South East Kelowna Irrigation District Demand Management Project

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Executive Summary

Background

Irrigation districts in the Okanagan Valley of British Columbia supply much of the regions domestic and irrigation water. Increased domestic use due to development and requests for additional land to be serviced with irrigation water have put pressure on various irrigation districts to seek opportunities for system expansion. Present water supplies are fully allocated and there is a need for more efficient use of existing water supplies. The South East Kelowna Irrigation District (SEKID) is one of the irrigation districts feeling this pressure. Members of the South East Kelowna Water Board recognize that the cheapest water available is the water that is already in storage. A demand side management (DSM) pilot project was implemented in 1995 to look at more efficient ways of using water presently in storage and to study how effective DSM is as a water management tool to reduce water use. An effective DSM strategy involves the integration of three parts; metering, education and an incentive.

Metering

Metering is the first part of a DSM strategy. Meters are required as a tool to monitor water use. The selection of the meters was based on the following criteria: product warranty, meter serviceability, service support, ease of installation, total cost, references from other clients and product delivery. Kent Meters were selected with Valley Waterworks as the distributor to supply the meters for the Irrigation District. Most of the meters were installed between 1994 and 1996. The equipment and manpower to install the meters were provided by the SEKID. It is very important that the meters are correctly installed as the accuracy expected may not be the accuracy achieved if; the meter is not installed according to manufactures' specifications. Five meters, one of each size, were selected randomly and tested for accuracy in the spring of 2000. The test shows a difference of –1.3 to 3.7 % between the given flow reading and the actual reading. The 1" meter however had a difference of 11.1%. The reason for this variation is unclear. These meters were installed in 1995 with the exception of the 1" meter, which was in stalled in 1997. As of 2000 there are 421 irrigation service connections and an additional 1650 commercial and domestic connections. Using a meter gun the process of reading the meters generally takes 3 to 4 days at the end of each month to read all the irrigation service meters.

Irrigation Scheduling

The second part of a DSM strategy is educating growers how to use irrigation water wisely. Irrigation management or scheduling involves the decision of when to irrigate, how much to apply, and where to apply it. The objective of the irrigation scheduling program is to demonstrate and evaluate various procedures for scheduling irrigation according to water use requirements of the crop. Over the five years of the project held three field were held days using the project sites for demonstrations.

Scheduling

Good management maximizes the efficiency of any irrigation system since even the most efficient system can use more water than the crop requires if it is not managed properly. To demonstrate various irrigation scheduling techniques available to growers in SEKID, eight growers with ten sites cooperated with the Ministry of Agriculture, Fisheries and Food in the irrigation scheduling pilot project over five years. Five sites were scheduled solely using tensiometers to determine the irrigation start time or how long to irrigate. Three sites were scheduled using climate data and tensiometers. For these sites the irrigation start time or the duration of the irrigation was calculated using climate data. The tensiometers were also used at these sites to adjust the calculations if necessary. Finally, two sites were automated with tensiometers also installed at the sites to check that the system was operating as designed. Of the two sites that were automated one used an atmometer (measures evaporation) to calculate daily set times while the other used a soil moisture sensor to override irrigation at the valve if the soil was above a pre-selected level. Other irrigation scheduling tools set up at the sites include, Watermarks, a type of electrical resistance block, time domain reflectometry and time domain transmissivity equipment, these accurately measure volumetric soil moisture.

All the irrigation scheduling methods described in this report could work for growers in SEKID to manage their water use. To be successful the grower would have to spend the time to monitor the devices, either the soil moisture instruments or the equipment used to monitor climate data and become familiar with what the information means to their particular situation. Knowing the soil water holding capacity and soil texture is key to a good water management program. The automated atmometer is the least labour intensive management system once it is set up. Soil moisture monitoring methods required the least amount of calculations and technical knowledge.

TDR/TDT devices require the least maintenance and provide accurate results that do not require conversion in percent soil moisture, however the cost is more prohibitive. Using soil moisture monitoring devices along with climate data for scheduling is very important.

