2 CLIMATE

Climate plays an important part in determining crop water use. It determines the rate at which the crop uses water and how much water the crop will require over the entire irrigation season. Climate information for over 80 locations in British Columbia is available online at www.farmwest.com.

www.farmwest.com

2.1 Climate Information

Evapotranspiration

Evapotranspiration (ET) is a combination of the evaporation of moisture from the soil and plant surfaces and water transpired through the plant. ET can be measured by using evaporation pans or atmometers, or calculated using climate data from a weather station. The amount of ET depends on temperature, solar radiation, relative humidity and wind speed (Figure 2.1). The hotter and windier it is, the higher the ET rate will be. ET is important to know because it is directly related to crop water use and therefore irrigation water requirement.

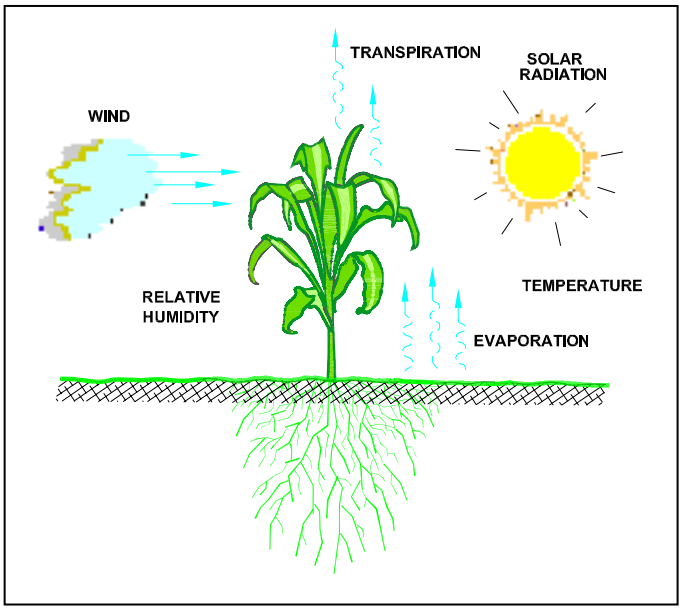

Figure 2.1 Elements of Evapotranspiration

ET may be reported in a number of different ways depending on how it is measured or calculated:

- ET_o is a reference ET for a well-watered grass crop of 10 to 15 cm
- ET_R is ET for an alfalfa reference crop
- ET_p is ET measured from a pan or atmometer

The type of reference crop used to report ET is important because this determines the crop coefficient that is used to convert the measured ET into the actual crop water use. This document and Farmwest use ET_o values.

Effective Precipitation

Effective precipitation (EP) is the amount of precipitation that is actually added and stored in the soil. The calculation for effective precipitation may need adjustments for drier periods to periods of wet weather as described below. In drier periods, not all rainfall is considered effective, but for extended periods of cool wet weather, most rainfall over a couple of millimetres may be considered effective. Very large rainfall events may not all be effective as more moisture than the soil's available water storage capacity (AWSC) may be applied to the soil.

Dry Periods

During extended warm dry periods, rainfall of less than five mm may not add any moisture to the soil reservoir because the precipitation would most likely evaporate from the soil surface before soaking into the groumd. This rainfall is therefore not considered effective as it does not provide any moisture to the plant. Consequently, on the Farmwest website (www.farmwest.com), if daily rainfall is less than five mm, a value of zero is reported for effective precipitation. In addition, only 75% of the rainfall over five mm is considered as effective precipitation. During dry periods, no changes need to be made to the effective precipitation reported on Farmwest. Equation 2.1 shows how to determine EP.

Equation 2.1 Effective Precipitation (EP)

$$EP = (RAIN - 5) \times 0.75$$

where:
EP = effective precipitation [mm]
RAIN = measured rainfall [mm]

Wet Periods

During prolonged cool wet periods, more of the rainfall that falls as daily showers may be considered to be effective. This is because the soil and air temperatures are cooler and humidity is higher, allowing the rainfall to soak into the soil before it evaporates. The judgement of whether or not rainfall is effective would be made after a number of days. Soil moisture monitoring can be helpful in determining how much of the rainfall is effective during the irrigation season.

