Assessment of Data Adequacy

The adequacy of catchment data, water resource data and urban water data is summarised below in Table A.1 to A.3.

While in most cases the available data is adequate, collation of data for this study was difficult due to the lack of a centralised data storage system and associated referencing system. Much of the available data was located in various reports throughout the Council. In many cases, the responsibility for the data that has been previously collected and its whereabouts was not widely known, making access to data more difficult.

Table A.1 *Adequacy of Catchment Data*

Characteristic	Data Type	Data Collected	Adequacy
Climate	Rainfall, evaporation, temperature	Monitored by Bureau of Meteorology	**Adequate**
Geology & Soils	Geologic features, soil types	Geologic and soils mapped and described by DIPNR	**Adequate**
	ASS	ASS mapped by Council	**Adequate**
Land Use	Land zonings	Zoning areas and types considered in LEP and SoE	**Adequate**
	Vegetation types	Distribution and condition mapped and considered in SoE	**Adequate**
	Riparian Vegetation	Distribution and condition mapped	**Currently inadequate**
Flooding	Flood levels and velocities	Detailed modelling recently undertaken providing detailed level and velocity data.	**Adequate**
	Floodgate locations & status	NSW Fisheries has records on Location & status	**Adequate**
Population	Size Demographics	Census Data	**Adequate**

Table A.2 *Adequacy of Water Resource Data*

Characteristic	Data Type	Data Collected	Adequacy
Surface Waters	Stream gauges	2 - managed by DIPNR (Tweed River, Uki & Oxley River, Eungella)	**Inadequate** – further gauges required on Oxley River, Tyalgum and Byrril Creek (in the vicinity of the proposed dam site.
	Flow gauges u/s & d/s of dams / weirs	Limited data collected to-date	**Inadequate** – permanent gauges required u/s and d/s of Clarrie Hall Dam and u/s of Bray Park Weir.
	System yields	Recent update of yield for Clarrie Hall Dam / Bray Park Weir and Tyalgum Weir.	**Inadequate** – further refinement of modelling required.
	Water quality – freshwater	Quarterly sampling on Tweed and Oxley Rivers by Council.	**Adequate**
	Water quality – estuaries	Quarterly sampling of estuary monitoring points by Council.	**Adequate**
Groundwater	Groundwater	Limited data collected to-date	**Inadequate** – a detailed assessment of groundwater quantity and quality is required (possibly by DIPNR).
Water Users	Extractions	Town water and irrigations extractions both monitored.	**Adequate**
	Commercial & recreational fishing	Monitored by NSW Fisheries	**Adequate**
	Commercial & recreational uses	Considered in river and estuary management plans	**Adequate**
	Dredging activities	Licensed and monitored by EPA	**Adequate**

APPENDIX A

Table A.3 *Adequacy of Urban Water Data*

Characteristic	Data Type	Data Collected	Adequacy
Town Water	Water production	Daily inflows and outflows from WTP's	**Adequate**
	Water Use	All properties metered	**Adequate**
	Water Loss	Leakage and unaccounted for water estimated	**Adequate**
	Water quality	Raw water and treated water quality extensively monitored	**Adequate**
	Key Performance Indicators	DEUS annual performance reporting	**Adequate**
	Asset Data	WTP and distribution system data	**Adequate**
Wastewater	Volume treated & discharged	Daily inflows and outflows from STP's	**Adequate**
	Dry weather discharges	Telemetry data monitors pump station performance	**Adequate**
	Inflow / Infiltration	Theoretical studies only carried out to-date	**Inadequate –** utilisation of Pump Station telemetry data as the first step to determine additional gravity flow monitoring sites and develop of calibrated models
	Effluent quality	Effluent quality extensively monitored	**Adequate**
	Effluent Reuse	Reuse volume monitored	**Adequate**
	Asset Data	STP and transportation system data	**Adequate**
Stormwater	Volumes	Not directly measured	**Adequate** – not feasible to monitor extensively
	Water quality – general	Not directly measured	**Adequate** – not feasible to monitor extensively
	Water quality – d/s of improvement devices	Not directly measured	**Inadequate** – temporary monitoring should be undertaken to prove / confirm effectiveness
	Asset Data	Collection / transportation system and treatment devices data	**Adequate**

APPENDIX B

Table B.1 *Preliminary Review of Yield Assessment (Sunwater 2002a)*

	Comment / Issue	Impact on Yield	Actions
1	The town water demand included in the IQQM is not climate dependent and consequently it does not increase in a dry year. Demand data is a monthly pattern (with averaged daily usage within the month) for a typical year based on consumption data over the period 1991 to 2001. While restrictions have been considered, they are assumed to result in a 20% reduction in average demand, not a 20% reduction in expected demand for a dry year.	Potential reduction	• Need to discuss with Sun Water the possibility of including a climatic based demand function. • TSC need to consider the likelihood of achieving 20% reduction (compared to average year demand) during a restriction (drought) event.
2	A calibration plot for Clarrie Hall Dam has not been included in the Sun Water report. Preliminary plots prepared by Hunter Water Australia (refer to attached **Figure B.1**) using IQQM data and observed data provided by TSC shows several significant differences between the two (particularly during 1997/98 and 2001).	Potential reduction	• Anthony Burnham has advised that some of the differences are due to flushing draw-downs due to water quality concerns at Bray Park Weir (eg late '96 & late '01). TSC to comment on remainder of discrepancies.
3	Clarrie Hall Dam inflows in the IQQM have been estimated from downstream gauge station at Uki (GS201900), on the Tweed River. Some correction of the Uki GS flows was performed to remove dam releases from the data, prior to factoring the flow (22-28%) to estimate inflows. Hunter Water Australia has obtained some data from TSC that has allowed us to estimate inflows to Clarrie Hall Dam. These have been compared to the inflows used in the model and again there are some significant differences between the modelled data and the derived observed data (refer to **Figure B.2**).	Potential reduction	• Need to discuss / confirm with Sun Water. • Need to look more closely at Clarrie Hall Dam inflows and releases. • Ideally it would be a good verification check to look at some comparisons of modelled behaviour to observed data at Bray Park Weir. However, TSC have advised that limited data is available at Bray Park Weir.
4	It appears that the IQQM may have been calibrated assuming an environmental release from Clarrie Hall Dam of 1 ML/d. Safe yield analysis using IQQM has also assumed an environmental release of 1 ML/d. In reality, TSC do not always actually release an environmental flow, but rather allows a leakage rate of approx 1 to 3 L/s from the dam to substitute for environmental flows.	Unsure	• Need to discuss / confirm with Sun Water.
5	Yield determined using IQQM seems to have been based on the demand that would almost, but not quite, result in an effective zero usable storage in dam (ie failure). Consideration needs to be given to allowing a carry over reserve (eg 12 months restricted demand). This assumption does not allow for a drought that is more severe then the worse drought on record. Also, it appears the 5/10/20 rule may have incorrectly been applied in the IQQM.	Potential reduction	• TSC need to consider the appropriateness of applying the 5/10/20 rule without considering the need for a carry over reserve to allow for drought events that are more severe then those on record.

Figure B.1 *Comparison of Clarrie Hall Dam Storage Behaviour (Modelled v Observed)*