Climate data

A climate station monitoring evapotranspiration (ET), precipitation and temperature was installed at the Irrigation District office. Two other atmometers, two simple evaporation pans and simple rain gauges were set up in various locations around the district. The correlation between atmometers in the district was very high, 92-98%. The correlation between pans and atmometers was lower, 59-76%. Pan readings were on average 1.5 mm/day higher or lower than the atmometer readings.

The readings from the atmometers at the SEKID and Agriculture Canada site were 12% higher than the atmometers in the orchard. Both the SEKID and station atmometers were in very open areas that were not irrigated, which would produce a higher rate of ET than in a more humid green setting of an orchard. Some of this variation could also be due to the variation between atmometer heads.

A strong relationship was found between maximum weekly temperature and weekly ET, and between average weekly temperature and weekly ET. This relationship is unique to the SEKID area and should not be adapted to other regions.

Reporting to participants

Weekly reports were produced and distributed to the mangers of the sites. The reports contained a graph showing the soil moisture profile from the beginning of the irrigation season and an irrigation scheduling recommendation for the following week. At the end of each year growers in the project were given a summary report comparing actual annual water use with the calculated water requirement for the year.

Data Management System and Water Use Reporting

The final part of a DSM strategy is an incentive for the user to save water, such as a water rate structure or being able to expand the irrigated area. An incentive that has been found effective in reducing water use in SEKID is peer pressure, by distributing water use reports that compare water use on a property to an average water use for a similar crop.

To produce the water use reports a data management system was needed to integrate meter data, actual water use, with crop water requirements and calculated water requirements. Two versions of data management systems were tried in this project. The first version, Land Analysis and Decision Support System (LANDS) was a geographical information system. This system was very robust but required considerable technical expertise to operate. The second data management system is the Water Use Reporting and Land-use Database (WURLD) developed in MS Access. This data management focused on being a user friendly database the district would be able to maintain and produce water use reports for distribution each month.

A complete land-use survey in 1995 collected information on crop-type, planting density, soil types and irrigation system were recorded along with legal property information. Climate information is downloaded into the data management system and is updated monthly or as required. Irrigation service meters are read monthly as close to the beginning of each month and downloaded into the database.

The climate data and physical property information are used in an algorithm to calculate the theoretical water use for the property. The program calculates a theoretical water use on a monthly basis to correspond with the meter reading that are taken monthly. WURLD produces water reports for the district to distribute to growers and provides tools to analyze data. The information from the database also has the potential to be used with a mapping program or GIS technology to visually display the data gathered in the district.

Statistics calculated for the district include: the average water use for the district, total irrigated area, number of meters read, evaporation, the average water use for each crop and soil type combination, the high monthly water users for each crop and the high water users to date.

Costs

The South East Kelowna Irrigation District, the Canada – BC Green Plan for Agriculture and the BC Ministry of Agriculture, Fisheries and Food shared the costs of the project. The total cost of the pilot project is summarized in the following table.

Total Project Costs

Item	Cost
Meter	$606,010
Irrigation Scheduling	$118,500
General Data Management	$22,800
LANDS	$70,330
WURLD	$37,265
Total	$854,905

*values have been rounded off

Costs of the meters include the capital cost of purchasing the meter, the labour to install the water meters, cost of the equipment to install the meters, costs associated with reading the meters and meter maintenance.

The irrigation scheduling project costs include the initial capital output to buy the tensiometers for the entire district, wages for a summer student each of the five years and time spent supervising the project. Miscellaneous costs include mileage for vehicle use and lab costs for soil sampling. Eleven hundred tensiometers were purchased, the bulk of these were distributed to landowners in the district when the meter project began. Other equipment costs include the purchase of data-loggers, atmometers, materials for evaporation pans, rain gauges, modems and software to collect climate data. Some of this equipment was already available through BCMAF and Agriculture Canada participants.

Data management costs include the programs / databases used to manage the information, the hardware associated with data collection and storage and the time involved in preparing the data and sending our water use reports monthly. The LANDS and WURLD items are the costs of developing the databases.

Growers Participation

The growers who participated were interviewed at the end of the project. Of the growers who have changed their irrigation management during the period of the study, 50% reported using less water than previously. They found that the water meters gave them a visual indication of their water use and made them more aware of conservation.

