the WATER HAULER'S BULLETIN

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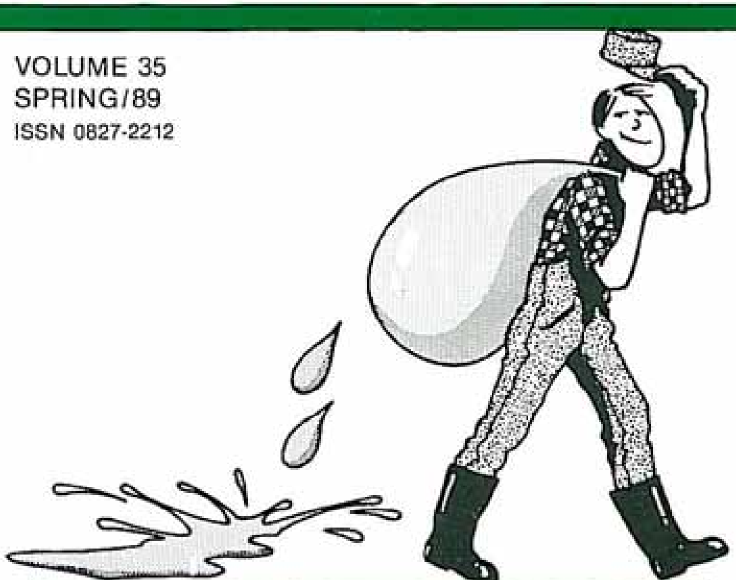


IN THIS ISSUE:

LONG-TERM IRRIGATION EFFECTS ON SOIL SALINITY IN SOUTHERN ALBERTA

Not As Detrimental As Predicted

Canada's largest irrigated land belt may not be suffering the overall long-term salinity problems often associated with years of irrigation. In southern Alberta over 460,000 ha of land are irrigated within the thirteen irrigation districts. This area constitutes about 3% of Alberta's arable land, but provides about 20% of Alberta's farm output. Even though a major part of this area has been successfully irrigated for over 80 years, the permanence and prosperity of irrigation in this region has been challenged from time to time. Drs. Chi Chang and Theron Sommerfeldt of the Lethbridge Research Station examined and summarized the research results, over the years, pertinent to soil salinity in this region.

The apparent low hydraulic conductivity of underlying fine textured glacial till, at about 1 metre (m) depth and deeper, impedes internal drainage of the soil. Some studies concluded that productivity of the irrigated and potentially irrigable land could be sustained only if adequate artificial subsurface drainage was provided. Because of these conclusions, it became necessary to

Salinity investigations in irrigated areas of southern Alberta.

thoroughly evaluate the long-term irrigation effects on soil salinity in southern Alberta to determine the viability of irrigation.

They examined causes of soil salinity of the irrigated land in southern Alberta, in both natural and management aspects. The soil in this area is generally shallow and overlays slowly permeable till at 1 m depth and deeper. By some standards, the hydraulic conductivity of the till is too low and the salinity is too high for sustained irrigation. However, two sets of fracture lines and structuring in the till have been noted. Both sets of fractures produced secondary permeability which counteracted the low hydraulic conductivity of the till matrix. Also, other natural factors, such as short growing season, long drainage period, lower total water requirement for various crop production than other parts of the world and good quality irrigation water [electical conductivity (EC) between 0.37 and 0.52 dS/m and sodium adsorption ratio (SAR) between 0.88 and 1.52] minimize the potential for soil salinization.

The management factors cannot be easily generalized.

However, research results indicate that under management practices normally used on the farm, a favorable salt balance was maintained in the soil after decades of irrigation. Studies indicate there had been an average of 16% leaching fraction on two farms after sixty years of irrigation. In addition, the salt status of the soils at 11 other long-term irrigated sites indicate that the total soluble salt content of soil in the root zone was either reduced or unchanged with time. Drs. Chang and Sommerfeldt reported that more than 80% of the land in the Taber Irrigation District, 90% of the land in the Western Division of the St. Mary River and the Lethbridge Northern Irrigation Districts had EC $<$ dS/m. The greatest cause of waterlogging and salinization of the land in the irrigation districts is seepage from the canals.

