FINAL DRAFT Memorandum CCL-CC6

Date: January 13, 2006 **Our File:** 044.03

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Subject: Carmacks Copper Project – Williams Creek Site Hydrology Update

1. Introduction

This memorandum presents an update to the Williams Creek area site hydrology using site and regional data available up to 2005. Previous summaries of the estimated site hydrology were presented in Clearwater Consultants Ltd. Memoranda CCL-CC2 (March 12, 1998) and CCL-CC2A (April 23, 1998). The purpose of the update presented herein is to present revised hydrological design parameters that will be applied to the updated water balance analysis for the Carmacks Copper Project using all the available site hydrology data and concurrent regional data. The hydrology update includes precipitation, evaporation and streamflow distributions.

2. Available Data

Since the 1998 hydrology studies, additional data have been collected at the Williams Creek site (station elevation 850 m). The station is operated by Yukon Government Water Resources. The data includes temperatures, solar radiation, wind speed and direction, snowpack surveys, and rainfall. The rainfall data were collected using a tipping bucket during non-freezing months: no winter snowfall data have been collected. Data are available up to September 2005. Regional data were used in the update from the following stations:

- Pelly River Ranch at elevation 454 m: temperatures, precipitation, rainfall, snowfall and lake evaporation
- Pelly Farm at elevation 472 m: snow surveys
- Carmacks at elevation 525 m: temperatures, precipitation, rainfall, snowfall
- Whitehorse at elevation 703 m: solar radiation, pan evaporation

Regional streamflow data were evaluated from the following stations:

Station Number	Station Name	Catchment Area (km^2)	Average Catchment Elevation (m)
08AA009	Giltana Creek near the mouth	194	1200
09AG001	Big Salmon River near Carmacks	6,760	1300
09AG003	South Big Salmon River below Livingstone Ck.	515	1430
09AH001	Yukon River at Carmacks	81,800	
09AH003	Big Creek near the mouth	1,750	1070
09AH004	Nordenskiold River below Rowlinson Creek	6,370	1090
09BC005	Tay River near the mouth	3,810	1160

3. Rainfall, Snowfall and Total Precipitation

All parties involved in design and review of the Carmacks Copper project have previously agreed that annual precipitation increases with increasing elevation. It has also been agreed that annual rainfall as a percent of annual total precipitation decreases with increasing elevation, that is to say that higher elevations experience proportionally more snowfall than do lower elevations. Orographic factors (the rate of change per 100 m elevation increase) will be different for rainfall and for snowfall.

The results presented following are based on comparison of the 29 months of concurrent precipitation data collected at Williams Creek and at Pelly River Ranch from 1995 to 2004, 11 years of concurrent snowsurvey data (1995 to 2005) at Williams Creek and at Pelly Farm, and the long-term precipitation data available for Pelly River Ranch from 1955 to 2004. The assumptions and results are believed to be conservative and appropriate for design applications for the Carmacks Copper Project.

3.1 Rainfall

There are 29 months of concurrent rainfall data at Williams Creek and at Pelly River Ranch as shown on Table CC6-1 in Appendix 1. Over this period average total monthly rainfall at Williams Creek was 3.73% higher than at Pelly River Ranch. Based on the station elevations this translates to an orographic factor for rainfall of 1.0373 or a 0.941% increase per 100 m elevation increase.

Tables CC6-2, -3 and -4 in Appendix 1 summarize precipitation, rainfall and snowfall data for Pelly River Ranch. Over the long term (1955 to 2004) annual rainfall has averaged 189.4 mm at Pelly River Ranch, therefore, the estimated average annual rainfall at Williams Creek is (189.4 x 1.0373) 196.5 mm.

3.2 Snowfall

Table CC6-6 summarizes snowsurvey data collected at Williams Creek (1995 to 2005) and Pelly Farm (1986 to 2005). The estimation of annual average snowfall at Williams Creek is summarized following:

	Williams Creek		Pelly River		
	1995-2004	Long-Term	1995-2004	1986-2004	Long-Term
Average Maximum Snowpack (mm water)	89.0	99.6 (B)	71.1	80.4	79.6 (A)
Total Snowfall (mm) (Oct-Apr)	n/a	141.6 (C)	110.7	114.4	113.2
Annual Snowfall (mm) (Jan-Dec)	n/a	141.9 (D)	108.5	115.6	113.7

where,
A = Pelly Long-Term Average Maximum Snowpack =
(Pelly 1986-04 Max Snowpack) x [(Pelly LT Total Snowfall) / (Pelly 1986-2004 Total Snowfall)]

B = Williams Creek Long-Term Average Maximum Snowpack =
(Pelly LT Average Maximum Snowpack) x [1995-2004 Avg. Max Snowpack (WC / Pelly)]

C = Williams Creek Total Snowfall (October to April) =
[(Pelly LT Total Snowfall)/(Pelly LT Avg. Max Snowpack)] x (Williams Ck LT Avg. Max Snowpack)

D = Williams Creek Long-Term Total Average Annual Snowfall (January to December) =
[(Pelly Snowfall Jan to Dec)/Pelly Snowfall Oct to Apr)] x Williams Ck Total Snowfall (Oct to April)

Based on the above, annual snowfall at Williams Creek is estimated to be about 24.8% higher than at Pelly River. Based on the station elevations this translates to an orographic factor for snowfall of 1.2480 or a 6.26% increase per 100 m elevation increase.

3.3 Total Precipitation

Based on the analyses above, the total annual average precipitation at Williams Creek is estimated to be 338.4 mm comprised of 196.5 mm rainfall (58.1%) and 141.9 mm snowfall (41.9%). The following shows comparative values of total precipitation, rainfall and snowfall for Pelly River Ranch and for Williams Creek and the associated orographic factors:

Item	Pelly River	Williams Creek	% per 100 m	Factor
Total Annual Precipitation	303.1 mm	338.4 mm	2.94%	1.1165
Annual Rainfall	189.4 mm	196.5 mm	0.941%	1.0373
Annual Snowfall	113.7 mm	141.9 mm	6.26%	1.2480

3.4 Wet and Dry Year Precipitation

Frequency analyses were carried out on Pelly River Ranch total annual precipitation (47 complete years of data from 1955 to 2004) and the results are shown on Table CC6-7. Based on the orographic factors for rainfall and snowfall developed above, the Table also shows updated estimated annual rainfall and snowfall for extreme wet and dry years for the Williams Creek site for a range of return periods from a 20 year dry year up to a 500 year return period wet year. Values shown on Table CC6-7 are the expected values (best estimates) for each return period: lower and upper bounds for each estimate are within +/-5% to +/-9% of the values shown.

An evaluation of Pelly River Ranch precipitation data corrected for the effects of precipitation undercatch by Environment Canada suggests that annual average total precipitation could be about 5% higher with the increase due to increased rainfall (i.e. more undercatch correction on rainfall data). Corrections each year varied from less than 3% to about 9%. Frequency analyses on the corrected precipitation database yielded values from 3% to 5% higher than the results using the uncorrected database. This difference is not significant and is within the lower to upper bound range calculated for the results using the uncorrected database.

3.5 Wet Periods – One Day, One Month to 12 Month Duration

Total precipitation for wet periods for one day and from one month to 12 months duration were estimated based on the analyses above and assuming the following:

- One day wet periods will have an orographic factor of 1.30 times Pelly River Ranch (Table CC6-1B)
- One month wet periods will have an orographic factor of 1.15 times Pelly River Ranch based on the available common monthly rainfall data (Table CC6-1B);
- Orographic factors for wet periods with durations of 2, 3 and 4 months were estimated by interpolation as shown on Table CC6-8.

- The annual rainfall orographic factor of 1.0373 will apply to five month duration wet periods extending from the start of May through to the end of September. This period is responsible for about 94% of the total annual rainfall recorded at Pelly Ranch;
- The snowfall orographic factor (1.2480) will apply to wet periods of six to seven months duration extending from the start of October through to the end of the following April;
- Wet periods starting in October and lasting more than seven months will be comprised of both snowfall and rainfall; therefore, the orographic factor will be less than the snowfall factor (1.2480) but more than the annual precipitation factor (1.1165). For wet periods of 8, 9, 10 and 11 months duration, the orographic factor was estimated by interpolation as shown on Table CC6-8;

Table CC6-8 summarizes orographic factors for rainfall, snowfall and total precipitation for a range of wet period durations and types. Based on the above, updated estimates of extreme wet and dry year and wet period precipitation depths were prepared. The results for the Williams Creek site are presented in Table CC6-7 (Wet and Dry Year Precipitation, Rainfall and Snowfall) and Table CC6-9 (Wet Period Precipitation – One Day and One to Twelve Month Duration).

Table CC6-10 presents updated estimated average monthly precipitation conditions for the Williams Creek Site. Figures CC6-1 and CC6-2 show average monthly rainfall, snowfall and total precipitation for Pelly River Ranch and for Williams Creek, respectively.

3.6 Snowmelt

Based on the Williams Creek snowsurvey data from 1995 to 2005, the maximum annual snowpack has been measured on April 1 eight times out of 11 years. On average about 50% of the snowpack has been depleted during each of April and May. For design purposes the following is recommended:

- For average conditions the snowmelt will be distributed 50% in April and 50% in May
- For the design of maximum storage volumes in the events pond, 100% of the snowpack will be assumed to melt in May. The total snowmelt could occur over a period of about two weeks.

4. Evapotranspiration and Lake Evaporation

Lake evaporation and land evapotranspiration (including transpiration from vegetation) were estimated using the computer model WREVAP, which was developed by Environment Canada's National Hydrology Research Institute (NHRI, 1985). WREVAP is a semi-empirical, semi-physical model that estimates evaporation from meteorological data (humidity, air temperature and sunshine duration). The model uses different routines to estimate lake evaporation and land evapotranspiration. Estimates were prepared for Whitehorse Airport (elevation 703 m), Mayo Airport (elevation 504 m), and Williams Creek (elevation 850 m). Table CC6-11 summarizes the calculated values of lake evaporation and evapotranspiration. Monthly values are shown on Figures CC6-3 and CC6-4.

Annual calculated total lake evaporation ranges from 467 mm/year at Mayo to 528 mm/year at Williams Creek. Values calculated for Williams Creek and for Whitehorse are very similar. During the typical open water season from May through September, calculated lake evaporation was 440 mm at Whitehorse and at Williams Creek, about 83% of the annual total. Pan evaporation data have been collected by Environment Canada for Pelly Ranch and for Whitehorse Airport. Table CC6-11 also shows lake evaporation calculated from the pan evaporation data assuming a typical pan coefficient of

0.7. Lake evaporation calculated from the pan evaporation data from May to September was 480 mm at Whitehorse, approximately 10% higher than calculated using the WREVAP program.

For application to the Carmacks Copper Project water balance it is recommended that lake (open water) evaporation losses be based on the values calculated for Williams Creek using the WREVAP program. For conservatism in design the following is recommended:

- For the evaluation of maximum design solution storage volumes a "low" estimate of open water season (May to September) annual lake evaporation of 400 mm corresponding to 10% less than the WREVAP calculated value.

- For average operating conditions and the evaluation of make-up water requirements an annual open water season lake evaporation of 440 mm.

Annual calculated areal evapotranspiration ranges from about 180 mm/year at Williams Creek to 220 mm/year at Mayo with about 80% of the total occurring from May through September. At Williams Creek annual areal evapotranspiration is equal to about 34% of annual lake evaporation. Actual evapotranspiration losses of 180 mm/year are recommended for application to the Carmacks Copper site water balance.

5. Temperatures and Solar Radiation

Table CC6-12 summarizes measured temperature data at the Williams Creek site. Figure CC6-5 compares the site data to long-term average temperature data reported for Carmacks. Overall, the Williams Creek site appears warmer than Carmacks: average annual temperatures of -0.6^{o}C and -3.0^{o}C, respectively.

Table CC6-13 summarizes measured global solar radiation at Williams Creek. Monthly average values are generally slightly less than reported for Whitehorse Airport.

6. Monthly Streamflow Distributions and Mean Annual Runoff

The monthly distribution of streamflows in the receiving waters downstream of the Williams Creek site is required in order to estimate potential impacts due to off-site flows from treatment plant and/or settling pond releases. Limited site area streamflow data are available and were reported in previous studies ("Baseline Data Compilation Report" prepared by Access Mining Consultants Ltd., January 1998). A regional evaluation of streamflow data was undertaken to estimate the seasonal distribution of flows within the Williams Creek catchment area. Table CC6-14 summarizes the regional streamflow data evaluated.

Figure CC6-6 shows the monthly distribution of streamflows as a percent of mean annual runoff for the regional streamflow stations. The legend on the Figure provides three characteristics of the catchments associated with the runoff distributions: drainage area; catchment median elevation; and mean annual runoff. Median elevation appears to be a reasonably good predictor of the shape of a stream's average monthly hydrograph. Low elevation catchments generally experience earlier peaks than high elevation catchments and winter baseflows tends to increase with increasing median elevation.

