3.0 WATER SUPPLY and AVAILABILITY

This section reviews summer runoff available in Southwestern and Eastern Ontario for potential capture by Conservation Drainage Systems (see Fig 3.1 to 3.5).

3.1 Southwestern Ontario (Essex and Lambton County)

3.1.1 Summer Rainfall

Over the 44 year period from 1962 to 2005 the average summer rainfall (June, July, August) at Kingsville in Gosfield South Township, Essex County was 235 mm (Fig 3.1 and 3.5). **The summer rainfall varied significantly from a low of about 90 mm in 1974 to 451 mm in 1980.**

3.1.2 Summer Stream Flow

For the period 1971 to 2005 the average individual month stream flow for Ruscom River near Ruscom Station in Rochester Township, Essex County is shown in Fig 3.2. Ruscom River has an agricultural watershed (125.0 km^2) with extensive subsurface drainage and is a potential area for installation of controlled drainage. **The average runoff in May is 18.0 mm, June 15.1 mm, July 8.6 mm and August only 3.8 mm. These data indicate that for early crop planting (by May 1) the potential for runoff capture by controlled drainage alone is about 45 mm but for late crop planting (by June 1), there is only about 27.5 mm on average for capture.** Average annual runoff is 274 mm for the period 1971 to 2005.

For the period 1966 to 2005, Bear Creek near Petrolia in Lambton County indicates that for early planting dates (May 1) 41.3 mm of runoff is potentially available for capture in controlled drainage systems, for late planting only 20 mm on average is available for capture. **The average runoff in August was only 3.0 mm.** Bear Creek is a mainly agricultural watershed. The slightly higher annual runoff of 299 mm in Bear Creek than Ruscom River may reflect increased lake effect snow fall in this watershed.

Water Survey of Canada records include runoff monitoring of Second Concession Drain a small 3.19 km^2 watershed near Essex in Essex County. For the monitoring period Jan 1990 to June 1994 the average flow in May was 9.5 mm, June 12.0 mm, July 11.1 mm and Aug 8.0 mm. The summer (June, July, August) runoff was 31 mm similar to that observed for longer term averages at Ruscom Creek indicating that use of the longer term averages for the larger agricultural watersheds provides a valid analogue for potential runoff capture by controlled drainage systems.

3.1.3 Water Deficit

Tan and Reynolds (2003) reported a recent growing season water deficit of 150 mm for Essex County. **On average maintenance of higher water tables, early planting and efficient controlled drainage runoff capture through the summer might supply up to one third of this deficit.** Low trafficability planting equipment with light cultivation for soil aeration and seedbed warming may be required for early planting success.

3.1.4 Extremes

Average annual summer flows for Ruscom River **from 1972 to 2005 demonstrate a low summer flow of 0.0 mm in 1988 and only 1.4 mm in May of that same year.** Runoff has exceeded the average in only 11 of 34 years of observations. Runoff was less than 50% of the average in 14 years out of 33. Only in the three years of 1980, 1983 and 1989 did runoff approach or exceed 100 mm during the summer months. Drainage systems would have had to be operated in free mode during this period.

3.2 Eastern Ontario (United Counties of Prescott and Russell)

3.2.1 Summer Rainfall

Over the 31 year period from 1975 to 2005 the summer rainfall (June, July, August) at Russell in Russell Township, averaged 266 mm with a maximum of 422 mm in 1981 and a minimum of 155 mm in 1991 (Fig 3.1 and 3.5). **The average summer rainfall over this period was 266 mm or about 30 mm greater than at Kingsville in Essex County.**

3.2.2 Stream Flow

Over the 38 year period from 1968 to 2005 the average monthly stream flow for the Castor River (watershed area 433 km^2) is shown in Fig 3.3. **The average runoff in May was 31.5 mm, June 15.4 mm, July 8.3 mm and August 6.3 mm.** This data suggests that for early planting (by May 1) 63.3 mm of runoff on average may be potentially captured by controlled drainage systems. However, for later plantings (by June 1) only 30 mm of runoff on average would be available. Average monthly stream flow on Castor River subwatersheds for different monitoring periods show similar runoff patterns.

3.2.3 Water Deficit

Maintenance of higher water tables in the deeper drains through the planting season will result in additional storage of soil moisture for growing season utilization. **Combined with early planting (May 1) controlled drainage systems may capture up to 40% of the summer** season water deficit in Eastern Ontario.

3.2.4 Extremes

Averages however are misleading (Fig 3.5). Runoff exceeded the average in only 10 years out of the 38 year period of record. During 18 years (out of 38) summer runoff was less than 50% of the average. **In 2003 summer runoff was 0.0 mm.** Rainfall and Stream Flow data indicate that with early spring planting and controlled drainage water deficits should have been minimal in 1972, 1973, 1981, 2000 and 2002 years. Conversely controlled drainage systems would have had to be operated in wet weather free drainage mode during significant portions of these years.

3.3 Soil Moisture Storage

Webber and Tel (1966) provided a summary of soil and water storage capacity for 102 Ontario soils. Available water reported for Harkaway silt loam was 15.9% (to 66 cm depth), Guelph sandy loam at 12.1% (to 76 cm depth), Tavistock silt loam 9.5% (to 69 cm depth), Haldimand clay loam at 10.5% (to 60 cm depth) and Brookston at 11.3% (to 60 cm depth). **The maximum available total water storage for these soils was therefore 105, 92, 63 and 68 mm respectively.**

Webber and Tel (1966) observed that available moisture decreased with clay content, increased more with coarse silt than with fine silt, increased with organic matter and decreased with sand.

The Brookston soil sampled had available water at 19.0% from 0 to 15 cm and 13% from 16 to 30 cm but only 7% from 31 to 45 cm and 6% from 46 to 60 cm. **Therefore most of the available water storage in the Brookston soil is in the upper 30 cm (48 mm) and the remainder (19.5 mm) in the depth zone between 31 and 60 cm.**

The Honeywood silt loam had available water of 18.8%. For an average silt thickness of 90 cm above the lower permeability till layer, this soil has **maximum available water of about 162 mm.** Therefore Honeywood soils should only require subirrigation in drought years or where soil organic matter is depleted and structure deteriorated. These data indicate considerable variability in moisture storage and availability for Ontario soils.

