the
WATER HAULER'S BULLETIN

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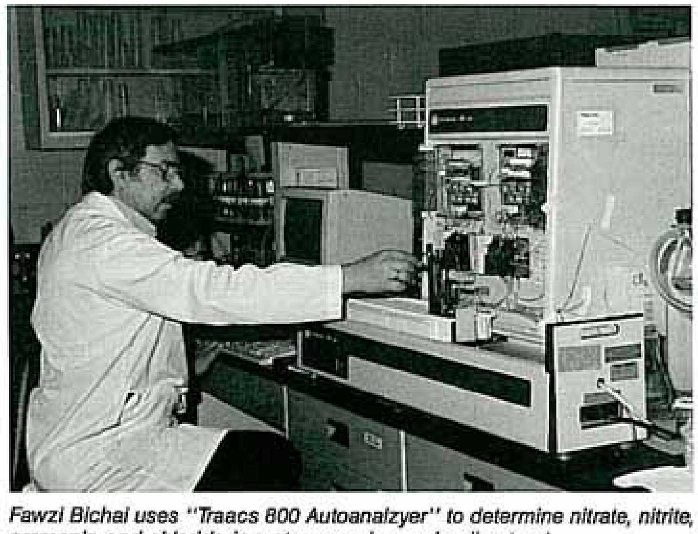
WATER QUALITY IN ALBERTA

Agricultural Impacts to be Studied

The agricultural industry is a major user of water in Alberta and therefore has the potential to significantly impact both surface water and groundwater quality. The impact of agriculture on water quality is becoming an increasingly important issue in Alberta, in light of the significant water contamination problems attributed to the agriculture industry in eastern Canada and in many areas of the United States and Europe.

Agriculture's impact on water quality has generally been considered to be minimal in Alberta because of relatively low precipitation levels and moderate use of agricultural inputs such as fertilizers and pesticides. As a result, very few studies of agriculture's impact on water quality were carried out in the past.

In 1991, a number of research projects were initiated by the Lethbridge Research Station and the land evaluation and reclamation branch to evaluate herbicide and nitrate levels in surface water and groundwater in irrigated areas. Surprisingly, this research revealed instances where certain agricultural management practices resulted in some contamination of surface water and groundwater. More recently, concerns about water quality have arisen in the County of Lethbridge relative to intensive livestock operations and the spreading of manure near irrigation canals.



Fawzi Bichai uses "Traacs 800 Autoanalzyer" to determine nitrate, nitrite, ammonia and chloride in water samples and soil extract.

As concern about agriculture's impact on water quality increases, sound information must be obtained to better understand the interaction between agriculture and all water resources. A water quality committee was formed in 1992, as part of the Canada/Alberta Environmentally Sustainable Agriculture Agreement (CAESA), to evaluate and prepare a report on the impacts of Alberta's primary agriculture industry on surface water and groundwater quality. The committee began its work in 1993 and will prepare its final report by the summer of 1997.

Brent Paterson, head of the land evaluation and reclamation branch, is chairman of this multi-agency committee, which has representatives from Alberta Agriculture, Food and Rural Development, Alberta Environmental Protection, Agriculture and Agri-Food Canada and Environment Canada. Paterson says "The lack of relevant water quality information makes the committee's work in preparing a comprehensive report on agriculture's impacts very challenging. To accomplish this task, we propose to review and evaluate existing water quality information thoroughly, plus carry out research and monitoring studies to fill in the gaps."

The main agricultural impacts that will be evaluated in this study include: pesticides, nutrients (mainly nitrates and phosphorus), runoff sediment and livestock wastes. An agricultural land use study was recently completed which identifies a number of key agricultural activities in each municipality, including cropping areas, summerfallow acreage, fertilizer rates, livestock density, etc. Figure 1 is an example of the information generated from this study. This report is currently being published. Based on the information from this study, representative irrigation and dryland sites will be selected and monitoring work will be initiated. The results from these sites will be extrapolated to other areas of the province where direct monitoring information is not available.

