some places at least, sufficiently fractured to provide enough permeability to support water bores and provide recharge pathways.

The Walloon Coal Measures have significant permeability over large parts of the Great Artesian Basin. However, in the Warrill Valley district the formation has a low permeability and no successful water supply bores have been established.

BORE DETAILS

The locations of existing Kalfresh bores on the SRAIP site are shown in Figure 1. Details of the alluvial and volcanic bores are provided in Tables 1 and 2.

Figure 1 – Bore Locations

Table 1 – Summary details of Alluvial Bores

	RN 189467	RN 189468	RN 189469	RN 198470
Date drilled	13 Mar 1995	13 May 1997	16 Mar 1995	24 May 1999
Depth (m)	17.7m	14.8m	16.8m	18.2m
Casing (mm)	203mm	203mm	203	210mm
Slots	N/K	N/K	N/K	N/K
Lithology	alluvium	alluvium	alluvium	alluvium
SWL when drilled (m)	-7.47m bgl	-9.5m bgl	-11.3m bgl	-8.4m bgl
Rate when drilled (l/s)	N/K	N/K	N/K	19 l/s

Table 2 – Summary details of Volcanic Bores

	RN 138334	RN 189466	RN 189471
Date drilled	6 Oct 2008	12 Nov 2002	29 Oct 2003
Depth (m)	142m	119m	119m
Casing (mm)	160mm	160mm	160mm
Slots (m)	130m – 142m	107 – 119m	107 – 119m
Lithology	0-16m alluvium	0 – 15m alluvium	0 – 17m alluvium
	16 – 142m volcanics	15 – 119m volcanics	17m – 119m volcanics
Equipped rate (l/s)	8.0 l/s	3.8 l/s	2.5 l/s

REGULATORY SETTING

The *Moreton Water Plan 2007* (the Moreton water plan) regulates the taking of groundwater in the area. Water use from the alluvium is high throughout the district and water levels have fallen. As a result, the Moreton water plan prevents increased access to water from the alluvium. The plan authorises the continued taking of water from the alluvium that was being taken as at 24 March 2005 when a Moratorium Notice was issued at the commencement of the water planning process. On that basis, the SRAIP can continue to use the four alluvial bores that supply the existing Kalfresh factory but additional bores cannot be installed to increase supply.

The Moreton water plan does not restrict use of the volcanic aquifer. Additional bores are permitted on the SRAIP site.

HISTORIC GROUNDWATER USE

Together, the alluvial and volcanic bores have provided water for irrigation and factory operations on the Kalfresh site. Historic use has been estimated as water meters have only recently been installed.

Kalfresh has used farm records to estimate the irrigation application for each year over the past 11 years of summer and winter cropping of its 31ha irrigation area. Kalfresh advises that the average annual water application over the 11-year period was 200 ML, ranging from a low of 151 ML in 2021 to a high of 226 ML in 2020.

Kalfresh has estimated historic factory use based on estimated pumping rates and estimated pumping hours needed to top up the water recycling system within the factory. Water use for factory operation is estimated at 130 ML/yr.

Total historic water use from the alluvial and volcanic bores for irrigation and factory use is therefore estimated at 330 ML/an.

RELIABILITY OF SUPPLY

ALLUVIAL BORES

Water supply from the alluvial bores is less secure than the volcanic bores. During dry periods when water levels are low the pumping rates from the alluvial bores reduces, and under past severe drought conditions the bores have needed to operate on a near continuous basis to maintain factory supply.

VOLCANIC BORES

MONITORING INSTRUMENTATION

The volcanic bores are much deeper than the alluvial bores. They have a much larger available drawdown and supply will be very resilient to extreme drought periods. Details of the three volcanic bores are a set out in Table 2. Integrated flow meters are now in place on each of the bores. Water level monitoring was installed in RN 189466 in mid-2021. Water level monitoring equipment has not yet been installed in RN 138334 or RN 189471. Kalfresh advise that it is not possible to install monitoring equipment in those bores as currently equipped. It is intended to install monitoring at the next infrastructure change such as pump replacement. Until then water level monitoring in the volcanics will be carried out using RN 189466.

MONITORING RESULTS

Water level behaviour in RN 189466

Water level behaviour over the three-month period ending December 2021 is shown in Figure 2. The short-term variation in water level reflects the pumping cycles of the volcanic bores. From that figure the maximum drawdown was 70m bgl during heavy pumping cycles, leaving 37m of available drawdown above the top of the slotted interval. Bore RN 189471 has the same slotted interval as RN 189466 and may therefore have the same available drawdown as the monitored bore. Bore RN 138334, which is only 11.4m from RN 189466, is deeper with slots for water entry set at a lower level and therefore the remaining available drawdown during the periods of greatest drawdown is likely to be greater than the 37M available in RN 189466.

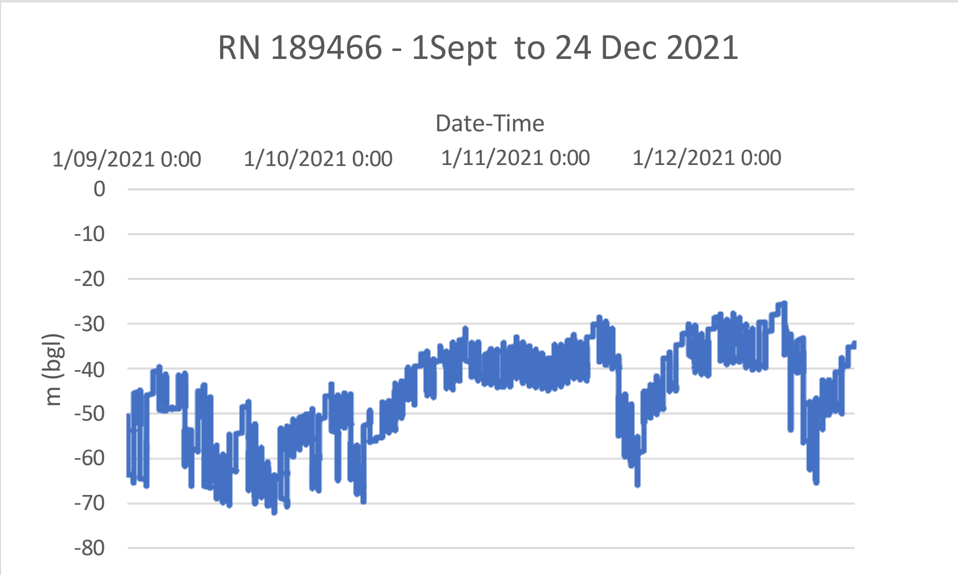

Figure 2 – RN 189466 long-term water level behaviour

Pump Test

Kalfresh carried out a test in August 2021 to stress the volcanic aquifer by pumping bores RN 189466 and RN 138334 at the same time, for a 24-hour period. Although only RN 189466 is monitored, the bores are only 11.4m apart and therefore interference between the bores could be expected. The water level behaviour level is shown in Figure 3. After the initial sharp fall in level on commencement of pumping the rate of drawdown settled to a small steady rate of drawdown. There is no indication of a discharge boundary being intersected during the 24-hour period. On cessation of pumping there was a sharp recovery reflecting the sharp initial drawdown, followed by a slow steady recovery. If recovery had not been disturbed at the end of the test by renewed pumping it is likely that full recovery to initial conditions would have occurred over a 24-hour recovery period.

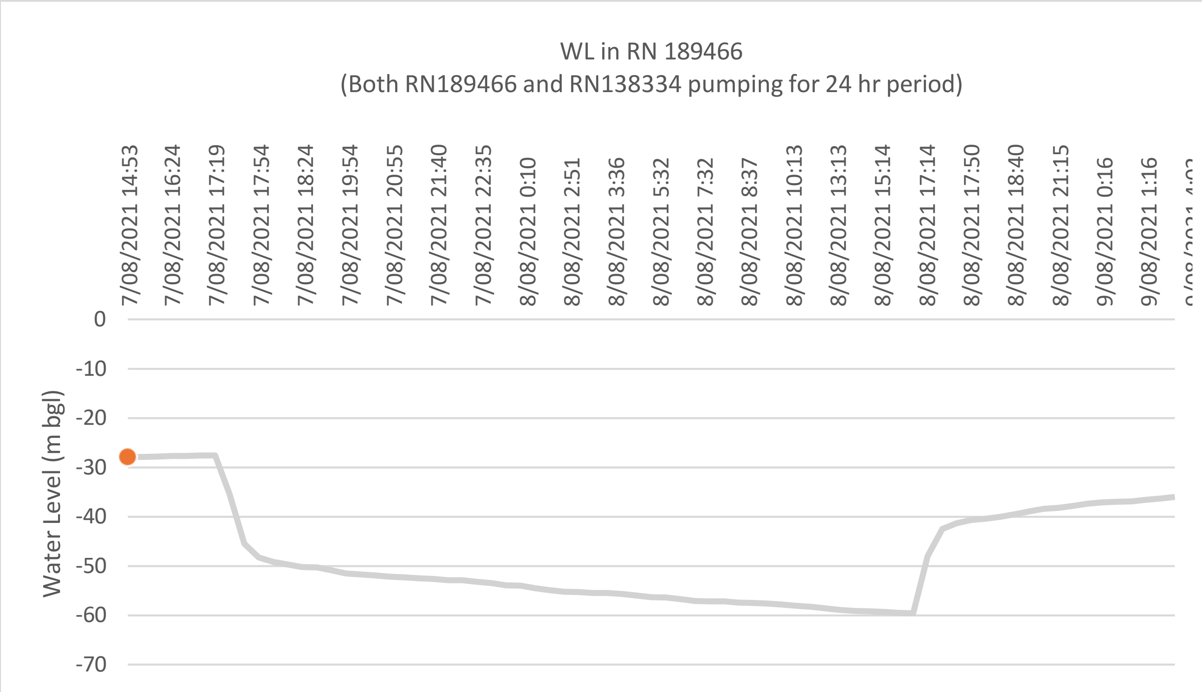

Figure 3 - Drawdown and recovery in RN 189466 during 24 hour pumping of both RN 189466 and RN 138334

CONCLUSIONS

- Kalfresh has established successful alluvial and volcanic bores at the site. Kalfresh advise that the bores have historically provided an estimated total supply of 330 ML/yr for a period in excess of 10 years.
- The volcanic bores are deep and less susceptible to low seasonal water levels than the alluvial bores. It can be expected that supply from the volcanic bores will have a high reliability.
- Data from recently installed monitoring equipment support the view that the volcanic bores can continue to operate at the equipped rates on a sustainable basis. If pumped on half-day cycles they could produce 200 ML/yr.
- Because there has been past success in establishing volcanic bores, there may be potential to increase supply from the volcanics by constructing additional bores into the deep volcanics on other parts of the SRAIP site.
- Kalfresh are planning to improve groundwater monitoring and to determine if supply from the volcanics can be increased.