The soil has capacity to accommodate the required irrigation water, when applied judiciously. The tills are fractured and structured to provide slow drainage of excess water. Because of the climate of this region, the irrigation requirements in the growing season are not as great as in some hotter and drier regions; the growing season is short followed by a long dormant period during which natural drainage lowers the water table that may have built up during the irrigation season.

Salt affected areas appear white.

Under normal irrigation, there is evidence of sufficient leaching to generally maintain a good salt balance in the soil. Some of this leaching can be attributed to precipitation, which has a desirable distribution. The mean annual precipitation is 405 mm, of which 70% falls from April 1 to September 30, with peak precipitation in the months of May and June, a period when the soil could contain considerable moisture from fall, winter and early spring precipitation. With the extra May-June precipitation the soil can become saturated and leaching occurs. This, along with the excess waters that percolate through the soil during normal irrigation, is sufficient to provide the leaching required to maintain a desirable salt balance.

In summation, it appears that long-term irrigation in Alberta is not as detrimental on the land as predicted by some researchers and that extensive artificial subsurface drainage is not necessary for sustained irrigation, say Drs. Chang and Sommerfeldt.

For more information please contact Dr. Chi Chang, Agriculture Canada, Research Station, Lethbridge, Alberta T1J 4B1. Telephone (403) 327-4561. ■

CONGRATULATIONS KENT BULLOCK

Congratulations to Mr. Kent Bullock, P.Eng. on your appointment to the position of Manager of the Taber Irrigation District.

FLOW MONITORING PROGRAM TAKES OFF

A New Tool for the Ditchrider

A basic requirement for water resource management is being able to measure water. In today's technological world where water shortages seem more and more prevalent it is a must. Modern science has provided many new ways to accomplish this task.

Water is essential to our view of the year 2000 and beyond here in irrigated southern Alberta. We have grown more conscious of the steady increase in demand against a limited supply of water. We can train ditchriders to deliver water effectively and point out ways and means to save this valuable commodity. However, the big savings in water can only come from knowing where and how much is needed, when, and for how long. The "where", "when" and "how long" are relatively easy to answer, but the "how much" requires the use of measuring devices.

The irrigation branch's Flow Monitoring Program began from just such a need says Jack Ganesh, P. Eng., evaluation and monitoring engineer. The objective of this relatively new program is to provide assistance to irrigation districts by providing flow and spill data to improve their conveyance efficiency and reduce waste. Presently, three irrigation districts are involved in the program (Lethbridge Northern, Taber, and United Irrigation Districts).

The basic requirement in water metering is being able to sense water level. More than 3000 years ago the Egyptians developed a system to measure the water height in the Nile River using a Nilometer (an early form of a staff gauge). Today, a canal or lateral system is monitored by installing water metering stations at the upstream headgate and at all the spillway outlets. The water metering station in the irrigation branch study consists of a weir, staff gauge, and stilling well with a recording device inside.

Weirs are the simplest least costly devices that can be built and used to measure the flow in open channels. A weir can be defined as an obstruction built across an open channel over which water flows (usually through an opening or notch). Flow through a weir is directly related to the level measured. The three types of weirs used are sharp-crested rectangular, cipolletti and broad-crested.

Every one of our stations includes a staff gauge which is simply a fibreglass gelcoated graduated scale from which the height of the water (head) can be determined, says Ganesh. The staff gauge provides a quick inexpensive method for obtaining a visual reading of water level. However, someone must be there to manually read it.