3.4 CDSI Water Losses

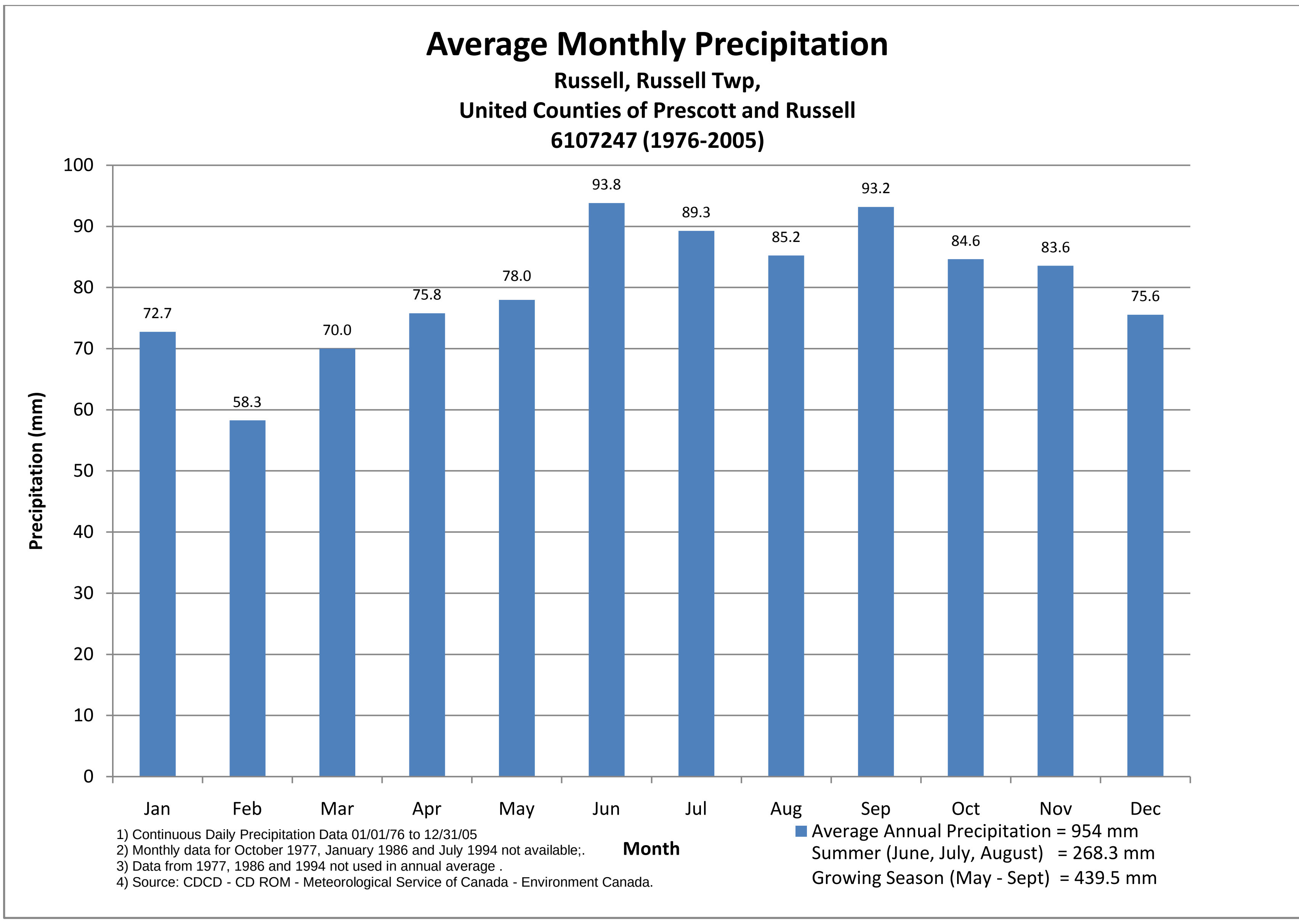
CDSI water losses are the result of increased uptake and evapotranspiration by the crop, marginally increased shallow lateral seepage to local stream base flow and marginally increased deeper recharge to aquifers due to maintenance of saturated conditions and slightly increased water table levels. The degree of horizontal and vertical seepage losses with controlled drainage will be dependent on saturated soil hydraulic conductivities. Vertical leakage to groundwater will be very low in fine textured soils groups (S1) and low in the medium textured and loamy lacustrine and glacial till deposits. Shallow lateral seepage losses may be significant in some S3 soils. The more pervious G2 and G3 soils are generally not suitable for controlled drainage and subirrigation. **Soils suitable for CDSI implementation in general have a low aquifer vulnerability.**

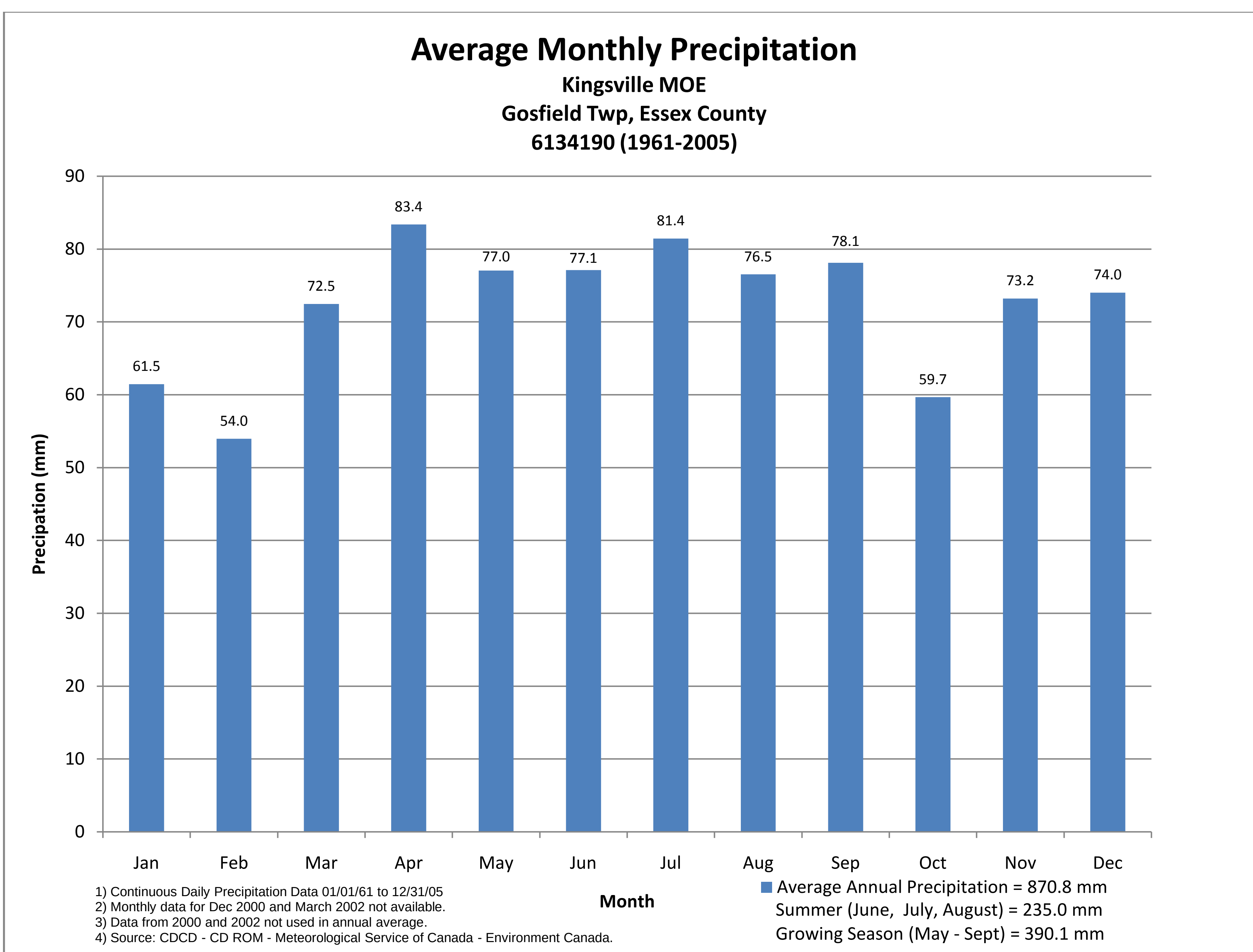
3.5 Summer Rainfall and Summer Streamflow

