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**TWEED SHIRE COUNCIL**

**DROUGHT MANAGEMENT STRATEGY**

**FINAL REPORT**

**APRIL 2009**



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## REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
Draft	3 April 2008	Draft	S O'Brien	G Gabriel	M Bowman
Final Draft	5 August 2008	Amendments as per email of 28 April 2008	S O'Brien	G Gabriel	M Bowman
Final	22 April 2009	Amendments as per email of 26 August 2008 and comparison of 1902 and 2002 drought flows	S O'Brien	E Hunter	M Bowman

## EXECUTIVE SUMMARY

### Purpose of Document

The purpose of this document is to outline the actions to be taken where water supply to customers in the Tweed Shire is required to be restricted for any reason. This may occur for various reasons, however is generally due to drought conditions resulting from lower rainfall and stream flows than the historical average.

Two of Tweed Shire's water supply schemes are covered by this report:

- Bray Park / Uki system supplied by the Tweed and Oxley Rivers as well as the Clarrie Hall Dam
- Tyalgum system supplied by the Tyalgum Weir.

### Recommended Restrictions Regime – Bray Park / Uki System

Based on the review of restriction trigger levels it is proposed to amend the current trigger levels in Clarrie Hall Dam as well as the targeted demand reductions as shown in the table below. It is important to the success of restrictions that early action is taken to commence the reduction of demand. Early action will provide sufficient time for water customers to adopt the restrictions and ensure that the demand savings are achieved. For Tweed Shire it is believed that high levels of savings, i.e. greater than 30% will be difficult to attain. This is due to the low level of external use in the Shire.

Restriction Trigger Levels	Target Demand Reduction	Restriction Level Imposed @ (% of Clarrie Hall Dam Full Capacity)
External Sales banned and Pre Activation Activities	0%	90%
Level 2 Restrictions	15%	75%
Level 4 Restrictions	20%	60%
Level 6 Restrictions	25%	50%
Level 7 Restrictions	30%	40%

An assessment of the performance of the existing water resources was undertaken using a water balance model. Modelling found that with the adoption of the above restrictions regime the expected performance would be as follows:

- Case 1 - With zero flow in the Upper Tweed catchment and zero inflow to the Clarrie Hall Dam, water supply would fail in around 12 to 14 months.
- Case 2 - With continuous operation under the low flows of 1902 (similar to 2002 flows), the supply would fail in around 48 months under 2008 demand and 30 months under 2018 demand. With an allowance for environmental flows of 4.5 ML/d through the fish ladder at Bray Park weir the time to failure would decrease by around 2 months.

The likelihood of either of these events occurring is extremely low, particularly for Case 1 as there has never been a cessation of all flow in the catchment for an extended period.

### **Preferred Contingency Plan – Bray Park / Uki System**

Contingency options to supply customers under a total failure scenario or to provide a supply back up if the dam reaches critical levels, were reviewed as part of the study. Based on a review of the South East Queensland performance over the past 2 years a supply of 14 ML/d (2008) and 18 ML/d (2018) would be required to sustain the shire under an emergency condition for an indefinite dry period. This compares to non-drought average day demands of 26.8 and 34.0 ML/day for 2008 and 2018 respectively.

To supply this level of demand the preferred approach would be to provide a pipeline link between the SEQ Water Grid and Coolangatta. The timing of this link is currently being investigated however it may not be available until after the construction of the Traveston Dam, programmed for 2012. Prior to that date, the most practical approach would be to utilise temporary desalination units located at acceptable points in the shire.

### **Recommended Restrictions Regime – Tyalgum System**

The Tyalgum weir has an estimated yield greater than the current and future demand. Carting has been required in the past as a result of taste and odour problems in the raw water due to algal blooms. This issue will be significantly improved in future following the upgrading of the water treatment plant.

It is recommended that the following drought restrictions triggers and targeted demand reductions be adopted:

- **Level 2 Restrictions** to be imposed when water flow over the weir ceases, i.e. no visible flow. A demand reduction of 20% is targeted under this level.
- **Level 4 Restrictions** to be imposed when water carting commences, due to poor water quality in the weir or reaching dead water level in the weir, as indicated by poor product water quality from the Water Treatment Plant. A demand reduction of 30% is targeted under this level.

### **Preferred Contingency Plan – Tyalgum System**

Water carting has previously been adopted as a contingency plan for supplying Tyalgum during water restrictions. The cost of this approach has increased significantly and is estimated at \$1,200 per day for 40kL. A state government subsidy for water carting may be available however the cost is likely to remain high.

The frequency of carting will be significantly reduced following the commissioning of a proposed Powdered Activated Carbon (PAC) process to be included as part of the water treatment plant upgrade.

## **Drought Management Strategy - Recommendations**

Based on the assessment of options for drought management in the Tweed Shire it is recommended that:

1. The current council drought management policy be revised including the current restriction triggers and targeted savings as outlined in this report. A further review of the restrictions triggers should be undertaken in 2012. At this stage the preferred contingency option will likely be available and the actual performance of the demand management program will be clearer.
2. The cessation level for flow bypass requirements at Bray Park Weir be set at a level of 50 % of the capacity of the Clarrie Hall Dam. This proposal should be reviewed in consultation with DWE and may be considered to accommodate growth. A revision of the proposed Conditions Statement for the Upper Tweed may be required.
3. Tweed Shire continues to pursue a pipeline link to the SEQ Water Grid with a capacity of up to 20 ML/day (a volume of 14 ML/d for 2014 and 18 ML/d for 2018 required to provide continuous supply under worst case conditions), as the preferred contingency plan for the Bray Park water supply system. This option is also being further investigated as part of the Bulk Water Options Assessment study as an option to improve reliability of supply.
4. Prior to 2012 (or other approval date as advised by the Queensland Water Commission), the preferred contingency plan would be temporary desalination package plants to a capacity of 16 ML/d. Such an option would likely be triggered at 40% level in the Clarrie Hall Dam.
5. A Blue Green Algae Management Plan be developed for Council's three water bodies in accordance with the template provided in the Water Directorate's management protocols.
6. A catchment management plan be developed for the Upper Tweed catchment (upstream of Bray Park Weir).
7. An additional mixer be installed in the Clarrie Hall Dam to enhance the capacity, flexibility of the existing system and to provide system redundancy.
8. A register of critical customers be developed for use in the drought communications plan.
9. Monitoring of the Tweed River and Doon Doon Creek flows be upgraded to enable monitoring as required under the draft Department of Water and Energy's Conditions Statement.

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## 1. INTRODUCTION

### 1.1 PURPOSE

The purpose of this document is to outline the actions to be taken where water supply to customers in the Tweed Shire is required to be restricted for any reason. This may occur for various reasons, however is generally due to drought conditions resulting from lower rainfall and stream flows than the historical average.

Tweed Shire has two water supplies, the Bray Park / Uki system serving a current population of some 75,000 persons and a smaller system at Tyalgum serving around 220 persons. Separate plans are provided for each of these water supplies.

This Drought Management Plan outlines the system background, water demand and population growth, climate conditions and available water resources and provides a strategy to manage these resources during drought or other emergency conditions. The plan aims at ensuring that the reliability of the water supply whilst recognising the needs of the community and protecting access to water as an essential service.

### 1.2 OBJECTIVE

The objective of this document is to develop a strategy to be implemented during periods of water shortages and to provide for the responsible use of the region's water resources. As part of the report, details of water restrictions to be implemented during droughts or other emergencies are provided.

### 1.3 OVERVIEW OF DOCUMENT

An overview of the Drought Management Plan is as follows:

Section of Report	Overview
1. Introduction	<ul style="list-style-type: none"> <li>This section</li> </ul>
2. Water Supply Background	<ul style="list-style-type: none"> <li>Provides data on population, water demand, water resources, water supply system and water quality for each water supply system</li> </ul>
3. Demand Management and Restrictions	<ul style="list-style-type: none"> <li>Outlines details of the plan including the restriction trigger levels, details of the actions to be taken under each level and the removal of restrictions</li> </ul>
4. Contingency Plans	<ul style="list-style-type: none"> <li>Addresses the contingency options available for the water supply should a drought continue</li> </ul>
5. Implementation of Plan	<ul style="list-style-type: none"> <li>Provides guidance on implementation aspects such as system monitoring, consultation with stakeholders and external agencies</li> </ul>
6. Recommendations	<ul style="list-style-type: none"> <li>Recommendations for the implementation of the Drought Management Plan</li> </ul>

## 2. WATER SUPPLY BACKGROUND

### 2.1 SYSTEM CHARACTERISTICS

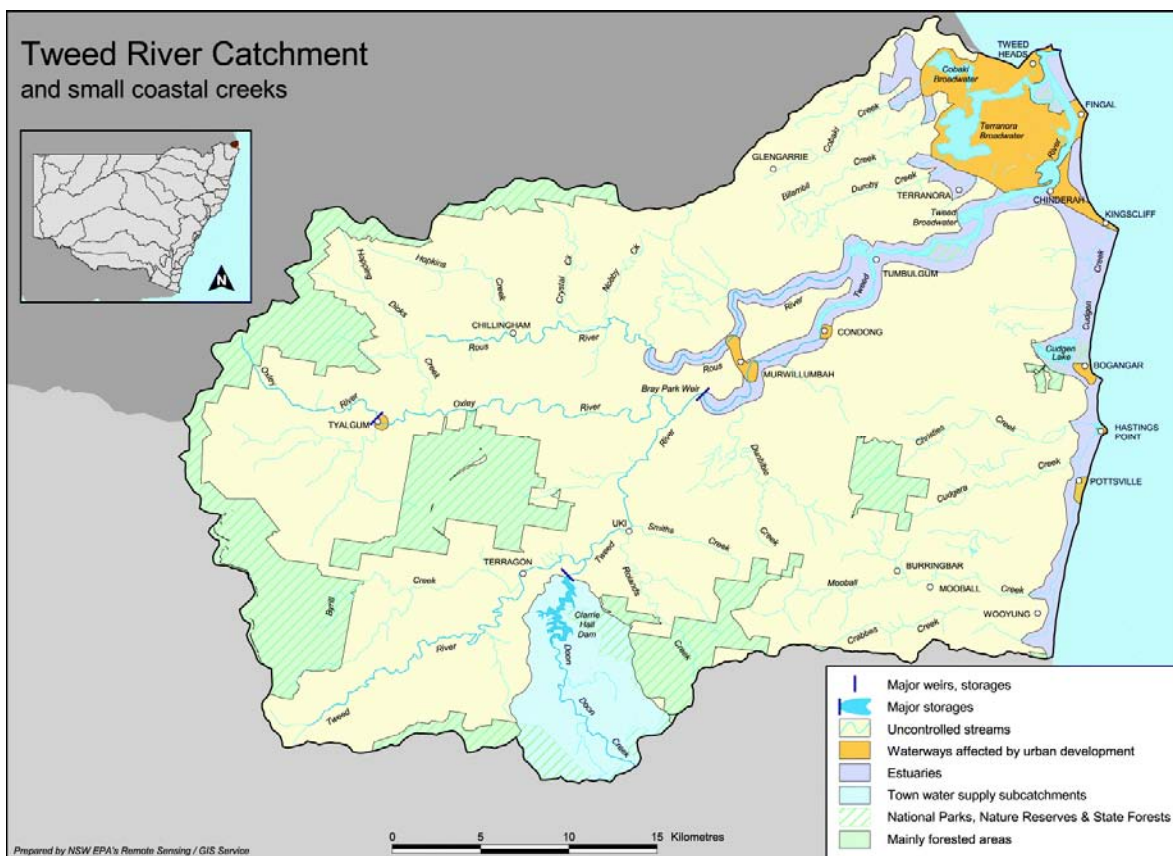
#### 2.1.1 LOCATION AND SCHEMES

Tweed Shire is located in the coastal far north of New South Wales. The shire is immediately south of the Gold Coast and adjoins the Byron Shire to the south and the Kyogle Shire to the west. Tweed Shire Council (TSC) operates two water supply schemes in the shire:

- Bray Park and Uki Scheme is the major water supply in the shire serving more than 99% of consumers. This scheme sources water from the Tweed and Oxley Rivers and has a major water treatment plant at Bray Park situated immediately upstream of Murwillumbah. The Bray Park WTP services the major urban areas including Murwillumbah, Tweed Heads, Kingscliff, Pottsville and Hastings Point. A second and much smaller plant draws water from the Tweed River and serves the village of Uki. Bulk water is drawn from the Tweed River with releases from the Clarrie Hall Dam on Doon Doon Creek used to augment flows when river flows reduce.
- Tyalgum Scheme is located on the Oxley River, approximately 20 kms west of Murwillumbah. The village draws water from the Tyalgum Weir.

The location of these centres in relation to the river systems is shown in Figure 1 (EPA 2000).

**Figure 1 – Locality Plan**



### 2.1.2 CLIMATE OVERVIEW

The climate of Tweed Shire is described as sub-tropical with wet summers and dry winters. Climate statistics for the Bray Park Weir site are summarised as follows:

- mean annual rainfall is 1,585 mm
- mean annual evaporation is 1,000 mm
- mean minimum 14.4°C
- mean maximum temperature is 25.8°C.

Historical rainfall is skewed towards the summer period of December to May, as shown in the summary in Table 1. The driest period is generally experienced in late winter and spring.

**Table 1 – Rainfall Statistics for Bray Park**

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	190	235	224	170	150	88	71	50	39	85	124	159	1,585
90 <sup>th</sup> Percentile	303	514	441	443	428	219	153	122	98	161	213	308	2,347
10 <sup>th</sup> Percentile	53	66	49	41	16	10	4	3	2	27	25	55	1,059

Figure 2 shows the monthly rainfalls from 1950 to 2007 for different areas of the shire.

**Figure 2 – Annual Rainfall 1950 to 2007**

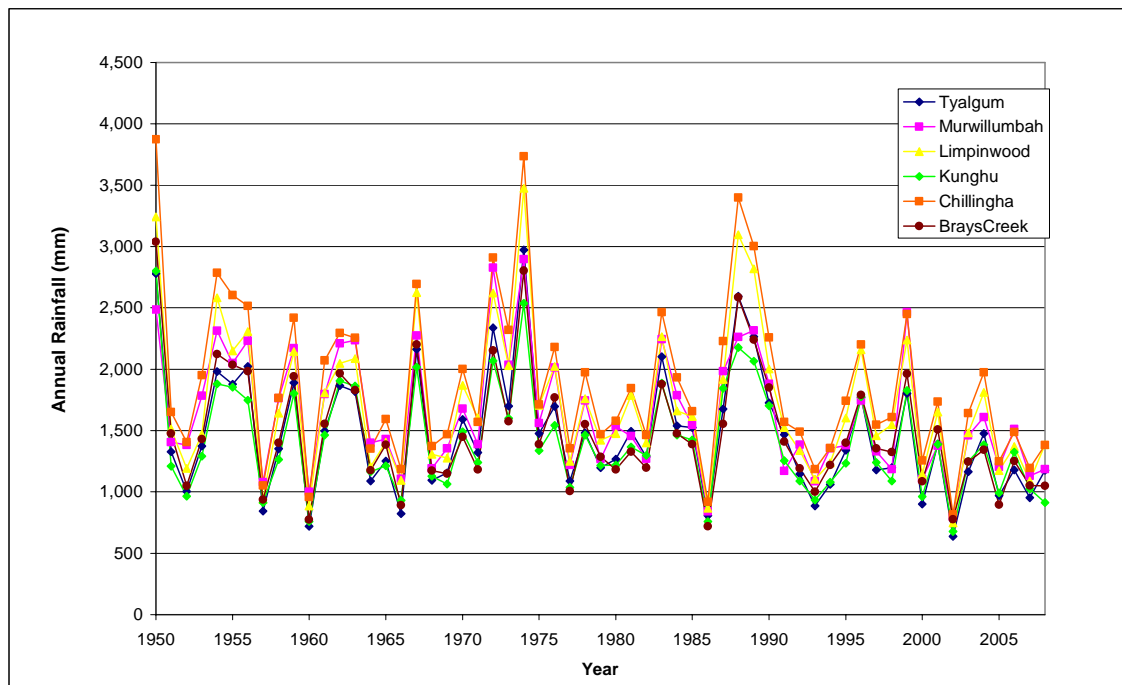
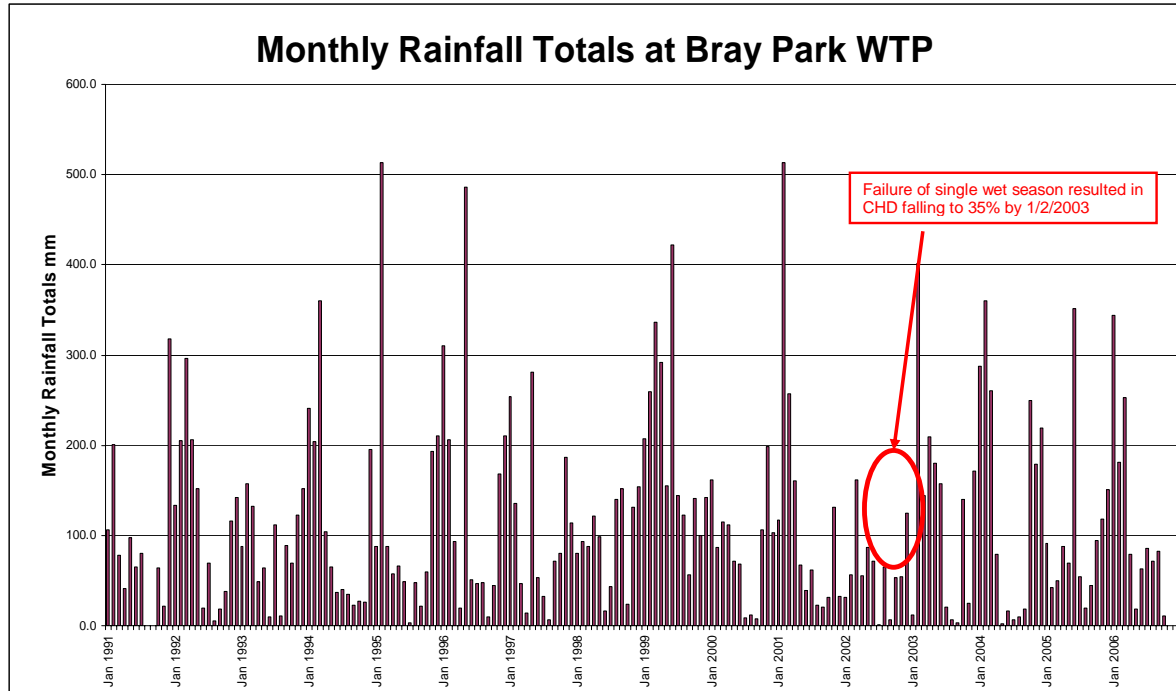


Figure 3 shows the monthly rainfall at Bray Park from 1991 to 2006. The drought of 2002/3 is highlighted showing the low monthly totals and the failure of the high summer rainfalls during the period.