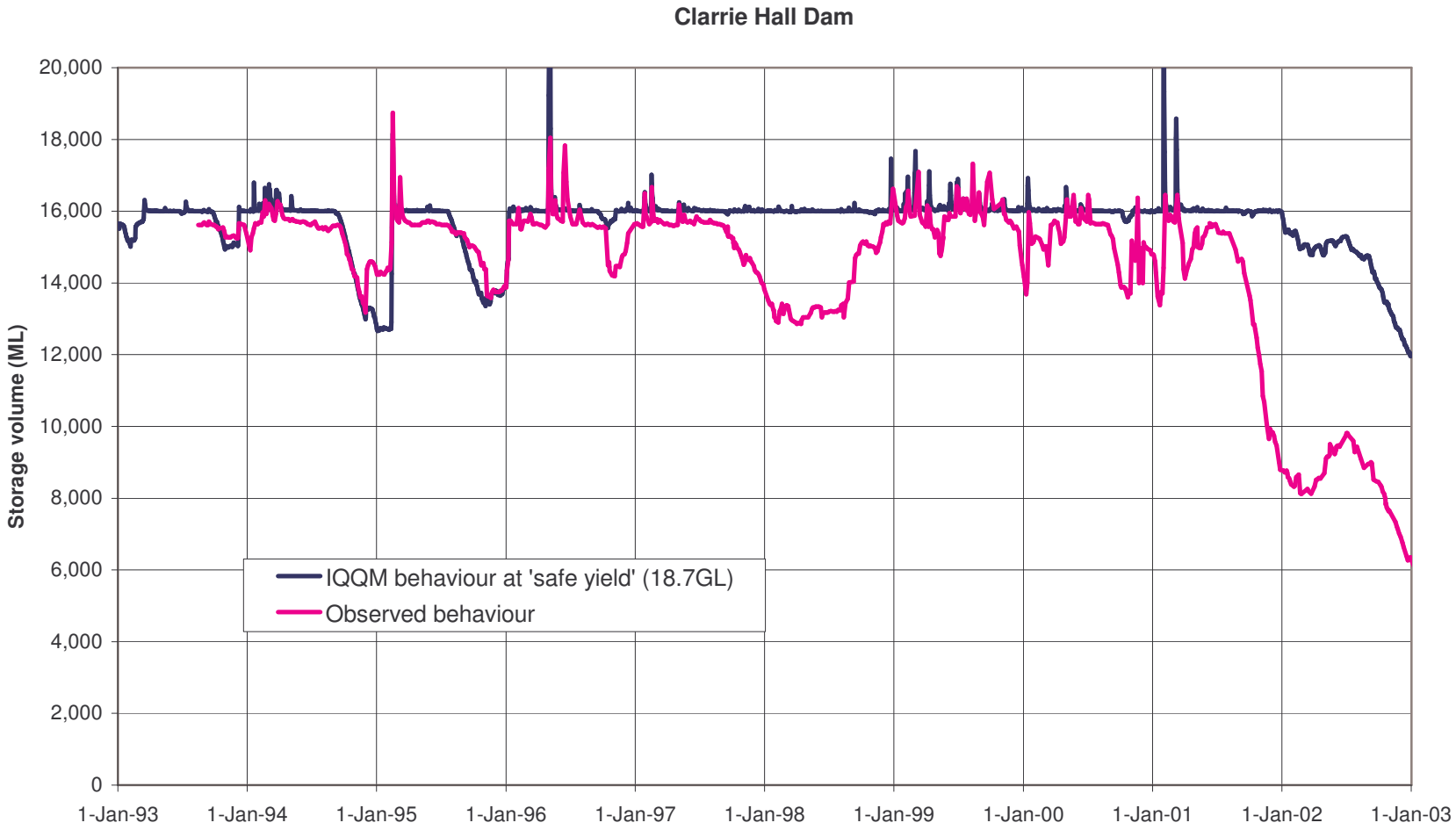
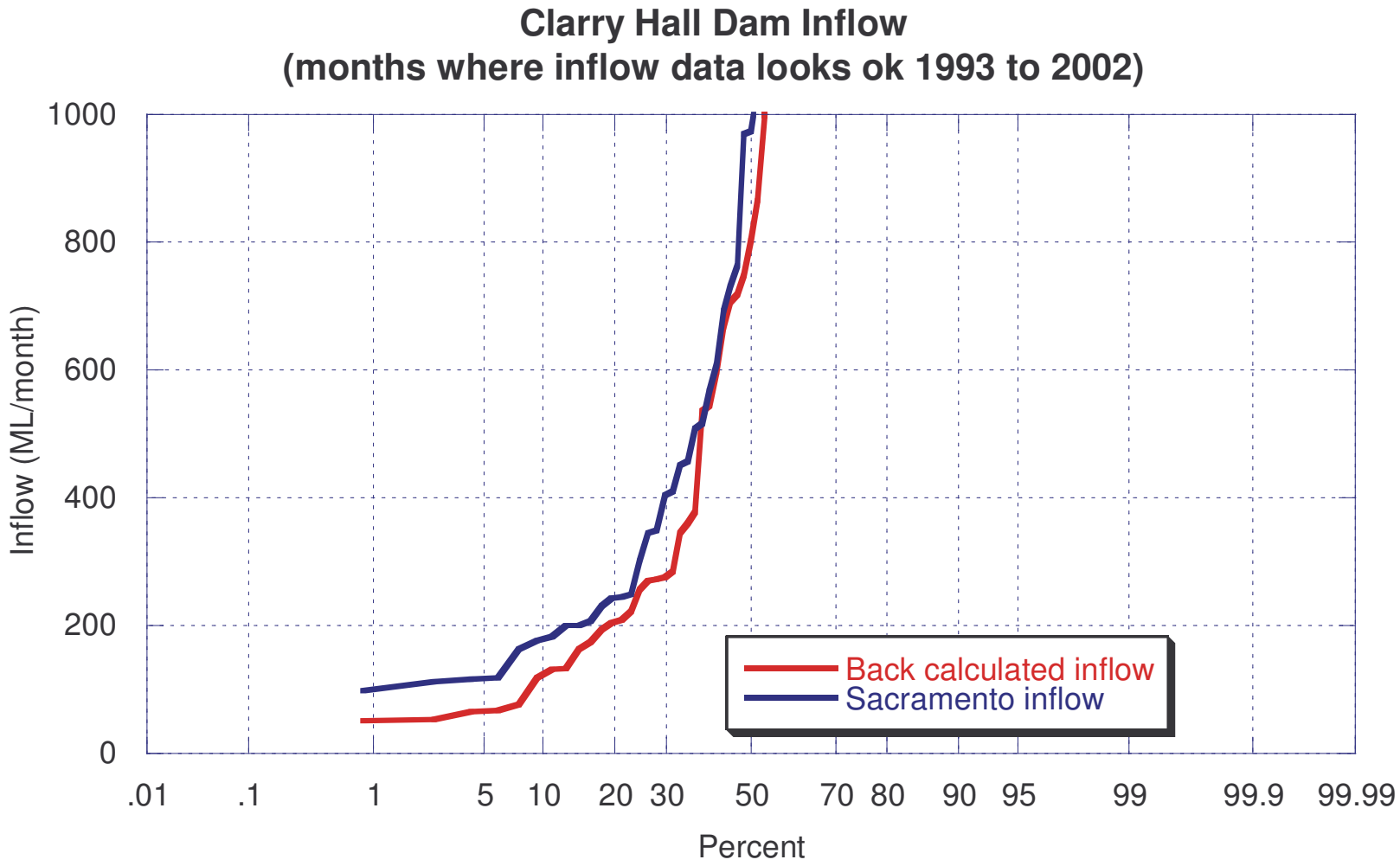


Figure B.2 *Comparison of Clarrie Hall Dam Inflows (Modelled v Estimated Observed)*



Surface Water Quality Assessment

Surface water quality has been assessed for both the fresh water sections of the Upper Tweed catchments and the estuarine water sections of the Lower Tweed and coastal estuaries.

1. Fresh Water Quality (Upper Tweed Catchments)

The key characteristics of *Fresh Water Quality* are summarised in Table C.1 below, with more detailed information following the table.

Table C.1 *Surface Water Quality - Key Characteristics*

Average results (1997-2003)	Units	Interim Water Quality Objective	Oxley River at Tyalgum	Clarrie Hall Dam (2 metre depth)	Tweed River d/s junction with Smith's Creek	Bray Park Weir (4 metre depth)
pH		6.5 – 9.0	7.5	7.2	7.4	7.6
True Colour	HU	Not Set	20	22	22	22
Dissolved oxygen	% saturation	>80%	84	72	90	72
Conductivity	us/cm^2	<1500	148	113	159	165
Iron	mg/L	Not Set	0.35	0.73	0.82	0.77
Manganese	mg/L	Not Set	0.07	0.10	0.09	0.06
Alkalinity	mg/L as $CaCO_3$	Not Set	57	28	39	49
Total Hardness	mg/L as $CaCO_3$	Not Set	51	28	45	47
Suspended solids	mg/L	Not Set	5.7	3.8	9.5	8.3
Turbidity	NTU	<10% seasonal change	5.5	4.5	9.5	10.3
Faecal Coliforms	cfu/100mL	<150	495	18	819	767
TKN	mg/L	0.1 –0.75	0.39	0.74	0.39	0.52
TP	mg/L	0.01 – 0.1	0.07	0.08	0.05	0.09
Algal Counts	cell/mL	<2000	96	909	120	1836
Chlorophyll "a"	ug/L	1 - 10	0.4	8.2	1.4	6.5

Water quality is monitored at around 16 sites throughout the Upper Tweed catchment with a focus on the management of the potable water supply (ie monitoring of fresh water quality). The four areas reported here represent key urban water supply points and also broadly demonstrate the significance of different sub-catchments and their contributions to water quality at Bray Park Weir.

An assessment of water quality in the Upper Tweed catchment in 1999 found that of the 16 monitoring sites:

- 5 sites reached or exceeded EPA's WQO for the Tweed River for faecal coliforms of 150 cfu/100mL
- 5 sites reached or exceeded EPA's WQO for the Tweed River for total phosphorus of 0.1 mg/L
- All sites reached or exceeded EPA's WQO for the Tweed River for total nitrogen of 0.75 mg/L
- 1 observation at 1 site (Bray Park Weir) exceeded EPA's WQO for the Tweed River for pH of 6.5 to 9.

