APPENDIX A COMMON PROBLEMS WITH IRRIGATION

The following are (typical) common problems with the implementation of irrigation designs. With proper management they can be avoided.

A.1 Licenses and Approvals

A water management study should be carried out to assess the availability and sustainability of water resources. This is critical to the viability of a golf course project.

It (almost) goes without saying that licenses and approvals for the use and/or storage of water may be required. These should be in place early, normally before the project is approved for development.

While rainfall generally could be considered the property of the landowner, it is not always so. It may be part of the catchment area for a reservoir and subject to control.

Ground water use is often licensed, monitored and may be chargeable. Large withdrawals from the water table will cause lowering of the water table and the consequential subsidence of the land. Responsible use will keep withdrawals within the limits of sustainable yields

In drawing from rivers or creeks, the rights of other users have to be considered.

Using of municipal water (normally a high value treated water) is normally restricted by costs and community acceptance.

Recycled water use is normally subject to regulations, particularly where there is human contact with irrigated areas. Requirements around the club house are likely to be different than the golf course.

A.2 Irrigation Product

Key considerations regarding the product supply are:

A.2.1 Imported Product

a) Main Components

This is typically broken down into 3 parcels (that are likely to have different delivery schedules):

- Pump Station(s)

  The pump station is the heart of the irrigation system and critical to the project planning.

- Proprietary Irrigation Product

  This is the branded product that normally comes via an agent or distributor appointed by the manufacturer.

- Allied Product

  This is the remainder of the product (pipes, fittings, cables, etc). This is the bulk of the materials.

b) Delivery

- Lead Time

  This varies depending on the country, the amount of imported product, financial arrangements, seasons, shipping etc. Typically you should allow 3 months in Asia for delivery. Please check with your supplier(s) for information specific to your project.

- Staging

  Ideally delivery should occur in one large shipment. Depending on the project program, it may be feasible to split the delivery into 2 stages. The first delivery should include the pump station(s) and materials for the first 9+ holes of construction.

  Splitting of the delivery into smaller deliveries is normally not beneficial in terms of costs and delays.

c) Letter of Credit

The supply of materials is a relatively large component of the irrigation contract (typically 60 to 70%). This is a significant financial consideration.

International suppliers are unlikely to deliver product without a Letter of Credit or other solid guarantee of payment. The contractor or supplier normally handles this but often (normally) passes this condition on to the Employer. Sometimes this responsibility may fall directly on the Employer.

d) Import Duties & Taxes

- These are critical components and each bid should be carefully assessed to see what has or has not been included.
- Depending on the situation, the government may hold the Employer ultimately responsible for payment if the supplier/contractor does not may the correct payments.
- There may be special inspection procedures required at the port of loading before dispatch.
- There may be duty/tax benefits derived from importing complete systems.

A.2.2 Local Product

Ideally this should be purchased in bulk at the beginning of the project. Otherwise, there may be potential holdups to the project because of delays in product supply.

For example, the product may be 'temporarily out of stock' or production may be disrupted due to holidays, industrial disputes transport or raw material shortages. It would also be subject to price increases.

A.3 Construction Program

A.3.1 Soil Settlement

The irrigation system must be installed in a stable soil environment. Often there are substantial bulk earthworks during the construction of the golf course.

The soil should be properly compacted and sufficient time allowed for settlement. For soils that will be unstable even after construction (eg, old rubbish dumps, swamps), special consideration may be required during the irrigation design phase.

A.3.2 Irrigation Lake, Intake Lines and Wet Wells

For ease of construction, it is necessary to construct these before the irrigation lake is allowed to fill with water. The construction of the wet well and intake lines are normally the highest priority irrigation items to get underway for the project (followed by the Irrigation Pump Station).

There are construction techniques that allow for the installation with lakes full of water but these are expensive and the structural integrity is not as good.

A.3.3 Silt

During construction there are higher levels of silt in the lakes than normal. Silt build up in lakes can be minimised by good construction practices (eg, minimising exposed cut areas, turfing as soon as practical, avoiding the wet season).

Silt is not only detrimental to the lakes themselves, but also to the pump station, irrigation components (wear and tear) and the golf course (blocking of drainage pores within the soil and pipes). Silt separators are available but are expensive.

A.3.4 Water for Turf

The construction program for the lakes should be such that there is sufficient time for the lakes to collect water so that there is sufficient water available for when turf is planted. Otherwise, it will be necessary to have alternative (perhaps temporary) water sources and/or storage.

It is normal to start the construction near the Irrigation Pump Station and work away from there. That will allow water to be pumped for establishment of turf.

