

A major course redevelopment in recent years also gave Adelaide's Glenelg Golf Club a perfect opportunity to investigate options to secure its future water source

As well as undergoing a substantial course redevelopment in recent years, Glenelg Golf Club in Adelaide has also embarked on a groundbreaking \$1.5million aquifer storage and recovery scheme.

Daryl Sellar outlines this innovative project which will effectively ensure the club's future water supply and demonstrates how the turf industry is again providing proactive and sustainable solutions to combating Australia's water shortage crisis.

## ASR scheme gives Glenelg the green light

Formed in 1927, Glenelg Golf Club is located on the original Fulham Sand Dune complex that once formed Adelaide's coastline, but now lies one kilometre from Gulf St Vincent. A Group 1 private club, Glenelg has some 1500 members and hosts its share of state and national events, as well as corporate and charity days throughout the year.

The course is situated on 49ha, and despite its sand dune features has many low lying areas that were once tidal and estuarine marshes, resulting in variable soil types and a very shallow saline water table within a metre of the surface in many areas.

Since its inception the course has been irrigated with bore water from two aquifers (T1 and T2) that lie between 100 and 200 metres below ground. Bore locations have been many and varied throughout the club's

history, with reports of bores "going salty" or losing productivity, and new locations being drilled.

Up until 1973, these bores were sufficient for the times to supply the manual irrigation system for the course. However, at that time the club was offered unlimited Class B effluent water from the nearby Glenelg Treatment Works, and so irrigation potential warranted the club investing in an automatic irrigation system. From this point until 2005, the course has been irrigated with various combinations of bore and effluent water.

### ADELAIDE'S WATER MANAGEMENT

Being located in the western suburbs of Adelaide and in close proximity to the Patawolong (one of the city's largest stormwater outlets), Glenelg Golf Club is acutely aware of the increased

pressure being placed on Adelaide's water management system. Urban development in recent decades has seen an increase in hardscape and resulted in increased pressure on the city's stormwater system, which has seen significant flooding of surrounding neighbourhoods and the golf course itself.

The western suburbs of Adelaide have always had a rich history of horticultural activity, and as a result have utilised groundwater for irrigation for many years. This usage increased dramatically as industry moved into the area, as well as increased residential use, and we have been aware of the impacts (increased salinity, slower recharge, etc) of this increase in extraction for a number of years.

### COURSE REDEVELOPMENT

From the late 1990's, the club embarked on a staged course redevelopment, initially with a view to improving turf quality. As the redevelopment moved into its second stage in the new century, it was evident that the quality turf the club was seeking was not going to be sustainable without addressing the water management issues the club faced.

The Glenelg ASR scheme demonstrates what can be achieved when golf clubs are proactive with water management strategies



for the potential harvesting and treating of stormwater that could be reused for irrigation.

### OPTIONS AND FEASIBILITY

In considering the club's options for water supplies for the future, we were mindful of many factors, including quality and quantity, cost, restrictions on use (quantity and hours), irrigation system capacity, community impacts, storage requirements, safety, sustainability of supply and environmental impacts.

All options were considered, including discussions with the relevant authorities regarding the likelihood of the Glenelg Treatment Works being able to supply Class A effluent in the future. We felt this option would have had enormous environmental and community benefit in reducing effluent outfall into Gulf St Vincent, as well as eliminating restrictions on hours of usage (in place for Class B) for health reasons.

Being mindful of the stormwater management issues of the local community, we also consulted the Patawolong Catchment Water Management Board (PCWMB - now Adelaide and Mt Lofty Ranges Natural Resources Management Board) about the concept of harvesting local stormwater and treating it through existing and proposed wetlands to a quality that would allow it to be pumped into the underlying aquifer for extraction when required (known as aquifer storage and recovery or ASR). Despite quality benefits, the use of mains (potable) water was never entertained.

After carefully considering the economics of either class of effluent and the stormwater harvesting concept, the club decided to pursue the latter option, with modelling suggesting we could effectively harvest, treat and store

The redevelopment provided the opportunity to improve drainage throughout the course through construction features and engineering, effectively raising the playing surfaces above the water table and reducing their susceptibility to inundation during heavy storm events. However, irrigation water supply for the club required some more strategic thinking.

In 2000, a Quality Turf Plan (QTP) was developed for the club, and considered the issues limiting our ability to produce and sustain the quality of turf we were seeking.

Irrigation management then and into the future was fundamental to the QTP. It included the facts about the existing water

supplies, with both the bore water and effluent possessing elevated pH, high levels of sodium, bicarbonates and chloride, total soluble salts of between 1100 and 1300mg/l and low calcium.