A number of projects were initiated in 1993 to provide specific information for this study. A study was carried out in the fall to evaluate nitrate leaching under long-term dryland and irrigated fertilizer and crop rotation experiments, some which have been in operation since 1911. Soils at 15 research sites were sampled. Site locations included Beaverlodge, Edmonton, Vegreville, Lacombe, Three Hills, Lethbridge and Bow Island. The well-documented histories of these rotation studies provide a good opportunity to determine the cropping and fertilizer treatments that may contribute to groundwater nitrate contamination.

In addition, two CAESA research projects were initiated in 1993 by the land evaluation and reclamation branch. The first three-year study on two different soil types in the Lethbridge Northern Irrigation District portion of the County of Lethbridge is designed to evaluate the impact of manure spreading activities on nitrate levels in shallow groundwater. Two dryland sites in the Ponoka-Red Deer area will be added to this study in 1994. The second study, located northeast of Vauxhall in the Bow River Irrigation District, is examining nitrate levels in the soil and groundwater on irrigated lands. Additional studies will be initiated in 1994 to evaluate agricultural impacts on surface water in dryland and irrigated areas.

The data collection and monitoring work being implemented by the CAESA Water Quality Committee will provide a better understanding of the existing and potential impacts of primary agricultural activities on the quality of our surface water and groundwater resources. Regular progress reports will be forthcoming throughout the four-year program, and results of completed studies will be published. Recommendations for improved management alternatives will be promoted, where water quality concerns are identified.

For more information on the work of the CAESA Water Quality Committee, contact Brent Paterson, Head of the Land Evaluation and Reclamation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7. Telephone (403) 381-5515. ■

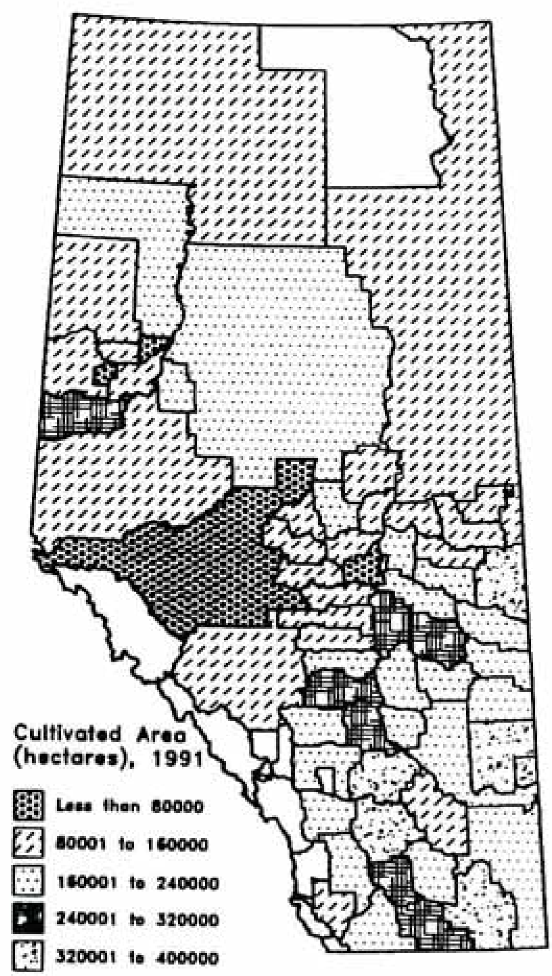


Figure 1

MONITORING FOR CONSERVATION AND EFFICIENCY

Conservation and efficiency are 1990's buzz words — and they apply directly to water management. In recent years public concern about the status and management of natural resources has focused its attention on water. In Alberta, this means that increasing attention is being applied to the operation of irrigation districts as the largest consumptive users of water in the South Saskatchewan River Basin.

