HYDROBULL No 145
A TECHNICAL BULLETIN from HYDROGOLD
INT'L WATER MANAGEMENT CONSULTANTS
WWW.HYDROGOLD.ORG

HYDROBULL is a technical bulletin covering issues related to water.

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MINIMISING IRRIGATION WATER USE

1 INTRODUCTION

Minimising water use is not really our objective. We can minimise water use simply by not irrigating at all (as the Government mandates in our West Australian winters). The condition of the turf and plants would then be totally dependent on the weather. That is clearly not the expectation with modern-day golf courses and landscapes, especially during the hot/dry season.

The real objective is optimising the use of water. The optimised balance of a range of factors associated with irrigated water. That is the role of management. **Optimising irrigation water use makes sense; Financially, Environmentally, and Socially.**

So, why aren't we minimising water use? If there was a simple answer, it would be money. The more complex answer comes to people and their decisions. The objective of this article is to enable people to make better-informed decisions at all phases of the project.

2 WATER BALANCE IN PICTURES

2.1 Ideal

Wide expanses of lush, green turf and high lake water levels.

2.2 Compromised

Low water levels (including exposed embankments and dry lake wetlands) to have "*wall to wall*" green turf.

2.3 Water Conservation by Design

No watering of roughs conserves water at this seaside golf course.

3 THE BALANCING ACT

THE WATER BALANCE DILEMMA TABLE **Balancing Factors to consider:**			
Factor	**Option**	**Advantages (Gains)**	**Disadvantage (Losses)**
Design of Golf Course and Irrigation System	Good	Conservation of water. Golf course establishes good market position.	Higher costs.
	Bad	Lower up-front costs.	Water use is higher. Golf course loses market position.
Obey Government Regulations	Yes	Builds integrity with members, staff and community.	Less water to use. Less or droughty irrigated turf.
	No	More water to use. Better turf.	Potential loss of allocation. Poor public relations.
Irrigation System	Complex	Better turf. Lower electricity cost, and water use.	Higher up-front cost. Higher skilled staff.
	Simple	Poorer turf. Wet and dry areas. Higher running costs Lower skilled staff.	Non-uniform irrigation. Inflexible control of the irrigation.
Staff Training	High	Better turf.	Higher staff costs.
	Low	Lower staff costs	Poorer turf.
Water Use	High	Good turf. Large area of turf.	Higher costs. Lower lake levels.
	Low	Lower costs. Higher lake levels.	Poorer turf. Smaller area of turf.
Fertiliser Use	Yes	Better turf	Higher costs
	No	Lower costs	Poorer turf
Injection System	Yes	Better turf	Higher costs
	No	Lower costs	Poorer turf

And so on… In a general sense, we are balancing quality with costs. There is no absolute right or wrong. When Hydrogold designs an irrigation system, we focus on achieving the lowest Total Cost of Ownership for our Clients.

$$\text{Total Cost of Ownership (\$ per Year)} = \frac{\text{Capital Cost + Running Costs}}{\text{Life of System (in years)}}$$

Some Clients choose to focus on the Up-Front Capital Cost and do not consider the Running Costs or the Life of the System. Renovation projects normally choose higher quality because of years of experience running their own Golf Course Irrigation System.

4 MINIMISING WATER USE ON GOLF COURSES - PROJECT PHASES

For a successful Golf Course Irrigation System, we break the project into 5 phases:

Refer to HydroView No. 1 first published in 2008 which is still relevant today.
www.hydrogold.org/jgp/pdf/hv0001_20080801_quality_chain.pdf

Planning is the foundation of good water management. During this phase the project team is selected and they set the all-important budget.

Design implements the visions of the planners and is a great opportunity to minimise irrigation water use within the budget. It may also cause the re-evaluation of the budget.

Product selection from the bewildering array of options is important. In the last 20 years there has been great pressure for more efficient irrigation to conserve our limited and valuable water resources. Many new products have been brought to the market.

Installation is important to ensure a reliable system that will require minimal maintenance without any catastrophic failures.

Maintenance is the longest and most difficult phase. The staff need to be skilled to make the most of what has been provided for them. It requires support from the Owner to fund training of staff and a workable maintenance budget.

Photo: *A club which operates at the highest level: Tanah Merah Country Club (Garden Course) renovation in 2019 with Robert Trent Jones II in Singapore. Hydrogold has designed the Club's Golf Course Irrigation Systems, and done their Water Balance Studies since 1996.*

5 PLANNING PHASE - THE GOLF COURSE ARCHITECT & WATER PLANNER

This is the foundation phase; the selection of the project team and the setting of the budget. The Owner needs to select competent and experienced people to set the project in the right direction from the start.

5.1 The Golf Course Architect

Nobody has a bigger influence on the water used than the Golf Course Architect. They determine the area of turf and the look of the golf course.

