Member of the Surbana Jurong Group

Eurobodalla Southern Storage

Concept Design Volume 1: Ancillary Works

Prepared for: Eurobodalla Shire Council

Reference No: 30012127_R04_V03

26/07/2017

Executive Summary

Scope

SMEC has been engaged by Eurobodalla Shire Council (Council) to complete an environmental assessment and detailed design of an off-stream storage located on an unnamed tributary to the Tuross River and ancillary infrastructure. The works are as follows:

- Preparation of an Environmental Impact Statement (EIS)
- Storage design (Referred to as Eurobodalla Southern Storage or ESS)
- Ancillary Works design
- Preparation of Tender documentation

This report forms Volume 1 of the concept design of the Eurobodalla Southern Storage and documents the concept design for the ancillary works. It outlines the options identified for construction and future operation of the ancillary works, summarises the option evaluation process undertaken during the 20% design for the ancillary works and provides recommendations on the most cost efficient and beneficial way forward for Council and stakeholders.

The storage design is addressed in Volume 2 of the concept design report (refer to 3001212_R05_V02). A summary of the key outcomes from the storage design is presented in this executive summary.

Project Drivers

A new water storage was recommended for Eurobodalla Shire in a 2003 Integrated Water Cycle Management Strategy (IWCMS) to increase water supply security for the region. The preferred solution was an off-stream storage supplied by high flow water from the Tuross River, to increase supply capacity to the southern parts of the system in peak summer months.

A concept design of the storage was subsequently undertaken in 2006 by the NSW Department of Commerce. At the time and due to the impact of water conservation measures, slower than anticipated growth and uncertainty associated with proposed water sharing plans, Eurobodalla Shire Council resolved not to proceed with the project beyond preparation of draft concept and environmental assessment documents.

A review of the water sharing plans and IWCMS in 2012 concluded that additional water storage would be required by 2023 and the Eurobodalla Southern Storage was identified as the preferred option.

Council engaged SMEC in 2016 to undertake an environmental assessment and design of the Eurobodalla Southern Storage (ESS) and the ancillary works required to integrate the ESS with existing infrastructure to service local communities.

Design Inputs

When operating, the Tuross River currently supplies approximately 4ML per day (ML/d) to areas south of Tuross Head via an existing borefield and treatment plant located directly adjacent to the river. This existing system has capacity to supply up to 6ML/d to the existing Southern Water Treatment Plant (Southern WTP). There is also an existing river intake pump station located near the Southern WTP which is no longer in service.

The concept design of the ESS includes an initial 3,000ML of storage, with an ultimate storage capacity of 8,000ML after a later upgrade, to secure water supply for the region in both the medium term (between 20 to 30 years) and long term (between 30 to 100 years).

The design of the ancillary works will provide capacity to supply up to 26ML/d from the river and borefield to the new ESS, initially to assist with filling the storage and ultimately to provide water supply security. Stage 1 water from the ESS will be directed to the Southern WTP for treatment and distribution via existing infrastructure. Ultimately the network will be upgraded to deliver up to 26ML/d from the ESS to Big Rock Reservoir via a future WTP (Stage 2), proposed to be constructed after the ESS. The siting of the future WTP was addressed in the 20% design for the ancillary works and is summarised in this report. The design of the WTP will be undertaken by others.

It is noted that geotechnical investigations are yet to be undertaken and that the findings from these may change some of the details discussed in this report. Geotechnical considerations will be incorporated into the detailed design phase of works.

Volume 1: Ancillary Works

Options Assessment

This report documents the concept design of the ancillary works infrastructure as required in sections 7.1, 7.2 and 7.5 of "The Services" and also provides a summary of the ancillary infrastructure options assessed in the 20% ancillary design workshop and report (refer to 30012127_R03_V02 dated 14/2/17), including:

River Intake Pump Station

- The Tuross river intake structure.
- A wet well pump station set back off the intake structure connected by twin pipes to the intake.
- Electrical supply and control panel for the pump station.
- Road works for access to the river intake pump station.

Water Treatment Plant Siting Options Assessment

In relation to the future WTP location, Council have established that the Southern WTP has sufficient capacity and remaining life to supplement the regional water demands in the medium term (up to 2030). A future WTP will be required post 2030 and Council has nominated a capacity of 25ML/d over 23 hours for this plant.

A multi criteria assessment (MCA) was undertaken to determine the preferred site for the future WTP, and is provided in Appendix E. A range of technical, social, environmental, cost and risk criteria were applied, including: hydraulics, available power supply, constructability, operability, exposure to flooding, land ownership, community impact, environmental impact, whole of life cost and risk.

Based on the MCA outcomes, the options adjacent to the Southern WTP and East of the Southern WTP appear to be least favoured due to land availability and potential community impacts (close proximity to residential property). The analysis indicates that the site adjacent to the proposed ESS (Option 3) and the option adjacent to Big Rock Reservoir (Option 4) were relatively comparable.

Option 3 was selected as the preferred site over Option 4 due to the expected reduced cost of extending power supply and the additional operational advantages of having the future WTP beside the ESS. Advice from the power supplier, Essential Energy, indicates that the upgrade required to the power network is significantly greater for Option 4 over that required for Option 3.

Pipeline Alignment Options Assessment

Four pipelines routes were identified and assessed for the future transfer pipeline to Big Rock Reservoir as documented in 30012127_R03_V02 dated 14/2/17. At this stage, the option to construct along an unsealed forestry road, Big Rock Road, is the preferred alignment due to a lower community impact.

This selection will need to be reviewed based on the outcome of the geotechnical investigations which are currently expected to commence in July 2017.

Recommendations

The following recommendations are made in relation to the ancillary infrastructure based on the outcomes documented within this report:

1. The concept design of the river intake pump station includes a wet well set back from the Tuross River with submersible pumps to transfer flow directly to the ESS. To construct the wet well it is anticipated that substantial excavation through suspected shale rock and to depths in the order of 20m would be required. This would introduce several issues to consider during design, in particular around design of the structure to resist buoyancy and constructability issues associated with a deep excavation through rock and adjacent to a major watercourse. Following development of the concept design, as documented in this report, and a greater understanding of these potential issues it is recommended that the wet well concept be revisited during the detailed design stage (after obtaining the geotechnical information) to assess whether it is still the preferred arrangement and/ or location of the intake structure.

2. SMEC to commence the design of the new pipelines required upfront to transfer flow to/from the ESS (Stage 1):
   a. Pipeline (Segment A) between river intake pump station and the ESS inlet along the proposed storage access road, with a capacity 26ML/d over 24 hours (302L/s); and
   b. Pipeline (Segment B) cross connection and valving to supply water from the ESS to the Southern WTP at 6ML/d, ensuring that the ESS outlet is sized for the ultimate capacity of 25ML/d over 23 hours plus allowance for treatment losses (approximately 320L/s), with provision for a future ESS pump station.

3. SMEC to confirm the preferred alignment for the future (Stage 2) pipeline between the future WTP and Big Rock Reservoir (Segment C) based on geotechnical data and commence the design based on a capacity of 25ML/d over 23 hours (302L/s).

Volume 2: Storage Design

The findings related to the storage design and documented in Volume 2 of the concept design report (refer to 3001212_R05_V04) are summarised in the sections below.

Geology and Geotechnical Conditions

The storage site is situated within the Narooma Accretionary Complex (Terrane) of the Lachlan Fold Belt and comprises generally Ordovician to early Silurian age rocks.

The past investigations at the storage site indicate that the site is suitable for an off stream storage. Based on existing documents, and a small geotechnical investigation conducted by SMEC at Eurobodalla Quarry it is currently concluded that:

- No materials suitable for construction of the earthfill core were identified on-site. This material will need to be imported.
- No materials suitable for construction of the embankment filters were identified on-site. This material will need to be imported.

- Weathered rock material suitable for use in the outer zone of the embankment is likely available from within the proposed reservoir, however is expected to exhibit soil like properties following excavation and placement.
- On site materials are not suitable for supply of Rip Rap, imported materials will be required.
- The rock type expected on site is not suitable as concrete aggregate.
- The depth of cutoff will need to be assessed during the proposed investigations. A variable and undulating weathering profile is expected as a result of the geological structure meaning that a cut-off structure may exist from 4m depth to potentially 12m depth on the left abutment.

Significant further geotechnical investigations and geological mapping is proposed. These further investigations are nominated to be conducted as a component of the detailed design.

Embankment

An options assessment was conducted in a previous phase of this project. The options assessment considered four dam types:

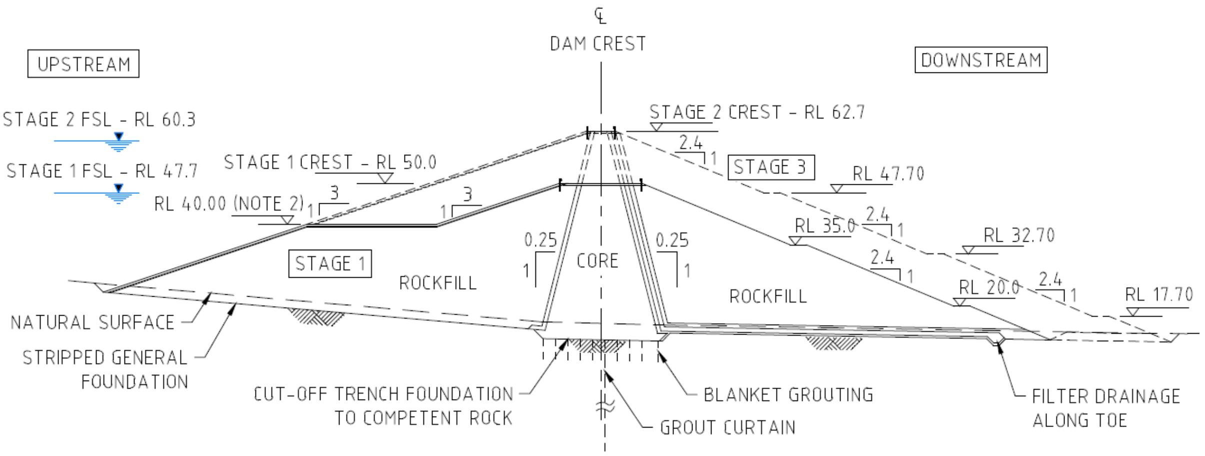
1. Roller compacted concrete dam
2. Zoned earth and rockfill embankment with central core
3. Zoned earth and rockfill embankment with sloping core
4. Concrete face rockfill dam

The results of the options evaluation concluded that the zoned earth and rockfill embankment with a central core is the preferred option to satisfy Council's Southern Storage objectives. Accordingly, this concept design report has been prepared based on the central core option.

The preferred alignment of the embankment was assessed to be positioned approximately along the lateral ridgeline on the left and right abutments, a similar position to the DoC concept design (2006b) but moved slightly to minimise earthworks for the Stage 1 embankment and the proposed cofferdam.

The key components of the embankment are described below and shown in the figure.

- Central clay core with symmetric side slopes at 0.25H:1V.
- Three stage filter/transition zone downstream of the core.
- Single stage transition zone upstream of the core.
- Rockfill shoulders:
  - Upstream shoulder to be constructed to full raised embankment profile to a berm at RL 40.0 m (level to be confirmed subject to allowable drawdown level during Stage 3 works).
  - Downstream should be designed to provide minimum width to achieve stability criteria and provide adequate support to the clay core, allowing for future raising of the core.
- Rip rap and bedding on the upstream face to provide erosion protection to the shoulder.
- Crest capping.



