Making Water Work

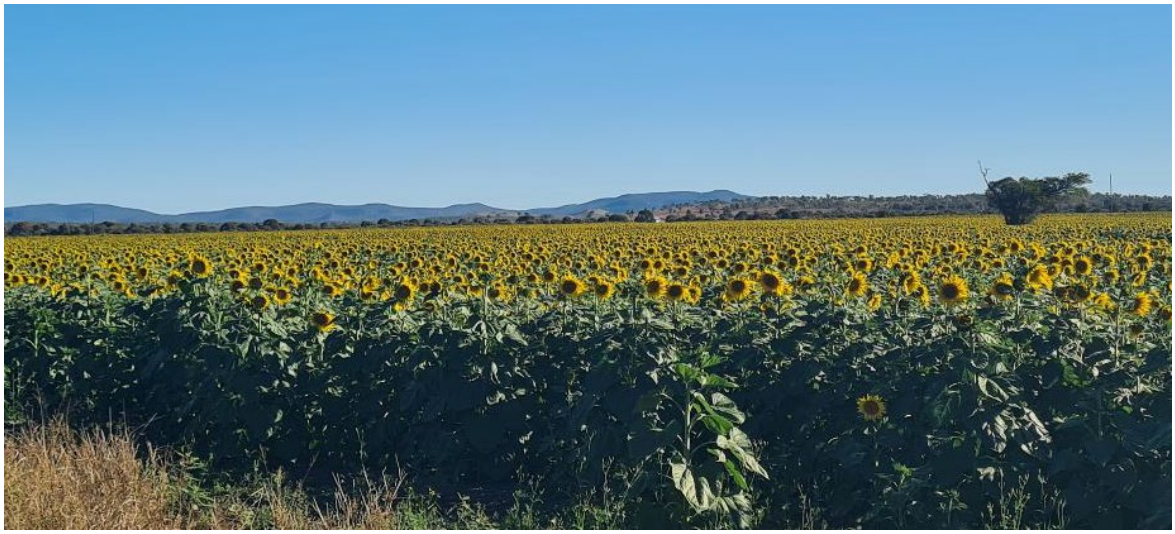
Visionary Land Use Planning

South Yaamba Irrigation Project

Milestone 4 Final Report:

Analysis and preference assessment – Preferred Option

October 2023





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Executive Summary

The Making Water Work project is a joint project with the lead funder Centre of Research Cooperation – Northern Australia (CRC-NA), Department of Agriculture and Fisheries (DAF) with contribution from Advance Rockhampton (Rockhampton Regional Council).

Pinion Advisory were engaged to complete a Preferred Option assessment of the South Yaamba area, located north-west of Rockhampton. This assessment was completed as project two under the Making Water Work project.

The assessment included running a local expression of interest process in partnership with Rockhampton Regional Council with local growers in the South Yaamba area. Expression of Interest responses returned 18 potential customers with a combined volume of 4,423ML/annum.

An irrigation scheme concept was developed which extracts water from the Fitzroy River and distributes through a piped HDPE network to customer property boundary over an irrigation season.

An agronomic assessment was also conducted in parallel with demand for a mix of annual cropping (forage sorghum & lucerne), orchards (lychees) and vegetable cropping.

A preliminary economic assessment found the scheme to have a positive benefit cost ratio and a strong case for further investigation and scheme development.

A variety of governance options for the scheme implementation and ownership were explored as part of this preferred option study.

1 Introduction

1.1 Making Water Work project

The Making Water Work project is a joint project with the lead funder Centre of Research Cooperation – Northern Australia (CRC-NA), Department of Agriculture and Fisheries (DAF) with contribution from Advance Rockhampton (Rockhampton Regional Council). The project aims to provide an integrated planning approach to maximise economic, social, environmental, and cultural value from the new Rookwood weir development along other available sources of water. The five sub-projects are summarised in Table 1.

Table 1: Making Water Work project summary

Project No.	Project Name	Organisation
1	Precinct Vision and Supply Chain Development update	Central Queensland University
2	South Yaamba Planning Foundations Report	Pinion Advisory
3	Water Governance	Central Queensland University
4	Integrating Nutrient Cycle - Hyacinth Pilot	Fitzroy Basin Association
5	Reef Water Quality Project	Advance Rockhampton

1.2 Our role

Pinion Advisory have been engaged to complete sub-project two *South Yaamba Planning Foundations Report* as part of the broader project for CRC-NA. We have experience in the concept development, planning, design, construction and operation of rural irrigation schemes across Australia. Our services range from private small commercial landowners through to federal government departments. We have approached this project like a preferred option analysis or pre-business case document for a new irrigation scheme project.

1.3 Report purpose and milestones

This report describes the current investigation for the final milestone (four) of the preferred option assessment of the South Yaamba irrigation project.

Milestone four outlines the final preferred option concept assessment including the following tasks:

- A completed preferred option analysis and preference report
    - Finalised capital and operational costing
    - Concept drawings for the scheme infrastructure
    - Opportunities and impact for the scheme
- Scheme case studies
- Implementation planning

The Milestone 4 report follows on from the previous Milestone 3 report which was submitted in March 2023 and previous Milestone 1 & 2 reports which were submitted in late 2022.

1.4 Rookwood weir development

Rookwood weir is a large water storage currently under construction on the Fitzroy River, approximately 66km south-west of Rockhampton. SunWater, Queensland's irrigation bulk water authority, are the proponents for the project.

The storage will enable 86,000ML of medium priority water for usage along the lower Fitzroy basin. With construction currently underway, operation is due in early 2024.



Figure 1: Proposed Rookwood plan

On the back of this significant state infrastructure project the Centre of Research Cooperation – Northern Australia (CRC-NA) commissioned a sub-project within the Making Water Work (MWW) business case. This project is also being completed in partnership with Rockhampton Regional Council.

The sub-project *Visionary land use planning facilitate development precincts* aims to confirm demand, access, and availability for a new greenfield irrigation scheme for growers not able to access direct water from the river frontage.

South Yaamba precinct has been identified as the potential irrigation development area with this pilot project to develop a greenfield irrigation scheme assessment.

2 South Yaamba area profile

2.1 Locality & opportunity

The South Yaamba precinct is located approximately 30km north-west of Rockhampton in central Queensland and is enveloped by the Fitzroy River to the north and east.

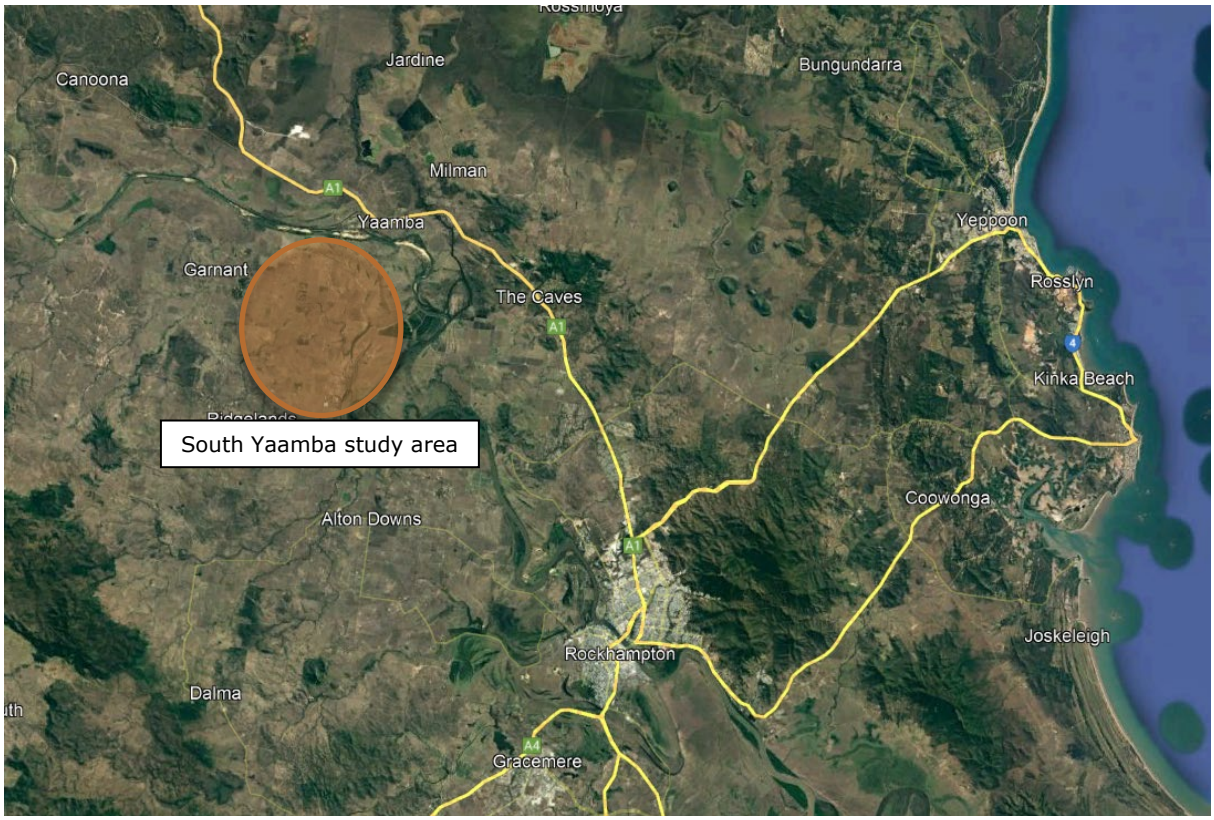


Figure 2: Locality map

The Lower Fitzroy is well recognised as a location for cattle grazing and pasture production. Larger scale irrigation development along the Fitzroy has been constrained due to landholder interest as well as water access constraints (purchase or lease larger water allocations). Furthermore, it is noted there have been water infrastructure challenges and knowledge barriers which have further hindered development.

The South Yaamba irrigation project offers the opportunity to deliver water access security to producers in the Lower Fitzroy area which can be used to support the increase in diversity and productivity of agricultural enterprise.

Irrigation could be used in the production of pasture and various food and fibre crops, including broadacre crops as well as annual and perennial horticultural enterprises.

The benefits of increased agricultural activity in the South Yaamba precinct would be for landowners and business entities directly involved in the production of agricultural commodities, an employment boost, additional demand for agribusiness services, increase supply of raw and processed agricultural products to domestic and export markets, and growth in the existing processing sector and potentially new manufacturing industries.

2.2 Fitzroy River

The Fitzroy basin is Australia's second largest seaward draining basin with an area of over 142,600 square kilometres. The basin is divided over eleven catchments across central Queensland and all flow into the Fitzroy River, estuaries and out into Great Barrier Reef. Figure 3 shows the basin schematic. Rookwood weir is situated in the lower Fitzroy and downstream of all the major river confluences.



Figure 3: Fitzroy River Basin

2.3 Climate

The South Yaamba area experiences a sub-tropical climate, with a typically hot and humid summer (December to March) and extended dry and mild winters (April to November).

The annual rainfall for this area is concentrated during summer and on average accounts for 520mm (60%) of the total annual rainfall of 822mm (Yaamba, Bureau of Meteorology station ID 33076). During summer, rainfall is generally a result of intense rainfall events associated with thunderstorms, and the monsoon trough.

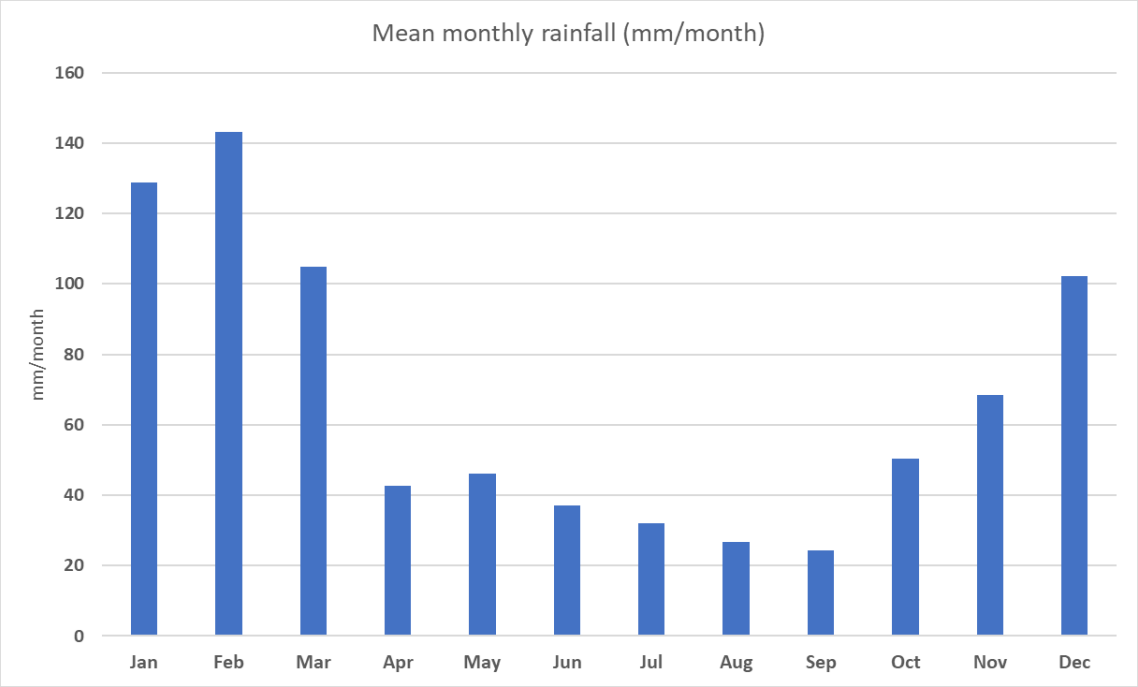


Figure 4: Mean monthly rainfall (BoM station ID 33076)

Evaporation exceeds rainfall throughout the year, and the moisture deficit increases progressively over winter and peaks from September to November. During summer class A pan the average evaporation rate is 7.1mm/day, whilst during winter evaporation averages at 5.2mm/day.

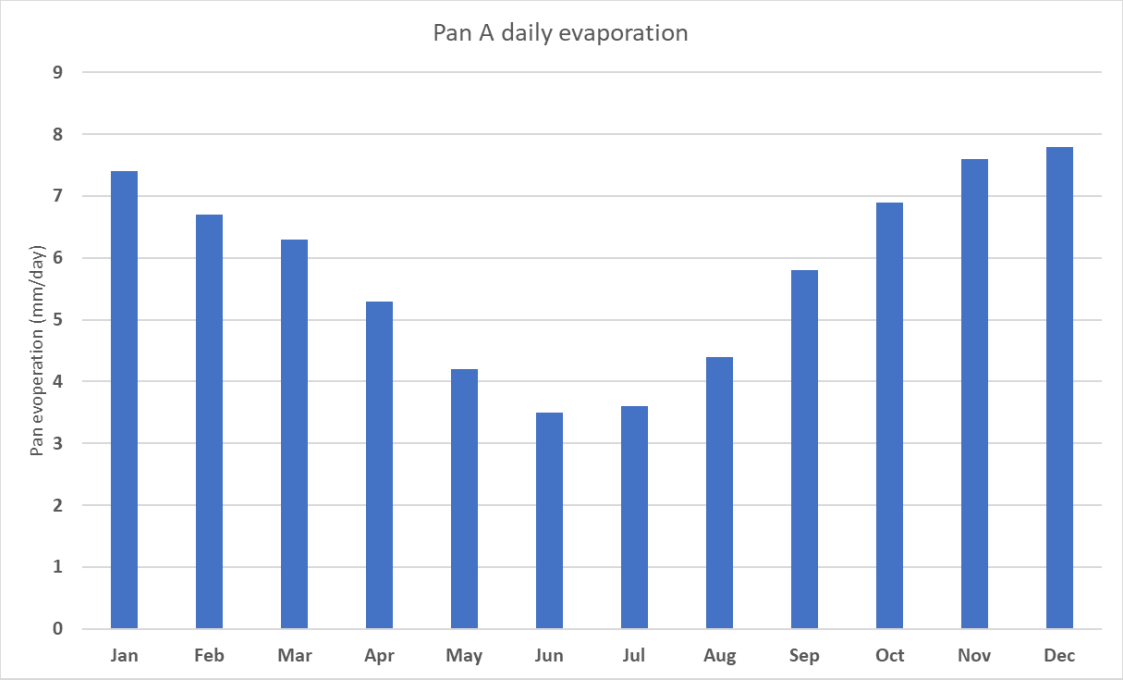


Figure 5: Daily evaporation

During summer the average daily temperatures range from 21.7 to 31.6°C, whilst during winter average daily temperatures range from 14.3 to 26.9°C. Frost events rarely occur in this area.

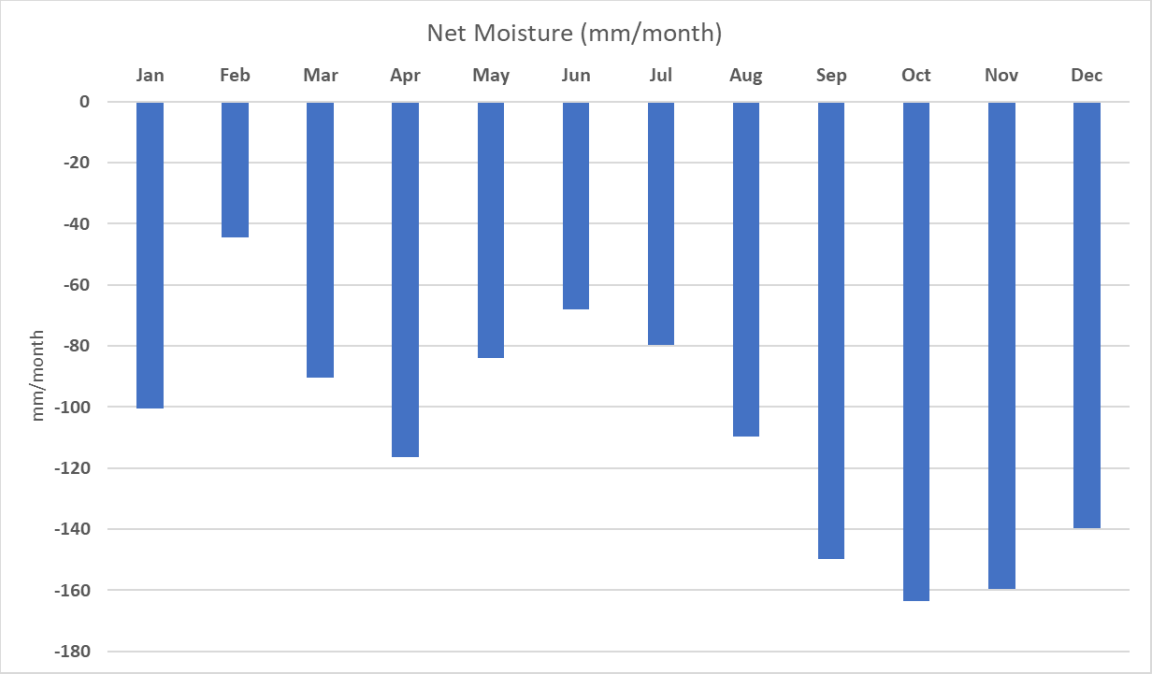


Figure 6: Net moisture

Net moisture is provided as Figure 6. It shows the monthly water deficit between evaporation and direct rainfall. Every month is shown as a deficit and shows the need for irrigated agriculture to supply consistent and reliable produce.

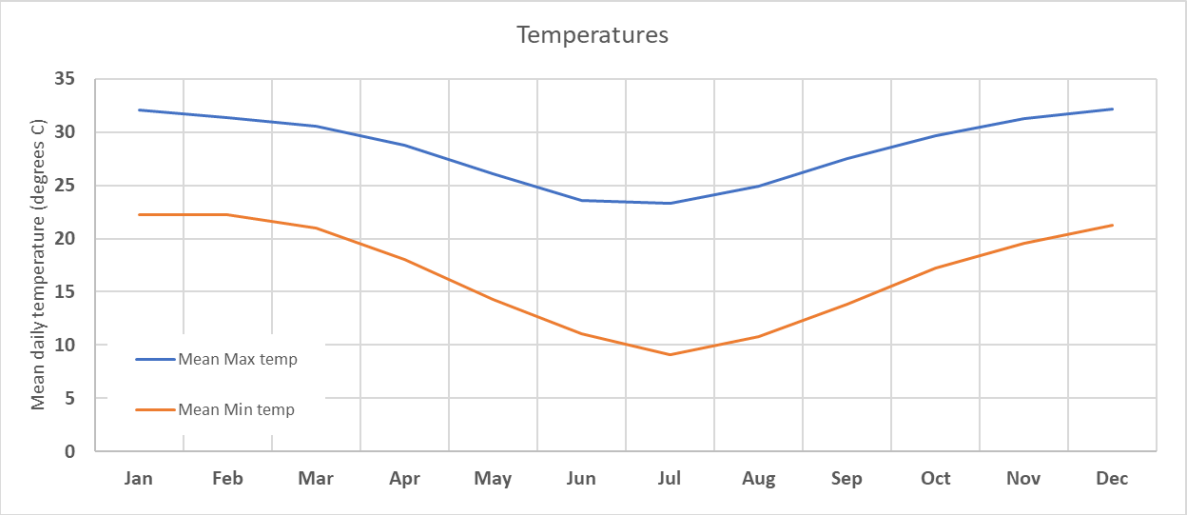


Figure 7: Mean daily temperatures

The South Yaamba precinct is not a particularly windy area, with average daily wind speeds during summer of 13.1 km/hr and during winter at 10.9 km/hr, although during cyclonic weather events wind speeds can exceed 100 km/hr.

2.4 Soils

The soils in the South Yaamba area are dominated by alluvial soils formed on the floodplains and river terraces associated with the Fitzroy River. Previous extensive mapping has been undertaken (Forster et al 2000). The various soil types include clay,

clay loam and texture contrast soils, and have been identified according to the Australian Soil Classification (ASC) system. A summary is presented in Table 2

Table 2: South Yaamba soils summary

ASC	Texture	Colour	Agricultural qualities	Relative land use intensity
Chromosols	Sandy/clay loam over clay	Black, brown	Susceptible to erosion and structure decline, moderate soil moisture and nutrient holding capacity and potentially prone to waterlogging	Low/ moderate
Dermosols	Clay loam	Black, brown	Susceptible to structure decline, lower soil moisture and nutrient holding capacity	Moderate/ high
Sodosols	Sandy loam over clay	Brown	Susceptible to erosion and structure decline, moderate moisture and nutrient holding capacity, prone to waterlogging and surface crusting	Low/ moderate
Tenosols	Loam and sandy loam	Grey/brown	Susceptible to wind erosion, poorly structured, low soil moisture and nutrient holding capacity	Low
Vertosols	Clay	Black, brown	Susceptible to structure decline, moderate/high soil moisture and nutrient holding capacity.	Moderate/ high

In general, the soils in the South Yaamba precinct are considered suitable for irrigated agricultural land use activity. Due to the diversity of soils present it would not be appropriate to undertake a blanket land management approach where all soils are considered as having equal properties and land management requirements.

At a property level, care must be taken to install the most appropriate type of irrigation system which best suits the soils' physical characteristics, including permeability and drainage capacity, along with the crop/enterprise being grown.

It will be critical to implement sustainable land management practices to ensure the long-term productivity of the soils is maintained and any risk of downstream environmental impacts is avoided. Best practice strategies include:

- Avoidance of excessive and/or unnecessary soil cultivation
- No cultivation of wet soils
- Where possible grow cover and green manure crops and incorporate crop stubbles
- Prevent surface erosion and control offsite sediment movement
- Monitor and manage soil nutrition to prevent excessive soil fertility and the risk of offsite nutrient movement (nitrates and phosphates)
- Implement correct/demand-based irrigation scheduling to prevent excess applications of water

2.5 Topography

The South Yaamba precinct is characterised by flat to gently undulating ground as well as slightly elevated river terraces which rise to an altitude of 15-25m ASL (above sea level) and are associated with the current Fitzroy River flood plain.

Further inland in the South Yaamba area are more elevated relic river terraces with an elevation of 25-45m ASL.

Due to the alluvial nature of this land, many relic and active drainage channels, depressions, and swales are present and is dissected by a number of minor waterways which flow into the Fitzroy River.

2.6 Land suitability for irrigation

The land covered by the proposed South Yaamba irrigation project contains land which has been identified (Forster et al 2000) as being suitable for irrigated agriculture, however this varies in its suitability depending upon the enterprise being undertaken, site specific limitations and the type of irrigation system utilised (overhead, sprinkler or surface irrigation).

The land's irrigation suitability is assessed based on a category scale of 1 to 21, which is an outcome of a combination of factors including soils, topography, sustainability issues, and suitable irrigation technology. These factors are linked to the potential severity of each limitation and associated limitations imposed on the potential agricultural enterprises.

Appendix Two provides a list of potentially suitable agricultural enterprises. Land has been identified (Forster and Sugar 2000) relative to the properties in the South Yaamba irrigation scheme concept plan.

2.7 Agricultural enterprise options

The South Yaamba precinct, and more broadly the Lower Fitzroy region has a climate which allows for a diverse agricultural sector that includes livestock, broadacre cropping, and annual and perennial horticultural enterprises.

The livestock sector is dominated by beef cattle breeding and finishing, with small undertakings in dairy. The production involves pasture (grass and lucerne) based as well as intensive feedlot type operations. Forage and fodder production supports the beef and dairy sectors.

The cropping sector is diverse and involves a variety of different enterprises including cotton, various legumes (navy bean, mung beans, soybean) and starch grains (wheat, sorghum and corn). Strong local markets exist for starch and legume grains for the supply of the beef feedlot enterprises, as well export to domestic and overseas markets.

Annual horticultural crops grown include melons, herbs and pumpkins. There is also potential for a range of vegetables such as salad and leafy greens. Root crops are also an option including sweet potato and solanaceous plants (chillies, tomatoes and capsicum).

Perennial horticulture involves the production of a number of sub-tropical fruits including lychees, mangos and avocados. Sub-tropical nuts, most notably macadamias, are also grown. There is potential for citrus crops such as oranges, mandarins, lemons and limes.

New crops are being trialled in the region, and the list of crops which are grown in the area will likely expand in the coming years. Significant ongoing agricultural research and development work is being undertaken in the region; examples including, Central Queensland University, the Central Queensland Innovation Research Precinct (CQIRP), and the 3200-hectare Belmont Research Station.

Horticultural crops grown in this region are a key source of fresh produce to domestic markets throughout Australia during winter and spring.

It would be appropriate for landowners and potential irrigators to undertake a detailed assessment of what enterprise they can and could engage in based on:

- Soil types present
- Individual enterprise investments required
- Financial performance outcomes
- Market opportunities
- Downstream processing markets and opportunities
- Lifestyle considerations

Appendix Two provides a list of enterprise options as identified in the Forster 2000 report based on the land's suitability for irrigation with the mapped soils along the Fitzroy River.

It must be noted that some the landholders who have expressed an interest in the project have had Agricultural Development Reports and Business plans completed as part of the Rookwood Weir Landholder Support and Grants Program.

2.8 Fitzroy River water quality

The Fitzroy River water quality is suitable for irrigation. There is no concern regarding key irrigation water quality parameters including electrical conductivity and pH.

The Fitzroy River water quality supplies Rockhampton with its drinking water, and the water quality is closely monitored.

2.9 Irrigation water demand

The volume of irrigation water required to produce many crops varies depending on the growing season, crop water efficiency, soil type and seasonal conditions. The South Yaamba area experiences a moisture deficit throughout the year and as result the volume of water required to grow the various types of crops is regarded as relatively high in most situations. Table 3 outlines typical crop irrigation demands for enterprises in the South Yaamba precinct.

Table 3: Typical crop irrigation water demands

Crop	Irrigation water demand (ML/ha/annum)
Cereals	4-5
Citrus	6-8
Corn	5-7
Cotton	6-8

Grazing pasture	7-9
Lucerne (multiple cuts/repeat grazing)	6-8
Macadamia	4-6
Melons	4-5
Sorghum (forage/grain)	5-7
Soybeans	5-7
Wheat	4-5
Vegetables	3-6

2.10 Land management considerations

Several important land management issues must be taken into consideration in the development and ongoing operation of irrigated agriculture production systems.

Land management considerations include:

- Sustainable soil management practices
- Irrigation system design
- Irrigation scheduling
- Nutrient management

Further discussion of land management consideration will be discussed in subsequent milestone reports.

3 Indicative water demand

3.1 Expression of interest process

A fundamental component of any new greenfield irrigation development is to understand real water demand. This enables efficient and purpose-built infrastructure sized to actual desired requirements. Alternatively, if no demand is validated, infrastructure is oversized and underutilised, leading to questionable funding arrangements and lost sunk costs.

The demand, typically expressed as ML/annum, shapes the scheme size and requirements, infrastructure needs, demand profile and ultimately the schemes financial viability.

Pinion Advisory recommended for this study; a one stage formal expression of interest (EoI) process be conducted. This was aimed to understand the demand response for irrigation in the South Yaamba precinct. The study was assisted and publicly run by Rockhampton Regional Council (RRC). Pinion Advisory and RRC developed a public submission form which was sent to identified properties in the South Yaamba precinct. Follow-up one on one landholder discussions were also had to further discuss the process. The EoI period was open for a four-week period with responses sent back to Council.

3.2 EoI results

EoI results are summarised in Table 4 with the results also charted in Figure 8. The medium volume (per landholder) is 205ML and a minimum EoI of 10ML. One customer has expressed demand for 35% of the total volume with that individual owning and leasing a significant amount of land in the area.