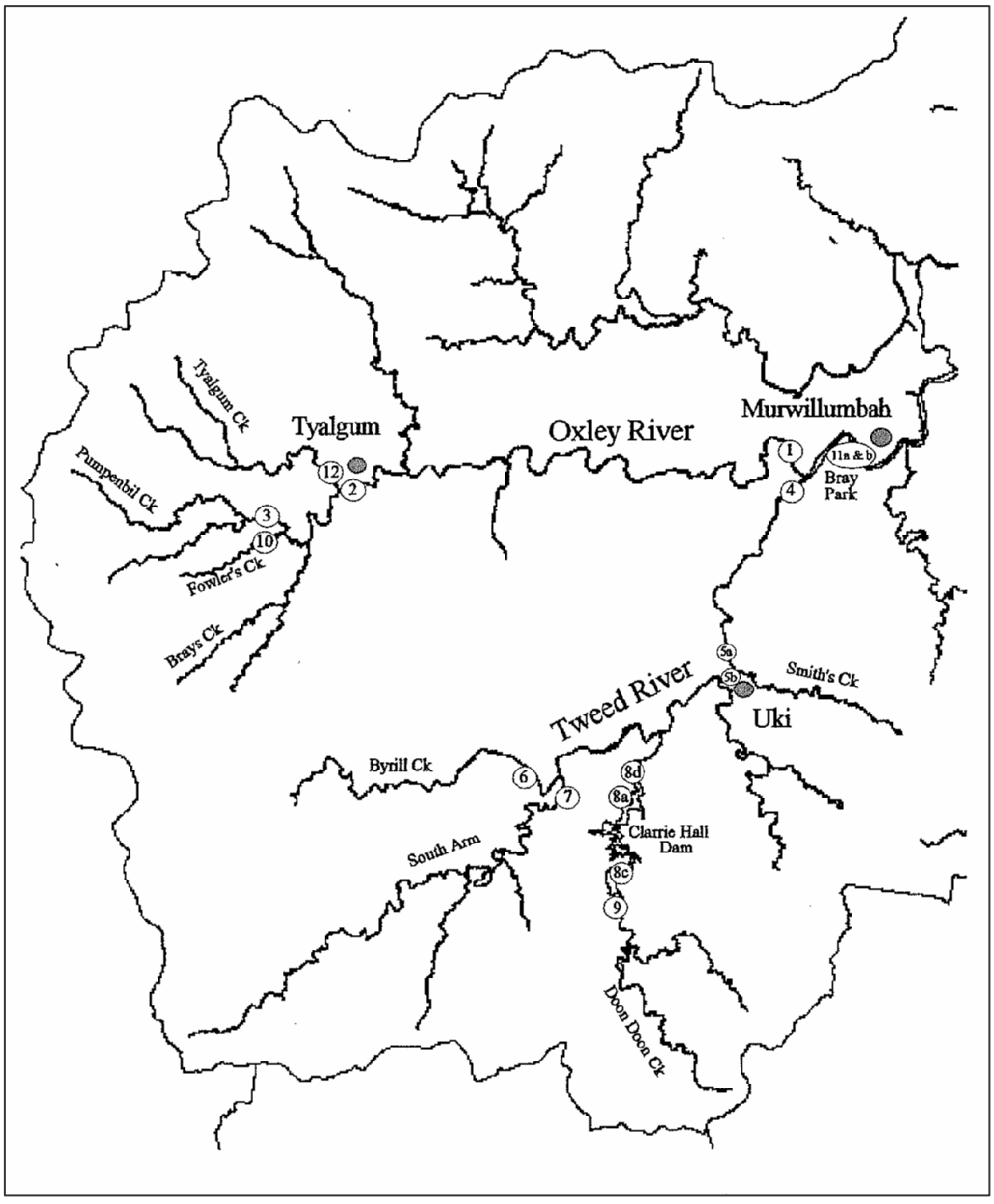


Figure C.1 *Upper Tweed River Catchment – Water Quality Monitoring Sites*

Oxley River at Tyalgum

The sample point on the Oxley River at Tyalgum is influenced by the Tylgum Creek, Pumpenbil Creek, Fowlers Creek and Brays Creek sub-catchments. River water at this point generally displays low turbidity (median 2.35 NTU) and moderate organic content (median true colour of 21 HU). Conductivity is low (median 150 uS/cm^2) with low hardness and alkalinity.

Extensive animal husbandry in the Fowlers Creek area routinely results in elevated faecal coliforms, suspended solids, nutrients and BOD upstream of the sample point.

Tyalgum weirpool (the raw water source) is of similar water quality to the Oxley River sample point, however it is fed only by Tyalgum Creek, and does not receive water from the Fowler's Creek area. Algal blooms have been experienced in the weir that, in combination with low water levels, have adversely affected the quality of drinking water supplied to the community.

Clarrie Hall Dam

Monitoring over the six years 1997 to 2003 indicates that dam water is generally of good quality with the 90th percentile turbidity of <10NTU. Hardness (total) and alkalinity are generally low with a 90th percentile of 36 mg/L as $CaCO_3$ and 35.2 mg/L as $CaCO_3$ respectively. Dam water pH ranged from pH 6.8 to pH 7.6 over the period.

Organic content of dam water is moderate with 90th percentile true colour <50 HU and 90th percentile Total Organic Carbon of 7.5 mg/L. No data was available for dissolved organic carbon.

Iron and manganese monitoring indicates periods of high levels in abstracted water (90 percentile iron and manganese of 1.4 mg/L and 0.29 mg/L respectively). Typically, high levels are associated with the period before destratification was installed however one high result was recorded in 2002.

The dam was subject to seasonal stratification and cyanobacterial blooms of increasing frequency during the 1990's, leading to the installation of the WEARS mixer in 2002. Monitoring at Clarrie Hall Dam since that installation shows that low levels of the cyanobacteria, *Aphanocapsa* are common in dam water. *Aphanocapsa* has not been previously associated with toxin production in Australia, but has been tentatively linked to taste and odour production. *Anabaena* also occurs in dam release water at cell densities up to 500 cell/mL. Recent monitoring indicates relatively uniform dissolved oxygen and temperature profiles have been achieved. Selective withdrawal to optimise the quality of water extracted from the storage is achieved through a multilevel outlet.

Tweed River downstream of confluence with Smith's Creek

Operation of the Clarrie Hall Dam spillway following high rainfall events leads to increased turbidity and general deterioration in downstream water quality through bed load transport and bank erosion mechanisms. This sample point reflects the contributions from South Arm and Byrrill Creek as well as the influence of animal husbandry in the Smith's Creek sub-catchment.

Turbidity at this point is generally low (mean 9.5 NTU, median 4.5 NTU) with low organic content (mean 22 HU, median 24 HU). Nutrients are low to moderate (median TKN 0.25 mg/L, median TP 0.04 mg/L). Monitoring indicates low green algal activity (median <100 cell/mL) with no cyanobacteria reported.

Bray Park Weir

Bray Park Weir is a relatively still water body fed from an extensive catchment comprising a range of agricultural activities. The weir forms the upper limit of tidal influence in the Tweed River.

Results indicate that raw water turbidity increases slightly with depth in the weir. Typical and 90th percentile turbidity was found to be 7-9 NTU and 15-18 NTU respectively. Maximum turbidity was recorded at 215 NTU.

Total organic carbon in raw water was found to be moderate to high with a mean and 90th percentile result for the period 1997 to 2003 of 4.2 mg/L and 6.6 mg/L respectively. The maximum TOC observed for this period was 7.5 mg/L. Monitoring at the weir pool indicates typical true colour was 30 HU with a 90th percentile value of approximately 60HU. The maximum observed result was 414 HU at the 4 metre intake level.

Typical total hardness measured daily at the WTP 1994 to 2003 was 46 mg/L as $CaCO_3$ with a 90th percentile and maximum value of 57 mg/L as CaCO3 and 96 mg/L as $CaCO_3$.

The Tweed River at this point has experienced increasing apparent levels of algal activity over the last 5 years. Algae occurring in the weirpool include bacillariophyta, various chlorophyta and the cyanobacteria *Anabaena*, *Pseudoanabaena, Aphanocapsa* and *Microcystis*. The dominant cyanobacteria over the last several years would appear to be *Anabaena,* and several substantial blooms have occurred in the weir pool since 1999.

2. Estuary Water Quality (Tweed & Coastal Estuaries)

Tweed Estuary

Water quality at the mouth of the Tweed estuary is good as it is relatively well flushed with oceanic water. Water quality in the remainder of the estuary is generally poor. Concentrations of faecal coliforms, total nitrogen and total phosphorous generally exceed water quality objectives in the lower, mid and upper Tweed Estuary (GHD 2002). There is a strong seasonal variation, with higher turbidity and nutrients and lower pH during wet seasons (Costanzo 2001; SKM 1998). Stormwater has a significant impact on estuarine water quality, accounting for 70-90% of the variation.

Terranora Inlet is well flushed by tidal movement but is subject to a high level of pollutant inputs from the adjacent heavily urbanised area including several canal estates (TSC 2000a).

Terranora and Cobaki Broadwaters are both shallow water bodies with reasonable water quality. They are subject to nutrient and sediment accumulation from the catchment. Terranora Broadwater catchment has substantial existing and future urban development and Cobaki Broadwater catchment will be developed within the next five to ten years (TSC 2000a).

The Interim Water Quality Objectives that apply to Tweed Estuary are those for the protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (Cooked) and commercial shellfish production (EPA 2000). The Aquatic Ecosystem and Edible Molluscs (Raw) environmental values are not met in the upper and mid estuary and there are numerous occasions where they were not met in the lower estuary. Conditions for primary and secondary contact for recreation are met in the mid and lower estuary, however primary contact recreation conditions are frequently exceeded in the upper estuary (WBM Oceanics 2000).

Point source loadings dominate water quality processes during the dry months whereas diffuse loads from the whole catchment dominate during rainfall periods (Dennison et al 1998). Sources of point and diffuse loadings include:

- Runoff from both the upper catchment and the local catchment play key roles in estuarine water quality in the lower estuary (KEC Science 1998 in WBM Oceanics 2000).
- The Kingscliff and Murwillumbah sewage treatment plants are likely to make a considerable contribution to nutrient loads in the estuary.
- Stormwater runoff, sewage treatment plant discharges, and septic tank overflows also contribute significantly to these loads.
- Agricultural practices including crop fertilisation, high density animal husbandry and direct access by cattle to streams are likely to exacerbate high nutrient content of stormwater flows.

Catchment erosion is likely to be the primary source of suspended solids in the estuary. Suspended solids exceeded water quality objectives in the upper estuary. In the lower estuary suspended solids increase in proportion to rainfall, with wet season levels higher than dry season (Costanza in GHD 2002).

Faecal coliforms, total nitrogen and total phosphorous generally exceed water quality objectives in the lower, mid and upper Tweed Estuary. In the lower estuary bacterial counts increased significantly after major storm events.

Total nitrogen and total phosphorous generally exceed water quality objectives in the lower, mid and upper Tweed Estuary (WBM Oceanics 2000). Both total nitrogen and total phosphorous levels are lower in the dry season than in the wet season (Costanza in GHD 2002).

Average total nitrogen levels in the estuary are relatively low at the mouth (approximately 50- 100 µg/L); increase upstream to a peak at about 20 km from the mouth (450 – 560 µg/L); and then decrease to about 200 µg/L 35 km upstream (WBM Oceanics 2000; Costanza in GHD 2002).

In the Rous River catchment there are high rates of phosphorous supply from volcanic soils and sediments in the area, and this may also apply for the Tweed River. Average total phosphorous levels at the mouth are about 10 µg/L and rise to over 60 µg/L 20 km upstream of the mouth.

Water quality objectives for pH are generally met in the Tweed Estuary however there are frequent minor entries of low pH water into the estuary associated with flushing by regular rainfall of low pH water that collects in isolated cane drains and trunk drainage channels (WBM Oceanics 2000).

Levels of both nitrogen and phosphorous in the middle sections of the estuary are more than adequate for high levels of algal growth (SKM 1998).

The monitoring point locations for the Tweed Estuary are shown below on Figure C.2.

