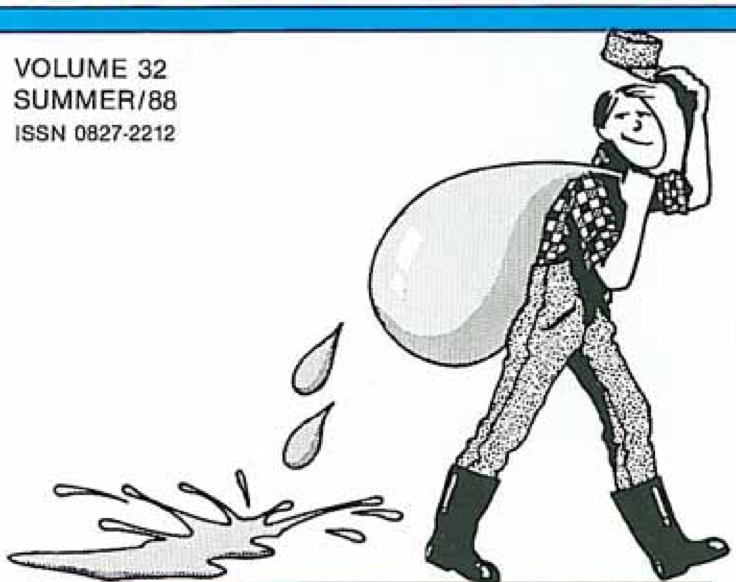
the WATER HAULER'S BULLETIN

VOLUME 32
SUMMER/88
ISSN 0827-2212

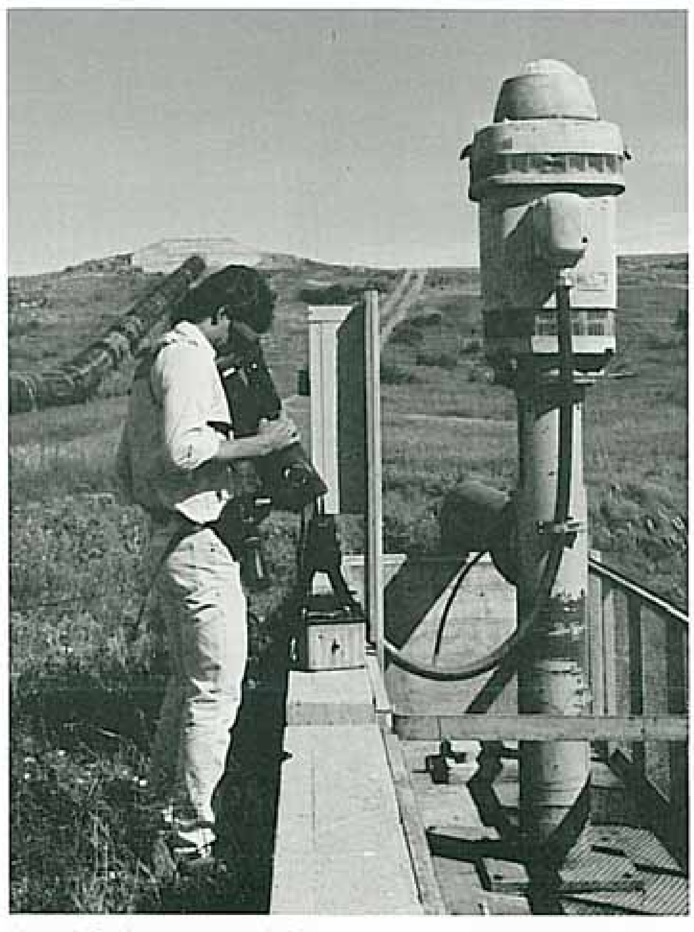


IN THIS ISSUE:

A WHITE SPOT MEANS TROUBLE

Does Your Maintenance Program Include Thermographic Inspections?