**Figure 3 – Monthly Rainfall at Bray Park (1991 to 2006)**



## 2.2 BRAY PARK AND UKI WATER SUPPLY SYSTEM

### 2.2.1 SYSTEM OVERVIEW

The Bray Park and Uki water supply systems are located on the Tweed River and supply the bulk of the shire. Water supply for the village of Uki is drawn from the Tweed River downstream of the Clarrie Hall Dam and upstream of the Bray Park Weir. There is no weir at Uki and the system relies on run of the river flows. Raw water is treated using coagulation with aluminium sulphate, clarification, sand filtration and disinfection. It is noted that there are no facilities for treating poor water quality events such as blue green algae. The plant has a capacity of 0.4 ML/day.

As discussed the Bray Park Water Treatment Plant (WTP) services more than 99% of the shire's water users, including Tweed Heads, the coastal towns south to Pottsville and the inland villages of Mooball and Burringbar. A treatment plant is located adjacent to the Bray Park Weir on the Tweed River, immediately south of Murwillumbah.

Raw water is pumped from the Bray Park Weir to the WTP via two pressure mains 1,400m in length. The existing conventional sand filtration process is being replaced with a membrane treatment plant. The plant will initially have a capacity of 100 ML/d and is being configured for future expansion to 150 ML/d. Adoption of the membrane treatment process will enhance the treatment plant's water quality performance particularly during periods of high turbidity or during outbreaks of blue green algae.

Treated water is pumped from the WTP to the Hospital Hill reservoirs in Murwillumbah prior to being transferred to the other demand centres. Three trunk transfer systems exist to supply Tweed Heads / Kingscliff, Bilambil and Hastings Point / Pottsville. A layout plan of the major supply systems is provided in 7.Appendix A.

## 2.2.2 BULK WATER STORAGE

### 2.2.2.1 STORAGE CHARACTERISTICS

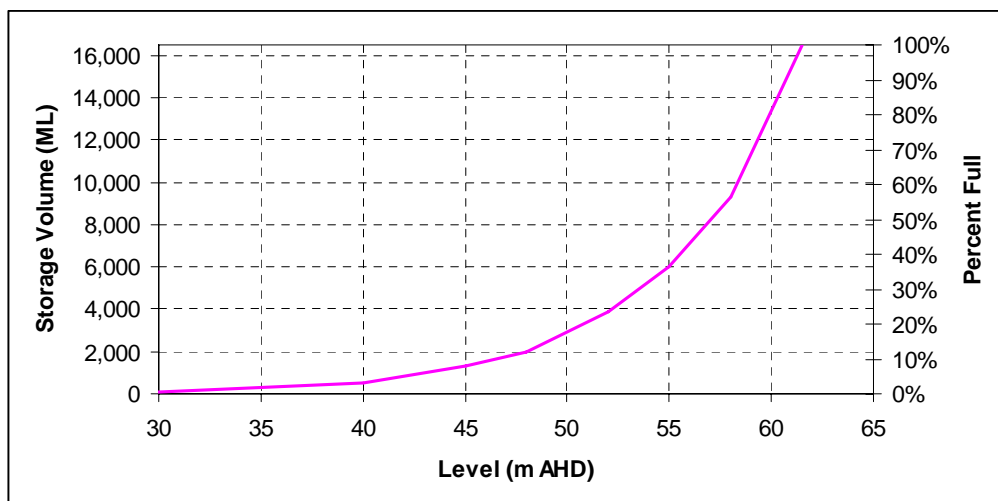
As shown in Figure 1 two storages are operated as part of the Bray Park / Uki system. These are the Clarrie Hall Dam, located on Doon Doon Creek and the Bray Park Weir on the Tweed River. The characteristics of these storages are summarised in Table 2 (SunWater 2006).

**Table 2 – Storage Characteristics – Bray Park System**

Description	Clarrie Hall Dam	Bray Park Weir
Source	Doon Doon Creek	Tweed River
Catchment Area	60.2 km <sup>2</sup>	565 km <sup>2</sup>
Top Water Level	61.5 m AHD	1.06 m AHD
Capacity	16,000 ML	839 ML
Dead Storage	1,000 ML	191 ML
Commandable Storage	15,000 ML	648 ML
Estimated System Yield	13,750 ML/a	
Maximum Surface Area	220 ha	35.5 ha

A storage versus level curve for the Clarrie Hall Dam is provided in Figure 4.

**Figure 4 – Storage Curve – Clarrie Hall Dam**



#### 2.2.2.2 OPERATING LICENSE

At present the operating license for the water supply is being reviewed by the Department of Water and Energy. The Draft Conditions Statement outlines the proposed license conditions which are summarised as follows:

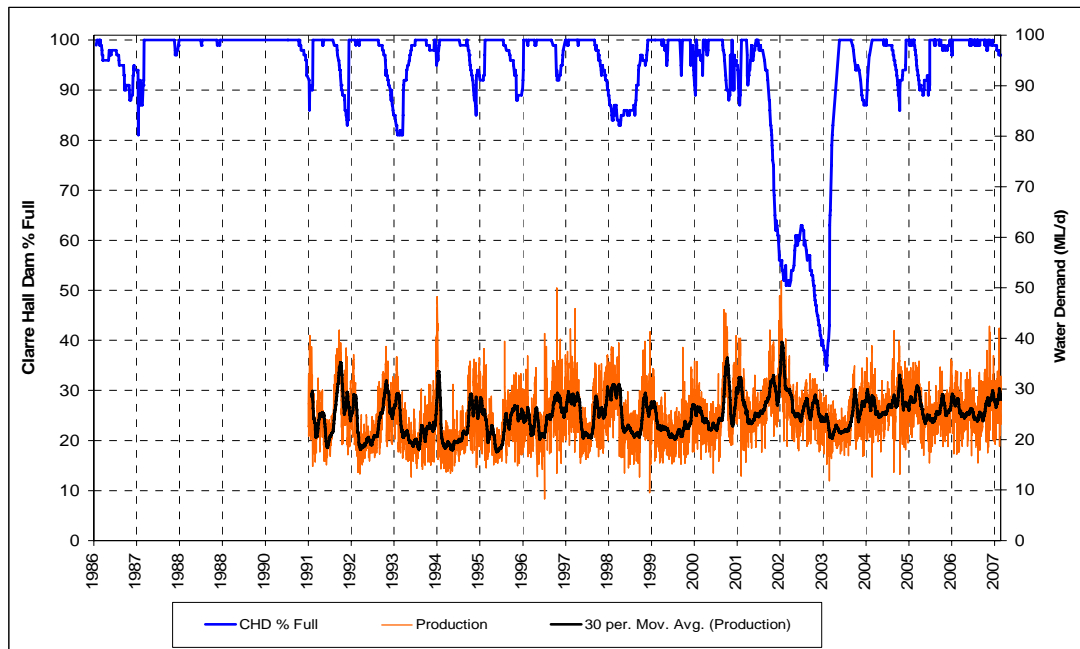
- Clause 5 states that the inflow to the Clarrie Hall Dam is to be bypassed to Doon Doon Creek to the lesser of:
  - The inflow to the dam; or
  - One third of the flow at the point upstream of the confluence with the Tweed River up to a maximum of 1.1 ML/day from September to April and 0.8 ML/day for the rest of the year.
- Clause 12A states that council will cease to pump from the river when the discharge from the Bray Park weir (through the fish ladder) is less than the 95<sup>th</sup> percentile flow.
- Clause 12B states that flow through the Bray Park Weir fish ladder may be ceased when the dam falls below 50% and where appropriate demand management strategies are in place (e.g. demand restrictions).
- Clause 14A states that the council must implement a demand management strategy consistent with the Regional Water Management Plan.
- Clause 16 outlines reporting requirements under the license.

#### 2.2.2.3 HISTORICAL PERFORMANCE

Figure 5 shows the performance of the Clarrie Hall Dam since 1986, together with the actual water production at the Bray Park Water Treatment Plant. The drought of 2001-3 was the worst on record (>100 years of record). During this drought the water storage reduced to 35% and had the drought continued, failure could have occurred within 6 months. It is noted that the restrictions policy in place at the time allowed the level in the dam to fall to 50% prior to the introduction of Level 1 restrictions. The drought broke shortly after Level 3 restrictions were imposed. The restrictions policy was as follows:

- External Sales Banned @ 65%
- Level 1 (Target 10% reduction) @ 50%
- Level 2 (Target 20% reduction) @ 45%
- Level 3 (Target 30% reduction) @ 35%
- Level 4 (Target 40% reduction) @ 25%



**Figure 5 – Performance of Clarrie Hall Dam (1986 to 2007)**


Demand reductions achieved during Level 2 Restrictions were assessed at approximately 24% of the average demand. Although this was slightly higher than the Target of 20%, the reduction was achieved almost entirely from the ban on external use, and occurred at the peak of summer. Tweed Shire has a low level of external use due to the generally high rainfall experienced in the area. To achieve higher levels of reduction (30 and 40% for Levels 3 and 4) within the available timeframe of one to two months, would have been difficult if not impossible to achieve.

Based on the assessment of the 2001-3 drought, it is evident that the restrictions regime included a high level of risk, that is, the restrictions policy did not allow time for management of the relatively small volume of storage in the dam. In 2007, a revised restrictions regime was adopted by council. The revised policy adopts increase trigger levels providing more time to manage both demand and supply. Revisions are discussed in Section 3.2.1.

Contingency planning taking account of the short lead times available for this system are discussed in Section 5.

### 2.2.3 HISTORIC WATER QUALITY PERFORMANCE

Algal blooms may occur under favourable conditions which vary from storage to storage but are generally related to elevated nutrient concentrations and higher water temperatures, long sunny days, calm water conditions and low turbidity. The occurrence of blue green algae or cyanobacteria in a storage does not automatically impact the quality of the treated water supply. Cyanobacteria are extremely diverse and the impact depends on the type and concentration. In low concentrations, cyanobacteria pose no risks, however high concentrations can produce tastes, odours and toxins that can be harmful to humans and animals.



A toxic algal event occurs when the concentrations of problem genera exist in the supply. Any algae event therefore needs to be carefully monitored to identify the presence of toxins and to take the necessary actions to address the risks of harm.

The Upper Tweed catchment generally experiences elevated nutrient levels within both the Oxley River and Tweed River sub-catchments. On occasions algal concentrations have reached or exceeded recommended thresholds for primary contact recreation. The upper catchment is significantly impacted by agricultural runoff, including soil erosion, and modified rural runoff containing fertilizers and animal waste. Consequently, Bray Park Weir has experienced increasing algal counts over the past decade.

During the summer of 2001/2, algal blooms of the genus anabaena occurred in the Tweed River resulting in the cyanobacterial metabolite, geosmin, being released into the river water. The existence of geosmin in the raw water may result in taste and odour issues in the treated water supply. This event coincided with a period of high demand resulting in the use of the existing Powdered Activated Carbon (PAC) dosing facility at the Bray Park water treatment plant for a period of approximately 3 weeks during November 2001 and for another 8 weeks during December-January 2001/2. As part of the drought response additional releases were also made from the Clarrie Hall Dam to flush algae from the Tweed River and Bray Park Weir.

Although there have been algal events in the weirs and in the dam there has not been a toxic event.

#### 2.2.3.1 MIXER PERFORMANCE

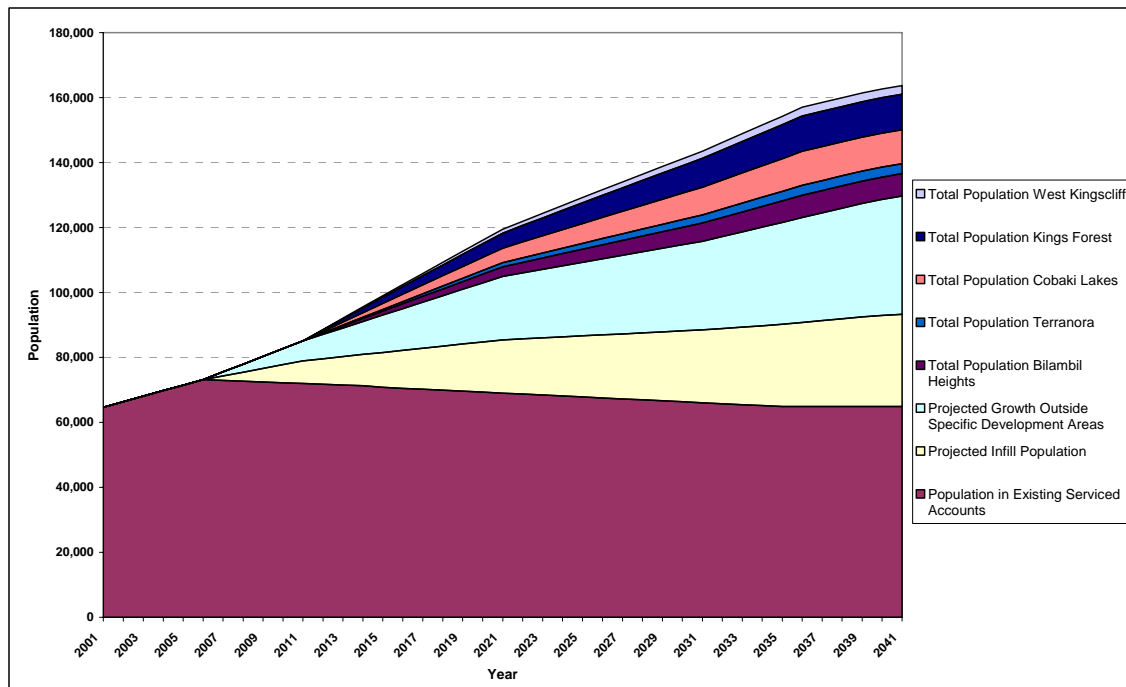
In early 2002 Council installed a high rate mixer in the Clarrie Hall Dam to assist in the management of water quality. The mixer is a ResMix Surface Mounted Destratification Impeller (Model SMDI-5 02). The mixer is designed to pump water from the surface to a set depth to limit the conditions under which algae grow. This operation oxygenates the lower waters in the reservoir and prevents the release of nutrients, which promote the growth of algae.

An initial study undertaken to assess the performance of the mixer found that there was no conclusive evidence that the mixer had been effective. However information presented in the report shows increased levels of dissolved oxygen in the lower levels of the reservoir during the period from May to October / November. It was also found that the frequency of major outbreaks declined since the introduction of the mixer.

#### 2.2.4 POPULATION AND DEMAND

##### 2.2.4.1 POPULATION PROJECTIONS

Tweed Shire is expected to grow strongly over the next 30 years as shown in Figure 6. The current population of the Bray Park system is approximately 75,000 persons. This is expected to increase to 106,000 persons in 2017. Population growth in Uki village is expected to be negligible.