Based on the regional data, Table CC6-15 and Figure CC6-6 show the recommended monthly streamflow distribution for Williams Creek catchment areas up to about 90 km^2 and the average monthly distribution of flow in the Yukon River downstream of Williams Creek. These monthly distributions of flows will be used in the overall site water balance analysis.

Mean annual runoff within the Williams Creek catchment was estimated as follows:

- Comparisons of measured Williams Creek flows (1992 to 1994 data) and concurrent flows in Big Creek (IEE Addendum #2, Report on Preliminary Design, May 1995, Tables 2.12 to 2.15) indicated a mean annual runoff depth of 56 mm for Williams Creek;
- For an estimated mean annual precipitation of 338 mm (Table CC6-7), annual areal evapotranspiration of 177 mm (Table CC6-11), and estimated winter sublimation loss of about 20 mm, the calculated mean annual runoff for the catchment would be about 141 mm.
- For water quality modeling purposes it is recommended that a mean annual runoff (MAR) of 100 mm is appropriate for Williams Creek based on the average of the above two values.

Mean annual runoff for the Yukon River downstream of Williams Creek (estimated 83,700 km^2 area) was assumed to be about 290 mm, the same as the average recorded for the streamflow gauging station 09AH001 "Yukon River at Carmacks" (81,800 km^2) from 1951 to 1995.

7. Conclusions

The estimated hydrologic characteristics of the Williams Creek site area have been updated using all the available site and regional data. The updated site hydrology parameter values will be applied to the site water balance analysis of the project. Table CC6-16 summarizes and compares hydrological parameters estimated in previous studies with the results of the present study.

The following conclusions are made:

1) 29 months of concurrent rainfall data are available between Williams Creek and Pelly River Ranch from 1995 to 2005
2) The updated estimated annual average precipitation at the Williams Creek site is 338 mm comprised of 196.5 mm rainfall (58.1%) and 141.9 mm snowfall (41.9%).
3) The results of updated frequency analyses for annual precipitation and one day and one to twelve month duration wet periods are shown on Tables CC6-7 and CC6-9, respectively.
4) Average monthly rainfall, snowfall and total precipitation depths for the Williams Creek site area are shown on Table CC6-10 and Figure CC6-2.
5) For average conditions the annual snowmelt will be assumed to be equally distributed between April and May. For design storage determination 100% of the snowmelt will be assumed to occur in May.
6) Annual average potential lake evaporation for Williams Creek is estimated to be 528 mm with about 83% of the lake evaporation (440 mm) occurring during the open water season from May to September. A 10% lower value (475 mm/year, 400 mm from May to September) is recommended as a conservative design parameter to evaluate maximum design solution storage volumes.
7) Annual average areal evapotranspiration for Williams Creek is estimated to be about 180 mm equal to 34% of lake evaporation with about 80% of the total occurring from May to September.
8) The Williams Creek site appears slightly warmer than Carmacks based on the limited available data.
9) Global solar radiation at Williams Creek is slightly less than reported for Whitehorse Airport.

10) Monthly streamflow distributions recommended for the Williams Creek catchment area and for the Yukon River downstream of Williams Creek are shown on Figure CC6-6 and Table CC6-15.

11) Mean annual runoff depth for Williams Creek is estimated to be 100 mm with 290 mm mean annual runoff depth for the Yukon River downstream of Williams Creek.

CLEARWATER CONSULTANTS LTD.

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APPENDIX 1

Williams Creek Site Hydrology Update

Tables

Table CC6-1A - Monthly Rainfall (mm) - Concurrent Data at Williams Creek & Pelly River Ranch

Williams Creek (elevation 850 m)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
1995			3.3	19.5					25.0	8.5			
1996				5.9	16.0	12.0	91.0	79.9	10.3				
1997					60.3	45.9	102.4	14.6	23				
1998				1.9	5.4	39.1	28.3	19.2	16	4.7			
1999					15.1	54.3	38.6	35.9					
2000													
2001													
2002													
2003					14.6	64.6	67.7						
2004													
2005				1.6	14.7	63.9	83.5	42.6	19.8				
Average - All Data			3.3	7.2	21.0	46.6	68.6	38.4	18.8	6.6			210.6
Average - Common with Pelly			**3.3**	**9.1**	**22.3**	**43.2**	**65.6**	**37.4**	**18.6**	**6.6**			**206.0**

Note: Precipitation measured by tipping bucket rain gauge.

Pelly River Ranch (elevation 454 m)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
1995			0.4	0.2					10.6	14.6			
1996				7.6	3.4	27.9	67.2	58.2	33.6				
1997					86.0	56.6	80.6	36.0	29.4				
1998				0.0	6.4	40.6	19.4	21.4	25.8	3.0			
1999					19.8	62.8	28.2	57.2					
2000													
2001													
2002													
2003					12.6	29.6	52.6						
2004													
2005													
Average - Common with WC			**0.4**	**2.6**	**25.6**	**43.5**	**49.6**	**43.2**	**24.9**	**8.8**			**198.6**
Avg - All Data	0.0	0.0	0.2	3.6	22.4	36.4	53.7	38.3	25.5	7.2	0.4	0.1	187.8

Calculation of Rainfall Orographic Factor based on 29 common months of data

Total Rainfall at Williams Creek = 206.0 mm
Total Rainfall at Pelly River Ranch = 198.6 mm
Orographic Factor per 100 m elevation = [(WC Rainfall / Pelly Rainfall) - 1] / [(WC Elev - Pelly Elev)/100]
= [(206.0 / 198.6) -1] / [(850-454)/100] = 0.00941 or 0.941% per 100 m elevation increase

Table CC6-1B - Comparison of Maximum Daily and Maximum One Month Rainfalls

	Maximum One Day mm			Maximum One Month mm		
Year	WC	PRR	WC/PRR	WC	PRR	WC/PRR
1995				25.0	14.6	1.712
1996	28.8	19.8	1.45	91.0	67.2	1.354
1997	22.9	26.4	0.87	102.4	86.0	1.191
1998	16.8	7.1	2.37	39.1	40.6	0.963
1999	17.6	23.4	0.75	54.3	62.8	0.865
2000						
2001						
2002						
2003	29.0	11.6	2.50	67.7	52.6	1.287
2004						
2005	19.7					
Averages	23.0	17.7	**1.30**	70.9	61.8	**1.15**

Averages based on common days / months of data

Table CC6-2 - PELLY RIVER RANCH Total Precipitation (mm)

Station 2100880 | Lat 62o 49' N
Elevation 454 m | Long 137o 22' W

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1951												48.3	
1952	48.3	5.1	6.4	2.5	6.6								
1954						6.1	40.6	17.8	23.4	2.5	18.8	32.8	
1955	22.4	5.3	8.1	0.1	7.1	43.2	14.0	86.1	10.7	4.8	26.4	23.6	251.8
1956	12.7	11.7		6.9	40.1	45.0	48.3	40.9	2.8	37.1	33.0	18.0	
1957	14.7	23.9	13.7	7.9	15.2	12.7	34.8	19.6	19.8	2.3	33.3	20.8	218.7
1958	20.8	16.3	1.3	3.0	14.2	33.5	62.0	67.1	17.0	45.2	35.1	12.4	327.9
1959	10.2	21.1	24.4	10.7	19.3	46.7	29.0	37.6	25.1	6.4	20.1	14.5	265.1
1960	11.2	15.2	12.7	5.1	18.5	26.4	117.9	36.6	28.4	8.4	24.1	17.8	322.3
1961	13.5	10.9	11.2	6.6	23.4	45.0	44.5	25.9	18.3	41.9	24.4	29.2	294.8
1962	25.4	17.3	4.1	24.9	16.3	55.9	35.6	39.4	13.0	6.4	15.0	37.8	291.1
1963	47.8	7.4	10.7	10.9		47.5	58.7	18.5	35.1	27.2	14.7	47.5	
1964	24.1	19.1	16.5	16.0	26.2	53.6	88.1	30.7	21.1	19.8	19.1	20.1	354.4
1965	12.2	9.9	5.1	3.6	14.0	30.0	41.9	17.5	40.4	42.4	17.8	24.9	259.7
1966	7.6	26.2	6.6	10.2	5.8	28.2	7.1	20.3	16.0	35.3	61.0	10.4	234.7
1967	37.6	26.7	31.2	14.2	16.5	46.2	65.0	56.4	28.4	13.0	16.3	18.5	370.0
1968	30.7	12.2	19.8	15.7	25.1	21.3	29.7	25.7	59.7	14.2	27.4	10.7	292.2
1969	11.7	3.6	14.5	11.9	30.5	3.3	81.5	12.2	22.9	7.9	25.7	14.5	240.2
1970	8.4	16.0	2.0	7.6	48.8	24.4	5.3	42.7	50.3	35.3	25.7	35.3	301.8
1971	4.6	6.6	7.9	4.8	7.4	11.7	24.1	45.0	22.1	28.4	28.4	40.4	231.4
1972	23.1	13.7	7.9	12.7	14.7	70.9	47.2	23.1	23.4	54.1	20.1	12.2	323.1
1973	25.1	12.4	17.8	30.5	5.1	50.8	47.5	54.1	8.6	17.3	22.6	34.3	326.1
1974	4.6	37.3	9.7	19.1	7.4	14.7	65.8	31.8	8.6	27.9	14.0	30.5	271.4
1975	20.3	4.6	0.3	18.3	13.7	16.5	71.6	29.0	32.3	20.8	15.7	12.2	255.3
1976	30.5	14.0	26.9	10.7	42.9	37.3	46.7	19.3	14.5	15.2	24.1	13.7	295.8
1977	31.1	4.1	16.8	25.0	24.2	44.8	30.3	18.3	14.9	18.1	21.7	11.7	261.0
1978	10.8	3.3	3.4	12.9	17.8	33.4	100.0	46.7	23.8	24.7	23.7	26.9	327.4
1979	23.8	19.5	20.9	4.6	29.5	47.7	54.1	10.2	33.5	4.0	18.9	17.6	284.3
1980	24.3	11.5	2.8	3.2	9.2	24.8	44.4	33.0	53.4	17.6	21.5	1.8	247.5
1981	5.4	27.0	4.3	11.0	13.2	33.3	87.9	43.6	52.9	43.0	41.5	6.0	369.1
1982	11.3	13.1	6.4	13.9	33.7	13.3	62.7	22.4	31.7	25.4	22.0	13.2	269.1
1983	30.1	27.2	3.3	5.8	29.0	50.3	53.8	82.2	26.0	20.6	6.6	11.3	346.2
1984	24.1	23.6	8.2	8.5	33.5	27.0	44.6	48.7	25.0	14.4	14.7	28.9	301.2
1985	27.6	17.0	5.6	8.9	20.5	69.8	88.4	48.8	28.5	23.1	17.2	10.9	366.3
1986	27.7	4.7	16.9	5.8	30.0	47.4	73.0	44.5	8.0	9.0	20.9	14.5	302.4
1987	11.7	25.7	8.3	9.2	22.3	26.6	53.4	34.6	43.1	42.9	32.4	25.2	335.4
1988	12.4	14.8	13.9	4.1	23.8	26.2	68.8	28.6	9.8	26.6	22.0	21.3	272.3
1989	14.0	6.0	5.6	0.2	32.6	49.1	13.1	20.4	23.8	18.6	35.9	12.0	231.3
1990	11.6	21.9	6.8	1.6	48.4	57.0	13.0	41.0	45.0	34.0	23.2	40.0	343.5
1991	16.6	23.8	9.9	4.0	25.1	30.0	47.8	34.7	43.0	23.4	40.1	30.0	328.4
1992	32.0	11.2	16.0	46.6	28.2	32.2	44.3	47.4	56.4	39.2	31.0	19.4	403.9
1993	24.9	6.8	34.4	8.8	18.4	16.8	61.9	40.0	20.8	28.1	34.8	7.0	302.7
1994	24.6	4.8	15.9	7.7	37.8	53.6	36.2	8.6	21.6	27.4	27.4	3.6	269.2
1995	5.8	12.4	4.6	0.2	16.8	31.8	84.4	78.2	10.6	22.9	15.8	22.4	305.9
1996	12.8	16.6	9.9	16.6	3.4	27.9	67.2	58.2	33.6	32.8	6.2	24.4	309.6
1997	7.6	17.0	18.4	12.6	86.0	56.6	80.6	36.0	29.4	24.0	24.7	18.2	411.1
1998	12.6	1.8	2.8	2.4	6.4	40.6	19.4	21.4	30.6	12.1	14.0	22.8	186.9
1999	21.2	21.0	8.2	12.4	19.8	63.0	28.2	57.2	35.2	38.4	33.9	31.8	370.3
2000	33.2	7.4	9.6	12.4	32.6	45.7	93.8	78.6	84.4	15.6	26.4	13.8	453.5
2001	16.0	7.0	5.6	12.6	12.3	47.8	99.4	36.4	23.0	22.0	23.2	12.4	317.7
2002	22.2	14.8	3.8	12.2	26.9	23.4	74.8	74.6	9.0	13.6	18.0	27.8	321.1
2003	8.7	13.4	15.2	3.0	16.0	29.6	52.6	26.8	20.4	9.8	50.6	34.0	280.1
2004	48.7	36.5	26.9	3.9	19.2								
2005													
# years	51	51	50	51	50	50	50	50	50	50	50	51	47
Mean	20.0	14.7	11.3	10.3	22.7	36.4	53.7	38.4	27.6	22.9	24.6	21.4	303.1
Max.	48.7	37.3	34.4	46.6	86.0	70.9	117.9	86.1	84.4	54.1	61.0	48.3	453.5
Min.	4.6	1.8	0.3	0.1	3.4	3.3	5.3	8.6	2.8	2.3	6.2	1.8	186.9
Std. Dev	11.13	8.50	7.95	8.34	14.42	16.18	26.22	19.35	15.85	12.74	10.08	10.98	53.34

