

Turf Irrigation Design – Why pay for your design ?

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Introduction

Irrigation design engineering is a somewhat under-estimated skill. It requires an understanding of hydraulic engineering, irrigation products and applications, soils, agronomy, water and environment analysis and electrical skills. A good designer is able to balance all these skills to provide a solution to their clients, which is practical, easy to install and maintain, provides value for money over the life of the system and considers environmental impacts. Unfortunately the irrigation industry has been it's own worst enemy when it comes to design practices. Competitive environments such as design and construct contracts and also some manufacturers and dealers offering so called FREE design services lead to price competitions rather than looking at the whole picture. Clients not understanding or caring about the role of good design often force this upon the industry. This paper serves as an example how design and price competition can be compared between good practices and bad.

Our Example

We have a standard turf area in our sample school that needs to be watered and the client has given us no brief to work to other than they require a fully automatic turf watering system. A competition is set in place with two local designers vying for the work. Lets see how they fare.

Designer A (A diligent IAA Member and CID Designer)

Even though no guidelines were set in the brief designer A works to some guidelines and principles from his CID training. They produce a design that meets all their design criteria and the overall price for the job is \$ 44,918.

Designer B (Desperately wanting work)

Designer B even though experienced desperately wants this job as they haven't won any jobs for a while and does not want to be forced to lay off any more staff. Therefore they are hungry to get the work and will provide a keen price. They carry out their design and submit a price of \$ 33,474.

The Client

The client gets the two quotes and a plan from each designer. They are somewhat confused at the large variation in the price but consider these two companies as reputable so awards the contract to the cheapest quote. Have they made the right decision?.

The analysis

Now lets look at the two submissions in more detail and see what the real story is :

Sprinklers

Both companies have used the same sprinkler with one major difference Designer B has used a lot less sprinklers. Designer A has used a spacing of 17 m x 15 m Triangular and Designer B a Spacing of 21m x 19 m Triangular. The water application rate is 12.2 mm/hr (A) compared to 5.4 mm/hr (B). Lets look at what effect this has to two things first our Sprinkler coverage and secondly our overall run time.

Sprinkler Coverage

We will use the CIT Space program to analyse the two sprinklers coverage. Designer A's coverage returns a scheduling coefficient of 1.1, whilst Design B returns 1.5. This means that system A needs to run for 1.1 times longer to apply the correct precipitation rate whilst B needs to operate for 1.5 times. This is a result from still sprinkler tests ie no wind. In real life wind effects can even increase scheduling coefficients even further. Designer B's spacing at 70% of the diameter of throw is likely to cause severe dry spots in windy conditions and it will be noticeable in summer on the turf quality. The pressure selected by Designer B is also a lot lower than Designer A and this will certainly affect uniformity.

Overall Run Time

To apply 25 mm of water over the area (an average weekly application) system A must run for 26.6 hours per week whilst system B must run for 46 hours per week.

System Hydraulics

Lets now analyse the hydraulics of the two systems. System A has a maximum sprinkler pressure variation of 375 kPa to 443 kPa (17%) whilst B is 278 kPa to 361 kPa (28%). When comparing this in flow rate terms A has a flow range from 50.5 to 54.2 LPM and B 35 to 39.5 LPM. This can vary the application rate by 7% for A and 13% for B across the sprinkler zone.

The mainline for Design A is 80 mm Class 9 and the peak velocity is 1.3 m/s, whilst B is 50 mm Class 12 with a peak velocity of 2.5 m/s. This is likely to cause water hammer effects for design B with the ramifications being a greater possibility of system pipe breaks over the life of the system. The other problem with Designer B's mainline choice is the energy requirement for the system.

Pumping Energy Costs

Design A has selected a 7.5 kW Multi Stage Centrifugal Pump whilst B has chosen a 15 kW Multi Stage Centrifugal Pump. In real terms system A requires about 6kW to operate whilst B requires 11.2 kW. Looking at current power costs of \$ 0.14 per kWhr system A will cost \$ 22.34 compared to B of \$72.13. Over a 20 week irrigation season this cost could be \$ 447 for A and \$ 1442 for B. That's a difference of \$995 per annum!.

Water Application Efficiency

There are a number of factors that effect the amount of water we use to irrigate our turf. We have discussed a number of them above lets now try and factor them into some rating system :

Design A

Scheduling Coefficient = 1.1

Pressure Variation effects = 1.035

Net Result = 1.14

Design B

Scheduling Coefficient = 1.5

Pressure Variation Effects = 1.075

Net Result = 1.61

The total run time for system A to apply 25 mm is 26.6 hours, therefore the system must run for at least 30.3 hours to apply the minimum. For B this is 74.1 hours.

This assumes no other environmental effects that will also reduce the water application efficiency such as wind, run-off and surface evaporation. These can severely affect water efficiency.

Average Water consumption

Based on the above operating hours each system must run for they will use 657kl per week (A) compared to 1117kl (B). This would be a water cost difference of \$ 414 per week or \$8280 per 20 week irrigation season!!!. (Based on \$0.90/kl).

The Life of the System

Lets now look at the system over a ten-year life and analyse the end result.

	System A	System B
Initial Capital Cost	\$ 44918	\$ 33474
Power Costs	\$ 4470	\$ 14420
Water Costs	\$ 118260	\$ 201060
Total Cost over ten years =	\$ 167648	\$ 248954

Assumptions

No inflation has been factored

Assumes no maintenance costs.

Conclusion

I hope this demonstrates to some extent the importance of good irrigation design and that it is important to utilize experienced design help when considering the design of a turf system. It is not just a capital investment but also an environmental and community consideration as we all enjoy our outside environments and can no longer treat water as the limitless commodity as it has been treated in the past. It also makes good management sense to properly analyse irrigation designs before proceeding with your long term investment.

And for the record Design A also includes a \$ 700 consultancy fee for an experienced designer to engineer the design. Company A is booming and Company B is still wondering what he is doing wrong.

Assumptions made in this paper

- All costings used are relative and recommended retail where applicable.
- Any product brands used in this paper are for evaluation purposes only and do not infer a preference. Aquatek Irrigation Consultants is proud to be a fully independent consultancy that acts in the best interest of its clients.

References

SPACE for Windows Evaluation software produced by CIT USA
IRRICAD V7.28 by AEI Software.

Aquatek is a member of the Irrigation Association of Australia and supports its CID (Certified Irrigation Designer) program.

Appendix 1 – Irrigation Plans