Spillway

The spillway for Stage 1 is proposed to be located through the right abutment and comprise:

- A trapezoidal shaped concrete crest
- A concrete lined chute
- A concrete dissipator structure at the downstream end
- Erosion control structures across the gully downstream of the dissipator to control velocities in the gully

Hydrology and Consequence Assessment

The study area is located on an unnamed tributary of the Tuross River with a catchment area of 4.6 km^2 including the area downstream of the proposed storage to the confluence with the Tuross River. The overall catchment ranges in elevation from approximately RL 1.0 m (at the confluence with the Tuross River) to RL 153 m, and consists predominately of forested area. Of that catchment, the proposed storage will command a smaller portion of that tributary with a catchment area of 1.6 km^2.

From the flood frequency analysis, the results indicate the peak PMF inflow to the storage is estimated to be 390 m^3/s. The design peak PMF outflow from the storage occurs in the 3 hour storm event with a peak outflow estimated at 76.1 m^3/s. The PMF 3 hour event brings the storage to the design peak PMF water level of RL 49.4 m.

The consequence category for the Stage 1 embankment in accordance with ANCOLD (2012) has been rated as High C for both sunny day and incremental flood failure scenarios.

Reliance

This report is provided solely for the purpose of the ancillary works concept design of the proposed Eurobodalla Southern Storage and for development of the Environmental Impact Statement (EIS). This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited (SMEC) and Eurobodalla Shire Council (Council) under which SMEC undertook to perform specific and limited tasks for Council. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Council or regulatory agencies involved in the EIS for the Eurobodalla Southern Storage. Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

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Appendices

1. Introduction

1.1. Objective

SMEC has been engaged by Eurobodalla Shire Council (Council) to complete an environmental assessment and design of an off-stream storage located on an unnamed tributary to the Tuross River catchment and ancillary infrastructure. The works are as follows:

- Preparation of an Environmental Impact Statement (EIS)
- Storage design (Referred to as the Eurobodalla Southern Storage or ESS)
- Ancillary Works design
- Preparation of Tender documentation

This report documents the outcomes of the concept design for the ancillary works. It outlines the options identified for the construction and future operation of the ancillary works, the option evaluation process undertaken incorporating physical, regulatory or environmental constraints, and makes recommendations on the most cost efficient and beneficial way forward for Council and stakeholders.

The other project objectives including preparation of the EIS, Storage Design (ESS) and tender documentation will be presented in additional reports.

1.2. Background

A new water storage was recommended for Eurobodalla Shire in a 2003 Integrated Water Cycle Management Strategy (IWCMS) to increase water supply security for the region. The preferred solution was an off-stream storage supplied by high flow water from the Tuross River, to increase supply capacity to the southern parts of the system in peak summer months.

A concept design of the storage was subsequently undertaken in 2006 by the NSW Department of Commerce. At the time and due to the impact of water conservation measures, slower than anticipated growth and uncertainty associated with the proposed water sharing plans, Council resolved not to proceed with the project beyond preparation of the draft concept and environmental assessment documents.

A review of the water sharing plans and IWCMS in 2012 concluded that additional water storage would be required by 2023 and identified the Eurobodalla Southern Storage as the preferred option.

Council engaged SMEC in 2016 to undertake an environmental assessment and design of the Eurobodalla Southern Storage (ESS) and the ancillary works required to integrate the ESS with existing infrastructure to service local communities.

1.3. Scope of Work

The scope of work associated with the concept design of the ancillary works consists of the following:

- Determine the preferred option to modify pumping arrangements to transfer water into the ESS. Where possible this will use existing infrastructure;
- Determine the preferred option for incorporation of the Southern WTP into delivery of water from the ESS to the Eurobodalla water supply system; and
- Determine the preferred option for the location of a future WTP and associated upgrades of transfer pumping systems.

2. Design Inputs

2.1. Existing System

The Tuross River currently supplies approximately 4ML per day (ML/d) to areas south of Tuross Head via an existing borefield and Southern WTP located directly adjacent to the river. This existing system has capacity to supply up to 6ML/d of potable water. There is an existing river intake pump station located near the Southern WTP which is no longer in service.

The location and configuration of the existing infrastructure is shown on Figure A-1 in Appendix A.

2.2. Basis for Options Development

The ESS will be an off-stream storage supplied by water from the Tuross River, to increase the secure yield of the Eurobodalla water supply system to cater for droughts.

The ESS concept design includes an initial 3,000ML storage, with an ultimate storage capacity of 8,000ML, to secure the water supply for the region in both the medium term (between 20 to 30 years) and long term (between 30 to 100 years).

It is proposed to provide capacity to supply up to 26ML/d from the Tuross River to the new ESS, initially to assist with filling the storage and ultimately for water supply security. Initially water from the ESS will be directed to the Southern WTP at up to 6ML/s for treatment and distribution to communities via existing infrastructure. Ultimately, the network will be upgraded to deliver up to 25ML/d (over 23 hours) from the ESS to Big Rock Reservoir via a future WTP. The siting of the future WTP is addressed in this report, however design of the WTP will be undertaken by others.

2.2.1. Value Engineering

After the initial draft of this report, additional value engineering was completed and these were presented to Council during the review period. Some of the value engineering included consideration of:

- Johnston Screens or similar
- Alternative river intake pumping methods from the wet well to the ESS
- Alternative to isolate the bore pumps supply directly to the ESS
- Re-investigate the dry well arrangement
- Alternative positions for the intake pump station

The Johnston type screens have been incorporated into this report and are determined to be the preferred intake screening option as opposed to the originally proposed river intake bar screen structure.

Alternative pumping systems were also investigated including:

- Vertical turbine pumps
- Vertical turbine pumps (or centrifugal) on an incline
- Rising pipe with internal pump (with inflatable casing packer)

In addition to these options, isolating the bore pump supply to be independent from the river intake was investigated. This option was discussed during the workshop where it was decided not to proceed as it would entail an additional pumping system which would not be cost effective. Depending on the outcome of the geotechnical investigations this option may be revisited during the detailed design stage.

After the workshop Council requested SMEC to review the option of a dry well pumping station to minimise excavation costs and the suction lift of pumps. Council's suggested arrangement included an allowance of 5m between the pump impeller and the lowest water level was, however this is dependent on the screen losses (open area of wedge wire), suction pipe, valve and inlet bellows losses, plus the actual Net Positive Suction Head Required (NPSHr) of the final pumps at the required flow rate. The 5m allowance could be marginal.

A major concern with the pumps being above the water level is that when the water level is low, the pumps are likely to lose their prime whenever they are stopped for a period of time. Without a foot valve, the only way to regain prime would be by use of a vacuum pump.

Potential flooding of the pumping station under flood conditions is another issue with a dry well arrangement. With the intake station, the screen and pipe losses, the head loss is estimated to be approximately 1m due to the very low velocity in the pipe (1.3m/s). Even though in theory 6m NPSHr for the pump is required, it is safer to design for at least 7m if not more. Cavitation has a higher occurrence when pumps are required to utilise the NPSHr to lift water on the suction side of the pump. During detailed design of a dry well system, cavitation needs to be checked as it can potentially occur at lower than the estimated NPSHr figures above.

Depending on the outcomes of the geotechnical investigations this option can be revisited during the detailed design stage.

2.2.2. 30% Concept Design Review Meeting

A concept design review meeting was held on the 8/5/17. The purpose of the meeting was to present the concept design of the project (inclusive of the storage and ancillary works packages) and to receive feedback from Council. Key outcomes from the meeting relating to the ancillary works are summarised below with the minutes provided as Appendix F:

- Confirmed design flows were:
  - 26 ML/d over 24 hours (302 L/S)for the river intake pump station
  - 6 ML/d (70 L/s) for the borefield
  - 25 ML/d over 23 hours (302 L/s) for the pipeline from the river intake pump station to the ESS
- The DN300 pipeline proposed to be constructed to transfer water from the Storage to the existing Southern WTP during Stage 1 is not required. If there is demand for water during Stage 1 while extracting from the Tuross River at the same time, water can be supplied from the borefield to the Southern WTP.
- Out of the alternative options considered for the river intake pump station, the wet well with Johnson Screens or a rising pipe with internal pump and inflatable casing packer were the preferred options. The selected option to progress to detailed design would be determined following completion of the geotechnical investigations.

2.3. Survey

Conway Burrows and Hancock were engaged by SMEC to undertake an engineering survey to locate existing services, structures, roads and cadastral boundaries at the existing intake pump station and Southern WTP. The survey drawings are presented in Appendix B for reference.

The following issues were identified by the surveyor:

- Trees down the riverbank were not included in the survey due to safety issues with access.
- The riverbank was not surveyed below the top of the bank due to safety issues with access.
- Sections of the optic fibre cable could not be located because they do not contain metal tracers.
- The total alignment of the pipeline between the existing borefields and the Southern WTP could not be verified because of lack of knowledge on the pipe route.

However, the details provided in the survey are sufficient for SMEC to make assumptions and undertake conceptual design work included as part of this submission.

2.4. Water Sharing Plan

The Water Sharing Plan for the Tuross River Unregulated and Alluvial Water Sources 2016 (Water Sharing Plan) sets out the extraction limits relating to the Tuross River. The water source relating to the proposed extraction location for the ESS is the 'Tuross River Water Source' as measured at the Eurobodalla gauge (No. 218008). The Water Sharing Plan came into force on 1 July 2016.

Our understanding of the water extraction limits defined in the Water Sharing Plan as they relate to the ESS are provided in Table 1.

Between 5 to 20ML/d the Draft Water Sharing Plan allows for 0.5*(F-3)+1 or 5ML/d. Similarly for flows between 20 to 50ML/d the maximum extraction limit is 0.2*(F-20)+5 or 8ML/d. This has been interpreted as meaning the lesser of these two values calculated for each flow range.

Table 1 - Summary of Water Extraction Limits from Tuross River (NSW DPI, 2016)

Tuross River Flow (ML/d)	Extraction limit From Tuross (water sharing plan) (ML/d)	Adopted Water Extraction Limit (ML/d)	Total daily Extraction Limit (ML/d)	Extraction Location
0 - 3	1 ML/d if Deep Creek Res. >40% capacity 2 ML/d if Deep Creek Res. <40% capacity	1	1	Borefield
>3 - 5	0.5*(F-3)			
> 5 - 20	0.5*(F-5)+1 OR 5	Lesser of extraction limit equation and 5 ML/d	5	Borefield
> 20 - 50	0.20*(F-20)+5 OR 8	Lesser of extraction limit equation and 8 ML/d	8	Borefield and/or River Intake
> 50- 200	0.5*(F-50)+8	Lesser of extraction limit equation and river intake PS capacity (26 ML/d)	26	River Intake
>200	NA	River intake PS capacity (26 ML/d)	26	River Intake

It is proposed that the control logic for the new river intake pump station is set to ensure these limits are not exceeded. This will be achieved by measuring the water level in the Tuross River at the Eurobodalla Gauge (No. 218008) to ensure compliance with the Water Sharing Plan.

2.5. Water Quality Monitoring

SMEC has recommended that additional water quality data monitoring be conducted to better inform later design and key assessment requirements outlined in the Department of Planning and Environment Secretary Environmental Assessment Requirements (SEAR). Location of the proposed monitoring includes:

- Upstream and downstream of the proposed river intake on the Tuross River;

- Upstream and downstream of the confluence of the unnamed tributary which drains the site and joins the Tuross River; and
- Extracted groundwater at the Southern WTP.

The objectives of the water quality monitoring are to provide a baseline result to be used as local reference data for future comparison during and post-construction. In addition it will measure the degree and nature of the sediment being mobilised by the river catchment during normal flow conditions.

