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DEPARTMENT OF PLANNING,
INDUSTRY & ENVIRONMENT

WATER DEMAND FINAL REPORT

SPECIAL ACTIVATION PRECINCT, MOREE

MARCH 2021

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Water Demand Final Report
Special Activation Precinct, Moree

Department of Planning, Industry & Environment

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REV	DATE	DETAILS
B	18/03/2021	Final Water Demand Report

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ABBREVIATIONS

AWD	Available Water Determinations
DPIE	Department of Planning, Industry and Environment
GAB	Great Artesian Basin
HBT	Health Based Targets
LGA	Local Government Area
LTAAEL	Long Term Average Annual Extraction Limit
MDBA	Murray-Darling Basin Authority
ML	Megalitres
MPSC	Moree Plains Shire Council
NRAR	Natural Resources Access Regulator
NSW	New South Wales
SAP	Special Activation Precinct
SDL	Sustainable Diversion Limit
STP	Sewage Treatment Plant
WALs	Water Access Licences
WRP	Water Resource Plan

EXECUTIVE SUMMARY

BACKGROUND

The Department of Planning, Industry and Environment (DPIE) has commissioned WSP to undertake a Water Demand Assessment for the Moree Special Activation Precinct (SAP) (referred to as Package D within the overall study structure) to support the preparation of the Master Plan. The scope of this package interfaces with and relies on various other technical studies and packages – hence key inputs and assumptions have been developed, challenged and refined in close collaboration with these teams and key stakeholders.

This report presents an assessment of the water supply and demand balance for the final Structure Plan which has been developed throughout the study.

The purpose of this assessment is to inform the finalisation of the Master Plan.

WATER DEMAND ASSESSMENT OUTCOMES

The provided master planning inputs are extremely high-level in nature and numerous assumptions were required to enable demand estimation. This included considering a range of demands for some land uses. Key assumptions are outlined in Section 3.4.

Based on the methodology and assumption detail in this report it is estimated that, for the proposed Structure Plan's 40 year outlook there is water demand of between 1,200 and 3,400 ML/a. Of the proposed land uses, the Horticulture/ Native Horticulture and Value Add Agriculture land-uses make up most of the total demand, and most of the variability. The existing available water sources, combined with additional recycled effluent, are insufficient to meet this demand. However, with the additional supplies potentially available, in particular the Great Artesian Basin (GAB) and stormwater harvesting, there is likely sufficient water available. A summary of the water resources opportunity assessment is provided in Table ES.1.

Table ES.1 Summary of water opportunity assessment

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Moree Plains Shire Council (MPSC) town potable water	500	$ Existing water supply source with a baseline level of infrastructure in place.	High	Potable		Potential for securing and additional 250 ML/a extraction volume within the licence.
MPSC existing town recycled wastewater	0	N/a	Low No capacity is available in the current system.	N/a	N/a	N/a
New dedicated SAP recycled wastewater[1]	53–276	$$-$$$ Requires new STP; extent of expenditure will depend on level of treatment targeted, per discussion in Section 4.3.3.1.	High Reliable recycled water stream, once system is established. Effluent quality targets would be regulated by the NSW EPA to ensure water quality is consistently monitored/ enforced.	Not Potable	Potential for environmental and public health risks Managing end users Dependant on land uses within the SAP that have reasonable discharge to sewer needs.	Potential to identify small cluster of customers to minimise conveyance cost and energy.
Existing MPSC licenced GAB artesian groundwater	40	$	High	High TDS. May be potable subject to expectations regarding water aesthetics and/or appropriate treatment.	Increase abstraction from existing bores would be subject to licence impact conditions.	Potential to access this without significant upfront capital costs.

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Potential GAB Surat Groundwater Source[2]	3,360 – 3,900	$$$	High Preliminary modelling suggests sustainable water yields are achievable.	High TDS. May be potable subject to expectations regarding water aesthetics and/or appropriate treatment.	Post drilling testing results in less favourable water yields due to impacts.	Water may be treated to potable standard if required.
Water trading LGA (Water allocation assignment/share assignment)	0 – > 2,000	$$ – $$$	Medium Long term reliability dependant on groundwater availability through licence holder's desire to sell to market.	Very Good	Trades subject to assessment and approval to ensure minimal impact considerations are met. Water availability limited to spatial and physical constraints. Price of water may not be economical for end use.	Additional water can be obtained on a temporary basis through water allocation assignment trading. Additional water can be obtained on a permanent basis through share assignment trade.

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Recycled stormwater[3]	290	$$$$	Medium MUSIC modelling suggests the quantity of water is relatively sustainable, as it was based on 25 years worth of rainfall data; however, reliability of treatment systems is difficult to predict without existing data on raw water quality.	Not potable Requires fit for purpose uses within the site.	Requires licensing to capture stormwater from land use development. Requires significant structures (tanks) which may present cost risks. Not reliably meeting water quality targets due to the variability of quality in the raw water. Rainfall patterns may change in future.	Given the dispersed nature of collection locations, may be best suited to decentralised use rather than a centralise collection, treatment and distribution scheme.

(1) Dependent upon land uses generating sewer and subject to staging needs

(2) Based on modelling undertaken by Aurecon and subject to field verification

(3) Based on modelling undertaken by Arcadis

Whilst surface water supply was considered in the assessment, it is unlikely to be suitable and is not presented in the outcomes summary. On site recycling may also feature as a potential source, however will be unique to particular business uses and specific technologies. More detailed constraints and opportunities are provided in Section 6.

STAGING CONSIDERATIONS

There are a number of items to consider in terms of staging, including:

- It would be prudent to maximise the use of available existing water sources prior to investing in new schemes.
- Whilst there are multiple new sources available, there will need to be consideration to the financial and operational realities of constructing and operating multiple water supply sources and schemes.
- As part of the continued investigation into the sustainable quantity of water from the GAB, it is anticipated that two test bores will need to be drilled for the purpose of monitoring as part of the validation process. This will result in a logical staging opportunity.
- It is unlikely that a wastewater/recycled treatment plant would be feasible in the first instance. Therefore, the timing of recycled water as a source may need further consideration. Similarly, stormwater runoff will only be realised as development occurs. Therefore, stormwater may not be available in the initial stages.
- The distribution infrastructure associated with alternate water supplies such as recycled effluent and stormwater harvesting may need to be delivered in stages. It may be most efficient to limit the use of these supplies to a small number of large uses to minimise the extent of distribution infrastructure and minimise operational management risk.

RECOMMENDATIONS

The following recommendations have been developed based on the opportunities and constraints identified in this report. These recommendations have been made to progress the water supply and demand assessment for the Moree SAP and support the robust Master Plan, and Delivery Plan. While the work relating to developing detailed water servicing plans is likely to include a long list of “next steps”, the following provides the key findings and short-term areas of focus to further develop a sustainable and achievable water servicing system for the Moree SAP.

- **Maximise Use of Existing Water Supplies:** The use of existing water supplies provides an economically sustainable method of servicing the SAP area as there is a baseline amount of infrastructure in place which therefore doesn’t incur the same “start-up” cost as is required with establishing new water sources. It is therefore recommended that the SAP maximise the use of existing water supplies prior to investing in new supplies and enabling infrastructure. The same logic, to maximise existing water supplies, also applies to future systems once they are established. While this report identifies several options for additional water supplies, their implementation must be considered holistically. That is, consideration must be given to what types of developments would use varying sources to determine the ones that warrant investment. Investigation of recycled water sources uptake is particularly important in this regard.
- **Integrate Findings into the Integrated Water Cycle Management (IWCM) Plan:** To allow for flexibility in planning water systems using varying water sources, it is recommended that the findings of this report are incorporated into the MPSC Integrated Water Cycle Management Plan.

- **Further Investigate Feasibility of Existing and New Water Sources:** To further validate the use of the water sources identified as opportunities in this report, it is recommended that the following activities are undertaken in the short term:
  - ***Initiate Discussions Regarding Licencing:*** While this report identifies possible water volumes that could be accessed from existing aquifers, or stormwater harvesting (overland flow), the ability to draw the water is predicated on acquiring the relevant water taking licences. It is recommended that discussions are initiated by DPIE and MPSC to progress discussion and seek confirmation of requirements to obtain WALs for the GAB Surat Groundwater Source and the Gwydir Regulated and Unregulated river water.
  - ***Undertake Field Investigations:*** To validate the sustainable yields of GAB Surat water, it is recommended that DPIE and the Regional Growth NSW Development Corporation (RGDC) work with MPSC to obtain necessary approvals to drill a groundwater production bores and undertake pump tests. Analysis from testing this bore will assist in determination of potential yield and quantification of drawdown impact on sensitive receptors. While the current analysis has developed preliminary modelling results (see Hydrogeology Report Package C) with potential volumes, these figures will have to be validated through additional work in the field and additional modelling.
- **SAP Water Demand allocation tracking:** It is recommended that a water demand tracking tool, and supporting policy, be developed and implemented to monitor water allocation and use. This will enable the new water sources to be planned and delivered based on actual demand triggers, if and when required.

1 INTRODUCTION

1.1 PURPOSE

In July 2018, the New South Wales (NSW) Government announced Regional NSW's first Special Activation Precinct (SAP) at Parkes. Since Parkes, SAPs have been announced for Wagga Wagga, Snowy Mountains, Moree, Williamtown and Narrabri. The SAP program aims to facilitate job creation and economic development in designated areas of regional NSW through infrastructure investment and fast-tracked, streamlined planning. The Moree SAP was announced on 3 December 2019 as the fourth SAP and covers an investigation area of approximately 5,880 ha directly south of Moree.

The Department of Planning, Industry and Environment (DPIE) is preparing a Master Plan for the Moree SAP that will be informed by the Structure Plan, community engagement and several technical studies. Collectively, the technical studies will identify any infrastructure requirements needed to activate the precinct and provide an evidence base to inform NSW Government decisions to undertake government-led infrastructure investment and catalyse economic activity in the precinct.

To support the Master Plan several technical packages (including various studies) have been engaged for the Moree SAP including:

- Package A Structure Plan: Structure Plan, social infrastructure and sustainability.
- Package B Engineering: transport, utilities infrastructure, flooding and water cycle management, and renewable energy.
- Package C Environmental Assessment: biodiversity, heritage, bushfire, hydrogeology, contamination, air, noise, odour.
- **Package D Water Demand Assessment**.
- Package E Spatial Data: 3D capture/LiDAR, photogrammetry and 3D modelling.
- Package F Study to Understand Moree's Indigenous Community.
- Economics Analysis (procured by the Department of Regional NSW).

DPIE has commissioned WSP to prepare a Package D Water Demand Assessment for the Moree SAP to support the preparation of the Master Plan.

1.2 MOREE SAP BACKGROUND

The Moree Township is located within the Moree Plains Shire local government area (LGA) about 120 kilometres south of the QLD border. At the 2016 census, Moree had a population of 13,159 with 21.6% identifying as Aboriginal and/or Torres Strait Island peoples.

Moree lies at the junction of the Newell, Gwydir and Carnarvon Highways, and has direct interface with the Melbourne to Brisbane Inland Rail. Moree also has rail access to Newcastle Port and connections to other regional centres in south-east Queensland and regional NSW such as Tamworth and Gunnedah. The Newell Highway connects Victoria to Queensland and the Gwydir Highway is the key link between the east coast, western New South Wales and South Australia (via other interconnecting highways). The proposed Inland Rail corridor will link Narrabri to Brisbane via Moree resulting in the upgrade of the existing track to North Star and a new corridor through to Brisbane.

The Moree Plains Shire is the most productive broad acre agricultural Shire in Australia. Extensive agricultural supporting industries are also established within the locality. The Moree Township and SAP is located over the Lower Gwydir Alluvium and Great Artesian Basin Aquifers. These valuable groundwater resources are managed to balance the needs of the environment with those of the agricultural economy the area relies on.

Halls Creek crosses the SAP investigation area midway in an east-west direction, south of the airport and the Mehi River runs east-west, through the Moree urban area, and outside of the SAP investigation area.

1.3 OBJECTIVES

The objectives of this water demand analysis are as follows:

- to assess potential water supply options (and their constraints) for the SAP from the managed water sources of the NSW Great Artesian Basin, Lower Gwydir Alluvium and the Mehi River
- to develop an understanding of existing demand, including the types of demand, seasonal and climatic variability and any known/planned future changes
- to understand the increased water demand potential as a result of further development in the SAP
- to identify opportunities to utilise existing sources further and develop new sources to support the SAP vision
- identify potential opportunities and areas of constraint for the SAP Master Plan to meet its anticipated water demand including barriers relating to identified opportunities (i.e. water quality, reliability, cost and policy factors).

1.4 SCOPE

The scope of works for the water demand analysis package includes the following activities, broken out per the three stages of work undertaken.

1.4.1 ACTIVITIES COMPLETED IN STAGE 1

- Provide a summary of relevant legislation relating to water resource management in the vicinity of the SAP.
- Undertake a comprehensive review of the existing water supply capacity and water resources management framework, allocations and historic and current water usage within and surrounding the Moree SAP. This will include assessing the availability of water from managed water sources and through the water trading market.
- Undertake an audit of existing and potential alternative water sources including; Moree Plains Shire Council (MPSC) recycled water sourced from Moree Sewerage Treatment Plant (STP); potential industrial, agricultural and artesian spa water recycling; stormwater harvesting; and other sources identified from available information and collaboration with stakeholders.
- Development of demand rates for potential land-uses within the SAP and initial assessment of the potential scale of additional water demand resulting from the SAP.
- Identify potential opportunities and constraints associated with the supply of water to the SAP.

1.4.2 ACTIVITIES COMPLETED IN STAGE 2

- Undertake an assessment of the water supply and demand balance of the SAP Master Plan scenarios including the following tasks:
  - determine the water demand associated with the three master planning scenarios provided 28/09/2020, which defined the development extent and land uses at a high-level
  - determine water quality needs associated with the proposed land uses
  - identify opportunities and constraints to utilise non-potable water sources
  - revise the initial water balance based on the estimated demand for the three scenarios, providing quantitative outcomes
  - assess the water balance outcomes and determine the extent to which identified water sources can meet the estimated demand for each scenario. In addition, identify potential opportunities and constraints relevant to the SAP Master Plan vision and other technical studies.

1.4.3 ACTIVITIES COMPLETED IN STAGE 3

- Undertake an assessment of the water supply and demand balance for the final Structure Plan as determined through the undertaking of the SAP Master Plan. The following tasks were undertaken as part of the Stage 3 work:
  - summarise the relevant legislation relating to water resource management in the vicinity of the SAP
  - determine the volumetric water demand associated with the final Structure Plan, which defined the development extent and land uses at a high-level (this excludes specifying the quality of water required in each land use area)
  - identify feasible supply volumes for all water sources considered, for both existing and future potential water supplies
  - identify opportunities and constraints to utilise non-potable water sources, including the requirements to plan for treatment infrastructure to abide by recycled water guidelines in Australia and indicative cost estimates for the potential infrastructure
  - identify opportunities and constraints for water supplies relevant to the SAP Master Plan vision and other technical studies, including:
    - commentary on the reliability and risk associated with each water source
    - commentary on the relative costs of utilising each water supply
    - a discussion of immediate next steps to further explore the feasibility of utilising some of the water supply options discussed in the report
    - a discussion regarding how the opportunities and constraints relate back to the regulatory framework used to plan water taking licences in the area.

1.4.4 LINKAGE WITH OTHER TECHNICAL ASSESSMENTS

The scope of the Water Demand Analysis package interfaces with and relies on other technical studies and packages including:

- hydrogeology (contained in Package C Environment Assessment)
- flood behaviour (contained in Package B Engineering Assessment)
- constraints and opportunities for water supply in the region (subject to this scope)
- supply and demand (subject to this scope)
- water cycle management incorporating detention and water quality and interaction of stormwater with groundwater (contained in Package B Engineering Assessment)
- reuse/recycling options to support specific land uses (subject to this scope)
- potential uses by industry and/or land use as identified in the master planning and economics scope to determine water demand.

Close collaboration with the above technical study teams and study stakeholders has enabled the key assumptions and outcomes of the water demand assessment to be challenged, scenario-tested and refined though an Enquiry by Design (EbD) process. This has enabled the development of a robust water demand assessment which is aligned with the overall study objectives and outcomes.

1.5 INVESTIGATION STUDY AREA

The investigation area for the Moree SAP is presented in Figure 1.1 and covers approximately 5,880 ha. This investigation area is being used to scope all technical studies for the SAP. The entire area will not necessarily form the final SAP boundary, which will be determined throughout the master planning process. The proposed SAP Structure Plan is provided in Figure 3.1. Figure 1.1 also indicates the current extent of the MPSC potable town water network.

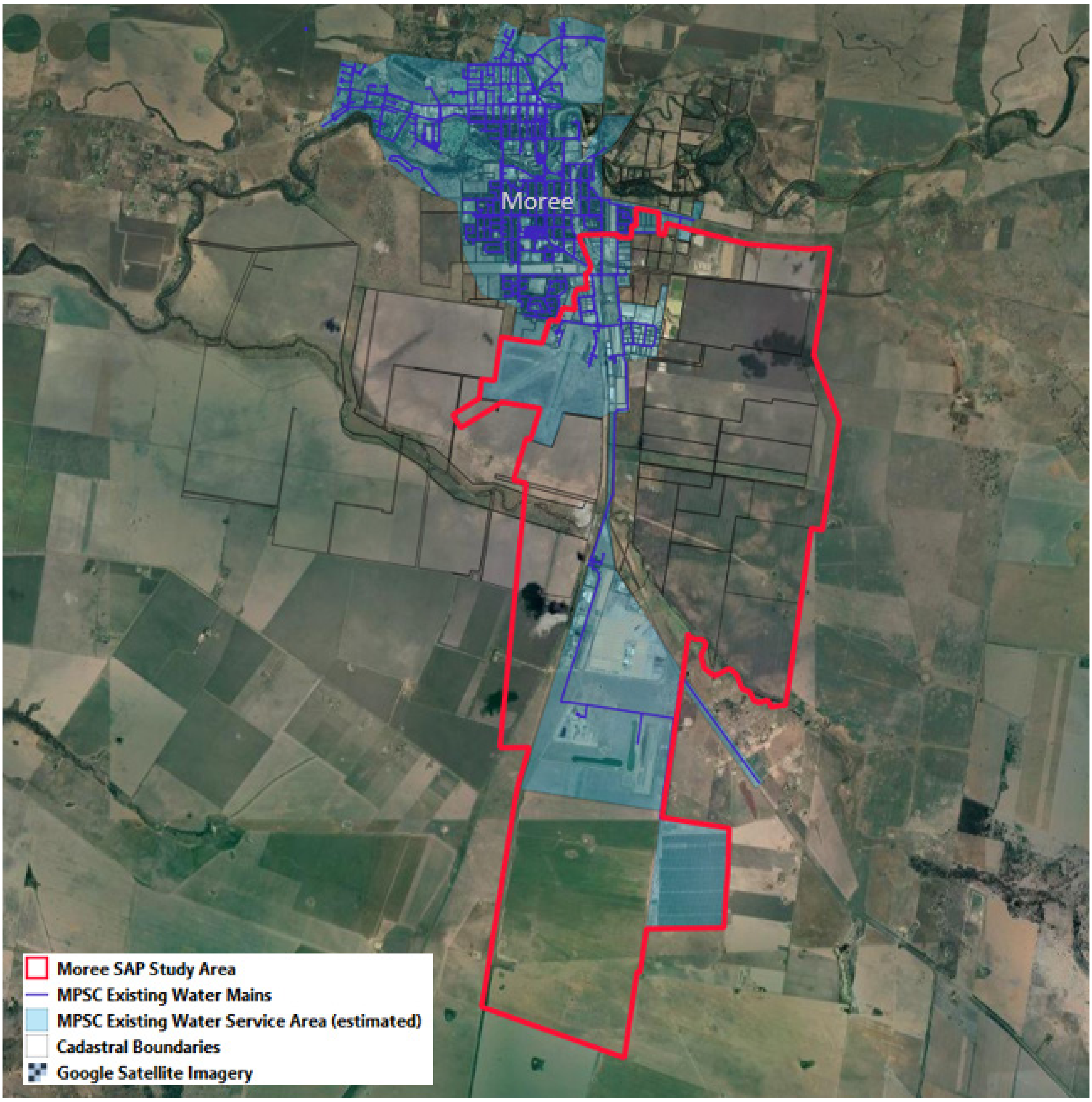


Figure 1.1 Moree SAP Study Area overview

2 CONTEXT

The following section provides an overview of the existing raw water sources and recycled water sources in Moree, as well as the regulatory framework and guidelines relevant to managing these water sources. An understanding of the available water within the geography and the rules that inform their regulation and management provided the context required to inform the development of the Water Demand Assessment for the Moree SAP.