For practicality, the water monitoring staff installs a float and recording device in the stilling wells just upstream of the weir. The up and down movement of the float with the water level is recorded on a Steven's mechanical recorder chart by means of a pen. The newer electronic instruments (data loggers) employ solid state circuitry that converts the float's motion to electronic impulses stored in the data loggers. The data logger is set to switch on and off at timed intervals and stores this information in its memory.

Choosing the right site and maintaining it during the season is very important to obtain accurate results.

In choosing a site, it is important that a downstream check or some other control structure does not affect the proper functioning of the weir. During the season, it is also necessary to flow meter the canal to check the calibration of the weir. The weir and the immediate area of the canal must be kept free of aquatic vegetation and trash to ensure consistent and accurate measurement, adds Ganesh. Rain gauges are also installed at these sites to keep information on precipitation amounts during the season.

The ditchrider is provided with rating curves of the weirs; the theoretical at the start of the season and the actual when it is available. At the end of each month, the data from the data loggers is "dumped" into a "data transfer module" and brought in to the office. Here, by the use of a computer, the data is "crunched" to produce printouts of daily flows including daily minimum and maximum, daily average, accumulated daily flow (volume), and the total for the month. This is done both in tabular and graphic forms. Within a two week period, all printouts are completed and reviewed. Information from the mechanical Steven's graphic recorders cannot be processed that fast.

With printouts in hand, we sit down with the operation and administrative heads of the district and discuss the results, says Ganesh. In many cases we can see ways and means of reducing their spill water. Once the ditchriders see the results, they pay more attention to

One of thirty-four typical Alberta Agriculture water measuring stations. This one utilizes a cipolletti weir.

their spill water. It is possible to reduce spill water down to less than 9% of the inflow. The most important part of the program is using the results to improve the efficiency by reducing the spillage, he explains.

It is our intention, says Ganesh, to use this program as an extension tool to demonstrate to irrigation districts and their operating staff what is achievable in terms of reduced spillage and improved efficiency. Once the ditchrider knows "exactly" how much water he is running and spilling in his canal at any given time, he is in control of the efficiency of that canal, he adds.

Technologists visit metering site every 2 weeks to retrieve data and check instrumentation.

For more information please contact Jack Ganesh, P. Eng., Irrigation Branch, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta T1J 4C7. Telephone (403) 381-5869. ■

FROM THE FARM PROSPECTIVE

Fluctuating Flow Rates

The amount of water pumped through a sprinkler irrigation system is not necessarily constant. Flow rates can change by as much as 50% without changing the equipment. Fluctuating flow rates can cause problems for the irrigation district and the farmer, especially when the availability of on-farm water storage is at a minimum. In some situations, the only practical solution left for the ditchrider is to spill excess water when on-farm demands intermittently diminish to prevent periods of water shortage to the farmer when system demands are greatest.

A center pivot sprinkler system with a corner arm is a good example, says Leigh Morrison, Irrigation Specialist. The flow rate will vary from 55 ℓ/s when the corner arm is trailing to 85 ℓ/s when the corner arm is extended and the end gun is on. The flow changes by 30 ℓ/s in twelve hours. This amounts to a volume of 312 m^3 in the twelve-hour period.

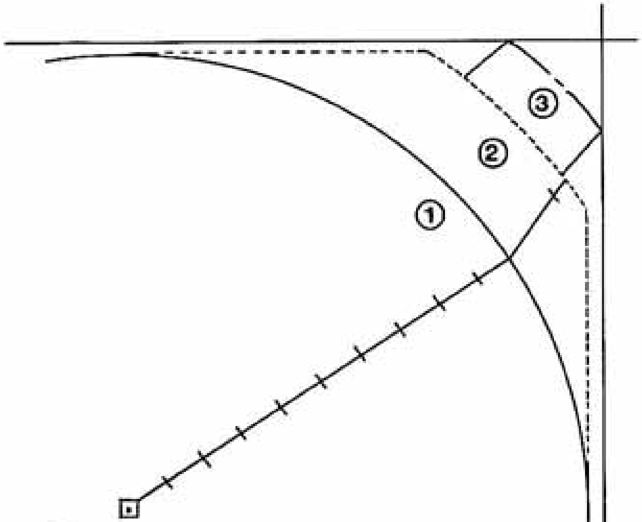
A dugout that measures 36 m x 18 m x 4.5 m will easily accommodate this excess water. The water level will change by only 0.5 m. If, however, the dugout is 12 m x 12 m x 3.5 m, the water level will fluctuate almost 3.0 m. Any smaller dugout than this is very difficult to manage and some spill should be expected. When the dugout is large enough and operated at a level less than full, this system is much easier to manage and the potential for spill is greatly reduced.