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ODHydrology

Kalfresh
Water Supply Assessment

Scenic Rim Agricultural Industrial Precinct (SRAIP) Project.

Prepared for: **Kalfresh Pty Ltd**

August 2023

Executive Summary

Introduction

OD Hydrology Pty Ltd (ODH) was appointed by Kalfresh Pty Ltd (Kalfresh) to undertake hydrological assessment of the availability and reliability of water for the development and long-term operation of the Scenic Rim Agricultural Industrial Precinct (SRAIP) Project ('the Project') within the Warrill Creek catchment near Kalbar, Queensland. The assessment seeks to:

- Inform Kalfresh of the required sources of supply to meet a defined, high level of water supply reliability/security based on known demand and standard anticipated industrial demand; and,
- Provide information to support the State Government Co-ordinated Project Planning process under which the Project is in the final stages.

Water security/supply performance

The SRAIP Project proposed to provide high security water supply to agriculturally based commercial and industrial use including processing and bio-energy facilities. The proposed water supply system is conceptually designed to meet clearly defined, demonstrably achievable levels of secure supply performance.

On this basis, Project water supply performance requirements were set to be in line with, and with additional security compared to, the performance of the high priority A group water allocation detailed in the *Water Plan (Moreton) 2007*[1]. These performance requirements are as follows:

Consistent with Water Allocation Security Objectives[2] (WASOs) defined in the *Water Plan (Moreton) 2007* (the Water Plan):

(a) the monthly supplemented water sharing index[3] ***be at least 95%;*** *and*

(b) the extent to which it is less than 100% be minimised.

Plus to demonstrate additional day-to-day supply security:

At least 85% *of daily demand met at all times.*

Put simply, over the full range of wet and dry conditions experienced over the past approximately 130 years, the system could meet full demand in at least 95% of months, with a required for reduced usage of no more that 15% at any time.

Projected demand/supply requirements

The scheme described herein has been designed and projected/expected water requirements based on known demand and standard anticipated industrial demand.

It is important to note that demands realised as the Project develops will be defined by the businesses that are attracted to operate from the precinct and as such the system described herein is designed to ensure this defined water supply performance regardless of the final actual demand/water requirements that eventuate. On this basis the Project

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[1] Water plans are developed under the Water Act 2000 to sustainably manage and allocate water resources in Queensland. The water plan may apply to: rivers, lakes and springs; overland flow; underground water.
[2] Water Allocation Security Objectives are defined within Queensland legislation to provide a defined minimum level of security for water access entitlements for the protection of the probability of being able to obtain water.
[3] Percentage of months in the simulation period in which the allocations are fully supplied.

water supply system will be developed in advance of water requirement needs to ensure supply performance at least equal to that above for the water requirements/demands as they exist and develop in reality:

- An initial system will be in place at Project commissioning to support up to a specified volume of water requirements based on committed customers and their specified water requirements, as well as a volume of 'buffer' supply which the system can additionally support to attract new/additional business and/or expansion of those already operating within the Precinct.
- Ongoing water use efficiency measures (e.g. disturbed/hard-stand area runoff capture and re-use, etc.) will be explored to ensure that production per unit volume of water used is optimised, as well as supply performance maximised and longer-term water requirement minimised.
- System augmentation as required in response to (and advance of) any planned increases in water requirements beyond the demonstrated capacity of the system to meet the above defined supply performance (e.g. new customers, changes in existing customer water requirements, etc.).

In this way the Precinct water supply system is continually operated and managed to ensure supply performance is maintained, while allowing for ongoing growth in demands as (and if) they eventuate, without over-design through adoption of potentially over-estimated long-term requirements that do not eventuate due to ongoing improvements in water use efficiency within the Precinct and/or final business types with lower water requirements than upper bound estimates assessed.

Table ES. 1 shows the levels of potential demand planned for under a range of future water requirement scenarios.

Table ES. 1: Planned Project water requirements

Project water demand	Annual demand (ML/a)
Low water requirement	270
High water requirement	371

Secured/existing water entitlements and supply sources

Kalfresh has existing access to three key water sources and entitlements, specifically:

- High priority (HP) allocation:
    - Kalfresh has recently acquired 145 ML Annual Volumetric Limit[4] (AVL) of high priority C group water allocation with the Warrill Valley Water Supply Scheme.
    - Availability for this allocation is subject to announcements by Seqwater determined via specific water sharing rules as defined in the Operations Manual for the scheme.

[4] Access condition on allocation which defines the maximum volume of water that can be accessed under the allocation in any single water year (July to June).

- Volcanic aquifer
    - Kalfresh possess a volcanic aquifer which provide Kalfresh with 200 ML/a at a very high reliability.
    - This represents an important water source for security of supply for both existing and planned demands and accordingly Kalfresh is commencing a program of ongoing investigation to better understand the potential for additional bores and the recharge characteristics of the aquifer under a range of climatic conditions. This will enable best use of this drought resilient resource, as a component of the portfolio of water sources to be identified.
    - For the current assessment supply is based on existing bores, existing pumping rates and known performance.
- Alluvial aquifer
    - Kalfresh has existing shallow alluvial bores which provides Kalfresh with 130 ML/a.
    - Aquifer recharge and water availability is subject to preceding climatic conditions with recharge under conditions of average to above average rainfall and drawdown occurring during prolonged dry conditions.
    - Historic water availability was correlated with the alluvial water level data, and the alluvial water level data was then correlated with rainfall data. Long-term water availability was then modelled using the long-term historic rainfall data. Analysis showed that there are short periods when availability falls below 130 ML/a.
    - Under the existing regulatory framework additional alluvial bores cannot be constructed to increase supply. Also, although the bores can continue to be used for industrial and irrigation purposes (usage has not materially changed since access to the alluvial aquifer was regulated under the Morton Water Plan in 2007) usage cannot be increased[5].

Existing sources of water are summarised in Table ES. 2.

Table ES. 2: Secured water source & entitlement summary

Source	Value
Volcanic (ML/a)	200
Alluvial (ML/a)	130
HP AVL (ML)	145

[5] Randall Cox (Groundwater Strategy Consultant) (2022) “SRAIP – Groundwater Source Assessment” Version: June 2022.

Water supply system assessment

Assessment of the Project water supply system has been undertaken using two modelling tools:

- Bremer/Warrill Valley Integrated Quantity-Quality Model (IQQM); and,
- SRAIP Project model (eWater Source-based Project water balance model).

Outputs from the Bremer/Warrill IQQM, such as Moogerah Dam storage behaviour and associated availability of high and medium priority allocations (i.e. 'announced allocations'), were used as inputs to the SRAIP source model to ensure catchment-wide climatic/hydrologic conditions and user behaviours were incorporated within the factors that potentially affect water supply for the SRAIP Project.

The SRAIP water supply system concept comprises utilization of the existing water sources above, with addition of on-site storage as required to maintain the required supply performance under increasing demand.

Assessment results and outcomes

Assessment outcomes demonstrate credible and practical immediate options for up to ~371 ML/a at very high security performance. Further increases in reliability are also possible by measures such as increased OSS, improved industrial use efficiency, etc.

Specific assessment outcomes demonstrate that the water supply system characteristics that meet the defined performance requirements comprise:

- Low water requirements (up to 270 ML/a):
    - Existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) are sufficient - no additional water entitlements required);
    - Potential need for minimal (< 5 ML) on-site storage.
- High water requirements (up to 371 ML/a):
    - Existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) are sufficient - no additional water entitlements required);
    - Approximately 50 ML on-site storage (noting potential for reduction based on sizing and/or lining to reduced evaporative and/or seepage losses).

Assessment outcomes and performance results for initial projected demand levels are provided in Table ES. 3.

Table ES. 3: Supply performance results

Water Requirement	Demand (ML/a)	On-site storage (ML)	% of months with 100% of demand met	% of months with at least 85% of demand
Low	270	5	100.0%	100.0%
High	371	55	96.8%	100.0%

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1. Introduction

OD Hydrology Pty Ltd (ODH) was appointed by Kalfresh Pty Ltd (Kalfresh) to undertake hydrological assessment of the availability and reliability of water for the development and operation of the SRAIP Project. The assessment seeks to:

- Inform Kalfresh of the required sources of supply to meet a defined, high level of water supply reliability/security based on known demand and standard anticipated industrial demand; and,
- Provide information to support the State Government Co-ordinated Planning process under which the Project is in the final stages.