2.1 RAW WATER SUPPLY: EXISTING CONDITIONS

The following section summarises the key regulatory framework, and water sources considered viable water supply options for the Moree SAP. These being the Gwydir Alluvium Groundwater Sources, Great Artesian Basin (GAB) Surat Groundwater Source and for harvested stormwater, the Gwydir Regulated and Unregulated river water (overland flow).

While several surface and groundwater sources were considered in the assessment, only the Lower Gwydir Alluvium through MPSC existing allocation, and the GAB Surat Groundwater Source were identified as potential reliable groundwater sources for the Moree SAP.

Licensing of water take from stormwater harvesting is also required as stormwater captured from open channels or retention system is classified as overland flow. As such Gwydir Regulated and Unregulated river water source is relevant to stormwater harvesting.

The full regulatory description and description of the existing conditions can be found within the Section 2.1.1.

2.1.1 REGULATORY FRAMEWORK

A review of Commonwealth and state legislation, policy and guidelines relevant to water resources management across the Moree SAP investigation area has been completed. Table 2.1 and Table 2.2 summarises the key legislation and policies which drive and govern the management of water resources and their relevance to the Moree SAP.

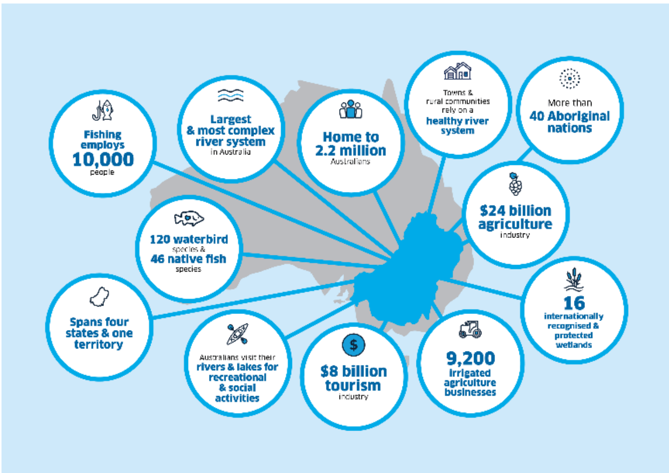
Table 2.1 Overview of relevant water resources Commonwealth legislation

COMMONWEALTH LEGISLATION	SUMMARY AND RELEVANCE
Commonwealth Water Act 2007 Murray-Darling Basin Plan 2012	— The Commonwealth Water Act 2007 sets out the role of the Murray-Darling Basin Authority (MDBA) in developing the Murray-Darling Basin Plan to ensure that is managed in the national interest. — The Murray-Darling Basin (MDB) includes water resources within or beneath the Murray-Darling Basin that extends across Australian Capital Territory (ACT), NSW, Queensland (QLD), SA and Victoria (VIC). However, it excludes any groundwater that forms part of the Great Artesian Basin. — The Murray-Darling Basin Plan (2012) is an instrument of the Commonwealth Water Act 2007 that enables the Commonwealth, in conjunction with the Basin States, to manage MDB water resources. — The MDB Plan defines discrete sustainable diversion limit (SDL) resource units within the MDB and sets out the SDL i.e. the quantity of water that may be taken from each unit. — Water resource plans (WRP) are then used to detail how a specific area of the MDB will be managed in accordance with the MDB Plan. Each WRP area may include a number of SDL resource units. There are 9 surface water and 11 groundwater WRPs for NSW. — Water Resource Plans for the water resources within the proposal study area are currently in negotiation.

Table 2.2 Overview of relevant groundwater State legislation

STATE LEGISLATION	SUMMARY AND RELEVANCE
Water Act 1912	— Water resources are administered under the *Water Act 1912* and the *Water Management Act 2000*, with the *Water Act 1912* being progressively phased out and replaced with the *Water Management Act 2000*. — Approximately five per cent of extracted water in NSW is still governed under the *Water Act 1912* and does not include the groundwater resources within the proposal study area.
Water Management Act 2000	— Groundwater and surface water resources within the Moree SAP investigation area are governed under the *Water Management Act 2000.* It provides for the sustainable and integrated management of the state's water sources for the benefit of present and future generations. — *The Water Management Act 2000* separates land and water rights, which were previously combined within the *Water Act 1912*. — It provides for the development of the NSW Aquifer Interference Policy 2012 which sets out the water licensing and assessment requirements for aquifer interference activities for mines and major projects. — Governs the issue of water access licences and approvals for those water sources (including groundwater and surface water) in NSW where water sharing plans have commenced (see below). — Provides for the development of Water Sharing Plans which set the rules for how water is allocated from a specific water source for a 10-year period. These plans are intended to provide a decade of security for the environment and water users relying on specific water sources. — Stormwater recycle volumes would also be governed under this act.
Water Management (General) Regulation 2018	— Specifies procedural, technical and licence requirements and exemptions under the Water Management Act 2000. — Defines the function and powers of water supply authorities.

2.1.1.1 MURRAY-DARLING BASIN PLAN 2012



The Murray–Darling Basin Plan (the Basin Plan 2012) aims to provide a coordinated approach to water use and management across the Murray–Darling Basin's four states and the ACT. It provides a framework to balance environmental, social and economic considerations for water use and water quality to an environmentally sustainable level. The Plan addresses both surface and groundwater use and water quality. Elements of the plan include:

- overall environmental water resource management objectives and outcomes
- defining separate water resource units within the Basin and sustainable diversion limits for these units i.e. how much surface water and groundwater can be taken from the Basin and a mechanism for adjustments to these limits

- an environmental watering plan – to protect and restore the Basin's rivers and wetlands
- a water quality and salinity management plan that sets objectives and targets
- identifying the risks to continued water availability in the Basin, and strategies to manage them
- a monitoring and evaluation program, including an annual report on the effectiveness of the Basin Plan
- the Basin Plan 2012 also required the preparation of **water resource plans** which implement the management objectives of the Basin Plan for specific areas containing one or several sustainable diversion limit (SDL) resource units.

2.1.1.2 WATER RESOURCE PLANS (WRP)

WRPs are an integral tool for implementing the objectives of the Basin Plan. They set rules on how much water can be taken from the Basin, ensuring that the SDL is not exceeded. The Murray-Darling Basin Authority (MDBA) works with the state governments to outline how each region aims to achieve community, environmental, economic and cultural outcomes and state water management rules to meet the Basin Plan objectives. Importantly, state governments have had to revise current water management rules, including water sharing plans within NSW, to ensure they comply with the Basin Plan, including SDL rules on the delivery, protection and monitoring of water for the environment; licence conditions on water access rights; and critical human water needs in extreme circumstances (when triggered).

The WRPs are supported by supplementary studies including water quality management, monitoring plans, risk assessments, community engagement and descriptions of the SDL resource units contained within each WRP area.

The MDB within NSW is covered by 20 WRPs (9 surface water and 11 groundwater). In 2020, NSW had submitted its 11 groundwater and nine surface water WRPs to the MDBA for assessment. The MDBA and NSW have agreed to a new bilateral agreement that will cover the 2020–21 water year as the NSW WRPs will be finalised and accredited after 1 July 2020.

2.1.1.3 WATER SHARING PLANS

Water Sharing Plans are established under the *Water Management Act 2000* and are the primary tool for defining water-sharing arrangements in NSW. Water Sharing Plans set the rules for how water is allocated and are intended to remain in force for 10 years thus providing consistency and security over this period for water users and the environment as to how water is allocated and shared. This not only ensures that water is specifically provided for the environment through a legally binding plan, but also allows licence holders, such as irrigators who require large volumes of water, to plan their business activities. Irrigation accounts for about 80% of all water used in New South Wales.

Water sharing plans cover the same areas as the Water Resource Plans and incorporate a number of water sources which typically equate directly to the SDL resource areas defined within the Water Resource Plans. Water sharing plans describe the annual surface and groundwater recharge volumes for each identified water source and the volumes of water that are available for sharing. Available water volumes are based on calculated long-term average annual extraction limit (LTAAEL). Provisions are made for environmental water allocation, basic landholder rights, domestic and stock rights and native title rights. Water sharing plans are typically in place for ten years, however they may be suspended in times of severe water shortages.

The key purpose of a water sharing plan is to:

- provide water users with a clear picture of when and how water will be available for extraction
- protect the fundamental environmental health of the water source
- ensure the water source is sustainable in the long-term.

There are three Water Sharing Plans of specific interest to the Moree SAP investigation area and are listed in Table 2.3, together with the water sources they include (the surface and groundwater sources of particular relevance to the Moree SAP are in bold text). The Water Sharing Plans for groundwater sources essentially "stack" on top of one another. Table 2.3 presents them in order from shallowest to deepest (NSW DPIE, 2020a).

Table 2.3 Water Sharing Plans and water sources relevant to the Moree SAP Investigation Area

WATER SHARING PLAN	STATUS	GROUNDWATER / SURFACE WATER SOURCES
Gwydir Unregulated and Alluvial Water Sources 2012	In force to 2022	Roumalla Creek Rocky River Boorolong Creek Upper Gwydir River Laura Creek Bakers Creek Georges Creek Keera Creek Copeton Dam Halls Creek Mackenzies Flat Myall Creek Gurley Creek Tycannah Creek Warialda Creek Millie Creek Slaughterhouse Creek Mosquito Creek **Moree** Gil Gil Creek Mehi River Gwydir Carole Creek Gingham Watercourse Barwon Upper Gwydir Alluvial
Gwydir Alluvial Groundwater Sources 2020	In force to 2030	**Lower Gwydir Alluvium** Upper Gwydir Alluvium
NSW Great Artesian Basin Groundwater Sources 2020	In force to 2030	GAB Eastern Recharge GAB Southern Recharge **GAB Surat** GAB Central GAB Warrego

(1) Groundwater sources listed in **bold** occur within the Moree SAP study area.

2.1.2 WATER SOURCES

This section summarises the key water sources identified as potentially viable to support the Moree SAP. The following sections include information on annual extraction limits, the level of allocation (i.e. whether a source is fully allocated or new access licenses may be granted), potential trading arrangements, and some of the practical considerations/ constraints with regard to accessing the water.

It is noted that there are additional surface and groundwater sources within the Moree SAP area. These water sources have been considered as unviable to support the Moree SAP and are not included in further discussions. Groundwater sources underlying the GAB groundwater source are considered too deep with significant drilling costs and unproven groundwater quality. Similarly, intermittent flow considerations and significant capital costs to establish meaningful storage has resulted in surface water sources from the Gwydir and Mehi rivers being deemed as unviable.

2.1.2.1 GWYDIR ALLUVIAL GROUNDWATER SOURCES

The Water Sharing Plan for the Gwydir Alluvial Groundwater Sources includes the Lower Gwydir Groundwater Source and the Upper Gwydir Alluvial Groundwater Source. Only the Lower Gwydir Groundwater Source is considered a potential supply source to the SAP and a brief description is presented below. This description is based largely on information presented in the Gwydir Alluvium Water Resource Plan Groundwater Resource Description (DPIE, Oct 2019). Information on the long term average annual extraction limit (LTAAEL) for the Gwydir Alluvium Groundwater Sources and historic usage volumes by licence type are presented in Table 2.6.

2.1.2.2 LOWER GWYDIR ALLUVIUM

The Lower Gwydir Alluvium is a broad alluvial fan of Cenozoic floodplain sediments in the mid Gwydir catchment extending west of Biniguy for approximately 90 km. This extensive alluvial fan was deposited by the Gwydir River and its tributaries and comprises clay, silt, sand and gravel.

The alluvium can be broadly divided into two main aquifer systems; a shallow aquifer up to approximately 30 m deep, and a deep aquifer up to a maximum thickness of approximately 90 m. There is no laterally continuous horizon or marker layer which defines a distinct boundary between the shallow and deep systems, however where the boundary layer occurs it is a relatively impermeable clayey layer of variable thickness.

The shallow, mainly unconfined aquifer is informally referred to as the 'Narrabri formation' and the deeper confined/ semi confined aquifer is informally referred to as the 'Gunnedah formation'.

In both the shallow and deep aquifer there may be more than one productive unit varying in thickness and extent. The productive horizons are thicker and more extensive in the "upstream" area, near Moree, and consist of coarse gravels in the shallow aquifer and fine to medium sand and gravel in the deep aquifer system. Further west the aquifers grade into finer sands and become more irregular in their occurrence. The groundwater flow direction is east to west.

Bore yields from the deeper aquifer system are up to 1,000 ML per year (ML/a) but supplies are typically in the range of 500 ML/a. The highest yielding bores are located in an area between Moree and Ashley.

NSW Government groundwater monitoring bore salinity data for the Lower Gwydir Alluvium ranges from 200 µS/cm close to the rivers to over 3,000 µS/cm in the far west and at the periphery of the alluvium.

A Parsons Brinkerhoff (2011) study found that groundwater in the deeper aquifer system is fresh (EC < 750 µS/cm). As a result, groundwater is suitable for multiple uses including drinking water supply, irrigation (cotton, barley and wheat) and stock watering.

In the main irrigation areas, groundwater from the shallow system is also suitable for drinking water supply (based on EC) but in the western and marginal areas of the alluvium it is unsuitable with EC > 1,500 µS/cm).

The majority of groundwater entitlement is used for irrigation, with a small portion reserved for basic landholder rights (stock and domestic). The Lower Gwydir Alluvium is also the primary source for town water supply to Moree.

Recharge to the Lower Gwydir Alluvium occurs via direct rainfall infiltration, flood infiltration and river leakage. In addition, other irrigation and groundwater inflows from the east also contribute to recharge. In some areas upstream of Moree, the alluvial sediments are in direct hydraulic connection with the Gwydir River and tributaries allowing direct recharge from the river into the aquifer system.

The main discharge in the Lower Gwydir Alluvium is extraction for irrigation. Other outflows are baseflow to watercourses in areas upstream of Moree and through flow towards the west. The Lower Gwydir Alluvium overlies the sediments of the GAB which have significantly lower permeability such that the volume of groundwater exchange across this boundary is considered insignificant.

The Moree SAP investigation area is directly underlain and surrounded by the Lower Gwydir Alluvium Groundwater Source. Despite the LTAAEL for the source being fully allocated it presents a potential water source for the Moree SAP through the availability of the currently unused portion (~500 ML) of the town water supply allocation of 3.5 GL.

2.1.2.3 GREAT ARTESIAN BASIN GROUNDWATER SOURCES

The Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources governs a number of groundwater sources, of which, the Surat Groundwater Source underlies the Moree SAP investigation area. This source includes all rocks of Cretaceous and Jurassic age at a depth of more than 60 m, excluding any alluvium.

The Jurassic and Cretaceous Surat Basin extends southwards from Queensland into NSW where it is referred to as the Coonamble Embayment. The Pilliga Sandstone in the Surat Basin contains significant aquifers.

The GAB Surat Groundwater Source is bounded by the GAB Warrego Groundwater Source to the northwest, the Eastern Recharge Groundwater Source to the east, the Southern Recharge Groundwater Source to the south, sub crops of the Lachlan Fold Belt rocks to the southwest and the Queensland border to the north.

The Surat Groundwater Source overlies the Gunnedah Basin in the east and the Lachlan Fold Belt in the west. It underlies the NSW GAB Surat shallow, Lower Gwydir alluvial and the western portion of Lower Namoi alluvial groundwater sources.

The thickness of the Surat Groundwater Source is up to about 1250 m. Groundwater through flow from the Eastern and Southern Recharge Groundwater Sources drives groundwater flow toward west and north-west direction. Artesian conditions exist over most of this groundwater source. Regionally, artesian aquifers are found in sandstones at depths between 200 m and 1250 m, the most significant of which is the Pilliga Sandstone at depths between 400 m to 1250 m yielding unrestricted flows of up to 45 L/s with salinity levels from 500–1300 mg/L. The artesian head of the Pilliga Sandstone aquifers varies across the region from 10 m to 52 m above ground level. High pressure and large free flowing bores are in the eastern, central and northern part of this groundwater source as the GAB sediments deepen in that direction. As the GAB sediments thin out over the Nebine Ridge on the western side of this groundwater source, the artesian pressure and free flow from bores becomes relatively low. The temperature of groundwater in these aquifers varies between 35ºC and 58ºC.

The Moree Artesian Aquatic Centre sources its water from the Pilliga Sandstone from bore approximately 700 m deep.

As groundwater migrates west from the recharge areas it evolves towards elevated sodium (Na) and bicarbonate (HCO3) concentrations and become sodium-bicarbonate-chloride (Na-HCO3-Cl) dominant type in the Jurassic – Lower Cretaceous aquifers (i.e. Hooray – Pilliga Sandstone and equivalent aquifers). As a consequence of the elevated relative sodium the groundwater becomes too sodic for irrigation.

The GAB Surat Groundwater Source, and specifically the Pilliga Sandstone, is a potentially viable water source for the Moree SAP. The LTAAEL for the source is not fully allocated although there are some constraints around the availability of the unallocated volume and the cost of accessing the Pilliga Sandstone at a depth of 500–800 m below the SAP is significant.

2.1.3 WATER ACCESS LICENCES

Water Access Licences (WALs) permit the licence holder to take water from a specified water source in accordance with the licence conditions. Each WAL has an associated water allocation account that, at the beginning of each water year (1 July), may be topped up to a predetermined volume. The predetermined volume for the new water year is based on the licence category and the available water determination (AWD) order announced at the beginning of each water year. Initial Available Water Determinations are made 1 July, then further Available Water Determinations may be made when water becomes available for distribution. For high security water uses such as town water supplies the available volume of water will equal the full licensed volume in all but exceptional circumstances. Lower security licences may have their allocation or share reduced in line with the AWD. In addition to listing the access licence category, a WAL also includes details on the share component, extraction component, nominated works and any conditions for use. Applications for WALs can be processed through the Natural Resources Access Regulator (NRAR) or WaterNSW, depending on the applicant. WALs typically are accompanied by a water supply work and a water use approval to allow for the holder of the WAL to construct and use a specified water supply at a nominated location.

2.1.3.1 PRIORITY OF ACCESS TO WATER

There are various WAL categories, with certain categories being given higher priority (security) of access to their water allocations. The priority rankings for WAL categories for surface water and groundwater sources are provided in Table 2.4 and Table 2.5. Priority rankings can change in times of severe water shortages. The *Water Management Act 2000* does not distinguish priority between different forms of take within a priority rank.

Table 2.4 Priority of access for surface water

PRIORITY	NORMAL CIRCUMSTANCES	EXTREME EVENTS (E.G. PROLONGED DROUGHTS)
Highest	— Needs of the environment	— Critical human water needs
High	— Basic landholder rights	— Needs of the environment
	— Local water utility access licences — Major utility access licences — Stock and domestic access licences	— Stock — High security licences — Commercial and industrial activities authorised by local water utility — Water for electricity generation on a major utility licence — Conveyance in supplying water for any priority 3 take
	— Regulated river (high security) access licences	— General security licences
Low	— All other forms of access licences — Supplementary access licences	— Supplementary licences

Source: NSW DPIE Regional water strategies supporting documentation 2020, adapted from the Gwydir Surface Water Resource Plan: Schedule G – Incident Response guide for the Gwydir Surface Water Resource Plan Area SW15

Table 2.5 Priority of access for groundwater

PRIORITY	NORMAL CIRCUMSTANCES	SEVERE WATER SHORTAGES	EXTREME EVENTS
Highest	— Water source and dependent ecosystems — Basic landholder rights	— Basic landholder rights (domestic purposes) — Domestic purposes or essential town services authorised by an access licence	Critical human water needs: — core human consumption requirements in urban and rural areas. — non-human consumption requirements that a failure to meet would cause prohibitively high social, economic or national security costs.
High	— Local water utility access licences — Major water utility access licences — Domestic and stock access licences	— Needs of the environment	Non critical human water needs: — basic landholder rights (domestic purposes) — essential town services authorised by an access licence
	— All other forms of aquifer access licences	— Basic landholder rights (stock purposes) — Domestic and stock access licence — Local water utility access licences for commercial and industrial activities in accordance with the licence and any drought management strategy established by the Minister	Non critical human water needs of the environment.
		— Taking of water authorised by any other category or subcategory of access licence.	Non critical human water needs: — basic landholder rights (stock) — domestic and stock access licence — local water utility access licences for commercial and industrial activities in accordance with the licence and any drought management strategy established by the Minister
Low			— Taking of water authorised by any other category or subcategory of access licence.