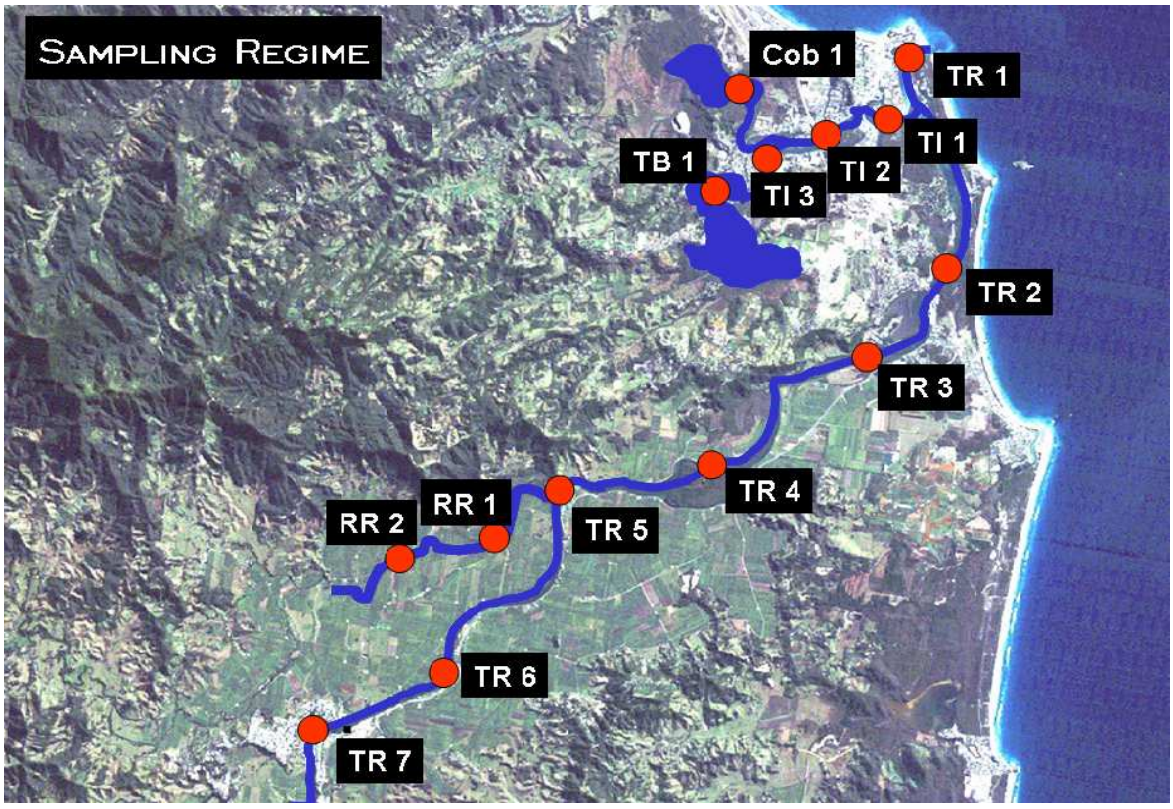


Figure C.2 *Tweed Estuary Catchment – Water Quality Monitoring Sites [UQ (2003)]*

Coastal Estuaries

Regular monitoring of the Coastal Estuaries was only commenced in late 1999. The median results from sampling to date (TSC 2000a) for each site in the three creeks are shown in Table C.2. The monitoring sites for each waterway move progressively upstream.

Table C.2 Tweed Coastal Estuary Median Water Quality (1999 to 2000)

Water-way	Site	pH	DO (mg/L)	Salinity (ppk)	TPO_4 (mg/L)	Total N (mg/L)	Chlor *a* (ug/L)	SS (mg/L)	Faecal (cfu/ 100mL)
Cudgen Creek	CGN1	8	6.8	34.5	0.01	0.6	1.6	3.7	100
	CGN2	7.6	6.3	12	0.02	0.82	1.6	8	80
	CGN3	7.3	6.4	0.65	0.02	0.81	5.3	9.1	160
Cudgera Creek	CGR1	8.2	6.5	33.5	0.01	0.61	0.5	4.2	70
	CGR2	8.1	6.6	33.5	0.01	0.64	1.1	6.8	80
	CGR3	7.5	6.5	14	0.02	0.72	2.7	7.9	540
Mooball Creek	MBL1	8.2	7.8	32	0.01	0.8	1.1	4.9	10
	MBL2	7.9	7.1	33	0.01	0.61	1.6	3.7	20
	MBL3	7.8	5.7	31.8	0.01	0.7	2.1	4.3	20
	MBL4	7.7	7.4	8.3	0.01	0.7	4	11	120

Cudgen Creek, with the most urban development, would appear to have the poorest water quality of the coastal creeks. Each of the waterways demonstrate the following characteristics:

- SS increases with distance upstream with all sites within the Interim Water Quality Objectives (<10mg/L estuary, <20 mg/L fresh).
- Chlorophyll a increases with distance upstream with all sites within the Interim Water Quality Objectives (<10ug/L).
- Total nitrogen increases slightly with distance upstream with all sites approaching or exceeding the Interim Water Quality Objectives (<0.5mg/L estuary, <0.75 mg/L fresh)
- Total phosphate is typically low with all sites within the Interim Water Quality Objectives (<0.05mg/L estuary, <0.1 mg/L fresh)
- Faecal coliforms generally increase with distance upstream with lower sites within the Interim Water Quality Objectives (<14 cfu/100mL estuary, <150 cfu/100mL fresh). The upper reaches of Cudgera and Mooball Creeks exceeded the WQO.

Urban Services Performance Assessment

The most recent data available for the Urban Services Performance Assessment is the 2001/02 NSW Water Supply and Sewerage Performance Comparison. A comparison can be made to the Tweed Shire Council's utilities and that of other similar sized utilities and the state average. Data was available for the Tweed Shire Council for 2002/03, but state wide data had not been collated to allow comparison to other water utilities.

Tweed Shire Council generally compares favourably with the State averages in terms of consumption, pricing and service levels. A summary is presented below. Unless otherwise noted, data is for the period 2001/02.

- The average annual residential consumption for Tweed was 243kL per dwelling. This is only marginally higher than the State average of 240kL per dwelling, and consistent with the average for other northern NSW coastal towns. The average annual consumption for 2002/03 was significantly lower, at 203kL per dwelling. Water restrictions were in force for 123 days of that year, resulting in reduced residential consumption.

- The **typical residential bill** for water supply and sewerage was $670 per assessment, again in line with the State median of $680. Tweed Shire faces **OMA costs** of $431 per connected property and **management costs** of $150 per connected property for water supply and sewerage. These are marginally lower than the State medians of $460 and $170 per connected property for OMA and management respectively.

- Typical **developer charges** ($7280 per ET) are significantly higher than the State average of $4,600 per ET.

- 100% of samples for **microbiological parameters** achieved compliance with the 1996 NHRMC/ARMCANZ Guidelines for drinking water. The percent of samples achieving compliance with the **chemical and physical parameters** in the guidelines were not reported in 2001/02. In 2000/02, 100% of samples for physical parameters and 99% of samples for chemical parameters achieved compliance with the guidelines.

- **Water quality and service complaints** were 3 and 29 respectively per 1000 connected properties. The state-wide medians are 6 quality and 0 service complaints per 1000 properties, indicating that although the level of quality complaints is low, a high number of service complaints were received.

- The percentage of effluent samples complying with EPA licence conditions for **BOD** and **Suspended Solids** was not reported in 2001/02. However, 2002/03 data indicates that 97.5% of samples from all the STPs complied with discharge limits for BOD_5 and 96.2% of samples complied with discharge limits for suspended solids.

- **Sewer odour and service complaints** were 2 and 7 respectively per 1000 connected properties. The state wide medians are 1.1 odour complaints and 13 service complaints.

- There were 12 sewer main chokes and collapses and 2 sewer overflows to the environment per 100km of main.

APPENDIX E

STP Details

Tweed Heads STP

Table E.1 *Tweed Heads STP Process and Performance*

Location	Rose St, Tweed Heads		EPL 581
Design EP	12000	Load EP	9300
Process	Primary	Coarse screen	
	Secondary	Trickling Filter	
	Tertiary	Maturation pond	
	Disinfection	NA	
Effluent Disposal	Submerged pipe off NW bank of Terranora Inlet approx 500m behind the Ampol service station and directly behind the exposed manhole approx 1km south of the works office		
Reuse	0%		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	14000	2454
BOD	mg/L	20/25/40	19.3
	kg/yr	14468	18661
O&G	mg/L	-/-/10	2.8
	kg/yr	7234	2121
TN	mg/L		11.1
	kg/yr	11000	10675
TP	mg/L		6
	kg/yr	7234	2693
SS	mg/L	20/25/40	41.1
	kg/yr	21701	39030

1 – Licence limits are shown as median/90th percentile / absolute

2 - 2003 Licence Return – (Mean concentration and load)

Banora Point STP

Table E.2 *Banora Point STP Process and Performance*

Location	Enterprise Ave, Sth Tweed Heads		EPL 1411
Design EP	625000	Load EP	45000
Process	Primary	Step screen, grit removal and odour control	
	Secondary	AS-BNR(MJE)	
	Tertiary	CPR-pond	
	Disinfection	UV	
Effluent Disposal	Submerged pipe in Terranora Creek adjacent to Naval Cadet Station Carpark on Dry Dock Road		
Reuse	0%		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	54000	12036
BOD	mg/L	-/15/35	3.2
	kg/yr	28590	13638
O&G	mg/L	-/-/10	2.3
	kg/yr	28590	6816
TN	mg/L		5.7
	kg/yr	28590	25038
TP	mg/L		5.1
	kg/yr	28590	21966
SS	mg/L		7.8
	kg/yr		33117

1 – Licence limits are shown as median/90th percentile /absolute

2 - 2003 Licence Return – (Mean concentration and load)

Kingscliff STP

Table E.3 *Kingscliff STP Process and Performance*

Location	Chinderah Rd, Chinderah		EPL 578
Design EP	14000	Load EP	10500
Process	Primary	Screening/ odour/grit removal	
	Secondary	AS-Bathurst box	
	Tertiary	CPR-pond	
	Disinfection	NA	
Effluent Disposal	Submerged pipe in Tweed River, approx 2km north west of the plant and 50m south of "Jenners Corner" adjacent to floodgates		
Reuse	0%		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	8000	2377
BOD	mg/L	20/25/40	5.9
	kg/yr	5727	5297
O&G	mg/L	-/-/10	2.3
	kg/yr	5727	1346
TN	mg/L		4.2
	kg/yr	2863	3755
TP	mg/L		5.3
	kg/yr	6820	4739
SS	mg/L	20/25/40	15.8
	kg/yr	8590	14219

1 – Licence limits are shown as median/90th percentile /absolute

2 - 2003 Licence Return – (Mean concentration and load)

Kingscliff STP will be replaced in 2007 with a new 25000 EP (ultimate capacity 50,000 EP) facility. The EIS for the new facility requires Class A effluent to be produced for disposal to the Tweed River.