In addition to the effects the water supplies were having on plant and soil, the Class B effluent supply had nutrient levels that were not desirable for producing sustainable quality turf, and restrictions on hours of use due to public health considerations.

The QTP highlighted in detail the management strategies necessary in utilising these water sources. But it also recommended the club investigate better quality water sources, and consider the use of some existing and proposed wetlands throughout the course





Construction of the wetland system on the par 3 16th at Glenelg which formed part of the reconstruction project

our annual water requirements with some surplus, so that in effect we will be contributing positively to the Adelaide Plains aquifer while utilising it.

One significant aspect of the feasibility work carried out was the modelling of the fate of the water once injected into the aquifer. This revealed that due to the very slow lateral movement of water within the aquifer (0.5-1m per year), even after 50 years of injecting more water than we extract, the 'bubble' of fresh water around the injection point is expected to remain within the Glenelg Golf Club's immediate boundary.

At this point, the club entered into a partnership with the PCWMB to develop a design brief that could go out to tender for design and construction.

At the same time, a submission was made by the PCWMB to the Federal Government for funding through the Australian Government Water Fund towards three projects that were designed to assist the western Adelaide Plains stormwater management problems. All three projects involved similar projects at golf clubs, the other two being The Grange and Royal Adelaide, and highlighted the potential for golf clubs to play significant positive roles within our local communities.

This submission was eventually successful, and saw the anticipated \$1.5 million cost of the project broken down as follows;

- 50 per cent Federal funding;
- 25 per cent PCWMB (now Adelaide and Mt Lofty Ranges Natural Resources Management Board); and
- 25 per cent Glenelg Golf Club.

## ASR SCHEME

Considerable time was spent investigating the most efficient means of harvesting stormwater for the club's needs and included;

- Gravity fed local catchment;
- Storm event pumping from local catchment;
- On demand pumping from adjacent Brownhill Creek; and
- On course site suitability for wetland development.

Topography, economics and water availability eventually resulted in the preferred method of harvesting being on-demand pumping from Brownhill Creek, which has a catchment area extending to the Mt Lofty Ranges, but also includes the local area catchment.

As a result, Brownhill Creek has annual flows in excess of 7.5 gigalitres, and retains permanent water that can be sourced as required, and allows pump sets to be considerably smaller than if we were required to capture the peak flows of major storm events. The scheme will have six major stages, which are as follows:

## 1. HARVESTING

This involves the pumping of water from Brownhill Creek as the water level within the wetland system demands with pumping rates projected at 30l/second.

The harvesting point for the scheme was critical to the success of the project as the relative height datum (RHD) of the proposed pump site is within one metre of the water level that can be influenced by salt water intrusion.

## 2. SEDIMENTATION

Water pumped approximately 500m from the creek will move into a sedimentation pond on the course. This 1500m<sup>2</sup> area of open water will allow sediment and gross pollutants to be retained, allowing cleaner water to pass into the secondary wetland. In effect, this will be a secondary sedimentation process, as the harvesting point is downstream of a similar structure within Brownhill Creek.

## 3. SECONDARY TREATMENT

This wetland will comprise approximately 8000m<sup>2</sup> of heavily vegetated water. The depth of this wetland will vary from 300mm to 1.5m to create variable flow rates which along with the vegetation selected will assist with further sediment removal and associated nutrients and contaminants.

## 4. TERTIARY TREATMENT

This wetland is already in existence and forms a 5000m<sup>2</sup> water feature on the par 3 16th. In its current form, however, this lake is naturally filled with groundwater from the shallow aquifer system and has salinity levels of between 3000 and 5000mg/l. This saline groundwater will need to be isolated from the harvested stormwater when the scheme is operational.

By the time the final stage of course redevelopment work (which incorporated the 16th) was undertaken in 2004, the club already had conceptual modelling for a proposed ASR wetland system. This allowed course architect Neil Crafter and us to configure a wetland that would satisfy the requirements of the ASR scheme at a later date.

This wetland will provide more open water to satisfy the aesthetic requirements of the 16th hole, but will be interspersed with dense aquatic vegetation to further "polish" the water prior to injection into the aquifer.

Initial modelling suggested the existing wetland would be of sufficient size to meet the scheme's demands, however more recent, detailed modelling has revealed an additional 1000m<sup>2</sup> or so was required. This additional water body area is to be created between the 15th and 16th holes and will frame some significant samphire vegetation which is home to some of the last remaining plant species of their type on the Adelaide Plains.

## 5. INJECTION

Having moved through the wetland system over a period of 72 hours, the treated stormwater will then be pumped some 700m to the first of two injection and production bores, where it will move into the T1 aquifer at a depth of approximately 100m.