Source: Adapted from the Gwydir Alluvium Water Resource Plan Incident Response Guide: Schedule E (DPIE, 2019a)

2.1.3.2 EXEMPTIONS

WAL exemptions are outlined within the *Water Management (General) Regulation 2018*. Basic landholder rights authorise the take of groundwater without the need for an access licence or water use approval, although a water supply work approval is still required to construct a water bore. Basic landholder rights are defined as domestic and stock rights, native title rights and harvestable rights.

Water use within the SAP that comes from extraction of groundwater or surface water will require appropriate licencing. For groundwater this will include an assessment of impacts on nearby licence holders, GDEs, the cumulative impact on the groundwater source and will be subject to the rules and conditions set out in the Water Sharing Plan for the source and the guidelines for assessing groundwater applications.

2.1.4 WATER ALLOCATIONS AND AVAILABILITY

2.1.4.1 GROUNDWATER SOURCES

Groundwater extraction from groundwater sources in NSW is managed to statutory long term annual average extraction limits (LTAAEL) as detailed in the source water sharing plans. Table 2.6 presents the LTAAELs and current licence allocations for the relevant groundwater sources within the Moree SAP investigation area.

Access licenses specify a volume or a number of "shares" which, under normal circumstances, are equivalent to 1 ML each. In sources where average annual extraction over a 5-year period exceeds the LTAAEL by 5–10% (depending on the source), the value of each share may be set to a volume less than 1 ML through an AWD at the start of the water year. In all but exceptional circumstances town water supplies and domestic and stock access licenses will maintain their full allocation while lower priority uses may have their share allocations reduced.

The current water allocations have been split by licence category with the combined total presented as the "total share component". This total also includes the estimated annual take under basic landholder rights for stock and domestic purposes. A simple comparison of the total share component to the LTAAEL for a source indicates whether there is currently any unallocated water for which a licence might be obtained (subject to conditions and necessary approvals).

There is a significant volume of unallocated water in the GAB Surat Groundwater Source although it is understood that the unallocated volume is currently only available for water utility licences and not aquifer access licences.

Table 2.6 Groundwater sources – LTAAELs and current entitlements

GROUNDWATER SOURCE	LTAAEL (ML/AA)	TOTAL SHARE COMPONENT[1]	LICENCE CATEGORY (NUMBER OF LICENCES)	UNIT SHARES[2]
Lower Gwydir Alluvial	33,000	33,330	Aquifer (162)	28,858
			Domestic and Stock (1)	200
			Local water utility (2)	3,572
			Basic landholder rights	700
GAB Surat	43,446 + See Note.	29,320	Aquifer (51)	5,502
			Town water supply (1)	25
			Local water utility (11)	3,393
			Basic landholder rights	20,400

[1] Data obtained from the NSW Water Register on 23 June 2020. waterregister.waternsw.com.au/water-register-frame

[2] Data obtained from the NSW Water Register on 23 June 2020. waterregister.waternsw.com.au/water-register-frame

Table 2.7 presents historic annual water take, by licence category, for each of the two groundwater sources considered to present viable options for groundwater supply to the Moree SAP:

- Lower Gwydir Alluvium
- GAB Surat.

The Lower Gwydir Alluvium is fully allocated and used heavily for irrigation with extraction for this purpose exceeding the allocation in recent years. However, MPSC has an entitlement from this source of 3500 ML/a for town water supply but over the last 5 years only 2,798 to 935 ML of this entitlement has been used leaving between 702 to 2,565 ML unused with an average unused allocation over the last 5 years of 1,550 ML. MPSC consider that the high degree of variability in the annual town water usage data is down to a number of factors including: metering accuracy/malfunction and breakdown; water main breaks; and climate. They believe that for recent years the data should be more accurate.

MPSC are keen to reserve part of this unused portion of town water entitlement for the development of the SAP and advise that 500 ML/a could be made available initially with potential for greater availability in the medium term. This estimate takes into consideration the variability seen in usage, the planned transfer of part of this entitlement to other projects and estimated population change. An initial review of the WAL for the town water supply indicates that there are no specific conditions that limit the extraction of water to a volume below the 3,500 ML of the entitlement.

Additional water supply from the Lower Gwydir Alluvium (above the available unused town water allocation), would have to be obtained through the water market where temporary or permanent trades might be available. Water trading and the associated costs are discussed in Section 2.1.4.2. Whilst an allocation from the Lower Gwydir Alluvium might be obtained through the water market, extraction of the water within the SAP may still be constrained by licensing conditions and would be subject to meeting various impact assessment criteria set out in the Water Sharing Plan and the guidance on assessing groundwater applications. It should also be noted that the aquifer access licences that might be obtained through trading are lower security and water entitlement may be reduced during times of heightened demand or drought.

There are significant volumes of unallocated water in the GAB Surat Groundwater Source. At present, the unallocated water in the GAB Surat Groundwater Source is currently only available for specific purpose access licences, domestic and stock access licences, aquifer (aboriginal cultural) access licence, and aquifer (Aboriginal community development) access licences. Table 2.7 indicates that for both of these sources the bulk of the general aquifer access entitlement is not being used. There may therefore be an opportunity to obtain allocations through trading from both sources, or by purchasing water from local licence holders who are not using their entitlement. In the case of new licences or licences transferred to new extraction points on the SAP, these would be subject to impact assessments.

Table 2.7 Annual extraction from water sources (NSW DPIE 2020b)

WATER RESOURCE	LTAAEL[1] (ML)	SHARE COMPONENT[2]	LICENCE TYPE / USE	EXTRACTION VOLUME FOR WATER YEAR (ML)[3]									
				2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Lower Gwydir Alluvium Groundwater Source	33,000	28,858	Aquifer	21,956	14,642	21,130	39,342	38,374	32,040	21,280	33,599	34,560	26,042
		200	Domestic and stock	na	na	na	na	na	na	na	na	na	na
		3,572	Local Water Utility	2,139	2,005	2,404	2,832	2,527	2,798	1,783	1,972	2,247	2,261
		-	Supplementary Water	8,837	6,841	5,100	3,510	1,729	supplementary licences were cancelled at the end of the 2014/15 water year				
		700	Basic landholder rights	It is assumed the full estimate of extraction under basic landholder rights is taken each year									
		33,330	**Total usage**	33,632	24,188	29,334	46,384	43.330	35,538	23,763	36,271	37,507	29,003
			unused/(excess) against total share	(302)	9,142	3,996	(13,054)	(10,000)	(2,208)	9,567	(2,941)	(4,177)	(4,327)
GAB Surat Groundwater Source	43,446 + see note 4	5,277	Aquifer	384	421	640	895	1063	1213	1199	1542	1931	1,197
		25	Town water supply	17	16	20.2	22.8	23.4	20.2	17.6	22.5	28.6	21
		3,393	Local water utility	1,202	1,087	1,510	1,597	1,769	1,676	1,726	1,742	2,280	1,195
		20,400	Basic landholder rights	It is assumed the full estimate of extraction under basic landholder rights is taken each year									
		29,095	**Total usage**	22,003	21,924	22,570	22,915	23,255	23,309	23,343	23,707	24,640	22,813
			Unused volume against total share	7,092	7,171	6,525	6,180	5,840	5,786	5,752	5,388	4,455	6,282

na – not available

(1) current Long Term Available Annual Extraction Limit

(2) current share component of licensed allocations, plus the estimated take under basic landholder rights, and the current estimate of uncontrolled flow for the GAB Surat Groundwater Source.

(3) numbers as of 09/12/2020 and corrected for error reported on the Water usage dashboard and crosschecked against NSW Water register.

(4) 43,446 ML/a plus the volume of water that is lost conveying water through inefficient distribution systems to deliver domestic and stock rights, plus 30% of the water savings made under cap and pipe projects undertaken after the commencement of the Water Sharing Plan

2.1.4.2 GWYDIR REGULATED AND UNREGULATED RIVER WATER

Water take from surface water sources, including overland flow from stormwater runoff, in the Gwydir region is managed to statutory LTAAEL established by the water sharing plans. Currently the LTAAEL for the Gwydir Regulated River water source is set out in Clause 26, Division 2 of the Water Sharing Plan for the Gwydir Regulated River Water Source 2020. The LTAAEL for the Gwydir unregulated water is set out in the Division 1 of the Water Sharing Plan for the Gwydir Unregulated and Alluvial Water Sources 2012 and Division 2 of the revised water sharing plan.

The availability of surface water and the variability of share components is significantly more complex than for groundwater source allocations. Highly variable available water determinations allocation and differing levels of access licence security all factor into the variability and reliability of surface water share entitlements. Typically, users of surface water (such as irrigators), will pump water to storage dams when river conditions permit entitlements to be taken and use the water as required from storage. Current share entitlements to regulated and unregulated surface waters within the Moree SAP investigation area are provided in Table 2.8.

The water sharing plans cover the regulated river, and most other surface water sources within the catchment including constructed waterways and open channel stormwater drainage lines, major dams and other surface water storage areas. There are limited exceptions for some usages as well as for water from certain dam types and water collected from roof runoff.

Table 2.8 Summary of Gwydir Regulated River surface water entitlements

LICENCE CATEGORY	TOTAL SHARE COMPONENT	SHARE COMPONENT (ML)				
		Carole / Gil Gil	Lower Gwydir	Mehi	Moomin	Rest of Gwydir Regulated River
Local water utility (4)	3,836	37	0	0	0	3,799
High security (21)	20,259	1,779	2,474	2,031	1,439	12,536
General security	509,665	134,037	116,512	115,656	122,523	20,937
Supplementary	181,398	55,386	41,690	38,109	43,837	2,376
Stock and Domestic	2,824	816	299	614	888	207
Sub total	**717,983**	**192,055**	**160,975**	**156,410**	**168,687**	**39,856**
Unregulated	**68,546**	1,503	13,064	19,452	12,515	22,012
Total	**786,528**	**193,558**	**174,039**	**175,862**	**181,202**	**61,867**

2.1.5 WATER TRADING MARKET

The water trading market offers a means of purchasing water access rights within sources that may be fully allocated, such as the Lower Gwydir Alluvium. However, in the case of groundwater trades, extraction of the water at the desired location would still be subject to the necessary risk assessments, impact assessments and conditions set out in the Water Sharing Plan and the guidelines on assessing groundwater applications.

2.1.5.1 GROUNDWATER

Under the *Water Management Act 2000*, dealings are permitted in access licences, shares, account water and the nomination of supply works. The most common type of dealings between groundwater licences are allocation assignment (temporary trades) and assignment of shares (permanent trades) made under sections 71T and 71Q respectively of the *Water Management Act 2000*.

Trading in groundwater is only reported for the Lower Gwydir Groundwater Source.

A total of 23 share assignments (permanent trades) have been reported in the Lower Gwydir Groundwater Source since 2009–2020 totalling 1,286 shares with an overall average price of $3,054 per ML. An additional 2 share assignments were made during this period for 470 ML and 18 ML. However, these trades were priced at $1 and zero per unit respectively and not reflective of open market conditions. The highest price paid per share occurred in 2020 when it reached $9,025/ML.

Recent water allocation assignment trades (temporary trades) within the Lower Gwydir Alluvium over the last 5 years have typically cost in the range of $130–$290/ML.

Due to the variability in price and volume, each potential trade would require an assessment from the applicant to ensure the trade is economically viable. This uncertainty has resulted in water trading been excluded from water balance assessment. Notwithstanding, individual future developments within the Moree SAP could obtain an additional supply through water trading on an individual basis. These trades would be subject the same approvals to ensure minimal impact criteria are met.

2.1.6 MPSC INTEGRATED WATER CYCLE MANAGEMENT (IWCM) STRATEGY

MPSC's current Integrated Water Cycle Management (IWCM) Strategy was developed in 2008. MPSC have engaged a consultant to complete an update this strategy by March 2023. The scope of an IWCM Strategy addresses water supply, demand, growth, resilience and will recommend appropriate actions and initiatives for MPSC to consider. These items are highly relevant to the SAP study and vision.

MPSC have adopted a target of 400 kL/connection annual average consumption (MPSC Strategic Business Plan for Water and Wastewater, 2018), which is an approx. 33% reduction compared to current figures. MPSC are currently undertaking demand management initiatives including:

- a customer meter replacement program, including the installation of smart meters; and
- addressing and repairing leaks.

Smart meters are customer water meters which enable continuous data logging and communications, integrated with a web-based monitoring platform. This data is used to proactively identify customer leaks and can be shared with customers via an app to enhance awareness and education around their water usage. These current measures are expected to achieve approx. 15–20% reduction in demand (i.e. reducing average annual consumption to approx. 500 kL/connection).

2.2 RECYCLED WATER: EXISTING CONDITIONS

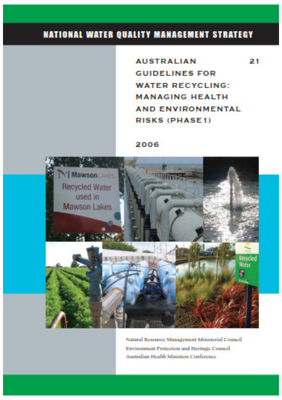
2.2.1 WATER REUSE GUIDELINES

There are numerous guidelines related to water recycling schemes in NSW; however, there are two key guidelines that are used by project proponents in NSW.

Note that there are numerous existing guidelines due to the growing interest in recycled water systems in the last few decades, driven by changing climate and an increased awareness of water efficiency practices. As more systems have been implemented in Australia, it has been observed that the planning and operation of systems across different jurisdictions has varied. Therefore, federal and state guidelines have been developed, at different times over the last few decades, to provide more guidance to water recycle system proponents. This is evident in the overlapping content of the Federal and State guidelines discussed in this document.

2.2.1.1 AUSTRALIAN GUIDELINES FOR WATER RECYCLING (AGWR): MANAGING HEALTH AND ENVIRONMENTAL RISKS (2006)

SCOPE OF GUIDELINES



The national guidelines were developed to provide guidance regarding the best practices for water recycling, including stormwater, greywater and treated sewage. The aim is to ensure a proponent plans and implements such a system without negatively impacting on the environment or human health. The main feature of the guidelines is that they provide a general risk management framework to plan for any water recycle system, such to eliminate or mitigate health and environmental risks. In short, the process requires the following key steps:

- **Identify Hazards/Risks:** a proponent must first systematically identify and consider all hazards associated with the recycled water and assess the risk profile for these hazards (i.e. "how likely will the bad thing happen and what is the impact of it happening").
- **Identify Mitigative Steps:** Once the risk profile is documented, the proponent must outline if they can mitigate the risks and how. The recommended practices must be founded in data and logic.
- **Verify Performance:** Once the system is implemented, ongoing performance is key for ensuring the management system is providing the required water quality for its intended use.

KEY TAKE-AWAY FROM THE GUIDELINES

The AGWR recommends a health-based performance target for managing pathogen risk. The assessment used for determining the indicative health risk is based on calculating the Log Reduction Value (LRV) for a treatment and recycle water system and comparing it to the target LRV for the intended use of the recycled water. To put it plainly, your system and management practices must meet or exceed the target LRV (see Equation 1).

$$\textit{Target LRV} - (\textit{Treatment System LRV} + \textit{Management System LRV}) \leq 0$$

Equation 1

The AGWR lists the LRV and quality targets for the existing recycled water uses in Moree, summarised in Table 2.9.

Table 2.9 Log reduction and quality targets for current recycle water uses in Moree

TYPE OF RECYCLE WATER USE	LRV[2] TARGET (VIRUS / PROTOZOA / BACTERIA)	QUALITY TARGETS
Municipal use — open spaces, sports grounds, golf courses, dust suppression, etc or unrestricted access and application	5.0 / 3.5 / 4.0	— To be determined on case-by-case basis depending on technologies — Could include turbidity criteria for filtration, disinfectant Ct or dose (UV) E. coli
Commercial food crops[1]	6.0 / 5.0 / 5.0	— BOD < 20 mg/L — SS <30 mg/L — Disinfectant residual or UV dose — E. coli < 100 cfu/100 ml

Notes

(1) These are indicative numbers only, as there are numerous categories of crops listed in the AGWR and they have different health-based targets associated with each.

(2) LRV's are used in reference to the physical–chemical treatment of water to remove, kill, or inactivate microorganisms such as bacteria, protozoa and viruses (1-log removal = 90% reduction in density of the target organism, 2-log removal = 99% reduction, 3-log removal = 99.9% reduction, etc).

To determine the actual LRV's for a treatment process and management practices, a calculation would have to be made using the indicative values provided in Tables 3.4 and 3.5 of the AGWR, and compared against the treatment requirements for each land use per the uses presented in Table 3.8 of the AGWR .

APPLICABILITY OF THE GUIDELINES

The risk management framework is applicable to all types and sizes of recycle water schemes. The guidelines may apply to on-site systems for single dwellings (i.e. residential owned systems) as well as large centralised treatment plants (i.e. systems owned and operated by water providers). The key focus is that the risk management system developed for any given recycle system must suit its risk profile.

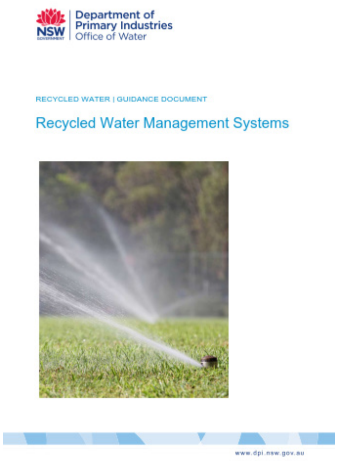
RELEVANCE TO MOREE SAP

The owners and operators of any recycled water system will have to undertake a health-based target approach, in line with the AGWR, when considering supply of recycled water to users. This applies to centralised systems such as treated wastewater from MPSC owned treatment system or private systems.

2.2.1.2 NSW GUIDELINES FOR RECYCLED WATER MANAGEMENT SYSTEMS (2015)

SCOPE OF GUIDELINES

The NSW Guidelines for Recycled Water Management Systems were developed to provide additional guidance for developing a RWMS which complies with the elements in AGWR (the national guidelines) and the applicable legislative requirements in NSW (notably s60 of the *Local Government Act 1993 (LGA)* or s292 of the NSW *Water Management Act 2000 (WMA)*). A RWMS includes a collection of documents, procedures, processes, data and records that support the proposal and continued use of recycled water. This guideline clearly states that it is to be referenced and read in conjunction with the AGWR.



KEY TAKE-AWAY FROM THE GUIDELINES

The guideline recommends a health-based performance target for achieving microbial and pathogen quality in recycled water, like the AGWR. The assessment used for determining the indicative health risk is based on calculating the Log Reduction Value (LRV) for a treatment and recycle water system and comparing it to the target LRV for the intended use of the recycled water. To put it plainly, your system and management practices must meet or exceed the target LRV (see Equation 2). Again, this is like the practice used in the AGWR.

$$\textit{Target LRV} - (\textit{Treatment System LRV} + \textit{Management System LRV}) \leq 0$$

Equation 2

The NSW Guidelines for Recycled Water Management Systems lists the LRV and quality targets for the existing recycled water uses in Moree are summarised in Table 2.10.

Table 2.10 Log reduction and quality targets for current recycled water uses in Moree

TYPE OF RECYCLE WATER USE	LRV[1] TARGET (VIRUS / PROTOZOA / BACTERIA)	QUALITY TARGETS
Municipal use — open spaces, sports grounds, golf courses, trees, shrubs, public gardens, dust suppression or unrestricted access and application	5.2 / 3.7 / 4.0	Refer to AGWR
Commercial food crops	6.1 / 4.8 / 5.0	Refer to AGWR

Notes

(1) LRV's are used in used in reference to the physical–chemical treatment of water to remove, kill, or inactivate microorganisms such as bacteria, protozoa and viruses (1-log removal = 90% reduction in density of the target organism, 2-log removal = 99% reduction, 3-log removal = 99.9% reduction, etc).