**Figure 6 – Population Projection (Bray Park System)**


#### 2.2.4.2 WATER DEMAND FORECASTS

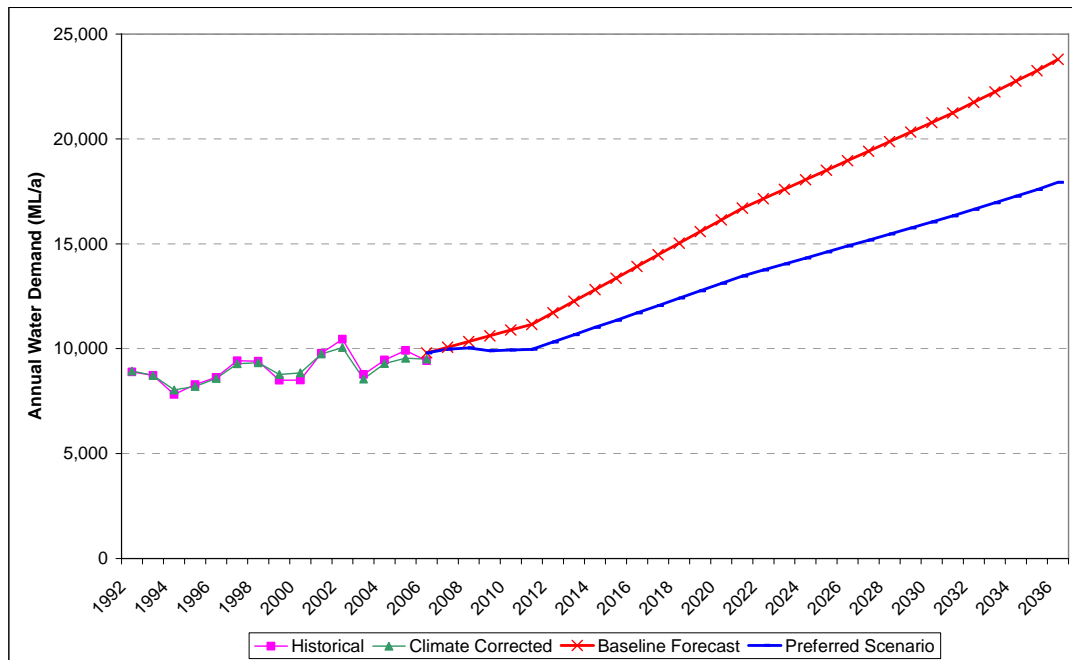
Based on the TSC Demand Management Strategy Stage 1 (MWH 2007), demand forecasts for Baseline and Demand Management Scenarios were developed. The Baseline forecasts assumed the continuation of historic demand with reductions due to Water Efficiency Labelling Scheme (WELS) and natural replacement of fittings and fixtures with efficient devices. The Demand Management preferred scenario was developed based on a rigorous analysis of options and a triple bottom line assessment.

Demand forecasts for the Bray Park system are summarised in Table 3 and Figure 7. Based on the Demand Management preferred scenario the water resources will not require augmentation until around 2021. If these demand reductions are not achieved then augmentation will be required by 2016.

**Table 3 – Demand Forecast - Bray Park System**

Scenario	Total Annual Demand (ML/a)						
	2006	2011	2016	2021	2026	2031	2036
Baseline Forecast	9,804	11,160	13,922	16,699	18,960	21,239	23,796
Preferred Demand Management Forecast	9,804	9,970	11,707	13,463	14,892	16,324	17,926

**Figure 7 – Water Demand Forecast – Bray Park System**



Based on the above average day demand to be considered as part of this drought strategy is:

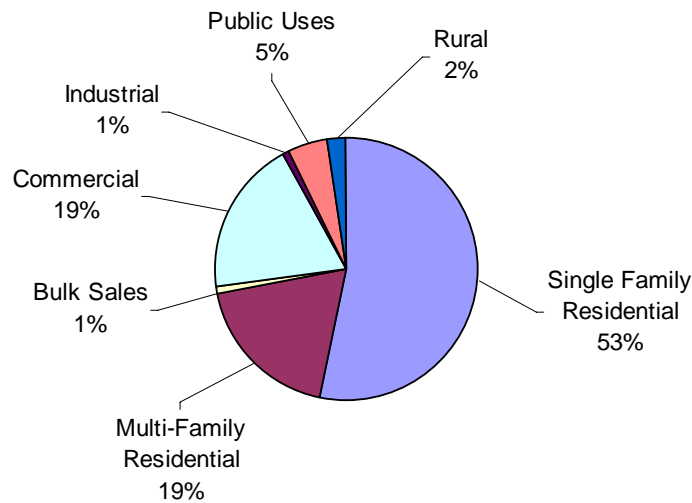
- 26.8 ML/d at 2008; and
- 34.0 ML/d at 2018 (under a Demand Management Strategy).

## 2.2.5 CUSTOMER WATER USE

### 2.2.5.1 SECTORAL DISTRIBUTION

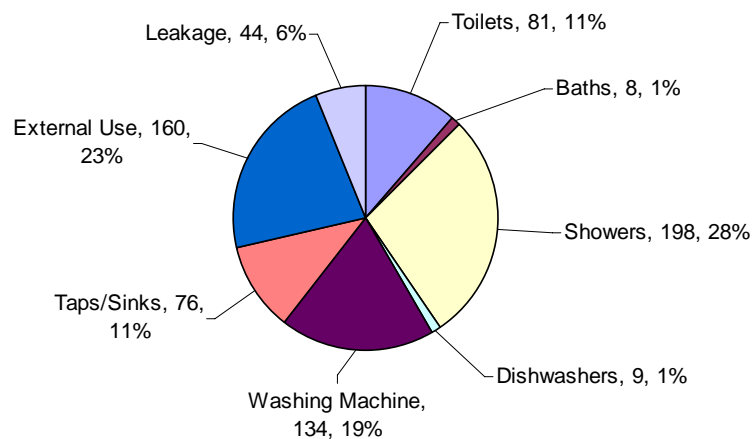
The distribution of demand amongst the various customer sectors in the Bray Park system is shown in Figure 8. The residential sector accounts for around 72% of the billed water demand, whilst commercial accounts for around 19%. There is little industry in the shire and demand by this sector is around 1%.

It is noted that the Uki customer base is nearly entirely residential.

**Figure 8 – Sectoral Distribution of Demand – Bray Park System**


#### 2.2.5.2 RESIDENTIAL WATER USE

As the residential sector accounts for the majority of usage in the shire, any restrictions policy must be based on the restriction of targeted end uses in this sector. To effectively develop restrictions levels the end use breakdown needs to be defined. **Error! Reference source not found.** summarises the end use of water developed as part of the Demand Management Strategy. As can be seen the external demand is approximately 23% and will decrease further as rainwater tanks are installed in new properties under the Demand Management Strategy. Demand from toilets and showers in new properties will also reduce.

**Figure 9 – Residential End Use Breakdown (L/household/day, percentage)**


### 2.2.5.3 NON-REVENUE WATER

Non-revenue water (NRW) is defined as treated water supply system losses and unaccounted for demand such as un-metered accounts, meter error and mains flushing. Based on assessment for the Demand Management Strategy the level of NRW in the Bray Park system is approximately 1,300 ML/a or 14% of water produced. This is expected to reduce in the future as TSC implements a leakage management program.

### 2.2.5.4 CRITICAL CUSTOMERS

For the purposes of drought restrictions, critical customers are defined as those which may be detrimentally impacted by reduction in supply. Such customers are often provided with exemptions from water restrictions on economic or health and safety grounds.

Customer categories which could be defined as critical in Tweed Shire include the following:

- Hospitals, aged care facilities
- Food processing businesses
- Sporting clubs with active playing surfaces
- Hotels, motels, resorts
- Schools (with active playing surfaces)
- Shopping centres and large retailers
- Large air-conditioned facilities
- Standpipes for construction users.

Tweed Shire has a number of large commercial (including hospitals and schools) and industrial customers that rely on the supply of water as an important commodity. A list of the top users is provided in Appendix E.

In all there are approximately 65 businesses that consume more than 10,000 kL/annum, and around 75 that consume between 5,000 and 10,000 kL/annum. These groups consumed a total of 1,500 ML/a and 500 ML/a respectively, which represents a high proportion of the overall non-residential and multi-unit residential demand.

Based on the 2006/7 year the top users in the shire were the NSW Sugar Milling Cooperative and a range of large resort / club developments in Tweed Heads and Banora Point. The Tweed Hospital at Murwillumbah was also identified as a major water user. Irrigation of sporting fields by the Tweed Shire Council was identified in the top group of users.

As part of the Drought Management Strategy, it is recommended that Tweed Shire identifies critical customers in the categories listed above as well as other customers that may be negatively impacted by water restrictions, for example home dialysis patients. This list should be maintained and regularly reviewed to enable a communication to be undertaken during the implementation of drought restrictions.

### 2.2.6 IRRIGATION USE FROM RIVER

A summary of the irrigation use from the Tweed River downstream of the Clarrie Hall Dam and the Oxley River downstream of the confluence with the Tweed River, is provided in Appendix D. Based on this information there are a limited number of irrigators, however these irrigators are stakeholders and any decisions that impact on their use needs to be communicated.

As part of the performance assessment of the Clarrie Hall Dam, it is assumed that these irrigation uses will cease upon the implementation of drought restrictions.

## 2.3 TYALGUM WATER SUPPLY SYSTEM

### 2.3.1 SYSTEM OVERVIEW

The Tyalgum water supply serves a small rural village located approximately 24 km west of Murwillumbah. Water is supplied from the Tyalgum Creek, a tributary of the Oxley River. Water is pumped from a small weir and treated via a filtration plant, which is to be replaced in the near future by a membrane treatment plant to improve water quality.

Tyalgum Weir has a full storage volume of 9 ML, with a dead storage volume of 1.48 ML, giving a useable storage volume of 7.52 ML. SunWater yield assessment indicated that:

“Even though Tyalgum Weir is capable of supplying 120 ML/a on a regular basis, during the extreme dry periods, when there is no recognisable inflow into the storage for more than 3 months, failure of supply does occur. These conclusions are based on the assumption that although there is recorded inflow downstream at Eungella, it is not proportionally represented at Tyalgum. However, this extreme period has only occurred once since 1887, and so the weir was able to provide 37 M/a for Tyalgum township for 99.9% of the time.”

Based on this assessment, it is not likely that this system will fail due to quantity constraints, however quality issues have occurred in the past as discussed below. It is noted that during the 2002/3 drought, water was carted to Tyalgum from Murwillumbah. This was however due to poor raw water quality, and the inability of the water treatment plant to meet water quality guidelines.

### 2.3.2 HISTORICAL DEMAND PERFORMANCE

Historical demand is difficult to determine due to the lack of flow monitoring equipment at the existing water treatment plant. Based on pump run hours it is estimated that the water demand averages 32 ML/a or around 90 kL/day.

### 2.3.3 HISTORIC WATER QUALITY PERFORMANCE

Based on historical knowledge, water in the Tyalgum Weir is subject to poor water quality, particularly during periods of low flow. High levels of algae, faecal coliforms, colour and turbidity have occurred at the site. It is noted that the catchment has significant sources of nutrients from cattle grazing activities.

During dry winter/spring periods, *cyanobacterial* blooms are prevalent. Measurements of above 2,000 cells per 100 mL, which is defined in the Water Directorate’s Blue Green Algae Management Protocols as “*Medium Alert Levels: Unsuitable for drinking unless treated with PAC/GAC*” are common. This situation has previously restricted pumping from the weir pool for up to 3 weeks depending on rainfall.

During the 2002/3 drought the water supply was suspended and restrictions imposed as a result of poor water quality and the inability of the treatment process to treat the water. It is noted that toxins have not been identified in any algal events. The major issue has been related to taste and odour.

### 2.3.4 POPULATION AND DEMAND

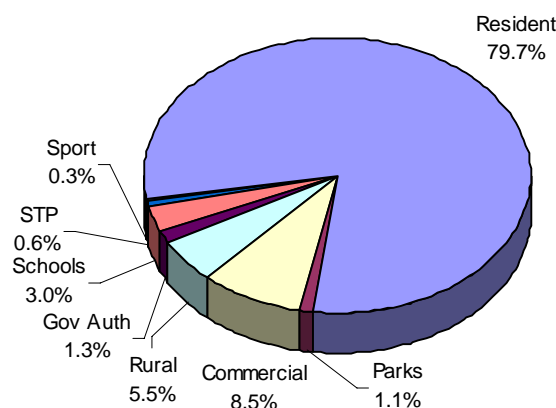
Census data indicates that the population of Tyalgum has had zero growth and has an anticipated future growth of less than 1 % growth per annum. The current population is 220 persons.

Water demand averages 32 ML/a or around 90kL/day. Non-revenue is relatively high at 28% which is likely due to un-metered water use and possibly unauthorised carting.

### 2.3.5 CUSTOMER DISTRIBUTION

The customer base at Tyalgum is as shown in Figure 10. It is evident that the water usage is generally residential with 20% being used by non-residential and public users. The estimated end use of water in the residential sector is summarised in Table 4. It is noted that the external use of 30% is higher than for other parts of the shire, however the overall usage is much lower due to lower household size.

**Figure 10 – Distribution of Customers (by Volume) - Tyalgum**





**Table 4 – Estimated Residential End Use of Water - Tyalgum**

<b>End Use Description</b>	<b>End Use (%)</b>	<b>Sectoral Demand (L/account/day)</b>
<b>Internal</b>	<b>100</b>	<b>377</b>
Toilets	20	75
Baths	2	8
Showers	30	113
Taps / Sinks	14.5	55
Dishwaters	0.5	2
Laundry	25	94
Internal Leakage	8	30
<b>External</b>	<b>100</b>	<b>161</b>
Garden Watering / Irrigation	80	129
Pools / Fountains	5	8
Wash-Down	5	8
Car Washing	5	8
External Leakage	5	8
<b>Total</b>		<b>538</b>

### 2.3.6 CRITICAL CUSTOMERS

Tyalgum does not have any critical customers, however a primary school and a number of small businesses exist in the town. The usage of these customers is around 15% of the total use.

## 3. DEMAND MANAGEMENT AND RESTRICTIONS

### 3.1 OVERVIEW

This section of the Drought Management Plan outlines the actions that are proposed for implementation during a drought. Actions include the imposition of temporary restrictions on the use of water in addition to the demand management program which is a longer term program for the improvement of water use efficiency and potable substitution.

#### 3.1.1 DEMAND MANAGEMENT PLAN

Tweed Shire has committed to a strategy to manage its water demand to ensure efficient use of water by all customer sectors. The strategy is outlined in the report entitled *TSC Demand Management Plan – Stage 1* (MWH 2007). As part of the strategy demand a range of measures will be implemented for the existing brownfield residential development, proposed greenfield residential development (including rainwater tanks for external and toilet use) and for existing and future non-residential users. Details of the non-residential program will be developed in Stage 2 of the strategy.

In addition to customer based demand management programs, Council proposes to reduce the system losses through the implementation of leakage management program including leak detection, pressure management and continuous monitoring.

The estimated outcomes of the demand management program are presented as demand forecasts in Figure 7 (for the Bray Park system).

### 3.2 BRAY PARK AND UKI SYSTEM RESTRICTIONS

#### 3.2.1 RESTRICTION TRIGGER POINTS

As discussed in Section 2.2.2.3 the performance during the drought of 2001/3 indicated that the restriction levels were introduced too late to provide a reasonable time to failure which is required to achieve higher levels of demand reduction for a population the size of Tweed Shire.

The failure of flows in the Upper Tweed catchment for a single wet season can result in severe supply shortages, as the usable volume of Clarrie Hall Dam is currently less than 1.5 years supply at full demand. The dam is essentially an emergency storage to support the shire during low river flows. Therefore it is important to ensure that the available volume in the dam is used effectively to extend the time to failure for as long as is possible. To do this Council needs to balance the level at which drought restrictions are implemented with the frequency of restrictions.

Department of Water and Energy (DWE) guidelines in respect to levels of service for water supplies and water restrictions due to drought are described by the 5/10/20 rule. This rule underpins the reasonableness of drought restrictions. Levels of Service under this rule are defined as follows:

- Restrictions implemented no more than 5% of the time, on average;

- Restrictions imposed no more than once every 10 years on average; and
- Demand reductions during drought restrictions should be 20%.

With these rules in mind restrictions triggers proposed for the Bray Park / Uki system were developed for 7 levels of restrictions as recommended by the NSW Premier's Department (Guiding Principles and Consistent Water Restrictions, July 2003), and the NSW Water Directorate's *Guidelines for the Development of Drought Management Plans* (2003). These levels, translated to the Clarrie Hall Dam, are outlined in Table 5.

**Table 5 – Possible Restriction Trigger Levels – Bray Park / Uki System (based on NSW Guidelines)**

Restriction Trigger Levels	Target Demand Reduction	Restriction Level Imposed @ (% of Clarrie Hall Dam Full Capacity)
External Sales banned and Pre Activation Activities	0%	90%
Level 1 Restrictions	5%	75%
Level 2 Restrictions	10%	70%
Level 3 Restrictions	15%	65%
Level 4 Restrictions	20%	60%
Level 5 Restrictions	25%	55%
Level 6 Restrictions	30%	50%
Level 7 Restrictions	40%	40%

One of the observations from the previous drought was that the time for the dam to drop by 5 % was found to be less than 4 weeks. It is not possible to administer and implement a level of drought restrictions within this time, therefore the revised restrictions levels adopted by Council in 2007 allowed for only Levels 2, 4, 6 and 7 to be used.

In addition to the timing of restrictions, the level of demand reduction is an important parameter that requires consideration in the development of policy. Based on the previous drought, a reduction of around 23% was achieved compared to pre-drought average demand. This level was achieved almost entirely through residential outdoor sprinkler bans. If further water demand reduction was to be achieved, changes to consumer behaviour would have been necessary. Whilst it is possible to achieve 30% reduction in Tweed Shire this will require a greater use of the media as an education forum (to advocate shorter showers and internal use changes) and therefore implementation costs will rapidly increase. In addition such a high level of savings is not achieved immediately upon announcement of a restriction, i.e. there is usually a ramp up time of one to two months dependent on the size of the community, the efficacy of the education program and the level of compliance monitoring.

To gauge the level of reduction that could be achieved in Tweed Shire a basic end use model was used. The results of this model are shown in Appendix B.

