Compromises in Irrigation Systems

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An irrigation system is generally used to allow applications of water through non rainfall periods to the plant / soil surface. The process of design, installation, operation and maintenance leads to compromises to the effectiveness of irrigation water applications.

Our collective review of many irrigation systems over the last ten years has raised questions to the standards, design process, interpretation of the installer, knowledge of the operator and the availability of replicated advice to what is required now and in 15 years time. This is not just looking at water efficiencies, but also knowledge, operational cost and the your operational requirements (people, soils, turf, customers, climatic conditions) or end game requirements.

One common basic concept of an "efficient" irrigation system is the term DISTRIBUTION UNIFORMITY LOWER QUATER. This can be shortened to DULQ or more commonly, but incorrectly DU. Another term from the United States is Distribution Uniformity Lower Half (DULH) which is supposed to represent the water distribution in a soil under turf in a 10cm profile (if you have 10 cm of roots or soil). From these criteria basic estimates of water consumption can be guessitmated for the end game.

These application rates, sprinkler uniformity assessments, runtime estimates are directly applicable to the ability of ground staff to complete fertiliser, pesticide application and washing in, in a timely manner and the on flow effects to plant / water / nutrient dynamics, water availability, with the final VISUAL or aesthetic sports field presentation (see Photos 1 – 3).

Even the process of assessing an irrigation system using catch cans, can cause large errors to the estimates of water required. This can range from the number of cans used (statistically a minimum of 21), to the areas selected. Reasons for this range from internal irrigation variations, sprinkler spacing issues and how the distribution of water precipitates over the area (e.g. densiograms). Early evidence suggest using 16 catch cans vs. 25 catch cans over an area can OVER ESTIMATE the distribution uniformity (further work to be done).

The sports turf industry is being guided into use of alternate water sources. Some of these sources will contain salts which can cause salinity and / or sodicity issues. Proper management of salinity requires calculations to estimate the flush (add extra water) below the root zone of these "salts", besides the agronomic soil modifications

	DULQ not ranked	DULQ Excellent	DULQ Very Good	DULQ Good	DULQ Fair	DULQ Poor
Fixed Sprays	0.85	0.75	0.65	0.55	0.50	0.40
Sprinklers (Gear and Impact)	0.9	0.80	0.70	0.65	0.60	0.50
	Scheduling Modifier	**Scheduling Modifier**	**Scheduling Modifier**	**Scheduling Modifier**	**Scheduling Modifier**	**Scheduling Modifier**
Fixed Sprays	1.10	1.18	1.27	1.37	1.43	1.56
Sprinklers (Gear and Impact)	1.06	1.14	1.22	1.27	1.32	1.43

Table 1 DULQ rating vs Estimated Scheduling Modifiers

The end game concept is simple – efficient irrigation systems use less water (power, etc), whist providing water for plant growth. Even for the current recommended "EXCELLANT" DULQ you require, in basic terms, about extra 15% more water over the area. Based upon on our observations most systems are around DULQ' of 60% or require about an extra 20% of water.

With a number of Australian Councils asking during the design phase of a new irrigation systems that a DULQ of >70% is the accepted minimum, (where as we know that design DULQ of >90% can be readily achieved from appropriate design methodology) the infield reality of the manager will lead to poor irrigation uniformity application "as installed" leading to wasted resources.

These poorer application uniformities also lead to longer required irrigation operational windows. With pressures on sports field staff with player training, games, down time – watering windows will need to be able to be completed within 4 to 6 hours at an application rate of Xmm/hr. Table 2 indicates some basic comparisons between application rates, watering windows and inlet pipe sizing estimates. Of course these figures DO NOT take into account the scheduling modifiers noted before (5% - 30% extra water and run time).

(e.g. Gypsum, aeration, returfing, etc). Subject to the EC water in / EC water out this can require extra 5% - 25% irrigation water BEFORE estimating SCHEDULING MODIFIERS.

Agronomically ineffective water applications can lead to:

- Under or over watering (poorer turf growth requiring turf replacement, etc)
- Compounding salinity issues (were saline water is used with little rainfall)
- Reduced nitrogen use efficiencies vs. water use efficiencies
- Aesthetically poor turf

Amongst others.

There are many compromises in an irrigation system, from design to operation. These and other observations (controller set up, wind, block sprinklers, inefficient pump selection, incorrect mainline sizing, time to charge between irrigation stations, poor station change over, variable soil characteristics, etc) compromise the integrity of the irrigation system from the design phase to the operational phase, but this is what mangers gets and finance does not.

There are many compromises to the design, installation, operation and maintenance of an irrigation system that can affect your end result.

Compromises in Irrigation Systems continued

Remember to aim the highest distribution uniformity, always design with knowledge and water on target on time ™.
Disclaimer: All figures provided are very basic baselines, use at own risk

Table 2: Area, Application Rate, Water Window, and Pipe sizing Comparison.

Area (Ha)	Application Rate (mm)	Estimated Water Volume (L)	Water Window (hrs)	L/sec Required	Inlet Pipe Size Generalised Guide
1	9	90,000	6	4.2	50mm PVC / 63mm Poly
1	9	90,000	8	3.1	50mm PVC / 63mm Poly
1.2	9	108,000	4	7.5	80mm PVC / 100mm Poly
1.2	9	108,000	6	5.0	50mm PVC / 63mm Poly
1.2	9	108,000	8	3.8	50mm PVC / 63mm Poly
1.2	10	120,000	4	8.3	80mm PVC / 100mm Poly
1.2	10	120,000	6	5.6	50mm PVC / 63mm Poly
1.2	10	120,000	8	4.2	50mm PVC / 63mm Poly
1.2	11	132,000	4	9.2	80mm PVC / 100mm Poly
1.2	11	132,000	6	6.1	80mm PVC / 100mm Poly
1.2	11	132,000	8	4.6	50mm PVC / 63mm Poly
1.2	12	144,000	4	10.0	100mm PVC / 125mm Poly
1.2	12	144,000	6	6.7	80mm PVC / 100mm Poly
1.2	12	144,000	8	5.0	50mm PVC / 63mm Poly

Photo 1: Football field after rainfall (has irrigation System)

Photo 2: Football field during extended dry (has irrigation System)

Photo 3: Football field during extended dry with non operational sprinklers (has irrigation System)

Photo 4: Edge Soil Profile of the above field