Obviously, wide expanses of lush turf will use more water than narrow corridors of green fairway edged by droughty rough. There is no absolute right or wrong; just different styles, e.g., having a droughty golf course in the lush tropical environment of Singapore will look out of place, whereas, in Arizona it would fit in.

5.2 The Water Resources Planner and the Water Balance Study

Water is the lifeblood of the turf. It makes sense to appoint a water planner at the planning stage. Their role is to advise the Owner and the Golf Course Architect so that there is sufficient storage of water on site for dry periods.

The financial and environmental viability of many projects rests on a proper assessment of water balance issues. Hydrogold uses mathematical modelling software to simulate the Inflow, Outflow and Storage of water on site. That, combined with our wealth of experience (over 300+ golf courses in 30+ countries over 30+ years), makes Hydrogold the ideal choice to carry out this important work.

One simple method is to calculate the Number of Days of Irrigation Storage:

$$\text{Number of Days of Irrigation Storage} = \frac{\text{Storage Volume of Lakes}}{\text{Daily Irrigation Volume}}$$

Henry Louis Mencken (1880-1956) - "The Sage of Baltimore"

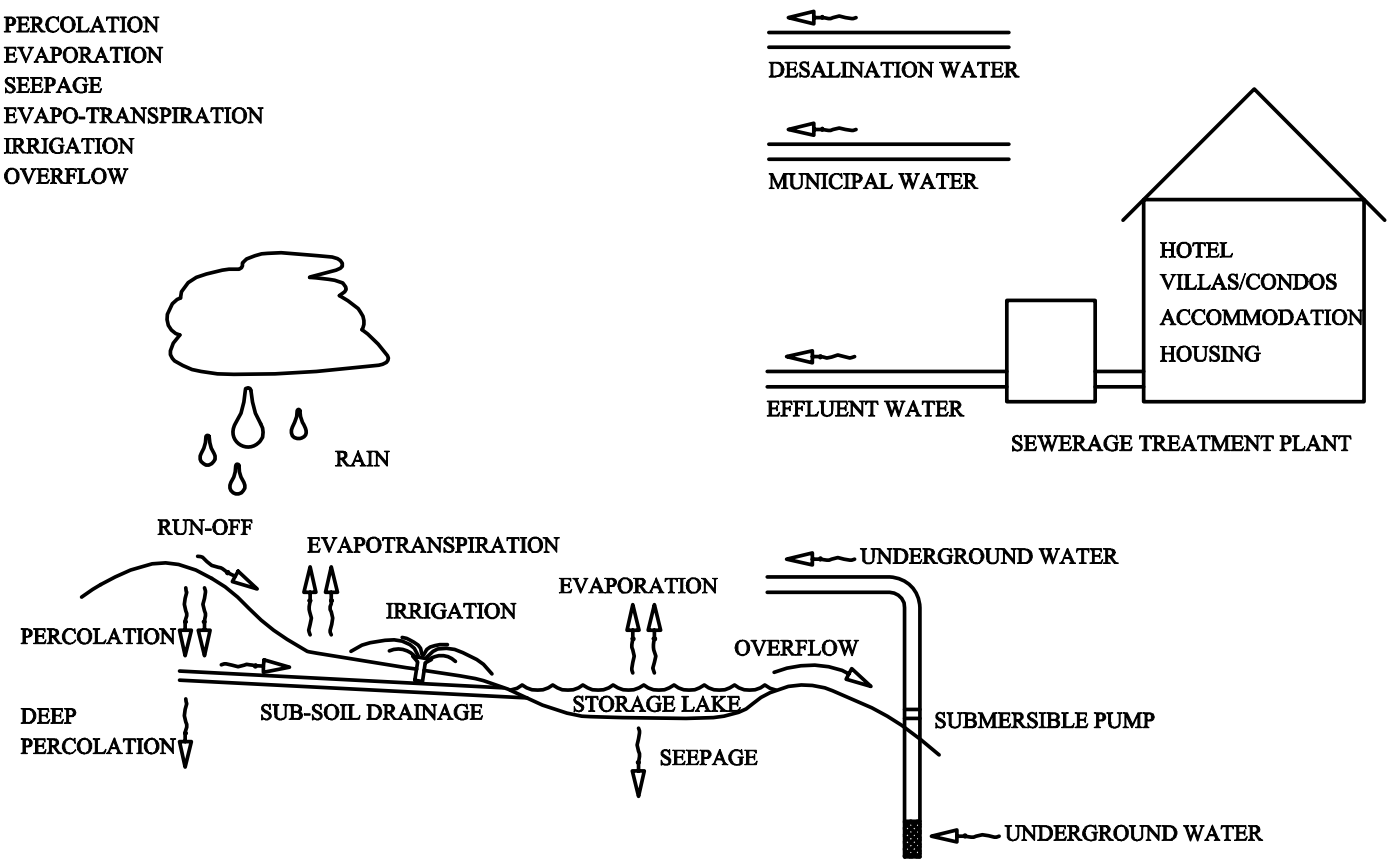
"For every complex problem, there is a solution that is simple, neat, and wrong."

