Saskatchewan
Watershed
Authority

WATER EFFICIENCY ON THE FARM

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WATER EFFICIENCY ON THE FARM

INTRODUCTION

"Water is essential to the Canadian economy. Whether in the context of generating electricity, raising crops*, developing the oil sands, producing forest products, or manufacturing consumer goods, the economic productivity of Canada is deeply connected to water. Canadians feel water is critical to the country's future and identity, and consider Canada's perceived abundance as a matter of sovereignty."* [1]

Water conservation and efficiency plays a key role in agricultural risk management and drought preparedness. Conserving Saskatchewan's water resource will be an important part of ensuring the sustainability of the agricultural industry into the future. Worldwide, an increasing number of countries are now considered to be "water scarce", meaning that they no longer have the water necessary to grow their own food. This provides Saskatchewan with both a warning and an opportunity. With responsible use of our water we can continue to prosper and grow economically, taking advantage of the opportunity to increase our exports to these countries that no longer have the capacity to grow their own food.

Economically, our province is growing, and with this growth comes an increased demand on water supplies. There will be increasing pressure on all sectors to prove efficient use of this precious resource. By implementing water conservation and efficiency practices, producers can ensure that their operations are sustainable. Responsible water management also has the ability to effectively increase production, which will benefit us with increased income while expanding the opportunity for increased output in all sectors.

We must realize that our water, although perceived as abundant, is a finite resource and that the more we conserve it today the better off we will be tomorrow. Adopting new management practices provides an opportunity for increased quality of life, economically and environmentally.

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1 Nik Nanos, "Canadians overwhelmingly choose water as our most important natural resource." Policy Options, July-August 2009

IN THE FARMHOUSE

Reducing water waste in the farmhouse requires a short-term investment of time and money, which will ultimately translate into long-term savings. Water efficiency does not mean that you need to give up convenience or comfort. It means that you are reducing pressure on your water source and delaying the possibility of having to find and pay for new sources by:

(a) **reducing** unnecessary use;

(b) regularly checking for and **repairing** leaks; and

(c) **retrofitting** existing taps, toilets and appliances.[2]

(a) REDUCE

- Ensure **taps are completely turned off** after use.
- **Do not run water** while washing your hands or brushing your teeth.
- **Plug the sink** while shaving.
- **Place a bucket** near the tub and sink to **collect discarded cool water**. Use this to water plants or feed pets.
- **Plug the sink** when washing or rinsing dishes.
- **Wash full loads only** when using your dishwasher and doing laundry.
- Use **demand-initiated regeneration** (DIR)[3] water softeners if you need to soften your water. These softeners use much less water than traditional softeners by responding to the amount of water used and the actual hardness of the water, rather than using a timed schedule.

(b) REPAIR

- Replace **worn washers** on faucets if leaks are coming from the spout.
- Replace the **o-ring** if there is leaking along the faucet handle.

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2 Water Use in Your Home: What You Need to Know to Use Less and Spend Less. Please use this resource for further details on these and other recommendations. You can find this resource at http://www.swa.ca/WaterConservation/default.asp or contact the Saskatchewan Watershed Authority at 306-694-3900 to receive a hard copy while quantities last.

3 Free drinking water. http://www.freedrinkingwater.com/water-education2/48-home-water-softener-basic.htm

- Repair a leaking toilet and save as much as 330 litres of water daily. You can check if your toilet is leaking by placing food colouring in the tank to see if any seeps into the bowl. If this is the case, you need to **fix either the flapper, the seal around the flapper or the fill valve**.[4]
- **Regularly check copper pipes, hose clamps and dishwasher and washing machine hoses** and replace when necessary.

(c) RETROFIT

- The toilet uses more water than any other appliance in the home. **Replacing your 13-litre or higher flush model toilet with a 6-litre or less** model can save a significant amount of water daily. Pre-1980's models of toilets can use more than 22 litres.[5]
- **Insulate your pipes** to decrease the wait time for hot water to run from the tank to your faucets, or replace your tank with an **on-demand/instantaneous hot water system** that can reduce water loss if placed close to the bathroom. This means considerably less water is lost down the drain while waiting for the tap water to heat up. This also means considerable savings on your energy bill as heat is not lost through tank walls and water pipes.
- **New efficient showerheads reduce use by around 50% of previous efficient models** and are generally well-received due to increased flow velocity as a result of aeration. With a relatively inexpensive investment of $8 – $50 you can increase household water savings of 10 – 40 litres per capita per day (lcd).
- **Retrofitting a high volume kitchen or bathroom faucet** with an **aerator** is simple and economical. It can reduce water used via household faucets by 50%.
- **High efficiency washing machines** can result in an annual savings of approximately 35,000 litres for each top-loading machine that is replaced.