Sum of Average Months = 303.9
Average of Complete Years = 303.1

Table CC6-3 - PELLY RIVER RANCH Total Rainfall (mm)

Station 2100880 Lat 62o 49' N
Elevation 454 m Long 137o 22' W

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1951												0.0	
1952	0.0	0.0	0.0	0.0	6.6								
1954						6.1	40.6	17.8	19.3	2.5	0.0	5.1	
1955	0.0	0.0	0.0	0.0	7.1	43.2	14.0	86.1	10.4	1.5	0.0	0.0	162.3
1956	0.0	0.0		0.0	40.1	45.0	48.3	40.9	2.5	16.0	0.0	0.0	
1957	0.0	0.0	0.0	7.6	15.2	12.7	34.8	19.6	13.5	0.1	2.5	0.0	106.0
1958	0.0	0.0	0.0	0.0	14.2	33.5	62.0	67.1	12.7	4.6	0.0	0.0	194.1
1959	0.0	0.0	0.0	0.1	18.8	46.7	29.0	37.6	25.1	0.0	0.0	0.0	157.3
1960	0.0	0.0	0.0	2.3	18.5	26.4	117.9	36.6	28.4	7.4	0.3	0.0	237.8
1961	0.0	0.0	0.0	0.0	23.4	45.0	44.5	25.9	18.3	12.4	0.0	0.0	169.5
1962	0.0	0.0	0.0	20.8	16.3	55.9	35.6	39.4	13.0	5.1	0.0	0.0	186.1
1963	0.0	0.0	0.0	5.1		47.5	58.7	18.5	35.1	14.5	0.0	0.0	
1964	0.0	0.0	0.0	0.0	19.8	53.6	88.1	30.7	21.1	4.6	0.0	0.0	217.9
1965	0.0	0.0	0.0	0.3	14.0	30.0	41.9	17.5	40.4	10.4	0.0	0.0	154.5
1966	0.0	0.0	0.0	10.2	5.8	28.2	7.1	20.3	16.0	8.6	0.0	0.0	96.2
1967	0.0	0.0	0.0	1.3	16.5	46.2	65.0	56.4	28.4	8.6	1.3	0.0	223.7
1968	0.0	0.0	2.5	5.1	25.1	21.3	29.7	25.7	50.8	0.0	0.0	0.0	160.2
1969	0.0	0.0	0.0	0.8	30.5	3.3	81.5	12.2	22.9	1.5	0.0	0.0	152.7
1970	0.0	0.0	0.0	1.0	47.5	24.4	5.3	42.7	41.7	11.9	2.5	0.0	177.0
1971	0.0	0.0	0.0	1.0	7.4	11.7	24.1	45.0	22.1	4.1	0.0	0.0	115.4
1972	0.0	0.0	0.0	0.0	13.0	70.9	47.2	23.1	17.3	2.8	0.0	0.0	174.3
1973	0.0	0.0	0.0	22.4	5.1	50.8	47.5	54.1	8.6	1.5	0.0	0.0	190.0
1974	0.0	0.0	0.0	0.8	6.4	14.7	65.8	31.8	8.6	12.7	0.1	0.0	140.9
1975	0.0	0.0	0.0	7.4	13.7	16.5	71.6	29.0	32.3	3.3	0.0	0.1	173.9
1976	0.0	0.0	0.0	0.1	42.9	37.3	46.7	19.3	14.5	2.3	2.0	0.0	165.1
1977	0.0	0.3	0.0	1.8	24.2	44.8	30.3	18.3	14.9	16.8	0.0	0.0	151.4
1978	0.0	0.0	0.0	4.0	17.8	33.4	100.0	46.7	23.8	0.5	0.0	0.0	226.2
1979	0.0	0.0	2.5	0.0	29.5	47.7	54.1	10.2	33.5	2.2	10.0	0.0	189.7
1980	0.0	0.0	0.0	3.2	9.2	24.8	44.4	33.0	49.9	11.2	0.0	0.0	175.7
1981	0.0	0.0	0.8	7.6	13.2	33.3	87.9	43.6	50.9	31.4	0.0	0.0	268.7
1982	0.0	0.1	0.0	0.0	33.7	13.3	62.7	22.4	31.7	2.3	0.0	0.0	166.2
1983	0.0	0.0	0.0	4.8	29.0	50.3	53.8	82.2	23.7	9.8	0.0	0.0	253.6
1984	0.0	0.0	0.0	3.4	33.5	27.0	44.6	47.7	25.0	8.7	0.0	0.0	189.9
1985	0.0	0.0	0.0	0.0	20.5	69.8	88.4	48.8	28.5	2.4	0.0	0.1	258.5
1986	0.0	0.0	0.0	0.1	30.0	47.4	73.0	44.5	8.0	9.0	0.0	0.1	212.1
1987	0.0	0.0	2.0	2.0	17.9	26.6	53.4	34.6	43.1	33.4	0.0	0.0	213.0
1988	0.0	0.0	0.0	2.9	23.8	26.2	68.8	28.6	9.6	0.0	0.0	0.0	159.9
1989	0.0	0.0	0.0	0.2	32.6	49.1	13.1	20.4	21.0	2.8	0.0	0.0	139.2
1990	0.0	0.0	0.1	0.6	48.4	57.0	13.0	41.0	45.0	12.4	0.0	0.0	217.5
1991	0.0	0.0	0.0	0.0	25.1	30.0	47.8	34.7	43.0	14.6	0.0	0.0	195.2
1992	0.0	0.0	0.8	18.0	24.4	32.2	44.3	47.4	34.2	2.6	0.0	0.0	203.9
1993	0.0	0.0	0.0	7.8	18.4	16.8	61.9	40.0	18.8	14.2	0.0	0.0	177.9
1994	0.0	0.0	0.1	1.4	37.8	53.6	36.2	8.6	21.6	7.4	0.1	0.0	166.8
1995	0.0	0.0	0.4	0.2	16.8	31.8	84.4	78.2	10.6	14.6	0.0	0.0	237.0
1996	0.0	0.0	0.0	7.6	3.4	27.9	67.2	58.2	33.6	0.0	0.0	0.0	197.9
1997	0.0	0.0	0.0	5.8	86.0	56.6	80.6	36.0	29.4	0.0	0.0	0.0	294.4
1998	0.0	0.0	0.0	0.0	6.4	40.6	19.4	21.4	25.8	3.0	0.0	0.0	116.6
1999	0.0	0.0	0.0	5.4	19.8	62.8	28.2	57.2	25.2	6.6	0.0	0.0	205.2
2000	0.0	0.0	0.0	7.0	32.6	45.7	93.8	78.6	77.6	0.4	0.0	0.0	335.7
2001	0.0	0.0	0.0	9.4	12.3	47.8	99.4	36.4	23.0	5.4	0.0	0.0	233.7
2002	0.0	0.0	0.0	8.2	26.9	23.4	74.8	74.6	9.0	9.6	0.0	0.0	226.5
2003	0.0	0.0	0.0	0.0	12.6	29.6	52.6	26.8	10.4	0.8	0.0	0.0	132.8
2004	0.0	0.0	0.0	0.8	19.2								
2005													
# years	51	51	50	51	50	50	50	50	50	50	50	51	47
Mean	0.0	0.0	0.2	3.7	22.3	36.4	53.7	38.3	25.5	7.2	0.4	0.1	189.4
Max.	0.0	0.3	2.5	22.4	86.0	70.9	117.9	86.1	77.6	33.4	10.0	5.1	335.7
Min.	0.0	0.0	0.0	0.0	3.4	3.3	5.3	8.6	2.5	0.0	0.0	0.0	96.2
Std. Dev	0.00	0.04	0.58	5.22	14.45	16.17	26.22	19.34	14.42	7.27	1.51	0.71	48.08

Sum of Average Months = 187.7
Average of Complete Years = 189.4

Table CC6-4 - PELLY RIVER RANCH Total Snowfall (mm)

Station 2100880 62o 49' N
Elevation 454 m 137o 22' W

(Note - Calculation of Total Precipitation (Table CC5-2) assumes constant 10% density for snowfall)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1951												48.3	
1952	48.3	5.1	6.4	2.5	0.0								
1954						0.0	0.0	0.0	4.1	0.0	18.8	27.7	
1955	22.4	5.3	8.1	0.1	0.1	0.0	0.0	0.0	0.3	3.3	26.4	23.6	89.6
1956	12.7	11.7		6.9	0.1	0.0	0.0	0.0	0.3	21.8	33.0	18.0	
1957	14.7	23.9	13.7	0.3	0.1	0.0	0.0	0.0	6.4	2.3	30.7	20.8	112.9
1958	20.8	16.3	1.3	3.0	0.0	0.0	0.0	0.0	4.3	40.6	35.1	12.4	133.8
1959	10.2	21.1	24.4	10.7	0.5	0.0	0.0	0.0	0.0	6.4	20.1	14.5	107.9
1960	11.2	15.2	12.7	2.8	0.0	0.0	0.0	0.0	0.0	1.0	23.9	17.8	84.6
1961	13.5	10.9	11.2	6.6	0.1	0.0	0.0	0.0	0.0	29.5	24.4	29.2	125.4
1962	25.4	17.3	4.1	4.1	0.0	0.0	0.0	0.0	0.0	1.3	15.0	37.8	105.0
1963	47.8	7.4	10.7	5.8		0.0	0.0	0.0	0.0	12.7	14.7	47.5	
1964	24.1	19.1	16.5	16.0	6.4	0.0	0.0	0.0	0.0	15.2	19.1	20.1	136.5
1965	12.2	9.9	5.1	3.3		0.0	0.0	0.0	0.1	32.0	17.8	24.9	
1966	7.6	26.2	6.6		0.0	0.0	0.0	0.0	0.0	26.7	61.0	10.4	
1967	37.6	26.7	31.2	13.0	0.1	0.0	0.0	0.0	0.0	4.3	15.0	18.5	146.4
1968	30.7	12.2	17.3	10.7	0.0	0.0	0.0	0.0	8.9	14.2	27.4	10.7	132.1
1969	11.7	3.6	14.5	11.2	0.0	0.0	0.0	0.0	0.0	6.4	25.7	14.5	87.6
1970	8.4	16.0	2.0	6.6	1.3	0.0	0.0	0.0	8.6	23.4	23.1	35.3	124.7
1971	4.6	6.6	7.9	3.8	0.1	0.0	0.0	0.0	0.1	24.4	28.4	40.4	116.3
1972	23.1	13.7	7.9	12.7	1.8	0.0	0.0	0.0	6.1	51.3	20.1	12.2	148.9
1973	25.1	12.4	17.8	8.1	0.0	0.0	0.0	0.0	0.0	15.7	22.6	34.3	136.0
1974	4.6	37.3	9.7	18.3	1.0	0.0	0.0	0.0	0.0	15.2	14.0	30.5	130.6
1975	20.3	4.6	0.3	10.9	0.0	0.0	0.0	0.0	0.0	17.5	15.7	12.2	81.5
1976	30.5	14.0	26.9	10.7	0.1	0.0	0.0	0.0	0.0	13.0	22.1	13.7	131.0
1977	31.1	3.8	16.8	23.2	0.0	0.0	0.0	0.0	0.0	1.3	21.7	11.7	109.6
1978	10.8	3.3	3.4	8.9	0.0	0.0	0.0	0.0	0.0	24.2	23.7	26.9	101.2
1979	23.8	19.5	18.4	4.6	0.0	0.0	0.0	0.0	0.0	1.8	8.9	17.6	94.6
1980	24.3	11.5	2.8	0.0	0.0	0.0	0.0	0.0	3.5	6.4	21.5	1.8	71.8
1981	5.4	27.0	3.5	3.4	0.1	0.0	0.0	0.0	2.0	11.6	41.5	6.0	100.5
1982	11.3	13.1	6.4	13.9	0.1	0.0	0.0	0.0	0.0	23.1	22.0	13.2	103.1
1983	30.1	27.2	3.3	1.0	0.0	0.0	0.0	0.0	2.3	10.8	6.6	11.3	92.6
1984	24.1	23.6	8.2	5.1	0.0	0.0	0.0	1.0	0.0	5.7	14.7	28.9	111.3
1985	27.6	17.0	5.6	8.9	0.0	0.0	0.0	0.0	0.0	20.7	17.2	10.9	107.9
1986	27.7	4.7	16.9	5.8	0.0	0.0	0.0	0.0	0.1	0.1	20.9	14.5	90.7
1987	11.7	25.7	6.3	7.2	4.4	0.0	0.0	0.0	0.0	9.5	32.4	25.2	122.4
1988	12.4	14.8	13.9	1.2	0.0	0.0	0.0	0.0	0.2	26.6	22.0	21.3	112.4
1989	14.0	6.0	5.6	0.1	0.0	0.0	0.0	0.0	2.8	15.8	35.9	12.0	92.2
1990	11.6	21.9	6.8	1.0	0.0	0.0	0.0	0.0	0.0	21.6	23.2	40.0	126.1
1991	16.6	23.8	9.9	4.0	0.0	0.0	0.0	0.0	0.0	8.8	40.1	30.0	133.2
1992	32.0	11.2	15.2	28.6	3.8	0.0	0.0	0.0	22.2	36.6	31.0	19.4	200.0
1993	24.9	6.8	34.4	1.0	0.0	0.0	0.0	0.0	2.0	13.9	34.8	7.0	124.8
1994	24.6	4.8	15.9	6.3	0.0	0.0	0.0	0.0	0.0	20.0	27.4	3.6	102.6
1995	5.8	12.4	4.2	0.0	0.0	0.0	0.0	0.0	0.0	8.3	15.8	22.4	68.9
1996	12.8	16.6	9.9	9.0	0.0	0.0	0.0	0.0	TR	32.8	6.2	24.4	111.7
1997	7.6	17.0	18.4	6.8	0.0	0.0	0.0	0.0	0.0	24.0	24.7	18.2	116.7
1998	12.6	1.8	2.8	2.4	0.0	0.0	0.0	0.0	4.8	9.1	14.0	22.8	70.3
1999	21.2	21.0	8.2	7.0	0.0	0.2	0.0	0.0	10.0	31.8	33.9	31.8	165.1
2000	33.2	7.4	9.6	5.4	0.0	0.0	0.0	0.0	6.8	15.2	26.4	13.8	117.8
2001	16.0	7.0	5.6	3.2	0.0	0.0	0.0	0.0	0.0	16.6	23.2	12.4	84.0
2002	22.2	14.8	3.8	4.0	0.0	0.0	0.0	0.0	0.0	4.0	18.0	27.8	94.6
2003	8.7	13.4	15.2	3.0	3.4	0.0	0.0	0.0	10.0	9.0	50.6	34.0	147.3
2004	48.7	36.5	26.9	3.1	0.0								
# years	51	51	50	50	49	50	50	50	49	50	50	51	45
Mean	20.0	14.7	11.1	6.7	0.5	0.0	0.0	0.0	2.2	15.8	24.2	21.3	113.4
Max.	48.7	37.3	34.4	28.6	6.4	0.2	0.0	1.0	22.2	51.3	61.0	48.3	200.0
Min.	4.6	1.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	1.8	68.9
Std. Dev	11.13	8.51	7.88	5.92	1.30	0.03	0.00	0.14	4.17	11.60	10.28	10.89	25.88