"Water is a limited resource," states the Eastern Irrigation District's (EID) Jim Webber, P. Eng., manager, "and the public is demanding that it be managed in an efficient manner and with conservation in mind." What conservation and efficiency mean in an Irrigation District setting, however, is not well defined. Does conservation mean to use less, or to use more effectively? Are the current perceptions about the relationship between water diversions and return flows from Irrigation Districts the most appropriate or even a correct measure of efficiency? These are questions that an initiative of the EID is attempting to clarify.

In announcing the EID's water monitoring initiative Webber indicated, "Even with everything that has been said or written about conservation and efficiency in Alberta's irrigation community there remain few facts. Our industry seems, instead, to have been painted with the brush of arbitrary assumptions while our future is constrained by the burdens of proof." As such, the EID selected the Rolling Hills area as the first phase of a district-wide flow monitoring program that is meant to determine the relationships between system operations, on-farm irrigation demand, temperature, rainfall and return flow. To gather enough data upon which to develop the "facts" of water management a total of 11 return flow monitoring sites were installed. In addition, daily diversions into the Rolling Hills area were correlated with precipitation amounts and maximum, minimum and mean temperatures.

Rolling Hills Statistical Summary:

Area Irrigated:	32,676 acres
Crop Mix:	Forages — 54%
	Cereals & Oil Seeds — 40%
	Specialty Crops — 6%

3 Water Distribution Areas

3 Return Flow Channels to the Bow River

The first year of the project was a combination of success mixed in with a few "Murphy's Law" lessons. Some of the monitoring equipment did not operate as anticipated. Brad Schroeder, superintendent for the EID's Rolling Hills area noted, "We were not originally aware that the warm-up times for the ultrasonic probes would be sensitive to low temperatures and given the very cool and wet season some of the equipment did not function for the entire season. Next year these problems will have been corrected." Information from the sites is generally available for the period of June through to the end of October.

Even with the technical difficulties experienced and the above average precipitation the EID believes that some very important information has been collected. "More than 300,000 readings were taken at the 11 sites during the year. These readings represent water level, gate position and temperature. Making some sense from all this information and putting it into the proper context was an interesting process," commented Dave Hill whose task it was to coordinate the data and provide the initial analysis for the district. Data collected in June provides a good basis for determining how the various components of water management are inter-related (Figure 1).

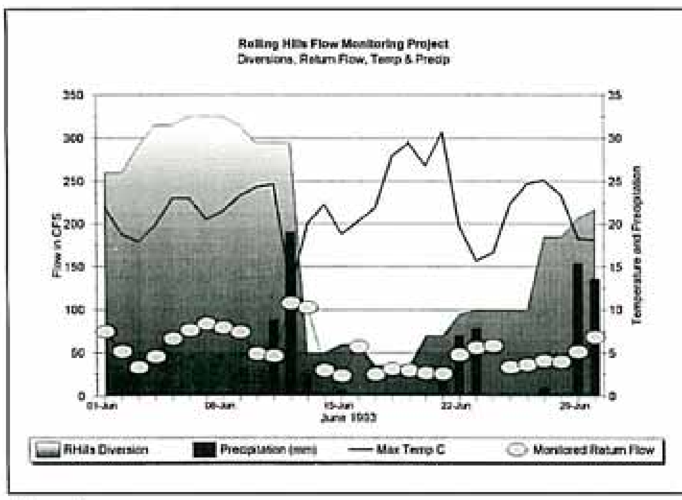


Figure 1

During the first couple of weeks of June, says Webber, there appeared to be a direct relationship between total diversion and recorded return flow. As demand began to rise so did return flow. As demand began to taper off, return flow also began to decrease. Then came the Brooks Kinsmen Rodeo Weekend (June 11-13) and rain, rain, rain. Demand dropped by 6.5 m³/s (cubic metres per second) *[230 cfs]* overnight and return flow took a sudden jump. For the rest of the month the relationships between diversion, rainfall, temperature and return flow were much harder to pinpoint. To get a better handle on how these components fit into the overall water management picture, data from one of the drainage areas in the Rolling Hills block was viewed on a daily acre feet per acre basis (Figure 2).

