Tweed Shire Council




Kingscliff Recycled Water Scheme Stage 1

Concept Design

Final Report

April 2005

MWH

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Quality Assurance Statement	
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Tweed Shire Council

Kingscliff Recycled Water Scheme Concept Design Final Report

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Background and Project Drivers

This report provides an outline of the options and costs for "Stage 1" recycled water supply from the Kingscliff Sewage Treatment Plant (STP) to various parks, sporting fields, foreshore reserves, a private golf course, bowls and rugby clubs within and around Kingscliff township. This report provides concept design for three key options and has demonstrated the technical feasibility of recycled water supply for irrigation on these various public and private sites, subject to controlled public access (ie. minimum 4 hour withholding period) after irrigation with the recycled water.

The key driver for this project is the EPA NSW endorsement of the Tweed Shire Council ("TSC") Effluent Reuse Strategy for Kingscliff. EPA NSW have recommended to council that effluent reuse from the Kingscliff Sewage Treatment Plant should be maximised to enable replacement of current potable water irrigation uses on public parks and reserves and private sporting fields.

Progressive implementation of an Effluent Reuse Strategy for Kingscliff starting with Stage 1 and potentially expanding to Kingscliff South will have clear environmental benefits including reduction in nutrient loads and other pollutants currently discharged to Tweed River at Chinderah. Future effluent quality license requirements set by EPA NSW for the Kingscliff discharge to Tweed River will depend on the extent of effluent reuse achieved and the resultant reduction in pollutant loads on the river. The establishment of Stage 1 of the Kingscliff Recycled Water Scheme as outlined in this report, commencing with Chinderah Golf Course (as a "Stage Zero") should enable TSC to proactively satisfy the future directions of EPA NSW and DEC.

The key findings of this study as detailed in this report are summarised below.

Proposed Recycled Water Customers

Stage 1 of the Kingscliff Recycled Water Scheme as outlined in this report would utilise about 180 ML/Yr of recycled water irrigation of TSC's parks and reserves, Chinderah golf course, bowling clubs and a private rugby field within Kingscliff. This recycled water use will include substitution of 70-80 ML/Yr of potable water currently used for irrigation.

Recycled Water Pipeline Alignment Options

Selection of a cost effective recycled water pipeline route for Stage 1 may depend on the future alignment for the proposed new sewer rising main to the proposed Kingscliff STP. TSC is still considering its options for the alignment of the sewer rising main. The most cost effective and least environmentally sensitive alignment for the recycled water main would appear to be from the new STP along the south boundary of Chinderah Golf Course to Tweed Coast Rd, through the existing STP site across the existing sewer main pipe bridge over the canal to the Kingscliff foreshore.

The construction of a new recycled water pipeline network along urban Kingscliff road reserves would be fairly straight forward, but there would be added costs (compared with a rural route) associated with locating and avoiding (eg. by boring under) various services (water, sewer, power, etc) and sensitive vegetation (eg. along

the foreshore), and running some sections of the pipeline under road pavement. Total length of the Stage 1 recycled water pipe network is about 7 km including about 600-700m for a golf course pipeline.

Recycled Water Demands

The capacity of the recycled pipeline network and require pipe diameters are critically dependent on peak water demand assumed. Peak water demand is dictated by:

- peak irrigation demand and area under irrigation on each irrigation site during hot and dry periods;
- limited hours of watering determined by 4 hour public access withholding period as specified in EPA NSW *Environmental Guidelines for Use of Effluent by Irrigation*.

Maximum irrigation demand can be as high as 10mm/day during heat wave periods but this is only likely to occur for a few days each year. Using such a higher rate for design purposes is not considered cost effective for pipeline design because it would result in significant increase in pipe size/capacity and therefore cost. This higher cost would be only be to meet the highest demands occurring only for a few days each year. Existing bore water and potable water sources could be used as a temporary backup supply during these periods.

Extended dry periods in this sub-tropical location tend to occur in the cooler winter and early spring. Therefore, a more conservative 5mm/day was assumed for concept design purposes, as well as 100% of all parks and gardens watered concurrently during the hot/dry periods. This was also consistent with assessment of existing irrigation water use data (potable and bore water) at each of TSC's parks and reserves as well as private customers that could make up the Stage 1 Recycled Water Scheme.

Precycled Water Scheme Options

The assessment of recycled water supply options has come up with three key options

- **Option 1** – High Flow Supply for direct irrigation at Kingscliff parks and reserves, except for subsoil irrigation at Jack Bayliss Park (Kingscliff foreshore), and separate pipeline to proposed 6 ML dam at Chinderah Golf Course;
- **Option 2** - Low Flow Supply to Onsite Storage Tanks at Kingscliff parks and reserves, but with subsoil irrigation to Jack Bayliss Park (ie. no tank required), and separate pipeline to Golf Course Dam;
- **Option 3** - High Flow Supply for direct Irrigation at Kingscliff parks and reserves, except for subsoil irrigation at Jack Bayliss Park, and separate pipeline to proposed 6 ML dam at Chinderah Golf Course via connection from Tweed Coast Rd.

Pipeline Sizes

Recycled water pipe sizes required for Options 1 and 3 were less than 250 mm (PVC Class 12) at the STP down to about 80-100 mm at the irrigation sites. With the lower flows associated with Option 2, pipe size reduce to less than 150 mm at the STP. These pipe sizes were based on delivery pressures at most irrigation sites of at least 20m, except for the golf course which only needed a head of around 2-3m for discharge into the proposed dam.

Pump Station Options

Pump station options include a combined pump station serving all customers in the Stage 1 scheme, or separate pump stations for the main Kingscliff Scheme and Chinderah Golf Course. Separating the pump

station would not be as hydraulically efficient and more costly, but it would enable metering of golf course pump volumes, pump times and therefore allocation of pump station capital and operating (power) costs.

Recycled Water Storage Options

For Options 1 and 3, a recycled water storage of around 320 kL might be needed at the new STP in the short term, because the peak recycled demand (occurring overnight) would be significantly higher than the current low overnight sewage flows to the STP. This balancing storage would prevent excessive drawdown of the chlorine contact tank. As the sewer flows increase with the forecast population growth in Kingscliff, the storage for Options 1 and 3 would eventually not be needed.

For Option 2, onsite storage tanks and individual irrigation pump systems would be needed for all parks, except for Jack Bayliss Park, which would have direct subsoil irrigation. Onsite storage tanks capacities need to be about the daily peak demand expected during dry/hot periods. Therefore some of the tanks, such as the 360 kL tank for Walter Peate and 125 kL tank for Reg Dalton public reserves may be too large to site above ground. Such large above ground tanks in public parks may be obtrusive and therefore attract community opposition. Option 2 would not need a buffer storage at the STP due to the lower flows.

There is the alternative of placing such large tanks underground to avoid being unsightly and attracting public objection. However the cost of underground storage tanks is roughly double that of above ground tanks, resulting in the overall cost of Option 2 approaching that of Options 1 and 3. It is for this reason that Option 2 is not necessarily favored over Options 1 and 3.

Cost Assessment

Taking into account total potential savings, the indicative capital cost estimates for the key Stage 1 options are:

- **Option 1:** $1.9 Million
- **Option 2:** $1.5 Million
- **Option 3:** $2.0 Million

If underground storage tanks were provided in Option 2 for Ned Byrne Field (assuming paid for by the Cudgen Leagues Club), Walter Peate and Reg Dalton (paid for by TSC), then Option 2 costs would increase to about $1.6 Million.

Despite Option 2 being the cheapest, direct irrigation supply Options 1 or 3 are considered more practicable and lower risk given:

- simplicity of operation and maintenance and reliability with direct irrigation for Options 1 and 3;
- minimal "footprints" for onsite recycled water storages and irrigation pump systems for Options 1 and 3;
- higher risk (ie. "more could go wrong with Option 2") and likely community objections and delays in project implementation associated with installing large recycled water storage tanks (either below or above ground) in public parks and reserves for Option 2.

Note that the difference in costs between Options is within the order of accuracy of the estimates.

The costs quoted in this report are indicative costs estimated for the purposes of comparing scheme options based on concept designs outlined in this report. They are sufficiently accurate for these stated purposes, however depending on the order of accuracy required and amount of contingency to be included functional design or detailed design is required if cost estimates are to be used for accurate budgeting purposes.

The financial viability of the Kingscliff Recycled Water Scheme depends on signing up large volume recycled water users such as the Chinderah Golf Course, Walter Peate, Reg Dalton and Cudgen Leagues (Ned Byrne Field and Bowls) Club. Implementation of Stage 1 could be staged over a number of financial years to reduce cost impacts on TSC.

Immediate Recycled Water Option – "Stage Zero"

The recycled water scheme could be easily kick started by a "Stage Zero" Scheme to supply Chinderah Golf Course from the present Kingscliff STP via the existing ti-tree farm recycled water pipeline, via a connection at Tweed Coast Road. The golf course would initially utilise about 30-40 ML/Yr, with potential annual demand increasing to more than 100 Ml/Yr following expansion with larger area under irrigation (around 20 Ha).

Total cost of a Stage Zero would be of the order $100,000 comprising $60,000 for the new pipeline and connection to the ti-tree pipeline at Tweed Coast Rd, plus about $40,000 for a temporary pump station at the existing STP. This "Stage Zero" would be at minimal cost to TSC if the golf course were made to pay for the pipeline and temporary pump station at the existing STP. The golf course management has already indicated that they propose to build a new 6 ML dam on the course at their own expense.

Triple Bottom Line Considerations

The key common advantages and disadvantages of all options include:

Advantages

- Social — Greening and drought proofing of Kingscliff parks and gardens. Substitutes about 70-80 ML/yr of potable water supply currently used on Kingscliff parks and gardens. Water restrictions avoided/deferred.
- Economic — Lower cost of recycled water supply compared with existing potable supply. Savings for TSC & other customers, and new income stream for TSC. Deferred/avoided capex for Kingscliff water supply and effluent management.
- Environmental — Water sustainability via substitution of potable water (70-80 ML/yr) and bore water (~$100 ML/yr) uses. Reduced discharges to Tweed River and reduced environmental impacts on estuarine ecosystem.

Disadvantages

- Social — Site access restrictions to public parks and reserves to avoid exposure to recycled water. Adverse public perceptions (health and aesthetic concerns) to recycled water irrigation and/or storages at these public reserves.
- Economic — High unit cost for low volumes used. Minor loss of income for TSC from substituted sales of potable and raw water to irrigation customers (bowls clubs, etc).
- Environmental — Possible high watertable, salinity and waterlogging issues at recycled water sites and potential foreshore vegetation damage.

Recommendations

Option 3 is recommended for further consideration for the Stage 1 Kingscliff Recycled Water Scheme. Selection of Option 3 would enable a "Stage Zero" Scheme to proceed to supply Chinderah Golf Course from the existing STP, not having to wait for the STP to be relocated.

Once the Kingscliff STP is relocated, then the pipeline could then be connected to a new recycled water main integrated as part of Option 3, or alternatively abandoned in favour of a new pipeline and dedicated pump station directly from the new STP site as part of Option 1.

However if TSC considered that recycled water storage tanks are feasible in Kingscliff's public parks and reserves (eg. by building these underground) then the lower cost (but slightly higher risk) Option 2 should be considered as an alternative to Option 3.

The next steps recommended in the Implementation Strategy as outlined in this report include further engineering, planning, environmental, social and economic investigations and consultations. Completion of such investigations should include pre-consultation with EPA NSW (now incorporated into DEC) and other relevant regulatory authorities, as well as pre-consultation with the local community (including residents, parks user, sports clubs, etc).

TSC will need to educate the local community (including residents, sports clubs and park users) about recycled water use and erect warning signs to ensure restricted human access during irrigation and the 4 hour withholding period to prevent exposure of humans to recycled water. If the public access cannot be effectively restricted, then TSC will need to consider higher levels of treatment and disinfection of the Kingscliff Recycled Water to enable unrestricted irrigation uses on the parks and reserves. The costs estimated in this report do not include costs of higher level of treatment, which would need to include tertiary treatment and filtration (eg. filter or membranes, and higher levels of disinfection). Costs of this higher levels of treatment can be of the order $1000/ML in the long term.

1. Introduction

1.1 Background and Key Project Drivers

Tweed Shire Council ("TSC") is proactively planning for the supply of recycled water to Kingscliff parks and foreshore reserves, as well as a number of private customers including Chinderah Golf Course. With the rapid increase in population occurring in the Kingscliff area, there is expected to be a commensurate increase in demand on the potable supply system, resulting in the need for major expansion in water supply infrastructure. Recycled water use will have a number of important water conservation and sustainability benefits, the key ones being:

1. Substitution of potable water currently used for irrigating TSC's parks and reserves;
2. Easing of peak demands on Kingscliff's potable water supply, particularly during the dry (irrigation) season;
3. Economic benefits through stimulation of development, irrigated agriculture and possibly industry through the availability of a reliable recycled water supply for restricted (non-potable) uses.

A key driver for this project is the EPA NSW endorsement of Kingscliff's Effluent Reuse Strategy as part of the basis of the NSW government approval of the proposed new Kingscliff STP. In their letter in January 2003, NSW EPA (now incorporated into DEC) stated their endorsement of the Effluent Reuse Strategy and recommended that Tweed Shire Council maximise effluent reuse and replace current potable water irrigation uses on Public Open Space. The EPA letter also indicates that future effluent quality requirements for the Kingscliff STP discharge to Tweed River at Chinderah will depend on the extent of effluent reuse achieved and the resultant reduction in pollutant load on the river.

This report outlines the options assessment and conceptual design and costs of "Stage 1" recycled water supply from the relocated Sewage Treatment Plant ("STP") to Kingscliff's parks and foreshore reserves, as well as a range of private customers along the potential pipe routes. The purpose of this report is to illustrate the feasibility and benefits of recycled water supply infrastructure enabling about 180 ML/Yr recycled water use to irrigate TSC's parks and reserves, Chinderah golf course, bowling clubs and a private rugby field within Kingscliff. Substitution of 70-80 ML/Yr of potable water currently used for irrigation could be achieved under a Stage 1 recycled water scheme.

1.2 Report Scope

The scope for this Concept Design Study was outlined in MWH's proposal to TSC dated 21 September 2004. MWH's approach to this study has involved the following general tasks:

1. Review of background information including:
   - effluent management options outlined in the EIS for the new Kingscliff STP (GHD December 2002),
   - recycled water pumping options from MWH's Concept Design Report for Kingscliff STP (July 2004), and
   - other information provided by TSC and potential private recycled water customers;

2. Visits to the Kingscliff study area and further consultations with TSC and potential private customers (various visits and discussion between November 2004 and February 2005);
3. Recycled water pipeline route selection options between the new STP and potential recycled water sites;
4. Recycled water pipeline sizing and pumping requirements from hydraulic modeling of peak and daily recycled water demands expected from the range of potential TSC and private recycled water sites;
5. Alternate storage dams and/or tanks sizing and siting options for both the new STP site as well as at individual recycled water sites;
6. Preliminary capital cost estimates of new recycled water pipeline, pumping and storage infrastructure based on conceptual design and hydraulic modeling;
7. Recycled water quality issues and resultant irrigation design and public access restrictions according to EPA NSW and National guidelines to prevent exposure of humans to recycled water;
8. Indicative timelines for planning, design, approvals (EPA, TSC and others), construction (including consideration of constructibility issues) and commissioning;
9. Preparation of a Report of above investigations (this report);
10. Presentation of the options and recommendations to TSC (15 March 2005); and
11. Preparation of this Final Report incorporating the comments and feedback from TSC.

1.3 Extent of Field Investigations and Consultations

In early November 2004 area inspections of Kingscliff Township and environs were undertaken. The extent of the Study area included (also shown in Figure A-1 in Appendix A):

- current Kingscliff STP, sewerage mains and recycled water pipe routes;
- locales of parks, gardens, reserves and other open spaces for potential recycled water use;
- locations of potential recycled water storage tanks/dams near or at recycled water end-use sites;
- possible alternative routes for new recycled water pipelines using proposed sewer main easements and existing road reserves, starting from the proposed site of the relocated STP) to the Chinderah Golf Course, Kingscliff parks and reserves, and private sites such as Kingscliff Bowls Club and Cudgen Leagues Club (rugby field and bowls club).

An initial workshop was held in early November 2004 at TSC offices, followed by a two-day inspection of the study area that included onsite discussions with TSC parks and reserves operators. The purpose of these meetings and discussions was early engagement and capturing vast local knowledge base of these experienced persons and to discuss the background information, options and potential cost savings for recycled water pipelines, pumping, storage, irrigation reuse, environmental and public health management.

Various other follow up discussions and information requests were made by telephone, correspondence and emails between November 2004 and March 2005 with TSC and the manager of the Chinderah Golf Course.

2. Description of the Study Area

2.1 Location and Extent of the Study Area

Kingscliff and surrounding areas (including Cudgen and South Kingscliff) are growing rapidly. The current sewage catchment population of the Kingscliff STP is over 10,000, and is expected to grow to around 40,000 equivalent population ("EP") by the year 2031.

The study area for the purposes of this recycled water concept design report includes the coastal village of Kingscliff and surrounding areas. For this report, "Stage 1" refers to a possible recycled water pipeline and supply area comprising TSC Kingscliff parks and foreshore reserves, as well as private sites (as shown in Figure A-1 in Appendix A) as follows:

- Chinderah Golf Course (private ownership);
- Jack Bayliss Park (TSC),
- Reg Dalton Oval (TSC);
- Walter Peat Reserve (TSC);
- Kingscliff Bowls Club (private); and
- Cudgen Leagues Club (private rugby field and bowling greens).

Potential future Stages for recycled water infrastructure which are to be briefly touched on in this report, include areas generally to the south and west of Kingscliff as follows (refer to Figure A-2 in Appendix A):

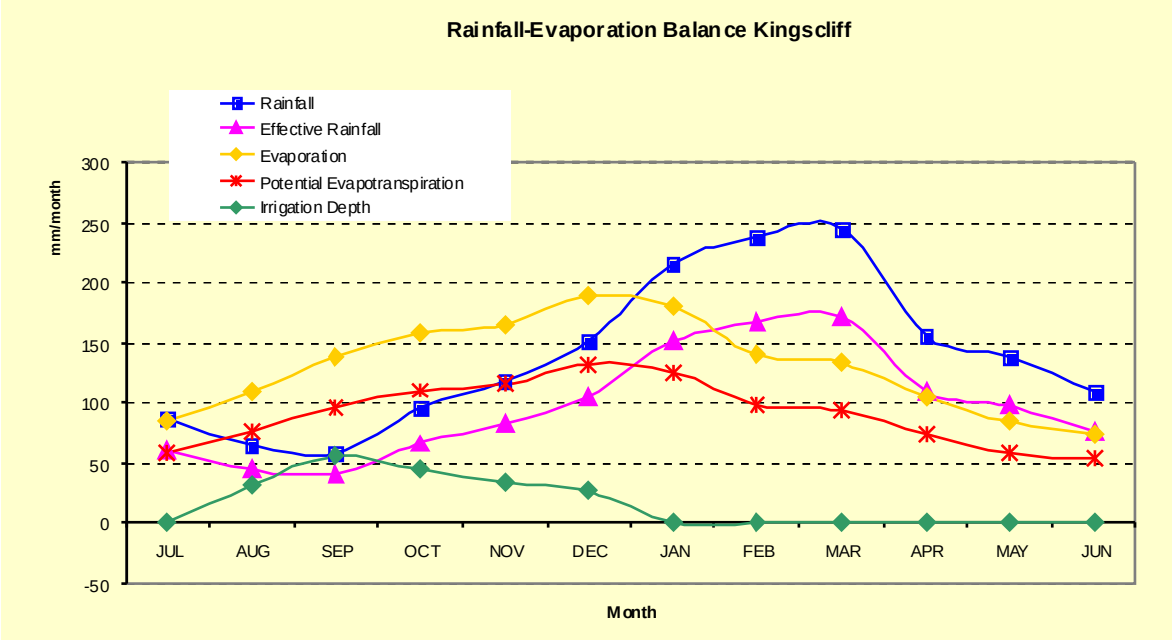
1. Kingscliff's southern foreshore areas (TSC) down to Cudgen Creek, and primary schools (fields);
2. South of the new STP down to Cudgen Creek including Gales Holdings proposed developments, Cudgen Rd market gardens, Kingscliff Tafe, High School and TSC reserves on Cudgen Creek;
3. agricultural areas, market gardens south of Cudgen along Tweed Coast Rd;
4. agricultural areas (mainly cane farms) west of Kingscliff towards Pacific Hwy;
5. South Kingscliff down towards the Salt, Casuarina and Kings Forest Developments (open space watering).

2.2 Climate and Irrigation Potential

Kingscliff experiences a subtropical climate, with most of the annual rainfall occurring during the wet season (~70% between December and May). The wettest months are January to March, when ~40% of annual rainfall occurs. The Environmental Impact Assessment for the proposed relocated Kingscliff STP (GHD December 2002) indicated that the Kingscliff area experiences a high annual rainfall (average 1374 mm/yr, with an average of around 158 rain days per year). Recent Tweed Shire Council rainfall records indicate annual rainfall is about 1680 mm/yr in the Kingscliff coastal region.

Kingscliff experiences high evaporation (~1560 mm/yr based on Bureau of Meteorology Alstonville station). Figure 2-1 illustrates the typical monthly rainfall and evaporation profile (in mm/month) throughout the year as well as irrigation demand (depth in mm/month) for warm season grasses based on potential monthly evapotranspiration (crop factor 0.7) minus effective monthly rainfall (roughly 70% of actual rainfall for grass).

Figure 2-1 Rainfall and Evaporation Profile for Kingscliff Area & Potential Irrigation Demand (mm/month)



Demand for irrigation water is obviously dependent on amount of rainfall and evaporation throughout the year. Based on potential evapotranspiration minus effective rainfall as per Figure 2-1 above, there is a relatively low irrigation demand of about 2 ML/Ha/Yr (compared with high demand further inland), particularly in the drier months between August/September through to December/January. The EIS for the proposed relocated Kingscliff STP (GHD December 2002) indicated irrigation demand of up to 5 ML/Ha/Yr for park and gardens, and 1.5 ML/Ha/Yr for sugar cane. A peak daily irrigation rate of 5 mm/day (or 50 kL/Ha/day) has been assumed in this report based on December/January potential evapotranspiration as per Figure 2-1.

Water use at Kingscliff's parks and reserves was assessed by review of TSC's potable meter records for recent years – see Table 2-1. This provided some basis for determining annual irrigation rates for design of the recycled water irrigation scheme. The existing irrigation rates for Kingscliff's parks/reserves given in Table 2-1 are quite high, but this may be due to recent years being drier than usual, and there being other uses of the potable water (sports pavilion amenities, etc) at the various parks and reserves.

Table 2-1 Existing Potable Water Use at Kingscliff Parks and Reserves (Based on TSC Meter Readings)

Park/Reserve	Existing Area Irrigated	Annual Use #	Annual Use per area irrigated	
	Ha	ML/Yr	ML/Ha/Yr	mm/yr
Walter Peate	7.2	33.4	4.6	460
Reg Dalton	1.3	9.5	7.1	710
Jack Bayliss (picnic areas)	0.28	1.8	6.4	640

Note to above table: # Water use would include some toilet/amenities usage (low in proportion to irrigation use).

Based on the climatic conditions, it is anticipated that the long term sustainable irrigation demand could range from 2 to 4 ML/Ha/Yr based on plant needs only. The lower irrigation demand rates are more appropriate for the sandy coastal/foreshore areas and cane growing areas, whilst the higher demand values may be needed further inland (market gardens, tree plantations, etc). However, with the highly permeable sandy soils across the study area and expected seepage losses, irrigation demand may need to be as high as 4-6 ML/Ha/Yr. This is more consistent with existing irrigation water use on Kingscliff's parks/reserves and previous recycled water irrigation investigations by TSC (eg. 1995 proposal for a turf farm at the existing Kingscliff STP).

2.3 Land and Soil Capability

Topography of the Tweed River Floodplain and Kingscliff hinterland sites is mostly flat and low lying, including the land of the existing and proposed STP. The floodplain is only about 1-2 m above sea level, and the land rises slightly to the east toward the foreshore areas (up to 3-5 m high associated with dune formations) along Marine Parade. The hinterland soils are predominantly interbedded estuarine sands and silty-sands (prior seabed, swamp, alluvial and windblown deposits). The foreshore dune areas contain fine to coarse windblown sands. All soils are highly permeable.

The watertable only about 0.5-1.5 m below natural surface at both the existing and proposed STP sites. The unconfined groundwater quality is brackish to saline (electrical conductivity 8-10 dS/cm, or 5000-6400 mg/l TDS). Groundwater of this salinity has limited beneficial uses, with only potential use being stockwater drinking (ie. for sheep), and support of local ecosystems (ie. from groundwater discharge to the estuarine ecosystems of Tweed River). High watertables present some risks for irrigation, underground storage and pipe construction.

Acid sulphate soils are present across the whole of the Stage 1 study area. Therefore any excavation works (ie. for pipe trenches, pump sumps, dams, etc) will require acid sulphate management measures for protection of steel and concrete fittings and structures. The soils at the proposed site for the relocated Kingscliff STP have been previously assessed (Coffey, 2004) as being mildly to moderately aggressive to steel, and moderately aggressive to concrete. This is also expected to be the case along any future recycled water pipe alignment.

To the south of the original Kingscliff township is the "Cudgen plateau", which is a relic basalt flow, containing highly fertile, productive red soils currently used extensively by market gardens along Cudgen Rd. The plateau rises to an elevation of up to 40 m. This plateau, together with Cudgen Ck forms natural southern boundaries to Stage 1 of this concept design study.

There are numerous potential sites (TSC and private customers) that could be supplied with recycled water in Kingscliff and environs. However, some of these customers may not be viable due to various reasons including:

- low irrigation water demands in this moderately high rainfall region;
- unsuitable soils (eg. highly permeable sandy soils), high watertables, salinity and waterlogging risks;
- adverse impact on local native vegetation (eg. foreshore areas);
- excessive recycled water pipeline distances;
- high capital cost and high operating cost per unit of recycled water supplied (ie. $/ML/Yr supplied);
- lack of willingness of private customers to pay for new recycled water infrastructure and true cost (ie. full cost recovery) of supplying the recycled water to the property.

There is potential for extending recycled water supply beyond Stage 1 to the extensive areas of orchards and market gardens on the Cudgen plateau, as well as to the south of Cudgen. In the longer term, there may be opportunities for extending recycled water supply pipelines even further south to tourism and residential developments in South Kingscliff hinterland and coastal areas including the Salt and Casuarina seaside developments and Kings Forest Parkway development further inland. These prospective larger future stages are abstractly shown in Figure A-2 (in Appendix A) for illustrative purposes for TSC's consideration of possible upsizing of Stage 1 recycled water supply infrastructure to provide reserve capacity for future stages.

Note that the concept design of pipelines and pumping requirements for future stages are beyond the scope of this Stage 1 Concept Design Study. Design of future stages can be evaluated in subsequent concept design studies following consideration of Stage 1 options and outcomes.

3. Background Information Review

3.1 Information Sources

Tweed Shire Council planning and engineering staff, as well as parks and reserves operators have supplied valuable background information and plans about the proposed Kingscliff STP and associated sewerage infrastructure relocation. Chinderah Golf Course manager (Jeff Holloway) also provided valuable information about current and future golf course proposals including proposed new storage dam and expanded golf course. TSC, Chinderah Golf Course manager as well as local land developers possess a great amount of documented information as well as extensive local officer knowledge about the local water systems and other infrastructure, land uses, soil/land capability, future development and recycled water use opportunities. It is important that the extensive information and local knowledge base of these organisations, developers and individuals be tapped further for any more detailed investigations.

3.2 Tweed Shire Council

TSC planners and engineers have provided MWH with current land use and infrastructure maps, future development maps (including the Gales Holdings Local Structure Plan for Kingscliff, Chinderah and Cudgen), and various background study reports to the "Tweed Futures" (2004) and Tweed Coast Strategy (2003).

TSC has also provided meter readings for current potable water volumes used in recent years at Kingscliff's various parks and reserves, including areas under irrigation and methods of irrigation. Previous recycled water studies for Kingscliff and Tumbulgum (1/2 way between Kingscliff and Murwillumbah) were also provided to MWH as follows:

- TSC Environmental Impact Statement: Proposed Disposal of Effluent and Biosolids by Application to Turf. Chinderah Sewage Treatment Works (MFA Consulting Engineers 1994-1995); and
- Tumbulgum Effluent Irrigation Investigation (Agricultural Water Management, 1998).

To determine the planning and development context for this recycled water concept design study, MWH has also reviewed various planning documents and instruments from TSC's Planning Service website including:

- Tweed Local Environmental Plan (2000), and proposed Amendment No.21) to the Tweed LEP;
- Various Development Control Plans ("DCP") and Plans of Management including for Kingscliff, West Kingscliff, South Kingscliff, etc;
- Tweed Shire Open Space Infrastructure Policy (2002);
- Vegetation management plans including lists and maps of Rare and Significant Trees and other vegetation on TSC's Recreational Reserves.

3.3 EIS for the Kingscliff Treatment Plant Relocation

TSC has also provided details of the EIS for the proposed relocation of the Kingscliff Sewage Treatment Plant. This EIS was prepared for TSC by GHD (December 2002) and contains a broad assessment of effluent management options based on previous studies and included a proposed strategy for development of reuse (within 3-4 km) from the relocated STP. This EIS refers to the need for assessment of recycled water proposals for any future Development Application under the EP&A Act 1979.

This Recycled Water Concept Design Study further explores some of the recycled water opportunities identified in the EIS with a focus on Kingscliff's parks and foreshore reserves as Stage 1. This Concept Design report is intended to assist TSC with any future Development Application for a new recycled water scheme for Kingscliff.

3.4 Kingscliff WWPP Concept Design

In July 2004, MWH prepared a Concept Design Report for TSC for the proposed relocated Kingscliff STP. That STP Concept Design report provides valuable background in terms of future sewage flows, possible STP site layout, effluent pump station sizing, outfall pipeline alignment, local soil and groundwater conditions, etc.

Since the concept design report by MWH, GHD has commenced the Detailed Design. TSC have provided updated site layout plans (showing revised location of effluent pump stations and outfall pipelines) and STP inflow projections for the proposed new Kingscliff STP.