Sum of Average Months = 116.4
Average of Complete Years = 113.4

Table CC6-5 - PELLY RIVER RANCH Wet Period Precipitation

(May through September = Rainfall, Winter October through April = Snowfall)

	Maximum One Months						Maximum Two Month Periods					Maximum Three Months				Winter Precipitation 6-mo.	7-mo.	8-mo.
Year	May	June	July	Aug	Sept	MAX	M/J	J/J	J/A	A/S	MAX	M/J/J	J/J/A	J/A/S	MAX	O - M	O - A	O - May
1951																		
1952	6.6																	
1954		6.1	40.6	17.8	23.4	40.6		46.7	58.4	41.2	58.4		64.5	81.8	81.8			
1955	7.1	43.2	14.0	86.1	10.7	86.1	50.3	57.2	100.1	96.8	100.1	64.3	143.3	110.8	143.3	89.9	90.0	97.1
1956	40.1	45.0	48.3	40.9	2.8	48.3	85.1	93.3	89.2	43.7	93.3	133.4	134.2	92.0	134.2			
1957	15.2	12.7	34.8	19.6	19.8	34.8	27.9	47.5	54.4	39.4	54.4	62.7	67.1	74.2	74.2	140.4	148.3	163.5
1958	14.2	33.5	62.0	67.1	17.0	67.1	47.7	95.5	129.1	84.1	129.1	109.7	162.6	146.1	162.6	94.8	97.8	112.0
1959	19.3	46.7	29.0	37.6	25.1	46.7	66.0	75.7	66.6	62.7	75.7	95.0	113.3	91.7	113.3	148.4	159.1	178.4
1960	18.5	26.4	117.9	36.6	28.4	117.9	44.9	144.3	154.5	65.0	154.5	162.8	180.9	182.9	182.9	80.1	85.2	103.7
1961	23.4	45.0	44.5	25.9	18.3	45.0	68.4	89.5	70.4	44.2	89.5	112.9	115.4	88.7	115.4	85.9	92.5	115.9
1962	16.3	55.9	35.6	39.4	13.0	55.9	72.2	91.5	75.0	52.4	91.5	107.8	130.9	88.0	130.9	142.3	167.2	183.5
1963		47.5	58.7	18.5	35.1	58.7		106.2	77.2	53.6	106.2		124.7	112.3	124.7	125.1	136.0	
1964	26.2	53.6	88.1	30.7	21.1	88.1	79.8	141.7	118.8	51.8	141.7	167.9	172.4	139.9	172.4	149.1	165.1	191.3
1965	14.0	30.0	41.9	17.5	40.4	41.9	44.0	71.9	59.4	57.9	71.9	85.9	89.4	99.8	99.8	86.2	89.8	103.8
1966	5.8	28.2	7.1	20.3	16.0	28.2	34.0	35.3	27.4	36.3	36.3	41.1	55.6	43.4	55.6	125.5	135.7	141.5
1967	16.5	46.2	65.0	56.4	28.4	65.0	62.7	111.2	121.4	84.8	121.4	127.7	167.6	149.8	167.6	202.2	216.4	232.9
1968	25.1	21.3	29.7	25.7	59.7	59.7	46.4	51.0	55.4	85.4	85.4	76.1	76.7	115.1	115.1	110.5	126.2	151.3
1969	30.5	3.3	81.5	12.2	22.9	81.5	33.8	84.8	93.7	35.1	93.7	115.3	97.0	116.6	116.6	82.1	94.0	124.5
1970	48.8	24.4	5.3	42.7	50.3	50.3	73.2	29.7	48.0	93.0	93.0	78.5	72.4	98.3	98.3	74.5	82.1	130.9
1971	7.4	11.7	24.1	45.0	22.1	45.0	19.1	35.8	69.1	67.1	69.1	43.2	80.8	91.2	91.2	115.4	120.2	127.6
1972	14.7	70.9	47.2	23.1	23.4	70.9	85.6	118.1	70.3	46.5	118.1	132.8	141.2	93.7	141.2	141.9	154.6	169.3
1973	5.1	50.8	47.5	54.1	8.6	54.1	55.9	98.3	101.6	62.7	101.6	103.4	152.4	110.2	152.4	141.7	172.2	177.3
1974	7.4	14.7	65.8	31.8	8.6	65.8	22.1	80.5	97.6	40.4	97.6	87.9	112.3	106.2	112.3	125.8	144.9	152.3
1975	13.7	16.5	71.6	29.0	32.3	71.6	30.2	88.1	100.6	61.3	100.6	101.8	117.1	132.9	132.9	97.6	115.9	129.6
1976	42.9	37.3	46.7	19.3	14.5	46.7	80.2	84.0	66.0	33.8	84.0	126.9	103.3	80.5	126.9	120.1	130.8	173.7
1977	24.2	44.8	30.3	18.3	14.9	44.8	69.0	75.1	48.6	33.2	75.1	99.3	93.4	63.5	99.3	105.0	130.0	154.2
1978	17.8	33.4	100.0	46.7	23.8	100.0	51.2	133.4	146.7	70.5	146.7	151.2	180.1	170.5	180.1	69.0	81.9	99.7
1979	29.5	47.7	54.1	10.2	33.5	54.1	77.2	101.8	64.3	43.7	101.8	131.3	112.0	97.8	131.3	139.5	144.1	173.6
1980	9.2	24.8	44.4	33.0	53.4	53.4	34.0	69.2	77.4	86.4	86.4	78.4	102.2	130.8	130.8	79.1	82.3	91.5
1981	13.2	33.3	87.9	43.6	52.9	87.9	46.5	121.2	131.5	96.5	131.5	134.4	164.8	184.4	184.4	77.6	88.6	101.8
1982	33.7	13.3	62.7	22.4	31.7	62.7	47.0	76.0	85.1	54.1	85.1	109.7	98.4	116.8	116.8	121.3	135.2	168.9
1983	29.0	50.3	53.8	82.2	26.0	82.2	79.3	104.1	136.0	108.2	136.0	133.1	186.3	162.0	186.3	121.2	127.0	156.0
1984	33.5	27.0	44.6	48.7	25.0	48.7	60.5	71.6	93.3	73.7	93.3	105.1	120.3	118.3	120.3	94.4	102.9	136.4
1985	20.5	69.8	88.4	48.8	28.5	88.4	90.3	158.2	137.2	77.3	158.2	178.7	207.0	165.7	207.0	108.2	117.1	137.6
1986	30.0	47.4	73.0	44.5	8.0	73.0	77.4	120.4	117.5	52.5	120.4	150.4	164.9	125.5	164.9	100.5	106.3	136.3
1987	22.3	26.6	53.4	34.6	43.1	53.4	48.9	80.0	88.0	77.7	88.0	102.3	114.6	131.1	131.1	90.1	99.3	121.6
1988	23.8	26.2	68.8	28.6	9.8	68.8	50.0	95.0	97.4	38.4	97.4	118.8	123.6	107.2	123.6	141.6	145.7	169.5
1989	32.6	49.1	13.1	20.4	23.8	49.1	81.7	62.2	33.5	44.2	81.7	94.8	82.6	57.3	94.8	95.5	95.7	128.3
1990	48.4	57.0	13.0	41.0	45.0	57.0	105.4	70.0	54.0	86.0	105.4	118.4	111.0	99.0	118.4	106.8	108.4	156.8
1991	25.1	30.0	47.8	34.7	43.0	47.8	55.1	77.8	82.5	77.7	82.5	102.9	112.5	125.5	125.5	147.5	151.5	176.6
1992	28.2	32.2	44.3	47.4	56.4	56.4	60.4	76.5	91.7	103.8	103.8	104.7	123.9	148.1	148.1	152.7	199.3	227.5
1993	18.4	16.8	61.9	40.0	20.8	61.9	35.2	78.7	101.9	60.8	101.9	97.1	118.7	122.7	122.7	155.7	164.5	182.9
1994	37.8	53.6	36.2	8.6	21.6	53.6	91.4	89.8	44.8	30.2	91.4	127.6	98.4	66.4	127.6	115.2	122.9	160.7
1995	16.8	31.8	84.4	78.2	10.6	84.4	48.6	116.2	162.6	88.8	162.6	133.0	194.4	173.2	194.4	81.2	81.4	98.2
1996	3.4	27.9	67.2	58.2	33.6	67.2	31.3	95.1	125.4	91.8	125.4	98.5	153.3	159.0	159.0	100.4	117.0	120.4
1997	86.0	56.6	80.6	36.0	29.4	86.0	142.6	137.2	116.6	65.4	142.6	223.2	173.2	146.0	223.2	106.4	119.0	205.0
1998	6.4	40.6	19.4	21.4	30.6	40.6	47.0	60.0	40.8	52.0	60.0	66.4	81.4	71.4	81.4	84.1	86.5	92.9
1999	19.8	63.0	28.2	57.2	35.2	63.0	82.8	91.2	85.4	92.4	92.4	111.0	148.4	120.6	148.4	99.3	111.7	131.5
2000	32.6	45.7	93.8	78.6	84.4	93.8	78.3	139.5	172.4	163.0	172.4	172.1	218.1	256.8	256.8	154.3	166.7	199.3
2001	12.3	47.8	99.4	36.4	23.0	99.4	60.1	147.2	135.8	59.4	147.2	159.5	183.6	158.8	183.6	84.4	97.0	109.3
2002	26.9	23.4	74.8	74.6	9.0	74.8	50.3	98.2	149.4	83.6	149.4	125.1	172.8	158.4	172.8	98.4	110.6	137.5
2003	16.0	29.6	52.6	26.8	20.4	52.6	45.6	82.2	79.4	47.2	82.2	98.2	109.0	99.8	109.0	96.7	99.7	115.7
2004	19.2															206.5	210.4	229.6
2005																		
# years	50	50	50	50	50	50	48	50	50	50	50	48	50	50	50	49	49	48
Average	22.7	36.4	53.7	38.4	27.6	63.5	59.9	90.1	92.1	66.0	103.8	113.8	128.5	119.7	137.7	114.5	125.0	147.5
Max.	86.0	70.9	117.9	86.1	84.4	117.9	142.6	158.2	172.4	163.0	172.4	223.2	218.1	256.8	256.8	206.5	216.4	232.9
Min.	3.4	3.3	5.3	8.6	2.8	28.2	19.1	29.7	27.4	30.2	36.3	41.1	55.6	43.4	55.6	69.0	81.4	91.5
Std. Dev	14.42	16.18	26.22	19.35	15.85	19.11	23.70	30.36	35.60	25.42	30.37	35.14	40.02	39.32	39.63	31.06	34.37	37.21
# Max.	1	11	28	6	4	44	4	16	24	6	44	7	25	18	50			