Table 4: EoI summary (October 2022)

EOI summary – October 2022	
Total entities	15
Total expressed volume (ML/annum)	4,423
Average ML/response	295

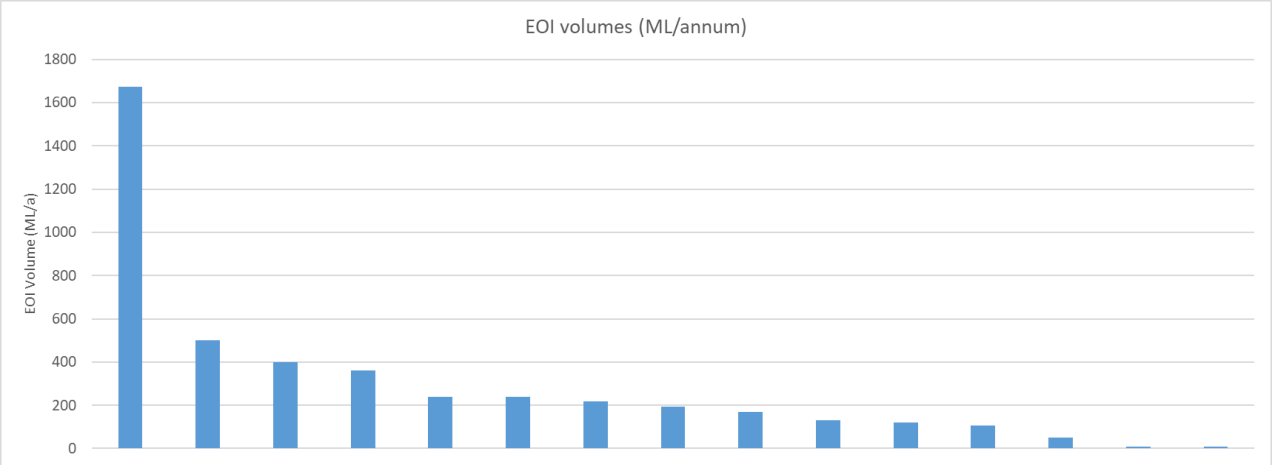


Figure 8: EoI individual responses

3.3 On ground consultation

During the EOI process, one on one meetings were held with each of the larger identified landholders. Scott Johnstone (Pinion Advisory) led the landholder consultation process with two area visits held on the 14-15 September and 23-24 November 2022.

The consultation interviews included the following aspects:

- Brief project overview and intent of this study
- Purpose of the EOI process
- Discussion of the landholder's current operations and existing enterprise/crops
- Discussion of potential future enterprises with irrigation water
- What the irrigation scheme could mean
- Likely/request for scheme outlet location for farm

All major landholders were visited with one-hour interviews held. A summary of the consultation interviews is provided in Appendix Three.

There were a few landholders which had either been identified in earlier studies to potentially want water, however upon follow-up were uncontactable or did not express any further interest.

4 Proposed concept

4.1 Scheme design criteria

The proposed concept will extract water from the Fitzroy River and distribute it via a pressurized pipeline system over a set delivery period directly to customers' property boundaries.

4.1.1 Tasmanian Irrigation model concept

This concept is comparable to irrigation scheme development projects seen throughout Tasmania in the last 15 years, as well as other recent developments in early planning or feasibility in other parts of Australia. Notably, the concept incorporates an intensive area of demand with the infrastructure designed and constructed accordingly.

Given the annual megalitres pumped and variability of supply to customers across the year for this scheme, a piped system concept is preferred for South Yaamba.

4.1.2 Irrigation season length

Each customer's purchased annual water allocation will be delivered 24 hours a day evenly over a set season length. The season length is an important parameter as it forms the effective flowrate customers will realise from their respective allocation.

A short season length means customers will receive their annual allocation quicker, however it also means the scheme distribution infrastructure (pipeline and pump station capacities) are required to be a larger size to accommodate the increased flows required. A longer season length will mean smaller scheme infrastructure with lower instantaneous flowrates over a longer timeframe.

The South Yaamba precinct is currently dryland cropping, horticulture and cattle grazing region with a mix of enterprises. Due to the variability of crop types and mix of enterprises, a diverse and flexible season length is warranted. It is envisaged Rookwood weir will be able to release allocation over the entire year and therefore is not considered a constraint on the annual period for supply.

A season length of 180 days (six months) has been adopted but with the ability to extend this allocation across a 350-day period. In practice it is believed growers will take less than their peak allocation (nominally 270-300 days), however the system peak capacity will be designed to 180 days. This period allows for a 15 day (2 weeks) planned shutdown maintenance period.

Prospective customers will need to plan their irrigation setup and enterprise around the season length and plan/augment their farm infrastructure to best fit their enterprise. This may be through the installation of on-farm water storage or specifically designed package sizes for centre pivot irrigation.

4.1.3 Design criteria

The overall scheme purpose is to provide an agricultural bulk water product to customers delivered through a pipeline network, with a consistent flow over a nominal irrigation season at minimum pressure. The scheme design criteria are outlined in Table 5.

Table 5: South Yaamba irrigation scheme design criteria

Design Parameter	Requirement	Comment
Scheme reliability	Medium priority water monthly	Water allocation is assumed to be secured as a third-party customer with medium priority. High priority may also be available. Bulk water entitlement is assumed to be purchased through the proponent from SunWater
Scheme annual allocation	**4,420 per annum** to be pumped	4,420 ML medium priority
Season length	180-day flowrate period of irrigation design supply. Supplied over a 350-day available irrigation season	Minimum period customers can take their allocation over. 180 days can be split or moved within the 350-day period.
Nominal peak scheme flowrate	24.4 ML/d (282L/sec)	4,420 ML over 180-day season length
Peak Flowrate	Annual entitlement delivered evenly (24 hours/day) over irrigation season.	Example: 200ML annual entitlement translates to: $\frac{200\ ML}{180\ days}$ = 1.11ML/d = 12.9 L/sec
On-farm Pressure	Guaranteed minimum residual pressure at customer outlet valve	Depending on outlet location and scheme demand residual pressure will vary
Civil asset design life	50-100 years	Concrete pits, pipes & structures
Mechanical asset design life	20-40 years	Pumps, valves, flowmeters
Electrical asset design life	15-20 years	Motors, variable speed drives, telemetry

4.2 Water source location

The Fitzroy River downstream of the proposed Rockwood Weir and within Zone A of the Fitzroy Barrage Water Supply Scheme. Figure 9 shows the town barrage and is the end point of the FBWSS.



Figure 9: Fitzroy River barrage, water supply scheme is upstream of barrage

4.3 Groundtruthing site investigations

4.3.1 Initial investigations

David Mohr of Pinion Advisory has completed two separate site investigations during September 2022 and February 2023. Both visits incorporated two part-days of onsite presence. The purpose of these visits was to:

- Conduct a reconnaissance investigation of the area
- Understanding the proposed scheme layout and concept
- Inspect/observe critical infrastructure locations (i.e. pumping extraction point and power locations)
- Observe local existing irrigation, agronomy and farming practices
- Validate assumptions and incorporate findings into the preparation of the project cost estimate.



Figure 10: Typical road and reserve for pipeline installation

Most areas of the current proposed alignment were accessible and driven to observe existing ground condition, agricultural enterprises and possible construction challenges. Interface with other existing infrastructure such as powerlines, crossings and roads was also observed.

The site investigation identified no major showstoppers for the further progression of the concept of the project. A recognised challenge for the project is to prepare a sound construction and contractor procurement methodology to ensure an efficient and cost-effective pipeline installation process. This will ensure costs are kept as low as practicable given the relatively small megalitres for the scheme.

4.3.2 May 2023 investigations

In May 2023, David Mohr and Bridget Lindsay of Pinion Advisory completed our last groundtruthing investigations. We inspected more specific locations for potential infrastructure including the pump stations, balance tank and pipeline routes.

As part of this field visit we along with Advance Rockhampton spoke to potential landholders and options for infrastructure along the Fitzroy River.

5 Pipeline design

5.1 Layout overview & schematic

A preliminary scheme overview map is included as Appendix One. It shows the scheme layout, including pipeline alignments, pump station location and proposed customer boundaries.

The scheme is proposed as a low-pressure pipeline scheme with outlets located at respective property boundaries. A scheme schematic is shown as Figure 11.

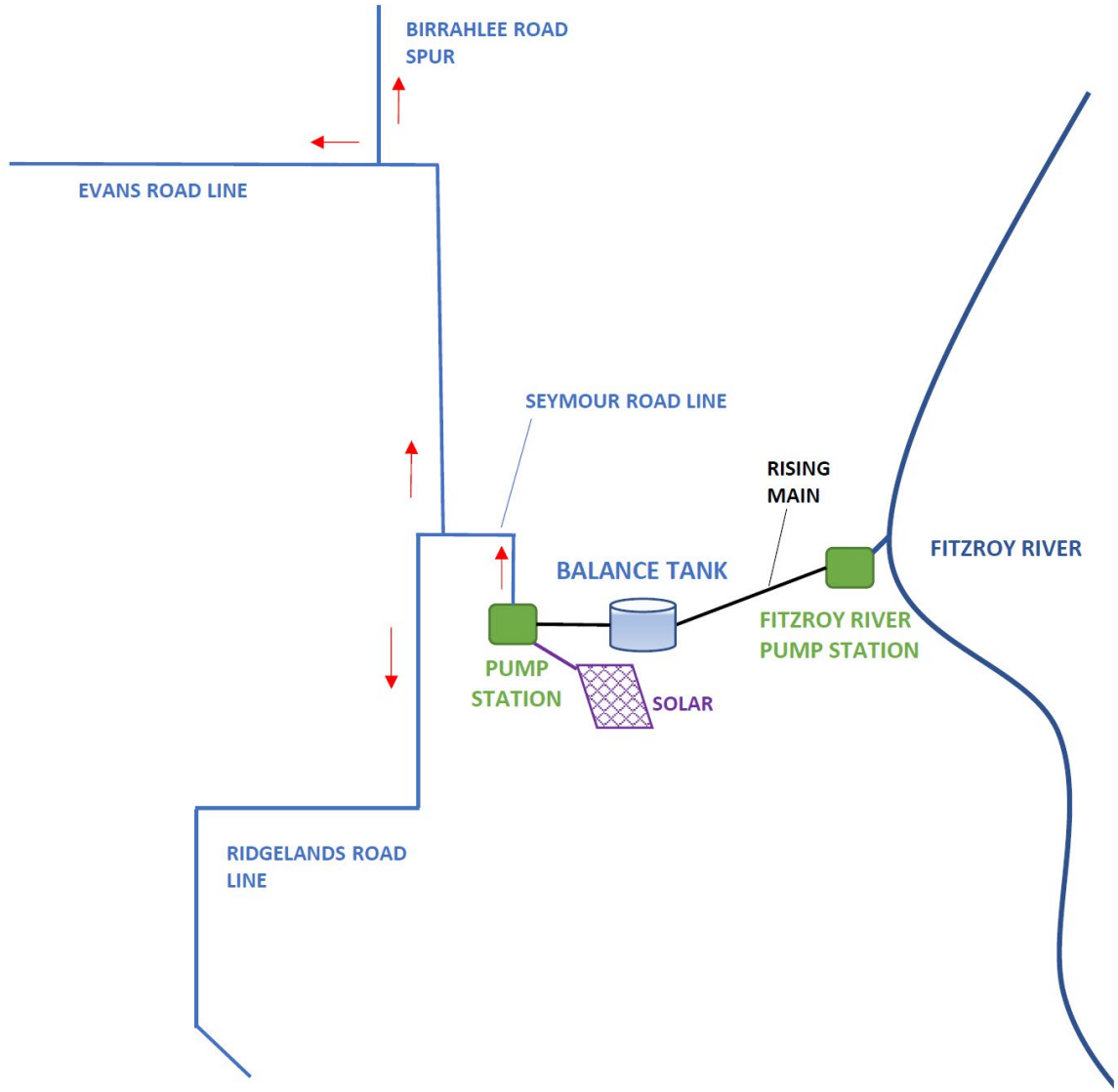


Figure 11: South Yaamba irrigation schematic

5.2 Pipeline specification

A pipeline concept design has been prepared for the scheme; general specification details are shown in Table 6. A total of 28.3km of pipe is included for the scheme. HDPE pipe is adopted as a versatile and reliable pipe material for rural irrigation schemes.

Table 6: Pipeline specification

Pipeline	Pipe Length (km)	Pipe Diameter (mm)	Peak Flowrate (ML/d)	Pressure Rating	Pipe Specification
Rising main	0.8	630	24.5	PN 6.3	PE100 HDPE
Delivery	18.9	560 - 160	Varies (24.5 - <1)	PN10 - PN6.3	PE100 HDPE
Total	**19.7 km**				

5.3 Alignment design

5.3.1 Horizontal alignment

A preliminary horizontal alignment has been prepared using desktop-based methods as well as corresponding with the groundtruthing. The alignment has largely followed existing road reserves with some traversing over private property.

It is not intended for this to be the final optimised alignment, rather a good indication of a typical scheme layout and total pipeline length. The alignment presented here for the reference design is **not** proposed to be the final alignment design for the irrigation scheme and is subject to change in subsequent project phases.

A 10-20m nominal pipeline corridor (dependent on pipeline size) will be finalised with the final detailed design post water sales. Before finalisation of alignment, subsequent detailed environmental (flora and fauna), cultural heritage and constructability assessments should be undertaken prior to final detailed design.

5.3.2 Vertical alignment

The pipeline will generally follow natural existing topography at a specified minimum cover depth and with consideration of adequate clearance from existing underground services. Pipeline protection devices will be sized and placed accordingly during the subsequent detailed design project phase. Nominal allowances of pipeline protection devices have been allocated for the system.

5.4 Hydraulic analysis

As part of the preliminary pipe design and subsequent costing for the project assessment, a static steady state hydraulic analysis was completed to size infrastructure and determine the system pumping requirements.

5.4.1 Hydraulic model description

The hydraulic analysis was undertaken in a sophisticated steady state excel based model program. The mainline pipeline was analysed through a linear pipe model divided into section lengths of 50 m per node.

Software EPANet and Optimizer were also utilised to confirm hydraulic conditions and design parameters for the project. The steady state hydraulic model was completed assuming 100% usage of customers' demands at their nominated parcel locations to determine pumping heads and pipe sizing.

Flowrates were derived from customers' respective allocation volumes over the season length of 180 days (24 hours per day). The model calculated a hydraulic grade line (HGL) profile from velocities and computed friction head loss per pipe section. Friction

calculations were completed using the Hazen Williams method. Topography elevations were also included in the calculations. These were extracted from 1m contours provided by RCC mapping team.

A discussion document is included in Appendix eight which describes the Optimizer software and usefulness with hydraulic design.

5.4.2 Static pressures

Capital costs are intended to be minimised through management of pipe size and pressure rating. In this assessment, efforts were made to minimise operating costs and the costs associated with the pump stations as much as practical.

The adopted minimum pipe pressure rating is PN6.3 for all scheme infrastructure. Due to the cost sensitivities for rural irrigation schemes, pipe pressure class is designed to be as minimal as practical whilst still ensuring a satisfactory design factor of safety.

5.4.3 Adopted hydraulic parameters

The hydraulic parameters applied to the hydraulic model are summarised in Table 7.

Table 7: Adopted hydraulic parameters

Design parameter	Adopted value	Comment
Assessed flowrate & demand point	Customer allocation over season length at nominated demand location	i.e. 360 ML/annum over a 180 day season length = 2.0 ML/d (23 L/s).
Friction Factor (HDPE)	Hazen Williams (C factor) 135	Australian Pipe Friction Handbook values used with a 10% allowance for aging pipe and modelling of minor losses. No additional fitting K factors have been included in the modelling. Given the pipe velocities are relatively low, the effect of additional K factors are not considered consequential for the model at this preliminary level of design.
Minimum pipe size	Nominally DN160	A minimum pipe size was adopted to allow for limited hydraulic flow flexibility within the pipeline capacity. There is a negligible cost saving achieved if a smaller diameter pipe than specified is installed.
Maximum Friction head loss	**0.0050** meters per meter length	Considered threshold for optimum pipe sizing. Assessment also made to limit the velocity under 1.5 m/s where practical.
Property Outlet Pressure	Minimum 15 m head	15m head upstream allows for a nominal head loss of ~10m through the property outlet train, yielding a minimum 5 m residual pressure on the downstream side of property outlet.
Minimum pipeline residual pressure	Minimum 5 m head	5 m allowance over ‘highpoints’ for topography variation and survey error.

Pipe pressure rating	Adopted next pressure rating above static head threshold	Minimum pipe rating PN6.3

5.4.4 Mainline hydraulic grade line

A hydraulic grade line plot for the rising mainline and distribution mainline is provided in Appendix Four. There will be some opportunities for further optimisation and design refinement during subsequent design stages. The initial purpose of the HGL and hydraulic analysis is to:

- Understand initial pipe sizing for costing elements
- Understand pipeline pressure ratings and static pressures
- Pump requirements, needs and location

5.4.5 Transient analysis assessment

A detailed system transient analysis (water hammer) assessment has not been undertaken at this preliminary stage of the project. This assessment will be performed during detailed design at a future project stage.

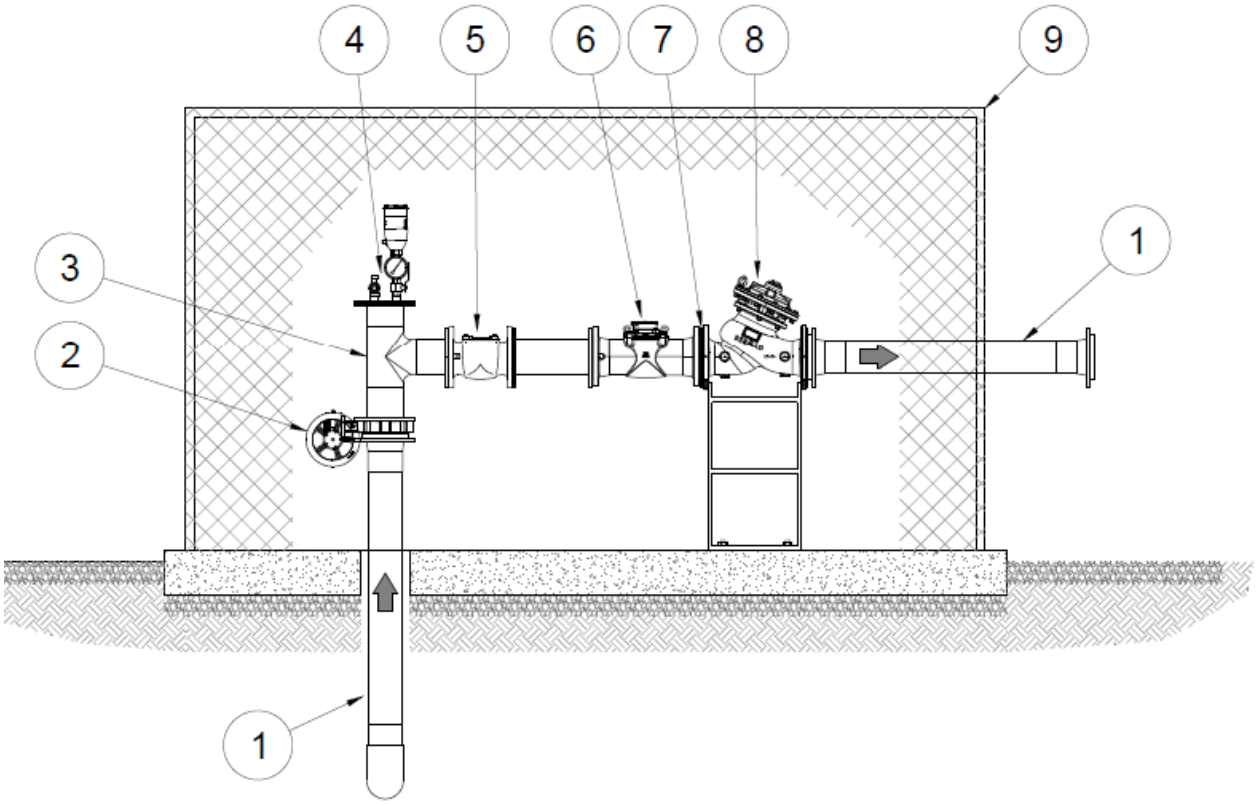
5.5 Property outlets

A property outlet will be the supply point from the irrigation scheme for customers. The property outlets will be located on the inside of a property boundary fence for customers' farm connection.

Largely, the property outlets will serve as the main visible component of the pipeline infrastructure. Their design is modelled off recent outlet designs completed for pipeline irrigation schemes in Tasmania. Figure 12 shows an example of a proposed property outlet. The general arrangement and schedule is provided in Figure 13.



Figure 12: Example of proposed property outlet



PIPE & FITTINGS SCHEDULE	
ITEM	**DESCRIPTION**
1	PE100 PN16 PIPE & FITTINGS (#1)
2	BUTTERFLY VALVE LUGGED C/W GEAR ACTUATOR (#1)
3	HDG GALV OR 316SS PIPE & FITTINGS (#1)
4	BLIND FLANGE C/W COMBINATION AIR RELEASE VALE, PRESSURE TRANSDUCER & PRESSURE GAUGE (#1)
5	DIRT BOX STRAINER (#1)
6	WATER METER C/W PULSE OUTPUT (#1)
7	ORIFICE PLATE (#1, #2)
8	OUTLET HYDRAULIC FLOW CONTROL VALVE (#1)
9	FENCED ENCLOSURE C/W SWING ACCESS GATE

Figure 13: Typical property outlet arrangement

The property outlet will be installed above ground and housed in a locked enclosure, accessed only by the scheme operator. The property outlet will consist of a pipe riser and air valve, strainer, flowmeter, flow control valve, isolation valves and an on/off customer operated butterfly valve. The flow control valve will ensure a constant flowrate related to the customer's annual entitlement which will be set during scheme commissioning.

The scheme design philosophy is to keep the hardware (and resultant scheme control philosophy) as simple as possible. No remote read or operating controlling telemetry is proposed for these outlets. Meter reads will be read annually or quarterly by scheme operators for billing, water accounting and reporting purposes.

Outlet sizing will be selected to allow two to three times the customers allocation. This ensures suitable outlet capacity should the customer want to trade allocation or flow capacity. This sizing is included within the project costings.

A total of 18 customer property outlets have been included for the scheme.

5.6 Installation method

Pipeline construction and installation is expected to be undertaken largely using conventional excavator machines (12-50 tonnes) with standard buckets, rippers, and shaker buckets. Figure 14 shows an example of HDPE pipe installation with this methodology along the inside edge of a road reserve. Additional gear including dump trucks, graders, smaller machinery will also be typical for a likely contractor.

Pipeline installation is to be undertaken to relevant state and local guidelines and Australian Standard 2566 (Parts 1&2) *Buried Flexible Pipelines*. While a minimum pipe pressure class of PN6.3 is adopted, structural pipe checks are to be completed during detail design to verify assumptions and soil conditions.

It has been assumed for the majority of the trenching and pipeline installation, in-situ soil is to be used as the embedment zone material with some mechanical and moisture treatment to be incorporated.

The pipeline will typically have a nominal minimum cover of 700 mm; however, deeper covers may be required within floodplains and farming fields or to avoid existing underground services.

5.7 Contracting methodology

It is envisaged to engage a single contractor to install the scheme. Some individual components may be sub-contracted to specialised contractors. The South Yaamba Irrigation project is proposed to be an agriculturally based irrigation scheme. While infrastructure will be required to be installed to Australian standards, gold plating or extreme conservatism will not enable a cost-effective product. Intentional and innovative solutions during procurement and contract preparation will be one cornerstone to successful project construction.



Figure 14: Example DN400 HDPE trench pipe installation

5.8 Balance tank

A balance tank is included as part of the concept as shown on the layout plan. An example of a similar tank is provided in Figure 15. The purpose of the balance tank is to provide a buffering of water between what is pumped from the river (into the scheme) and what is supplied to customer outlets (out of the scheme). A nominal 2ML tank will give approximately two hours of peak supply (24.5ML/d) without starting the pumps.

The tank is proposed to be installed on a local area highpoint with the ability to provide sufficient pressure to all parts of the scheme under gravity flow. This means a second boost pump is not required within the distribution pipelines. Exact access, fencing and earthwork requirements would need to be determined at a later design stage.

The inclusion of a balance tank will ensure a simplified control philosophy and operational requirement.



Figure 15: Example of scheme balance tank

6 Pump stations

6.1 Basis of design

The following general design guidelines were used to determine the number and location of the pump stations:

- Minimisation of the total number of pump stations
- Strategic placement of pump stations nearby to existing suitable ancillary infrastructure (power connections, access)
- Topographic influence on design and overall concept assessment

There are two pump stations proposed for the South Yaamba concept, pump details are listed in Table 8.

Table 8: South Yaamba pump station pertinent details

Pump Station	Peak Flowrate (ML/d) (Pumped Annual ML over scheme length)	Total Dynamic Head (m head)	Total Peak Power Load (kW)
Fitzroy River Lift	24.5 ML/d (4,420 ML)	20 m	125 kW
Distribution	24.5 ML/d (4,420 ML)	80 m	335 kW

6.2 Fitzroy River Lift Pump Station

The general arrangement of the proposed Fitzroy River pump station is proposed in Figure 16 and the concept plan for the pump station is included in Appendix One.

It is proposed to install a number of submersible pumps in a concrete pit adjacent to the Fitzroy River. A piped intake to the pit will be installed from the river to the pit to supply water to the pumps. A major advantage of this concept is to ensure protection in flood events. A rising main is installed to take the water to the balance tank.

A proposed pump station arrangement is included as Figure 18. An intake structure is placed on the left with a piped intake to the pump well. This arrangement is considered conceptual at this stage of the assessment.

Preliminary pump sizing selection were undertaken to validate the pump station configurations and checked against operational efficiency. Detailed selections will need to be undertaken post water sales during detailed design, when exact flow and pressure heads are known with each pump station location set.

Table 9: Fitzroy River pump station configurations

Pump Station	Pump arrangement	Flow per pump (ML/d)	Motor size (kW)
Fitzroy River	4 submersible turbine (including 1 standby pump)	6.3	37

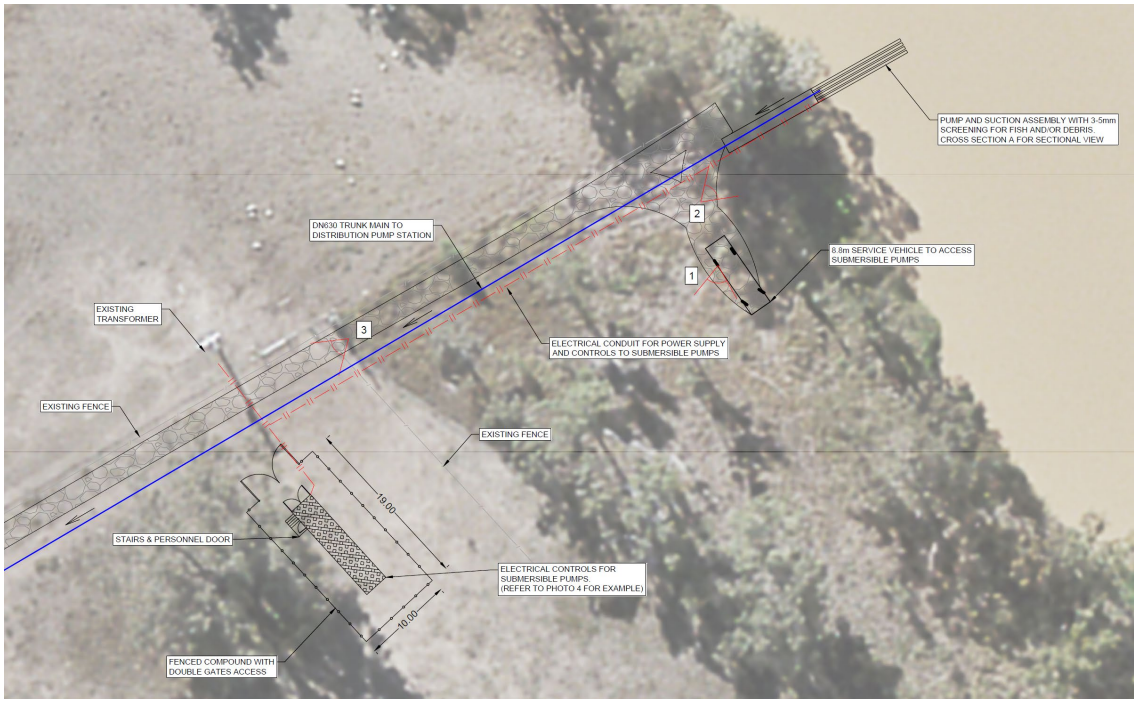


Figure 16: South Yaamba Fitzroy pump station

It is proposed to site the electrical and control building for the pump station on the raised riverbank. Exact land tenure for this area is currently unknown.