4 WikiHow http://www.wikihow.com/Fix-a-Running-Toilet
5 Saskatchewan Watershed Authority http://www.swa.ca/WaterConservation/ToiletRebateProgram

IN THE FARMYARD

Outdoor water use can put a substantial amount of pressure on water sources. In Saskatchewan, water use in the summer increases anywhere from 30 – 75%, depending on weather such as drought or excessive heat. Improving outdoor water efficiencies will provide considerable benefits for your water source and your water infrastructure. Water efficiency in the farmyard can be addressed through:

(a) **reducing** water use by implementing **beneficial management practices (BMPs)** and

(b) **repairing** leaks.

(a) REDUCE

Residents can significantly reduce their outdoor use of tap water with good planning, thoughtful use of stored rain water, and xeriscaping. A one-millimetre rainfall on an 8 by 15-metre house roof amounts to approximately 120 litres of water, and during a storm a property can easily receive several millimetres. Rain water collection offers homeowners a water source that is usually warmer than outdoor tap water, subsequently making it better for plants as well as for washing vehicles.

(i) XERISCAPING

Farmyards can be very large areas to maintain and often water is limited, therefore it is helpful to adopt BMPs to best utilize that water source. Xeriscaping is the practice of "environmental design of residential land using various methods for minimizing the need for water use."[6] Once a landscape is established using xeriscaping principles, water use is minimized and often eliminated. Weeds are naturally controlled and grass coverage is minimal. Benefits include less time

Photo courtesy of Arlene Unvos

6 http://dictionary.reference.com/browse/xeriscape

spent maintaining the yard through watering, mowing grass and pulling weeds, and you are left with a yard that is resilient, colourful and low-maintenance.

Some of the principles of xeriscaping include:

- **Reduce the size** of your lawn to an area that is determined by what you actually use.
- Landscape using **drought resistant or native trees, shrubs and flowers**. Once established, these will thrive without added water, pesticides and fertilizers. To help choose appropriate plants for your area, go online to see Agriculture Canada's *Plant Hardiness Zone Map of Canada*: http://sis.agr.gc.ca/cansis/nsdb/climate/hardiness/intro.html
- Choose **appropriate grass seed** for the climate.
- The landscape should be designed with the topography in mind. Ensure that plants with **higher water needs** are located where water will collect.
- **Add organic matter (compost)** to your soil to improve water penetration and retention. To help you get started with composting go to: http://gardenline.usask.ca/yards/compost2.html
- **Add mulch**, which helps to moderate soil moisture, reduce erosion, suppress weeds and act as food for your plants. There are various products that can be used as mulch. For information on appropriate mulch go to: http://gardenline.usask.ca/yards/mulching.html
- **For more information** please see:
    - *Water Use in Your Home: What You Need to Know to Use Less and Spend Less*, available online at www.swa.ca or contact the Saskatchewan Watershed Authority for a hard copy while quantities last;
    - *Creating the Prairie Xeriscape: Low maintenance, water-efficient gardening*, by Sara Williams. University of Saskatchewan Extension Press, 1997; and
    - http://gardenline.usask.ca/yards/xeri1.html

IN THE FARMYARD

(ii) LAWN WATERING

If you are not quite ready to xeriscape your yard, there are a number of techniques to ensure your lawn receives the right amount of water and that water is not wasted due to over-watering or excessive evaporation.

- **Watering should only** be done when the temperature is between 10°C and 20°C. Watering when it is cold leaves your lawn susceptible to disease. Watering when it is hot results in evaporation causing shallow root systems to develop, leaving your lawn susceptible to drought.
- **Water in the morning** between 6 am and 10 am. Temperatures are lower and winds are calmer.
- **Watering systems** should be designed so that they water only the lawn and not the area around the lawn that doesn't require watering.
- Your lawn should never be cut shorter than six centimetres. Any shorter and your lawn becomes significantly more susceptible to drought. **To maintain a healthy lawn** during long periods of hot weather it is beneficial to leave the length between eight and ten centimetres.
- **Aerate** your lawn periodically.
- If you have a lawn irrigation system, **use timers with rain shutoff devices** that prevent watering during rain or after rainfall.
- **Water only the amount necessary**. A good rule of thumb is to set out a shallow container, such as a Frisbee or a tuna can, and when it is full, the lawn has had sufficient water for that watering.

(iii) RAIN WATER COLLECTION

Rain water collection can be as simple as a rain barrel under a downspout from your roof, a cistern or a series of water collection ponds. The design you choose will depend on your outdoor needs (e.g. water needs of the vegetable garden) and your collection capacity (e.g. roof size, topography needed to develop collection ponds, cistern size, etc.).