Large Amounts of Precipitation

Very large rainfall events may apply more moisture than the soil's holding capacity, or exceed the soil's infiltration capabilities. Large amounts of rainfall may move moisture beyond the plant's root zone making the water unavailable to the plant. If rainfall intensity is greater than the soil infiltration rate, precipitation will be lost to runoff and will not be stored in the root zone. Therefore, the effective amount of rainfall recorded during periods of heavy precipitation may be much more than what is actually being stored in the field. A portion of the precipitation may have been lost to deep percolation or runoff.

2.2 Historical Climate Information for Irrigation Planning

Historical regional climate information that can be used for irrigation planning is summarized in this section. This information is used for planning water requirements for the farm, and to set up a basic irrigation schedule that can be adjusted using real-time climate data and soil moisture measurements.

Peak Flow Rate and Annual Crop Water Requirements

Tables 2.1 through 2.4 are used to estimate peak flow rates and annual crop water requirements for sprinkler irrigation systems. The peak flow rate values should also be used for trickle systems; however, annual requirements can be reduced due to a smaller application area and higher system efficiencies. Chapter 3 includes methodology to reduce the annual water requirements for crops irrigated with a drip/trickle system.

Table 2.1 lists the historical peak evapotranspiration (ET) rates for locations in B.C. using an average maximum soil water deficit (MSWD) of 3-inch or 7.5-cm. The irrigation system flow rate requirement can be estimated using the peak ET value chosen in Table 2.1 and comparing with the flow rates assigned to the peak ET values in Table 2.2. The values shown are for a risk factor of 10% (the crop will be short of water once every 10 years). Table 2.3 provides a quick reference for peak flow rates for various British Columbia locations.

The estimated annual crop water requirements for various B.C. locations are listed in Table 2.4. The irrigation system application efficiency must be applied to the values in Table 2.4 to determine annual water use. An efficiency of 72% should be used for licensing purposes.

When planning the annual amount and peak flow of water required for a farm, the values in these tables should be used regardless of the type of irrigation system or crop grown. This way, enough water will be available for the land to be productive regardless of the crop grown and the type of irrigation system used.

The values in these tables are used to estimate a licensed water requirement for irrigation throughout the province, and to ensure sufficient water is available to manage the irrigation system effectively.

Peak flow rate and annual crop water requirements will vary depending on:

- crop type
- soil type
- rooting depth
- irrigation system efficiency
- climate and field elevation that determine peak ET rates (farms at the bottom of valleys have higher peak ET rates than those in the same area but at a higher elevation)

Table 2.1 Peak Evapotranspiration Rates for B.C. Locations with Average (3 in or 7.5 cm) Maximum Soil Water Deficit