The SRAIP project is located adjacent to Warrill Creek near Kalbar (Figure 1). Water use in the area regulated under the *Water Plan (Moreton) 2007* ('the Moreton Water Plan').

The Project is located within the Warrill Zone A surface water trading zone within the Moreton water plan area (shown in Appendix A), with surface water supplied via the Seqwater owned and operated Warrill Valley Water Supply Scheme ('WVWSS'). The WVWSS comprises Moogerah Dam as its major storage on Reynolds Creek and a series of weirs and offtakes along Warrill Creek downstream to the Bremer River.

Kalfresh proposes to create a fully integrated agricultural processing precinct at the existing operating base. At the time of the planning approval, the Project development will commence with building two factories:

- A High-Care & Medium-Care Processing Factory for the value-adding and processing of fresh vegetables;
- A Snacking & Organic Vegetable Packing Facility.

The SRAIP Project proposed to provide high security water supply to agriculturally-based commercial and industrial use including processing and bio-energy facilities. The proposed water supply system is conceptually designed to meet clearly-defined, demonstrably achievable levels of secure supply performance.

On this basis, Project water supply performance requirements were set to be in line with, and with additional security compared to, the performance of the high priority A group water allocation detailed in the Moreton Water Plan. Specifically, consistent with Water Allocation Security Objectives[6] (WASOs) defined in the Water Plan:

(a) the monthly supplemented water sharing index ***be at least 95%;*** *and*

(b) the extent to which it is less than 100% be minimised.

Plus to demonstrate additional day-to-day supply security:

- ***At least 85%*** *of daily demand met at all times.*

Put simply, over the full range of wet and dry conditions experienced over the past approximately 130 years, the system could meet full demand in at least 95% of months, with a required for reduced usage of no more that 15% at any time.

[6] Water Allocation Security Objectives are defined within Queensland legislation to provide a defined minimum level of security for water access entitlements for the protection of the probability of being able to obtain water.

Figure 1: Locality plan

The information detailed in this report is aimed at providing a summary of the key factors influencing the supply of water to the SRAIP Project. Conceptual infrastructure and water entitlement details are described, as well as relevant elements of the operation of the property and how this behaviour is represented in the modelling. The current stage of assessment has been developed as a benchmark for projected demands and assumptions.

Results have been provided for a series of modelling runs summarising quantitative information into the behavioural characteristics of the operations under historical climatic and hydrologic conditions. Important operational and performance outcomes have been simulated based on adoption of the best available modelling tools and datasets, as well as site-specific operational information.

Modelling summarised and discussed within this report has been undertaken using historically-based datasets and a single, long-term simulation approach. This approach is consistent with the methodologies and datasets adopted by the Queensland Government in assessment supporting the development of water planning documents throughout Queensland (and Australia). This approach generally provides information regarding the potential variability and long-term average performance that could be expected from a water supply system within the range of climatic conditions experienced in the past 50 to 100 years.

2. Project demans/supply requirements

The scheme described herein has been designed for of projected/expected water requirements which the proponent has a high degree of confidence will be realised demands, with assessment of potential differences in Project water supply system requirements under conditions in which the specific water uses realised within the Project tend towards low or high water requirements for those types of uses.

It is important to note that actual demands realised as the Project develops will be defined by the businesses that are attracted to operate from the precinct and as such the system described herein is designed to ensure this defined water supply performance regardless of the final actual demand/water requirements that eventuate.

The Project water supply system will be developed in advance of water requirement needs to ensure supply performance at least equal to that above for the water requirements/demands as they exist and develop in reality:

- An initial system will be in place at Project commissioning to support up to a specified volume of water requirements based on committed customers and their specified water requirements, as well as a volume of 'buffer' supply which the system can additionally support to attract new/additional business and/or expansion of those already operating within the Precinct.
- Ongoing water use efficiency measures (e.g. disturbed/hard-stand area runoff capture and re-use, etc.) will be explored to ensure that production per unit volume of water used is optimised, as well as supply performance maximised and longer-term water requirement minimised.
- System augmentation as required in response to (and advance of) any planned increases in water requirements beyond the demonstrated capacity of the system to meet the above defined supply performance (e.g. new customers, changes in existing customer water requirements, etc.).

In this way the Precinct water supply system is continually operated and managed to ensure supply performance is maintained, while allowing for ongoing growth in demands as (and if) they eventuate, without over-design through adoption of potentially over-estimated long-term requirements that do not eventuate due to ongoing improvements in water use efficiency within the Precinct and/or final business types with lower water requirements than upper bound estimates assessed.

Table 1 shows the levels of potential demand planned for under a range of future water requirement scenarios.

Table 1: Planned Project water requirements

Project water demand	Annual demand (ML/a)
Low water requirement	270
High water requirement	371

3. Secured Water Entitlements

Kalfresh has existing access to three key water sources and entitlements.

3.1 High priority (HP) allocation

Kalfresh has recently acquired 145 ML Annual Volumetric Limit[7] (AVL) of HP water allocation within the WVWSS. Availability for this allocation is subject to announcements by Seqwater determined via specific water sharing rules as defined in the Operations Manual for the scheme.

Assessment of availability of HP allocations is included within Appendix B.

3.2 Volcanic aquifer

Kalfresh access a volcanic aquifer which provides 200 ML/a at a very high reliability. This represents an important water source for security of supply for both existing and planned demands and accordingly Kalfresh is commencing a program of ongoing investigation to better understand the potential for additional bores and the recharge characteristics of the aquifer under a range of climatic conditions. This will enable best use of this drought resilient resource, as a component of the portfolio of water sources to be identified.

For details concerning the volcanic groundwater supply see Appendix C.

3.3 Alluvial aquifer

Existing shallow alluvial bores provide 130 ML/a. Availability is subject to preceding climatic conditions. Historic water availability was correlated with the alluvial water level data, and the alluvial water level data was then correlated with rainfall data. Long-term water availability was then modelled using the long-term historic rainfall data. Analysis showed that there are short periods when availability falls below 130 ML/a.

Under the existing regulatory framework additional alluvial bores cannot be constructed to increase supply. Also, although the bores can continue to be used for industrial and irrigation purposes (usage has not materially changed since access to the alluvial aquifer was regulated under the Morton Water Plan in 2007) usage cannot be increased[8].

For details concerning the alluvial groundwater supply see Appendix D.

Table 2: Existing water source & entitlement summary

Source	Value
HP AVL (ML)	145
Volcanic (ML/a)	200
Alluvial (ML/a)	130

[7] Access condition on allocation which defines the maximum volume of water that can be accessed under the allocation in any single water year (July to June).

[8] Randall Cox (Groundwater Strategy Consultant) (2022) "SRAIP – Groundwater Source Assessment" Version: June 2022.

4. Assessment – methodology, inputs and assumptions

The following sections provide a summary of the modelling tools, inputs, assumptions, and approach underpinning the water supply assessment undertaken.

4.1 SRAIP project demands

The water supply assessment was undertaken for projected demands, representing those levels of projected demand for which there is a high degree of confidence. Specifically:

- Projected low water requirements: 270 ML/a; and,
- Projected high water requirements: 371 ML/a.

Demand for water within the precinct is anticipated to increase over time as development occurs, with estimated demand summarised in Table 3.

Table 3: Projected total water demand

Project water demand	Annual demand (ML/a)
Low water requirement	270
High water requirement	371

Water supply options assessment has been undertaken based on providing suitably secure supply under low and high projected water requirements.

Summary of assessment of estimated upper bound water requirements to assess and demonstrate that credible options for maintaining the defined supply performance at these higher potential water requirements is provided in Appendix E.

4.2 Performance requirements

Project water supply performance requirements were set to be in line with, and with additional security compared to, the performance of the high priority A group water allocation detailed in the *Water Plan (Moreton) 2007*[9]. These performance requirements are as follows:

Water Plan 'standard' WASO:

(a) the monthly supplemented water sharing index[10] ***be at least 95%;*** *and*

(b) the extent to which it is less than 100% be minimised.

Plus

At least 85% of daily demand met at all times.

[9] Water plans are developed under the Water Act 2000 to sustainably manage and allocate water resources in Queensland. The water plan may apply to: rivers, lakes and springs; overland flow; underground water.
[10] Percentage of months in the simulation period in which the allocations are fully supplied.

4.3 Modelling platforms/tools

Two modelling tools are relevant to the Kalfresh assessment:

- Bremer/Warrill Valley Integrated Quantity-Quality Model (IQQM); and,
- Kalfresh-specific model (eWater Source-based Project water balance model).

The following sections provide a brief description of these two modelling tools and their application within this assessment.

4.3.1 Bremer/Warrill IQQM (catchment-scale behaviours)

The IQQM is a Fortran-based, daily time-step modelling tool developed by the Department of Land and Water Conservation, NSW (DLWC) for planning and evaluating water resource management policies at the river basin scale. The IQQM can be applied to supplemented and unsupplemented streams and is capable of addressing water quality and environmental issues, as well as water quality issues. It is used extensively throughout New South Wales and Queensland. The Bremer/Warrill IQQM simulates streamflow and water allocation and use within the Bremer and Warrill catchment, located within the Moreton Basin and Water Plan area, including supplemented account crediting and announcements of access to unsupplemented allocations. The set-up and use of the Bremer/Warrill IQQM is the responsibility of the Queensland Hydrology group within the Department of Environment and Science (DES) and the catchment models such as the Bremer/Warrill IQQM used in this study are directly used to support water planning and development across the State.

Outputs from the Bremer/Warrill IQQM, such as Moogerah Dam storage behaviour and associated availability of high and medium priority allocations (i.e. 'announced allocations'), were used as inputs to the SRAIP source model.