Summer rainfall and summer streamflow are imperfectly correlated due to seasonal geographic variation in rainfall distribution and intensity. **The data indicate that about 275 mm of summer precipitation and supplementary irrigation is required for normal crop water needs in Ontario (See Fig 4.1).** This estimate does not include pond evaporation, and field leakage and seepage losses.

3.6 Subirrigation Water Supply

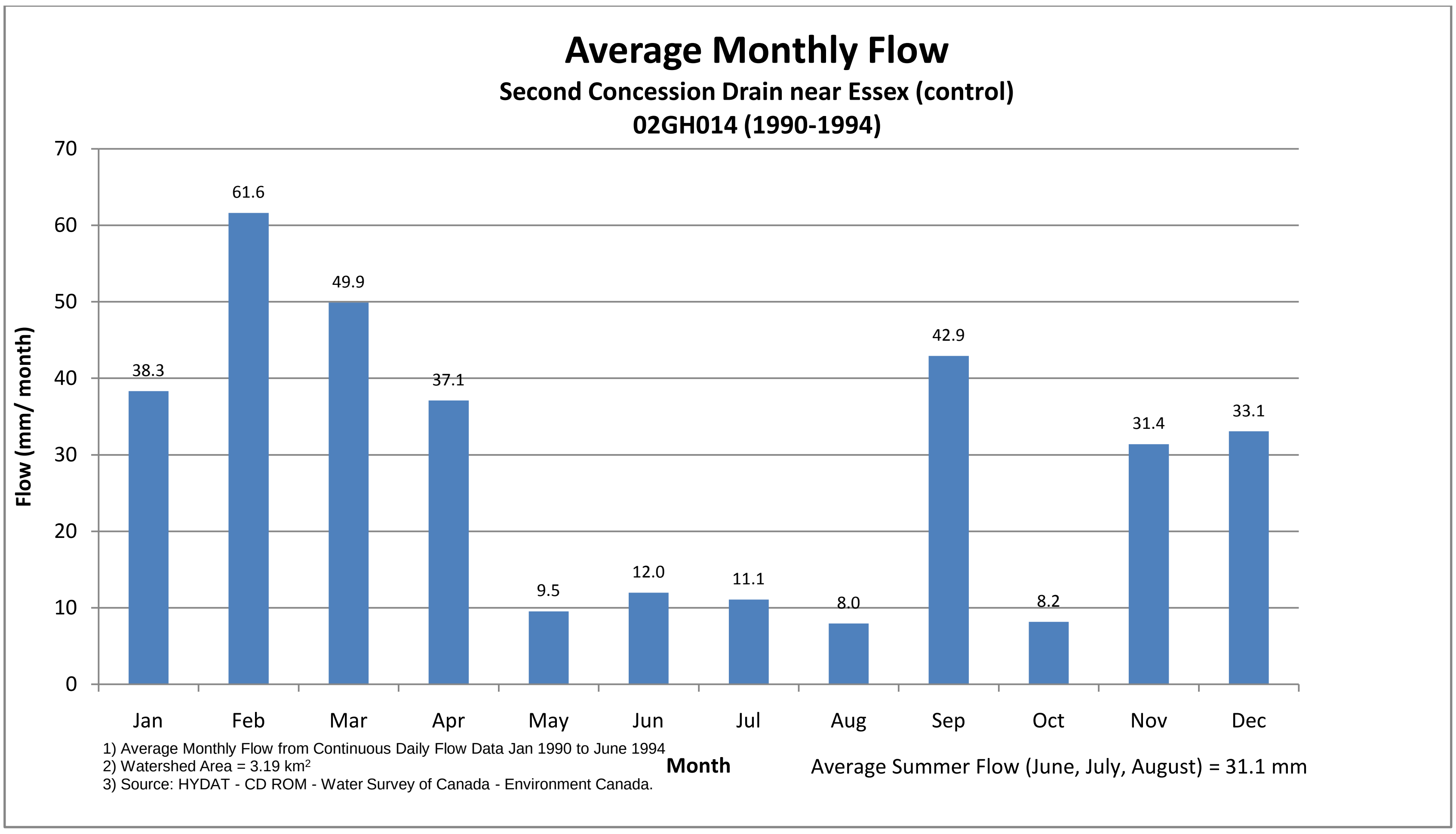
For most farms remote from streams and lake shores, the only viable additional source of subirrigation water will be through the capture and storage of surplus spring runoff for utilization in the dry summer months. This will require excavation of reservoir ponds and/or construction of impoundments. There may be a greater number of natural reservoir impoundment sites in gently undulating terrain. Reduced costs of pond construction may offset increased costs for water level control devices on fields with slopes above 0.5%.