Everything in this world of ours emits heat in the form of invisible infrared radiation. Infrared Thermography (IR) is rapidly becoming a more and more commonly used preventative maintenance tool to help diagnose hidden problems in electrical and mechanical installations, building heat loss surveys, and medicine. Here in southern Alberta we located two private companies who can provide thermographic inspection services. TransAlta Utilities has a thermographic unit working out of Calgary, while Marcel Chaloux of Thermo Scan Consulting of Vauxhall provides similar services plus more agricultural oriented work such as measuring the heat buildup in stored potatoes, grain, etc.

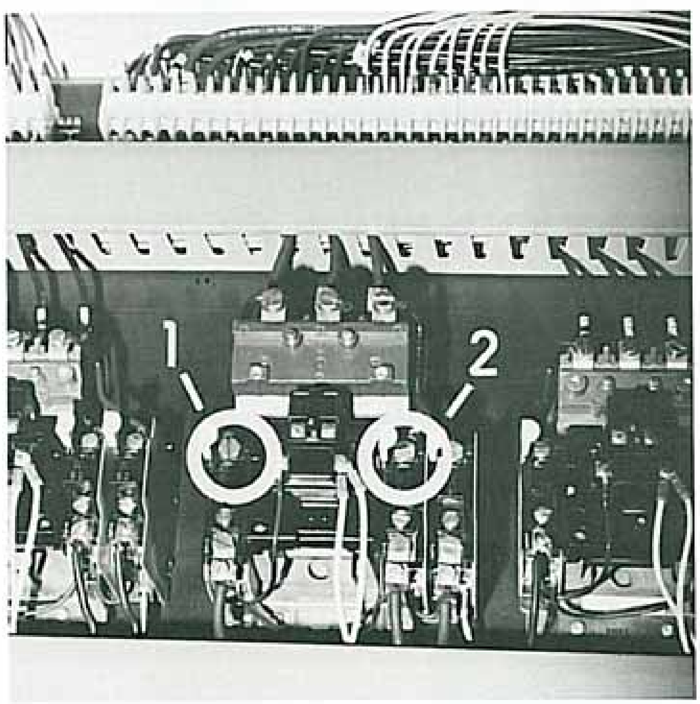


Marcel Chaloux uses an infrared camera to check for "hot spots" or problem areas in one of the SMRID's Yellow Lake pumps.

But how can IR help an irrigation district in their own maintenance program,

was the question posed to TransAlta Utilities' Verne Powell. He had this to say, "In the electrical area of pump motors and switchgear IR is used to identify potential problems resulting from component failure, loose connections, poor contacts, phase imbalance and overloaded conductors. In addition to finding these problems before they might cause expensive downtime, is the safety and protection aspect for personnel and equipment. IR surveys, for mechanical preventative maintenance, might indicate and be used to evaluate such problems as overheated bearings, heating due to lube system failure, and missing or ineffective insulation."

How does it Work? All objects emit infrared radiation which is invisible to the eye. The intensity of this emission is dependent upon the temperature of the object relative to its surroundings. An infrared camera can "see" infrared radiation and display it on a screen. Commonly used IR cameras can accurately measure temperatures of −20 to +1500° C.



Although a normal photograph does not indicate any problems in a main control panel, circle #1 has been placed around a normal connection, while circle #2 is around a loose or corroded connection.

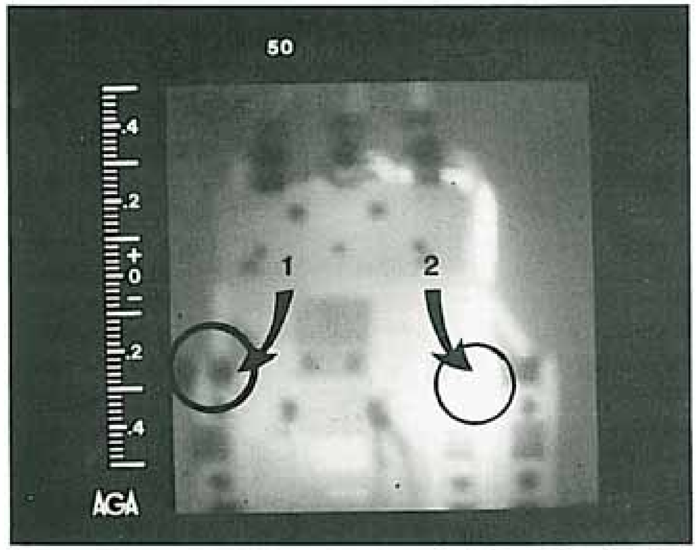


Photo: Thermo Scan Consulting

However, in this thermogram of the same control panel, the infrared camera picks up a hot white area (circle #2) which is 178°C hotter than the normal connection in circle #1. Use of a infrared camera is an important part of a preventative maintenance program.