4.3.2 SRAIP Source model (Project-specific simulation)

The SRAIP Source model is set up in the eWater source modelling software which is a nationally consistent modelling platform with planning, operations and forecasting capability. The software allows for daily simulation for such applications as water balance studies from catchment to river basin scale, analysis of supply and demand balances, including agricultural, hydropower, urban, industrial and environmental demands.

Modelling of the Kalfresh operations was undertaken for a series of purpose-developed scenarios to provide information regarding the estimated operational performance of the SRAIP project under a range of realistic input assumptions, model inputs and operational assumptions.

4.4 Modelling inputs and assumptions

In order to provide information regarding the operation and behaviour of the Kalfresh SRAIP project, simulation modelling was undertaken adopting Departmental model simulated streamflow and entitlement access information with project infrastructure and operational water source inputs set to conditions as advised by Kalfresh operational personnel. Key assumptions and adopted inputs are detailed in the following sections.

The following set of inputs and assumptions were applied across the assessment framework, with consistent assumptions and data used for catchment-scale and Project-specific simulation.

4.4.1 Period of assessment

All modelling has been undertaken for an assessment period of 1 July 1889 to 30 June 2021, representing the combination of currently available Department developed catchment information (up to 2000) and extended information based on recorded data as described in Appendix B.

4.4.2 Climatic data

Climatic data inputs were obtained from the SILO (Scientific Information for Land Owners) database, hosted by the Science Delivery Division of the Queensland Department of Environment and Science (DES). SILO is a database of historical climate records for Australia which contains climate data from 1889 (current to 'yesterday'). SILO datasets are constructed from observational records provided by the Bureau of Meteorology. All climatic data inputs were obtained from the SILO database and based on long-term patch-point data for:

- Station No. 40104 – Kalbar State School (Lat: -27.9424 Long: 152.6235)

Two data streams were used in the modelling comprising:

- Rainfall; and,
- Morton evaporation over shallow lakes (for evaporation from storages).

4.4.3 Hydrologic data

The underlying hydrological (streamflow) and channel process (routing, losses) information contained in the Bremer/Warrill IQQM is based on recorded information and is the outcome of a well-documented and tested calibration process.

Streamflow data incorporated into the model includes allocation and announcement inflows relevant to the licences held by Kalfresh.

4.4.4 Water entitlements and access

Water entitlements within the modelling have been represented as individual nodes with simulated access conditions (pass-flow, pump rate) directly consistent with conditions specified in the range of entitlements held.

Licences to take are directly represented in the model and are consistent with the relative physical location of each entitlement and significant hydrological aspects of the catchment (i.e. access to Warrill Creek).

The model calculates, on a daily basis, the volume of water able to be diverted under the licences, constrained by flow in the watercourse, licenced access conditions, annual volumetric limits (instantaneous or daily as relevant) and on-site storage conditions.

4.4.5 Volcanic aquifer

Due to the depth of the volcanic aquifers, this water source is less susceptible to the seasonal lowering of water levels during drought periods than the alluvial groundwater source. Moreover, flow and water level monitoring data gathered over the last 12 months provides confidence that the volcanic bores alone as currently equipped can provide a high reliability supply of 200 ML/a if pumped on regular half day cycles. Therefore, the volcanic groundwater availability was assumed to be fully available under all climatic conditions experienced historically (1889-2022).

For further details concerning the volcanic groundwater supply, see Appendix C.

4.4.6 Alluvial aquifer

In any particular year, the alluvial groundwater availability was assumed to be subject to preceding climatic conditions. The alluvial availability was based on Kalfresh's knowledge of historic constraints on groundwater take and associated water levels at nearby Qld Government water level monitoring points, which together define the following access constraints:

- Groundwater level > 63.5 m: Full access;
- Groundwater level between 63.5 m and 61.0 m: Increasingly constrained; and,
- Groundwater level < 61.0 m: No access.

The daily alluvial groundwater levels are comprised of historically recorded groundwater levels from 1961 and simulated/synthetic groundwater levels for the period 1889 to 1961. The historically recorded groundwater levels were obtained from Queensland Globe and contained data from two bores, specifically:

- Bore RN14310154 for the period 1961 to mid-2007; and,
- Bore RN14310239 (replacement bore at same location as RN14310154) for the period mid-2007 to current.

Through data analysis, it was found that the historically recorded alluvial water level at any time was strongly correlated with the sum of approximately the prior 3 years of rainfall. Using this statistical relationship, a linear model was then used to generate simulated alluvial water levels for the period 1889 to 1961. For further details regarding the generation of the alluvial water level data set, see Appendix D.

4.5 Modelling approach

4.5.1 Catchment-scale (IQQM) simulation

Key linkages between catchment-scale (IQQM) behaviours and project-specific (Source) modelling comprise:

- Warrill Valley Water Supply Scheme (WVWSS) Announced Allocation (AA) for High Priority-C allocations (AAhpc): Defines availability from year to year of 145 ML HP-C allocation purchased by Kalfresh.
- WVWSS AA for medium priority allocations (AAmp): Defines availability of MP allocation from year to year (for potential scenario assessment to explore potential for MP allocation to improve/form part of SRAIP water supply).

The above AA outcomes are dependent on system-wide hydrological and water use behaviours and as such must be simulated using the Bremer/Warrill IQQM.

The currently publicly available Bremer/Warill IQQM model has been calibrated/validated for data up to the year 2000, with recent model updates and extension being undertaken by the Queensland Hydrology group within the Department of Environment and Science (DES).

In lieu of this as-yet to be available extended data, ODH have undertaken preliminary extension of the Moogerah storage behaviour in order to allow calculation of representative/realistic AAhpc & AAmp values up to 2022. Approach to extension involved the merging of available simulated and recorded Moogerah Dam storage data is described in Appendix B.

4.5.2 Project-specific (SRAIP Source) modelling

The operational behaviour and performance of Kalfresh was simulated using a project-specific model with inputs from/linkages to the catchment-scale behaviour, simulation of operationally accurate and appropriate property-specific scenarios. Figure 2 illustrates the Kalfresh SRAIP project-specific model and how it was set-up for this assessment; noting that although the model includes OLF and Runoff inflow nodes, these inflows were set to 0 ML/a as they are currently not available water sources.

Assessment comprised of water supply requirement assessment under two (2) demand levels for which there is a high degree of confidence in expected/project water requirement:

1. Low water requirements: 270 ML/a; and,
2. High water requirements: 371 ML/a.

The underlying approach adopted for the operation of the SRAIP water supply system was that the Project would aim to maintain OSS at its full supply level (FSV) at all times, with water brought onto site daily to meet the combined requirements of industrial demand plus evaporative/seepage losses from the OSS. Supply was assumed to match full demand (i.e. 100% supply) under all 'normal' climatic and supply system conditions. Under conditions in which insufficient supply under existing sources (combined HPC, alluvial &

volcanic) was available to meet the combined requirements of meeting both 100% of industrial demand plus all OSS losses, supply is then limited to 85% of full industrial demand and on-site storage is accessed and drawn down, with full supply re-instated when existing supply sources are replenished (e.g. increased HPC due to Moogerah Dam inflows, etc) and OSS re-filled.

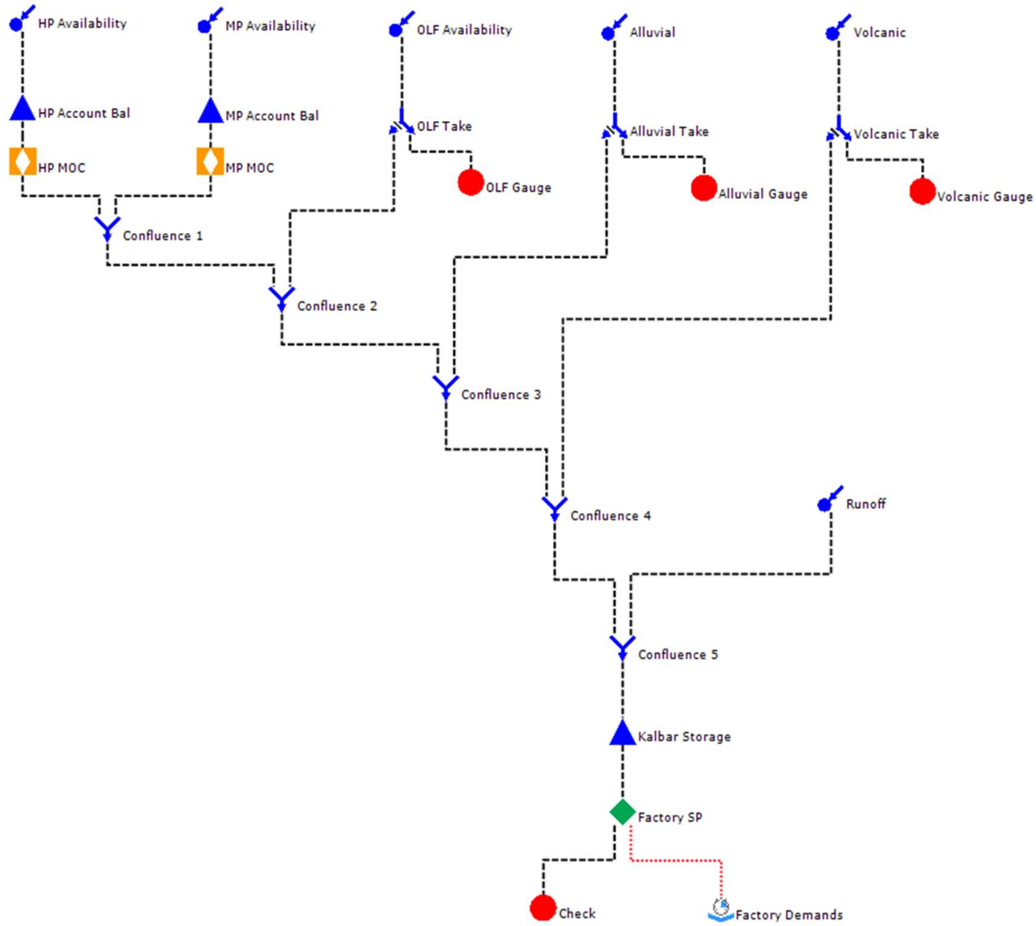

Figure 2: Project specific (Source) model schematic

Existing sources of supply are as summarised in Table 4 based on information as detailed in Cox (2022)[11] and recently purchased allocations within the WVWSS.