Location	ET		Location	ET		Location	ET	
	[in/d]	[mm/d]		[in/d]	[mm/d]		[in/d]	[mm/d]
Abbotsford	0.15	3.8	**Golden**	0.15	3.8	**Oliver**	0.24	6.1
Agassiz	0.15	3.8	**Grand Forks**	0.19	4.8	**100 Mile House**	0.23	5.8
Alexis Creek	0.15	3.8	**Grandview Flats**	0.25	6.4	**Osoyoos**	0.28	7.1
Armstrong	0.21	5.3	**Grasmere**	0.22	5.6	**Oyster River**	0.12	3.0
Ashcroft	0.30	7.6	**Grindrod**	0.14	3.6	**Parksville**	0.16	4.1
Aspen Grove	0.21	5.3	**Hazelton**	0.19	4.8	**Pitt Meadows**	0.13	3.3
Barriere	0.20	5.1	**Hixon**	0.16	4.1	**Port Alberni**	0.20	5.1
Baynes Lake	0.25	6.4	**Hope**	0.22	5.6	**Prince George**	0.15	3.8
Campbell River	0.20	5.1	**Invermere**	0.23	5.8	**Princeton**	0.25	6.4
Canal Flats	0.26	6.6	**Kamloops**	0.28	7.1	**Quesnel**	0.26	6.6
Castlegar	0.31	7.9	**Kelowna**	0.24	6.1	**Radium**	0.20	5.1
Cawston	0.32	8.1	**Keremeos**	0.29	7.4	**Riske Creek**	0.28	7.1
Chase	0.21	5.3	**Kersley**	0.22	5.6	**Saanichton**	0.16	4.1
Cherryville	0.21	5.3	**Kettle Valley**	0.27	6.9	**Salmon Arm**	0.17	4.3
Chilliwack	0.17	4.3	**Kimberley**	0.30	7.6	**Smithers**	0.15	3.8
Clinton	0.23	5.8	**Ladner**	0.13	3.3	**Spillimacheen**	0.19	4.8
Cloverdale	0.14	3.6	**Langley**	0.14	3.6	**Sumas**	0.17	4.3
Comox	0.20	5.1	**Lillooet**	0.28	7.1	**Summerland**	0.26	6.6
Creston	0.18	4.6	**Lister**	0.21	5.3	**Terrace**	0.30	7.6
Dawson Creek	0.19	4.8	**Lumby**	0.23	5.8	**Vancouver**	0.18	4.6
Douglas Lake	0.21	5.3	**Lytton**	0.30	7.6	**Vanderhoof**	0.20	5.1
Duncan	0.16	4.1	**Malakwa**	0.19	4.8	**Vernon**	0.22	5.6
Ellison	0.23	5.8	**Merritt**	0.26	6.6	**Walhachin**	0.29	7.4
Fort Fraser	0.19	4.8	**Nanaimo**	0.19	4.8	**Westwold**	0.27	6.9
Fort Steele	0.22	5.6	**Natal**	0.18	4.6	**Williams Lake**	0.28	7.1
Fort St. John	0.19	4.8	**Notch Hill**	0.20	5.1			

Peak Flow Rate

Figure 2.2 gives a general overview of flow rates in B.C. The flow rates provided in tables and figures in this section are for general guidance only. Use one of the following methods to obtain peak flow rate:

1. If an irrigation water licence indicates a peak flow rate, use the flow rate stated on the licence.
2. If water is supplied by a water purveyor, use the flow rate established by the purveyor.
3. Otherwise, use Table 2.3 to estimate the peak irrigation flow rate of a location listed in the table and is closest to the farm.

