B.C. IRRIGATION MANAGEMENT GUIDE

Chapter 8

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BRITISH COLUMBIA

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LIMITATION OF LIABILITY AND USER'S RESPONSIBILITY

The primary purpose of this B.C. Irrigation Management Guide is to provide irrigation professionals and consultants with a methodology to assess the irrigation system performance and manage the system effectively.

While every effort has been made to ensure the accuracy and completeness of these materials, additional materials may be required to complete more advanced assessments. Advice of appropriate professionals and experts may assist in completing assessments that are not covered in this Guide.

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8 ENERGY CONSERVATION AND OPERATING COSTS

Economics are usually the most important consideration when purchasing or operating a farm. The selection of farm location certainly depends on the crop type, soil type and the geographical climate condition. More importantly, the operating cost of the farm should be considered to determine if the farm operation is financially feasible before buying a farm property. If you already own a farm, there are still ways that you may save money. Irrigation costs can be significant. This chapter focuses on how to evaluate the irrigation system to determine if there are potential energy savings, thereby, minimizing operating costs.

8.1 Methods of Reducing Operating Costs

In previous chapters the Irrigation Management Guide has provided methodology on how to assess the irrigation system for performance. Many of these improvements result in lower operating costs by improving irrigation system efficiencies. Operating costs can also be lowered by developing water conservation strategies, implementing an irrigation schedule and conducting the pump assessments as shown in this chapter.

Irrigation System Efficiency

This guide has provided a great deal of the information required to improve the irrigation system efficiency:

- Having a proper irrigation design done be a Certified Irrigation Designer. Contact the Irrigation Industry Association of British Columbia for a list of Certified Designers.
- Replacing old nozzles (check with drill bits) and installing new nozzles to match the soil, crop and operating conditions of the irrigation system.
- Spacing sprinklers at the proper distance to achieve uniform application over the field.
- Checking the pressure at both the farthest and the highest points of the lateral line to ensure pressure variation is ±10% (no more than 20% variance)
- Selecting a pump that is operating at or close to its best efficiency point (BEP)

  ➔ **Pump Selection, Section 8.5**
- Improving friction losses in fittings at the pump intake and discharge.

  📖 **Reducing Pumping Costs by Increasing Irrigation System Efficiencies**


Irrigation FACTSHEET

REDUCING PUMPING COSTS BY INCREASING IRRIGATION SYSTEM EFFICIENCIES

- Using a systematic irrigation scheduling program

  ➔ **Irrigation Scheduling, Chapter 7**

Water Conservation

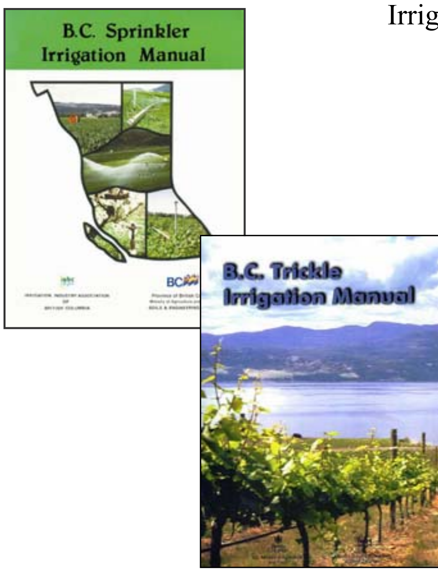
Water conservation is an integral part of energy conservation. Water conservation in agricultural irrigation systems can be achieved by:

- improving irrigation system efficiencies as mentioned previously
- selecting irrigation systems that are not as susceptible to evaporation
  - Using sprinklers instead of a stationary or travelling gun can reduce water use by 10 – 15%, especially in windy areas. Using a drip system instead of a sprinkler system can save as much as 20% of total water use.
- repairing leaks in the irrigation system
  - If a water meter has been installed, the irrigation system can be checked for leaks by turning off the system and monitoring the meter to see if it is still running. Look for ‘perpetual wet spots’ along the irrigation line that do not dry up between irrigations.
- adjusting operating parameters under windy conditions
  - When operating gun systems under windy conditions, lower the trajectory level and/or narrow the spacing to achieve the best uniformity possible. Refer to the B.C. Sprinkler Irrigation Manual for a detailed explanation on how to adjust the spacing based on wind speed.
- refraining from irrigating during hot windy periods of the day if possible
  - During the peak of the irrigation season, it may not be possible to wait to irrigate due to the logistics of getting around the entire farm. However, during the early and

late part of the irrigation season there may be more flexibility in planning irrigation times. Studies in B.C. have shown that water savings can be realized by scheduling the system during the early and late part of the irrigation season, May and June, and also in September.

Irrigation Tips to Conserve Water on the Farm

Irrigation Scheduling



Irrigation scheduling can be done by:

- using soil moisture monitoring devices, climate conditions and weather forecast to determine when to irrigate (climate information is available at www.farmwest.com for various climate stations throughout B.C.)
  - **Soil Moisture Monitoring, Chapter 7**
  - **Climate Monitoring, Chapter 7**
  - **www.farmwest.com**
- finding the maximum irrigation set time and only applying as much water as your soil can hold
  - **B.C. Sprinkler Irrigation Manual**
  - **B.C. Trickle Irrigation Manual**
- knowing the crop's water requirements by monitoring the evapotranspiration (ET) rates and applying a crop coefficient (K_c)
  - **Crops and the Climate, Chapter 7**

Assessing Pump Performance and Operating Costs

If all of the above steps have been taken operating costs may still be able to be lowered by conducting a pump assessment and evaluating other water delivery costs. This chapter provides some checks that can be done to assess pump performance and to determine potential energy savings.