Table 4: Adopted construction water access conditions

Source	Annual volume (ML)	Maximum daily volume (ML/d)
Volcanic aquifer groundwater	200	0.55
Alluvial aquifer groundwater	130	0.36
High Priority C (HPC) supplemented allocation	145	Limited by pump capacity

[11] Randall Cox (Groundwater Strategy Consultant) (2022) "SRAIP – Groundwater Source Assessment" Version: June 2022.

5. Results & Outcomes

The following sections provide a summary of assessment outcomes and results.

5.1 Low projected water requirements

The following table displays the achieved performance metrics and Project water supply system requirements necessary to achieve required supply performance with a project demand of 270 ML/a.

Table 5: Low water requirements performance results

Water Requirement	Demand (ML/a)	On-site storage (ML)	% of months with 100% of demand met	% of months with at least 85% of demand
Low	270	5 (nominal)	100.0%	100.0%

As displayed in Table 5, for the SRAIP project to achieve the required performance, the following requirements were identified:

- Adopted minimal (< 5 ML) on-site storage as an indication of likely operationally beneficial balancing storage to allow flexibility in accessing existing supply sources (such as HPC allocation) for such operational requirements as pump maintenance, etc.
- A reduction in supply to 85% of full demand when insufficient existing supply sources is available to meet the combined requirements of full industrial demand plus OSS losses and access to on-site storage leads to drawdown to approximately 80% of FSV.

With the existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) and the additional requirements defined above, the full project demand is met at all times.

5.2 High projected water requirements

The following table displays the achieved performance metrics and Project water supply system requirements necessary to achieve required supply performance with a project demand of 371 ML/a.

Table 6: High water requirements performance results

Scenario		*Requirements*		*Monthly Results*	
Water Requirement	Demand (ML/a)	OSS (ML)	Restricted supply (max 15% reduction)	% of months with 100% of demand met	% of months with 85% of demand met
High	371	55	Yes - 90% FSV	96.8%	100.0%

As displayed in Table 6, for the SRAIP project to achieve the required performance, the following requirements were identified:

- A need for approximately 50 ML on-site storage (noting potential for reduction based on sizing and/or lining to reduce evaporative and/or seepage losses).
- A reduction in supply to 85% of full demand when on-site storage is drawn down to 90% of FSV.

With the existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) and the additional requirements defined above, the full project demand is met in 96.8% of months, and 85% of project demand is met at all times.

5.3 Outcomes

The key outcomes from the assessment and results described above include:

- The projected water supply requirements have been assessed to meet the performance requirements of:
  1. Monthly supplemented water sharing index of at least 95%; and
  2. Minimum 85% of demand met over full simulation period.

The water supply system characteristics that meet the defined performance requirements comprise:

- Low water requirements (up to 270 ML/a):
  - Existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) are sufficient (i.e. no additional water entitlements required);
  - Potential need for minimal (< 5 ML) on-site storage.
- High water requirements (up to 371 ML/a):
  - Existing supply sources (volcanic aquifer, high priority allocation and alluvial aquifer) are sufficient (i.e. no additional water entitlements required);
  - Approximately 50 ML on-site storage (noting potential for reduction based on sizing and/or lining to reduced evaporative and/or seepage losses).

Assessment outcomes demonstrate credible and practical short-term options for up to circa 370 ML/a at very high security performance. Further increases in reliability are also possible by measures with Kalfresh's control (e.g. increased on-site storage, improved industrial use efficiency etc.).

Planning processes could look to the possibility of synergistic arrangements with Local Government to improve Kalbar supply security.

It is also important to note that assessment has been undertaken as a long-term (132-year) assessment as an indication of potential year to year variability and supply reliability and depending on the final design of the construction water supply system (threshold, rate of take, storage volume) and in further, advanced stages of Project development consideration of the likelihood and time to fill OSS is recommended.

Appendix A: Warrill Valley Water Supply Scheme

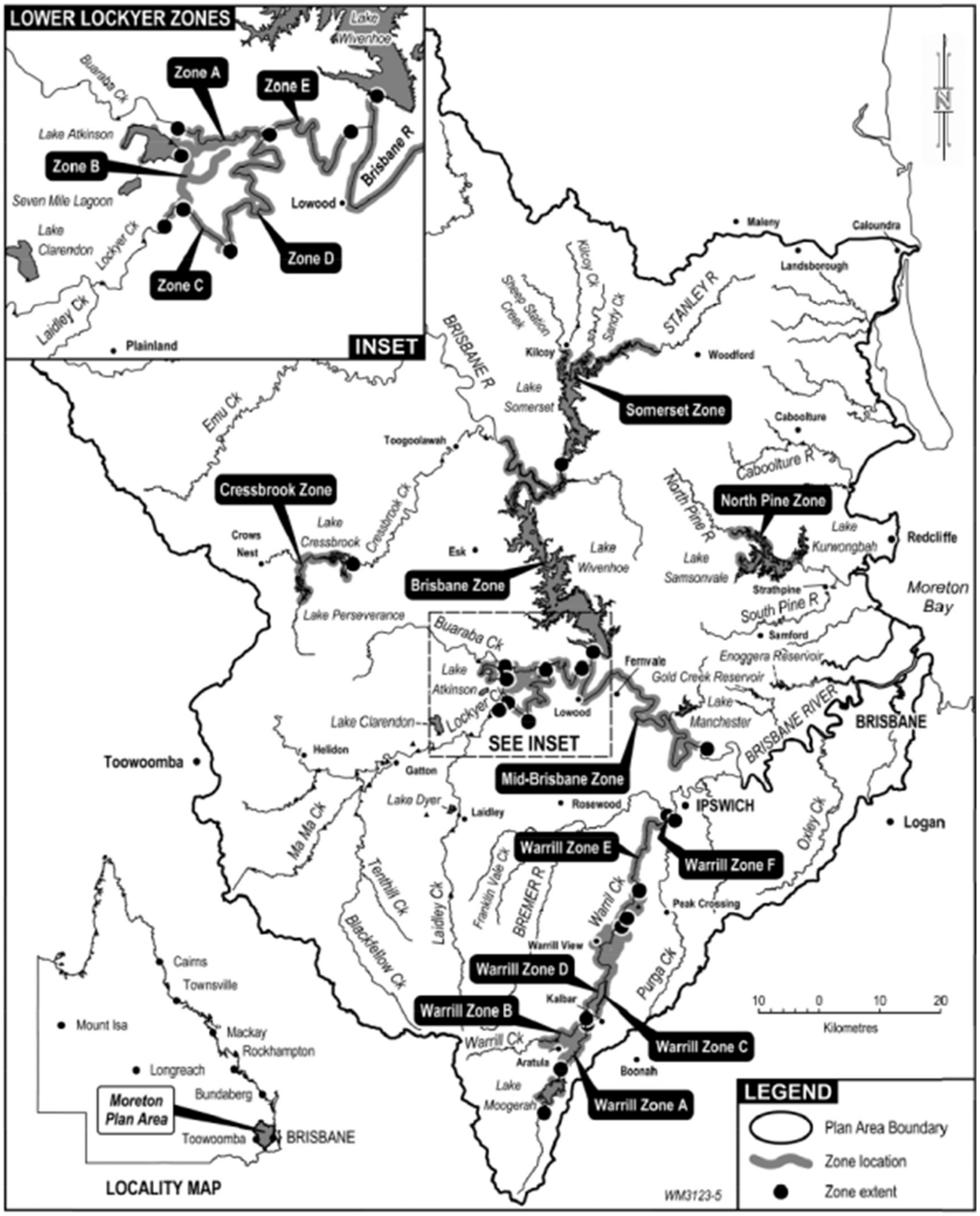

Figure A. 1: Moreton Water Plan surface water trading zones (source: Schedule 5A, *Water Plan (Moreton) 2007*)

