4. Flow and Salinity Statistics

4.1 Statistics explained

The statistical analysis is based on available raw data listed in Table 3.1. Flow and salinity statistics for 1999 are presented in Table 4.1 Table 4.2.

MEAN DAILY - the average value of all measurements on a specified day.

MEDIAN - the value above (or below) which half the data set falls. The median gives an indication of the 'most usual' flow or salinity in the stream.

UPPER QUARTILE - the value below which three quarters of the data set falls, giving an indication of how high the flow and salinity can ordinarily get without being influenced by extreme events.

LOWER QUARTILE - the value below which one quarter of the data set falls, giving an indication of how low the flow and salinity ordinarily falls without being influenced by extreme events.

MAXIMUM - the highest value recorded. It is generally not a good indication of the flow or salinity of the stream because such a high value may be rare. However it is sometimes useful to be aware of extreme values, and the maximum may highlight uncharacteristic behaviour that contributes to high flow and salinity.

MINIMUM - the lowest value recorded. It is generally not a good indication of the flow or salinity of the stream because such a low value may be rare or is zero on one or a number of days.

SALT LOADS – a measure of the total quantity of salt transported by a stream, measured in tonnes/day. The figures quoted in this report are mean daily values which have been calculated by averaging the instantaneous salt loads throughout the day. The instantaneous salt load is calculated as follows:

Salt Load = Flow (ML/day) x EC (μs/cm) x (0.6/1000)

FLOW WEIGHTED SALINITY (FWS) - a measure of the salinity of water during flow events. This measure is of particular relevance to downstream interests. In many Australian streams the salinity during average to high flow events is much lower than the salinity during low flow periods. The FWS is derived by dividing the salt load for a study period by the total flow for the same period (which produces a salinity in tonnes/megalitre) then dividing by 0.0006 to express the result in the more familiar EC units.

4.2 Flow Statistics

The key flow statistics as described in the previous section are presented below in Table 4.1. All flows are quoted in ML/day. Time series plots of the raw flow data are included in Appendix A.

- **Table 4.1: Statistical Analysis of Flow (ML/day)**

Station Name	Station Number	Period of Analysis	Mean Daily	Median	Upper Quartile	Lower Quartile	Max	Min
Ovens River @ Peechelba	403241	1/1/2000 – 31/12/2000	6,275	2,646	9,235	542	45,261	200
		22/9/1998 – 31/12/2000	5,075	2,228	6,146	531	95,667	183
Black Dog Creek @ Parris Rd, Brimin	403247	1/1/2000 – 31/12/2000	80	10	86	0	1,636	0
		22/8/1998 – 31/12/2000	55	3	45	0	1,695	0
Indigo Creek	403248	1/1/2000 – 31/12/2000	69	17	58	3	2,284	0
		24/6/1999 – 31/12/2000	63	17	49	7	2,284	0
Three Mile Creek	403249	2/6/2000 – 31/12/2000	279	167	326	87	1,456	43

4.3 Salinity Statistics

The salinity statistics presented in this report are all quoted in Electrical Conductivity (EC) units of microsiemens per centimetre, standardised to the value at 25^0C. The key salinity statistics are presented in Table 4.2 and time series plots of the raw data are included in Appendix A.

■ Table 4.2: Statistical Analysis of Salinity (μs/cm)

Station	Number	Period of Analysis	Flow Weighted Salinity	Mean Daily	Upper Quartile	Median	Lower Quartile	Max	Min
Ovens River @ Peechelba	403241	1/1/2000 – 31/12/2000	51	64	76	60	52	133	40
		22/9/1998 – 31/12/2000	-	70	80	65	54	145	37
Black Dog Creek @ Parris Rd, Brimin	403247	1/1/2000 – 31/12/2000	129	167	200	161	133	295	70
		22/8/1998 – 31/12/2000	-	180	211	178	151	295	70
Indigo Creek	403248	1/1/2000 – 31/12/2000	176	354	477	327	225	696	77
		24/6/1999 – 31/12/2000	-	350	444	339	248	696	77
Three Mile Creek	403249	2/6/2000 – 31/12/2000	98	119	130	103	88	302	65

It can be seen from Table 4.2 that the salinity of Indigo Creek is significantly higher than Black Dog Creek and Three Mile Creek, whilst the Ovens River is relatively fresh compared to other streams. Salinity levels in 2000 were consistent with previous data collected, which is to be expected as the climate has not changed significantly during this time. It may be beneficial to review rainfall data in subsequent studies to examine the link between climate and stream salinity.