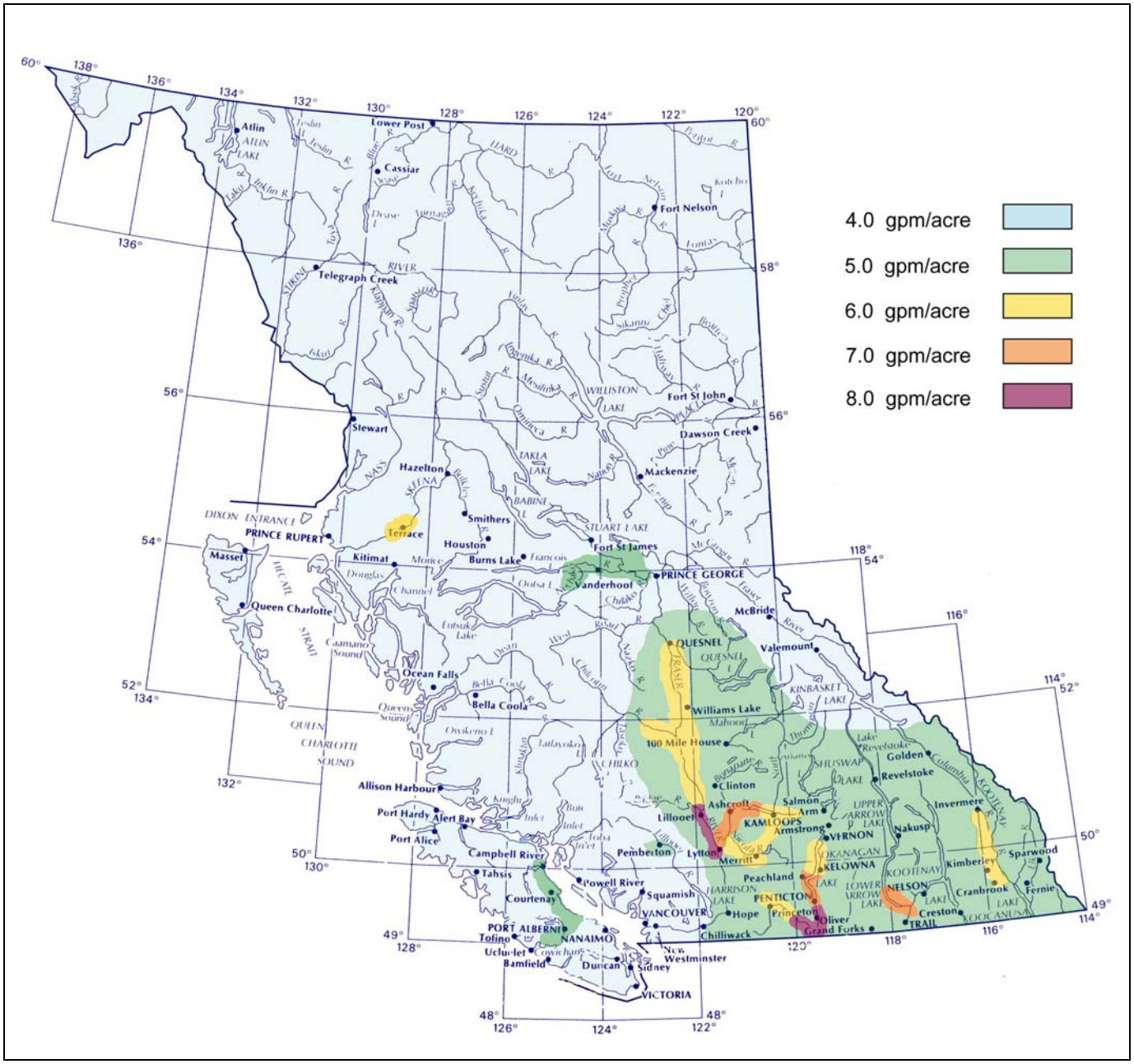

Figure 2.2 Estimated Peak Irrigation Flow Rate Requirements in B.C. [US gpm/acre]

Table 2.2 Estimated Peak Irrigation System Flow Rate Requirements Based on Peak ET Rates (with 10% risk factor)

ET		Irrigation System Flow Rates	
[in/d]	[mm/d]	[US gpm/acre]	[m^3/hr/ha]
0.16	4.1	4.0	2.24
0.18	4.6	4.5	2.52
0.20	5.1	5.0	2.80
0.22	5.6	5.5	3.10
0.23	5.8	6.0	3.36
0.25	6.4	6.5	3.64
0.27	6.9	7.0	3.92
0.29	7.4	7.5	4.20
0.31	7.9	8.0	4.48

Table 2.3 Estimated Peak Irrigation Flow Rate Requirements for B.C. Locations[1,2]

Location	Flow Rate [US gpm/acre][3]	Location	Flow Rate [US gpm/acre][3]	Location	Flow Rate [US gpm/acre][3]
Abbotsford	4.0	**Golden**	4.0	**Oliver**	6.5
Agassiz	4.0	**Grand Forks**	5.0	**100 Mile House**	5.5
Alexis Creek	4.0	**Grandview Flats**	5.5	**Osoyoos**	7.5
Armstrong	5.0	**Grasmere**	5.5	**Oyster River**	4.0
Ashcroft	8.0	**Grindrod**	4.0	**Parksville**	4.0
Aspen Grove	5.0	**Hazelton**	5.0	**Pitt Meadows**	4.0
Barriere	5.0	**Hixon**	4.0	**Port Alberni**	5.0
Baynes Lake	6.5	**Hope**	5.0	**Prince George**	4.0
Campbell River	5.0	**Invermere**	6.0	**Princeton**	6.0
Canal Flats	6.0	**Kamloops**	6.5	**Quesnel**	6.0
Castlegar	8.0	**Kelowna**	6.0	**Radium**	5.0
Cawston	8.0	**Keremeos**	7.5	**Riske Creek**	7.0
Chase	5.0	**Kersley**	5.5	**Saanichton**	4.0
Cherryville	5.0	**Kettle Valley**	7.0	**Salmon Arm**	4.5
Chilliwack	4.5	**Kimberley**	7.0	**Smithers**	4.0
Clinton	6.0	**Ladner**	4.0	**Spillimacheen**	5.0
Cloverdale	4.0	**Langley**	4.0	**Sumas**	4.5
Comox	5.0	**Lillooet**	7.5	**Summerland**	6.5
Creston	4.5	**Lister**	5.0	**Terrace**	5.5
Dawson Creek	4.0	**Lumby**	5.5	**Vancouver**	4.5
Douglas Lake	5.0	**Lytton**	8.0	**Vanderhoof**	5.0
Duncan	4.0	**Malakwa**	5.0	**Vernon**	5.0
Ellison	6.0	**Merritt**	6.5	**Walhachin**	6.5
Fort Fraser	5.0	**Nanaimo**	5.0	**Westwold**	6.5
Fort Steele	5.5	**Natal**	4.5	**Williams Lake**	6.0
Fort St. John	4.0	**Notch Hill**	5.0		