The growers liked the water use reports that were distributed by the district every month, especially the comparison of water use between other growers in the area that had similar crops.

Those who used tensiometers when making irrigation scheduling decisions used them to determine if the soil moisture was sufficient, especially at the 24-inch depth and to determine when to begin irrigation. When asked what they learned about irrigation scheduling, most answered that they were made more aware of water conservation. Some found that irrigation scheduling was useful only to a point. Maintaining consistency in soil moisture and using evaporation to schedule irrigation were two other points that growers stated learning about in this study. Benefits of the project were perceived to be water savings, better water management and a forum to show growers how to conserve water.

Results

To determine if universal metering was saving water without having other incentives, such as a rate structure, in place the total water use in the district before metering and after metering were compared. Changes in irrigated area in the district and annual cumulative ET were taken into consideration to compare actual water use for the annual climate conditions. Results could indicate a saving of 5-23%; an average of 13% lower after the demand management project began. These savings could also be due in part to conversions in the district from inefficient irrigation systems to systems that are more efficient and a greater awareness of water conservation. During the time of this project the district also switched to a telemetry system at the intake instead of controlling the water level in the reservoir manually, this would result in less spilling out the end of the system.

The information gathered throughout the project aided the district in calculating the per acre demand of the district for a drought year using the water use data from 1998, one of the hottest years on record. The analysis concluded that the district's drought year demand is an average of 2.25- acre-feet of water per acre of land. This is ten percent lower than the original figure of 2.5 acre-feet used to design the system in the late 60's. This saving represents over 1,300 acre-feet of water. As in the above analysis this saving can be attributed to a number of causes.

A comparison was done between the calculated water requirement for various crops throughout the season and the average water use for crops in the district. It was found that irrigation scheduling is most important in the early part of the season when water demand is the lowest. This is when most of the water savings can be realized. Meter data has indicated that the average property is using nearly the same volume of water each month during the irrigation season or only a couple inches less in the spring. There could be significant water savings by reducing water use in the spring and early summer.

The use of tensiometers in the SEKID is not wide spread as of yet. Some growers now use the tensiometers to schedule their irrigation faithfully and come back to the district for replacement meters and gauges. Other growers may have tried the tensiometers for one year and were not satisfied with the results. As the growers gain experience with tensiometers in specific soil and crop conditions, predicting irrigation start times gets easier. It may take an irrigation season or two to gain confidence with the tensiometer.

Water use reporting was not implemented consistently district wide until 1999. The impact of the water use report on water use in the district will not be known for a few years.

Quantitative water savings were not the only benefits of the metering project. Other benefits include the acquisition of data on water use and water requirements that the district can use for future planning for water requirements and land re-grade. A reduced work time for the bailiffs when investigating possible water misuse. The district's as-built drawing were updated and connections were improved while the meters were being installed.

To the landowners having a meter located on their property gives them a tool to locate leaks in their system, monitor daily water use, and make adjustments to stay within their allotment.

The growers in SEKID are concerned about water use and most are doing their best within their means and resources to use water efficiently. With more education on irrigation scheduling techniques and awareness of crop needs and water use through the water use reports the growers will be in the position to make better irrigation management decisions.

Addendum

SEKID Demand Management Project Update – November 2002

Since the completion of the Demand Management project in 1999 the South East Kelowna Irrigation District has continued to meter water use and provide growers with monthly water use reports.

The reports have be changed to show the landowner the amount of water they used during the past month and the amount left on their irrigation allotment. This was found to mean more the landowners than the water requirement based on soil, crop and climate information.

The District has found the meters to be a useful tool in managing the water supply for the district. The meters have allowed some management options that were not available in the past.

In 2002 the District fined landowners that were significantly over the annual water allotment of 2.25 ft-acre.

In 2003 the District is considering adopting a system that charges landowners a metered rate for any water they use that is over the allotment for the year. The annual allotment could change – i.e. if there is a water shortage. The landowners will still pay the flat rate for their water use that is within the allotment.

These measure are being taken after having the benefit of the experience and the information collected from the meters over the past 8 years.

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