The trigger levels and target demand reductions for the Shire as outlined in Table 6 were adopted by Council in 2007. These levels may require revision over time, to take account of demand growth. Growth is expected to result in an increase in the demand from around 9,900 ML/a to 12,000 ML/a in 2018. The secure yield of the existing system is estimated to be around 13,750 ML/a (SunWater 2006). The performance of Clarrie Hall Dam under a range of hydrologic conditions and future demand (for the next ten years) is outlined in Section 3.2.3.

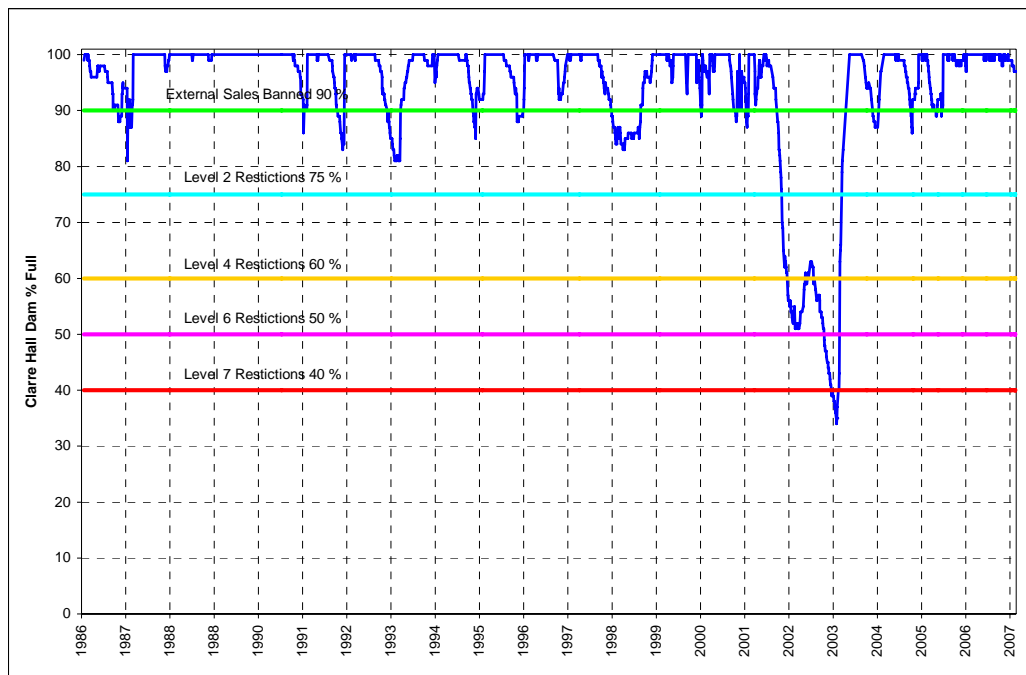
To account for the impact on levels of service resulting from demand growth, it is recommended that the trigger levels be reviewed at 2013 or when any new permanent or emergency water source is implemented, e.g. a permanent contingency supply.

**Table 6 – Recommended Restriction Levels and Demand Targets – Bray Park / Uki System**

Restriction Trigger Levels	Target Demand Reduction	Restriction Level Imposed @ (% of Clarrie Hall Dam Full Capacity)
External Sales banned and Pre Activation Activities	0%	90%
Level 2 Restrictions	15%	75%
Level 4 Restrictions	20%	60%
Level 6 Restrictions	25%	50%
Level 7 Restrictions	30%	40%

Restriction triggers in relation to historic levels of the Clarrie Hall Dam are shown in Figure 11. It is clear that the carting ban will occur regularly (approximately once every two years). Water restrictions however occur only once every 20 years. It is therefore believed that the level of service will meet the 5/10/20 rule for the foreseeable future.

**Figure 11 – Restrictions Levels versus Historic Storage Levels**



### 3.2.2 ACTIONS UNDER RESTRICTION LEVELS

#### 3.2.2.1 PERMANENT LOW LEVEL RESTRICTIONS

Permanent water restrictions are being implemented in many parts of Australia in response to long term water shortages, and the need to ensure that customers are efficient with water use. These restrictions generally aim to ensure that water is not wasted on over-watering of gardens or watering during hot parts of the day. In addition the restrictions assist council to deliver a constant message on water conservation.

Low level permanent restrictions may include the following:

- Watering on alternate days (3 days per week) for odd and even house numbers
- External water use only during the hours of 6am to 9am and 5pm to 8pm
- No runoff allowed from watering into gutters and stormwater systems
- Vehicles not to be washed on hard surfaces and trigger sprays to be used.

It is proposed that these permanent restrictions will be implemented in July 2012.

#### 3.2.2.2 ACTIONS UNDER DROUGHT RESTRICTIONS

Water restrictions should be commenced with low effort, high return activities such as external watering bans. In most circumstances there is sufficient time to develop the details of the more difficult actions such as commercial customer demand reduction or managing active playing fields, which will be implemented in the following stages.

In the case of Tweed Shire the time available is short due to the small storage in the dam. This means that Council needs to commence planning for a drought at the earliest stage. In addition the success of any drought restrictions will depend on the ability of council to communicate the requirements and effectively police the implementation, albeit with a small number of staff. Therefore the review and revision of management tools such as the communications plan, marketing and education material and the list of critical users should be undertaken at this stage.

A summary of the proposed actions is provided in Table 7, and details of all actions across the various customer sectors are provided in Appendix C.

**Table 7 – Proposed Restriction Actions**

Restriction Trigger Levels	Typical Residential Restrictions
Permanent Low Level Restrictions (From July 2012)	<ul style="list-style-type: none"> <li>• Watering on alternate days (3 days per week) for odd and even house numbers</li> <li>• Runoff not allowed</li> <li>• External water use only during the hours of 6am to 9am and 5pm to 8pm</li> <li>• Vehicles not to be washed on hard surfaces and trigger sprays to be used.</li> </ul>
External Sales banned and Pre Activation Activities	<ul style="list-style-type: none"> <li>• Water carters banned from selling and delivery water outside of shire boundary</li> <li>• Initiate public awareness campaign</li> </ul>

Restriction Trigger Levels	Typical Residential Restrictions
	<ul style="list-style-type: none"> <li>Develop or review and update drought management planning including register of critical users, education and marketing material, and communications plan.</li> </ul>
Level 1	<ul style="list-style-type: none"> <li>Not Used</li> </ul>
Level 2 Restriction (Target 15% reduction)	<ul style="list-style-type: none"> <li>Sprinklers and fixed hoses banned</li> <li>Hand held hoses or micro sprinklers permitted for one (1) hour, 3 days per week</li> <li>Emptying and refilling of existing pools banned</li> <li>Irrigation between Clarrie Hall Dam and Bray Park weir banned</li> </ul>
Level 3	<ul style="list-style-type: none"> <li>Not Used</li> </ul>
Level 4 Restriction (Target 20% reduction)	<ul style="list-style-type: none"> <li>Sprinklers and fixed hoses banned</li> <li>Micro sprinklers banned</li> <li>Hand held hoses permitted for one (1) hour, 2 days per week</li> </ul>
Level 5	<ul style="list-style-type: none"> <li>Not Used</li> </ul>
Level 6 Restriction (Target 25% reduction)	<ul style="list-style-type: none"> <li>Sprinklers and fixed hoses banned</li> <li>Micro sprinklers ban</li> <li>Hand held hoses banned</li> <li>Limited use of hygiene buckets permitted for outdoor use</li> </ul>
Level 7 Restriction (Target 30% reduction)	<ul style="list-style-type: none"> <li>As directed by the Water Supply Authority</li> </ul>

### 3.2.3 PERFORMANCE OF WATER RESOURCES DURING DROUGHT

A water balance model, developed by SunWater in 2002, was updated and utilised as part of the performance assessment of the Clarrie Hall Dam under drought conditions. A range of cases were run to review the performance of the system for a range of conditions as outlined below:

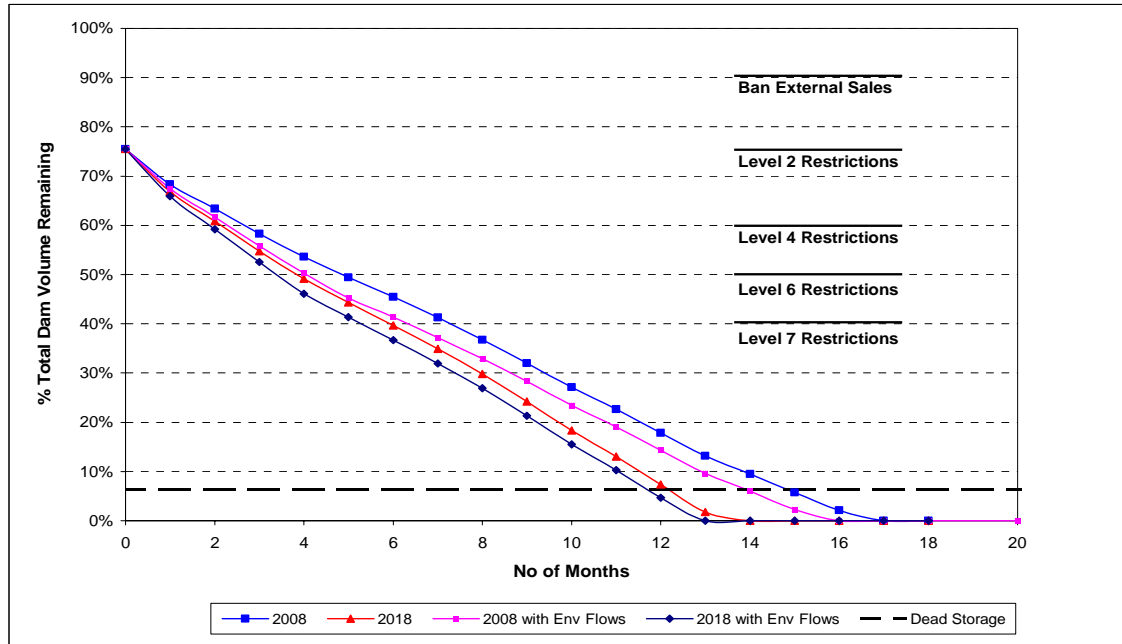
- Case 1 - Zero Flow** – This case assumes zero inflow to Clarrie Hall dam and zero flow in the Tweed and Oxley Rivers. In addition it was assumed that the environmental flows through the Bray Park Weir would continue at 4.5 ML/d until the dam capacity reaches 50% full. This volume of environmental flow is less than the 95<sup>th</sup> percentile flow suggested under the draft Conditions Statement, but is sufficient to ensure that the fish ladder operates effectively. Irrigation demand would cease at the time of imposition of restrictions.

This case was run assuming the restriction triggers outlined in Table 6. Scenarios with 2008 and 2018 demand were assessed to determine the range of performance that could be expected. The results of this modelling are shown in Figure 12.

Assuming no flow in the system Clarrie Hall Dam would fail in 14 to 15 months at 2008 demand levels and in around 12 months under 2018 demands. This is the worst case scenario and the probability of occurrence is very low as there has always been some level of flow in the Tweed system based on the available records spanning around 120 years. During this period, a flow of 8,570 ML/a is exceeded 99% of the time. Case 1 does however serve as a measure of the dam's performance under extreme conditions that could occur under a climate change scenario.

If this case did eventuate it is noted that the supply may in fact fail in a shorter period as there is little time available to effectively implement restrictions, i.e. the demand reduction targets may not be achieved until say 4 to 6 weeks after the imposition date. As the period between each restriction level under Case 1 is likely to be only 8 to 12 weeks this is a significant problem, which will require pre-planning and in particular an effective marketing and communication strategy.

**Figure 12 - Case 1 - Zero Flow Upstream of Bray Park Weir**



- Case 2 – Continuous Period of 1902 Drought Conditions** – This case was run to review the performance under continuous hydrologic conditions that occurred during the 1902 drought. A comparison of Tweed River flow for the 1902 and 2002 drought years indicates that the total annual flow for the two periods was within 1%. Therefore basing the assessment on the 1902 flows provides a reliable guide to drought performance, particularly taking account of the low probability of back to back, worst on record, drought years.

During the 1902 drought year, inflow to the weir was approximately 4 % of the long term median, as shown in Table 8.

**Table 8 – Comparison of System Flows for 1902**

Month	Clarrie Hall Dam Inflow			Bray Park Weir Inflow		
	Median	1902	% of Median	Median	1902	% of Median
January	1,480	174	12%	12,718	1,558	12%
February	3,333	130	4%	27,935	1,125	4%
March	5,054	68	1%	42,834	606	1%
April	3,143	59	2%	27,395	509	2%
May	2,302	34	1%	17,231	285	2%
June	1,943	20	1%	14,635	170	1%
July	1,199	30	3%	9,414	251	3%

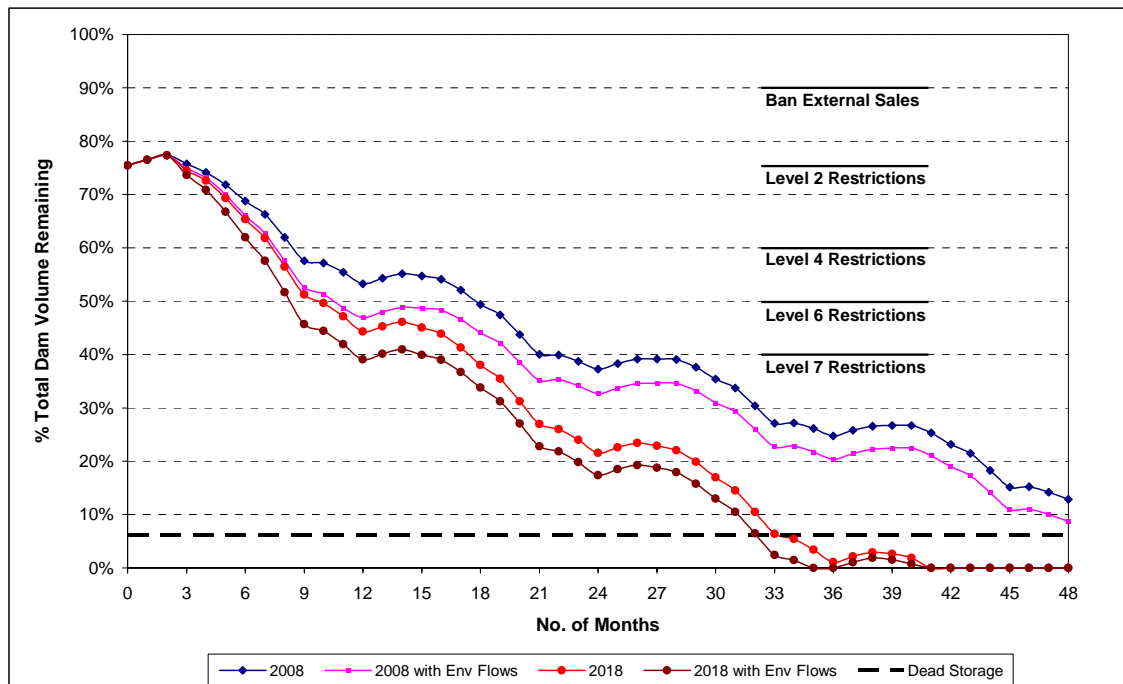


Month	Clarrie Hall Dam Inflow			Bray Park Weir Inflow		
	Median	1902	% of Median	Median	1902	% of Median
August	718	13	2%	6,005	107	2%
September	443	20	5%	4,019	152	4%
October	364	74	20%	3,382	593	18%
November	314	51	16%	3,173	414	13%
December	373	54	14%	4,212	428	10%
<b>Totals</b>	<b>20,666</b>	<b>727</b>	<b>4%</b>	<b>172,953</b>	<b>6,198</b>	<b>4%</b>

A range of conditions was modelled to assess the performance of the system under these continuous low flows. As part of this scenario it was assumed that restriction triggers and demand reductions are implemented as per Table 6. Cases were run without environmental flows and with an assumed environmental flow of 4.5 ML/d up to the point where the dam reaches 50% capacity. The results of the assessment are shown in Figure 13.

As shown in Figure 13, the water supply would be capable of an extended period of low flows similar to the 1902 drought. For the 2008 demands the storage would be capable of supplying around 50 months of demand. For the 2018 demands the supply would fail after around 33 months from the start of restrictions. In each case the impact of environmental flows at 4.5 ML/d until the dam reaches 50% capacity reduces the period of supply by 2 to 3 months.

**Figure 13 - Case 2 – 1902 Flows (Repeated for 4 years)**



A comparison was undertaken between the predicted performance for 1902 conditions and the actual performance during the 2002/3 drought. It was found that during the 2002/3 drought the storage fell rapidly to 50% capacity; however it is noted that the restriction regime in place at that time allowed the dam to fall to 50% prior to the imposition of Level 1 restrictions. If restrictions had been imposed at an earlier point then this rapid decline could have been arrested.

Additional modelling was undertaken to assess the impact on the supply of the contingency planning options. The results of this analysis are outlined in Section 4.2.1.

### 3.2.4 RECOVERY AFTER DROUGHT

Any decision to lift water restrictions needs to consider whether the drought event has ended or whether the rainfall is merely an isolated event. Lifting restrictions too early may require a rapid reversal if there is no follow up rainfall. On the other hand retaining severe restrictions during times when there is clearly sufficient water available may result in criticism and angst. Therefore restrictions are generally removed at a point that is 10 to 20 % higher than the equivalent level where they were imposed.

For the Bray Park / Uki system, the recommended levels for lifting restrictions are summarised in Table 9.