- Common commercial **rain barrels** vary from approximately 50 litres to over 200 litres. Barrels range from a few dollars for a home-built model to several hundred dollars for a large retail model with several options. Please see *Water Use in Your Home: What You Need to Know to Use Less and Spend Less*[7], for instructions on how to build your own rain barrel.
- Impervious surfaces such as paved driveways, cement walkways or patios can all be designed to direct water to collection ponds or cisterns through pipes or landscape grading. Be sure that your cistern is **covered with a screen** or some other barrier that will protect children and animals from accessing it.
- **Cisterns** should be located near a catchment area or underground. In underground systems, the surrounding area should be graded and sloped away to prevent pooling and contamination from surface water.
- **Rain water** can be used for potable purposes but must have filtration and treatment systems added.
- Many designs for **rain water harvesting** are available online. However, it is recommended that your system be engineered to ensure functionality for your personal needs.

(b) REPAIR

- **Regularly check and maintain** your irrigation system to ensure there is no leakage from broken pipes, sprinkler heads or seals. Signs of leakage underground include overly green areas of turf or soggy areas along the lines or sprinkler heads.
- **Replace** broken hoses immediately.
- **Check and repair** leaking taps regularly.

7 Please use this resource for further details on these and other recommendations. You can find this resource at http://www.swa.ca/WaterConservation/default.asp or contact the Saskatchewan Watershed Authority at 306-694-3900 to receive a hard copy while quantities last.

WATER EFFICIENCY AND BENEFITS TO YOUR SEPTIC SYSTEM

Water conservation is beneficial for septic systems. Continual saturation of the soil in the drain field affects the quality of the soil and its natural ability to remove toxins, bacteria, viruses and other pollutants from the wastewater. Following these simple steps will go a long way in reducing the amount of water you use.

- **Ensure your toilet's reservoir** is not leaking into the toilet bowl. Add five drops of liquid food colouring to the reservoir before bed. If the dye is in the bowl the next morning, the reservoir is leaking and repairs are needed.
- **A small drip from a faucet** adds unnecessary water to your system every day.
- Selecting the proper load size on your **washing machine** will reduce water and energy waste. If you cannot select a load size on your washer, run only full loads of laundry. A new Energy Star high efficiency clothes washer uses up to 35% less energy and up to 60% less water than a standard model.
- **A septic tank must be watertight**. Water entering from surface runoff or groundwater will reduce the storage capacity for wastewater. Wastewater leaking from the tank can threaten groundwater quality. The tank should be installed in accordance with the manufacturer's instructions.
- **Water purification systems** (water softeners, purifiers, etc.) can add hundreds of litres of water to the septic tank. This can agitate the solids, which will plug filters and cause problems with your septic disposal system.
- **Garbage disposal systems** add unwanted solids to the tank causing more frequent pump-outs. Composting is a safe, natural way to get rid of that unwanted vegetable refuse and turn it into valuable organic matter.
- **Install low-flow toilets**.[8]
- **Install aerators** on all taps in the house.[9]

8 Onsite Wastewater Treatment & Disposal-System Maintenance http://www.health.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=d657dfb1-2869-4f72-a5ad-7198754accb3&MediaID=3323&Filename=owts-maintenance-mar-2009.pdf&l=English

9 Ibid.

LIVESTOCK

(a) DRINKING WATER NEEDS OF FARM ANIMALS

Water intake varies among livestock species and breeds, and depending on maturity, over stages of production and the environment.

Table 1: Average daily water requirements (water use/consumption in imperial gallons per day or gpd) – Source: Alberta Agriculture[10]

TYPE OF ANIMAL	ANIMAL SIZE	GPD
Beef		
Feeders*	550 lb.	4.0
	900 lb.	7.0
	1250 lb.	10.0
Cows with calves**	1300 lb.	12.0
Dry cows**	1300 lb.	10.0
Calves**	250 lb.	2.0
Swine* **		
Farrow — finish		20.0/sow
Farrow — late wean	50 lb.	6.5/sow
Farrow — early wean	15 lb.	5.5/sow
Feeder	50 – 250 lb.	1.5/sow
Weaner	15 – 50 lb.	0.5/pig
Horses, Bison, Mules		10.0
Household use: People		60.0/person
Elk, Donkeys		5.0
Ostriches		1.0
Dairy		
Milking cow** (Holstein)		30.0
Dry cows/replacement heifers (Holstein)		10.0
Calves	to 550 lb.	3.0

10 Government of Alberta. Agriculture and Rural Development http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1349

Table 1: Average daily water requirements – continued

TYPE OF ANIMAL	ANIMAL SIZE	GPD
Poultry		
Broilers		0.035
Roasters/pullets		0.040
Layers		0.055
Breeders		0.070
Turkey growers		0.130
Turkey heavies		0.160
Sheep/Goats		
Ewes/does		2.0
Milking ewes/does		2.0
Feeder lamb/kids		1.5
Deer, Llamas, Alpacas		2.0

* For peak demand on hot summer days above 25°C — multiply gpd x 2.
** For peak demand on hot summer days above 25°C — multiply gpd x 1.5.
*** The numbers for all types of swine and milking dairy cows include wash water.