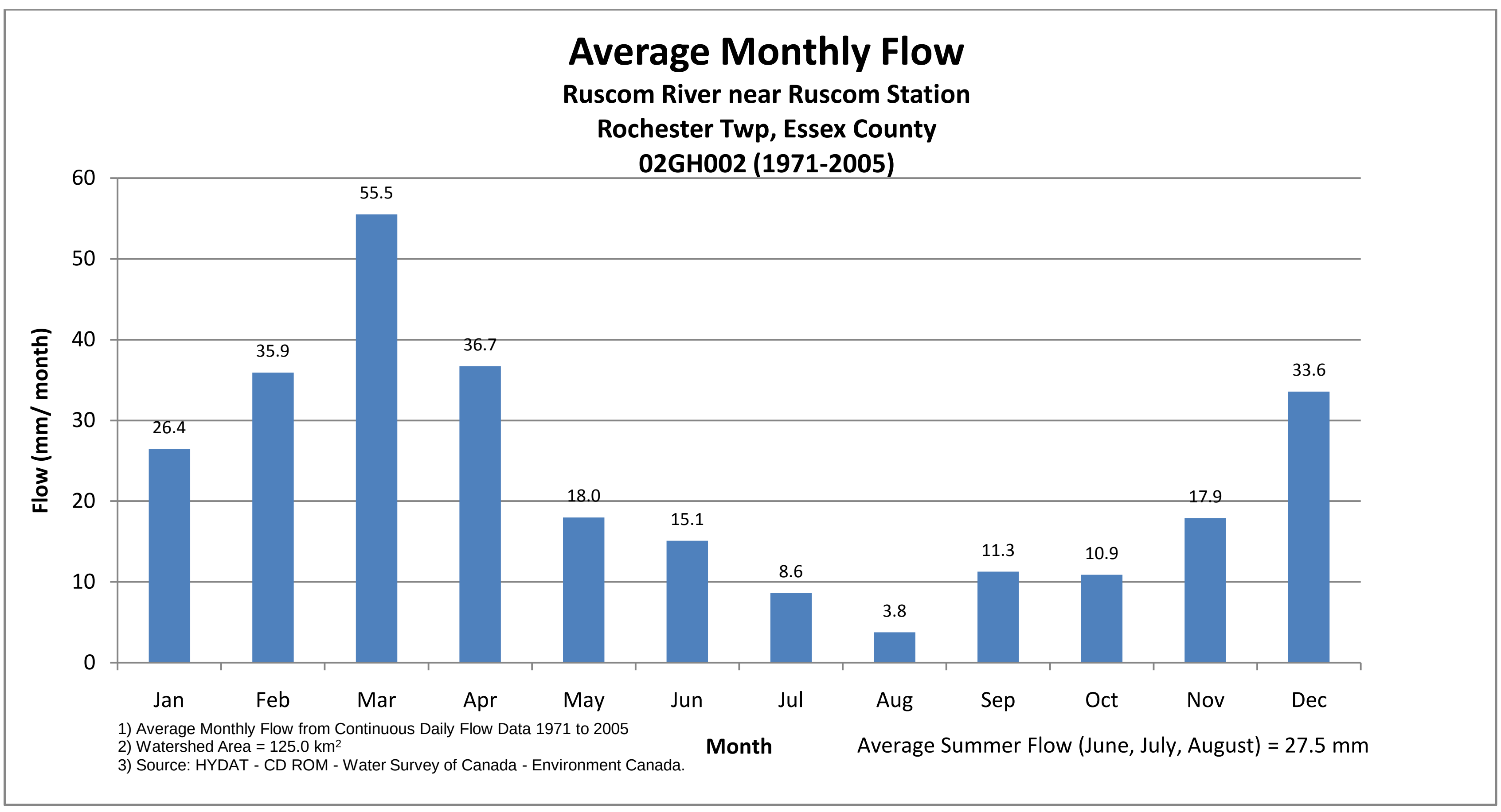


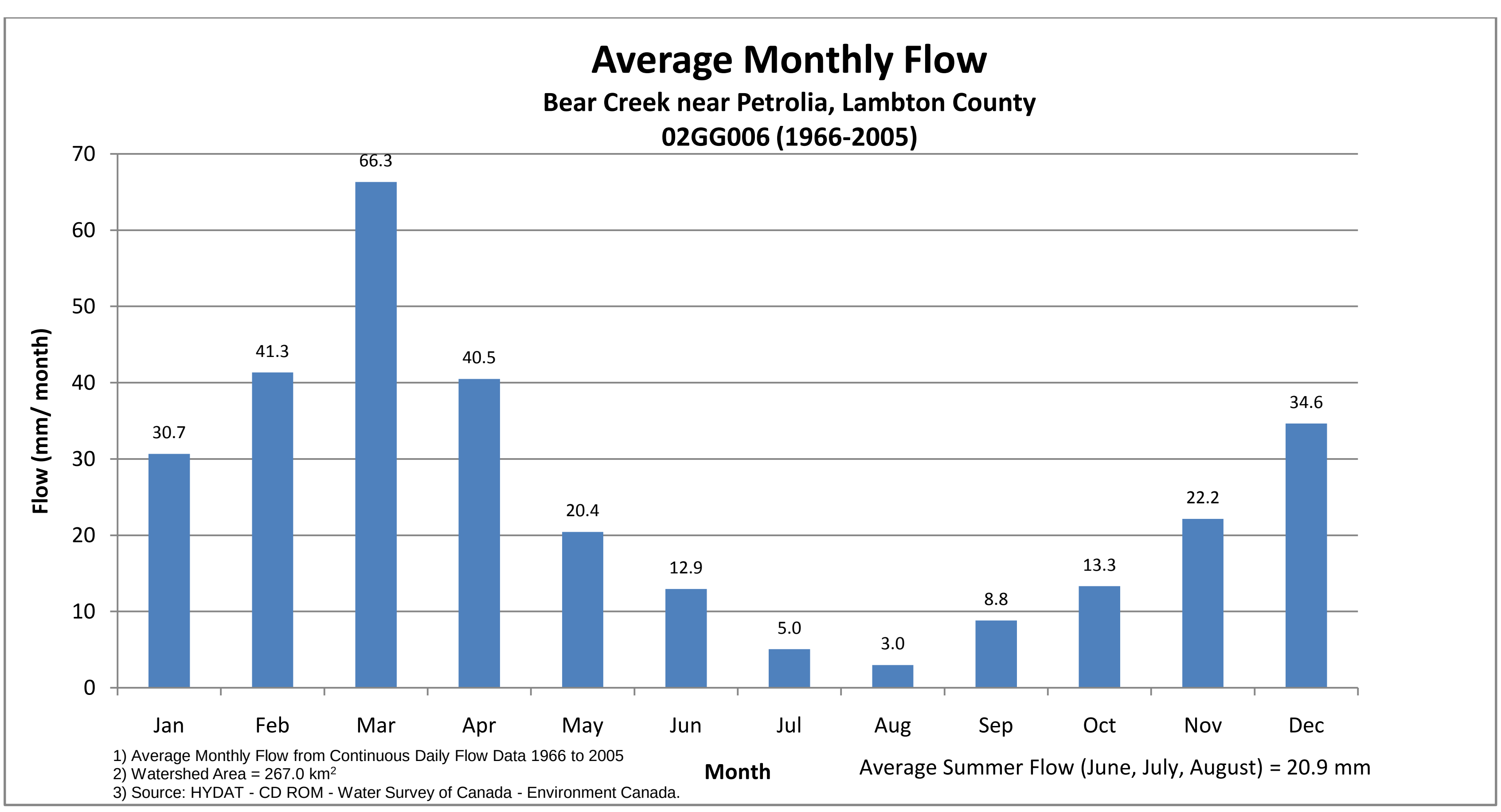


Comparison of Average Monthly Precipitation in Eastern Ontario (Russell) and Southwestern Ontario (Kingsville).