2.6. Opportunities and Constraints

Key opportunities and constraints impacting the proposed ancillary infrastructure include:

- Network Operation - the proposed southern system is required to supplement peak summer demands and provide sufficient storage to allow the system to provide a secure yield in accordance with State Government guidelines and comply with the requirements of the Water Sharing Plans;
- Operational water balance – Current planning is based around a future WTP with a design capacity of 25ML/d (23hour operation) and an equivalent raw water pumping capacity of 26ML/d (24hour operation).
- The Water Sharing Plan states that the 79 percentile flow is 50ML/d and the 42 percentile flow is 200ML/d.
- Condition of existing assets – A visual inspection has been completed for this report and as presented in the 20% workshop the Southern WTP appears to be well maintained and in good condition. A complete condition assessment will be necessary to confirm the remaining life and probability of failure of existing assets before 2030.
- Construction cost estimates – The construction cost estimates for ancillary works are likely to be higher than current budgets shown within the RFT, and higher than costs shown within this report which have been developed using DPI Water's reference rates for option comparison only. Updated cost estimates will be undertaken for the project following completion of the concept design phase of works.
- Existing site conditions – The available site for construction of the river intake pump station is in close proximity to a steep riverbank and other road embankments. A layout of the river intake pump station has been developed and presented in this report. Due to the height of the riverbank the current layout has a number of construction and safety issues which are difficult to mitigate. In particular, the depth of the wet well, the need for retaining walls and difficulty associated with gaining access to the intake screens for maintenance purposes. These aspects will likely increase the complexity of the civil/structural design and construction associated with the structures. Options to reduce the complexity and safety risks of the current layout will be developed further to reduce their impacts during detailed design.;
- Existing utilities along Eurobodalla Road – Construction of the new access road servicing the river intake pump station need to take account of the existing utilities (i.e. Telstra Optic Fibre network has been identified);
- Easements and Services – There is an existing high voltage overhead power transmission that runs through the existing site. The design of the river intake pump station will be designed to retain and protect this;
- Protection of Existing Significant Trees (if any) – All new works will be designed to minimise impacts to existing trees;
- Health & Safety – Design to mitigate risk of working in confined spaces, near the river and at heights;
- Staging of Works – Design to ensure minimal disruption to the operation of the Southern WTP during construction and commissioning;

- Environmental Impacts – Minimise impacts to the environment and the river throughout the construction period by providing sufficient controls (i.e. sediment and erosion control measures, noise control measures, etc.); and
- Water Quality in River – Ensure corrosive attack on concrete structures is mitigated. Water quality monitoring will be undertaken and results used to complete the detailed design.

3. Infrastructure Staging

Based on the outcomes of the 20% design workshop and report (refer to 30012127_R03_V02 dated 14/2/17), it was concluded that the following ancillary works and staging plan would effectively integrate the planned ESS and achieve the greatest long term benefit to Council, community and environment.

3.1. Stage 1

Stage 1 ancillary works will be constructed with the ESS (3,000ML) and are proposed to be commissioned by 2023. The works will involve:

- New river intake pump station with a total river extraction capacity of 26ML/d via a combination of bores and direct river extraction over 24 hours (302L/s);
- Reconfigure the existing pipework to enable the transfer of borefield water supply to the Southern WTP and/or new river intake pump station, with a capacity of 6ML/d over 24 hours (70L/s);
- New Pipeline between the new river intake pump station to the ESS inlet. The pipeline to be aligned along the new ESS access road, with a capacity of 26ML/d over 24 hours (302L/s). This will also include a connection to the Southern WTP to enable transfer of water from the ESS to the Southern WTP; and

See drawing number AW-4130 in Appendix B for the process flow diagram of the stage 1 system

3.2. Stage 2

Stage 2 works, to be constructed with the new water treatment plant and scheduled for construction by 2030 (or later), includes:

- New ESS outlet pump station and intake pipeline between the ESS outlet and the future WTP, sized for 25ML/d plus treatment plant losses over 23 hours (approximately 320L/s);
- New pump station and pipeline from the future WTP to Big Rock Reservoir, sized for 25ML/d over 23 hours (302L/s). The preferred alignment for the pipeline is along Option 1 (most southern alignment along the Big Rock Road), and this will be confirmed following geotechnical investigations;
- Decommission the existing WTP; and
- New WTP - Option 3 (near the ESS) is the preferred site based on the NPV and MCA included in the 20% design workshop and report (refer to 30012127_R03_V02 dated 14/2/17).

See drawing number AW-4131 in Appendix B for the process flow diagram of the stage 2 system.

3.3. Stage 3

Stage 3 works involve upgrading the ESS to increase the capacity of the storage to 8,000ML. No additional/upgrade of the ancillary works is required as part of this stage.

4. Raw Water Transfer System

It is proposed to provide capacity to supply up to 26ML/d (over 24 hours) from the river and borefield to the new ESS, initially to assist with filling the storage and ultimately for water supply security.

The river water extraction has been sized at 26ML/d to take full advantage of high flow in the Tuross River, with 6ML/d supply being maintained from the existing borefield. The pipeline between river intake pump station and ESS will be sized at 26ML/d.

4.1. Existing Borefield

The existing raw water supply to the Southern WTP is fed by a borefield located along the Tuross River shown in Figure 1 below. The borefield was constructed in response to drought in 2003, therefore is approximately 14 years old and reported to be in good condition. There are five bore pumps, with a combined maximum pumping capacity of 10.8ML/d. Three capacities of bore pumps exist, 2 x 2.6ML/d (30L/s), 2 x 1.7ML/d (20L/s) and 1 x 2.2ML/d (25L/s).

The bore pumps are fitted with variable speed drives (VSD) and telemetry control. A combination of these pumps is used to supply water to the WTP. During normal operations two pumps are sufficient to supply 50L/s to the WTP balance tank (approximate TWL 28m AHD) and cater for current local demands.

Council operational staff reports that all bore pumps provide a reliable raw water supply to the WTP. Each of the bore pumps produces consistent flow rates. However, some produce better water quality than others and these are predominantly used. Future options considered in this report incorporate the long term use of the existing borefield.

The borefield aquifer is directly connected to the Tuross River and drawdown of the water table may occur during extensive pumping. Recharge of the aquifer may require higher river levels to occur. Given this constraint, extension of the borefield has not been considered.

Figure 1 - Existing Borefield located along Tuross River

4.2. Existing River Intake

There is an original river intake pump station located near the Southern WTP. The river intake pump station has a design capacity of 10.24ML/d at 20m head. The operation of this system has been troublesome since inception due to operational issues outlined below, and is currently not in use. In addition, the Southern WTP is not capable of reliably treating raw water extracted from the river.

The site consists of:

- An access road between the pump station and Southern WTP;
- A circular dry well with pumps located at an elevation of approximately 4.5m above the low water level of the Tuross River;
- One pump 48L/s at 16m head and second pump 79.8L/s (16m head). Both pumps can be operational to deliver water to the balance tank at 118.5L/s (20m head) with no provision of standby.
- One DN250 diameter suction pipe extending from the dry well into the river, including screens and foot valves;
- DN150 diameter delivery pipe extending from the pumps to the WTP balance tank;
- Electrical switchboard and controls for the pumps contained within the dry well caisson; and
- A platform located above normal river height for water quality monitoring and river height measurement. The platform is accessed by a steeply inclined ladder.

4.2.1. Condition and Constraints

Key operational issues associated with the existing river intake pump station are outlined below:

- Flooding: based on a review of the original drawings, recent photographs indicate that the access platform for the dry well was raised in elevation to increase flood immunity.
- Safety: the raised access platforms have been isolated due to erosion making them unsafe. Uncertainty over whether the dry well is classified as a “Confined Space”.
- Access: difficult access for maintenance of the foot valve. Difficult access to the pump well interior area for maintenance of the pumps and associated infrastructure. Difficult and potentially unsafe access to the lower platform and river level monitoring system; and
- Pumps operation: frequent loss of prime in the suction line requires operators to address this situation. Only one pump is sized to supply 6ML/d, with no redundancy at this flow rate.

Based on the safety, design and operational issues outlined above, it is not feasible to reinstate the existing structure for future use. It is recommended that the existing structure be decommissioned.

Given the bank is relatively straight and stable at this location, future options considered in this report incorporate a new river intake pump station at this location.

ESS operational staff reports that sediment loading in the Tuross River is not a major issue. Sand bars extend upstream from the site. Anecdotal reports indicate that the existing intake screen only needed to be cleared of sand occasionally when the pump station was in operation. A river water sampling plan has been developed to confirm sediment loadings and inform the detailed design of future infrastructure.

Figure 2 - Existing River Intake

4.3. Raw Water Transfer System Requirements

The following raw water transfer options were identified and assessed:

1. Transfer flow from the new river intake and borefield to the Southern WTP and new ESS;
2. Transfer flow from the new river intake and borefield directly to the new ESS; and
3. Transfer flow from the river and borefield to the new ESS, with the option of bypassing the pump station to transfer flow directly from the borefield to the Southern WTP.

As presented in the 20% ancillary design workshop Option 1 was dismissed due to the drinking water quality risk, as the Southern WTP is not suitable for treating river water. Option 3 was selected over Option 2 to provide maximum operational flexibility in the short term and has the lowest operating costs. It was recommended that Option 3 be taken forward to detailed design.

It is possible to achieve Option 3 with a combined river intake and transfer pump station. The design capacity of the new transfer pump station was agreed with Council to be 26ML/d over 24 hours. A key design consideration will be flooding and availability of electricity supply, which is the subject of discussions with the local energy supplier (Essential Energy).

4.4. Options Assessment

The following options were identified and assessed in the 20% ancillary design workshop (as documented in 30012127_R03_V02) for the combined river intake and transfer pump station:

1. Upgrading of the existing dry well
2. Floating pontoon
3. Inclined tubes

4. Structure in the river with submersible pumps
5. New larger dry well
6. Wet Well beside the River
7. Wet well set back from the Riverbank

Option 1 was dismissed due to design constraints and cost of modification. Options 2, 3 and 4 were dismissed due to operational and safety considerations.

Option 7 was selected over the other alternatives (Options 5 and 6) due to enhanced operability and safety for operators, surety of construction away from the riverbank and the lowest capital cost (based on relevant project estimates), and reduced environmental impact on river and banks.

4.5. Proposed Concept

4.5.1. Applicable Standards

The following standards and guidelines will form the basis of the detailed design:

- Water Supply Code of Australia WSA 03 - 2011 v3.1;
- Water Supply Code of Australia WSA 01 – 2004 Polyethylene Pipeline Code Version 3.1;
- AS3735 – 2001 Concrete Structures Retaining Liquid
- AS1675 – 2013 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation;
- AS1289.0 – 2000 Method of Testing Soils for Engineering Purpose;
- AS 3500.3 Plumbing and Drainage Part 3: Stormwater Drainage;
- AS4058 – 2007 Precast Concrete Pipes (Pressure and Non-pressure);
- AS2280 – 2004 Ductile Iron Pipes and Fittings;
- AS4130 – 2009 Polyethylene (PE) Pipes for Pressure Applications;
- Eurobodalla Shire Council's Infrastructure Design Standard;
- Australian Standard AS3000:2007 (Wiring Rules);
- Electrical Safety Regulation 2002;
- Electricity Supply Authority's rules and regulations;
- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Eurobodalla Local Environmental Plan 2012 (Eurobodalla LEP);
- Eurobodalla Rural Local Environmental Plan 1987; and
- Environmental Planning and Assessment Model Provisions 1980 (Model Provisions).

Particular attention will be directed to the following:

- Work Health and Safety Act 2011;
- Work Health and Safety Regulation 2011; and
- Risk Management Code of Practice 2007.

4.5.2. Proposed River Intake / River Intake Pump Station

4.5.2.1. *River Intake*

The new river intake is to be located next to the existing intake pump station, which is located on the riverbank of the Tuross River close to the Southern WTP compound as shown in drawing no. AW-4011 in Appendix B.

The proposed river intake comprises the following components:

- Upstream bollards for large debris diversion
- Dual Submerged Inlet Screens with integrated scour
- Twin pipes with valving arrangement connecting the river intake and the high lift pump station;

4.5.2.2. *River Intake Pump Station Arrangement*

The new river intake pump station is to be located next to the new river intake, separated by twin culverts (refer to drawing no. AW-4011 in Appendix B).