(b) OUTDOOR LIVESTOCK PRODUCTION SYSTEMS

Outdoor production systems in Saskatchewan, such as cow-calf, bison, sheep, goat, horse and wild game operations, mainly use water for livestock consumption. Limiting livestock water consumption would negatively affect production. To determine your operation's livestock consumption needs, see the Alberta Agriculture online calculator at: http://www.agric.gov.ab.ca/app19/calc/livestock/waterreq_dataentry1.jsp

There are, however, other on-farm water uses that provide opportunities to conserve water.

- **Fix leaks**. A leaking pipe joint or dripping faucet could contribute to the loss of 10 gallons per unit per day.
- **Secure water bowls** by constructing concrete bases to prevent shifting and water from leaking/overflowing the side of the trough.

- Pay attention when filling tubs or tanks. A water tub that is accidentally left to spill over while filling could be responsible for the loss of 5 gallons per minute. **Install a float with a shut-off**.
- **Collect rainwater from the barn roof** to use for watering livestock. This collected water should be tested to determine the suitability for livestock watering. These parameters can be inserted in the water quality calculator at the Alberta Agriculture website at: http://www.agric.gov.ab.ca/app84/rwqit
- **Metering and recording water** use can assist in identifying potential leaks and allow for analysis to improve efficiencies.
- **Implement off-site watering systems**, which can potentially improve cattle performance, grazing distribution, source water quality, pasture utilization, and maintain proper functioning of riparian zones. The various watering systems can be found in the publication *Livestock Watering Systems In Saskatchewan: Producer Experiences*.[11]

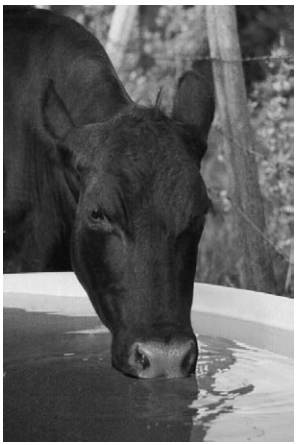

Photo courtesy of Tracy Harrison

(c) IN-BARN PRODUCTION SYSTEMS

In-barn production systems, such as dairy and hog operations, have greater potential for water conservation measures because they use water for both livestock consumption and wash water. Dairy producers also use water during milking.

As with outdoor production systems, maintaining and repairing water distribution systems to prevent leaks in piping, hoses and nozzles is important.

11 Saskatchewan Watershed Authority. Stewardship http://www.swa.ca/Publications/Default.asp?type=Stewardship

Other water saving ideas for in-barn production systems include:

- A Prairie Swine Centre study showed significant water savings for hog operators from **switching the style of watering systems**. "By replacing standard bite water drinkers with ball-bite water drinkers the research documented a 35% decrease in total water usage."[12] This has the additional benefit of reducing liquid manure production/volume, resulting in substantial savings to the producer.
- Historically, most producers used the bell-style watering system—a circular trough with a gravity-fed reservoir—to provide water to growing birds. Recent advances in poultry watering equipment have introduced a nipple-style watering device that contributes to drinker hygiene and reduced water spillage. For cage-reared poultry, water wastage is reduced through the use of a cup water device or by installing a trough under the water nipples.[13]
- **Switching to wet-dry feeders** for hogs was also shown to improve water use efficiency.
- **Controlling the in-barn temperature** may reduce animal perspiration, resulting in reduced water consumption.[14]
- **Inspecting pipes and watering systems** for leaks and fixing any leaks.
- **Manually cleaning floors and alleys before washing**. The more manure that can be removed, swept and scraped out before the wash, the less water will be required for washing.
- **Recycling pre-cooler water** that chills the milk to reuse for washing.
- **Washing small equipment** in a sink to save running water.

12 Increasing Drinking Water Use Efficiency in a Commercial Alberta Pork Production Facility http://www.prairieswine.com/?s=water+savings -

13 The OMAFRA factsheet Water Requirements for Livestock makes some good points on poultry and water consumption http//www.omafra.gov.on.ca/english/engineer/facts/07-023.htm#6

14 Once air temperatures exceed 30°C (or 87°F), the expected water consumption can increase by 50% above normal consumption rates. Poultry are unable to sweat as a means of regulating body temperature. Their method of heat control involves increasing the respiratory rate (panting) to expel surplus heat, which results in the release of large amounts of moisture from the bird that must be replaced or the bird will become dehydrated.