A more thorough approach is needed to protect the investment in the golf course; a Water Balance Study.

More information at:
www.hydrogold.com/jgp/pdf/doc_wms_1.pdf

THE WATER BALANCE EQUATION

△STORAGE =	INFLOW -	OUTFLOW
LAKES	RAINFALL	PERCOLATION
TANKS	S.S. DRAINAGE	EVAPORATION
	TRANSFER PUMPS	SEEPAGE
	MAIN DRAINS	EVAPO-TRANSPIRATION
	CREEK/RIVERS	IRRIGATION
	UNDERGROUND	OVERFLOW
	EFFLUENT	
	DESALINATION	
	MUNICIPAL	



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NOT TO SCALE

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WATER BALANCE MODEL:
THE EQUATION

5.3 The Budget

The budget becomes the primary constraint on the project. It needs to be realistically assessed for a successful project. Unfortunately this opportunity is often lost. **Too often the development team's focus is on minimising the Up-Front Capital Cost results, in the longer term, with a higher Total Cost of Ownership.**

6 DESIGN PHASE

Here we are mainly concerned with 3 disciplines:

6.1 Golf Course Architect

The concept and layout (defining the different irrigated areas) is the prerogative of the Architect. However, they need to understand they are part of a team. They should liaise with other members of the team, but ultimately they are responsible to the party employing them; usually the Owner or Developer.

6.2 Agronomist

6.2.1 Turf Selection

Unfortunately many projects do not engage an agronomist. What we often end up with are turf suppliers providing biased advice to promote the sales of their specific turf varieties.

There are many turf varieties available. The agronomist should work in conjunction with the Golf Course Architect to select the appropriate turf species for the site and set it up for on-going maintenance. They should also determine the amount of water that needs to be applied to the turf.

So far there has not emerged a magical turf offering a lush green look with minimal water consumption. Turf suppliers often say their variety is, but I am sceptical. I have not seen any independent data supporting their assertions.

It appears to me that lushness and the ability of a turf to repair itself (from divots, buggy & foot traffic and cultural practices) is directly linked to the amount of water applied, regardless of the turf species.

6.2.2 Landscaping Plants

The traditional advice is to use native plant species to minimise irrigation. This is fine if you want to the same look at the natural local environment.

Creating a distinctive landscape often requires non-native plants which may have higher water requirements (more irrigation) or sometimes lower water requirements (better drainage).

The different water requirements of the different landscape plants requires matched zoning of the irrigation system ("*Hydro-Zoning*"). This may involve the use of part-circle sprinklers to avoid overspray to other (adjacent) zones.

6.2.3 Soil Structure - Water Management of the Root Zone

The soil structure is of paramount importance to the water management within the plants' root zone. The soil must:

- Retain Water -
  It acts as an underground water storage for the plant.
- Be Aerated -
  It needs to have pockets of air - not fully saturated.
- Drain -
  It must allow water to pass through.

These requirements conflict. So the selection of soil is a decision balancing technical requirements, and budget.

In some special circumstances, this soil environment is created (if you have that luxury) by a sand cap over a gravel layer with an underlying (sub-soil) drainage system. That is, a "*Perched Water Table*". This is expensive and normally reserved for golf greens (USGA Specifications) and high-value sports turf (e.g., professional football fields, bowling greens…)

6.3 Irrigation Designer/Consultant

The irrigation design is critical to allow the Golf Course Superintendent to fine-tune the irrigation system, and produce the best turf with minimal water.

What is provided for at the design stage will determine the flexibility of the Golf Course Superintendent to conserve water in day to day operations.

From a water conservation point of view, critical items are:

6.3.1 The Sprinkler and Nozzle Selection

Photo: Measuring the sprinkler nozzle pressure on site

This is the fundamental point of the irrigation system; the point of uniformly distributing the water onto the irrigated area.

The single-most important factor in sprinkler/nozzle selection is the wind. We need to know how the wind varies between night and day, and between the seasons.

Nozzle selection is about operating pressure, flow rate, and uniformity. When designing, we typically we look at Coefficient of Uniformity rather than Distribution Uniformity (which is normally used for field measurements). This gives us a measure of the efficiency of the sprinkler nozzle.

Higher nozzle pressures (resulting in higher velocity streams) and higher flows (resulting in larger drops) result in the droplets having more inertia (= ½*m*v^2) which "*fights*" the wind better.