A side-wheel roll irrigation sprinkler system presents a different problem. The flow rate can change by up to 19 ℓ/s on a quarter section with an 18 m elevation difference. But unlike the pivot, this change happens over twelve days. The corresponding volume is over 4500 m^3 in the twelve-day period. Contrary to the opinion of some, providing a "buffer" dugout of this capacity or magnitude would do little to solve this type of fluctuating flow and delivery requirement, let alone its impracticality of size.

In this case, if a side-wheel roll sprinkler was equipped with such devices as flow control nozzles, the flow rate would be nearly constant. This again makes the system manageable and greatly reduces the potential for spill.

Two approaches are brought forward from these examples. One approach would be to have sufficient on-farm storage to compensate for system flow fluctuations. The other approach is to have a controlled constant flow rate.

SYSTEM FLOW RATES



① MAIN SYSTEM ONLY ..... 55 l/s

② CORNER FULLY EXTENDED .... 75 l/s

③ CORNER EXTENDED AND END GUN ON .... 85 l/s

VARIATION .... 30 l/s

However, cooperation is the key. Cooperation between the farmer, irrigation district and the irrigation branch will assist in efforts toward a more manageable and water efficient system.

For more information please contact Leigh Morrison, Irrigation Specialist, Irrigation Branch, Alberta Agriculture, 770 - 6 Street S.W., Medicine Hat, Alberta T1A 4J6. Telephone (403) 529-3616 or your nearest Irrigation Specialist.■

IRRIGATION IN ALBERTA — FACTS AND IMPACTS

The sum of $350 million represents a significant public investment (the Oldman Dam), but we must also acknowledge the significant commitment and capital investment by Alberta's irrigation farmers. During the period 1975-1987, irrigation farmers spent $38 million as their share of rehabilitation costs, $294 million for farm irrigation systems and $208 million for farm system operation and maintenance. This total of $540 million closely parallels public investments by Albertans from government for irrigation system rehabilitation.■

CAN YOU AFFORD NOT TO FENCE?

Canal Banks and Cows Don't Mix.

Cows need on the average about 50 litres of water a day to aid in digestion and other body processes When they are drinking directly out of a recently rehabilitated canal, the banks often suffer the consequences of these visits to the watering hole. As the herd comes for its twice daily drink, they trample and sink into the soft and wet interior canal sideslopes. This, over a period of time, causes the banks to slough into the canal bed. Yet still another problem is that cattle often foul the water by defecation after drinking. Fencing both sides of the canal is obviously one answer to solve these problems, yet creates a "watering problem" for the cattlemen.

In years bygone, pasturing of ditchbanks was an accepted and practical method of controlling many weeds and utilizing forage along irrigation ditchbanks and adjacent right of way. Not so today, with modern day membrane liners.

Where a buried membrane liner has been installed, it is a must to fence. If not, cattle, over time, will sink up to their knees in the saturated earth cover material over the liner. As more of the earth or armour material sloughs down the bank, the hoofs begin penetrating the liner causing irreparable damage.

The question then arises, how do cattlemen water their herd, if the cattle are not allowed direct access to the canal? The Bow River Irrigation District (BRID) developed a unique plan whereby they provide a small stock watering dugout alongside the canal. When done during a rehabilitation project, the earth may be used to help build canal banks.