LIVESTOCK

- **Restricting usage of a cow cooling system** to times of need rather than continuous use.
- **Reusing the last wash water cycle** (cleanest water) for the first wash on the next milking cycle.
- **Capturing water from barn roof** for use in wash or cow cooling systems.
- **Using lower pressure for washing** to reduce debris splatter.
- **Diverting wash water** from a clean-in-place system to a storage tank. This water can be reused to wash the parlour.
- **Tuning up your wash system** to assure the air injection system is working properly and checking the setting to see that you are only using the amount of water needed for each wash cycle.

IRRIGATION

Agricultural irrigation covers some 340,000 acres of Saskatchewan farmland. Irrigation annually uses, on a per acre basis, between 326,000 and 652,000 US gallons (12–14 acre inches) of water. Irrigation triples crop yields while following sustainable farming practices.

Today, Lake Diefenbaker supports 100,000 irrigated acres, consuming less than 4% of the average annual inflow. Plans are in place for an additional 500,000 acres, which would consume less than 25% of the average annual inflow.

Figure 1: Lake Diefenbaker is the water source for 100,000 irrigated acres and a potential 500,000 acre increase.

Figure 2: Irrigation with a low-pressure centre pivot is the most common irrigation type in Saskatchewan.

DEFINITION

Irrigation water use efficiency is defined as the units of crop yield per unit of water withdrawn from the source (e.g. 50 bushels of irrigated canola per acre-foot of water).

Irrigation water use efficiency in Saskatchewan is very high for drip irrigated fruits and vegetables, as found in the Moon Lake Irrigation District, and for pressurized mainline sprinkler irrigation, as found in the Luck Lake and Riverhurst Irrigation Districts. Irrigation water use efficiency is much lower for flood irrigation, as was constructed by the Prairie Farm Rehabilitation Administration (PFRA) and the province in southwest Saskatchewan in response to the droughts of the 1930s.

An understanding of water use efficiency can be gained by examining the two elements of irrigation system infrastructure:

(a) water conveyance, and

(b) field application.

(a) WATER CONVEYANCE

Water conveyance systems move water from the source to the edge of the irrigated field and consist of the source itself (e.g. river, lake and reservoir), a canal or pipeline and, in the case of pressurized mainline irrigation districts, a turnout enabling the hook-up of the irrigation system on the irrigator's field.

(i) SOURCE

Sources of water for irrigation in Saskatchewan include large and annually available water supplies, notably the Lake Diefenbaker reservoir and South Saskatchewan River. These permanent water sources sustain major irrigation districts and numbers of individual irrigators. Offshoots from Lake Diefenbaker, such as the Qu'Appelle River or the Saskatoon South East Water Supply System (SSEWS), sustain smaller irrigation districts and numbers of individual irrigators.

Smaller rivers, creeks and reservoirs such as the Frenchman River, Cypress Lake, Swift Current Creek or the Val Marie Reservoir are often subject to greater variations in flows, but are used to supply small districts and individual irrigators when demand is high and water is available.

Sloughs, small lakes and dugouts are sometimes used by individual irrigators if the water quality is acceptable and needs are relatively small. A few individuals irrigate from groundwater sources, such as wells or springs.

Often irrigation complements other water uses such as domestic and industrial water supplies, recreation and wild life conservation areas, such as the Luck Lake Heritage Wildfowl Marsh.

Figure 3: Start of M1 Canal from Lake Diefenbaker at Gardiner Dam.

Figure 4: Irrigation district pumps in the Luck Lake Pumpstation.

(ii) PUMPS

Pumps supply water when large volumes and moderately high pressure are needed for irrigation. The most common pumps used are the vertical turbine type. Horizontal centrifugal pumps are less common, and submersible pumps are rarely used. Pumps are typically driven with three phase electric power. Diesel fuel, gasoline, propane or natural gas are sometimes used in isolated locations.

Well designed pumping units supply the needed water flow at the appropriate pressure with a highly efficient use of power. Pumps are selected to best match the water demand without wasting water — a saving of both water and power.

In the future, advances in pump design, use of computerized automated controls, single phase power, and greater utilization of variable speed pumping units will allow for better water conservation by better matching the water supply to water demand.

(iii) CANALS

Canals carry water by gravity flow. Water is lost from canals principally by seepage, evaporation and water delivery operations. Seepage happens when canal waters saturate and drain through the soil on the canal bottom and sides.

Evaporation losses occur from the water surface, which is open to the atmosphere. Delivery losses occur during operations due to periodic filling and draining of the canal as well as emergency discharges.

Seepage losses can be minimized by covering the canal sides and bottom with plastic or other impermeable liners. New materials and installation techniques continue to make the linings more effective.