3.5 Chinderah Golf Course

Chinderah Golf Course (Jeff Holloway, Golf Operations Manager) has provided valuable information about current and future golf course proposals including proposed new storage dam and expanded golf course. At present only the golf course tees and greens are manually irrigated using onsite bore and onsite catchment dam water. There are proposals to expand the golf course to the west with 9 new longer holes, and refurbish the existing 18 holes with irrigation to also include fairways (ultimately up to about 20 Ha area under irrigation, 700-1400 kL/day maximum use). A new 6 ML day is to be constructed in the center of the golf course – about 600-700 m from the proposed site of the relocated STP.

It should be noted that Chinderah Golf course management is very keen to receive recycled water supply within the next 12 months – not having to wait for the treatment plant to be relocated. In the interim (ie. "Stage Zero") it should be possible to supply the golf course using existing private recycled water main running from the existing STP to the Ti Tree plantation with a new 500-600 m long pipeline directly into the proposed new 6 ML golf course dam.

4. Proposed Recycled Water Customers

4.1 Staging

4.1.1 Stage 1

It is recommended to commence with a "Stage 1" Scheme for Kingscliff including the following TSC parks and foreshore reserves in Kingscliff, as well as various private customer sites (see Figure A-1 in Appendix A):

- Jack Bayliss Park (foreshore reserve – by subsoil irrigation only);
- Reg Dalton Oval (Wommin Rd);
- Walter Peat Reserve (Wommin Rd);
- Chinderah Golf Course (Tweed Coast Rd);
- Kingscliff Bowl Club;
- Cudgen Leagues Club (containing Ned Byrne Rugby field and the Leagues Club bowling greens).

Stage 1 scheme should also make provision for possible connections such as:

- future Driving Range and Hospital/Medical Institute (lawns and gardens),
- local industry north of existing sewage treatment plant other land uses proposed in the Gales Holdings Local Structure Plan to the north and east of the relocated STP site and;
- possible customers for Stages 2 to 5 to the east, south and west of the relocated STP site (see below).

4.1.2 Stage 2

As a 2nd stage, the recycled water pipelines on the Kingscliff foreshore could be extended south to a number of other TSC Parks and Gardens and private sites along the foreshore and adjacent to Cudgen Ck including:

- Surf Life Saving Club (limited lawn areas – by subsoil irrigation);
- Faulks Park (limited lawn areas, many trees - subsoil irrigation);
- St Anthony's Primary School (playgrounds – surface spray or subsoil irrigation);
- Kingscliff Primary School (playgrounds – surface spray or subsoil irrigation);
- Hansen Park (limited lawn area - subsoil irrigation).

4.1.3 Stage 3

As a possible 3rd stage, additional private customers could be supplied by extending the pipeline along Tweed Coast Rd and Cudgen Rd, and also to parks and reserves adjacent to Cudgen Ck. Sites that could be supplied by a 3rd stage could include:

- Future Driving Range and Hospital/Medical Institute identified in Gales Holdings local structure plan;
- North East Institute of Tafe (large open areas);
- Kingscliff Highschool;
- TSC reserves on Cudgen Creek (Jack Julius Park, Parker Rotary and Cudgen Headland); and
- Orchards and Market gardens (crops not in direct contact with recycled water or cooked food crops only irrigated with recycled water).

4.1.4 Stage 4

For the 4th Stage, agricultural areas (mainly cane growing) to the west of the proposed relocated Kingscliff STP could also be developed, initially as far west as the Pacific Hwy and potentially later on to Tweed River.

4.1.5 Stage 5

For a possible 5th stage (longer-term), pipelines supplying Stages 1 to 3 customers could be initially upsized (or alternatively duplicated) to enable extension of the recycled water scheme to new seaside and inland developments in South Kingscliff. New developments that may require irrigation water for open space and parklands include South Kingscliff Gateway (tourism site and open space reserve), Salt Development (eg. proposed Salt-South Kingscliff Central Park), Casuarina Development and Kings Forest Development.

Stage 1 customers and suggested pipeline alignments and possible future Stages (2 to 5) as described above, are shown in Figures A-1 and A-2 respectively in Appendix A. Possible customers supplied in these future stages are outlined in Appendix I (potential demands shown in Appendix B, Table B1).

4.2 Description of Stage 1 Recycled Water Irrigation Sites

Brief discussion of each Stage 1 irrigation site is given in the subsections to follow, with Recycled Water Site Summary Sheets for each potential irrigation site given in Appendix C.

4.2.1 Jack Bayliss Park

Jack Bayliss Park ("JBP", managed by TSC) and runs north to south from Kingscliff North Holiday Park to Kingscliff Holiday Park in the south along Kingscliff's foreshore over a distance of about 1.5 km. The potential area for irrigation is the flat grassed and partly treed area about 40-60 m wide between Marine Parade and the narrow band of native scrub and sand dunes that separates the park from the beach.

The park has a number of active public uses including BBQ/picnic areas, tables, toilet blocks, pedestrian/bicycle paths, open space lawns areas, etc. There a two small areas (1400 m^2 each) around the two BBQ/picnic areas currently irrigated from potable water mains (via stainless steel pop-up sprinklers). Given that public access to the foreshore is unrestricted and could occur at any time of the day or night (particularly during holiday periods), any future recycled water irrigation should be via subsoil (in-line) drippers (~150-300 mm below ground). The existing BBQ/picnic areas have even higher public use and therefore should continue to be irrigated using pop-up surface sprays using the potable water mains.

At MWH's site visit, substantive native bush corridors were observed at JBP both parallel and perpendicular to Marine Parade. The native vegetation observed consisted of isolated mature trees (Fig trees, Banksia, paperbark, ti-tree, Pandanus, wattle, Casuarina, Hakea, rubber trees, etc) in the south of the park, becoming more densely spaced towards the north (mostly Pandanus and Banksia).

Much of the dune vegetation and isolated trees on JBP is degraded, trampled, weed-infested and in varying stages of dieback. However there are manure remnant trees that are worth conserving and should be avoided for any recycled water irrigation development. There is also a row of tall Norfolk Pines along Marine Parade, which are highly recognisable and historic features of the Kingscliff foreshore, and therefore important to the local community. Disturbance of these pines should also be avoided.

The Tweed Coastline Management Plan (May 2004) indicates a narrow vegetated strip along the Kingscliff foreshore at JBP as having a vegetation management rating of: "1 to 5 significant native species". JBP therefore contains important remnants of the extensive coastal dune vegetation that was once all along the foreshore area. Recycled water use on the Kingscliff foreshore will require careful irrigation design, low watering rates, and layout to provide adequate setbacks to avoid significant native dune vegetation as well as the Norfolk Pines planted along Marine Parade.

Subsoil irrigation is ideally suited for the JBP foreshore, because the flexible poly-irrigation lines and drippers can be readily placed and bent to avoid obstacles. This includes avoiding important native vegetation and isolated trees on lawns areas, as well as the BBQ/picnic areas and other existing park infrastructure to prevent exposure of park users to recycled water. Subsoil irrigation is also more efficient than surface spray irrigation (which has significant misting losses) and watering rates can be accurately controlled to ensure protection of native vegetation and groundwater from possible recycled water seepage/leaching.

The potential area for irrigation expansion for recycled water use is limited to the narrow strip of lawns, which range in width 30 – 50 m. However, to protect the native dune vegetation and BBQ/picnic areas a setback of at least 10m is suggested. This will further limit the available irrigation area to about a 20 – 40 m wide strip.

For the purposes of estimating total irrigation area and to delineate key features along the JBP foreshore reserve, the open space lawn areas have been divided into six sections from South to North (see Table 4-1 as well as Figure A-1 in Appendix A). The estimated water demands for JBP are shown in Table 4-1 for an assumed irrigation rate of 5 mm/day (or 50 kL/Ha/day) for hot/dry days. Predicted demands are critically dependent on this assumed daily irrigation rate and total area irrigated on that day. Peak demand (4.2 L/s or litres/second) for JBP is dependent on the assumed times of watering, which are also shown in Table 4-1.

Based on review of aerial photographs, site visits to pace the area, and providing the above mentioned setbacks, total available irrigation area for recycled water use at JBP is roughly estimated to be between 4.5 and 5 Ha (assumed 4.8 Ha). Note that the aerial photographs provided by TSC were of low resolution and there has been no other detailed survey of JBP foreshore. The entire foreshore reserve should be subject to a detail feature and vegetation survey prior to any detailed design of the recycled water scheme and any new irrigation development at JBP. This should be undertaken to accurately determine total park area, location of natural and manmade features to be avoided, available open space areas for recycled water irrigation and the required setbacks.

4.2.2 Reg Dalton Oval

Reg Dalton Reserve (managed by TSC) has a cricket oval (with a turf pitch) and hockey pitch, with total area of about 2.5 Ha. The cricket oval (areas 1.3 Ha) is currently irrigated using potable water via the mains tapping on Kingscliff Street east of the oval, and controlled by a Raindial™ irrigation controller. The adjacent grass hockey/soccer field (area ~1.2 Ha) is not presently irrigated.

Bore water (not presently used) can be used to water the lawns and gardens around the toilets and grandstand. Irrigation from this onsite bore (located in south east corner of the reserve next to the cricket ground) was via a pump located in a brick pump house between the toilet blocks on the south boundary of the reserve. This pump could be upgraded and used as a recycled water irrigation pump for both the oval and hockey field – ie. for low pressure recycled water supply and onsite storage tank option (to be discussed in section 5).

Total potential area for recycled water irrigation at Reg Dalton Oval incorporating a new irrigation system for the hockey/soccer field is about 2.5 Ha. The estimated recycled water demand (8.7 L/s) for Reg Dalton is given in Table 4-1. This estimated demand is based on 2.5 Ha, 5mm/day irrigation rate, and watering restricted to overnight (11 pm to 3 am) to ensure a 4-hour withholding period before dawn (ie. the earliest expected time that the public start using the park each day).

No disturbance or removal of native or other significant vegetation should be necessary at Reg Dalton.

4.2.3 Walter Peate Recreational Reserve

This reserve is used for soccer, hockey, and little athletics. The reserve is currently irrigated with potable water from mains tapping on Wommin Bay Road. Total area under irrigation is about 7.2 Ha. The irrigation systems at Walter Peate have been progressively upgraded over the last 15 years from south to north, with the athletics track irrigation system upgrade (to) being completed (by contractor "Water Force" 4 years ago. Watering is via Hunter I-31 pop-up sprinklers and is controlled by a Toro 2001 Scorpion System Controller located in the pavilion in the center of the reserve.

Watering of the reserve currently occurs overnight between 11:30 pm and 5:30 am. Note that if recycled water is to be used on this reserve, a 4-hour withholding period will be needed before dawn (ie. when public access to the reserve is expected each day). Recycled watering times should be restricted to between 11pm and 3am. The estimated recycled water demand for Walter Peate is given in Table 4-1. This estimated demand is based on 7.2 Ha, 5 mm/day irrigation rate, and watering restricted to overnight (11 pm to 3 am) to ensure a 4-hour withholding period before dawn (ie. the earliest expected time that the public start using the park each day).

Note that Walter Peate (with the large area and tight watering period) has the highest peak demand (25 L/s) of all potential irrigation sites, and therefore has the greatest influence on the sizing of recycled water pipe mains and any onsite storage tank.

No disturbance or removal of native or other significant vegetation is required at Walter Peate Recreational Reserve.

4.2.4 Chinderah Golf Course

Chinderah Golf Course presently has 18 holes, with tees and greens manually irrigated using onsite bore water and onsite catchment dam water. About 1.5 Ha area (tees and greens) is currently irrigated, with about 125 kL/day maximum use using small petrol driven pumps on the bore and each dam. There are proposals to expand the golf course to the west with 9 new longer holes, and refurbish the existing 18 holes with irrigation to also include fairways (ultimately up to about 20 Ha area under irrigation, 700-1400 kL/day maximum use). The golf course owner proposed to build a new 6 ML day in the center of the golf course, about 600-700 m from the proposed site of the relocated STP.

The peak demand for Chinderah Golf Course (13.9 L/s) is given in Table 4-1. This estimated demand is based on 20 Ha of ultimate irrigation area, 5 mm/day irrigation rate, and pumping (20 hours per day) directly into the proposed golf course dam. The golf course would then irrigate from the dam using their own irrigation pump station (to be upgraded by the golf course at their own expense as part of the future expansion).

Chinderah Golf course are keen to obtain recycled water supply as early as possible without having to wait for the STP to be relocated. In the interim period before the STP relocation, it should be possible to supply the golf

course using the existing 225 mm private recycled water main running from the existing STP to the Ti Tree plantation with a new 500-600 m long (100 mm diameter uPVC) pipeline directly into the proposed new 6 ML dam on the golf course. After the STP is relocated and commissioned, there are two options for supplying the golf course:

(i) Connection via new recycled water trunk main on Tweed Coast Road (resulting in higher recycled water trunk main demands and diameter, and combined pump station capacity);

(ii) Separate pipeline direct from relocated STP, pumped from the buffer storage after the chlorine contact tank (lower demand on recycled water trunk main, and lower diameter, but cost associated with abandoning any pipeline from trunk main connection at Tweed Coast Rd to the golf course).

For a pipeline direct from the relocated plant (option (ii) above) there should be no disturbance or removal of native or other significant vegetation required at the golf course given that the pipeline would be across fully cleared paddocks. However for option (i) above, there may be need to clear some mature native trees for a pipe trench corridor along the west side of Tweed Coast Rd and in the south east corner of the golf course land up to the proposed new dam.

4.2.5 Cudgen Leagues Club (Ned Byrne Field and Bowling Greens)

The Cudgen Leagues Club has Ned Byrne Rugby Field (~1.4 Ha) and two lawn bowling greens (areas ~0.3 Ha), located to the east and north of the Cudgen Leagues pavilion respectively. The rugby field and lawn bowls greens are watered using bore water. The bore water irrigation pump may be utilised for any future recycled water supply scheme. The capacity of the Cudgen Leagues irrigation pump was not determined in this investigation, and would therefore need to be verified to determine need for any upgrade requirements prior to any change to recycled water supply.

A 2 m high mesh fence surrounds the rugby field and bowling greens. This provides opportunity to restrict public access, prevent human exposure to recycled water, and to also increase watering times (compared to public reserves with no ability to restrict public access). However, the rugby field is utilised in the evenings for training under lights. Therefore recycled water irrigation times (excluding rugby field training nights) should be able to commence as early as 7 pm and go through to 3 am. The estimated recycled water demand for the Cudgen Leagues Club is given in Table 4-1. Estimated demands for Ned Byrne Field (2.5 L/s) and the bowling greens (0.5 L/s) is based on the respective areas under irrigation mentioned above, 5 mm/day irrigation rate, and watering restricted to overnight (7 pm to 3 am) to ensure a 4-hour withholding period before dawn.

No disturbance or removal of native or other significant vegetation is required on Cudgen Leagues Club land.

4.2.6 Kingscliff Bowls Club

There are three bowling greens at the Kingscliff Bowls Club, currently irrigated with potable water via mains tapping on Marine Parade. The bowling greens are fenced off and closed overnight, providing the opportunity to restrict public access to prevent of exposure to recycled water, and to also increase watering times. Therefore recycled water irrigation times should be able to commence as early as 7 pm and go through to 3 am. The estimated recycled water demand for the Kingscliff Bowls Club is given in Table 4-1. Estimated demands for the bowling greens (0.9 L/s) is based on 0.5 Ha area under irrigation, 5 mm/day irrigation rate, and watering restricted to overnight (7 pm to 3 am) to ensure a 4-hour withholding period before dawn.

4.3 Alternative Recycled Water Irrigation Options

4.3.1 Surface irrigation on Jack Bayliss Park foreshore areas

Various other options were considered including supplying Jack Bayliss Park ("JBK") foreshore reserve to surface irrigation with and without storage tanks. The advantage of surface irrigation is that installation is about 25% cheaper than subsoil methods. However there are public access issues associated with surface irrigation, including the need for restricted watering hours to periods when the foreshore reserve is not expected to have public access. However even with a tight watering period of 11 pm to 3 am (to provide 4-hour withholding), there is no guarantee that the public will not use the foreshore during irrigation times and inside the 4-hour withholding period. This is expected to be an issue during summer holiday periods.

In addition, the surface irrigation option at JBP would require the installation of large storage tanks (~40 kL in the south, ~200 kL in the north) on the foreshore. The option of providing any large storages either above or below ground on the foreshore is not feasible given the aesthetic impacts and anticipated community objections.

4.3.2 Subsoil irrigation on other Kingscliff Parks and Reserves

Options were considered for providing subsoil irrigation to existing recreational reserves including Reg Dalton Oval and Walter Peat Reserve. Subsoil irrigation has the same advantages as that described for the foreshore reserve, including no public access issues, longer watering periods, lower peak flows and capacity requirements for the recycled water supply infrastructure, potential direct irrigation and no need for storage tanks.

However, these parks already have efficient surface irrigation systems - some of these have only recently been upgraded (eg. Walter Peate). Major refurbishment of playing fields would be needed to convert to subsoil irrigation, and this would be at great cost (~$15,000/Ha) to TSC. Such refurbishment would put playing fields out of action for some time potentially disrupting the use of these fields by local sports clubs. In addition the sub-soil irrigation systems do not provide as uniform irrigation as surface methods, which are most important for athletics and ball sports like cricket, soccer, hockey and rugby.

Even though sub-soil irrigation would be 25% more expensive to install at JPK, it would have following major advantages over the surface irrigation option:

- Direct irrigation and no need for onsite storage tank;
- Longer watering periods and therefore lower peak demands, resultant pipe and pump sizing;
- Flexibility to install lines to avoid damage to foreshore vegetation;
- More efficient irrigation (25-50% less water wastage) due to no evaporation and spray drift losses;
- More accurate control of irrigation rates to minimise impacts on foreshore vegetation, etc;
- No public access issues, provided recycled water does not come to the surface;
- Overall cost savings and no public objections based on all of the above.

Potential disadvantages of subsoil irrigation include the possibility of biological slimes/algal growth and root intrusion into the dripper lines. Sub-soil irrigation products such as Netafim™ Eflow are widely and successfully utilised in agriculture and woodlots using wastewater, recycled water and other algal laden water supplies. Netafim poly-tubes and emitters can be impregnated with registered herbicides to control root intrusion (10 year effectiveness warranty available). The turbulent flow through the labyrinth of the in-line emitters, regular flushing cycles and proper maintenance ensures control over blockages from slimes/algae build-up.

4.4 Summary of Stage 1 Recycled Water Demands

Table 4-1 provides a summary of the estimated Stage 1 peak recycled water demands based on the above discussion of potential recycled water irrigation sites. The peak demands given in Table 4-1 are the basis for analysing pipeline diameters, pumping requirements and recycled water storage requirements both at the STP and at individual recycled water sites.

The recycled water demands will vary throughout the day depending on which recycled water site is being watered at the time. Figure 4-1 shows the expected diurnal (24 hour) profile for recycled water demand, compared with expected initial STP sewage inflow profile.

The highest peak flows (37.6 L/s) are expected to occur overnight (from 11 pm to 3 am) during hot and dry (heat wave) periods when Reg Dalton (8.7 L/s), Walter Peate (25 L/s), Cudgen Leagues Club (Ned Byrne Field 2.5 L/s, bowling greens 0.5 L/s); and Kingscliff Bowling Club (0.9 L/s) are all watered at the same time.

Jack Bayliss Park should be able to watered during periods that avoid the above mentioned peak periods. Subsoil irrigation enables watering from early morning through to late morning (3am to 11am), and a second watering period in the evening (7 pm to 11 pm). There are no issues with public access during these watering times provided recycled water from the subsoil irrigation system remains underground and does not come to the surface. The period of lowest recycled water demand is associated with the Chinderah Golf Course demand, which is assumed to be by pumping directly into the proposed golf course dam, spread over 20 hours per day.

Figure 4-1 Kingscliff Stage 1 Recycled Water Scheme – Expected Summer Peak Daily Demand Profile

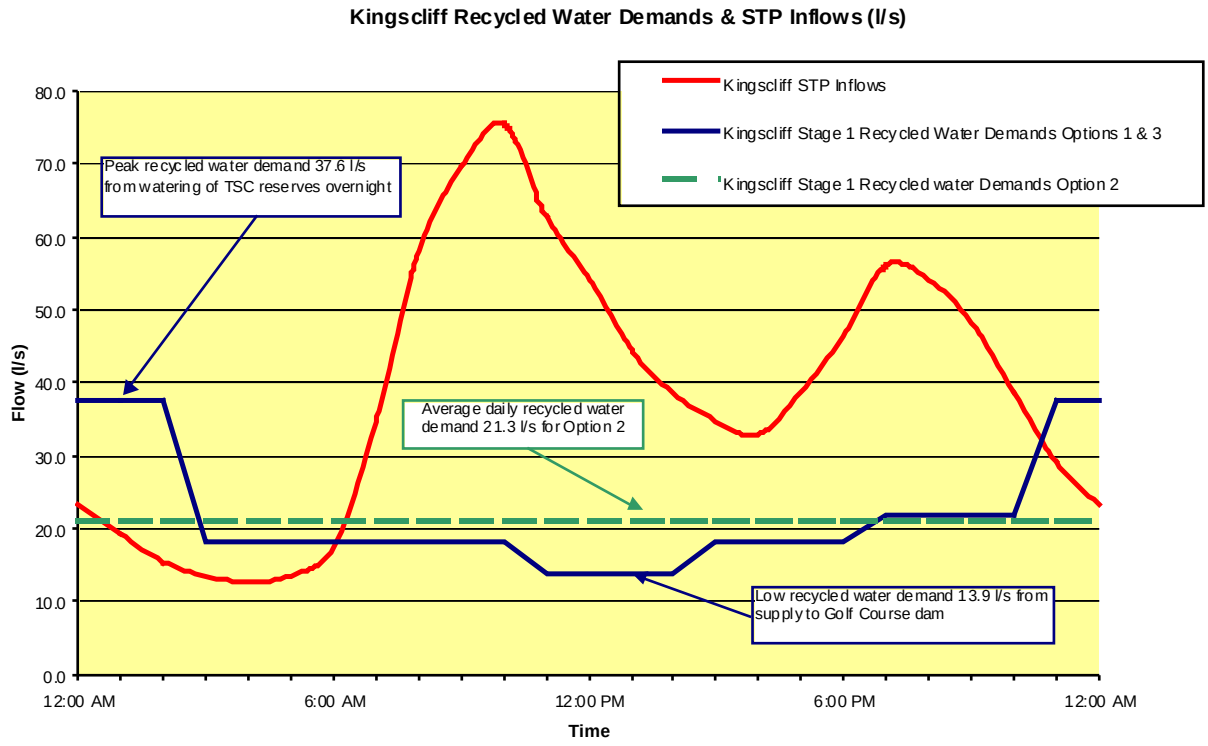


Table 4-1 Kingscliff Stage 1 Recycled Water Scheme – Potential Customers and Irrigation Demand Calculations and Assumptions

Recycled Water Sites	Existing Irrigation Uses	Estimated Area for Recycled Water Irrigation (Ha)	Estimated Annual Recycled Water Use (Ml/Yr)	Estimated Daily Demand (for 5mm/d) see note 1 (Ml/d)	Irrigation Method	Pumping times for direct irrigation option (restricted irrigation times) see note 2	Estimated Peak Pumping Demand for Direct Irrigation Options 1 & 3 (l/s)	Estimated 24hr Pumping Demand with Site Storages Option 2 (l/s)
Jack Bayliss Park Section 1	Potable used only on BBQ Areas: 2 x 0.14Ha	0.3	2.6	0.04	Subsurface Drip (direct)	3am-11pm (excl. 11am-3pm)	0.7	0.5
Jack Bayliss Park Section 2		0.3						
Jack Bayliss Park Section 3		0.2						
Jack Bayliss Park Section 4		3.5	12.8	0.20	Subsurface Drip (direct)	3am-11pm (excl. 11am-3pm)	3.5	2.3
Jack Bayliss Park Section 5		0.2						
Jack Bayliss Park Section 6		0.3						
Jack Bayliss Park (Total) see note 2		4.8	15.4	0.24	Subsurface Drip	3am-11pm (excl. 11am-3pm)	4.2	*2.8*
Kingscliff Bowls Club	Potable	0.5	2.5	0.025	Surface spray	7pm-3am	*0.9*	*0.3*
Reg Dalton Cricket Oval	Potable (old bore - not used)	1.3	18.3	0.125	Pop-up spray	11pm-3am	*8.7*	*1.4*
Reg Dalton Hockey	Not Irrigated	1.2						
Walter Peate Reserve	Potable	7.2	33.0	0.360	Pop-up spray	11pm-3am	*25.0*	*4.2*
Ned Byrne Field	Potable & Bore Water	1.4	7.0	0.070	Pop-up spray	7pm - 3am	*2.5*	*0.8*
Cudgen Leagues Bowls	Potable	0.3	1.5	0.015	Surface spray	7pm - 3am	*0.5*	*0.2*
Chinderah Golf Course	Bore Water	20.0	100.0	1.00	Pop-up spray (via new 6ML dam)	3am - 11pm (Golf Course Irrig: 8pm - 3am)	13.9	*11.6*
Total for Stage 1 See note 3			**177.7**	**1.835**			***37.6***	***21.3***

Notes to above Table:

1. Estimated daily demand for 5 mm/day (or 50 kL/Ha/day) irrigation depth over whole irrigation area
2. Restricted surface irrigation times to provide 4-hour withholding period in accordance with DEC effluent irrigation guidelines (Oct 2004) to prevent exposure of humans to recycled water. Jack Bayliss Park is the exception with sub-soil irrigation requiring no public access restrictions.
3. Total Peak Flows in last 2 columns based on sum of cells in columns with numbers in *italics* and having same highlighted cell colors.

5. Stage 1 Recycled Water Pipeline Options

5.1 Introduction

There is a wide range of possible water demand scenarios and pipeline alignment options. Pipeline sizing is most sensitive to assumed recycled water demands, particularly whether the recycled water supply is either:

(i) **high peak demand** recycled water supply direct to irrigation systems; or

(ii) **low peak demand** to individual onsite storage tanks and irrigation pump systems.

The assumed water demands for Stage 1 were discussed in Section 4 and Table 4-1. The critical cost issue is whether the costs of on-site storage tanks and irrigation systems offset the cost of larger supply pipelines for the higher flow direct irrigation (no-storage) option.

After considering various sub-options based on the above permutations and combinations, three primary options were short-listed as follows:

1. **Option 1** – High Flow Supply for direct irrigation at Kingscliff parks and reserves, with subsoil irrigation on foreshore at Jack Bayliss Park, and separate pipeline to proposed 6 ML dam at Chinderah Golf Course;
2. **Option 2** - Low Flow Supply to Onsite Storage Tanks at Kingscliff parks and reserves, but with no tank and subsoil irrigation on foreshore at Jack Bayliss Park, and separate pipeline to Golf Course Dam;
3. **Option 3** - High Flow Supply for direct Irrigation at Kingscliff parks and reserves, with subsoil irrigation on foreshore at Jack Bayliss Park, and separate pipeline to proposed 6 ML dam at Chinderah Golf Course via connection from Tweed Coast Rd.

The proposed pipeline alignment and three options above are discussed next.

5.2 Recycled Water Pipeline Alignment

Various pipeline alignments were considered, but it was found that different routes through the flat hinterland of the Stage 1 Kingscliff area do not have a great impact on the pipe sizing and overall costs. The suggested recycled water pipeline route for the Stage 1 scheme is generally described in Table 5-1, and also shown in Figure A-1 in Appendix A. Table 5-1 also includes approximate lengths and diameters of all pipeline sections from hydraulic modeling discussed later in this report.

The recycled water main initially follows the proposed easement for the various service pipelines between the existing Kingscliff STP and proposed relocated STP. TSC propose an easement between the existing Kingscliff STP and the relocated Kingscliff STP, which will contain two separate trenches for the following pipelines:

(i) Trench 1 (about 2.5 m wide):
- Two incoming 500 mm DICL (PN20) sewer rising mains (transferring raw sewage to the new STP site);
- One outgoing 600 mm DICL (PN20) effluent rising main (discharges ultimately to Tweed River);

(ii) Trench 2 (~1 m wide):
- One incoming 150 mm DICL (PN35) potable water main;
- One outgoing recycled water main (sizing estimated in this report).

TSC advise that there will be a 4 m separation between Trench 1 and Trench 2 described above. A 450 mm separation will also be needed between the potable main and recycled water main (expected to be at least 225 mm diameter) in accordance with draft WSA Code WAS03-2002 for Dual Water Reticulation Systems. Sharing of same trench should enable cost savings to be made – estimated for this report to be of the order 50% saving compared with the installation costs for a single pipe trench.

Table 5-1 Proposed Kingscliff Stage Pipeline Route Description

Section	Approx. Chainage (m)	From/to	Diameter (mm) (Note mPVC unless stated)		
			Option 1	Option 2	Option 3
A	0-250 (200)	Chlorine contact tank to north boundary of new STP site	250 DICL	150 DICL	250 DICL
B	250-1500 (1200)	Easement along new STP site northern boundary to Tweed Coast Rd	250	150	250
C	1500-2000 (500)	Tweed Coast Rd (west side road reserve) to start of driveway of existing STP site	250	150	250
D	2000-3000 (1000)	Along driveway (south boundary) and then east boundary of existing STP site to DICL pylon pipe bridge for sewer main over canal	250	150	250
E	3000-3050 (50)	Pylon Pipe bridge over canal (shared with sewer main) see note 1	225 DICL	150 DICL	250 DICL
F	3050-3630 (580)	From Pipe Bridge to Jack Bayliss Park foreshore reserve (Marine Pde) via Elrond Rd (road reserve on west side) and Beach St (road reserve – south then north side after Lorien Way)	250	150	250
G	3630-4150 (520)	Jack Bayliss Pk south branch down Marine Pde to Kingscliff Bowls Club	100	100	100
H	3630-4530 (900)	Jack Bayliss Pk North branch up Marine Parade to Terrace St node (roughly at white toilet block)	200	150	250
I	4530-4900 (370)	Jack Bayliss Pk (Marine Parade) from Terrace St node (white toilet block) to south east corner of Reg Dalton Oval via Shell St	200	100	200
J	4900-5100 (200)	south east corner of Reg Dalton Oval to bore pump shed on south boundary, Shell St	100	80	100
K	4900-5250 (350)	Reg Dalton Oval (south east corner) to Ned Byrne Field via Kingscliff St & Wommin Bay Rd into Walter Peate Res.	200	100	200
L	5250-5380 (130)	Ned Byrne Field to Cudgen Leagues Bowls	100	80	80
M	5250-5450 (200)	Ned Byrne Field to Walter Peate Reserve pavilion in centre of reserve	200	80	200
Golf Pipe Options 1& 2	0-700 (700)	Chlorine contact tank to proposed 6 ML dam in centre of golf course property	100	100	
Golf Pipe Option 3	1950-2500 (550)	Tweed Coast Rd (west side opposite existing STP driveway) to proposed 6 ML dam in centre of golf course property			100

Notes to Above Table:

1. If the existing 225 mm DICL pipe bridge is not required for future sewer, then utilise for recycled water main. Otherwise attach new DICL pipe (of diameter given in the above Table) to existing pylon bridge on opposite side of sewer main.