**Table 9 – Levels for Lifting of Restrictions**

Restriction Levels	% of Clarrie Hall Dam Full Capacity	
	Restriction Imposed @	Restriction Lifted @
External Sales Banned	90%	100%
Level 2 Restrictions	75%	95%
Level 4 Restrictions	60%	80%
Level 6 Restrictions	50%	70%
Level 7 Restrictions	40%	60%

### 3.2.5 BLUE GREEN ALGAE CONTINGENCY PLANNING

Algal blooms may occur under favourable conditions which vary from storage to storage but are generally related to elevated nutrient concentrations and water temperatures, long sunny days, calm water conditions and low turbidity. The occurrence of blue green algae or cyanobacteria in water storages does not automatically impact the quality of the treated water supply. Cyanobacteria are extremely diverse and the impact depends on the type and concentration. In low concentrations, cyanobacteria pose no risks, however high concentrations can produce tastes, odours and toxins that can be harmful to humans and animals.

A toxic algal event occurs when the concentrations of problem genera exist in the supply. Any algae event therefore needs to be carefully monitored to identify the presence of toxins and to take the necessary actions to address the risks of harm.

Management of water storages to control the occurrence and impact of blue green algae is a significant issue in Australia. In the Tweed system, algal outbreaks have occurred, however no toxic events have yet been experienced.

### 3.2.5.1 MANAGEMENT PROCEDURES

The accepted approach to management of blue green algae in NSW is outlined in the Water Directorate's document entitled "Draft Blue-Green Algae Management Protocols", January 2007. These guidelines recommend a three alert level approach to surveillance and response. Table 10 summarises the recommended actions.

**Table 10 – Recommended Actions for Blue Green Algae Management**

Alert Level	Recommended Actions
<b>Surveillance Mode (Green Level)</b>	Regular Monitoring: <ul style="list-style-type: none"> <li>- Weekly sampling and cell counts at representative locations where known toxigenic species are present</li> <li>- Fortnightly sampling for other species and visual inspection of water surface for scums</li> </ul>
<b>Alert Mode (Amber Level)</b>	<ul style="list-style-type: none"> <li>- Notify agencies where appropriate, including the Regional Algal Coordinating Committee (RACC)</li> <li>- Increase sampling frequency of toxigenic species in area affected to twice weekly to establish rate of growth and spatial variability in the water body</li> <li>- Monitor other species weekly or fortnightly</li> <li>- Make regular inspections for scums</li> <li>- Decide on requirement for toxicity assessment or toxin monitoring</li> <li>-</li> </ul>
<b>Action Mode (Red Level)</b>	<ul style="list-style-type: none"> <li>- Continue monitoring as per alert mode</li> <li>- Immediately notify health authorities for advice on health risk</li> <li>- Make toxicity assessment or toxin measurement of water</li> <li>- Health authorities warn of risk to public health (based on risk assessment)</li> </ul>

### 3.2.5.2 CONTINGENCY RESPONSES

Tweed Shire has, and is currently implementing, a number of contingency responses to address the occurrence of blue green algae in the water supply. These are as follows:

- **Flushing Bray Park Weir** – This response was used during the 2001/3 drought to flush algae from the Tweed River upstream of the Bray Park Weir. Although this is a successful approach it is not an efficient method as water is wasted through the process.
- **Utilise the PAC Treatment Process at Bray Park WTP** – The activated carbon process at Bray Park WTP will be upgraded as part of the treatment plant expansion. The capacity of the new facility will be sufficient to treat the entire water demand, without the imposition of restrictions.
- **Cart Water to Tyalgum** – Council has previously carted water to the village of Tyalgum in response to an algal bloom in the weir. Although this is an expensive option it proved to be effective in conjunction with water restrictions. In the near future the Water Treatment Plant will be upgraded and will have the capacity to treat affected water using PAC without resorting to carting or water restrictions.

The actions outlined above are contingency plans rather than preventative measures to minimise the risk of the formation of algae in the water storages. It is recommended that the following preventative measures be investigated and actions implemented to address the source of algae:

- **Catchment Management** – The Tweed Integrated Water Cycle Management Plan' 2006, outlines a range of catchment managements initiatives that will provide improvement in the water quality at Bray Park. These include:
  - Identification and monitoring of hotspots that adversely affect water quality in the Upper Tweed
  - Targeted riparian vegetation restoration
  - Stewardship Agreements and farm forestry
  - Engagement with the Catchment Management Authority.

To support these initiatives it is recommended that council develops a Catchment Management Plan and land management guidelines aimed at actively managing the catchment.

- **Additional Mixing in Clarrie Hall Dam** – As discussed in Section 2.2.3.1, a high rate mixer is installed in Clarrie Hall Dam to inhibit the growth of cyanobacteria. The unit has achieved some success in mitigating the conditions under which algal blooms occur and has reduced the frequency of major outbreaks. It is considered that the effectiveness and flexibility of the system would however be significantly enhanced through the installation of a second unit. Such an investment would also provide a level of redundancy for the system. The capital cost of the upgrade would be approximately \$150,000.

Finally, it is recommended that Council develop a Blue Green Algae Response Plan using the template included in Section 9 of the Water Directorate's management protocols (refer to Appendix F for details).

### 3.3 TYALGUM SYSTEM RESTRICTIONS

#### 3.3.1 RESTRICTION TRIGGER POINTS

Restrictions for Tyalgum will be triggered by lack of flow in the Tyalgum Creek and falling water levels in the weir. Alternatively restrictions will be required if there is an algal bloom which cannot be treated by the existing water treatment plant. An upgrade of the water treatment plant, which will include a PAC process, is proposed for the near future.

Water restrictions will be imposed as follows:

- **Level 2 Restrictions** (refer to Appendix C) to be imposed when water flow over the weir ceases, i.e. no visible flow.
- **Level 4 Restrictions** (refer to Appendix C) when water carting commences, due to poor water quality in the weir or reaching dead water level in the weir, as indicated by poor product water quality from the Water Treatment Plant.

### 3.3.2 RESTRICTED DEMAND FORECASTS

Demand reductions during restrictions are estimated to be as follows, based on assessment of current customer usage and previous water carting:

- **Level 2 Restrictions** – an estimated reduction of 20% over normal demand.
- **Level 4 Restrictions** – an estimated reduction of 30% over normal demand.

### 3.3.3 RECOVERY AFTER RESTRICTIONS

Recovery after water restrictions for the Tyalgum system would be as follows:

- Where flow over the weir re-commences Level 2 would be lifted;
- In the event of restrictions due to low level in the weir and poor water quality, restrictions would be lifted when flow is evident over the weir and the water quality improves to a point that allows potable water to be produced through the WTP;
- Where the water quality improves to a point that allows potable water to be produced through the WTP and there is no flow over the weir, then restrictions would remain at Level 2.

## 4. CONTINGENCY OPTIONS

### 4.1 OVERVIEW

Contingency options are investigated in this section to identify practical alternatives to the existing water supply should these supplies be either incapable of serving the customer base during a more serious drought than that used for design. The risk of this occurring is low, however it is important to consider the options due to the long lead times that are required to deliver infrastructure to provide water to a community the size of Tweed Shire, i.e. 75,000 persons. In addition, the available lead time is relatively short due to the small volume of storage available in both the Clarrie Hall Dam and the Tyalgum Weir.

A range of options are available to provide water to the shire during such times:

- Water carting
- Pipeline link to Rous water supply
- Pipeline link to the South East Queensland Water Grid
- Groundwater
- Desalination of seawater.

### 4.2 BRAY PARK SYSTEM OPTIONS

#### 4.2.1 EMERGENCY SUPPLY REQUIRED

The emergency or minimum supply level, i.e. that supply required beyond Level 7 restrictions to provide a sustenance level to customers was estimated as a guide to contingency planning. An estimate was undertaken based on the assumption of 120 L/p/day for the residential sector (as achieved in SEQ during 2008 under the Target 140 campaign), plus a reduced demand (25% reduction) for all non-residential use by both industry and commerce.

Based on these assumptions a supply of 14 ML/day in 2008, increasing to around 18 ML/day in 2018 would be needed. This emergency supply could provide the community with water indefinitely under extreme conditions. To achieve continuous supply the demand reductions would be greater than the 30% assumed to be achieved under Level 7 restrictions. Required reductions would be around 48% in 2008 and 42% in 2018.

#### 4.2.2 PERFORMANCE OF SYSTEM WITH BACKUP SUPPLY

It is important to assess the impact of a contingency supply on the performance of the water sources. An assessment was undertaken for the worst flow condition (zero flow) assuming the following:

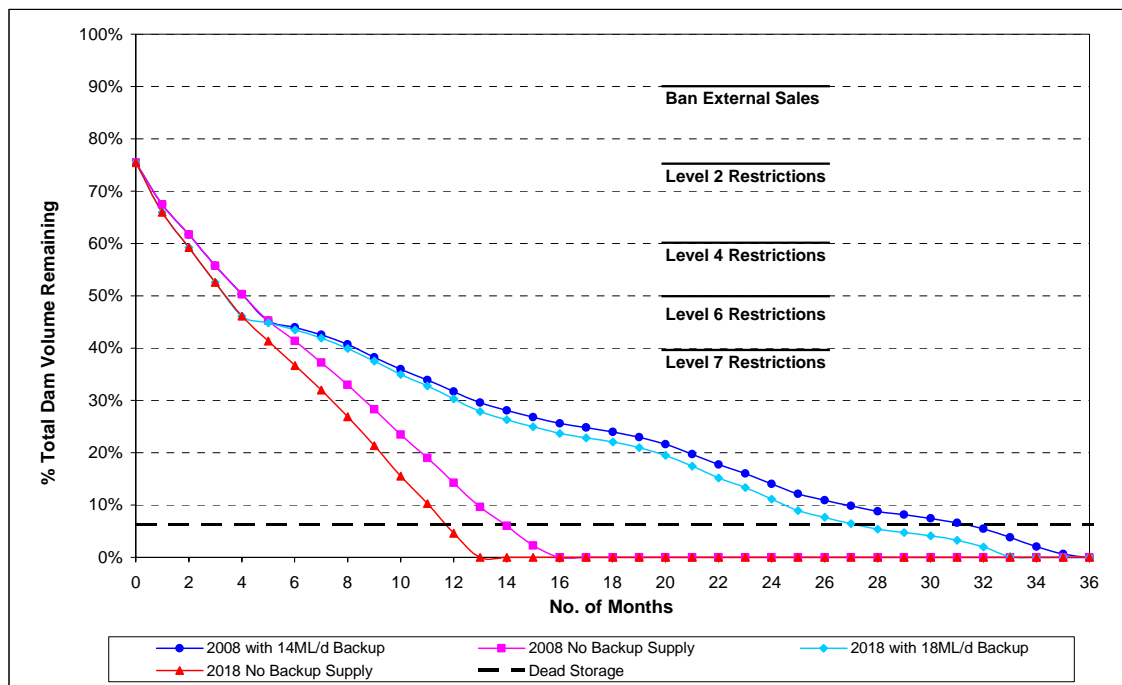
- Zero flow in the rivers supplying Bray Park and zero inflow to the Clarrie Hall Dam;
- Restriction triggers and demand targets as per Table 6;
- Environmental flows of 4.5 ML/d until the dam reaches 50% capacity;

- Demand reductions up to Level 7 restrictions, i.e. not taking account of the emergency supply discussed above; and
- Commencement of the supply from a contingency source at 50% capacity in the dam.

As shown in Figure 14 the performance of the dam could be extended through the provision of contingency supply. Results of the assessment under the above conditions are summarised as follows:

- For 2008 a backup supply of 14 ML/day would extend the life of the dam to around 27 months; and
- For 2018 a backup supply of 18 ML/day would extend the life of the dam to around 31 months.

**Figure 14 – Performance of Clarrie Hall Dam with External Supply**



#### 4.2.3 WATER CARTAGE

Water cartage is an option for small water supplies; however it would be difficult and expensive to supply the Bray Park water supply system with carted water. This option was not considered in any detail for this major supply area.

Another alternative would be to provide tanker ships to provide water to the shire if the existing supplies were to fail. Such an option requires lead times of around 6 months based on the SEQ planning during the current drought.

For the village of Uki, water carting would be used where the water supply is suspended for any reason.



#### 4.2.4 LINK TO SEQ WATER GRID

The construction of a link from the South East Queensland Water Grid to the Tweed Shire would provide a contingency water supply that could be used in times of water scarcity. The SEQ Water Grid is currently being constructed to improve the reliability of the water supply from Noosa to Coolangatta and inland to Toowoomba. When completed, the grid will link the major bulk water supplies in SEQ including the Tugun Desalination Plant and the Hinze / Mudgeeraba Dams in the south and the Wivenhoe and Wyalong Dams in the north. This will essentially drought proof SEQ for at least 20 years.

It is possible to construct a pipeline link to the water supply system at Coolangatta or directly to the Tugun Desalination Plant, located at the northern end of the Coolangatta Airport. This plant will have a capacity of 110 ML/day. A link to the SEQ Water Grid at the desalination plant with a capacity of 14 ML/d in 2008 and 18 ML/d in 2018 would ensure continuity of supply for an indefinite period under extreme conditions.

Timing of the availability of water from the SEQ Water Grid needs to be considered as it is possible that water will not be available until 2012 following completion of Stage 1 of the proposed Traveston Dam, assuming that approval for the construction is gained.

This option is being examined in more detail as part of the Bulk Supply Options Study. The preliminary capital cost of the link would be \$5m assuming a 500 mm diameter main. Discussions with the SEQ Grid Manager and further examination of the costs of constructing the pipeline will be undertaken as part of the study. It is possible however that if Tweed Shire were to be connected to the SEQ Water Grid, the contract may be conditional on the shire agreeing to the SEQ Water Strategy Levels of Service and regional restrictions policy.

#### 4.2.5 LINK TO ROUS SUPPLY

Similarly to the pipeline link to SEQ, it may be possible to construct a pipeline to link the Rous Water supply to the southern end of the Tweed Shire to supplement the supply during times of scarcity. This option has the disadvantage of being a significant distance from the main water users in the north of the shire and would therefore need to be used earlier in a drought to maximise the benefits. In addition the supply would not likely be at the volume that could be supplied from the SEQ Water Grid.

This option is being examined in more detail as part of the Bulk Supply Options Study.

#### 4.2.6 DESALINATION

The option of providing desalinated water to the Tweed region was investigated in the report entitled *Evaluation of Desalination and Future Water Supply Issues*, DEUS, December 2005. The study objectives were as follows:

- to provide an overview of desalination technologies, projects, scenarios and implementation issues;

- to assess the capacities of the major water supply systems in each of the catchments under consideration, the population which could be supported with the implementation of water saving measures, and to identify possible system expansion options and costs to cater for projected population growth including desalination and alternative options; and
- to provide an evaluation of desalination and future water supply issues.

The report looked at a range of options including a two stage 20 ML/day plant at Kingscliff, using seawater from Cudgen Creek with the brine being disposed of through an ocean discharge. A membrane process would be used and the product water pumped to the Tweed Heads distribution system. An option of having a thermal process at Condong was also assessed. It was found that the NPV in 2005, was around \$100m to \$145m which compares poorly to the cost of raising Clarrie Hall Dam and other contingency options.

One of the major issues with the delivery of any desalination plant is the lead time for approvals and construction and the environmental issues related to both construction and operation of the plant (energy consumption and brine disposal in particular). In addition, temporary decommissioning of the plant is difficult and costly.

Construction of a large desalination plant within Tweed Shire would only be considered under the current environment should the option of constructing further water storages not be possible. Alternatively temporary package plants could be used as a contingency should be need arise. The temporary solution would still require a minimum lead time of 6 to 8 months. Such an option would be considerably cheaper using multiple 1 ML/day containerised units, at strategic points across the shire. The cost of such an approach would be dependent on the period of the contract as well as the ability of the supplier to reuse the equipment.

#### 4.2.7 GROUNDWATER SUPPLIES

In a severe drought, the use of groundwater resources is an option where suitable water can be located. Based on the research undertaken by Hunter Water Australia for the Integrated Water Management Plan (HWA 2006), there are more than 650 licensed bores within Tweed Shire. The dominant extraction purpose is for stock and domestic use. Other bores are utilised for the purposes of irrigation, horticulture, industry, and testing and monitoring. It is estimated that around 750 ML/annum is utilised for stock, farming and domestic purposes and around 900 ML/annum for other purposes. The main area of groundwater extraction is near Murwillumbah but the most reliable resources are considered to be on the Tweed coastal dunes.

Beach and dune sands are considered to be principally recharged from direct infiltration of rainwater and runoff from Cudgen Ridge. Yields of up to 40 L/s have been recorded however careful management is required to prevent saline intrusion and upconing. Groundwater vulnerability for this system is rated as *High* due to the low depth to groundwater and high hydraulic connection with the surface. Groundwater salinity within the beach and dune sands is variable with records showing low (<500 mg/L) salinity along the beaches grading to higher salinity (1500 – 5000 mg/L) within the dunes, probably due to the effect of numerous tidal creeks running parallel to the coast. Water quality problems in some areas have been reported as a result of iron or hydrogen sulphide in extracted water. Little agricultural use is made of the resource, however numerous spear points are used for domestic and tourist facility use.