Fig. 3.1

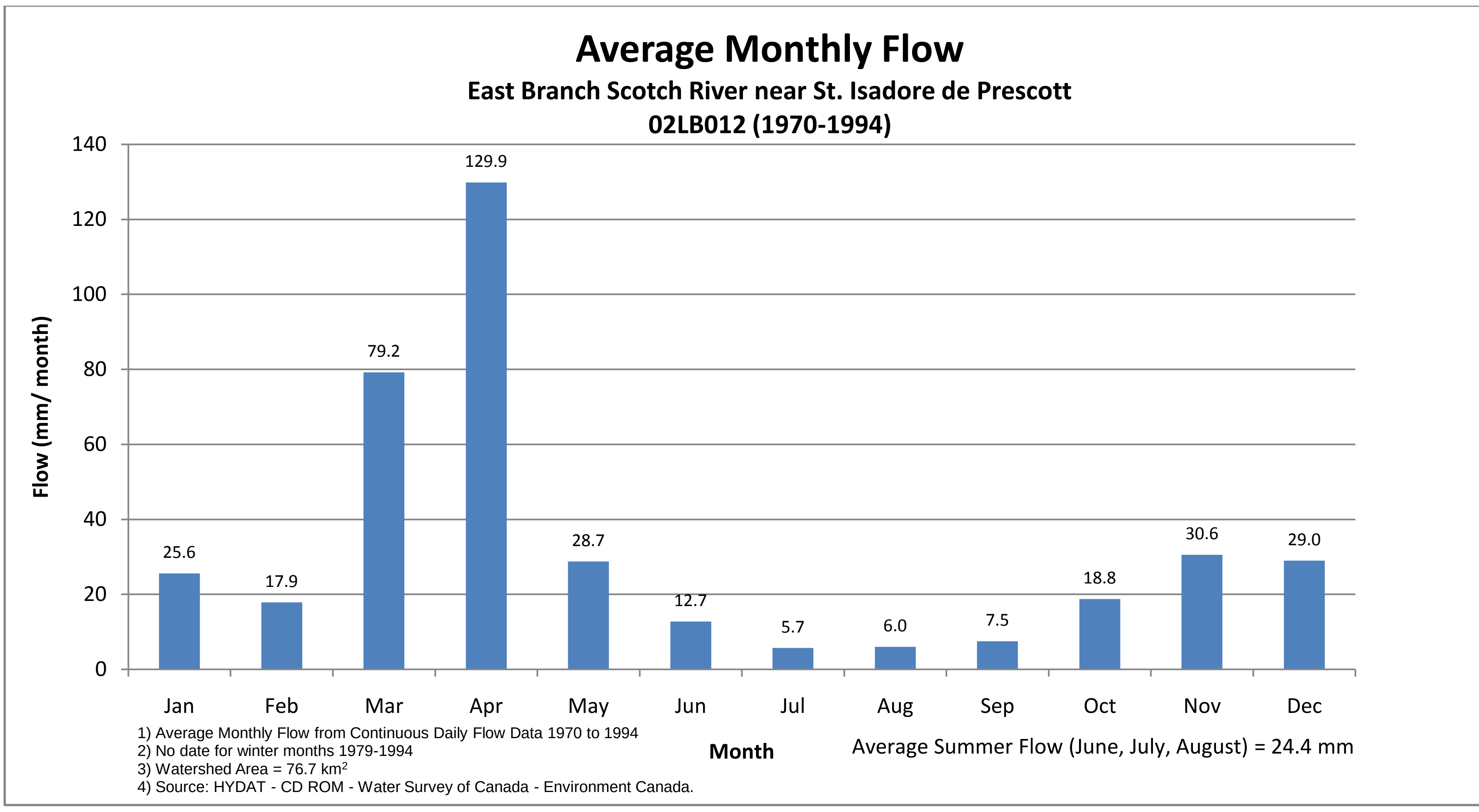


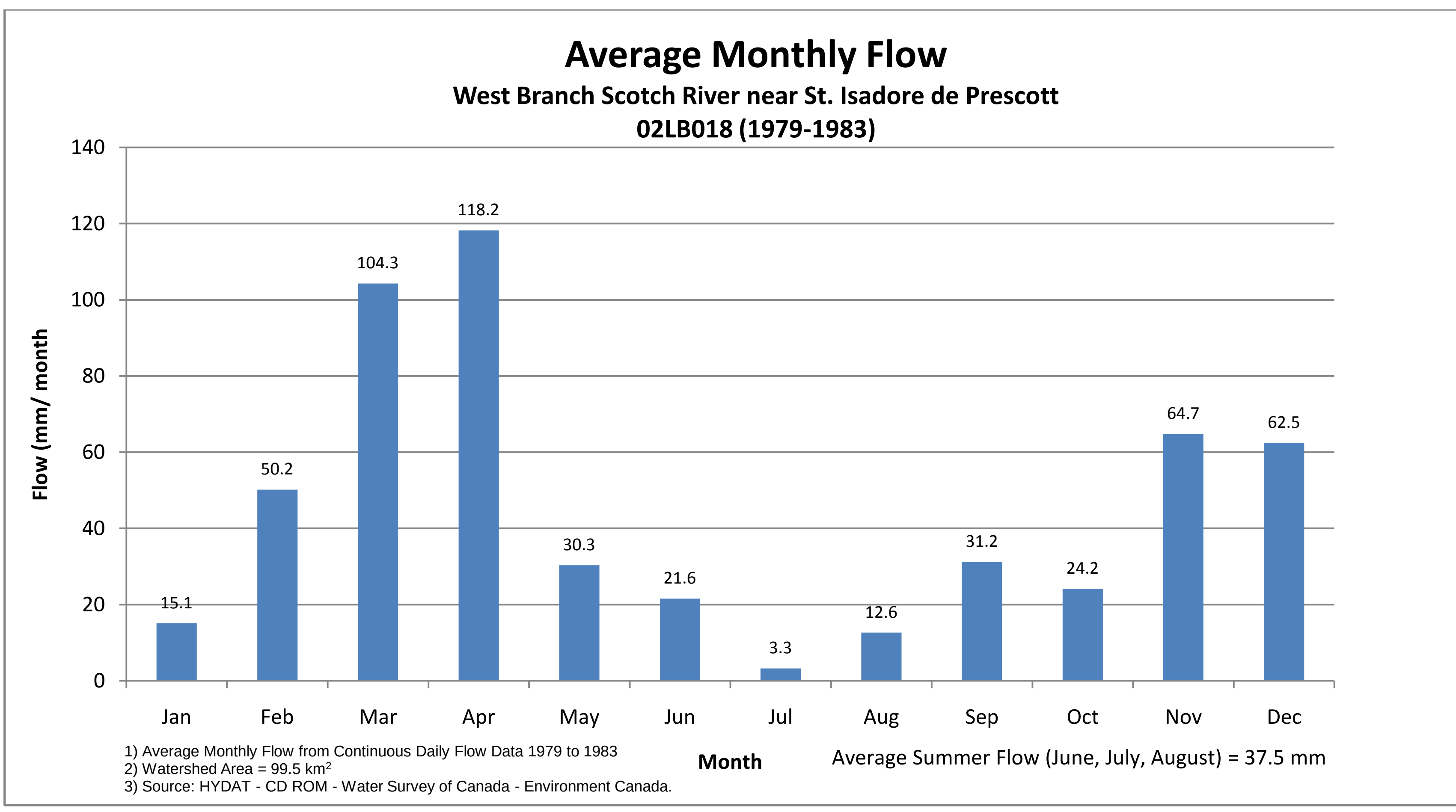


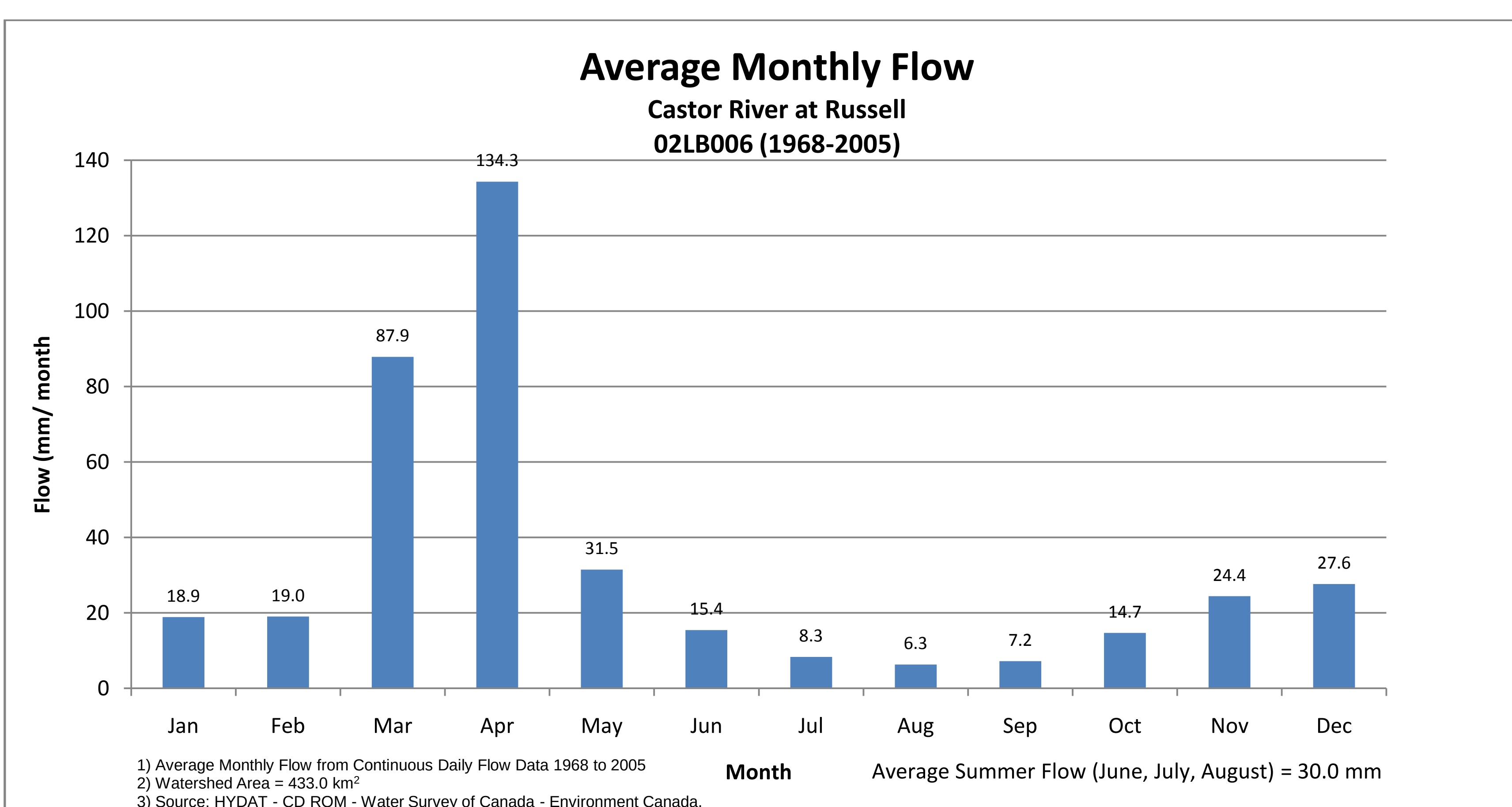


Southwestern Ontario average monthly stream flow provides an analogue of water availability for controlled drainage capture. Potential summer runoff capture (June to August) is 20 to 30 mm. Early planting (May 1) would add 10 to 20 mm on average.