Hastings Point STP

Table E.4 *Hastings Point STP Process and Performance*

Location	Round Mountain Rd, Hastings Pt		EPL 3618
Design EP	16000	Load EP	8000
Process	Primary	odour/ grit/ washpactor	
	Secondary	AS - 2 x EAT	
	Tertiary	Dynasand	
	Future	Milliscreen (2004)	
	Disinfection	Sodium hypochlorite	
Effluent Disposal	Dune disposal system at beach between Norries Head and Hastings Point (approx 100 metres east of the junction of Coast and Round Mountain Roads). Discharge limit of 3.8ML/d		
Reuse	0%		
Wet Weather Discharge	Christies Ck - 4ML/d limit on discharge		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	2500	1842
BOD	mg/L	20/25/40	2.6
	kg/yr	5000	1754
O&G	mg/L	-/-/10	2.3
	kg/yr	4823	445
TN	mg/L		4.55
	kg/yr	9645	3044
TP	mg/L		6.07
	kg/yr	665[3]	4039
FC	cfu/100mL		
SS	mg/L	20/25/40	3.2
	kg/yr	9645	2137

1 – Licence limits are shown as median/90th percentile / absolute

2 - 2003 Licence Return – (Mean concentration and load)

3 - TSC entered into a Load Reduction Agreement (LRA) for the STP beginning 2003 that requires a TP load of 665 kg/yr.

A Trade Waste Receival and treatment facility operated by contractor treats high strength waste prior to discharge to Hastings Point STP.

The STP was augmented in 2003/04 to include milliscreening of secondary effluent prior to discharge to the dune infiltration system. Chemical phosphorus removal is achieved by alum dosing into the biological reactors.

Murwillumbah STP

Table E.5 *Murwillumbah STP Process and Performance*

Location	Frances St, Murwillumbah		EPL 582
Design EP	16000	Load EP	9000
Process	Primary	Step screen, grit removal and odour control	
	Secondary	AS - 2 x IDEA	
	Tertiary	CPR-pond	
	Dis	UV	
Effluent Disposal	Submerged pipe in Rous River approximately 80 metres west of UV Disinfection System		
Reuse	0%		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	14000	3090
BOD	mg/L	-/10/20	1.7
	kg/yr	14468	1402
O&G	mg/L	-/2/10	2.2
	kg/yr	9645	1539
TN	mg/L	-/10/20	5
	kg/yr	19290	4571
TP	mg/L	-/0.5/1.0	0.37
	kg/yr	965	259
SS	mg/L	-/15/30	8.3
	kg/yr	14468	7509

1 – Licence limits are shown as median/90th percentile / absolute

2 - 2003 Licence Return – (Mean concentration and load)

Tumbulgum STP

Table E.6 *Tumbulgum STP Process and Performance*

Location	Pacific Hwy (East), Tumbulgum		EPL 5622
Design EP	700	Load EP	283
Process	Primary	Coarse screen	
	Secondary	AS - EAT	
	Tertiary	CPR	
	Disinfection	UV	
Effluent Disposal	Submerged pipe on the southern bank of Tweed River directly north of the treatment plant Proposed irrigation of 5ha TSC owned land (Lot 22 DP 849883) of 170kL allowable.		
Reuse	80kL/d		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	756	78
BOD	mg/L	-/15/35	1.5
O&G	mg/L		2.2
TN	mg/L	-/15/25	5.6
TP	mg/L	-/1/3	0.3
FC	cfu/100mL	-/200/600	
SS	mg/L	-/20/40	4.6

1 – Licence limits are shown as median/90th percentile / absolute

2 - 2003 Licence Return – (Mean concentration and load)

Tumbulgum STP is licensed to discharge to the Tweed estuary however there is currently agricultural reuse on adjacent private land with further reuse for cane irrigation on adjacent TSC owned land.

Tyalgum STP

Table E.7 *Tyalgum STP Process and Performance*

Location	Brays Ck Rd, Tyalgum		EPL 3470
Design EP	500	Load EP	198
Process	Primary		
	Secondary	Simon Eng IDEA	
	Tertiary	pond	
	Disinfection		
Effluent Disposal	Turf / tree irrigation on the irrigation area labelled "A" on Tweed Shire Council plan No. A1-833 issue B.		
Reuse	100%		
Performance		Licence Conditions[1]	2003 (Mean) [2]
Volume	kL/d	480	20.2
BOD	mg/L	20/25/40	4.6
O&G	mg/L	-/-/10	2.1
FC		-/200/600	788
SS	mg/L	-/50/75	16.7

1 – Licence limits are shown as median/90th percentile / absolute

2 - 2003 Licence Return – (Mean concentration and load)

Agricultural reuse opportunities for the STP are limited due to the prevalence of stock grazing operations and high winter rainfall

Uki STP

Table E.8 *Uki STP Process and Performance*

Location	Uki		(Unlicensed)
Design EP	600	Load EP	46
Process	Primary	Coarse screen	
	Secondary	AS - Ludowici BNR	
	Tertiary	Lagoon	
	Disinfection	Sodium hypochlorite	
Effluent Disposal	Location	Onsite Irrigation area. Licensing in process	
Reuse	100%	Method	Drip filter

The system was commissioned in March 2004. The number of connections will increase as the sewerage scheme expands.

STP effluent reuse is through onsite koala fodder production contracted to Currumbin Bird Sanctuary.

Triple Bottom Line (TBL) Assessment

Overview

Tweed Shire Council performs a number of functions, including delivery of services, building and maintaining infrastructure and working with the community in making decisions, including defining the community vision. A community vision is the community statement of the type of community that it aspires to be and is effectively the community's definition of what sustainability means to them. The vision is often further interpreted through mission statements, strategic objectives or other thematic breakdowns to define key aspects of importance for the particular community, for example tourism, agriculture, cultural diversity etc. The "how" of delivery is usually interpreted through value statements like working with transparency, commitment to service, accountability or innovation.

The Triple Bottom Line (TBL) concept provides a useful framework for completing detailed project assessments, in that it ensures social and environmental costs and benefits are taken into consideration. In Section 8 of the Local Government Act 1993 (amended 1997) is the requirement for a Council to "properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible in a manner which is consistent with and promotes the principles of Ecologically Sustainable Development" and "have regard to the long term and cumulative effect of its decisions".

In the IWCM Plan context, TBL assessment will be used to rank each scenario/ option against how well it achieves the community's objectives in terms of economics, and social and environmental impact.

TBL Assessment Methodology

Triple Bottom Line (TBL) is the decision-making methodology used to embed ESD principles and social impact into the strategic, development and financial planning processes of local government and ensure that not only economic, but also social and environmental impacts are taken into consideration in all aspects of local government service delivery and operation.

For the current Integrated Water Cycle Management Study being prepared for Tweed Shire Council, the TBL assessment will likely be undertaken by the Project Control Group (PCG) in consultation with stakeholders during the next stage of the IWCM process.

The economic assessment of each scenario or option will be conducted using:

1. Lifecycle costing to determine the net present value over the asset life based on all known costs (capital and operating) and benefits.
2. The dollar value change for a typical rate bill compared to the traditional scenario.
3. Cost benefit ratio or similar economic index.

Environmental and social assessment will follow a number of steps.

APPENDIX F

Table F.1 *Steps in developing & assessing environmental & social criteria for TBL assessment*

Step 1	Apply principles of Ecologically sustainable development (Table F.2).
Step 2	Determine relevant environmental and social criteria with reference to Government and Shire Policies and Objectives (refer to Table F.3)
Step 3	Evaluate description / weight matrix for relevance to situation, Context Study results and Team Resolutions (modify Table F.5)
Step 4	Assign weights to individual criteria (use Table F.6)
Step 5	Assign relative weights to TBL categories (Env, Social, Economic)
Step 6	Rank scenarios/ options against compliance with developed criteria (Table F.6)

Table F.2 *Principles of Ecologically Sustainable Development*

Concept	Description
The Precautionary Principle	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. • Evaluation to avoid, wherever practicable, serious or irreversible damage to the environment. • Assessment of the risk weighted consequences of various options.
Intergenerational Equity	The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
Conservation of Biological Diversity and Ecological Integrity	Conservation of biological diversity and ecological integrity should be a fundamental consideration.
Improved Valuation	Environmental factors should be included in the valuation of assets and services. • Polluter pays - those who generate pollution and waste should bear the cost of containment, avoidance or abatement. • Users of goods and services should pay prices based on the full lifecycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. • Environmental goals should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise the benefits or minimise costs to develop their own solutions and responses to environmental problems.

The social and environmental criteria are then developed in conjunction with stakeholders, the community and with reference to existing Council Plans, Policies and Strategies. Typical criteria used in similar assessments are shown below, however it is expected the PCG will add, delete or modify these criteria to suit the local circumstance.

Table F.3 *Typical Social and Environmental Assessment Criteria*

Environmental	Ensures the efficient use of the fresh water resource
	Minimises water extractions and protects low flows
	Minimises greenhouse gas emissions
	Minimises pollutants being discharged to the aquatic environment
	Minimises urban stormwater volumes
	Consistent with ESD Principles
Social	Improves security of town water supply
	Improves the quality of drinking water
	Improves urban water service levels
	Increases public awareness of urban water issues
	Minimises non-compliance to Legislation
	Protects Public Health
	Consistent with TSC Strategies

Alternate criteria and weighting that may be considered are shown in Table F.4.