Higher pressure means more stress on the pipe, and higher electricity costs. A balance is struck, typically 4.82 Bar (70 PSI) for a golf course sprinkler (spaced about 20 m or 69 feet apart).

6.3.2 Irrigation Control System

The Irrigation Control System is the fundamental tool the Golf Course Superintendent will use to control the irrigation. Ideally, the sprinklers will be Valve in Head and able to be controlled individually (Individual Valve in Head control).

With the old-style Satellite systems, this needed the significant expense of additional Satellites. Nowadays with the module/decoder system, this comes built-in with the system.

6.3.3 Soil Moisture Sensor System

Gone are the days where the weather station was the primary tool to determine the amount to irrigate.

Since 2008, Hydrogold have been strong promoters of Soil Moisture Sensor Systems. While American manufacturers have been slow to let go of their Weather Stations, they now know the future is Soil Moisture Sensor Systems.

Soil Moisture Sensor Systems measure the actual water in the root zone (the "*underground water tank*").

See more on Soil Moisture Sensor Systems at:
www.hydrogold.org/education.soil_moisture_concepts.html

7 PRODUCT SELECTION

Product selection is important for a good irrigation system. There is a bewildering array of products available.

7.1 Experience and New Products

And this is where experience counts. An experienced Irrigation Designer knows which products work and which product is applicable for each situation.

My gold standard for products is for them to have worked in the ground for 20+ years.

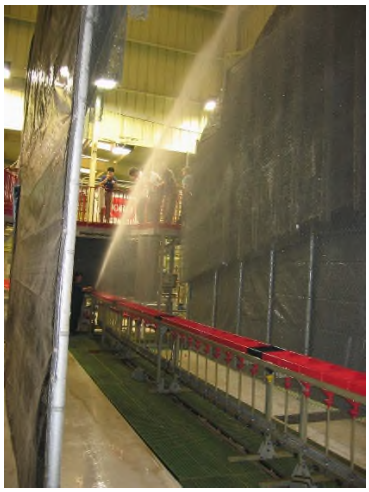
Why 20+ years? Because that is how long we expect the Golf Course Irrigation System to last. That makes it difficult for new products. But there are many products which meet that gold standard and we use them in our designs.

I am happy to experiment with new products provided my Client is aware of that, and the vendor is prepared to offer a substantial discount for the risk involved.

7.2 What has Happened to Irrigation Products in the Last 20+ Years?

There has been a lot of pressure to not "*waste water*" on golf courses. Golf is often viewed as an elitist sport and comes under public pressure. And the easiest way to be "*seen to be doing the right thing*", is to "*do the right thing*".

7.2.1 Sprinkler Nozzles

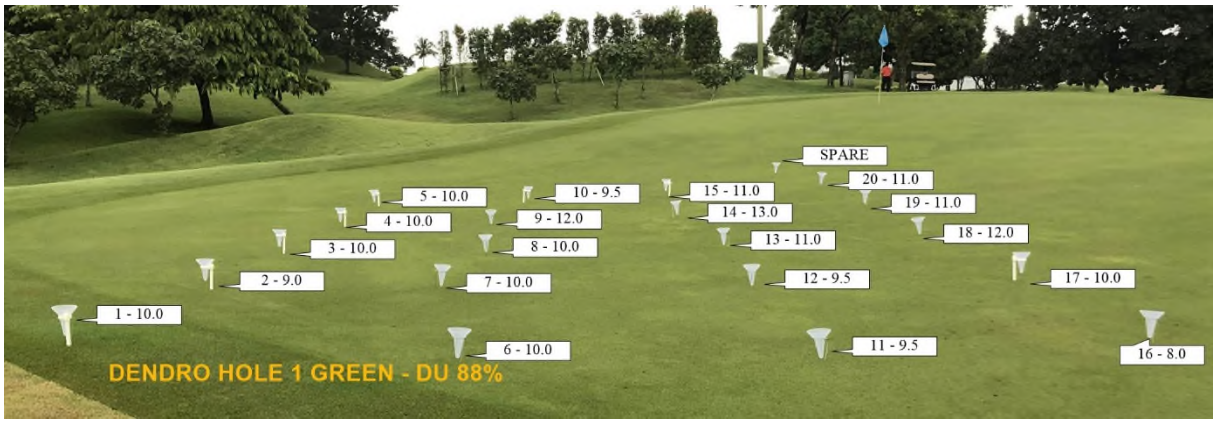


This low value nozzle (say, USD$ 5) is critical to the performance of the sprinkler and its uniformity. In the old days, they were typically a single brass nozzle with a hole drilled in them. Nowadays they are plastic and moulded with flares and non-round holes. A sprinkler may also have 2, 3 or more nozzles to provide better uniformity.