A.3.5 Contiguous Construction Sequence

It is best to have a construction program that allows the irrigation to be installed contiguously (side by side or end on end). That is, the installation should avoid having a disjointed (unconnected) installation. This will improve the integrity of the finished system by minimising the temporary works and number of cable joins.

A.3.6 Mainline Crossings

Mainlines often cross other non-irrigation items such as roads, bridges, waterways, drainage channels, etc.. Sometimes the construction of these items can impact the irrigation mainline (and therefore the distribution of water).

As a general rule, the crossings closer to the pump station are the most critical.

a) Road Crossings

These mainline crossings are best done before the roads are laid. If the irrigation contractor is not yet appointed at the time of the road building, sleeves (large enough for the bell-ended pipe) and a pair of conduits (one either side of the sleeve) for the electrical cables should be installed beforehand.

b) Bridge Crossings

The bridge needs to be constructed well in advance of the mainline construction. Bridges often are delayed in construction and consequently hold up critical mainline connections.

The bridge design needs to make allowances for the mainline pipe and cables that need to cross with it. This is both in terms of space and load bearing capacity. A 300 mm (12") steel pipe over a 30 m (100 foot) long bridge will have 2,000 kg (4,400 lb) of water when full (not including the weight of the pipe and fixtures.

Existing bridges will need to be checked by a Professional Engineer for both capacity of the bridge to take the load and the method of attachment.

c) Waterway Crossings

These are best constructed in the dry season.

When a mainline passes under a waterway, it is likely that temporary works will be involved. Perhaps a temporary dam may be needed or temporary diversion.

d) Drainage Channels

Almost always the irrigation mainline will pass under the drainage channels and therefore should be installed before the drainage channels.

A.3.7 Temporary Facilities

a) Generators

- The main concern is for the Irrigation Pump Station that normally has high power demand. The generators have high capital and operating costs.
- Generators (especially older ones) are notorious for 'dirty power'. This will be detrimental to the pump station and also the irrigation control system.
- Pump station manufacturers will have particular requirements for the power. It is necessary to ensure these requirements are met so that the warranty is not voided.
- See our separate comment on the specific power requirements for this project.

a) Temporary Pumping Plants

The need for temporary pumping plants can normally be avoided by planning the construction to start near the Irrigation Pump Station and work away from there.

A.4 Contract Administration

A.4.1 Delineation of Contracts

The responsibilities of individual contractors are important. This issue needs to be addressed by the project manager who is responsible for the overall coordination. Please see our earlier comments on delineation.

A.4.2 Damages

Irrigation product is (relatively) expensive. Damages are often caused by other (sometimes irresponsible) Contractors who do not respect other's works. Damages represent higher costs that ultimately are paid for by the Client (either directly or built into the contract). A repaired system is never quite as good.

Measures to minimise damages include:

a) A system where Contractors are held accountable for damages that they cause. They are more careful if they know they will be paying for damages.

b) Pressuring the system on a 24 hour basis as early as possible is preferable. That way, breaks become immediately obvious rather than being buried and detected later (where responsibility will be harder to assess).

c) Automation at an early point will reduce damage to the irrigation system. This is particularly true of valve in head (VIH) sprinklers where the selector mechanisms are not designed for continuous manual operation.

d) Distribution of irrigation as built drawings to other contractors as soon as they are available.

e) Not only is clear staking of equipment necessary, but the maintenance of the staking is important (refer to Irrigation Technical Specifications on staking).

f) Promotion of liaison between the Irrigation Contractor and others. The Irrigation Contractor should always have someone available for locating irrigation pipes and wires for other parties.

g) Landscaping Contractors regularly damage irrigation systems (particularly with tree planting) and often need special attention.

A.5 Maintenance - **"A stitch in time saves nine."**

This is the last link in the chain for a successful irrigation system. Minimal maintenance procedures for a typical golf course should include:

A.5.1 Checking of Earth Connections

Earth connections are the first line of defence against lightning. The earth resistance can change with corrosion (particularly at terminal points), disconnections and soil moisture content. They should be checked every 6 months but at least yearly.

Earth resistance needs to be measured with an earth resistance meter (not a multi-meter). Each manufacturer will have their specific requirements. Typically, this should be in the range of 5 to 10 ohms. The lower resistance is better.

The critical points are for checking are:

a) Pump Stations

b) Computerised Central Controller

c) Each Satellite

A.5.2 Pump Station

A maintenance schedule will be provided by the pump station supplier who may also offer cost-effective maintenance packages. Typical minimum regular maintenance will include:

a) Lubrication

b) Checking, tightening or replacing packing gland material

c) Checking / removing accumulated silt from wet well.

d) Checking / preventing corrosion.

e) Checking for obstruction of the intake line or screen (indicated by excessive drawdown in the wet well).

f) Water quality should be checked, particularly Total Dissolved Solids and pH.