Table CC6-6 - Snowsurvey Data - Williams Creek & Pelly Farm

(Snow Water Equlivalents in mm water)

PELLY FARM (09CD-SC03)

Year	Feb-01	Mar-01	Apr-01	May-01	May-15
1986		74	**84**	70	0
1987		**73**	56	0	0
1988		88	**89**	0	0
1989		76	**77**	0	0
1990		**105**	89	0	0
1991		113	**116**	0	0
1992		95	**97**	31	0
1993		95	**113**	15	0
1994		**62**	60	0	0
1995		52	**52**	0	0
1996		50	**73**	0	
1997			**77**	9	
1998		**59**	56	0	
1999		54	**61**	0	0
2000		78	**82**	38	
2001		58	**70**	0	
2002		58	**67**	55	
2003		42	**48**	5	
2004		**122**	112	42	
2005		**71**	56	0	
Avg.		75.0	**76.8**	13.3	0.0
Max.		122	116	70	0
Min.		42	48	0	0
No. of Maximums		6	14	0	0

Average Maximum Snowpack	
1995 to 2004	**71.1**
1986 to 2004	**80.4**

WILLIAMS CREEK #09AH-SC04

Year	Feb-01	Mar-01	Apr-01	May-01	May-15
1995		55	**78**	20	
1996		79	**88**	17	
1997		84	**93**	59	
1998		80	**92**	0	
1999		73	**91**	36	0
2000		76	82	**84**	
2001		**99**	**99**	72	
2002		78	**84**	31	
2003		**44**	43	11	
2004		108	**137**	124	
2005		**79**	78	0	
Avg.		77.7	**87.7**	41.3	
Max.		108	137	124	
Min.		44	43	0	
No. of Maximums		3	8	1	

Average Maximum Snowpack	
1995 to 2004	**89.0**

Table CC6-7 - Wet & Dry Year Precipitation, Rainfall and Snowfall - Williams Creek Site

Return Period (years)	Annual Percent Probability	Pelly Ranch Total Precipitation	Williams Creek Total Precipitation	Williams Creek Rainfall	Williams Creek Snowfall
		(Elev. 454 m) Note 1	(Elev. 850 m) Note 2	Note 3	Note 3
20 (Dry)	95.0%	222	248	144	104
5 (Dry)	80.0%	258	288	167	121
Average	50.0%	303	338	196	142
5 (Wet)	20.0%	346	386	224	162
10 (Wet)	10.0%	373	416	242	175
20 (Wet)	5.0%	397	443	257	186
50 (Wet)	2.0%	424	473	275	199
100 (Wet)	1.0%	444	496	288	208
200 (Wet)	0.5%	462	516	299	217
500 (Wet)	0.2%	486	543	315	228

NOTES

1) Frequency analysis results from 3 parameter log normal distribution for Pelly Ranch 1955 to 2004
Mean Annual Total Precipitation = 303 mm (62% Rainfall, 38% Snowfall)
Standard Deviation = 53.34 mm
Coefficient of Variation = 0.176

2) Williams Creek total annual precipitation estimated assuming 2.9% increase per 100 m elevation increase between Pelly River Ranch and Williams Creek, equal to a factor of 1.1165 times the precipitation at Pelly River Ranch.

3) Rainfall and Snowfall for extreme years above estimated assuming Rainfall = 58% of Total Precipitation and Snowfall = 42% of Annual Total Precipitation.

Table CC6-8 - Summary of Wet Period Orographic Factors

Wet Period Starts	Wet Period Ends	Wet Period Duration	Type of Precipitation	Orographic Factor	
October 1	March 31	6 months	Snowfall only	1.2480	
	April 30	7	Snowfall only	1.2480	
	May 31	8	Snow and Rain	1.22	*
	June 30	9	Snow and Rain	1.19	*
	July 31	10	Snow and Rain	1.16	*
	August 31	11	Snow and Rain	1.13	*
	September 30	12	Snow and Rain	1.1165	
Any Day May to September		One Day	Rainfall only	1.30	(see Table CC5-1B)
May 1	May 31	1 month	Rainfall only	1.15	
	June 30	2	Rainfall only	1.12	*
	July 31	3	Rainfall only	1.09	*
	August 31	4	Rainfall only	1.07	*
	September 30	5	Rainfall only	1.0375	(see Table CC5-1A)

Notes
1) Value for Pelly Ranch *times* Orogrpahic Factor *equals* value for Williams Creek
2) * values are interpolated

Table CC6-9 - Wet Period Precipitation - One Day and One to Twelve Month Duration

Table CC6-9A - Pelly River Ranch

			Wet Periods Starting on May 1					Wet Periods Starting October 1			Annual
Return Period (years)	Annual Percent Probability	One Day	1 -Month Rainfall	2 -Month Rainfall	3 -Month Rainfall	4 -Month Rainfall	5 -Month Rainfall	6 -Month Snowfall	7 -Month Snowfall	8 -Month Precipitation	12 -Month Precipitation
20 (Dry)	95.0%	9.0	37	58	80	99	112	76	83	92	222
5 (Dry)	80.0%	12.7	47	78	104	125	142	88	85	116	258
Average	50.0%	17.6	63	104	138	163	181	115	125	147	299
5 (Wet)	20.0%	24.1	78	128	169	198	218	137	150	176	346
10 (Wet)	10.0%	28.3	89	144	190	221	242	157	176	199	373
20 (Wet)	5.0%	32.2	99	157	209	241	262	178	199	220	397
50 (Wet)	2.0%	37.2	113	173	231	267	287	207	227	247	424
100 (Wet)	1.0%	40.9	122	185	247	284	304	229	248	267	444
200 (Wet)	0.5%	44.6	132	195	262	302	321	252	270	287	462
500 (Wet)	0.2%	49.5	145	209	282	324	342	285	300	314	486

Table CC6-9B - Williams Creek Site

			Wet Periods Starting on May 1					Wet Periods Starting October 1			Annual
Return Period (years)	Annual Percent Probability	One Day	1 -Month Rainfall	2 -Month Rainfall	3 -Month Rainfall	4 -Month Rainfall	5 -Month Rainfall	6 -Month Snowfall	7 -Month Snowfall	8 -Month Precipitation	12 -Month Precipitation
Orographic Factor		**1.30**	**1.15**	**1.12**	**1.09**	**1.07**	**1.0375**	**1.248**	**1.248**	**1.22**	**1.1165**
20 (Dry)	95.0%	11.7	42.6	65.0	87.2	106	116	94.8	103.6	112	248
5 (Dry)	80.0%	16.5	54.1	87.4	113	134	147	110	106	142	288
Average	50.0%	22.9	72.5	116	150	174	188	144	156	179	334
5 (Wet)	20.0%	31.3	89.7	143	184	212	226	171	187	215	386
10 (Wet)	10.0%	36.8	102	161	207	236	251	196	220	243	416
20 (Wet)	5.0%	41.9	114	176	228	258	272	222	248	268	443
50 (Wet)	2.0%	48.4	130	194	252	286	298	258	283	301	473
100 (Wet)	1.0%	53.2	140	207	269	304	315	286	310	326	496
200 (Wet)	0.5%	58.0	152	218	286	323	333	314	337	350	516
500 (Wet)	0.2%	64.4	167	234	307	347	355	356	374	383	543

Notes
1) Orographic Factors (see Table CC6-8) *times* Pelly River values *equals* Williams Creek values
2) Snowmelt for 6 to 8 month duration wet periods will allow for 20 mm sublimation loss from the snowpack

Table CC6-10 - Average Monthly Precipitation Conditions - Williams Creek Site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pelly River Ranch at Elevation 454 m													
Average Conditions - Monthly Depths - mm													
Average Rainfall	0.0	0.0	0.2	3.5	22.6	36.3	53.5	38.1	27.6	7.1	0.4	0.1	189.4
Average Snowfall	20.0	14.7	11.1	6.7	0.0	0.0	0.0	0.0	0.0	15.8	24.2	21.2	113.7
Average Precipitation	20.0	14.7	11.3	10.2	22.6	36.3	53.5	38.1	27.6	22.9	24.6	21.3	303.1
Percent per month of Total Annual Precipitation													
Average Rainfall	0.0%	0.0%	0.1%	1.2%	7.5%	12.0%	17.6%	12.6%	9.1%	2.3%	0.1%	0.0%	62.5%
Average Snowfall	6.6%	4.9%	3.7%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	5.2%	8.0%	7.0%	37.5%
Total Precipitation	6.6%	4.9%	3.7%	3.4%	7.5%	12.0%	17.6%	12.6%	9.1%	7.6%	8.1%	7.0%	100.0%
Williams Creek Site at Elevation 850 m													
Percent per month of Total Annual Precipitation													
Average Rainfall	0.0%	0.0%	0.0%	1.2%	7.1%	11.7%	16.9%	12.2%	9.0%	0.0%	0.0%	0.0%	58.1%
Average Snowfall	6.4%	4.8%	4.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	7.9%	6.9%	41.9%
Total Precipitation	6.9%	5.3%	4.2%	7.6%	3.6%	11.2%	16.4%	11.7%	8.4%	8.9%	8.4%	7.4%	100.0%
Average Conditions - Monthly Depths - mm													
Average Rainfall	0.0	0.0	0.0	4.1	24.0	39.6	57.2	41.3	30.5	0.0	0.0	0.0	196.5
Average Snowfall	21.7	16.2	13.5	12.2	0.0	0.0	0.0	0.0	0.0	28.1	26.7	23.3	141.9
Total Precipitation	21.7	16.2	13.5	16.2	24.0	39.6	57.2	41.3	30.5	28.1	26.7	23.3	338.4

NOTES

1) Williams Creek % per month for rainfall, snowfall and total precipitation estimated assuming annual rainfall = 58.1% and annual snowfall = 41.9% of total annual precipitation.