Against intuition, plastic nozzles keep their shape longer (less wear) than brass nozzles. We are measuring Distribution Uniformity on 10-year old sprinklers, similar to new nozzles.

The picture on the left shows the Toro factory testing of a sprinkler nozzle. Small catch cans collect the water and provide us with a distribution profile.

Below is a catch-cup test with 10-year old Rain Bird sprinklers.



7.2.2 Sprinklers

The old impact sprinkler is dead, replaced universally by gear-driven rotors which ensures a more reliable rotation speed over the life of the sprinkler.

There are now models that can be switched between full and part-circle operation which helps conserve water in dry periods.

Most Golf Course Irrigation Systems use Individual Valve in Head sprinklers and not the old Block system (using a Remote Control Valve to run 3 or more sprinklers the same amount of time).

Pop-up heights are higher to clear turf that can disrupt the nozzle stream causing too much water to fall near the sprinkler.

7.2.3 Irrigation Control Systems

These have changed remarkably. The software is much better (intuitive) and allows much more control.

The major change is the almost total switch from the old Satellite based system to the Modular/Decoder systems. This has drastically dropped the cost of providing Individual Valve in Head control of sprinklers.

We now have affordable Individual Valve in Head control of sprinklers. This is the ultimate in providing optimum irrigation for each individual sprinkler.

Soil Moisture Sensor Systems are becoming integrated with the software.

Soil Moisture Sensor Systems provide a better basis for determining the amount of water to apply in an irrigation cycle.

As I have said, more complex; more training of staff is required.

7.2.4 Earthing (Grounding) - Increased Reliability

Lightning is the enemy of the Irrigation Control System. Earthing is the first line of defence against lightning.

In my 30+ years, I have listened to Lightning Professors and lightning protection Sales People. I trust my eyes more than any of them. What I have seen is that lightning damage is minimal nowadays compared to the past. What has changed?

For one, our specified earthing points now incorporate not only an earth rod but also an earth plate with earth enhancing material. This makes them more effective and increases the reliability of the Irrigation Control System.

Critically, the manufacturers have incorporated better surge protection in their hardware..

8 INSTALLATION

Contractors make use of technology to create better As-Built Drawings of the Golf Course Irrigation System. This helps in the day to day management of the golf course.

However, the basic focus is still the same; the pipe laying and the wire joining. All installation need to be about **99.99% right** for the system to work reliably. E.g., a typical sprinkler system may have about 30,000 pipe joins. If 1% fail, that is 300 failed joins. Our expectation is 3 failed joins or a 0.01% failure rate; hence the **99.99% right.**

The main point is that installation is to be consistently good so the completed system is reliable. This means overseeing the Contractor.

While the Contractor may only have a 12-month Defects Liability Period, it is the Owner who has to look after it the next 20 years. They should be closely monitoring the Contractor during installation to ensure high standards.

9 MAINTENANCE PHASE

The maintenance phase of the project is the long-term operation and management of the system by the Owner. That is, the day to day operation.

9.1 Golf Course Superintendent

The key person is the Golf Course Superintendent. There is a great article written by Gary Grigg that lists 10 attributes of a great Golf Course Superintendent:

1. Sound Agronomic Skills
2. Good Communication Skills
3. Works Effectively with People
4. Motivates Their Employees
5. Delegates Effectively
6. Plans, Prepares and Presents Projects
7. Properly Prepares and Sells His Project
8. A Good Environmental Steward
9. A Skilled Professional
10. Bonus: Knows and Plays Golf Well

Read the full article at:
http://www.hydrogold.org/jgp/pdf/lib.gary_grigg.10_most_wanted.pdf

9.2 Training

It is people who run systems. The better skilled these people are, the better these systems will run.

There is a little anecdote that goes like this:

> CHIEF EXECUTIVE OFFICER:
> "What happens if we invest in developing our people and then they leave?"
>
> CHAIRMAN OF THE BOARD:
> "What happens if we don't, and they stay?"
>
> You not only need to pay for their training, but also pay more to retain them. The upside to it is that staff will work more effectively and have increased loyalty.

Are you too busy re-inventing the wheel with no time for Training?

Check out Hydrogold's Free Education Centre at: www.hydrogold.org

9.3 The Systems are More Complex Nowadays - We know, now get on with life

There is a complaint I hear too often, "*Can't we just use the same sprinkler with the same nozzle throughout the golf course?*" No. Larger greens require larger sprinklers. Tees normally require smaller-throw sprinklers to avoid throwing water onto areas that don't need irrigation. Yes, we have Individual Head Control so you can adjust the watering time of each individual sprinkler.

A fact of modern life is that it is much more complex than when I started working 45 years ago. There are increased expectations in terms of managing water more efficiently.

