APPENDIX A

Single Station Frequency Analysis

- Convert maximum daily flows to maximum instantaneous peak flows
- List maximum insantaneous peak flows
- Test for data validity
- Summary of statistics from various distributions
- Summary of previous analysis

The 34 years of maximum instantaneous peak flows, as derived from Water Survey of Canada records, will provide a reliable estimate of the 100 year peak flow on the Jock River at Moodie Drive. Single Station Frequency Analysis assumes that the maximum instantaneous peak flows are independent random events from a homogeneous population: in other words, the annual flood peak maxima are the result of a single set of annual, flood-causative mechanisms that vary only in their magnitude.

For the Jock River, the peak flows are from a homogenous dataset in that: all maximum peaks occurred during the Springmelt; there is no significant change in land use over the period of record; and the system is unregulated ie. there are no manmade reservoirs with significant storage or significant intakes that would affect the peak flows. Also, the record length is greater than 1/3 the Return Period flow being estimated which adds confidence to the statistical estimate.

The record at the gauge is provided in Table A1a while the maximum instantaneous peak flows are provided in Table A1b: this table has been supplemented by converting maximum daily flows to maximum instantaneous, where required, using a derived factor of 1.03 and using additional, unpublished data, provisional data from 1997, 2001, 2002 and 2003. The derivation of the appropriate factor and its application to maximum daily flows is provided in Tables A1c and A1d, respectively.

The Consolidated Frequency Analysis (CFA) program (version 3.1), distributed by Environment Canada, was used to fit the data, using statistical analysis, to four different staistical distributions. Initially the 34 peak flows were tested using tests, as follows, in order to confirm their validity. The results are summarised in Table A1e and discussed below :

The Spearman test for **independence** suggests that the data does not display serial dependence. Analysis produced a student T value of 1.475 which is less than the critical T values of 1.696 and 2.454, at 5% and 1%, confidence levels respectively.

The Spearman test for **trend** suggests there may be a trend: but, if there is one, it is not highly significant. Analysis produced a student T value of 2.639 which is greater than the critical T value of 2.038 at a 5% confidence level but less than the critical T value of 2.741 at a 1% confidence level….. As a result, the data and the watershed characteristics over the past 34 years were reviewed with respect to any significant changes in the watershed land use, potential river operations and spring precipitation characteristics that might cause a change in annual flood peak maxima: none were identified and it was considered appropriate to continue with SSFA. The plot of annual peak flows is provided in Figure A1.

The Run test for **randomness** suggests that the sample is significantly random. Analysis produced a RUNAB value of 12 which lies between the values of 12 and 24 at a 5% confidence level.

With the dataset being acceptable, two of the four distributions were more closely examined: the Three Parameter Lognormal (3PLN) and the Log Pearson3 (LP3). The former is recommended for Ontario by MNR (Floodplain Management in Ontario – Technical

Guidelines – 1985) if the statistical values of skew and kurtosis are close to 0.0 and 3.0 respectively; if the skew is negative, an LP3 distribution is recommended. The latter is obligatory for all Federal Agencies in the USA (Alexander - 2002).

Results are provided, in detail, in Table A2 and Table A3 for 3PLN and LP3 respectively and plots of the distribution are provided in Figures A2(a) and A2(b). The results clearly suggest using the estimates provided by the LP3 distribution, due to negative skew and and a Kurtosis value of 1.8 for the3PLN distribution; additional confidence can be gained by the wide acceptance of this distribution in the US. A summary of Return Period Flows by SSFA distribution is provided in Table A4.

The results of previous studies of 100 year peak flows in the Jock River subwatershed, at the Moodie Drive gauge, are provided, below, for comparison purpose:

SSFA (2004)	196 m3/s	(LP3)
SSFA (1995-JL Richards)	173 m3/s	(3PLN)
Regional Frequency Analysis (1995-JL RIchards)	194 m3/s	
Regional Frequency Analysis (Acres –1981)	187 m3/s	
Regional Frequency Analysis – Regression Factors	185 m3/s	
Index Flood – Region 1	143 m3/s	
Index Flood – Region 2	366 m3/s	
MTO Watershed Classification Method	140 m3/s	

In order to identify any influence from the four years of provisional data, data from 1997, 2001, 2002, 2003 was removed and SSFA was applied to the 30 year dataset. A summary of the results are provided in Table A4 and detailed in Table A5: the results suggest that, for the LP3 distribution, the inclusion of the provisional data has negligible effect on the resulting flow estimates.