8.2 Irrigation Water Supply

The cost for obtaining irrigation water will depend on the waters source. In British Columbia there are three main sources of irrigation water for agriculture:

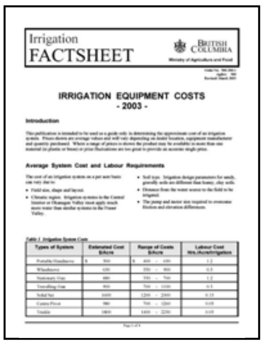
1. well water (groundwater)
2. surface water including lakes, streams and ditches
3. water supplied by irrigation districts, municipalities or improvement districts

Groundwater is often a good source of quality irrigation water. The cost of installing a well and pump and operating the system must be determined to ensure that the irrigation system will be viable. At times there may also be chemicals in the water that may cause problems with the irrigation system or the crop. A water test should be conducted to ensure the quality is adequate for irrigation purposes.

Care should be taken to protect groundwater resources. Many aquifers are at risk of contamination or pollution. The most common occurrence of contamination is through leachate or backflow down the well.

➔ **Environmental Concerns of Irrigation Water Supply, Chapter 2**

Water purveyors usually charge a few based on the acreage irrigated or volume of water used. The quality of irrigation water from irrigation districts, municipalities or improvement districts is often controlled and regulated and generally is of good quality. For more information about irrigation and improvement districts, contact the following organizations:


Irrigation FACTSHEET

IRRIGATION EQUIPMENT COSTS

- 2003 -


Irrigation FACTSHEET

IRRIGATION ECONOMICS

- Local Government Services (Improvement District) of the Ministry of Community, Aboriginal and Women's Services
- Water Supply Association of B.C. (WSABC), formerly called Association of British Columbia Irrigation Districts
- Vancouver Island Improvement District Association (VIIDA)

Most farmers in British Columbia pump their own water from surface water sources such as ditches, lakes, streams and reservoirs. The quality from sources can be very poor. Caution should be used when irrigating ready to eat crops with water that is contaminated with e-coli or other contaminants.

This chapter covers a process to assess the operating costs of the irrigation system. Capital costs for system purchase and maintenance costs are not covered. The following factsheets provide additional information on irrigation costs and economics.

📖 **Irrigation Equipment Costs**

📖 **Irrigation Economics**

8.3 Pump Selection and Assessment

Selecting the proper pump for an irrigation system is important to optimize energy efficiency and operating cost savings on the farm. As pumps get older they should be evaluated to ensure that the impellor is not worn, the motor is not over heating and the pump is still sized to match the operating specifications of the irrigation system, especially after any major system modifications.

Pump

Centrifugal Pump


Irrigation
FACTSHEET
BRITISH COLUMBIA
CENTRIFUGAL PUMP SELECTION
AND INSTALLATION
PUMP SELECTION
STEP 1
STEP 2

Centrifugal pumps are the most common choice for irrigation systems to pump water from lakes, rivers, creeks or shallow wells. Horizontal centrifugal pumps have total dynamic heads of less than 400 ft and suction lift capabilities of less than 20 ft. The pump selected should provide the operating requirements of the irrigation system at or close to its best efficiency point (BEP). The BEP of a centrifugal pump can vary from 45 – 80%, but consideration should be given to selecting pumps that have a BEP of 65% or better. A centrifugal pump should not be operated at less than 80% of its BEP; therefore, a pump with a BEP of 80% should not be operated at an efficiency of less than 64%.

Refer to the Factsheet *Centrifugal Pump Selection and Installation* for additional information.

Centrifugal Pump Selection and Installation

Turbine and Submersible Pumps

Turbine pumps are most often used when dynamic head conditions exceed 450 ft or when a combination of head and flow conditions exceed the capability of centrifugal pumps. They are also used in well systems where the horsepower and well diameter do not allow for the installation of a submersible pump.

Submersibles are used in all small well applications and for most agricultural well applications in British Columbia. Submersibles are available up to 10 inch in diameter and motor sizes up to 100 hp.

Where centrifugal pumps are limited to a suction capability of 20 ft the advantage of both submersible and turbine pumps is that they do not to be primed and have the ability of drawing water from great depths. This is because the impellors for turbines and submersibles are submerged.

Pump Assessment

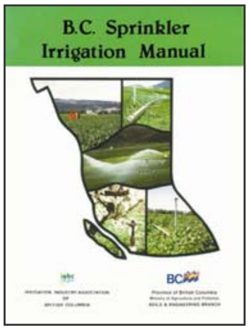
The following items should be assessed in order to conduct a pump assessment:

- Check the pump impellor and volute for wear. If worn consider replacing the components or the entire pump.
- Check the system flow rate requirements. Earlier chapters in this guide provide information on how to ensure that the irrigation system is operating at the proper flow rate. The pump operating flow rate should match the irrigation system required flow at a good efficiency point.
- Check the total dynamic head of the irrigation system. Consider making improvements to the irrigation system if the dynamic head can be improved. In most cases the pump will need to be changed to take advantage of any changes in total dynamic head.

Total Dynamic Head

The total dynamic head is the pressure that must be delivered by the pump to the irrigation system. The total dynamic head (TDH) consists of static suction head (H_s), elevation head (H_e), friction head (H_f) and the pressure head (H_p). Equation 8.1 provides the formula for total dynamic head. The first three are relatively easy to obtain. The friction head is a little more difficult and requires a mainline assessment.