The proposed pump station comprises the following components:

- A weir in the wet well chamber to even out the flow approaching the pumps;
- Three duty submersible pumps (each with rated power of 105kW to be confirmed during detail design) and pipework;
- Valves on a concrete foundation, containing, isolation valves, check valves and fittings;
- Flow meter to monitor delivery flow rates to the storage;
- Scour line from the valve to the wet well back for flushing the pipeline when required. Should the wet well be required to be drained, the DN600 butterfly valves would be shut with the submersible pumps in operation;
- Weather proof electrical switchboard and pump control cabinet containing variable speed drives, installed 500mm above the 1 in 100 AEP flood level;
- Electrical switchboard housed within a masonry building. Details to be provided in detailed design;
- Access road from Eurobodalla Road;
- Compressor for automatic purging of the inlet screens.
- Retaining walls as required to provide a flat working platform for access, operation and maintenance of the river intake pump station.

4.5.2.3. *Design Limitations*

The following limitations apply to the concept design presented in this report:

- Geotechnical considerations are based upon a note in the “As Built” drawings, which indicate shale just below ground level. As part of the geotechnical investigations planned during the detailed design stage of works, two boreholes are planned to be drilled on site to understand the ground conditions; and
- The estimated 1 in 100 AEP flood Level at the proposed site has been extrapolated by conducting an elevation frequency analysis on the gauge level at Eurobodalla (218008) with uncertainty range of 12.8m to 15.4m AHD.

4.5.2.4. *Design Flow*

The following design flows have been adopted for design:

- The river intake capacity is to be designed for 26 ML/d (over 24 hours);

- The river intake pump station is to be designed for a capacity of 26 ML/d (over 24 hours) may be either 26ML/d from the river intake, 20ML/d from the river intake and 6ML/d from the borefield or combinations in between; and
- Variable flows from 4 ML/d to 26 ML/d are proposed for the river intake pump station, controlled by the installed VSD's. This is to be confirmed in detailed design.

The system curve and hydraulic grade lines have been calculated based on the ground surface levels and expected system losses.

4.5.2.5. *Civil Design*

The civil works designed for the river intake pump station include:

- General site earthworks for construction of these structures and access road;
- Utilisation of the existing access road from Eurobodalla Road to enter the proposed river intake pump station, existing the site to the east via a new road;
- Hardstand and working area next to the river intake pump station for maintenance;
- Provision for site drainage to prevent water ponding;
- Temporary construction platform;
- All new facilities will be serviceable, energy efficient, easily maintained and able to optimise pump and WTP operations;
- Retaining wall where there are excessive differences in the surface level;
- Road safety guardrails along the access road for safety;
- Accommodation for a wide range of water levels expected in the Tuross River;
- Bollard and signage to be provided around the river intake pump station for public safety;
- Relocation and protection of existing utilities (i.e. optic fibre, Telstra, water main, etc.) impacted by the construction; and
- Provision of safe access for operators.

4.5.2.6. *River Intake/river intake pump station Layout and Site Levels*

The proposed location for the river intake and the river intake pump station is next to the existing intake pump station, where there is a straight section of the Tuross River.

Site levels have predominately dictated the specific layout arrangement as follows:

- River intake screens are proposed to be constructed as close to the submerged river edge as practicable to minimise the transfer pipe and pump station depth;
- Electrical equipment, switchboard and instrumentation kiosk will be placed at least 500mm above the 1 in 100 AEP flood level (approximately 14.2m AHD);
- Steep ground conditions throughout the site; and
- Proximity of existing river intake which will be decommissioned.

4.5.2.7. *Access and Laydown Area*

Access is proposed from Eurobodalla Road from the existing Southern WTP entrance, as shown in drawing no. AW-4011 in Appendix B. The intention is to have maintenance vehicles enter the site from the existing access (west of the existing river intake) and exiting the site through a new access road connection to Eurobodalla Road (east of existing LLPS). This avoids the need for construction of a turning area for maintenance vehicles.

Road guardrails are proposed to mitigate the risks associated with trucks and tankers manoeuvring in proximity to the river embankments.

A hardstand area has been allocated next to the river intake pump station for maintenance and for extracting the pumps.

4.5.2.8. *Water Supply*

A DN40 potable water service will be provided from the Southern WTP to the river intake/ and river intake pump station for maintenance work and wash down. A Reduced Pressure Zone (RPZ), backflow prevention device, will be installed if required and two (2) hose connections will be included for maintenance and cleaning purposes.

4.5.2.9. *Estimation of Water Level in the Tuross River*

Detailed rainfall runoff modelling to establish the 1 in 100 AEP flood level at the proposed river intake pump station has not been undertaken, however, SMEC has completed an analysis of the gauge levels at Eurobodalla (218008). The analysis is based upon 40 years of available records which included a large flood in the Tuross River on 7 December 1992 (discharge of 230,066 ML/d at 13.8m AHD). It has been estimated that this flood equates to an 1 in 67 AEP. The results from the analysis were extrapolated as presented in Figure 3.

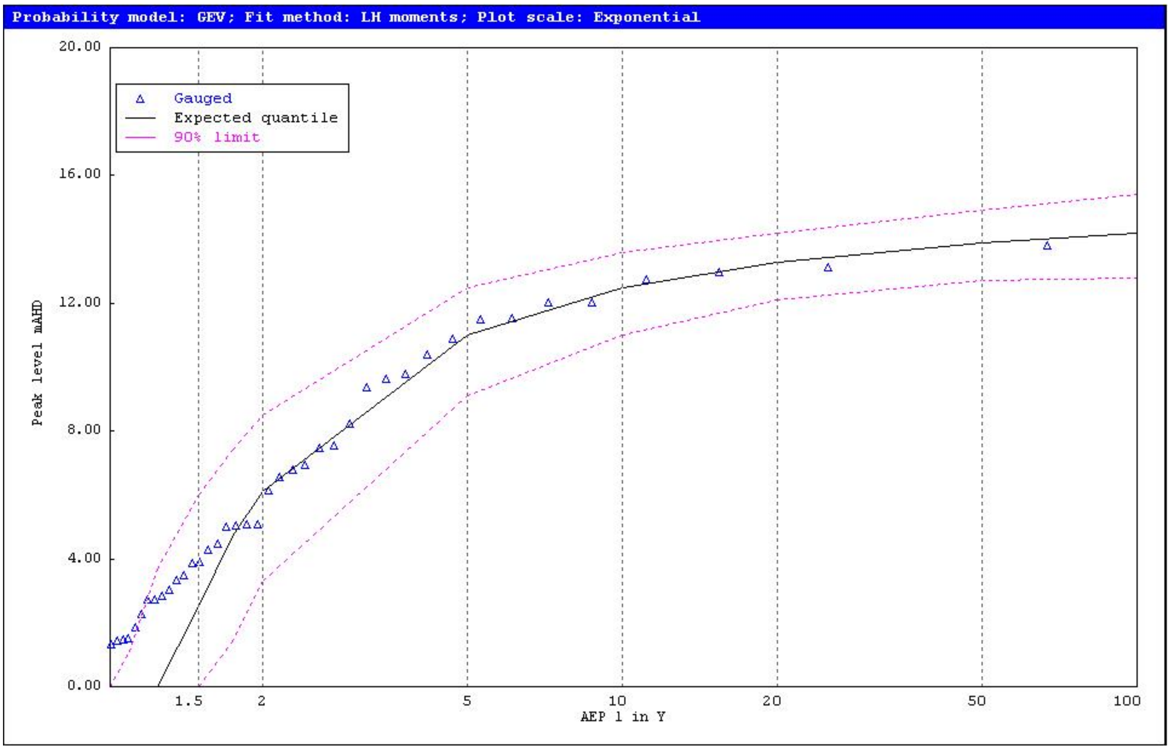

Figure 3 - Estimated Water Level in Tuross River

From Figure 3, it is estimated that the peak water level in the Tuross River for a 1 in 100 AEP flood is approximately 14.2 mAHD. Based on available historical data (from the NSW DPI website), the lowest water level recorded at the Eurobodalla Gauge is approximately -0.3 mAHD.

An analysis of the gauge levels at Eurobodalla (218008) was also undertaken to estimate the percentage of time water levels were above set stream levels to produce a level duration curve. The results are presented in Figure 4.

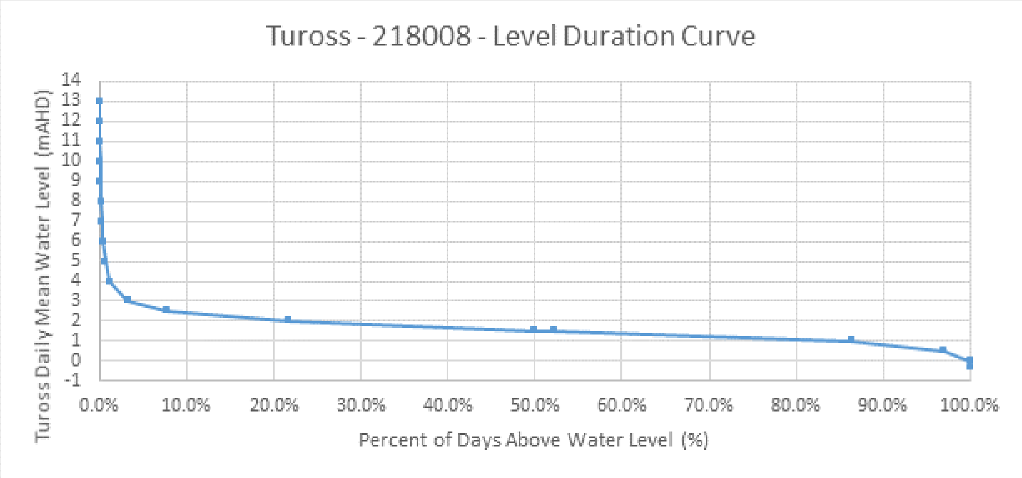

Figure 4 - Tuross - 218008 - Level Duration Curve

From this curve it is estimated that the water level in the Tuross Rover is below 2.3m AHD for approximately 90% of the time.

A river depth survey is recommended within 50m of the nominated submerged screens, to determine the riverbed level and set the location for minimum operation of the submerged intake screens, these will be nominated during the detailed design phase of works.

4.5.2.10. *Maintenance of the River intake Pump Station*

The following is proposed for maintenance

- Intake screens – Manual cleaning by divers (if the river levels are high) should the screens be clogged by debris which cannot be dislodged by the self-cleaning action. Cleaning should be done during low river level with stringent safety measures.
- Sediment in r sump – Regular maintenance by use of portable pumps is proposed.
- Removal of the river intake pumps in the wet well – Each of the pump weighs approximately 1200 kg. It is proposed that the pumps be lifted up to the surface through the use of a hoist attached to the back of the ESC maintenance trucks, using a staged lift approach. The pumps come pre-installed with guiderails for easy removal and installation.

4.5.2.11. *Mechanical Design*

The mechanical design includes the following key components:

- Submerged screens on the river intake;
- Submersible pumps installed on pedestals and guiderails;
- Variable Speed drives (to be confirmed during detailed design);
- Valves, pipes and fittings;
- Flowmeter; and
- Steel handrail, stairway and platforms.

4.5.2.12. *Submersible Pump Selection*

The river intake pump station will contain three submersible pumps.The specification of each pump will include the parameters provided in the table below (to be verified during detail design).

Table 2 - Submersible Pump Requirements

Pump Type:	Submersible (complete with guardrails and pedestals)
Total Head:	70.2m
Static Head:	63.3m
Inlet Diameter Size:	300mm
Discharge Diameter Size:	300mm

4.5.2.13. *Internal Pipework and Valves*

Design of the internal pipework and valves is in accordance with standard pump station design. All pipework and valves included within the valve chamber in the river intake pump station are shown in drawing no. AW-4012 in Appendix B.