Figure 17: Looking on crest of bank down towards Fitzroy River to proposed pump station installation

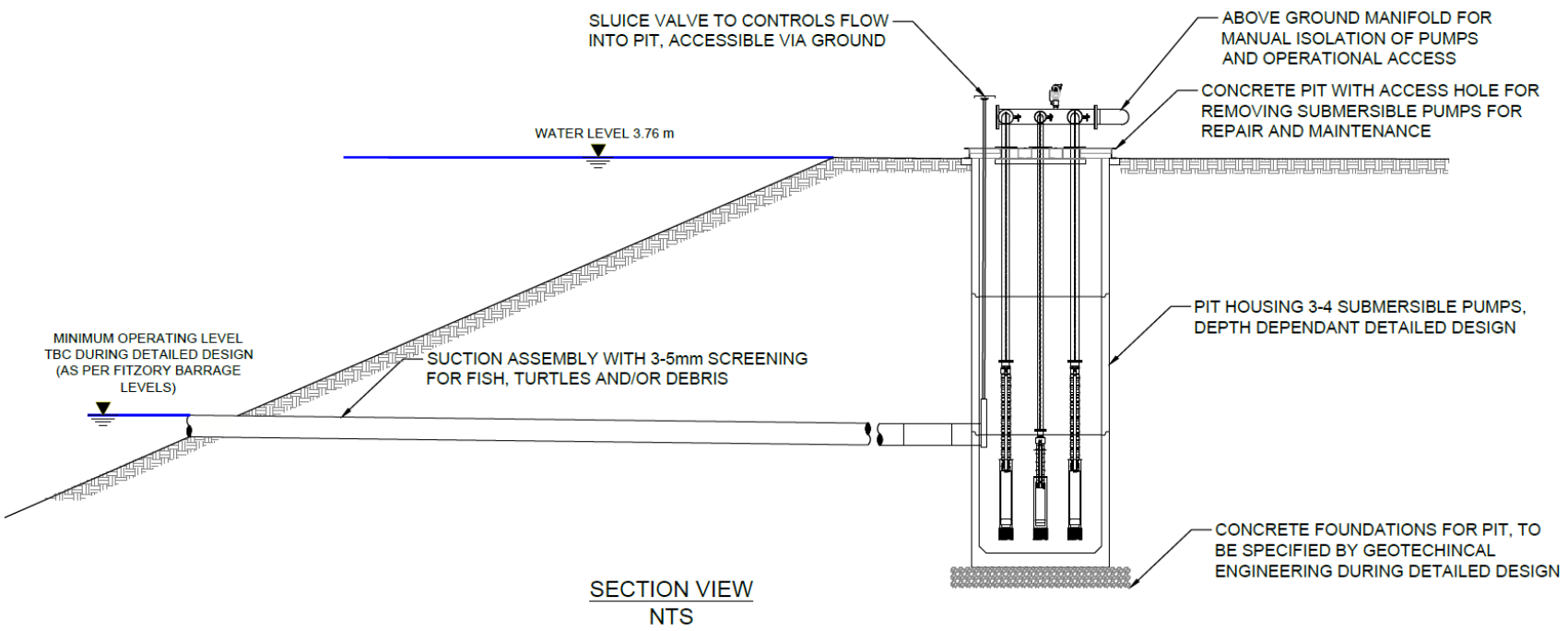


Figure 18: Nominal pump station arrangement

6.3 Distribution Pump Station

The general arrangement of the proposed distribution pump station is proposed in Figure 19 and the concept plan for the pump station is included in Appendix One.

The pump station is situated adjacent to South Yaamba road. Water is extracted from a 2ML balance tank with a number of end suction pumps arranged in a steel building shed.

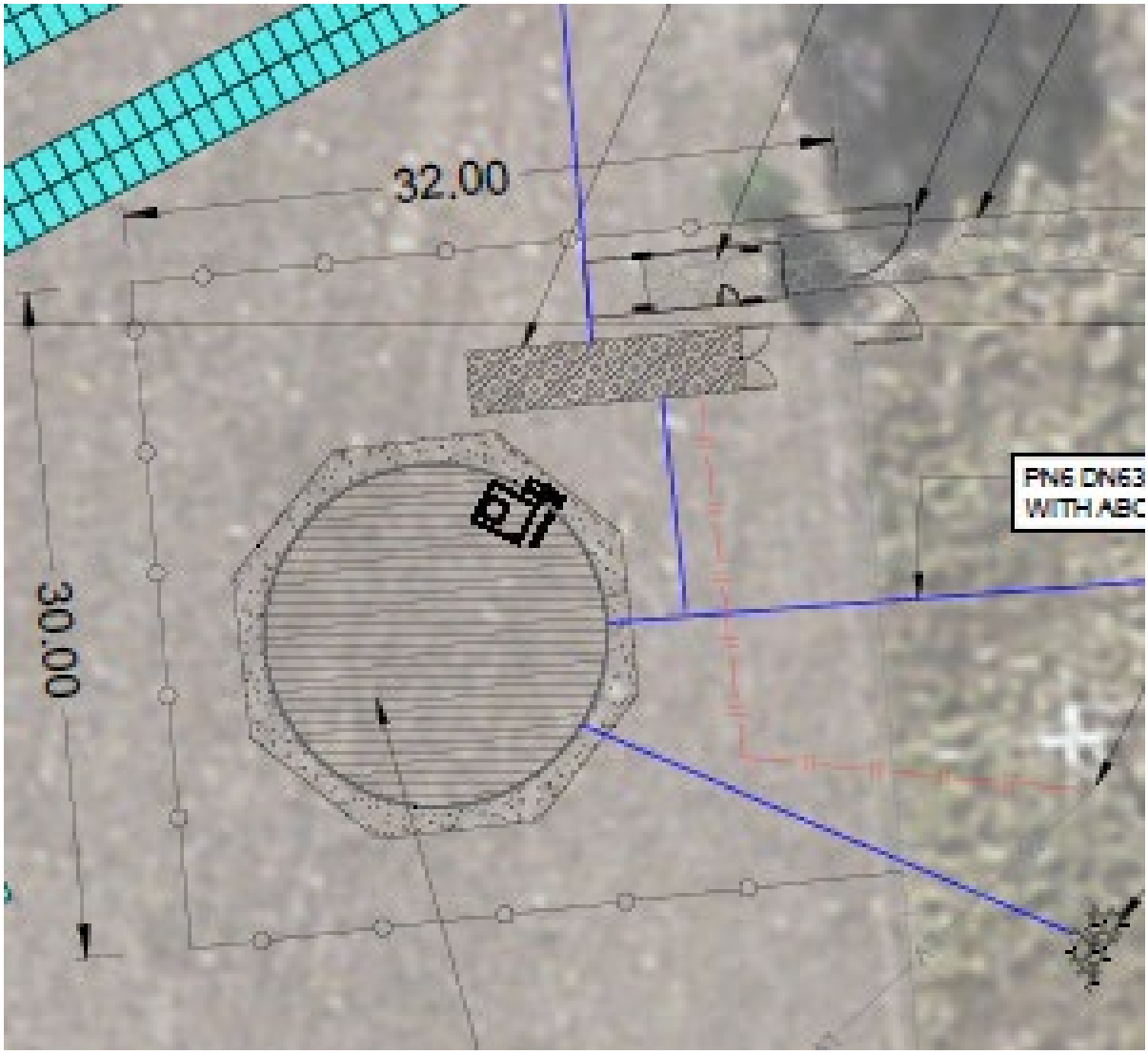


Figure 19: Distribution Pump Station general arrangement

Preliminary pump sizing selection were undertaken to validate the pump station configurations and checked against operational efficiency. Detailed selections will need to be undertaken post water sales during detailed design, when exact flow and pressure heads are known with each pump station location set.

Table 10: Fitzroy River pump station configurations

Pump Station	Pump arrangement	Flow per pump (ML/d)	Motor size (kW)
Distribution	4 end suction centrifugal (including 1 standby pump)	6.3	100

7 Energy and power connection

7.1 Ergon Energy network

Ergon Energy own and operate the regional Queensland electricity network including the South Yaamba and greater Rockhampton area. Figure 20 shows the greater Ergon Energy network capacity with greater the 1.0MWA remaining on the feeder lines. It shows sufficient existing capacity for the network for future development of pumping and on farm irrigation infrastructure. While only an initial assessment, it is believed the South Yaamba area has a well serviced and adequate electricity infrastructure with high potential for development. This development could be through both power extraction and generation.

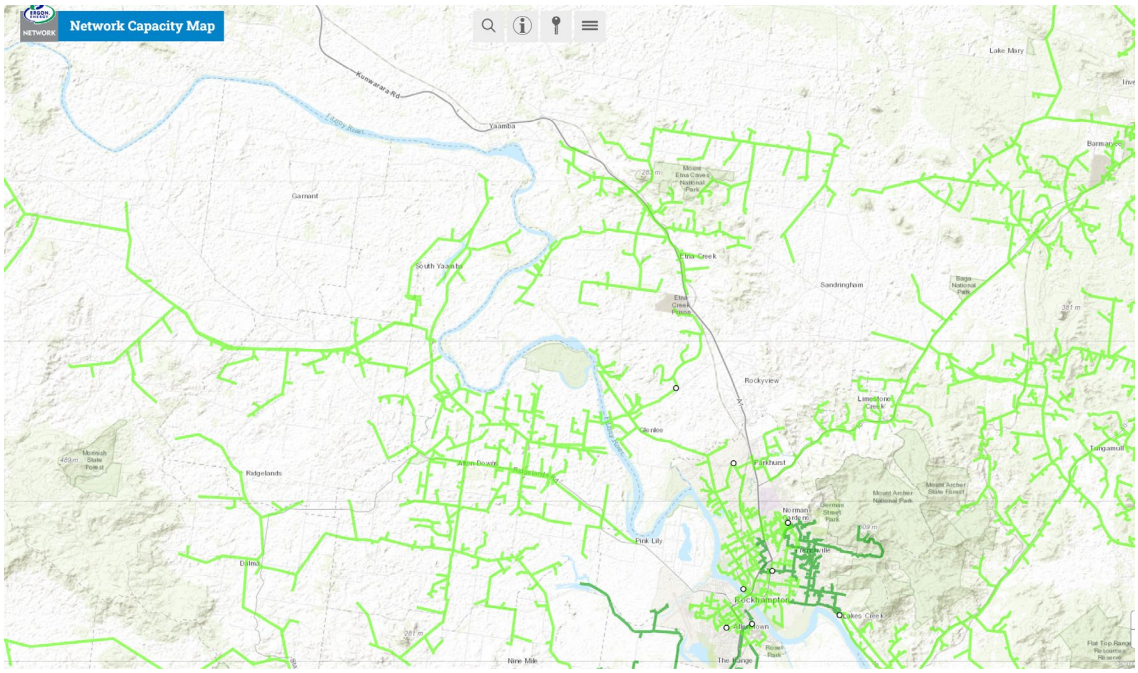


Figure 20: Greater Ergon Energy network capacity

7.1.1 Pump station connection

The Fitzroy River pump station is located adjacent to Fitzroy River, east of South Yaamba Road. The existing electrical infrastructure is a 22kV feeder (Alton Downs). Remaining capacity of above 1 MVA is shown. The Fitzroy River pump station is circa 120kVA, with three phase power and a pole next to the proposed site. This suggests (however at this stage unknown) it can be included on the feeder without extensive or expensive power augmentation (i.e voltage regulations). Exact sightings and checks with Ergon will need to be completed at a later design stage.

Similar to the Fitzroy River site, the Distribution Pump Station is adjacent to the same feeder line (Alton Downs) with a 22kV supply also available. Again, exact sightings and checks with Ergon will need to be completed at a later design stage.



Figure 21: South Yaamba Fitzroy pump station capacity map

7.2 Renewable energy inclusion

The pumping cost (part D-variable) makes up for a significant portion of the overall operational costs. The provision of a solar (renewable energy) aims to offset this operational charge for customers.

A concept sizing of 1.5 MW has been completed for the entire project (three times the installed peak pumping capacity of the project). This is forecast to reduce variable charges by an estimated 40% through periods of direct solar operation and excess generation revenue.

A detailed timestep analysis is proposed as part of the next project phase. This will determine an optimised renewable energy sizing and technology mix.

An example of a large scale solar installation for the offsetting of pump station power is shown in Figure 22.



Figure 22: Example of large scale solar installation for pump station offset

8 Auxiliary infrastructure

8.1 Roads and access

The general South Yaamba area is serviced through a good network of bitumen and gravel access roads.

Some minor access tracks will need to be constructed to the balance tank infrastructure. Generally, no major transport infrastructure will be required for the broader scheme.

The existing road infrastructure is observed to service the area's agricultural enterprises well, there may be some more local network upgrades required (i.e upgraded B-double access and intersections) in the future with increased demand through additional freight loads.

8.1.1 Level of service change

While no major new road access would be required with the development of this irrigation scheme. In time with the increased demand of service and with land use change the level of service required for maintenance and repairs would be increased.

An example of this is the need to increased unsealed road gradings from twice yearly to three times – given the higher level of traffic and demand usage.

8.2 Buildings

A suitable local office/commercial building is proposed to be used as the scheme's office and workshop base.

8.3 Raw water stock and domestic reticulation system

The addition of stock and domestic water with the irrigation scheme might be an additional community wide benefit the entity way wish to include as part of a future scheme. With the block sizes getting smaller and the growth in blocks sized between rural residential and agriculture around the South Yaamba. This gives rise to a possible demand of raw water piped to each property for market gardens, home orchards and residential garden use.

While this would not yield any largescale measurable benefit, it would allow a cheaper water alternative to treated town water, improve land values and make a larger rural block more attractive with expanded opportunities for the local rate payers.

A raw water reticulation system could be constructed alongside the irrigation scheme infrastructure with a small pumpset located next to the main pumps. A small diameter reticulation system would distributed around the community with a water meter and connection point at the property boundary.

8.4 Communications

The area is serviced with a network of originally Telecom copper phoneline cables. Mobile phone coverage is considered good across the region. 4G coverage is shown in Figure 23.

Scheme infrastructure connection will be through a closed-circuit system with possible SCADA interface through a telephone mobile network.

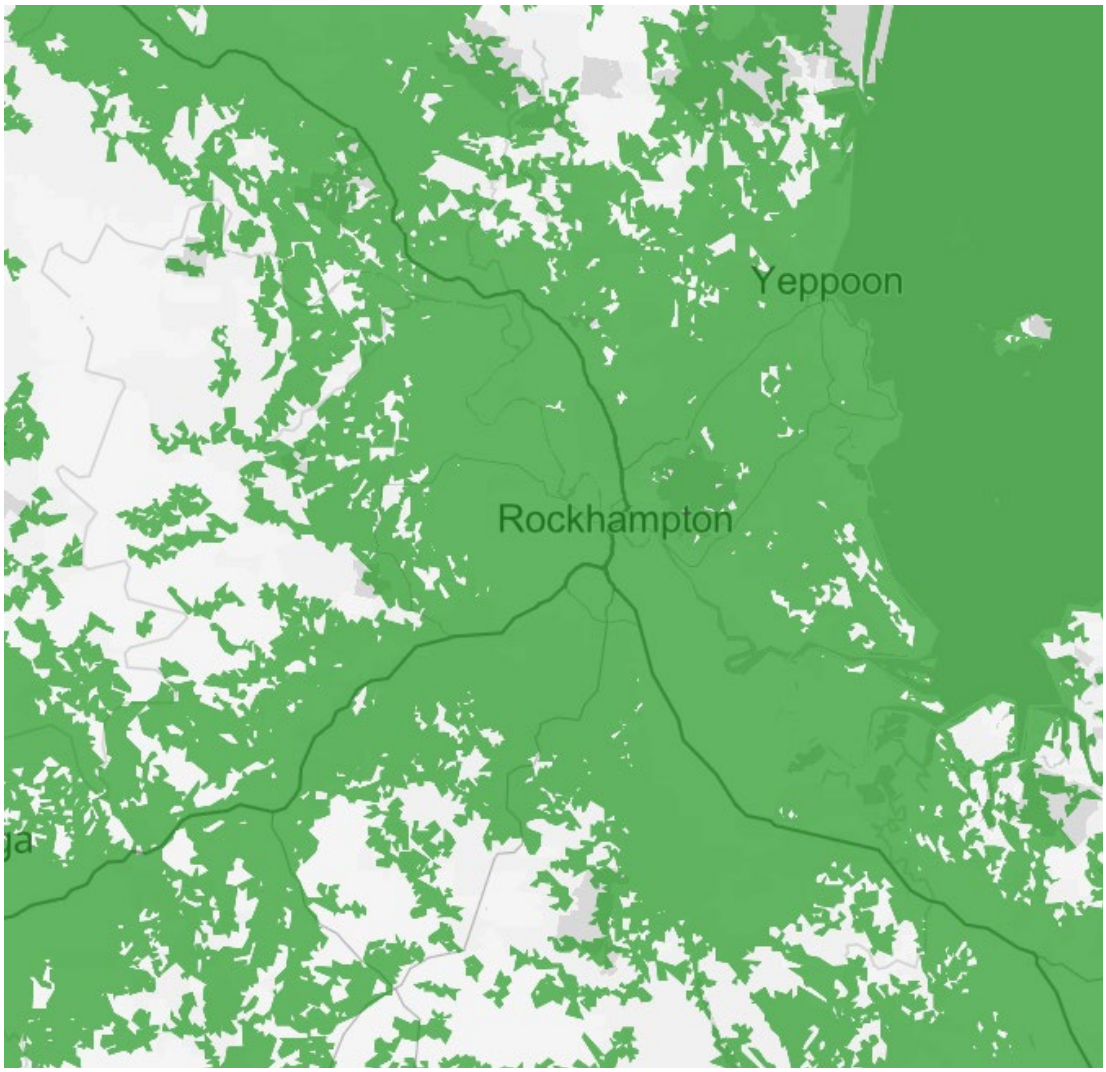


Figure 23: Telstra 4G coverage map

9 Environmental impact

9.1 Pre-construction

Whilst the development of the South Yaamba irrigation project would be considered a small infrastructure project, a number of federal, state and local environmental and planning approvals are required prior to construction. As part of the pre-construction activities, relevant investigations will need to be undertaken in line with the appropriate planning and approvals processes.

9.2 Flora and fauna

Initial desktop assessments of the Wildnet database (The State of Queensland 2022) and the Protected Matters Search Tool (DCCEEW 2023) has identified a number of threatened species listed under the Nature Conservation Act (1992) and the Environmental Protection and Biodiversity Conservation Act (1999) that could be impacted by the South Yaamba irrigation project. There are three main aspects of the project that could impact on listed threatened species; the extraction of water from the Fitzroy River, the construction of water delivery infrastructure and storage facilities and the conversion of habitat from natural and semi-natural ecosystems to irrigated pastures and crops.

The extraction of water from the Fitzroy River and its associated infrastructure has the potential to impact threatened fauna, in particular the federally vulnerable **Fitzroy River turtle** (*Rheodytes leukops*) and the critically endangered **White-throated snapping turtle** (*Elseya albagula*). Further literature studies may determine that the project will require targeted surveys and specialised assessments during the approvals process. With the possibility of referral to the federal government for review under the EPBC Act (1999). Riparian vegetation will also require assessment to determine if infrastructure will impact on threatened flora, fauna and threatened vegetation communities.

The construction of pipelines, pump stations and storage facilities (dams and/or tanks) and the development and conversation of irrigation areas have the potential to remove habitat for threatened flora and fauna and isolate ecosystems. Threatened species and communities could be impacted by the works required to take water from the Fitzroy River to the irrigation areas. Threatened species could also be removed or populations isolated due to the development and conversion of natural and semi-natural vegetation communities into irrigated crops and pastures. The desktop searches have identified the following threatened species and communities that could be present in the area based on range or historic records.

A Nature Conservation Act (1992) WildNet Database search found the following threatened species which could occur within the habitats where piping, pumping and storages are likely to be constructed. These are summarised in Table 11.

Table 11: National Conservation Act (1992) Wildnet database search summary

Type	Common Name	Scientific Name	Species status
Birds	Glossy black cockatoo	*Calyptorhynchus lathami erebus*	Vulnerable
	Squatter pigeon (southern subspecies)	*Geophaps scripta scripta*	Vulnerable
Mammals	Koala	*Phascolarctos cinereus*	Endangered
Reptiles	Grey snake	*Hemiaspis damelli*	Endangered
Plants		*Graptophyllum excelsum*	Near threatened
		Rhaphidospora cavernarum	Vulnerable
		Leichhardtia brevifolia	Vulnerable
		Capparis humistrata	Endangered
		Cycas megacarpa	Endangered
		Cycas ophiolitica	Endangered
		Pultenaea setulose	Vulnerable
		Myrsine serpenticola	Endangered
		Corymbia xanthope	Vulnerable
		Neoroepera buxifolia	Vulnerable
		Cossinia Australiana	Endangered
		Samadera bidwillii	Vulnerable
		Corchorus hygrophilus	Vulnerable
		Stackhousia tryonii	Near threatened
		Tectaria devexa var. devexa	Endangered
		Pimelea leptospermoides subsp. Leptospermoides	Near threatened
		Macrozamia serpentina	Endangered

An Environmental Protection and Biodiversity Conservation Act (1999) Protected Matters Search Tool (DCCEEW 2023) search found the following threatened species and communities which could occur within the habitats where piping, pumping and storages are likely to be constructed. These are summarised in Table 12.

Table 12: EPBC Protected Matter search summary

Type	Common Name	Scientific Name	Species status
Vegetation communities	Brigalow	*Acacia harpophylla* dominant and co-dominant	Endangered
	Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion		Endangered
	Poplar Box Grassy Woodland on Alluvial Plains		Endangered
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions		Endangered
	Weeping Myall Woodlands		Endangered
Birds	Red goshawk	*Erythrotriorchis radiatus*	Endangered
	Squatter pigeon	*Geophaps scripta scripta*	Vulnerable
	Painted honeyeater	*Grantiella picta*	Vulnerable
	Star finch (Southern subspecies)	*Neochmia ruficauda ruficauda*	Endangered
	Southern black-throated finch	*Poephila cincta cincta*	Endangered
	Australian painted snipe	*Rostratula australis*	Endangered
	Black breasted button-quail	*Turnix melanogaster*	Vulnerable
Mammals	Koala	*Phascolarctos cinereus*	Endangered
	Large-eared pied bat	*Chalinolobus dwyeri*	Vulnerable
	Corben's long-eared bat	*Nyctophilus corbeni*	Vulnerable
	Greater glider	*Petauroides volans*	Endangered
Reptiles	Collared delma	*Delma torquata*	Vulnerable
	Ornamental snake	*Denisonia maculata*	Vulnerable
	Yakka skink	*Egernia rugosa*	Vulnerable
	Dunmall's snake	*Furina dunmalli*	Vulnerable
	Grey snake	*Hemiaspis damelli*	Endangered
Plants		*Bulbophyllum globuliforme*	Vulnerable
		Cycas megacarpa	Endangered
		Cycas ophiolitica	Endangered
		Dicanthiuim setosum	Vulnerable
		Eucalyptus raveretiana	Vulnerable
		Leichardtia brevifolia	Vulnerable
		Pimelea leptospermoides subsp. Leptospermoides	Near threatened
		Samadera bidwillii	Vulnerable

To ensure that threatened species and communities are protected, surveys of construction areas will be required. On-farm biodiversity values and the risks of habitat conversion should be managed through the farm assessments, undertaken prior to awarding water. This should include the assessment of proposed irrigation areas during the farm WAP's by a suitably qualified ecologist. Based on the initial desktop assessment, referral to the federal government for review under the EPBC Act (1999) is likely due to the potential for the project to impact on threatened species.

9.3 Drainage and run-off benefit

The development of a greenfield irrigation scheme generally allows movement of water away from the natural waterway catchment and allows for a potential overall environmental benefit from decreased runoff. Furthermore, nutrient loadings and irrigation leaching are also decreased with the irrigation activity well away from water shedding.

9.4 Operations (Farm WAP)

Prior to full operations and customer water usage, it would be recommended to implement and complete farm water access plans (Farm WAP) for each connection. It is proposed that these plans be modelled to what is currently carried out across the Tasmanian Irrigation scheme developments.

A Farm WAP is a management tool demonstrating that the use of water on farm is sustainable and environmental risk is minimised. A Farm WAP must be in place for every property that receives water from the irrigation district. During operation irrigation properties are audited to ensure ongoing compliance with the plans.

Farm WAPs contain soil, water and biodiversity modules and specify management actions where environmental risks associated with irrigation are identified.

Each Farm WAP must cover the area of land directly affected by the use of scheme water and ensure that the land is managed in accordance with any recommendations or restrictions identified in the Farm WAP.

Farm WAPs are completed by pre-qualified consultants authorised by the Minister for Primary Industries and Water. To keep costs to a minimum, Tasmanian Irrigation assists with the preparation of maps and baseline information required to complete Farm WAPs and can arrange for tendering work to the pre-qualified consultants.

9.4.1 Farm WAP delivery process

The Tasmanian Irrigation Farm WAP process is shown in Figure 24. Prequalified consultants complete the plans in accordance with biodiversity, soil and water modules.

Adoption of a similar model on the South Yaamba project may assist in minimising the cost of compliance as while ensuring a sustainable environmental outcome for the scheme district and surrounding environments.

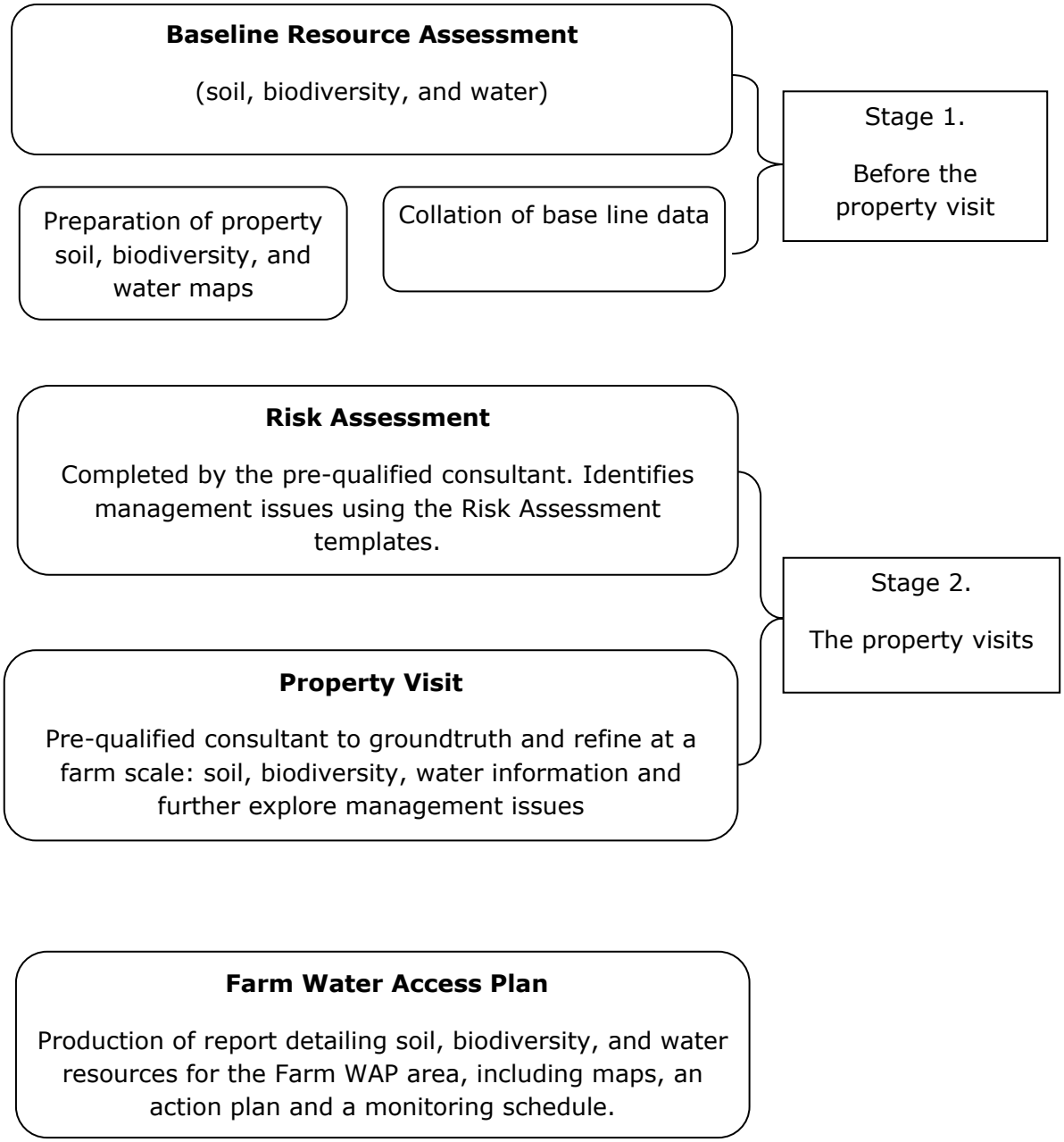


Figure 24: FWAP delivery process

10 Cost estimate

As part of the preferred option design and assessment a totalised cost estimate (capital and operational costs) has been prepared.

The costing estimate (capital and operational) will form an input into the economic and financial analysis for the preferred option which will be completed in the final milestone report.

10.1 Capital costs

The costing estimate methodology is aligned with the Association for Advancement of Cost Engineering (AACE) guidelines for a class 4 estimate. It is noted, however, that the maturity level of project definition does vary across elements of the work.

10.1.1 Estimate accuracy

The expected accuracy range for this AACE class 4 Estimate is within -20% to +40%. This accuracy is considered acceptable for this concept project development. Given the level of project definition and early project phase a 35% contingency (risk) allowance has been applied for the costing.

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Figure 25: AACE cost estimate project definitions

10.1.2 Quantities

The costing is broadly split between the headings of pipelines, pump stations and renewable energy. The pipeline network was itemised, with pipe supply, installation, fittings allowance, crossings, property outlets and pipe sections attributed. Rates were

determined and assigned against their raw units in accordance with the current project definition.

Pipeline quantities were determined using a GIS desktop tool. Pipeline lengths were measured for pipeline installation. Pipe weights were calculated using the manufacturer's weights table for relevant sizes.

The pump stations' costings are broken down by components, civil, mechanical and electrical items. Kilowatt sizing were calculated through preliminary flow and head pumping parameters.

Relevant overheads and additional costing items as directed were also included into the costing.

10.1.3 Development of rates

The unit rates developed to enable preparation of this capital costing estimate have been based upon information drawn from a number of sources, including:

- Previous rates based on similar projects undertaken by Pinion Advisory
- Budget pricing received from material and equipment vendors.

10.1.4 Cost estimate – summary

A summary of the costing is included as Table 13.

Table 13: South Yaamba capital summary cost estimate

Item	Medium Sub-total Cost ($M)
Pipelines	$8.0
Pump Stations & Power Connections	$3.0
Renewable Energy Provision	$1.8
Contractor Costs	$3.8
Proponents Costs	$3.7
^Water Allocation	$0.0
Contingency (risk allowance) (35%)	$7.0
Total DBC Construction Capital	**$27.1**

The detailed breakdown of the capital costing is included as Appendix Five.

Recent case studies have shown a federal and state government funding subsidy of up to 75%, with the scheme users responsible for covering a minimum of 25%. This information is summarized in Table 14.

^The water allocation price has been excluded from the scheme capital costs.