Static Suction Head



Static suction head (H_s) is the distance from the water level to the centre of the pump impellor. The static suction head may change if the water level fluctuates during the irrigation season. For centrifugal pumps the static suction head must be less than the pump's suction capability (NPSHR).

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Elevation Head

The elevation head (H_e) is the elevation from the centre of the impeller to the highest sprinkler on the irrigation system. The elevation head can be positive or negative depending on whether the irrigation system goes up hill or down hill.

Pressure Head

Pressure head (H_p) is the pressure required at the start of the highest lateral on the system. A lateral line assessment should be done to ensure that the sprinklers are operating within the allotted pressure range. The important locations to measure the pressure and flow are shown in Figure 8.1.

Equation 8.1 Total Dynamic Head *Worksheet 26*

$$H = H_s + H_e + H_p + H_f$$

where

H = total dynamic head [ft]
H_s = static suction head [ft]
H_e = elevation head [ft]
H_p = pressure head [ft]
H_f = friction head [ft]

Friction Head

Friction head (H_f) is the total friction loss of all suction and discharge fittings, mainline piping and valves. There are also miscellaneous losses such as pipe and sprinkler fittings throughout the system.

Pipe costs increase as the pipe diameter increase but larger pipe reduces friction head. For the same flow rate larger pipe has less friction losses than smaller pipe. To minimize operating costs, pipe sizes throughout the irrigation system should be optimized to balance capital cost with operating cost. Friction head should be assessed for both mainlines and lateral lines.

Mainline Friction Head

A mainline friction loss assessment is the best place to start when assessing friction head. The mainline friction losses should be assessed for the worst case condition when the furthest sprinklers from the pump are operating.

Mainline friction loss can also be assessed by determining the flow velocity. A guide to mainline selection is to use pipe sizes that will allow for a flow speed of 1.5 m/sec (5 ft/sec) through the pipe. Flow rates higher than this will often result in excessive friction losses. Equation 8.2 can be used to determine the flow velocity for a given pipe size and flow rate. Assessment 8.1 provides a process to calculate mainline friction losses and assess the flow velocity.

Equation 8.2 Pipe Flow Speed — *Worksheet 25*

$$Flow\ Speed = \frac{Q \times 0.125}{d^2}$$

where Flow Speed = speed that irrigation water is delivered [m/s]
Q = irrigation system flow rate (Box 9 in Worksheet 4(a) or 4(b) [US gpm]
d = pipe diameter [in]

Assessment 8.1 Mainline Friction Loss Assessment

Worksheet 25

Use Appendix B in the B.C. Sprinkler Irrigation Manual. Values in these tables are in imperial units. See Appendix B in this Guide for converting into metric units.

Friction Loss Assessment

Information

Indicate the following information on the irrigation system plan. Figure 8.1 can be used as an example.

- **i.** The start and end of the pipe length with the same features (diameter and type) should be indicated by X_o, X_1, X_2, X_3, …, X_n (Figure 8.1).
- **ii.** Write down the length and nominal pipe diameters.

In the table within the worksheet, input the following pipe characteristics:

- **i.** Pipe locations
- **ii.** Pipe material type (PVC, steel, aluminum) – pipe material affects the friction loss
- **iii.** Nominal pipe diameter (ID)
- **iv.** Pipe flow rate for each section
- **v.** Pipe length
- **vi.** Pipe friction loss factor per 100 ft based on the pipe material, ID and flow rate (from Appendix B of the B.C. Sprinkler Irrigation Manual)

Assessment

- **i.** Multiply the pipe length by the friction loss factor per 100 ft
- **ii.** Add up all the head losses to give total friction losses along the mainline
- **iii.** Check to see if the friction loss for the section of mainline exceeds 10 psi.

Flow Velocity Assessment

Information

- **i.** Record the nominal pipe diameter for each section of pipe.
- **ii.** Determine the pipe flow rate for each section of pipe as in **iv** above.

Assessment

- **i.** Calculate the flow velocity using Equation 8.2.
- **ii.** Check to see if the flow velocity exceeds 1.5 m/sec

Actions for Worksheet 25 – Mainline Friction Loss Assessment

The mainline assessment can be done by using the flow velocity or friction loss for each section of pipe. The following actions can be taken based on the mainline assessment:

- ✓ If the flow velocity exceeds 1.5 m/sec and the friction loss for the section of mainline exceeds 5 psi consider increasing the mainline pipe size to reduce the flow velocity and friction head.
- ✓ If a section of mainline has friction losses exceeding 10 psi but still has a flow velocity that is less than 1.5 m/sec consider increasing the pipe size.

Example 8.1 Sprinkler Irrigation in Armstrong (V)

Worksheet 25 Mainline Friction Losses

Question: A mainline assessment is done for the wheelmove system shown in Figure 8.1. Based on the assessment, is a change to the mainline pipe sizing required?

Assessment:

(a) Record all the information in the table below:

Location	Type	ID [in]		Flow Rate [US gpm]		Length [ft]	x	Friction Loss Factor per 100 ft			Head Loss [psi]		Flow Speed [m/s]	
$X_0 - X_1$	*AL*	*10*	1	*856*	2	*800*	x	*0.21*	÷ 100 ft	=	*1.68*	3	*1.07*	4
$X_1 - X_2$	*AL*	*10*	1	*856*	2	*720*	x	*0.21*	÷ 100 ft	=	*1.51*	3	*1.07*	4
$X_2 - X_3$	*AL*	*8*	1	*616*	2	*900*	x	*0.33*	÷ 100 ft	=	*2.97*	3	*1.20*	4
$X_3 - X_4$	*AL*	*6*	1	*376*	2	*900*	x	*0.53*	÷ 100 ft	=	*4.77*	3	*1.31*	4
$X_5 - X_6$	*AL*	*5*	1	*240*	2	*900*	x	*0.55*	÷ 100 ft	=	*4.95*	3	*1.20*	4

Total friction loss along mainline [psi] = *16* **5**

(b) Friction loss check
Check the head loss for all of the pipe sections (boxes labelled 3)

E.g., $X_5 - X_6$ Is *4.95* **3** psi less than or equal to 10 psi?