Fig. 3.2

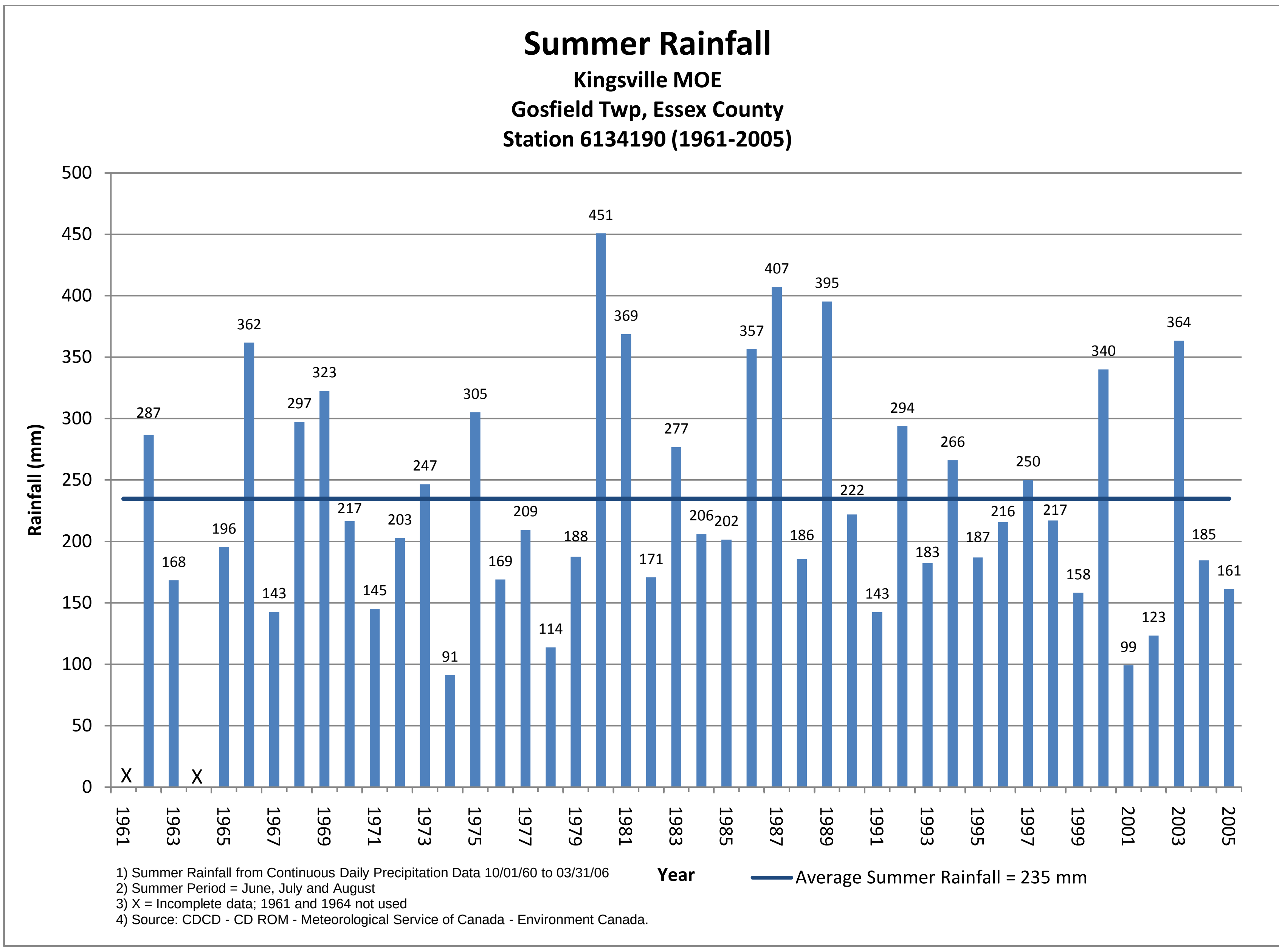


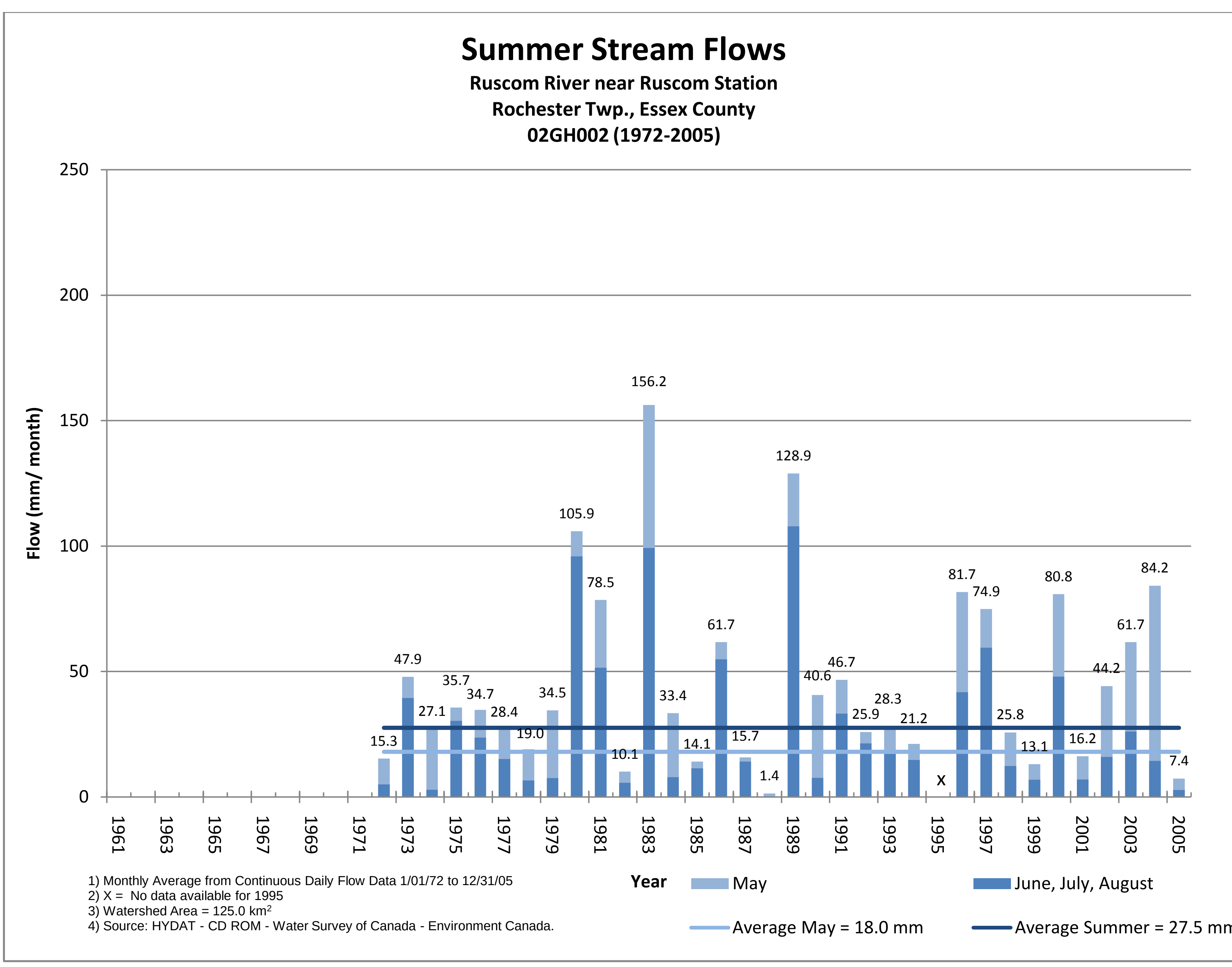




Eastern Ontario average monthly stream flow provides an analogue of water availability for controlled drainage capture. Potential summer runoff capture (June to August) is about 25 mm. Early planting would add up to 30 mm to this capture on average.