Table A1a- Maximum observed peak flows – Spring WSC Gauge – Moodie Drive

Station : 02LA007 JOCK RIVER NEAR RICHMOND Prov-Terr-State : ON
Latitude:45°15'0 N Longitude:75°47'28 W
Region : Burlington Drainage Area (km²): 559(G),--------(E) Parameter : Flow

Year	Maximum Instantaneous Water Discharge		Maximum Daily Water Discharge		Minimum Daily Water Discharge	
1970	125 22:40 ES	Apr 14	121	Apr 14	0.057	Aug 27
1971	116 23:30 ES	Apr 19	112	Apr 19	0.045	Aug 13
1972	---------		136B	Apr 19	0.413	Sep 25
1973	---------		119B	Mar 18	0.085	Sep 03
1974	---------		79.3B	Mar 08	0.031	Sep 25
1975	123 05:55 ES	Apr 20	122	Apr 20	0.034	Aug 12
1976	140 18:06 ES	Apr 01	137	Apr 01	0.252	Aug 07
1977	---------		117B	Mar 15	0.031	Sep 11
1978	148B22:00 ES	Apr 14	133B	Apr 14	0.031	Aug 18
1979	---------		114B	Mar 25	0.031	Jul 23
1980	---------		103B	Mar 22	0.050	Aug 26
1981	111B09:50 ES	Feb 24	108B	Feb 24	0.612	Aug 30
1982	---------		75.5B	Apr 01	0.072	Aug 22
1983	---------		49.8B	Mar 20	0.014E	Sep 05
1984	120 12:27 ES	Apr 06	118	Apr 06	0.048	Sep 21
1985	---------		59.1B	Mar 15	0.012	Sep 13
1986	65.0 17:00 ES	May 23	62.0	May 24	0.606B	Mar 03
1987	80.9 20:20 ES	Mar 26	79.2	Mar 26	0.239	Sep 07
1988	64.8 17:25 ES	Mar 27	63.1	Mar 27	0.040	Sep 29
1989	---------		63.6B	Mar 29	0.058	Sep 14
1990	---------		65.9B	Mar 18	0.120	Jul 19
1991	82.8 14:21 ES	Apr 10	78.8	Apr 10	0.017	Sep 09
1992	74.0 20:12 ES	Apr 08	72.2	Apr 08	0.302	Jun 18
1993	145 10:38 ES	Apr 11	142	Apr 11	0.180	Sep 22
1994	67.5 02:47 ES	Apr 11	66.2	Apr 11	0.355	Sep 25
1995	55.6 10:00 ES	Jan 17	54.9B	Jan 17	0.119	Jul 14
1996	---------		50.0B	Feb 25	0.028	Sep 04
1997	---------		---------	---------	0.035	Aug 12
1998	126 21:00 ES	Mar 29	124	Mar 31	---------	---------
1999	136 07:00 ES	Apr 08	135	Apr 08	0.010	Aug 30
2000	46.5 02:30 ES	Feb 28	44.7	Feb 28	0.282B	Feb 08

A - Manual Gauge
D - Dry
R - Revised within the last two years
* - Asterik-occurs more than once
P - Partially Dry

B - Ice Conditions
E - Estimated
  - no symbol
d - Complete and Some Dry

Project 411-02
Prep for: JFSA Inc.

Table A1b- Determination of Qp(imax)/Qp(dmax) ratio

Preparation of a ratio of Instantaneous Daily Qp to Maximum Daily Qp
Ratio Definition

Year	*I_MAX*	*D_MAX*	*Ratio 2003 I_MAX / D_MAX*	*Ratio HYDAT I_MAX / D_MAX*
1970	125.0	121.0	1.03	1.03
1971	116.0	112.0	1.04	1.04
1972		136.0		
1973		119.0		
1974		79.3		
1975	123.0	122.0	1.01	1.01
1976	140.0	137.0	1.02	1.02
1977		117.0		
1978	148.0	133.0	1.11	1.11
1979		114.0		
1980		103.0		
1981	111.0	108.0	1.03	1.03
1982		75.5		
1983		49.8		
1984	120.0	118.0	1.02	1.02
1985		59.1		
1986	65.0	62.0	1.05	1.05
1987	80.9	79.2	1.02	1.02
1988	64.8	63.1	1.03	1.03
1989		63.6		
1990		65.9		
1991	82.8	78.8	1.05	1.05
1992	74.0	72.2	1.02	1.02
1993	145.0	142.0	1.02	1.02
1994	67.5	66.2	1.02	1.02
1995	55.6	54.9	1.01	1.01
1996		50.0		
1997*	127.0	125.0	1.02	
1998	126.0	124.0	1.02	1.02
1999	136.0	135.0	1.01	1.01
2000	46.5	44.7	1.04	1.04
2001*	113.0	107.0	1.06	
2002*	44.2	41.6	1.06	
2003*	62.0	57.4	1.08	
Average			**1.03**	**1.03**

NOTE

All data provided by HYDAT, Environment Canada,
except when indicated otherwise

Ratio HYDAT was calculated only with the official data available from HYDAT

I_MAX = Instantaneous peak flow
D_MAX = Daily maximum peak flow

* Data provided by RVCA - not official yet.