The reality is that life nowadays is more complex and we need to adapt or be left behind.

9.4 Components of an Irrigation System - These systems are complex

To run a Golf Course Irrigation System you need to have a high level of understanding of the:

9.4.1 Irrigation Control System

This helps you with your day-to-day operations. If you do not have your Computerised Central Controller operational and set up correctly, you are already behind.

Again, this takes skill, training, and persistence to run it properly. However, the rewards are there with increased work efficiency and better control. Both Rain Bird and Toro have good-value support plans that I recommend you subscribe to.

9.4.2 Irrigation Pump Station

When you have the technician to come in for their regular (at least every 6 months) check-up of the Irrigation Pump Station, spend time with them. Ask questions. You will learn.

9.4.3 Sprinklers

Sprinklers are relatively simple. As they are the delivery point, they are critical to the efficient distribution of the water. Understand what the different nozzles are, measure the nozzle pressures, do catch-cup tests, check the arcs of part-circle sprinklers, and watch them operate.

9.4.4 Other Components

There are many components to learn about in the irrigation system: Mainline Isolation Valves, Lateral Isolation Valves, Air Release Valves, Quick Coupling Valves, Control Valves, pipes, wires, joiners, thrust blocks, fittings, grounding points, surge protection devices, Soil Moisture Sensors, etc.

If you ever have a chance to be involved with the installation of a system, grab it.

9.5 Day to Day Conservation of Water

9.5.1 Know Your Weather and the Upcoming Weather

This is obvious, but it is not only today's weather that is important. The upcoming weather is also important. You may delay or reduce an irrigation cycle on the expectation of future rainfall.

An irrigation cycle delayed may be an irrigation cycle saved.

How do you know if you can delay the irrigation cycle? The old-style weather station is no real help. We need a Soil Moisture Sensor System.

9.5.2 Know your Soil Moisture

Before you top up the water level in the root zone, you really need to know how much water is in "*your underground water tank*". Know your Field Capacity; Wilting Point; Refill point…

9.5.3 Use Your Computerised Central Controller

This particularly applies to the older Satellite systems where the Satellites can operate in stand-alone mode without the Computerised Central Controller. I see this many times due to a lack of training or maintenance.

9.5.4 Watch Your Water Consumption and Lake Levels

Monitor the water consumption, both daily and monthly.

Monitor the storage lakes' levels. Know at what point you need to implement Water Conserving Strategies to get you through dry periods. What levels of Water Conserving Strategies do you have?

Keep within water allocations/budgets.

9.5.5 Avoid Hand-Watering

It is more efficient to have one knowledgeable person controlling a Computerised Central Controller than teams hand-watering.

The theory is that with a good irrigation system you do not need to hand-water. In practice, there is wind, soil variability and other occasions that hand-watering is needed.

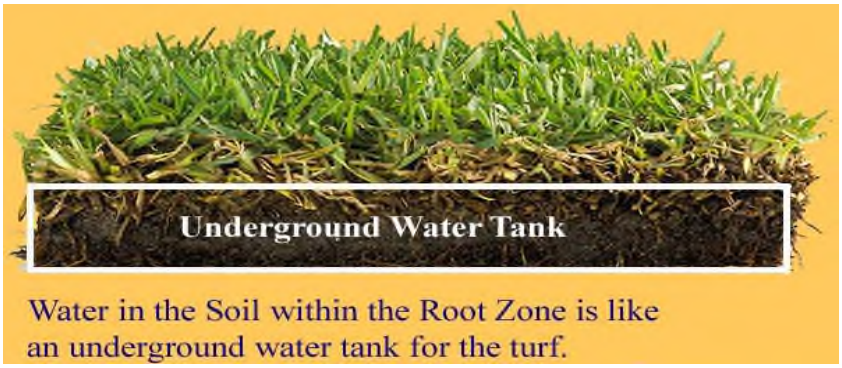
However, hand-watering is notoriously wasteful. Staff hand-watering are usually low-skilled and do not know how much water they are applying. They typically over-water.

9.5.6 Use Your Eyes

It is fine to have all the modern technology for feedback, but get in the field and observe. Train your staff to observe. Does the sprinkler pressure look low? Measure it. Investigate. Is there a dry or wet area? Investigate.

9.5.7 Soil Moisture Sensor Systems

The key to conserving water is a Soil Moisture Sensor System.