The existing pylon pipe bridge over the canal for the 225 mm DICL sewer main on the east side of the existing STP can be utilised for any proposed recycled water main. TSC are considering sewer upgrade options for the sewer mains and Kingscliff St and Turnock St pump stations, either as:

1. a new 300 mm rising main, with a new 300 mm DICL pipe over the canal into the existing STP site and then onto the future STP site; or
2. re-routing of the trunk sewer mains down to the upgraded Turnock St pump station and then onto the future STP site via road reserves in the possible Turnock St extension to Tweed Coast Rd.

The sewer main upgrade option "2" above might result in the existing 225 mm DICL sewer pipe section over the canal becoming available for use as a canal crossing for the proposed recycled water main. This would provided significant cost savings for TSC, compared with costs (of the order $25,000-50,000) of having to build a new canal crossing for the recycled water pipe into Kingscliff.

Various alternative recycled water pipe routes have been considered, including a route via the proposed Turnock St extension. Compared with the route via the existing STP site as described in Table 5-1, an alternative route via the proposed Turnock St extension does not have any real advantages in terms of pipe length, diameter, cost and environmental impact. The Turnock St extension would be through significant remnant wetland areas requiring detailed environmental and vegetation impact assessment and subsequent longer approval times. Given the Turnock St extension is still in early days of planning and impact assessment, there is some uncertainty as to whether it will proceed.

5.3 Hydraulic Modeling

Hydraulic modeling was undertaken using EPANet modeling software, to investigate options for the supply of recycled water to Kingscliff's foreshore areas, sporting ovals and other potential end users for Stage 1 of the recycled water supply scheme. The three short listed options 1, 2 and 3 are outlined below.

5.3.1 Option1 High Flow Supply, Separate Golf Course Pipeline

General assumptions for Option 1 modeling include the following:

(i) Roughness coefficient k = 0.6 mm;
(ii) Elevations at each recycled water site based on TSC contour mapping and listed in Table 5-2;
(iii) Peak flows from recycled water demands and times as listed in Table 4-1 (ie. 2nd last and 3rd last columns respectively), the daily recycled water profile shown in Figure 4-1 and summarised in section 4.4;
(iv) Minimum pressure of about 20 m head delivered to each recycled water site to enable direct irrigation, except for Chinderah Golf Course (see below);
(v) Chinderah Golf Course has been assumed to receive recycled water into the proposed 6 ML golf course dam, with assumed top water level (TWL) of 5 m;
(vi) Jack Bayliss Park foreshore areas carry out irrigation by subsoil methods only, whereas all other sites irrigated by surface methods (pop-up sprays).

The model was used to determine minimum diameters to achieve ~20 m head delivery pressures, and to size the pump to achieve this. Figure D1 and D2 in Appendix D show the minimum pipe diameters to deliver the required flows at peak demand for Option 1. The modeling suggests that the recycled water pumps at the relocated Kingscliff Treatment Plant would be required to deliver a peak flow of around 37.6 L/s (135 kL/hour) at about 45-50 m head.

5.3.2 Option 2 Low Flow Supply to Tanks, Separate Golf Course Pipe

General assumptions for Option 2 modeling include the following:

(i) Roughness coefficient k = 0.6 mm;
(ii) Elevations at each recycled water site based on TSC contour mapping and listed in Table 5-2;
(iii) Peak flows from 24 hour average daily recycled water demands to storage tanks, except for Jack Bayliss Park which is direct subsoil irrigation, as listed in last column in Table 4-1;
(iv) Minimum pressure of about 20 m head delivered direct to sub-soil irrigation at Jack Bayliss Park, and sufficient head (2-3 m) to fill recycled water storage tanks at other recycled water sites;
(v) Chinderah Golf Course has been assumed to receive recycled water into the proposed 6 ML golf course dam, with assumed top water level (TWL) of 5 m;
(vi) Jack Bayliss Park foreshore areas carry out irrigation by subsoil methods only, whereas all other sites irrigated by surface methods (pop-up sprays, etc).

The model was used to determine minimum diameters to achieve these delivery pressures, and to size the pump to achieve this. Figure D4 in Appendix D shows the minimum pipe diameters to deliver the required flows at peak demand for Option 2. The modeling suggests that the recycled water pumps at the relocated Kingscliff Treatment Plant would be required to deliver a peak flow of around 21.3 L/s (77 kL/hour) at about 50 m head.

For this option, all parks, reserves and private customers (except for Jack Bayliss Park and the golf course) would require storage tanks with capacities equivalent to peak daily demand. Walter Peate would require the largest storage of about 360 kL, whilst the Cudgen Leagues Club bowling greens site would need the smallest tank at 15 kL. Construction of the larger sized tanks is not considered feasible in public parks and foreshore reserves that are immediately adjacent to (ie. overlooked by) developed residential and tourist areas. Design and feasibility of the above onsite storage tanks are discussed in Section 7, and estimated storage tank capacities listed in Table 7-1.

5.3.3 Option 3 High Flow Supply, with Golf Course Pipe from Tweed Coast Rd

General assumptions for Option 3 modeling include the following:

(i) Roughness coefficient k = 0.6 mm;
(ii) Elevations at each recycled water site based on TSC contour mapping and listed in Table 5-2;
(iii) Peak flows from recycled water demands and times as listed in Table 4-1 (2nd last and 3rd last columns respectively), the daily recycled water profile shown in Figure 4-1 and summarised in section 4.4;
(iv) Minimum pressure of about 20 m head delivered to each recycled water site to enable direct irrigation, except for Chinderah Golf Course (see below);
(v) Chinderah Golf Course has been assumed to receive recycled water into the proposed 6 ML golf course dam from a connection from Tweed Coast Rd, with assumed top water level (TWL) of 5 m;
(vi) Jack Bayliss Park foreshore areas carry out irrigation by subsoil methods only, whereas all other sites irrigated by surface methods (pop-up sprays).

The model was used to determine minimum diameters to achieve these delivery pressures, and to size the pump to achieve this. Figure D5 in Appendix D shows the minimum pipe diameters to deliver the required flows at peak demand for Option 3. The modeling suggests that the recycled water pumps at the relocated Kingscliff Treatment Plant would be required to deliver a peak flow of about 37.6 L/s (135 kL/hour) at 45-50 m head.

The advantage of Option 3 is that it enables the golf course to be supplied with recycled water even before the Kingscliff STP is relocated. The golf course could be supplied via a connection from the existing 225 mm PVC recycled water main (originally for supply to the Ti tree Farm) from where it comes out of the current Kingscliff STP driveway and crosses over to the west side of Tweed Coast Rd. When the STP is relocated it would be simple matter of reconnecting the golf course to the new recycled water main to Kingscliff at Tweed Coast Rd. The only disadvantage is the higher flows, pipe pressures and larger diameters required to also supply the golf course demand from a common recycled water main, resulting in larger diameter pipelines and pump heads.

5.4 Comparison of Supply Pipeline Options

Modeling of the 3 options above suggests that the recycled water pumps at the relocated Kingscliff Treatment Plant would be required to deliver a peak flow of:

(i) Option 1: 37.6 L/s (135 kL/hour) at about 45-50 m head;

(ii) Option 2: 21.3 l/s (76.7 kL/hour) at about 50 m head

(iii) Option 3: 37.6 l/s (135 kL/hour) at about 45-50 m head.

The modeled delivery pressures and peak demands for each user are summarised in Table 5-2 below:

Table 5-2: Recycled Water System delivery pressures

Recycled Water Site	Modeled elevation (m)	Peak Demand (L/s)		Delivery Pressures (m)		
		Options 1 & 3	Option 2	Option 1	Option 2	Option 3
Jack Bayliss Park - South	5	0.7	*0.5*	33	34	28
Jack Bayliss Park - North	5	3.5	*2.3*	25	31	25
Kingscliff Bowls Club	5	*0.9*	*0.3*	33	34	28
Reg Dalton Oval	3	*8.7*	*1.4*	19	28	20
Walter Peate Reserve	5	*25.0*	*4.2*	19	22	19
Ned Byrne field	5	*2.5*	*0.8*	19	24	19
Cudgen Leagues Bowls	5	*0.5*	*0.2*	19	24	19
Chinderah Golf Course (Dam)	5 see note 1	13.9	*11.6*	3.4	3.1	7.8
TOTAL see note 2		***37.6***	***21.3***			

Notes to above table:
1. Chinderah Golf Course Dam bank height estimated as 5m
2. Total Peak Demands for different options based on sum of cells in columns with numbers in *italics* and having same highlighted cell colors

High Pressure Options 1 and 3 are for comparison with Option 2 involving Lower Pressure and Lower Flow supply to Onsite Storage Tanks (or shared tanks) at individual customer sites, to determine likely pipe size reduction and reduced pumping requirements, and therefore cost impacts to be discussed in Section 8. Note that supply to individual storage tanks at each irrigation site, a separate irrigation pump system will be needed, the costs of which may be offset the costs of larger recycled water supply pipework and pumpstation capacity associated with the high pressure system.

6. Recycled Water Pumping Options

6.1 Pump Station Location

GHD is currently carrying out the detailed design for the relocated Kingscliff STP. At the time of writing this report, GHD's preliminary detailed design drawings indicate a pump tank after the chlorine contact tank ("CCT"). This pump tank is on capacity around 40 m^3 containing space for "Future Pumps" in the north end of the tank about 200-250 m from the northern boundary of the future STP site (refer to Figure E1 in Appendix E).

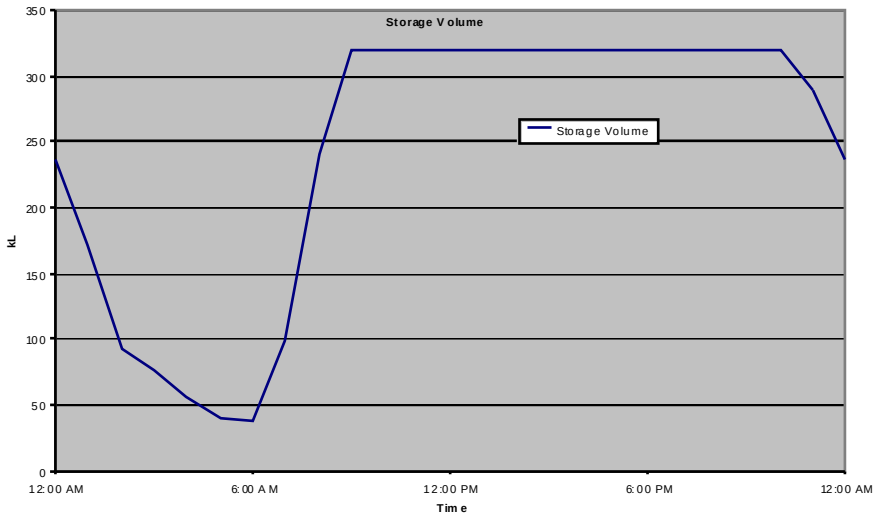
6.2 Potential Drawdown of the Chlorine Contact Tank

GHD's preliminary design indicates the capacity of the CCT is about 378 m^3, and taking flows ranging between 13 L/s (derived as 0.3 x ADWF at start-up for 15,000 EP) and up to 350 L/s. The effluent outfall pumps (discharging to the Tweed River) are located in a downstream tank hydraulically linked to the CCT. These VFD-controlled pumps are predicted by GHD to also draw the CCT down by 0.5 m max. GHD have also highlighted an issue that the reclaimed water service pumps for STP uses could potentially use more than the 13 L/s minimum sewage inflow but on their own are unlikely to cause CCT drawdown (pers. comm. Kevin Bourne GHD, Mar 05). The concern is the possible excessive CCT drawdown from the simultaneous operation of the Kingscliff Recycled Water pump station, STP reclaimed water service pumps and outfall pump station.

6.3 Recycled Water Buffer Storage Volume

Modeling of the expected recycled water demands (see Figure 4-1) compared with STP inflows (ie. when relocated), suggests that a buffer storage of about 320 m^3 (separate from the CCT) might be needed to prevent excessive drawdown in the chlorine contact tank for Options 1 and 3 – see Figure 6-1 below. A concrete tank of this capacity (with dimensions ~5 m x 20 m x 3.2 m deep) could be built in the spare area north of the CCT.

Figure 6-1 Estimated Recycled Water Buffer Storage Volume needed at Kingscliff STP – Options 1 and 3



6.4 Pump Station

6.4.1 Combined or Separate Pump Station Options

The recycled water pumps for the Kingscliff Stage 1 recycled water scheme contained in this buffer storage basin could be arranged either as:

(a) Combined pump station capable of pumping to both the Golf Course pipeline as well as the recycled water to Kingscliff public and private parks and reserves; or

(b) Separate pump stations to deliver recycled water to the Chinderah Golf Course proposed 6 ML dam, and to the trunk main to deliver recycled water to Kingscliff public and private parks and reserves.

A combined pump station will need to be capable of delivering up to 37.6l/s at around 50m for options 1 and 3, and up to 21.3 L/s at ~50 m head for option 2. Any separate golf course pump station needs to supply 13.9 L/s at about 45 m head to the start of the golf course pipeline. If the golf course supply is separated from the Kingscliff Scheme main supply, then the pump set for the main supply will need to deliver a wider range of flows from peak of 37.6 L/s down to zero flow (4 hours/day). With the larger range of flows, a separate pump station arrangement would be less efficient as running a combined pump station.

The recycled water pumps could be placed on a slab at the level of the fill (RL 3 m) as per the GHD preliminary design for the STP reclaimed water pumps. Alternatively, the pumps could be placed in a pump pit (2 m deep) excavated in the fill material adjacent to the buffer storage connected by a 300 mm DICL conduit to ensure that the pump suction line remains primed at all times. The pump pit would be provided with an isolation valve for easier pump access and maintenance purposes, and without having to isolate the buffer storage. End-suction pumps would be more efficient (~80%) for this arrangement compared with submersible pumps (~50-60%). Pump station options are further outlined below.

6.4.2 Pump Station for Options 1 and 3

Combined pump station: For options 1 and 3, the required pumps could be either:

(i) 1 x ~40 kW pump (eg. end-suction variable speed drive) running 24hrs/day delivering flows on demand ranging from lows of ~14 L/s up to peak demands of ~40 L/s; or

(ii) 2 x ~20 kW pump (eg. end-suction, VSD), with 1 pump running for 24 hours/day at flows ranging 14-20 L/s, and the 2nd pump running for 4 hrs/day at peak times at ~20 L/s.

Separate Pump Station: Instead of a combined pump station, separate pump sets could be provided to deliver separate flows to the Golf Course pipe and the Kingscliff mains as follows:

(i) Golf course supply: 1 x ~15 kW end-suction single speed pump running up to 20-24 hrs/day at 11.6-13.9 L/s and 35-45 m head delivering into the separate 100 mm pipe to the golf course dam. Note that if the golf course pipe is increased in size to 150 mm PVC (40% more expensive pipe supply cost), then the head reduces to 10-15 m for 11.6-13.9 L/s flows; and

(ii) Kingscliff main supply: same 1-pump or 2-pump arrangement as described in section 6.4.2, given the need to supply peaks flows of up to ~40 L/s. However, a smaller pump could be installed for the low flow period (3 am to 11 pm) to deliver flows of 4.2-8.1 L/s at up to 25 m head. The 2nd pump would need to kick in for high peak flows (11 pm to 3 am) capable of handling up to ~30 L/s at 45-50 m head.

6.4.3 Pump Station for Option 2

The required pumps for option 2 depend on combined or separate pump sets as follows:

(i) Combined Pump Station: 1 x ~20 kW pump (eg. end-suction variable speed drive) running 24hrs/day delivering flows on demand up to ~21.3 L/s and 50 m head;

(ii) Separate Pump Station:

- Golf course supply: 1 x ~15 kW end-suction single speed pump running up to 24 hrs/day at 11.6 L/s at 45 m head into the separate pipe to the golf course dam;
- Kingscliff Main supply: 1 x 15 kW end-suction single speed pump running up to 24 hrs/day at ~10 L/s at 50 m head.

The above pump arrangements for Options 2 could also include a standby pump to provide a level of redundancy, but to save on costs one pump may be sufficient provided that TSC or its contractors can provide an adequate response time in the event of pump failure.

The combined pump station arrangements for options 1, 2 and 3 will have some cost advantages associated with one less pump and associated electrical and civil works, and lower power consumption associated with higher pumping efficiency. However use of variable speed pumps does increase operational and maintenance complexity and potentially costs. If a completely separate golf course pump arrangement is preferred by TSC, the additional capital (and operating costs) could be allocated to the golf course. Refer to cost assessment in section 8.

7. Storage Options at Recycled Water Sites

7.1 Storage Tank Capacities

For the lower flow Option 2, all parks (except for Jack Bayliss Park foreshore reserve which would have direct subsoil irrigation) would need storage tanks of capacities equivalent to the peak daily demand. See Table 7-1 for expected recycled water storage tank capacities.

Table 7-1 Recycled Water Site Storage Tanks and Approximate Capacities for Option 2

Recycled water site:	Storage Capacity	Possible Storage Tank Type
Reg Dalton Oval	125 kL	1 x 125 kl steel
Walter Peate Reserve	360 kL	1 x360 kl steel, or 3 x 125 kl
Ned Byrne Field	70 kL	1 x 85 kl steel, or 1 x 70 kl steel & 1 x 15 kl plastic
Cudgen Leagues Club Bowls	15 kL	
Kingscliff Bowls Club	25 kL	1 x 25 kl plastic
Chinderah Golf Course (dam)	6 ML	6 Ml dam (proposed by golf course)

Notes to above table:
1. Possible Steel Tank suppliers include APT, Pioneer and Southern Cross
2. Plastic Tank Suppliers include Nylex

7.2 Storage Tank Siting and Construction Issues

An assessment of possible tank types (plastic, steel, concrete), dimensions, heights (above ground and below ground considerations), and required storage tank compound footprints has been undertaken for each recycled water site.

7.2.1 Above Ground Tanks

The larger tanks at Walter Peate and Reg Dalton require large footprints permanently occupied within the public reserves, which could create an eyesore and subsequent community objections. Walter Peate Reserve has the largest storage tank requirement which could require a 15 x 15 m (225m^2) compound and up to 3 m high for a single tank. Reg Dalton's 125 kl tank would require a 12 x 12 m compound (2.2 m high). A 70 kL tank at Ned Byrne Field would need a 10 x 10 m compound (2.2 m high). Refer to Appendix F, Figures F1 to F10 for sketches of possible compound arrangements for above ground tanks at relevant recycled water sites, and expected footprints (shown on aerial photographs).

There are numerous potential social impacts and construction limitations associated with the siting of above ground tanks in Kingscliff's public reserves – see Table 7-2. The permanent occupation of public land with large and unsightly tanks may result in strong objections from local residents, park users and community groups – particularly for the larger tanks needed for Walter Peate and Reg Dalton reserves.

The 70kl tank for Ned Byrne Field might be feasible by being sited adjacent to the existing toilet block or Cudgen Leagues Grandstand, but may still be highly visible and likely to cause public objections. Cudgen

Leagues Club bowling club and Kingscliff Bowls Club above ground tanks are the smallest and are therefore considered feasible to construct.

Table 7-2 Above Ground Recycled Water Storage Tank Costs and Construction Issues

Recycled Water site:	Indicative Cost (supply & installation)	Construction Issues/Limitations
Reg Dalton (~125 kl)	$43K	Tall tank, large compound on public land, difficult to hide from view, unsightly, community objections
Walter Peate (~360 kl)	$85K	Tall tank, large compound on public land, difficult to hide from view, unsightly, community objections
Ned Byrne Field (~70 kl)	$35K	Build abutting existing brick toilet block or near grandstand, may still be unsightly, objections
Cudgen Leagues Club Bowls (~15 kl)	$5K	Relatively small, easily hidden near grandstand
Kingscliff Bowls Club (~25 kl)	$6K	Relatively small, easily hidden near clubhouse
Chinderah Golf Course 6ML (dam)		Golf course management proposing new dam to be built in middle of course

As already mentioned in Section 4.3.1, the construction of above ground tanks along the Kingscliff Foreshore (Jack Bayliss Park, "JBP") is not considered feasible due to anticipated very strong opposition from local residents, developers and community groups. The installation of subsoil irrigation at JBP absolves the need for any storage tanks.

The approximate costs of above ground storage tanks were shown in Table 7-2. Note that the costs of tanks for Ned Byrne Field, Cudgen Leagues Bowls and Kingscliff Bowls Club could be allocated to these private customers – ie. total allocated cost of about $46,000. The cost of the Chinderah Golf Course dam would also be borne by the golf course owners. Tank costs are discussed further in Section 8.

7.2.2 Underground Storage Tanks

As an alternative to above ground tanks, underground concrete tanks were considered for each recycled water site, to avoid the above mentioned community objections. Whilst underground tanks would present lower social impacts and issues with aesthetics and occupation of public land, there are additional construction issues and costs as listed in Table 7-3. The parks that could have the greatest public objection to above ground tanks and therefore need underground tanks would be Walter Peate Reserve, Reg Dalton Oval and Ned Byrne Field.

Comparing Table 7-2 with Table 7-3, the cost of underground tanks is roughly double the construction cost of above ground tanks. This is due to the combination of all the additional construction requirements listed in the last column of Table 7-3, and as itemised in the cost spreadsheets in Appendix G.

Total additional cost of constructing underground concrete tanks (3m deep) at Walter Peate Reserve, Reg Dalton Oval and Ned Byrne Field would be of the order $150,000. Note that the costs of underground tank for Ned Byrne Field and above ground tanks for Cudgen Leagues Bowls and Kingscliff Bowls Club could be allocated to these private customers – ie. total allocated cost of about $60,000. Therefore total additional cost of underground storage tanks for TSC parks and reserves reduces to about $90,000.

Table 7-3 Underground Recycled Water Storage Tank Costs and Construction Issues

Recycled Water site:	Indicative Cost (supply & installation)	Construction Issues/Limitations
Reg Dalton (~125 kl)	$75K	• 3m deep tanks assumed • More extensive excavations • dewatering of excavations to deal with high watertables • protection of concrete and associated below groundworks from saline groundwater and acid sulphate soils • water proofing of tanks to prevent saline groundwater infiltration • higher geotechnical and structural concrete costs • offsite soil cartage and disposal.
Walter Peate (~360 kl)	$185K	
Ned Byrne Field (~70 kl)	$55K	

Costs of underground storage tanks are discussed further in Section 8.

7.2.3 Storage Dams

Construction of small storage dams were not considered feasible at public parks and reserves again due to costly construction, lining and groundwater issues, public safety, public land occupation and likely opposition. However, Chinderah Golf Course is proposing a new 6 ML dam (at their own cost) within their own private land and at their own cost, which could be safely used for recycled water storage.

8. Cost Assessment

8.1 Capital Costs

Preliminary estimates of capital costs for Options 1, 2 and 3 are summarised in Table 8-1 based on the concept design outlined in this report. Estimated cost rates for various works items including pipeline and pump station supply and installation, irrigation system infrastructure, recycled water storage tanks (above and below ground) , etc are provided in Appendix G. These cost estimates are based on recent MWH design projects, budget rates from pipe, pump and tank suppliers, local (NSW and South East Queensland) contractors and TSC.

Given the preliminary nature of this report a cost range (Best, Medium, Worst Case) has been provided. The main cost sensitivities are associated with variability in pipeline supply and installation costs. Given that survey and geotechnical investigations for pipeline alignments and storage tank locations have not yet been undertaken, there are cost uncertainties at this concept stage of this project. Pipeline supply costs also vary significantly in response to global markets, pipe supplier activity and also in-situ conditions such as the presence of high watertables along the proposed pipe alignment.

There is also some uncertainty as to value of various larger cost items at the proposed STP given the preliminary detailed designs of the site layout such as the recycled water pump station, recycled water buffer storage; and recycled water pipeline through the STP site. Note that double counting could occur for some cost items that may already be included in budget forecasts for the Kingscliff STP relocation project (eg. pump station costs). However, this report has endeavored to identify these to ensure double counting is minimal.

Table 8-1 summarises the various options investigated, cost estimates and other factors considered in the options determination. The estimated capital costs of Kingscliff Recycled Water Supply Scheme Stage 1 Options 1 to 3 are taken from the cost breakdowns given in Appendix G. From Table 8-1, Total Gross capital cost estimates for the Kingscliff Recycled Water Scheme Stage 1 for Options 1, 2 and 3 are as follows:

- **Option 1** High Flow Direct to Irrigation, Separate Golf Course Pipeline from new STP: $2.2 Million
- **Option 2** Low Flow Onsite Storage Tanks, separate golf course pipe from STP: $1.7 Million
- **Option 3**High Flow Direct to Irrigation, Golf Course Pipeline from Tweed Coast Rd: $2.3 Million.

Options 1 and 3 (higher flow, direct irrigation) have highest costs, due to the larger pipelines, pumping and buffer storage costs. Option 3 has an advantage of enabling the golf course to connect to recycled water supply using existing Ti-Tree recycled water pipeline before the STP is relocated. If this early golf course connection is not possible, then Option 1 (ie. with a separate golf course pipeline) would be suggested.

Cost of the lower flow (storage tank) Option 2 is around $0.5-0.6 Million less than Options 1 and 3, given the smaller pipe sizes. However, there are higher recycled water sites costs due to need for storage tanks, irrigation pumps and system controls, and also major doubts as to the feasibility and public acceptance of siting large above ground storage tanks in public parks and reserves.

Table 8-1 Kingscliff Recycled Water Scheme Stage 1, Comparison of Options and Costs

Description	Option 1 High Flow Supply to Direct Irrigation, Separate Pipe to Chinderah Golf Course Dam	Option 2 Low Flow Supply to Storage Tanks, Separate Pipe to Chinderah Golf Course Dam	Option 3 High Flow Supply to Direct Irrigation, Pipe to Chinderah Golf Course Dam from Tweed Coast Rd
Recycled Water sites served	• Jack Bayliss Park (new subsoil irrigation) • Kingscliff Bowling Club (surface irrigation) • Reg Dalton Oval (existing surface irrigation for cricket field, new surface irrig. for hockey field) • Walter Peate Rec Res. (existing surface irrig.) • Ned Byrne Field (existing surface irrig.) • Cudgen Leagues Club Bowling Greens (existing surface irrig.) • Chinderah Golf Course (supply to 6Ml dam)	• Jack Bayliss Park (new subsoil irrigation) • Kingscliff Bowling Club (15 kL tank) • Reg Dalton Oval (125 kL tank) • Walter Peate Rec Res. (360 kL tank) • Ned Byrne Field (70ml tank) • Cudgen Leagues Club (Bowling Greens) (15 kL tank)) • Chinderah Golf Course (supply to 6Ml dam)	• Jack Bayliss Park (new subsoil irrigation) • Kingscliff Bowling Club (surface irrigation) • Reg Dalton Oval (existing surface irrigation for cricket field, new surface irrig. for hockey field) • Walter Peate Rec Res. (existing surface irrig.) • Ned Byrne Field (existing surface irrig.) • Cudgen Leagues Club Bowling Greens (existing surface irrig.) • Chinderah Golf Course (supply to 6Ml dam)
Minimum Supply Pressure	20m to Direct Irrigation Sites 3m to Golf Course Dam	20m to Jack Bayliss Park direct subsoil irrig. 3m to tanks	20m to Direct Irrigation Sites 3m to Golf Course Dam
Volume of Water Used	178 ML/Yr, 1.835 ML/Day	178 ML/Yr, 1.835 ML/Day	178 ML/Yr, 1.835 ML/Day
Peak Daily Flow Range and times	Low: 13.9 l/s 11am to 3pm Peak: 37.6 l/s 11pm to 3am	Peak: 21.3 l/s (24hr pumping to storages)	Low: 13.9 l/s 11am to 3pm Peak: 37.6 l/s 11pm to 3am
Pump Station Costs	$0.31 M	$0.14 M	$0.31 M
Pipeline Costs	$1.39 M	$0.94 M	$1.44 M
Irrigation Infrastructure, Tank Costs	$0.11 M	$0.31 M	$0.11 M
Design, Contract Admin, other	$0.41 M	$0.35 M	$0.42 M
Total Gross Costs Capital Costs	**$2.2 Million (Range $1.6M - $2.9 M)**	**$1.7 Million (Range $1.1M - $2.4 M)**	**$2.3 Million (Range $1.7M - $3.0 M)**
Potential Savings	**$0.28 M**	**$0.19 M**	**$0.28 M**
Total Revised Costs with Savings	**$1.9 Million**	**$1.6 Million**	**$2.0 Million**
Total additional cost for Option2 underground storage tanks		**$0.15 M**	
Total Operating Costs	~$25,000/Yr	~$21,000/Yr	~$25,000/Yr
NPV (25Yr, 8%)	$2.1 Million	$1.9 Million	$2.3 Million

Note that there are potential cost savings for various major works items (see Appendix G) including:

- Sharing trenches for recycled water with potable, sewer and/or effluent pipes (potential savings of about $160,000 for Options 1 and 3, and $65,000 for Option 2);
- Utilisation of the existing pipe bridge over the canal east of the existing STP (~$50,000 for Options 1 and 3, ~$25,000 for Option 2);
- Allocating some of the capital cost of the golf course pipeline and pump station to Chinderah Golf Course (potential savings of about $90,000 for Options 1 and 2, and about $70,000 for Option 3);
- Allocating the costs of recycled water storage tanks at private customer sites to the customer (~$46,000 for above ground, ~$60,00 for underground tanks);
- Utilising common prefab concrete walls for the Buffer Storage Tank and Chlorine Contact Tank (potential savings of $30,000 for Options 1 and 3. Note that no buffer storage is required for lower flow Option 2).