✓ **Yes** Ok.

☐ **No** See action items

(c) Flow speed check
Check the flow speed for all of the pipe sections (boxes labelled 4)

Equation 8.2

$$\text{Flow Speed} = \frac{Q \times 0.125}{d^2}$$

$$= \frac{240 \; [1] \text{ US gpm} \times 0.125}{(5 \; [1] \text{ in})^2}$$

$$= 1.20 \; [6] \text{ m/s}$$

E.g., $X_5 - X_6$ Is *1.20* **4 or 6** m/s less than or equal to 1.5

✓ **Yes** Ok.

☐ **No** See action items

GENERAL FARM INFORMATION

• CROP	ALFALFA
• IRRIGATED AREAS (acres)	170
• IRRIGATION INTERVAL (days)	15
• No. OF IRRIGATIONS PER YEAR	4

PUMP SPECIFICATIONS

• MODEL NUMBER	ST007
• HORSEPOWER (hp)	125
• IMPELLOR SIZE (in. diameter)	15-7/32
• REVOLUTIONS PER MINUTE (rpm)	3,600
• FLOW RATE (US gpm)	850

NOZZLE SPECIFICATIONS

	for ①, ②, and ③	for ④
• No. OF NOZZLES	30 EACH	17
• NOZZLE SIZE (in. x in.)	11/64 x 3/32	11/64 x 3/32
• NOZZLE OPERATING PRESSURE (psi)	50	50
• NOZZLE FLOW RATE (US gpm)	8.0	8.0
TOTAL No. OF NOZZLES	107	
TOTAL FLOW RATE (US gpm)	856	

LEGEND

M/L	MAINLINE
W/M	WHEELMOVE
➡	DIRECTION OF WHEELLINE MOVEMENT
	M/L with HYDRANTS
	LATERAL
	CHANNELIZED STREAM
	ROAD
	BUSH
	DITCH
■	SOIL PIT
▲ ELEV	ELEVATION
	BUILDINGS
✱	LOCATION OF LATERAL PRESSURE READING
●	LOCATION OF MAINLINE FLOW AND PRESSURE READING

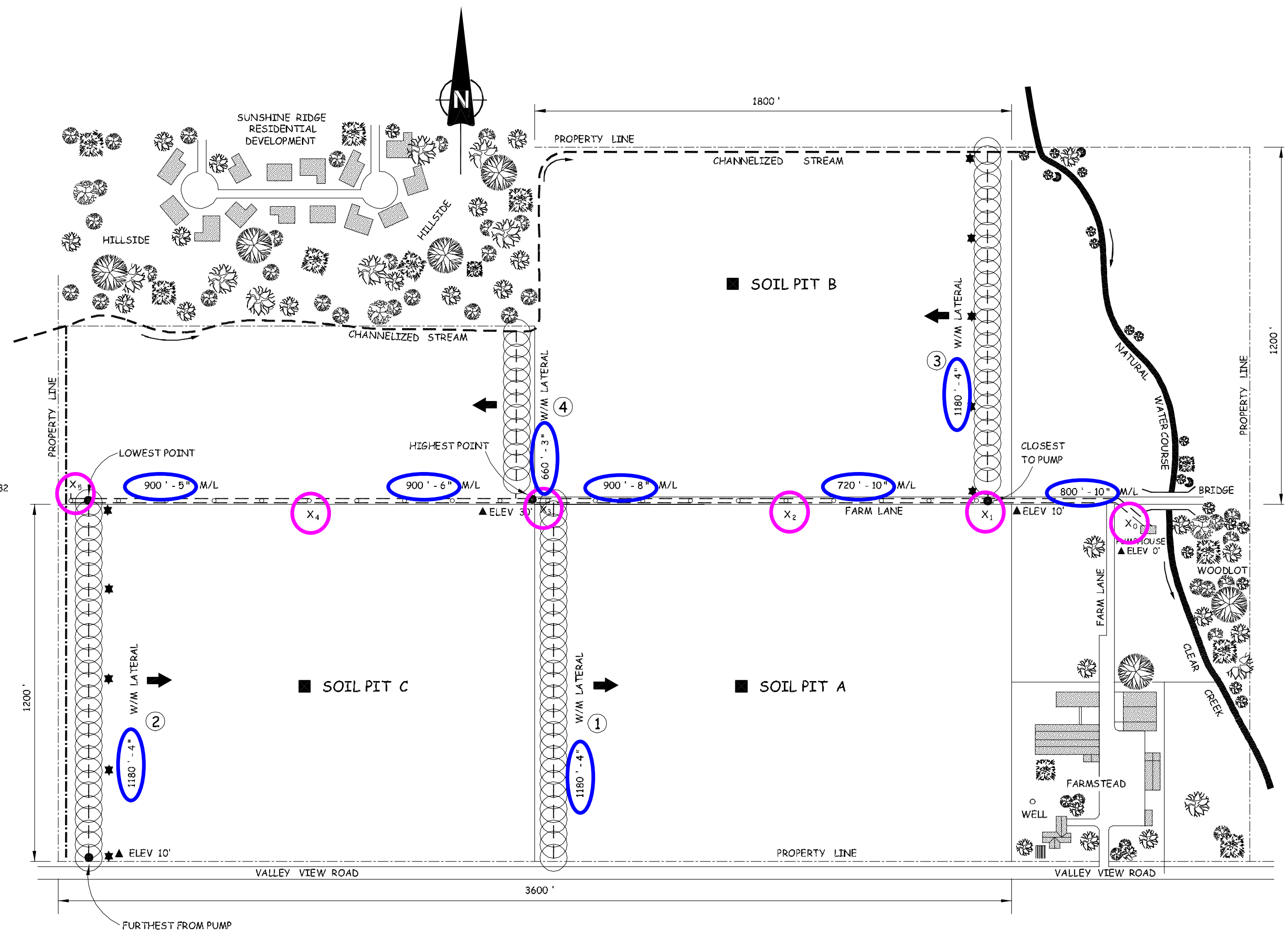
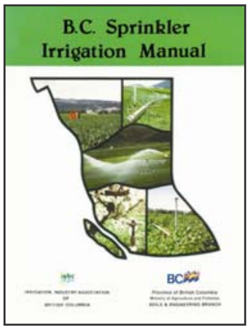