Table CC6-11 - Average Areal Evapotranspiration and Lake Evaporation

Month	**Average Monthly Areal Evapotranspiration (mm)**		
	Williams Creek	Whitehorse A	Mayo A
Jan	0	0	0
Feb	0	0	0
Mar	16.7	12.8	0
Apr	16.5	24	19.3
May	27.0	35.1	33.2
Jun	40.5	45.2	49.9
Jul	38.3	44.5	55.9
Aug	18.4	23.9	38.7
Sep	15.3	15.3	17.3
Oct	4.6	8.1	6
Nov	0	0	0
Dec	0	0	0
Annual Total	177.3	208.9	220.3
May-Sept	139.5	164.0	195.0
Elevation (m)	850	703	504

	Average Monthly Lake Evaporation (mm)				
Month	Williams Creek (WREVAP)	Whitehorse A (WREVAP)	Mayo A (WREVAP)	Whitehorse A (adjusted Class A pan)	Pelly Ranch (adjusted Class A pan)
Jan	0	0	0		
Feb	0	0	0		
Mar	21.6	15.3	0		
Apr	61.6	58.4	47.8		
May	99.7	97.3	90.6	104.3	107.6
Jun	119.4	118.7	110.5	124.8	120.3
Jul	110.7	113.1	108.4	109.9	108.0
Aug	76.5	81.2	77.9	96.0	79.8
Sep	34	34.1	26.2	47.7	37.2
Oct	4.1	10.3	5.7		
Nov	0	0	0		
Dec	0	0	0		
Annual Total	527.6	528.4	467.1	482.7	452.9
May-Sept	440.3	444.4	413.6	482.7	452.9
Elevation (m)	850	703	504	703	454

Notes
1) Areal evapotranspiration and average monthly lake evaporation estimated using WREVAP program
2) Class A pan evaporations adjusted by Environment Canada using 0.7 pan coefficient

Table CC6-12 - Monthly Average Temperatures at Williams Creek (°C)

Year	Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	Daily Maximum										2.0	-12.9	-13.0
	Daily Mean										-0.7	-15.9	-16.4
	Daily Minimum										-3.3	-18.8	-19.7
1995	Daily Maximum	-12.9	-8.9	-6.6	9.2	15.8	19.6	18.9	15.8	15.1	1.2	-10.2	
	Daily Mean	-15.3	-11.9	-10.4	4.4	10.7	14.9	14.8	11.6	10.7	-1.1	-12.5	
	Daily Minimum	-17.7	-14.6	-13.9	-0.2	5.8	10.0	11.0	8.2	7.0	-3.0	-14.7	
1996	Daily Maximum				5.5	10.8	17.2	19.3	14.6	8.9	-5.4		
	Daily Mean				1.1	6.9	12.7	14.8	10.5	5.2	-7.7		
	Daily Minimum				-3.1	2.8	8.3	10.8	7.1	1.7	-9.8		
1997	Daily Maximum	-18.3	-5.1	-8.0	6.4	11.8	17.1	19.8	17.6	12.1	-3.6		
	Daily Mean	-21.6	-7.5	-11.4	2.0	7.6	13.2	15.5	13.7	8.4	-5.9		
	Daily Minimum	-24.6	-9.7	-15.3	-2.8	3.1	9.1	11.4	9.5	4.8	-8.4		
1998	Daily Maximum	-19.3	-4.7	-2.1	7.1	15.0	18.9	20.3	16.8	10.3	0.8	-10.1	-10.8
	Daily Mean	-21.5	-7.9	-6.2	2.8	10.2	14.6	15.9	12.2	6.4	-1.8	-12.2	-13.7
	Daily Minimum	-23.3	-10.8	-10.2	-1.2	5.3	10.6	11.6	7.7	3.1	-4.0	-14.1	-16.6
1999	Daily Maximum	-18.1	-14.7	-2.0	4.8	10.0	19.2	19.6	18.8				
	Daily Mean	-21.2	-17.8	-6.2	0.7	5.9	14.6	15.2	14.2				
	Daily Minimum	-24.0	-20.4	-9.8	-3.0	2.1	10.4	11.0	10.2				
2000	Daily Maximum											-5.4	-12.9
	Daily Mean											-7.6	-15.7
	Daily Minimum											-9.4	-18.5
2001	Daily Maximum	-3.6											
	Daily Mean	-6.6											
	Daily Minimum	-9.4											
2002	Daily Maximum	-10.5	-8.5	-7.2									
	Daily Mean	-12.9	-11.7	-10.6									
	Daily Minimum	-15.2	-14.6	-14.1									
2003	Daily Maximum					11.1	16.1						
	Daily Mean					6.8	12.1						
	Daily Minimum					2.6	8.2						
2004	Daily Maximum	-17.0	-1.7	-2.1						7.2			
	Daily Mean	-20.9	-4.9	-6.3						3.5			
	Daily Minimum	-23.6	-8.1	-9.9						0.3			
2005	Daily Maximum		-9.6	1.7	7.2	15.3	17.6						
	Daily Mean		-12.8	-2.3	3.0	10.8	13.2						
	Daily Minimum		-15.7	-5.9	-1.1	6.1	8.9						
Average	Daily Maximum	-14.2	-7.6	-3.8	6.7	12.8	17.9	19.6	16.7	10.7	-1.0	-9.7	-12.3
	Daily Mean	-17.1	-10.7	-7.6	2.3	8.4	13.6	15.2	12.4	6.9	-3.4	-12.1	-15.3
	Daily Minimum	-19.7	-13.4	-11.3	-1.9	4.0	9.3	11.2	8.5	3.4	-5.7	-14.2	-18.3

Carmacks	Daily Maximum	-20.3	-11.0	-1.1	8.1	15.0	20.8	22.3	20.1	13.4	3.0	-9.8	-17.3
	Daily Mean	-25.7	-17.9	-10.2	0.5	7.5	13.4	15.3	12.9	6.8	-1.8	-14.0	-22.4
	Daily Minimum	-31.3	-25.0	-19.1	-7.0	0.1	5.9	8.3	5.6	0.4	-6.4	-18.2	-27.5
Pelly Ranch	Daily Maximum	-22.2	-14	-2	8	15.4	20.9	22.6	20	12.9	1.8	-11.7	-19.2
	Daily Mean	-27.5	-21.1	-11.2	0.5	8	13.4	15.5	12.7	6.5	-2.7	-16.1	-24.4
	Daily Minimum	-32.8	-28.1	-20.3	-7	0.6	5.9	8.3	5.5	0	-7.2	-20.5	-29.6

Table CC6-13 - Monthly Average Global Solar Radiation at Williams Creek ($MJ/m^2/d$)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994										3.7	1.2	0.4
1995	0.6	3.3	8.6	17.2	19.2	21.0	15.0	13.4	9.3	3.3	1.2	
1996				15.9	19.0	21.5	17.8	13.4	9.4	2.4		
1997	0.3	2.2	8.7	15.8	18.7	19.9	17.4	14.7	9.9	3.7	1.5	
1998	0.2	3.1	9.9	15.9	20.5	20.2	19.5	14.8	8.6	3.8	0.5	0.2
1999	0.1	0.9	9.7	14.4	18.7	20.0	19.2	14.2				
2000											0.4	0.2
2001	0.9											
2002	0.5	2.1	10.1									0.1
2003					19.3	20.2	17.9					
2004	0.2	2.5	7.7						9.0			
2005		2.3	9.4	16.2	20.3	20.8						
Average	**0.4**	**2.3**	**9.1**	**15.9**	**19.4**	**20.5**	**17.8**	**14.1**	**9.2**	**3.4**	**1.0**	**0.2**

Monthly Averages for Whitehorse

Average	**1.3**	**4.0**	**9.2**	**15.7**	**19.6**	**21.0**	**18.8**	**15.0**	**9.0**	**4.4**	**1.6**	**0.7**

Table CC6-14 - Regional WSC Streamflow Stations

Station Number	Station Name	Catchment Area (km2)	Average Catchment Elevation (m)
08AA009	Giltana Creek near the mouth	194	1200
09AG003	South Big Salmon River below Livingstone Ck.	515	1430
09AH003	Big Creek near the mouth	1,750	1070
09BC005	Tay River near the mouth	3,810	1160
09AH004	Nordenskiold River below Rowlinson Creek	6,370	1090
09AG001	Big Salmon River near Carmacks	6,760	1300
09AH001	Yukon River at Carmacks	81,800	
	Williams Creek	up to 87.8 km2	

Table CC6-15 - Regional Streamflow Data & Monthly Distributions

Station Number	Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	MAR (mm)
Monthly Average Streamflow (m3/s)															
08AA009	Giltana Creek	0.097	0.077	0.076	0.187	1.94	1.59	0.700	0.626	0.653	0.493	0.278	0.165	0.577	94
09AG003	South Big Salmon River	0.691	0.472	0.393	0.549	4.88	13.3	9.33	5.96	5.64	3.70	1.78	1.06	4.02	246
09AH003	Big Creek	0.306	0.178	0.152	1.83	25.0	17.6	18.9	13.8	10.6	3.98	1.29	0.588	8.01	144
09BC005	Tay River	5.37	4.32	3.98	8.23	66.8	71.0	47.9	33.5	46.7	23.5	11.0	7.84	27.5	227
09AH004	Nordenskiold River	3.83	3.25	3.09	6.93	41.1	31.2	21.3	19.1	19.7	13.0	7.47	5.07	14.6	72
09AG001	Big Salmon River	20.9	18.4	16.9	17.8	75.6	205.7	142.6	94.8	85.5	64.5	37.9	26.4	67.6	316
09AH001	Yukon River at Carmacks	310	284	262	268	592	1560	1620	1290	1120	923	551	364	756	291
Monthly Percent of Annual Discharge															
08AA009	Giltana Creek	1.4%	1.0%	1.1%	2.7%	28.6%	22.6%	10.3%	9.2%	9.3%	7.3%	4.0%	2.4%	100.0%	
09AG003	South Big Salmon River	1.5%	0.9%	0.8%	1.1%	10.4%	27.3%	19.9%	12.7%	11.6%	7.9%	3.7%	2.3%	100.0%	
09AH003	Big Creek	0.3%	0.2%	0.2%	1.9%	26.8%	18.3%	20.2%	14.8%	11.0%	4.3%	1.3%	0.6%	100.0%	
09BC005	Tay River	1.6%	1.2%	1.2%	2.4%	20.5%	21.1%	14.7%	10.3%	13.9%	7.2%	3.3%	2.4%	100.0%	
09AH004	Nordenskiold River	2.2%	1.7%	1.8%	3.9%	23.8%	17.5%	12.3%	11.1%	11.0%	7.5%	4.2%	2.9%	100.0%	
09AG001	Big Salmon River	2.6%	2.1%	2.1%	2.2%	9.5%	25.1%	18.0%	11.9%	10.4%	8.1%	4.6%	3.3%	100.0%	
09AH001	**Yukon River at Carmacks**	3.4%	2.9%	2.9%	2.9%	6.6%	16.8%	18.0%	14.3%	12.0%	10.2%	5.9%	4.0%	100.0%	
Recommended for Williams Creek		1.2%	0.6%	0.7%	5.0%	25.9%	18.7%	12.8%	11.3%	11.2%	7.2%	3.4%	2.0%	100.0%	

Notes

1) MAR = Mean Annual Runoff depth (mm)
2) Catchment area for Yukon River at Williams Creek is estimated to be 83,700 km2. The flow distribution for Yukon River at Carmacks is assumed applicable to the Yukon River at Williams Creek. Flow rates/volumes could be increased by the ratio of the catchment areas (approx. 2.3%).
3) Estimated MAR for the Williams Creek catchment is 100 mm.
4) Distribution recommended for WIlliams Creek is based on the Nordenskiold River distribution.
5) Estimated MAR for Yukon River downstream of Williams Creek is 290 mm.