Table F.4 *Alternate social and Environmental Assessment Criteria*

Criteria		Indicative Assessment Questions
SOCIAL	Diversity	Will the proposal address the diverse needs of all sectors of the community? What effect will this proposal have on the development of a healthy, equitable, active and involved community?
	Amenity	Will the proposal enhance the amenity of public space? Will the proposal enhance and/or be, consist with the existing urban form?
	Public Health and Safety	What effect will the proposal have on the safety of the public environment eg streets, laneways, parks and gardens?
	Cultural and Heritage Values	What effect will this proposal have on the cultural heritage? Will the proposal protect, enhance and/or be consistent with built form of heritage value?
	Community Services	What effect will the proposal have on the community access to education, leisure, cultural and health services?
		Will the proposal improve the quality of services available to the community? Will the proposal increase the number and /or variety of services available to the community?
ENVIRONMENTAL	Energy Consumption	What effect will the proposal have on the quantity of energy consumed by Council operations and/or in the municipality? Will the proposal encourage greater levels of energy efficiency? Will the proposal encourage the use of alternative fuel / energy sources eg renewable energy?
	Greenhouse Emissions	What effect will the proposal have on the level of greenhouse gas emissions generated by Council activities and/or in the municipality? Will the proposal maximise opportunities to reduce emission levels through the use of lower emission fuels, the use of renewable sources of energy or through carbon sequestration?
	Resource Use	Will the proposal delivery methods facilitate a reduction in the quantity of non-renewable or hazardous materials used Will the proposal delivery methods give preference to materials derived from sustainably managed / renewable sources by the Council and/or the community?
	Waste Generation	What effect will the proposal have on the total quantity and type of waste including prescribed waste generated by Council activities and/or in the municipality? Will the proposal delivery methods encourage the minimisation of waste? Will the proposal delivery methods facilitate the recovery, reuse and / or recycling of waste materials?
	Water Consumption	What effect will the proposal have on the quantity of water consumed and disposed of by the Council and/or in the municipality? Will the proposal encourage greater levels of water efficiency? Will the proposal encourage water recycling? Will the proposal facilitate improvements in water quality?

The description/ weight matrix shown in Table F.5 is used to assign the importance of each criteria in achieving the objectives of ESD and stakeholders and community values or objectives.

Table F.5 *Description Weight Matrix*

Description	Weight
High Impact or Importance	5
Moderate Widespread Impact or Importance	4
Moderate Impact or Importance	3
Moderate Local Impact or Importance	2
Minimal or No Impact or Importance	1

Once the criteria are agreed and weighting assigned, the relative weighting of economic, social and environmental factors will be determined by the PCG in consultation with stakeholders.

The PCG will then score each of the options or scenarios against each of the identified criteria. The scoring tool shown in Table F.6 can be used at this stage or stakeholders can add, delete or modify the description and score to suit the local situation.

Table F.6 *Scoring tool for Social & Environmental Assessment of IWCM scenarios/ options*

Description	Score
Best Practice	3
Industry Standard	2
Non compliant but can be brought in with modifications	1
Unlikely to achieve objective in this situation	0

Finally, the TBL assessment will calculate the individual social, environmental and economic weighted scores and rank each option or scenario in terms of economics, environmental and social impact.

An example of an incomplete TBL evaluation worksheet is shown in Figures F.1 and F.2. The scenarios/ options, assessment criteria and weightings are informational only and should be reviewed and must be developed/ modified by the PCG in consultation with stakeholders.

APPENDIX F

Figure F.1 *Example TBL Criteria and Weighting*

Environmental		Adjusted Weight
Ensures the efficient use of the fresh water resource	5	4.8%
Minimises water extractions and protects low flows	5	4.8%
Minimises greenhouse gas emissions	3	2.9%
Minimises pollutants being discharged to the aquatic environment	5	4.8%
Minimises urban stormwater volumes	5	4.8%
Consistent with ESD Principles	3	2.9%
		0.0%
		0.0%
Environmental Weighting	**25%**	25.0%

Social		
Improves security of town water supply	5	3.6%
Improves the quality of drinking water	5	3.6%
Improves urban water service levels	5	3.6%
Increases public awareness of urban water issues	5	3.6%
Minimises non-compliance to Legislation	5	3.6%
Protects Public Health	5	3.6%
Consistent with TSC Strategies	5	3.6%
		0%
Social Weighting	**25%**	**25%**

Economic		
NPV @7% over 30 years	20	20%
Cost Benefit Ratio	20	20%
Change in typical residential rate bill from the traditional scenario	10	10%
Economic Weighting	**50%**	**50%**

Figure F.2 *Example TBL Assessment Tool*

	21-Oct-2004	Implementation Strategies								
Triple Bottom Line		Planning Controls			Water Conservation Education					
Crtiteria	**Weighting**	Water Efficiency	WSUD	DCP Content	Target Groups	Labelling of water appliances	Garden Watering	Residential water audit	Non-residential water audit	Demonstration house
Environmental	**25%**									
Ensures the efficient use of the fresh water resource	4.8%	3	3	3	3	3	3	3	3	3
Minimises water extractions and protects low flows	4.8%	3	3	3	3	3	3	3	3	3
Minimises greenhouse gas emissions	2.9%	3	3	3	3	3	3	3	3	3
Minimises pollutants being discharged to the aquatic enviro	4.8%	1	3	2	1	1	2	0	0	0
Minimises urban stormwater volumes	4.8%	0	3		3	0	0	0	0	1
Consistent with ESD Principles	2.9%	3	3	3	2	3	2	2	2	2
Environmental Sum		12.7	18.8	13.9	15.6	12.7	13.2	10.8	10.8	12.0
Environmental Rank		5	1	3	2	5	4	12	12	11
Social	**25%**									
Improves security of town water supply	3.6%	3	3	3	2	3	3	2	2	1
Improves the quality of drinking water	3.6%	0	0	0	0	0	0	0	0	0
Improves urban water service levels	3.6%	2	2	2	1	1	1	1	1	1
Increases public awareness of urban water issues	3.6%	2	2	2	2	2	3	2	2	2
Minimises non-compliance to Legislation	3.6%	3	3	3	1	2	1	1	1	1
Protects Public Health	3.6%	0	2	2	2	0	0	0	0	0
Consistent with TSC Strategies	3.6%	0	2	2	2	0	0	0	0	0
	0.0%									
Social Sum		8.9	12.5	12.5	8.9	7.1	7.1	5.4	5.4	4.5
Social Rank		5	1	1	5	8	8	13	13	15
Economic	**50%**									
NPV @7% over 30 years										
Water Supply										
Sewerage										
Stormwater										
Total	20%	$0	$0	$0	$0	$0	$0	$0	$0	$0
Change in typical residential rate bill from the traditional scenario										
Water Supply										
Sewerage										
Stormwater										
Total	10%	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cost Benefit Ratio	20%									
Financial Rank										
TBL										
Economic	**50%**									
Social	**25%**									
Environmental	**25%**									
TBL Sum										
TBL Rank										

Compliance with Best Practice Management

The NSW Department of Energy, Utilities & Sustainability (DEUS) has produced best practice management guidelines (DEUS 2004a) in order to encourage continuing improvement in the performance of NSW local water utilities (LWU). The DUES guidelines state,

> *"LWUs which achieve the outcomes required by these guidelines will have healthy and sustainable water supply and sewerage businesses and will have demonstrated best practice management of these businesses as well as their compliance with National Competition Policy."*

The status of current compliance and suggested improvements to achieve compliance to best practice management are summarised in Table G.1 below, with more detailed information following the table.

Table G.1 *Best Practice Management – Current Compliance & Suggested Improvements*

Criteria	Compliance	Suggested Improvements
Strategic Business Plan	• Previous plans were produced in 1997 • Due for update in 2005	• Update Strategic Business Plan (including financial plan).
Water, Sewerage & Trade Waste Pricing / Developer Charges	• Best Practice Pricing implemented in 2003/04 • Revenue from residential and non-residential usage charges are currently 62% and 81% respectively • Revised developer charges are currently being prepared for implementation by July 2005.	• Revenue from residential usage charge will need to increase to 75% by 2007. • Excess water charge of at least 150% of standard usage charge needs to be implemented for residential usage above 450 kL/a.
Demand Management	• An ongoing, informal demand management program has been implemented.	• A coordinated demand management program is needed. • Increase the level of effluent & stormwater reuse.
Drought Management	• A Drought Management Strategy was completed in 2002.	• Minor amendments / updates are required to ensure compliance with guidelines.
Performance Reporting	• Annual performance monitoring and reporting is achieved.	• Ongoing improvements needed to meet requirements
Integrated Water Cycle Management	• Substantial commencement of IWCM Plan will be achieved by June 2005.	• Completion and implementation of IWCM Plan is required by June 2006.

Strategic Business Planning

Council previously prepared strategy business plans for water and wastewater in 1997. These plans are now out of date and Council is planning to update them during 2005, after the preparation of developer charges and a financial plan have been completed.

Water, Sewerage and Trade Waste Pricing / Developer Charges

Council adopted a user pays water pricing policy in 2002, consisting of a fixed service charge and a volumetric charge. The fixed service charge represents the cost to maintain the system before any water is used. The volumetric charge applies for all water usage.

DEUS guidelines recommend that over time Council should increase usage charges to increase the revenue from residential usage charges from a current 62% to at least 75%. The guidelines also recommend that an excess water charge of at least 150% of the base usage charge be implemented for high residential usage levels (say for water usage above 450 kL/a). Ideally, the excess usage charge should be applied at a level closer to existing average residential usage rates (currently around 225 kL/a) to achieve the maximum demand management benefit. However, an assessment will also need to be undertaken of the likely impact on a broad spectrum of customers.

Sewerage pricing for residential customers are in line with DEUS guidelines, with the far majority of residential customers paying a uniform annual sewerage bill. Only customers with discharge volumes exceeding 400 kL/a are charged an additional volumetric charge. The uniform access charge and excess volumetric charge for sewerage also applies to non-residential customers. However, the DEUS guidelines require that in the future, the access charge should be modified to increase with water meter size (factored by the square of the meter size).