To determine the actual LRV's for a treatment process and management practices, a calculation would have to be made using the indicative values provided in Tables 8 and 9 of the NSW Guideline for Recycled Water Management Systems.

APPLICABILITY OF THE GUIDELINES

The guidelines have been prepared to guide water utilities. While the water utilities are responsible for planning and managing the infrastructure typically, if third party end users are involved (i.e. a third party is a user of the water recycle stream), the latter may also bear some of the risk associated with the system. It is therefore critical that detailed user agreements are set in place to establish the responsibilities of each party (i.e. obligations of each party, who bears the risks, who bears the cost of specific components of the system, etc.).

RELEVANCE TO MOREE SAP

The owners and operators of any recycled water system will have to undertake a health-based target approach, in line with the AGWR, when considering supply of recycled water to users. This applies to centralised systems such as treated wastewater from MPSC owned treatment system or private systems. Note that any private system owners that intend to distribute recycled water to other users would require licencing for their treatment system and would therefore be liable for the cost related to the licensure requirements and would also be subject to owning the risk associated with any potential non-compliance of the treatment process.

2.2.1.3 RECYCLED WATER POLICY

MPSC has written a Recycled Water Policy to state their commitment to provide sustainable and safe recycled water. MPSC recognizes the need to continually maintain and improve the Recycled Water Management System (RSMS), which follows the best practice guidance provided in the AGWR.

2.2.2 RECYCLED WATER SOURCES

2.2.2.1 MOREE STP RECYCLED WATER

The Moree STP recycled water system, which utilises effluent from the Moree STP, is the only recycled water reticulation system in Moree and has been in use since early 2002. The recycled water is supplied to four users within Moree, including: Kirkby's (a farm), the Moree Golf Course & Moree Cemetery; and, the Ron Harborne Oval. User agreements are in place for all third party recycled water users.

Based on a review of recycled water consumption data provided by MPSC and consultation with the latter, it was determined that 100% of the effluent generated is used by recycled water users and on average, the uptake is about 750 ML per year (an effluent generation rate based on the plant being at 75% capacity).

3 METHODOLOGY

3.1 OVERVIEW OF THE KEY STAGES OF WORK

The water supply and demand assessment for the Moree SAP was undertaken in a stepwise approach including three stages, with the work in each stage building on the last. A summary of the objectives and outputs of each stage is provided described below. Additional details regarding the work understand and key resulting outputs of Stages 1 and 2 are described in more detail in Sections 3.2 and 3.3. Section 3.4 provides details regarding the key inputs and assessment undertaken in Stage 3.

– **Stage 1 – Water Demand Baseline Assessment:** This stage was designed to provide context, baseline analysis and information regarding water supply constraints and opportunities to the SAP technical study groups and stakeholders. Significant engagement with MPSC was undertaken at this stage to understand the existing water supply and demand context for MPSC-operated systems. This solid baseline understanding of the existing available water supplies and system helped to guide the development of potential opportunities and constraints with respect to providing water to future development within the SAP.

– **Stage 2 – Water Demand Scenario Analysis:** This stage quantitatively assessed the water supply and demand requirements for three development scenarios developed for the Moree SAP Master Plan. Each of the development scenarios was comprised of a varying scale and types of development. The purpose of this stage of the work was to test the types and scale of developments that could be feasibly serviced by means of existing water supplies and potential recycled water supplies generated within the SAP development (i.e. rainfall harvesting, stormwater harvesting, treated wastewater, etc.). In addition, the key opportunities and constraints identified at Stage 1 were also developed further based on the specific details of these scenarios.

– **Stage 3 – Water Demand Final Report:** The final stage provides the assessment of the water demand and supply analysis for the Moree SAP growth plan. At a high level, the assessment identified possible water sources (including recycled water sources), a breakdown of the feasible volumes of water that can be provided by each source, and the treatment infrastructure required to utilise each water source. At a more detailed level, the report identifies the opportunities and constraints associated with each water source "pathway" as a well as the key recommendations for what further work to undertake in the short term.

3.2 STAGE 1 – WATER DEMAND BASELINE ASSESSMENT

Stage 1 of the study focused primarily on establishing a baseline understand of the available water sources and systems within Moree as well as the potential demand rates that may result in the SAP based on a discussion of potential land uses.

3.2.1 WATER SUPPLY ANALYSIS

A detailed review of the regulatory context and requirements was undertaken to underpin this study and to consider the feasibility of using the respective groundwater, surface water and recycled water sources in the region to support the SAP development. Refer to Section 2.1.1 and Section 2.1.2 above for detailed information regarding these items.

The key outcome from this review was to confirm that there are significant supply constraints which needed to be considered.

3.2.2 DEMAND RATES

Land-use types which could potentially be developed in the SAP were identified in collaboration with other SAP technical study groups, stakeholders and DPIE. Typical water demands associated with these land-uses were investigated, based on industry guidelines, published research and comparable developments.

Demand rates to be adopted for the study were developed, based on the above investigation and appropriate assumptions. For some land-uses demand can vary significantly depending on development-specific factors, and a wide range in demand rate was adopted. Key assumptions were tested with other SAP technical study groups, stakeholders and DPIE to refine these to the extent possible.

The key outcomes from the above steps were to demonstrate that:

- water demand for development of the entire SAP study area (or a significant portion) is expected to be substantial
- some land uses have potentially very high demands and, due to the limited information available, assumptions will be required which result in a very wide range in estimated demand. This was shown to be a significant issue for the 'value-add agriculture' and 'horticulture/intensive agriculture' land-uses, hence these required additional stakeholder review and effort during the scenario definition phase.

3.2.3 ALTERNATIVE WATER SOURCES

An overview of the guidelines applicable to recycled water systems was provided as context for how recycle water systems are typically planned for and managed. Both the federal and state guidelines for planning recycled water systems rely on undertaking Health Based Target Assessments (HBT) which essentially evaluate the risk associated with a potential water use and the capability of the treatment and recycled water systems to manage human and environmental exposure to the recycle water.. An understanding of the guidelines provides context on how feasible recycled water uses are ideated (i.e. high quality vs. lower quality uses).

Potential alternative water sources to support the SAP development were identified preliminarily and included:

- recycled wastewater (either from the existing Moree STP or a new system located within the SAP)
- recycled stormwater harvested from within the SAP.

The water quality requirements for the identified land-uses, and treatment requirements for these alternative sources was considered. Specifically, an indicative Health Based Target (HBT) assessment was undertaken to ascertain the feasibility of using the existing recycled water from the MPSC system for existing and future users. Potential infrastructure requirements were identified based on risks associated with the Moree STP treatment capability which require further consideration by MPSC. Generally, recycled water generated by the existing STP was determined to feasible to use for lower quality uses with a high degree of irrigation system management.

The key outcome from this item was to provide a robust basis for these opportunities to be considered and developed by the SAP study team during the subsequent stages of the study.

3.2.4 IDENTIFICATION OF CONSTRAINTS AND OPPORTUNITIES

Based on the above items, a detailed register of relevant constraints and opportunities was developed covering water supply, demand, alternative water sources and integrated water cycle management. Further to this a series of recommended actions (for both the SAP study team and later studies) was developed to guide Stage 2 and 3 of the study.

3.3 STAGE 2 – WATER DEMAND SCENARIO ANALYSIS

Stage 2 of the study focused on testing water supply solutions based on the three development scenarios developed by the SAP Master Planning team. The three development scenarios considered were quite different in scale and composition and provided a good basis for understanding which scales of development and land-use types could be more feasibly serviced by the available water supplies.

3.3.1 DEVELOPMENT SCENARIOS

Key inputs to Stage 2 were:

- three scenarios developed by the SAP master planning study team
- guidance and refinement of development expectations based on market-sounding exercise undertaken by the SAP economics study team
- ongoing input from other SAP technical study teams and stakeholders

The development scenarios ranged from 1,500–3,800 ha gross area and contained generally similar land-uses but in different proportions and with a different spatial layout. Accompanying this information was high-level commentary regarding the types of development which could occur within each land use category.

The market sounding exercise by the SAP economics study team included consultation with 21 businesses within the study area, the region or who were identified as ‘considering investment into Moree (and other regional towns). The key outcomes of this exercise relevant to this water demand assessment were as follows:

- Medicinal cannabis is a potential new industry which could establish trial sites to grow field hemp initially and has potential for further development of related manufacturing/processing facilities within these sites in future.
- Horticulture businesses (specifically glasshouses, requiring high quality water for irrigation) are potentially suitable for consideration in the SAP, from an economics perspective. Mushrooms and medicinal cannabis were noted as example crops however, many other types of crops could be considered.
- Fertilizer and early stage processing, related to existing agricultural industries in the region (i.e. wheat, cotton) are potentially suitable for consideration in the SAP, from an economics perspective.
- Flour milling and oil crushing plants were noted as examples of early-stage processing which could be suitable for consideration in the SAP, from an economics perspective.
- Aquaculture is potentially suitable for consideration in the SAP, from an economics perspective. Moree Plains Shire Council has in the past received a development proposal relating to growing Barramundi using spent artesian water from the GAB Surat Groundwater Source.
- Hydrogen production is potentially suitable for consideration in the SAP, from an economics perspective.
- Various other land-uses such as intermodal, bulk handling and solar energy are well suited to the Moree SAP, from an economics perspective.
- Ethanol production and abattoirs may not be well-suited to the Moree SAP, from an economics perspective although it is understood that this is being further considered.

3.3.2 PRELIMINARY DEMAND ESTIMATE AND WATER BALANCE

Based on the project inputs as described in Section 3.3.1, the demand rate assumptions were refined where possible and an estimate of the demand for each scenario was developed. Given the uncertainties and significant assumptions relied on, the estimated demand for each scenario was presented as a range. Only the fully developed extent of each scenario was considered in these demand estimates.

A water balance assessment of supply vs. demand for each scenario was undertaken. The available supply considered existing water sources within the SAP plus the additional volume of recycled water which would be available as a proportion of the new demands would be ‘returned to sewer.’ Assumptions were made regarding this proportion as well as potential losses within the recycled water treatment and storage system.

For all three scenarios, it was found that within the existing supply sources there was insufficient available water supply to meet the SAP development demands. This would require additional water sources (or allocations) to be developed in order to support the SAP development.

3.3.3 ADDITIONAL WATER SOURCES

The water balance undertaken for all three scenarios assumed that demand is to be met using the following approach regarding different fit-for-purpose water sources:

- The full available quantity of recycled wastewater is to be used (including additional volume generated by the SAP development)
- The full available allocation of MPSC town potable water is to be used, up to the existing allocation (assumed at the time to be 750 ML/a above existing demand)

  Note this assumption has been revised for the final report based on advice from MPSC that an additional 500ML/a, above the existing demand is considered available for the SAP, based on current commitments and planning.
- All remaining demand is to be met with treated groundwater from the GAB Surat Groundwater Source (i.e. similar quality to potable quality after being treated).

The intent of this approach is to utilise the minimum quality/fit-for-purpose water source to meet each type of development demands to promote:

- full utilisation of lower quality water sources; and
- a balance of water sources (including climate independent sources), enhancing supply resilience.

Other potential recycled water sources such as recycled stormwater were considered as opportunities to be explored, rather than a necessary part of the solution. The constraints associated with using recycled stormwater were also explored.

Based on the scenario water balance assessment, potential infrastructure requirements and costs were developed at a high-level to provide guidance to the subsequent EbD workshop.

3.3.4 OPPORTUNITIES AND CONSTRAINTS

An updated assessment of relevant opportunities and constraints was developed to inform the subsequent EbD workshop. This developed on the general opportunities and constraints identified in Stage 1 and incorporated key quantitative and scenario-specific findings.

3.4 STAGE 3 – FINAL WATER DEMANDS REPORT

The work in Stage 3 included developing a final water balance based on a final development scenario prepared by the Master Planning team. This final development scenario was informed based on the scenario testing that occurred in Stage 2 and the outcomes of the EbD workshop. The inputs used for the final water demand and supply assessment, as well as the methodology for the review, are described within the following section. The outputs of the assessment are summarised in Section 4.

3.4.1 WATER SUPPLY ASSESSMENT

3.4.1.1 STAKEHOLDER ENGAGEMENT

The collaborative nature undertaken by the project team in Stage 1 and 2 continued throughout the Stage 3 assessment. Initial understanding of potential supply estimates was developed through discussion with key stakeholders including MPSC and DPIE's Water Team. The findings of the scenario water demand assessment were tested and challenged by all stakeholders through the EbD workshop. Refined assumptions and demand estimates were developed through the EbD workshop.

Similarly, once the Structure Plan was defined, stormwater volumes were provided from the Flooding and Hydrology team.

The joint focus on the GAB Surat Groundwater Source resulted in frequent communication with the Hydrogeology team undertaking Package C works and DPIE's Water Team.

3.4.1.2 MPSC POTABLE WATER (LOWER GWYDIR ALLUVIUM)

The Moree town water supply is sourced entirely from groundwater. This is primarily from Yarraman borefield (north of Moree, with seven operational bores) and supplemented by two additional bores which pump directly into the distribution network (MPSC Strategic Business Plan for Water and Wastewater, 2018). MPSC is currently delivering a project to augment supply capacity with a new borefield south of Moree.

MPSC has advised that 500 ML from its existing WAL is available to supply future demand within the SAP based on current planning and commitments. This water is sourced from a currently unused allocation. Utilisation of this allocation would be subject to the existing conditions on MPSC licences.

3.4.1.3 RECYCLED WATER (TREATED WASTEWATER)

SOURCES AND AVAILABILITY OF TREATED WASTEWATER FOR RECYCLE

The existing MPSC recycled water system is fully utilised by existing users, based on plant capacity being 75%, and is distant from the SAP (approximately 7 km). Moreover, existing recycled water users have expressed interest in utilising more recycled water than is currently available to them. For these reasons, it is assumed that no volume is available from this system to support the SAP development.

For the purpose of the study, it is assumed that a new STP would be built within the SAP area to provide wastewater servicing to these developments and with the aim of 100% recycling of treated wastewater to support appropriate uses within the SAP. The scale of the new STP (and the recycled water supply it generates) has been determined using the assumptions documented below.

The assumption of implementing a new STP has been based on the understanding that the existing STP is a significant distance from the SAP area (about 7 km) and will require not only an upgrade to the plant itself, but also linear infrastructure to convey wastewater flows to the STP and then to redistribute recycled water back to the SAP area. This option has not been explored in detail and is therefore presents another opportunity in terms of the make-up of the future infrastructure that can be further explored in the next stage of infrastructure planning for the Moree SAP.

ASSUMPTIONS FOR CALCULATING FUTURE RECYCLED WATER DEMANDS

The volume of recycled water available within he SAP has been estimated based on assumed proportion returned to sewer for each precinct category (per Table 3.1) and 25% losses within the treatment and storage system.

Table 3.1 Assumed proportion of SAP water demand potentially available as additional recycled water source volume

LAND USE	PROPORTION OF WATER DEMAND ASSUMED RETURNED TO SEWER	LOSES WITHIN THE STP AND NETWORK	OVERALL PROPORTION OF WATER AVAILABLE FOR REUSE TO RECYCLED WATER CUSTOMERS
Intermodal	75%	25%	56%
Freight & Logistics	75%	25%	56%
Horticulture/Native Horticulture	0%	N/a	N/a
Resource Recovery	50%	25%	38%
Value Add Agriculture	25%	25%	19%
Bio-Energy	25%	25%	19%
Potentially Hazardous	25%	25%	19%
Enterprise/Hub	50%	25%	38%
Solar	0%	N/a	N/a

3.4.1.4 RECYCLED WATER (TREATED STORMWATER)

Recycled stormwater has been considered in this report in so far as volumes can be collected, treated and used within a development lot. The volumes and location of recycled stormwater have been determined through the work undertaken by Arcadis (2021) in their Stage 3 Flood and Water Cycle Management report. The results of Arcadis' assessment indicates that a total volume of 290 ML/a is available for reuse within Moree SAP development.

3.4.1.5 GAB SURAT GROUNDWATER SOURCE

Through the Stage 1 supply assessment, it was identified that the Surat Groundwater Source has unallocated volume available for water utility licences. Following the development of the water demand scenarios quantification of potential groundwater impacts were required.

Analytical modelling was undertaken as part of Package C Hydrogeology Final Report (Aurecon 2021 to assess the supply potential from the Surat Groundwater source. The modelling used aquifer properties derived from a groundwater pumping test undertaken near the township of Bellata approximately 40 km to the south.

The analytical modelling scenarios were undertaken to understand the potential maximum abstraction that can be obtained from a proposed borefield of four supply bores spaced across the SAP while assessing the potential impact on existing bores surrounding the Moree SAP. A maximum resulting drawdown of no more than 2.0 m was considered the acceptable potential impact to these existing bores.

The modelling assumes a hydraulic conductivity of 2.5 md^{-1} (as derived from the Bellata pumping test), a specific storage of 6.6 x 10-6 m^{-1} and an aquifer thickness of 160 m. Annual yield estimations for four pumping bores distributed evenly across the SAP investigation area is **3,900 ML/a.**

A sensitivity assessment, with various aquifer parameters was also undertaken as part of Aurecon's modelling. Using a lower hydraulic conductivity (1.5 md-1) sensitivity case, a total of **3,360 ML/a** would be available.

It is noted in Aurecon's modelling that there are alternatives if more water is required. For example, if the location of supply bores within the borefield were moved to an alternative southern configuration, then potentially up to 5,500 ML/a could be obtained. However, preliminary modelling has indicated that a single existing groundwater bore west of the SAP could potentially be impacted by unacceptable drawdown within this bore.

Refinement to the predictive drawdown modelling will be undertaken following the conclusion of drilling and testing of a GAB groundwater bore. This will refine aquifer properties used in the modelling and provide a better estimate of expected groundwater drawdown. In the event that refined modelling indicates that unacceptable drawdown is likely to occur, then optimisation of the bore field will be required to improve bore spacing.

Full details of analytical modelling undertaken to inform the supply potential of the Surat Groundwater Source is provided within Package C Hydrogeology Final Report (Aurecon 2021).

3.4.1.6 INTERNAL PRIVATE WATER RECYCLING

The potential for on-site private recycled water reuse has not been considered in this assessment. Given that it is only possible for some specific uses it is considered opportunistic. This type and scale of initiative would be best considered from the perspective of reducing customer demands rather than being considered available as 'additional supply' from a centralized system.

3.4.2 WATER DEMAND ASSESSMENT

3.4.2.1 STAKEHOLDER ENGAGEMENT

Water demands for the SAP development have been developed based on various inputs and assumptions detailed in the sections below. This approach has been developed throughout the study with significant engagement with other SAP technical study teams (including the master plan, economics, infrastructure and sustainability study teams), MPSC and DPIE. Key assumptions have also been tested with these stakeholders and refined where possible to utilise the best available information and ensure consistency across the different technical study outputs.

3.4.2.2 STRUCTURE PLAN INPUTS

The three scenarios developed in Stage 2 were tested and explored at the EbD workshop. Whilst this process addressed the full range of planning considerations, the water supply and demand considerations were an important element. A final Structure Plan arising from the EbD workshop was developed by master planning study team, as shown in Figure 3.1. This defines the development precinct categories and land-use types and assumptions, associated with each category.