Table 14: South Yaamba customer contribution

Capital cost	ML Demand per Annum	$/ML (pre-subsidy)	Customer contribution	Customer cost ($/ML)
$27.1M	4,420	$6,130	25%	**$1,530**

10.2 Operating costs

10.2.1 Fixed OPEX

Operational costs include three main components: operations, maintenance, and asset renewal.

Estimates for scheme fixed operational costs are listed in Table 15.

Table 15: Pipeline fixed OPEX

Fixed Operational Cost	Estimated Annual Cost	$/ML	% of Fixed Cost
Operations (Including labour, insurances, admin, board and all other fixed scheme costs)	$215,000	49	52%
Scheduled repairs and maintenance	$40,000	9	10%
Unscheduled repairs and maintenance	$30,000	7	7%
Asset renewal levy	$131,000	30	32%
Total fixed operational (part C charge)	**$0.42M**	**$95**	**100%**

10.2.2 Variable OPEX

Variable operating (scheme pumping) costs were estimated for the pump station to calculate the relevant dollars per megalitre based on reasonable combined pump station efficiencies.

Costs were estimated for tariff prices of $0.19 for the pump station connections. Pump station tariffs are summarised in Table 16.

Table 16: South Yaamba variable OPEX pump cost

Zone Reference	ML Demand per Annum	($/ML) Pre-Renewable Energy	($/ML) Post-Renewable Energy
All distribution	4,420	$85	**$50**

10.2.3 Total OPEX

Estimated total operational costs (fixed plus variable) are given in Table 17. There is no assumed discounting or subsidy for the ongoing operational costs of the scheme. All costs are assumed to be covered through the scheme irrigators.

The Part A & B fees will need to be negotiated with SunWater; however it is expected to will be similar to the current Fitzroy water supply charges. Currently this fee is circa $25/ML and is included in the totalised OPEX costs.

Table 17: Total OPEX cost

Zone Reference	ML Demand per Annum	$/ML
All distribution	4,420	**$170**

11 Financial analysis

A financial analysis was completed with this preferred option to gain appreciation of what could be possible with the addition of an irrigation scheme in the South Yaamba area for a typical farm. The analysis has been completed on-farm only, no off-farm or regional economic benefits have been included. This broader work would be included with a detailed business case at a later project stage.

11.1 Current agricultural output

The South Yaamba region produces a diverse range of dryland commodities across industries including livestock cropping, horticulture and perennial horticulture.

The current mix of agricultural outputs for the region have been summarised below:

1) Livestock: Beef cattle with pasture production including lucerne and sorghum.
2) Broadacre cropping: Wheat and sorghum.
3) Perennial horticulture: Lychees and macadamias.

There is some irrigation available in the area (direct take off river) that is currently utilised for agriculture, however the ability for landholders to access this water is limiting future expansion in the broader region.

11.2 Potential agricultural outputs

Access to reliable irrigation water will allow landholders to expand crop enterprises and improve current crop performance and diversify current farming practices. Similarly, access will enable some growers to change their enterprise production to higher value crops. During the on-farm surveys, Pinion discussed with most growers their intent of the expected water usage and changes to farming outputs.

The volume of irrigation water required to produce crops varies depending on the growing season, crop water efficiency, soil type and seasonal conditions. The South Yaamba area experiences a moisture deficit throughout the year resulting in the demand for a high volume of water to grow various crops.

When looking at the EOI results in Figure 8, two landholders expressed an interest in 20ML or less and was not to be used for commercial irrigation purposes.

Based on the land suitability for irrigation summarised in Appendix Two, agricultural outputs that could be potentially grown in the South Yaamba region include:

1) Livestock: Beef cattle with pasture production including lucerne and sorghum (forage)
2) Broadacre cropping: Soybeans, cotton, mungbeans, navy beans and starch grains including wheat, sorghum and maize
3) Perennial horticulture: sweet potato, mangos, rockmelon, capsicum, lychees and macadamias.

Derived from the expression of interests and landholder interviews along with enterprise potential our irrigation agronomist have developed an expected regional crop mix (years 1-5). This mix is shown in Figure 26.

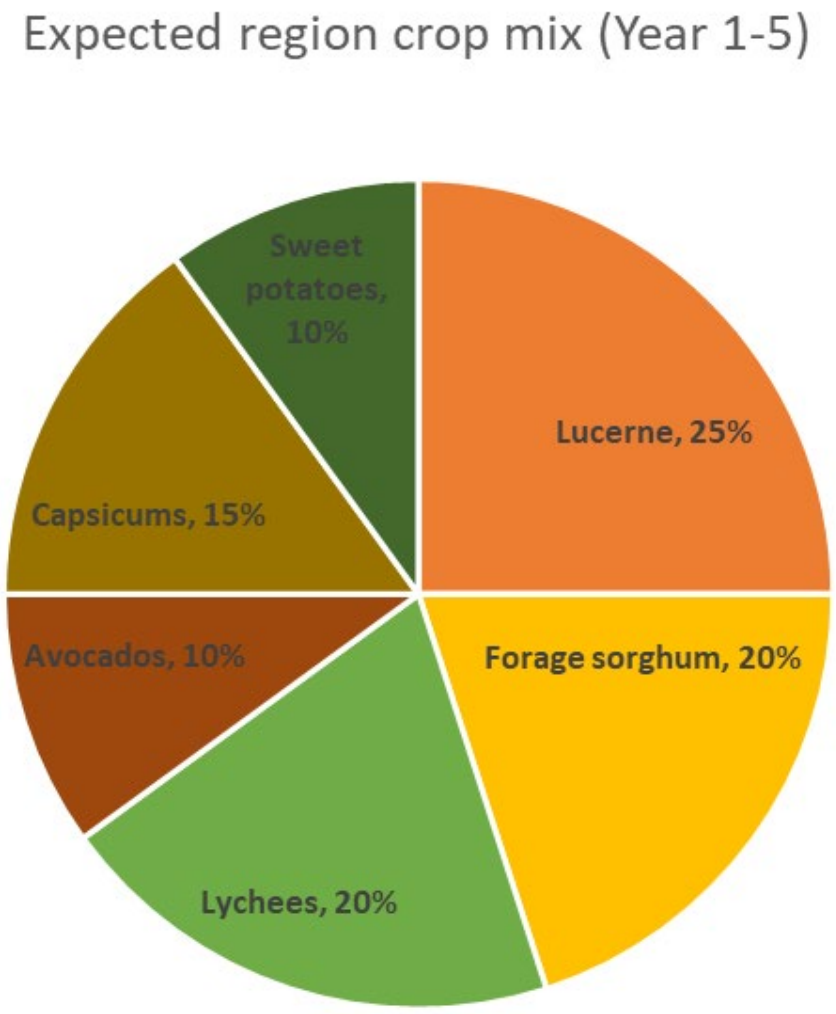


Figure 26: Expected region enterprise mix (year 1-5)

The enterprise mix percentages are outline in Table 18.

Table 18: Expected region enterprise mix (year 1-5)

Crop type	Enterprise	Mix percentage
Annual cropping (hay)	Forage sorghum, Lucerne	45
Annual cropping, vegetables	Sweet potatoes, Capsicums	30
Orchard horticulture	Avocados, Lychees	25

Some perennial horticulture will have an extended period for the trees to reach full production (maturity) which is summarised in Table 19. The trees will begin to fruit earlier, however at a significantly reduced yield. This has been included within the gross margin calculations.

Table 19: Perennial horticulture maturity

Crop type	Years to maturity
Avocados	8
Macadamias	12
Mangos	10
Lychees	10
Citrus	7

It is important that landowners and irrigators complete their own individual assessment for irrigation to consider the following impacts and suitability including:

- Soil types, topography, and agronomy requirements
- Individual enterprise investments required
- Financial performance outcomes
- Market opportunities
- Downstream processing markets and opportunities
- Lifestyle considerations

11.2.1 On-farm capital expenditure

The expected capital expenditure at an on-farm level has been broken down to the following categories:

1. Upfront water cost to purchase water allocation.
2. Irrigation infrastructure.
3. Water storage facilities.
4. Other establishment costs.
5.

An expected cost for irrigators within the South Yaamba region has been based on an average expected investment. Costs are expected to vary between landholders based on a variety of factors including size of investment, system design and overall efficiency.

11.2.1.1 Scheme cost

Section 10 outlines the Milestone 4 capital cost estimate for the entire scheme. A customer contribution has been based on recent case studies having up to 75% federal and state government funding subsidy with a minimum 25% to be covered by the scheme users. Table 20 summarises the expected scheme cost and customer cost.

Table 20: South Yaamba customer contribution

Capital cost	ML Demand per Annum	$/ML (pre-subsidy)	Customer contribution	Customer cost ($/ML)
$26.7M	4,420	$6,000	25%	**$1,500**

The estimated total operational costs (fixed plus variable) are summarised in Table 21. There is no assumed discounting or subsidy for the ongoing operational costs of the scheme. All costs are assumed to be covered through the scheme irrigators.

Table 21: Total OPEX cost

Zone Reference	ML Demand per Annum	$/ML
All distribution	4,420	**$170**

11.2.1.2 Irrigation infrastructure

The main infrastructure choices include micro irrigation for horticulture and centre pivot irrigation systems for broadacre cropping. The estimated cost for irrigators in the region includes:

1. Broadacre cropping: $10,000/ha (centre pivot installation)
2. Perennial horticulture: $20,000/ha (micro irrigation installation)

Prices have increased approximately 40% over the last five years alone due to the importation of irrigation equipment, with influencing factors including the cost of materials and movements in the Australian dollar.

11.2.1.3 Water storage facilities

With access to limited flow from the scheme, potential customers would need the ability to buffer their allocation to store water for their peak seasonal crop requirements on-farm. This also give the ability for additional water security necessary for permanent plantings.

An estimated cost of $300,000 for landholders has been assumed which includes a small (circa 20ML) holding dam and some minor drainage associated infrastructure.

11.2.1.4 Establishment costs

The establishment costs include capital items required for planting and establishing the system excluding water supply. The establishment cost for a perennial tree horticulture crop includes the cost for seedlings, specialised equipment and additional works required. The crop establishment cost for all other enterprises has been included in the Gross Margin variable expense.

Appendix Six includes a detailed breakdown of the cost of establishing long-term perennial horticulture crops.

11.3 Gross margins

Gross margin has been adopted as a financial measure for comparing alternative farm enterprise performance. A gross margin is calculated by subtracting all variable costs. It excludes all other selling costs including commissions and levies. Given gross margin does not include the overhead cost of the operation, it is not a measure of overall business profitability.

Gross margin information for agricultural outputs has been sourced from the Queensland Government's Department of Agriculture and Fisheries information published in 2018 (Queensland Government, 2023). To adjust for inflation, the gross margin has been

adjusted using the Consumer Price Index (CPI). CPI has been summarised on an annual basis in Table 22 (Australian Bureau of Statistics, Mar-quarter-2023).

Table 22: Annualised CPI

Year	CPI % (annualised)
2019/20	1.35
2020/21	1.63
2021/22	4.58
2022/23 to date	7.37

11.3.1 Current gross margins

Figure 27 summarises the gross margin per hectare for Central Queensland from information in Appendix Seven (Queensland Government, 2023).

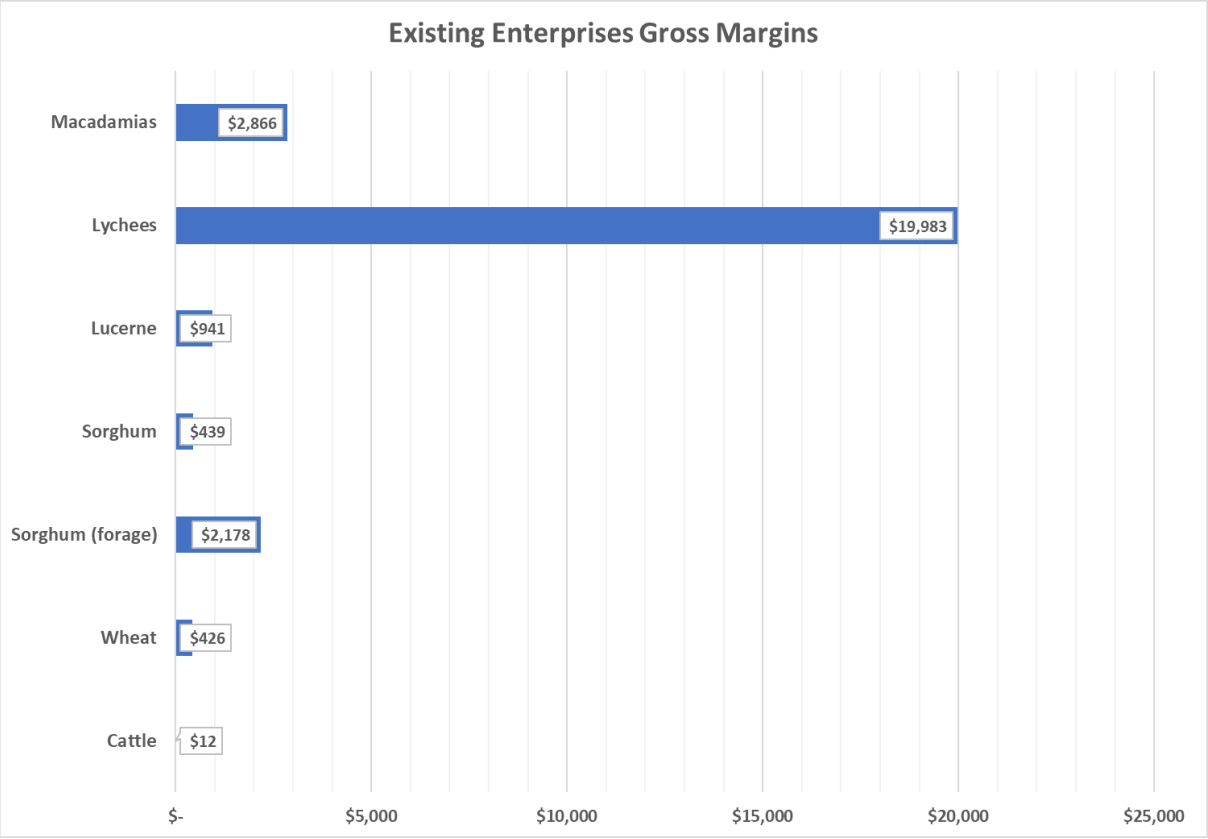


Figure 27: Current gross margins for existing enterprises

The average gross margin for the region is $4,481/ha or $455/ha for dryland and $13,686/ha for irrigated.

Lychees and macadamias are the irrigated crops in this scenario and include a water cost of $44.73/ML and $20/ML respectively.

11.3.2 Potential gross margins

The gross margins for an irrigated enterprise in the South Yaamba scheme have been based on capital expenditure outlined earlier in this section.

The gross margins do not include overhead expenses. It should be noted that when considering incorporating irrigation to a system, additional overheads including labour could be expected. However again this will be variable for each operation.

The assumptions for potential crop gross margins with irrigation include:

1. Gross margin values adopted from information available per designated region with the existing cost of irrigation excluded summarised in Appendix Seven. Production returns may vary when growing in a different region (Queensland Government, 2023).
2. Gross margins values have been adjusted for CPI to March 2023 (Australian Bureau of Statistics, Mar-quarter-2023).
3. Upfront water cost of $1,850/ML and an annual water cost of $170/ML.
4. Broadacre cropping system (centre pivot) 50ha size at $10,000/ha for irrigation infrastructure.
5. Perennial horticulture system (drip line irrigation) 10ha size at $20,000/ha for irrigation infrastructure.
6. Water allocation purchased: 10% additional for broadacre, 30% additional for perennial horticulture. This accounts for some degree of additional water surety; however no exact modelling has been completed as this stage.
7. Water storage facility of $300,000 for all enterprises.
8. Perennial horticulture orchard establishment cost as detailed in Appendix Six.
9. All other crop establishment costs included in gross margins.
10. Perennial horticulture tree crops assume gross margin at 10 years. They do not consider the extended time to maturity.
11. Repayment period of 15 years for irrigation infrastructure to match useful life.
12. Repayment period of 25 years for all other capital infrastructure to match commercial term.

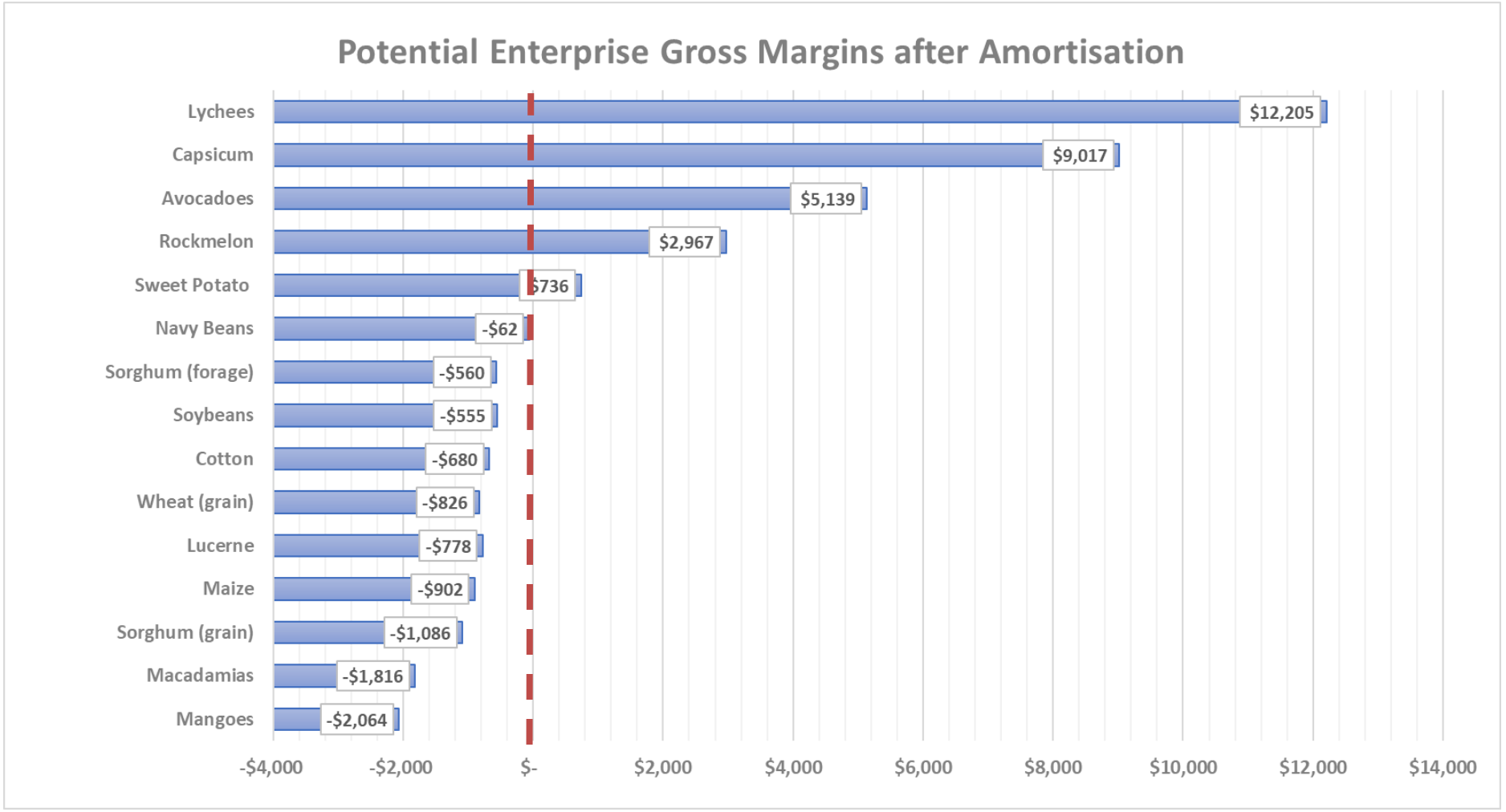


Figure 28: Potential enterprise gross margins

Figure 28 summarises the gross margin per hectare for potential irrigation enterprises for the South Yaamba region from Appendix Seven.

The average existing gross margin for the area is $799/ha. Excluding forage sorghum the margin drops to $455/ha. No forage sorghum is currently farmed in the area, accordingly for economic assessment, $455/ha is adopted as the existing base case. Based on the addition of irrigation water, the potential gross margins show the broadacre crops are below average returns that do not amortise in the given timeframe.

Using the average existing irrigated gross margin of $11,424/ha, potential enterprise options including lychees represent an above average return at $12,205/ha.

Rockmelon, avocados, capsicums, and sweet potatoes show sound returns with the ability to amortise development cost within the preferred timeframe. The gross margin for mangos and macadamias shows a poor result and an inability to amortise within the timeframe.

Access to reliable irrigation water may see the potential crop varieties available in the region increase outside of the scope of this report that may in turn generate higher returns.

The poor returns demonstrated for broadacre crops is caused by the high upfront cost of establishing an irrigated system. This is consistent with what has also been seen with other new irrigation schemes in Australia.

In the past three years there have been significant price increases due to international markets, shipping delays and a falling US/AUS dollar. This has also been exasperated with general CPI increases domestically.

There has been an increased cost to irrigation development in the past three years of up to 60%. Prices have recently stabilised and industry experience has also recently seen a flattening of demand for development work. Landholders should undertake their own due diligence when considering irrigation to understand the individual impacts.

11.3.3 Capital expenditure

The EOI information showed a total effective area for farms able to access water at 7,595ha. Landholders intended to irrigate a total area of 931.5ha with an average available water of 3.5ML/ha.

Based on the potential gross margins, Table 23 shows the average capital cost for developing irrigation across broadacre and perennial horticulture at $35,571.35/ha and $8,158.57/ML.

When adjusted for the 3.5ML/ha from the EOI information, the development cost remains constant at $35,571.35/ha, however increases to $10,163.24/ML. If adopted across the total area landholders intended to irrigate, this would be a total individual farm capital injection totalling $9,467,061 for the region.

Table 23: Average capital cost for EOI

	Average from Gross Margin	Average from surveys
ML/Ha	4.4	3.5
Size (Ha)	31.3	25.1
Total capital cost ($)	$1,114,569	$894,723
$ per Ha	$35,571	$35,571
$ per ML	$8,158	$10,163

Additional expenditure outside of the gross margins may include:

- Livestock purchases
- Additional machinery or use of contractors
- Additional labour units
- Additional overhead expenses

11.3.4 Land values

The current land values in the South Yaamba region have been trading around the $7,000/ha. When considering the potential uplift from irrigation investment, the average cost of upfront water, water holding infrastructure and establishment costs included. The cost of irrigation infrastructure and establishment costs have not been included due their depreciating nature.

Table 24 shows the expected uplift from $7,000/ha to $15,365/ha. Irrigation development in other regions have shown a multiplier effect can apply from money spent due to the additional earning capacity and future opportunities. When assuming an additional 20% above the capital expenditure, this increases land values to $18,438/ha.

Table 24: Area land values

Land value	$/Ha
Current land value	$7,000
Potential average land value	$15,365
Land value adjusted (20%)	$18,438

11.4 Preliminary cost benefit analysis

11.4.1 Background

A preliminary cost benefit analysis (CBA) has been completed following from the on-farm analysis work completed.

The CBA analysis has been completed using information provided from Marden Jacob and Associates (MJA). MJA are industry leading economics and analysis and were directly involved in the preferred options and business case developments with the Tasmanian Irrigation development work over the past 15 years.

The purpose of an economic analysis is to assess the project on its financial merits and determine if the cost in development would reflect a financial beneficial outcome.

11.4.2 Assumptions

The following assumptions have been included for this preliminary CBA:

- Total water sales of 4,420ML of water over demand period as per Figure 29.
- Construction period of one year and operations beginning in year two
- 20-year project period of appraisal
- Discount rate: 7%

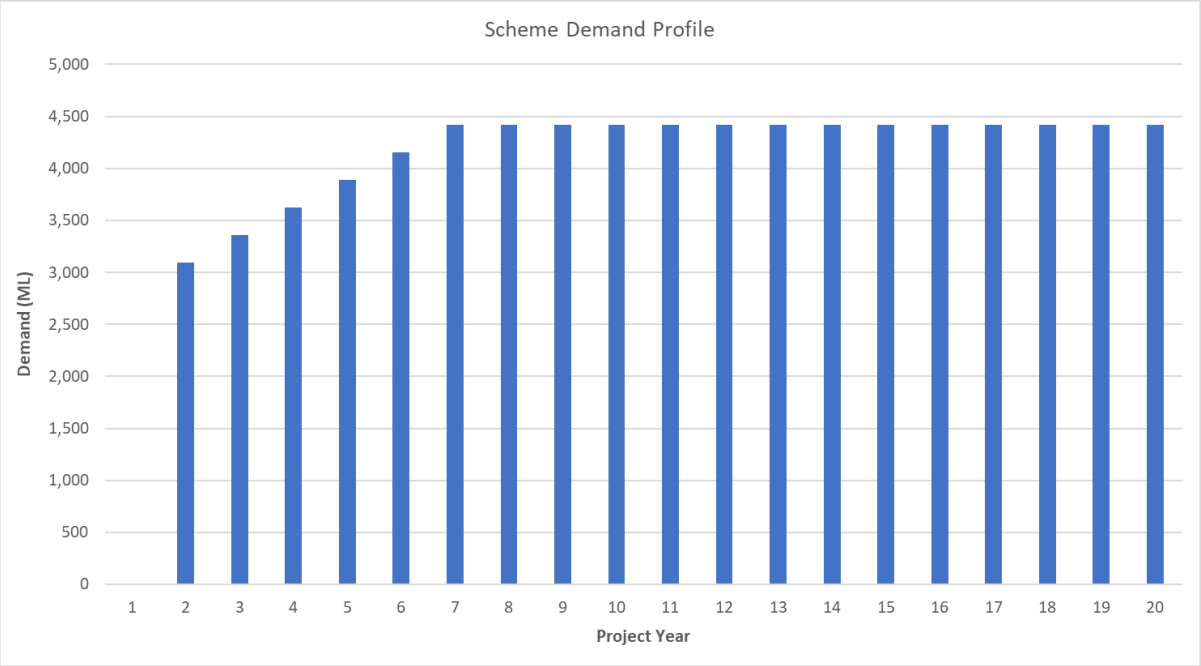


Figure 29: Scheme proposed demand schedule

11.4.3 Revenue benefit

The CBA revenue assessment has assumed benefit with a crop mix and makeup as given in Figure 26. Most of the crop mix is identified as lucerne as is currently used. With a reasonable percentage of water assumed to be utilised on vegetable and horticultural.

11.4.4 Scenarios and summary

Five scenarios were tested for this analysis with their summary included in Table 25.

Table 25: Preliminary cost benefit analysis scenarios

Scenario Number	Scenario	Comment
1	Base (No uplift & WA included)	No uplift in margins but assumed % as per Figure 26
2	Uplift (10%)	10% uplift commencing in year 5 and over 10 years (ie 2% increase per year cumulative)
3	Uplift (20%)	20% uplift commencing in year 5 and over 10 years (ie 4% increase per year cumulative)
4	Excluding Water Allocation	No uplift but excluding capital cost of entitlement
5	Base (No uplift & WA included) with 4% rate	Base case but assuming 4% rather than 7% real discount rate

The model results are summarised in Table 26 including reporting for the net present value, benefit cost ration and internal rate of return.

Table 26: Economic analysis summary

Scenario	Net Present Value ($000's)	Benefit Cost Ratio (BCR)	Internal rate of return (IRR)
Base (No uplift & WA included)	8,384	1.22	9%
Uplift (10%)	11,222	1.30	10%
Uplift (20%)	14,061	1.37	10%
Excluding Water Allocation	13,341	1.41	11%
Base – No uplift & WA incl. @ 4%	37,362	1.90	10%

Under all scenarios, including the base the project is seen to have a positive BCR. This means if the scheme is funded and constructed it would generate a direct net economic benefit under all modelled scenarios evaluated. The benefits are directly attributed to the farmgate margins generated by a new irrigation scheme. Wider socio-economic benefits are not included in this cost benefit analysis.

11.4.5 Water allocation

The preferred option assessment report was revised from its July 2023 submission to exclude the water allocation cost of $1200/ML.

Currently there is approximately 30% of allocation held by existing growers (within the expression of interest pool) who would not need to pay for any allocation however who would benefit from the scheme infrastructure to transport it. The previous water allocation was assessed as an approximant market price.

The preliminary CBA reported within its sensitivity analysis exclusion of the water allocation ($1200/ML), which does improve the economic assessment does not change the outcome substantially.

11.4.6 Infrastructure changes

There are other changes which could be made to the scheme to change the infrastructure inclusions, which could adjust the final cost and sensitivity of the analysis.

An example would be the exclusion of the renewable energy package. This would further reduce the capital cost (subsidised grower contribution) $130/ML. However the trade-off would be an increased pumping cost attributed for the life of the scheme.

This preferred option design and associated costing provides an appropriate infrastructure solution for the initial requested demand. It is believed it also provides the correct scale of the area benefit to the demand measured in terms of infrastructure $/ML. A detailed business assessment would further investigate and refine this benefit with a feedback demand assessment to customers to refine the infrastructure need.

11.5 Wider area benefits

While wider area benefits are not included in the cost benefit analysis there are additional social and intangible benefits linked to the development of these types of schemes. A directed impact assessment to investigate these benefits more broadly would be described as part of a detailed business case.

11.5.1 Employment

The area will see additional direct employment on-farm through more intensive agriculture production enterprises such as vegetables and horticulture. These may be as many as 10 full time equivalent positions, including farm hands, harvesting labour and associated on farm jobs.

Additional employment will also be created in the regional farm dependant economy and are estimated to be a ratio of 2-3:1. With one on-farm FTE providing 2 to 3 FTE in the community through the supply of goods and services in the individual business and from the downstream processing of farm produce. These additional jobs are estimated to be an additional 20 FTE persons.

11.5.2 Downstream processing

Depending on the nature and scale of the goods produced from a new agricultural irrigation project there can be significant downstream processing facilities associated with the installation of a new scheme.