Project 411-02 Date: April 2, 2003
Prep for: JFSA Inc. Updated: February 26, 2004
Prep by: JoF

Calculated I_MAX with ratio (1.03) of Instantaneous Daily Qp to Daily Maximum Qp

ID	Year	I_MAX	I_MAX x Ratio 2003	I_MAX x Ratio HYDAT	HH:MM	MM-DD	D_MAX	MM-DD
02LA007	1970	125.0	125.0	125.0	22:40	04--14	121.0	04--14
02LA007	1971	116.0	116.0	116.0	23:30	04--19	112.0	04--19
02LA007	1972		140.7	140.2			136.0	04--19
02LA007	1973		123.1	122.7			119.0	03--18
02LA007	1974		82.0	81.8			79.3	03--08
02LA007	1975	123.0	123.0	123.0	5:55	04--20	122.0	04--20
02LA007	1976	140.0	140.0	140.0	18:06	04--01	137.0	04--01
02LA007	1977		121.0	120.6			117.0	03--15
02LA007	1978	148.0	148.0	148.0	22:00	04--14	133.0	04--14
02LA007	1979		117.9	117.6			114.0	03--25
02LA007	1980		106.6	106.2			103.0	03--22
02LA007	1981	111.0	111.0	111.0	9:50	02--24	108.0	02--24
02LA007	1982		78.1	77.9			75.5	04--01
02LA007	1983		51.5	51.4			49.8	03--20
02LA007	1984	120.0	120.0	120.0	12:27	04--06	118.0	04--06
02LA007	1985		61.1	60.9			59.1	03--15
02LA007	1986	65.0	65.0	65.0	17:00	05--23	62.0	05--24
02LA007	1987	80.9	80.9	80.9	20:20	03--26	79.2	03--26
02LA007	1988	64.8	64.8	64.8	17:25	03--27	63.1	03--27
02LA007	1989		65.8	65.6			63.6	03--29
02LA007	1990		68.2	68.0			65.9	03--18
02LA007	1991	82.8	82.8	82.8	14:21	04--10	78.8	04--10
02LA007	1992	74.0	74.0	74.0	20:12	04--08	72.2	04--08
02LA007	1993	145.0	145.0	145.0	10:38	04--11	142.0	04--11
02LA007	1994	67.5	67.5	67.5	2:47	04--11	66.2	04--11
02LA007	1995	55.6	55.6	55.6	10:00	01--17	54.9	01--17
02LA007	1996		51.7	51.6			50.0	02--25
02LA007	1997*	127.0	127.0			04--08	125.0	04--07
02LA007	1998	126.0	126.0	126.0	21:00	03--29	124.0	03--31
02LA007	1999	136.0	136.0	136.0	7:00	04--08	135.0	04--08
02LA007	2000	46.5	46.5	46.5	2:30	02--28	44.7	02--28
02LA007	2001*	113.0	113.0				107.0	
02LA007	2002*	44.2	44.2				41.6	
02LA007	2003*	62.0	62.0				57.4	
	MAX	**148.0**	**148.0**	**148.0**			**142.0**	
	MIN	**44.2**	**44.2**	**46.5**			**41.6**	
	AVG	**98.8**	**95.3**	**96.4**			**92.2**	

NOTES

I_MAX = Instantaneous peak flow
D_MAX = Daily Maximum peak flow
Ratio = I_MAX / D_MAX (see Ratio Definition page)
* Data provided by RVCA - not official yet.