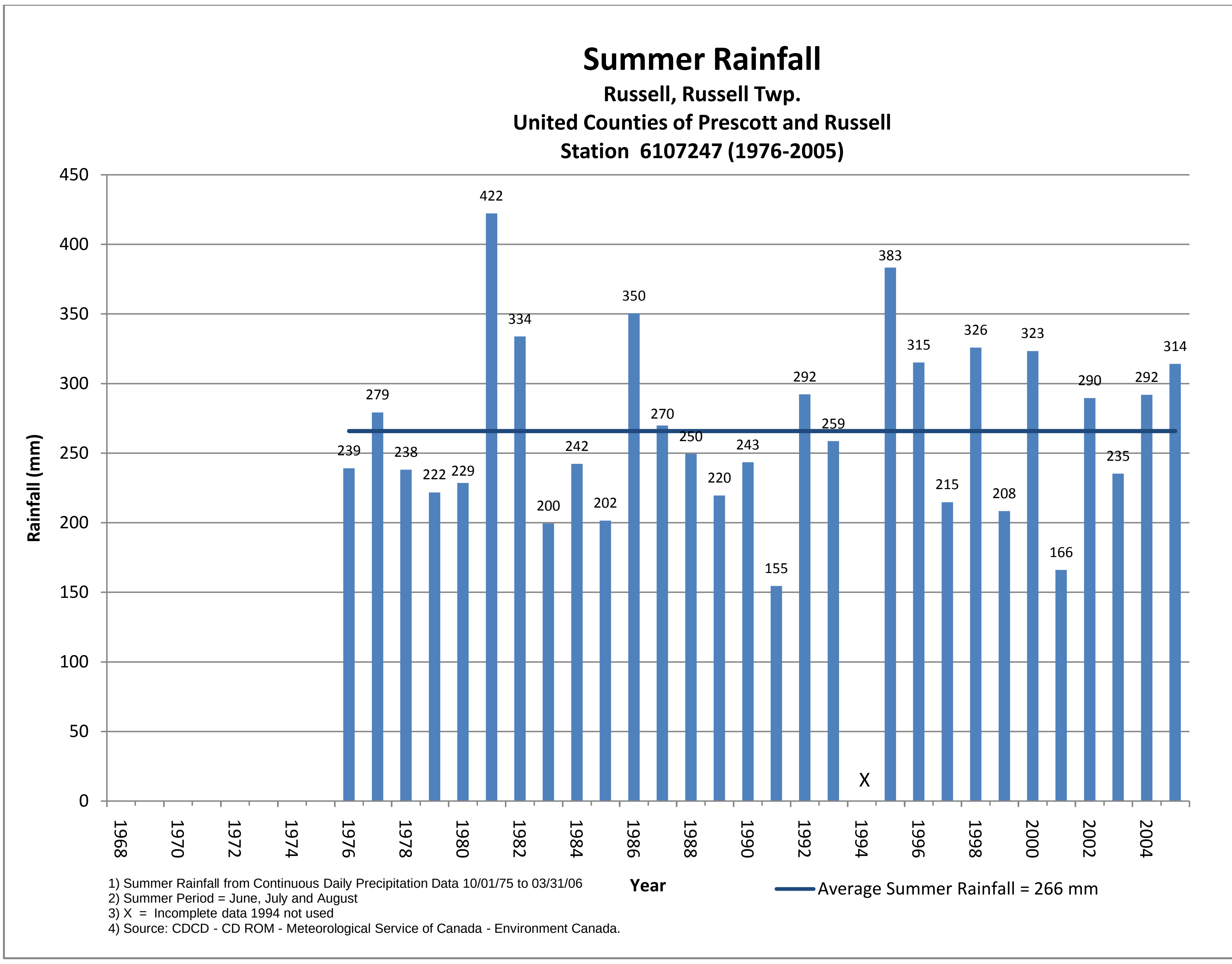
Fig. 3.3

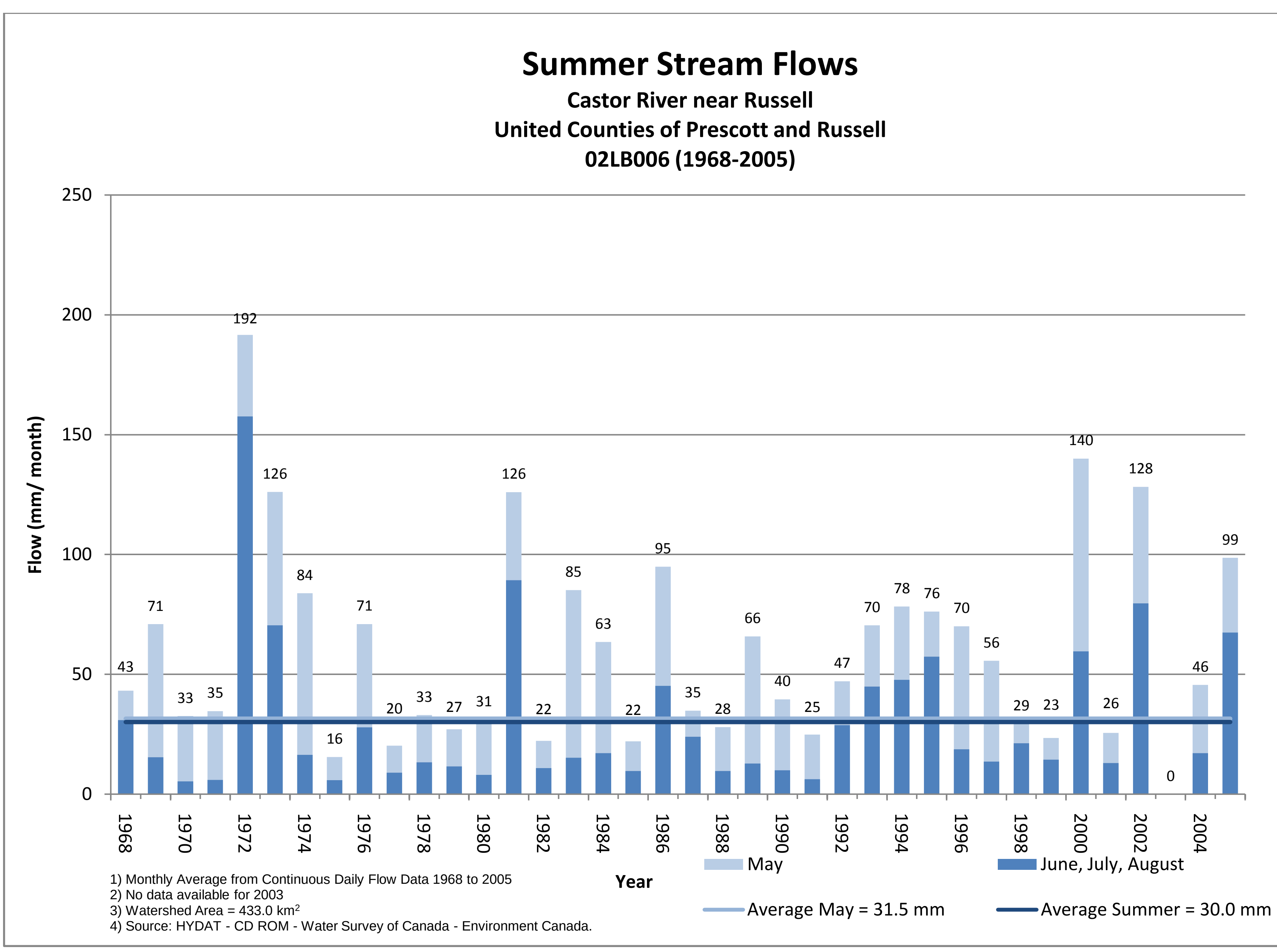




Southwestern Ontario summer rainfall and summer stream flow illustrates year to year variability. Wet years contribute disproportionately to average flow. Conversely in some years there was little runoff to be captured by controlled drainage systems (ie. 1988)

Fig. 3.4





Eastern Ontario demonstrates similar year to year variation in summer precipitation and stream flow. Wet years also contributed disproportionately to stream flows. Conversely in 2003 there was zero runoff over the summer. However there was generally more runoff available for controlled drainage capture than in Southwestern Ontario.

Fig. 3.5