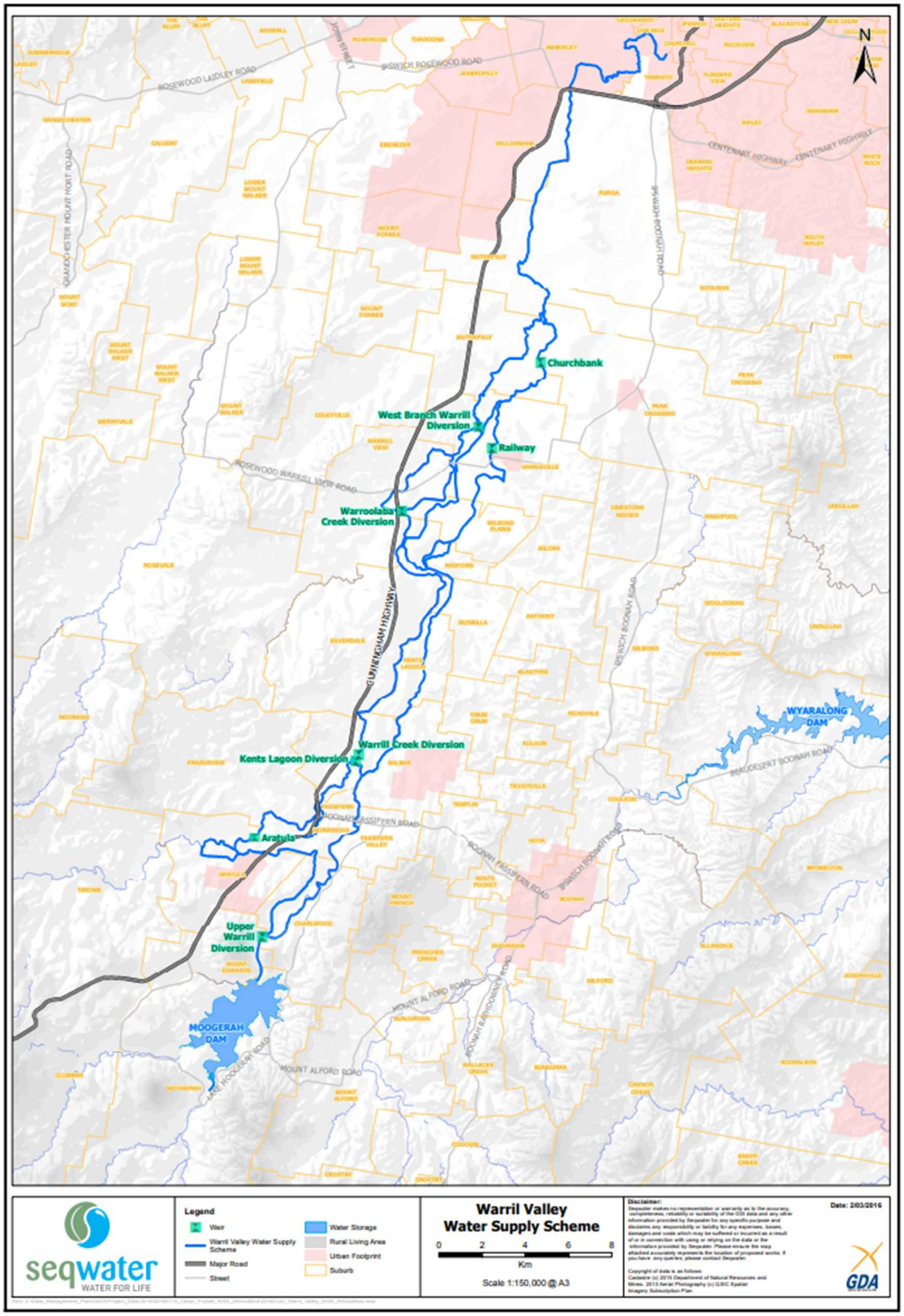

Figure A. 2: Warrill Valley Water Supply Scheme (Sunwater, 2016)

Appendix B – Catchment-scale behaviours

Key linkages between catchment-scale (IQQM) behaviours and project-specific (Source) modelling comprise:

- Warrill Valley Water Supply Scheme (WVWSS) Announced Allocation for High Priority-C allocations (AAhpc): Defines availability from year to year of 145 ML HP-C allocation purchased by Kalfresh.
- WVWSS AA for medium priority allocations (AAmp): Defines availability of MP allocation from year to year (for potential scenario assessment to explore potential for MP allocation to improve/form part of SRAIP water supply).

The above AA outcomes are dependent on system-wide hydrological and water use behaviours and as such must be simulated using the Bremer/Warrill IQQM.

The currently publicly available Bremer/Warill IQQM model has been calibrated/validated for data up to the year 2000, with recent model updates and extension being undertaken by the Queensland Hydrology group within the Department of Environment and Science (DES).

In lieu of this as-yet to be available extended data, ODH have undertaken preliminary extension of the Moogerah storage behaviour in order to allow calculation of representative/realistic AAhpc & AAmp values up to 2022. Approach to extension involved the merging of available simulated and recorded Moogerah Dam storage data (Figure B. 1) which comprised:

- Simulated: 1 January 1889 to 31 December 2000; and,
- Recorded: 24 January 1971 to 4 April 2022.

For a combined Moogerah storage volume dataset spanning the period 1 January 1889 to 4 April 2022. The merging of simulated and recorded data prioritised use of recorded data over simulated, with simulated storage behaviour based on several key assumptions to as closely as possible represent recent/current real world conditions:

- Assumed 70% MP utilisation/demand;
- Most recent water sharing rules (Warrill Valley Water Supply Scheme Operations Manual, version date: October 2020) inclusive of 6,000 ML Moogerah Dam 'cutoff' for non-TWS uses;
- Assumed actual/recent HP demands
    - Boonah/Kalbar 730.5 ML/a,
    - Swanbank reduced use/supply
- TWS with defined restrictions levels.

The merged Moogerah Dam storage data was then used to calculated AAhpc & AAmp over the full period 1889-2022 (Figure B. 3).

An important point of note regarding prioritisation of recorded data over simulated is that the recorded data will include the effect of Swanbank up until 2008 and so will be conservative (i.e. Moogerah storage levels would have been higher if Swanbank wasn't using back then with consequent AAhpc outcomes better in those years than estimated based purely on the recorded levels).

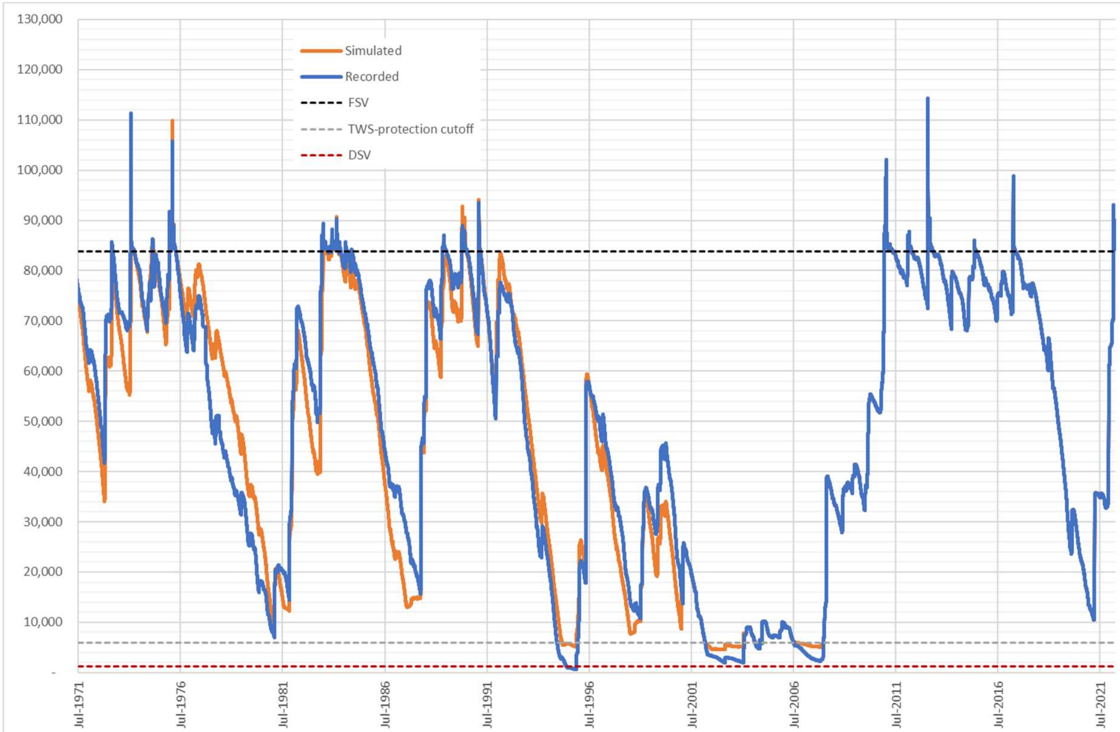

Figure B. 1: Recorded and simulated Moogerah Dam storage (1971-2022)

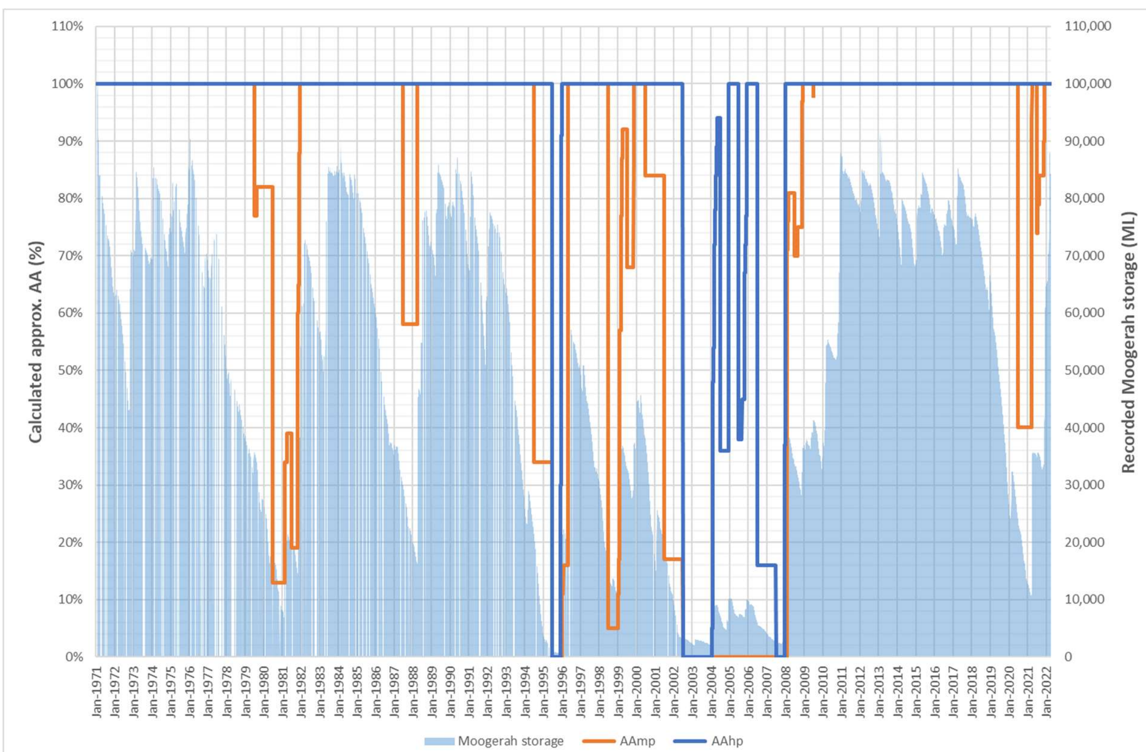

Figure B. 2: Calculated AAmp & AAhpc (1971-2022 on basis of recorded Moogerah Dam storage data)