4.4 Salt Loads

Salt loads have been calculated as described above in Section 4.1. There were a number of periods where missing flow data needed to be infilled for the sites examined. The infilling techniques are documented in Appendix D. A summary of monthly salt loads is presented below in Table 4.3.

- **Table 4.3: Monthly Salt Loads, 2000**

Month	Monitoring Station											
	Ovens River at Peechelba 403241			Three Mile Creek 403249			Black Dog Creek 403247			Indigo Creek 403248		
	Flow (ML/mth)	Salt Load (t/mth)	FWS (μs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (μs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (μs/cm)	Flow (ML/mth)	Salt Load (t/mth)	FWS (μs/cm)
January	25,855	990	64	N/A	N/A	N/A	31	4	189	113	25	369
February	9,058	511	94	N/A	N/A	N/A	0	0	0	2	1	649
March	15,576	667	71	N/A	N/A	N/A	0	0	0	165	43	436
April	15,662	814	87	N/A	N/A	N/A	0	0	0	113	39	584
May	34,385	1,524	74	N/A	N/A	N/A	0	0	0	813	124	255
June	105,665	3,526	56	4,674 (1)	440 (1)	157 (1)	735	81	185	1,994	230	192
July	240,244	6,784	47	12,686	793	104	3,538	270	127	4,537	474	174
August	347,207	10,804	52	17,650	980	93	5,208	398	127	5,681	536	157
September	605,655	17,306	48	17,310	879	85	11,604	825	119	9,768	832	142
October	430,966	12,019	46	12,815	703	91	7,989	550	115	8,683	901	173
November	381,235	11,859	52	13,064	736	94	4,083	418	171	1,611	257	266
December	85,151	3,269	64	2,595	234	150	368	53	239	411	105	427
Total	2,296,660	70,072	51	80,794	4,765	98	33,555	2,599	129	33,892	3,570	176

N/A = Data not available (Hence totals shown do not represent full year)
(1) Figures do not represent entire month.

5. Conclusions

The following conclusions are drawn from the monitoring information collected during 2000:

- The North East stream monitoring for the year 2000 was of good quality.
- The only gaps in the record were caused by backup of flow at the gauges. These instances of backup are thought to be caused by high River Murray and Ovens River flows.
- There is currently insufficient data available to accurately determine a methodology for estimating the effect of backup at the monitoring sites. The salt loads produced in this report are based on best estimates using limited information and should be reviewed in the future.
- The following catchment information is currently available from NRE
  - Digital Elevation Model (DEM)
  - Land systems
  - Landuse
  - Salinity discharge sites
  - Geology and soil data

6. Recommendations

The recommendations from this report are:

- Data collection at the four locations included in this study should continue to provide an on-going record of flow and salinity parameters in the Ovens catchments.