The entire turnout/dugout system is often designed to be self-balancing, thus eliminating the need for the ditchrider to deliver water on demand. Some of the dugouts have been built in low lying seepage areas alongside the canal and are kept full by groundwater. Still others are pumped full or are fed by syphon tubes over the bank. The cost of building these extra watering systems is borne entirely by the district. Jake Friesen, manager of the BRID, feels the extra dollars spent are more than worthwhile when one considers the cost of repair of worn-down canal banks. The cost to the district is often less than $600 per dugout.

When questioned as to how the individual stockmen view this new watering option, he stated "they are very satisfied, I have only received a couple of very minor complaints."■

PUMPING WATER WITH SOLAR POWER

The New Alternative

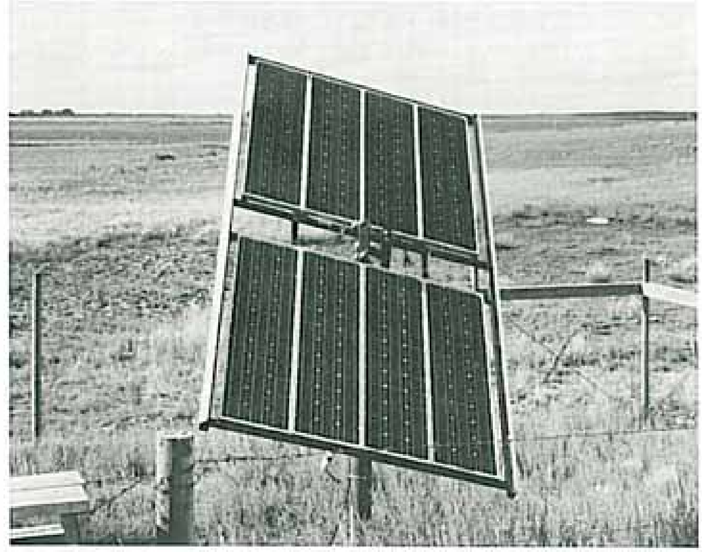
Testing of wind and solar water pumping systems has been carried out at the Lethbridge Wind Research Test Site for the past six to eight years. Interest in using these systems continues to grow, in part because of the dry years experienced in western Canada over the last four to five years. The main use for these systems, particularly the wind pumps, has been by farmers and ranchers wanting to pump water for cattle in remote locations. Until recently, few if any solar pumping systems were purchased because the capital cost of the solar panels and pumps was too high to compete seriously with the lower priced wind pumps.

Since 1987, the price of solar panels has decreased significantly and competition between solar and wind pumping systems is now much closer. This is particularly true for shallow (9 m lift) pumping requirements such as wells, dugouts, drainage systems, etc. The reduction in the cost of the solar pumping systems, combined with good performance numbers and low maintenance requirements, is making solar power an attractive alternative for pumping water in many locations.

In 1988, the land evaluation and reclamation branch, in cooperation with Jensen Engineering Ltd. (Olds) and the St. Mary River Irrigation District (SMRID), installed a solar pumping system on the SMRID main canal (northeast of Bow Island) to pump water from an existing interceptor drain. This system replaced two small wind turbines which had failed to perform.

The solar system consists of an eight panel tracking system and small variable voltage DC centrifugal pump. The unique feature of "tracker system" is that the solar panels move with the sun during the day to ensure that the maximum angle of sunlight is always hitting the panels. Test results from the Lethbridge Wind Research Test Site show that the tracking system is capable of pumping significantly more water during an average day than the stationary panel systems.

The pumping capacity of the eight panel unit at Bow Island was approximately 45,000 ℓ/day (reasonably sunny day). The water was pumped from the drainage sump into the irrigation canal at a lift of about 6 m. This volume was very close to the designed pumping capacity for these panels. More importantly, the sys-



Solar panel tracks sun.

tem operated continuously throughout the summer without any operational problems. A slightly larger system will be required to effectively handle the drainage flow (30 ℓ/minute) at this site, particularly during days with some cloud cover. Overall however, this system appears well suited for pumping water at locations such as the SMRID site near Bow Island, where electric power is not readily available.