Marcel Chaloux of Thermo Scan Consulting says "An operator using an infrared camera can measure actual temperature differences as far away as 30 metres. Normal operating surface temperatures appear as grey, while "hot spots" which indicate abnormal heat buildup appear as bright white. An experienced operator can: interpret each problem area for its severity, determine a possible cause, and often have it fixed on the spot."

The cost of having an infrared equipment scan done by either company is very minimal. Marcel Chaloux says a typical single pumping unit scan amounts to $50.00 while TransAlta Utilities bill for their service by the day. TransAlta operators say they can usually do a number of typical installations in a day (5-10) but this of course is dependent upon the distance between each installation. A detailed written report on each inspection is prepared complete with pictures and IR thermograms of any trouble spots, including suggestions for necessary action.

Spring and fall are the ideal times to have equipment inspected. Problems can be identified and repaired long before they become serious enough to shut down an irrigation pumping system. Maintenance can be scheduled rather than being forced into reacting to a crisis situation. With a once a year IR scan, your maintenance will become preventive not reactive.

For further information please contact Marcel Chaloux, Thermo Scan Consulting in Vauxhall, telephone (403) 654-4254 or Verne Powell, P. Eng., TransAlta Utilities in Calgary, telephone (403) 267-3777.■

POLYETHYLENE MARKS THIRTY YEARS

Buried Membrane Liners More Popular Than Ever

During the past three decades, buried polyethylene sheeting has been used for lining irrigation canals on an ever increasing scale. Tremendous technological strides have been made in all technical aspects from manufacturing to design engineering. In recent years, much effective work has been done to reduce the incidence of leakage and to make maintenance operations less troublesome.

In the early pioneer years of canal lining, the norm was to install a 6 mil or 8 mil low density polyethylene liner on a 3:1 side slope with an earth cover of 300 mm. Over the past 10 years, this philosophy has changed significantly with the majority of liners now being fabric woven polyethylene, with excavation and backfill taking on a broad range of dimensions. Since the first lining in 1958, a total of 391 installations have been undertaken amounting to about 486,750 lineal metres of lining (of this total, 272,000 lineal metres have been installed under the Irrigation Capital Works Program).

When we talk about the new liners being installed today, you would think you were in Star Wars IV, with liners called Fabrene TE, TFBU, TPNN, 1455 and Ruffco SS4. Approximately 28 different types of liners have been used in the irrigation districts to date, with a total of 43% being fabric woven type liners.

Of the canals studied, 29% have been excavated at 2:1, 64% at 3:1, with the remainder being at 1:1 or 2½:1. In most cases the canals were over-excavated by approximately 0.5 m and then backfilled with earth and/or gravel.

During the past five years, the trend has been to gravel armour lined canals which have a capacity greater than 1.4 m^3/s. This armouring usually consists of 0.15 m to 0.20 m of gravel, over 0.3 m to 0.5 m of earth cover. This backfill has been placed at either 2½:1 or 3:1 slopes in 80% of the canals. The main reasons given for the different excavation and backfill slopes were: soil type, right of way restrictions and canal slope stability.

In many of the older installations, there is little physical evidence left to show that a liner had been installed. This has caused problems over the years when cleaning and maintenance is required.

Without "as-builts" and field markers mistakes have happened – chunks of liner can be seen in the spoil piles after a ditch cleaning. To protect liners from the

Screened granular backfill being placed directly on polyethylene lining (depth 300 mm).

bite of the hydraulic hoe, many districts insist on having as-built plans and profiles done immediately after construction is completed. Fences should be erected around the lined sections to keep cattle out and signs posted to notify anyone of a liner's unforeseen presence.

