# Contents

# Overview

In 2006 the ACT was hit particularly hard by the drought that was affecting most of Australia. We received only 373mm of rainfall during the year and inflows to our catchments were almost 90 per cent below the long-term average. Dam levels were fast dwindling and it was clear the situation was very serious.

ACTEW Corporation undertook a water conservation initiative 'Grass Roots' with the aim to develop 'best practice' watering regimes for turf. The primary focus of Grass Roots was large, open urban spaces which are traditionally one of Canberra's largest consumers of water. It was an exciting project for many reasons, not least of all because a research project of this nature and scale is unique in Australia.

Local irrigation specialist Austin Goodfellow initiated the project and has worked closely with teachers and students at Rosary Primary and ACTEW over its life. The Rosary Oval became a closely monitored research space, with changes made in response to changing weather conditions, to pest outbreaks and increased foot traffic by students. But it was far from a lab project; Grass Roots also allowed the Rosary students to play on grass at a time when most other ovals turned to dust.

Four years on the results, outcomes, observations and learnings made during the project are significant. They will be used to make important irrigation and turf management decisions throughout the Canberra region and beyond. While the focus is on large open spaces, the results are applicable for anywhere turf is used; from Manuka Oval to our suburban yards.

I thank and congratulate everyone involved, particularly Austin Goodfellow and the Board and management of Rosary Primary. I strongly encourage Canberrans to use the Grass Roots legacy to research and select the best turf and watering combinations for their needs; if we all make wise decisions now it will make a big difference to water sustainability into the future.

**Mark Sullivan**
Managing Director, ACTEW Corporation

## From Austin Goodfellow – Project Coordinator

This project has been one of the most proactive projects I have been associated with and is still seen as the only one of its kind around the country. I guess what has been the major highlight is that throughout the project we have made some good decisions and some not so good decisions which we can learn from to help the Canberra region. While this has been very much a 'region specific' project, the interstate interest has been overwhelming. I am sure that most who have visited and/or corresponded with us have obtained a wealth of knowledge that will be used to grow better quality turf, with less water, while maintaining sustainable turf management practices. Obviously the first question that comes from most visitors is 'which turf variety and which form of irrigation is best'. The common answer is usually along the lines of 'it depends on the specific site requirements where climate, water and soil quality, aesthetic requirement and pedestrian pressure factors need to be considered'. Unfortunately there is not one single combination that will suit all sites.

The whole process has been an integrated approach combining cutting edge irrigation technology, modern soil and turf management processes. Congratulations and many thanks to all who have contributed and I am sure this project has assisted with us all in achieving 'better turf with less water'.

# The Grass Roots Project

## Project Objectives

In developing the Grass Roots project, the project team aimed to:

- develop and monitor precise watering regimes to help save water on a commercial 'high traffic' turf site in the ACT
- inform the community about efficient ways to use water on turf based on results from the site
- use historical water usage data collated during the project as a benchmark for 'actual' water usage requirements for different turf varieties on other sites in the ACT
- maintain 'best practice' turf management processes for a typical school ground playing field

### THE SITE

Constructed in 1963, Rosary Primary School has long suffered from failed attempts to keep its oval green. The principal at the time, Sister Louise Welbourne, comments 'the agony extended to a playground that lacked any vegetation and was a mud field after the lightest of rainfalls. In due time the trees, grass and gardens were planted and the children, armed with ice-cream containers of water, faithfully but not always as the 'coalition of the willing', joined the morning ritual of improving the oval and its environment'.

In the early 1970s a Quick Coupler Irrigation System was successfully installed, but over time the system deteriorated leaving the oval a wasteland once more. In 1988 the system was resurrected and the green pastures were revived, but by 2000 the system had deteriorated to the point of disrepair. Between 2000 and 2005 the oval received no irrigated water, and limited rainfall due to drought, rendering the playing area compacted and completely devoid of vegetation as it was in the 1960s.

A primary school where hundreds of children would be playing on the oval daily was the perfect choice for this project as the students were exposed to a practical education in water use and conservation, while the wider community were also informed about the project and ways to keep Canberra green via responsible water use.

In November 2005 site preparation began. A border of trees was planted and mulched reducing the irrigated turf area minimally to approximately 8000m$^2$.