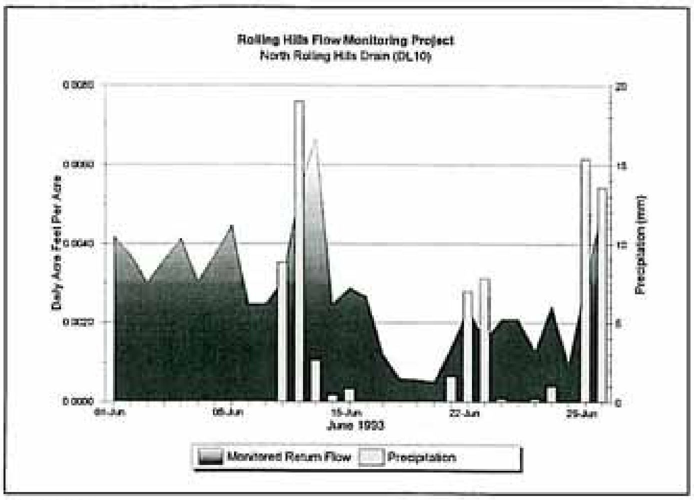


Figure 2

The North Rolling Hills Drain includes 10,120 acres of irrigation, 28% of which is irrigated by flood, 18% by sideroll wheel moves and 54% by centre pivot. The data from this area indicated a high degree of variability. "The daily variation in return flow is an indicator that EID operations and on-farm operations are not always coordinated," suggests Schroeder. "There are many times in a season when the district will have water available to meet an on-farm request and a farmer may be a few hours to a day late in picking the water up." Checking the return flow for the latter part of June to the actual delivery records indicates that a large portion of the return flow is likely directly related to rainfall and not to system operations or on-farm irrigation demand.

The EID is not yet prepared to suggest how conservation and efficiency should be defined, but they do believe that they are much closer to asking the most important questions. "The monitoring network in the Eastern Irrigation District will continue to be expanded and more sophisticated methods for collecting and analyzing the data will be developed," indicates Webber. "We have learned enough in one season to know that the relationship between how we managed the irrigation network, how farmers irrigate, the timing and amount of rainfall and daily temperatures are highly inter-dependent." More work is needed to develop targets to reduce operational conveyance flows and to separate the on-farm components of return flow. It is clear that many of the assumptions about conservation and efficiency should be revisited. Having the "facts" is the first step in demonstrating stewardship for our water resources and in coming up with the practical definitions for efficiency and conservation.

For more information please contact Jim Webber, Manager, Eastern Irrigation District, P.O. Bag 8, 551 Industrial Road, Brooks, Alberta, Canada T1R 1B2. Telephone (403) 362-1400. ■

LNID LAND CLASSIFICATION

District Provides Service to Farmers

The privatization of Level II land classification in irrigation districts has led the Lethbridge Northern Irrigation District to contract to a local company for this service. Recognizing that hiring an experienced consultant and working through the whole process may be difficult for the individual farmer, the board decided that district management may be the best to provide this service.

The Irrigation Act, says Rick Ross, P. Eng., district manager, stipulates that land within district boundaries must be classified "irrigable" before water rights may be granted and the area added to the assessment roll. The Irrigation Council of Alberta adopted the first classification standards back in 1969. Today's standards were adopted in 1990.

The irrigation land classification process includes a systematic assessment of the general capability of land for sustained irrigation based on the nature and degree of both permanent and changeable characteristics. Permanent characteristics include such things as profile development and soil texture, while changeable characteristics are often soil salinity and water-table depth. Assignment of a final land class includes prediction of potential changes to characteristics such as soil salinity or water-table levels that may result from irrigation.