4.5.2.14. *Electrical Design*

The electrical design principles considered for design will include:

- Appropriate fail safe control and instrumentation;
- Ability to connect an external power source (generator);
- 2 hours backup power supply (for RTU and instrumentation);
- Electrical equipment designed with flood immunity;
- Equipment and operation alarm requirements;
- Monitoring of raw water quality (pH and turbidity);
- Flow meter; and
- Switchboard housed within masonry building with details to be provided in detailed design.

All electrical equipment will be located in a kiosk which will be located above the 1 in 100 AEP level of 14.2m AHD.

4.5.2.15. *Instrumentation and Controls*

The following instrumentation requirements are proposed for the river intake pump station:

- Level sensor in the wet well of the pump station;
- pH and turbidity analyser;
- Pressure sensors in the valve chamber at the river intake pump station;
- Actuators for operation of valves at the river intake pump station;
- Actuators for operation of other valves required for operation; and
- Flow meter on the delivery main.

4.5.2.16. *Computational Fluid Dynamics (CFD)*

ANSI/HI 9.8-1998 states that for a pump station exceeding 300 L/s (26 ML/s) capacity, analysis of the hydraulic performance of the pump station by Computational Fluid Dynamics (CFD) analysis is recommended. No CFD modelling is proposed for the detailed design for the river intake pump station as the layout of the pump station will be based upon the manufacturer's recommendations and best industry practice in accordance with the ANSI standards.

The hydraulic design in the well is based upon the following:

- A weir before the pumps to ensure uniform flow across the width of the wet well;
- Introduction of simple fillets between the pumps;

- Design of base level of wet well to ensure minimum submergence in the wet well during pumping to reduce possible occurrence of air entraining vortices, swirling flow and the effects of any surface waves which may arise; and
- Providing sufficient length in the approach to the pumps to ensure uniform and steady flow to the inlet of the pumps.

4.5.2.17. *Structural Consideration*

The following structural design considerations will be incorporated into the detailed design stage:

- Corrosion attack on reinforced concrete structures in accordance with Australian Standards;
- Water tightness of structures;
- Loadings on structures such as lateral earth, hydrostatic, seismic, buoyancy, surcharge, live and equipment.

4.5.2.18. *Geotechnical Consideration*

The following geotechnical design considerations will be incorporated into the detailed design stage:

- Safe construction slopes for open excavation;
- Safety of construction near steep embankments;
- Recommended dewatering options; and
- Foundation types.

4.5.2.19. *Construction Consideration*

The following construction related issues will be considered at the detailed design stage:

- Potential of footprint reduction of the river intake pump station (i.e. reduce construction costs);
- Open cut or caisson type construction methodology for the construction of the pump well/shaft. The methodology is dependent on the geotechnical conditions encountered in the area of the pumps station and will be detailed in the detailed design;
- Use of pipe jacking or boring machines for installation of pipes;
- Temporary coffer dams and dewatering requirements for screen installation pipe jacking; and
- Excess excavated material and safe means of disposal.

4.5.3. Operational Philosophy

The operating philosophy proposed for new river intake pump station is described in the sections below.

4.5.3.1. *General*

- Level sensors in the river intake wet well for start/stop operation of the pumps;
- Pump operation will be controlled by Council operations to determine flow rate and time of pump operation. Checks will be made by the pump control system on the river water levels to ensure compliance with the Water Sharing Plan, installed instruments and ESS water levels to set alarms and stop pumps. The Water Sharing Plan could be programmed into the SCADA to manage flows based on the river level if required i.e. set up constraints so that the Water Sharing Plan requirements couldn’t be exceeded without resorting to manual operation.
- The river intake pump station operation will be partially automated by operator inputs and controlled by the ESS SCADA System based on daily flows with consideration on daily extraction limits. This includes provision for manual operation of the pumps and borefield pumps by the operators if required. Manual operation mode is essential for commissioning and maintenance
- Flow meters will be installed downstream of the river intake pump station on the;
  - DN600 delivery main; and

- The borefield pipeline to the river intake pump station.

- Turbidity and pH monitors installed and alarms triggered when the water quality is outside acceptable limits.
- The pumps in the river intake pump station will consist of three duty installed in a parallel configuration noting Council's preference for no standby pumps. All the pumps will be operated through VSD controls. Each pump has a capacity of 8.67ML/d with a total head requirement of 70.2m. Full hydraulic calculations will be completed during detailed design to confirm the pumps selection and ability to supply water across the full operating range.
- At start-up pumps will start individually. The first pump will start and increase speed until the maximum flow rate for the pump is achieved, the next pump would then be called to start up. This will occur until the set flow rate is achieved.
- The operating procedure will allow for rotation between the pumps.
- Each of the pumps will have a dedicated Variable Speed Drive (VSD). VSD pumps are preferred over fixed speed pumps for the following reasons:
  - To meet the expected flow ranges of between approximately 70L/s to 302L/s, fixed speed pumps would require different sized pumps. Concurrently running different sized pumps within the one system could create instabilities during operation;
  - Design of a fixed speed pump system would need to consider the excessive current draw during pump start-up; and
  - VSD will ensure that the system is running at the most efficient level to reduce ongoing operational costs.

4.5.3.2. *Normal Water Level*

- The number of pumps required to operate will depend upon the levels in the well and can be set by the operators. The pump control PLC will determine the optimum pump configuration for the flow, based on the water level in the wet well and it can be set by the operators.
- Pump speed will be controlled by the VSD. The speed reference signal to the VSD will be modulated based on the water level in the wet well.
- When the pumps start, the VSD will start at the lowest speed to generate flow and slowly increase speed based on the water levels set by the operators.
- The pump operation will be cycled on starting and stopping of the pumps to ensure even run time between all pumps.

4.5.3.3. *Flood Level*

- Based on data extracted from the NSW DPI website, the estimated maximum water level for the 1 in 100 Annual Exceedance Probability (AEP) flood in the Tuross River at the Eurobodalla Gauge is 14.20m AHD. When the water level in the wet well pump reaches the 1 in 100 flood level, an alarm will go off to indicate that that there is excess flooding. All pumps will stop operating when the level has been breached.

4.5.3.4. *Low Water Level*

- When water level in the wet well is below the minimum submergence level of the pumps, an alarm will sound and all pumps will stop operation.

4.5.3.5. *Safety*

- High pressure limit switches will be provided in the discharge piping from the pumps. These sensors will shut off any pumps that are running and issue an alarm if high pressure is sensed. Pumps will be latched off upon high pressure shut down.
- Upon receiving a fault signal from the VSD an alarm will be issued.

4.5.3.6. *Automated Valves*

- Values will be automated to ensure remote control of the system. The location of actuated valves will be agreed with Council staff during detailed design.

5. Pipeline To/From Storage

5.1. Raw Water Transfer Pipelines

In the short term (Stage 1), the pipelines required to supply raw water to/from the ESS include:

- New pipeline to enable transfer of raw water from the river intake pump station to the ESS (Segment A);
- Cross connection and valving to supply water from the ESS to the Southern WTP (Segment B); and
- Connection from the borefield rising main to the river intake pump station

These pipelines are illustrated in Figure A-5 of Appendix A.

5.2. Design Limitations

The following limitations apply to the concept design presented in this report:

- The current alignment drawings are based on a combination of survey drawings produced by Conway Burrows and Hancock and light detection and ranging (LIDAR) which may not capture the exact location and surface level;
- Where not surveyed, the location and details of the existing infrastructure has been obtained from dial before you dig (DBYD) request.

5.3. Pipe Sizing Selection

WSAA recommends that head losses per km be kept below 3m, and design velocities in the range of 0.8 to 1.2 m/s. An analysis of the potential pipe sizes and associated velocities for Segments A (from the river intake pump station to ESS) and B (from ESS to Southern WTP) are presented in Table 3 and Table 4, respectively. Based on this analysis, the recommended pipe diameter for Segment A is 600mm and 300mm for Segment B.

Table 3- Segment A Pipeline Sizing and Velocities

Pipe Diameter (mm)	Velocity in Pipe (m/s)	Discharge Rate (ML/d)
450	1.89	26
500	1.53	26
600	1.06	26
750	0.68	26

Table 4- Segment B Component Pipeline Sizing and Velocities

Pipe Diameter (mm)	Velocity in Pipe (m/s)	Discharge Rate (ML/d)
200	2.21	6
225	1.75	6
250	1.41	6
300	0.98	6
375	0.73	6

The optimum velocity in the pipeline is typically between 0.8m/s and 1.4m/s according to WSA 03-2011-3.1. The implication of not reaching 0.8m/s is potential siltation built-up in the pipeline which will reduce the capacity of the pipes. There is potential siltation issue at the river intake pump station. This becomes an operational maintenance issue which can be reduced by regular flushing of the pipeline with high flow rates.

5.4. General Design

The pipelines proposed to/from the storage are summarised on the process flow diagram drawings no. AW-4130 and 4131 in Appendix B.

Segment B has some connection components that can be installed in a small diameter (DN300) pipeline which could be constructed out of PVC to reduce upfront project costs (capacity 6ML/d over 23 hours). While these components are only required to be in service until approximately 2030 based on current recommendations, it could potentially be left in-service beyond this timeframe with a new connection established downstream of the future WTP.

HDPE pipe material is proposed for Segment A (from the river intake pump station to the ESS) as it has a number of advantages including:

- Available from a number of manufacturers which provides for competitive pricing;
- Delivered to site in long lengths, reducing the number of pipe joints;
- When completed by competent operators and in accordance with the technical specifications field welding of the pipe lengths provides a durable jointing system with less likelihood of leaks at joints;
- Pipe is flexible and number of bends can be eliminated by bending the pipe. For a DN710 HDPE (equivalent to DN600 for a PN16 HDPE) the minimum bending radius is 10.65 m. Changes in direction can also be accommodated at the pipe joint by inclusion of fabricated bends.
- Issues associated with joint failures are normally mitigated by ensuring the technical specification is adequate and appropriately trained staff are used to make the weld. Good site inspection and testing requirements also reduce the risks associated with poor workmanship.

DICL pipe is proposed for above ground pipework, pipework within the pump stations and potentially road crossings.

At low and high points in the pipeline, tee connections will be provided for the installation of scour valves at low points (provides a means of draining the pipeline) and air valves at all high points.

The alignment of the proposed pipelines is detailed in the Concept Design Drawings (refer Appendix B).

When the reservoir level in the ESS is at the proposed Minimum Operating Level (27.4m AHD), it will not be possible to provide 6ML/d gravity flow from the ESS to the balance tank (at the existing Southern WTP). Therefore, provision for pumping of 6ML/d between the ESS and the balance tank should be allowed for. Under these circumstances a temporary pump could be used. This pump could be connected to the outlet pipe from the ESS via a tee with a butterfly valve when required.

In order for gravity flow to occur, the level in the ESS must not be below approximately 35m AHD. This corresponds to approximately the lower 18% of the storage.

5.4.1. Operational Philosophy

- Flow to the existing balance tank at the inlet to the Southern WTP will be controlled by a flow control valve at the inlet to the balance tank. Council operations staff will set the desired flow rate to supply the balance tank from ESS.
- Automatic valves will be included to enable automatic isolation of the delivery pipe from the ESS to the balance tank should this be required.

5.5. Head Summary

Summary of pumping head for each of the new pump stations are summarised in Table 5 and Table 6.