Evaporation losses are often unavoidable, but can be reduced to some extent by matching the canal flow to the water demands. In this way, there is less water in the canals when irrigation demand is low.

Delivery losses can continue to be reduced by advances to the delivery system operations and equipment — such as Supervisory Control and Data Acquisition (SCADA) systems and automated control gates.

Increased use of flow metering, remote monitoring of flows and water levels, automated structures for water control and other management improvements will continue to reduce water losses in the future.

(iv) PIPELINES

Pipelines carry water with pressure. Pipelines prevent water losses from both seepage and evaporation.

Greater use of pipelines, particularly pipelines made of low-pressure and large diameter pipe, takes advantage of new materials and operating practices in order to increase water conveyance efficiency.

In many irrigation districts, water delivery uses a combined system of gravity and pressurized flow. For example: in the South Saskatchewan River Irrigation District No. 1 (SSRID#1), large pumps supply water from Lake Diefenbaker into a pipeline, then to the M1 Canal, which in turn carries water overland to smaller canals and fields. Here a smaller pump supplies pressurized water through a pipeline to an irrigated field's centre pivot sprinkler system.

IRRIGATION

Irrigation districts around Lake Diefenbaker using pressurized pipeline water delivery systems include the Luck Lake Irrigation District and the Riverhurst Irrigation District. The SSRID#1 uses a combined system that is making greater use of lined canal and pipeline systems to supply pressurized water to centre pivot irrigation systems and to the SSEWS canal.

Water use efficiency is continually improving in the irrigation districts around Lake Diefenbaker as canals are lined, pipelines replace canal systems and delivery systems use more sophisticated water controls.

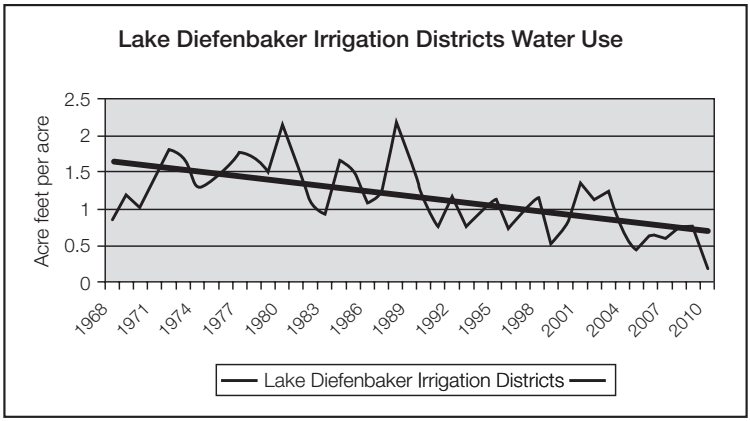

Figure 5: Irrigation District Water Use.

For more information on irrigation water conveyance and irrigation districts, contact the Ministry of Agriculture's Irrigation Branch (306) 867-5500.

(b) FIELD APPLICATION

Water use efficiency in the field application of water requires a properly engineered design (Saskatchewan Ministry of Agriculture's Irrigation Development Process) for land and water that are suitable for irrigation (Irrigation Certification under *The Irrigation Act, 1996*). The selection of the proper irrigation system takes into account the intended crops and the proper scheduling of irrigation to precisely meet crop water demands and complete the due diligence needed for the efficient use of water.

(i) IRRIGATION DEVELOPMENT PROCESS

Properly engineered designs enhance water use efficiency all along the water delivery system. All prospective irrigators can access engineering services. The Ministry of Agriculture's website http://www.agriculture.gov.sk.ca/Default.aspx?DN=fdffca1a-e1e6-46ba-a816-903a1553705e provides the Saskatchewan Irrigation Development Process. This process is designed to take a proponent's project from its start through to completion with the issuing of Saskatchewan Watershed Authority's Approval to Construct and Operate, instructions for which are at: http://www.swa.ca/Publications/Documents/RG-108.pdf

(ii) IRRIGATION CERTIFICATION

The Irrigation Act, 1996 in Saskatchewan requires that all new irrigation projects receive Irrigation Certification. These standards are used by the Ministry of Agriculture to ensure that a suitable quality of water is applied to irrigable land. This ensures that Saskatchewan's irrigation is both water use efficient and environmentally sustainable.