1 Based on peak evapotranspiration rates on an average deep-rooted crop in a medium-textured soil (values in Table 2.1), as well as overall topographic knowledge of each location.
2 Based on 10% risk factor, i.e., water shortage once in 10 years.
3 Multiply values in US gpm/acre by 0.156 to convert to L/s/ha.

Annual Crop Water Requirement

Figure 2.3 gives a general overview of annual crop water requirements in B.C. If a farm is near one of the locations listed in Table 2.4, use the annual crop water requirement from this table in the worksheet calculations.

High summer temperatures mean a high peak flow rate. An area with a high peak flow rate does not necessarily give a high annual irrigation requirement. However, the annual crop water requirement is lower for a short irrigation season than a longer one. For example, Terrace and Kelowna have the same peak flow rate, but Kelowna has a much longer growing season; thus, a larger annual crop water requirement.

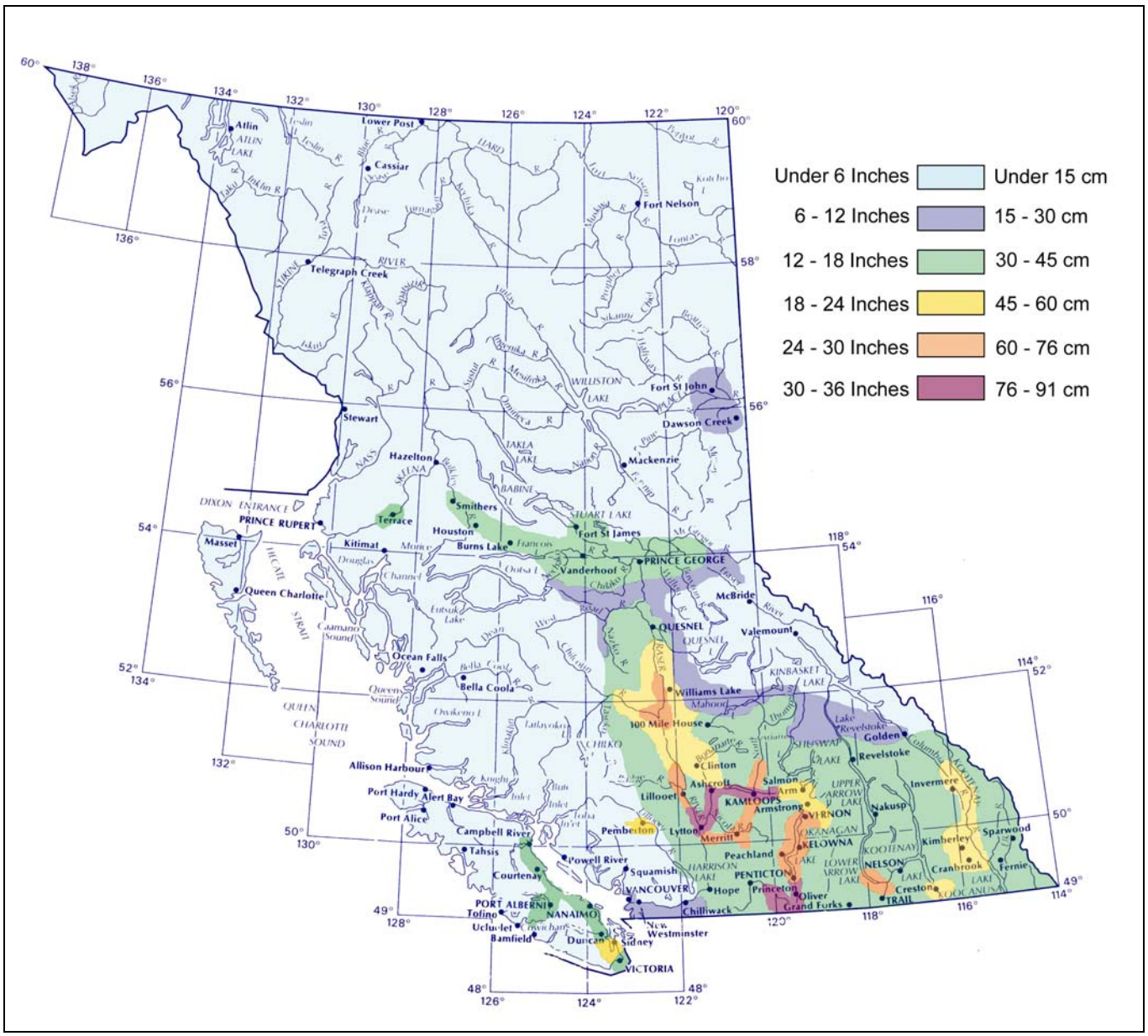

Figure 2.3 Estimated Annual Crop Water Requirements in B.C. [inches or cm]

Table 2.4 Estimated Annual Crop Water Requirements for B.C. Locations with Average (3 in or 7.5 cm) Maximum Soil Water Deficit

Location	Water		Location	Water		Location	Water	
	[in]	[mm]		[in]	[mm]		[in]	[mm]
Abbotsford	9	220	**Golden**	11	274	**Oliver**	24	622
Agassiz	4	109	**Grand Forks**	11	274	**100 Mile House**	17	439