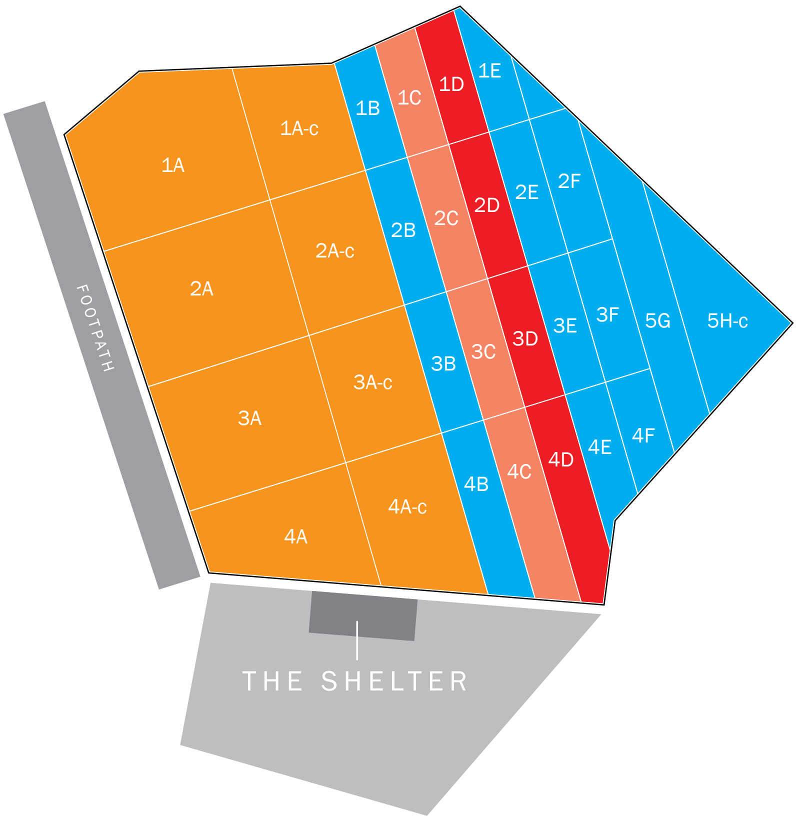
## THE PROJECT

The oval irrigation design and turf layout was developed to:

- include the latest and (preferably) most efficient irrigation products and methodology available in Australia
- introduce the latest cool and warm season turf varieties that could be used in backyards, commercial turf areas and some sports fields
- develop and monitor precise watering regimes using different irrigation methodology and turf varieties on a commercial 'high traffic' turf site
- use results to inform the community about efficient ways to use water on turf

To meet these objectives a program was developed involving ground preparation, irrigation equipment installation and the introduction of new turf.

**Figure 1. Oval Sections – The oval is separated into sections, each with different grass type and irrigation method**




### LEGEND

**GRASS TYPE**

**1** = Transcontinental Couch
**2** = RTF Tall Fescue 90% Eureka Hard Fescue 10%
**3** = 3X Tall Fescue blend
**4** = RTF
**5** = Sir Walter

NOTE:
**c** = Control

**METHOD OF WATERING**

- Sprinkler system
- Drip irrigation (Type DI)
- Drip irrigation (Type Wrap)
- Drip irrigation (Type Flat)

### Irrigation System Design

In designing the irrigation system, the oval was split into two distinct irrigation methodology areas. The south end was irrigated with sprinklers and the north was irrigated with sub surface drip irrigation (SDI). To meet the project's objectives these systems were configured to allow separate operation and monitoring.

## South End – Sprinklers

Smaller nozzled sprinklers were selected to ensure maximum coverage without requiring an exorbitant number of valves. As predicted this did affect watering uniformity during the establishment of the project as high winds played havoc on the wetted patterns of these sprinklers. The smaller nozzle (Toro 640 #40) sprinklers deliver smaller droplet sizes and these are more affected by wind than larger ones. A 'catch can' test was carried out to calculate the Distribution Uniformity (DU) in July 2007 and results revealed a DU of 71 per cent – 4 per cent lower than the industry benchmark of 75 per cent.

*Distribution Uniformity (DU) This is how efficiently and uniformly an area is watered. The lower the DU, the less efficient the distribution, and thus the more water which must be applied to meet the minimum requirement the irrigator has set for the particular type of grass.*

The sprinkler area was designed based on specific flow rate and pressure information from ACTEW. However, the project managers discovered that the anticipated flows and pressures obtained from ACTEW were conservative in comparison to actual flow and pressure. Therefore, the sprinklers were upgraded with larger nozzles (#42) to increase DU to at least 75 per cent. This resulted in shorter waterings and a more uniform application during wind events than expected. A further 'catch can' test was carried out on the sprinklers with the #42 nozzle and a DU result of 81 per cent was achieved.

A commercial low pop rugged sprinkler was selected to reduce the likelihood of vandalism with a 'head to head' spacing of around 15m. This meant the sprinklers were laid out so that the throw of one sprinkler hit the housing of the adjacent sprinkler. This practice assists with irrigation efficiencies especially in times of high wind.

Valves were grouped into half-circle and full-circle combinations. To ensure the same application of irrigation, the full-circle sprinklers run for twice as long as the half-circle sprinklers.

*In some domestic systems, where a mixture of full and half-circle sprinklers are run on a single valve, different nozzles are normally used to ensure precipitation rates don't vary between the different sprinklers during operation.*

## North End – Sub Surface Drip Irrigation (SDI)

Like the sprinkler section of the project, the SDI area was designed in sections to match the flow rates available. Owing to the sheer quantity of product and installation expense, SDI has traditionally cost around twice as much per square meter to install than pop up sprinklers. Special in-line drip product was installed into the ground at a depth of around 125mm. The drip-line used in the DI sections (marked in light blue in figure 1) used drippers emitting 2.4 litres per hour (LPH) 30cm apart with 40cm spacing between drip-lines.