Table CC6-16 - Carmacks Copper Project - Comparison of Hydrology Studies

	Previous Values Knight Piesold	Previous Proposed Values - Clearwater Consultants Ltd.		
Item or Issue	**KP Report # 1785/1, April 23/97**	**Memo CCL-CC2, March 12, 1998**	**Memo CCL-CC2A, April 23, 1998**	**Current Proposed Values (Clearwater Memo CCL-CC5), Jan. 13, 2006**
1) Orographic Factor (Williams Creek 850 m v. Regional Data)	Total Precipitation increases at **8% per 100 m**, also applied to Rainfall and Snowfall	Total Precipitation **3.2%/100m**, Annual Rainfall = **58%** and Annual Snowfall = **42%** of annual total precipitation	Total Precipitation **6.1%/100m**, Annual Rainfall = **55%** and Annual Snowfall = **45%** of annual total precipitation	Total Precipitation **2.94%/100m**, Annual Rainfall = **58%** and Annual Snowfall = **42%** of annual total precipitation
2) Annual Total Precipitation, Rainfall, Snowfall	- used average of Pelly Ranch and Carmacks precipitation increased 8%/100m. Average Precipitation = **375 mm**, Average Rainfall = 233 mm, Average Snowfall = 143 mm.	- used Pelly River Ranch precipitation increased as above. Average Precipitation = **338 mm**, Average Rainfall = 195 mm, Average Snowfall = 143 mm.	- used Pelly River Ranch precipitation increased as above. Average Precipitation = **372 mm**, Average Rainfall = 205 mm, Average Snowfall = 167 mm.	- used Pelly River Ranch precipitation increased as above. Average W.C. Precipitation = **338 mm**, Average Rainfall = 196 mm, Average Snowfall = 142 mm.
3) Wet & Dry Year Precipitation	- used assumed normal distribution with assumed coefficient of variation of 0.20 based on Carmacks data.	- used frequency analysis of Pelly River Ranch data, GEV distribution, increased to Williams Creek site using factors in (1) above.	- used frequency analysis of Pelly River Ranch data, GEV distribution, increased to Williams Creek site using factors in (1) above.	- used frequency analysis of Pelly River Ranch data, 3 parameter log normal distribution, increased to Williams Creek site using factors in (1) above.
	Results - 20 year Dry = 252 mm, 10 year Wet = 471 mm, 100 year Wet = 549 mm.	Results - 20 year Dry = 252 mm, 10 year Wet = 416 mm, 100 year Wet = 491 mm.	Results - 20 year Dry = 278 mm, 10 year Wet = 458 mm, 100 year Wet = 541 mm.	Results - 20 year Dry = 248 mm, 10 year Wet = 416 mm, 100 year Wet = 496 mm.
4) Wet Periods	100 year wet year = **550 mm**	100 year wet year = **491 mm**	100 year wet year = **541 mm**	100 year wet year = **496 mm**
	100 year April (snowmelt) = **286 mm**	100 yr (Oct - April 7 month wet period), snowmelt in April = **263 mm**	100 yr (Oct - April 7 month wet period), snowmelt in April = **311 mm**	100 yr (Oct - April 7 month wet period), snowmelt runoff in April = **290 mm**
	100 year April + May, total runoff in (April + May) = **386 mm**	100 year (Oct - May 8 month wet period), total runoff in (April + May) = **284 mm**	100 year (Oct - May 8 month wet period), total runoff in (April + May) = **325 mm**	100 year (Oct - May 8 month wet period), total runoff in (April + May) = **306 mm**
	- average snowmelt (April) plus 100 year wet May, total April + May runoff = **261 mm**	- average snowmelt (April) plus 100 year wet One Month in May, total April + May runoff = **290 mm**	- average snowmelt (April) plus 100 year wet One Month in May, total April + May runoff = **316 mm**	- average snowmelt (April) plus 100 year wet One Month in May, total April + May runoff = **276 mm**
	100 year (April + May + June), total runoff in (April + May + June) = **450 mm**	100 year (Oct - May 8 month wet period) + avg. June, total runoff in (April+May+June) = **322 mm**	100 year (Oct - May 8 month wet period) + avg. June, total runoff in (April+May+June) = **367 mm**	100 year (Oct - May 8 month wet period) + avg. June, total runoff in (April+May+June) = **346 mm**
		- average snowmelt (April) plus 100 year wet Two Months in May/June, total April+May+June runoff = **360 mm**	- average snowmelt (April) plus 100 year wet Two Months in May/June, total April+May+June runoff = **390 mm**	- average snowmelt (April) plus 100 year wet Two Months in May/June, total April+May+June runoff = **343 mm**
5) Snowmelt Runoff Distribution	- assumed snowmelt distributed 70% in April, 30% in May.	- propose 100% snowmelt in April for design storage, 70/30% split for average conditions. Will check 100% snowmelt in May.	- propose 100% snowmelt in April for design storage, 70/30% split for average conditions. Will check 100% snowmelt in May.	- propose 100% snowmelt in May for design storage, 50/50% split for average conditions.
6) Annual Evaporation	- used 400 mm per year lake evaporation	- propose 400 mm/year for design storage, 520 mm/year to determine make-up water, 460 mm/year for average conditions.	- propose 400 mm/year for design storage, 520 mm/year to determine make-up water, 460 mm/year for average conditions.	- propose 400 mm/year (open water season) for design storage, 440 mm/year to determine make-up water and for average conditions.

APPENDIX 2

Williams Creek Site Hydrology Update

Figures

Figure CC6-1 - Pelly River Ranch Average Monthly Precipitation

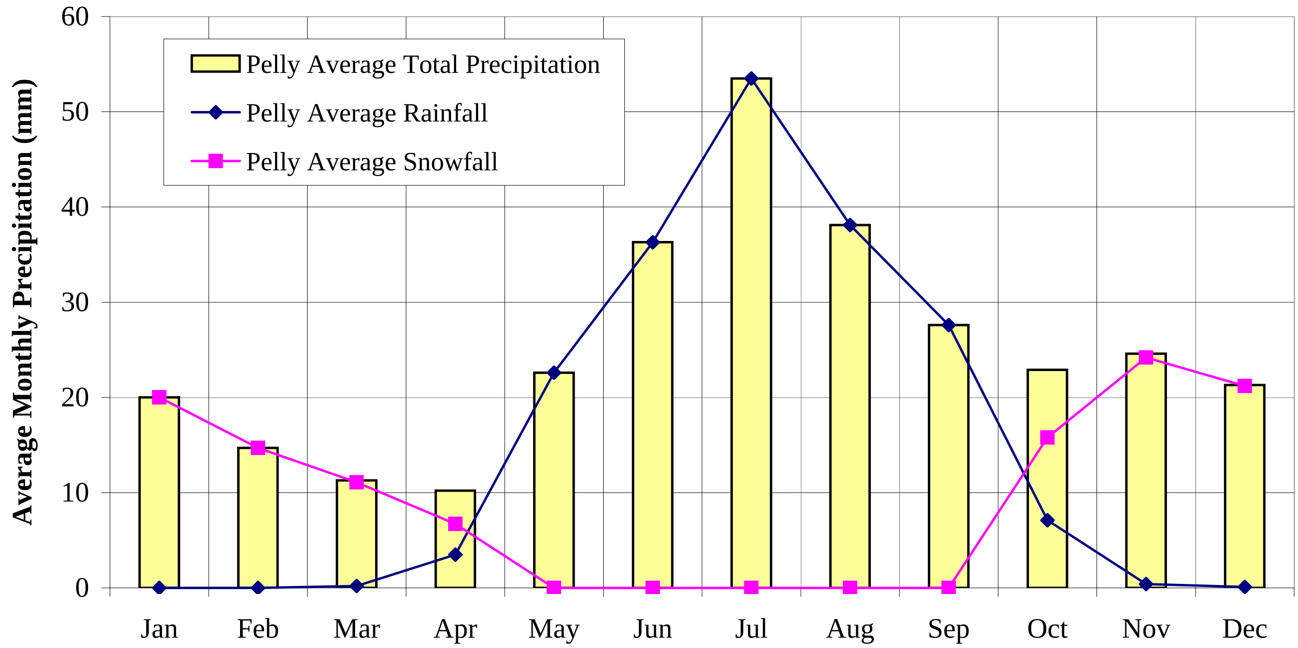


Figure CC6-2 - Williams CreekAverage Monthly Precipitation

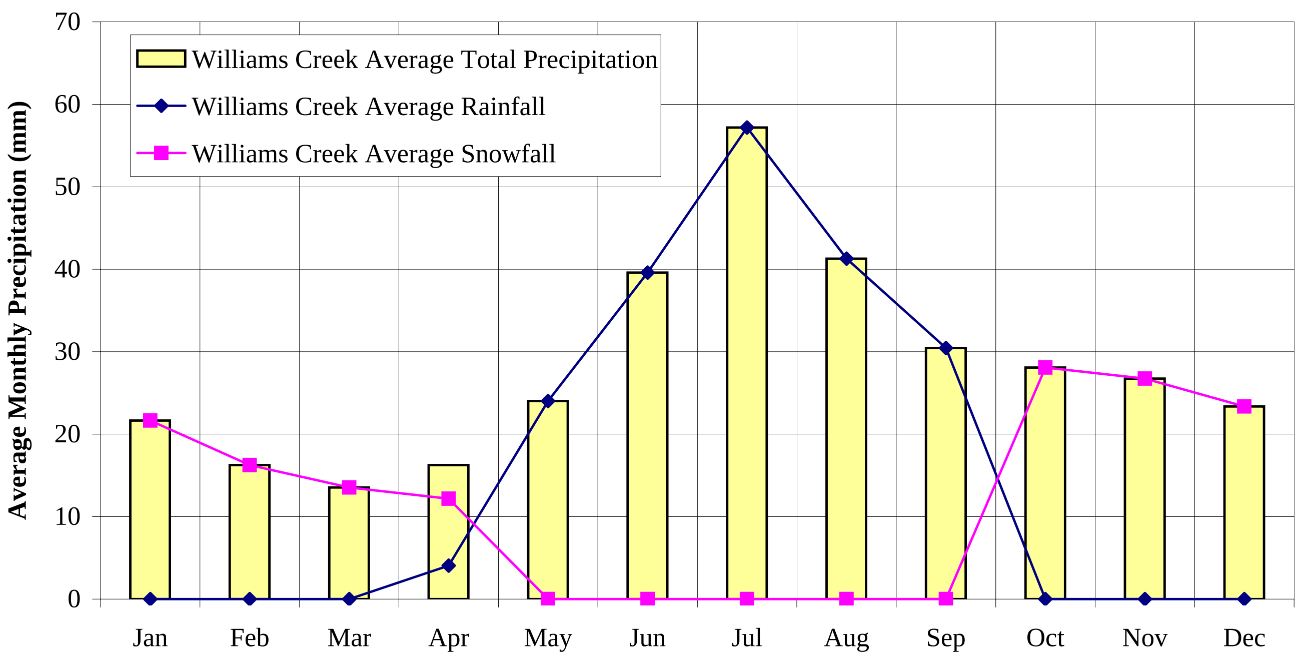


Figure CC6-3 - Estimated Monthly Evapotranspiration

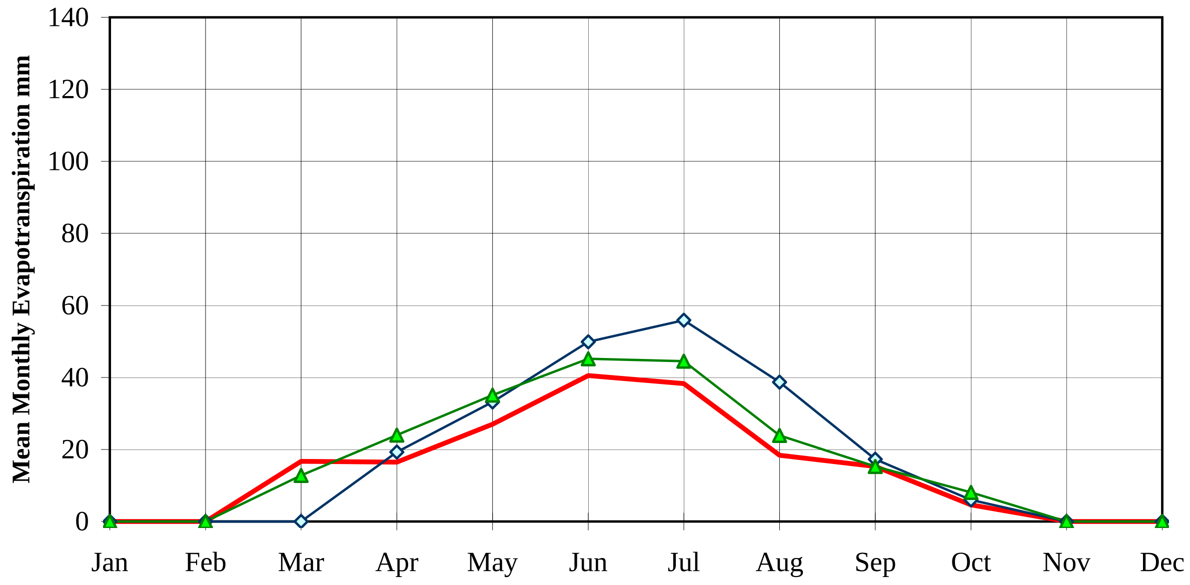
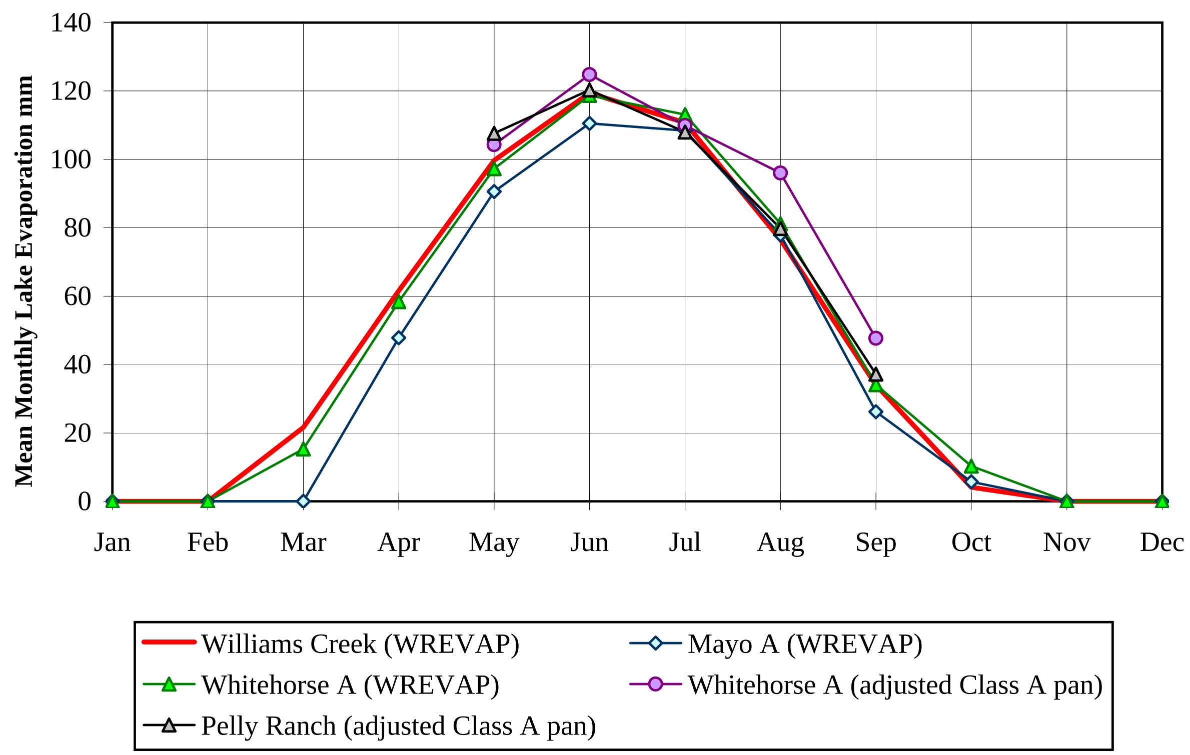