FIGURE 8.1
SAMPLE SPRINKLER IRRIGATION PLAN - WHEELMOVE SYSTEM 3

Pump Horsepower



The pump horsepower is determined by the system flow rate, total dynamic head and the pump efficiency. Horsepower is the energy delivered to the water by the pump, and can be determined by using Equation 8.4.

The right pump will deliver the required horsepower but will also be operating at or close to its best efficiency point (BEP). A pump should not be operated at less than 80% of its BEP. Consideration should always be given to pumps with a higher efficiency. For centrifugal pumps the NPSHR may also need to be checked. See Assessment 8.2 and Figure 8.2.

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Equation 8.3 Pump Horsepower

Worksheet 26

$$HP = \frac{Q \times H}{39.6 \times E}$$

where HP = horsepower required by the system [hp]
Q = irrigation system flow rate (Box 9 in Worksheet 4(a) or 4(b)) [US gpm]
H = total dynamic head [ft]
E = pump efficiency [%]

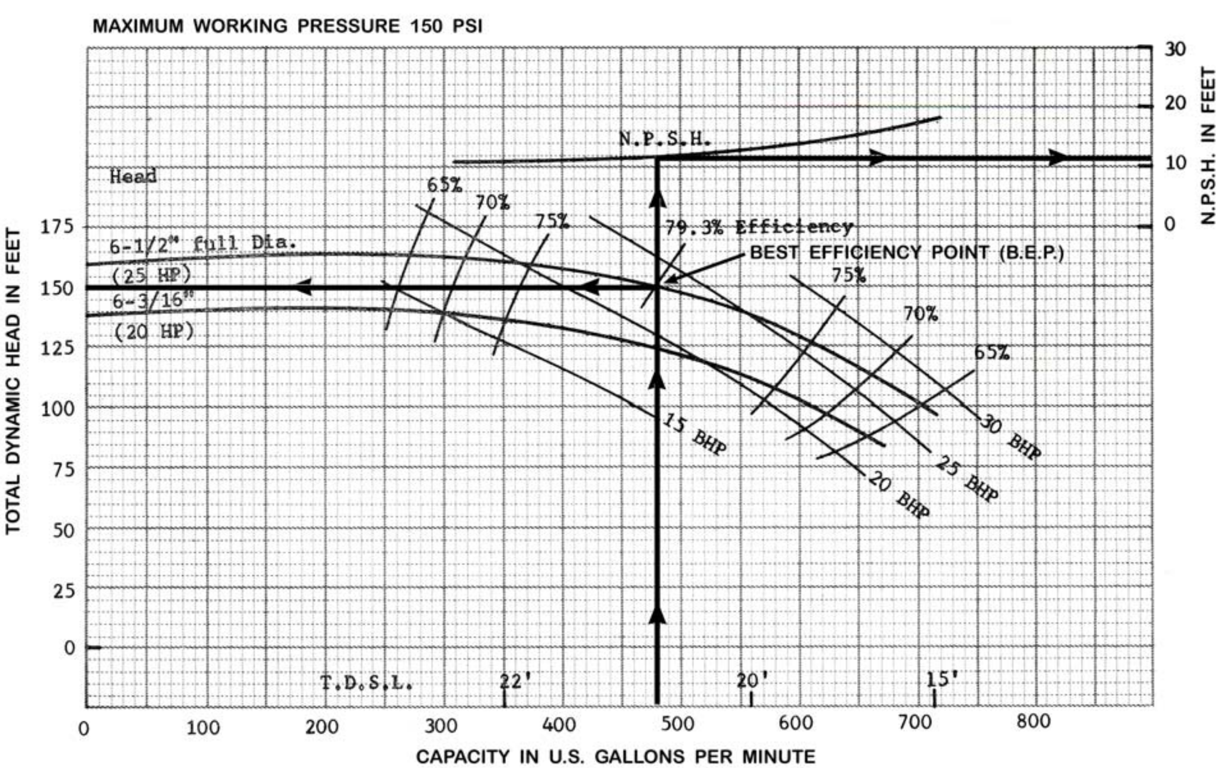

Figure 8.2 Pump Curve

Assessment 8.2 Pump Assessment

Worksheet 26

The pump should be assessed by evaluating the flow rate and total dynamic head and checking the pump curve to determine if the pump selected is providing the best performance for the operating conditions required.