Alluvium in the Tweed Rivers thickens from approximately 7 to 10 metres in the upper reaches of the catchment to 23 to 35 metres at the lower extremities of the river system where a more estuarine environment prevails. Groundwater investigations previously undertaken by DWE indicate that there are no significant fresh groundwater sources on the alluvial flats downstream of Murwillumbah. In general, shallow groundwaters associated with the floodplain are brackish and overlie increasingly saline groundwaters. To date, groundwater use has been very limited and restricted to stock and domestic supplies, with only supplementary irrigation documented in the estuarine area. Limited flow and poor water quality can also be attributed to the limited use of the resource.

Based on this high level assessment it is unlikely that groundwater would provide significant or sustainable supplies during an extended drought.

#### 4.2.8 PREFERRED CONTINGENCY APPROACH

As discussed above the most likely contingency plans would include:

- Carting for the village of Uki; and
- A pipeline link to the SEQ Water Grid for the Bray Park system.

Lead times are an important issue to be considered and the time to construct a pipeline to the Tweed system is likely to be around 6 months, assuming that design and critical approvals including land acquisition, easements and cultural heritage are in place at an early stage. With pre-planning and the development of an agreement with the Queensland Water Commission the time for construction could be slightly reduced.

A possible further issue with the supply from the SEQ Water Grid is that water may not be available until 2012 when the Traveston Dam is commissioned. If Tweed Shire were to face a severe drought prior to 2012 there would likely be up to 48 months (repetitions of 1902 drought) in which to take action. Where water is not available from SEQ, Tweed could construct a 14 to 16 ML/d desalination plant (or number of temporary plants) within a period of 6 to 8 months. Such a decision would need to be made around the 40% dam capacity to supply continuity.

Contingency planning should also consider the coincidence of droughts in the Tweed, Richmond and SEQ. For example the probability of the Tweed and Rous catchments being in drought at the same time for an extended period is high. On the other hand the diversification of supplies provided in SEQ will provide a lower risk option.

It is therefore recommended that Tweed Shire considers the pipeline link to SEQ and Rous further as possible contingency plans. Prior to 2012 the preferred option will be temporary (containerised) desalination plants.

### 4.3 TYALGUM SYSTEM OPTIONS

For the village of Tyalgum, water carting was successfully adopted to overcome a water quality issues in 2002/3, when the supply was contaminated as the result of an algal outbreak in the weir. Over the four month period from 14 October 2002 to 16 February 2003, water was extracted from the Bray Park water supply system in Murwillumbah and transported to Tyalgum by tanker to fill the village's service reservoir. The cost of carting water over this period of time was \$42,110. Financial assistance of \$13,371 or around 30% of the cost was received from the state government.

The costs of water carting have increased significantly since 2002/3. It is estimated that the cost of providing water to Tyalgum for a similar period is now closer to \$150,000 (or \$1,200 per day for 40kL); an increase of more than 3 times the previous cost. Even so this would be preferred solution to providing emergency supply to Tyalgum.

It is proposed to upgrade the Water Treatment Plant to improve the processes for treating algae affected raw water and hence the frequency of water carting should be reduced.

## 5. IMPLEMENTATION OF PLAN

### 5.1 OVERVIEW

Implementation of the Drought Management Plan will occur based on the trigger levels as outlined in Section 3. It is necessary for Tweed Council to develop a detailed implementation plan including a consultation and communication plan as well as a monitoring program.

At the Pre-activation level these plans need to be reviewed and amended to take account of regulatory requirements, community expectations and other issues.

### 5.2 MONITORING PROGRAM

#### 5.2.1 DEMAND

Monitoring of demand during a drought is an essential element of managing the water supply. Tracking of daily demands requires the following:

- Measurement of extractions from the river – volume and timing
- Treated water volumes through the treatment plant adjusted by the change in system reservoir storage
- Assessment of the non-revenue water following the completion of each billing cycle.

Demand tracking should provide input to a water balance model to predict the performance of the storage under various climate scenarios. Daily production can also be compared to the target demand reductions to identify whether the community is meeting the challenge of reducing demand.

#### 5.2.2 SUPPLY

Supply monitoring involves the measurement of the performance of the water resources as required for management of the supply and to report to the DWE. Monitoring will required as follows:

- Measurement of flow in the Tweed River upstream of the confluence with Doon Doon Creek (Palmer's Crossing) on a daily basis
- Measurement of flow into and out of Clarrie Hall Dam on a daily basis
- Measurement of level and flow in the Tweed River at Bray Park Weir intake on a daily basis
- Level and volume of water in Clarrie Hall Dam on a daily basis
- Water quality monitoring to assess any public health risks including algae blooms in the dam and rivers.

For Tyalgum, monitoring of the supply would be based on the level in the weir.

### 5.3 CONSULTATION

Consultation is a key element in the success of any Drought Management Plan. The imposition of water restrictions often causes angst in the community and customers require advance understanding of proposed actions so that they plan their compliance. Groups that rely on the use of town water for their livelihood need to be consulted as early as possible. These include nurseries, house washers, mobile dog and car washers, laundries and other businesses.

Irrigators in the areas upstream of the weir will need to be consulted regarding the requirement to implement restrictions at the 75% capacity level in the Clarrie Hall Dam. In addition council should contact any local environmental groups to communicate changes in flow regimes.

At the pre-activation stage of the drought plan, it is important to update the drought communication plan. This plan should detail the contacts for consultation, as well as outline the consultation necessary and the timing required.

Prior to the pre-activation stage it is recommended that Tweed Shire develops a critical customer register in the categories listed above and identifies other customers that may be negatively impacted by water restrictions, for example home dialysis patients. This list should be maintained and regularly reviewed to enable communication during the implementation of drought restrictions.

### 5.4 SUMMARY OF IMPLEMENTATION ACTIONS

A summary of the critical actions to be undertaken as part of the implementation of the drought management strategy is given in

**Table 11 – Summary of Critical Actions**

Dam Level	Recommended Action
90%	<p><b>Pre-activation Stage</b></p> <ul style="list-style-type: none"> <li>• Review drought preparedness:                             <ul style="list-style-type: none"> <li>- Cease carting to areas external to the shire</li> <li>- Advise registered water carters</li> <li>- Review drought management action plan and update roles, responsibilities and actions</li> <li>- Review human resource requirements</li> <li>- Review stakeholder list for consultation</li> <li>- Develop or update Communication Plan</li> <li>- Advise irrigators of possible future curtailment of water supply</li> <li>- Review critical customers list</li> <li>- Review and implement Monitoring Program</li> </ul> </li> </ul>
75%	<p><b>Implement Level 2 Restrictions</b></p> <ul style="list-style-type: none"> <li>• Advise customers as outlined in Communication Plan</li> <li>• Implement enforcement arrangements</li> <li>• Implement restrictions reporting process (through media as part of Communication Plan)</li> <li>• Initiate contingency planning process</li> </ul>

Dam Level	Recommended Action
60%	<b>Implement Level 4 Restrictions</b> <ul style="list-style-type: none"> <li>• Implement restrictions and undertake communications / consultation</li> <li>• Progress to tendering of contingency plan (unless link to SEQ Water Grid in place)</li> </ul>
50%	<b>Implement Level 6 Restrictions</b> <ul style="list-style-type: none"> <li>• Implement restrictions and undertake communications / consultation</li> <li>• Cease environmental flows at Bray Park Weir</li> <li>• Commence supply from contingency source (SEQ Water Grid if available)</li> <li>• Commence construction of desalination plant if SEQ Water Grid connection is not available.</li> </ul>
40%	<b>Implement Level 7 Restrictions</b> <ul style="list-style-type: none"> <li>• Implement restrictions and undertake communications / consultation</li> <li>• Complete construction of contingency plan</li> </ul>
<20 %	<b>Implement Emergency Restrictions</b> <ul style="list-style-type: none"> <li>• Supply from contingency source</li> <li>• Implement emergency restrictions to achieve target demand.</li> </ul>



## 6. RECOMMENDATIONS

Based on the assessment of options for drought management in the Tweed Shire it is recommended that:

1. The current council drought management policy be revised including the current restriction triggers and targeted savings as outlined in this report. A further review of the restrictions triggers should be undertaken in 2012. At this stage the preferred contingency option will likely be available and the actual performance of the demand management program will be clearer.
2. The cessation level for flow bypass requirements at Bray Park Weir be set at a level of 50 % of the capacity of the Clarrie Hall Dam. This proposal should be reviewed in consultation with DWE and may be considered to accommodate growth. A revision of the proposed Conditions Statement for the Upper Tweed may be required.
3. Tweed Shire continues to pursue a pipeline link to the SEQ Water Grid with a capacity of up to 20 ML/day (a volume of 14 ML/d for 2014 and 18 ML/d for 2018 required to provide continuous supply under worst case conditions), as the preferred contingency plan for the Bray Park water supply system. This option should also be further investigated as part of the Bulk Water Options Assessment study as an option to improve reliability of supply.
4. Prior to 2012 (or other approval date as advised by the Queensland Water Commission), the preferred contingency plan would be temporary desalination package plants to a capacity of 16 ML/d. Such an option would likely be triggered at 40% level in the Clarrie Hall Dam.
5. A Blue Green Algae Management Plan be developed for Council's three water bodies in accordance with the template provided in the Water Directorate's management protocols.
6. A catchment management plan and land management guidelines be developed for the Upper Tweed catchment (upstream of Bray Park Weir).
7. An additional mixer be installed in the Clarrie Hall Dam to enhance the capacity, flexibility of the existing system and to provide system redundancy.
8. A register of critical customers be developed for use in the drought communications plan.
9. Monitoring of the Tweed River and Doon Doon Creek flows be upgraded to enable monitoring as required under the draft Department of Water and Energy's Conditions Statement.

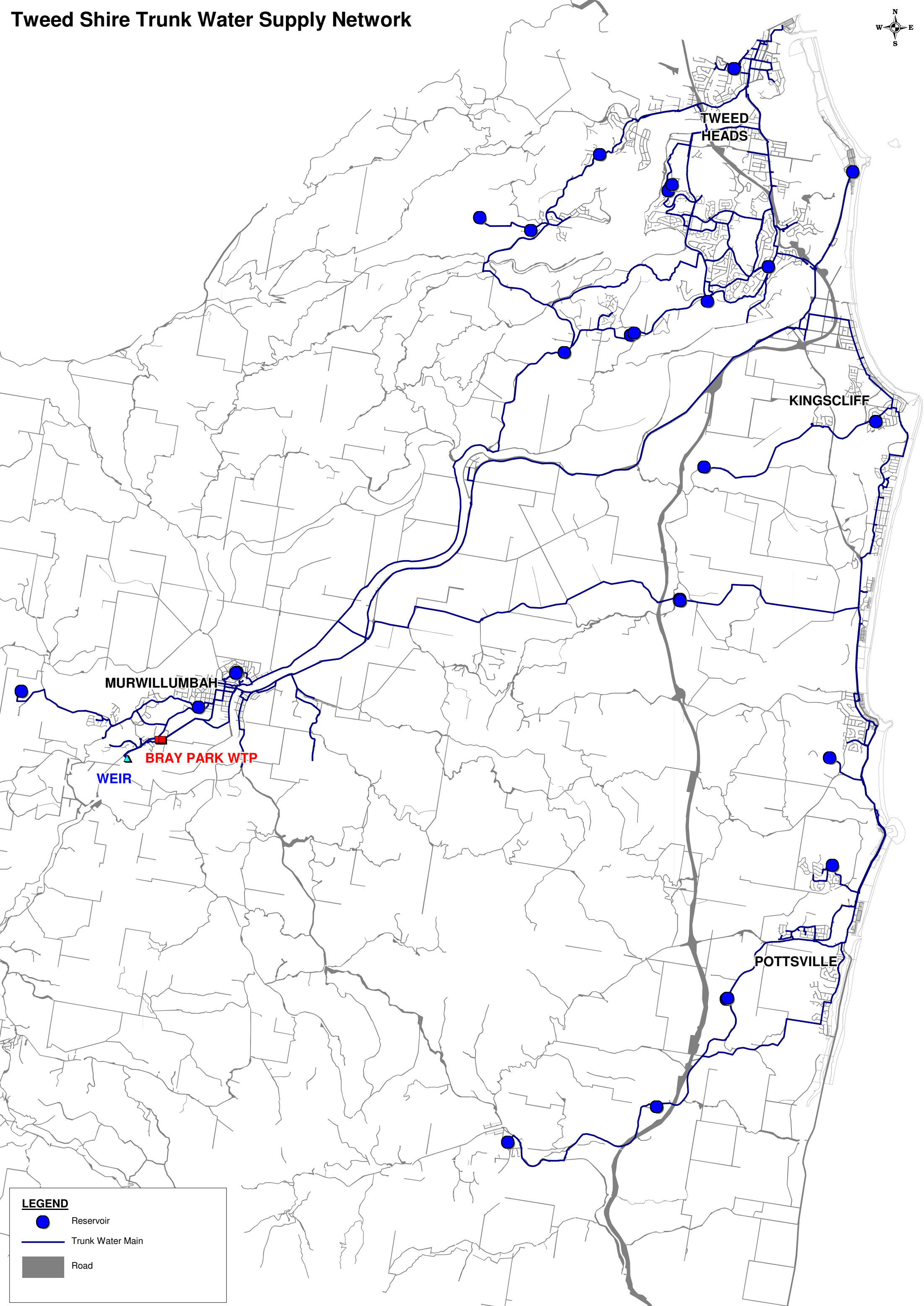
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## APPENDIX A

**WATER SUPPLY DISTRIBUTION SYSTEM**

# Tweed Shire Trunk Water Supply Network



MURWILLUMBAH

BRAY PARK WTP




WEIR

TWEED HEADS

KINGSCLIFF

POTTSVILLE

## LEGEND

-  Reservoir
-  Trunk Water Main
-  Road

## APPENDIX B

**DROUGHT DEMAND MODEL OUTPUTS**

## Drought Management End Use Model

### Summary Data

<b>Water Production</b>		Units	
Average Day	ML/d		27.4
Per Capita	L/d		372.8
<b>Unaccounted for Water</b>		Units	
Total	ML/d		3.8
Per Capita	L/d		52.2
% of Production	%		14.0%
<b>Consumption</b>		Units	
Total	ML/d		23.6
Per Capita	L/d		320.6
Internal	ML/d		17.7
External	ML/d		5.8
<b>Wastewater Flows</b>		Units	
Dry Weather	ML/d		17.0
Average Day	ML/d		20.4
Design Wet to Dry Ratio	none		3.0
Design Wet	ML/d		50.9
Design Infiltration/Inflow	L/d per Account		1,708.7
Population Served with Water:			73,500

### Consumer Categories and Number of Accounts

No.	Consumer Category	Number of Accounts	% Internal Consumption as Wastewater Flow
1	Residential	19,190	95.0%
2	Commercial	1,120	100.0%
3	Industrial	50	100.0%
4	Other	500	90.0%
Total		20,860	

### Consumption Per Account by Consumer Category

No.	Consumer Category	Baseline % of Total Consumption	Total Consumption (L/d)
1	Residential	72.0%	884.0
2	Commercial	20.0%	4,207.4
3	Industrial	1.0%	4,712.3
4	Other	7.0%	3,298.6
Total (Should = 100%)		100%	

### Internal Use Tables (Consumption Per Account)

No.	Consumer Category	% of Total Consumption (L/d)	Consumption (L/d)
1	Residential	77.0%	680.7
2	Commercial	70.0%	2,945.2
3	Industrial	90.0%	4,241.1
4	Other	70.0%	2,309.0

### External Use Tables (Consumption Per Account)

No.	Consumer Category	% of Total Consumption (L/d)	Consumption (L/d)
1	Residential	23.0%	203.3
2	Commercial	30.0%	1,262.2
3	Industrial	10.0%	471.2
4	Other	30.0%	989.6

% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
14%	20%	25%	31%

0.0%	0.0%	0.0%	0.0%
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16.2%	22.7%	28.7%	35.8%
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2.6%	7.6%	11.3%	15.4%
13.6%	15.1%	17.5%	20.4%

% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
90.0%	90.0%	90.0%	90.0%
50.0%	60.0%	70.0%	90.0%
20.0%	30.0%	40.0%	50.0%
80.0%	80.0%	90.0%	90.0%

% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
19.0%	26.7%	32.2%	38.5%
7.8%	12.0%	19.0%	29.4%
1.3%	2.8%	5.2%	7.9%
12.5%	16.0%	24.4%	29.5%

% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
4.3%	12.9%	18.8%	24.7%
1.0%	2.4%	4.2%	8.8%
0.4%	1.2%	2.4%	4.0%
1.6%	3.2%	5.4%	9.0%

% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
68.5%	72.9%	77.2%	85.0%
23.8%	34.3%	53.4%	77.3%
9.5%	17.2%	30.5%	43.0%
38.1%	45.8%	68.7%	77.3%

**End Use Tables (Litres/account/day)**
**Category 1: Residential**

## Internal End Uses

No.	Description	% of Total Internal	Consumption (L/d)	% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
1	RES Toilets	19.0%	129.3	2.0%	4.0%	6.0%	8.0%
2	RES Baths	1.9%	12.9	2.0%	4.0%	6.0%	8.0%
3	RES Showers	36.1%	245.7	5.0%	20.0%	30.0%	40.0%
4	RES Taps/Sinks	11.4%	77.6	10.0%	20.0%	30.0%	40.0%
5	RES Dishwashers	1.9%	12.9	2.0%	4.0%	6.0%	8.0%
6	RES Washing Machine	24.7%	168.1	5.0%	15.0%	20.0%	25.0%
7	RES Int. Leakage	5.0%	34.0	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