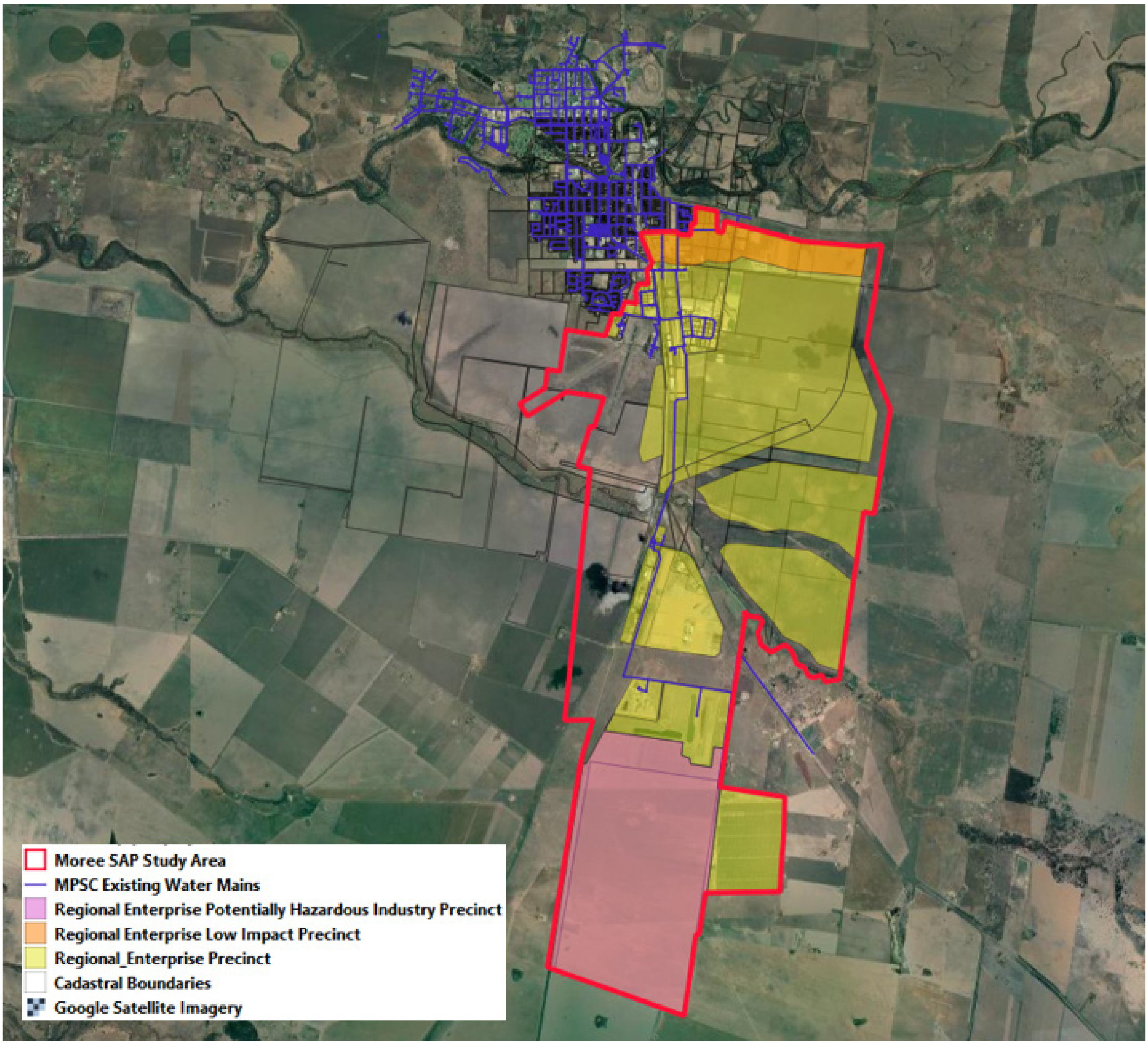


Figure 3.1 Final Structure Plan layout

Based on the final Structure Plan configuration, an estimate of the realistic extent of development within each precinct and land-use category within the 40-year planning horizon was developed by the master planning and economics study teams. These areas are summarised in Table 3.2 in terms of net developable area (i.e. excluding land required for roads and infrastructure) for each land-use category and, as an excerpt from the Economics study Draft Technical Report in Appendix A.

Table 3.2 Summary of final Structure Plan development areas and indicative uses

LAND-USE CATEGORY	NET AREA DEVELOPED IN 40 YEARS (HA)	INDICATIVE BUILDING FOOTPRINT AREA[1] (% OF NET AREA)	POTENTIAL DEVELOPMENT TYPES / DESCRIPTION (FROM BEST AVAILABLE INFORMATION)
Intermodal	30	30%	Rail sidings and marshalling yards; storage areas; transfer facilities; assembly and parking of vehicles; buildings for administration purposes; ancillary activities.
Freight & Logistics	20	30%	Warehouses; storage areas for goods; transfer facilities; parking and assembly; buildings for offices and administration; ancillary activities.
Horticulture / Native Horticulture	520	50%	Greenhouses; storage areas; processing facilities; buildings for administration purposes; hard stand areas; aquaculture ponds; intensive plant agriculture; ancillary activities.
Resource Recovery	60	17%	Intermodal facilities; resource recovery facilities; waste transfer stations; storage area; waste processing facilities; micro-factories (specific recycling products); industrial uses; refuse storage; waste to energy production; landfill.
Value Add Agriculture	80	18%	Intermodal facilities; industrial facilities; warehouses and production facilities; good transfer and storage.
Bio-Energy	30	17%	Intermodal Facilities; waste collection and storage; waste processing; energy production; storage and transfer.
Potentially Hazardous	25	8%	Chemical and fertilizer processing facilities development types as above for 'Bio-Energy' category.
Enterprise/Hub	10	40%	Offices; showrooms; service centres; warehouses; bulky goods retailing; recreation facilities; industrial retail outlets, rural supplies.
Solar	710	N/A	Solar farms; energy production facilities. Hydrogen generation via electrolysis.
TOTAL	**1,030**	**N/A**	

(1) The indicative building footprint area % figures have been approximated as single overall figures for each land-use category from the economics study final report, which in some cases adopts varying figures across the respective types of development within each category

3.4.2.3 DEMAND RATES

Demand rates for a range of potential land uses (the development of which is described in Section 3.2 and Section 3.3) and were tested with the study stakeholder group to refine assumptions and utilise best available information.

Although able to be significantly refined throughout the study, the land-use types considered remain quite broad, given the uncertainty about the exact nature of development that will occur. Even where a specific type of development is known, the resulting demand can vary significantly based on many development-specific factors.

The demand rates adopted for this assessment are summarised in Table 3.3,including key assumptions.

Table 3.3 Summary of adopted demand rates

LAND-USE CATEGORY	DEMAND RATE (ANNUAL)		ASSUMPTIONS / COMMENTS
	Minimum (ML/ha)	Maximum (ML/ha)	
Intermodal	3.0	3.0	Demand rate for light industry[1] (based on gross ha) adopted but only applied to the estimated building footprint area. This is due to large storage yard and hardstand areas are expected which will have zero demand. Demand is only expected for site offices and minor ancillary activities.
Freight & Logistics	3.0	3.0	Demand rate for light industry[1] (based on gross ha) adopted but only applied to the estimated building footprint area. The nature of this development is expected to be similar to 'intermodal.'
Horticulture/Native Horticulture	4.0	8.0	Cropped area taken as 50% of gross area, aligning with economics study, which assumes a significant portion of greenhouse horticulture. Maximum demand rate taken as upper end of typical broadscale agriculture irrigation rates, (noting this will vary significantly with proposed land-use and intensity/practices). Minimum demand rate assumes that 50% of area is greenhouse horticulture with efficient recirculating practices used and 50% broadscale. Although an opportunity, it is assumed that aquaponics would only be implemented at a limited scale.
Resource Recovery	3.0	3.0	Demand rate for light industry[1] (based on gross ha) adopted but only applied to the estimated building footprint area. The nature of this development is expected to be similar to 'intermodal.'
Value Add Agriculture	3.0	82.0	Minimum demand rate based on typical rates for flour mills[1] (the lowest water usage type of food processing, which is also similar to general light industry). Maximum demand rate weighted based on assumption of 20% cereals and 20% food oils (both water intensive), with 20% flour mills and 40% general light industry/warehouses (both lower demand). Demand rates have been applied to the building footprint area estimated in the economics study, which is based on comparable case-study businesses. This assumption aligns well with the existing building density in the Moree South industrial area.

LAND-USE CATEGORY	DEMAND RATE (ANNUAL)		ASSUMPTIONS / COMMENTS
	Minimum (ML/ha)	Maximum (ML/ha)	
Bio-Energy	3.0	15.0	Minimum demand rate for light industry adopted[1]. Maximum demand rate based on heavy industry[1]. Demand rates have been applied to the building footprint area estimated in the economics study.
Potentially Hazardous	3.0	15.0	Assumed as per 'Bio-Energy' category.
Enterprise/Hub	3.0	3.0	Assumed as per ‘Intermodal’ category.
Solar	N/A	N/A	Typically zero or near-zero water demand, hence zero area based demand applied. Although no area-based demand rate has been applied, the estimated demand for one hydrogen generation facility with 5,000 kg/day production capacity has been included (24 ML estimated annual water demand).

(1) Typical annual water demand rates estimated based on Section 64 Determinations of Equivalent Tenements Guidelines, NSW Water Directorate, 2017. Note built up hectares refers to the building floor area. This figure provides an order of magnitude indication only (and may be highly site specific).

3.4.2.4 WATER QUALITY REQUIREMENTS

The water balance developed for the study does not include a prescriptive breakdown of the required water quality in each area. That is, for a given area, it was not determined that it would definitively need say 70% potable water and 30% recycled water from the STP. Given the broad nature of the Structure Plan, which generally defines the categories of land use types but not specific planned developments, it is not feasible to develop a detailed breakdown in this regard. Instead, the water balance was developed to identify all potential water sources under the assumption that a range of different quality waters could be used within the SAP area. The study therefore considers the use of recycled water that is not treated to a potable water standard. The discussion on recycled water sources provides details on the levels of treatment and potential end uses possible for the different water sources.

3.4.3 WATER BALANCE

3.4.3.1 ASSESSMENT METHODOLOGY

A water balance assessment of supply vs. demand was undertaken for the final Structure Plan. This represents the situation at the end of the 40-year planning horizon (based on the demands descried in the previous section).

The available supply considered existing water sources within the SAP plus the additional volume of recycled water which would be available from the proportion of SAP development demands are ‘returned to sewer’ (as described in Section 3.1).

Supply (based on each source) has been compared to total demand for the SAP study area to quantify the deficit (i.e. the additional supply from new sources which is required to support the SAP development).

The scope of this water balance assessment has been deliberately limited to the SAP study area with considerations regarding external supply and demand having already been factored into the inputs and assumptions described in the previous sections.

3.4.3.2 WATER TREATMENT CONSIDERATIONS

The water balance assessment includes discussion on the varying quality of recycled water that can be produced within the SAP and some of the potential uses. The discussion includes consideration of the type of infrastructure, and potential costs associated with the infrastructure. The assumptions to form the basis of the infrastructure assessment are noted below, for each water source.

Note that the methodology for the assessment also does not assume that any one water source is “used up” as priority, but rather provides a discussion on the available recycled water sources and the potential volumes of those recycled water sources.

RECYCLED WASTEWATER

The assessment for recycled wastewater assumed plausible end uses for the water to be varying types of irrigation and grey water use (i.e. typical recycled water uses as described in the federal and state guidelines). It is assumed that the new STP to service the Moree SAP could be of a similar technology to the existing Moree STP, a secondary treatment plant with lagoon detention and chlorination prior to reuse, or a STP with a higher level of treatment such as a membrane bioreactor followed by chlorine and UV disinfection.

RECYCLED STORMWATER

The assessment to determine stormwater volumes has been undertaken by Arcadis for input into their final Flooding and Water Cycle Management Report (Withnall 2021). Modelling was undertaken by Arcadis using a MUSIC model to determine stormwater flows in the catchment using the Structure Plan as documented in Section 3.4.2.2. Stormwater flows were modelled to estimate the realistic volumes for capture and reuse. The assumptions and methodology for the modelling are captured in Arcadis’ final report. Arcadis’ modelling assumes stormwater will be treated on site; however, not to a potable water standard. It is assumed that recycled stormwater would be treated to the extent required on a site by site basis by the users.

TREATED GAB WATER

Although water sourced from the GAB Surat Groundwater Source is not a recycled water source per se, this report does consider the treatment requirements to utilise this water to a potable water standard. The treatment requirement for this water source will have to be determined through consultation of future users as it currently has a higher Total Dissolved Solids (TDS) within the typically acceptable range for potable water in Australia. Within the current report, the assessment has assumed that a higher level of treatment may be required to meet end user needs. To ascertain the volumetric flow available for this source, Aurecon has undertaken a modelling exercise to determine the sustainable yield of GAB water that could be drawn from the aquifer, which is used as a basis in the current assessment. Discussion of the treatment infrastructure required in this report is based on a total GAB water yield of up to 3,360 ML/a.

4 KEY FINDINGS

4.1 WATER SUPPLY ASSESSMENT

The available supply from existing and assumed new sources is summarised in Table 4.1 based on the methodology described in Section 3.1.

Table 4.1 Summary of available supply

SOURCE	AVAILABLE SUPPLY (ML/A)	COMMENTS
MPSC town potable water	500	Based on MPSC advice, considering remaining allocation and future planning/commitments.
MPSC existing town recycled wastewater	0	Advised by MPSC to be fully utilised, distant from the SAP area and requires further investigation to confirm actual water balance if to rely on for the Moree SAP.
MPSC new dedicated SAP recycled wastewater	52 – 276	Adopted/proposed new water source, consistent with SAP sustainability vision and other SAP technical studies. Water will not be treated to a potable water use standard, but rather applicable for irrigation and greywater uses.
Existing MPSC licenced GAB Surat Groundwater Source	40	Remaining MPSC allocation, which isn't currently used for at the Moree Artesian Aquatic Centre and consider treatment to required quality for uses within the SAP.
Potential GAB Surat Groundwater Source	3,360 – 3,900	Preliminary modelling indicates that the development of a new GAB Surat Groundwater Source borefield could provide significant volumes of raw water for use within the SAP subject to MPSC obtaining suitable WALs.
Recycled stormwater	290[1]	Identified potential source which is an opportunity for additional water supply within the SAP that would require on site treatment by users. Not likely to be a potable water source, but rather a fit for purpose recycle stream.

Notes

(1) Yield based on preliminary MUSIC modelling results by Arcadis (to be confirmed through last modelling results by Arcadis).

4.2 DEMAND ASSESSMENT

The estimated water demand for the SAP development is 1,200–3,400 ML/a. A breakdown the demand into each land-use category is shown in Figure 4.1 and a more detailed breakdown is provided in Appendix B.

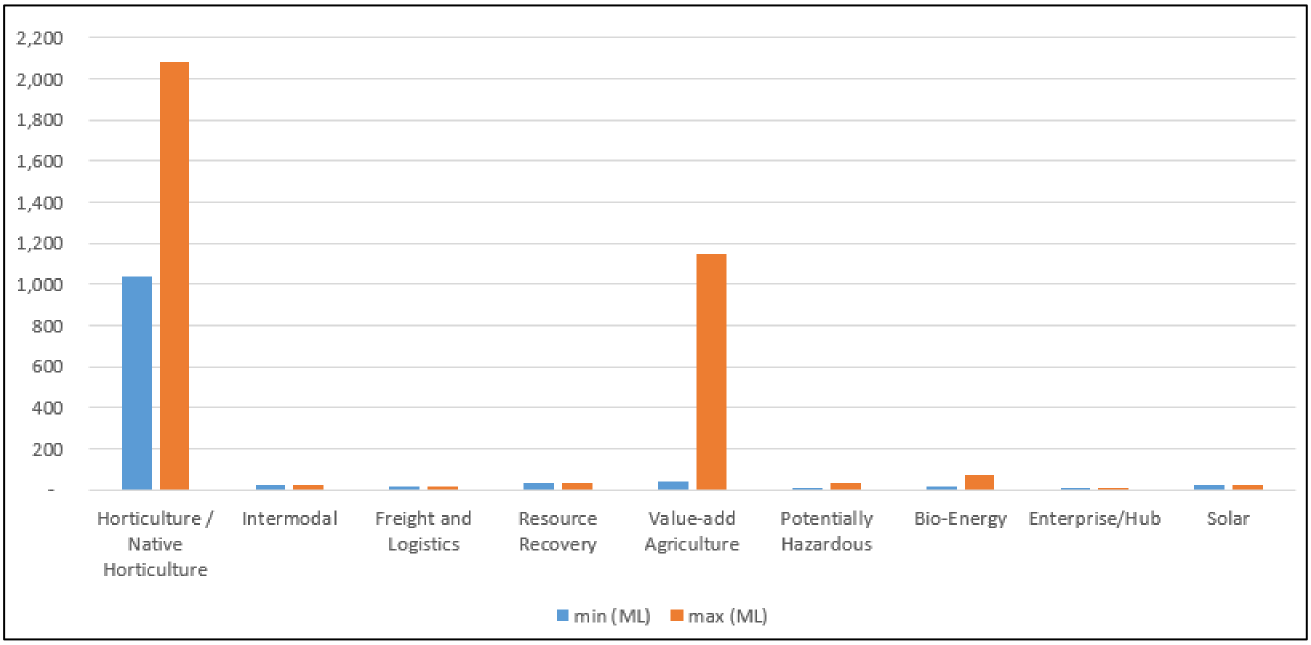


Figure 4.1 SAP development demand (annual)

As shown in Figure 4.1, the Horticulture/Native Horticulture and Value Add Agriculture land-uses make up most of the total demand, and most of the uncertainty (i.e. difference between the minimum and maximum demand figures).

4.3 WATER BALANCE ASSESSMENT

4.3.1 WATER SUPPLY VS. WATER DEMAND (EXISTING SOURCES)

The available supply is insufficient to meet the estimated demands (based on the estimated extent of development within the 40-year planning horizon). The deficit is approx. 600–2,600 ML/a, which would need to be provided from new sources.

The water balance outcomes are summarized in Figure 4.2 and Figure 4.3.

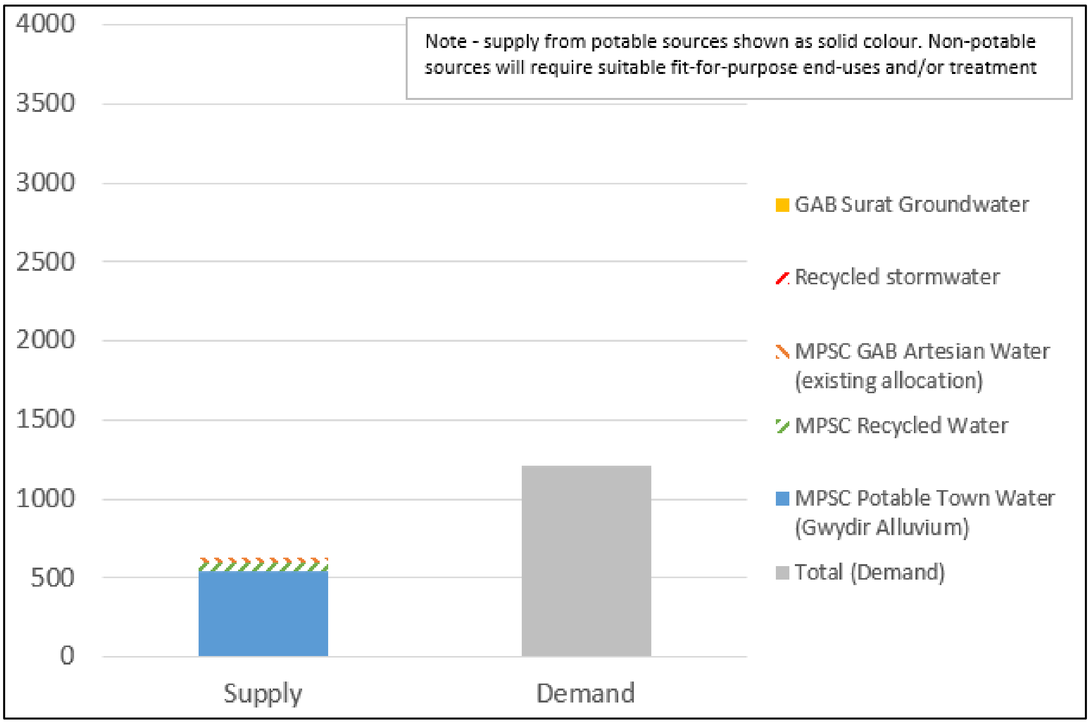


Figure 4.2 Water balance – minimum demand (annual)

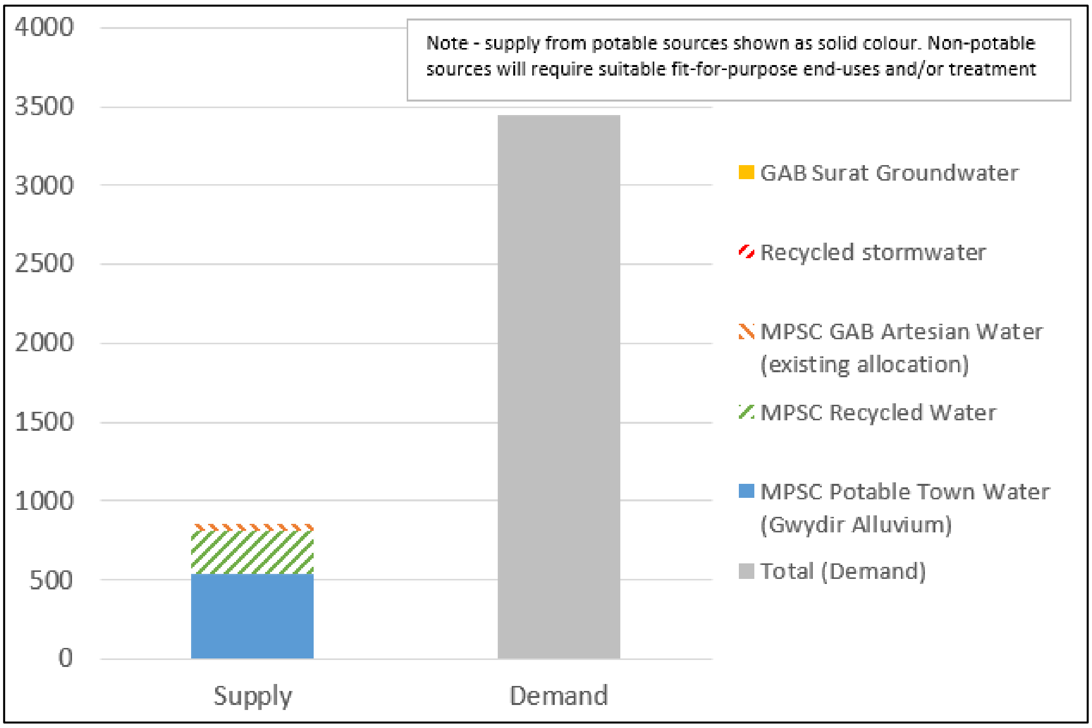


Figure 4.3 Water balance – maximum demand (annual)

4.3.2 WATER SUPPLY VS. WATER DEMAND (WITH POTENTIAL FUTURE SOURCES)

The water balance outcomes considering potential future sources are summarised in Figure 4.4 and Figure 4.5.