An example of this is the processing of tomatoes, alongside the harvesting and processing of fresh tomatoes there are additional value add processes which create jobs and industry with the product. Out of the season products such as sauces, powders and paste can be extracted and processed alongside in season.

The downstream processing prospects further create a stable and socio-economic benefit stimulating additional jobs and industry outside of the on-farm jobs.

11.5.3 Resilient farm businesses

The addition of irrigation to a dryland farm operation gives new opportunity to grow higher value crops and to yield greater volumes. While this is captured in the margin

analysis, there is also an intangible benefit of a more resilient business which is able to be more adaptable and flexible in their operations. It places their business in a better position to offer longer term contract supply to larger customers and opportunity which otherwise would not be seen as possible. Again, this influence decision making on-farm about labour, employment and general business decision making which ultimately give a positive area benefit.

11.5.4 Broader stock and domestic scheme

As discussed in section 8.3 a possible wider community benefit which is difficult to estimate in terms of economic benefit is the inclusion of a regional stock and domestic pipeline to small property holdings.

A broad raw water supply scheme which could sit adjacent to the irrigation scheme (seen in many of the Goulburn Murray Water irrigation areas) would supply a cheaper water product to small landholders who could run market gardens, small orchards or the like and are seeking a small volume of water but are cost and physically prohibited to access due to their location. A strategically placed scheme in either a new or developed estate which Council support could enable an attracts small land and water holding package for a region.

11.6 Discussion

The gross margins after amortisation for the proposed South Yaamba scheme show a limited number of potential enterprise options with sound returns. This is not unlike other assessed returns of new irrigation schemes in Australia. The main drivers of the poor returns have been limited by potential gross margin returns and the cost of establishing the farm irrigation setup.

Table 27: Assessment of GM against selected enterprises

Enterprise	Enterprise Mix	Net Margin $/ML
Lucerne	25%	-104
Forage sorghum	20%	-203
Lychees	20%	2,631
Avocados	10%	975
Capsicums	15%	2,829
Sweet potatoes	10%	59
Total	**100%**	**987**

The capital cost was annualised (over 40 years with a 5% interest rate) to make a more fair comparison with the determined gross margins, and is calculated as **$110/ML per annum.**

Changes to the upfront water cost show there is little effect to the overall gross margin return when changing the cost to purchase water. The calculated figure of $1,550/ML (excluding water allocation) for South Yaamba is consistent with recent schemes in Tasmania:

- Swan Valley commenced in 2018: $1,500/ML purchased predominantly for horticultural, viticultural, and merino breeding operations.
- Northern Midlands expected commencement date October 2025: $1,450/ML purchased predominantly for broadacre cropping, lamb and cattle finishing operations.

The gross margin dataset for the individual enterprises were sourced from the Queensland Government, Department of Agriculture, Fisheries and Forestry (DAFF). The assessments were viewed as a complete cost of the establishment of their individual farms. For an individual grower to make an informed decision each would need to undertake their own assessment and financial analysis.

As is seen in Table 27 summary the margins of the scheme are driven by higher value crop types such as lychees and capsicum. There is material risk around this project relying on one or two enterprises. A more detailed water demand assessment with the landholder would need to be completed with the projected costs to further validate and benchmark the renewed proposed enterprise mix if the scheme were to proceed.

The case studies presented on Tasmanian Irrigation schemes including the Swan Valley and South East irrigation schemes highlights the change irrigation can bring to a region. Access to water has enabled landholders to expand or diversify production. This has led to greater drought resilience and has transformed the viability of what were considered marginal areas.

It would be expected that with access to reliable irrigation water, the potential enterprise options would expand for the region as highlighted in the Tasmanian case studies.

Other benefits that have not been included in this report include the net benefit on an individual farm basis. It would be beneficial for additional survey data from landholders to capture the current operation, expected investment and changes to enterprise including additional labour. Additional reporting examining the net benefit for the scheme would highlight the overall regional benefit including additional revenue expected and an increased workforce.

12 Case studies

Tasmania has demonstrated over the past forty years the ability to develop and deliver high-surety irrigation water to Tasmanian landowners. Tasmanian Irrigation was established in 2008 to take over management of several existing schemes and establish new projects. Since its establishment, Tasmanian Irrigation has delivered 15 new irrigation projects through Tranches 1&2 and advanced planning on a further five projects with Tranche 3.

Irrigation has transformed the agricultural landscape for Tasmania, allowing farmers to expand their farm production through extensive intensification and diversification. Changes to production have driven key to the state's economic growth and created additional jobs at a regional level. Commsec have ranked Tasmania again on top of the list of state economies against the State of State report, this due to their equipment investment, dwelling starts and low unemployment. Extensive development and investment in agriculture, fisheries and dairies have contributed to continued economic growth.

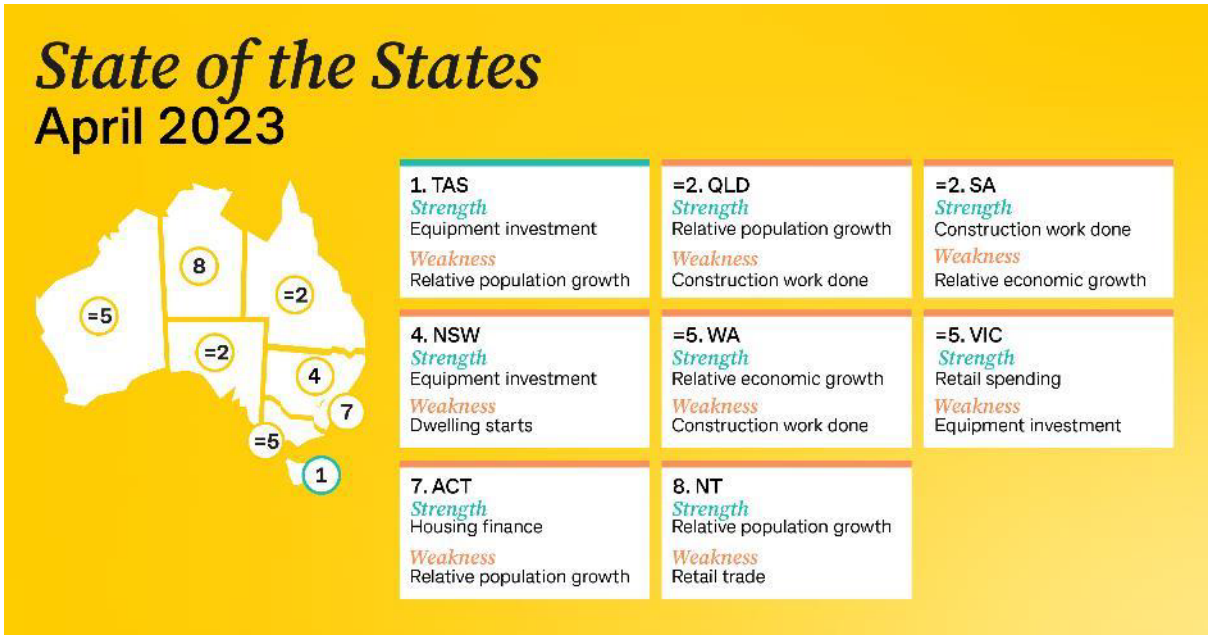


Figure 30: Commsec State of State report (May 2023)

The Tasmanian Government sees sustainable irrigation growth in Tasmania as a key element of their Agri-Food Plan that aims to grow the value of agriculture to $10 billion by 2050. The target is more than double the growth rate experienced by the sector over the past 20 years. While ambitious, in 2022 the sector saw a value exceeding $3.5 billion.

We have included a summary of three irrigation schemes in Tasmania (Figure 31) which highlight the potential they give to an area like South Yaamba.

South East Irrigation Scheme	• 7,631ML • First stage operational from 1985 (three stages) • 252 customers supplied • Grapes, vegetables, perennial fruit crops
Swan Valley Irrigation Scheme	• 2,000ML • Operational in 2018 • 20 customers supplied • Grapes, Walnuts
Dial Blyth Irrigation Scheme	• 2,885ML • Operational in 2015 • 44 customers supplied • Grapes, vegetables, perennial fruit crops

Figure 31: Scheme case studies snapshot



Figure 32: Engagement and education is key during change

12.1 South East Irrigation Scheme

The South East Irrigation Scheme (SEIS) first commenced in 1986, delivering water to the Coal River district. The Coal River district is one of the driest catchments in the State with an annual average rainfall of 500mm – 700mm.

The region was traditionally broadacre farming, predominantly wool, fat lambs, beef and cropping of oats and barley. Pressure from farmers for increased water availability led to the development of the SEIS delivering 2,650ML under Stage 1. This water allowed landholders to introduce or expand their irrigated cropping and animal grazing enterprises.



Figure 33: SEIS location

With access to reliable water, the Coal River Valley was identified for its potential to grow horticultural crops due to its cool climate and hills to the north and east offering protection from westerly weather systems. The land use has since evolved to include high value crops including perennial fruit crops, vegetables, poppies, turf, wine grapes, poultry industries and specialist seeds. The change to the region has seen the scheme expanded over an additional two stages increasing the volume of water and region accessed.

Stage 1 – Operations commenced in November 1986 with 2,650ML delivered to 79 irrigators. Water was supplied to the Coal River District, along Coal River Valley to Richmond.

Stage 2 – Operations commenced in May 1992 with 1,981ML delivered to 96 irrigators. Water was supplied to the Richmond, Dulcot and Cambridge areas. Initial water sales cost of $2,700/ML.

Stage 3 – Operations commenced in September 2015 with 3,000ML delivered to 77 irrigators. Water was supplied to the Tea Tree, Campania, Orielton, Pawleena, Penna, Sorell and Forcett areas. Initial water sales cost of $2,700/ML.



Figure 34: New vineyard developments are a common sight in the Coal Valley

A survey completed in November 2008 by the Coal River Products Association detailed the economic benefit from agricultural intensification. At the time of the survey, Stage 1 and Stage 2 were complete. The regional investment was around $100 million over the last 20 years predominantly led by investment in stone fruit and fresh vegetable production. In 2008, the value of production for the region was estimated at $83.06m. The wage growth for the area was substantial, with approximately $27 million spent in 2008, predominantly led by the additional labour force required in intensive horticulture.

Since the delivery of Stage 3 of the SEIS in 2015, the diversification of agriculture has continued to expand. There has been significant investment in large developments across the region from international and interstate buyers, particularly in the vineyard and stone fruit industries. Land values have increased exponentially, including dryland properties given the demonstrated value of potential from water investments.

12.2 Swan Valley Irrigation Scheme

Tasmania's Swan Valley Irrigation Scheme delivered water to one of the driest areas of Tasmania that commenced in January 2018. Water was delivered to irrigators on the East Coast of Tasmania from Cranbrook to Swansea shown Figure 35, with water pumped from the Swan River during winter and stored in Melrose Dam.

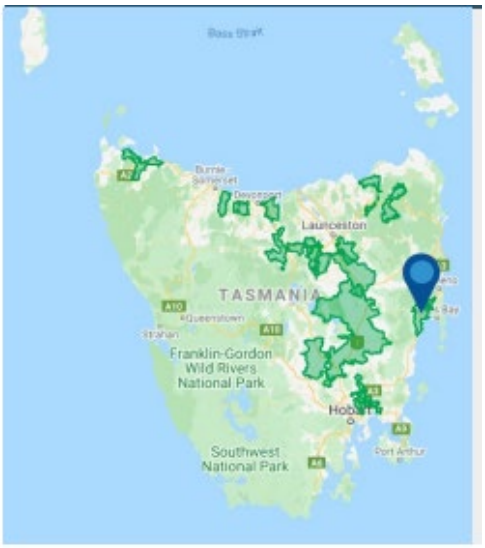


Figure 35: SWAN location

The scheme delivered 2,000ML capacity at an initial water sales cost of $1,500ML to 16 landholders. Scheme water was delivered to primary production including vineyards, orchards, pastures for livestock finishing, nuts and other cropping.

The region has an average annual rainfall of 587mm that is predominantly summer based. The climate remains mild however faces extended dry periods because of westerly weather patterns. The East Coast has traditionally been a strong superfine merino wool breeding region.



Figure 36: Dryland grazing (pre irrigation)



Figure 37: Sheep grazing on irrigated Lucerne pasture

Due to the temperate climate, vineyard development began in the region in the late 1980s and expanded significantly into the early 2000s. The diversified income stream saw exponential benefits for farmers ability to manage droughts, however expansion was limited by water accessibility.

Since the development of the scheme, the agricultural production for the region has expanded significantly. The area has seen approximately 150ha of new vines planted across several farms, with the majority expanding the existing operations. Landholders have also invested in centre pivot irrigation predominantly for lamb finishing and cash cropping. Without access to reliable water, these operations would not have been possible for the region.

Due to the early age of the scheme, the overall benefit for the region has not been quantified, however the agricultural output for the region alone has increased substantially. Additional labour on-farm and contractors has expanded to meet output. The East Coast, or 'The Great Eastern Wine Drive', has seen an increase in the number of cellar doors as well as other ancillary tourist businesses further supporting the growth of the region.

12.3 Dial Blythe Irrigation Scheme

The Dial Blythe Irrigation Scheme commenced in May 2015, delivering 2,885ML to Penguin, West Pine, South Riana, Cuprona and Howth in North West Tasmania. The region was well-regarded as having some of the state's most fertile ground supporting vegetable growers and dairy farmers. The scheme was constructed to allow a more diverse range of agricultural activity, including vegetables, poppies, pyrethrum, berries, and pasture for livestock finishing and dairy production.

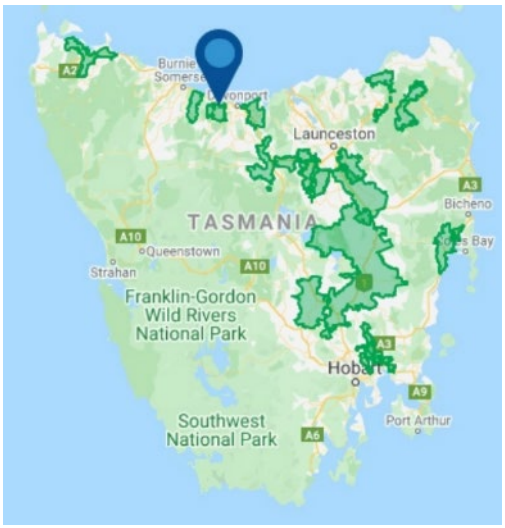


Figure 38: DBIS location

The access to reliable water allowed farmers to capitalise on their location being close to market, including shipping ports and local processing facilities. Water was delivered to 44 irrigators with an initial water sales costs of $1,200/ML.

During the construction period, the Dial Blythe scheme created more than 50 full time jobs. It was expected to create 70 direct and 35 indirect farm jobs that would further positively impact the North West and wider Tasmanian economy.



Figure 39: Irrigated annual cropping



Figure 40: Polytunnel with raspberry production

13 Governance, implementation and risk

13.1 Governance

Successful implementation of a large project requires a good governance arrangement. Governance includes the initial project team setup, implementation strategy, staffing, procurement guidelines and leadership.

The functional use of governance will be a key to the full success, cost efficiency and management of the project, from feasibility through to completion and operations.

Alongside good governance, clear and transparent stakeholder engagement, across the project timeline, will be essential in ensuring project success.



Figure 41: Good governance cornerstones

Table 27 shows different governance arrangements with advantages and disadvantages of each model. A governance recommendation is not given for the South Yaamba project at this stage. The matrix is provided to simulate as a discussion prior to the finalisation of this document.

Table 28: Governance matrix

Governance ownership	Example	Advantage	Disadvantage	Comment
State Government GBE	SunWater Tasmanian Irrigation	• Relevant skills based within organisation • Specialised procurement arrangements • Differentiation from community • Strong balance sheets	• Differentiation from community viewpoint	A special created GBE Unit specific for irrigation development could be developed
Local Council	Regional recycled water schemes Proston Rural Water Supply Scheme (D&S)	• Strong balance sheets • Some technical capability within Council which can be leveraged	• Cyclic nature of Council elections	Strong interest from RCC to proceed as proponent is noted
Community entity ownership and management	Local management arrangement (LMA) SunWater transferred irrigation schemes	• Potential for more local based solutions • Cost effective cooperative local management	• Community members become a target under difficult circumstances • Difficulty to meet and manage regulatory needs • Lack of strong balance sheet	Arrangement is an alternative but will require dedicated locals with political connections
Community entity management only (publicly owned infrastructure)	VIC and NSW local examples Western Murray Irrigation	• Cost effective cooperative local management	• Community members become a target under difficult circumstances • Limited to undertake large capital upgrades from regulatory point of view	Generally unsuitable for a new greenfield irrigation scheme
Fully private	Private individuals and syndication schemes	• Less constrained on decision making process	• Lack of governance for large scale project development	Generally unsuitable for a new greenfield irrigation scheme

13.2 Implementation and risks

A significant tool in success of a new greenfield irrigation scheme is the implementation plan for how and when to progress the stages of development. Figure 42 shows the nominal project phases and respective outcomes for an infrastructure project.

The South Yaamba project is at a pre-feasibility stage (Table 28). The deliverable outcome for this project is to prepare a preferred option report.

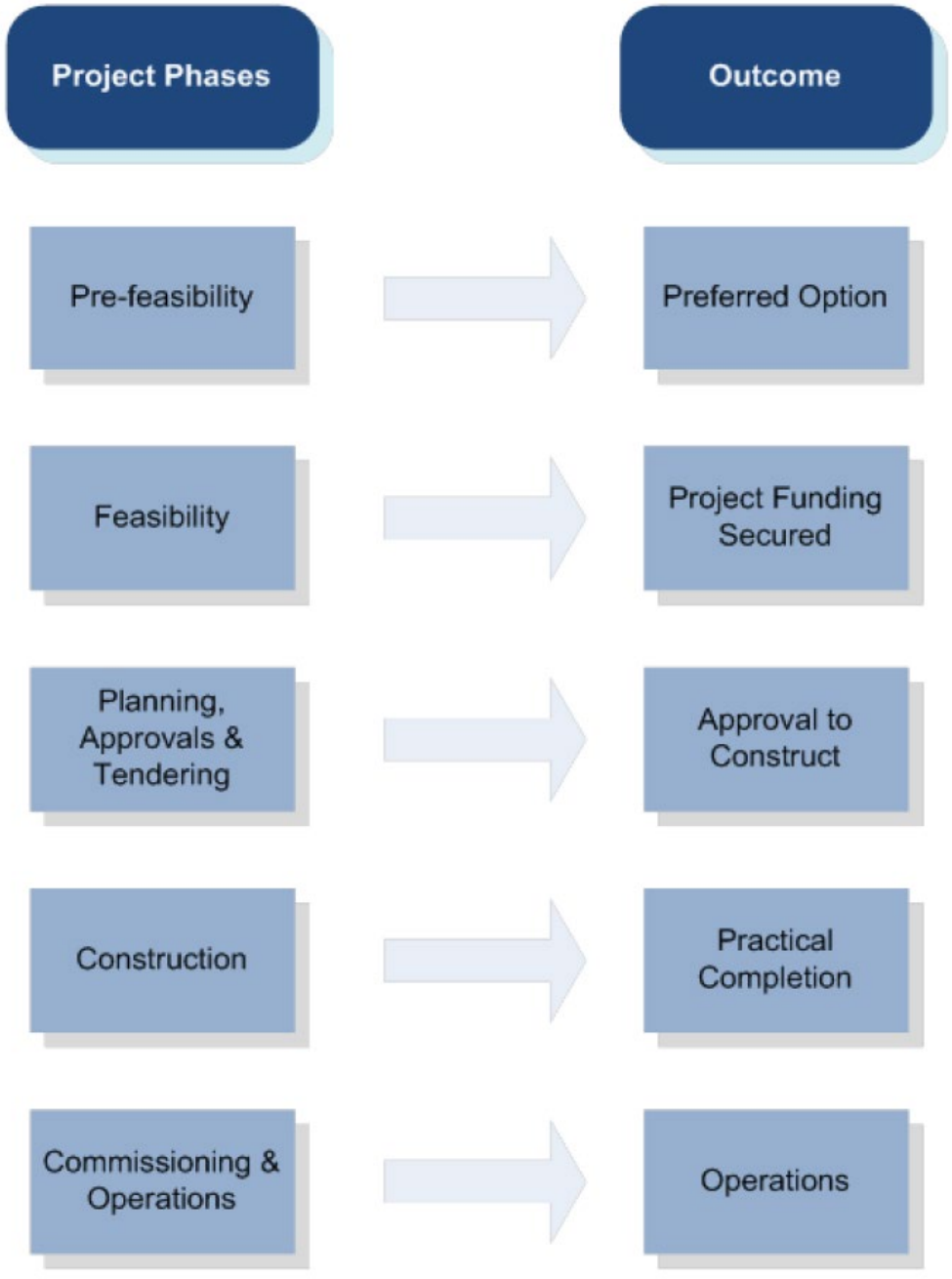


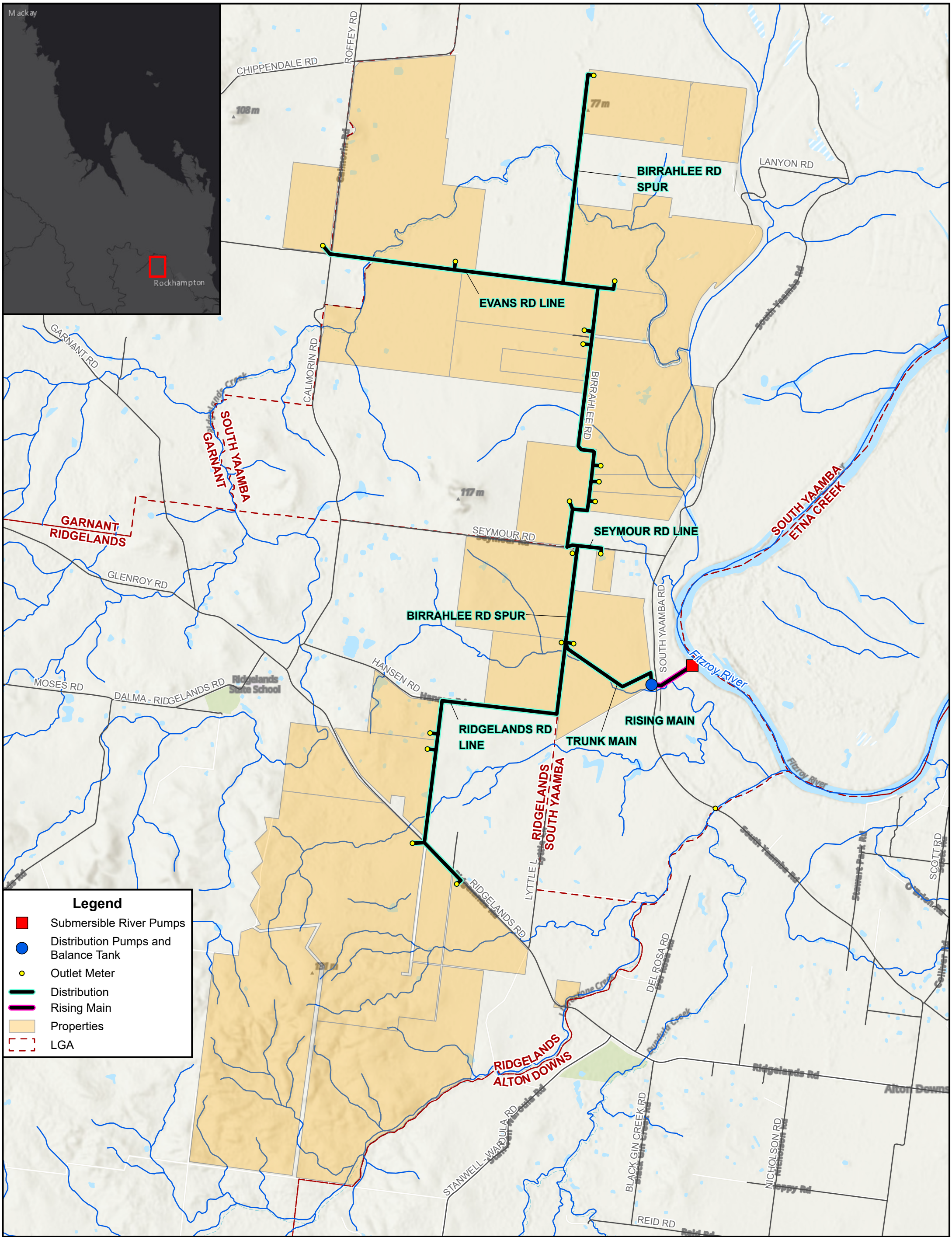
Figure 42: Implementation phases for infrastructure projects

Table 29: Implementation roadmap

Project Phase	Outcome	Key stakeholder engagement	Key activities	Potential risks & fatal flaws	Learnings from experience
Pre-feasibility	A preferred option highlighting a potential irrigation scheme development	Potential scheme customers	• Initial expression of interest • Prepare potential local options assessment	• Further develop prepared options • Assessment and test viability and confirm funding	• Expression of interest often higher than sold water sales • Scheme pre-feasibility design may look very different to final developed scheme
Feasibility/ Business Case	A comprehensive go or no-go document to obtain funding and progress next project gateway	Scheme customers, local industry, local authorities, funders	• Water sales expression of interest • Further develop prepared options • Assessment and test viability and confirm funding • Water sales (optional – early process)	• Low expression of interest in water • Low benefit cost ratio • No available funding	• Different methods with alternative risk appetites • Local champions who have community influence and recognition a key to promoting scheme understanding, confidence and driving water sales
Planning, design, approvals and tendering	Due diligence assessment of approvals and contractor selection	Local, state and federal authorities, customers & landholders	• Water sales finalisation • Undertake engineering due diligence activities (geotechnical, hydrology) • Obtain all relevant local, state and federal planning, environmental and cultural heritage approvals • Tendering and Contractor selection • Procurement	• Misalignment of water sales to expression of interest • Scope creep resulting from changed capital requirements • Planning/approvals delay or rework concept again possible increasing capital • Landholder & access cooperation • Tender prices higher than expected	• Often sold water sales are lower than expression of interest • Earlier implementation of design and approvals to project including close client impact and parallel design making • Continued stakeholder engagement • Break project up into portioned pieces for suitable contractors
Construction	A successfully constructed and operating irrigation scheme to design parameters	Contractors, suppliers, customers & landholders	• Scheme infrastructure construction • Contract management • Contractor oversight	• Landholder & access cooperation • Construction timeline delays (inherent conditions)	• Appropriate data and design information captured prior to contract award • Continued stakeholder engagement with contractor collaboration
Commissioning & operations	Defect free and operating scheme serving customers	Scheme customers	• Post construction commissioning of infrastructure	• Defects and liabilities • Design requirements	• Ensure wholistic commissioning plan completed with full design parameters tested

14 Appendices

14.1 Appendix One – South Yaamba Irrigation System concept drawings



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CRC Northern Australia

South Yaamba Preferred Option Concept Site Layout

Date: 27/06/2023 Job reference: 27COOPR-SOUTH-16308 Drafter: MI

Spatial grid datum and projection: GDA 1994 MGA Zone 56

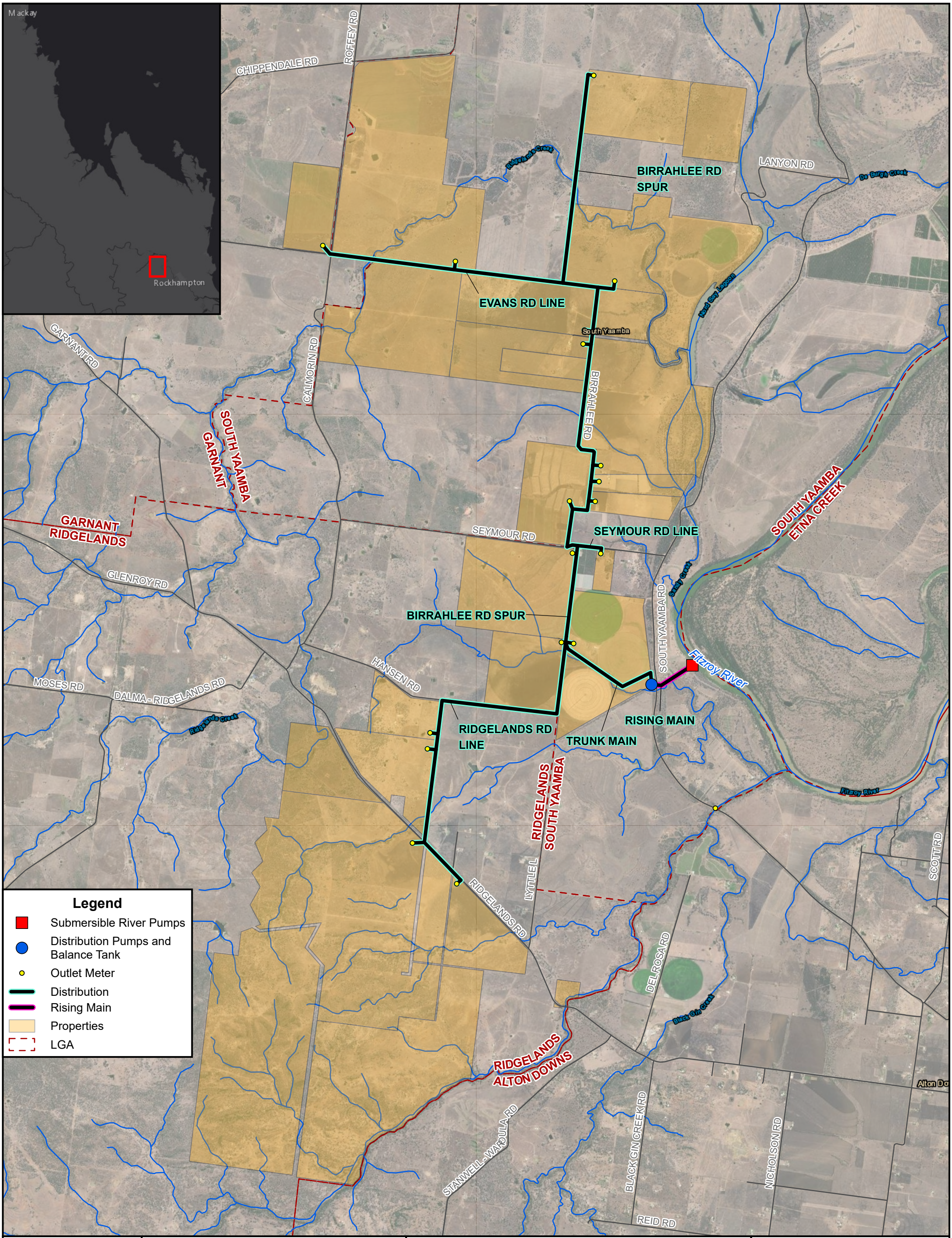
Imagery: Esri, HERE, Garmin, USGS, Livingstone Shire Council, Department of Resources, Dept.of Environment and Science, Esri, HERE, Garmin, Foursquare,