Our district, says Ross, decided to help our farmers by contracting to a local consultant (Canadian Challenger Associates Ltd. of Lethbridge) for a year. If, over eighty acres per parcel are classified, the consultant's fee is based on a flat fee for each acre. A lump sum payment is made if fewer acres are requested. Either fee structure includes all costs for drilling, laboratory analysis, professional time and report writing. Our staff does all the coordinating with the consultant and Alberta Agriculture, Food and Rural Development. In turn, we bill back the entire amount charged by the consultant to the landowner, and a small administration fee for our time, states Ross.

"For our farmers, who may only once in their lifetime ever be involved with the land classification process, our service provides one-stop-shopping so to speak. We will ensure that the final report meets standards," concludes Ross.

For more information, please contact Rick Ross, P.Eng. General Manager, Lethbridge Northern Irrigation District, 334 - 13 Street North, Lethbridge, Alberta, Canada T1H 2R8. Telephone (403) 327-3302. ■

LONG-TERM DATALOGGER OPERATION

This is the first article in a series describing: electronic dataloggers, accessory equipment available, and the training needed to record data reliably.

Man has attempted to accurately measure flowing water since Egyptian times. In the past decade, water-measuring and recording has taken on a new approach with the advent of the electronic datalogger. Until this time, the only instruments available to record canal and stream flows were mechanical recorders.

Costly mechanical recorders were often clock-driven and used paper charts. Although precision instruments, they record only one type of event. The older recorders suffered other limitations as well. Because the recorders were often exposed to the elements, clocks didn't keep accurate time and ink pens dried out, clogged, skipped or blotted. Later, models were equipped with accurate quartz movement clocks and more reliable felt-tip pens but still experienced problems.

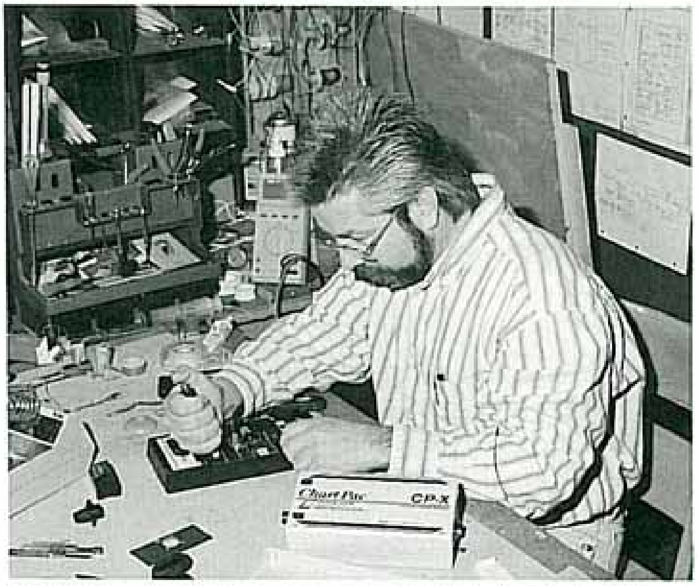
Brian Cook, an electronics technologist with Alberta Agriculture, Food and Rural Development, irrigation branch has been using, programming and repairing electronic dataloggers since 1983. In many areas, electronic dataloggers prove to be an inexpensive and practical method of measuring and recording canal or stream flows, says Cook.

"There is nothing mystical about electronic recorders" states Cook. The first electronic recorders appeared on the scene about 12 years ago.

An electronic datalogger is a specialized computer designed to measure and store data. A datalogger may differ from a computer in that most will not have screens, keyboards or disk drives. Instead loggers have solid state memories, circuits to convert a voltage or a current to a number (analog to digital conversion or A to D conversion), a wiring harness or connectors and battery packs. They are programmed and the recorded data is retrieved through an external terminal, laptop computer, telephone modem or memory module.

The advantages of dataloggers says Cook are:

- Cost — dataloggers are one half to one quarter the price of mechanical recorders and man-hours required to process the data from loggers is reduced to about one tenth of that what is required to interpret paper graphs.



Technologist Don Roth replaces integrated circuit chip in electronic datalogger.