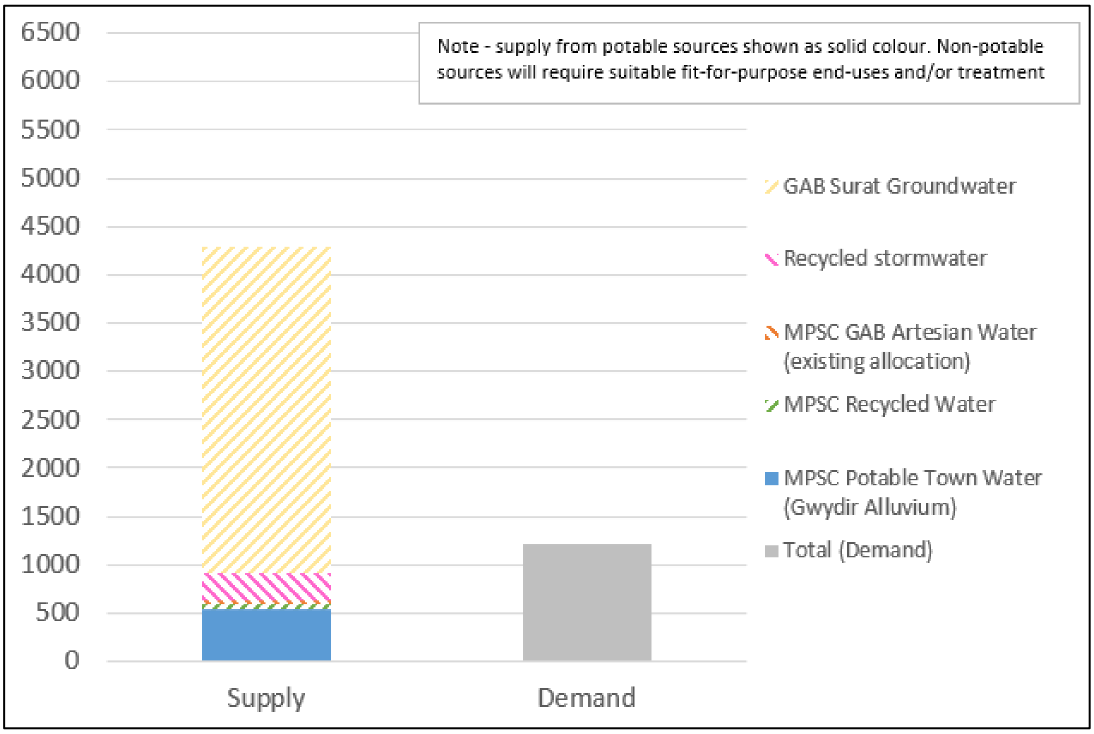


Figure 4.4 Water balance – minimum demand (annual)

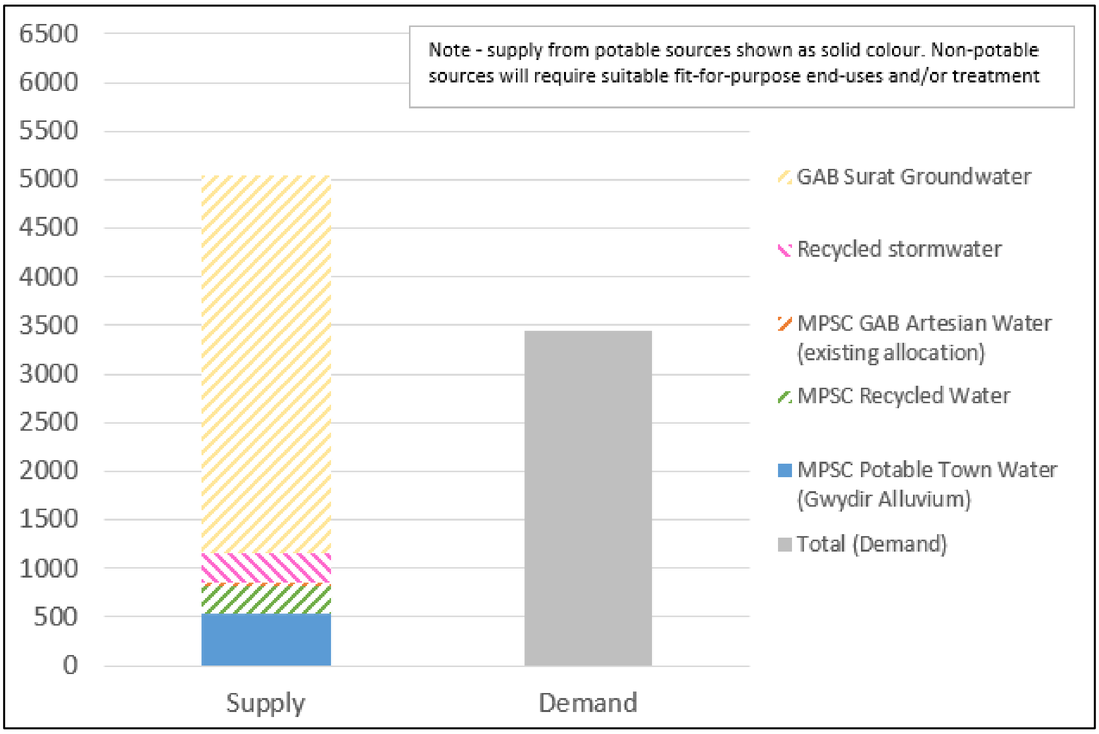


Figure 4.5 Water balance – maximum demand (annual)

4.3.3 TREATMENT CONSIDERATIONS FOR RECYCLED WATER AND ALTERNATIVE WATER SOURCES

4.3.3.1 RECYCLED WASTEWATER

The current assessment assumes that only wastewater generated in the Moree SAP will be recycled within the SAP (i.e. no recycled water volumes from the existing Moree STP will be accessible by SAP developments). Wastewater volumes generated within the SAP have been calculated to be between 70–368 ML/a which results in the production of 52–276 ML/a of recycled water. The calculations for recycled water volumes assume all wastewater at the plant is available for recycling, but that there are water loses up to 25% through the plant and network (assumption per Section 3.4.1.3).

POSSIBLE RECYCLED WATER USES BASED ON LEVEL OF TREATMENT

The current report includes consideration of the types of recycled water uses possible, based on the level of wastewater treatment implemented at the new Moree SAP STP. Since the demand assessment didn't have sufficient information to consider water quality requirements, the current assessment provides discussion on a range of water quality for the treated wastewater recycle system. Table 4.2 provides an indication of the types of uses possible for varying levels of treatment, as well as the performance criteria required at the treatment plant to validate the use of the recycled water stream for each proposed use. These uses and the plant performance objectives are informed by the federal and state water reuse guidelines. Compliance with these guidelines, including a site based recycled water risk assessment would need to be undertaken on a site by site basis to verify the allowable uses and manage risks related to the use of recycled water.

Table 4.2 Recycled water uses and performance criteria

TREATMENT PROCESS	ALLOWABLE USES	USAGE RESTRICTIONS / APPLICATION REQUIREMENTS	WATER QUALITY OBJECTIVE
Secondary Treatment w/ Lagoon Detention & Chlorination	Municipal uses (ovals, golf courses, etc.)	— no access after irrigation for 4 hrs — min 25–30 m buffer to nearest point of public access — spray drift control such as low-throw sprinklers or ideally subsurface irrigation	— BOD <20 mg/L — SS < 30 mg/L — E.coli <1000 cfu/100 mL
	Landscape irrigation (trees, shrubs, public gardens)	— microspray — drip irrigation — no public access	— BOD <20 mg/L — SS < 30 mg/L — E.coli <1000 cfu/100 mL
	Commercial food crops, for crops with limited or no ground contact or skins removed before consumption	— no access and use of drip or subsurface irrigation — no access during irrigation and if using spray irrigation and a 25–30 m buffer — spray drift control such as low-throw sprinklers)	— BOD <20 mg/L — SS < 30 mg/L — E.coli <100 cfu/100 mL

TREATMENT PROCESS	ALLOWABLE USES	USAGE RESTRICTIONS / APPLICATION REQUIREMENTS	WATER QUALITY OBJECTIVE
	Nonfood crops (trees, turf, woodlots, flowers)	— no access and drip irrigation — min 25–30 m buffer to nearest point of public access — spray drift control such as low-throw sprinklers	E.coli < 10,000 cfu/100mL
	Commercial food crops, cooked/processed before consumption (potatoes, beetroot), raised crops (i.e. apples, apricots, grapes)	— no access and use of drip or subsurface irrigation — no access during irrigation and if using spray irrigation and a 25–30 m buffer — spray drift control such as low-throw sprinklers	— BOD <20 mg/L — SS < 30 mg/L — E.coli <100 cfu/100 mL
MBR (with chlorine and UV disinfection)	Same Uses as for a process like the existing plant (per the above)	See above	See above.
	Commercial food crops consumed raw or unprocessed	— pathogen reduction between harvesting and sale (holding period)	— To be determined on a case by case basis depending on tech — Could include turbidity criteria for filtration, disinfectant Ct or dose (UV) — E.Coli <1 per 100 ml
	Dual reticulation, toilet flushing, washing machines	-	— To be determined on a case by case basis depending on technology used — Could include turbidity criteria for filtration, disinfectant Ct or dose (UV) — E.Coli <1 per 100 ml

INDICATIVE INFRASTRUCTURE REQUIREMENTS

To provide context for future planning of the Moree SAP, Table 4.3 presents the indicative costs for implementing STP's that in line with the types of uses summarised in Table 4.2. Indicative cost estimates are presented for a plant like the existing Moree STP (i.e. secondary treatment with lagoon detention and chlorination) and a plant with a higher level of treatment such as a membrane bioreactor (MBR) with UV and chlorine disinfection. Note that cost estimates are indicative only and should be not used for budget setting purposes. Estimates were produced at a high level based on an indicative treatment process and cost curves. The costs are indicative of contractor delivery costs and do not include allowances for client costs, contingencies, etc and have not been informed by any site-specific challenges or consideration of local market conditions.

Table 4.3 Indicative capital costs for Moree SAP STP

TYPE OF PLAN	MIN SIZE OF PLANT (ML/A)	MAX SIZE OF PLANT (ML/A)	RANGE OF PLANT COST ESTIMATES ($)
STP – Lower Level of Treatment (Secondary Treatment, Lagoon Detention & Chlorination)	52	276	$5M – $12M
STP – Higher Level of Treatment (MBR (with chlorine and UV disinfection)	52	276	$9M – $25M

4.3.3.2 RECYCLED STORMWATER

Treatment requirements for recycled stormwater have been considered at a cursory level in this report. There are several challenges and some limitations associated with treating stormwater flows which requires more detailed investigations. For the purpose of this final report, it has been assumed that any collection and use of stormwater flows would occur within lots. As there is less certainty regarding the quality of water that could be achieved after treatment and the potential uses for this water, a centralised stormwater recycle system has not been further considered at this time. That said, stormwater recycling does present another opportunity that should not be discounted. The following subsections provide some insight as to the challenges associated with treating stormwater to higher water quality standards as well as case study for an indirect-to-potable stormwater harvesting systems in Orange, NSW.

WATER QUALITY AND QUANTITY CONSIDERATIONS FOR PLANNING STORMWATER RECYCLING SYSTEMS

Developing a design to treat stormwater for potable drinking water purposes is not a straightforward task. The regulation and planning for a plant with this intended purpose are not clearly defined in Australia. The number of quality hazards present in these waters is unpredictable and quite variable, pending the development within which the water is captured. Apart from the potential risk to the environment and public health, mitigating drinking quality hazards is required to reduce operational risk. Water with high organic material for instance can block pipes and impact the water treatment process. While a stormwater harvesting system for potable uses is not impossible in Australia, it requires a substantial level of consultations (community, regulators, water customers, etc.); and planning, design and validation.

Treated stormwater could alternatively be used for non-potable uses such as irrigation. The issues with defining the raw water quality (and the level of treatment required) are still a risk in this scenario; however, less so than for potable water uses.

It is important to note that the MUSIC modelling has assumed significant losses of stormwater volumes by means of infiltration which has resulted in a relatively minor volume of water available for reuse. There is potential to optimise the system such to reduce the losses which may be considered through more detailed planning and concept design exercises.

LICENCING CONSIDERATIONS

In consultation with DPIE, it was determined that stormwater generated in the SAP would be considered overland flow water and would therefore be subject for licencing requirements under the *Water Management Act 2000* for capture, treatment and reuse within the SAP. The pathway for acquiring licensure will be investigated in the next infrastructure planning phase.

> ### ORANGE COUNCIL INDIRECT-TO-POTABLE STORMWATER RECYCLING SYSTEM
>
> Orange City Council have in recent years implemented an indirect-to-potable stormwater harvesting scheme; the first of its kind in Australia. Orange City Council started exploring the potential to implement the scheme after the Millennium drought. Orange City Council was motivated to identify a new reliable water supply. Orange City Council had explored several options including groundwater supplies; however, at the time most options were simply not feasible; therefore, Council was led to seriously consider stormwater harvesting.
>
> The stormwater harvesting scheme exists within the Ploughmans Creek and Blackmans Swamp Creek. Water collected in both the creeks is pre-treated and drained into several intermediary holding ponds before it is pumped into the City's main storage at Suma Park Dam. The locations were chosen due to the land availability, catchment size and reliability of flow. Planning and designing the scheme was particularly challenging given there were no other precedents within Australia. For instance, significant effort was applied to undertaking investigations to better understand the quality of the water and to consult with the public and regulators. The lack of the regulations for the harvesting and use of stormwater for potable uses surely did not make this process straightforward.
>
> There were several key factors that made this project feasible, including: the close proximity of the Creeks to Suma Park dam, and the availability of existing infrastructure such as the existing Icely Road Treatment Plant which provides reliable treatment. More details regarding the scheme are available on the Orange City Council website (https://www.orange.nsw.gov.au/water/stormwater/).

4.3.3.3 GAB WATER

The GAB Surat Groundwater is an alternative water source that can be considered beyond its current uses. GAB water has a high total dissolved solids (TDS) concentration (with levels around 600 mg/L) comparable with tradition surface water supplies. However, it can be used as drinking water with limited treatment, but that would be subject to the community's expectation regarding water aesthetics and taste. TDS consist of inorganic salts and organic matter dissolved in water, including but not limited to: sodium, potassium calcium, magnesium, chloride, sulfate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate, nitrite and phosphates. Water with a high TDS can be a source of scaling in pipes, fittings, and household appliances and may not have an appealing taste. Treatment should be considered, subject to the SAP community's expectations regarding water quality needs.

A higher level of treatment of GAB water, such as by means of reverse osmosis, would help with expanding the potential uses and community acceptance of the water; however, the reverse osmosis plants can expensive . In addition to infrastructure cost, discussed below, this may also have significant energy and carbon requirements/costs. The following discussion provides some insight into which considerations should be made with respect to planning for the treatment of GAB groundwater to either supplement potable water sources or offset current potable water use.

WATER QUALITY CONSIDERATIONS

The required level of treatment of water with a high TDS is determined based on the level of service expected by users. For water with TDS levels below 1000 mg/L, there is no strict standard for what level of treatment would be required. For instance, the ADWG's indicate that in major Australia cities, TDS values can range from below 100 mg/L to more than 750 mg/L while regional supplies can have values up to 1000 mg/L and remote communities may have levels even beyond 1000 mg/L.

The World Health Organisation (WHO) also provides commentary regarding TDS in water, but just in terms of its palatability as it is not considered a health risk in the lower range of concentrations. The latter indicates levels between 0–600 mg/L to be "good", levels between 600-900 mg/L to be "fair", levels between 900–1200 mg/L to be poor and levels beyond 1200 mg/L to be unacceptable. In other words the need for additional treatment of the GAB water will be highly dependent on community expectations but also the asset's owner's preference regarding lifecycle maintenance and replacement requirements.

HIGHER LEVEL OF TREATMENT – REVERSE OSMOSIS

If a higher level of treatment is required, due to the service levels expected by customers, treatment by means of reverse osmosis will be required. While the ADWG indicates most larger centres within the country accept a TDS between 100–750 mg/L in their drinking water, based on experience, most users' preferred range (with respect to taste and aesthetics) is between 300 and 450 mg/L. To treat the GAB water to this level, a reverse osmosis treatment steps would be required. Cost considerations for such a treatment process are provided in the section below. If using this type of treatment process, consideration to the initial temperature of the extracted GAB water (~44°C) would also be required. Since some process equipment, such as membranes would have glue that might be impacted under higher temperatures (i.e. above 30°C), water would likely have to be cooled prior to treatment.

BASELINE LEVEL OF TREATMENT – DISINFECTION BY CHLORINATION

If community acceptance of drinking water with a higher TDS is possible, the water source would like only require disinfection by means of a chlorination.

INFRASTRUCTURE REQUIREMENTS

HIGHER LEVEL OF TREATMENT – REVERSE OSMOSIS

A dedicated reverse-osmosis plant could be required to treat GAB water. The capital cost of installing reverse-osmosis package plants treating water with a higher TDS concentration in like to the GAB source generally runs in the order of $1 million per 1 ML/d (365 ML/a) of treated water, for plants sized up to about 5 ML/d (1,825 ML/a). The limitation with treating such water at a plant located in-land however (i.e. not nearby an ocean as is the case for many reverse-osmosis desalination plants), is that there are limited options for disposing of the brine. A reliable solution to this problem is to implement brine lagoons, which are large lagoons in which the brine is stored and dried. It should be noted that this solution requires additional land beyond just the footprint of the plant. The limitation with using the brine lagoons is that once the scale begins to increase, the amount of surface area required for drying increases as well. Land availability may not be a constraint in Moree; however, the cost of land as well as the factors related to maintaining the lagoons may present a limitation.

Currently, brine lagoons containing spent GAB water are recreationally used within Moree at the Moree Water Park as part of their EPA licencing requirements. Opportunities to expand the water park to meet infrastructure requirements and to manage waste brine streams from a future reverse-osmosis treatment plant could be explored.