If required, the solar panels can be hooked up to battery packs, which will allow the system to pump throughout the night and during cloudy periods for up to three or four days. This solar/battery hybrid configuration appears particularly well suited for situations where a continuous supply of water is required. Further testing of one of these hybrid units will take place at the Lethbridge Wind Research Test Site during the summer of 1989.

The number of solar pumping systems are expected to increase significantly throughout the prairie provinces over the next two to three years. Additional solar pumps will be installed and tested in 1989 at the Lethbridge Wind Research Test Site.

For more information contact Brent Paterson, Land Evaluation and Reclamation Branch, Alberta Agriculture, Lethbridge, Alberta at telephone (403) 381-5515, Eric Jensen, Jensen Engineering Ltd., Olds, Alberta at telephone (403) 556-8755, or Olivier LaRocque, Twin Butte, Alberta at telephone (403) 627-3630. ■

IS YOUR IRRIGATION MOTOR ENERGY EFFICIENT?

It May Be Costing You Money

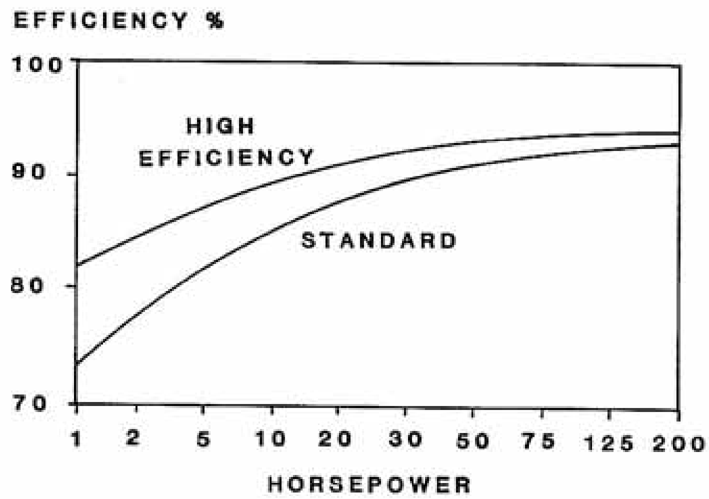
"The electric motor is a relatively efficient device," says Lloyd Healy of TransAlta Utilities Corporation in Calgary. "However, since I began working at TransAlta Utilities, I have become aware of just how much the efficiency and power factor can vary from one manufacturer to another. The difference between the highest efficient motor and the lowest efficient motor in any given horsepower rating is anywhere from 6 to 10%. Typically, as the horsepower increases, the difference in efficiency decreases."

Most 3 phase induction motors used in the irrigation industry have an efficiency rating above 80%. On this basis, some manufacturers will claim their standard motor is energy efficient. Most standard motors are designed to provide good service at a competitive price. Some manufacturers have designed energy efficient motors to provide the highest practical efficiency, at a somewhat higher cost. The improvement in efficiency is accomplished by using more and higher grade material in the motor, along with certain design changes.

The core loss (15 to 30% of the total losses) represents the energy required to magnetize the material (hysteresis) and losses due to small eddy currents that flow in the core. By using low-loss silicon electrical steels in the core, hysteresis loss is reduced. Making the core laminations thinner reduces the eddy current loss. Core losses can also be reduced by lengthening the core to reduce the magnetic density, explains Healy.

Stator losses represent 20 to 50% of the total losses. Stator loss is the heating loss as current flows through the winding conductors at a resistance "R". Lowering the resistance losses is accomplished by using larger diameter wire and using copper wire instead of aluminum wire in the stator winding. By reducing resistance, there will be a reduction in heat generated. This will result in a lower operating temperature, thus reducing losses due to less cooling requirements.