- Data is immediately available in digitized form and can be used as is, or imported into spreadsheet or database programs.
- Accuracy — precise electronic clocks and A to D circuits enable dataloggers to record data extremely accurately.
- Versatility — most loggers have at least eight channels that are capable of recording a great variety of physical events.
- Reliability — electronic dataloggers have proven to be as reliable or more so than mechanical recorders.
- Maintenance — other than battery replacement, very little maintenance is required.

Once the decision has been made to use dataloggers, states Cook, the next question to be answered is "What has to be measured?" There are many different types of probes or sensors that can be used with electronic dataloggers. Cook describes a probe or sensor as a device that converts a physical measurement into a voltage, which in turn is received and stored as a bit of information in the datalogger. Probes or sensors are available to measure:

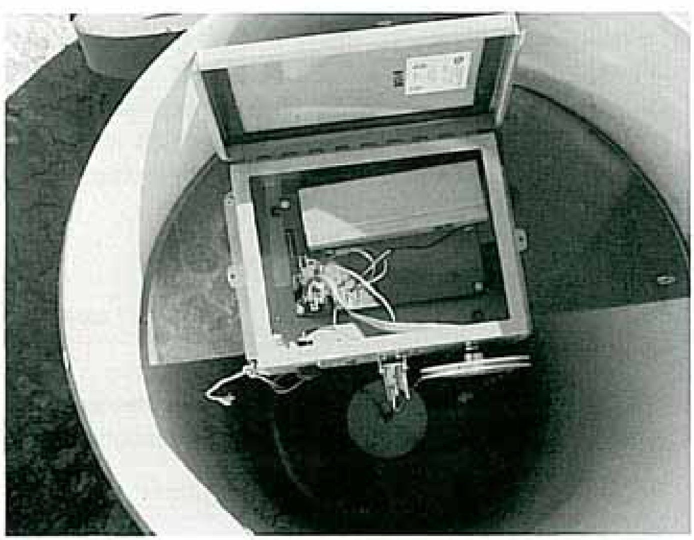
- Water level — canal flows and groundwater.
- Water quality — pH, salinity, dissolved oxygen, temperature, etc.
- Weather — temperature, humidity, wind (direction and speed), rainfall, evaporation and solar radiation.
- Pump operation — hours of operation, power or fuel used, discharge flow and pressure.
- Pipeline — flows and pressures.
- Gate openings.

If it moves, changes or can be measured, says Cook, there is probably a probe that can be used with a logger to record it.

Probes or sensors vary in price from two to thousands of dollars, states Cook. Usually the more accurate a probe is the more it costs, however, an inexpensive float potentiometer ($100) has an accuracy of ±1 mm and a useful life of at least ten years, while some very expensive pressure transducers ($400 to $2000) have an accuracy of ±25 mm and a useful life of only two years. Temperature probes run from $2 to $40, tipping bucket rain gauges from $90 to $900.

Another question often asked says Cook is "How much training will my staff require?" This will depend upon which type of logger is used and the skills your staff have. All dataloggers require users to be computer literate. Some datalogger manufacturers have strived to produce very user-friendly instruments which require only a few hours instructions to program and use, while other instruments require days or weeks of training. Proper staff training is the most important factor in accurate and reliable data collection. Manufacturers' support in training and proper maintenance procedures are also important factors for successful data collection, concludes Cook.

For more information please contact Brian Cook, Electronics Technologist, Irrigation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Centre, Lethbridge, Alberta, Canada T1J 4C7. Telephone (403) 381-5878. ■



Looking down at Datalogger in stilling well.

MANUAL COLLECTION OF DIGITAL DATA

"Data, data everywhere . . . and ne'er a way to collect it! Without a doubt, field operational data collection will be increasing in emphases for water managers and researchers, now and in the years to come." So says Wally Chinn, head of the irrigation development section of Alberta Agriculture, Food and Rural Development.