Overall, liners installed seem to be doing the job they were designed for, to prevent seepage from the canal.

Technological advances in liner material are ensuring that a better product is being installed in the ground and not as susceptible to rodent attack, microorganisms and tear during installation. New design practices and better records are helping to ensure that canal maintenance can be carried out safely and economically without the fear of tearing a chunk out. Thirty years of product development and installation practices have made polyethylene a very viable alternative as a water barrier to control canal seepage. ■

WANT TO REPRINT AN ARTICLE FROM THIS BULLETIN?

We would like to encourage readers to reprint articles from this publication in their newsletters, newspapers, magazines, or other periodicals; but we request that you notify us before reprinting the information by calling (403) 381-5170, and add a line to the story that says: This article is being reprinted from Alberta Agriculture's Water Hauler's Bulletin.

ON-FARM GRID DRAINAGE TO CONTROL CANAL LEAKAGE AND GROUNDWATER

Alberta's Largest Grid Drainage Project.

A shallow subsurface drainage system to control canal leakage and groundwater adjacent to the Monarch Branch Canal will be initiated this fall under the ICW program by the Lethbridge Northern Irrigation District (LNID). The drains will be installed at depths of 1.2-1.6 m and 15-30 m apart on about 770 acres of saline/waterlogged land. The drainage, which was proposed by the Land Evaluation and Reclamation Branch of Alberta Agriculture, is the largest grid drainage undertaking in the history of the province. This method of reclamation was determined to be more effective in controlling the excess water problems than conventional seepage control measures.

Drainage of the 770 acres will require about 175 km of drain tubing ranging in diameter from 100 to 200 mm. About half the drainage will outlet by gravity, the other half by pump lift stations. Construction will take place over three years (1988 to 1990).

The LNID examined several seepage control alternative methods including canal lining, interior and exterior cutoff curtains, deep interceptor drainage and compacted embankments. Compacted embankments were not practical because of the wet and sandy nature of the local materials and the lack of suitable borrow. Suitable anchor material was not available for use with cutoff curtains. Natural groundwater flow was identified in the area and a midwinter water table above the canal bed eliminated the possibility of using a full canal liner. The till and sandstone bedrock underlying the sandy loam overburden undulates and a deep interceptor would be unlikely to intercept all of the seepage water. Cost of the deep interceptor was high because construction would occur below the water table in unstable soils. It is estimated that the presence of natural groundwater would result in a deep interceptor reclaiming only about 30% of the affected land.

The grid drainage option has the advantage of controlling both canal seepage and natural groundwater and has the potential to reclaim all of the affected land. The cost of the grid drainage is estimated at approximately $900/acre, which is lower than all other alternatives examined. According to Gary Buckland, Head of the Reclamation Section, it's simply a matter of "choosing the right alternative for the existing conditions".

Wolfe plough is capable of installing drain tubing at a speed of 15 m/min.

The LNID will own and maintain the entire drainage system for a warranty period of one year. Thereafter, ownership of the drainage system is turned over to the landowner. The district, however, will retain ownership and responsibility for the lift stations.

For more information contact Gary Buckland of the Land Evaluation and Reclamation Branch, Alberta Agriculture, telephone (403) 381-5159 or Duane Climenhaga, P. Eng. of the LNID, telephone (403) 327-3302. ■

VALVE OPERATION WARNING

The St. Mary River Irrigation District has come up with an innovative idea for warning farmers who receive water from district pipelines about the danger of improper valve operation or start up or shut down of their irrigation pumps. This inexpensive weatherproof decal is a visual reminder to the farmer every time he comes to operate his turnout valve. ■

ROCK GABIONS

Age Old Rock and Space Age Technology Form Very Durable Irrigation Structures.

Not long ago, it seemed that stone filled often rusting wire mesh gabions would go the way of the dinosaur. Now it looks like the new PVC coated steel wire mesh rectangular mat gabions when filled with age old Freddy Flintstone rocks are meeting with great success in irrigation works as evidenced by their new found popularity. Both the Bow River and Eastern Irrigation Districts have designed and built gabion structures.