Based on the above (see also Appendix G) total potential savings for each option would be roughly as follows:

- **Option 1** $330,000
- **Option 2** $225,000
- **Option 3** $315,000

Taking into account total potential savings, the preliminary capital cost estimates for Options 1, 2 and 3 for Kingscliff Recycled Water Scheme Stage 1 reduce to the following:

- **Option 1** High Flow Direct to Irrigation, Separate Golf Course Pipeline from new STP: $1.9 Million
- **Option 2** Low Flow Onsite Storage Tanks, separate golf course pipe from STP: $1.5 Million
- **Option 3** High Flow Direct to Irrigation, Golf Course Pipeline from Tweed Coast Rd: $2.0 Million.

If underground storage tanks were provided for Option 2, ie. for Ned Byrne Field (assuming tank is paid for by Cudgen Leagues Club), Walter Peate and Reg Dalton (paid for by TSC), then Option 2 costs would increase to about $1.6 Million.

Despite Option 2 being the cheapest, direct irrigation supply Options 1 or 3 are considered more practicable and lower risk given:

- simplicity of operation and maintenance and reliability with direct irrigation for Options 1 and 3;
- minimal "footprint" for recycled water storage and irrigation pump system works at individual irrigation sites for Options 1 and 3;
- higher risk (ie. "more could go wrong with Option 2") and likely community objections and delays in project implementation associated with installing large recycled water storage tanks (either below or above ground) in public parks and reserves for Option 2.

Note that the relatively high cost of Stage 1 could be spread over a number of financial years. The financial viability of the scheme depends on connecting large volume recycled water users such as the Chinderah Golf Course, Walter Peate, Reg Dalton and Cudgen Leagues (Ned Byrne Field and Bowls) Club. As was discussed in Section 3.5 a "Stage Zero" could commence to kick start the scheme, by supplying Chinderah Golf Course with recycled water (30-40ML/Yr initial demand), which is possible even before the Kingscliff STP is relocated. This "Stage Zero" would be at minimal cost to TSC if the golf course were made to pay for the pipeline and temporary pump station at the existing STP (~$100,000 total). The golf course management has already indicated that they propose to build a new 6 ML dam on the course at their own expense.

8.2 Operating Costs

Preliminary operating cost estimates for the recommended Options 1, 2, 3 are summarised in Table 8-2 (see also Appendix G). The preliminary operating cost estimates listed in Table 8-2 include: Operating and Maintenance (O&M), Labour, Equipment replacement, Power costs for infrastructure including pipelines, main pump station, irrigation site storage tanks and irrigation systems, and associated equipment.

Table 8-2 Estimated Operating Costs for Kingscliff Recycled Water Scheme Stage 1

Kingscliff Recycled Water Scheme Stage 1 O&M Costs for Options 1 & 3			
Equipment	Operating Costs $/Yr		Comments
Pump station			
Power Costs			
	$	8,784	TSC would get a more competitive (bulk) power tariff than that assumed here, therefore power costs could be lower (by ~25%)
Labour O&M	$	5,000	2 major servicing visits per year, 35 regular checks during the year
Equipment replacement	$	6,000	2% of capital for PS civil, mechanical and Electrical works
Pipeline			
O& M	$	3,500	0.25% of capital for pipeline, valve and fittings
TSC Storage Tanks			
O&M	$	-	1 visit/yr per tank prior to irrigation season
Irrigation @ TSC Sites			~15% of Irrig. Equipment + ~7% of Irrigation Pump System
O&M	$	1,500	(~5% pump operating power + 2% pump maintenance/repair)
	$	**25,000**	

Kingscliff Recycled Water Scheme Stage 1 O&M Costs for Option 2			
Equipment	Operating Costs $/Yr		Comments
Pump station			
Power Costs			
	$	7,776	TSC would get a more competitive (bulk) power tariff than that assumed here, therefore power costs could be lower (by ~25%)
Labour O&M	$	5,000	2 major servicing visits per year, 35 regular checks during the year
Equipment replacement	$	2,800	2% of capital for PS civil, mechanical and Electrical works
Pipeline			
O& M	$	2,250	0.25% of capital for pipeline, valve and fittings
TSC Storage Tanks			
O&M	$	625	1 visit/yr per tank prior to irrigation season
Irrigation @ TSC Sites			~15% of Irrig. Equipment + ~7% of Irrigation Pump System
O&M	$	3,600	(~5% pump operating power + 2% pump maintenance/repair)
	$	**22,000**	

Notes to above table:

- Irrigation system operation and maintenance costs at TSC parks and reserves should not be significantly more than existing parks and gardens annual budgets.
- Above O&M costs do not include TSC's administration costs and corporate overhead for managing, monitoring, staffing and auditing the recycled water scheme,
- Above does not account for possible income from TSC recycled water charges on private customers (eg. range $0-300/ML),
- income or losses for TSC from substitution of current potable water uses (~70-80ML/Yr) with recycled water.

The overall operating cost for Options 1 and 3 are about the same at about $24,000/year, and about $21,000/Yr for option 2. For about 180 ML/yr supplied to the new customers for Stage 1 by Options 1 and 3, and factoring in ~$2 Million capital cost and NPV of ~$2.2 Million (25 year @ 8% discount rate), the cost of supplying recycled water would be of the order $500/ML.

On the Eastern seaboard of Australia, recycled water charges range between $0/ML and 300/ML. Charges for recycled water are typically about one-fifth the cost of potable water. By comparison, cost of Kingscliff's potable water supply is expected to increase in the short term to 80 cents/kl (or $800/ML). Therefore, for Options 1 and 3 the estimated cost of supplying recycled water to Kingscliff parks and reserves could be just over 60% the current cost of supplying potable water.

Any income from recycled water sales to private customers (110ML/yr to the golf course, Kingscliff Bowls Club and Cudgen Leagues Club) would at best be around $30,000/year (for ~$300/ML), but more likely less than $15,000/year. TSC have in recent times not charged for the recycled water.

Based on the gross operating costs and NPV estimates in Table 8-2, it may be possible to recover about 50% of the cost of recycled water supply by charging about $250/ML for the recycled water. This would. exclude TSC administration costs and overhead for managing, monitoring, staffing and auditing the recycled water scheme, and other externalities mentioned in the notes to Table 8-2).

The above cost estimates will need to be subject to more detailed financial modeling, once the recycled water demands, design and costs of the recycled water supply infrastructure (pipelines, pump stations, storage, etc) are better understood and in particular the design of the new treatment plant and sewer pipeline relocations are finalised. In addition, this financial model will need to take into account the impact of:

- TSC's recycled water charges to privates customers,
- income or losses for TSC from substitution of current potable water uses with recycled water, and
- the impact of numerous other externalities expected for any new recycled water infrastructure.

Excluding possible income from private customers (Chinderah Golf Course, Cudgen Leagues Club, Kingscliff Bowls Club – potential total of about $15,000-20,000/yr at $150-200/Ml), and depending on the effect of the above externalities, the costs of supplying the recycled water is expected to be less than $400-500/Ml.

8.3 Caution on Use of Capital and OperatingCost Estimates

The costs quoted in this section and elsewhere in this report are indicative costs estimated for the purposes of comparing scheme options based on concept designs outlined in this report. They are sufficiently accurate for these stated purposes, however depending on the order of accuracy required and amount of contingency to be included functional design or detailed design is required if cost estimates are to be used for accurate budgeting purposes.

9. Implementation Strategy

9.1 Further Investigations

More detailed assessment for Kingscliff Recycled Water Scheme Stage 1 is required of the following:

1. Recycled water demands for all Stage 1 customers. Water audits of irrigation uses during next dry period to verify required watering rates at all potential sites and resultant pipe and pumping capacities.
2. As the Kingscliff West area is being rapidly developed, any proposed recycled water pipeline routes and possible storage tank locations should be inspected by a TSC approved contractor who is familiar with the area, to identify and report on any serious barriers to construction including existence of utilities and services, existence of acid sulphate soils, high watertables, etc.
3. At the same time as item 2 above, the proposed pipeline alignments will need to be walked by qualified environmental and archaeological/heritage specialists (also familiar with the area) to assess and report on the potential impacts of any pipeline on native or historically important flora and fauna, aboriginal sites and other sites of potential archaeological significance.
4. Carry out water balance, nutrient and salt loading calculations for all proposed parks and reserves based on DEC's recently released *Environmental Guidelines Use of Effluent by Irrigation (Oct 2004)*, including the "Effluent Reuse Irrigation Model" (ERIN) outlined in the guidelines. Alternative irrigation water balance models should be considered including "Model for Effluent Disposal Using Land Irrigation (MEDLI) or other models that may be approved by NSW DEC. Any water balance modeling should be undertaken to determine the range of application rates throughout the year including winter, as well as long-term sustainable irrigation rates taking into account soil and groundwater factors and vegetation impacts.
5. To complement the further modeling of effluent irrigation on the foreshore, drilling of a series of groundwater bores into the upper aquifer is recommended to enable assessment of potential impacts of irrigation on the groundwater, risk of watertable rise and consequent impacts on foreshore vegetation. About four new investigation bores along the foreshore are recommended.
6. Recycled water pumping system requirements should be verified based on review of irrigation water demands, pipeline routes and capacities from the investigations 1 to 5 above.
7. Further assessment of the need for a buffer storage downstream of the proposed chlorine contact tank (CCT) at the new STP, to prevent excessive drawdown of the CCT is required.
8. Further assessment of potential Stage 1 pipeline/pump station upsizing requirements to cater for possible additional customers to the west and south of the Stage 1 area in required.
9. Other more detailed engineering, planning, environmental, vegetation, social and economic impact assessments to enable the project to proceed to the more design and implementation phase.

Completion of the above further investigations should be as part of a consultation and functional design phase prior to approval, detailed design and tendering phases.

9.2 Approvals Phase

The two primary approvals processes for the Kingscliff Recycled Water Scheme are through TSC as the planning authority for Development Consents and EPA (now incorporated into DEC) for possible Environment Protection Licences. Note that TSC is the relevant regulatory authority for the use of effluent at the private customer sites – unless EPA considers a licence is necessary. Given TSC is the owner and operator of the public parks and foreshore reserves, then EPA would become the appropriate regulatory authority to assess and approve effluent reuse.

9.2.1 TSC

TSC is the responsible authority for Development consents for the recycled water scheme infrastructure including:

- Pipelines including road reserves and crossings as well as canal crossings;
- Pump station
- any Storage tanks, dams, irrigation pump stations and other significant infrastructure on parks, reserves and private customers sites;
- removal/disturbance and restoration of important vegetation and archaeological artifacts associated with construction works;
- buffer storage and other changes to the works and layout at the proposed new Kingscliff STP.

Further details of subsequent investigation and design phases is given in Appendix H.

9.2.2 DEC (incorporating EPA)

DEC's recently released *Environmental Guidelines Use of Effluent by Irrigation (Oct 2004)* provides an outline of the possible approval requirements for effluent irrigation schemes that are not on the STP site. Unless specifically required to be licensed under the *Protection of the Environment Operations Act 1997* (POEO Act), as environment protection licence is not likely to be required for effluent irrigation schemes operating in accordance with the DEC guideline.

Effluent irrigation is not specifically listed in the Schedule 1 of the POEO Act, therefore it does not generally have to be licensed. If the recycled water is used or stored on a site not directly associated with the STP, then the recycled water scheme proposal needs to be characterised to determine if it is allowed and whether development consent is required under the Local Environment Plan (LEP).

TSC is the appropriate local regulatory authority for the use of effluent at any of the private customers, whilst the EPA is the regulatory authority for use on TSC owned and operated parks and reserves.

Prior to any detailed design and environmental investigations, it is recommended that the proposal be discussed at these early planning stages with relevant authorities including:

- DEC incorporating NSW EPA;
- DIPNR;
- NSW Health
- Workcover NSW.

In addition to the above authorities, pre-consultation should be undertaken with potential private customers as identified in this Concept Design including:

- Chinderah Golf Course management (Jeff Holloway, Golf Operations Manager)
- Kingscliff Bowls Club
- Cudgen Leagues Club (Rugby and Bowls Clubs).

Pre-consultation with the local Kingscliff community including residents adjacent to the potential recycled water use sites and park users is required as part of the application processes to the relevant authorities. Early pre-consultation is fundamental to demonstrating the social and environmental benefits of recycled water use and potable water substitution and obtaining public support for this recycled water scheme.

9.3 Design and Tendering

Options for the detailed design and tendering phases include:

(a) Pipeline, pump station: (i) Functional Design then Detailed Design and Tendering, or
(ii) Functional Design then Design and Construct contract documentation and tendering;

(b) New irrigation systems or upgrades:
Functional Design then Design and Construct contract documentation and tendering

9.4 Construction Program

Estimated time to complete design for Stage 1 is about 3-6 months.

EPA and TSC Planning approvals are likely to take at least 3 months.

Tendering typically takes 2-3 months, including evaluation and contract award.

Construction should take at least 6 months.

Therefore, TSC should allow at least 12-15 months for the planning, approval, detailed design and construction and commissioning phases to be completed. Allowance for an 18 month program for Stage 1 is recommended.

Note that the time taken to complete the above design and approvals program for a Stage Zero Scheme to Chinderah Golf Course is likely to be less than 12 months given simplicity of design and construction.

9.5 Operation and Maintenance

9.5.1 Recycled Water Supply Infrastructure

The Kingscliff Recycled Water main supply pipeline and pumps will require dedicated staff to its operation and maintenance. These could be existing STP plant operators, but our experience is that new specifically trained

and dedicated recycled water supply staff are required to properly manage (eg. schedule flow demands) and maintain the recycled water scheme and all the potential customers drawing from the system.

The Chinderah Golf Course Pipeline would be managed by the golf course operator. The pump station for the golf course supply should be managed by TSC STP plant operators for an annual contract fee.

9.5.2 Recycled Water Site Practices

For all sites proposing to utilise recycled water for irrigation, there will need to be changes to watering practices and public access restrictions. This applies to all of Kingscliff's public parks and reserves as well as for private Customers sites such as the Chinderah Golf Course, Kingscliff Bowling Club, and the Cudgen Leagues Club. To avoid exposure of humans to the recycled water, a range of site controls and best practice measures will need to be implemented in accordance with Department of Environment and Conservation (NSW) *Environmental Guidelines Use of Effluent by Irrigation* (DEC, October 2004).

New site practices and works should include:

- night-time watering (irrigation during times of no public access, and timed to finish 4 hours before public access to the site);
- possible sub-surface irrigation (eg. on the Kingscliff foreshore) to avoid public exposure and thereby allowing watering at any time;
- signs stating for example: "*Warning, Recycled Water in Use – Do Not Drink & Avoid Exposure to Irrigation Sprays*";
- adequate setbacks to site boundaries and waterways from irrigation areas;
- new fencing to exclude cars from irrigated areas (eg. Jack Julius and Parker Rotary Reserves);
- soil and groundwater monitoring to check for impacts on soils and seepage to groundwater;
- new OH&S working practices for TSC parks and reserves operators and contractors;
- Color coding of pipe mains and irrigation, laterals, above ground taps, tanks, pumps, pumpsheds, etc

Monitoring of the following will also be needed to check customer performance and impacts of recycled water use:

- Recycled water quality from the STP and within the pipeline: by TSC STP operators;
- Soil conditions at each recycled water site (fertility, salinity, sodicity, acidity, etc);
- Watertables and Groundwater quality in areas of high unconfined aquifers (applicable to most of Kingscliff's recycled water sites); and

vegetation impacts – particularly on Kingscliff's foreshore.

All of the above best management practices and new works should be documented in an environmental/site management plan addressing all of the DEC guideline requirements.

10. Conclusions and Recommendations

10.1 Conclusions

This report has provided an outline of the options, concept designs and costs for a "Stage 1" recycled water supply scheme from the Kingscliff STP to several parks, sporting fields, foreshore reserves, as well as a private golf course, bowls and rugby clubs within Kingscliff and environs. This report has demonstrated the technical feasibility of recycled water supply for irrigation these public and private parks, sporting fields and reserves, subject to nighttime watering, with minimum 4 hour withholding period before public access.

The key driver for this project is the EPA NSW endorsement of the Tweed Shire Council Effluent Reuse Strategy for Kingscliff. EPA NSW have recommended that effluent reuse from the Kingscliff Sewage Treatment Plant should be maximised to enable replacement of current potable water irrigation uses on public parks and reserves and private sporting fields.

Progressive implementation of an Effluent Reuse Strategy for Kingscliff starting with Stage 1 and potentially expanding to Kingscliff South will have clear environmental benefits including reduction in nutrient loads and other pollutants currently discharged to Tweed River at Chinderah. Future effluent quality license requirements set by EPA NSW for the Kingscliff discharge to Tweed River will depend on the extent of effluent reuse achieved and the resultant reduction in pollutant loads on the river.

The establishment of Stage 1 of the Kingscliff Recycled Water Scheme as outlined in this report, commencing with Chinderah Golf Course (as a "Stage Zero") should enable Tweed Shire Council to make proactive steps towards satisfying the future directions of EPA NSW and DEC.

The key conclusions of this Concept Design study were as follows:

1. Stage 1 of the Kingscliff Recycled Water Scheme as outlined in this report would utilise about 180 ML/Yr of recycled water irrigation of Kingscliff's TSC's parks and reserves, Chinderah golf course, bowling clubs and a private rugby field. This recycled water use will include substitution of 70-80 ML/Yr of potable water currently used for irrigation.
2. Selection of a cost-effective recycled water pipeline route for Stage 1 may depend on the future alignment for the proposed new sewer rising main to the proposed Kingscliff STP. TSC are still considering various options for the alignment of the sewer rising main.
3. Even if new sewer rising main was from the Turnock St pumpstation to Tweed Coast Rd via a new road through the wetland, a more cost effective and environmentally sensitive alignment for the recycled water main is considered to be from the new STP, along the south boundary of Chinderah Golf Course to Tweed Coast Rd then through the existing STP site across the existing sewer main pipe bridge over the canal to the Kingscliff foreshore.
4. Construction of a new recycled water pipeline network along urban Kingscliff road reserves would be fairly straight forward. However, there would be added cost (compared with a rural route) associated with locating and avoiding (eg. by boring under) various utilities (water, sewer, power, etc) and sensitive

vegetation (eg. Pines along the foreshore), and running some sections of the pipeline under road pavement. Total Chainage of the Stage 1 pipeline is about 7 km including about 600-700m for the golf course pipeline.

5. It is possible to save on pipeline installation costs (about 50% of pipeline costs in a single pipe trench) by sharing about 3 km of pipeline trenches with the proposed potable supply main to the new Kingscliff STP site and utilising this existing pipe bridge.
6. The capacity of the recycled pipeline network and required pipe sizes are dependent on peak water demand assumed including the following factors:
   - peak irrigation demand and area under irrigation on each irrigation site during hot and dry periods;
   - limited hours of watering determined by 4 hour public access withholding period as specified in EPA NSW *Environmental Guidelines for Use of Effluent by Irrigation*.
7. Note that EPA NSW's *Environmental Guidelines for Use of Effluent by Irrigation* requires a 4 hour withholding period before public access to sites irrigated with recycled water. Therefore, hours of watering will need to be at nighttime. These restrictions significantly shorten the available hours to water each park and reserve and have a major impact on peak water demand estimates and therefore sizing of recycled water supply mains and pump stations, as well as size of possible irrigation pumps and on-site storage tanks. Some of the openly accessible parks and gardens (including Kingscliff foreshore, Walter Peate, Reg Dalton reserves) will be restricted to a 4 hour watering period (11 pm - 3 am) to prevent exposure of the public to recycled water.
8. TSC will need to educate the local community (including residents, sports clubs and park users) about recycled water use and erect warning signs to ensure restricted human access during irrigation and the 4 hour withholding period to prevent exposure of humans to recycled water. If the public access cannot be effectively restricted, then TSC will need to consider higher levels of treatment and disinfection of the Kingscliff Recycled Water to enable unrestricted irrigation uses on the parks and reserves. The costs estimated in this report do not include costs of higher level of treatment, which would need to include tertiary treatment and filtration (eg. filter or membranes, and higher levels of disinfection). Costs of this higher levels of treatment can be of the order $1000/ML in the long term.
9. Maximum irrigation demand can be as high as 10mm/day during heat wave periods but this is only likely to occur for a few days each year. Using this higher rate for design purposes is not considered a cost effective means of pipeline design because it would result in significant increase in pipe main capacity and diameters and therefore cost for very high demands that only occur rarely. During such higher water demand peak periods, existing bore water and potable water sources could be used as temporary backup supply.
10. Extended dry periods tend to occur in the cooler winter early spring in this sub-tropical location. Therefore, this report assumed a conservative 5mm/day for concept design as well as 100% of all parks and gardens watered concurrently during the hot/dry periods. This demand was consistent with existing irrigation water use data (potable and bore water) at each of TSC parks and reserves and private customers that could make up the Stage 1 Recycled Water Scheme.
11. The assessment of recycled water supply options has come up with three key options
    - **Option 1** – High Flow Supply for direct irrigation at Kingscliff parks and reserves, except for subsoil irrigation at Jack Bayliss Park (Kingscliff foreshore), and separate pipeline to proposed 6 ML dam at Chinderah Golf Course;
    - **Option 2** - Low Flow Supply to Onsite Storage Tanks at Kingscliff parks and reserves, but with subsoil irrigation to Jack Bayliss Park (ie. no tank required), and separate pipeline to Golf Course Dam;

- **Option 3** - High Flow Supply for direct Irrigation at Kingscliff parks and reserves, except for subsoil irrigation at Jack Bayliss Park, and separate pipeline to proposed 6 ML dam at Chinderah Golf Course via connection from Tweed Coast Rd.

12. Recycled water pipe sizes for Options 1 and 3 were less than 250 mm (PVC Class 12) at the STP, down to about 80-100 mm at the irrigation sites. With the lower flows associated with Option 2, pipe sizes reduce to less than 150 mm at the STP.
13. The above pipeline diameters were based on delivery pressures at most irrigation sites of at least 20m, except for the golf course which only needs a head of around 2-3m for discharge into the proposed dam.
14. For Options 1 and 3 a recycled water storage of around 320 kL would be initially needed at the new STP, because the peak recycled demand (occurring overnight) would be significantly higher than the current low overnight sewage flows to the STP. This balancing storage would prevent excessive drawdown of the chlorine contact tank. Ultimately this storage would not be needed for Options 1 and 3 once the sewer flows increased from the rapid population growth occurring in Kingscliff. Option 2 would not need a storage at all.
15. Pump station options include a combined pump station (~40kW) serving all customers in the Stage 1 scheme, or separate pump stations for the main Kingscliff Scheme (~40kW) and Chinderah Golf Course (~15kW). Separating the pump station would not be as hydraulically efficient and more costly, but it would enable monitoring of golf course pump volumes, pump times and therefore allocation of pump station capital and operating (power) costs to the golf course operator.
16. For Option 2, onsite storage tanks and individual irrigation pump systems would be needed for all parks, except for Jack Bayliss Park, which would have direct subsoil irrigation. Onsite storage tanks capacities need to be about the same as the daily peak demand expected during dry/hot periods. Therefore some of the tanks for the larger parks might be too large to site above ground within public reserves, including the 360 kL tank for Walter Peate and 125 kL tank for Reg Dalton. Such large above ground tanks in public parks are likely to be obtrusive and result in community opposition.
17. There is the option of placing these larger tanks underground to avoid being unsightly and attracting public objection. However the cost of underground storage tanks is roughly double that of above ground tanks, resulting in the overall cost of Option 2 approaching that of Options 1 and 3. It is for this reason that Option 2 is not necessarily favored over Options 1 and 3.
18. Taking into account total potential savings, the preliminary capital cost estimates for Options 1, 2 and 3 for Kingscliff Recycled Water Scheme Stage 1 are as follows:
    - **Option 1** $1.9 Million
    - **Option 2** $1.5 Million
    - **Option 3** $2.0 Million
19. If underground storage tanks were provided in Option 2 for Ned Byrne Field (assuming it was paid for by Cudgen Leagues Club), Walter Peate and Reg Dalton (paid for by TSC), then Option 2 costs would increase to about $1.6 Million.
20. The difference in costs between all options is within the order of accuracy of the estimates.
21. Despite Option 2 being the cheapest, direct irrigation supply Options 1 or 3 are considered more practicable and lower risk given:
    - simplicity of operation and maintenance and reliability with direct irrigation for Options 1 and 3;
    - minimal "footprints" for onsite recycled water storages and irrigation pump systems for Options 1 and 3;
    - higher risk (ie. "more could go wrong with Option 2") and likely community objections and delays in project implementation associated with installing large recycled water storage tanks (either below or above ground) in public parks and reserves for Option 2.

22. The financial viability of the scheme depends on connecting large volume recycled water users such as the Chinderah Golf Course, Walter Peate, Reg Dalton and Cudgen Leagues (Ned Byrne Field and Bowls) Club.
23. Implementation of Stage 1 could be spread over a number of financial years to lessen the cost impact on TSC. The recycled water scheme could be readily kick started by a "Stage Zero" Scheme to supply Chinderah Golf Course from the present Kingscliff STP via the existing ti-tree farm recycled water pipeline, via a connection at Tweed Coast Road. The golf course would initially utilise about 30-40 ML/Yr, increasing to more than 100 Ml/Yr with proposed expansion to a larger course area to be irrigated (around 20 Ha).
24. Total cost of a Stage Zero would be of the order $100,000 comprising $60,000 for the new pipeline and connection to the ti-tree pipeline at Tweed Coast Rd, plus about $40,000 for the temporary pump station at the existing STP. This "Stage Zero" would be at minimal cost to TSC if the golf course were made to pay for the pipeline and temporary pump station at the existing STP. The golf course management has already indicated that they propose to build a new 6 ML dam on the course at their own expense.

10.2 Recommendations

Option 3 high flow supply for direct irrigation at Kingscliff parks and reserves, except for subsoil irrigation at Jack Bayliss Park, and separate pipeline to proposed 6 ML dam at Chinderah Golf Course via connection from Tweed Coast Road is recommended for further consideration for the Stage 1 Kingscliff Recycled Water Scheme.

Option 3 will enable a "Stage Zero" Scheme to proceed to supply Chinderah Golf Course from the existing STP, not having to wait for the STP to be relocated. Once the Kingscliff STP is relocated, then the pipeline could then be connected to a new recycled water main integrated as part of Option 3, or alternatively abandoned in favour of a new pipeline directly from the new STP site as part of Option 1.

However if TSC considered that recycled water storage tanks are feasible in Kingscliff's public parks and reserves (eg. by building these underground) then the lower cost (but slightly higher risk) Option 2 should be considered as an alternative to Option 3.

The next steps recommended in the Implementation Strategy for this project include further engineering, planning, environmental, social and economic investigations and consultations as outlined in Section 9 of this report.

Completion of the above further investigations should include pre-consultation with EPA NSW (now incorporated into DEC) and other relevant regulatory authorities, as well as pre-consultation with the local community (including residents, parks user, sports clubs, etc).

The above further investigations and consultations should be undertaken as part of the functional design phase, prior to approval, detailed design and tendering phases.