The goal was to give the turfed area a total wetted root zone to achieve good uniform growth.

The WRAP section (marked in pink in figure 1) uses a similar product to the DI section. While the flow rate and spacing are the same, this product is wrapped in a geo-textile fabric. The aim of WRAP is to further enhance the lateral spread of the water and reduce the effect of 'tunnelling' which can occur with the traditional SDI product.

Within the FLAT section (marked in red in figure 1) is another in-line drip product. This product uses a 1 LPH dripper spaced at 20cm along the drip-line. This product has a flat polyethylene strip attached to the bottom side of the drip-line while the top side is covered with a geo-textile fabric. The dripper is engineered this way to further increase the lateral spread of irrigation water in the soil. Therefore it has been placed with 60cm spacing between the drip-lines. Installation of this system is far cheaper than the traditional SDI systems.

Further information on the emitter products used can be found on the Grass Roots website.

### Filtration

Despite ACTEW's water being among the best in the country, particles may occasionally become dislodged from the internals of pipes and find their way into the irrigation system. The SDI system is protected by one common 'disc' type filter along with individual filters on each of the SDI valves to protect the system from such particles.

### Operation

An irrigation controller and software was installed in order to schedule, operate and monitor the irrigation remotely.

## Managing soil and nutrients

An intensive soil testing program was developed by Nuturf guiding the application of fertiliser and soil remediation products across the site. This program, in addition to weedicide and insecticide applications, was crucial in maintaining turf performance and in providing a sustainable turf surface for the kids and community to use. These programs enhanced the turf's ability to use less water and survive longer during drier periods. Coupled with good irrigation practices root depth was able to reach 40cm. The initial site establishment was also a major factor that helped create an above average growing base. The incorporation of 100 tonnes of sand across the site during establishment and renovation to 200mm greatly assisted the infiltration of irrigation and rainfall to depth.

## OUTCOMES

### Irrigation

The site's irrigation layout has been designed to enable stakeholders to reduce the amount of water applied to different sections of the project across the different turf varieties. The layout allowed all sprinkler watering to be carried out at night. Some drip irrigation was carried out during sunlight hours but not in the hottest part of the day. The site was fortunate enough to only experience a few irrigation failures during the 'growing in' period, and again in 2008 where hydraulic valves did not close down, allowing overwatering to occur. These problems were quickly identified using reports from the irrigation controller and the problems were rectified. Unlike many other sites in the region, the SDI sections of the site were fault free up until the final year where a tube fitting failed. The failure was caused by an unusual situation where a pressure reducing valve was tampered with, possibly by a very young and upcoming irrigator from the school.

The key to faultless irrigation equipment operation was the preventative maintenance and monitoring program implemented by the project coordinator and a contracted irrigation company. Without this program the project would have experienced many more failures.

The irrigation was normally adjusted remotely with weekly site visits during the growing season. Initially irrigation adjustments were made pending weather data obtained from the Bureau of Meteorology. Later in the project more emphasis was placed on results from the soil

moisture sensors. These sensors did not trigger any irrigation actions but served as a tool to assist with the irrigation scheduling.

From an aesthetic point of view, the performance of the sprinkler area performed slightly better than the SDI areas that had similar applications of irrigation water. Unfortunately, as expected, when the SDI areas were put under stress the 'railway tracking' became more evident. Although the colour discrepancy was not ideal, the average colour was similar to that of the sprinkler area. Further comment on SDI in turf can be viewed in the document 'SDI in Sports Turf – A Turf Managers Perspective' available on Grass Roots website.

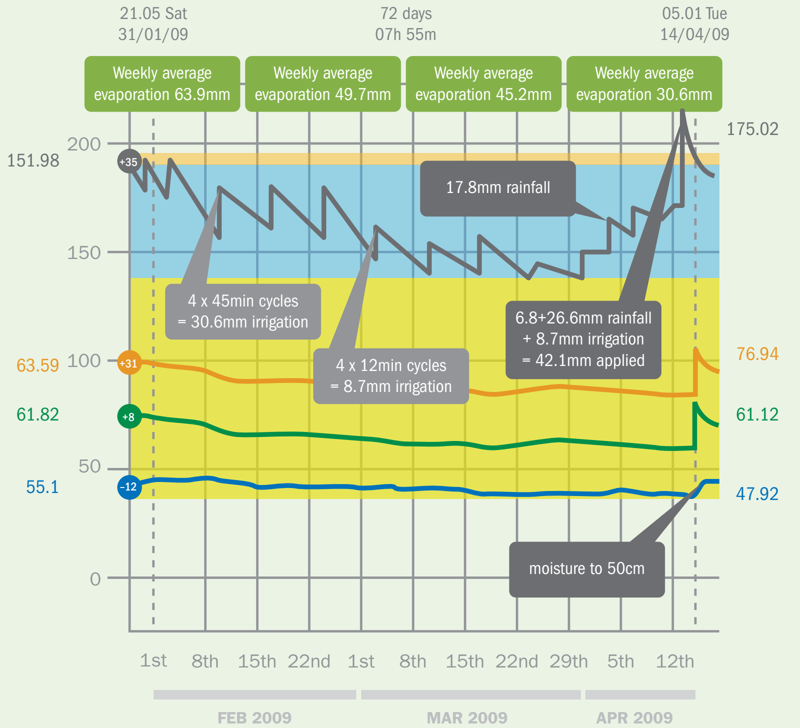
Although the SDI section that contained the flat product spaced at 60cm laterally was noted as demonstrating heavy signs of 'railway tracking' it's important to note that this area received less water than average. Despite this, the product experienced tremendous root growth within the geo-fabric that may lead to a long term root intrusion issue if used with low applications of water. However, there were no visual signs of root intrusion at the time of photographing this sample. (17/8/10)