A.5.3 Computerised Central Controller

a) At least each month a backup needs to be made of the database. Backups should not be stored at the same location as the Computerised Central Controller in case of fire or theft.

b) Normal computer maintenance (typically monthly) should be carried out. Eg. de-fragmenting of the hard disk, deleting unnecessary (temporary) files and keeping the equipment clean.

c) Check communication of central controller with satellites.

A.5.4 Satellites

a) Checking operation of sprinklers from satellite.

b) Checking of insects and rodents in satellites.

c) Check for corrosion at terminals and on the electrical boards.

d) Clearing of turf around electrical join boxes.

A.5.5 Weather Station

a) Annually - Replace the relative humidity chip.

b) 6 monthly - Disconnect and check battery voltage.

c) Monthly - Check rain bucket is clean and tips freely.

A.5.6 Sprinklers

a) Checking for dry / yellow turf that may indicate a sprinkler that is not operating (may be turned off).

b) Check for wet areas that may indicated a seeping valve.

c) Cleaning blocked sprinklers.

d) Clearing of turf around the sprinkler heads.

e) Raising sprinklers as turf height increases.

f) Are the pressure regulators in Valve in Head sprinkler set to the correct pressure?

A.5.7 Valves

a) Clearing of turf around valve boxes.

b) Ensure that when gate valves are opened, that they are fully opened and then closed by half a turn (does not apply to ball or butterfly valves). This will prevent damage to the valve when "frozen" valves are forcibly freed.

A.5.8 Remote Control Valves

a) Check the setting of the pressure regulator (if fitted).

b) Check that flow control stems set correctly.

c) Check if downstream rotors are seeping. This may indicated a faulty Remote Control Valve. Alternatively it may be a faulty Elevation Check Valve (Rain Bird SAM valve) in the sprinkler itself (not applicable to all models of sprinklers).

A.6 Miscellaneous Problems

A.6.1 Flooding

Some sites are prone to flooding. Flooding affects the irrigation system as follows:

a) Pump Stations

The pads of pump stations should be a minimum 0.5 m (20 inches) above the highest flood level (preferably 1.0 m or 40 inches). The electrical components are typically a further 0.5 m (20 inches) above the pump station pad. So typically there would be a minimum 1 m (40 inches) safety margin when flooding occurs.

b) Control System

The satellite bases should be at least 0.5 m (20 inches) above the flood level when installed.

Ideally, cables (and particularly joins) should not be laid in water logged areas.

A.6.2 Drainage Outlets Near Pump Intakes

Drainage outlets should be avoided near the intake for pumps since they often contain suspended sediment. Sometimes they create turbulence that disturbs existing sediment on the lake floor. Pumping sediments through the irrigation system must be minimised if not totally avoided.

A.6.3 Pump Station Power Supply

a) Provision of Power Supply

The power required is large and consequently the cables are large and costly. As noted in our remarks on contract delineation, the supply of power to the Pump Station(s) is normally not included in the Irrigation Contractor's scope of works. It is normally included in the works of the Contractor responsible for power distribution.

b) Voltage and Frequency

The voltage and frequency of the power supply and the voltage of the electric motors used to drive the pumps need to be matched.

3-phase voltages typically vary between 380 and 440 V. Frequencies are normally 50 or 60 Hz. The Contractor must confirm the voltage and frequency with the Employer before the pumps are ordered.

A.6.4 Pump Column Length & Wet Well Depth

a) The depth of the wet well and hence the length of the pump columns is primarily determined by:

- Depth of the Intake Line

  In our standard specification, the intake line depth is within 0.5 m (20 inches) of the lake bottom. This is to ensure that all the useable water can pumped out in an emergency situation. The last 0.5 m (20 inches) is typically too contaminated.

- Pump Station Pad Level

  This must be above the flood level.

b) We have calculated these levels and the pump column length in the Irrigation Technical Specifications based on drawings available to us at the time of the irrigation design.

c) These levels need to be confirmed by the Contractor with the Employer before the pumps are ordered.

A.6.5 Weather Station Location

The parameters for the location of the weather station are contained in the Irrigation Technical Specifications.

The precise location of the weather station should be determined early in the project so that the optimum location can be used. It also allows the best opportunity for laying the communication cable with the mainline. Leaving it too late in the project limits the choice of sites since roads, paths and other hardscapes may make access impractical.