In addition to the sewerage access and volumetric charges for non-residential properties, trade waste charges are also imposed on all liquid trade waste customers. These charges are volumetric and load based.

Developer charges, which are levied on all new developments that impose additional demand / loading on the water and wastewater systems, have been prepared. The developer charges are being determined in accordance with DEUS guidelines. Council are implementing the revised charges in July 2005.

Demand Management

Council currently does not have a coordinated or formal demand management program. However, the following demand management tools have been implemented:

- Tweed Shire Council was the first local government area in NSW to implement full metering (of new properties) in 1966.
- Public use areas including parks / reserves / sporting fields were all metered by 1988.
- Council has gradually ensured that all existing connections to the water supply system are now metered.
- A metered standpipe program has been implemented.
- Tweed Link (weekly council newsletter) includes water efficiency promotions during billing times.

- Significant promotions are undertaken during Annual Water Week.
- Council's Resource Centre includes links to water related environmental issues for schools and the general public.
- Public tours are undertaken of water and wastewater facilities.
- Per capita residential consumption has reduced from 95 kL/person/yr in 1991 to 82 kL/person/yr in 2004.

A formalised demand management program will need to be implemented in the future to ensure that water efficiency principals are conveyed to the public and adopted. The ongoing pursuit of a range of demand management, water conservation and water recycling initiatives is a fundamental component of modern water resource planning and is fundamental to creating a sustainable culture of water use efficiency in the community. The more effective these initiatives are over the long term, the more flexible the water supply system is to cope with population and non-domestic growth, by means other than increasing water supply. Gains in water efficiency can easily be lost if an ongoing program of demand management / water conservation is not maintained.

Demand management for all new residential developments will be initially driven by BASIX from July 2005. BASIX will require all new developments to be water efficient, with a targeted 40% savings compared to average homes. An ongoing demand management program will also be required to ensure existing and future residential and non-residential properties follow sustainable water efficient practices.

Preliminary Assessment of Potential Actions

Water Quality Improvement Options

A preliminary assessment of a range of water quality improvement options are summarised in Table H.1 below, with a discussion following the table.

Table H.1 *Preliminary Assessment of Water Quality Improvement Options*

Option	Details	Benefits
Targeted Riparian Vegetation Restoration	• Funding program to help landowners and Landcare groups replant riparian areas	• Increased filtering of runoff from agricultural and urban landuses • River bank stabilisation
Stewardship agreements and farm forestry	• Foster best management practices on farms • Fencing of riparian zone to restrict stock access.	• Improve quality of runoff from agricultural land
Improve Treatment Processes at STP's	• Upgrade STP's to produce high quality effluent.	• Increases reuse potential while reducing nutrient and bacterial loadings on waterways.
Stormwater Quality Improvement Devices (SQIDS)	• Existing SQIDS installed throughout the catchment • SQIDS located in appropriate locations for future development	• Can intercept a range of stormwater pollutants before they enter local waterways
Rainwater Tanks	• The implementation of BASIX in 2005 will include an option to install a rainwater tank for new residential development • Incentive scheme for installation of rainwater tanks to existing residential homes and connection to internal water uses	• Conserve mains water supply by substituting use with rainwater • Reduction in peak discharges related to storm events
Water Sensitive Urban Design (WSUD)	• WSUD requirements in Draft Version 1.2 Development Design Specifications D7	• Minimise erosion and discharge of sediments, nutrients and pollutants into the stormwater system

Some of these measures can be implemented through stormwater management plans and associated council planning instruments. Existing planning instruments may need to be reviewed and subsequently revised. However, many of these measures will require a partnership to be formed with other management or community groups such as the Catchment Management Authority or Farming community to ensure that water quality improvements are achieved.

There is the opportunity for local Landcare groups to be supported financially by Council to undertake projects which aid in the replanting or restoration of riparian areas. This would ensure that Landcare projects can be well planned and long term maintenance will be carried at each site. This approach also allows community participation and ownership of improvement options.

APPENDIX H

Demand Management Options

A preliminary assessment of a range of demand management options are summarised in Table H.2 below, with a discussion following the table.

Table H.2 *Preliminary Assessment of Demand Management Options*

Option	Details	Benefits
Targeted Residential Retrofit Program	• Installation of AAA showerheads, tap aerators & toilet flush control.	• Directly contributes to reductions in consumption in existing dwellings, around 20kL/a, while also raising water conservation awareness. • Secondary benefit of reduced power costs.
Showerhead Subsidies	• Subsidies provided by Council to offset the cost of new AAA showerheads.	• Each showerhead can save around 15kL/a. • Secondary benefit of reduced power costs.
Water Efficiency Labelling (WEL)	• Mandatory water efficiency labelling of showerheads, toilets, washing machines & dishwashers. • Will be dealt with at a national level.	• Around 5% reduction in total household indoor consumption. • If mandatory, inefficient appliances would overtime become obsolete.
BASIX	• The implementation of BASIX in 2005 will require all new residential developments to be water efficient.	• Minimum water savings of 40% of town water usage (compared to average NSW homes).
Monitoring Programs	• Metering of the various components of indoor and outdoor usage to monitor impact of demand management strategies.	• Provides valuable local data to aid in the formulation of future demand management initiatives.
Permanent Restrictions	• Permanent banning of daytime watering and washing of impervious surfaces	• The reduced consumptions associated with lower level restrictions could be achieved every year.
Loss Reduction	• Improve the efficiency of the water supply system	• Total water loss is currently around 15%. Further reductions in this amount are likely to only be minor.

An ongoing demand management program should contain a suite of tools that target a broad spectrum of customers. The tools should target existing residential properties, future residential properties that are built under the requirements of BASIX and non-residential properties.

While most low-cost demand management options should be implemented, the benefits associated with more costly demand management options, such as retrofit programs, will need to be compared to alternative options such as water recycling and supply enhancement.

APPENDIX H

Water Recycling Options

A preliminary assessment of a range of water recycling options are summarised in Table H.3 below, with more detailed information following the table.

Table H.3 *Preliminary Assessment of Water Recycling Options*

Option	Details	Benefits
Non-Residential Reuse	• Supplying effluent to selected commercial, industrial properties to offset existing town water usage.	• As there are limited very large commercial, industrial users – non-residential reuse is likely to be limited.
Agricultural Reuse	• Supplying effluent to selected agricultural properties to offset existing town water and/or raw water usage.	• Agricultural water usage is limited in areas adjacent to major urban areas (mainly the Tweed River floodplain).
Dual Reticulation	• Supply effluent to residential properties via a third pipe for outdoor and toilet usage.	• Residential average town water consumption could be reduced by around 50%.
Environmental Flow Substitution	• Use effluent to provide an environmental flow downstream of Bray Park Weir.	• Secure yield reductions of up to 4 GL/a could be offset by advanced quality effluent flows.
Sewer Mining	• Similar to Dual Reticulation except sewage is extracted from transportation system and treated locally, in the vicinity of the demand.	• Potentially beneficial where future development areas are remote from STP's.
Stormwater Recycling	• Use rainwater collected from residential roofs for outdoor, and some indoor (eg toilet) usage. • Community based stormwater collection, treatment & reuse for open spaces	• Residential average town water consumption could be reduced by up to 50%.
Greywater Reuse	• Use of domestic greywater for irrigation and toilet usage.	• Further research is required to assess the potential benefits and the risks of greywater reuse.
Aquifer Storage & Recovery	• Recharge of coastal dune system with suitable effluent or stormwater	• Local spear point extraction by residents and council for irrigation and non-potable reuse in expanding coastal communities

Non-Residential Reuse

Approximately 8,000 ML of tertiary treated / disinfected effluent is currently discharged to the rivers and estuaries of the study area on an annual basis. A small percentage (< 5%) of the annual flow volume is currently being reused for irrigation purposes.

There are numerous opportunities to establish effluent reuse schemes in the study area, particularly in new development areas. However, as there are relatively few industries operating in the study area where effluent could be used, effluent reuse schemes will need to focus on urban non-potable use.

Dual Reticulation

Dual reticulation is an alternative to effluent disposal. This option is particularly relevant to Tweed, due to the large amount of undeveloped urban land. Tertiary treated effluent could be substituted for potable water for the purposes of outdoor use (eg garden watering, car washing), toilet flushing and laundry.

The provision of dual reticulation to new development areas would be a more cost effective solution than retrofitting existing urban areas. This would potentially reduce the demand for potable water in new developments by up to 50%. Significant reductions in potable water demand could be achieved without the need to retrofit dual reticulation to existing urban areas, as new development will account for around half of the total developments in the next 25 years. Further savings in potable water consumption would be achieved by the use of treated effluent for irrigation of public parks, gardens and sporting fields incorporated in these new development areas.

A number of land parcels, currently at the planning stage, have been identified as potential areas to which dual reticulation could be supplied. treated effluent from Banora Point STP could be transported to the future Bilambil development areas (Area E, Cobaki Lakes). A dual reticulation line could also be constructed from the new Kingscliff STP to the Kings Forest and West Kingscliff developments.

Environmental Flow Substitution

There is also potential to return advanced treated effluent flows to Bray Park Weir. This could be either downstream of the weir to satisfy environmental flow requirements or upstream of the weir for indirect potable reuse and environmental flows. With the majority of sewage being generated and treated on the coast, large pumping stations and pipework infrastructure will be required to pump any return flows back up the river, with associated ongoing energy costs.

Sewer Mining

Sewer mining involves extracting wastewater from the sewerage transportation system at the point of use. Reclaimed water is treated and can be used for a variety of irrigation or industrial purposes. The solids are returned to the sewerage system for further treatment.

Sewer mining can be a more feasible option than typical effluent reuse schemes where the irrigation site is remote from an STP. Typically sewage is transported to the STP for treatment and the effluent then transported back to the reuse site, which can result in high infrastructure costs for pipeline and pumps, as well as ongoing operation and maintenance costs.

Sewer mining could be used to supply industrial or commercial developments, either to new developments or as a retrofit to existing development. This option would require a packaged STP to be located at new estates.