Rotor losses make up 10 to 25% of the total losses in an electric motor. In squirrel cage induction motors, the winding is actually conductive bars running axially along the rotor and joined at the ends. Reducing these losses is generally not feasible without changing the motor operating characteristics.



MOTOR EFFICIENCY COMPARISON

Stray load losses include high frequency losses in the core iron, circulating current losses in the windings, and harmonic losses in the rotor conductors. They are very elusive and as a result very difficult to reduce.

Windage and friction losses are approximately 5% of the total losses. They are made up of air and bearing friction against the rotor. Improving the bearing and the air flow design reduces the losses somewhat. However, reducing the other losses reduces the cooling requirements and a smaller fan can be used.

Changes to the construction of the electric motor are limited. Eventually the efficiency improvements conflict with other design parameters, says Healy. "One example of this is as rotor resistance is decreased to reduce losses, inrush of current increases and starting torque decreases. Increasing the air gap reduces the stray losses but increases the magnetizing current and lowers the power factor. Therefore, compromises must be made in the design," he says.

Energy efficient motors have other benefits also. This motor has a longer insulation life due to less internal heat being produced, resulting in a cooler running motor. It is less sensitive to abnormal voltage conditions as well.

Small improvements in these areas have improved the standard motor and resulted in the energy efficient motor. When comparing motors, the buyer should look at the efficiency rating and the power factor rating. When these two components are combined the price premium for the energy efficient motor may be paid back in a relatively short time through reduced operating costs, adds Healy.

For further information please contact Lloyd Healy, Agricultural Programs Engineer, TransAlta Utilities Corporation, 7th Floor, 1202 Centre Street South, Calgary, Alberta T2P 2M1. Telephone (403) 267-3775. ■

IRRIGATION REHABILITATION STANDARDS

To Be In Place By 1990

Acting upon one of the recommendations in the "Assessment of the Irrigation Rehabilitation and Expansion Program" report, the Irrigation Council has directed that irrigation rehabilitation standards be prepared. In order to guide this process, a steering committee has been named with membership from three irrigation districts, an engineering consulting firm, irrigation secretariat and the irrigation branch. Actual writing of the standards will be done by staff of the irrigation branch. After reviewing initial drafts, the steering committee will solicit constructive comments and input from all related groups including the consulting community and all irrigation districts. Following this input and preparing next to final drafts, a general meeting with all the related groups will be convened to review final drafts.

Standards will include aspects of design, materials quality and construction methods. They will provide for minimum and maximum levels of quality and allow for flexibility to accommodate differences between districts and design initiatives. Major headings will be (1) Canals, (2) Pipelines, (3) Structures, (4) Seepage Control, (5) Drains, (6) Water Control and Measurements.

Production of a final report is planned to be presented to Irrigation Council for implementation prior to any new funding program mandate in 1990.

For more information please contact Larry Spiess, P. Eng., Section Head, Irrigation Branch, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta T1J 4C7. Telephone (403) 381-5152. ■

WATER HAULER'S BULLETIN SUCCESS

Communicate your resourcefulness by having an article published in the Bulletin. Its success depends upon your help in obtaining and submitting new and useful ideas.

ERRATA

Note: On Page 2, paragraph 3, line 14 should read $EC < 2$ dS/m instead of $EC <$ dS/m.

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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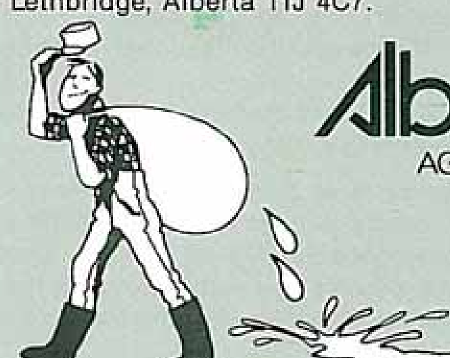

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