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0 1,000 2,000 m

1:48,000 @ A3



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Spatial grid datum and projection: GDA 1994 MGA Zone 56

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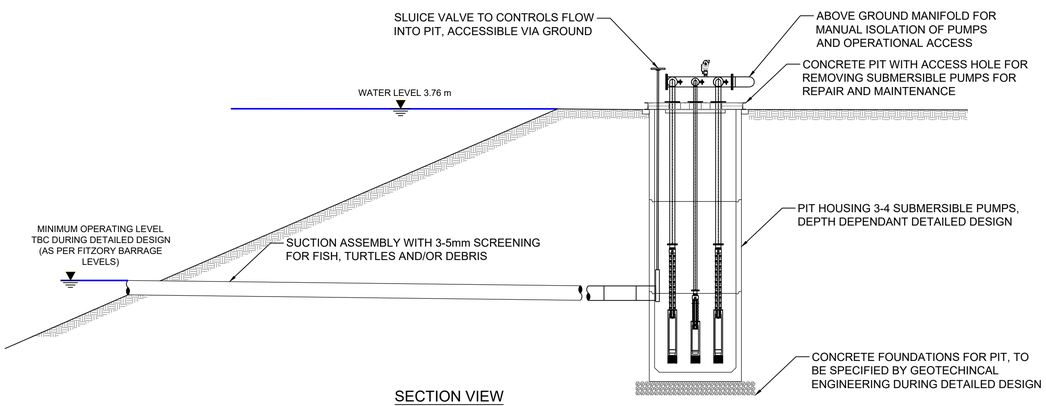
N

0 1,000 2,000 m

1:48,000 @ A3



LOCATION PLAN
SCALE: 1:250 (A1)
SCALE 1:500 (A3)



SECTION VIEW
NTS

LEGEND

- PIPE LINE & FLOW
- EXISTING WATER COURSE
- EXISTING FENCE
- PROPERTY BOUNDARY
- FENCE
- POWER SUPPLY LINE
- ROAD BOUNDARY
- 1 — PHOTO LOCATION DIRECTION & REFERENCE NUMBER

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PHOTO 1: ACCESS POINT FOR SUBMERSIBLE PUMPS ALONG FITZROY RIVER



PHOTO 2: VIEW UPHILL FROM SUBMERSIBLE PUMPS



PHOTO 3: VIEW DOWNHILL TOWARDS FITZROY RIVER



PHOTO 4: EXAMPLE OF SWITCHROOM STORAGE CONTAINER ON STILTS FOR FLOOD LEVEL REQUIREMENTS

PRELIMINARY
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-2.5 0 2.5 5 7.5 10 12.5 25m

SCALE 1:250 ORIGINAL SIZE A1
SCALE 1:500 SIZE A3

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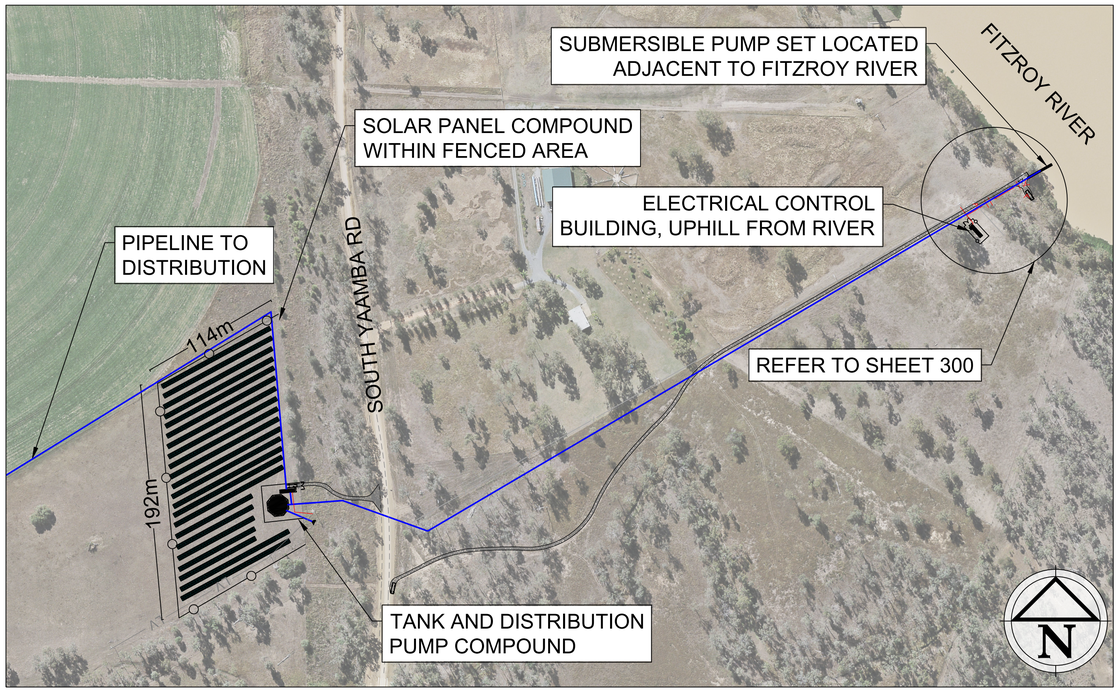
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PROJECT REF.:	27COOP-SOUTH

CLIENT: SOUTH YAAMBA PROJECT

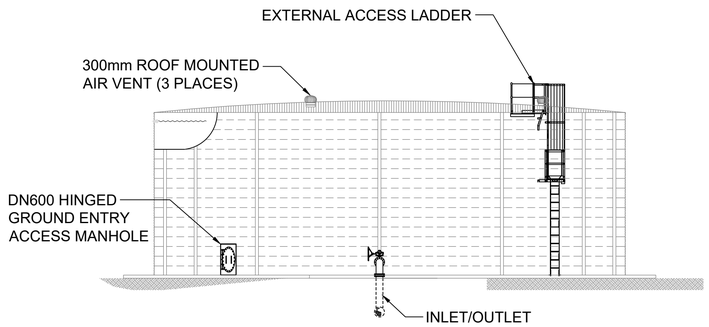
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PRELIMINARY CONCEPT PUMP STATION

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OVERALL TANK LOCATION PLAN

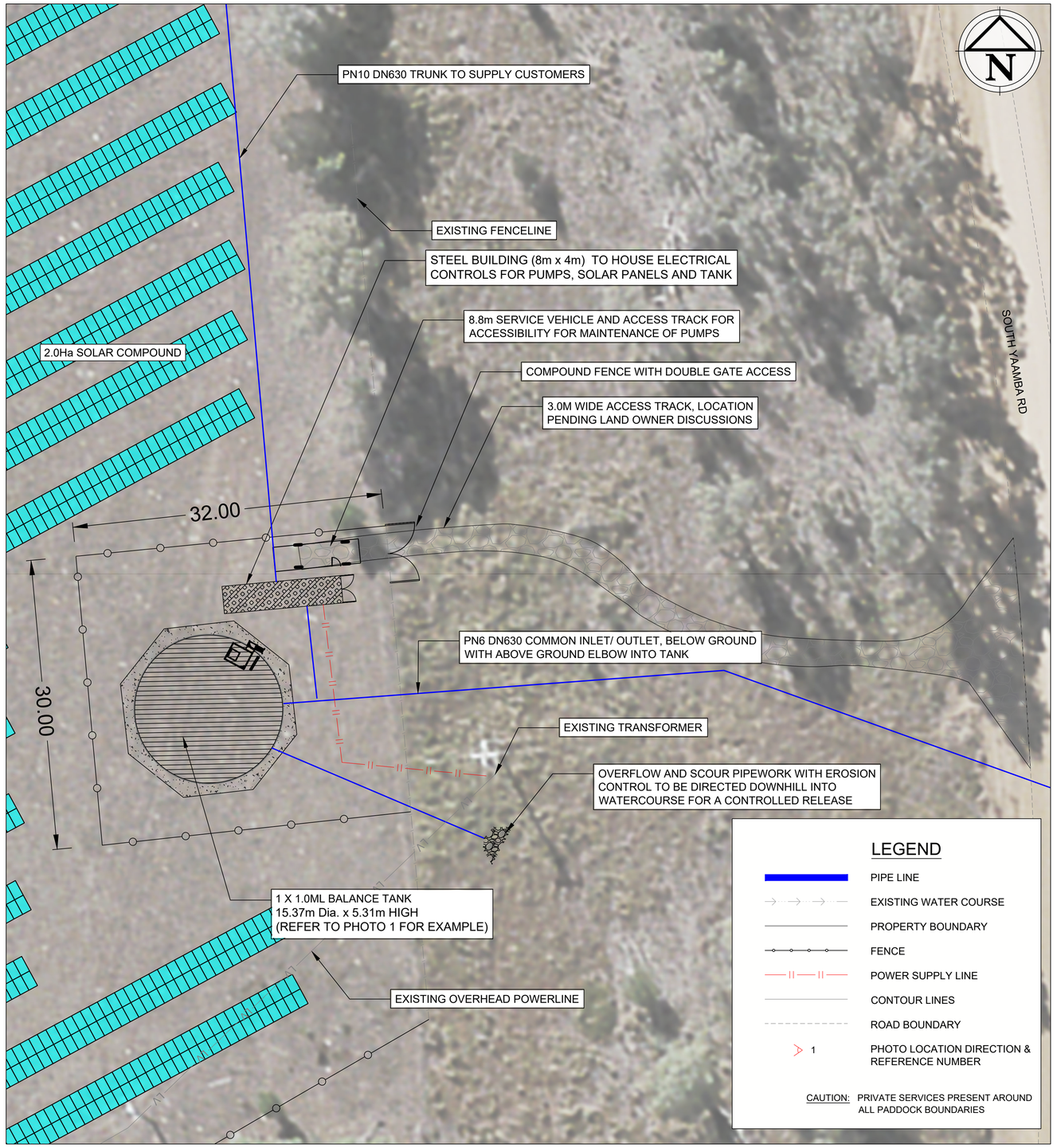


TYP. TANK DETAIL ELEVATION VIEW

SCALE: 1:100 (A1)
SCALE: 1:200 (A3)



PHOTO 1: 2ML STEEL TANK EXAMPLE



TANK LOCATION PLAN VIEW

SCALE: 1:250 (A1)
SCALE: 1:500 (A3)

PRELIMINARY
NOT FOR CONSTRUCTION

-1 0 1 2 3 4 5 10m

SCALE 1: 100 ORIGINAL SIZE A1
SCALE 1: 200 SIZE A3

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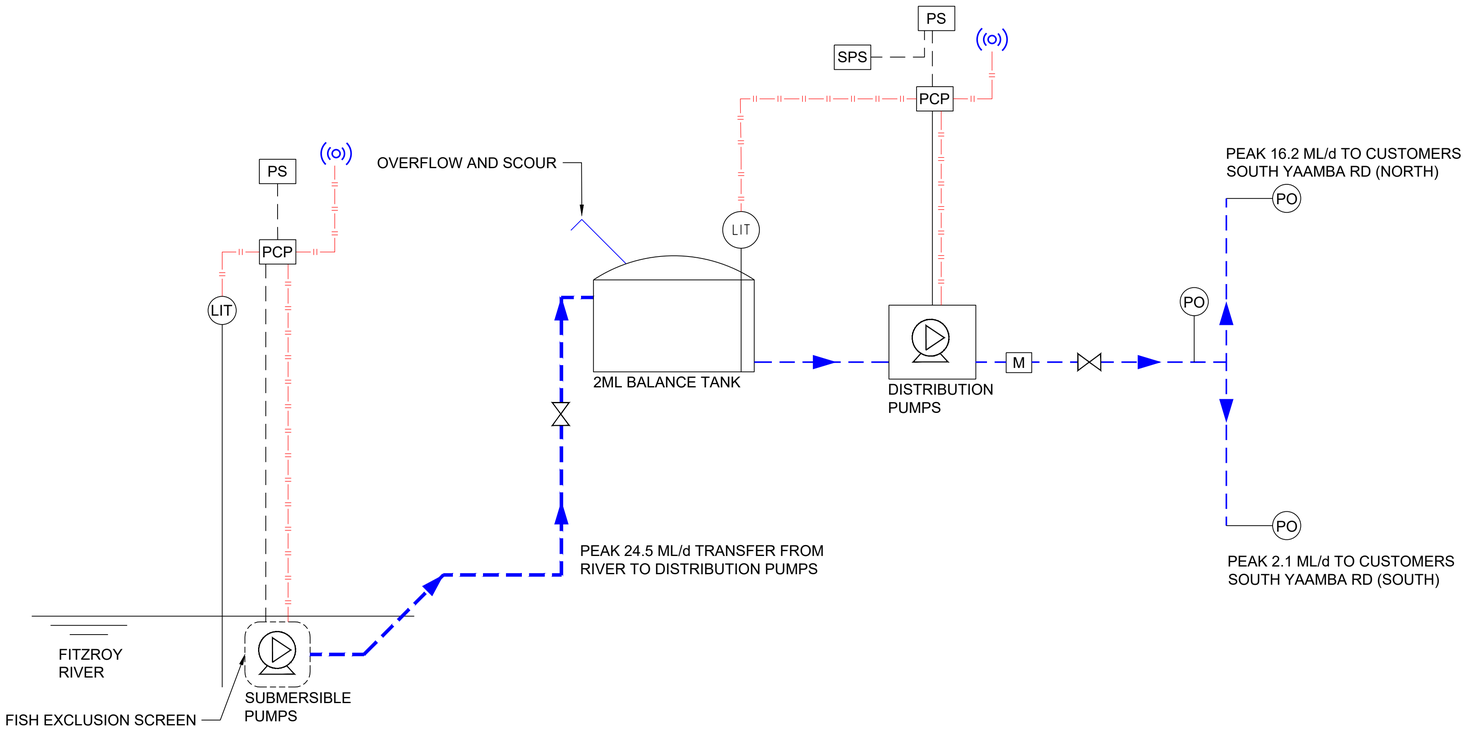
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CLIENT: CRC - NORTHERN AUSTRALIA

PROJECT: SOUTH YAAMBA
GENERAL ARRANGEMENT TANK & SOLAR COMPOUND

DRAWING No. 27COOP-200 | SHEET 2 OF 3 | REVISION 01

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LEGEND

- DISTRIBUTION PIPE LINE
- RISING MAIN PIPE LINE
- POWER SUPPLY LINE
- INSTRUMENTATION COMMUNICATION LINE
- STORAGE TANK
- PUMP
- FLOW DIRECTION
- M — FLOW METER
- ISOLATION VALVE
- ((o)) — TELEMETRY
- PO — PROPERTY OUTLET
- LIT — LEVEL INDICATOR TRANSDUCER
- PCP — PUMP CONTROL PANEL
- PS — POWER SUPPLY
- SPS — SOLAR POWER SUPPLY

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REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION
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CLIENT: SOUTH YAAMBA PROJECT

PROJECT: RIVER PUMP
PROCESS AND FLOW DIAGRAM

DRAWING No.: 27COOP-400
SHEET: 3 OF 3
REVISION: 01

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14.2 Appendix Two - Soils map and property agricultural capability assessment

SOILS
FITZROY RIVER

SCALE 1:100 000

TRANSVERSE MERCATOR PROJECTION

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NOTES

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Base map compiled from Digital Cadastral Data Base, Department of Natural Resources, June 1999.

SURVEY by S.A. Forster, M.A. Sugars and M.J. Koolstra, Resource Management, Central West Region, Department of Natural Resources, Rockhampton.

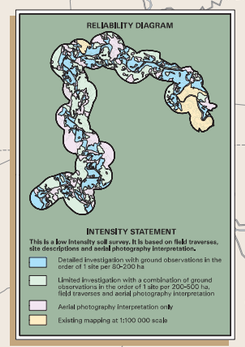
CARTOGRAPHY by M.J. Koolstra and A.R. McDonough, Land and Water Information Development Group, Central West Region, Department of Natural Resources, Rockhampton.

Printed by the Land and Water Information Development Group, Central West Region, Department of Natural Resources, Rockhampton.

LOCALITY MAP



RELIABILITY DIAGRAM



INTENSITY STATEMENT

This is a low intensity soil survey. It is based on field traverses, site descriptions and aerial photography interpretation.

- Detailed investigation with ground observations in the order of 1 site per 80-200 ha
- Limited investigation with a combination of ground observations in the order of 1 site per 200-500 ha, field traverses and aerial photography interpretation
- Aerial photography interpretation only
- Existing mapping at 1:100 000 scale

REFERENCE

Soil Code	Features of the Dominant Soil	Australian Soil Classification
SOILS OVERLYING RECENT ALLUVIUM		
Level to Gently Undulating Plains, Terraces, Active Levees and Backplains		
Uniform Sands and Loams		
ARU1	Deep, pale to brown sand	Orthic Tenosol
ARU2	Loamy or clay loamy surface over buried loamy and sandy soils	Stratic Rudosol
Gradational Soils and Non-Cracking Clays		
ARG1	Sandy surface grading to a massive, brown, loamy or clay loamy subsoil often over buried soils	Brown Kandosol
ARG2	Clay loamy or clay surface grading to a black or brown, alkaline clay subsoil occasionally over buried soils	Black or Brown Dermosol
Texture Contrast Soils		
ACS1	Medium thick, bleached, loamy or clay loamy surface over a brown or black, alkaline clay subsoil	Brown or Black Chromosol
ACS2	Thick to very thick, bleached sandy surface over a brown or grey clay subsoil	Brown or Grey Chromosol
ASO1	Thick sandy or medium thick loamy, bleached surface over a mottled, brown or grey, sodic clay subsoil; rarely over buried soils	Brown or Grey Sodosol
Cracking Clays		
ARU3	Deep, self-mulching, black cracking clay	Black Vertosol
ARU4	Deep, pedal, black or grey cracking clay	Black or Grey Vertosol
ARU5	Pedal, black cracking clay overlying buried soils	Black Vertosol
ARU6	Deep, black or grey cracking clay; sodic in the upper subsoil and often saline in the upper subsoil	Black or Grey Vertosol
ARU7	Deep, black cracking clay; sodic and sodic in the upper subsoil; moderate gilgai or melonhole	Black Vertosol
Dissected Floodplains with Scrolls, Swales, Channel Benches, Billabongs and Floodways		
Uniform Sands and Loams		
ATE1	Deep, pale to brown sand	Orthic Tenosol
ATE2	Loamy or clay loamy surface over buried sandy and loamy soils	Orthic Tenosol; Stratic Rudosol
Gradational Soils and Non-Cracking Clays		
AMA2	Sandy or loamy surface grading to a massive, brown, loamy or clay loamy subsoil; often over buried soils	Brown Kandosol
ACE2	Clay loamy or clay surface grading to a black or brown clay subsoil; often over buried soils	Black or Brown Dermosol
Texture Contrast Soils		
ACH1	Very thick, bleached sandy surface over a mottled, brown or grey clay subsoil	Brown or Grey Chromosol
Cracking Clays		
ACH2	Black or brown cracking clay; rarely sodic in the upper subsoil and occasionally saline in the lower subsoil	Black or Brown Vertosol
SOILS OF LOCAL ALLUVIUM AND COLLUVIUM		
Valley Flats, Drainage Depressions and Fans		
Gradational Soils and Non-Cracking Clays		
ACE1	Clay loamy or clay surface grading to a black or brown clay subsoil	Black or Brown Dermosol
Texture Contrast Soils		
ASO3	Saline, bleached loamy surface over a grey, sodic clay subsoil	Grey Sodosol
ASO5	Medium thick, bleached clay loamy surface over a black or brown, sodic clay subsoil; saline in the lower subsoil	Black or Brown Sodosol
Cracking Clays		
ARU8	Moderately deep to deep, self-mulching, black cracking clay; occasionally gravelly	Black Vertosol
ARU9	Moderately deep to deep, self-mulching, black cracking clay; overlying magnesite, or magnesium carbonate nodules throughout	Black or Brown Vertosol
SOILS OVERLYING OLDER ALLUVIUM		
Level to Gently Undulating Plains and Relict Levees		
Texture Contrast Soils		
SMO1	Thin, bleached, loamy or silty surface over a brown, sodic clay subsoil; occasionally mottled	Brown Sodosol
SMO2	Medium thick clay loamy surface over a black or grey, sodic clay subsoil; occasionally over buried soils	Black or Grey Sodosol
SMO3	Medium thick to thick, bleached, sandy or loamy surface over a mottled, grey or brown, sodic clay subsoil	Grey or Brown Sodosol; Grey Kurosol
Cracking Clays		
SMU1	Deep, self-mulching, black cracking clay; alkaline	Black Vertosol
SMU2	Deep, brown or grey cracking clay; sodic in the upper subsoil; occasionally minor to moderate gilgai or melonhole	Brown or Grey Vertosol

Soil Code	Features of the Dominant Soil	Australian Soil Classification
SOILS OVERLYING UNCONSOLIDATED CAINOZOIC SEDIMENTS		
Level to Undulating Plains		
Gradational Soils and Non-Cracking Clays		
CGE1	Loamy or clay loamy surface grading to a red clay subsoil	Red Dermosol
CGE2	Clay loamy surface grading to a black or brown, sodic clay subsoil	Black or Brown Dermosol
CGE3	Black, brown or red clay	Black, Brown or Red Dermosol
CGE4	Black or brown, sodic clay	Black or Brown Dermosol
Texture Contrast Soils		
CSO1	Medium thick to thick, bleached, sandy or loamy surface over a mottled, brown or grey clay subsoil	Brown or Grey Chromosol
CSO2	Thin to medium thick, bleached, sandy or loamy surface over a mottled, black or grey, sodic clay subsoil	Black or Grey Sodosol
CSO3	Thin to medium thick clay loamy surface over a black or brown, sodic clay subsoil; occasionally bleached and saline in the lower subsoil	Black or Brown Sodosol
Cracking Clays		
CHU1	Deep, fine to medium self-mulching, black or brown cracking clay; may be sodic in the lower subsoil	Black or Brown Vertosol
CHU2	Deep, coarse self-mulching, black or brown cracking clay; saline and sodic in lower subsoil; occasional gilgai	Black or Brown Vertosol
CHU3	Deep, medium to coarse self-mulching, black or brown cracking clay; sodic in the upper subsoil and saline in the lower subsoil	Black or Brown Vertosol
CHU4	Deep, pedal or weak crushing, grey cracking clay; sodic in the upper subsoil and saline in lower subsoil; normal gilgai	Grey Vertosol
CHU5	Deep, grey, brown or black cracking clay; sodic and saline in the upper subsoil; moderate to severe melonhole	Grey, Brown or Black Vertosol
SOILS OVERLYING DEEPLY WEATHERED, FLAT LYING TERTIARY SEDIMENTARY ROCKS		
Flat to Gently Inclined Summit Surfaces and Gently Undulating Rises		
Uniform Sands		
TEC1	Very thick, bleached sandy surface over a yellow sandy subsoil	Bleached-Orthic Tenosol
Gradational Soils and Non-Cracking Clays		
TKA1	Deep, loamy or clay loamy surface grading to a massive, red clay subsoil; generally acidic	Red Kandosol
TDE1	Gravelly, clay loamy or clay surface grading to a red or brown clay subsoil; occasionally acidic	Brown or Red Dermosol
Texture Contrast Soils		
TKS1	Very thick, bleached sandy surface over a mottled, yellow or brown, sodic, acidic clay subsoil	Yellow or Brown Kurosol
Steep Slopes and Escarpments		
Gradational Soils		
TRK2	Shallow, cobbly clay loamy surface grading to a gravelly, brown or grey clay subsoil; acid throughout	Brown or Grey Dermosol; Grey Kandosol
SOILS OVERLYING BASALT		
Gently Undulating Plains to Undulating Rises		
Gradational Soils and Non-Cracking Clays		
RFE1	Deeply weathered, clay loamy or clay surface grading to a red, acidic clay subsoil	Red Ferrosol
Cracking Clays		
RVE1	Deep, self-mulching, black cracking clay	Black Vertosol
RVE2	Shallow, self-mulching, black cracking clay; occasionally cobbly	Black Vertosol
SOILS OVERLYING INTERMEDIATE VOLCANIC ROCKS		
Gently Undulating Plains to Undulating Rises		
Gradational Soils and Non-Cracking Clays		
RCE1	Moderately deep, slightly to moderately gravelly, clay loamy or clay surface grading to a red, brown or black clay subsoil; occasionally red cracking clay	Red, Brown or Black Dermosol; Red Vertosol
RVE1	Complex of red non-cracking clay and black or red cracking clay	Red Dermosol and Black or Red Vertosol
Cracking Clays		
RVE1	Moderately deep, self-mulching or pedal, black cracking clay; occasionally gravelly	Black Vertosol
Undulating to Rolling Low Hills		
Gradational Soils and Non-Cracking Clays		
LKE2	Shallow, gravelly, clay loamy or clay surface grading to a red or brown clay subsoil; occasional rock outcrop	Red or Brown Dermosol; Lepitic Tenosol

Soil Code	Features of the Dominant Soil	Australian Soil Classification
SOILS OVERLYING GRANITIC ROCKS		
Gently Undulating Rises		
Gradational Soils and Non-Cracking Clays		
GDL1	Shallow to moderately deep, clay loamy or clay surface grading to a brown or red clay subsoil; occasionally gravelly	Brown or Red Dermosol
Texture Contrast Soils		
GSO1	Sandy or loamy surface over a brown or red clay subsoil	Brown or Red Chromosol
GSO2	Sandy or loamy surface over a brown, sodic, clay subsoil	Brown Sodosol
SOILS OVERLYING MIXED ACID AND INTERMEDIATE VOLCANIC AND SEDIMENTARY ROCKS		
Undulating Rises		
Gradational Soils and Non-Cracking Clays		
MDE1	Shallow to moderately deep clay loamy or clay surface grading to a slightly gravelly, brown or red clay subsoil; occasionally sodic	Brown or Red Dermosol
Texture Contrast Soils		
MSO1	Moderately deep, gravelly, loamy or clay loamy surface over a brown, sodic clay subsoil; occasionally bleached	Brown Sodosol
Undulating to Steep Low Hills		
Gradational Soils and Non-Cracking Clays		
RDE2	Shallow, clay loamy or clay surface grading to a very gravelly, brown or red clay subsoil; occasional rock outcrop	Brown or Red Dermosol
SOILS OVERLYING STEEPLY DIPPING AND FOLDED SEDIMENTARY ROCKS		
Gently Undulating Plains to Undulating Rises		
Gradational Soils and Non-Cracking Clays		
GDE1	Gravelly, clay loamy or clay surface grading to a slightly gravelly, brown clay subsoil	Brown Dermosol
GDE2	Gravelly, clay loamy or clay surface grading to a slightly to moderately gravelly, brown or grey, sodic clay subsoil; occasionally mottled	Brown or Grey Dermosol
SDE1	Slightly to moderately gravelly, red non-cracking clay	Red Dermosol
Texture Contrast Soils		
SSO1	Bleached, loamy or clay loamy surface grading to a slightly gravelly, brown or grey, sodic clay subsoil	Brown or Grey Sodosol
Cracking Clays		
CDE1	Moderately deep, gravelly, black cracking clay	Black Vertosol
Undulating to Steep Low Hills		
Gradational Soils and Non-Cracking Clays		
RDE3	Shallow, gravelly, sandy or loamy surface grading to a grey or brown clay loamy or clay subsoil	Grey or Brown Dermosol; Brown Kandosol
SOILS OVERLYING ULTRAMAFIC ROCKS		
Gently Undulating Plains to Undulating Rises		
Gradational Soils and Non-Cracking Clays		
UDE1	Shallow to moderately deep, gravelly, clay loamy or clay surface grading to a red or brown clay subsoil	Red or Brown Dermosol
Undulating Low Hills to Steep Hills and Mountains		
Gradational Soils and Non-Cracking Clays		
UFE1	Shallow to moderately deep, gravelly, clay loamy or clay surface grading to a red clay subsoil	Red Ferrosol
UDE2	Shallow, very gravelly, red or black clay loam or clay; abundant rock outcrop	Red or Black Dermosol; Lepitic Tenosol

OTHER

- SWP — Swamp
- 7SS — Unique Mapping Area (UMA) Number
- Principal Roads
- Secondary Roads
- Rivers, Creeks

MAP 1 of 5
Soils, Fitzroy River
DNR,REF.No, 99-LFZ-R-A0-4152

Property agricultural capability assessment

Property ID	Land category	Irrigation system		
		Surface	Overhead	Trickle
1	17		w, sb, nb	v
2	us/4	c, s w	w, sb, nb	v
3	11		w, sb, nb	v
	16		w, sb, nb	v
	marginal			
4	17		w, sb, nb	v
	11		w, sb, nb	v
5	4	c, s w	w, sb, nb	v
	17		w, sb, nb	v
	US			
6	US/17		w, sb, nb	v
	5	c, s w	w, sb, nb	v
7	6	c, s w	w, sb, nb	v
	marginal			
8	19			v
	7	c, s w	w, sb, nb, p	c, m, g, v
9	11		w, sb, nb	v
	untested			
10	17		w, sb, nb	v
	19			v
11	11		w, sb, nb	v
	18			c, m, g, v
12	US/17		w, sb, nb	v
	5	c, s w	w, sb, nb	v
13	6	c, s w	w, sb, nb	v
	marginal			
	10		w, sb, nb, p	c, m, g, v
14	US/17		w, sb, nb	v
15	4	c, s w	w, sb, nb	v
	17		w, sb, nb	v
16	11		w, sb, nb	v
	untested			
17	US/17		w, sb, nb	v
18	6	c, s w	w, sb, nb	v
19	6	c, s w	w, sb, nb	v
	marginal			
	10		w, sb, nb, p	c, m, g, v
20	17		w, sb, nb	v
21	11		w, sb, nb	v
	16		w, sb, nb	v
	marginal			
22	11		w, sb, nb	v

23	US/17		w, sb, nb	v
24	7	c, s w	w, sb, nb, p	c, m, g, v
	18			c, m, g, v
25	4	c, s w	w, sb, nb	v
26	4	c, s w	w, sb, nb	v
27	US/17		w, sb, nb	v
28				
29	marginal			
30	11		w, sb, nb	v
31	19			v
	11		w, sb, nb	v
	6	c, s w	w, sb, nb	v
	7	c, s w	w, sb, nb, p	c, m, g, v
	18			c, m, g, v
32	11		w, sb, nb	v
	16		w, sb, nb	v
	marginal			
33	11		w, sb, nb	v
	untested			
34	US/17		w, sb, nb	v
35				
36	4	c, s w	w, sb, nb	v
37	US/17		w, sb, nb	v

Irrigation System	Crop type
Surface	c: cotton
	s: sorghum
	w: wheat
Overhead	w: wheat
	sb: soybean
	nb: navy bean
Trickle	c: cotton
	m: macadamia
	g: grape
	v: vegetable

14.3 Appendix Three - Expression of interest information and results

LANDHOLDER DATA

MAKING WATER WORK - CRCNA, ADVANCE ROCKHAMPTON & RRC

VISIONARY LAND USE PLANNING, SOUTH YAAMBA - Preferred Option Feasability St CRCNA REF #: CN00421 **LANDHOLDER BASELINE IRRIGATION DATA COLLECTION** Date 9/12/2022 Rev: 0 By: SJ **ON-FARM IRRIGATION - SUMMARY KEY PARAMETERS**

NOTES: Original scope is to assess those listed in EOI, 18 landholders which are listed in column 2 below as Yes.