BASELINE LEVEL OF TREATMENT – DISINFECTION BY CHLORINATION

If customers are accepting of a lower level of treatment, the preliminary assessment has indicated that potable would could be produced with only disinfection.

Chlorinating water supplies to achieve disinfection is very common, with thousands of installations across Australia. Typical sources of chlorine used for disinfection include chlorine gas (99.8% concentration), sodium hypochlorite (10–12% concentration) or onsite sodium hypochlorite generation (OSHG) (<0.8% concentration).

In addition to the chemical dosing facility, a process to achieve adequate mixing time (known as chlorine contact time) is required. This is commonly achieved by use of a chlorine contact tank or contact within a pipeline with appropriate instruments and flowmeters to validate the process is operated as intended.

Note that a disinfection system would still apply to the option of implementing a reverse osmosis plant; therefore, the option of only disinfecting reduces complexity of the proposed infrastructure and by consequent, the cost.

INDICATIVE COST OF INFRASTRUCTURE

Per the review of potential alternative water sources within this report, the use of GAB water was determined to be a feasible option to provide additional potable water within the Moree SAP. Based on the above assumption, a summary of the indicative plant costs is provided in Table 4.4. These costs are indicative only and based on WSP's experience with reverse osmosis treatment plants used for brackish water and sized between 1–5 ML/d. These are therefore very rough order of magnitude costs for the infrastructure that has not considered detailed water quality or site-specific information.

A summary of indicative costs is presented in Table 4.4. The costs presented do not include the cost of the brine lagoons, nor the cost of land to accommodate the brine lagoons. Note that the total sustainable water yield modelled to date is about 3,900 ML/a which is be beyond the range of a typical package treatment plant with a predictable cost. Therefore, future work should investigate the feasible scale (technical and economical) at which GAB water can be treated to a potable water standard in the Moree SAP.

Table 4.4 Indicative reverse osmosis plant costs

REVERSE OSMOSIS PLANT SIZE	PLANT UNIT COST ($/ML PER DAY)
1–5 ML/d (365–1825 ML/a)	$1.5 M
>5 ML/d (>1825 ML/a)	Scale is too great to predict the capital cost without a design

Another consideration to make in the implementation of a system to draw and treat GAB water are the additional cost of the bores as well as the network required to pump raw water to a centralised treatment plant. The modelling undertaken and published in the Hydrogeology Report for the Moree Special Activation Precinct (CMJA 2021) indicates that bores would have to be quite spaced out within the SAP to optimise yields and reduce inter-bore interference effects, as illustrated in Figure 4.6. Note the bores are displayed within the investigation area and not the final Structure Plan area.

In terms of capital cost for a chlorination system, an allowance of between $400–500k would be suitable for a chlorine gas or sodium hypochlorite (10–12%) installation treating up to 5 ML/d. This value excludes extensive civil or axillary works (such as chlorine contact tanks or connecting transfer pipelines).

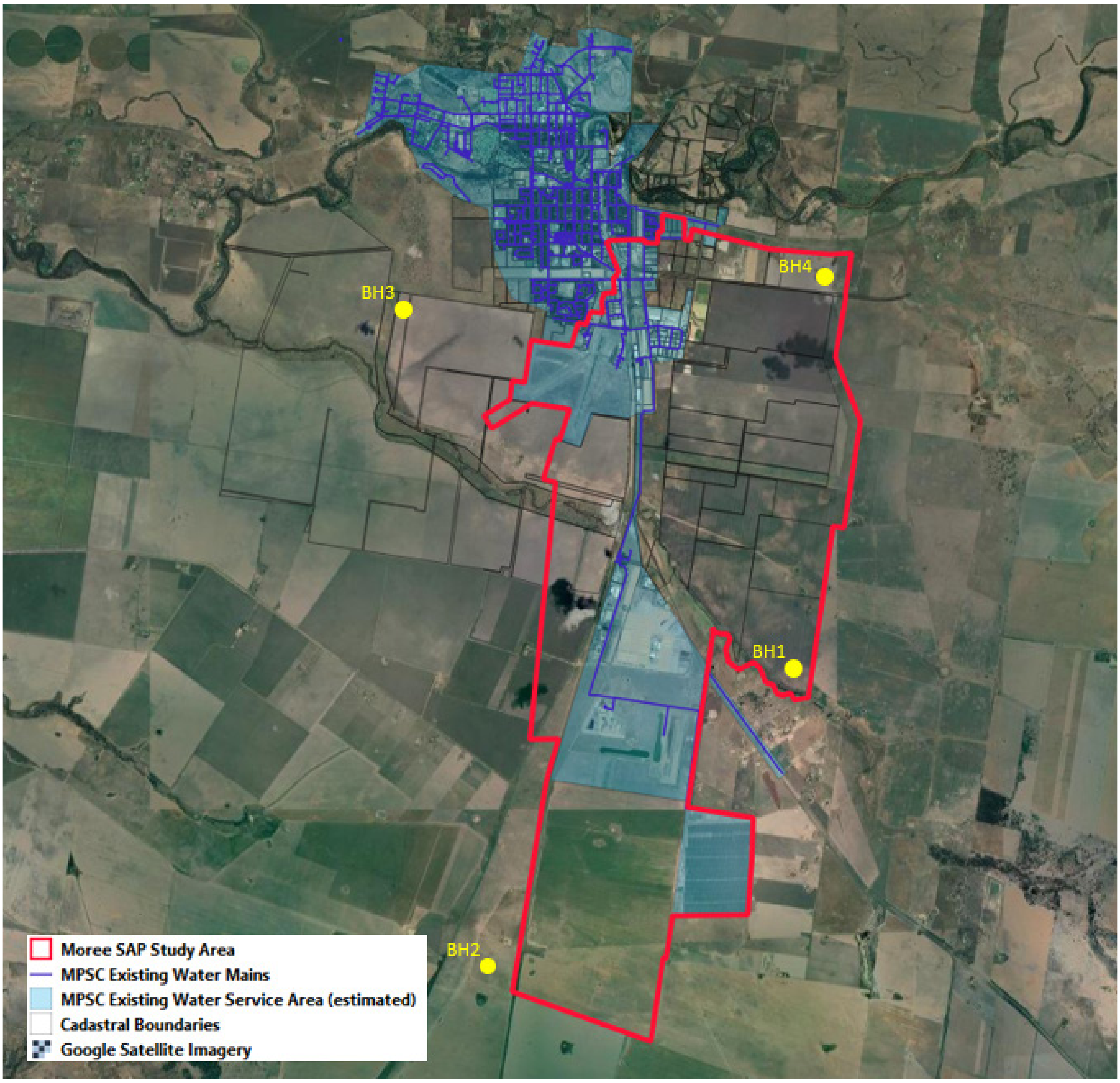


Figure 4.6 Locations of bores used in modelling sustainable water yields from the GAB

5 OUTCOMES OF WATER DEMAND ASSESSMENT

5.1 STRUCTURE PLAN BASED OUTCOMES

Based on the methodology and assumption detail in this report it is estimated that, for the proposed Structure Plan's 40 year outlook there is water demand of between 1,200 and 3,400 ML/a and the existing available water sources, combined with additional recycled effluent, are insufficient to meet this demand. However, with the additional supplies potentially available, from the GAB and stormwater harvesting in particular, there is likely sufficient water available.

As discussed in Section 2.1, the Stage 3 assessment has focused on the Lower Gwydir Alluvium, and GAB Surat groundwater sources as being considered the most reliable water supply options. The assessment undertook a review of all groundwater sources and the regulated and unregulated surface water sources of the Gwydir and Mehi Rivers. These water sources were considered less reliable under the current regulatory framework and existing conditions. These water sources should be reconsidered should changes in the regulatory framework occur or supply potential improve the reliability to supply the SAP.

Table 5.1 Summary of water demand assessment outcomes

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Moree Plains Shire Council (MPSC) town potable water	500	$ Existing water supply source with a baseline level of infrastructure in place.	High	Potable		Potential for securing and additional 250 ML/a extraction volume within the licence.
MPSC existing town recycled wastewater	0	N/a	Low No capacity is available in the current system.	N/a	N/a	N/a
New dedicated SAP recycled wastewater[1]	53 – 276	$$-$$$ Requires new STP; extent of expenditure will depend on level of treatment targeted, per discussion in Section 4.3.3.1.	High Reliable recycled water stream, once system is established. Effluent quality targets would be regulated by the NSW EPA to ensure water quality is consistently monitored/ enforced.	Not Potable	Potential for environmental and public health risks. Managing end users. Dependant on land uses within the SAP that have reasonable discharge to sewer needs.	Potential to identify small cluster of customers to minimise conveyance cost and energy.
Existing MPSC licenced GAB artesian groundwater	40	$	High	High TDS. May be potable subject to expectations regarding water aesthetics and/or appropriate treatment.	Increase abstraction from existing bores would be subject to licence impact conditions.	Potential to access this without significant upfront capital costs.

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Potential GAB Surat Groundwater Source[2]	3,360 – 3,900	$$$	High Preliminary modelling suggests sustainable water yields are achievable.	High TDS. May be potable subject to expectations regarding water aesthetics and/or appropriate treatment.	Post drilling testing result in less favourable water yields due to impacts.	Water may be treated to potable standard if required.
Water trading LGA (Water allocation assignment/share assignment)	0 – > 2,000	$$ – $$$	Medium Long term reliability dependant on groundwater availability through licence holder's desire to sell to market.	Very Good	Trades subject to assessment and approval to ensure minimal impact considerations are met. Water availability limited to spatial and physical constraints. Price of water may not be economical for end use.	Additional water can be obtained on a temporary basis through water allocation assignment trading. Additional water can be obtained on a permanent basis through share assignment trade.

WATER SOURCE	VOLUME (ML/A)	RELATIVE COST ($-$$$$)	LONG TERM RELIABILITY	WATER QUALITY	RISKS	OPPORTUNITIES
Recycled stormwater[3]	290	$$$$	Medium MUSIC modelling suggests the quantity of water is relatively sustainable, as it was based on 25 years worth of rainfall data; however, reliability of treatment systems is difficult to predict without existing data on raw water quality.	Not Potable Requires fit for purpose uses within the site.	Requires significant structures (tanks) which may present cost risks. Not reliably meeting water quality targets due to the variability of quality in the raw water. Low overall quantity of water available. Likely presents a high cost of infrastructure with a limited return in benefit. Rainfall patterns may change in future.	Given the disbursed nature of collection locations, may be best suited to decentralised use rather than a centralise collection, treatment and distribution scheme.

(1) Dependent upon land uses generating sewer and subject to staging needs

(2) Based on modelling undertaken by Aurecon and subject to field verification

(3) Based on modelling undertaken by Arcadis

5.2 STAGING OUTCOMES

The long-term outcomes are focused on the long term (40 year) Structure Plan. However, there are several issues that will need to be considered as the site develops and water demand needs are realised.

- It would be prudent to maximise the use of available existing water sources (e.g. MPSC town potable water) prior to investing in new schemes. This approach will also enable development almost immediately.
- As the business case is established and delivery phase rolls out the actual water demand will become more apparent and the need for new water sources affirmed. Whilst there are multiple new sources available, there will need to be consideration to the financial and operational realities of constructing and operating multiple water supply sources and schemes.
- As part of the continued investigation into the sustainable quantity of water from the GAB, it is anticipated that two test bores will need to be drilled for the purpose of monitoring as part of the validation process. This will result in a logical staging opportunity. Distribution and treatment infrastructure to utilise these bores will be subject to the location and specific requirements of the end-use developments.
- It is unlikely that a wastewater/recycled treatment plant would be feasible in the first instance. Not only would this be expensive but would have limited inflow to maintain the treatment processes. Therefore, further consideration around the timing of this as a water supply source will be required. Alternatively, load from the existing sewage system could be diverted to a new treatment plant in the early stages to facilitate the supply or recycled water. Similarly, stormwater runoff will only be realised as development occurs (and impervious area increases). Therefore, stormwater may not be available in the initial stages.
- The distribution infrastructure associated with alternate water supplies such as recycled effluent and stormwater harvesting may need to be delivered in stages. It may be most efficient to limit the use of these supplies to a small number of large uses to minimise the extent of distribution infrastructure and minimise operational management risk.

6 OPPORTUNITIES AND CONSTRAINTS

Based on the water supply and demand assessment in the previous sections, the following key opportunities are noted:

- Refine the assumptions regarding the SAP development to reduce uncertainly in the business case. In particular, key assumptions regarding Horticulture/Native Horticulture and Value-Add Agriculture land-uses should be developed as best possible, as these have by far the largest impact on total water demand and the uncertainly of the estimates. Further, the Master Plan could consider mechanisms to monitor and manage development water demand within these land-use categories within a framework designed to suit the integrated water cycle planning objectives.
- Solar generation has minimal water demand (constrained by available land, rather than water). There is opportunity to expand the area of this land-use (if desired) or prioritise this type of development without significantly impacting the water balance.
- The scale of hydrogen generation assumed (i.e. 5,000 kg/day generation based on research in the economics study) does not require a substantial volume of water (approx. 24 ML/a) and is a valid opportunity for the SAP Master Plan.
- Alternative water sources are potentially of suitable quality to meet demands for horticulture / value-add agriculture land uses, which make up a large proportion of the total estimated demand. These sources could be privately sourced raw groundwater (Lower Gwydir Alluvium, providing water access licences can be obtained by the development) or recycled wastewater or stormwater.
- Fully utilise available supply of recycled wastewater, which is a reliable and climate independent water source, enhancing overall water security. To the extent practical, improve the efficiency of the Moree STP and recycled water system to reduce losses and maximize available water (even if a new STP were built dedicated to the SAP, this may be worthwhile in order to substitute potable water demand within Moree, outside of the SAP).
- Investigate in more detail options for providing additional wastewater treatment capacity for the whole of the existing and future growth within the existing built-up area in Moree and the future Moree SAP. Options to include at minimum building a) a new STP dedicated to the SAP with 100% (or close to 100%) of treated effluent volume made available as recycled water within the SAP and b) expanding the existing Moree STP with 100% (or close to 100%) of treated effluent volume being recycled between existing recycled water users and new recycled water users in the SAP. While the existing study assumed the implementation of a new STP dedicated to the Moree SAP to reduce linear infrastructure requirements, a more detailed assessment of the options can be undertaken.
- MPSC pursues additional water efficiency measures, policy changes and/or technology/asset upgrades to reduce baseline water demand, making more water available for the SAP development.
- MPSC to pursue water utility licence for the GAB Surat Groundwater Source to provide raw water supply.
- Develop a GAB Surat Groundwater Source (with suitable treatment, if required) to support the SAP development. This includes validating required levels of treatment required by end users to inform the level of treatment required.
- Investigate the potential for a stormwater harvesting scheme if recycled water use volumes for existing and future users can be confirmed. If high demand for recycled water use cannot be validated, the implementation of such a system may create an oversupply.
- Development of the SAP business case should be aligned with MPSC’s updated IWCM strategy to realise efficiencies and develop a consistent vision. The IWCM objectives and technical content align closely with key items of the SAP study – and is an appropriate mechanism to address a number of the opportunities identified above. The IWCM strategy development is currently in progress and will be finalised by March 2023 including an initial draft which is released for public comment.

- Alluvial aquifer systems within the Murray-Darling basin have been identified in high level studies as being potentially suitable for managed aquifer recharge (MAR). MAR has the potential to act as a storage mechanism for 'banking' excess water during wetter periods for recovery during drier months. The effectiveness of MAR is highly dependent on local scale conditions and requires site-specific investigations to determine the feasibility and effectiveness at a given location. MAR may be a future opportunity for additional water supply should future studies confirm the suitability of the Lower Gwydir Alluvium, and change in regulatory framework support MAR based licensing. Further detailed studies are required to validate this opportunity.
- Additional water supply could be obtained through water trading within the Lower Gwydir Alluvium however variability of price and availability limits the viability in considering water trading as a long term water supply.

The following key constraints are also noted:

- The final Structure Plan adopted for this assessment is high-level in nature and results in a significant range of uncertainty in the water demands presented in this report.
- There is limited MPSC potable town water allocation available to supply the SAP development.
- Historical high water-use, absence of restrictions and pricing structure are all barriers to improving water efficiency for the MPSC potable town water system.
- There is limited available/unused volume of recycled water from Moree STP.
- Water quality requirements for many land-uses may prevent or restrict the use of recycled wastewater, stormwater or raw/untreated GAB Surat Groundwater Source (or only allow a limited portion of the total demand to be met with these sources).
- Additional testing and modelling required to demonstrate recoverable water supply sourced from the GAB Surat Groundwater Source.
- GAB water can be utilised as an additional potable water source; however, the actual sustainable water yields from this source and the required level of treatment requires further investigation. Specifically, the key actions include::
  - validating the capability for extracting the water must be verified both from an infrastructure standpoint, but also licencing
  - confirming the raw water quality and determining the level of treatment required based on customer needs. This will determine whether a higher level of treatment (i.e. reverse osmosis) is required or if a lower level of treatment (i.e. chlorination) will meet customer needs.
- Additional water extraction from surface (overland flow stormwater) and groundwater sources exceeding WAL limits and licence conditions may cause a breach of the Basin Plan SDL resulting in compliance action that impact on other licence holders.

7 RECOMMENDATIONS

The following recommendations have been identified based on the opportunities and constraints identified in this report. These recommendations have been made to progress the water supply and demand assessment for the Moree SAP and support the robust Master Plan, and Delivery Plan. While the work relating to developing detailed water servicing plans is likely to include a long list of “next steps”, the following provides the key findings and short-term areas of focus to further develop a sustainable and achievable water servicing system for the Moree SAP.

- **Maximise Use of Existing Water Supplies:** The use of existing water supplies provides an economically sustainable method of servicing the SAP area as there is a baseline amount of infrastructure in place which therefore doesn’t incur the same “start-up” cost as is required with establishing new water sources. It is therefore recommended that the SAP maximise the use of existing water supplies prior to investing in new supplies and enabling infrastructure. The same logic, to maximise existing water supplies, also applies to future systems once they are established. While this report identifies several options for additional water supplies, their implementation must be considered holistically. That is, consideration must be given to what types of developments would use varying sources to determine the ones that warrant investment. Investigation of recycled water sources uptake is particularly important in this regard.
- **Integrate Findings into the IWCM Plan:** To allow for flexibility in planning water systems using varying water sources, it is recommended that the findings of the current study are incorporated into the MPSC Integrated Water Cycle Management Plan.
- **Further Investigate Feasibility of Existing and New Water Sources:** To further validate the use of the water sources identified as opportunities in the current report, it is recommended that the following activities are undertaken in the short term:
  - ***Initiate Discussions Regarding Licencing:*** While the report identifies possible water volumes that could be accessed from existing aquifers, the ability to draw the water is predicated on acquiring the relevant water taking licences. It is recommended that discussions are initiated by DPIE and MPSC to progress discussion and seek confirmation of requirements to obtain WAL for the GAB Surat Groundwater Source and Gwydir Regulated and Unregulated river water for harvest stormwater.
  - ***Undertake Field Investigations:*** To validate the sustainable yields of GAB Surat water, it is recommended that DPIE and the SAP development authority should work with MPSC to obtain necessary approvals to drill a groundwater production bores and undertake pump tests. Analysis from testing this bore will assist in determination of potential yield and quantification of drawdown impact on sensitive receptors. While the current has developed preliminary modelling results with potential volumes, these figures will have to be validated through additional work in the field and additional modelling.
- **SAP Water Demand allocation tracking:** Consider developing a water demand tracking tool to monitor water allocation and use. This will enable the new water sources to be planned and delivered based on actual demand triggers, if and when required.

8 CONCLUSIONS

The findings from the Water Demand Assessment aimed to address multiple objectives. Table 8.1 presents a summary of these objectives as outlined at the beginning of the current report and how and where these were addressed within the document. The work provides a foundation on which to base the completion of the Moree SAP Master Plan and Delivery Plan.