### Irrigation Scheduling

Despite the irrigation system being noted for its high efficiencies, the correct operation of the system is crucial in obtaining maximum irrigation efficiency in relation to turf growth and management practices. Therefore a moderately sophisticated control system was installed to allow maximum flexibility in irrigation control. Typically, in and around the Canberra region, a mix of clay to clay loam soils is prevalent. The applications of irrigation water are well managed on these soils to reduce the incidence of run off or ponding. Therefore, in most cases multiple short waterings are required with a pause between waterings. This type of methodology is commonly known as pulse or cyclic watering. By using this methodology at Grass Roots, it was possible to limit waterings on some of the sprinkler areas to one watering day per week. The waterings had four start times with approximately 1 hour between each, depending on the run time. Due to an application rate of around 10mm per hour the waterings were quite long.

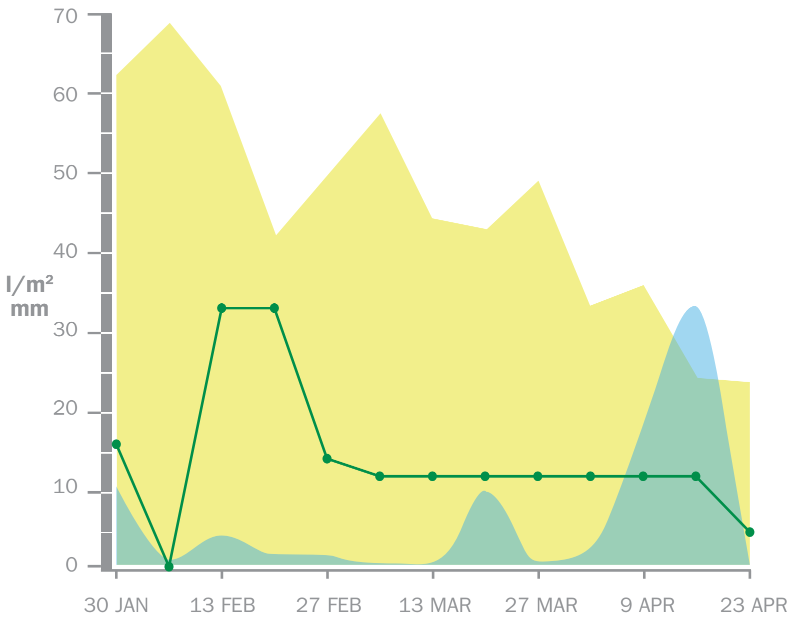
The graph below (figure 2) details a snapshot of weekly waterings through a period of very high evaporation and eventual rainfall. This is a snapshot of probe readings from Section A (fescue) and can be read in conjunction with the rainfall, evaporation and irrigation shown in figure 3 (source: www.actew.com/grassroots). During the period of evaporation the subsoil moisture fell to a point where there was no water at depth even with watering of 4 cycles per day once a week. Interestingly, this graph highlights that as the amount of evaporation reduced, watering times also reduced and were maintained at the reduced levels until the rainfall event. The amount of evaporation continued to reduce and then, with the inclusion of some rainfall events, moisture finally increased. It was not until after these rainfall events that soil moisture was recorded down through the profile to 50 cm.

**Figure 2. Soil Moisture Probe readings – once a week watering Jan 09–April 09**



The graph below displays a snapshot of rainfall, evaporation and irrigation data. The high evaporation, rainfall and irrigation applications line up with the moisture shifts in the soil profile as shown in figure 2 on page 7.

**Figure 3. Rainfall, evaporation and irrigation data Jan09 – April09 (source;www.actew.com.au/grassroots)**




The timeframe captured in figure 2 was a prolonged dry period. Aesthetically the turf presented well during this period, however, waterings should have been spread out further to increase the application at each watering and include a regular deep watering. The risk with an adjustment such as this, especially during prolonged periods of high evaporation, is the potential deterioration of the playing surface. It would also probably increase the total application slightly over the relevant period while maintaining good moisture levels throughout the profile. Fortunately or unfortunately, it rained and the schedule was not adjusted.

# Warm Season Grasses

## Couch (Trans Continental) seeded

The couch area of the oval generally performed exceptionally well. The less water it received, the better it looked. However, to keep the turf at its best an annual application of weedicide was required to remove foreign grasses and broadleaf plants in the winter/spring period. The couch went into dormancy over the months of May and June and came out of dormancy over the months of September and October.