This monolithic flexible alternative to a series of precast drop structures and rip-rap is suitable in many smaller canals. The gabion mats are less expensive to construct than a series of precast concrete drop structures and require much less maintenance.

Ice buildup, from freeze/thaw cycles, can play havoc with most structures often resulting in failure. Little damage occurs to the gabion structure as the large ice buildup begins melting in the spring time, and the huge chunks of ice break off and slide down. Gabions do not seem to be subject to the monstrous ice jams which often occur with precast structures.

Slope, rate of flow, hydraulic and other physical factors and limitations are taken into account in designing gabion mat chutes. They must be designed to satisfy the field conditions of each individual site.

According to Earl Wilson, P. Eng. (District Engineer, EID), a good rule of thumb is not to exceed a 10% slope for an upper gradient limit. If steeper, the rocks tend to shift to the downslope side of the gabion mat and cause distortion. Failure will occur when this happens. Generally when the rate of flow is within 1 m^3/s, the 225 mm thick gabion mat is adequate when filled with washed rock ranging in size from 50 mm to 200 mm. However, rock gradation should be specified according to the gabion design guide.

Construction of these chutes is not a difficult task. Number one, the channel must be over-excavated and shaped to accommodate the mat. There should be a geotextile filter below and it is advisable to provide a "cutoff" at the upstream end. This upstream edge is one of the most vulnerable parts of the structure. It must not cause undue turbulence while still being sufficiently well anchored to resist uplift and movement downstream. One method of anchoring gabions in a channel, is to lay the upstream end of the mattress in a trench excavated into the bed and side slopes. The downstream end should emerge with its top flush with the surface of the channel.

The wire units are filled by machine, however, some handwork is required to obtain an even placement of the rocks.

A number of assembled wire units are placed in position and laced together. The PVC coated wire mats are filled with rocks and then the lid secured by PVC coated wire. A trapezoidal shape can be achieved by one or two mat widths for the bed and multiple units for the side slopes. Side slopes should not exceed 1:2. Within a year or two, silt accumulates between the voids and a lush growth of grass appears.

The new PVC gabion chute structure has been found by engineers to be unique in flexibility, permeability, strength, and possesses the durability to withstand the powerful forces of nature. Recent inspection of several of these gabion mat chutes leaves one convinced that they are a reliable solution if the slope of the natural ground is less than the 10 percent.

However, if you are contemplating installing one of these gabion mat chutes please contact Steve Topping, P. Eng. of BRID, telephone (403) 654-2111; Earl Wilson, P. Eng. of EID, telephone (403) 362-3161; or Jack Ganesh, P. Eng., Alberta Agriculture, telephone (403) 381-5164; for they may have some ideas that will save you time and money. ■

A SOUND MARRIAGE

Sidewalk Blocks and Polyethylene Combine to Form A Unique Canal Liner.

Marriages are made in heaven, so the saying goes, but this marriage between black polyethylene plastic sheeting and concrete sidewalk was contrived at the Lethbridge Research Centre. Originally the idea of Dr. Theron Sommerfeldt of Canada Agriculture and Larry Spiess of the Irrigation Branch, Alberta Agriculture, the trial lining was installed as one of four different types back in the spring of 1982 in a small farm lateral at the Centre. The search then as it is still today was to find the ultimate low cost canal lining material. The 1982 Fall Edition of the Water Hauler's Bulletin reported on this unique combination.

With the concrete sidewalk block system: the channel is trimmed and graded to a smooth surface, a herbicide applied to prevent weed growth, the plastic sheeting laid down and keyed into the upper part of the sideslope and finally the 600 x 600 x 50 mm unreinforced concrete sidewalk blocks laid directly on top of the liner.

According to Dr. Sommerfeldt, the blocks have performed well since installation. The plastic appears to be in the same condition as when installed and this has been confirmed by recent laboratory tests done by the manufacturer Canadian Industries Limited. A few weeds have grown between the joints. Their roots extend under the blocks between the plastic and the blocks themselves, however, no damage has occurred. The rigid blocks and flexible liner are not suffering any damage from frost heaving and normal problems associated with shifting soil.