The second injection and production bore is a further 300m away, also in the T1 aquifer system, but at a depth of 200m. This variation in depth is caused by the aquifer flowing across a geological fault which runs through the course, and sees the aquifer connected but at different levels either side of the fault line.

## 6. EXTRACTION

In conjunction with an additional two production bores, the course will be supplied by four bores in total with anticipated combined production levels of 60l/second.

## PLANNING AHEAD

Due to the planning of the ASR scheme starting in 2003, the club has been able to include several key components of the scheme into remaining course redevelopment capital works. These works included;

- Construction of new bore water holding tanks (2 x 250,000l), eliminating use of original open top holding tank;
- Drilling of two new bores to provide the necessary injection and production capacities for the scheme;
- Installation of a new supply line from production bores, and proposed bore sites, to new holding tanks.

These projects have seen the club contribute about \$300,000 towards the project already. ▶



Water is pumped from Brownhills Creek into a sedimentation pond on course before moving through a series of wetland cells. After moving through this system over 72 hours the treated water is then pumped to the injection and production bores

The drilling of the new bores was elevated on the priority list in mid 2005 when negotiations with SA Water broke down over the supply of either Class A or Class B effluent, reducing water supply to just 50 per cent of requirements from the two existing bores.

As always, Murphy's Law came into play and despite the best of efforts from all parties to have the new bores commissioned by the start of summer, the irrigation system was not operating at full capacity until the first day of autumn 2006! (Christmas 2005 was hardly relaxing as we were reliant on just one bore for two weeks, with that bore failing within one week of the new bores being commissioned!).

The construction of the wetlands will present a logistical challenge, as the shallow aquifer is within one metre of the surface throughout this section of the course, and this saline groundwater must be prevented from contaminating the treated stormwater. This will see the lake 16th hole that was constructed as part of the 2004 course redevelopment works being drained prior to lining, and with work scheduled to have started in July 2007, fighting nature could be challenging.

Exploratory bore holes have been drilled in the area to determine the suitability of any underlying material for lining of these wetlands. Due to the site's history of tidal and estuarine inundation, a seam of clay of varying depth (1-3m) has been located, with early indications suggesting this material could be suitable. If approved, this material would be excavated and stockpiled which would represent a significant cost saving for the project.

As a result of the wetland construction, it is anticipated there will be in excess of 10,000m<sup>3</sup> of spoil to be utilised. Plans are being drawn up to use this material for screen and safety mounding at the opposite end of the course property along the 5th hole, helping to address some safety issues with this hole and being mindful of possible design modifications that will be required.

### SCHEDULING AND SENSORS

For the past seven years, our irrigation scheduling has been based around climatic data and evapotranspiration (ET<sub>o</sub>). When combined with the conversion of turf species, irrigation upgrades, and improved growing environments as a result of the course redevelopment, water savings of up to 40 per cent have been demonstrated.

In an effort to continually improve our water management at Glenelg we have begun utilising soil moisture sensing equipment, with some models offering temperature and salinity monitoring as well. Over the past six months, this technology has demonstrated the potential to;

- Improve our understanding of the fate of the water we apply;
- Illustrate the influence of renovation techniques and rainfall on salinity management;
- Provide documentation of water use efficiency both for internal and external (regulatory) use;
- Allow remote monitoring of irrigation system performance and soil moisture levels;

- Allow the efficient study of soil/water relationships;
- Accurately monitor effectiveness of "flushing" cycles;
- Provide supporting data for the irrigation management strategies already in place;
- Illustrate the influence of water quality on plant water requirements over time;
- Assist in monitoring of environmentally sensitive areas.

While there is still much to learn about the roles this technology can play, there is no doubt in my mind it has a place alongside the sophisticated control systems and pumps stations we now utilise, as well as the art of greenkeeping.

### CONCLUSION

In total, the ASR Scheme for Glenelg Golf Club is expected to cost approximately \$1.5 million, with a payback period of 30 years. The benefits of the project include:

- Utilisation and quality improvement of local and greater metropolitan stormwater;
- Provision of up to 400M per year, well in excess of the club's annual water requirements, supplying a net surplus of water in the aquifer as a result of injection and extraction process;
- Improved quality of irrigation water source, with anticipated salinity levels of approximately 600mg/l, with anticipated turf management cost advantages;
- Preservation of good quality water supply for the club for years to come;
- Improvement of water quality within the Adelaide Plains aquifer;
- Reduction in stormwater outfalls to Gulf St Vincent and subsequent protection of marine environment.

The Glenelg Golf Club scheme, and others like it, is a positive demonstration of what can be achieved when golf clubs are proactive with water management strategies. Importantly, these schemes should be viewed as case studies of how turfgrass can be part of the solution to society's water management problems, rather than the cause. [🌱](#)