This variety demonstrated very good wear characteristics for a winter dormant grass, with results corresponding to the ACT Government's experience in some of the goal-mouth areas of playing fields where a similar couch product is used.

## Soft Leaf Buffalo (Sir Walter) turf

Similar to couch, the less water the soft leaf buffalo received the better it performed. Section H received only 17mm over the growing season of 2009/2010. Although a figure as low as this was not ideal, the turf survived. One noticeable effect of the section H watering regime during this period was the high incidence of foreign weed infestation when compared to section G which received regular low applications of water. The adjacent photo shows the ingress of foreign grass onto the area when compared to section G on the right hand side. It will be interesting to observe how this area responds to water during the next growing season.

Chasing the higher application rates in the fescue areas, the soft leaf buffalo product was extremely invasive into fescue areas. Movement of this grass into the adjacent fescue area was measured in areas at 9m as can be seen in the picture adjacent.

As this variety got older and increased its 'thatch density' it went through a transition to a far lighter straw colour over the winter months than when in its first year of growth.

# Cool Season Grasses

## Fescue (RTF) seeded

Unlike the older varieties of fescue these new varieties have a tremendous ability to regenerate. This was evident after the black beetle attack on the site in March 2008 as seen in the photos above.

This turf variety required higher amounts of water than the warm season varieties, however, they were still well below the average requirements for the older fescues found elsewhere in the Canberra region. Another great advantage of this variety of fescue was that when it was maintained at a cut height of around 50mm it presented a fantastic surface for most uses as can be seen in the adjacent photo.

## Fescue (three fescue blend) seeded

The three fescue blend performed similarly to the RTF variety although it seemed to go off or deteriorate a little quicker than the RTF and also developed clumps. This was due to the dominance of one of the varieties showing up at different times of the growing season.

**Water Usage**

Historical and current water consumption figures for each of the turf varieties and irrigated areas can be viewed on the Grass Roots website.

## Fescue (RTF + 10% hard fescue) seeded

This variety of fescue also performed similarly to the RTF and appeared to withstand heavy foot traffic better that the straight RTF product. As expected, water consumption was almost identical to the RTF.

## Water saved – The Facts.

The question of how much water can be saved is difficult to answer. Project consumption data is available, however, what it should be compared to is not straight forward. This is further complicated by a 30 per cent reduction of water use in the control sections during the project to comply with commercial water restriction parameters set by ACTEW for commercial areas. The best estimation can be made by comparing the Grass Roots crop factors with previous standard crop factors. Senior turf experts in the Canberra region traditionally use crop factors of between 0.75 and 0.65. When calculating a direct comparison against these, the Grass Roots site has done extremely well – but how much water has been saved? The easiest and fairest way to quantify this is to compare Grass Roots data with ACT Government data presented in their guidelines: *Water Resources (Amounts of water reasonable for uses guidelines) Determination 2007 (No1).*

***A crop factor relates to how much water the turf should need to use in comparison to water evaporation from an Evaporation Pan (Epan).*** ***See further commentary on pg 16.***

The guidelines stipulate that 'the annual irrigation requirement for parkland and residential gardens in Canberra in addition to rainfall is 0.5 Megalitres (MGL) /1000m$^2$ / year'. This equates to 5MGL per hectare per year. The document uses average evaporation and rainfall figures taken from Canberra Airport which are within 1 per cent of our data.

The results show consumption was greater than the ACT guideline for the first year. This was due to crop factors being set at what was considered the ACT industry standard at the time. Furthermore, the soil moisture probes were not in place and operators were reacting to the very dry conditions without accurate moisture data.

A lot was learned in the first year and enormous savings were gained right across the site as the project progressed. As a result, the school benefitted from significant monetary savings in the form of reduced water bills.

The final analysis on water savings are as follows:

- a saving of approximately 40 per cent was achieved when comparing to operating the system using a traditional crop factor
- when comparing actual water use against modelled ACT Government figures that use average climatic data figures to develop a consumption figure of 5 MGL per annum per Hectare (0.5MGL/1000m$^2$), a saving of 7 to 17 per cent was achieved
- a saving of 20 to 27 per cent was achieved when comparing actual water use against modelled ACT Government figures that use the actual climatic data figures to develop a consumption figure that varied each growing season

If the entire area was to be converted to a warm season grass further savings in the vicinity of 30 per cent could be made.

The data used for this analysis can be found in the Data and Other Information section at the end of this report.

### Wetting Agent Trial

The project team had intended to incorporate the application of a wetting agent to analyse its effect on water consumption. Unfortunately due to the inconsistent application of the agent, no substantiated conclusions can be made. There were slight differences in moisture to depth between the two probe sites but there was not enough available data to analyse its effectiveness.

## Project Handover

The grazed bodies and torn clothes of children playing on the Rosary Primary School oval have been replaced by laughter and grass stains as the children enjoy and manage their new oval. The children are extremely excited about their new 'green' oval which has taught them and the broader community so much about water usage and sustainable turf irrigation.