Additional Landholder ID#'s covers all shape files provided by RRC GIS data to cover all potential landholders in catchment area - refer key plan - in case they may express interest to be included at a later date, so they have been allocated ID#.

Inclusion of other future landholders (no EOI details & not assessed at this stage) is subject to response from Advance Rockhampton communications plan & data available from any future EOI.

	<select-list>	<select-list>									<select-list>								<select-list>			
Landholder ID #:	EOI - Y/N/TBA	If not EOI, add/delete/ TBA	Comments - Wade - EOI - for review	Landholder name	Farm, Business name or ABN (w/a)	Address	Town	Phone	Email	Data available - Enterprise report, Needs Assessment	Data validation - Comments	GIS total property area, ha	Proposed irrig area, ha	Fitzroy Ag Corridor Water Demand Map Water Allocation, ML/yr	South Yaamba EOI Water Demand Map Water Allocation, ML/yr	Adjusted Water Allocation (PA assessed), ML/yr	Ave adj'd Irrig area allocation equivalent, ML/ha/yr	Supply - Pressure on Demand, Storage/Repump or Either	Est Flow (L/s) at outlet	Discharge Head req'd (m) at outlet	Est Contour elevation (m) at outlet
1	Yes		Greg, maybe, cost concerns?	AG Osborne and GA Osborne		2033 Ridgelands Road	Ridgelands	0428 649 920			Rang 9/12/22 - ph assessed	555	30		150	120	4.0	Either	28	40	
2	Yes		Keen, low demand 10ML	AJ McLean	A.S.McLean (12152523273)	2340 Ridgelands Road		0412 379 425	aveco1@bigpond.com	Enterprise Report	Mainly stock & domestic	214	0		10	10	0.0	Either	0.8	40	
3	No		Unable to contact	BJ Daniels		439 Seymour Road	Ridgelands					16									
4	Yes		Keen, sharefarms 5,6,12	BJ Price		341 Birrahlee Road	South Yaamba	0427 358 587			visit 3.30pm wed 14/9/22	122	120	2000	1000	500	4.2	Either	111	50	
5	Yes		Keen, already done	Chantal Booth		2249A Ridgelands Road	Ridgelands	0427 345 524			Unknown irrig ha, visit 2.30pm Tl	1213	48		280	240	5.0	Pressure on Demand	45	50	
6	Yes		Keen, already done	CW Albert and M Albert		814 Calmorin Road	South Yaamba	0428 582 410			Unknown irrig ha, visit 11.30am T	500	40	1000	500	240	6.0	Either	37	40	
7	No		Unable to contact	Cashmia Investments Pty Ltd		68 Birrahlee Road	South Yaamba					65		0							
8	No		Unable to contact	D B Chisholm and S G Chisholm		212 Lanyon Road	South Yaamba					195									
9	No	Delete	Early interest, not proceeding	D P MacAulay	<assessed at 150ML & 28L/s>	569 Calmorin Road	Garnant	0428 740 645			Unknown irrig ha, visit 10am Thu	327	30	800	800	0	0.0	Pressure on Demand	0	0	
10	Yes		Keen, Exist irrig & allocation	Scott Keating	Dibbs Holdings Pty Ltd	257 Lanyon Road	South Yaamba	0429 020 029			Visited, 3.30pm 23/11/22	347			500	360	0.0	Pressure on Demand	56	35	
11	Yes		Unable to contact	Prue & Tim	Draycorp Pty Ltd	309 Seymour Road	Ridgelands				Unknown irrig ha	141			200		0.0				
12	Yes		Keen, sharefarms (Barry P)	G J Ramsey		L 44 Evans Road	Garnant				Rang Barry & ph assessed, 9/12/	85	40		300	168	4.2	Either	37	40	
13	Yes		Keen, done (RWLEP) - TBC	J A Silvester and RC Silvester	16212396336	108 Birrahlee Road	South Yaamba	0428 678 006	josh_0250@hotmail.com	Enterprise Report		40	22		60	132	6.0	Either	22	40	
14	Yes		Keen, horti 50ML, SJ to ring	JC Prince		75 Seymour Road	South Yaamba	0428 586 890			Not assessed - TBC	16				50	0.0	Either	10	40	
15	No		Not interested, own water	J S MacKenzie	MacTango Pty Ltd	181 Lyttle Lane	Ridgelands				Stock & domestic	370			20		0.0				
16	Yes		Unable to contact	K G Stewart and M J Stewart		453 Calmorin Road	Garnant				Unknown irrig ha & ML	336									
17	No		Not interested	K J Johnson		309 Birrahlee Road	South Yaamba					41									
18	No		Unable to contact	K M Priddle		45 Seymour Road	South Yaamba					26									
19	Yes		Keen, done	L E N Stanke		70 Birrahlee Road	South Yaamba	0407 659 505			visit 1pm 15/9/22	40	21	330	360	105	5.0	Either	20	50	
20	No		Unable to contact		Laudale Holdings Pty Ltd	355 Bishop Road	Garnant					581									
21	No		Unable to contact	M J Tomkins and K J Tomkins		455 Seymour Road	Ridgelands					16									
22	No		Not interested	M P Hunt		290 Calmorin Road	South Yaamba	0474 873 781			Only available Fridays	169									
23	Yes	Delete	Not interested	M P Hunt and RA Hunt		183 Birrahlee Road	South Yaamba	0474 873 781			Unknown irrig ha, only avail Frida	279		640	640		0.0				
24	TBA		Unable to contact	J R Robson and E S Bambling		2432 South Yaamba Road	South Yaamba				In Fitroy Ag Corridor list only	220		150			0.0				
25	No	Add	Keen, sharef (Callum Dunn)	PA Bahnisch		Lot 1 Lyttle Lane	South Yaamba				refer C.Dunn alloc /flows	113									
26	Yes		Keen, done	PA Dunn, M A Dunn and CJ Dunn		881 South Yaamba Road	South Yaamba	0427 154 999			Leases extra land, visit 8.30am TH	203	400		4000	1675	4.2	Pressure on Demand	163	50	
27	TBA		Keen, (lush lychees)	P R Caton and K E Caton		65 Birrahlee & 123 Seymour Rd	South Yaamba	0427 380 181	Visited 2.30pm 23/11/22		In Fitroy Ag Corridor list only	142	48	1110		218	4.5	Pressure on Demand	36	40	
28	No			*< intentionally blank >*																	
29	TBA		Unable to contact	RH Little		2228 Ridgelands Road	Ridgelands				In Fitroy Ag Corr-Ridgelands list c	25		75							
30	Yes		Unable to contact	RT Humphrey and A Humphrey		223 Seymour Road	Ridgelands				Leases land, unknown ha/ML	210									
31	No		Keen, direct access - unlikely	R W Smith		2083 South Yaamba Road	South Yaamba	0407 433 260	Visited 10am 24/11/22		Has direct river access & bore	139	100			400	4.0	Pressure on Demand	93	40	
32	No		Not interested	S G Cussons and KE Silvester		413 Seymour Road	Ridgelands					16									
33	Yes		Interested TBC - ring Steve	S G Richards and D Richards		L 20 Calmorin Road	Ridgelands	0477 015 010			Rang - waiting call back - TBA	253					0.0				
34	Yes		Keen	SL Merchin	"IONA" (65 549 881 539)	1195 South Yaamba Road	South Yaamba	0408 286 604	stevemerchin@bigpond.com	Enterprise Report	Add & updated	505	32.5		200	195	6.0	Either	30	40	
35	No		Unable to contact	TA Buckton and PM Buckton		47 Seymour Road	South Yaamba					7									
36	TBA		Keen, goats low dem 10ML	V L Southey		142 Hansen Road	Ridgelands	0439 713 522			Not assessed - TBC	68		10		10	0.0	Either	3	40	
TOTALS												7595	931.5	6115	9020	4423					

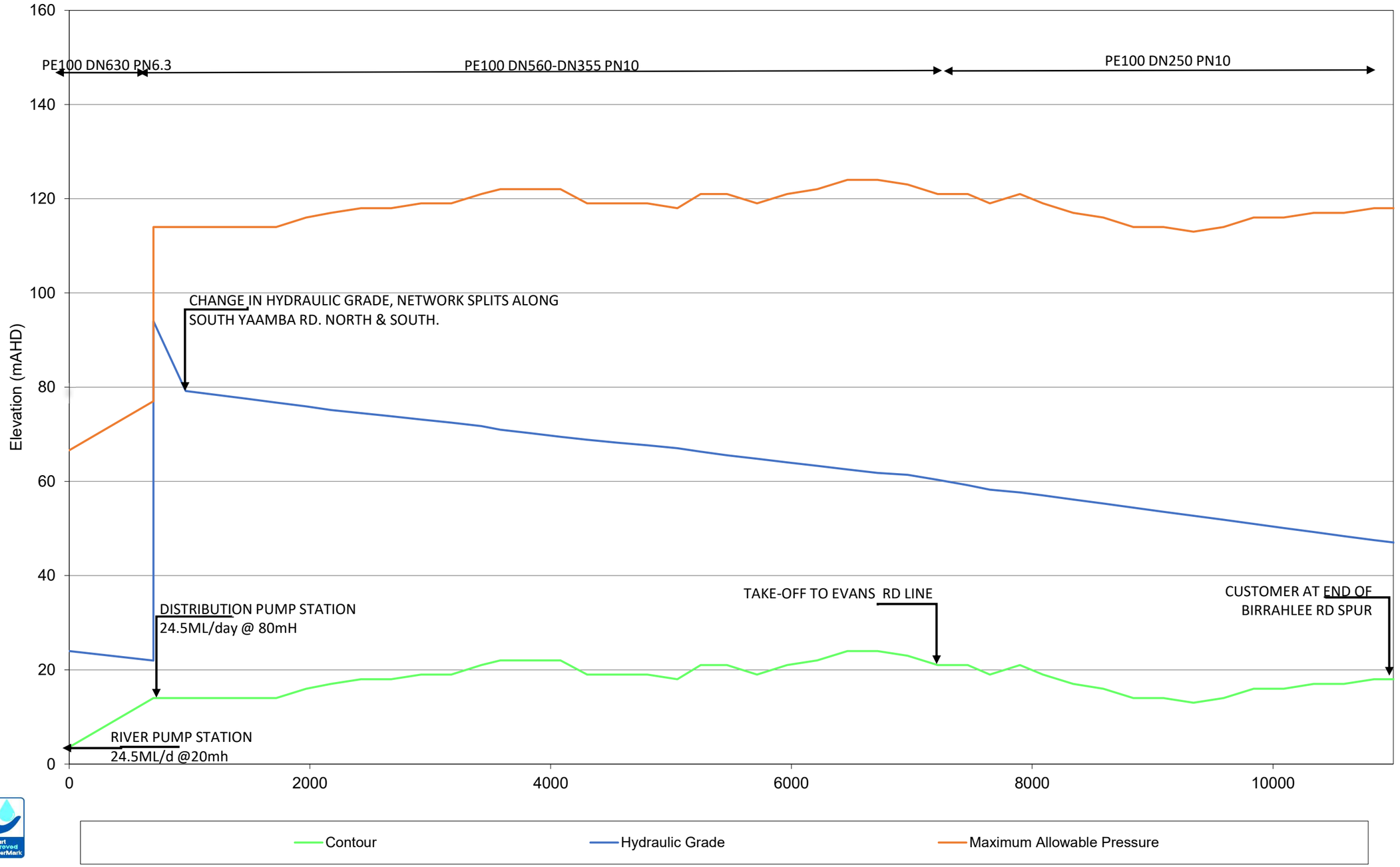
General comments:

To Do:

Refer individual enterprise reorts or data collection forms for more details of crop types and irrigation parameters

14.4 Appendix Four – Rising main hydraulic grade line

SOUTH YAAMBA - RISING MAIN & DISTRIBUTION PRELIMINARY HYDRAULIC GRADE LINE



REV	ISSUED	DRAWN	APRVD	REVISION DESCRIPTION
01	29/06/2023	BL	DM	ISSUED WITHIN REPORT

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DRAWN: BL	CLIENT : CRC - NORTHERN AUS
CHECKED: DM	PROJECT: SOUTH YAAMBA
APPROVED: DM	
DATE: 29/06/2023	
DRWING NO: 27COOP-HGL-01	

14.5 Appendix Five – Scheme capital & operational costing estimate summary

	South Yaamba Irrigation Scheme - Preferred Option	Quantity	Unit	Rate/unit	SubTotal
A	**INFRASTRUCTURE DIRECT ESTIMATES**	**1**	**LOT**		**$ 12,632,000**
1	**Pipelines**				**$ 7,333,000**
A1.1	**Mainline Rising Main (Fitzroy River to Balance Tank) (750m)**		**LOT**		**$ 395,390**
	Site Supplied Pipeline HDPE DN630 PN6.3	35,100	kg	$ 3.90	$ 136,890
	Weld, String, Excavate, Install and Backfill pipeline HDPE DN630	750	m	$ 250	$ 187,500
	Supply&Install DN100 Air Valve, Fittings and Pit	3	Item	$ 5,000	$ 15,000
	Supply&Install DN50&DN100 Scour valves, Fittings and Pit	1	Item	$ 6,000	$ 6,000
	DN630 HDD crossings (30m)	2	Item	$ 25,000	$ 50,000
A1.2	**Distribution Pipes (18,887m)**		**LOT**		**$ 5,089,297**
	Site Supplied Pipeline HDPE PN10 DN200-560	557,136	kg	$ 3.90	$ 2,172,828
	Weld, string, install, backfill & remediate HDPE DN200	2,934	m	$ 130	$ 381,423
	Weld, string, install, backfill & remediate HDPE DN225	1,817	m	$ 135	$ 245,350
	Weld, string, install, backfill & remediate HDPE DN250	7,843	m	$ 140	$ 1,098,073
	Weld, string, install, backfill & remediate HDPE DN355	1,352	m	$ 160	$ 216,277
	Weld, string, install, backfill & remediate HDPE DN450	1,939	m	$ 180	$ 349,038
	Weld, string, install, backfill & remediate HDPE DN500	1,707	m	$ 200	$ 341,440
	Weld, string, install, backfill & remediate HDPE DN560	1,295	m	$ 220	$ 284,867
A1.3	**Pipeline Fittings**		**LOT**		**$ 832,969**
	Nominal allowance for tees, flanges, fixtures and fittings	10%	%	$ 5,484,687	$ 548,469
	Supply Isolation Valve (DN630-400)	2	Item	$ 12,000	$ 24,000
	Supply Isolation Valve (<DN400)	6	Item	$ 3,000	$ 18,000
	Supply of Auxilliary Valving and Tappings	15	Item	$ 500	$ 7,500
	Installation of Valving	23	Item	$ 5,000	$ 115,000
	Supply&Install DN50&DN100 Air Valve, Fittings and Pit	18	Item	$ 5,000	$ 90,000
	Supply&Install DN50&DN100 Scour valves, Fittings and Pit	5	Item	$ 6,000	$ 30,000
A1.4	**Irrigation Outlets**		**LOT**		**$ 465,000**
	Supply Property Outlet valving - 1-3ML/d (Iso, AV, strainer, meter and control valves)	3	Item	$ 15,000	$ 45,000
	Supply Property Outlet valving - <1ML/d (Iso, AV, strainer, meter and control valves)	15	Item	$ 10,000	$ 150,000
	Installation Property Outlet - Medium	18	Item	$ 15,000	$ 270,000
A1.5	**Pipeline Crossings**		**LOT**		**$ 550,000**
	HDD Contractor Mobilisation and Demobilisation	2	Item	$ 50,000	$ 100,000
	<DN300 HDD Road Crossings (30m)	5	Item	$ 15,000	$ 75,000
	DN400-630 HDD Road Crossings (30m)	3	Item	$ 25,000	$ 75,000
	<DN300 HDD Waterway Crossings (50m)	3	Item	$ 20,000	$ 60,000
	DN400-630 HDD Waterway Crossings (50m)	2	Item	$ 25,000	$ 50,000
	HDPE Trenched Road Crossings - Large DN	7	Item	$ 10,000	$ 70,000
	HDPE Trenched Waterway Crossings - Large DN	5	Item	$ 5,000	$ 25,000
	HDPE Trenched Road Crossings - Small DN	15	Item	$ 5,000	$ 75,000
	HDPE Trenched Waterway Crossings - Small DN	10	Item	$ 2,000	$ 20,000
2	**Structures and Auxilliaries**				**$ 590,000**
A2.1	**South Yaamba Tank (2ML)**		**LOT**		**$ 590,000**
	General civils, base and earthworks & access	1	Item	$ 150,000	$ 150,000
	Supply, Erect and Install 2ML Balance Tank	1	Item	$ 300,000	$ 300,000
	Nominal allowance for tees, flanges, fixtures and fittings in and out of tank	30%	%	$ 300,000	$ 90,000
	Limited simple SCADA implementation on tanks	1	Item	$ 50,000	$ 50,000
3	**Pump Stations**				**$ 2,613,000**
A3.1	**Fitzroy River Submerisble Pump Station (120kW)**		**LOT**		**$ 1,648,000**
	CIVIL				
	Concrete wetwell pits, headwalls and pipes, suppy and install (Precast units)	1	Item	$ 200,000	$ 200,000
	Intake pipe	40	m	$ 1,200	$ 48,000
	Instream works/sheetpiling, river installations	1	Item	$ 100,000	$ 100,000
	Bulk earthworks & access works to pump station site	1	Item	$ 250,000	$ 250,000
	Supply and eract electrical and control building including raised floor level	1	Items	$ 100,000	$ 100,000
	MECHANICAL				
	6.25ML/d submersible pumps inc 37kW motors	4	Item	$ 50,000	$ 200,000
	Manifold pipework	40	m	$ 1,200	$ 48,000
	Checkvalves and mounting	4	Item	$ 15,000	$ 60,000
	Auxilliary Valving	4	Item	$ 3,000	$ 12,000
	Installation and Fitout	4	Days	$ 50,000	$ 200,000
	ELECTRICAL				
	Pump Drives LV	4	Item	$ 50,000	$ 200,000
	Electrical Switchroom LV with switchgear	1	Item	$ 100,000	$ 100,000
	Limited simple SCADA implementation	1	Item	$ 50,000	$ 50,000
	Transformer (200kW)	1	Item	$ 80,000	$ 80,000

A3.2	**Booster Station (330kW)**		**LOT**		**$ 965,000**
	CIVIL				
	Bulk earthworks & access works	1	Item	$ 20,000	$ 20,000
	Supply and eract electrical and control building including conc slab (8x4m)	1	Items	$ 100,000	$ 100,000
	MECHANICAL				
	6.2ML/d pumps inc 90kW motors (4x duty, 1xstand-by)	5	Item	$ 30,000	$ 150,000
	Manifold pipework	50	m	$ 1,000	$ 50,000
	Checkvalves and mounting	5	Item	$ 10,000	$ 50,000
	Auxilliary Valving	5	Item	$ 5,000	$ 25,000
	Installation and Fitout	5	Item	$ 25,000	$ 125,000
	ELECTRICAL				
	Pump Drives LV	5	Item	$ 15,000	$ 75,000
	Electrical Switchroom LV with switchgear	1	Item	$ 150,000	$ 150,000
	Limited simple SCADA implementation	1	Item	$ 100,000	$ 100,000
	Transformer (0.5MW)	1	Item	$ 120,000	$ 120,000
4	**Power Supply**				**$ 313,000**
A4.1	**Power Transmission & Connections**		**LOT**		**$ 312,500**
	Powerlines to electical panels for both pump stations	150	m	$ 750	$ 112,500
	Powerline augmentations allowance	1	Item	$ 200,000	$ 200,000
5	**Renewable Energy Provision**				**$ 1,784,000**
A5.1	**Solar Power Generation (nominal 1.2MW) as standalone D&C contract**		**LOT**		**$ 1,784,000**
	Solar Farm Substation (11kV tee off and switch yard & connection)	1	Lot	$ 200,000	$ 200,000
	Solar Farm Panels, Cabling & Inverter Supply and Installation	1,200	kW	$ 1,100	$ 1,320,000
	Solar Farm Civils and Structural	20%	%	$ 1,320,000	$ 264,000
B	**CONTRACTOR INDIRECT ESTIMATES**	**1**	**LOT**		**$ 2,283,000**
B1.1	**Contractors Indirect & Site Overhead Costs**		**LOT**		**$ 1,200,000**
	Site Mobilisation & Demobilisation	1	Item	$ 250,000	$ 250,000
	Site Facilities Establishment & Disestablishment	1	Item	$ 200,000	$ 200,000
	Onsight Project Supervision	1	Item	$ 400,000	$ 400,000
	QA Management plans, planning and IT allowances	1	Item	$ 250,000	$ 250,000
	Environmental management	1	Item	$ 100,000	$ 100,000
B1.2	**Contractors Assiocated Project Costs**		**LOT**		**$ 1,083,455**
	Surveying, Setting out, pegging & As-Con pickups	1	Item	$ 150,000	$ 150,000
	Materials Testing Allowances	1	Item	$ 50,000	$ 50,000
	Temp works and Site laydown yard allowances	1	Item	$ 50,000	$ 50,000
	Other assoicated costs	1	Item	$ 250,000	$ 250,000
	Systems Commissionings - Pipelines & Auxilliaries	2%	%	$ 7,923,000	$ 158,460
	Systems Commissionings - Pump Stations & Renewables	5%	%	$ 4,710,000	$ 235,500
	Project As-Constructed Plans and Close Outs	1.5%	%	$ 12,633,000	$ 189,495
C	**SUBTOTAL**	**1**	**LOT**		**$ 14,915,610**
C1.2	**Contractor Allowances**		**LOT**		**$ 1,491,561**
	Contractor profit & overheads allowance (Subtotal)	10.0%	%	$ 14,915,610	$ 1,491,561
D	**CONSTRUCTION COST ESTIMATE**	**1**	**LOT**		**$ 16,407,171**
E	**CLIENT COSTS**	**1**	**LOT**		**$ 3,684,000**
E1.1	**Construction Management**		**LOT**		**$ 1,193,249**
	Project Management, Contract Admin, Superintendence	8.0%	%	$ 14,915,610	$ 1,193,249
E1.2	**Design, Investigations & Other-Post Activites**		**LOT**		**$ 2,150,000**
	Pre-design site investigations and modelling including, geotechnical, hydrology, survey and preliminary energy applications	1	Item	$ 1,500,000	$ 1,500,000
	Support project proponents during pre-construction project phase (Risk management, financial management, prospects management, stakeholder engagement, legal, board & management expenses and insurance	1	Item	$ 500,000	$ 500,000
	Confirming proponent and delivery model for construction and operations for the project	1	Item	$ 150,000	$ 150,000
E1.3	**Land Purchase**		**LOT**		**$ 250,000**
	Easements and Pipline Route Compensation	10	Ha	$ 25,000	$ 250,000
E1.4	**Other Owners Costs**		**LOT**		**$ 90,950**
	Principals Insurance	0.12%	%	$ 12,632,000	$ 15,158
	Portable long service levee and WHS fee	0.10%	%	$ 12,632,000	$ 12,632
	Commissioning and Handover Costs	0.50%	%	$ 12,632,000	$ 63,160
F	**BASE ESTIMATE**	**1**	**LOT**		**$ 20,091,000**
G	**CONTINGENCY**	**1**	**LOT**		**$ 7,032,000**
G1.1	**Contingency**		**LOT**		**$ 7,031,850**
	Rate, risk & quantity contingent risk (Pre-feasability)	35%	Item	$ 20,091,000	$ 7,031,850
H	**Water Allocation**	**1**	**LOT**		**$ -**
H1.1	**Bulk water allocation**		**LOT**		**$ -**
	Medium Priority water allocation^ (Removed from capital infrastructure costing)	4,420	Item	$ -	$ -
I	**PROJECT ESTIMATE**	**1**	**LOT**		**$ 27,123,000**

Operational Expenditure Base Estimate

Part A&B Charge

Pipeline Zone	Part A&B charge		$/ML
Distribution	Tarriff Area 1		**25**

Part C Charge

Operations	49
Scheduled O&M	9
Unscheduled O&M	7
Assest Renewal	30
Total	**95**

Part D Pricing (Post-Renewals)

Pipeline Zone	Part D.1 Tariff $/ML (Post-Renewable Energy Provision)	Demand ML	$/ML
Distribution	Tarriff Area 1	4,420	50

Total Opex Nodel Pricing (Post-Renewals)

Pipeline Zone	Part C&D Tariff $/ML (Post-Renew))	Demand ML	$/ML
Distribution	Tarriff Area 1	4,420	**170**

14.6 Appendix Six – Investment costs for perennial horticulture

Contents

MAY 2023

CAPITAL COSTS AVOCADOES

Area Planted	10 hectares

General capital		Year 0 ie start of year 1	Year 1	Year 2	Year 3	Total	
Property							
Buildings			$100,000			$100,000	
Water right			$0			$0	
Buffer tank			$0			$0	
Irrigation controller			$25,000			$25,000	
Machinery							
Vehicles		$60,000				$60,000	
Tractors		$90,000				$90,000	
Sprayer(s)			$70,000			$70,000	
Slasher/orchard equipment			$50,000			$50,000	
Miscellaneous			$10,000			$10,000	
Total general capital		**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha

Orchard establishment			Year 1	Year 2	Year 3		
Surveying/marking out		$2,000/ha	$20,000				
Land preparation		$4,000/ha	$40,000				
Tree prices		$4,200/ha	$42,000				
Planting/guards		$3,000/ha	$30,000				
Irrigation mains/filters/valves		$0/ha	$0				
Irrigation dripper tube		$0/ha	$0				
Laneways		$5,000/ha	$50,000				
Drainage		$3,000/ha	$30,000				
Contingency	10%	$1,920/ha	$19,200				
Total orchard establishment		$21,120/ha	**$211,200**	**$0**	**$0**	**$211,200**	$21,120 /ha

Total Capital Costs	Year 0 ie start of year 1	Year 1	Year 2	Year 3	Totals	
General capital	**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha
Orchard establishment		**$211,200**	**$0**	**$0**	**$211,200**	$21,120 /ha
	$150,000	**$466,200**	**$0**	**$0**	**$616,200**	$61,620 /ha

Contents

MAY 2023

CAPITAL COSTS MANGOES

Area Planted	10 hectares

General capital		Year 0 ie start of year 1	Year 1	Year 2	Year 3	Total	
Property							
Buildings			$100,000			$100,000	
Water right			$0			$0	
Buffer tank			$0			$0	
Irrigation controller			$25,000			$25,000	
Machinery							
Vehicles		$60,000				$60,000	
Tractors		$90,000				$90,000	
Sprayer(s)			$70,000			$70,000	
Slasher/orchard equipment			$50,000			$50,000	
Miscellaneous			$10,000			$10,000	
Total general capital		**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha

Orchard establishment			Year 1	Year 2	Year 3		
Surveying/marking out		$2,000/ha	$20,000				
Land preparation		$4,000/ha	$40,000				
Tree prices		$5,550/ha	$55,500				
Planting/guards		$3,000/ha	$30,000				
Irrigation mains/filters/valves		$0/ha	$0				
Irrigation dripper tube		$0/ha	$0				
Laneways		$5,000/ha	$50,000				
Drainage		$3,000/ha	$30,000				
Contingency	10%	$2,055/ha	$20,550				
Total orchard establishment		$22,605/ha	**$226,050**	**$0**	**$0**	**$226,050**	$22,605 /ha

Total Capital Costs	Year 0 ie start of year 1	Year 1	Year 2	Year 3	Totals	
General capital	**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha
Orchard establishment		**$226,050**	**$0**	**$0**	**$226,050**	$22,605 /ha
	$150,000	**$481,050**	**$0**	**$0**	**$631,050**	$63,105 /ha