Table A1d – Maximum instantaneous peak flows – Spring WSC Gauge - Moodie Drive

Jock2

Number of occurences < 5

WSC STATION NO=02LA007
WSC STATION NAME=Jock River near Richmond

MONTH	YEAR	DATA	ORDERED	RANK	PROB.	RET. PERIOD
(1)	(2)	(3)	(4)	(5)	(6) (%)	(7) (YEARS)
4	1970	125.000	148.000	1	1.75	57.000
4	1971	116.000	145.000	2	4.68	21.375
4	1972	140.100	140.100	3	7.60	13.154
3	1973	122.500	140.000	4	10.53	9.500
3	1974	81.600	136.000	5	13.45	7.435
4	1975	123.000	127.000	6	16.37	6.107
4	1976	140.000	126.000	7	19.30	5.182
3	1977	120.500	125.000	8	22.22	4.500
4	1978	148.000	123.000	9	25.15	3.977
3	1979	117.400	122.500	10	28.07	3.563
3	1980	106.000	120.500	11	30.99	3.226
2	1981	111.000	120.000	12	33.92	2.948
4	1982	77.700	117.400	13	36.84	2.714
3	1983	51.300	116.000	14	39.77	2.515
4	1984	120.000	113.000	15	42.69	2.342
3	1985	60.800	111.000	16	45.61	2.192
5	1986	65.000	106.000	17	48.54	2.060
3	1987	80.900	82.800	18	51.46	1.943
3	1988	64.800	81.600	19	54.39	1.839
3	1989	65.500	80.900	20	57.31	1.745
3	1990	67.800	77.700	21	60.23	1.660
4	1991	82.800	74.000	22	63.16	1.583
4	1992	74.000	67.800	23	66.08	1.513
4	1993	145.000	67.500	24	69.01	1.449
4	1994	67.500	65.500	25	71.93	1.390
1	1995	55.600	65.000	26	74.85	1.336
2	1996	51.500	64.800	27	77.78	1.286
4	1997	127.000	62.000	28	80.70	1.239
3	1998	126.000	60.800	29	83.63	1.196
4	1999	136.000	55.600	30	86.55	1.155
2	2000	46.500	51.500	31	89.47	1.118
4	2001	113.000	51.300	32	92.40	1.082
4	2002	44.200	46.500	33	95.32	1.049
3	2003	62.000	44.200	34	98.25	1.018

Table A1e- Statistical Tests – Spring flows - WSC Gauge/Moodie Drive

--- SPEARMAN TEST FOR INDEPENDENCE ---

02LA007 Jock River near Richmond
ANNUAL MAXIMUM DAILY FLOW SERIES 1970 TO 2003 DRAINAGE AREA = 559.0000

SPEARMAN RANK ORDER SERIAL CORRELATION COEFF = .256 D.F.= 31
CORRESPONDS TO STUDENTS T = 1.475
CRITICAL T VALUE AT 5% LEVEL = 1.696 NOT SIGNIFICANT
- - - - 1% - = 2.454 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the correlation is zero.

At the 5% level of significance, the correlation is not significantly different from zero. That is, the data do not display significant serial dependence.

--- SPEARMAN TEST FOR TREND ---

02LA007 Jock River near Richmond
ANNUAL MAXIMUM DAILY FLOW SERIES 1970 TO 2003 DRAINAGE AREA = 559.0000

SPEARMAN RANK ORDER CORRELATION COEFF = .423 D.F.= 32
CORRESPONDS TO STUDENTS T = 2.639
CRITICAL T VALUE AT 5% LEVEL = 2.038 SIGNIFICANT
- - - - 1% - = 2.741 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the serial(lag-one) correlation is zero.

At the 5% level of significance, the correlation is significantly different from zero, but is not so at the 1% level of significance. That is, the trend is significant but not highly so.

--- RUN TEST FOR GENERAL RANDOMNESS ---

02LA007 Jock River near Richmond
ANNUAL MAXIMUM DAILY FLOW SERIES 1970 TO 2003 DRAINAGE AREA = 559.0000

THE NUMBER OF RUNS ABOVE AND BELOW THE MEDIAN (RUNAB) = 12
THE NUMBER OF OBSERVATIONS ABOVE THE MEDIAN(N1) = 17
THE NUMBER OF OBSERVATIONS BELOW THE MEDIAN(N2) = 17
Range at 5% level of significance: 12. to 24. NOT SIGNIFICANT

Interpretation: The null hypothesis is that the data are random.

At the 5% level of significance, the null hypothesis cannot be rejected. That is, the sample is significantly random.