Stormwater Recycling

Traditional stormwater management has focused on efficiently removing excess water from the urban environment to prevent water logging and flooding. On-site rainwater harvesting provides a dual benefit by reducing potable water consumption and reducing stormwater discharges to the environment.

Studies have shown that the use of rainwater tanks for outdoor purposes and toilet flushing can reduce potable water consumption by up to 50%. The effectiveness is largely influenced by the size of the tank and the amount of runoff from the roof area that can be captured. This is increased by utilising rainwater for internal purposes which continually draw down the rainwater supply in the tank and provide empty tank space for stormwater storage and detention.

The climate in the Tweed District is characterised by high coastal rainfall. Rainfall tends to be highest in the summer months, coinciding with the period of highest demand. The use of rainwater, particularly if connected to internal plumbing, would also reduce the pressure on existing water infrastructure.

An alternative to the installation of rainwater tanks in new development areas is collecting stormwater runoff from future developments, such as Pottsville and Seabreeze, to recharge the coastal aquifer system via wetlands/ infiltration systems. Domestic spear points could then be utilised to supply water for outdoor usage.

Greywater Reuse

Greywater is wastewater generated from domestic fixtures such as the kitchen sink, shower, basin and washing machine, but excluding the toilet. Greywater can be reused in the garden, in the laundry or for toilet flushing, provided it undergoes pre-treatment. The use of untreated greywater can pose a health risk and is generally discouraged, although it is permitted in association with a greywater diversion device which directs greywater to sub-surface or sub-soil irrigation (with no storage).

Supply Enhancement Options

A preliminary assessment of supply enhancement options are summarised in Table H.4 below, with more detailed information following the table.

Table H.4 *Preliminary Assessment of Supply Enhancement Options*

Option	Details	Potential Benefits
Augmentation of Existing Infrastructure	• An increase in the total storage in Clarrie Hall Dam could be achieved in association with a spillway upgrade.	• Potential storage increase and associated yield increase are unknown at this stage.
	• Construct pipeline from dam to weir or WTP.	• Potential increase in yield is unknown at this stage.
	• Augmentation of Bray Park Weir.	• Increased yield (with associated local flooding issues).
Construction of New Dam	• Byrrill Creek has been flagged as potential future dam site.	• Potential storage volume and associated yield are unknown at this stage.
Supply from other water supply catchments	• Import water from adjacent catchment to the north or south.	• Potential feasibility is unknown at this stage.
Desalination	• Removal of salt from sea water.	• Potential limitless source of water.

Augmentation of Existing Infrastructure

Clarrie Hall Dam is in need of augmentation in order to satisfy dam safety requirements in regards to the ability to pass extreme flood events. Consideration should also be given to the feasibility of additional augmentations to increase the total storage volume of the dam. Over the past ten years, a large number of dams in NSW have been subject to augmentations due to dam safety concerns and in many cases consideration was also given to further augmentations to increase the total storage.

Initial assessments indicate the wall can be safely raised to accommodate an increased top water level (TWL) of 5 to 10m, increasing the dam storage volume by up to twice the existing capacity. Potential yield increases have not been assessed to-date.

In association with an augmentation of the dam, the construction of a pipeline from the dam to Bray Park Weir or WTP may also be considered. Any increase in yield associated with reduced losses would need to be considered in the context of the adverse environmental impacts associated with construction and operation (reducing flows to the Upper Tweed River).

Detailed assessment of options, selection of the preferred option and concept / detailed design are due to occur in 2005, with construction currently scheduled for completion by 2012.

Augmentation of Bray Park Weir has previously been assessed as being an unfeasible option as it is inconsistent with the NSW Government's Water Sharing Policy and the State Weir Policy (Patterson Britton 2003). In addition to the statutory obligations, there are also local adverse impacts associated with flooding of upstream farm land.

Construction of New Dam

In 1984, Council purchased 1,000 Ha of land at Byrrill Creek, for a second dam if and when it was ever required. A further 120 Ha was purchased in 1994. Byrrill Creek was the alternative choice of dam sites to Clarrie Hall Dam prior to its construction in 1983.

Further detailed assessment (both technical and environmental) of this option is required in order to allow comparison with other supply enhancement and demand side options.

Supply from Other Water Supply Catchments

Augmentation of urban water supplies in adjacent catchments to the north and south are being or will be considered in the future. The option of sharing water resources with adjacent catchments has not been considered in detail to-date and may need to be assessed in association with the assessment of a new dam within the catchment. There may be potential options to import or export water, particularly with Gold Coast Council to the north who have a common boundary with Tweed Council within an urban area (Tweed – Coolangatta).

Desalination

Desalination has historically been considered a feasible but expensive, last choice option for coastal urban water supply systems. However, in the last couple of years desalination has become more popular and is increasingly being considered as a major supply enhancement option. Water Corporation in Western Australia has recently let contracts for a 45 GL/a desalination plant, while South Australia and several east coast water authorities (including Sydney Water and Gosford / Wyong Councils) are presently assessing the feasibility of desalination.

The feasibility of desalination and the comparative costs to other supply enhancement options have not previously been considered for the study area.

Summary of Historical Effluent Reuse Projects

Following is a brief summary of effluent re-use projects undertaken in the Tweed Valley over the last 25 years.

Banora Point STP and Kingscliff STP	In the late 1990's the Lower Tweed Community Consultation program revealed a community preference for revegetating and irrigating the Crown Land areas on Letitia Spit and between North Kingscliff and Fingal. Several assessments of this proposal were conducted. There is currently little community support for the project and further studies has concluded that there is limited area available for the significant quantities generated from Banora Point and Kingscliff STP. It is noted that this land is currently under the control of the Tweed Byron Local Aboriginal Land Council.
Banora Point STP	Since the late 80's Coolangatta Tweed Heads Golf Course has used effluent from Banora Point STP for irrigation. The Golf Club installed their own pump equipment and pipeline from the treatment plant to their site. The current agreement provides up to 2 Megalitres per day (approximately 10%) of the Effluent from Banora Point STP.
Kingscliff STP	The establishment of turf farm adjacent to the existing Kingscliff STP was investigated. This project entailed the use of effluent and sludge for the growing of turf for the local market. As a sustainable project which provided effective use of the effluent Council invested over $300,000 in preparing a development application and eventually awarding a Contract to install the irrigation system. Following development approval there were some objections from adjoining landholders which eventually led to an appeal in the Land and Environment Court. Council lost the appeal. As it was eventually determined to relocate the STP site following community pressure the Turf Farm venture was shelved.
Kingscliff STP	In 1999 Council constructed a 250 mm diameter effluent reuse pipeline from Kingscliff STP to a Tea Tree Farm off Crescent St, Cudgen. The owner reimbursed the pipeline costs over a 5 year period under a funding agreement. To date the pipeline has not been used.
Kingscliff STP	In late 1980's small size pipe and pump was installed to reuse effluent from Kingscliff STP on Banana Farm at Cudgen. This system was used for a couple of years and then abandoned.
Kingscliff STP	As part of the upgrade to Kingscliff STP Council is investigating the possibility of re-using effluent for irrigation on the Kingscliff foreshore area, sporting fields and golf course. MWH have been engaged to undertake a concept design for this proposal and it is envisaged that the report will be finalised by May 2005. This project has the potential to utilise up to 0.5 Megalitre per day which represents approximately 17% of the current Dry Weather Flow to the plant.
Hastings Point STP	A small dunal revegetation area effluent irrigation was investigated at Hastings Point in 1998. A local Conservation group representative argued that the natural vegetation cover in this area is dry heath, not rainforest species and therefore opposed the use of nutrient rich effluent irrigation. Potable water was used instead for this project.

Hastings Point STP	Council is currently in association with a local company investigating the feasibility of supplying effluent from Hastings Point STP for the irrigation of a Turf Farm. This project has potential to utilise up to 2 Megalitres per day which is approximately all the current average Dry Weather Flow from the Plant.
Tumbulgum STP	An Effluent irrigation system was installed in 1999 for sugar cane on Council land adjacent to the Sewage Treatment Works at Tumbulgum. The system utilised a travelling irrigator to irrigate 3.4 hectares of sugar cane. The irrigation system was abandoned due to operational difficulties and requirement for operator presence during operation. Part of the abandoned installation is now used to supply effluent to a Taro grower on the adjoining property. Up to 70kl/day can be used by Taro grower for reuse which is approximately the current Average Dry Weather Flow for the plant.
Murwillumbah STP	"The Murwillumbah Sewage Effluent Re-use by Irrigation" study was conducted in 1994. Two areas were investigated near the STP namely cane land and sporting fields. Investigation concluded that the agricultural soils are heavy and are not favourable for irrigation.
Murwillumbah STP	The options for irrigation of the golf course and racecourse using effluent from Murwillumbah STP were investigated in 1994/95. At the time there was little support for the options as they involved high capital cost and current availability of bore and surface water for irrigation on site. Recently both organisations have contacted Council with an interest to further discussions on the use of Effluent for irrigation. These options have not been pursued due to the Council pursuing the agreement for the supply of Effluent to the Condong Mill for the Co-generation Facility.
Murwillumbah STP	For the last 4 years Council has been negotiating with Delta Electricity and Sunshine Sugar for the supply of Tertiary Treated Effluent for a Co-generation Facility at Condon Mill. Council has signed the agreement ad the project is awaiting financial Closure. The Treated effluent from Murwillumbah STP will be used for cooling tower water and boiler feed make up. This project proposes to re-use all average dry weather flow from Murwillumbah STP which is in the order of 2.4 to 3 Mega Litres per day.
Uki STP	Uki sewerage scheme commissioned in 2004 was designed to re-use over 99% of effluent on irrigation of eucalyptus trees in a joint venture with Currumbin Wildlife Sanctuary. The treatment plant has a design capacity of 600 Equivalent Persons. The trees are to be harvested by the Sanctuary for koala food. A 10 Megalitre Wet weather effluent storage dam was constructed to limit discharges to the adjoining creek to extreme wet weather events only.
Tyalgum STP	Tyalgum STP reuses approximately 95% of its effluent to irrigate pastures adjacent to the STP. The plant has been operational since the late 80's and has a average daily flow of 50 kilolitres.