Contents

MAY 2023

CAPITAL COSTS MACADAMIAS

Area Planted	10 hectares

General capital		Year 0 ie start of year 1	Year 1	Year 2	Year 3	Total	
Property							
Buildings			$100,000			$100,000	
Water right			$0			$0	
Buffer tank			$0			$0	
Irrigation controller			$25,000			$25,000	
Machinery							
Vehicles		$60,000				$60,000	
Tractors		$90,000				$90,000	
Sprayer(s)			$70,000			$70,000	
Slasher/orchard equipment			$50,000			$50,000	
Miscellaneous			$10,000			$10,000	
Total general capital		**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha

Orchard establishment			Year 1	Year 2	Year 3		
Surveying/marking out		$2,000/ha	$20,000				
Land preparation		$4,000/ha	$40,000				
Tree prices		$7,500/ha	$75,000				
Planting/guards		$3,000/ha	$30,000				
Irrigation mains/filters/valves		$0/ha	$0				
Irrigation dripper tube		$0/ha	$0				
Laneways		$5,000/ha	$50,000				
Drainage		$3,000/ha	$30,000				
Contingency	10%	$2,250/ha	$22,500				
Total orchard establishment		$24,750/ha	**$247,500**	**$0**	**$0**	**$247,500**	$24,750 /ha

Total Capital Costs	Year 0 ie start of year 1	Year 1	Year 2	Year 3	Totals	
General capital	**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha
Orchard establishment		**$247,500**	**$0**	**$0**	**$247,500**	$24,750 /ha
	$150,000	**$502,500**	**$0**	**$0**	**$652,500**	$65,250 /ha

Contents

MAY 2023

CAPITAL COSTS LYCHEES

Area Planted	10 hectares

General capital		Year 0 ie start of year 1	Year 1	Year 2	Year 3	Total	
Property							
Buildings			$100,000			$100,000	
Water right			$0			$0	
Buffer tank			$0			$0	
Irrigation controller			$25,000			$25,000	
Machinery							
Vehicles		$60,000				$60,000	
Tractors		$90,000				$90,000	
Sprayer(s)			$70,000			$70,000	
Slasher/orchard equipment			$50,000			$50,000	
Miscellaneous			$10,000			$10,000	
Total general capital		**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha

Orchard establishment			Year 1	Year 2	Year 3		
Surveying/marking out		$2,000/ha	$20,000				
Land preparation		$4,000/ha	$40,000				
Tree prices		$5,390/ha	$53,900				
Planting/guards		$3,000/ha	$30,000				
Irrigation mains/filters/valves		$0/ha	$0				
Irrigation dripper tube		$0/ha	$0				
Laneways		$5,000/ha	$50,000				
Drainage		$3,000/ha	$30,000				
Contingency	10%	$2,039/ha	$20,390				
Total orchard establishment		$22,429/ha	**$224,290**	**$0**	**$0**	**$224,290**	$22,429 /ha

Total Capital Costs	Year 0 ie start of year 1	Year 1	Year 2	Year 3	Totals	
General capital	**$150,000**	**$255,000**	**$0**	**$0**	**$405,000**	$40,500 /ha
Orchard establishment		**$224,290**	**$0**	**$0**	**$224,290**	$22,429 /ha
	$150,000	**$479,290**	**$0**	**$0**	**$629,290**	$62,929 /ha

14.7 Appendix Seven – Gross margin analysis

Dryland Scenario							
	Cattle	Wheat	Sorghum (forage)	Sorghum	Lucerne	Lychees	Macadamias
Unit of Measure	kg	tonne	tonne	tonne			
Price / unit of measure	1.53	283	220	250	200		
Gross Income/ha	$ 19.05		$ 2,640.00	$ 698.67	$ 1,600	$ 29,568	$ 11,342
Variable Cost/ha	$ 8.47	$ 329.95	$ 756.36	$ 318.69	$ 708	$ 10,629	$ 8,625
Gross Margin/ha	$ 10.58	$ 368.54	$ 1,883.64	$ 379.98	$ 892	$ 18,939	$ 2,716
GM/ha adjusted CPI	$ 12.24	$ 426.19	$ 2,178.31	$ 439.42	$ 941.15	$ 19,982.65	$ 2,866.18

Irrigated Scenario															
	Mangoes	Macadamias	Sorghum (grain)	Maize	Lucerne	Wheat (grain)	Cotton	Soybeans	Sorghum (forage)	Navy Beans	Sweet Potato	Rockmelon	Avocadoes	Capsicum	Lychees
Region	Dry Tropics	NQ	SQ	NQ	NQ	SQ	NQ	NQ	SQ	NQ	SQ	NQ	NQ	Dry Tropics	NQ
Unit of Measure	tray	kg	tonne	tonne	tonne	tonne	bale	tonne	tonne	tonne	tonne	carton	tray	carton	tray
$/unit of measure	13.22	2.65	160	130	200	231.5	500	340	160	750	802.7	15.81		15.56	40
ML/ha	3	3	5	5	7	2.5	7	5	0.75	4	3.5	3	8.05	3	5.6
$/ML	4.5	20		45	45	0	45	45		45	0	4.5		4.5	44.73
Gross Income/ha	$ 29,348	$ 9,938	$ 1,280	$ 975	$ 1,532	$ 908	$ 3,750	$ 1,190	$ 1,600	$ 2,250	$ 11,342	$ 39,525	$ 28,018	$ 46,680	$ 29,568
Variable Cost/ha	$ 26,348	$ 2,934	$ 908	$ 669	$ 1,068	$ 487	$ 3,201	$ 584	$ 1,073	$ 1,243	$ 8,625	$ 34,358	$ 14,856	$ 36,281	$ 10,629
GM Less Existing Water	$ 3,014	$ 7,063	$ 372	$ 531	$ 779	$ 421	$ 864	$ 831	$ 527	$ 1,187	$ 2,716	$ 5,181	$ 13,163	$ 10,413	$ 19,190
Gross Margin/ha	$ 2,839	$ 6,888	$ 197	$ 356	$ 604	$ 246	$ 689	$ 656	$ 352	$ 1,012	$ 2,541	$ 5,006	$ 12,988	$ 10,238	$ 19,015
GM/ha adjusted CPI	$ 3,283	$ 7,966	$ 227	$ 412	$ 698	$ 284	$ 797	$ 759	$ 408	$ 1,170	$ 2,939	$ 5,789	$ 15,019	$ 11,839	$ 21,989
Assumed Size (ha)	10	10	50	50	50	50	50	50	50	50	10	10	10	10	10
Water Required	39	39	275	275	385	137.5	385	275	41.25	220	45.5	39	104.65	39	72.8
Water Cost (upfront)	$ 72,150	$ 72,150	$ 508,750	$ 508,750	$ 712,250	$ 254,375	$ 712,250	$ 508,750	$ 76,313	$ 407,000	$ 84,175	$ 72,150	$ 193,603	$ 72,150	$ 134,680
Irrigation Infrastructure	$ 200,000	$ 200,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 100,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
Water Holding Infrastructure	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000
Other Establishment	$ 631,050	$ 652,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 616,200	$ -	$ 629,290
Total Capital Cost	$ 1,203,200	$ 1,224,650	$ 1,308,750	$ 1,308,750	$ 1,512,250	$ 1,054,375	$ 1,512,250	$ 1,308,750	$ 876,313	$ 1,207,000	$ 484,175	$ 572,150	$ 1,309,803	$ 572,150	$ 1,263,970
Gross Margin after amortisation	-$ 2,064	-$ 1,816	-$ 1,086	-$ 902	-$ 778	-$ 826	-$ 680	-$ 555	-$ 560	-$ 62	$ 736	$ 2,967	$ 5,139	$ 9,017	$ 12,205

14.8 Appendix Eight – Optimiser discussion document

OPTIMISER hydraulic analysis

From the expression of interests received along with the individual interviews conducted with landholders, Pinion have prepared two overall alignment options each with a high- and low-pressure supply. Both options have their water supply sourced from the Fitzroy River from a different supply point. Ultimately, providing four different scenarios for concept design.

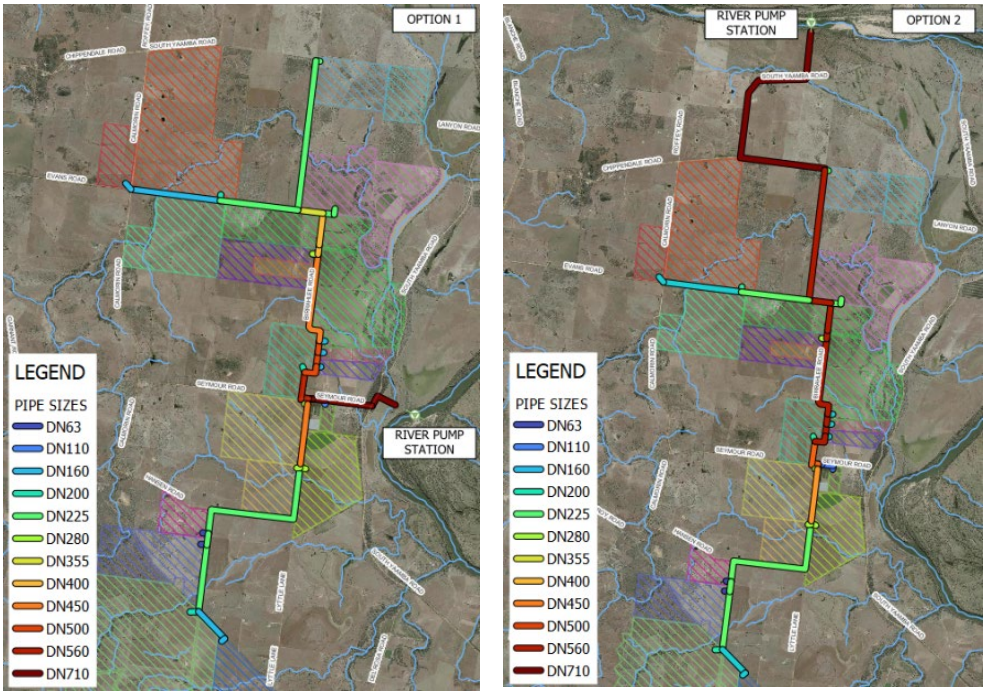


Figure 1: Northern and Eastern pumping option

To determine the best solution, Pinion employed Optimizer™, a powerful software developed by Optimatics. This software uses a penalty-based approach to determine the best fit of capital vs operation. Determining and applying the penalty structure is critical for successful optimisation. These penalties include but not limited to;

- Capital input – cost of pipelines, pump stations, storages.
- Demand penalties – if supply to critical points is not met.
- Operational penalties – cost of ongoing inputs such as energy and maintenance.
- Source penalties – input costs of source water.

Optimizer™ uses a genetic algorithm which is a computing process that begins with a trial population of say 200 solutions chosen at random, and then each one is assessed for cost and hydraulic fitness to the objectives. Poor hydraulic solutions receive a proportional penalty cost, and then the fittest become parents of a second population. The process repeats to 'evolve' the final population of near-optimal solutions, creating a pareto front of feasible solutions (as shown in Figure 2 below). Genetic operators like population size, probability of mutation and crossovers will

be trialed during this process to determine the best fit. See Optimatics brochure attached for an overview of the software, as developed by our subcontractors involved in this project.

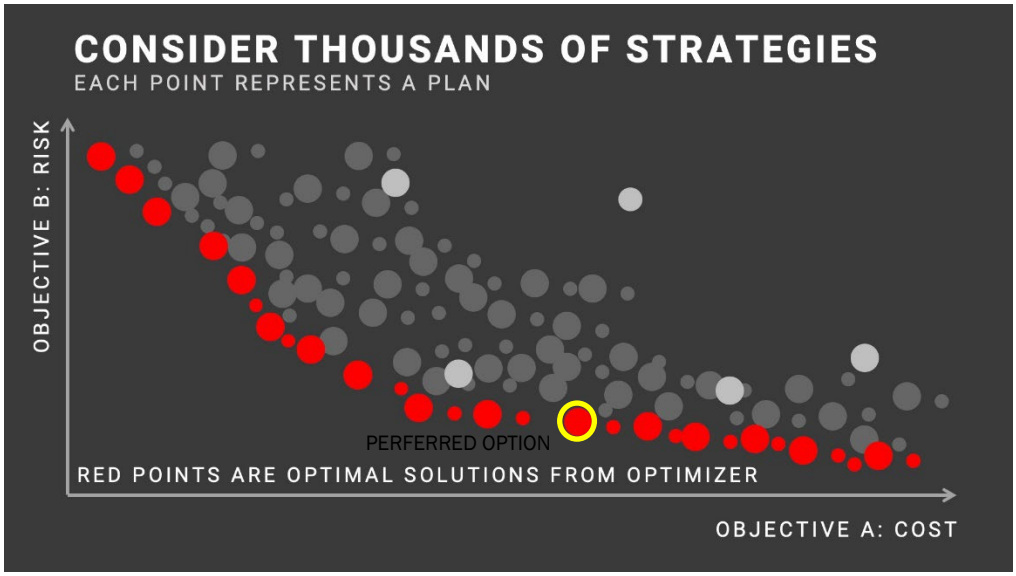


Figure 2: Visual representation of Optimizer™ results

The network was first modelled using EPANET and QGIS, ensuring the baseline of relevant parameters is established for the optimisation process in Optimizer™. During the program setup, infrastructure is manually sized to establish a baseline for cost estimation and to identify any hydraulic constraints in the network. This was done based on the net present value (NPV). The NPV analysis include the following assumptions:

- Design life of 50 years
- Discount rate of 5.8%
- Typical unit rates for pumping (energy)
- Typical industry unit rates for capital expenditure

Figure 3 shows the lifetime NPV analysis for varying HDPE (high density polyethylene) PE100 pipelines. The costings presented are an aggregate total expenditure cost and is not a real reflection of unit rates for the pipelines. This is just for comparative purposes.

An example given shows the most cost-effective pipeline size for a flow rate of 250L/s is DN560 (all things being equal).

The comparison of NPV for each pipe size allowed for the network to be initially sized based on the flow rate for individual. EPANet was used as the hydraulic program and interfaces with Optimizer™.

pinion ADVISORY

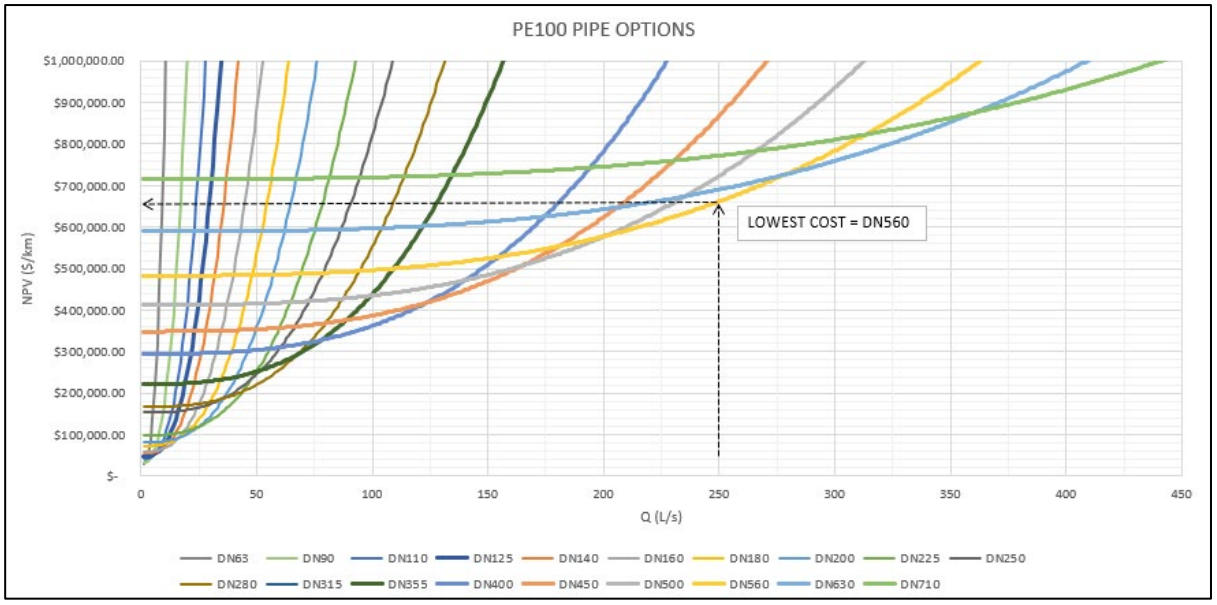


Figure 2: Net Present Value for all PE100 pipe options

The optimisation process has resulted in considerable cost savings, with the best solution providing a cost savings of up to 20% for one of the low-pressure scenarios. These results highlight the effectiveness of the optimization process in reducing costs and finding the most cost-effective solution between pipe size and pumping head.

In conclusion, after thorough analysis and optimisation, Option 1 with a low-pressure service level emerged as the most favorable solution among the four scenarios. This option sets the foundation for the distribution network, providing a solid framework to be further enhanced and refined during the ground-truthing process.

The *Optimizer*™ software

The *Optimizer*™ software is a powerful tool for analysing virtually limitless planning options across multiple asset types, determining the best plan to reduce capital, operating, and energy costs while meeting an organization's planning objectives. The software is designed to enhance an organization's hydraulic modelling experience by automating the traditional "trial and error" planning approach, producing many potential combinations that meet the desired requirements.

Optimizer helps utilities transform their infrastructure economics by considering all possibilities, then locating the best strategies for growth, project completion, and cost-effective implementation. The software's transparent and verifiable data allows utilities to back-up their decisions with facts and approach shareholders and other invested parties with confidence. The unbiased and defensible outcomes promote financial stewardship and ensure sustainability for an organization and its stakeholders.



Recognized advantages of the software includes the ability to:

- Avoid significant capital and operating costs through an exhaustive analysis of infrastructure improvement and system operating alternatives.
- Identify a range of feasible, alternative solutions for stakeholder consideration.
- Produce highly defensible solutions based on a comprehensive, unbiased process.
- Improve system performance in terms of security of supply, water quality, and customer service levels.
- Reduce energy consumption, minimize risk, and meet regulatory and environmental standards.
- Improve decision-making transparency.
- Be confident in meeting regulatory and environmental standards at the lowest costs.

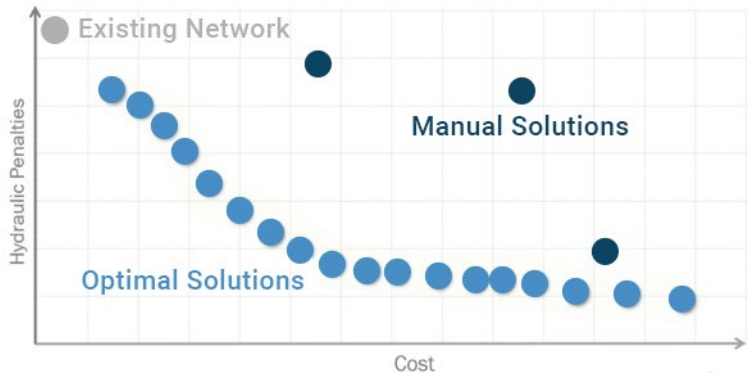
HOW MULTI-OUTCOME AND MULTI-PARAMETER ASSESSMENTS ARE ENABLED IN *OPTIMIZER*

Optimizer is a multi-criteria, multi-objective decision support platform that allows users to assess a variety of CAPEX and OPEX options and balance their costs against hydraulic performance, risk, and other social/environmental criteria as well as operational costs. For water assets, options may include pipe renewal, pipe rehabilitation, new pipe alignment/sizing, tanks, pumps, valves, and operations. For wastewater applications users can define options for conveyance, storage, RTC, SUDS, inflow reduction, etc.

pinion ADVISORY

Optimizer is designed to automate a lot of manual effort typically required for optioneering. The platform automates the assessment of new capital strategies, uses evolutionary algorithms to select strategies, and utilizes cloud computing to streamline the running of hydraulic models. The software allows for manual effort to be reduced as well as for more optimal capital strategies to be defined.

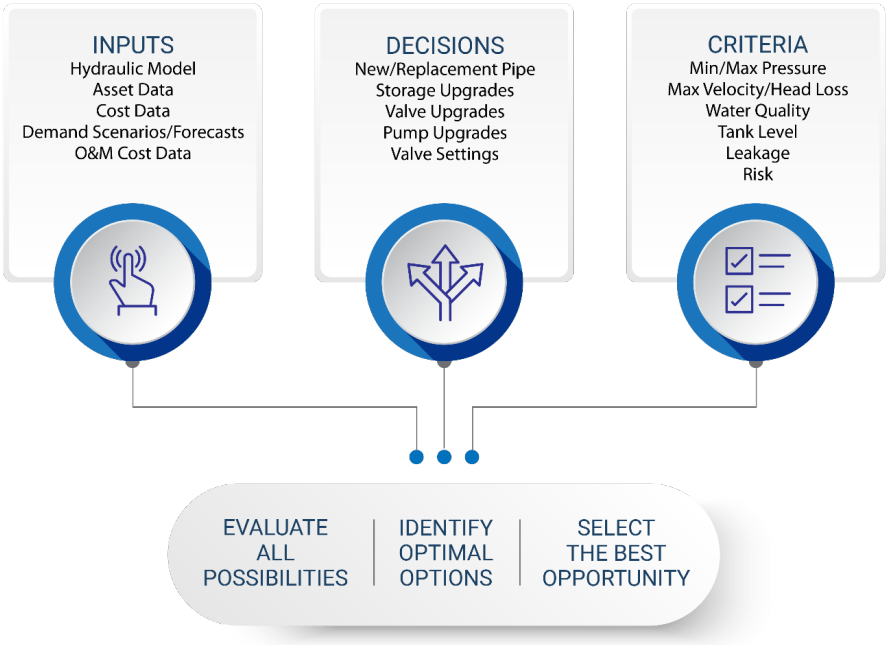
Optimizer allows the engineer to consider many more options than possible through trial and error. It also allows many "what if" scenarios to be considered independently. The software allows a range of least-cost solutions to be produced for the same engineering problem. These solutions can then be assessed using engineering judgment by the utility engineer and their consulting team, before deciding on a preferred plan to proceed with.



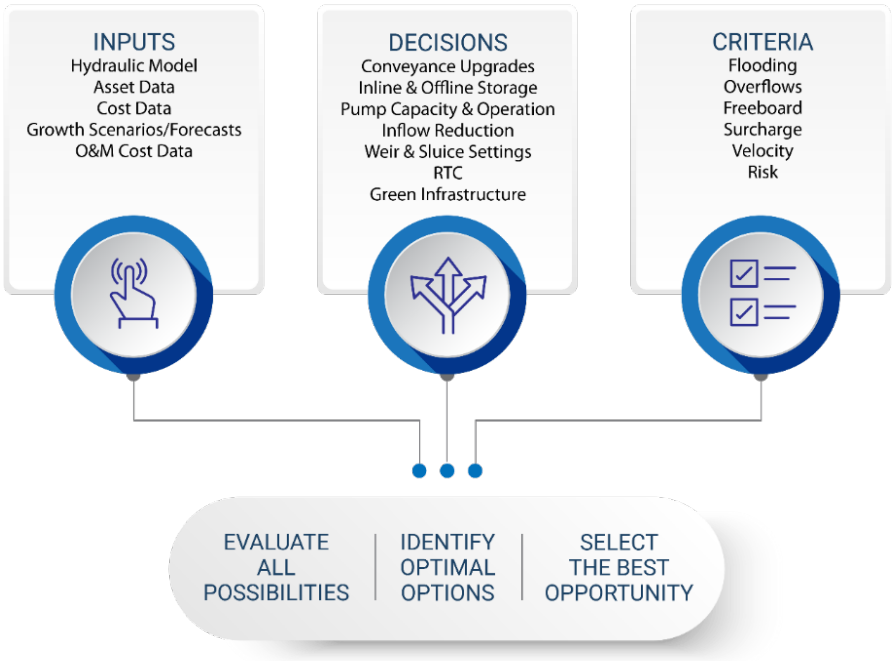
Optimizer identifies the optimal solutions for a given level of investment, beating the traditional manual approach in level of service and cost. It can incorporate multiple objectives (cost, risk, performance, community impact, etc) to determine trade-offs and target investments with a holistic view of the system.

As shown in the diagrams below (one for water systems and another for wastewater systems), there are a variety of options available in *Optimizer* for configuration of inputs, decisions, and design criteria.

Water System Configuration



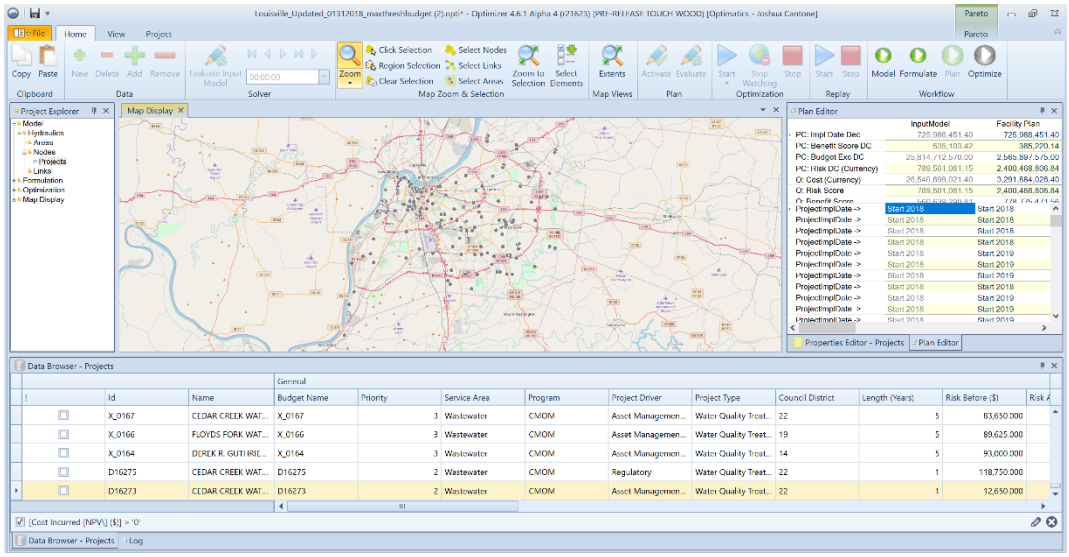
Wastewater System Configuration



SCRIPTING CAPABILITY

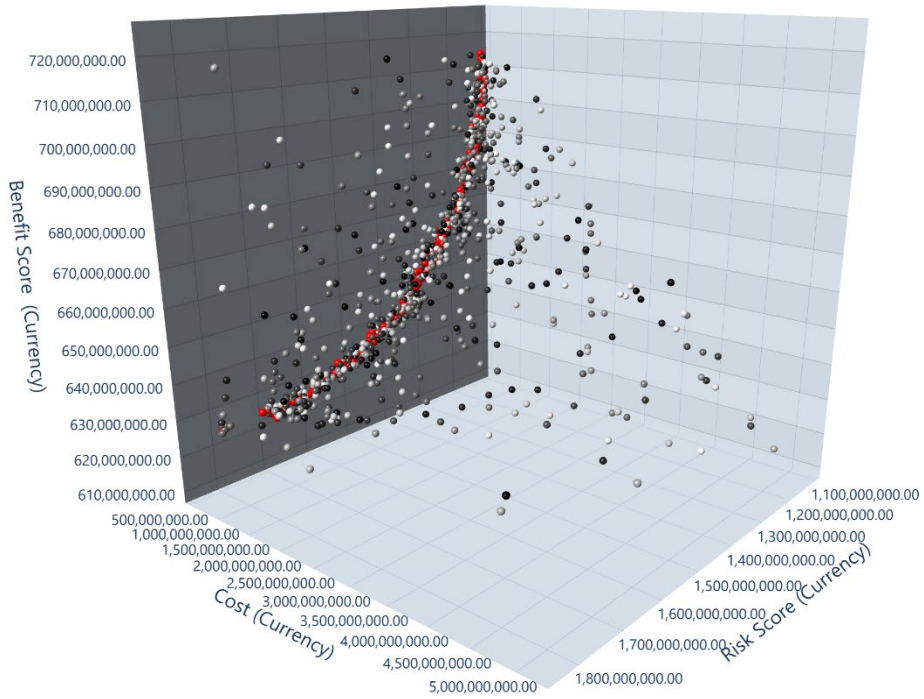
Optimizer is Optimatics' off-the-shelf offering and although it is highly configurable, the needs of water and wastewater utilities are complex and varied. In recognition of this *Optimizer* includes a scripting capability which can be used to develop extensions which customize the behaviour of *Optimizer* to meet specific needs.

Optimizer Graphical User Interface



***Optimizer* 3D Pareto balancing Cost, Benefit and Risk**

(the red points are the optimal trade-off curve)



Integrated Modelling Packages

For most applications, the *Optimizer* software calls a hydraulic modelling package to evaluate the hydraulic performance of proposed solutions. *Optimizer* has been integrated with Innovyze WS Pro, Bentley WaterGEMS and EPANET (for water systems) and Innovyze ICM and EPASWMM for (wastewater systems).

The versions of the modelling packages currently supported are summarized as follows:

MODELLING PACKAGE	VERSION SUPPORTED
Innovyze WS Pro	WS Pro 4.0 through to 2021.8
Bentley WaterGEMS	WaterGEMS 10.00 through to 10.03
EPANET	EPANET 2.0
Innovyze ICM	ICM 8.0 through to 2021.6
EPASWMM	EPASWMM 5.1

SCALABILITY

Optimizer currently utilizes cloud computing provided by Amazon Web Services (AWS). This setup allows us to scale for demand without limitation and is currently

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used by all our customers worldwide. Our AWS partnership is strong, and we continue to look for new ways to innovate with them. The current arrangement allows us to leverage a wide variety of compute options that are required of our different products and to run in a LINUX and Windows environment. The capacity to use powerful machines for large hydraulic simulations is essential for *Optimizer*. The software has often been used to optimize city-wide water distribution systems with between 50,000 and 100,000-pipe network models.



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