Table 8.1 Summary of how the water demand assessment objectives were achieved

WATER DEMAND ASSESSMENT OBJECTIVE	HOW THE OBJECTIVE WAS MET
To assess potential water supply options (and their constraints) for the SAP from the managed water sources of the NSW Great Artesian Basin, Gwydir Alluvium and the Mehi River.	— The regulatory context for implementing additional or new water supplies (Section 2) was documented. — An assessment of the feasibility for introducing a new water supply, including a discussion on the infrastructure requirements for enabling the use of these water sources (Section 4.3.3) was also documented.
To develop an understanding of existing demand, including the types of demand, seasonal and climatic variability and any known/planned future changes.	— Water demands were calculated, per the inputs developed and refined across the broader Master Planning team during the study (Section 4.2). — Water supply volumes for alternate water sources were determined with consideration of climatic changes and hydrogeological constraints (Section 3.4.1.4, 3.4.1.5).
To understand the increased water demand potential as a result of further development in the SAP.	
To identify opportunities to utilise existing sources further and develop new sources to support the SAP vision.	— The report provides a spectrum of potential water sources that were explored based on the feasibility to implement and cost considerations (Section 4.3.3). — The potential use of recycled and alternate water sources was explored (Section 4.3.3.1 & Section 4.3.3.2 & Section 4.3.3.3) and discussed based on risk, reliability, cost and staging (Section 5.1 and 5.2). — Additional work related to validating the use of the water sources is still required; however, the report provides a starting point for this future work, with considerations of the opportunity and constraints (Section 6).
Identify potential opportunities and areas of constraint for the SAP Master Plan to meet its anticipated water demand including barriers relating to identified opportunities (i.e. water quality, reliability, cost and policy factors).	— The report provides a succinct account of all opportunities and constraints related to providing water services to the Moree SAP (Section 6).

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APPENDIX A

STRUCTURE PLAN AND ECONOMICS STUDY INPUTS

EXCERPT OF DATA FROM CIE DRAFT TECHNICAL REPORT TABLE 7.3 (DATED 21 JANUARY 2021)

	LAND TAKE	EMPLOYMENT	
	ha	persons	FTE's
Building on water and land availability			
Aquaculture	5	400	300
Outdoor horticulture	150	180	81
Undercover horticulture			
— Medicinal marijuana stage 1	40	90	80
— Medicinal marijuana stage 2	-	70	60
— Medicinal marijuana additional small	80	288	103
— Medicinal marijuana additional large	40	600	450
— Glasshouse/aquaponics stage 1	40	333	250
— Glasshouse/aquaponics stage 2	0	333	250
— Glasshouse/aquaponics additional	80	667	500
— Poly tunnels (berries and vegetables)	45	480	300
Building on grain/cotton advantage			
Increasing value from the supply chain			
— Grain storage, sorting and handling	25	50	50
Early stage processing			
— Flour/chickpea milling/canning	10	20	20
— Oil crushing plant	5	10	10
— Plant proteins	10	60	48
Grain ethanol	30	30	24
Reducing reliance on imported inputs			
Diesel replacement (methanol) — Gas to liquids	0	0	0
Chemicals manufacture — mixing of reactive ingredients	15	15	15
Fertiliser mixing— Urea Ammonium Nitrate	10	10	10
Building on location			
Intermodal terminal (public access)	30	15	10
Freight and logistics	20	10	10
Abattoir	0	0	0
Circular economy			
Resource recovery (tyres and plastics)	60	20	20
Waste to energy — Biogas	30	10	10
Solar electricity	700	4	4
Hydrogen production	10	4	4

APPENDIX B

DEMAND AND WATER BALANCE CALCULATIONS

FINAL SCENARIO - Water demand estimate (based on high-level land uses inputs from final economics study)

Land Use	Net Ha	Building footprint area (% of Net area)	Area demand rate applied to	Water demand rate (annual) min (ML/ha)	Water demand rate (annual) max (ML/ha)	Water demand (annual) min (ML)	Water demand (annual) max (ML)	Assumptions/comments
Horticulture / Native Horticulture	520.00	50%	260	4	8	1,040	2,080	Net ha area and % building footprint adopted from final CIE Report figures. Maximum demand rate taken as upper end of typical broadscale ag. irrigation rates, (noting this will vary significantly with proposed land-use and intesity/practices). Minimum demand rate assumes 50% propoprtion of area is greenhouse horticulture with efficient recirculating practices used and 50% broadscale. Although an opportunity, it is asssumed that aquaponics would only implemented at a limited scale (i.e. a minor overall % which doesnt imnpact the overall demand rates)
Intermodal	30.00	30%	9	3	3	27	27	Net ha area and % building footprint adopted from final CIE Report figures. Possible land-uses include: rail sidings and marshalling yards; storage areas; transfer facilities; assembly and parking of vehicles; buildings for administration purposes; ancillary activities. Demand rate for light industry (typically based on gross ha) adopted, however applied to the building footprint area only - which is considered more applicable for this purpose
Freight and Logistics	20.00	30%	6	3	3	18	18	Net ha area and % building footprint adopted from final CIE Report figures. Possible land-uses include: warehouses; storage areas for goods; transfer facilities; parking and assembly; buildings for offices and administration; ancillary activities. Demand rate for light industry (typically based on gross ha) adopted, however applied to the building footprint area only - which is considered more applicable for this purpose
Resource Recovery	60.00	16.6%	10	3	3	30	30	Net ha area and % building footprint adopted from final CIE Report figures. Possible land-uses include: intermodal facilities; resource recovery facilities; waste transfer stations; storage area; waste processing facilities; micro-factories (specific recycling products); industrial uses; refuse storage; waste to energy production; landfill. Demand rate for light industry (typically based on gross ha) adopted, however applied to the building footprint area only - which is considered more applicable for this purpose
Value-add Agriculture	80.00	17.5%	14	3	82	42	1,148	Net ha area and % building footprint adopted from final CIE Report figures. The building footprint % is similar to existing South Moree industrial area density. Minimum demand rate based on typical rates for flour mills (the lowest water usage type of food processing and similar to general light industry), maximum demand rate weighted based on assumtion of 20% cereals and 20% food oils (both water intensive), with 20% flour mills and 40% general light industry/warehouses (both lower demand).
Potentially Hazardous	25.00	8%	2	3	15	6	30	Net ha area and % building footprint adopted from final CIE Report figures. Possible land-uses: chemical and fertilizer manufacturing. Minimum demand rate for light industry (based on gross ha) adopted. Maximum demand rate based on 100% heavy industry adopted. Demand rates (typically based on gross ha) applied to the building footprint area only - which is considered more applicable for this purpose
Bio-Energy	30.00	16.6%	5	3	15	15	75	Net ha area and % building footprint adopted from final CIE Report figures. Possible land-uses include: resource recovery facilities; waste processing facilities; waste to energy production. Minimum demand rate for light industry (based on gross ha) adopted. Maximum demand rate based on 100% heavy industry adopted. Demand rates (typically based on gross ha) applied to the building footprint area only - which is considered more applicable for this purpose
Enterprise/Hub	10.0	40%	4	3	3	12	12	Net ha area and % building footprint adopted from final CIE Report figures. Possible land uses include: offices; showrooms; service centres; warehouses; bulky goods retailing; recreation facilities; industrial retail outlets, rural supplies; etc. Demand rate for light industry (typically based on gross ha) adopted, however applied to the building footprint area only - which is considered more applicable for this purpose
Solar	710.0	0%	0	-	-	24	24	Solar farms; energy production facilities. Typically zero or near-zero water demand, hence zero area based demand applied Assumed to have one hydrogen generation facility - capacity and operational assumptions adopted from Final CIE Report (based on 14L water consumption per kg hydrogen produced, which is potenially conservtive but reasonable)
TOTAL	*1485*		310		132	1,213	3,443	Note - highlighted cells are for input into the Water Balance Spreadsheet

MOREE SAP WATER DEMAND ANALYSIS - FINAL MASTERPLAN SCENARIO (EXISTING SOURCES ONLY) 23-02-21

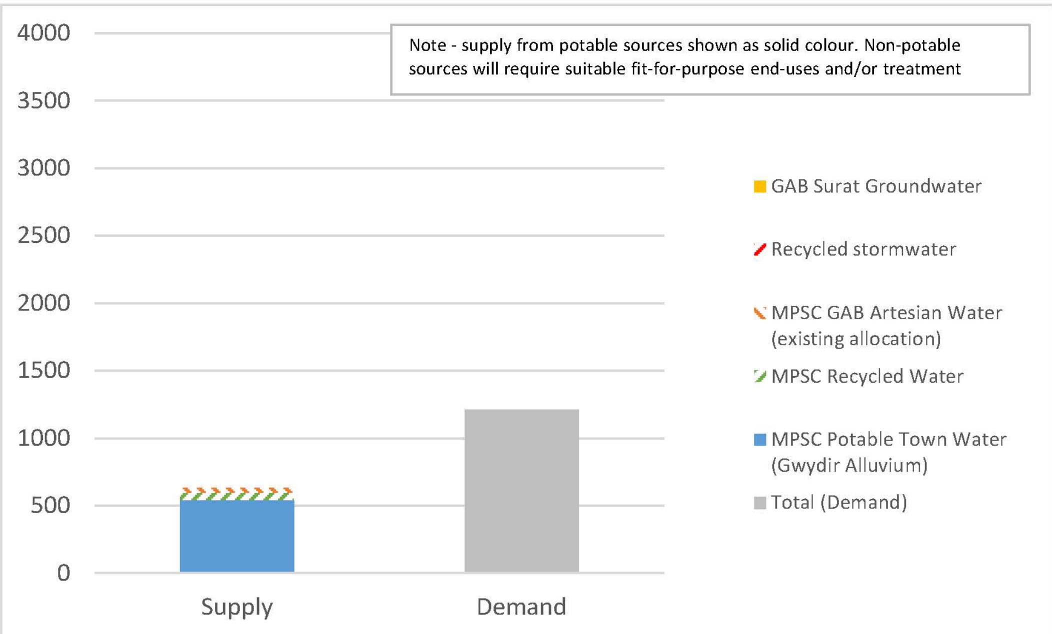
Minimum SAP Development Demand (i.e. of range considered in demand estimate)

	Supply		Notes
MPSC Potable Town Water (Gwydir Alluvium)	540	ML/year	500ML additional available supply advised by MPSC + 40ML estimated current demand within SAP area
MPSC Recycled Water	53	ML/year	Manually input from Demand Estimate Spreadsheet
MPSC GAB Artesian Water (existing allocation)	40	ML/year	Available remaining component of MPSC allocation (620ML allocation - 580ML current demand)
GAB Surat Groundwater	0	ML/year	Zero current supply - can be increased/source developed to meet deficit
Recycled stormwater	0	ML/year	Zero current supply - can be increased/source developed to meet deficit
Total (supply)	633	ML/year	
Demand			
Total (Demand)	1213	ML/year	Manually input from Demand Estimate Spreadsheet
Surplus/Deficit			
Existing Supply minus Total Demand	-580	ML/year	i.e. required additional supply to support masterplan scenario

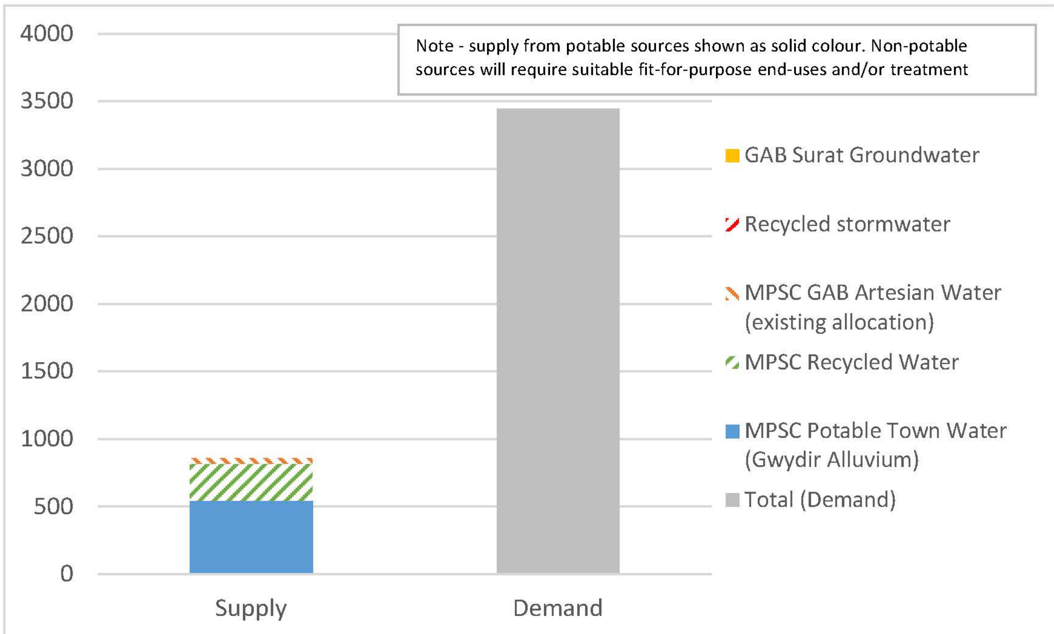
Maximum SAP Development Demand (i.e. of range considered in demand estimate)

	Supply		Notes
MPSC Potable Town Water (Gwydir Alluvium)	540	ML/year	500ML additional available supply advised by MPSC + 40ML estimated current demand within SAP area
MPSC Recycled Water	276	ML/year	Manually input from Demand Estimate Spreadsheet
MPSC GAB Artesian Water (existing allocation)	40	ML/year	Available remaining component of MPSC allocation (620ML allocation - 580ML current demand)
GAB Surat Groundwater	0	ML/year	Zero current supply - can be increased/source developed to meet deficit
Recycled stormwater	0	ML/year	Zero current supply - can be increased/source developed to meet deficit
Total (supply)	856	ML/year	
Demand			
Total (Demand)	3443	ML/year	Manually input from Demand Estimate Spreadsheet
Surplus/Deficit			
Existing Supply minus Total Demand	-2587	ML/year	i.e. required additional supply to support masterplan scenario

WATER BALANCE - MINIMUM DEMAND (ML/year)



WATER BALANCE - MAXIMUM DEMAND (ML/year)



MOREE SAP WATER DEMAND ANALYSIS - FINAL MASTERPLAN SCENARIO (POTENTIAL FUTURE SOURCES INCLUDED) **23-02-21**

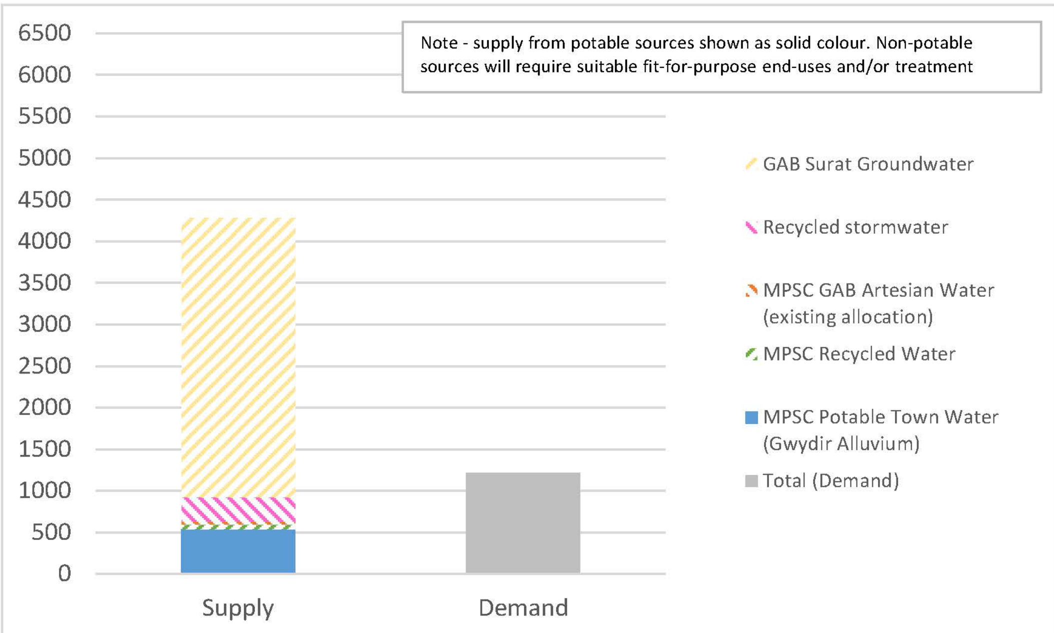
Minimum SAP Development Demand (i.e. of range considered in demand estimate)

	Supply		Notes
MPSC Potable Town Water (Gwydir Alluvium)	540	ML/year	500ML additional available supply advised by MPSC + 40ML estimated current demand within SAP area
MPSC Recycled Water	53	ML/year	Manually input from Demand Estimate Spreadsheet
MPSC GAB Artesian Water (existing allocation)	40	ML/year	Available remaining component of MPSC allocation (620ML allocation - 580ML current demand)
GAB Surat Groundwater	3360	ML/year	Zero current supply - can be increased/source developed to meet deficit
Recycled stormwater	290	ML/year	Zero current supply - can be increased/source developed to meet deficit
Total (supply)	4283	ML/year	
Demand			
Total (Demand)	1213	ML/year	Manually input from Demand Estimate Spreadsheet
Surplus/Deficit			
Existing Supply minus Total Demand	3070	ML/year	i.e. required additional supply to support masterplan scenario

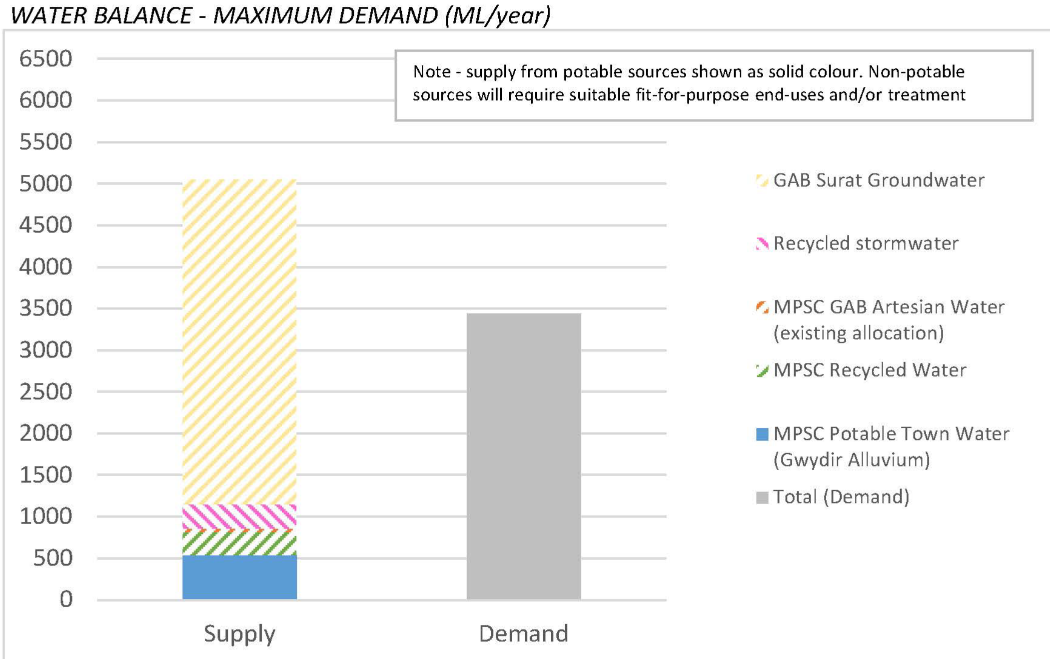
Maximum SAP Development Demand (i.e. of range considered in demand estimate)

	Supply		Notes
MPSC Potable Town Water (Gwydir Alluvium)	540	ML/year	500ML additional available supply advised by MPSC + 40ML estimated current demand within SAP area
MPSC Recycled Water	276	ML/year	Manually input from Demand Estimate Spreadsheet
MPSC GAB Artesian Water (existing allocation)	40	ML/year	Available remaining component of MPSC allocation (620ML allocation - 580ML current demand)
GAB Surat Groundwater	3900	ML/year	Zero current supply - can be increased/source developed to meet deficit
Recycled stormwater	290	ML/year	Zero current supply - can be increased/source developed to meet deficit
Total (supply)	5046	ML/year	
Demand			
Total (Demand)	3443	ML/year	Manually input from Demand Estimate Spreadsheet
Surplus/Deficit			
Existing Supply minus Total Demand	1603	ML/year	i.e. required additional supply to support masterplan scenario

WATER BALANCE - MINIMUM DEMAND (ML/year)



WATER BALANCE - MAXIMUM DEMAND (ML/year)



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