Alexis Creek	11	274	**Grandview Flats**	18	457	**Osoyoos**	25	640
Armstrong	12	311	**Grasmere**	13	329	**Oyster River**	6	165
Ashcroft	25	640	**Grindrod**	7	183	**Parksville**	10	256
Aspen Grove	13	329	**Hazelton**	2	55	**Pitt Meadows**	6	146
Barriere	13	329	**Hixon**	6	165	**Port Alberni**	12	292
Baynes Lake	17	420	**Hope**	9	238	**Prince George**	10	256
Campbell River	10	256	**Invermere**	17	439	**Princeton**	18	457
Canal Flats	14	366	**Kamloops**	23	585	**Quesnel**	9	238
Castlegar	21	531	**Kelowna**	19	475	**Radium**	12	311
Cawston	25	640	**Keremeos**	23	585	**Riske Creek**	16	402
Chase	15	384	**Kersley**	9	238	**Saanichton**	10	256
Cherryville	14	348	**Kettle Valley**	18	457	**Salmon Arm**	13	329
Chilliwack	5	128	**Kimberley**	17	439	**Smithers**	9	220
Clinton	17	439	**Ladner**	8	201	**Spillimacheen**	14	348
Cloverdale	7	183	**Langley**	6	165	**Sumas**	6	165
Comox	12	292	**Lillooet**	19	494	**Summerland**	19	494
Creston	16	402	**Lister**	16	402	**Terrace**	9	220
Dawson Creek	7	183	**Lumby**	15	384	**Vancouver**	11	274
Douglas Lake	16	402	**Lytton**	25	640	**Vanderhoof**	8	201
Duncan	9	220	**Malakwa**	9	220	**Vernon**	16	402
Ellison	17	420	**Merritt**	21	531	**Walhachin**	20	512
Fort Fraser	8	201	**Nanaimo**	10	256	**Westwold**	20	512
Fort Steele	10	256	**Natal**	10	256	**Williams Lake**	13	329
Fort St. John	7	183	**Notch Hill**	14	366			

Note: An irrigation system efficiency needs to be applied to the figures to obtain the gross annual requirements.