The school has received a computer from ACTEW that allows students to monitor ongoing precipitation and evaporation rates. They will also be able to continue to compare water usage rates from the subsurface irrigation system against the above ground sprinklers.

The project was handed over to the school prior to the commencement of the growing season in October 2010.

### FURTHER INFORMATION

**Grass Roots Website**

Visit the Grass Roots website at www.actew.com.au/grassroots for up-to-date information on the project and to view real time irrigation data.

**Contact**

Contact the Water Conservation Office for more information.

waterconservation@actew.com.au
(02) 6248 3131

**Thank you**

ACTEW thanks stakeholders, Rosary Primary School and sponsors for their valuable contributions and ongoing support.

# Data and Other Information

## WATER CONSUMPTION

The tables below show the water consumption per annum for each of the four full years of the project.

| | AREA | Litres | MGL/ Ha | 06–07 TOTALS | Average CF | Average Airport BOM | Yrs | Difference from average year | % Difference |
|---|---|---|---|---|---|---|---|---|---|
| **RAINFALL** | | | | **396** | | **618.9** | **69** | **–222.9** | **–36.02** |
| **EVAPORATION** | | | | **1922** | | **1708** | **41** | **214** | **12.53** |
| **DEFECIT** | | | | **1526** | | **1089.1** | | **436.9** | **40.12** |
| A | 1900 | 1,974,813 | 10.39 | 831.5 | 0.60 | | | | |
| Ctrl A | 1900 | 2,574,975 | 13.55 | 1084.2 | 0.73 | | | | |
| B | 570 | 779,333 | 13.67 | 1093.8 | 0.73 | | | | |
| C | 610 | 487,085 | 7.99 | 638.8 | 0.50 | | | | |
| D | 805 | 562,091 | 6.98 | 558.6 | 0.46 | | | | |
| E | 627 | 548,312 | 8.75 | 699.6 | 0.53 | | | | |
| F | 526 | 439,618 | 8.36 | 668.6 | 0.51 | | | | |
| G | 410 | 183,116 | 4.47 | 357.3 | 0.35 | | | | |
| H | 338 | 196,209 | 5.81 | 464.4 | 0.41 | | | | |
| **Average** | | | **8.88** | | **0.53** | | | | |
| **TOTALS** | **7686** | **7,745,551** | | | | | | | |

| | AREA | Litres | MGL/ Ha | 07–08 TOTALS | Average CF | Average Airport BOM | Yrs | Difference from average year | % Difference |
|---|---|---|---|---|---|---|---|---|---|
| **RAINFALL** | | | | 514 | | 618.9 | 69 | –104.9 | –16.95 |
| **EVAPORATION** | | | | 1706.4 | | 1708 | 41 | –1.6 | –0.09 |
| **DEFECIT** | | | | 1192.4 | | 1089.1 | | 103.3 | 9.48 |
| A | 1900 | 731,738 | 3.85 | 308.1 | 0.42 | | | | |
| Ctrl A | 1900 | 919,838 | 4.84 | 387.3 | 0.47 | | | | |
| B | 570 | 487,065 | 8.55 | 683.6 | 0.64 | | | | |
| C | 610 | 223,641 | 3.67 | 293.3 | 0.41 | | | | |
| D | 805 | 272,392 | 3.38 | 270.7 | 0.40 | | | | |
| E | 627 | 182,692 | 2.91 | 233.1 | 0.38 | | | | |
| F | 526 | 300,149 | 5.71 | 456.5 | 0.51 | | | | |
| G | 410 | 79,950 | 1.95 | 156 | 0.33 | | | | |
| H | 338 | 137,608 | 4.07 | 325.7 | 0.43 | | | | |
| Average for all sies | | | 4.33 | | 0.44 | | | | |
| **TOTALS** | **7686** | **3,335,072** | | | | | | | |

| | AREA | Litres | MGL/ Ha | 08–09 TOTALS | Average CF | Average Airport BOM | Yrs | Difference from average year | % Difference |
|---|---|---|---|---|---|---|---|---|---|
| **RAINFALL** | | | | 498.6 | | 618.9 | 69 | –120.3 | –16.95 |
| **EVAPORATION** | | | | 1790.2 | | 1708 | 41 | 82.2 | 4.81 |
| **DEFECIT** | | | | 1291.6 | | 1089.1 | | 202.5 | 18.59 |
| A | 1900 | 850,013 | 4.47 | 357.9 | 0.42 | | | | |
| Ctrl A | 1900 | 880,413 | 4.63 | 370.7 | 0.43 | | | | |
| B | 570 | 489,915 | 8.60 | 687.6 | 0.61 | | | | |
| C | 610 | 249,490 | 4.09 | 327.2 | 0.41 | | | | |
| D | 805 | 290,102 | 3.60 | 288.3 | 0.38 | | | | |
| E | 627 | 200,483 | 3.20 | 255.8 | 0.37 | | | | |
| F | 526 | 351,434 | 6.68 | 534.5 | 0.52 | | | | |
| G | 410 | 149,804 | 3.65 | 292.3 | 0.39 | | | | |
| H | 338 | 103,597 | 3.07 | 245.2 | 0.36 | | | | |
| Average for all sies | | | 4.67 | 373.3 | 0.43 | | | | |
| **TOTALS** | **7686** | **3,565,250** | | | | | | | |