Figure CC6-4 - Estimated Monthly Lake Evaporation



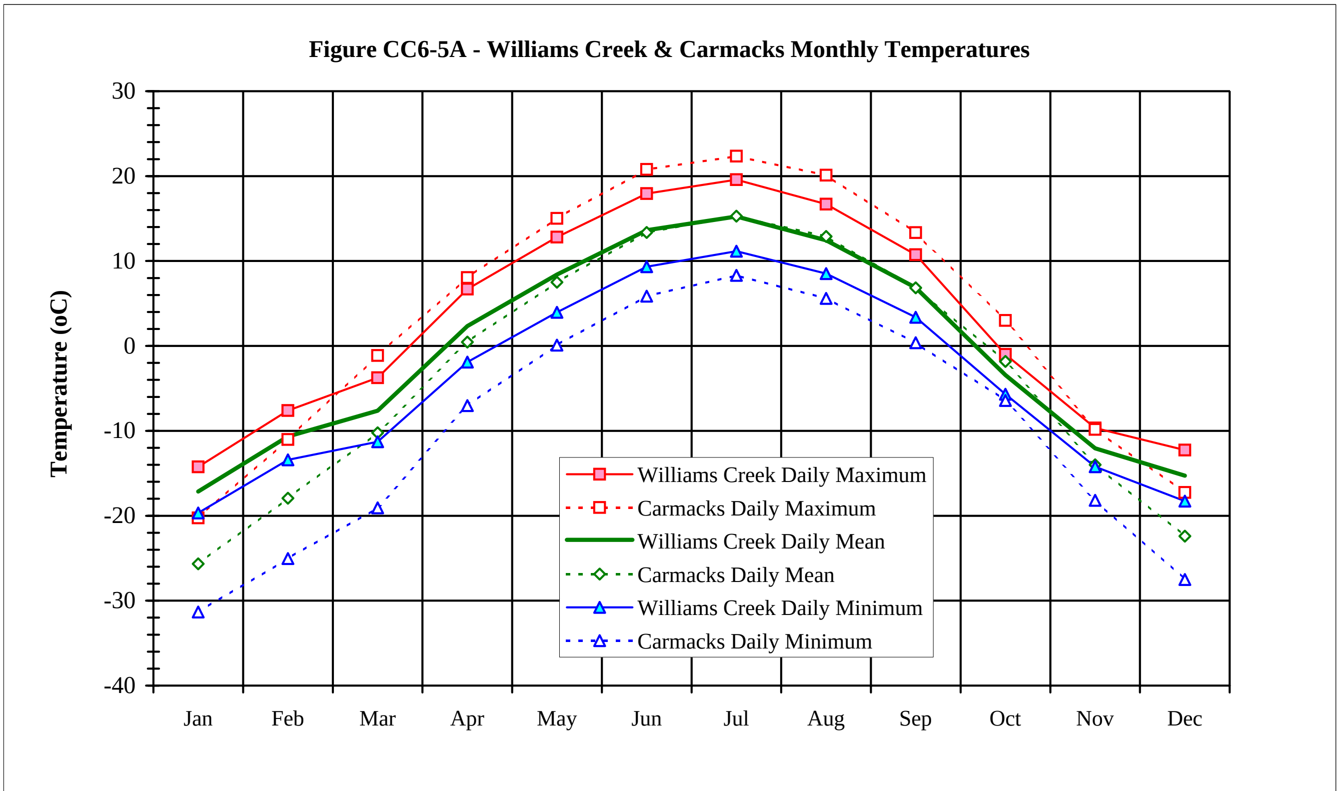


Figure CC6-5A - Williams Creek & Carmacks Monthly Temperatures
Temperature (oC)
30
20
10
0
-10
-20
-30
-40
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Williams Creek Daily Maximum
Carmacks Daily Maximum
Williams Creek Daily Mean
Carmacks Daily Mean
Williams Creek Daily Minimum
Carmacks Daily Minimum

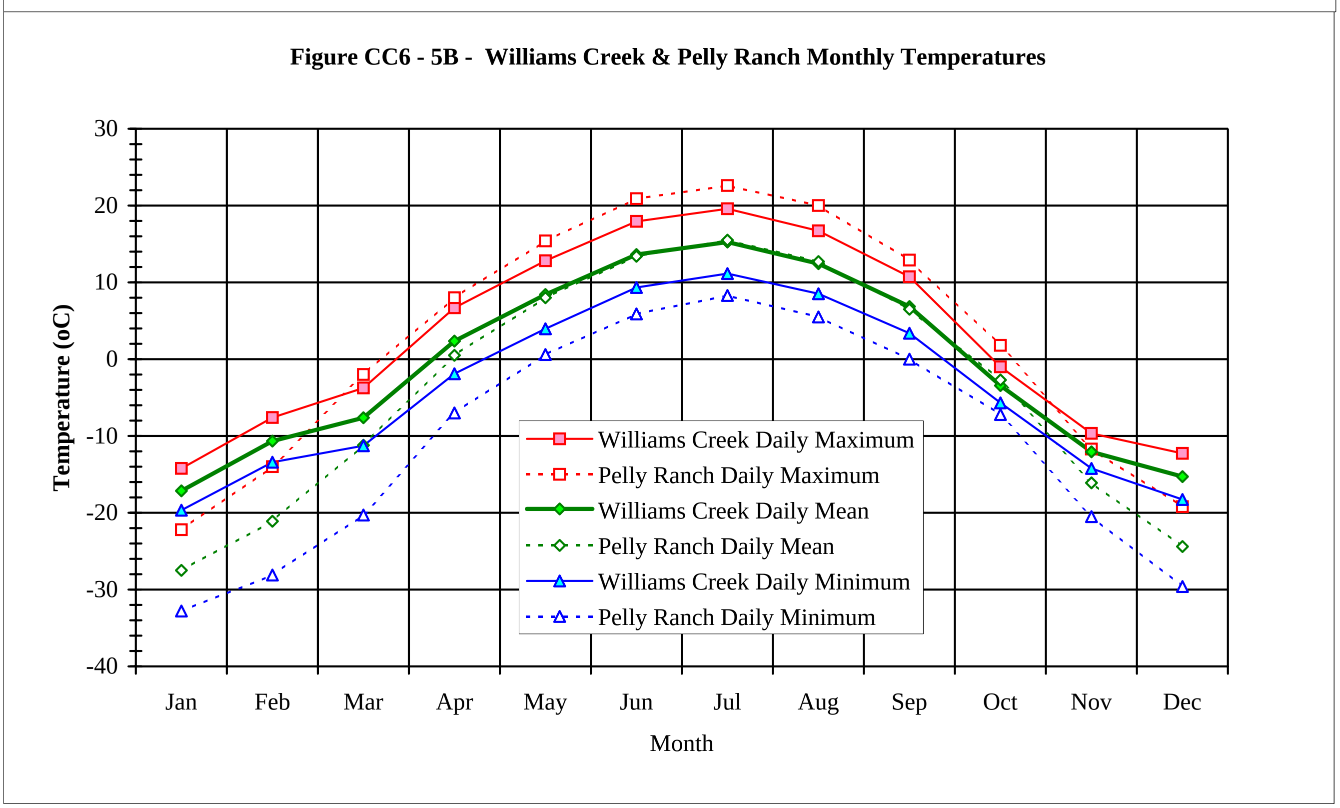


Figure CC6 - 5B - Williams Creek & Pelly Ranch Monthly Temperatures
Temperature (oC)
30
20
10
0
-10
-20
-30
-40
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Williams Creek Daily Maximum
Pelly Ranch Daily Maximum
Williams Creek Daily Mean
Pelly Ranch Daily Mean
Williams Creek Daily Minimum
Pelly Ranch Daily Minimum

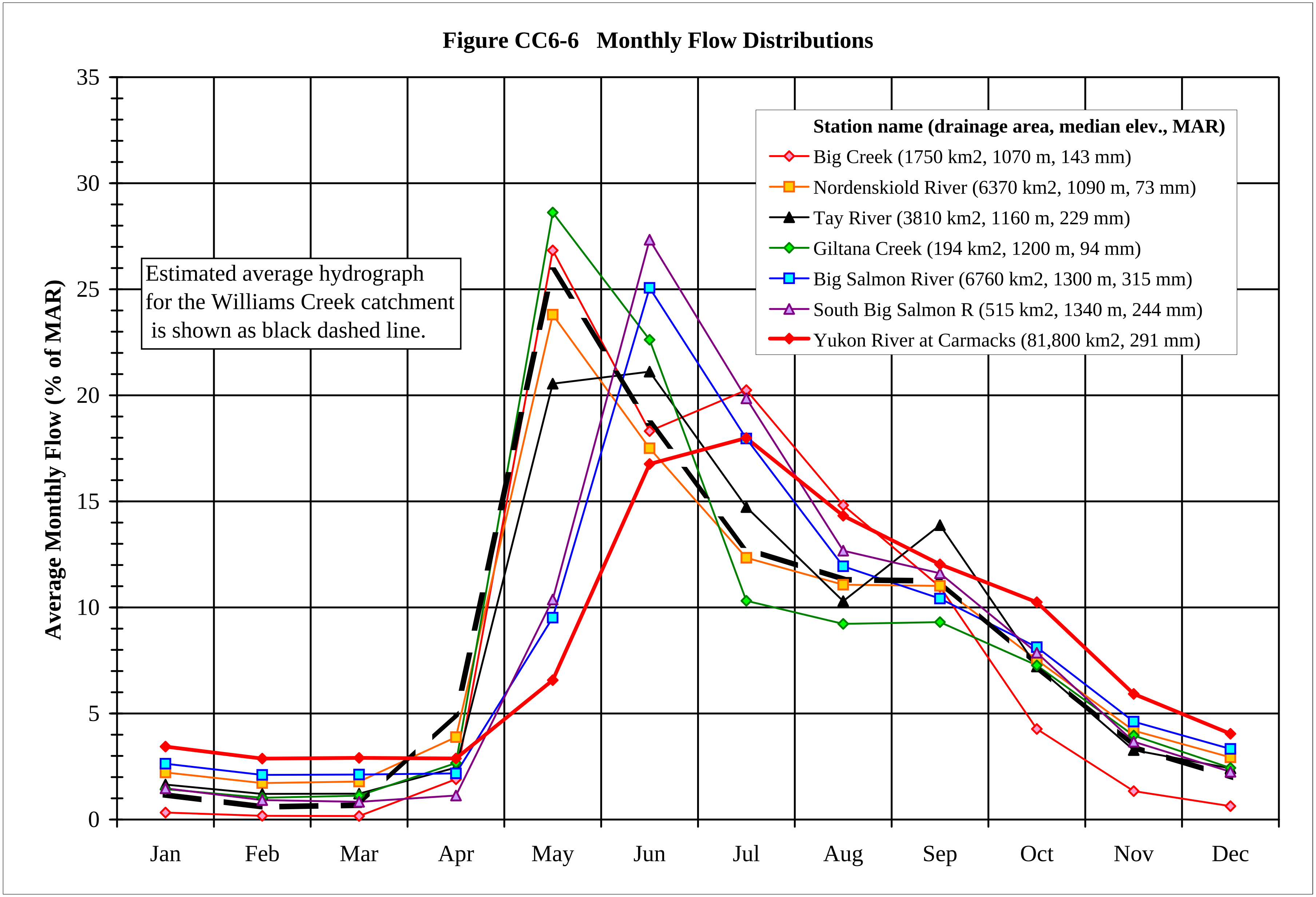


Figure CC6-6 Monthly Flow Distributions
Average Monthly Flow (% of MAR)
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Estimated average hydrograph for the Williams Creek catchment is shown as black dashed line.
Station name (drainage area, median elev., MAR)
Big Creek (1750 km2, 1070 m, 143 mm)
Nordenskiold River (6370 km2, 1090 m, 73 mm)
Tay River (3810 km2, 1160 m, 229 mm)
Giltana Creek (194 km2, 1200 m, 94 mm)
Big Salmon River (6760 km2, 1300 m, 315 mm)
South Big Salmon R (515 km2, 1340 m, 244 mm)
Yukon River at Carmacks (81,800 km2, 291 mm)