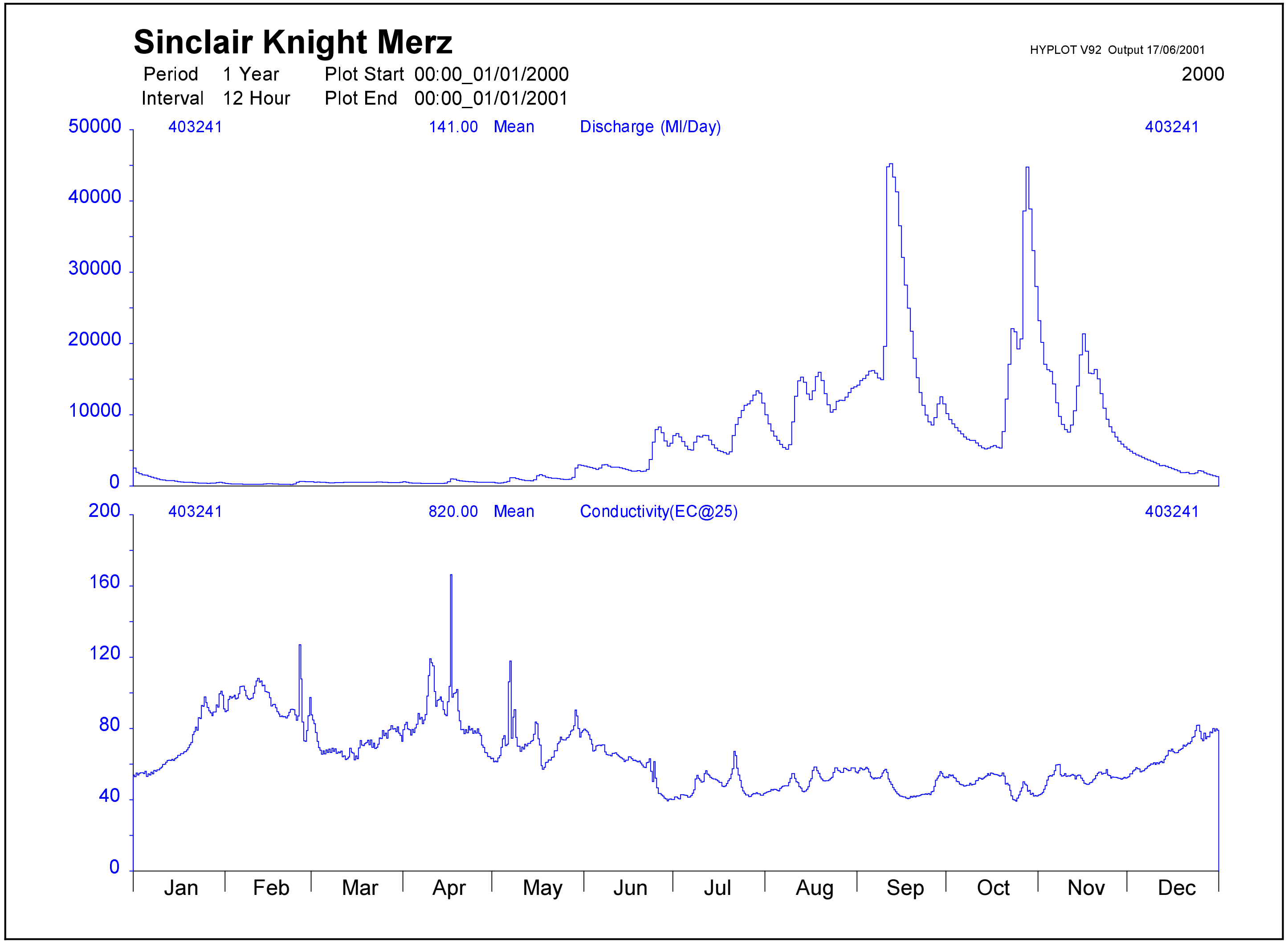
- Consideration should be given to the continued development of more detailed catchment and climate information, based on the monitoring data available, that will assist with the future evaluation of the North-East Salinity Strategy. This process has been initiated and should be formally coordinated to ensure efficient utilisation of resources.

- Catchment boundaries should be defined for both low flow and high flow conditions to enable better understanding of salt load generation.