| | AREA | Litres | MGL/ Ha | 09–10 TOTALS | Average CF | Average Airport BOM | Yrs | Difference from average year | % Difference |
|---|---|---|---|---|---|---|---|---|---|
| **RAINFALL** | | | | 498.6 | | 618.9 | 69 | –14.3 | –2.31 |
| **EVAPORATION** | | | | 1790.2 | | 1708 | 41 | 132.5 | 7.76 |
| **DEFECIT** | | | | 1235.9 | | 1089.1 | | 146.8 | 13.48 |
| A | 1900 | 909,388 | 4.79 | 382.9 | 0.47 | | | | |
| Ctrl A | 1900 | 1,141,425 | 6.01 | 480.6 | 0.52 | | | | |
| B | 570 | 183,184 | 3.21 | 257.1 | 0.40 | | | | |
| C | 610 | 283,345 | 4.65 | 371.6 | 0.46 | | | | |
| D | 805 | 121,052 | 1.50 | 120.3 | 0.33 | | | | |
| E | 627 | 352,923 | 5.63 | 450.3 | 0.51 | | | | |
| F | 526 | 129,593 | 2.46 | 197.1 | 0.37 | | | | |
| G | 410 | 57,554 | 1.40 | 112.3 | 0.32 | | | | |
| H | 338 | 7,225 | 0.21 | 17.1 | 0.27 | | | | |
| Average for all sies | | | 3.32 | 265.5 | 0.41 | | | | |
| **TOTALS** | 7686 | 3,185,688 | | | | | | | |

Of particular note is the nett difference between the evaporation and rainfall figures. While these figures are taken as totals over the entire year, some results were better than others when collating the data for the growing seasons. The deficit difference percentage in RED shows that the difference each year was greater than the average. For example, in 2006–2007 the deficit was 40 per cent greater than the 69/41 year average. This meant that irrigated areas need approximately 40 per cent more water over the year than would be required in an average year.

If the deficit data is set aside the results would be as follows:

| Site Area Data | 06–07 | 07–08 | 08–09 | 09–10 |
|---|---|---|---|---|
| Consumption (KL) | 7745 | 3335 | 3565 | 3185 |
| Average Year* guideline | 3843 | 3843 | 3843 | 3843 |
| Result (KL) | 3902 | –508 | –278 | –658 |
| Result % | 101.54 | –13.22 | –7.23 | –17.12 |

** 5ML /Ha no adjustment for actual weather conditions*

The figures above compare actual consumption figures (taken from the site over the four years) to average climatic data. When compared to actual climatic data for those years the following figures give a better representation as to the savings that were made.

| Site Area Data | 06–07 | 07–08 | 08–09 | 09–10 |
|---|---|---|---|---|
| Consumption (KL) | 7745 | 3335 | 3565 | 3185 |
| Average Year* guideline | 5426.3 | 4207.3 | 4557.4 | 4361 |
| Result (KL) | 2318.7 | –2091 | –1861 | –2241 |
| Result % | 42.73 | –20.73 | –21.78 | –26.97 |

*** 5 ML /Ha adjusted to meet actual weather data.*

The final analysis on water savings are as follows:

- a saving of approximately 40 per cent was achieved when comparing to operating the system utilising traditional crop factor
- when comparing actual water use against modelled ACT Government figures that use average climatic data figures to develop a consumption figure of 5MGL per annum per Hectare (0.5MGL/1000m$^2$), a saving of 7 to 17 per cent was achieved
- a saving of 20 to 27 per cent was achieved when comparing actual water use against modelled ACT Government figures that use the actual climatic data figures to develop a consumption figure that varied each growing season

If the entire area was to be converted to a warm season grass further savings of around 30 per cent could be made.

## CROP FACTORS

A crop factor is utilised in a variety of formulas. There are continual debates as to exactly how this should be presented. The following is the example of how these crop factors should be used.

*Nett Irrigation Requirement (mm) = ((Epan – 15%1.) x crop factor) – effective rainfall 2.*

1. **Pan factor** – pan evaporation may be affected by a number of factors, including the size and type of pan and any upward buffer zone. These effects need to be corrected for. For the Canberra Airport the pan factor has been calculated from field trials undertaken by the NSW Department of Primary Industries at 0.85. This pan factor should be used for all ACT calculations (reference: *Water Resources (Amounts of water reasonable for uses guidelines) Determination 2007 (No1))*.
2. **Effective rainfall** – the effective rainfall is the total rainfall multiplied by a factor of 0.7. Research into rainfall available for crop uptake recommends discounting the first 5mm in winter and the first 10mm in summer. As this is difficult to incorporate into a formula, the factor of 0.7 has been identified as an acceptable method for discounting this actual rainfall (reference: *Water Resources (Amounts of water reasonable for uses guidelines) Determination 2007 (No1))*.