"This is becoming more essential now for irrigation operators as water availability becomes more critical and they must also rationalize their operations under much more public and environmental scrutiny." This was emphasized quite explicitly in the summary of the recent Alberta Irrigation Projects Association Annual Conference by C. Doug Radke, deputy minister of Alberta Agriculture, Food and Rural Development.

As the saying goes, "You cannot manage what you cannot measure!" The need for a variety of measuring systems is being recognized by the stewards of the water resource. But although one can and does measure, what happens to all that information? The world of computers has aided in assembling, collating and correlating all this potential data in countless ways. But how can one actually collect the vast amount of data demanded these days in an effective and efficient manner? Certainly, automatic data recording stations are a great asset and are currently assisting extensively in this regard. However, when tying-in interfaces between irrigation district operations and individual on-farm systems, the number and cost of fixed data recorders required to keep track of some 12,000 plus serviced parcels would be prohibitive to say the least.

Recognizing the need for this data collection at the on-farm irrigation level and its interface with district works, the irrigation branch has carried out some preliminary evaluations of one type and make of portable data recorder that could become a standard tool for water supervisors in the irrigation districts.

The picture shows a "Polycorder 600" in field use. This type of unit is simply a battery operated, manual entry, portable electronic notebook that can be custom programmed to accept, store and download data in and from a spreadsheet format. Such a rugged unit with its large entry and scrolling keypad, can be used by a water supervisor on a daily basis to "inventory" the operations within his or her block, right down to information about the associated on-farm situations. There are many manufacturers of similar equipment which could quite likely equally serve this purpose.

"Polycorder 600" being used in the field.

The intent within this evaluation was not to test a particular product but only to evaluate the concept.

Depending upon the size of memory installed within the unit, the "Polycorder" can hold up to five different spreadsheet applications, with any one application supporting up to 99 different data fields and 9,999 records per field.

A sample operational records spreadsheet was set-up for evaluation. A portion of the input data and field labels (Flow & System Type) is displayed within the LCD readout as shown in the picture. By scrolling across or up and down the display, more fields and input data can be recorded or viewed. Figure 1 shows the full-width portion of the printout of the evaluation spreadsheet. Within this example, three different sets of records are shown for the ten fields programmed into the unit. These fields represent:

1) Land location
2) Parcel no.
3) Turnout no.
4) Water "On" time
5) Water "Off" time
6) Deliv. flow rate
7) On-farm system type
8) Acres irrigated
9) Pumping energy
10) Crop type

IRRIGATION DISTRICT FIELD/SYSTEM DATA - 1993

LAND LOCATION	PARC. NO.	T/O NO.	TIME ON	TIME OFF	FLOW	SYS. TYPE	AC.	NRG	CROP
NW 321018	1	C3	6272100	3016000	2.22	CP	132	EL	SWSW
NE 321018	2	C4	6220840	7051630	1.89	WM	116	NG	BEET
NE 321018	1	D5	6221045	6261230	3.58	GR	72	GR	ALF

Figure 1 — "Polycorder" output spreadsheet

There are some obvious benefits from these units says Chinn.

The unit can be set-up and programmed during the off-season. The operational season data can be recorded from the cab of the supervisor's truck and quickly downloaded on a daily or weekly basis to a larger computer storage and handling system for various analyses.

The list price for a unit such as the one shown in the evaluation test is about $1400 U.S. depending upon quantity ordering.

Of course there are many applications that these units could be used for but the objective remains the same . . . to collect as much relevant information, without the in-field paper work, and with a minimum of transfer or downloading and analyses time afterward. Jack Ganesh, P. Eng. of the irrigation branch, who has been searching for an electronic recording device for water supervisors, will be evaluating this model along with others. The device should be capable of storing water requests, turn-off times and using this data to compute daily demands. By storing rating curves in the recorder, the ditchrider makes gate adjustments to meet flow demands and minimize return flow. In addition, the electronic recorder should be capable of keeping records of other relevant data. Some of these devices will be tested as part of the overall water management strategy of the Block Study currently underway in Bow River Irrigation District. With cooperative efforts between agencies, tools such as this offer tremendous potential for necessary database development and ongoing maintenance as well as data sharing.