Base requirements for installation are less demanding than for installation of the rigid linings, such as concrete. No earth pad is required. For simple farm delivery ditches a 1½:1 sideslope is probably adequate, however, for larger ditch sections where more than 1 block is required along the sideslope a 2:1 sideslope would be more stable. A smooth, flat, channel surface is necessary to obtain a relatively good fit between adjoining blocks.

"The ditch is on a steep 1% grade. Because of the rapid flow of water and turbulence, it is difficult to obtain accurate depths of flow for determining the coefficients of roughness" says Dr. Sommerfeldt. His measurements place the coefficient of roughness at .016.

The cost of materials converted to today's prices for the "Sommerfeldt/Spiess liner" is around $8.00 a square metre. For the small section of ditch used in this experiment, labor requirements were considerable during construction, but for a large project much of the hand labor could be reduced by the use of machines.

Dr. Sommerfeldt feels the block system is unique in that the blocks can be removed should the plastic membrane ever become damaged. A new section of the liner can be installed and the blocks replaced with little disruption and no specialized machinery. He contends that this marriage of two different types of lining materials has its place here in southern Alberta and will be economical and sufficiently durable to withstand the rigors of our often harsh climate. Both men wish to see a larger lateral requiring multiple adjoining blocks on the sideslopes be lined with their unique system.

For further information please contact Dr. Theron Sommerfeldt, Soil Science Section, Canada Agriculture, telephone (403) 327-4561 or Larry Spiess, P. Eng., Research, Planning and Monitoring Section, Irrigation Branch, Alberta Agriculture, telephone (403) 381-5152. ■

The sidewalk blocks, because they are not joined at the butt, have not suffered any cracking or misalignment from frost action.

FROM THE FARM PERSPECTIVE

Irrigation Pumping Sumps

The rehabilitation of irrigation delivery canals and laterals has afforded the opportunity for individual irrigators to have their pumping diversion facilities upgraded. These improvements are often in the form of eliminating old weed infested or seeping pumping ponds and/or merely providing more convenient or tidier installations.

However, these upgraded installations are not without their shortcomings if not properly designed. The "wet-well" from which an irrigation pump draws its water, regardless of the type and style of the sump and its supply conduit, must be considered as nothing less than an integral extension of the pump's intake.

There are several factors that must be considered in the design of a pumping sump and its impact on the operational and maintenance concerns of the pump itself:

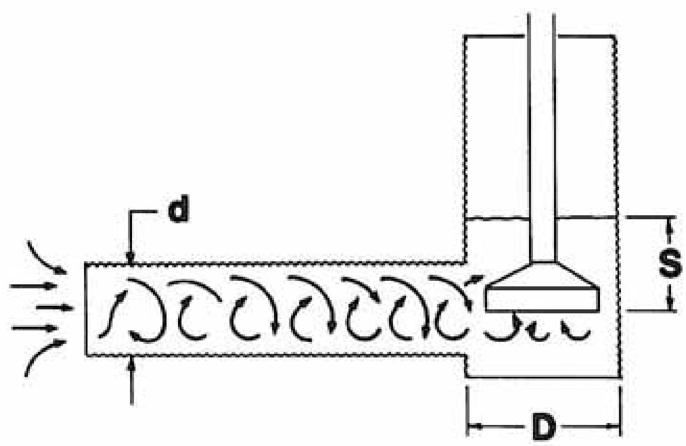
1) the "hydraulic state of the water" as it enters the pump intake pipe;
2) the amount of "bed-load" or siltation in suspension in the water as it is drawn to the pump intake pipe;
3) the amount of trash collected within the sump and around the pump intake pipe.

In essence, all of the above factors, but primarily the first two, relate strongly to the velocity of the water moving from the source of supply (i.e., irrigation canal/lateral) into and within the sump. For any given flow rate of water, the most effective way to control this velocity is through adequate sizing of both the inlet conduit as well as the sump well, including proper orientation of the actual pump intake pipe within the sump.

Irrigation districts have some concern with the configuration of these sumps as well. As the irrigator tries to ensure an adequate depth of water within the sump to provide adequate submergence of the pump intake pipe orifice, some installations then force undesirably high checking of water within the canals. Otherwise vortexing of the pump intake water in the sump could result, developing damaging pump cavitation.