Information

- Determine the peak irrigation system operating flow rate (Worksheet 4(a) or 4(b)
- Determine the total dynamic head of the irrigation system (Equation 8.1)

Assessment

- Check the pump curve to determine the pump efficiency for the system operating conditions
- Check to see if the pump is operating at its best efficiency point
- For centrifugal pumps record the NPSHR from the pump curve and compare to the elevation of the center of the impellor above the water level
- Calculate the pump horsepower using the efficiency determined from the pump curve– this value is used to determine annual operating costs

Actions for Worksheet 26 – Pump Assessment

Consider the following if the pump is not operating properly or is not operating at the best efficiency point:

- ✓ Make sure that the pump impellor is not worn.
- ✓ If possible lower the total dynamic head by installing larger mainlines. See Worksheet 25.
- ✓ Lower the system flow rate by changing to a different nozzle size or replacing worn nozzles. See Assessment 6.1.
- ✓ Ensure that the irrigation system operating conditions have not drastically changed. If irrigation lines have been added the pump may no longer be capable of supplying the required flow rate at a good efficiency. If the change is permanent consider changing the pump model or the pump impellor.
- ✓ For centrifugal pumps check that the NPSHR by the pump is actually available. A quick method to check this is to determine the elevation of the impellor above the water level. If the elevation is not 1.5 m (5 ft) less than the value of the NPSHR shown on the pump curve move the pump closer to the water surface or conduct a more detailed assessment. Check the B.C. Sprinkler Irrigation Manual.
- ✓ If the pump is not operating close to the BEP consider another pump or a different impellor. Worksheet 27 can be used to determine the annual operating cost to see if this would be worthwhile.

Example 8.2 Sprinkler Irrigation System

Worksheet 26 Pump Assessment

Question: A centrifugal pump is supplying an irrigation system with a flow requirement of 480 gpm. The pump is drawing water from a stream with the water surface 10 feet below the pump impellor. The sprinkler pressure required is 45 psi (104 ft). The mainline friction losses are 15 ft. The highest sprinkler is located 21 feet above the pump. Calculate the total dynamic head required and determine if the pump shown in Figure 8.2 is adequate for the job. Refer to Appendix B for conversion factors.

Information for Total Dynamic Head:

Static suction head	10	1	ft
Elevation head	21	2	ft
Sprinkler pressure (H_p)	104	3	ft
Friction head (H_f) (Worksheet 25, Box 5))	15	4	ft

Calculate Total Dynamic Head:

Equation 8.1

$$H = H_s + H_e + H_p + H_f$$

= (10 [1] + 21 [2] + 104 [3] + 15 [4]) ft

= 150 [5] ft

Information for Pump Assessment:

Pump Best Efficiency Point (BEP) from Figure 8.2	80	6	%
Pump operating efficiency from Figure 8.2	79	7	%
NPSHR from Figure 8.2	12	8	ft
Irrigation system flow rate	480	9	US gpm

Calculate Pump Horsepower:

Equation 8.3

$$HP = \frac{Q \times H}{39.6 \times E}$$

= (480 [9] US gpm x 150 [5] ft) / (39.6 x 79 [7] %)

= 23 [10] hp

Pump Assessment:

Is the pump operating within 80% of the best efficiency point?

80% of the pump BEP = 80 [6] x 80%

= 64 [11] %

Is 79 [7] % within 64 [11] %?

- ✓ Yes — Ok.
- No — See action items.

Pump NPSHR Check:

Is the pump operating close enough to the water level to function properly?

Is 10 [1] ft 5 ft less than 12 [8] ft?

- Yes — Ok.
- ✓ No — See action items.

8.4 Operating Cost

The operating cost of an irrigation system may consist of a water licence or water purveyor fee and the fuel cost to operate the pump.

Water Licence Fee

A water licence must be obtained from Land and Water British Columbia Inc. (LWBC) before irrigation water can be taken from a surface water source or stored in a pond or reservoir. The water licence is attached to the parcel of land and remains in effect as long as the fees are paid. There is a cost to apply for a water licence as well as an annual fee. Many of British Columbia's surface water sources are now fully recorded for full term licences. Opportunities for part season licences may be an option in some instances.

Table 8.1 provides information on the fees that are charged when applying for a water licence for agricultural use and the annual fee to keep the licence. There is also a fee to store water. The annual water requirement that should be used to determine the fees that apply can be calculated from Equation 8.4 using the irrigated area and the annual crop water requirement from Table 3.4.

Table 8.1 Application Fees and Annual Fee for a Water Licence[1]

Fee Category		Amount [$]
Land Tenure Purpose and Application Fees		
Flat Rate		267.50 (250.00 + GST)
Water Application Fee[2]		
Irrigated area [hectares]	< 5 (approx. 12.35 acres)	100.00
	> 5 but <50 (approx. 123.5 acres)	150.00
	≥ 50 (approx. 123.5 acres)	400.00
Water conveyed by a local authority for irrigation		400.00
Storage Application Fee[2]		
Amount of water stored [m^3]	< 125,000 m^3 (approx. 101.3 ac-ft)	150.00
	= 125,000 m^3 (approx. 101.3 ac-ft) but < 1,250,000 m^3 (approx. 1,013.3 ac-ft)	400.00
	> 1,250,000 m^3 (approx. 1,013.3 ac-ft)	2,000.00
Annual Water Licence Fee[2]		
Water conveyed by a local authority [ac-ft]	≤ 50 ac-ft	25.00
	each additional 10 ac-ft	5.00
Private water use [ac-ft]	≤ 40 ac-ft	22.00
	each additional 2 ac-ft	1.10
Annual Storage Licence Fee[2]		
Amount of water stored [ac-ft]	≤ 2,000 ac-ft	11.00
	each additional 1,000 ac-ft	5.50