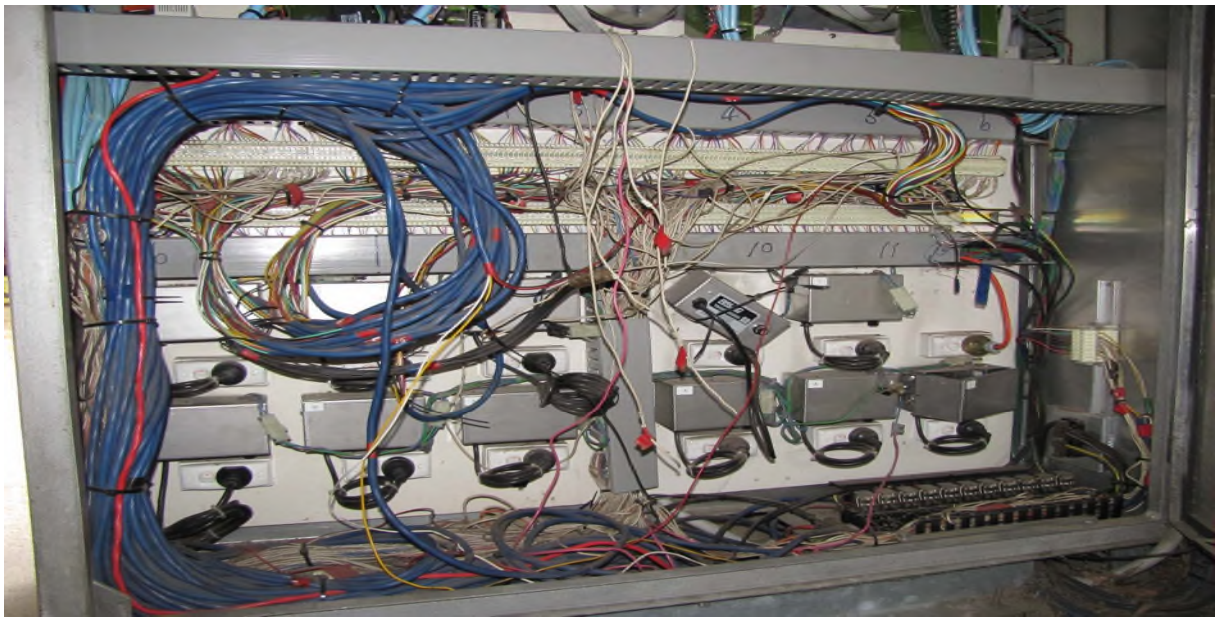
Knowing how much water you have in the ground allows you to make better-informed irrigation decisions.

Good knowledge on the storage and movement of underground water is essential for the Golf Course Superintendent. See more on Soil Moisture Sensor Systems at:
www.hydrogold.org/education.soil_moisture_concepts.html

9.5.8 Irrigation Control Systems

The Irrigation Control System is your key tool for managing where and how much water is applied.

- Make sure the database is set up correctly. Update it for changes in the field (including nozzle changes).
- Judiciously assign sprinklers to zones (same irrigation demands) otherwise known as "*Hydro-Zoning*".
- Program it to allow you the flexibility of control.
- Keep it maintained, fix faults, and check grounding.



Hopefully your Computerised Central Controller is not as messy at this…

9.5.9 Keep Records

Keeping records is a fundamental part of being a good Golf Course Superintendent. The best Golf Course Superintendents are great keepers of records. Not only does it help them make better decisions, it helps justify those decisions to upper management.

Keep records of:

- Water use
- Water Quality - test regularly based on seasons
- Weather
- Power Use
- Irrigation Incidents (breakages, failures, etc.)

9.5.10 General Irrigation Maintenance

It is important to maintain the irrigation system. The following is a generic schedule you may modify to suit your particular needs.

Description	Comment
GENERAL COMMENTS	
Objective	The objective of maintenance is to keep the system operating in optimum condition. This maintains the efficiency of the system and extends the life of the system. That is, it minimises the Total Cost of Ownership. Theoretically you could spend so much on maintenance that the cost would outweigh the benefit. In practice, I have yet to see this.
Budget	The first requirement for maintenance is a workable budget. The irrigation system is a large electro-mechanical system subject to wear and tear, exposed to the elements (e.g., lightning, freezing, earth movement...) and human interference (e.g., digging, improper operation...). Things will break! Automatic does not mean no maintenance.
Different Types of Systems	Following is a generic maintenance schedule. Customise it for your particular system and needs.
Indicative Frequency	This table categorises the tasks by their Indicative Frequency. The actual frequency will vary depending on the experience at that particular site and management objectives. E.g., the frequency of testing may be reduced if testing is always returning similar results. E.g., the frequency of filter cleaning may be increased if the water quality deteriorates.
Equipment	Basic maintenance equipment needs to be purchased. E.g., pressure gauges, sprinkler tools, multi-meters, Earth Resistance Meter, Total Dissolved Solids meters, pH meters, etc.