The facility to screen-out trash has not been adequately handled in a lot of installations as well. Trash screen boxes on pump intake pipes are very inaccessible to be properly cleaned. Self-cleaning screens within a closed sump are a wasted expenditure, for unless the trash buildup is fully removed from the sump, simply spraying the material off of a screen is only an acutely temporary solution at best as the trash continues to accumulate within the well.

The diagram below illustrates a common sump and intake configuration with the smaller, typical 450 mm ϕ intake and 1200 mm ϕ sump diameters providing for high intake velocities and consequently, considerable turbulence. Compounding the problem is the orientation of and the necessary placement of the pump intake in a shallow sump well with the orifice right where the turbulence is likely to be the greatest. Not only is there little opportunity for siltation settlement but the water turbulence increases the potential for unstable hydraulic conditions into the pump's suction intake.

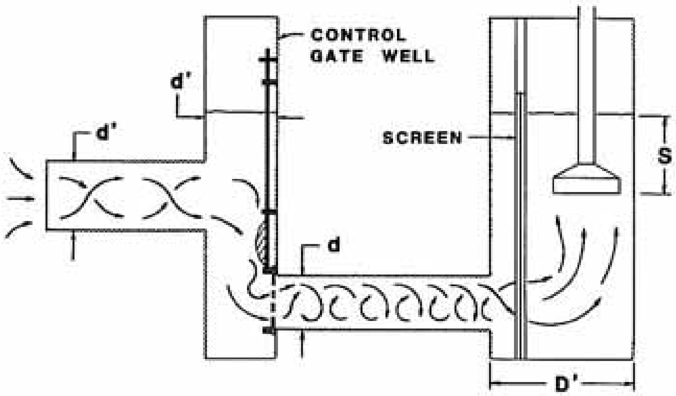


UNDESIRABLE DESIGN

It is clear then that the most effective way to satisfy most of the concerns is to arrive at a low velocity of flow into the turnout conduit from the canal to reduce the bed-load draw. This can be achieved, for example, by an installation such as is delineated (see next page) where an offset or staggered intake conduit is utilized.

The advantages to this type of installation are:

1) Larger diameter inlet conduit from canal that ensures low velocities.
2) Smaller diameter inlet conduit to sump well and associated control slide gate which are more economical.
3) Individual gate well for improved operational access and cleaner slide gate operation. (Gate well diameter may have to be determined for maintenance access).
4) Larger diameter "still-water" pumping sump of moderate depth.



COMPROMISE DESIGN

5) Lower canal checking requirements.
6) Slide-in/slide-out trash screens that can be cleaned outside the sump and do not become imbedded in silt.

The attempt is to restrict intake velocities at the canal diversion point to less than 0.3 m/s. Some typical dimensions for a variety of common flows are listed in the following table.

TABLE 1

Maximum Delivery Rate	d'	d	D'
45 L/s	450 mm	450 mm	1200 mm
85 L/s	600 mm	450 mm	1525 mm
130 L/s	750 mm	600 mm	1800 mm
190 L/s	900 mm	600 mm	1800 mm

For more information please contact Wally Chinn, P. Eng., Irrigation Development Section, Irrigation Branch, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta. Telephone (403) 381-5143. ■

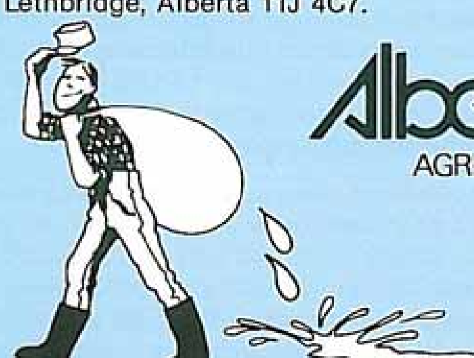
WATER HAULER'S BULLETIN SUCCESS

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.

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) 381-5170, Lethbridge.

Published quarterly by the Irrigation Branch, Irrigation and Resource Management Division, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta T1J 4C7.



Alberta AGRICULTURE