Appendices

List of Appendices

Appendix A Kingscliff Recycled Water Scheme Maps

List of Figures:

Figure A-1 Kingscliff Stage 1 Recycled Water Scheme

CUSTOMER	Estimated Area under Recycled Water Irrigation Ha	Estimated Annual Use ML/Yr	Estimated Peak Pumping Demand for Direct Irrigation Option L/s
Stage 1			
Chinderah Golf Course & Range	20.0	100.0	13.9
Jack Bayliss Park (Total)	4.8	15.4	4.2
Kingscliffe Bowls Club	0.5	2.5	0.9
Reg Dalton Oval	1.3	18.3	8.7
Reg Dalton Hockey	1.2		
Walter Peate Reserve	7.2	33.0	25.0
Ned Byrne Field	1.4	7.0	2.5
Cudgen Leagues Bowls	0.3	1.5	0.5
Total for Stage 1		**177.7**	**37.6**
Future Stages			
SLSC Lawns	0.3	1.5	To be determined
Kingscliff Lions Park	0.3	1.5	
Faulks Park	0.8	4	
St Anthony's Primary School Fields	0.5	2.5	
Primary School Fields	1.0	5.0	
Hansen Park	0.6	3.0	
Kingscliff High School Fields	1.0	5.0	
North Coast Institute Of Tafe	4.0	20.0	
The Jack Julius Park	1.0	5.0	
Cudgen Headland Res (Southerland Pt)	1.0	5.0	
Future Driving Range (Gales Holdings Local Structure Plan)	10.0	50.0	
Future Hospital, Medical Or Institutional (Gales Holdings LSP)	2.0	10.0	
Existing Ti Tree Plantation	9.0	45.0	
Possible Supply to South Kingscliff, Salt Development, Casaurina, etc	To be determined		
Possible Supply To Orchards, Markets Gardens, Cane Farms	To be determined		

TWEED RIVER
EXISTING OUTFALL MAIN (Ø450GRP)
CHINDERAH
PACIFIC HWY
WOMMIN BAY RD
CUDGEN LEAGUES BOWLS
NED BYRNE FIELD
WALTER PEATE RESERVE
REG DALTON OVAL
100Ø UPVC
200Ø UPVC
POSSIBLE STORAGE TANK (ALTERNATIVE)
POSSIBLE STORAGE TANK
CAR ACCESS (DIRT)
JACK BAYLISS PARK (JBP) SECTION 6
JBP SECTION 5
BBQ/PICNIC AREA (IRRIGATION 0.14Ha)
POSSIBLE STORAGE TANK SCREENED BY WHITE TOILET BLOCK
JBP SECTION 4
CAR PARK
BBQ PICNIC AREA (IRRIGATION 0.14Ha)
AVOID VEGETATED BEACH TO ROAD CORRIDOR (20-30M WIDE)
JBP SECTION 3
BEACH ACCESS POINT
JBP SECTION 2
POSSIBLE STORAGE TANK BEHIND BROWN BRICK TOLIET BLOCK
JBP SECTION 1
EXISTING HYDRANT & WATER METER
CHINDERAH GOLF COURSE & RANGE
STP SITE
150Ø UPVC
250Ø UPVC
DEDICATED GOLF COURSE PIPELINE
FUTURE DAM (6ML)
ALTERNATIVE PIPELINE TO GOLF COURSE
USE EXISTING SEWER PIPE BRIDGE (225Ø DICL)
PROPOSED RECYCLED WATER PUMP STATION
MAIN TO BE RELOCATED TO NEW PIPE TRACK
TWEED COAST RD
NEW STP SITE
FUTURE DRIVING RANGE
FUTURE HOSPITAL, MEDICAL OR INSTITUTIONAL
KINGSCLIFFE BOWLS CLUB
MOOPE RDG
SLSC LAWNS
KINGSCLIFF
ST ANTHONY'S PRIMARY SCHOOL
FAULKS PARK
EXISTING TI TREE PLANTATION
EXISTING Ø200MM RW MAIN FROM EXISTING STP TO TI TREE PLANTATION (NEVER COMMISIONED)
PRIMARY SCHOOL FIELDS
HANSEN PARK
CUDGEN HEADLAND RES
TURNOCK ST
PARKER ROTARY PARK
CUDGEN
GEN RD
NORTH COAST INSTITUTE OF TAFE
KINGSCLIFF HIGH
THE JACK JULIUS PARK
CUDGEN CREEK
SUTHERLAND ST
CUDGEN RD
POSSIBLE SUPPLY TO ORCHARDS MARKETS GARDENS (FUTURE STAGE)
0 250 500
Metres

LEGEND

- Proposed Storage
- Proposed Storage
- Treatment Plant
- Potential Recycled Water Customers (Stage 1)
- Potential Recycled Water Customers (Future)
- Proposed Recycled Water Main (Stage 1) (Pipe Diameter shown for direct irrigation option)
- Proposed Recycled Water Main (Future stages)
- Alternative Recycled Water Main to supply Golf Course
- Existing Recycled Water Main (Never comissioned)
- Existing Outfall (Ø450mm GRP)
- Proposed Outfall (Ø600mm)
- Contour

THE TWEED
TWEED SHIRE COUNCIL

Date: 26/04/2005	**Drawn:** K.B
Rev. No:	**Rev. Date:**
Checked: R.A	**Approved:**
Status: Final	**Fig No:** A.1
Scale: 1: 7,500	**Project No:** 831/001346
Wor: 831001346_A1P_FIG_A_1	

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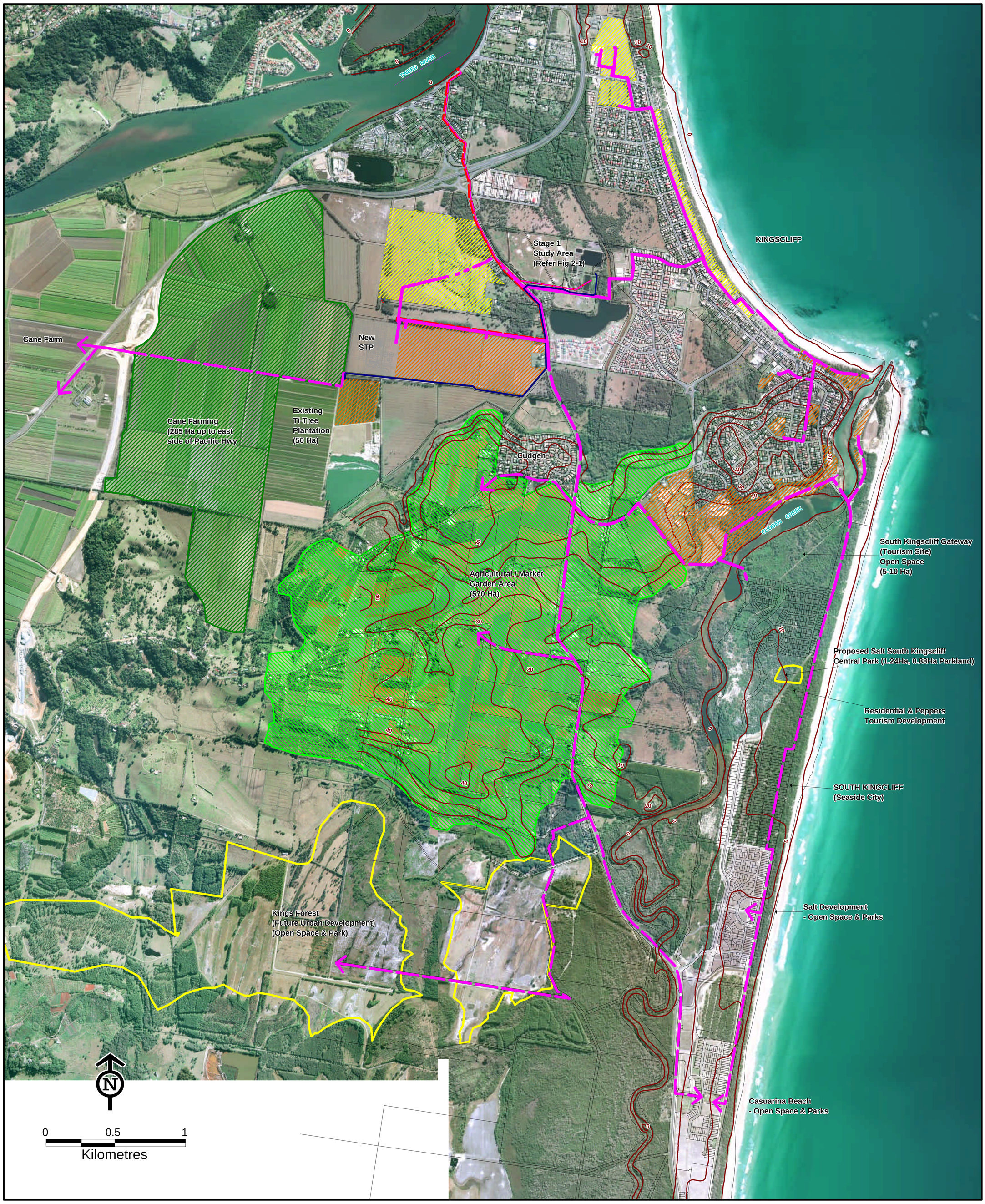
Kingscliff Stage 1 Recycled Water Scheme

MWH

Figure A-2 Kingscliff Recycled Water Scheme – Future Stages Study Area



LEGEND

- Contour
- Cadastre
- Proposed Recycled Water Main (Stage 1)
- Alternative Recycled Water Main to supply Golf Course
- Proposed Recycled Water Main (Stage 2)
- Existing Recycled Water Main (Never comissioned)
- Existing Outfall (Ø450mm GRP)
- Proposed Outfall (Ø600mm)
- Proposed Outfall (Ø600mm)
- Potential Recycled Water Customers (Stage 1)
- Potential Recycled Water Customers (Future)

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Wor: 831001346_A1P_FIG_A_2	

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Kingscliff Recycled Water Scheme
Future Stages Study Area

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Appendix B Potential Recycled Water Customers & Demands

Table B.1 Kingscliff Potential Recycled Water Sites and Customers (Stage 1 and Possible Future Stages). Irrigation Water Demands, Calculations and Assumptions

Recycled Water Site or Customer	Existing Uses	Estimated Area under Recycled Water Irrigation Ha	Estimated Annual Use ML/Yr	Estimated Daily Demand ML/D (for 5mm/d)	Irrigation Method	Pumping time for direct irrigation option NB: Restricted Irrigation Hrs to prevent human exposure	Estimated Peak Pumping Demand for Direct Irrigation Option L/s	Pumping Time for storage option at Customer Sites	Estimated Peak Pumping Demand for Storage Option L/s
Stage 1									
Chinderah Golf Course & Range	Bore Water	20.0	100.0	1.00	Surface spray (via 6ML dam)	3am - 11pm (Golf Course Irrig: 8pm - 3am)	13.9	24hrs	11.6
Jack Bayliss Park Section 1	Potable use on BBQ Areas: 2 x 0.14Ha	0.3	2.6	0.04	Subsurface Drip	3am-7pm	0.7	24hrs	0.5
Jack Bayliss Park Section 2		0.3							
Jack Bayliss Park Section 3		0.2							
Jack Bayliss Park Section 4		3.5	12.8	0.20	Subsurface Drip	3am-7pm	3.5	24hrs	2.3
Jack Bayliss Park Section 5		0.2							
Jack Bayliss Park Section 6		0.3							
Jack Bayliss Park (Total)		4.8	15.4	0.24	Subsurface Drip (direct)	3am-7pm	4.2	24hrs	2.8
Kingscliffe Bowls Club	Potable Use	0.5	2.5	0.025	Surface spray	7pm-3am	0.9	24hrs	0.3
Reg Dalton Oval	Potable Use	1.3	18.3	0.125	Surface spray	11pm-3am	8.7	24hrs	1.4
Reg Dalton Hockey	Not Irrigated	1.2							
Walter Peate Reserve	Potable Use	7.2	33.0	0.360	Surface spray	11pm-3am	25.0	24hrs	4.2
Ned Byrne Field	Potable Use	1.4	7.0	0.070	Surface spray	7pm - 3am	2.5	24hrs	0.8
Cudgen Leagues Bowls	Potable Use	0.3	1.5	0.015	Surface spray	7pm - 3am	0.5	24hrs	0.2
Total for Stage 1		36.7	177.7	1.835			37.6		21.2
Future Stages									
SLSC Lawns		0.3	1.5	0.015	Surface spray	11pm-3am	To be determined	24hrs	0.2
Kingscliff Lions Park		0.3	1.5	0.015	Surface spray	11pm-3am		24hrs	0.2
Faulks Park		0.8	4	0.040	Surface spray	11pm-3am		24hrs	0.5
St Anthony's Primary School Fields	?	0.5	2.5	0.025	Surface spray	8pm - 3am			0.3
Primary School Fields	?	1.0	5.0	0.050	Surface spray	8pm - 3am		24hrs	0.6
Hansen Park	?	0.6	3.0	0.030	Surface spray	11pm-3am		24hrs	0.3
Kingscliff High School Fields	?	1.0	5.0	0.050	Surface spray	8pm - 3am		24hrs	0.6
North Coast Institute Of Tafe	?	4.0	20.0	0.200	Surface spray	11pm-3am		24hrs	2.3
The Jack Julius Park	?	1.0	5.0	0.050	Surface spray	11pm-3am		24hrs	0.6
Cudgen Headland Res (Southerland Pt)	?	1.0	5.0	0.050	Surface spray	11pm-3am		24hrs	0.6
Future Driving Range (Gales Holdings Local Structure Plan)	Not Developed	10.0	50.0	0.500	Surface spray	8pm - 6am			5.8
Future Hospital, Medical Or Institutional (Gales Holdings LSP)	Not Developed	2.0	10.0	0.100	Surface spray	11pm-3am		24hrs	1.2
Existing Ti Tree Plantation	Not irrigated	50.0	250.0	2.500	Surface spray	Any time		24hrs	28.9
Possible Supply to South Kingscliff, Salt Development, Casaurina, etc	Not Developed	To be determined	150-200	1.5-2.0	Surface spray	11pm-3am		24hrs	TBD
Possible Supply To Orchards, Markets Gardens, Cane Farms	some irrigated	TBD	800-1000	8-10	Surface spray	Any time		24hrs	TBD

Appendix C Potential Recycled Water Site Summary Sheets

This Appendix contains a summary of Potential Recycled Water Irrigation Sites, key site features, public access and recycled water management issues important to the assumptions behind the recycled water demand calculations and concept design.

Table C.1 Jack Bayliss Park (Kingscliff foreshore reserve) – Key Site Features

Recycled Water Use Purposes	***Lawns (excludes BBQ/picnic areas)***
Existing Water Sources (Potable, Bore, Other)	***Potable on BBQ/picnic areas***
Total Property Area (Ha)	***~10Ha (~1500m x ~70m)***
Potential Recycled Water Irrigation Area (Ha)	***~4.8Ha (4.5-5 Ha)***
Maximum Daily Recycled Water Use (Ml/day)	***0.24***
Average Annual Recycled Water Use (Ml/Year)	***15.4***
Recycled Water Watering Times	***Anytime (only with subsoil irrigation)***
Peak Flows (l/s)	***4.2***
Type of Recycled Water Storage Tank & Capacity (Ml)	***No storage (impractical)***
Method(s) of Irrigation	***Subsoil Irrigation (in-line drippers, ~150-300mm below ground, 4l/hr per dripper)***
Soil Profile/Types (topsoil & subsoil)	***Fine to Coarse Sands***
Adjacent Sensitive Land Uses	***Residential ~30m to west separated by Marine Pde. Native dune vegetation adjacent to east.***
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	***Drainage outlet to beach roughly opposite Beach & Zephyr St***
Public Access (Hrs of Opening)	***Unrestricted 24 hours.***

Table C.2 Reg Dalton Oval (Cricket oval and Soccer/Hockey Field) – Key Site Features

Recycled Water Use Purposes	*Playing Fields, Gardens/Lawns around toilets & grandstand*
Existing Water Sources (Potable, Bore, Other)	*Potable on cricket oval & Bore water on gardens/lawns around toilets & grandstand*
Total Property Area (Ha)	
Potential Recycled Water Irrigation Area (Ha)	*2.5 (cricket oval 1.3, soccer/hockey field 1.2Ha)*
Maximum Daily Recycled Water Use (Ml/day)	*0.125*
Average Annual Recycled Water Use (Ml/Year)	*18.3*
Recycled Water Watering Times	*Overnight: 11pm to 3am*
Peak Flows (l/s)	*8.7*
Type of Recycled Water Storage Tank & Capacity (Ml)	*1 x 125 kL steel (eg. by Pioneer or APT)*
Method(s) of Irrigation	*Pop-up spray irrigation.*
Soil Profile/Types (topsoil & subsoil)	*Fine to Coarse Sands*
Adjacent Sensitive Land Uses	*Residential ~40m to south and east separated by Shell St & Kingscliff St respectively*
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	*Drainage outlets to surrounding council street drains*
Public Access (Hrs of Opening)	*Unrestricted 24 hours*

Table C.3 Walter Peate Recreational Reserve (Sports Fields) – Key Site Features

Recycled Water Use Purposes	***Playing Fields (Soccer, Hockey, Athletics)***
Existing Water Sources (Potable, Bore, Other)	***Potable***
Total Property Area (Ha)	
Potential Recycled Water Irrigation Area (Ha)	***7.2***
Maximum Daily Recycled Water Use (Ml/day)	***0.36***
Average Annual Recycled Water Use (Ml/Year)	***33***
Recycled Water Watering Times	***Overnight: 11pm to 3am***
Peak Flows (l/s)	***25***
Type of Recycled Water Storage Tank & Capacity (Ml)	***1 x 360 kL steel (eg. by Pioneer or APT), or 3 x 125 kL steel (eg. by Pioneer or APT)***
Method(s) of Irrigation	***Pop-up spray irrigation (Hunter I-31)***
Soil Profile/Types (topsoil & subsoil)	***Fine to Coarse Sands***
Adjacent Sensitive Land Uses	***Residential ~40m to east separated by Murphy's Rd. Wommin Bay Ret. Village adjacent to west***
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	***Drainage outlets to surrounding council street drains, and flora/fauna reserve to the north***
Public Access (Hrs of Opening)	***Unrestricted 24 hours***

Table C.4 Cudgen Leagues Club (Ned Byrne Rugby Field, Bowling Greens) – Key Site Features

Recycled Water Use Purposes	***Rugby Field, 2 Bowling Greens***
Existing Water Sources (Potable, Bore, Other)	***Bore and Potable***
Total Property Area (Ha)	
Potential Recycled Water Irrigation Area (Ha)	***2.7 (Rugby Field 1.4 Ha, Bowling Greens 0.3 Ha)***
Maximum Daily Recycled Water Use (Ml/day)	***0.085 (Rugby 0.07Ml/d, Bowling Greens 0.015M/ld)***
Average Annual Recycled Water Use (Ml/Year)	***8.5 (Rugby 7Ml/yr, Bowling Greens 1.5Ml/yr)***
Recycled Water Watering Times	***Overnight: 7pm to 3am***
Peak Flows (l/s)	***3 (Rugby 2.5 l/s, Bowling Greens 0.5 l/s)***
Type of Recycled Water Storage Tank & Capacity (Ml)	***1 x 85 kL steel (eg. by Pioneer or APT), or 1 x 70 kL (steel), & 1x15 kL (plastic eg. by Nylex)***
Method(s) of Irrigation	***Rugby: Pop-up spray irrigation Bowling Greens: spray, hand held hoses***
Soil Profile/Types (topsoil & subsoil)	***Fine to Coarse Sands***
Adjacent Sensitive Land Uses	***Wommin Bay Ret. Village ~20m to north of bowling greens. Walter Peate adjacent to east***
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	***Drainage outlet to surrounding council street drains (Wommin Bay Rd)***
Public Access (Hrs of Opening)	***Mostly Daylight Hours (dawn to dusk) Nighttime (up to 11pm) training on Rugby Field***

Table C.5 Kingscliff Bowls Club – Key Site Features

Recycled Water Use Purposes	***3 Bowling Greens***
Existing Water Sources (Potable, Bore, Other)	***Potable***
Total Property Area (Ha)	
Potential Recycled Water Irrigation Area (Ha)	***0.5***
Maximum Daily Recycled Water Use (Ml/day)	***0.025***
Average Annual Recycled Water Use (Ml/Year)	***2.5***
Recycled Water Watering Times	***Overnight: 7pm to 3am***
Peak Flows (l/s)	***0.9***
Type of Recycled Water Storage Tank & Capacity (Ml)	***1x25 kL (plastic eg. by Nylex)***
Method(s) of Irrigation	***Spray & hand held hoses***
Soil Profile/Types (topsoil & subsoil)	***Fine to Coarse Sands***
Adjacent Sensitive Land Uses	***Kingscliff commercial strip ~20m to west separated by Marine Pde (~5m to public path)***
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	***Drainage outlet (south side) to beach***
Public Access (Hrs of Opening)	***Mostly Daylight Hours (dawn to dusk)***

Table C.6 Chinderah Golf Course – Key Site Features

Recycled Water Use Purposes	***18 Hole golf Course & Driving Range***
Existing Water Sources (Potable, Bore, Other)	***Bore Water & Onsite Catchment Dams (current watering of tees and greens only)***
Total Property Area (Ha)	
Potential Recycled Water Irrigation Area (Ha)	***~20Ha (for extended 18hole golf course, greens, tees, fairways, driving range)***
Maximum Daily Recycled Water Use (Ml/day)	***1.0***
Average Annual Recycled Water Use (Ml/Year)	***100***
Recycled Water Watering Times	***Overnight: 7pm to 3am***
Peak Flows (l/s)	***13.9 (supply to golf course dam)***
Type of Recycled Water Storage Tank & Capacity (Ml)	***6ML dam (proposed)***
Method(s) of Irrigation	***Pop-up spray & hand held hoses***
Soil Profile/Types (topsoil & subsoil)	***Fine to Coarse Sands***
Adjacent Sensitive Land Uses	***Rural residential adjacent to south east corner of golf course, ~50m from nearest greens/tees.***
Drainage Outlets & Nearest Surface Waters (name & buffer distance)	***Drainage to open drain from south west corner (ultimately to Tweed River via open drains)***
Public Access (Hrs of Opening)	***Daylight Hours (dawn to dusk).***

Appendix D Hydraulic Modeling of Kingscliff Stage 1 Recycled Water Options

This appendix contains screen dumps of the EPANET hydraulic modeling of the 3 main Kingscliff Stage 1 Recycled Water Supply Infrastructure Options, which were discussed in Section 5.

Figure D1 Option 1 High Flow Supply for Direct Irrigation at Parks (Separate Pipeline to Golf Course Dam)

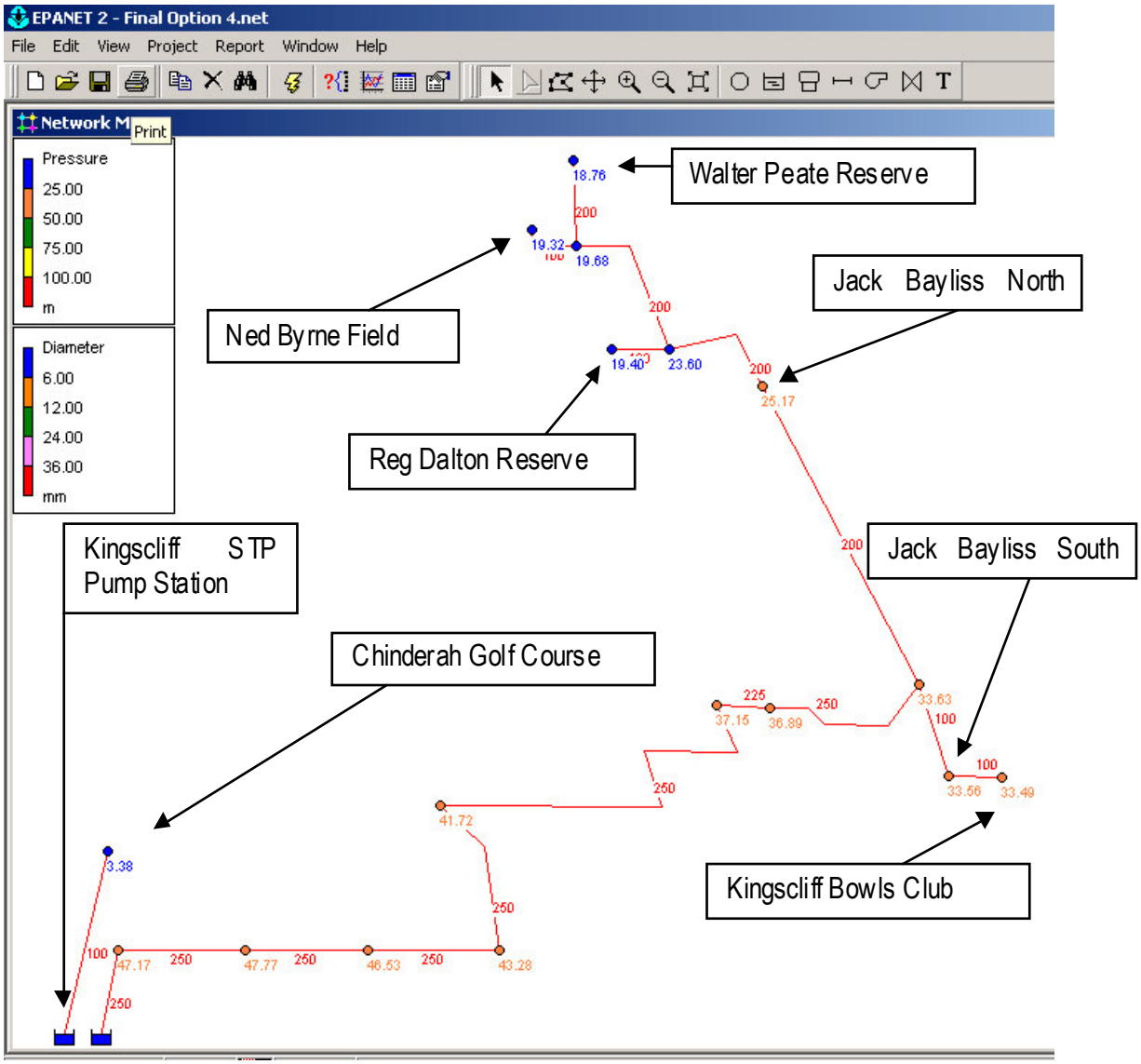


Figure D2 Option 1 Pipe Lengths by Section

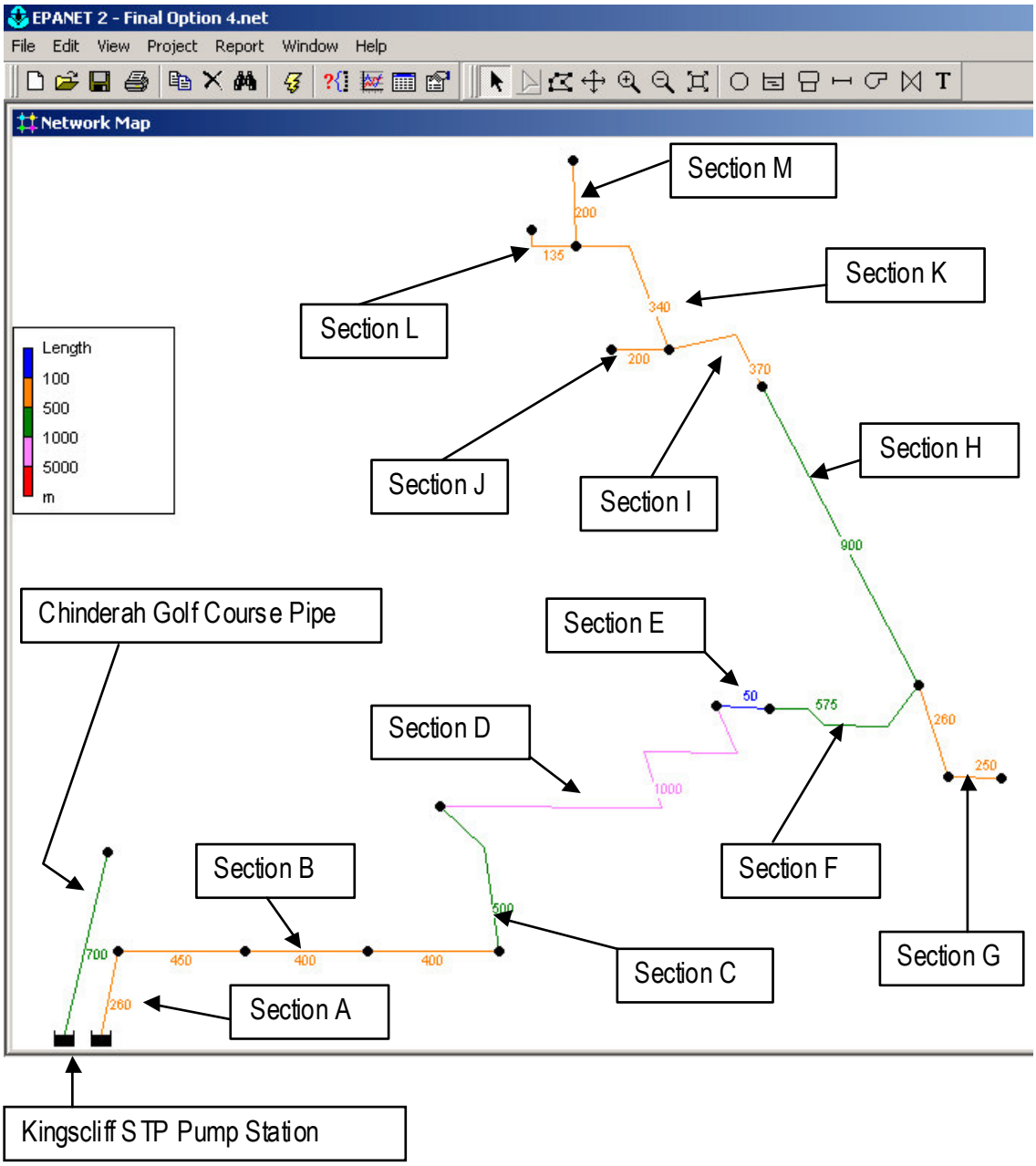


Figure D3 Option 2 Lower Flow Supply to Onsite Storage Tanks at Parks (Separate Pipeline to Golf Course Dam)