This formula falls in line with ACT government guidelines. Further information on the make-up of this formula can be found in the guidelines document. If using other reference Epan (evaporation pan) figures, the 15 per cent may need to be removed i.e. average Epan figures from Canberra City are 20 per cent less than from Canberra Airport, obviously these two sites have very different Epan environments.

While there is much commentary about crop factors and how they are calculated, the data represents an annual average crop factor that gives us a guide only as to what the crop factor should be. The crop factor in agricultural crops varies throughout the year depending on growth stage of the plant. In turf the crop factor also varies depending on the specific period within the growing season. The following crop factors have been developed from the data collated over the last four years as a year average. These crop factors would be suitable for community parks and local sports grounds.

| | |
|---|---|
| ***Warm Season Grasses*** | |
| *Couch – Trans Continental* | *0.27–0.33* |
| *Soft Leaf Buffalo – Sir Walter* | *0.29–0.35* |
| ***Cool Season Grasses*** | |
| *Fescue – RTF* | *0.38–0.46* |
| *Fescue – three blend mix* | *0.46–0.56* |

These crop factors would also be suitable for most yards and park sites incorporating these turf varieties and similar irrigation and turf/soil management practices.

Factors for differing grades and types of turf could be applied to these figures. Other capital cities have developed categories for their turf surfaces that vary from premium and elite turf categories down to recreational turf. In the Canberra region the figures above should represent a minimum requirement for parks and non-sports turf areas.

Given the quality of turf maintained at Grass Roots, sports turf crop factors should fall into the following categories.

### High Quality Ovals and Sports Grounds

| | |
|---|---|
| ***Warm Season Grasses*** | |
| *Couch – Trans Continental* | *0.34–0.42* |
| *Soft Leaf Buffalo – Sir Walter* | *0.36–0.44* |
| ***Cool Season Grasses*** | |
| *Fescue – RTF* | *0.47–0.57* |
| *Fescue – three blend mix* | *0.57–0.69* |
| ***Premium Sports Turf*** | |
| *Warm Season Grasses* | |
| *Couch – Trans Continental* | *0.41–0.5* |
| *Soft Leaf Buffalo – Sir Walter* | *0.43–0.53* |
| ***Cool Season Grasses*** | |
| *Fescue – RTF* | *0.58–0.7* |
| *Fescue – three blend mix* | *0.68–0.84* |

**Example 1**

If a high quality oval planted with seeded couch (crop factor 0.38) had just been through a week of no rain with an average of 8mm per day evaporation (Epan) and it was forecast for similar conditions over the following week the following weekly requirement would be calculated.

*Nett Irrigation Requirement (mm) = ((Epan – 15%1.) x crop factor) – effective rainfall 2.*

*Nett Irrigation Requirement (mm) = ((56 – 15%1.) x 0.38) – 0*

*= 18 mm*

**Example 2**

If a community park planted with RTF (crop factor 0.42) had just been through a week of no rain with an average of 8mm per day evaporation (Epan) and it was forecast for similar conditions over the following week the following weekly requirement would be calculated.

*Nett Irrigation Requirement (mm) = ((Epan – 15%1.) x crop factor) – effective rainfall 2.*

*Nett Irrigation Requirement (mm) = ((56 – 15%1.) x 0.42) – 0*

*= 20 mm*

Please note these crop factors are for growing only and do not include maintenance activities such as watering in of fertilisers, insecticides and soil remediation products, or syringe watering for frost and cooling events. These figures are nett requirements and do not allow for application efficiencies of the irrigation system. A system that is 80 per cent efficient would have to increase these nett figures by approximately twenty per cent.

These figures should be able to provide sound turf management and soil maintenance programs for most turf environments throughout the region.

## Project Evolution

### 2004

Project coordinator Austin Goodfellow begins talks with ACTEW in response to a period of drought and water restrictions

### 2005

Work commences on the project despite the challenge of extreme temperatures and prevailing winds increasing evaporation at the site

### 2006

'Catch can' test used to measure sprinkler efficiency

### 2007

First year outcomes reveal 2.5 million litres of water saved compared to normal irrigation practice

Three capacitance type soil moisture probes were installed into the sprinkler areas of the turf to help monitor ground moisture levels

Control sections in both the drip and sprinklers were reduced to comply with new commercial water restriction parameters set by ACTEW

Rosary Primary School receives a Commonwealth Community Water Grant of $40,977 for the installation of water tanks to be used for irrigation

### 2008

Black beetles attack the site

Problem with hydraulic valve causes overwatering

Canberra receives below average rainfall for the fourth year in a row

Grass Roots gains a mention as an important turf trial at the 2008 Turf Producers Association Conference

The project manager presented at the Irrigation Australia conference, discussing the comparison between sprinkler irrigation systems versus drip irrigation systems

A total of 242 people attend 14 workshops on water efficient practices and irrigating methods

ACTEW and Rosary Primary School celebrated the October 2008 National Water Week with a free family fun day on the Grass Roots oval

### 2010

Project to be handed over to Rosary Primary School prior to the start of the growing season

# Notes

## Notes