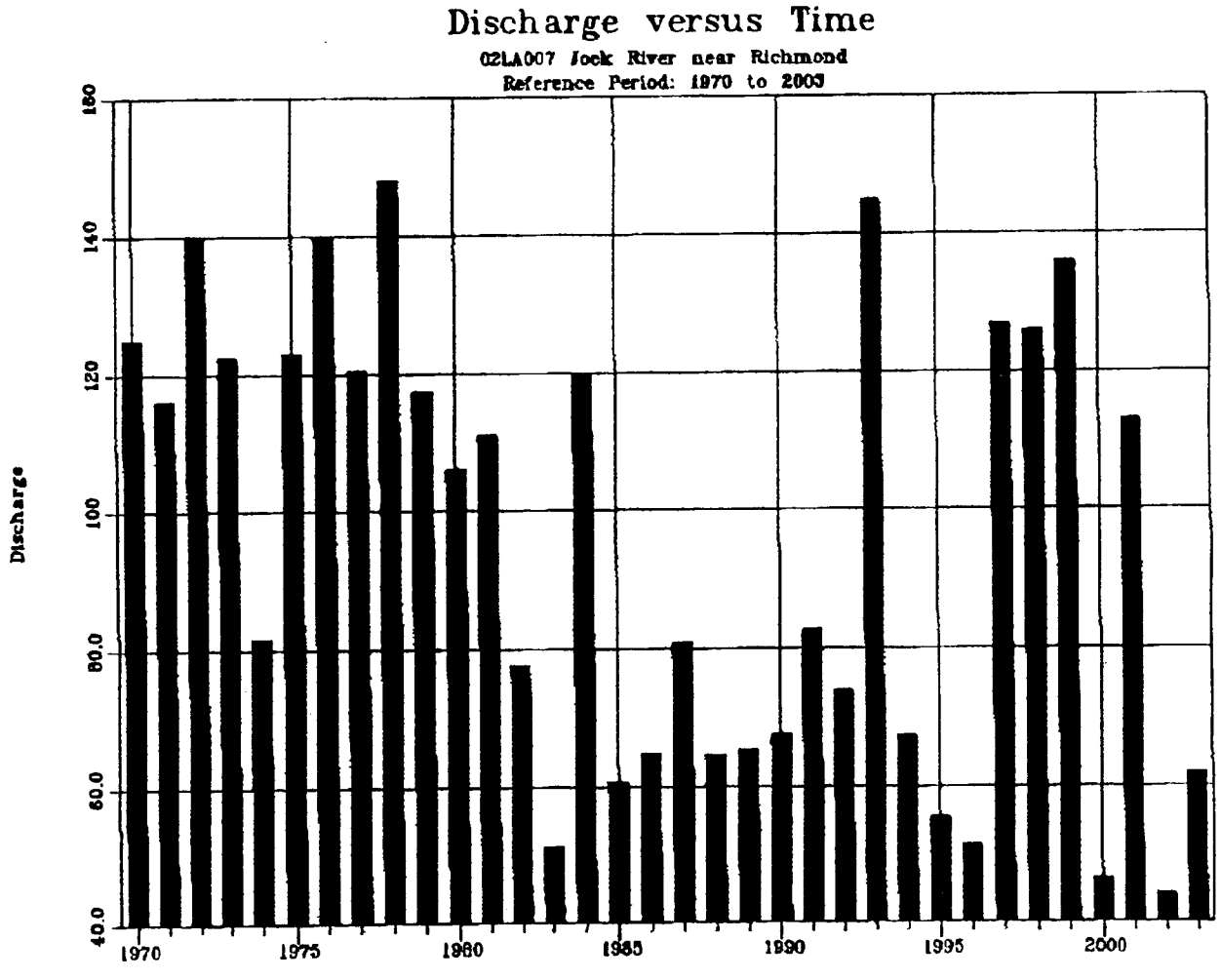

Figure A1 – Plot of Annual Peak Flow by Year (1970-2003)

Table A2 – SSFA – 3PLN Maximum instantaneous peak flows – Spring

FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
02LA007 Jock River near Richmond

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	95.176	33.205	.349	.011	1.761
LN X SERIES	4.491	.375	.084	-.304	1.961
LN(X-A) SERIES	6.770	.038	.006	-.020	1.758

X(MIN)= 44.200 TOTAL SAMPLE SIZE= 34
X(MAX)= 148.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 33.401 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

3LN PARAMETERS: A= -776.566 M= 6.770 S= .038

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	7.91
1.050	.952	40.9
1.250	.800	67.1
2.000	.500	94.6
5.000	.200	123
10.000	.100	138
20.000	.050	151
50.000	.020	166
100.000	.010	175
200.000	.005	184
500.000	.002	196

Table A3 – SSFA – LP3 Maximum instantaneous peak flows – Spring

FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
02LA007 Jock River near Richmond

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	95.176	33.205	.349	.011	1.761
LN X SERIES	4.491	.375	.084	-.304	1.961

X(MIN)= 44.200
X(MAX)= 148.000
LOWER OUTLIER LIMIT OF X= 33.401

TOTAL SAMPLE SIZE= 34
NO. OF LOW OUTLIERS= 0
NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MOMENTS

DISTRIBUTION IS UPPER BOUNDED AT M= 1055.
LP3 PARAMETERS: A= -.5705E-01 B= 43.31 LOG(M)= 6.961
M = 1055.