For more information on Irrigation Certification contact the Ministry's Irrigation Branch (306) 867-5500 or go to: http://www.agriculture.gov.sk.ca/Default.aspx?DN=88bd0590-0078-4796-bfad-aa653f3516fc

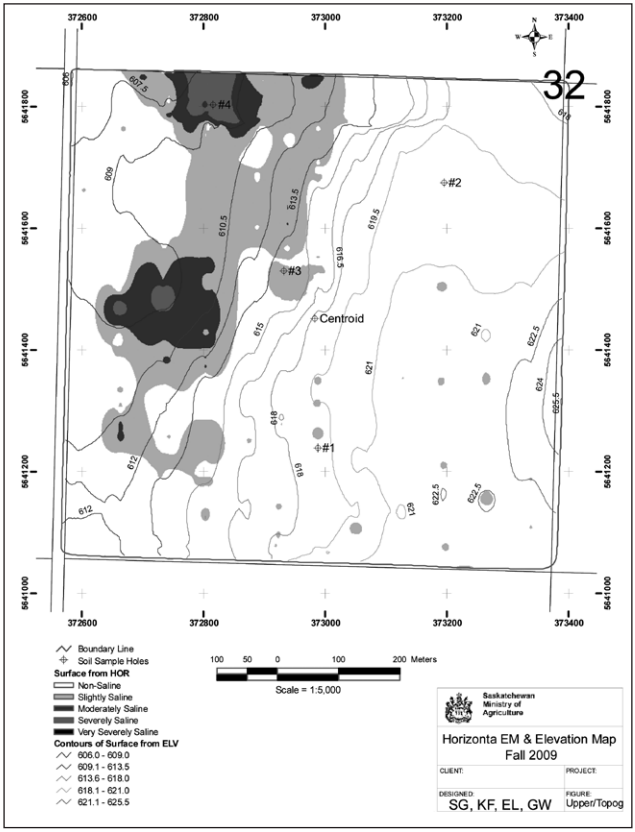

Figure 6: Irrigation Certification soil salinity/topography map.

(iii) IRRIGATION SYSTEM

Choose the type of irrigation that applies water most efficiently to the land for the intended crops. Irrigation water can be applied either by flood, by sprinkler or by drip methods. Water application efficiency equals the quantity of irrigation water entering the crop root zone divided by the quantity of water withdrawn from the source.

The water application efficiency of drip irrigation is higher than sprinkler irrigation which, in turn, is much higher than flood irrigation.

The conversion of flood-irrigated fields to centre pivot sprinklers is occurring and results in improved water application efficiencies.

Low-pressure centre pivot sprinkler irrigation provides controlled water applications and improved crop productivity. The reduction in operating pressures of centre pivots and the use of "drop nozzles" that emit water close to the crop canopy are developments that have occurred over the past ten years. These advances have reduced costs and increased water use efficiency.

For high-value crops such as fruits and vegetables, drip irrigation provides state-of-the-art irrigation water application efficiency.

Table 2: Irrigation Efficiency

TYPE OF IRRIGATION SYSTEM	IRRIGATION EFFICIENCY
Drip	> 90%
Low-Pressure Centre pivot	85%
Centre pivot	80%
Wheel Move	75%
Flood	60%

For example: assume an irrigated canola crop requires 14 inches of irrigation during a growing season. To account for the application efficiency of a low-pressure centre pivot at 85%, the total amount of water needing to be applied equals 16.5 inches. If the system is designed to provide 7 US gallons per minute per acre, the system would have to operate 50 days to apply 16.5 inches in order to meet the crop demand exactly.

IRRIGATION

Water use efficiency has continuously improved as flood irrigation has been converted to sprinkler irrigation and as centre pivot systems have been upgraded to new types of low-pressure sprinkler systems. Water use of approximately 18 inches with gravity irrigation has decreased to less than 12 inches with low-pressure centre pivot sprinkler irrigation.

For more information on the irrigation development process and system selection contact the Ministry of Agriculture's Irrigation Branch (306) 867-5500.

Figure 7: Low-pressure centre pivot.

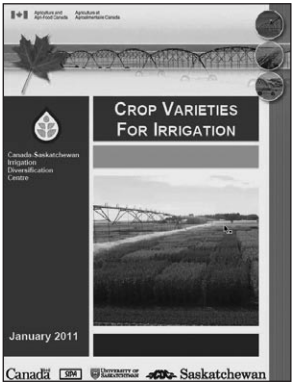

Figure 8: *Crop Varieties for Irrigation*, Saskatchewan.

(iv) CROP SELECTION

By selecting the highest-yielding varieties with the best disease, pest and lodging resistance, the most "crop per drop" can be achieved. When spraying crops, avoid the use of potable water by using slough water whenever possible. Caution must be taken that chemicals are not handled close to natural water bodies to ensure the risk of potential contamination is mitigated.

Irrigators in Saskatchewan use the publication *Crop Varieties for Irrigation* to select top-yielding irrigable varieties, found at the following web address:
http://www.irrigationsaskatchewan.com/ICDC/2011%20CSIDC%20Crop%20Varieties%20For%20Irrigation.pdf

Ministry of Agriculture Irrigation Agrologists provide **in-field advice** to irrigators regarding irrigation scheduling, crop choice, soil fertility, field scouting, pesticide application and harvest timing. All these activities contribute to increasing irrigation water use efficiency.