DAILY	
Maintain an Irrigation Incident Log	This objectively records all incidents. It provides good evidence to management and committees to justify budgets, repairs, replacement, renovations, etc.
Carry out repairs	"A stitch in time save nine." Repair failures as they happen. This will keep the system in optimum condition improving efficiency and lowering Total Cost of Ownership. Fix weeping heads and blocked sprinklers.
Review Dry and Wet Points	Observe what is happening on the ground.
Irrigation Control System	Take acount of current conditions and predicted weather.
WEEKLY	
Staff Meeting	Review faults and plan tasks.
Records	Update records, e.g., water use, tests, etc
MONTHLY	
Central Diagnotics	Dependent on the type of Irrigation Control System. Check communication between Central / Modules / Decoders / Satellites (as applicable). Check line voltages on communication and power (as applicable).
QUARTERLY (3-Monthly)	
Service the Irrigation Pump Station and Ancillary Equipment	Minimum of 6-monthly service interval. The Irrigation Pump Station is around 17% of the irrigation construction budget. It is a high cost item and needs to be looked after. It is the heart of the irrigation sytems. It is critical to the function of the system. Regular maintenance extends the life of the system, (thereby lowering the Total Cost of Ownership).
Filter Cleaning	Many filters automatically self-flush but even these should periodically be manually cleaned. Check the condition of the filter (e.g., damaged screens) and remove debris that the auto flushing does not. Depending on the water quality, the frequency may be extended to 6-monthly or reduced to monthly. If weekly cleaning of the filter is required, then it would be prudent to review the water quality (e.g., possibility of water treatment) or the filtration (e.g., type, capacity, arrangement).
Check operation of all Sprinklers, Remote Control Valves, Modules, Decoders or Satellites.	Good to do at the start of the irrigation season. Check arc of operation of part-circle sprinklers.
Adjust height of Sprinklers and Valve Boxes to grade	Raise lower sprinkler heads and valve boxes. Clear turf away from the valve box. A good off-season job.
Review Spare Parts	Ensure you have essential components on hand.

BI-ANNUALLY (6-Monthly)	
Staff Training	Update staff skills and reinforce previous training.
Open and Close all Mainline Isolation Valves	Ensures all Mainline Isolation Valves are fully open and not restricting flow. Note: some Mainline Isolation Valves need to be closed for normal operation and this should be noted on the valve.
Laboratory Testing of Water and Soils	Typically once at the Peak Irrigation Period and another 6 months later.
Check operation of Air Release Valves	Failure of Air Release Valve (or closing of their isolation valves) often leads to failures of pipes and fittings due to trapped air.
Check Earth Resistance Measurements	All earthing should be within the manufacturer's specifications. This should also be checked after a significant lightning event.
ANNUALLY	
Review Maintenance Procedures	Get input for the ground staff.
Service the Weather Station	At least every 2 years.
Winterising in Freezing Climate	Before the likelihood of freezing.
Upgrade Drawings and Computer Database	Upgrade As-Built Drawings for changes made. Update the database, maps and hydraulic tree (as applicable in the central controller)
Clean the Inside of Valve Boxes	Remove debris. Check for water in valve box.
5-YEARLY	
Independent Irrigation Audit	Employ an independent, qualified Irrigation Auditor to review the irrigation system and its operation. Typically this will maximise the efficiency and extend the life of the system (thereby lowering Total Cost of Ownership).
RENOVATION / REPLACEMENT	
Life of the System	Typically we expect 20+ years out of an irrigation system. However, this is highly variable depending on the design, installation, products and maintenance. Climate, water quality, soil chemistry and ground stability also play a role.
Planning	Planning for the renovation should be underway now, particularly the arrangements for financing it.

10 IN SUMMARY…

Water is a limited resource on most golf courses. It needs to be used efficiently.

Modern-day products provide opportunities to save irrigation water. Sprinklers are better designed; Irrigation Pump Station more efficient; Irrigation Control System are more sophisticated; and we now have reliable, cost-effective Soil Moisture Sensor Systems.

The Golf Course Irrigation System is a significant capital investment by the Owner. It needs to be maintained.

The Staff controlling the Golf Course Irrigation System need to be trained in many areas to operate the systems efficiently as well as manage the staff under them. A culture of good management needs to pervade the organisation.

And perhaps the greatest water saving challenge is changing the expectation of Golfers to always have large expanses of lush green turf. That is the toughest one.

Hainan Jianhu Blue Bay Golf Club - JMP Golf Design golf course in Hainan, China. Irrigation by Hydrogold. Photo by Tom Breazeale.

Changchun Clear Moon Lake Golf and Country Club - JMP Golf Design in China Irrigation by Hydrogold. Photo by Tom Breazeale.

Since 1992, **Hydrogold has designed over 35 Golf Course Irrigation Systems for JMP Golf Design,** a golf course architectural firm designing top-level golf courses world-wide.