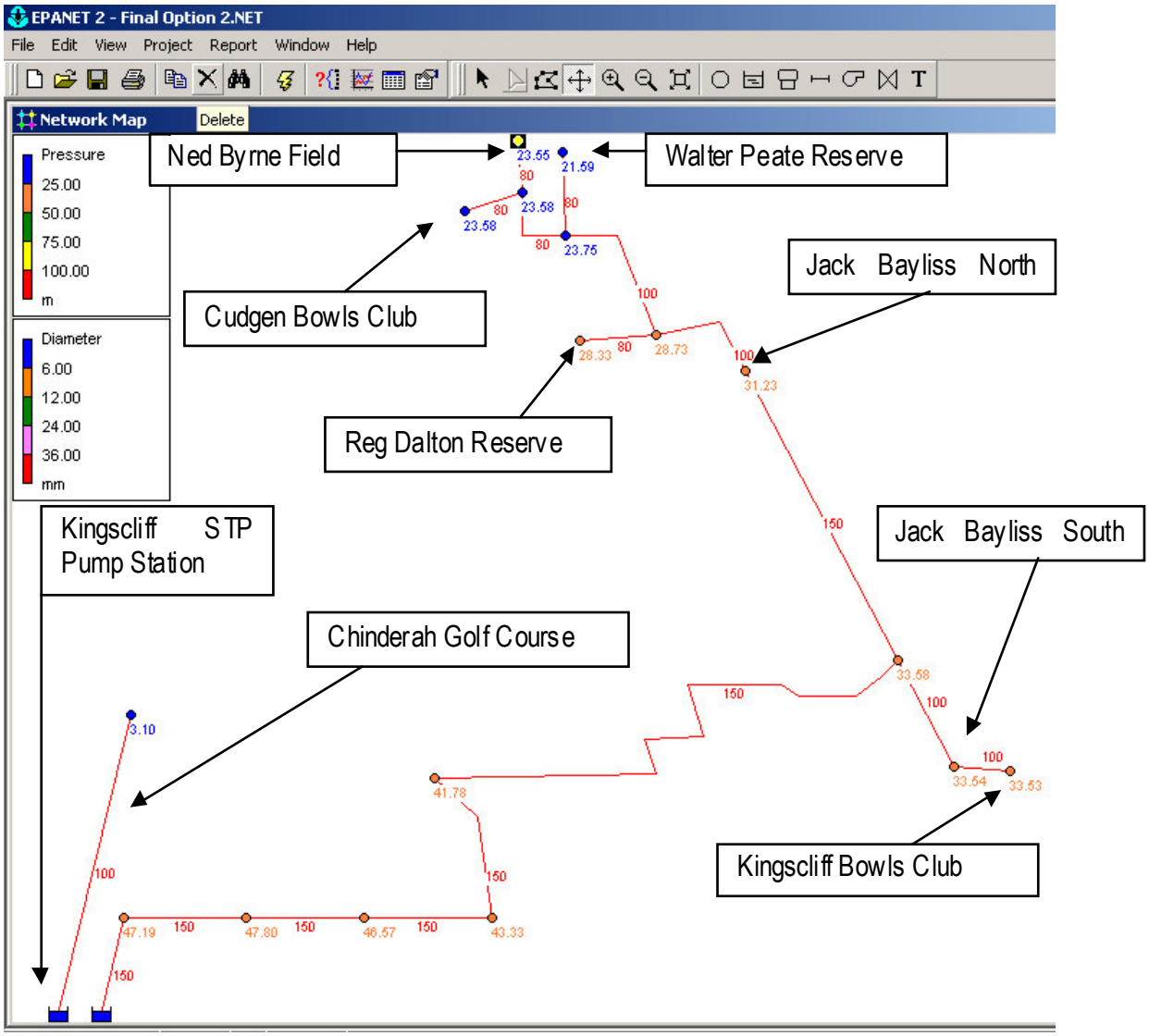


Figure D4 Option 2 Pipe Lengths by Section

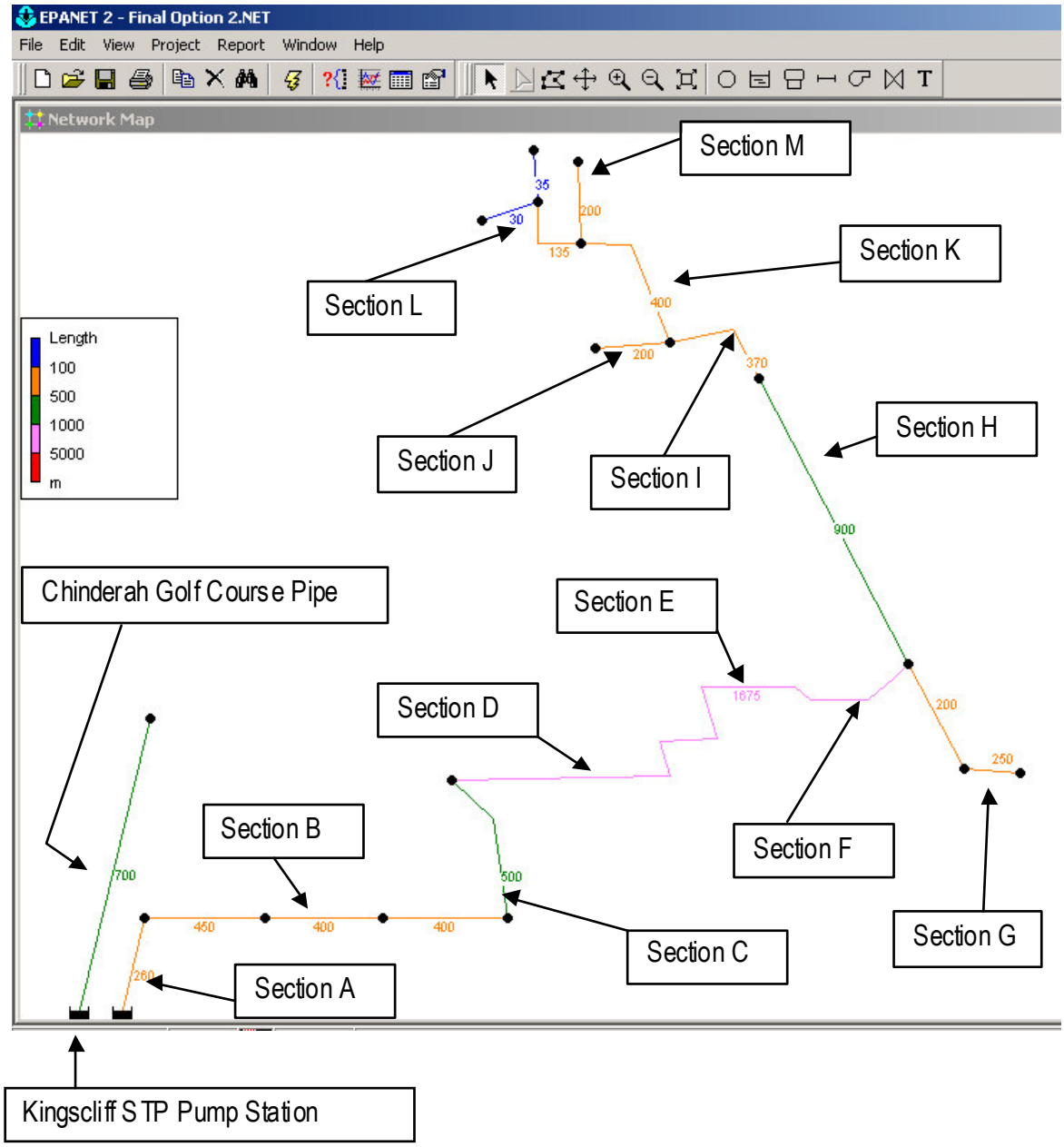


Figure D5 Option 3 High Pressure Supply for Direct Irrigation at Parks (Pipeline to Golf Course Dam from Tweed Coast Rd connection)

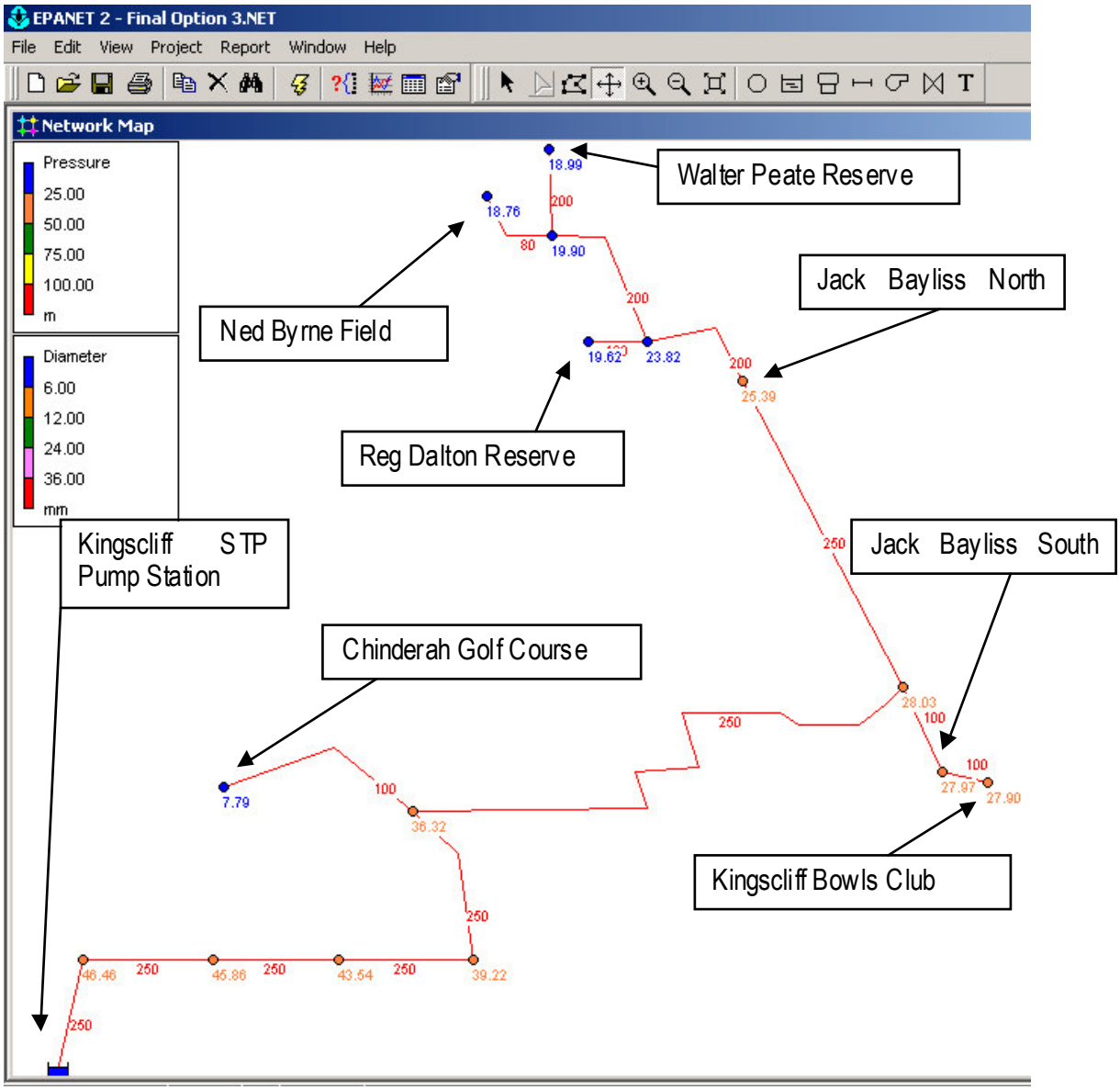
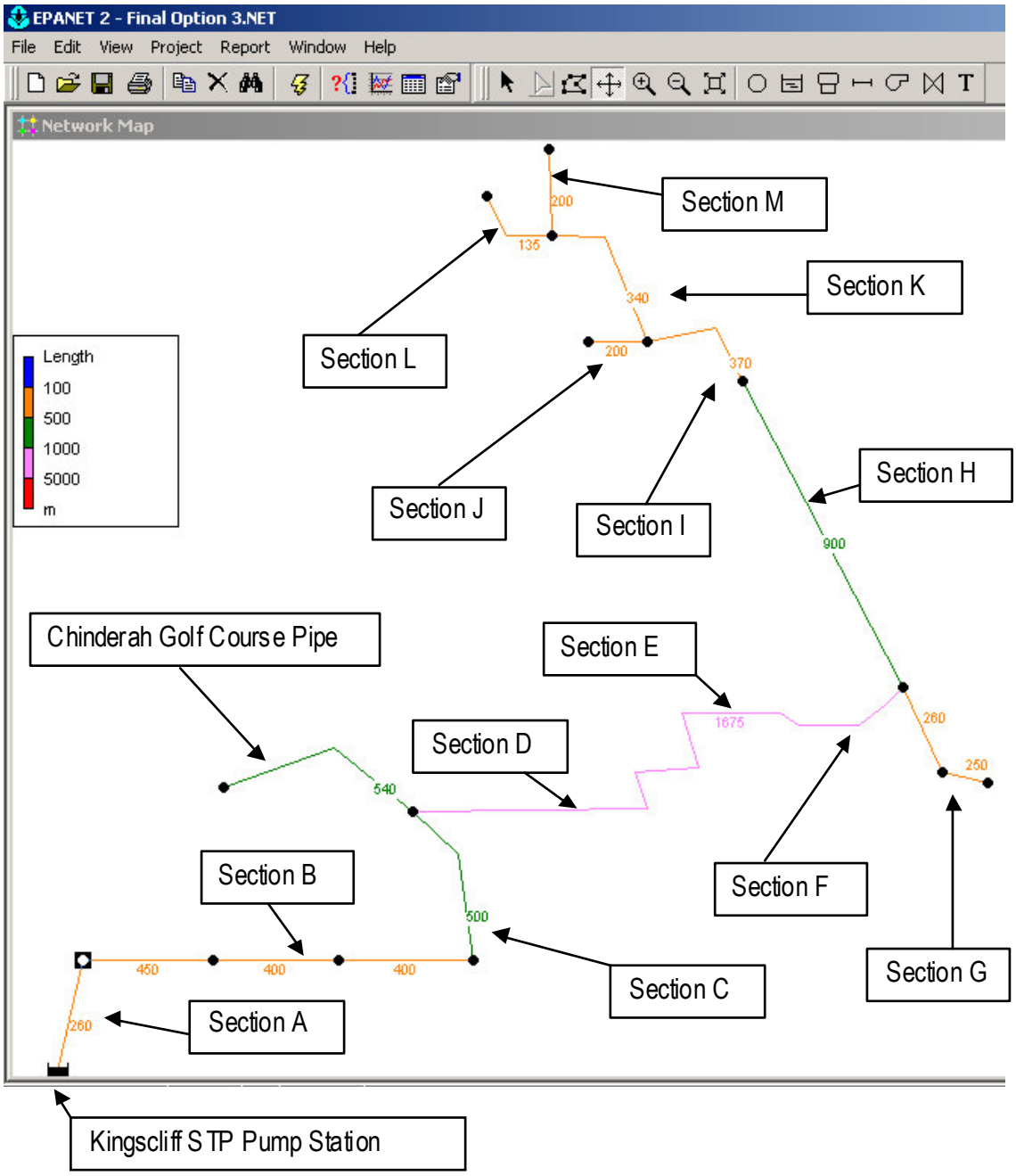


Figure D6 Option 3 Pipe Lengths by Section

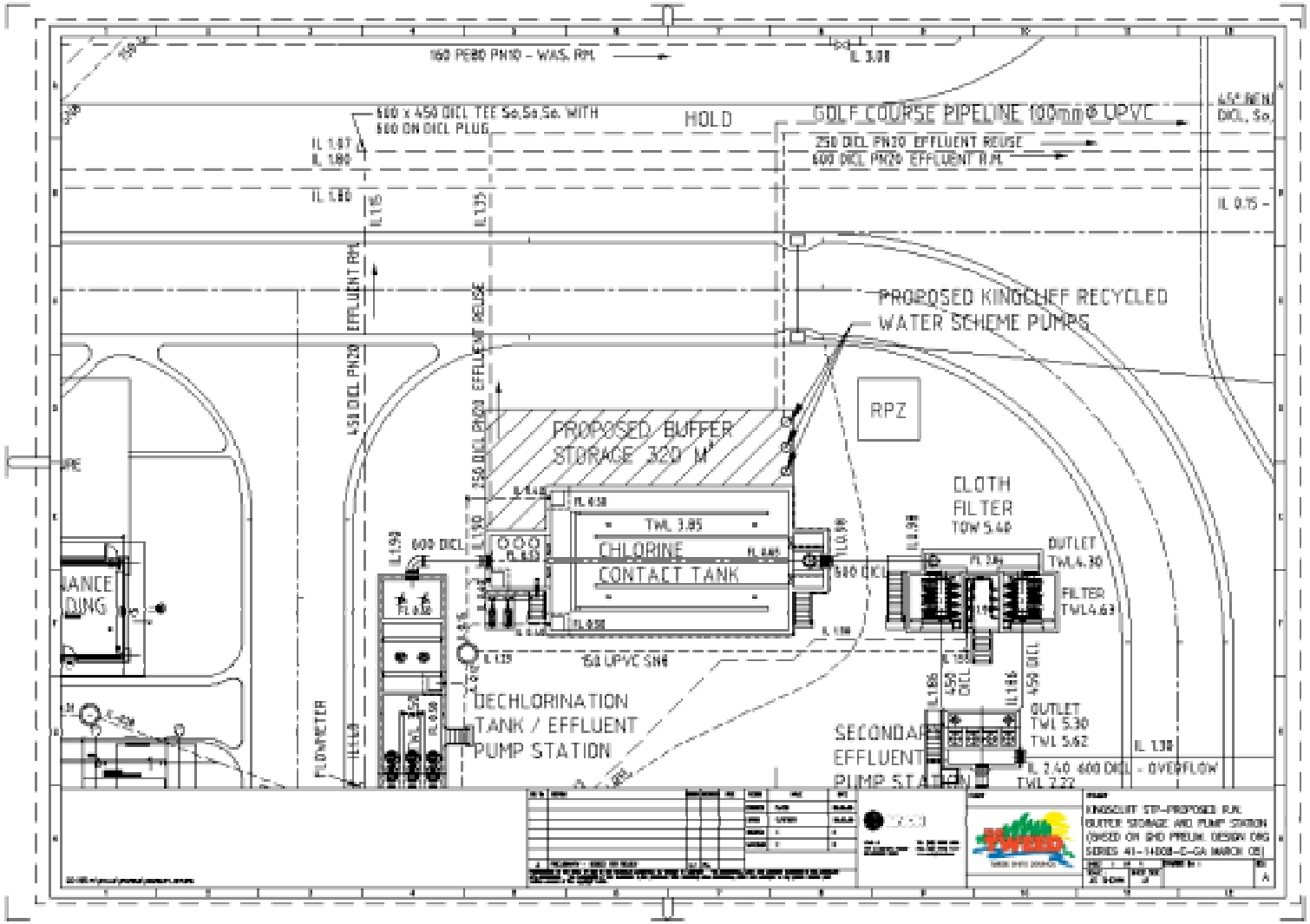


Appendix E Buffer Storage at Kingscliff STP

Figure E1 in this appendix is a conceptual illustration of where a recycled water buffer storage (320m^3 capacity) could be located to ensure the Chlorine Contact Tank is not drawdown by the recycled water pumps during low STP flows.

This drawing is based on the preliminary design drawings by GHD of the proposed site arrangement of the relocated Kingscliff STP as at 9 March 2005.

Figure E1 Conceptual Location of Buffer Storage Tank at new Kingscliff STP (NB. for illustration only – not for design)

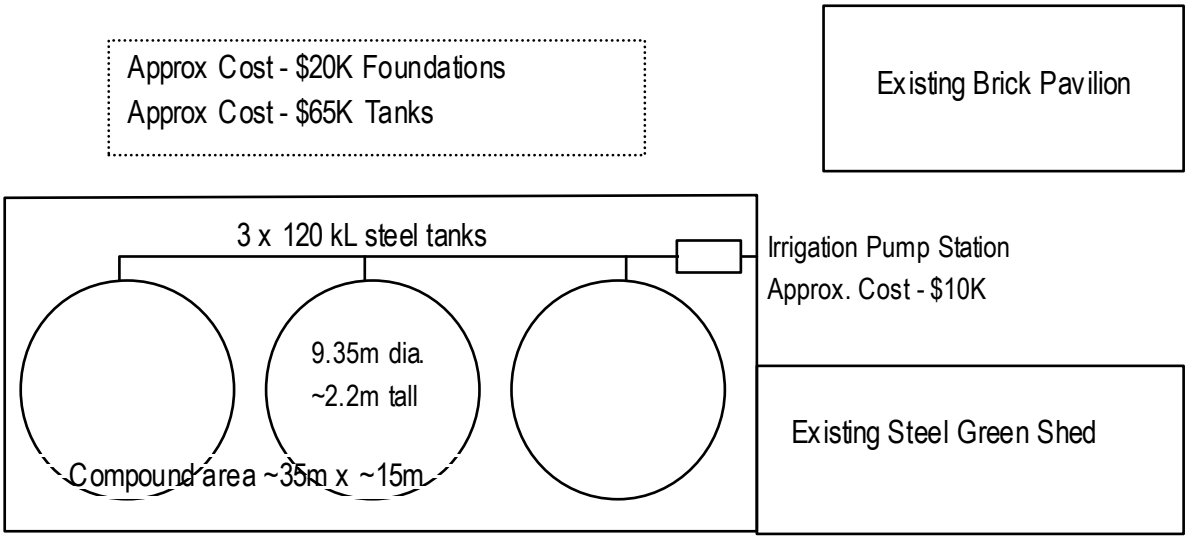


Appendix F Recycled Water Site Storage Tanks

This appendix contains manufacturers details of possible recycled water storage tanks, materials, dimensions, etc as well as sketches of possible storage tank compounds at each recycled water site for Option 2 of Stage 1 of the Kingscliff recycled water scheme.

Figure F1 Walter Peate Reserve Approx. Recycled Water Storage Tank Location

Figure F2 Walter Peate Multiple Storage Tank (3 x 120 kL) Option and Irrigation Pump Compound



Note to above figure: Alternative to above tank is 3 x 8.4m dia., 2.9m tall tanks for approximately same cost.

Figure F3 Walter Peate Single Storage (1 x 360 kL) Tank Option and Irrigation Pump Compound

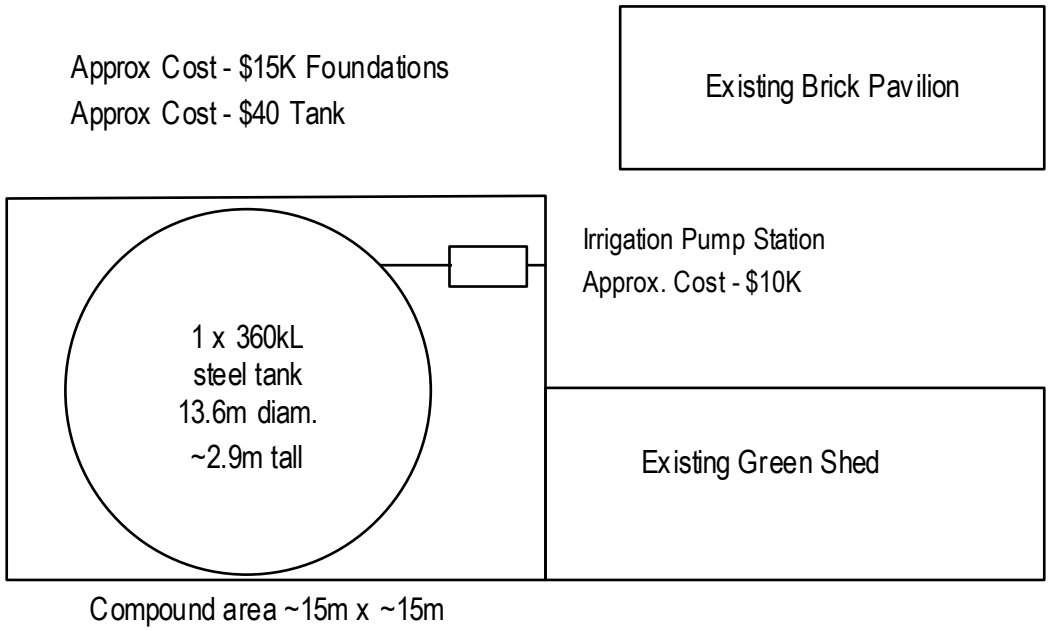
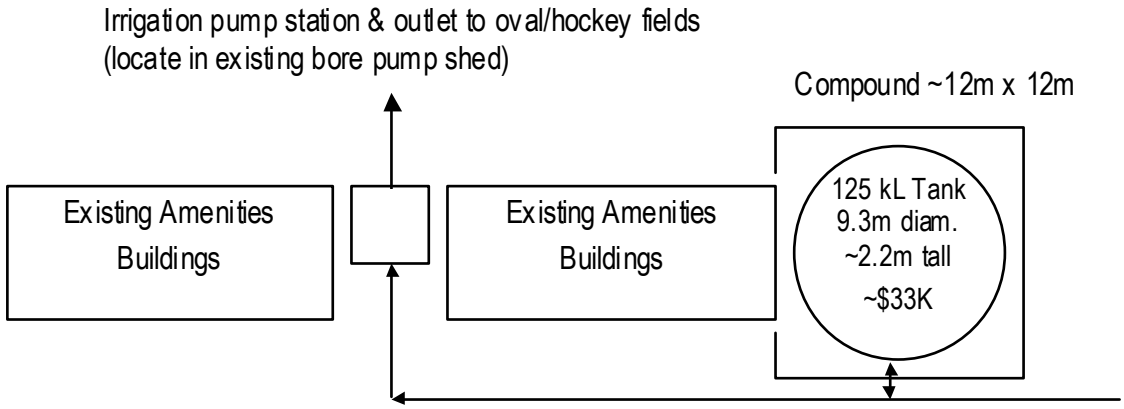


Figure F4 Walter Peate Pavilion and Maintenance Shed

Note to above photo:
1. Recycled Water Storage tank compound would be other side of the green shed from this view.
2. Height of storage tanks to be less than height of existing shed and pavilion

Figure F5 Reg Dalton Oval Approx. Recycled Water Storage Tank Location

Figure F6 Reg Dalton Oval Single Storage Tank (1 x 125kL) Option and Irrigation Pump Compound



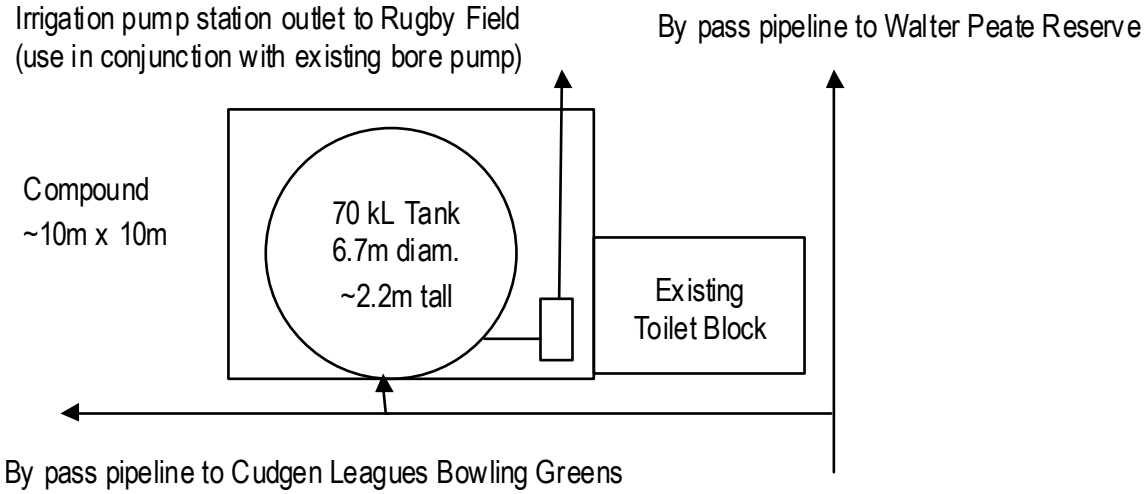
Note to above figure: Alternative to above tank is ~2.9m tall, ~8.5 diameter tank for roughly same cost.

Figure F7 Reg Dalton Oval Existing Amenities Buildings & Existing Bore Pump Shed (centre)

Notes to above Figure:
1. Location of recycled water storage tanks adjacent (to east or west) of amenities building.
2. Height of tank to be less than height of buildings

Figure F8 Cugden Leagues Club - Ned Byrne Field Approx. Recycled Water Storage Tank Location

Figure F9 Ned Byrne Field Single Storage Tank (70 kL) Option and Irrigation Pump Compound



Note to above figure: Alternative to above tank is ~6.5m dia., ~2.9m tall tank for roughly same cost.

Figure F10 Existing Brick Toilet Block south east corner of Ned Byrne Field

Notes to above Figure:
1. Location of recycled water storage tank adjacent (to west) of toilet bock.
2. Height of tank to be less than height of toilet block

Appendix G Cost Spreadsheets

This appendix contains preliminary ("first order") cost estimates for the Stage 1 Kingscliff Recycled Water Scheme, including capital costs, operating and NPV.

Appendix G Kingscliff Recycled Water scheme Stage 1 **Cost Summary**

Total Gross Costs

Option	Cost	Say
Option 1, High Flow Golf Course from STP	$ 2,210,933	$ 2.2 Million
Option 2, Low Flow to Storage Tanks Golf Course form STP	$ 1,730,774	$ 1.7 Million
Option 3, High Flow Golf Course from Tweed Coast Rd	$ 2,274,068	$ 2.3 Million

Potential Reductions/Savings:

						Not Shared		Savings
1	Potential Savings from Shared Pipe Trench up to east side of existing STP	Diam.	Length	Pipe		Installation		(~50%)
	Option 1	250mm	3000	$ 215,000	$	325,000	=	$162,500
	Option 2	150mm	3000	$ 84,000	$	126,000	=	$ 63,000
	Option 3	250mm	3000	$ 215,000	$	325,000	=	$162,500

2	Golf Course Pipeline Costs							
	Option 1	for 700m of 100mm golf course pipeline						$ 70,000
	Option 2	for 700m of 100mm golf course pipeline						$ 70,000
	Option 3	for 550m of 100mm golf course pipeline						$ 55,000
3	Golf Course Pump Costs							
	Option 1	Golf Course pays	33%	of pump supply & installation	$	50,000	=	$ 16,500
	Option 2	Golf Course pays	50%	of pump supply & installation	$	40,000	=	$ 20,000
	Option 3	Golf Course pays	33%	of pump supply & installation	$	50,000	=	$ 16,500
4	Private Customer Tank Costs							
	Option 2 All above Ground	Customers Pay	100%	of tank construction costs	$	46,000	=	$ 46,000
	Option 2 Ned Byrne Underground, rest above ground	Customers Pay	100%	of tank construction costs	$	60,000	=	$ 60,000
5	Buffer Storage shared wall (87m^2 prefab) with CCT							
	Option 1 and 3	(25m^3 less concr.)	20%	savings on full buffer storage	$	150,000	=	$ 30,000

6	Recycled water main over canal using existing Sewer Pylon Pipe Bridge. Two alternatives:				Cost	Boring/sleeve/connect		
	(i) Attach new 250mm DICL recycled water pipe to bridge & connect to recycled water main				$ 35,000			
	(ii) If redundant, retain & connect 225mm DICL sewer main over canal to new RW main				$ 10,000			
	Options 1&3					$ 85,000		$ 50,000
	Option 2					$ 59,600		$ 24,600

Revised Lower Cost with Potential Reductions/Savings (1 to 6 as above)

Option	Cost	Say	Total Savings
Option 1, High Flow Golf Course from STP	$ 1,881,933	$ 1.9 Million	$329,000
Option 2, Low Flow to Storage Tanks Golf Course from STP	$ 1,507,174	$ 1.5 Million	$223,600
Option 3, High Flow Golf Course from Tweed Coast Rd	$ 1,960,068	$ 2.0 Million	$314,000

(Note: additional $25000 saving for all options if the existing 225mm DICL sewer main over the canal becomes available for recycled water scheme.)