Table 5 - Summary of Head Stage 1

Stage 1 Head Summary Table							
Description		Flow (ML/d)	Start Level (m AHD)	Discharge Level (m AHD)	Static Head Loss (m)	Friction and Fitting Head Loss (m)	Total Pumping Head Required (m)
From	To						
River Intake Pump Station	ESS	26	-0.3	62.7	63.0	8.8	71.8
Outlet Valve Chamber at ESS	Existing Balance Tank (at Southern WTP)	6	27.4 (MOL of ESS)	29.5	2.1	4.5	6.6

Table 6 - Summary of Head Stage 2

Stage 2 Head Summary Table							
Description		Flow (ML/d)	Start Level (m AHD)	Discharge Level (m AHD)	Static Head Loss (m)	Friction and Fitting Head Loss (m)	Total Pumping Head Required (m)
From	To						
Future Storage Outlet Pump Station	Future WTP (at ESS)	25	27.4 (MOL of ESS)	73.0	45.6	5.0	50.6
Future WTP Pump Station (at ESS)	Big Rock Reservoir	25	73.0	145.0	72.0	18.2	90.2

5.6. Power Summary

The pumping requirement for the new pump stations to/from the storage is summarised in Table 7 and Table 8.

Table 7- Pumping Power Requirements Stage 1

Stage 1 Power Summary Table					
Description		Flow (ML/d)	Total Head Required (m)	Total Power Requirement (kW)	Pump Configuration
From	To				
River Intake Pump Station	Eurobodalla Southern Storage	26	71.8	360 (120kW each)	3 Duty
Outlet Valve Chamber	Existing Balance Tank (at Southern WTP)	6	6.6	9	1 emergency pump

Table 8- Pumping Power Requirements Stage 2

Stage 1 Power Summary Table					
Description		Flow (ML/d)	Total Head Required (m)	Total Power Requirement (kW)	Pump Configuration
From	To				
Future Storage Outlet Pump Station	Future WTP (at ESS)	25	50.6	225 (75kW each)	Expected 3 Duty and 1 Standby
Future WTP Pump Station (at ESS)	Big Rock Reservoir	25	90.2	396 (132kW each)	Expected 3 Duty and 1 Standby

6. WTP Consideration

6.1. Design Basis

Based on previous Council planning, the Southern WTP has sufficient capacity and remaining life to supplement regional water demands in the medium term (up to 2030). The future WTP will be required post 2030 to replace the existing plant and Council have nominated a future WTP capacity of 25ML/d over 23 hours.

The future WTP will be designed to enable remote operation where practical, reducing future workload for Council operational staff.

The WTP will be designed to treat water quality from the ESS allowing for potential algal blooms. This could be achieved by a DAFF and PAC plant, similar to the existing Northern WTP currently being successfully operated by Council. This type of plant is favoured by Council as it would streamline operations and maintenance for staff, and require less power in comparison to a membrane type plant.

On this design basis, the approximate footprint of the future WTP has been assumed to be 15,000 m^2, consistent with the approximate size of the existing Northern WTP (of similar capacity). This footprint may need to be increased during detailed design to allow for a greater sludge volume and the sludge treatment process. This may be required if the sludge produced is more than the Northern WTP. This will be reviewed when the water quality results are available and included within the detailed design if required.

6.2. Existing Water Treatment Plant

The Southern WTP has the capacity to produce up to 6ML/d of potable water. The Southern WTP is operated during the peak summer months to supplement regional supply to Big Rock Reservoir. For the remainder of the year, the plant is run intermittently to keep it operational.

The WTP consists of the following process components:

- Direct filtration for treatment of raw water from the Tuross River via the bore pumps;
- Backwash lagoon to store wash-water from the direct filtration process;
- Sludge lagoon to store sludge from the direct filtration process;
- Balance tank to store raw water supply from either the river intake or borefield;
- Recycled water pump station supplying recycled water from the backwash/sludge lagoons to the balance tank;
- Sodium fluoride dosing shed injecting chemical at the pump station intake;
- Dosing facility containing sodium hypochlorite dosing tanks, caustic tanks and poly-aluminium chloride tank;
- Ancillary works such as hard stand delivery area, workshop, site lab and chemical dosing pumps;
- Clear water storage tank; and
- Clear water pump station capable of delivering 7.34 ML/d at 138m head of treated water from the clear water storage tank to Big Rock Reservoir.

Key operational considerations associated with the Southern WTP are outlined below:

- The existing treatment process is not capable of reliably treating raw water extracted from the river. Therefore, the plant is supplied solely from the existing borefield. The Southern WTP can be operated remotely. There are no reported operational issues with this existing arrangement;
- The Southern WTP supplies treated water to a 0.22ML Clear Water Tank. It is noted that the Clear Water Tank provides just over one hour of storage at the current supply rate of 4ML/d,

and under one-hour storage at the design capacity of 6ML/d. an ideal storage volume for a clear water tank is between 3 to 6 hours of plant capacity;

- Based on regional planning by Council, the Southern WTP is to be replaced in 2030 or later. The Southern WTP is in a good condition and would be serviceable beyond this timeframe if needed. There is insufficient space available at the Southern WTP site to allow for an extensive expansion or upgrade, therefore future options considered in this report incorporate a future WTP of 25ML/d over 23 hours from 2030 located at an alternative site. The option to upgrade the Southern WTP to meet future requirements is further addressed in section 6.3; and
- It is noted that the Southern WTP does not have the capability of treating algae blooms in the short/medium term. Additional measures to mitigate the impact of algae at the Southern WTP and/or ESS have been considered, however, as there is sufficient operational flexibility within the existing network, upgrade to the existing WTP was assessed as not being required at this stage. Should an algal bloom occur the proposed ESS and existing Southern WTP could be taken offline for up to 3 months at a time. This will allow sufficient time for the process to be enhanced should this become a problem. This decision was documented in the 20% ancillary works design review workshop, with the minutes provided in Appendix F. The need for additional pre-treatment will be confirmed when water quality data is available.

Figure 5- Existing Southern WTP clean water tank

Figure 6- Existing Southern WTP Balance Tank

Figure 7- Existing Southern WTP clear water reservoir

6.3. Option to Upgrade Southern WTP

The option of upgrading the Southern WTP to meet 25ML/d over 23 hours' future capacity and treatment requirements has not been considered. However, a partial upgrade to 6 ML/d could be achieved by the addition of an upstream dissolved air flotation (DAF) process to enable this plant to treat water from the Tuross River.

In terms of upgrading the existing treatment process, advantages and disadvantages include:

Advantages:

- Use of existing pumping facilities and pipelines (to end of serviceable life).

Disadvantages:

- Land space is unavailable;
- Design could be compromised due to constraints with the existing process;
- Retrofitting would create high risks associated with construction and commissioning; and
- Higher CAPEX expected.

The option to upgrade the capacity to 25 ML/d over 23 hours is considered unviable based on the disadvantages and constraints listed above. Consideration could be given to upgrading the existing WTP by a DAF process if this becomes necessary and prior to the addition of the future WTP.

6.4. Options for Future WTP Location

It is anticipated that the future WTP process and footprint will be similar to the existing Northern WTP. The Northern WTP occupies a footprint of approximately 15,000 m^2 and is a DAFF system. The existing process utilises drying beds and the Council is considering the use of a portable mechanical dewatering system during times of high sludge volumes. As limited water quality data from the Tuross River was available at the time of writing this report consideration may need to be given to increasing the footprint area greater than 15,000 m^2. This will be considered during the detailed design if it is anticipated that greater volumes of sludge will be produced at the future WTP.

The following WTP siting options were identified and assessed within the 20% design workshop and report (refer to 30012127_R03_V02 dated 14/2/17):

1. Adjacent to the Southern WTP
2. Directly East of the Southern WTP
3. Adjacent to the ESS
4. Near Big Rock Reservoir

The locations of these options are illustrated on Figure A-3 in Appendix A.

It must be noted that the above sites are based on suitable landform for the required footprint. Sites such as to the east of the ESS were not considered further due to the significant earthworks required to prepare a suitable platform.

Options 1 and 2 are located at elevations similar to the Southern WTP around 21m AHD. They could be supplied via a gravity connection from the ESS (with a minimum operating level of approximately 27.4m AHD), and would require relatively larger clear water pump stations to transfer flow to Big Rock Reservoir.

Both Options 3 and 4 are situated at higher elevations (around 70m AHD and 135m AHD respectively), therefore require supply to be pumped from the ESS to the future WTP site. Following treatment, all options require a clean water pump station and pipeline connection to transfer water to Big Rock Reservoir.

A summary of the options assessment completed in the 20% design workshop and report (refer to 30012127_R03_V02 dated 14/2/17) are presented below.

6.4.1. Option 1 – Adjacent to the Southern WTP

Option 1 was dismissed due to space constraints.

6.4.2. Option 2 – Directly East of the Southern WTP

Option 2 is based on the discontinuation of the Southern WTP and construction of the future WTP within the vicinity (i.e. across the Eurobodalla Road) as shown in Appendix A.

The advantages of this option have been identified below:

- Proximity to existing infrastructure such as power, drainage, water supply, roads etc.;
- Availability of area for construction;
- Cleared of vegetation;
- Ease of accessibility from Eurobodalla Road, albeit requiring construction of a crossing of the valley; and
- Ease of access to borefield and future river intake pump station.

The disadvantages of this option are as follows:

- Proximity to neighbouring residents and private property
- Land acquisition and property rezoning required; and
- Risk of flooding and restricted access during flood events.

This option would require the following ancillary works and connections:

- River intake/river intake pump station and pipeline to ESS (Segment A);
- Gravity pipeline connecting from ESS to the future WTP site; and
- Clear water pump station and pipeline to Big Rock Reservoir (Segment C).

This Option appears least favoured (relative to Options 3 and 4) due to potential community impacts (close proximity to residential property).

6.4.3. Option 3 – Adjacent to the ESS

Option 3 is based on the future WTP being located on the Western ridge (left abutment) above the proposed ESS. Consideration was given to siting the future WTP on the Eastern ridge (right abutment) adjacent to the proposed ESS, however for the estimated dimensions of the WTP the Eastern ridgeline was considered too narrow and hence would require extensive earthworks to construct. Accordingly, for options considered adjacent to the proposed ESS, the Western ridge (left abutment) was preferred.

The advantages of this option are as follows:

- Accessible through the proposed access road to the ESS although would require construction of a short additional section to the ridgeline;
- ESS and WTP are located together to streamline operation and maintenance;
- WTP is located away from the general public and community;
- Earthworks could be undertaken in parallel to ESS construction; and
- Site could be used as lay down area for ESS construction.

The disadvantages of this option are as follows:

- Additional WTP inlet/outlet chambers/pipework required between ESS and future WTP compared to other options.

This location will require the following ancillary works and connections:

- River intake/river intake pump station and pipeline to ESS (Segment A);

- Cross connection between the ESS pipeline and the Southern WTP (Segment B) (Segment B);
- Future pump station at the outlet chamber of the ESS to pump water up to the future WTP;
- Additional inlet/outlet chambers and pipework between the ESS pump station and the future WTP;
- Clear water pump station at the future WTP to pump potable water to Big Rock Reservoir;
- Future transfer pipeline to Big Rock Reservoir (Segment C).

6.4.4. Option 4 – Near Big Rock Reservoir

Option 4 is based on the future WTP being located near Big Rock Reservoir.

The advantages of this option are as follows:

- Proximity to existing access road and closer to town; and
- Big Rock Reservoir and WTP are located together;

The disadvantages of this option are as follows:

- Additional cost to extend power supply.
- Raw water pipeline will have higher maintenance requirements, swabbing etc.

This location will require comparable ancillary works and connections to Option 3, with the following changes:

- Future pump station at the ESS would be larger than Option 3;
- Less ancillary inlet/outlet pipework around the WTP in comparison with Option 3;
- Clear water pump station at the future WTP would be smaller than that of Option 3.

6.4.5. Options Assessment

A multi criteria assessment (MCA) approach has been applied to determine the preferred location for the future WTP. A range of technical, social, environmental, cost and risk criteria were applied, including: hydraulics, available power supply, constructability, operability, exposure to flooding, land ownership, community impact, environmental impact, whole of life cost and risk.