## External End Uses

1	RES External	95.0%	193.2	80.0%	85.0%	90.0%	99.0%
2	RES Ext. Leakage	5.0%	10.2	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

**Category 2: Commercial**

## Internal End Uses

No.	Description	% of Total Internal	Consumption (L/d)	% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
1	COM Toilets	26.5%	780.5	2.0%	4.0%	6.0%	10.0%
2	COM Urinals	6.6%	194.4	2.0%	4.0%	6.0%	20.0%
3	COM Showers	4.0%	117.8	2.0%	4.0%	6.0%	20.0%
4	COM Taps/Sinks	20.1%	592.0	2.0%	4.0%	6.0%	8.0%
5	COM Dishwashers	3.8%	111.9	2.0%	4.0%	6.0%	8.0%
6	COM Washing Machine	34.0%	1001.4	2.0%	4.0%	6.0%	8.0%
7	COM Int. Leakage	5.0%	147.3	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

## External End Uses

1	COM External	95.0%	1199.1	50.0%	60.0%	80.0%	90.0%
2	COM Ext. Leakage	5.0%	63.1	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

**Category 3: Industrial**

## Internal End Uses

No.	Description	% of Total Internal	Consumption (L/d)	% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
1	IND Int	95.0%	4029.0	2.0%	4.0%	6.0%	8.0%
2	IND Int Leakage	5.0%	212.1	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

## External End Uses

1	IND External	95.0%	447.7	50.0%	60.0%	80.0%	90.0%
2	IND Ext Leakage	5.0%	23.6	2.0%	4.0%	6.0%	8.0%
Total		100.0%					

**Category 4: Other**

## Internal End Uses

No.	Description	% of Total Internal	Consumption (L/d)	% Reduction in Level 2	% Reduction in Level 4	% Reduction in Level 6	% Reduction in Level 7
1	OTH Int	95.0%	2193.6	2.0%	4.0%	6.0%	10.0%
2	OTH Int Leakage	5.0%	115.5	2.0%	4.0%	6.0%	10.0%
Total		100.0%					

## External End Uses

1	OTH External	95.0%	940.1	50.0%	60.0%	80.0%	90.0%
2	OTH Ext. Leakage	5.0%	49.5	2.0%	4.0%	6.0%	8.0%
Total		100.0%					



## APPENDIX C

**DETAILS OF RESTRICTION LEVELS**

CUSTOMER GROUP	LEVEL 2 RESTRICTIONS
<p><b><u>Residential &amp; Connected Rural Dwellings</u></b></p> <p>Gardens, Car Washing, Window Cleaning</p> <p>Lawn Watering</p> <p>Washing Down Boats, Boat Motors &amp; Trailers used in saltwater</p> <p>New Turf</p> <p>Swimming Pools - Private</p> <p>Washing of driveways, paved areas and roofs</p> <p>Rainwater Tanks</p> <p>Spear Pumps</p>	<p>Hand held hoses allowed 6pm to 8pm on odds and even house numbers, three days per week</p> <p>Micro sprinklers allowed for a maximum of 15minutes between 6pm to 8pm every second day on odd or even days matching house number.</p> <p>Sprinklers, soaker hoses <b>banned</b></p> <p>Fixed hoses <b>banned</b></p> <p><b>Banned</b></p> <p>Permitted</p> <p>Watering in - then sprinklers for 7 days 6.30pm to 7.30pm - then hand held hoses as per above</p> <p>Filling of new pools permitted</p> <p>Topping up of pools allowed 6pm to 7pm on same day and hand held hose use</p> <p>Emptying &amp; refilling of existing pools <b>banned</b></p> <p><b>Banned</b>, Only permitted for health and safety reasons (efficient High Pressure low flow rate cleaners with Trigger Control are encouraged)</p> <p>Use from tank permitted at any time. Sign must be displayed</p> <p>No restrictions. Sign must be displayed</p>
<p><b><u>Public Facilities (inc Sports Clubs)</u></b></p> <p>Public Gardens</p> <p>Active Playing Surfaces (turfed playing areas)</p> <p>Public Showers</p>	<p>Sprinklers 1 hr per day 5am to 6am. Alternative times by approved application</p> <p>Sprinklers 1 hr per day 5am to 6am. Alternative times by approved application</p> <p>Permitted</p>
<p><b><u>Business &amp; Commercial Premises</u></b></p> <p>Window Cleaning, Essential Maintenance</p> <p>Market Gardens, Orchards, Nurseries &amp; Commercial Flower Gardens</p> <p>All external Irrigation</p> <p>Farming Use and irrigation</p> <p>Stock Watering if connected</p> <p>Motor Vehicle Dealers</p> <p>Commercial Car Washing Premises</p> <p>Washing of Buses, Taxis, Food Transport, Ambulances &amp; Garbage Vehicles</p> <p>Golf Courses, Bowling Clubs &amp; Tennis Clay/Grass Courts</p> <p>Building / Construction Industry / Ready Mixed Concrete</p> <p>Other Commercial uses eg., Dog Washing, High Pressure Cleaning, House Washing, Carpet Cleaning</p> <p>New Turf</p> <p>Paved Public area, where food is prepared or consumed, or for health reasons</p> <p>Water Cartage - Potable Supply</p>	<p>Permitted</p> <p>Sprinklers 2 hrs per day - application for times</p> <p><b>Banned</b></p> <p><b>Banned</b></p> <p>Permitted</p> <p>Car washing permitted at any time</p> <p>Permitted</p> <p>Permitted</p> <p>Watering of greens - allowed with permit</p> <p>Fairway and other watering - <b>Banned</b></p> <p>Permitted</p> <p>For registered businesses no restriction</p> <p>Watering in - then sprinklers 1 hr per day for 7 days - 6pm to 7pm</p> <p>Permitted</p> <p><b>Banned</b> (Cartage from Murwillumbah permitted)</p>

CUSTOMER GROUP	LEVEL 4 RESTRICTIONS
<p><b><u>Residential &amp; Connected Rural Dwellings</u></b>                      Gardens, Car Washing, Window Cleaning</p> <p>Lawn Watering</p> <p>Washing Down Boats, Boat Motors &amp; Trailers used in saltwater</p> <p>New Turf</p> <p>Swimming Pools - Private</p> <p>Washing of driveways, paved areas and roofs</p> <p>Rainwater Tanks</p> <p>Spear Pumps</p>	<p>Hand held hoses allowed 6.00pm to 7.00pm on Wednesdays and Saturdays only</p> <p>Micro sprinklers <b>banned</b>                      Sprinklers, soaker hoses <b>banned</b>                      Fixed hoses <b>banned</b>                      Watering cans or buckets permitted at any time                      Car washing with buckets only</p> <p><b>Banned</b></p> <p>Use of hand held hoses or "muffs" for a maximum of 10 minutes for cleaning after each use</p> <p>Watering in - then sprinklers for 7 days 6.30pm to 7.30pm. Then hand held hoses between 6.30pm and 7.30pm on Sundays, Tuesdays &amp; Thursdays for two additional weeks only. Then as per above.</p> <p>Filling of new pools allowed                      Topping up of pools allowed 6.30pm to 7.30pm on Wednesday and Saturdays only                      Emptying &amp; refilling of existing pools <b>banned</b></p> <p><b>Banned</b></p> <p>Use from tank permitted at any time. Sign must be displayed</p> <p>No restrictions - signs must be displayed</p>
<p><b><u>Public Facilities and Institutions</u></b>                      Public Gardens</p> <p>Turf Wickets</p> <p>Sports Grounds - Active Playing Surfaces</p> <p>Lawn Watering</p> <p>Paved Public Areas</p> <p>Beach Showers</p>	<p>Hand held hoses from 7.30am to 8.30am on Mondays, Wednesdays &amp; Fridays (Application for alternate times will be considered)</p> <p>Mondays soaker hoses for 3hrs, Wednesdays &amp; Fridays 1hr with hand held hoses</p> <p>Permitted with approved application only</p> <p><b>Banned</b></p> <p>Hand held hoses permitted for safety or health reasons on application</p> <p><b>Banned</b></p>
<p><b><u>Business &amp; Commercial Premises</u></b>                      Window Cleaning, Essential Maintenance</p> <p>Market Gardens, Orchards, Nurseries &amp; Commercial Flower Gardens</p> <p>All external Irrigation</p> <p>Farming Use and irrigation</p> <p>Stock Watering if connected</p> <p>Motor Vehicle Dealers</p> <p>Commercial Car Washing Premises</p> <p>Washing of Buses, Taxis, Transport, Ambulances &amp; Garbage Vehicles</p> <p>Golf Courses, Bowling Clubs &amp; Tennis Clay/Grass Courts</p> <p>Building / Construction Industry / Ready Mixed Concrete</p> <p>Land Development and Road Construction</p> <p>Other Commercial uses eg., Dog Washing, High Pressure Cleaning, House Washing, Carpet Cleaning</p> <p>New Turf</p> <p>Paved Public area, where food is prepared or consumed, or for health reasons</p> <p>Water Cartage - Potable Supply</p>	<p>7.30am to 8.30am Mondays, Wednesdays &amp; Fridays</p> <p>Sprinklers/hand watering 2 hrs per day - application for times</p> <p><b>Banned</b></p> <p><b>Banned</b></p> <p>Permitted</p> <p>Hand held hoses 7.30am to 8.30am Mondays, Wednesdays, &amp; Fridays                      Buckets permitted at any times</p> <p>Permit required. Water recycling required</p> <p>Permitted</p> <p>Watering of Greens &amp; Courts no restrictions</p> <p>Fairway watering banned</p> <p>Permitted</p> <p>Compaction and dust suppression - approval required for town water use</p> <p>For registered businesses no restriction</p> <p>Watering in - then sprinklers for 7 days 7.30am - 8.30am - then hand held hoses between 7.30am and 8.30am on Mondays, Wednesdays &amp; Fridays for two additional weeks only</p> <p>Hand held hoses permitted for safety or health reasons</p> <p><b>Banned</b> (Cartage from Murwillumbah permitted)</p>

CUSTOMER GROUP	LEVEL 6 RESTRICTIONS
<p><b><u>Residential &amp; Connected Rural Dwellings</u></b></p> <p>Gardens, Car Washing, Window Cleaning</p> <p>Lawn Watering</p> <p>Washing Down Boats, Boat Motors &amp; Trailers used in saltwater</p> <p>New Turf</p> <p>Swimming Pools - Private</p> <p>Washing of driveways, paved areas and roofs</p> <p>Rainwater Tanks</p> <p>Spear Pumps</p>	<p>Hand held hoses <b>banned</b>                      Micro sprinklers <b>banned</b>                      Sprinklers, soaker hoses <b>banned</b>                      Fixed hoses <b>banned</b>                      Watering cans or buckets permitted from 6.00pm to 7.00pm on Wednesdays and Saturdays only</p> <p><b>Banned</b></p> <p>Use of hand held hoses or "muffs" for a maximum of 10 minutes for cleaning after each use</p> <p>Watering in - then sprinklers for 7 days 6.30pm to 7.30pm. Then hand held hoses between 6.30pm and 7.30pm on Sundays, Tuesdays &amp; Thursdays for two additional weeks only. Then as per above.</p> <p>Filling of new pools allowed                      Topping up of pools - By hose 6:30pm to 7:30pm Sundays where premises has pool cover, dual flush toilets, low flow showerhead and 5,000L rainwater tank (or downpipe diverter)</p> <p>Emptying &amp; refilling of existing pools <b>banned</b></p> <p><b>Banned</b></p> <p>Use from tank permitted at any time. Sign must be displayed</p> <p>No restrictions - sign must be displayed</p>
<p><b><u>Public Facilities and Institutions</u></b></p> <p>Public Gardens</p> <p>Turf Wickets</p> <p>Sports Grounds</p> <p>Lawn Watering</p> <p>Paved Public Areas</p> <p>Beach Showers</p>	<p>Hand held hoses - <b>Banned</b></p> <p>Hand held hoses only - limited to amount required to keep surfaces operational</p> <p>All watering <b>banned</b></p> <p><b>Banned</b></p> <p><b>Banned</b> except for health reasons and then only with permit</p> <p><b>Banned</b></p>
<p><b><u>Business &amp; Commercial Premises</u></b></p> <p>Window Cleaning, Essential Maintenance</p> <p>Lawn Watering</p> <p>Market Gardens, Orchards, Nurseries &amp; Commercial Flower Gardens</p> <p>Other Irrigation &amp; Farming Use</p> <p>Stock Watering if connected</p> <p>Motor Vehicle Dealers</p> <p>Commercial Car Washing Premises</p> <p>External washing of Buses, Taxis, Transport, Ambulances &amp; Garbage Vehicles</p> <p>Internal washing - commercial vehicles</p> <p>Golf Courses, Bowling Clubs &amp; Tennis Clay/Grass Courts</p> <p>Building Industry / Ready Mixed Concrete</p> <p>Land Development and Road Construction</p> <p>Other Commercial uses eg., Dog Washing, High Pressure Cleaning, House Washing, Carpet Cleaning</p> <p>New Turf, Grass Seeding</p> <p>Paved Public area, where food is prepared or consumed, or for health reasons</p> <p>Water Cartage - Potable Supply</p>	<p>Hand held hoses banned. Water cans or buckets only</p> <p><b>Banned</b></p> <p>Sprinklers/hand watering 2 hrs per day - application for times</p> <p><b>Banned</b></p> <p>Permitted</p> <p>Fixed and hand held hoses banned. Rainwater allowed</p> <p>Permit required. Water recycling required</p> <p>Fixed and hand held hoses banned. Rainwater or recycled water allowed</p> <p>Hoses permitted for health and safety reasons only</p> <p>Watering of Greens &amp; Courts - limited to amount required to keep surfaces operational. Hand held hoses only.                      All other watering banned</p> <p>No restriction</p> <p>Recycled water only</p> <p>For registered businesses no restriction</p> <p>Approval required for town water use</p> <p>Hand held hoses - <b>Banned</b>. Buckets permitted. Watering banned in all other public areas</p> <p>No restriction - private carriers must be registered. No delivery outside of shire</p>

## APPENDIX D

**RIPARIAN USER SUMMARY**

### 1. Doon Doon Creek to Bray Park Weir Licence Summary

Surface Water Licences – 16

#### **Volume by purpose (Active and Suspended Contract Only) -**

	<b>Volume Regulated:</b>	<b>Volume Unregulated:</b>
Domestic	0	2
Farming	0	5
Irrigation	0	872
<b>Total Volume (ML)</b>	<b>0</b>	<b>879</b>

Active surface water licences authorised on this catchment, with totals attached to the primary catchment = 0

#### **Irrigation area (Active and Suspended Contract Only)**

Regulated (ha)	0
Unregulated (ha)	136.50
<b>Total Irrigation Area (ha)</b>	<b>136.50</b>

### 2. Oxley River to Tweed River Licence Summary

(may gain some benefit from releases from Clarrie Hall Dam)

Surface Water Licences – 5

#### **Volume by purpose (Active and Suspended Contract Only)**

	<b>Volume Regulated:</b>	<b>Volume Unregulated:</b>
Domestic	0	1
Farming	0	5
Irrigation	0	183
Stock	0	3
<b>Total Volume (ML)</b>	<b>0</b>	<b>192</b>

Active surface water licences authorised on this catchment, with totals attached to the primary catchment = 0

#### **Irrigation area (Active and Suspended Contract Only)**

Regulated (ha)	0
Unregulated (ha)	48.0
<b>Total Irrigation Area (ha)</b>	<b>48.0</b>