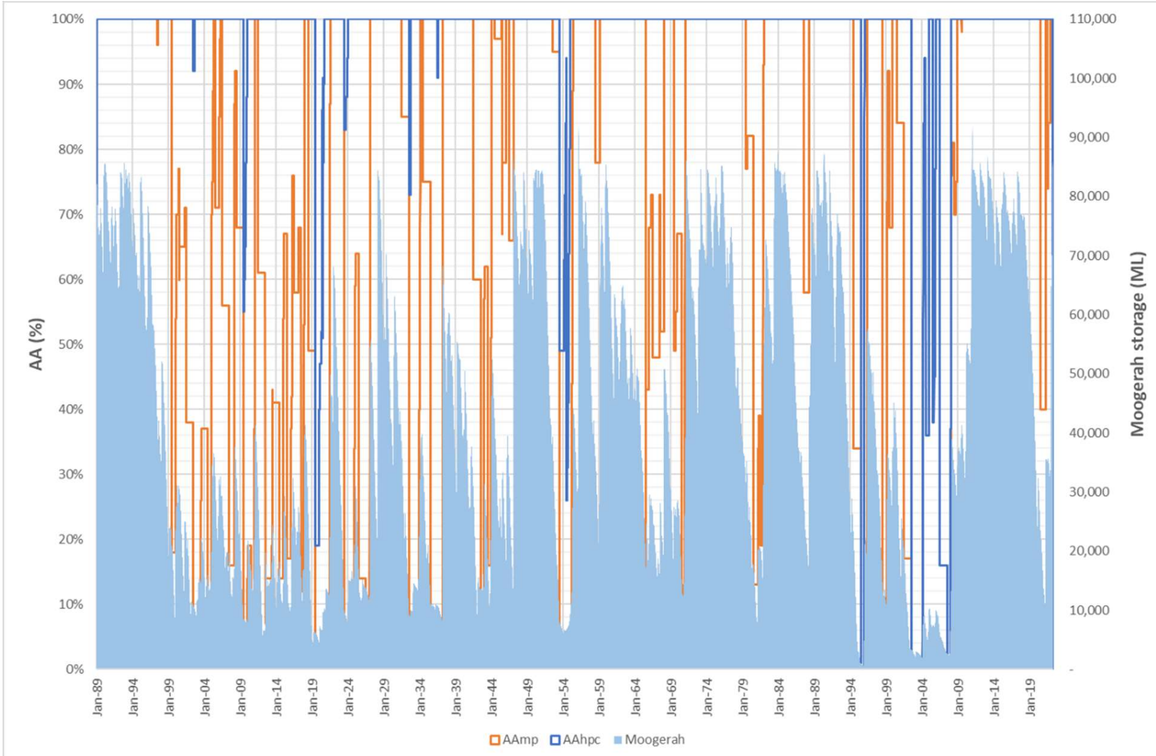

Figure B. 3: Adopted AAmp & AAhpc (1889-2022 based on merged recorded and simulated Moogerah Dam storage data)

Appendix C – Reliability of Volcanic Bores

Summary details of volcanic bores

Details of the volcanic bores are provided below in Table C. 1.

Table C. 1: Summary details of Kalfresh's volcanic bores

	RN 138334	RN 189466	RN 189471
Date drilled	6 Oct 2008	12 Nov 2002	29 Oct 2003
Depth (m)	142m	119m	119m
Casing (mm)	160mm	160mm	160mm
Slots (m)	130m – 142m	107 – 119m	107 – 119m
Lithology	0 – 16m alluvium	0 – 15m alluvium	0 – 17m alluvium
	16 – 142m volcanics	15 – 119m volcanics	17m – 119m volcanics
Equipped rate (l/s)	8.0 l/s	3.8 l/s	2.5 l/s

Monitoring instrumentation

Details of the three volcanic bores are as set out in Table C. 1. Integrated flow meters are now in place on each of the three volcanic bores. Water level monitoring was installed in RN 189466 in mid-2021. Water level monitoring equipment has not been installed in RN 138334 or RN 189471. Kalfresh advise that it is not possible to install monitoring equipment in those bores as currently equipped. It is intended to install monitoring at the next infrastructure change such as pump replacement. Until then water level monitoring in the volcanics will be carried out using RN 189466.

Recent water level behaviour

Water level behaviour in RN 189466 over the three-month period ending December 2021 is shown in Figure C. 1. The short-term variation in water level reflects the pumping cycles of the volcanic bores. From that figure it can be seen that the maximum drawdown was 70m bgl during heavy pumping cycles, leaving 37m of available drawdown above the top of the slotted interval. Bore RN 189471 has the same slotted interval as RN 189466 and may therefore have the same reserve of available drawdown as the monitored bore. Bore RN 138334, which is only 11.4m from RN 189466, is deeper with slots for water entry set at a lower level and therefore the remaining available drawdown during the periods of greatest drawdown is likely to be greater than the 37M available in RN 189466.

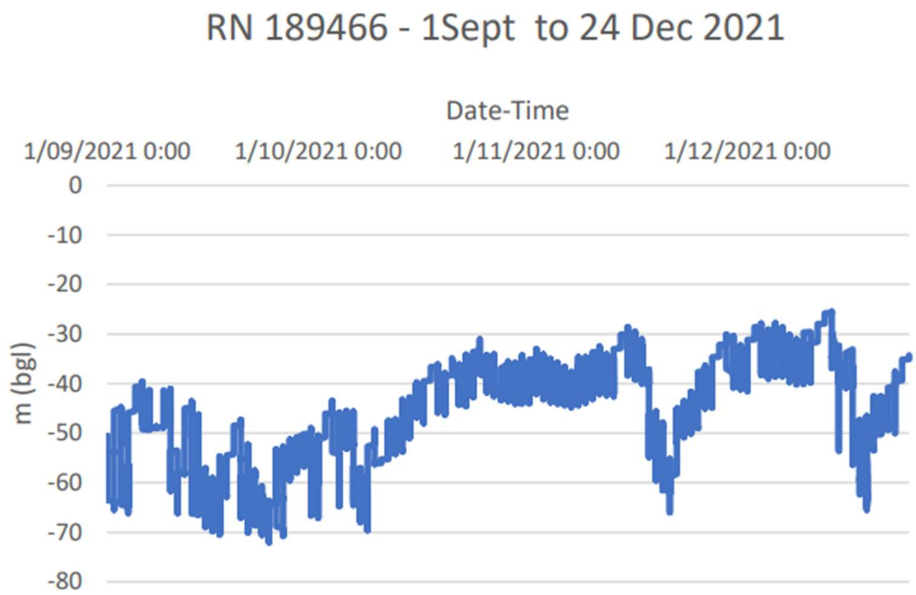

Figure C. 1: RN 189466 long-term water level behaviour

Stress test

Kalfresh carried out a test in August 2021 to stress the volcanic aquifer by pumping bores RN 189466 and RN 138334 at the same time, for a 24-hour period. Although only RN 189466 is monitored, the bores are only 11.4m apart and therefore interference between the bores could be expected. The water level behaviour is shown in Figure C. 2. After the initial sharp fall in level on commencement of pumping the rate of drawdown settled to a small steady rate of drawdown. There is no indication of a discharge boundary being intersected during the 24-hour period. On cessation of pumping there was a sharp recovery reflecting the sharp initial drawdown, followed by a slow steady recovery. If recovery had not been disturbed at the end of the test by renewed pumping it is likely that full recovery to initial conditions would have occurred over a 24-hour recovery period.