The outcomes of the MCA process are included in Appendix E.

Based on the MCA outcomes, Option 2 is not favoured due to potential community impacts (close proximity to residential property).

A key impact on the preferred site selection is the cost of extending available power supply to each of the sites. Based on advice from Essential Energy, Option 3 adjacent to the ESS is favoured over Option 4 due to better access to energy supply, along with the ability to streamline the ESS surveillance with WTP operations. A schematic representation is shown in Figure A-6 in Appendix A.

7. Pipeline to Big Rock Reservoir

7.1. Existing Transfer System to Big Rock Reservoir

Big Rock Reservoir is a 4.6ML concrete tank which provides regional storage for the Eurobodalla water supply system. There is a transfer pump station at the Southern WTP that supplies Big Rock Reservoir through a DN375 main running north along Eurobodalla Road.

Key operational issues associated with the transfer pumping/pipeline system are outlined below:

- Redundancy - The transfer pump station consists of two duty centrifugal pumps at 86L/s (approximately 7ML/d over 23 hours). At the time of inspection in September 2016, one of the duty pumps was removed for maintenance leaving only one pump in operation. This was not an issue at the time because the plant was not in use. The lack of redundancy at this pump station is considered to be an operational constraint during the summer months should one pump fail. It noted that the regional network has flexibility to meet demands over a short period if a pump failure was to occur;
- Asset Condition - Based on visual inspection only, the existing transfer pump station building, the switchboard and communication system appear to be in poor condition. The pipeline is reported to be in fair condition. A condition assessment is recommended for the existing transfer pump station and pipeline to confirm ability to meet requirements until 2030.

Figure 8- Existing Transfer Pump

7.3. Route Options

Four pipeline routes have been identified for the project and were presented in the 20% design workshop and report (refer to 30012127_R03_V02 dated 14/2/17). The routes are illustrated on Figure A-4 in Appendix A and described below:

- Route 1 (Along Big Rock Road) – This is the most southern alignment considered, and follows an existing unsealed forestry road, Big Rock Road.
- Route 2 (Existing Alignment) – This is the most northern alignment considered, and follows the existing transfer pipeline route.
- Route 3 – This alignment initially follows the existing transfer pipeline route, and then diverts to follow the forestry boundary.
- Route 4 – This alignment follows an unformed and un-named trail through the forestry area.

Route 1 is considered to be the preferred option due to the lowest community impact and ease of construction, provided extensive rock is not encountered. It is expected that vegetation clearing can be limited by aligning the pipeline within the existing access track. Planned site investigations will confirm the geotechnical conditions and the sensitivity of the affected vegetation, and will inform the final route selection.

All pipelines will be designed to WSAA standards, with consideration to heavy vehicle loadings and thrust block requirements. The design will also make provision for future addition of surge protection (to be designed with the future clear water pump station at the future WTP). All options have potential for surge, including Option 1 which has an Intermediate high point (i.e. risk of column separation) and maximum elevation change of 116m.

7.4. Pipeline Material Selection

In relation to material selection, a range of viable options have been considered including HDPE, DICL and GRP. DICL is recommended within the pump stations.

The recommended solution nominated pipe sizes/materials which are available in Australia, from pipeline suppliers. Based on previous pipeline installations, Council prefers GRP due to ease of construction. It is noted that GRP pipes have the following disadvantages:

- Performance and durability is sensitive to damage incurred by poor handling;
- Thrust blocks required;
- Limited methods to verify field joint quality; and
- Construction cost expensive for larger pipe sizes.

However, the ease of construction associated with GRP due to its lightweight is a distinct advantage over the other pipe materials.

The construction cost using steel pipes are approximately 15% more than DICL and approximately 47% more than HDPE. Construction costs using HDPE pipes will be significantly lower than either DICL or steel pipes. It is recommended to use an HDPE installation for the pipeline to Big Rock Reservoir due to its ease and speed of installation, elimination of thrust blocks at large bends, high durability and low construction cost. However, it is understood that there are some related constructability issues with regards to HDPE pipes installation such as welding defects. However, these issues can be mitigated by:

- Engaging a HDPE specialist contractor;
- Providing construction supervision throughout the duration of the installation; and
- Developing detailed technical specification for installation of the HDPE pipe.

7.5. Pipe Sizing Selection

WSAA recommends that head losses per km be kept below 3m, and design velocities in the range of 0.8 to 1.2 m/s. A summary of the minimum pipe sizes for the pipeline from the ESS to the future WTP and from the future WTP to Big Rock Reservoir is provided in Table 9.

Table 9- Stage 2 Pipeline Sizing and Velocities

Pipe Nominal Internal Diameter (mm)	Velocity in Pipe (m/s)	Discharge Rate (ML/d)
450	1.82	25
500	1.47	25
600	1.02	25
750	0.65	25

A cost benefit analysis has been completed and presented in section 7.8 below. This demonstrates that the DN600 pipeline (this corresponds to a DN710 for HDPE [ID of 578mm]) in has the best NPV for the design flow rate of 25ML/d supplied over a 23hr period.

7.6. Air Release, Scour and Isolation Valves

Scour valves should be provided at low points to facilitate draining of the pipeline when required. For the purposes of costing an equal number of scour valves as air valves has been assumed.

Isolation valves will be provided at regular intervals to allow sections of the pipeline to be taken off-line for maintenance if required. For cost estimating purposes spacing of isolation valves has been assumed to be 5 km as per WSA-2011.

Air release valves are essential for discharge and intake of air during pipeline charging, draining and operation. Under normal pumping conditions air would be released from the water and require discharge to prevent air collecting at the pipeline high points and restricting flow. Automatic air valves facilitate this air bleed-off. They also provide a point for air intake and help mitigate risks of negative pressures occurring during a water hammer event.

DN100 size air release valves are proposed for the pipeline in accordance with WSA-2011. A hydrant type isolator would facilitate the isolation of the valve for maintenance and removal. For the purpose of costing, the number of air valves required has been estimated by taking the total pipeline length and dividing by the maximum spacing of air valves permitted by WSA-2011 (800m).

7.7. Surge Protection

The pipeline design will need to make allowance for the future addition of surge protection devices and pipeline connections, noting the design of the Future ESS Pump Station, connecting pipework to/from the future WTP, clear water pump station and associated surge protections.

An initial surge analysis will be completed during detailed design to assess mitigation measures likely to be required and to identify the pipe pressure rating which will be required for costing purposes. Based upon the selected route, surge mitigation is likely to include surge vessels at the outlet of the future WTP and anti-vacuum valves along the rising main to Big Rock Reservoir, especially at the highest point.

7.8. Net Present Value (NPV)

Net present value calculations for different pipe materials, pipe size and pump combinations has been undertaken and is provided in Appendix D-2 with a summary presented in Table 10. Pipe sizes have been considered for the recommended pipe size based on Table 9 and the next pipe size down and up according to pipe material.

Table 10 - NPV of Pipelines for different materials and relative diameters

Pump Requirements	Nominal Diameter (DN)	Internal Diameter (approx)	Pipe Material	7% NPV
225KW (Storage Outlet PS) 396KW (Future WTP Clear Water PS)	600	600	GRP	$11,657,403
	600	600	DICL	$10,055,823
	710	578	HDPE	$9,956,734
	600	600	STEEL	$10,419,147
255KW (Storage Outlet PS) 510KW (Future WTP Clear Water PS)	525	525	GRP	$13,144,121
	500	500	DICL	$11,253,387
	630	513	HDPE	$11,175,437
	500	500	STEEL	$11,682,770
210KW (Storage Outlet PS) 315KW (Future WTP Clear Water PS)	675	675	GRP	$10,848,809
	750	750	DICL	$9,750,783
	800	651	HDPE	$9,618,665
	700	700	STEEL	$9,915,931

Based on the analysis presented in Table 10, the most cost efficient arrangement is for a DN800 HDPE pipeline, with this having a marginally lower NPV than for a DN710 HDPE pipeline. The expected velocities in the smaller diameter pipe are, however, preferred from a water quality perspective and this has been selected as the preferred pipe size to transfer water from the ESS to Big Rock Reservoir. This will be confirmed during detailed design.

8. Power Supply

8.1. Power Supply Requirements

The estimated maximum demand for the Stage 1 and Stage 2 works are provided in Table 11 and Table 12, respectively. The estimations were based on information provided by NSW Public Works Advisory and internal design inputs. A power factor of 0.85 has been used for estimating in kVA.

At this stage the maximum demand for the new storage has only been provided as an order of magnitude estimate for communicating with Essential Energy. The actual power demand for the storage is dependent on design of the preferred destratification system, which has not yet been designed.

These estimated maximum demands have been provided to Essential Energy as part of the Design Information Package Application process.

Table 11 - Stage 1 Maximum Demand Estimation

Stage 1 - Estimated Maximum Demand for River Intake Pump Station and Storage						
Item	**Asset Description**	**New/Existing**	**Estimated MD (kVA)**	**NMI**	**Remark**	**Data Source**
1	WTP	Existing	280	NDDD00GK89	Supplied from existing 315kVA substation. Includes allowance for additional disinfection and pumping to big rock reservoir	NSW PWA 15/12/2016
2	Low Lift Pump Station	Existing	-	-	Not in use. Will be replaced by Item 3	
3	River Intake Pump Station	New	424	-	Pumps 26 ML/d to Eurobodalla Southern Storage (to be constructed together with the ESS)	Internal design inputs
4	Emergency pump at Valve Chamber Outlet	New	11	-	Emergency 6ML/d pump to cater for low water level in the storage (< 35m AHD)	Internal design inputs
5	Eurobodalla Southern Storage	New	300	-	Nominal allowance at this stage to account for potential destratification system, lighting, communication, valve operation etc. To be refined following design of these systems.	Internal design inputs
Total maximum demand			**1,015**	**KVA**		
Allow			**1,100**	**KVA**		
Note: Power factor 0.85 has been used for estimating power in kVA						

Table 12 - Stage 2 Maximum Demand Estimation

Stage 2 - Estimated Maximum Demand for Future Storage Outlet Pump Station and Future WTP Pump Station						
Item	**Asset Description**	**New/Existing**	**Estimated MD (kVA)**	**NMI**	**Remark**	**Data Source**
1	WTP	Existing	-	NDDD00GK89	To be decommissioned in Stage 2	
2	Low Lift Pump Station	Existing	-	-	Not in use. Will be replaced by Item 3	
3	River Intake Pump Station	New	424	-	Pumps 26 ML/d to Eurobodalla Southern Storage (to be constructed together with the ESS)	Internal design inputs
4	Eurobodalla Southern Storage	New	300	-	Nominal allowance at this stage to account for potential destratification system, lighting, communication, valve operation etc. To be refined following design of these systems.	Internal design inputs
5	WTP	New	1,000		Estimate provided by NSW PWA	NSW PWA
6	Future Storage Outlet Pump Station	New	265	-	Pumps 25 ML/d from Valve Chamber Outlet to Future WTP (at ESS)	Internal design inputs
7	Future WTP Pump Station	New	466	-	Pumps 25 ML/d from future WTP to Big Rock Reservoir	Internal design inputs
Total new maximum demand			**2,455**	**KVA**		
Allow			**2,500**	**KVA**		
Note: Power factor 0.85 has been used for estimating power in kVA						

8.2. Power Supply Authority Requirements

Based on advice received from Essential Energy's planning department, the existing 11kV line from the 33kV zone sub-station will need to be upgraded (reconductored) even for the load added by the Stage 1 work. After reconducting the line, it is understood that it will have enough capacity for the future WTP and pump station (Stage 2 work) to the Big Rock Reservoir.

The estimated length of the existing 11kV line which requires upgrading is approximately 5.3 km. Essential Energy has advised that this design will have to be carried out externally by an accredited designer.