## APPENDIX E

**LARGE USER SUMMARY**



Prop	Address	Owners
85150	123 McLeod Street CONDONG NSW 2484	Nsw Sugar Milling Co-Operative Limited
26835	2-64 Ourimbah Road TWEED HEADS NSW 2485	The Owners Strata Plan 35574
44527	Falcon Way TWEED HEADS SOUTH NSW 2486	The Neighbourhood Association Npp 270281
101963	1-25 Bells Boulevard KINGSCLIFF NSW 2487	The Owners Strata Plan 76024
12478	2 Wharf Street TWEED HEADS NSW 2485	Twin Towns Services Club Limited
42923	1-3 Tweed Coast Road HASTINGS POINT NSW 2489	Ladehai Pty Ltd
9834	16 Machinery Drive TWEED HEADS SOUTH NSW 2486	Wright Industries Pty Ltd
72960	Leisure Drive BANORA POINT NSW 2486	Twin Towns Services Club Limited
95700	Bells Boulevard KINGSCLIFF NSW 2487	The Owners Strata Plan 73905
84020	Casuarina Way CASUARINA NSW 2487	South Kingscliff Developments Pty Ltd
39186	38 Minjungbal Drive TWEED HEADS SOUTH NSW 2486	Sas Trustee Corporation
43652	Tweed Coast Road CASUARINA NSW 2487	Tweed Shire Council
34576	Pacific Highway East BANORA POINT NSW 2486	Caraco Pty Ltd
29393	Kirkwood Road TWEED HEADS SOUTH NSW 2486	Tweed Broadwater Village Pty Ltd
38869	192 Piggabeen Road TWEED HEADS WEST NSW 2485	Cobaki Broadwater Village Pty Ltd
5351	Durroon Avenue BRAY PARK NSW 2484	Tweed Shire Council
42048	Navigation Lane TWEED HEADS NSW 2485	Twin Towns Services Club Limited
42636	34 Monarch Drive KINGSCLIFF NSW 2487	Baclon Pty Ltd t/as Noble Lakeside Australia
42242	Gollan Drive TWEED HEADS WEST NSW 2485	North Sydney Leagues Club Limited
24819	Ingram Place MURWILLUMBAH NSW 2484	The Owners Strata Plan 34198
89290	1-33 Harrier Street TWEED HEADS SOUTH NSW 2486	The Owners Strata Plan 76333 & 77053
38716	Wharf Street TWEED HEADS NSW 2485	Centro Properties Group
18698	12-46 Wommin Bay Road CHINDERAH NSW 2487	Tejoem Pty Ltd
77560	122 Dry Dock Road TWEED HEADS SOUTH NSW 2486	The Palms Tweed Heads Pty Ltd
12667	21-35 Chinderah Bay Drive CHINDERAH NSW 2487	Gennacker Pty Ltd
41516	Murwillumbah Pool Tumbulgum Road MURWILLUMBAH NSW	Tweed Shire Council
101414	North Point Avenue KINGSCLIFF NSW 2487	South Kingscliff Developments Pty Ltd
7848	Keith Compton Drive TWEED HEADS NSW 2485	Ncahs Tweed District Hospital
31437	57-79 Leisure Drive BANORA POINT NSW 2486	The Owners Strata Plan 42960 47115 48556
12352	186-202 Chinderah Bay Drive CHINDERAH NSW 2487	Tweed Heritage Park Pty Ltd
33705	5-7 Soorley Street TWEED HEADS SOUTH NSW 2486	The Owners Strata Plan 50820
43091	Marine Parade KINGSCLIFF NSW 2487	Tweed Coast Holiday Parks Res Trust
8086	147 Kennedy Drive TWEED HEADS WEST NSW 2485	Sunrise Property Holdings Pty Ltd
43268	Dry Dock Road TWEED HEADS SOUTH NSW 2486	Tweed Coast Holiday Parks Res Trust
84600	Kirkwood Road TWEED HEADS SOUTH NSW 2486	Ybos Pty Ltd
43051	Wommin Bay Road CHINDERAH NSW 2487	Tweed Shire Council
38235	Davey Street TWEED HEADS SOUTH NSW 2486	Coolangatta/Tweed Heads Golf Club Limited
22171	1 Carramar Drive TWEED HEADS WEST NSW 2485	The Owners Strata Plan 31331
8591	22 Kirkwood Road TWEED HEADS SOUTH NSW 2486	The Owners Strata Plan 19650
28214	27 Tweed Coast Road POTTSVILLE NSW 2489	Tweed Coast Holiday Parks Res Trust
38447	67 Winders Place BANORA POINT NSW 2486	Walter Elliott Holdings Pty Ltd
35925	Mariners Drive East TWEED HEADS NSW 2485	Neighbourhood Association Np 285240
939	53 Bay Street TWEED HEADS NSW 2485	The Owners Strata Plan 20856 & Strata Plan 49690
32473	73-101 Darlington Drive BANORA POINT NSW 2486	The Owners Strata Plan 53361
41355	126 Leisure Drive BANORA POINT NSW 2486	Rsl (Old) War Veterans' Homes Limited
38029	Mariners Drive East TWEED HEADS NSW 2485	Neighbourhood Association Np 270102
29195	22-38 Florence Street TWEED HEADS NSW 2485	Tweed Heads Bowls Club Pty Ltd
81920	1-9 Gray Street TWEED HEADS WEST NSW 2485	The Owners Strata Plans 71205 73418 & 77158
28089	24A Kingscliff Street KINGSCLIFF NSW 2487	Uniting Church In Australia Property Trust Nsw
9506	36-42 Lundberg Drive SOUTH MURWILLUMBAH NSW 2484	Tweed Shire Council
54840	38/12 Trigonie Drive TWEED HEADS SOUTH NSW 2486	The Owners Strata Plans 69629 & 70239
34655	60 Elsie Street BANORA POINT NSW 2486	Neighbourhood Association Np 285117
78660	3 Cedarwood Court CASUARINA NSW 2487	The Owners Strata Plan 70892
101894	Fraser Drive BANORA POINT NSW 2486	Tweed Shire Council
12669	37-63 Chinderah Bay Drive CHINDERAH NSW 2487	Hacienda Caravan Park Pty Ltd
22589	24 Machinery Drive TWEED HEADS SOUTH NSW 2486	Readymix Holdings Pty Ltd
30648	6-8 Thomson Street TWEED HEADS NSW 2485	The Owners Strata Plan 39108 The Owners Strata Plan 40453
37019	Tyalgum Road EUNGELLA NSW 2484	Tweed Valley Water Supplies
21603	3 Island Drive TWEED HEADS NSW 2485	The Owners Strata Plan 30843
72190	Urunga Drive POTTSVILLE NSW 2489	Tweed Shire Council
27835	33-51 Darlington Drive BANORA POINT NSW 2486	Rsl (Old) War Veterans Homes
7928	68-78 Keith Compton Drive TWEED HEADS NSW 2485	The Uniting Church Australia Property Trust Nsw
8809	Kyogle Road BRAY PARK NSW 2484	Tweed Shire Council
101917	Marana Street BILAMBIL HEIGHTS NSW 2486	Terranora Group Management Pty Ltd
33795	Tweed Valley Way SOUTH MURWILLUMBAH NSW 2484	Duncan's Holdings Limited

## APPENDIX F

**BLUE GREEN ALGAE MANAGEMENT PLAN  
TEMPLATE**

## 9.0 BLUE-GREEN ALGAE MANAGEMENT PLAN TEMPLATE

### Background

This Blue-Green Algal Management Plan has been provided to assist councils in developing specific algal management plans for their local region.

This is not intended to be a complete guide but an aid to staff whose responsibility is the preparation the documents. For more detailed information individuals should consult the Blue-Green Algae Management Protocols.

This generic plan is provided in an electronic format to allow precise information from individual councils to be inserted into the document and easily updated as and when required.

The management of an algal incident will require resources from the council as well as external authorities. The incident management processes outlined here are based on the established "PPRR" disaster planning model which deals with Prevention, Preparedness, Response and Recovery.

**Prevention of blooms is addressed in Chapter 4 of the Blue-Green Algae Management Protocols.**

**Preparation for blooms is addressed in Chapter 5 of the Protocols and Response and Recovery are covered in Chapter 7 and 8 of the Protocols.**

This document specifically deals with the response or management part of the algal bloom.

### Preparation

Preparation before an algal bloom occurs is essential. Below is a checklist that must be completed before an incident occurs: (circle yes or no to indicate your preparedness)

- |                                        |     |    |
|----------------------------------------|-----|----|
| • Roles and responsibilities defined   | Yes | No |
| • Prevention activities in place       | Yes | No |
| • Incident management team established | Yes | No |
| • Incident management room prepared    | Yes | No |
| • Contacts list prepared               | Yes | No |
| • Backup resources established         | Yes | No |
| • Communication procedures in place    | Yes | No |
| • Notification forms developed         | Yes | No |
| • Council spokesperson identified      | Yes | No |
| • Media plan developed                 | Yes | No |
| • Recovery plan established            | Yes | No |

### Response Plan

Visual monitoring for algae is advisable during high risk periods, this may need to be done on a daily basis as algal distribution within a water body can change rapidly when conditions are favourable, especially with changes of wind direction. Visual monitoring may provide a rapid means of assessing the situation instead of collecting a sample and waiting for results of the laboratory analysis. The best place to look for blue-green algal scums is around the down-wind edges of the water bodies. Scums will not be present when windy conditions exist, as the algae will be mixed into the water column.

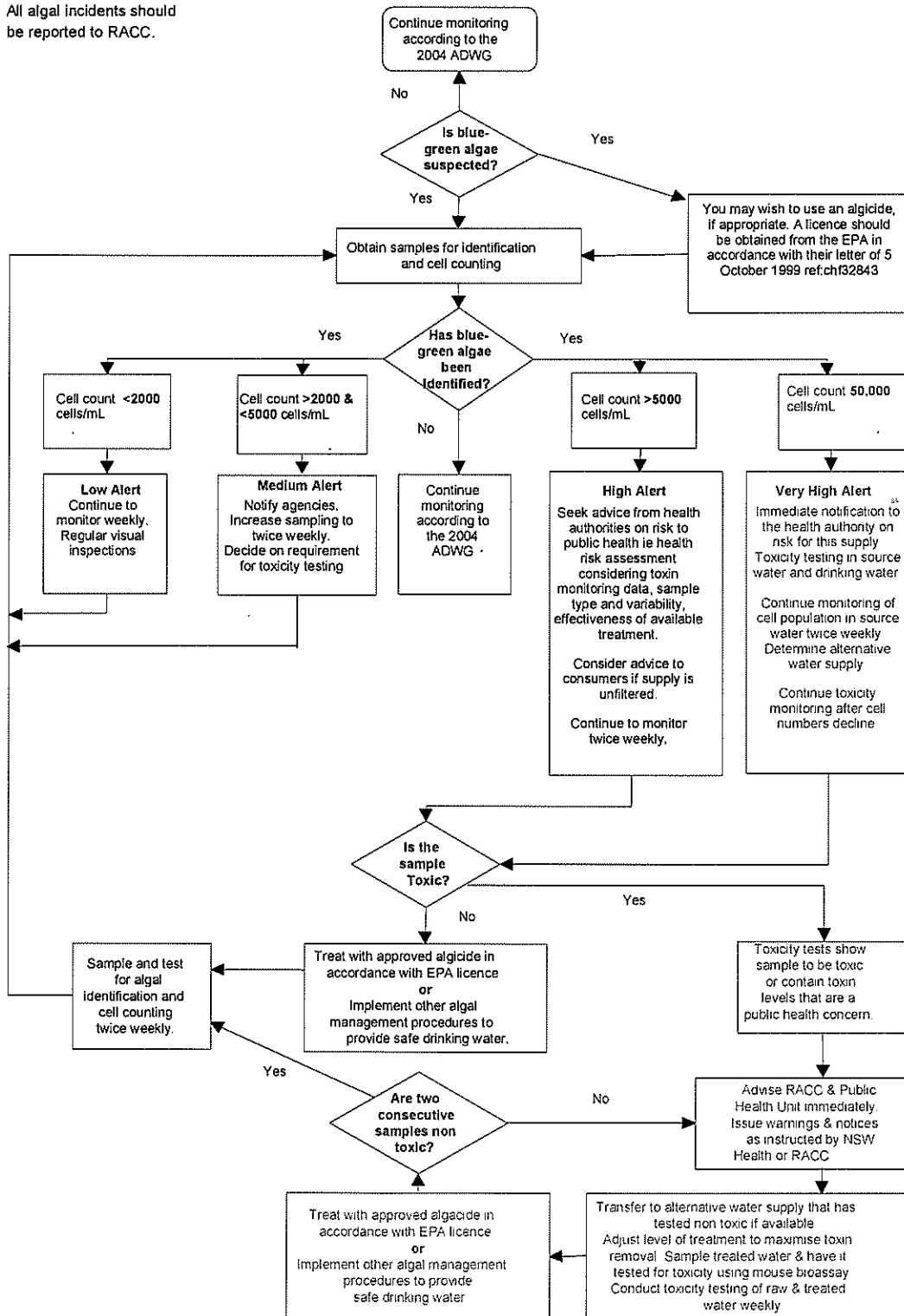
The different responses to algal blooms are based on the identification of algal type, counts and the presence of toxins. Where laboratory results are not available immediately, field assessments will be useful to determine the possibility of risk associated with a potential bloom.



The flow chart below presents an easy to follow action plan and responses to undertake depending on the cell counts and toxicity of the bloom.

**Flow Chart**

All algal incidents should be reported to RACC.



## APPENDIX G

**BEST PRACTICE CHECKLIST**

## Appendix D - Drought Management

### Check List – August 2007

A comprehensive drought management plan details the demand and supply issues to be addressed during drought conditions and includes adoption of a schedule of trigger points for the timely implementation of appropriate water restrictions. Appropriate drought management planning will ensure that town water supplies with significant storage do not fail in times of drought.

Drought management planning includes documenting basic data on water demands, rainfall, evaporation, records of past droughts, the existing water supply system, and its water resources, and strategies to achieve the objective of having sufficient water to satisfy the basic needs of the community.

This check list is essentially a road map to assist LWUs to quickly implement sound drought management planning. LWUs should have a sound drought management plan in place and be ready to implement their plan when drought conditions arise.

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### Drought Management – Check List

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Topic	Outcome Achieved
1. Executive Summary	<ul style="list-style-type: none"><li><input checked="" type="checkbox"/> Covers all major issues, objectives, planning, strategies and monitoring for existing essential supplies of water to the service area(s).</li><li><input checked="" type="checkbox"/> Includes a summary of the drought management plan and an adopted schedule of trigger points for timely implementation of appropriate water restrictions.</li></ul>
2. Background	<ul style="list-style-type: none"><li>A. <input checked="" type="checkbox"/> Includes the existing water supply system(s) in the service area(s) and a locality map.</li><li>B. <input checked="" type="checkbox"/> Includes history of past droughts.</li><li>C. <input checked="" type="checkbox"/> Includes information on the impact of past droughts on water services, eg. restrictions, effect of restrictions on demands, any emergency sources identified, etc.</li></ul>
3. Objectives	<ul style="list-style-type: none"><li>A. <input checked="" type="checkbox"/> Identifies key objectives required to maintain a basic/restricted supply to all users. There is a need to consider social and environmental impacts.</li><li>B. <input checked="" type="checkbox"/> Tailor strategies relevant to the service areas.</li><li>C. <input checked="" type="checkbox"/> Endorse and implement a plan that minimises the risk of the community running out of water.</li></ul>

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## Drought Management – Check List

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Topic	Outcome Achieved
4. Data	<p>A. <input checked="" type="checkbox"/> Identification of all communities served by the LWU's reticulated water supply, those with private reticulated water services and those with no reticulated water services within the service area(s).</p> <p>B. <input checked="" type="checkbox"/> Identification of any properties, businesses, other LWUs etc. that may seek water in times of drought.</p> <p>C. <input checked="" type="checkbox"/> Identification of all water requirements. Identify the normal and minimum potable and non-potable water requirements.</p> <p>D. <input checked="" type="checkbox"/> Identify water dependent industry/businesses, any fire fighting requirements and opportunities for recycled water use.</p> <p>E. <input checked="" type="checkbox"/> Includes a description and plan of all water supply schemes in the service area(s).</p> <p>F. <input checked="" type="checkbox"/> Includes height/storage volume and height/surface area graphs for all water supply dams and weirs.</p> <p>G. <input checked="" type="checkbox"/> Historical performance of rivers, dams, weirs and bores in previous droughts.</p> <p>H. <input checked="" type="checkbox"/> Includes the average rainfall figures and evaporation rates.</p>
<b>Note:</b> All data to be specified on a daily basis.	
5. Plan	<p>A. <input checked="" type="checkbox"/> Demand management options.</p> <p>B. <input checked="" type="checkbox"/> Restriction strategies including means and methods for the enforcement of restrictions and the expected results of imposing restrictions.</p> <p>C. <input checked="" type="checkbox"/> Adopted schedule of trigger points for the timely implementation of appropriate water restrictions in order to minimise the risk of failure in times of drought.</p> <p>D. <input checked="" type="checkbox"/> Availability of alternative water sources (including estimated costs and times to implement).</p> <p>E. <input checked="" type="checkbox"/> Water cartage options.</p> <p>F. <input checked="" type="checkbox"/> Identify legislation, local laws and council policies affecting the contingency arrangements.</p> <p>G. <input checked="" type="checkbox"/> Links to water sharing plans/committees, water management plans/committees, irrigators, etc.</p>



## Drought Management – Check List

Topic	Outcome Achieved
	<ul style="list-style-type: none"> <li>H. <input checked="" type="checkbox"/> Impact of extraction on downstream stakeholders.</li> <li>I. <input checked="" type="checkbox"/> Impact of reduced flows in watercourses.</li> <li>J. <input checked="" type="checkbox"/> Level of prediction and intervention.</li> <li>K. <input checked="" type="checkbox"/> Identify human resource requirements.</li> </ul>
6. Monitoring During Drought	<ul style="list-style-type: none"> <li>A. <input checked="" type="checkbox"/> Daily monitoring of demands.</li> <li>B. <input checked="" type="checkbox"/> Daily monitoring of water supply sources (dams, bores and streams).</li> <li>C. <input checked="" type="checkbox"/> Monitoring impact of restrictions on consumption</li> <li>D. <input checked="" type="checkbox"/> Monitoring the electrical conductivity, alkalinity and algae levels in the water sources.</li> </ul>
7. Consultation	<ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Comprehensive media strategy and public consultation.</li> <li><input checked="" type="checkbox"/> Regular consultation with appropriate government agencies (DWE, DECC, NSW Health etc).</li> </ul>
8. Operation of Drought Management Plan (DMP)	<ul style="list-style-type: none"> <li>A. <input checked="" type="checkbox"/> DMP should discuss, analyse and identify any impact on other regions and localities ie. upstream, downstream or conjunctive water users.</li> <li>B. <input checked="" type="checkbox"/> DMP should demonstrate a sustainable strategy that considers all other stakeholders.</li> <li>C. <input checked="" type="checkbox"/> DMP documents an agreed procedure for progressive implementation of water restrictions.</li> </ul>

### REFERENCE

*Drought Management Guidelines*, NSW Local Government Water Directorate, December 2003.