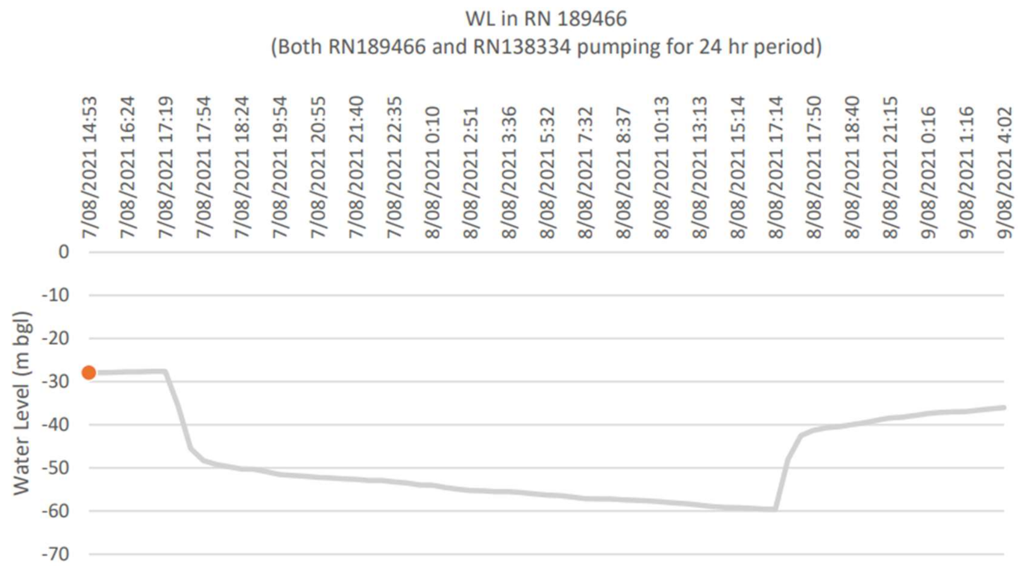

Figure C. 2: Drawdown and recovery in RN 189466 during 24-hour pumping of both RN 189466 and RN 138334

Conclusions

The volcanic bores are deep and less susceptible to reduction in supply during periods of low water levels than the alluvial bores. It can be expected that supply from the volcanic bores will have a high reliability.

Data from recently installed monitoring equipment support the view that the volcanic bores can continue to operate at the equipped rates on a sustainable basis. If pumped on half day cycles they could produce 200 ML/yr.

As more data is accumulated about bore behaviour over time it is likely to prove practicable to use portfolio water sources conjunctively by increasing reliance on the volcanic bores during severe drought when less reliable sources are unavailable and resting the volcanic bores at other times. There is no regulatory impediment to increasing use of the volcanics. The fact that three successful bores have been established on the site provides some confidence that additional bores could be established.

Appendix D – Alluvial Groundwater Availability

Historical Data

The historically recorded groundwater levels were obtained from Queensland Globe for the following two bores:

- Bore RN14310154 for the period 1961 to mid-2007; and,
- Bore RN14310239 (replacement bore at same location as RN14310154) for the period mid-2007 to current.

As these recorded datasets did not consist of daily alluvial water levels, linear interpolation techniques were used to convert the recorded data into daily alluvial water levels.

Correlation Analysis

Correlation analysis was performed to examine the relationship between the long-term rainfall records and the historic alluvial water levels found downstream of Kalfresh. From the analysis, it was found that the peak correlation between the two variables occurs when rainfall is represented as the cumulative sum of rainfall over approximately the last 3 years, which results in a correlation coefficient of 0.79. Figure D. 1 below summarises the correlation analysis as it illustrates the resulting correlation coefficient between rainfall and the historic alluvial water levels against the cumulative sum of the last X days of rainfall (from 1 to 2190 days).

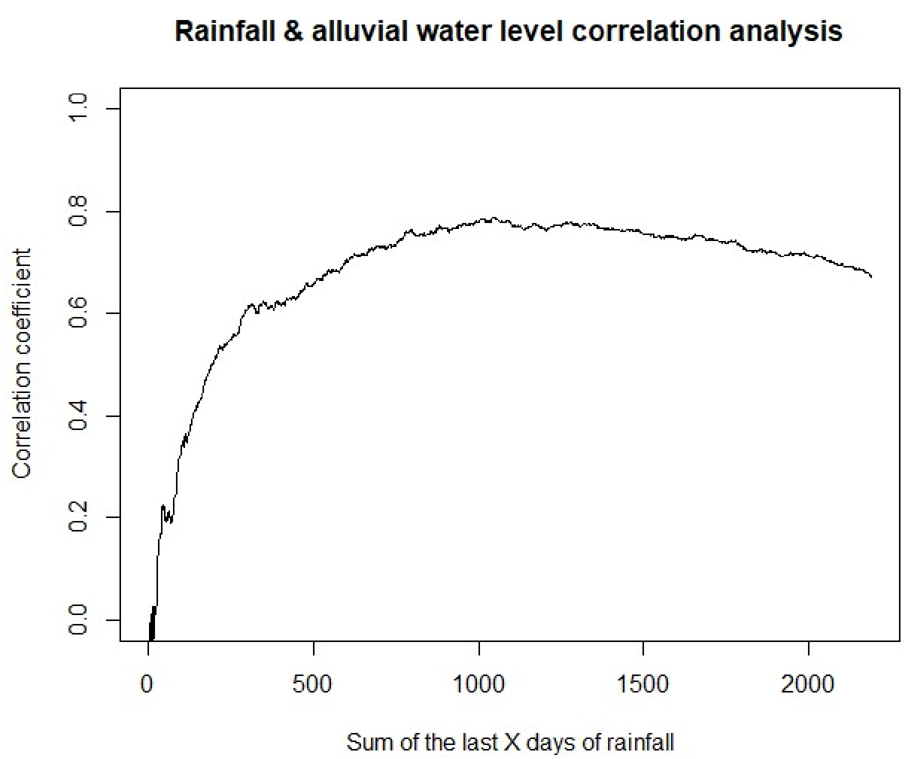

Figure D. 1: Alluvial water level correlation analysis

Linear Modelling

Using the results from the correlation analysis, a linear model was built based on the historic alluvial water level data and its relationship to the last 3 years of rainfall. This model was then used to generate the long-term alluvial water levels using the long-term rainfall data.

Resulting Data Set

The alluvial water level data set for the full assessment period comprised of the following components/data sources:

- The synthetic data generated through linear modelling was used for the period 1889 to 1961;
- Historically recorded and interpolated alluvial water level data from Bore RN14310154 was used for the period 1961 to mid-2007;
- Historically recorded and interpolated alluvial water level data from Bore RN14310239 (replacement bore at same location as RN14310154) for the period mid-2007 to current.

Figure D. 2 below is a graphical representation of the alluvial water level dataset used for this assessment.

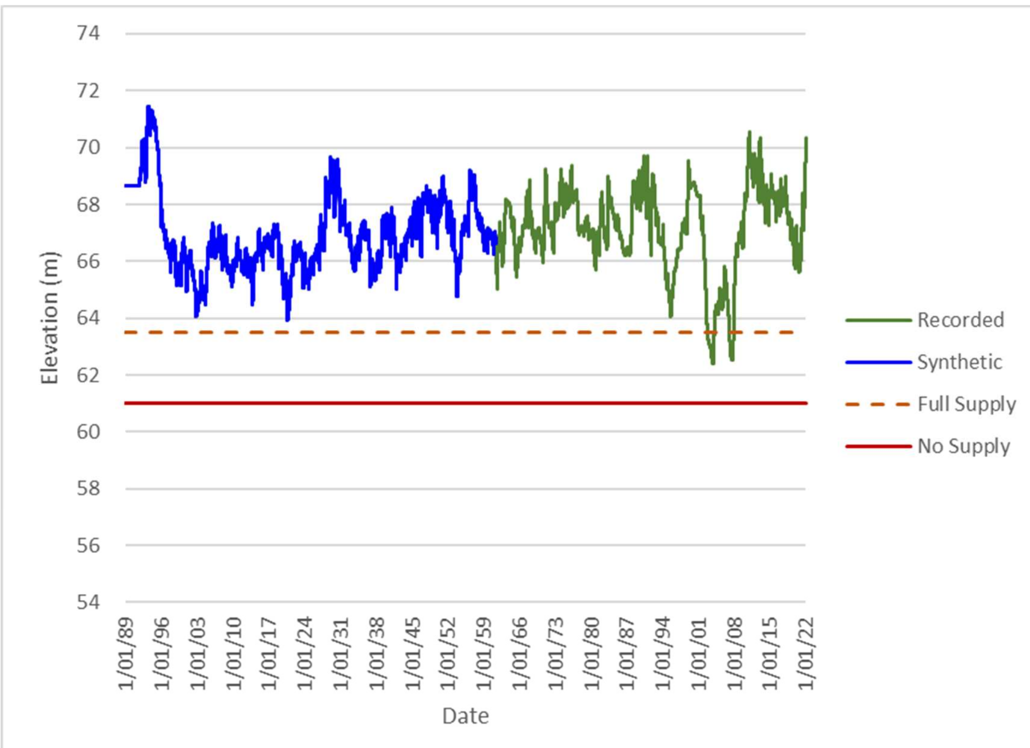

Figure D. 2 Alluvial water level over time

0 10 20 40 60 80 **1 : 2,500 @ A1**

SCENIC RIM AGRICULTURAL INDUSTRIAL PRECINCT

6200 CUNNINGHAM HWY KALBAR WATER SUPPLY CONNECTION MAP

PLAN REF: **142489 - 16**
DATE: 15 JUNE 2022
CLIENT: KALFRESH
DRAWN BY: NV
CHECKED BY: JC

Legend

- Site Boundary
- SRAIP Boundary
- Existing Contours (2.5m)
- Existing Boundaries
- Existing Easement
- Proposed Composter Lot Road Access
- Proposed Wagner Quarry Access - *(not part of the SRAIP proposal and subject to separate development approval)*
- Environmental Protection Area *(clearing within the Environmental Protection Area is subject to future investigation/approvals)*
- Road Connection to Composter Area
- Access Easement for Wagners Road Alignment
- Proposed Pipeline / Easement

DRAFT
For Discussion Only

Note:
All Lot Numbers, Dimensions and Areas are approximate only, and are subject to survey and Council approval.

Dimensions have been rounded to the nearest 0.1 metres.

Areas have been rounded down to the nearest $5m^2$.

The boundaries shown on this plan should not be used for final detailed engineers design.

Source Information:
Site boundaries: DCDB.
Adjoining information: DCDB.
Aerial photography: Google Earth.
Overland Flow Path: Aurecon.

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