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	28.0
1.050	.952	46.2
1.250	.800	65.5
2.000	.500	90.9
5.000	.200	123
10.000	.100	142
20.000	.050	160
50.000	.020	181
100.000	.010	196
200.000	.005	211
500.000	.002	229

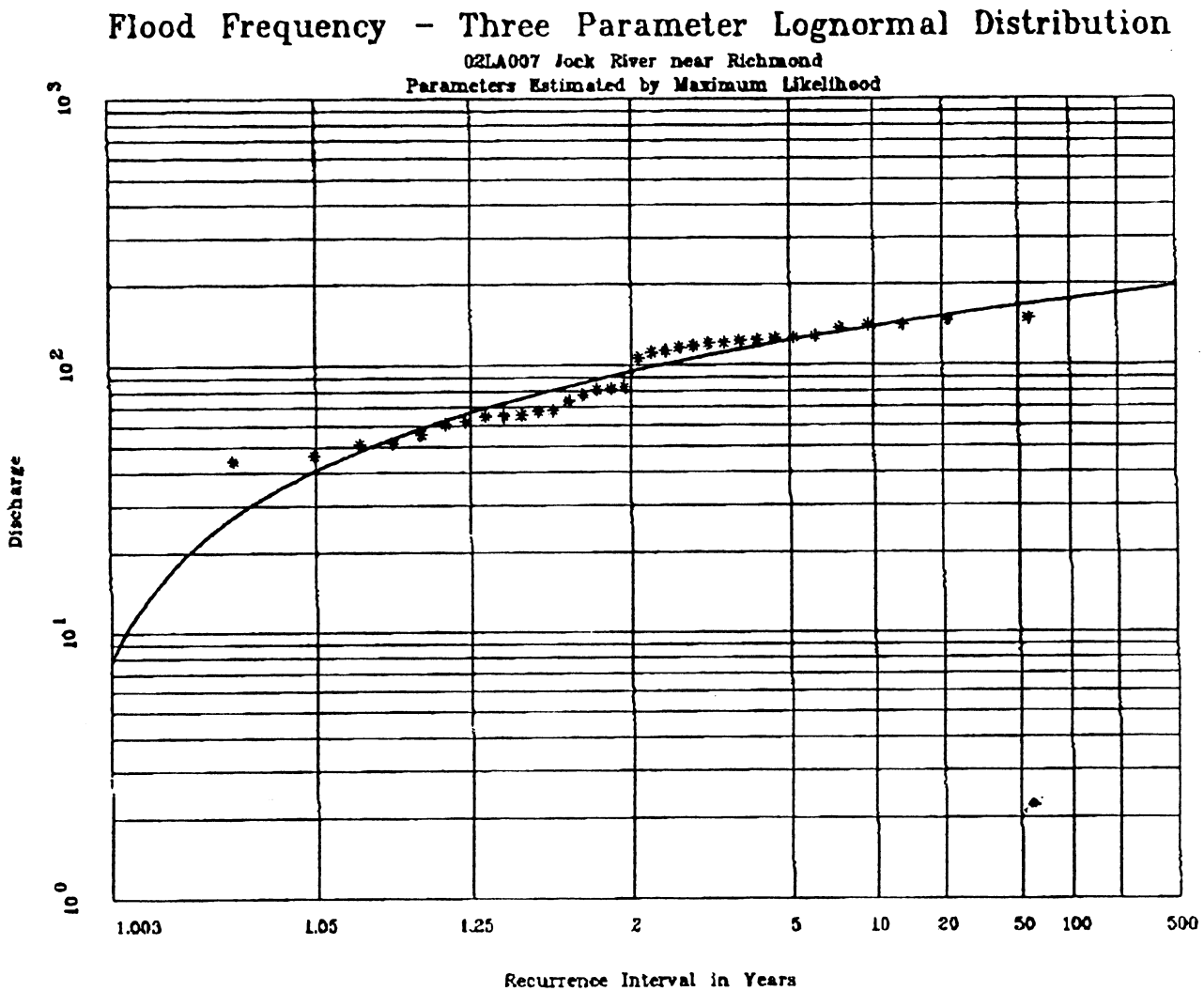

Figure A2(a) – 3PLN – distribution plot – Spring – Moodie Drive

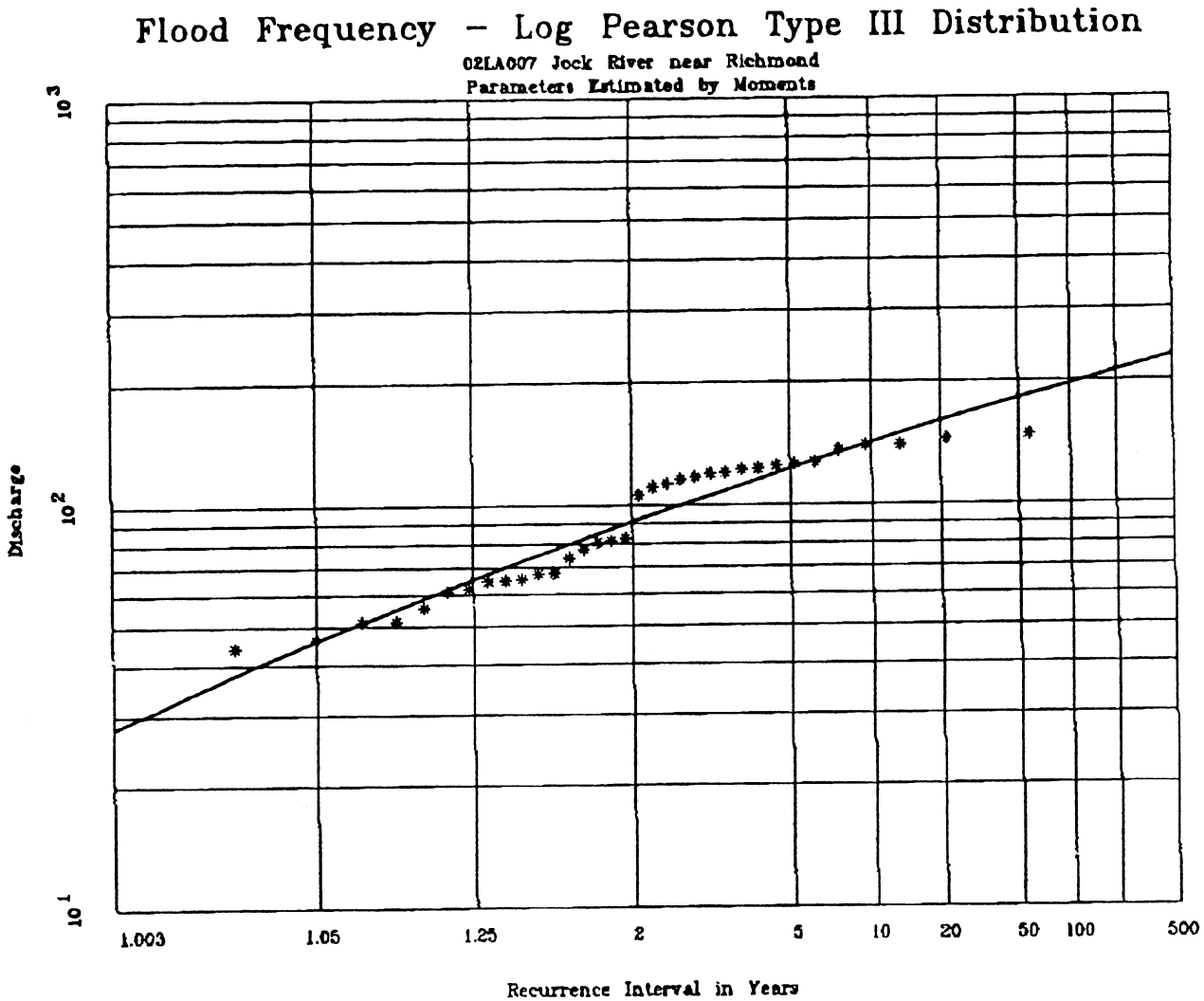

Figure A2(b) – LP3 – distribution plot – Spring – Moodie Drive

Table A4: Summary SSFA Results - Maximium Instantaneous Peak Flows (m3/s)								
Frequency Distribution =>	**GEV**	**GEV**	**3PLN**	**3PLN**	**LP3**	**LP3**	**Wakeby**	**Wakeby**
Years of record =>	34	30	34	30	34	30	34	30
Return Period								
(years)								
1.003	8	11	8	19	28	30	46	48
1.05	40	42	42	46	46	48	49	51
1.25	67	68	68	69	66	67	60	62
2	95	96	95	94	91	92	85	86
5	124	125	123	123	123	124	117	117
10	139	140	138	139	142	143	131	131
20	151	151	150	153	160	160	140	140
50	163	164	166	170	181	181	148	147
100	170	171	175	182	196	197	152	151
200			184	192	211	211		
500			196	206	229	230		