Revised Higher Costs for Option 2 Underground Storage Tanks

Option	Cost	Say	Total Additional Cost
Option 1, High Flow Golf Course from STP	$ 1,881,933	$ 1.9 Million	
Option 2, Low Flow to Storage Tanks Golf Course from STP	$ 1,592,174	$ 1.6 Million	$ 85,000
Option 3, High Flow Golf Course from Tweed Coast Rd	$ 1,960,068	$ 2.0 Million	

Kingscliff Recycled Water Scheme

Table B1 - Option 1 - Cost Estimate for Peak Irrigation Pressure System excluding Golf Course

Item	Description	Number of	Best Case	Medium Case	Worst Case				
1	**Pump Station Costs at WWTP (excluding supply pipeline) 37.6L/s @50m**								
1.1	Pump station insitu concrete slab (no pumphouse building)	1	$ 10,000	$ 12,000	$ 14,000				
1.2	Supply & installation of 3 pumps	1	$ 40,000	$ 50,000	$ 60,000	1/3 Cost allocation to Golf Course			
1.3	Supply & installation of associated pipework, pipe supports, pump valves, fittings, etc	1	$ 20,000	$ 25,000	$ 30,000				
1.4	Supply & Installation of Auto Backwash Filter, associated pipework, valves, fittings, etc	1	$ 20,000	$ 25,000	$ 30,000				
1.5	Supply & Installation of switchboard (power distribution & metering)	1	$ 20,000	$ 25,000	$ 30,000				
1.6	Electrical, Power Mains, pump cabling, isolators, general lighting & power outlets	1	$ 15,000	$ 20,000	$ 25,000				
1.7	Buffer Storage Tank d/s of CCT (320 cubic metres concrete tank)	1	$ 120,000	$ 150,000	$ 180,000				
	Sub total Item 1		**$ 245,000**	**$ 307,000**	**$ 369,000**		**15%**	**14%**	**13%**
2	**Canal Crossing - Bore Under Canal**								
2.1	ϕ300 DICL Sleeved Pipe	60	$ 11,400	$ 15,000	$ 19,800				
2.2	Boring Cost	1	$ 50,000	$ 60,000	$ 70,000				
2.3	Connection to recycled water main, flanges, valves, pits	1	$ 8,000	$ 10,000	$ 12,000				
	Sub total Item 2		**$ 69,400**	**$ 85,000**	**$ 101,800**		**4%**	**4%**	**3%**
3	**Recycled Water Supply Infrastructure**								
3.1	Sections A to F: ϕ250 uPVC trunkmain from WWTP to Jack Bayliss Park (JBP) juncture	3,600 m	$ 648,000	$ 864,000	$ 1,152,000				
3.2	Section G: ϕ100 uPVC pipework from JBP juncture to JBP South	260 m	$ 13,000	$ 26,000	$ 40,560				
3.3	Section G: ϕ100 uPVC pipework from JBP South to Kingscliff Bowls Club	260 m	$ 13,000	$ 26,000	$ 40,560				
3.4	Section H: ϕ200 uPVC pipework from JBP juncture to JBP North	900 m	$ 81,000	$ 139,500	$ 207,000				
3.5	Section I: ϕ200 uPVC pipework from JBP North to Reg Dalton juncture	370 m	$ 33,300	$ 57,350	$ 85,100				
3.6	Section J: ϕ100 uPVC pipework from Reg Dalton juncture to Reg Dalton Oval	200 m	$ 10,000	$ 20,000	$ 31,200				
3.7	Section K: ϕ200 uPVC pipework from Reg Dalton juncture to Ned Byrne juncture	340 m	$ 30,600	$ 52,700	$ 78,200				
3.8	Section L: ϕ100 uPVC pipework from Ned Byrne juncture to Cudgen Bowling Greens	135 m	$ 6,750	$ 13,500	$ 21,060				
3.9	Section M: ϕ200 uPVC pipework from Ned Byrne juncture to Walter Peate Res.	200 m	$ 18,000	$ 31,000	$ 46,000				
3.10	Chinderah Golf Course Pipe: ϕ100 uPVC trunkmain from WWTP to Golf Course dam	700 m	$ 35,000	$ 70,000	$ 109,200	Cost allocation to Golf Course			
	Sub total Item 3		**$ 888,650**	**$ 1,300,050**	**$ 1,810,880**		**56%**	**59%**	**61%**
4	**Irrigation Infrastructure**								
	South Line								
4.1	Jack Bayliss Park South								
4.1.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.1.2	Irrigation infrastructure supply and installation - 0.7L/s @ 20m	1	$ 14,250	$ 19,000	$ 23,750				
4.2	Kingscliff Bowls								
4.2.2	Storage Tank (not required)	1	$ -	$ -	$ -				
4.2.2	Irrigation Infrastructure supply and installation - 0.9L/s @ 20m	1	$ 4,500	$ 6,000	$ 7,500				
	North Line								
4.3	Jack Bayliss Park North								
4.3.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.3.2	Irrigation infrastructure supply and installation - 3.7L/s @ 20m	1	$ 36,000	$ 48,000	$ 60,000				
4.4	Reg Dalton Oval								
4.4.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.4.2	Irrigation infrastructure (8.7L/s @ 20m) supply and installation,	1	$ 11,625	$ 15,500	$ 19,375				
4.5	Walter Peate Reserve								
4.5.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.5.2	Irrigation infrastructure (25L/s @ 20m) supply and installation	1	$ 6,750	$ 9,000	$ 11,250				
4.6	Ned Byrne Field & Cudgen Leagues Bowls								
4.6.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.6.2	Irrigation infrastructure (3L/s @ 20m) supply & installation	1	$ 6,000	$ 8,000	$ 10,000				
	Sub total Item 4		**$ 79,125**	**$ 105,500**	**$ 131,875**		**5%**	**5%**	**4%**
5	**Preliminaries, Site Establishment, Cleanup and Commisioning**								
5.1	Preliminaries, Site Establishment	1	$ 80,000	$ 100,000	$ 120,000				
5.2	Site Cleanup, Demobilisation	1	$ 10,000	$ 12,500	$ 15,000				
5.3	Commisioning & Defects	1	$ 10,000	$ 12,500	$ 15,000		**1%**	**1%**	**1%**
	Sub total for Item 5		**$ 100,000**	**$ 125,000**	**$ 150,000**				
							0%	**0%**	**0%**
	Sub total for scheme		**$ 1,382,175**	**$ 1,922,550**	**$ 2,563,555**				
6	**Design and Administration Costs**								
6.1	Investigation, approvals, design, tender/contract documentation	1	$ 138,218	$ 192,255	$ 256,356				
6.2	Tweed Shire contract admin. & supervision, corporate overheads	1	$ 69,109	$ 96,128	$ 128,178				
	Sub total Item 6		**$ 207,326**	**$ 288,383**	**$ 384,533**		**13%**	**13%**	**13%**
	TOTAL for Scheme		**$ 1,589,501**	**$ 2,210,933**	**$ 2,948,088**		**100%**	**100%**	**100%**
		Say							

Basis of Costs

1. Pump station costs based on other recent projects and supplier costs.
2. Pipe rates based on compiled data from MWH projects and water authorities.

The following rates have been used

Pipe Details	Best Case	Medium Case	Worst Case	Price from Vini	Tyco Water	Tycowater
ϕ300 uPVC / DICL	$ 190	$ 250	$ 330	$ 111	$ 93	$ 83
ϕ250 uPVC	$ 180	$ 240	$ 320	$ 72	$ 79	$ 62
ϕ200 uPVC	$ 90	$ 155	$ 230	$ 46	$ 50	$ 42
ϕ150 uPVC	$ 70	$ 140	$ 200	$ 28	$ 30	$ 21
ϕ100 uPVC	$ 50	$ 100	$ 156	$ 14	$ 15	$ 13
ϕ80 uPVC	$ 45	$ 95	$ 151	$ 8	$ 10	-

3.Typical contingencies of 20% have been applied to the medium case and more conservative contingencies of 50% have been applied for the worst case

4. Irrigation Infrastructure Costs

(copy of table used for calcutlation in Table B2)

Prices for supply of water tank	Pioneer	Nylex Plastank	Australian Panel Tanks	Note: APT 2.8m tall
Jack Bayliss Park South Storage Tank ***Design 40KL***	$ 15,665	$ 5,020	$ 11,700	
Kingscliff Bowls Storage Tank ***Design 24KL***	-	$ 2,420	$ 10,351	
Jack Bayliss Park North Storage Tank ***Design 200KL***	$ 42,976		$ 26,800	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488		$ 21,364	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 64,464		$ 39,300	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488		$ 15,960	

Storage Tank Construction Construction costs	Tank	Foundations / Earthworks	Geotech Investigation	Tank Valves and Fittings	2m high Fencing	Warning Signage	Tank Sub Total	
Jack Bayliss Park South Storage Tank *Design 40KL (if required)*	*$ 5,020*	*$ 8,000*	*$ 1,000*	*$ 1,000*	*$ 500*	*$ 100*	*$ 15,620*	***No tank req'd***
Jack Bayliss Park North Storage Tank *Design 200KL (if required)*	*$ 26,800*	*$ 15,000*	*$ 6,000*	*$ 5,000*	*$ 3,000*	*$ 200*	*$ 56,000*	***No tank req'd***
Kingscliff Bowls Storage Tank ***Design 24KL***	$ 2,420	$ 2,000	$ 500	$ 500	$ 500	$ 100	$ 6,020	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488	$ 12,000	$ 5,000	$ 3,000	$ 1,500	$ 200	$ 43,188	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 39,300	$ 22,000	$ 10,000	$ 9,000	$ 4,000	$ 400	$ 84,700	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488	$ 12,000	$ 3,000	$ 2,000	$ 1,000	$ 300	$ 39,788	

Irrigation Infrastructure Costings	Water Meter (TSC)	Connect to RW main, valves	Irrigation control system	Potable Backflow Valve & Backup Supply	Irrigation Pump Station Suuply/Inst.	Irrigation Sprinkler Network	Infrastr. Sub Total	Ha Irrigated	Existing Irrig Pump?
Jack Bayliss Park South, Sub Soil Irrigation (0.7l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 12,000	$ 19,000	0.8	No pump req'd
Kingscliff Bowls (0.9 l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ -	-	$ 6,000	Existing	No pump req'd
Jack Bayliss Park North, Sub Soil Irrigation (3.5 l/s @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 40,000	$ 48,000	4	No
Reg Dalton (oval existing, plus new spray irrigation for Hockey) (8.7 l/s @ 20m head)	$ 3,000.00	$ 3,000.00	$ 1,000.00	$ 1,000.00	$ -	$ 7,500	$ 15,500	0.5	Yes but upgrade needed
Walter Peate Reserve (25 l/s @ 20m head)	$ 3,000.00	$ 4,000.00	$ 1,000.00	$ 1,000.00	$ -	-	$ 9,000	Existing	No
Ned Byrne Field & Cudgen Leagues Bowls (2.5 l/s & 0.5 l/s respectively @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	-	$ 8,000	Existing	Yes

Irrigation System Installation Rates	$ / Hectare
Pop up Surface Spray	
Best Case	$ 8,000.00
Medium	$ 12,000.00
Worst	$ 16,000.00
Sub-Soil Irrigation	
Best Case	$ 10,000.00
Medium	$ 15,000.00
Worst	$ 20,000.00

Kingscliff Recycled Water Scheme

Table B2 - Option 2 - Cost Estimate for Daily Demand Storage Tanks System excluding Golf Course

Item	Description	Number of	Best Case	Medium Case	Worst Case				
1	**Pump Station Costs at WWTP (excluding supply pipeline) 21L/s @50m**								
1.1	Pump station insitu concrete slab (no pumphouse building)	1	$ 10,000	$ 12,000	$ 14,000				
1.2	Supply & installation of 2 pumps	1	$ 35,000	$ 40,000	$ 45,000	1/2 Cost allocation to Golf Course			
1.3	Supply & installation of associated pipework, pipe supports, pump valves, fittings, etc	1	$ 15,000	$ 20,000	$ 25,000				
1.4	Supply & Installation of Auto Backwash Filter, associated pipework, valves, fittings, etc	1	$ 15,000	$ 20,000	$ 25,000				
1.5	Supply & Installation of switchboard (power distribution & metering)	1	$ 20,000	$ 25,000	$ 30,000				
1.6	Electrical, Power Mains, pump cabling, isolators, general lighting & power outlets	1	$ 15,000	$ 20,000	$ 25,000				
1.7	Buffer Storage Tank d/s of CCT (not required for option 2)	1	$ -	$ -	$ -				
	Sub total Item 1		**$ 110,000**	**$ 137,000**	**$ 164,000**		**10%**	**8%**	**7%**
2	**Canal Crossing - Bore Under Canal**								
2.1	200ϕ DICL Sleeved Pipe	60	$ 6,000	$ 9,600	$ 14,400				
2.2	Boring Cost	1	$ 30,000	$ 40,000	$ 50,000				
2.3	Connection to recycled water main, flanges, valves, pits	1	$ 8,000	$ 10,000	$ 12,000				
	Sub total Item 2		**$ 44,000**	**$ 59,600**	**$ 76,400**		**4%**	**3%**	**3%**
3	**Recycled Water Supply Infrastrucure**								
3.1	Sections A to F: ϕ150 uPVC trunkmain from WWTP to Jack Bayliss Park (JBP) juncture	3,600 m	$ 252,000	$ 504,000	$ 720,000				
3.2	Section G: ϕ80 uPVC pipework from JBP juncture to JBP South	260 m	$ 11,700	$ 24,700	$ 39,260				
3.3	Section G: ϕ80 uPVC pipework from JBP South to Kingscliff Bowls Club	260 m	$ 11,700	$ 24,700	$ 39,260				
3.4	Section H: ϕ**150** uPVC pipework from JBP juncture to JBP North	900 m	$ 63,000	$ 126,000	$ 180,000				
3.5	Section I: ϕ100 uPVC pipework from JBP North to Reg Dalton juncture	370 m	$ 18,500	$ 37,000	$ 57,720				
3.6	Section J: ϕ80 uPVC pipework from Reg Dalton juncture to Reg Dalton Oval	200 m	$ 9,000	$ 19,000	$ 30,200				
3.7	Section K: ϕ100 uPVC pipework from Reg Dalton juncture to Ned Byrne juncture	400 m	$ 20,000	$ 40,000	$ 62,400				
3.8	Section L: ϕ80 uPVC pipework from Ned Byrne juncture to Cudgen Bowling Greens	135 m	$ 6,075	$ 12,825	$ 20,385				
3.9	Section M: ϕ80 uPVC pipework from Ned Byrne juncture to Walter Peate Res.	200 m	$ 9,000	$ 19,000	$ 30,200				
3.10	Chinderah Golf Course Pipe: ϕ100 uPVC trunkmain from WWTP to Golf Course dam	700 m	$ 35,000	$ 70,000	$ 109,200	Cost allocation to Golf Course			
	Sub total Item 3		**$ 435,975**	**$ 877,225**	**$ 1,288,625**		**41%**	**51%**	**54%**
4	**Irrigation Infrastructure**								
	South Line								
4.1	Jack Bayliss Park South								
4.1.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.1.2	Irrigation infrastructure supply and installation - 0.7L/s @ 20m	1	$ 14,250	$ 19,000	$ 23,750				
4.2	Kingscliff Bowls								
4.2.2	Storage Tank (25kl) Installed	1	$ 4,515	$ 6,020	$ 7,525				
4.2.2	Irrigation Infrastructure supply and installation - 0.9L/s @ 20m	1	$ 4,500	$ 6,000	$ 7,500				
	North Line								
4.3	Jack Bayliss Park North								
4.3.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.3.2	Irrigation infrastructure supply and installation - 3.7L/s @ 20m	1	$ 36,000	$ 48,000	$ 60,000				
4.4	Reg Dalton Oval								
4.4.1	Storage Tank (125kl) Installed	1	$ 32,391	$ 43,188	$ 53,985				
4.4.2	Irrigation infrastructure & pump (8.7L/s @ 20m) supply and installation,	1	$ 18,375	$ 24,500	$ 30,625				
4.5	Walter Peate Reserve								
4.5.1	Storage Tank (360kl) Installed	1	$ 63,525	$ 84,700	$ 105,875				
4.5.2	Irrigation infrastructure & pump (25L/s @ 20m) supply and installation	1	$ 20,250	$ 27,000	$ 33,750				
4.6	Ned Byrne Field & Cudgen Leagues Bowls								
4.6.1	Storage Tank (85kl) Installed	1	$ 29,841	$ 39,788	$ 49,735	$ 173,696	Total Storage Tank Costs		
4.6.2	Irrigation infrastructure & pump (3L/s @ 20m) supply & installation	1	$ 6,000	$ 8,000	$ 10,000				
	Sub total Item 4		**$ 229,647**	**$ 306,196**	**$ 382,745**		**22%**	**18%**	**16%**
5	**Preliminaries, Site Establishment, Cleanup and Commisioning**								
5.1	Preliminaries, Site Establishment	1	$ 80,000	$ 100,000	$ 120,000				
5.2	Site Cleanup, Demobilisation	1	$ 10,000	$ 12,500	$ 15,000				
5.3	Commisioning & Defects	1	$ 10,000	$ 12,500	$ 15,000		**1%**	**1%**	**1%**
	Sub total for Item 5		**$ 100,000**	**$ 125,000**	**$ 150,000**				
							0%	**0%**	**0%**
	Sub total for scheme		**$ 919,622**	**$ 1,505,021**	**$ 2,061,770**				
6	**Design and Administration Costs**								
6.1	Investigation, approvals, design, tender/contract documentation	1	$ 91,962	$ 150,502	$ 206,177				
6.2	Tweed Shire contract admin. & supervision, corporate overheads	1	$ 45,981	$ 75,251	$ 103,089				
	Sub total Item 6		**$ 137,943**	**$ 225,753**	**$ 309,266**		**13%**	**13%**	**13%**
8	**TOTAL for Scheme**		**$ 1,057,565**	**$ 1,730,774**	**$ 2,371,036**		**100%**	**100%**	**100%**
		Say							

Kingscliff Recycled Water Scheme

Table B2 - Option 2 - Cost Estimate for Daily Demand Storage Tanks System excluding Golf Course

Item	Description	Number of	Best Case	Medium Case	Worst Case

Basis of Costs

1. Pump station costs based on other recent projects and supplier costs.
2. Pipe rates based on compiled data from MWH projects and water authorities.
The following rates have been used

Pipe Details	Best Case	Medium Case	Worst Case	Price from Vini	Tyco Water
ϕ200 uPVC	$ 100	$ 160	$ 240	$ 47	$ 50
ϕ150 uPVC	$ 70	$ 140	$ 200	$ 28	$ 30
ϕ100 uPVC	$ 50	$ 100	$ 156	$ 14	$ 15
ϕ80 uPVC	$ 45	$ 95	$ 151	$ 8	$ 10
DICL	$ 70	$ 140	$ 200		

3.Typical contingencies of 20% have been applied to the medium case and more conservative contingencies of 50% have been applied for the worst case

4. Irrigation Infrastructure Costs
(copy of table used for calculation in Table B2)

Prices for supply of water tank	Pioneer	Nylex Plastank	Australian Panel Tanks	Note: APT 2.8m tall
Jack Bayliss Park South Storage Tank ***Design 40KL***	$ 15,665	$ 5,020	$ 11,700	
Kingscliff Bowls Storage Tank ***Design 24KL***	-	$ 2,420	$ 10,351	
Jack Bayliss Park North Storage Tank ***Design 200KL***	$ 42,976		$ 26,800	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488		$ 21,364	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 64,464		$ 39,300	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488		$ 15,960	

Storage Tank Construction Construction costs	Tank	Foundations / Earthworks	Geotech Investigation	Tank Valves and Fittings	2m high Fencing	Warning Signage	Tank Sub Total	
Jack Bayliss Park South Storage Tank ***Design 40KL (if required)***	***$ 5,020***	***$ 8,000***	***$ 1,000***	***$ 1,000***	***$ 500***	***$ 100***	***$ 15,620***	***No tank req'd***
Jack Bayliss Park North Storage Tank ***Design 200KL (if required)***	***$ 26,800***	***$ 15,000***	***$ 6,000***	***$ 5,000***	***$ 3,000***	***$ 200***	***$ 56,000***	***No tank req'd***
Kingscliff Bowls Storage Tank ***Design 24KL***	$ 2,420	$ 2,000	$ 500	$ 500	$ 500	$ 100	$ 6,020	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488	$ 12,000	$ 5,000	$ 3,000	$ 1,500	$ 200	$ 43,188	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 39,300	$ 22,000	$ 10,000	$ 9,000	$ 4,000	$ 400	$ 84,700	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488	$ 12,000	$ 3,000	$ 2,000	$ 1,000	$ 300	$ 39,788	

Irrigation Infrastructure Costings	Water Meter (TSC)	Connect to RW main, valves	Irrigation control system	Potable Backflow Valve & Backup Supply	Irrigation Pump Station Suuply/Inst.	Irrigation Sprinkler Network	Infrastr. Sub Total	Ha Irrigated	Existing Irrig Pump?
Jack Bayliss Park South, Sub Soil Irrigation (0.7l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 12,000	$ 19,000.00	0.8	No pump req'd
Kingscliff Bowls (0.9 l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ -	-	$ 6,000.00	Existing	No pump req'd
Jack Bayliss Park North, Sub Soil Irrigation (3.5 l/s @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 40,000	$ 48,000.00	4	No
Reg Dalton (oval existing, plus new spray irrigation for Hockey) (8.7 l/s @ 20m head)	$ 3,000.00	$ 2,000.00	$ 1,000.00	$ 1,000.00	$ 10,000	$ 7,500	$ 24,500.00	0.5	Yes but upgrade needed
Walter Peate Reserve (25 l/s @ 20m head)	$ 3,000.00	$ 2,000.00	$ 1,000.00	$ 1,000.00	$ 20,000	-	$ 27,000.00	Existing	No
Ned Byrne Field & Cudgen Leagues Bowls (2.5 l/s & 0.5 l/s respectively @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	-	$ 8,000.00	Existing	Yes

Irrigation System Installation Rates	$ / Hectare
Pop up Surface Spray	
Best Case	$ 8,000.00
Medium	$ 12,000.00
Worst	$ 16,000.00
Sub-Soil Irrigation	
Best Case	$ 10,000.00
Medium	$ 15,000.00
Worst	$ 20,000.00

Kingscliff Recycled Water Scheme

Table B3 - Option 3 - Cost Estimate for Peak Irrigation Pressure System including Golf Course

Item	Description	Number of	Best Case	Medium Case	Worst Case				
1	**Pump Station Costs at WWTP (excluding supply pipeline) 37.6L/s @50m**								
1.1	Pump station insitu concrete slab (no pumphouse building)	1	$ 10,000	$ 12,000	$ 14,000				
1.2	Supply & installation of 3 pumps	1	$ 40,000	$ 50,000	$ 60,000	1/3 Cost allocation to Golf Course			
1.3	Supply & installation of associated pipework, pipe supports, pump valves, fittings, etc	1	$ 20,000	$ 25,000	$ 30,000				
1.4	Supply & Installation of Auto Backwash Filter, associated pipework, valves, fittings, etc	1	$ 20,000	$ 25,000	$ 30,000				
1.5	Supply & Installation of switchboard (power distribution & metering)	1	$ 20,000	$ 25,000	$ 30,000				
1.6	Electrical, Power Mains, pump cabling, isolators, general lighting & power outlets	1	$ 15,000	$ 20,000	$ 25,000				
1.7	Buffer Storage Tank d/s of CCT (320 cubic metres concrete tank)	1	$ 120,000	$ 150,000	$ 180,000				
	Sub total Item 1		**$ 245,000**	**$ 307,000**	**$ 369,000**		**15%**	**14%**	**12%**
2	**Canal Crossing - Bore Under Canal**								
2.1	ϕ300 DICL Sleeved Pipe	60	$ 11,400	$ 15,000	$ 19,800				
2.2	Boring Cost	1	$ 50,000	$ 60,000	$ 70,000				
2.3	Connection to recycled water main, flanges, valves, pits	1	$ 8,000	$ 10,000	$ 12,000				
	Sub total Item 2		**$ 69,400**	**$ 85,000**	**$ 101,800**		**4%**	**4%**	**3%**
3	**Recycled Water Supply Infrastructure**								
3.1	Sections A to F: ϕ250 uPVC trunkmain from WWTP to Jack Bayliss Park (JBP) juncture	3,600 m	$ 648,000	$ 864,000	$ 1,152,000				
3.2	Section G: ϕ100 uPVC pipework from JBP juncture to JBP South	260 m	$ 13,000	$ 26,000	$ 40,560				
3.3	Section G: ϕ100 uPVC pipework from JBP South to Kingscliff Bowls Club	260 m	$ 13,000	$ 26,000	$ 40,560				
3.4	Section H: ϕ250 uPVC pipework from JBP juncture to JBP North	900 m	$ 162,000	$ 216,000	$ 288,000				
3.5	Section I: ϕ200 uPVC pipework from JBP North to Reg Dalton juncture	370 m	$ 33,300	$ 57,350	$ 85,100				
3.6	Section J: ϕ100 uPVC pipework from Reg Dalton juncture to Reg Dalton Oval	200 m	$ 10,000	$ 20,000	$ 31,200				
3.7	Section K: ϕ200 uPVC pipework from Reg Dalton juncture to Ned Byrne juncture	340 m	$ 30,600	$ 52,700	$ 78,200				
3.8	Section L: ϕ100 uPVC pipework from Ned Byrne juncture to Cudgen Bowling Greens	135 m	$ 12,150	$ 18,900	$ 27,000				
3.9	Section M: ϕ200 uPVC pipework from Ned Byrne juncture to Walter Peate Res.	200 m	$ 9,000	$ 19,000	$ 30,200				
3.10	Chinderah Golf Course ϕ100 uPVC pipe from Tweed Coast Rd to Golf Course Dam	550 m	$ 27,500	$ 55,000	$ 85,800	Cost allocation to Golf Course			
	Sub total Item 3		**$ 958,550**	**$ 1,354,950**	**$ 1,858,620**		**57%**	**60%**	**62%**
4	**Irrigation Infrastructure**								
	South Line								
4.1	Jack Bayliss Park South								
4.1.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.1.2	Irrigation infrastructure supply and installation - 0.7L/s @ 20m	1	$ 14,250	$ 19,000	$ 23,750				
4.2	Kingscliff Bowls								
4.2.2	Storage Tank (not required)	1	$ -	$ -	$ -				
4.2.2	Irrigation Infrastructure supply and installation - 0.9L/s @ 20m	1	$ 4,500	$ 6,000	$ 7,500				
	North Line								
4.3	Jack Bayliss Park North								
4.3.1	Storage Tank (not required for any options)	1	$ -	$ -	$ -				
4.3.2	Irrigation infrastructure supply and installation - 3.7L/s @ 20m	1	$ 36,000	$ 48,000	$ 60,000				
4.4	Reg Dalton Oval								
4.4.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.4.2	Irrigation infrastructure & pump (8.7L/s @ 20m) supply and installation,	1	$ 11,625	$ 15,500	$ 19,375				
4.5	Walter Peate Reserve								
4.5.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.5.2	Irrigation infrastructure & pump (25L/s @ 20m) supply and installation	1	$ 6,750	$ 9,000	$ 11,250				
4.6	Ned Byrne Field & Cudgen Leagues Bowls								
4.6.1	Storage Tank (not required)	1	$ -	$ -	$ -				
4.6.2	Irrigation infrastructure & pump (3L/s @ 20m) supply & installation	1	$ 6,000	$ 8,000	$ 10,000				
	Sub total Item 4		**$ 79,125**	**$ 105,500**	**$ 131,875**		**5%**	**5%**	**4%**
5	**Preliminaries, Site Establishment, Cleanup and Commisioning**								
5.1	Preliminaries, Site Establishment	1	$ 80,000	$ 100,000	$ 120,000				
5.2	Site Cleanup, Demobilisation	1	$ 10,000	$ 12,500	$ 15,000				
5.3	Commisioning & Defects	1	$ 10,000	$ 12,500	$ 15,000		**1%**	**1%**	**0%**
	Sub total for Item 5		**$ 100,000**	**$ 125,000**	**$ 150,000**				
							0%	**0%**	**0%**
	Sub total for scheme		**$ 1,452,075**	**$ 1,977,450**	**$ 2,611,295**				
6	**Design and Administration Costs**								
6.1	Investigation, approvals, design, tender/contract documentation	1	$ 145,208	$ 197,745	$ 261,130				
6.2	Tweed Shire contract admin. & supervision, corporate overheads	1	$ 72,604	$ 98,873	$ 130,565				
	Sub total Item 6		**$ 217,811**	**$ 296,618**	**$ 391,694**		**13%**	**13%**	**13%**
8	**TOTAL for Scheme**		**$ 1,669,886**	**$ 2,274,068**	**$ 3,002,989**		**100%**	**100%**	**100%**
		Say							

Basis of Costs

1. Pump station costs based on other recent projects and supplier costs.
2. Pipe rates based on compiled data from MWH projects and water authorities.