The irrigation branch welcomes the opportunity to work with any irrigation district interested in pursuing this type of venture. For more information, contact Wally Chinn (403) 381-5864, or Jack Ganesh (403) 381-5869 — Irrigation Branch, Alberta Agriculture, Food and Rural Development, Agriculture Center, Lethbridge, Alberta, Canada T1J 4C7. ■

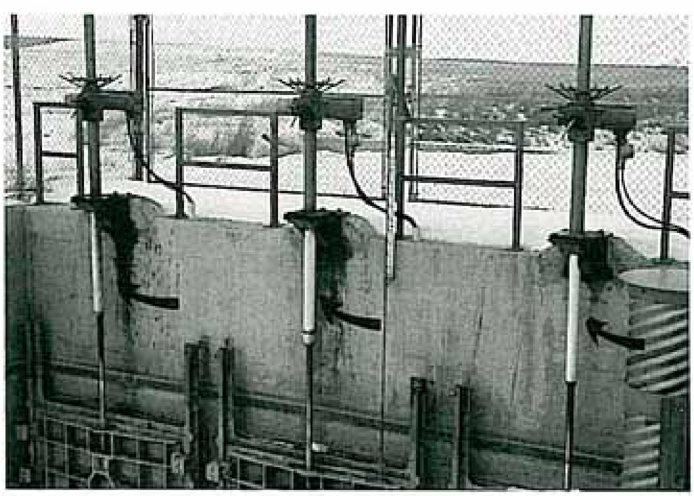
GATE STEM COVERS

One major element on any threaded gate stem is a good uncontaminated lubricant. The lubricant protects the stem from corrosion and provides for smooth operation. One day of blowing dirt can ruin the best lubricant and cause the Rotork operators to bind, says Ralph Oldenburger, watermaster, Lethbridge Northern Irrigation District. In our windy area, a gate stem cleaned and oiled in the morning can be severely contaminated by blowing dust before evening. Removing the contaminated lubricant with a diesel fuel soaked brush from all the grooves between the threads isn't easy and takes time especially if it has to be done after dark.

The problem becomes very serious if the Rotork operator mechanism becomes heavily fouled and compacted with oily dirt. When this happens, says Oldenburger, the mechanism must be removed and sent in for factory trained service. The gate remains closed for a number of days.

For Oldenburger there had to be something better. That something better was a gate stem protector made out of a piece of surplus PVC pipe and couple of shop-made metal brackets. Once the measurements are obtained — diameter of stem, length of thread to be protected and the angle of the brackets, it's time to go to work. A thin-walled PVC pipe 12 mm (inside diameter) larger than the diameter of stem is cut 12 mm longer than the threaded part. To allow the pipe to be opened-up and slipped around the stem, a single saw cut is made for the entire length of the pipe. When asked about a cost, Oldenburger grins and replies "almost nothing if you have a surplus piece of the right diameter PVC pipe and a welder to make a couple of brackets."

It didn't take long to see that the gate stem protectors worked. After our first big blow, says Oldenburger, the lubricated stems remained clean and free of contaminants. His district installed the covers on five of their major control gates. Based on the first year's positive test results and



Arrows point to in-place gate stem covers.

Ralph Oldenburger lifts gate stem cover from hand wheel gate.

low cost, it won't be long before others are calling and wanting to know how to make and install the gate stem protectors.

For more information please contact Ralph Oldenburger, Watermaster, Lethbridge Northern Irrigation District, 334 13 Street North, Lethbridge, Alberta, Canada T1H 2R8. Telephone (403) 327-3302. ■

THE WATER HAULER'S BULLETIN

Designed to provide the operation and management personnel of Irrigation Districts with items of interest in their line of work. Comments are welcome.
Please contact Duncan Lloyd, editor, at Area Code (403) 381-5539, Lethbridge.

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