Table A5 - SSFA Detail – 30 years record

WSC STATION NO=02LA007
WSC STATION NAME=Jock River near Richmond

TOTAL TIME SPAN, YT= 30 YRS. FLOW THRESHOLD = 46.500
OBSERVED PEAKS, N= 30 HISTORIC PEAKS ABOVE THRESHOLD, NHA= 0

OBSERVED PEAKS ABOVE THRESHOLD, NA= 30
OBSERVED PEAKS BELOW THRESHOLD, NB= 0
MISSING PEAKS BELOW THRESHOLD, NC= 0

MONTH (1)	YEAR (2)	FLOOD (3)	DESCENDING ORDER (4)	RANK M (5)	RANK ADJ. (6)	CUM. PROB. (7)	RET.PERIOD YEARS (8)
4	1970	125.000	148.000	1	1.00	1.99	50.33
4	1971	116.000	145.000	2	2.00	5.30	18.88
4	1972	140.200	140.200	3	3.00	8.61	11.62
3	1973	122.700	140.000	4	4.00	11.92	8.39
3	1974	81.800	136.000	5	5.00	15.23	6.57
4	1975	123.000	126.000	6	6.00	18.54	5.39
4	1976	140.000	125.000	7	7.00	21.85	4.58
3	1977	120.600	123.000	8	8.00	25.17	3.97
4	1978	148.000	122.700	9	9.00	28.48	3.51
3	1979	117.600	120.600	10	10.00	31.79	3.15
3	1980	106.200	120.000	11	11.00	35.10	2.85
2	1981	111.000	117.600	12	12.00	38.41	2.60
4	1982	77.900	116.000	13	13.00	41.72	2.40
3	1983	51.400	111.000	14	14.00	45.03	2.22
4	1984	120.000	106.200	15	15.00	48.34	2.07
3	1985	60.900	82.800	16	16.00	51.66	1.94
5	1986	65.000	81.800	17	17.00	54.97	1.82
3	1987	80.900	80.900	18	18.00	58.28	1.72
3	1988	64.800	77.900	19	19.00	61.59	1.62
3	1989	65.600	74.000	20	20.00	64.90	1.54
3	1990	68.000	68.000	21	21.00	68.21	1.47
4	1991	82.800	67.500	22	22.00	71.52	1.40
4	1992	74.000	65.600	23	23.00	74.83	1.34
4	1993	145.000	65.000	24	24.00	78.15	1.28
4	1994	67.500	64.800	25	25.00	81.46	1.23
1	1995	55.600	60.900	26	26.00	84.77	1.18
2	1996	51.600	55.600	27	27.00	88.08	1.14
3	1998	126.000	51.600	28	28.00	91.39	1.09
4	1999	136.000	51.400	29	29.00	94.70	1.06
2	2000	46.500	46.500	30	30.00	98.01	1.02
			THRESHOLD				

HISTORICAL FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
02LA007 Jock River near Richmond

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	96.387	32.850	.341	.035	1.796
LN X SERIES	4.507	.363	.081	-.266	1.960
LN(X-A) SERIES	5.550	.128	.023	-.066	1.800

X(MIN)= 46.500 TOTAL SAMPLE SIZE= 30
X(MAX)= 148.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 35.718 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

3LN PARAMETERS: A= -162.882 M= 5.550 S= .125

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	19.3
1.050	.952	45.8
1.250	.800	68.6
2.000	.500	94.4
5.000	.200	123
10.000	.100	139
20.000	.050	153
50.000	.020	170
100.000	.010	182
200.000	.005	192
500.000	.002	206

HISTORICAL FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
02LA007 Jock River near Richmond

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	96.387	32.850	.341	.035	1.796
LN X SERIES	4.507	.363	.081	-.266	1.960

X(MIN)= 46.500 TOTAL SAMPLE SIZE= 30
X(MAX)= 148.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 35.718 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MOMENTS

DISTRIBUTION IS UPPER BOUNDED AT M= 1389.
LP3 PARAMETERS: A= -.4841E-01 B= 56.37 LOG(M)= 7.236
M = 1389.

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	.997	30.0
1.050	.952	48.1
1.250	.800	67.2
2.000	.500	92.1
5.000	.200	124
10.000	.100	143
20.000	.050	160
50.000	.020	181
100.000	.010	197
200.000	.005	211
500.000	.002	230