The following rates have been used

Pipe Details	Best Case	Medium Case	Worst Case	Price from Vini	Tyco Water	Tycowater
ϕ300 uPVC / DICL	$ 190	$ 250	$ 330	$ 111	$ 93	$ 83
ϕ250 uPVC	$ 180	$ 240	$ 320	$ 72	$ 79	$ 62
ϕ200 uPVC	$ 90	$ 155	$ 230	$ 46	$ 50	$ 42
ϕ150 uPVC	$ 70	$ 140	$ 200	$ 28	$ 30	$ 21
ϕ100 uPVC	$ 50	$ 100	$ 156	$ 14	$ 15	$ 13
ϕ80 uPVC	$ 45	$ 95	$ 151	$ 8	$ 10	-

3.Typical contingencies of 20% have been applied to the medium case and more conservative contingencies of 50% have been applied for the worst case

4. Irrigation Infrastructure Costs

(copy of table used for calculation in Table B2)

Prices for supply of water tank	Pioneer	Nylex Plastank	Australian Panel Tanks	Note: APT 2.8m tall
Jack Bayliss Park South Storage Tank ***Design 40KL***	$ 15,665	$ 5,020	$ 11,700	
Kingscliff Bowls Storage Tank ***Design 24KL***	-	$ 2,420	$ 10,351	
Jack Bayliss Park North Storage Tank ***Design 200KL***	$ 42,976		$ 26,800	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488		$ 21,364	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 64,464		$ 39,300	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488		$ 15,960	

Storage Tank Construction Construction costs	Tank	Foundations / Earthworks	Geotech Investigation	Tank Valves and Fittings	2m high Fencing	Warning Signage	Tank Sub Total	
Jack Bayliss Park South Storage Tank ***Design 40KL (if required)***	***$ 5,020***	***$ 8,000***	***$ 1,000***	***$ 1,000***	***$ 500***	***$ 100***	***$ 15,620***	***No tank req'd***
Jack Bayliss Park North Storage Tank ***Design 200KL (if required)***	***$ 26,800***	***$ 15,000***	***$ 6,000***	***$ 5,000***	***$ 3,000***	***$ 200***	***$ 56,000***	***No tank req'd***
Kingscliff Bowls Storage Tank ***Design 24KL***	$ 2,420	$ 2,000	$ 500	$ 500	$ 500	$ 100	$ 6,020	
Reg Dalton Oval Storage Tank ***Design 125KL***	$ 21,488	$ 12,000	$ 5,000	$ 3,000	$ 1,500	$ 200	$ 43,188	
Walter Peate Reserve Storage Tank ***Design 360KL***	$ 39,300	$ 22,000	$ 10,000	$ 9,000	$ 4,000	$ 400	$ 84,700	
Ned Byrne Field & Cudgen Leagues Bowls Storage Tank ***Design 85KL***	$ 21,488	$ 12,000	$ 3,000	$ 2,000	$ 1,000	$ 300	$ 39,788	

Irrigation Infrastructure Costings	Water Meter (TSC)	Connect to RW main, valves	Irrigation control system	Potable Backflow Valve & Backup Supply	Irrigation Pump Station Suuply/Inst.	Irrigation Sprinkler Network	Infrastr. Sub Total	Ha Irrigated	Existing Irrig Pump?
Jack Bayliss Park South, Sub Soil Irrigation (0.7l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 12,000	$ 19,000	0.8	No pump req'd
Kingscliff Bowls (0.9 l/s @ 20m head)	$ 3,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ -	-	$ 6,000	Existing	No pump req'd
Jack Bayliss Park North, Sub Soil Irrigation (3.5 l/s @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	$ 40,000	$ 48,000	4	No
Reg Dalton (oval existing, plus new spray irrigation for Hockey) (8.7 l/s @ 20m head)	$ 3,000.00	$ 3,000.00	$ 1,000.00	$ 1,000.00	$ -	$ 7,500	$ 15,500	0.5	Yes but upgrade needed
Walter Peate Reserve (25 l/s @ 20m head)	$ 3,000.00	$ 4,000.00	$ 1,000.00	$ 1,000.00	$ -	-	$ 9,000	Existing	No
Ned Byrne Field & Cudgen Leagues Bowls (2.5 l/s & 0.5 l/s respectively @ 20m head)	$ 3,000.00	$ 2,000.00	$ 2,000.00	$ 1,000.00	$ -	-	$ 8,000	Existing	Yes

Irrigation System Installation Rates	$ / Hectare
Pop up Surface Spray	
Best Case	$ 8,000.00
Medium	$ 12,000.00
Worst	$ 16,000.00
Sub-Soil Irrigation	
Best Case	$ 10,000.00
Medium	$ 15,000.00
Worst	$ 20,000.00

Costs for Below Ground Storage Tanks at Kingscliff

			Concrete Volume m3					
Location	Capacity Kl	Radius m	Floor Slab (400mm) (40mPa)	Roof Slab (600mm) (40mPa)	Walls (300mm) (40mPa)	Total Concr	Surrounds	Total Excav
JB Park Sth	40	2.5	8	12	10	30	64	133
JB Park Nth 2m tank depth	200	5.6	40	60	21	121	134	456
Reg Dalton 2m tank depth	125	4.5	25	37.5	17	79	108	312
Walter Peate 2m tank depth	360	7.6	72	108	29	209	178	747
Ned Byrne 2m tank depth	85	3.7	17	25.5	14	56	90	231
JB Park Nth 3m tank depth	200	4.6	27	40	26	93	148	441
Reg Dalton 3m tank depth	125	3.6	17	25	21	62	119	306
Walter Peate 3m tank depth	360	6.2	48	72	35	155	195	710
Ned Byrne 3m tank depth	85	3.0	11	17	17	45	100	230

Location	Capacity Kl	Excavation in sand $10/m3	Dewatering $35/m2	Concrete Supply, inst. Re-inf, Formwork $1100/m3	Offsite Disposal of Spoil $5/m3	Geotech Inv. $	Tank Valves & Fittings $	Under ground tanks Total $	Compare with Above Ground $	Additional Costs for Underground tanks $
JB Park Sth	40	$ 1,334	$ 600	$ 32,463	$ 348	$ 1,000	$ 1,000	$ 34,744	$ 15,620	$ 19,124
JB Park Nth	200	$ 4,557	$ 3,000	$ 133,396	$ 1,606	$ 6,000	$ 5,000	$ 142,559	$ 56,000	$ 86,559
Reg Dalton	125	$ 3,120	$ 1,875	$ 87,246	$ 1,022	$ 5,000	$ 3,000	$ 93,263	$ 43,188	$ 50,075
Walter Peate	360	$ 7,465	$ 5,400	$ 229,390	$ 2,843	$ 10,000	$ 9,000	$ 245,098	$ 84,700	$ 160,398
Ned Byrne	85	$ 2,313	$ 1,275	$ 62,003	$ 707	$ 3,000	$ 2,000	$ 66,298	$ 39,788	$ 26,510
JB Park Nth 3m tank depth	200	$ 4,407	$ 2,000	$ 101,988	$ 1,464	$ 6,000	$ 5,000	$ 109,858	$ 56,000	$ 53,858
Reg Dalton 3m tank depth	125	$ 3,061	$ 1,250	$ 68,487	$ 936	$ 5,000	$ 3,000	$ 73,735	$ 43,188	$ 30,547
Walter Peate 3m tank depth	360	$ 7,104	$ 3,600	$ 170,444	$ 2,575	$ 10,000	$ 9,000	$ 183,723	$ 84,700	$ 99,023
Ned Byrne 3m tank depth	85	$ 2,299	$ 850	$ 49,847	$ 652	$ 3,000	$ 2,000	$ 53,648	$ 39,788	$ 13,860

				Say
Total Additional Costs for Underground Tank Options $	Reg Dalton, Walter Peate & Ned Byrne	2m deep tanks	$ 236,982	$ 240,000
	Reg Dalton, Walter Peate & Ned Byrne	3m deep tanks	$ 143,430	$ 145,000

Kingscliff Recycled Water Scheme Stage 1 O&M Costs for Options 1 & 3				
Equipment	Cost Calculation Basis	Sub totals $/Yr	Operating Costs $/Yr	Comments
Pump station				
Power Costs	20kW pump x 8hrs x 180 days x peak $0.2/kWhr =	$ 5,760		
	20kW pump x 4hrs x 180 days x off-peak $0.07/kWhr =	$ 1,008		
	40kW pump x 4hrs x 180 days x off-peak $0.07/kWhr =	$ 2,016		
	Total pumping power cost/year =		$ 8,784	TSC would get a more competitive (bulk) power tariff than that assumed here, therefore power costs could be lower (by ~25%)
Labour O&M	(2 visits x 1hr x 35 wks) + (2 visits x 5hrs) x $62.50/hr =		$ 5,000	2 major servicing visits per year, 35 regular checks during the year
Equipment replacement	2% of capital cost (~$300,000) =		$ 6,000	2% of capital for PS civil, mechanical and Electrical works
Pipeline				
O& M	0.25% of capital (~$1.4 Million) =		$ 3,500	0.25% of capital for pipeline, valve and fittings
TSC Storage Tanks				
O&M	0.25% of capital ($0) =		$ -	1 visit/yr per tank prior to irrigation season
Irrigation @ TSC Sites				~15% of Irrig. Equipment + ~7% of Irrigation Pump System
O&M	15% of irrig.capex ($100k)+ 7% of pump capex ($0) =		$ 1,500	(~5% pump operating power + 2% pump maintenance/repair)
	Total Options 1 and 3		**$ 25,000**	

Kingscliff Recycled Water Scheme Stage 1 O&M Costs for Option 2				
Equipment	Cost Calculation Basis	Sub totals $/Yr	Operating Costs $/Yr	Comments
Pump station				
Power Costs	20kW pump x 8hrs x 180 days x peak $0.2/kWhr =	$ 5,760		
	20kW pump x 8hrs x 180 days x off-peak $0.07/kWhr =	$ 2,016		
	Total pumping power cost/year =		$ 7,776	TSC would get a more competitive (bulk) power tariff than that assumed here, therefore power costs could be lower (by ~25%)
Labour O&M	(2 visits x 1hr x 35 wks) + (2 visits x 5hrs) x $62.50/hr =		$ 5,000	2 major servicing visits per year, 35 regular checks during the year
Equipment replacement	2% of capital cost (~140,000) =		$ 2,800	2% of capital for PS civil, mechanical and Electrical works
Pipeline				
O& M	0.25% of capital (~$0.9 Million) =		$ 2,250	0.25% of capital for pipeline, valve and fittings
TSC Storage Tanks				
O&M	0.25% of capital ($250,000) =		$ 625	1 visit/yr per tank prior to irrigation season
Irrigation @ TSC Sites				~15% of Irrig. Equipment + ~7% of Irrigation Pump System
O&M	15% of irrig.capex ($100k)+ 7% of pump capex ($30k) =		$ 3,600	(~5% pump operating power + 2% pump maintenance/repair)
	Total Option 2		**$ 22,000**	

Kingscliff Recycled Water Scheme Stage 1
NPV ANALYSIS

PROJECT	Kingscliff Recycled Water Scheme Stage 1

23//12/04

ASSUMPTIONS	
Start of Project	**2005**
Length of Evaluation	**25**
Estimated Project Life (years)	
Discount rate	**8%**

OPTION SUMMARY

Criteria	*Option 1*	*Option 2*	*Option 3*	*Option X*
CAPITAL COST	$1,900	$1,600	$2,000	$1,900
RECURRENT COSTS (25yr)	$650	$572	$650	$624
INCOME				
NPV	-$2,120	-$1,857	-$2,292	-$2,005

NOTES:

1. Option 1 is the Base Option
2. Enter data in the Project Heading and Project Data box on this page only.
3. Enter information for each option in the appropriate Worksheet.
4. Do not enter information in the red coloured areas.
5. Residual values, if applicable, should be calculated and included as income in the 25th year.

PROJECT	Kingscliff Recycled Water Scheme Stage 1

Option 1	High Flow, Direct irrigation, Separate Golf Course Pipe from STP

File Name: 831/001346

Date: 10-Mar-05

PROJECT DATA

Start of Project (financial year ending 30/6)	2006
Length of Evaluation (maximum 25 years)	25
Estimated Project Life	
Discount Rate (8% suggested)	8%
NPV	-$2,120

WORKSHEET

Sensitivity Factors:		
	Capital - Construction	1.00
	Capital - Other	1.00
	Recurrent - O & M	1.00
	Recurrent - Other	1.00
	Income	1.00

YEAR	COSTS ($,000s)				TOTAL COST	INCOME	NET CASH FLOW	PV 8%
	CAPITAL		RECURRENT					
	Construction	Other	O & M	OTHER				
0	$1,900	$0	$25	$0	$1,925	$20	-$1,905	-$1,905
1	$0	$0	$25	$0	$25	$20	-$5	-$5
2	$0	$0	$25	$0	$25	$20	-$5	-$4
3	$0	$0	$25	$0	$25	$20	-$5	-$4
4	$0	$0	$25	$0	$25	$0	-$25	-$18
5	$0	$0	$25	$0	$25	$0	-$25	-$17
6	$0	$0	$25	$0	$25	$0	-$25	-$16
7	$0	$0	$25	$0	$25	$0	-$25	-$15
8	$0	$0	$25	$0	$25	$0	-$25	-$14
9	$0	$0	$25	$0	$25	$0	-$25	-$13
10	$0	$0	$25	$0	$25	$0	-$25	-$12
11	$0	$0	$25	$0	$25	$0	-$25	-$11
12	$0	$0	$25	$0	$25	$0	-$25	-$10
13	$0	$0	$25	$0	$25	$0	-$25	-$9
14	$0	$0	$25	$0	$25	$0	-$25	-$9
15	$0	$0	$25	$0	$25	$0	-$25	-$8
16	$0	$0	$25	$0	$25	$0	-$25	-$7
17	$0	$0	$25	$0	$25	$0	-$25	-$7
18	$0	$0	$25	$0	$25	$0	-$25	-$6
19	$0	$0	$25	$0	$25	$0	-$25	-$6
20	$0	$0	$25	$0	$25	$0	-$25	-$5
21	$0	$0	$25	$0	$25	$0	-$25	-$5
22	$0	$0	$25	$0	$25	$0	-$25	-$5
23	$0	$0	$25	$0	$25	$0	-$25	-$4
24	$0	$0	$25	$0	$25	$0	-$25	-$4
25	$0	$0	$25	$0	$25	$0	-$25	-$4
								-$2,120

YEAR	COSTS				INCOME
	CAPITAL		RECURRENT		
	Construction	Other	O & M	OTHER	
0	$1,900		$25		$20
1			$25		$20
2			$25		$20
3			$25		$20
4			$25		
5			$25		
6			$25		
7			$25		
8			$25		
9			$25		
10			$25		
11			$25		
12			$25		
13			$25		
14			$25		
15			$25		
16			$25		
17			$25		
18			$25		
19			$25		
20			$25		
21			$25		
22			$25		
23			$25		
24			$25		
25			$25		
	$1,900		$650	$650	$80

NOTES:

1. Option 1 is the Base Option
2. Enter data in the Project Heading and Project Data box on this page only.
3. Enter information for each option in the appropriate Worksheet.
4. Do not enter information in the red coloured areas.
5. Residual values, if applicable, should be calculated and included as income in the 25th year.

PROJECT	Kingscliff Recycled Water Scheme Stage 1

Option 2	Low Flow Supply to Onsite Storage Tanks, Separate Golf Pipe from STP

File Name: 831/001346

Date: 10-Mar-05

WORKSHEET

PROJECT DATA

Start of Project (financial year ending 30/6)	2006
Length of Evaluation (maximum 25 years)	25
Estimated Project Life	
Discount Rate (8% suggested)	8%
NPV	-$1,857

Sensitivity Factors:

Capital - Construction	1.00
Capital - Other	1.00
Recurrent - O & M	1.00
Recurrent - Other	1.00
Income	1.00

YEAR	COSTS ($,000s)				TOTAL COST	INCOME	NET CASH FLOW	PV 8%
	CAPITAL		RECURRENT					
	Construction	Other	O & M	OTHER				
0	$1,600	$0	$22	$0	$1,622	$0	-$1,622	-$1,622
1	$0	$0	$22	$0	$22	$0	-$22	-$20
2	$0	$0	$22	$0	$22	$0	-$22	-$19
3	$0	$0	$22	$0	$22	$0	-$22	-$17
4	$0	$0	$22	$0	$22	$0	-$22	-$16
5	$0	$0	$22	$0	$22	$0	-$22	-$15
6	$0	$0	$22	$0	$22	$0	-$22	-$14
7	$0	$0	$22	$0	$22	$0	-$22	-$13
8	$0	$0	$22	$0	$22	$0	-$22	-$12
9	$0	$0	$22	$0	$22	$0	-$22	-$11
10	$0	$0	$22	$0	$22	$0	-$22	-$10
11	$0	$0	$22	$0	$22	$0	-$22	-$9
12	$0	$0	$22	$0	$22	$0	-$22	-$9
13	$0	$0	$22	$0	$22	$0	-$22	-$8
14	$0	$0	$22	$0	$22	$0	-$22	-$7
15	$0	$0	$22	$0	$22	$0	-$22	-$7
16	$0	$0	$22	$0	$22	$0	-$22	-$6
17	$0	$0	$22	$0	$22	$0	-$22	-$6
18	$0	$0	$22	$0	$22	$0	-$22	-$6
19	$0	$0	$22	$0	$22	$0	-$22	-$5
20	$0	$0	$22	$0	$22	$0	-$22	-$5
21	$0	$0	$22	$0	$22	$0	-$22	-$4
22	$0	$0	$22	$0	$22	$0	-$22	-$4
23	$0	$0	$22	$0	$22	$0	-$22	-$4
24	$0	$0	$22	$0	$22	$0	-$22	-$3
25	$0	$0	$22	$0	$22	$0	-$22	-$3
								-$1,857

YEAR	COSTS				INCOME
	CAPITAL		RECURRENT		
	Construction	Other	O & M	OTHER	
0	$1,600		$22		
1			$22		
2			$22		
3			$22		
4			$22		
5			$22		
6			$22		
7			$22		
8			$22		
9			$22		
10			$22		
11			$22		
12			$22		
13			$22		
14			$22		
15			$22		
16			$22		
17			$22		
18			$22		
19			$22		
20			$22		
21			$22		
22			$22		
23			$22		
24			$22		
25			$22		
		$1,600	$572	$572	$0

NOTES:

1. Option 1 is the Base Option
2. Enter data in the Project Heading and Project Data box on this page only.
3. Enter information for each option in the appropriate Worksheet.
4. Do not enter information in the red coloured areas.
5. Residual values, if applicable, should be calculated and included as income in the 25th year.

PROJECT	Kingscliff Recycled Water Scheme Stage 1

OPTION 3	High Flow, Direct irrigation, Golf Course Pipe from Tweed Coast Rd

File Name: 831/001346

Date: 10-Mar-05

WORKSHEET

PROJECT DATA

Start of Project (financial year ending 30/6)	2006
Length of Evaluation (maximum 25 years)	25
Estimated Project Life	
Discount Rate (8% suggested)	8%
NPV	-$2,292

Sensitivity Factors:

Capital - Construction	1.00
Capital - Other	1.00
Recurrent - O & M	1.00
Recurrent - Other	1.00
Income	1.00

YEAR	COSTS ($,000s)				TOTAL COST	INCOME	NET CASH FLOW	PV 8%
	CAPITAL		RECURRENT					
	Construction	Other	O & M	OTHER				
0	$2,000	$0	$25	$0	$2,025	$0	-$2,025	-$2,025
1	$0	$0	$25	$0	$25	$0	-$25	-$23
2	$0	$0	$25	$0	$25	$0	-$25	-$21
3	$0	$0	$25	$0	$25	$0	-$25	-$20
4	$0	$0	$25	$0	$25	$0	-$25	-$18
5	$0	$0	$25	$0	$25	$0	-$25	-$17
6	$0	$0	$25	$0	$25	$0	-$25	-$16
7	$0	$0	$25	$0	$25	$0	-$25	-$15
8	$0	$0	$25	$0	$25	$0	-$25	-$14
9	$0	$0	$25	$0	$25	$0	-$25	-$13
10	$0	$0	$25	$0	$25	$0	-$25	-$12
11	$0	$0	$25	$0	$25	$0	-$25	-$11
12	$0	$0	$25	$0	$25	$0	-$25	-$10
13	$0	$0	$25	$0	$25	$0	-$25	-$9
14	$0	$0	$25	$0	$25	$0	-$25	-$9
15	$0	$0	$25	$0	$25	$0	-$25	-$8
16	$0	$0	$25	$0	$25	$0	-$25	-$7
17	$0	$0	$25	$0	$25	$0	-$25	-$7
18	$0	$0	$25	$0	$25	$0	-$25	-$6
19	$0	$0	$25	$0	$25	$0	-$25	-$6
20	$0	$0	$25	$0	$25	$0	-$25	-$5
21	$0	$0	$25	$0	$25	$0	-$25	-$5
22	$0	$0	$25	$0	$25	$0	-$25	-$5
23	$0	$0	$25	$0	$25	$0	-$25	-$4
24	$0	$0	$25	$0	$25	$0	-$25	-$4
25	$0	$0	$25	$0	$25	$0	-$25	-$4
								-$2,292

YEAR	COSTS				INCOME
	CAPITAL		RECURRENT		
	Construction	Other	O & M	OTHER	
0	$2,000		$25		
1			$25		
2			$25		
3			$25		
4			$25		
5			$25		
6			$25		
7			$25		
8			$25		
9			$25		
10			$25		
11			$25		
12			$25		
13			$25		
14			$25		
15			$25		
16			$25		
17			$25		
18			$25		
19			$25		
20			$25		
21			$25		
22			$25		
23			$25		
24			$25		
25			$25		
	$2,000		$650	$650	$0

NOTES:

1. Option 1 is the Base Option
2. Enter data in the Project Heading and Project Data box on this page only.
3. Enter information for each option in the appropriate Worksheet.
4. Do not enter information in the red coloured areas.
5. Residual values, if applicable, should be calculated and included as income in the 25th year.

PROJECT	Kingscliff Recycled Water Scheme Stage 1

OPTION X	Option 1 with $15,000/Yr income from recycled water sales

File Name: 831/001346

Date: 10-Mar-05

PROJECT DATA

Start of Project (financial year ending 30/6)	2006
Length of Evaluation (maximum 25 years)	25
Estimated Project Life	
Discount Rate (8% suggested)	8%
NPV	-$2,005

WORKSHEET

Sensitivity Factors:		
	Capital - Construction	1.00
	Capital - Other	1.00
	Recurrent - O & M	1.00
	Recurrent - Other	1.00
	Income	1.00

YEAR	COSTS ($,000s)				TOTAL COST	INCOME	NET CASH FLOW	PV 8%
	CAPITAL		RECURRENT					
	Construction	Other	O & M	OTHER				
0	$1,900	$0	$24	$0	$1,924	$15	-$1,909	-$1,909
1	$0	$0	$24	$0	$24	$15	-$9	-$8
2	$0	$0	$24	$0	$24	$15	-$9	-$8
3	$0	$0	$24	$0	$24	$15	-$9	-$7
4	$0	$0	$24	$0	$24	$15	-$9	-$7
5	$0	$0	$24	$0	$24	$15	-$9	-$6
6	$0	$0	$24	$0	$24	$15	-$9	-$6
7	$0	$0	$24	$0	$24	$15	-$9	-$5
8	$0	$0	$24	$0	$24	$15	-$9	-$5
9	$0	$0	$24	$0	$24	$15	-$9	-$5
10	$0	$0	$24	$0	$24	$15	-$9	-$4
11	$0	$0	$24	$0	$24	$15	-$9	-$4
12	$0	$0	$24	$0	$24	$15	-$9	-$4
13	$0	$0	$24	$0	$24	$15	-$9	-$3
14	$0	$0	$24	$0	$24	$15	-$9	-$3
15	$0	$0	$24	$0	$24	$15	-$9	-$3
16	$0	$0	$24	$0	$24	$15	-$9	-$3
17	$0	$0	$24	$0	$24	$15	-$9	-$2
18	$0	$0	$24	$0	$24	$15	-$9	-$2
19	$0	$0	$24	$0	$24	$15	-$9	-$2
20	$0	$0	$24	$0	$24	$15	-$9	-$2
21	$0	$0	$24	$0	$24	$15	-$9	-$2
22	$0	$0	$24	$0	$24	$15	-$9	-$2
23	$0	$0	$24	$0	$24	$15	-$9	-$2
24	$0	$0	$24	$0	$24	$15	-$9	-$1
25	$0	$0	$24	$0	$24	$15	-$9	-$1
								-$2,005

YEAR	COSTS				INCOME
	CAPITAL		RECURRENT		
	Construction	Other	O & M	OTHER	
0	$1,900		$24		$15
1			$24		$15
2			$24		$15
3			$24		$15
4			$24		$15
5			$24		$15
6			$24		$15
7			$24		$15
8			$24		$15
9			$24		$15
10			$24		$15
11			$24		$15
12			$24		$15
13			$24		$15
14			$24		$15
15			$24		$15
16			$24		$15
17			$24		$15
18			$24		$15
19			$24		$15
20			$24		$15
21			$24		$15
22			$24		$15
23			$24		$15
24			$24		$15
25			$24		$15
		$1,900	$624	$624	$390

Appendix H Subsequent Investigation and Design Phases

The following investigation and design phases are needed to progress the Kingscliff Recycled water project. Next steps are "flagged' here in recognition of their importance as part of the wider scope of work necessary for approval of the Development Application process of TSC.

H1 Separate Development Application for the Recycled Water Scheme

The EIS for the new Kingscliff STP (GHD, December 2002), Section 4.1.2 refers to the need for the assessment of recycled water proposals under Part 4 of the EP&A Act 1979, whereby a separate Development Application is required for a recycled water proposal. This is distinct from the Development Application, which has already been approved for the new STP.

The Concept Design Study reported here is a starting point to support Tweed Shire Council's Development Application for the recycled water scheme.

H2 Management of Public Health

The irrigation layout and control systems will need to be designed to comply with NSW DEC guidelines as well as national guidelines for reclaimed water use including:

- Environmental Guidelines Use of Effluent by Irrigation (DEC, NSW Oct 2004);
- NSW Guidelines for Urban and Residential Use of Reclaimed Water (NSW Recycled Water Co-ordination Committee 1993), and
- National Water Quality Management Strategy Guidelines for Sewerage Systems: Reclaimed Water (ARMCANZ, ANZECC, NH&MRC 2000).

The proposed irrigation method and control systems for the foreshore areas and sporting ovals should be designed to ensure accurate watering rates and scheduling to ensure > 4 hour withholding period before public access and to minimise offsite spray drift. Watering on high use public areas will need to be restricted to overnight watering (eg. 11pm to 3am) to prevent exposure of humans to recycled water.

The detailed design should also incorporate a layout with appropriate setback distances and sprinkler systems with automatic wind direction and wind speed anemometer controls that are sensitive to wind drift impacts.

H3 Soil/Land Capability and Environmental Issues

The following environmental issues should be addressed to confirm the assumptions made in the Concept Design Study. These are normally analysed by field investigations (soil, geotechnical, hydrogeological) with the aid of modeling techniques and to support any Development Application:

A. Management of Nutrients

The ability of an area to assimilate the nutrients supplied (particularly nitrogen and phosphorus), is determined by soil characteristics, groundwater conditions and the type of vegetation to which the recycled water is applied.

The above parameters should be analysed so that the application is sustainable in the tong-term and thus avoids site run-off, excessive seepage to groundwater, potential high watertables, waterlogging and salinity problems and resultant vegetation damage (particularly on the foreshore).

B. Soils and Geology

Recycled water re-use studies require accurate information and site-specific data as input parameters to effective impact assessment. Without such information the confidence of recommendations is diminished and can provide misleading and speculative conclusions.

Soil and geological conditions should be assessed for all sites to evaluate the land capability for long term recycled water irrigation, which may have been modified by existing development and onsite activities and to effectively assess them for water, nutrient and salinity balance modeling.

C. Groundwater Issues

Determining an appropriate application rate of the irrigated recycled water based on the characteristics of the soil and plants, and their ability to assimilate that volume over the long-term without adverse environmental impact, is critical to prevention of groundwater pollution and excessive watertable rise. In Kingscliff hinterland and foreshore areas, the watertable is only about 1-2m below natural ground surface. The unconfined upper aquifer is also brackish – influenced by sea water intrusion.

An irrigation-scheduling model can be designed to assess plant demands and minimise excessive seepage to groundwater as far as practicable, but assuring adequate leaching fraction to prevent salt accumulation in the root zone..

H4 Stakeholder and Social Issues

The areas to be used as part of the recycled water scheme are subject to regular public access, as they include:

- Outdoor sporting venues (eg. Walter Peate Recreation Reserve, Reg Dalton Oval),
- Picnic / BBQ facilities (Jack Bayliss Park), and
- Major pedestrian corridors between residential / caravan parks and Dreamtime Beach foreshore areas.

In addition, private customer sites also have public and member access, but with ability to restrict access to the site's opening times including to Chinderah Golf Course, Kingscliff Bowls Club, and Cudgen Leagues Club (Rugby and Bowls).

The various interests in these areas, include:

- Stakeholder and community concerns (sporting groups, schools, etc.);
- Local interest groups (foreshore conservation and recreation groups);
- Native Title and Cultural Heritage issues (local indigenous communities);
- Land use and tenure of existing developments (local developers eg. Gales Holdings).

Stakeholder and community liaison with the various groups who use the sporting facilities and the foreshore areas is an essential part of Council's Development Application process.

Appendix I Other Potential Customers – Future Stages

This appendix contains a brief listing and description of possible additional recycled water customers, outside the Stage 1 area. Expected annual demands and expected watering times for these potential customers were listed in Table B1 in Appendix B. The feasibility of supplying these potential customers beyond stage 1, and the possibility of upsizing the Stage 1 infrastructure are for discussion purposes for the workshop on 15 March 2005.

I1 Stage 2 – Kingscliff's Southern Foreshore Areas to Cudgen Creek

Future sites and customers for Stage 2 could include:

- Kingscliff Surf Life Saving Club – subsoil irrigation
- Kingscliff Beach Holiday Park – subsoil irrigation
- Kingscliff Lions park – subsoil irrigation
- Faulks Park – subsoil irrigation
- Parker Rotary – sub-soil irrigation (could be in Stage 3 pipeline via Tafe College, etc)
- St Anthony's primary school (fields)
- Kingscliff Primary School (fields)
- Hansen Park (fields).

Total potential irrigation area ~4-5Ha, recycled water demand 20-25 ML/yr.

I2 Stage 3 – Kingscliff South to Cudgen Creek

Future sites and customers for Stage 3 could include:

- Future Driving Range – Gales Holdings Local Structure Plan proposal
- Future Hospital/Medical/Institutional Development (gardens/lawns) – Gales Holdings LSP proposal
- Market Gardens – close to Cudgen, adjacent to Tafe
- North Coast Institute of Tafe (Kingscliff Campus) – Header Tank on Tafe or Market garden land
- Kingscliff High School
- The Jack Julius Park – sub-soil
- Parker Rotary – sub-soil
- Cudgen Headland Reserve – utilise bridge to cross Cudgen Ck.

Note that it could be possible to form a ring main connecting to Stage 2 at Parker Rotary.

Total potential irrigation area of about 300-400Ha, potential volume 1500-2000 ML/Yr.

I3 Stage 4 – Agricultural Areas to the West

Future sites and customers for Stage 4 could include:

- Ti-Tree Farm (50Ha)– using existing 225mm PVC recycled water pipeline from current STP
- Cane Farms/Market Gardens – potential irrigation area of about 250-300Ha as far west as Pacific Hwy

Potential recycled water demand for Stage 3 is about 1500-1800 ML/Yr.

I4 Stage 5 – South Kingscliff

Future sites and customers for Stage 5 could include:

- Market Gardens – South of Cudgen along (west and east of) Tweed Coast Road
- Salt Development – open space watering (Salt South Kingscliff Central Park) – surface/subsoil
- Casuarina Beach township – open space watering – surface/subsoil
- Kings Forest developments – open space watering – surface/subsoil

Pipelines could follow routes of proposed sewer mains and watermains as proposed in Tweed Coast Strategy Development Control Plan No.51 (Version 1.0, Dec 2003).

Potential irrigation area of agricultural/market gardens areas about 500-600Ha. Potential recycled water demand ~2500-300 ML/Yr. Potential volume of use by the various South Kingscliff Developments would be similar to Kingscliff Stage 1 – ie. about 150-200 ML/Yr.