[1] Effective June 01, 2003
[2] GST not applicable

Equation 8.4 Annual Water Requirement — *Worksheet 27*

$$Annual\ Water\ Requirement = \frac{Irrigated\ \ Area \times Crop\ Water\ Requirement \times 100\%}{12 \times AE}$$

where
- Annual Water Requirement = total amount of water used for irrigating a farm [ac-ft]
- Irrigated Area = entire area covered by irrigation system [acres]
- Crop Water Requirement = value from Table 3.3 [in]
- AE = application efficiency (Table 6.1) [%]

Water Purveyor Costs

Some growers obtain their irrigation water directly from a water purveyor such as a municipality or irrigation district. Water purveyors charge by the acre irrigated or by the total volume of water used. Table 8.2 lists the charges of six water purveyors in British Columbia. The values indicate the range of costs that are charged throughout the province.

Table 8.2 Summary of Annual Water Charges of Six Major Purveyors

District	Total Charges per Acre of Irrigation		Amount of Water Allowed [US gpm/acre]	Regrade Fee to Bring Additional Land under Irrigation per Acre [$/acre]
	2004 rates	Estimated Cost Comparison [$/m³]		
Capital Regional District	$0.206/m³	0.206	unlimited	Refer to total charges
Osoyoos Irrigation District[1]	$177.50/acre	0.036	8	Refer to total charges
South East Kelowna Irrigation District (SEKID)[1]	$60/acre	0.020	5	2,670
Regional District of North Okanagan[2]	$83.21/acre	0.037	5	800 (the first quarter acre of land); 600 (each additional quarter acre of land or part thereafter)
District of Lake Country[3]	$62/acre	0.024	6	4,000
Regional District of Central Kootenay[4]	$45/acre	0.020	4.5	9,300

[1] Improvement District
[2] Formerly called Vernon Irrigation District
[3] Formerly called Winfield Irrigation District
[4] Formerly called Erickson Improvement District

Pumping Costs

British Columbia's mountains allow many users to gravity feed water to irrigate their fields, avoiding the need for pumps. However many situation still require farms to use pumps to operate their irrigation systems. Table 8.3 provides information on the cost of using hydro electric for agricultural irrigation.

The irrigation season rate is one of hydro's lowest rates. Hydro charges a minimum charge based on the connected load per month for eight months. The minimum charge works out to about 750 – 800 hours of use. Therefore if the irrigation system is operated for less than 800 hours, your account will still be charged for this amount of use. Most regions in British Columbia use more than the minimum amount in normally dry years.

Irrigation accounts are penalized if they use their irrigation pumps outside the irrigation season. Irrigating during non-irrigation season will cost about eight times more than during irrigation season. Equation 8.5 (a) can be used to determine the annual cost of operating an irrigation pump using electricity.

Rates for fuel such as propane, natural gas and gasoline are not provided as these rates fluctuate too frequently. Equation 8.5 (b) can be used to determine the annual operating cost of these fuels. The price of fuel and the operating hours of the irrigation system must be known.

Table 8.3 B.C. Hydro Electric Rates for Agricultural Irrigation – Year 2004

Minimum Charge		
Irrigation Season[1]	$/KW of connected load per month for a period of eight months commencing in March in any year whether consumption is registered or not	3.35
Non-Irrigation Season[2]	≤ 500 KWh	0.00
	> 500 KWh, $/KW of connected load	26.76
Electric Rate		
Irrigation Season[1]	Cents/KWh	3.35
Non-Irrigation Season[2]	Cents/KWh for the first 150 KWh	3.35
	Cents/KWh for all additional KWh	26.54

[1] Irrigation season starts from March 01 to October 31 in the same year.
[2] Non-irrigation season starts from November 01 in the current year to February 28 (or February 29 for a leap year) in the following year.

Figure 8.3 is a sample bill from BC Hydro for an irrigation account. As discussed in Chapter 6, this information can be used to determine the annual amount of water applied by the irrigation system.

BC hydro

Prepared For

John Doe
123 ABC RD
ABBOTSFORD, BC V1V 1V1

Invoice Number: 87654321

Billing Date
Jul 29, 2004

Pay By
Aug 20, 2004

Account Number
123456

Please Pay
$706.15

Meter Reading Information

Electric:

Meter #	
Mar 01	1659
Mar 31	1730
Mult	x60
31 days	71

Meter #	
Apr 01	1730
Apr 19	1767
Mult	x60
19 days	2220

Meter #	
Apr 20	0
Jul 14	110
Mult	x60
86 days	6600

kVarh:

Meter #	
Mar 01	1637
Mar 02	1672
Mult	x60
	2100

Meter #	
Mar 03	1672
Apr 19	1751
Mult	x60
	4740

Meter #	
Apr 20	0
Jul 14	100
Mult	x60
	6000

Connected load:
44.760 kW

Next meter reading on or about Oct 29

Customer Service

Phone: (604) 224-9376 **Power Out?** 1-888-769-3766
Mail to: BC Hydro, PO Box 9501 Stn Terminal, Vancouver BC, V6B 4N1

Previous Bill

0.00

Balance from previous bill $0.00

BC Hydro

Electric Charges

Mar 01 to Jul 14 (Irrigation rate 1401)
Minimum charge: 659.95*
kVarh: power factor 71% surcharge 24% 0.00

Starting Dec 01, 2004, your bill will include a surcharge when the power factor is less than 90%. We have waived a surcharge of $102.81 for this bill. For more information, please call (604) 224-9376.