8.3. Substations/Transformers Siting

The proposed substation will be located near the Southern WTP to supply the WTP and the new river intake pump station. A new 315kVA substation will be installed near the storage area at end of the extended 11kV line to supply the ESS.

8.4. Cabling

The power lines to the ESS will be designed to cater for the future Stage 2 load encompassing the additional demand from the new WTP.

For the 11kV line extension, the cost of construction for overhead power line option will be cheaper than the underground cabling option, however this will be subject to land owner's agreement when acquiring the easement.

8.5. Solar Panels

Sizing of a solar photovoltaic (PV) system will be undertaken following confirmation of the likely demand associated with the destratification system for the storage. This will be the dominant demand from the storage for Stage 1 works.

It is recommended to limit the system size to only offset the energy usage by the new storage (destratification, lighting, communications, valves etc.) rather than generating excessive energy for exporting or storing for later use. If the PV system size exceeds the maximum demand of the ESS, the new substation will need to be sized to match the maximum output of the PV system which in turn increases the cost of electrical infrastructure. The return for exporting energy to the grid will be minimal based on the current feed-in tariff rate. The option of transferring solar energy to the river intake pump station is also considered uneconomical at this point.

Solar panels would only be installed to supplement mains power supply at the storage site, rather than replace mains supply, as power demand would still be required during non-daylight hours. The new extension line will need to be designed to cater for the future WTP which is to be located near the ESS.

Justification for installation of solar PV system would be based on financial return for reduced power consumption, against additional upfront capital expenditure or for environmental considerations. Financial modelling will be undertaken to determine the expected payback period for the solar panels following confirmation of the likely power demand for the storage.

Should solar panels be justified, detailing will be required for their installation on the downstream slope of the embankment. The panels will be required to be installed with clearance above the ground surface to allow for inspection of the bank for dam safety purposes.

9. Cost Estimate

9.1. Construction Methodology

The proposed construction methodology for the river intake pump station will be influenced by the outcomes of the geotechnical investigation. The proposed construction methodology described below is based on the current wet well arrangement for the river intake pump station . Further river bed and water depth studies are also recommended to be conducted which may influence the proposed construction methods. For this, it has been assumed that sheet piling can be used to construct a coffer dam in the river and that a cast in situ concrete structure is constructed.

- Construct coffer dam in river using sheet piles
- Dewater coffer dam and keep pump running
- Commence excavation of pump station shaft and shore as it progresses
- Dewater shaft if required
- Erect safety structures around shaft and access to coffer dam
- Remove excess spoil from the shaft to an approved disposal site
- Once the required shaft depth has been reached provide blinding
- Start with mass concrete for preventing of uplift if elevated water table is present or expected to be present
- Start formwork for shaft construction
- Also complete bases for the Johnson type screens
- Complete pump station shaft
- Provide gear for directional drilling of connection pipes to the Johnson type screens and complete pipes
- Seal around pipes and install isolation valves
- Install Johnson type screens and gear and connect to pipework
- Provide power to site and install the MCC
- Complete roads and earthworks on surface
- Install pumps and pipework and connect to the outside valving and pipe work
- Install all safety gear such as handrails etc.
- Energise total system and dry test
- Pump water into sump after isolation from the river and test pumps
- Remove coffer dam and conduct full scale commissioning

9.2. Cost Estimate

Construction cost estimates for individual components of the work based on Option 3 (with the WTP adjacent to the ESS) are presented in Table 13 and Table 14 below. These cost estimates were developed based on the NSW Reference Rates Manual. Following completion of the concept design phase of works, an updated risk based estimate will be developed for the whole of project i.e. including ancillary works, storage construction and clearing and fencing.

Table 13 - Stage 1 Cost Estimate

Description	Quantity	Rate	Units	Total Amount ($)
River Intake Pump Station	1	$1,379,268	Lump Sum	$1,379,268
DN600 twin pipes at River Intake Pump Station	40	$972	m	$38,880
Connection to existing DN250 borefield pipeline with new DN250 uPVC pipeline connection to river intake pump station	100	$295	m	$29,500
New 26 ML/d DN710 HDPE pipeline from river intake pump station to ESS inlet chute (Segment A)	1337	$1,112	m	$1,486,744
New 6 ML/d uPVC pipeline from storage pipeline on West side of Eurobodalla Rd to balance tank in existing WTP (Segment B)	300	$367	m	$110,100
			Subtotal	$3,044,492
			10% Preliminaries	$304,449
			30% Contingencies	$913,348
			Total Stage 1 Construction Cost	**$4,262,289**

Table 14- Stage 2 Cost Estimate

Description	Quantity	Rate	Units	Total Amount ($)
New 25 ML/d storage outlet pump station	1	$676,350	Lump Sum	$676,350
New 25 ML/d DN710 HDPE pipeline from storage outlet pump station to future WTP near ESS	300	$778	m	$233,400
New clear water pump station at future WTP near ESS	1	$1,018,008	Lump Sum	$1,018,008
New 25 ML/d DN710 HDPE pipeline from future WTP to Big Rock Reservoir (Segment C)	7070	$778	m	$5,500,460
New 25 ML/d DAFF Water Treatment Plant	1	$36,500,000	Lump Sum	$36,500,000
			Subtotal	$43,928,218
			10% Preliminaries	$4,392,822
			30% Contingencies	$13,178,465
			Total Stage 2 Construction Cost	**$61,499,505**

10. Conclusions

A summary of the components associated with the ancillary works are presented in Table 15.

Table 15- Summary of ancillary works

Asset	Component	Description	Comments
River Intake	Screen	Johnson Screens or similar, installed in river with bollards and air sparge to clear any potential blockages	• Regular maintenance and working at depths (divers) maybe required • Installation requires a coffer dam or caisson construction sequence to be detailed in detailed design • Requires air supply to have automated cleaning sequence
	Pipes	Size Class DN600 Pipes	• Pipe material dependant on installation method, will be detailed in detailed design • Installation method dependant on geotechnical conditions will be detailed in detailed design • Connection method to be detailed in detailed design • Pipe jacking, drilling or alternative installation method to be detailed in detailed design
Pump Station Wet Well	Pumps	Submersible type complete with guide rail for easy removal during maintenance	• 3 duty • Variable speed driven • Each pump with capacity of 8.6 ML/d
	Weir Structure	Prevents sediments from entering the pumps and slows down the velocity entering the pumps.	
	Pipes	DN300 pipes and fittings	• Pipes and fittings must be suitable for analysed water quality
	Concrete splitters	Place to reduce turbulence at the pump intake and improve hydraulic flows	
	Retaining wall	3.5m high reinforced concrete retaining wall	

Asset	Component	Description	Comments
	Control panel	Weather proof type	• Placed at surface level above the 1 in 100 AEP flood level
	Culvert	2 nos. reinforced concrete culvert (class 6)	• Rubber ring jointed
Access Road	Road safety guard rail	RMS approved type	• Placed on both sides of the road
	Pavement	Suitable for Council maintenance vehicle	
	Road	Utilises the existing access road	• Potentially connecting to existing Eurobodalla Road south of the site to allow for one-way vehicle path. This will be dependent on the exit location meeting applicable guidelines for site distance etc. • Potential relocation of existing utilities (i.e. Telstra optic fibre) due to construction of road. This will be avoided where practicable.
Pipeline River Intake Pump Station to ESS	Size	DN710	
	Capacity	26 ML/d	
	Type	HDPE PN16	
	Joint	Butt welded	
	Length	Approximately 1337m	
Pipeline ESS to Balance Tank (at Southern WTP)	Size	DN300 & DN710	
	Capacity	6 ML/d	
	Type	PVC RRJ PN6 Pressure Pipe for DN300 and DN710 HDPE PN16	• Supplied in the detailed design the valving and sections of PVC to interconnect the ESS outlet to the existing Balance Tank to utilising the existing rising main if required
	Joint	Rubber ring jointed for PVC, Butt welded for HDPE	
	Length	Approximately 900m	

11. Recommendations

The following recommendations are made in relation to the ancillary infrastructure based on the outcomes documented within this report:

1. The concept design of the river intake pump station includes a wet well set back from the Tuross River with submersible pumps to transfer flow directly to the ESS. To construct the wet well it is anticipated that substantial excavation through suspected shale rock and to depths in the order of 20m would be required. This would introduce several issues to consider during design, in particular around design of the structure to resist buoyancy and constructability issues associated with a deep excavation through rock and adjacent to a major watercourse. Following development of the concept design, as documented in this report, and a greater understanding of these potential issues it is recommended that the wet well concept be revisited to assess whether it is still the preferred arrangement and/ or location of the intake structure. Cost of construction of wet well will be influenced significantly by construction technique and the geotechnical conditions. Subject to the outcome of the geotechnical investigation, the construction technique may vary from what has been proposed. Options for dry well, cast insitu or caisson type construction will be considered when the geotechnical information is available.
2. SMEC to continue design of new pipelines to transfer flow to/from the ESS (Stage 1):
    a. Pipeline (Segment A) between combined river intake pump station and ESS intake along access road alignment, capacity 26ML/d over 24 hours (302L/s); and
    b. Pipeline (Segment B) cross connection and valving to supply water from the ESS to the Southern WTP at 6ML/d, ensuring that the ESS outlet is sized for the ultimate capacity of 25ML/d over 23 hours plus allowance for treatment losses (approximately 320L/s), with provision for a future ESS pump station.
3. SMEC to confirm the preferred alignment for the future (Stage 2) pipeline between the future WTP and Big Rock Reservoir (Segment C) based on geotechnical data and commence the design based on a capacity of 25ML/d over 23 hours (302L/s).

12. Reference Documents

The following documents have been referenced in development of this report.

- River and borefield extraction spreadsheet provided by Council (HGL Tuross River Bores data.xls);
- NSW Reference Rates Manual for Valuation of Water Supply, Sewerage and Stormwater Assets (NSW DPI Office of Water) dated June 2014;
- Eurobodalla Shire Council Tuross Water Scheme Low Lift Pump station (As-built drawing no. 5115-29);
- Eurobodalla Shire Council Tuross Pump station Rising Main from Low Level PS Augmentation (As-built drawing no. 80-1207/Council Plan no. M-116);
- Eurobodalla Shire Council Tuross Water Scheme Site Plan Layout of Services at Pump stations – Existing Condition at January 1977 (Council Plan no. M-838);
- Tuross River Bore Figure dated 26 July 2011 (Tuross River Bores Location.pdf);
- Eurobodalla Shire Council Eurobodalla Road Tuross Pump Station Filtration Plant Site Plan (Project No. 3564/Cad reference no. 3564-A-00);
- Southern Water Treatment Plant Schematic Drawing (SWTP Schmatic.pdf);
- Eurobodalla Shire Water Supply Headworks Tuross River Intake General Arrangement (Project no. 001/Figure no. 23);
- Eurobodalla Shire Water Supply Headworks Bodalla Reservoir General Arrangement (Project no. 001/Figure no. 70);
- Eurobodalla Shire Council 1,000,000 Gall. Surface Reservoir at Bodalla Pipe Work Details and Schedule (Drawing no. 5115-11/002003);
- NSW Department of Commerce Stony Creek Storage Concept Design Report dated March 2006 (Report no. DC05202);
- GHD Tuross River Valley Borefield Additional Hydrological Investigations Report (Document no. 31/16433/100879);
- Public Works NSW Water Solutions Eurobodalla Water Supply Headworks Yield Study dated May 2013 (Report no. 13030); and
- NSW Legislation, Water Sharing Plan for the Tuross River Unregulated and Alluvial Water Sources 2016, Part 9 (1 July 2016).
- Eurobodalla Southern Storage , Concept Design Volume 2: Storage, SMEC 30012127_R05_V01 (20/03/2017)
- Tyrone Bridge Replacement Hydrology & Hydraulic Assessment Report, Northrop 166016 (20/09/2016)

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