(v) IRRIGATION SCHEDULING

Irrigation scheduling, or irrigation water management, ensures that water is consistently available to the plant and that it is applied according to crop requirements. This is possible where "on-demand" water is available. Where "on-demand" water is not available, crops with lower water requirements should be planted.

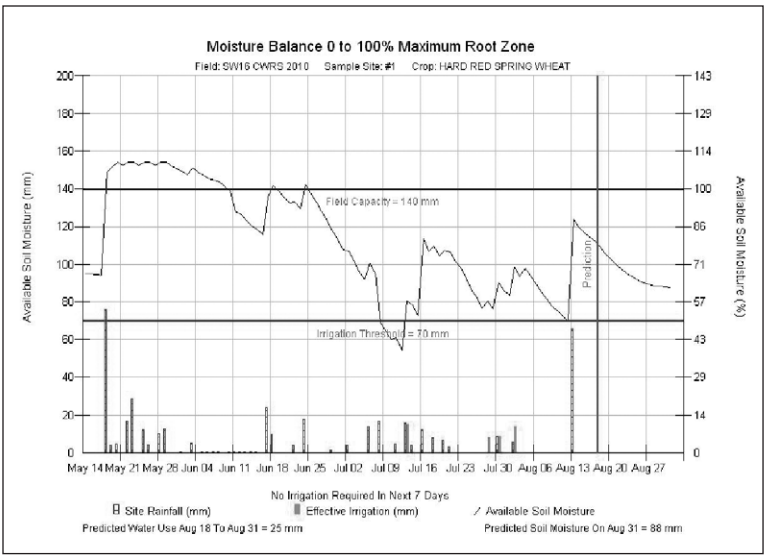

Figure 9: Example AIMM Soil Moisture, Precipitation and Irrigation Graph.

IRRIGATION

Proper irrigation scheduling will improve profitability and water use efficiency by:

- maximizing crop yield and quality;
- decreasing water lost through deep percolation and runoff; and
- optimizing pumping costs.

To effectively schedule irrigation applications, four key pieces of information need to be known:

- soil texture;
- water-holding capacity of the soil;
- soil moisture content and the maximum allowable soil moisture depletion for a given crop; and
- crop water use at the specific crop development stage.

The Ministry and its clients use the Alberta Irrigation Management Model (AIMM) combined with WeatherBug on-farm meteorological stations. AIMM can be found at: http://www.agric.gov.ab.ca/app49/imcin/aimm.jsp

The Ministry has published its recommendations in its *Irrigation Scheduling Manual*: http://www.agriculture.gov.sk.ca/Default.aspx?DN=db049612-1252-4e04-a656-4a97297065fa

The Ministry's publication *Irrigating With a Centre Pivot* is also available online: http://www.agriculture.gov.sk.ca/Default.aspx?DN=72268c98-b9c1-4c02-a87f-78093731b5cb

For more information on irrigation crop selection and scheduling, contact the Ministry's Irrigation Branch (306) 867-5500.

Table 3: Total Annual Water Requirements for Irrigated Crops in Saskatchewan

CROPS	SEASONAL CROP WATER USE (in)	PEAK MOISTURE USE (in/day)	ACTIVE ROOT ZONE (ft)	ALLOWABLE DEPLETION (%)
Alfalfa	24.4	0.31	3.9	60
Grass	19.7	0.28	2.6	50
Potatoes	19.7	0.24	2.6	40
Faba beans	24	0.31	2.6	35
Corn				
Silage	18.5	0.24	3.3	50
Wheat				
Hard	18.1	0.28	3.3	50
Soft	18.9	0.28	3.3	50
Canola	16.9	0.28	3.3	50
Flax	18.1	0.28	3.3	50
Peas	15.7	0.24	2.6	40
Barley				
Forage	15.4	0.28	3.3	50
Malt	13	0.28	3.3	50
Dry beans	15	0.24	2.6	40

Table 4: Unit Conversion Factors

1 inch	= 25.4 millimetres (mm)	
1 foot	= 0.305 metres (m)	
1 US gallon (USg)	= 0.833 Imperial Gallon (Impg)	
1 cubic foot (ft^3)	= 7.48 US gallons (USg)	= 0.0283 cubic metres (m^3)
1 acre-foot (ac-ft)	= 12 acre-inches (ac-in) = 325,851 US gallons (USg)	= 43,560 cubic-feet (ft^3) = 1,233 cubic metres (m^3)

NOTES

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Assiniboine Watershed Stewardship Association

Swift Current Creek Watershed Stewards

NSRBC North Saskatchewan River Basin Council