* GST 46.20

$706.15

Taxes

The following is a summary of taxes billed to your account:
GST at 7% on 659.95 46.20

Balance payable $706.15

On April 1, 2004, a new, interim rate increase of 7.23% came into effect and may be reflected on this bill. Our regulator, the BC Utilities Commission, will determine the final rate increase by the fall, following a public hearing. If lower, the difference would be refunded to your account.

Our electricity rates have not changed since 1993. They continue to be the third lowest in North America. For more information, visit www.bchydro.com.

Thank you for keeping your account up to date.

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Figure 8.3 Sample Hydro Bill for an Irrigation Account

Equation 8.5 Annual Electric and Fuel Cost

Worksheet 27

(a) Electric

$$Annual\ Electric\ Cost$$
$$= Electric\ Charge \times Number\ of\ Operating\ Hours \times Pump\ Power \times 0.746$$

(b) Fuel

$$Annual\ Fuel\ Cost = Fuel\ Unit\ Cost \times Fuel\ Consumption \times Number\ of\ Operating\ Hours$$

where
Annual Pumping Fee = total cost to pump irrigation water per year [$]
Electric Charge = value from Table 8.2 [$/KWh]
Number of Operating Hours = total number of hours the pump is operated [hr]
Pump Power = pump horsepower [hp]
Annual Fuel Cost = total cost of fuel consumed for irrigation water per year [$]
Fuel Unit Cost = cost per gallon of fuel consumed [$/gal]
Fuel Consumption = amount of fuel consumed per hour [gal/hr]

Assessment 8.3 Irrigation Operating Cost

Worksheet 27

The system operating cost may include water licence fees or water purveyor charges in addition to a pump operating cost.

Information

- Determine the water licence rental rate if any - Table 8.1
- Determine the water purveyor fee if any – check with your purveyor

Calculation

- Calculate the annual fuel cost if a pump is used – Equation 8.5

Example 8.3 Irrigation System Cost Evaluation

Worksheet 27 Irrigation Operating Cost

Question: A 40-acre farm near Barriere is applying for a water licence from the North Thompson River. The crop water requirement for Barriere from Table 3.4 is 16 in. The irrigation system requires a 20 hp pump. The pump is operated for 90 days during the irrigation season. The irrigation efficiency is 70%. Determine the total cost of the water licence and annual pump operating cost.

Information:

Farm location	*Little Fort*		
Water Purveyor	*–*		
Water source (stream or lake)	*Thompson*		
Irrigated area	*40*	1	acres
System Efficiency	*70*	2	%
Number of days system is operated	*90*	3	days

Annual Water Licence Fee

Water use ≤ 40 ac-ft (Table 8.1) $	*22.00*	4	
Each additional 2 ac-ft of water use (Table 8.1) $	*1.10*	5	
Crop water requirement (Table 3.4)	*16*	6	in

Annual Water Storage Licence Fee

Water stored ≤ 2,000 ac-ft (Table 8.1) $	–	7	
Each additional 1,000 ac-ft of water use (Table 8.1) $	–	8	
Crop water requirement (Table 3.4)	–	9	in
Amount of water stored	–	10	in

Electric Cost

Electric rate in irrigation season (Table 8.2)	*0.035*	11	$/Kw-hr
Operating hours per season (days x 24 hours /day)	*2160*	12	hrs
Pump horsepower	*20*	13	hp

Fuel Cost

Fuel unit cost $	–	14	/gal
Fuel consumption	–	15	gal

Water Purveyor

Total charges per acre of irrigation (Table 8.3)	–	16	$/acre
Amount of water allowed (Table 8.3)	–	17	US gpm/acre

Calculation:

1. **Annual Water Licence Rental**

Equation 8.4

$$\text{Amount of Water Use} = \frac{\text{Irrigated Area} \times \text{Crop Water Requirement} \times 100\%}{12 \times AE}$$

$$= \frac{40\ [1]\ \text{acre} \times 16\ [6]\ \text{in} \times 100\%}{12 \times 70\ [2]\ \%}$$

$$= 76\ [18]\ \text{ac-ft}$$

Annual Water Licence Fee

$$= \$\ 22.00\ [4] + \$\ 1.10\ [5] \times \frac{(76\ [18] - 40)\ \text{ac-ft}}{2}$$

$$= \$\ 41.80\ [19]$$

Annual Storage Licence Fee

$$= \$\ –\ [7] + \$\ –\ [8] \times \frac{(–\ [10] - 2{,}000)\ \text{ac-ft}}{2}$$

$$= \$\ –\ [20]$$

2. Annual Water Pumping Fee (choose either a or b)

(a) Electric

Equation 8.5(a)

Annual Electric Cost = Electric Charge x Number of Operating Hours x Pump Power x 0.746

= $ *0.035* **11** /KWh x *2160* **12** hr x *20* **13** hp x 0.746

= $ *1,128* **21**

(b) Fuel

Equation 8.5(b)

Annual Fuel Cost = Fuel Unit Cost x Fuel Consumption x Number of Operating Hours

= $ – **14** /gal x – **15** gal x – **12** hr

= $ – **22**

3. Water Purveyor Cost

Water Purveyor Cost = $ – **16** /acre x – **17** acres

= $ – **23**