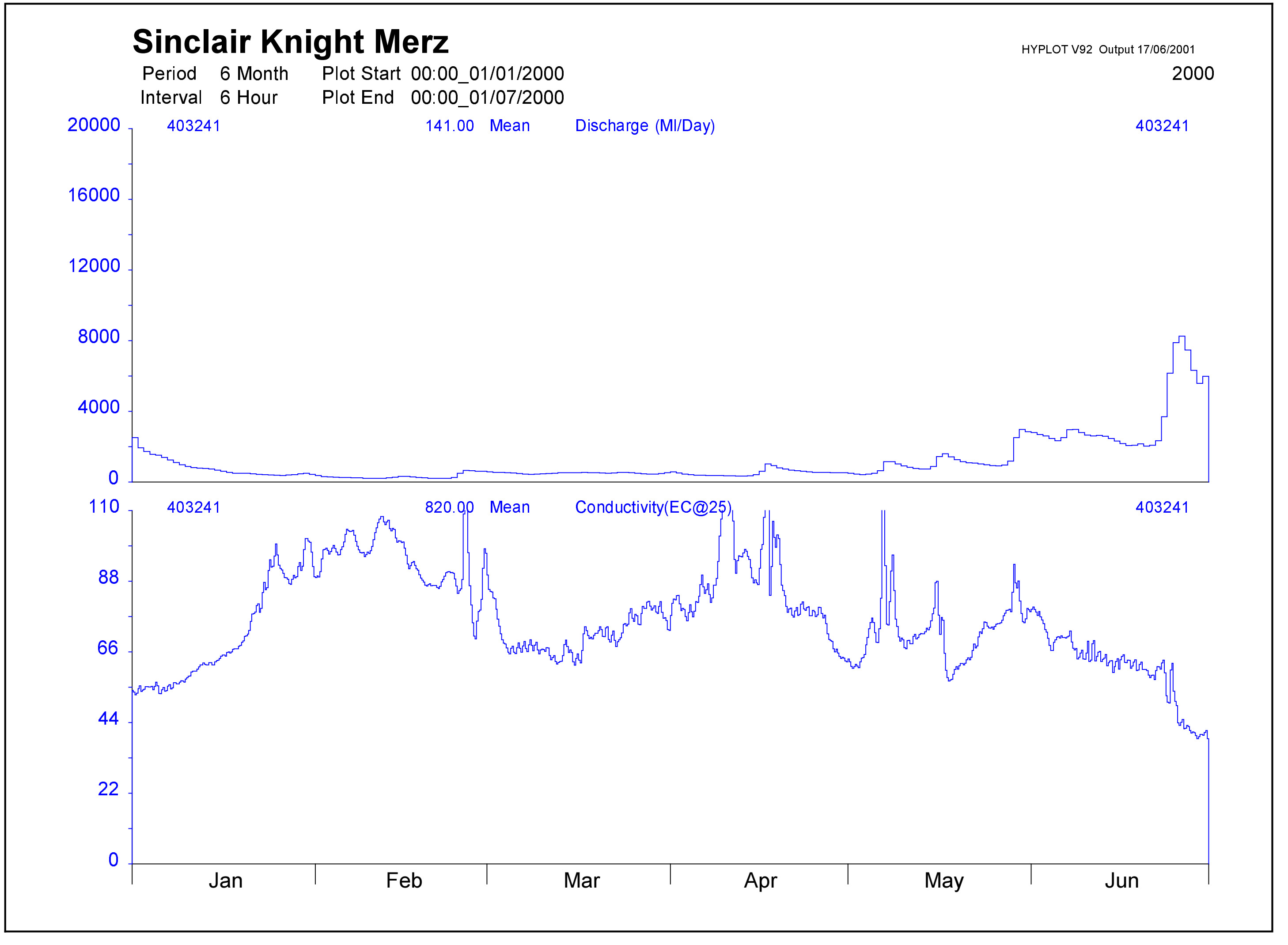
- Further investigation should be undertaken to improve flow estimation during periods when high flows in the Ovens River cause the Three Mile gauge to flood and when the River Murray causes the Black Dog Creek and the Indigo Creek gauges to flood.

Appendix A Raw Data Plots

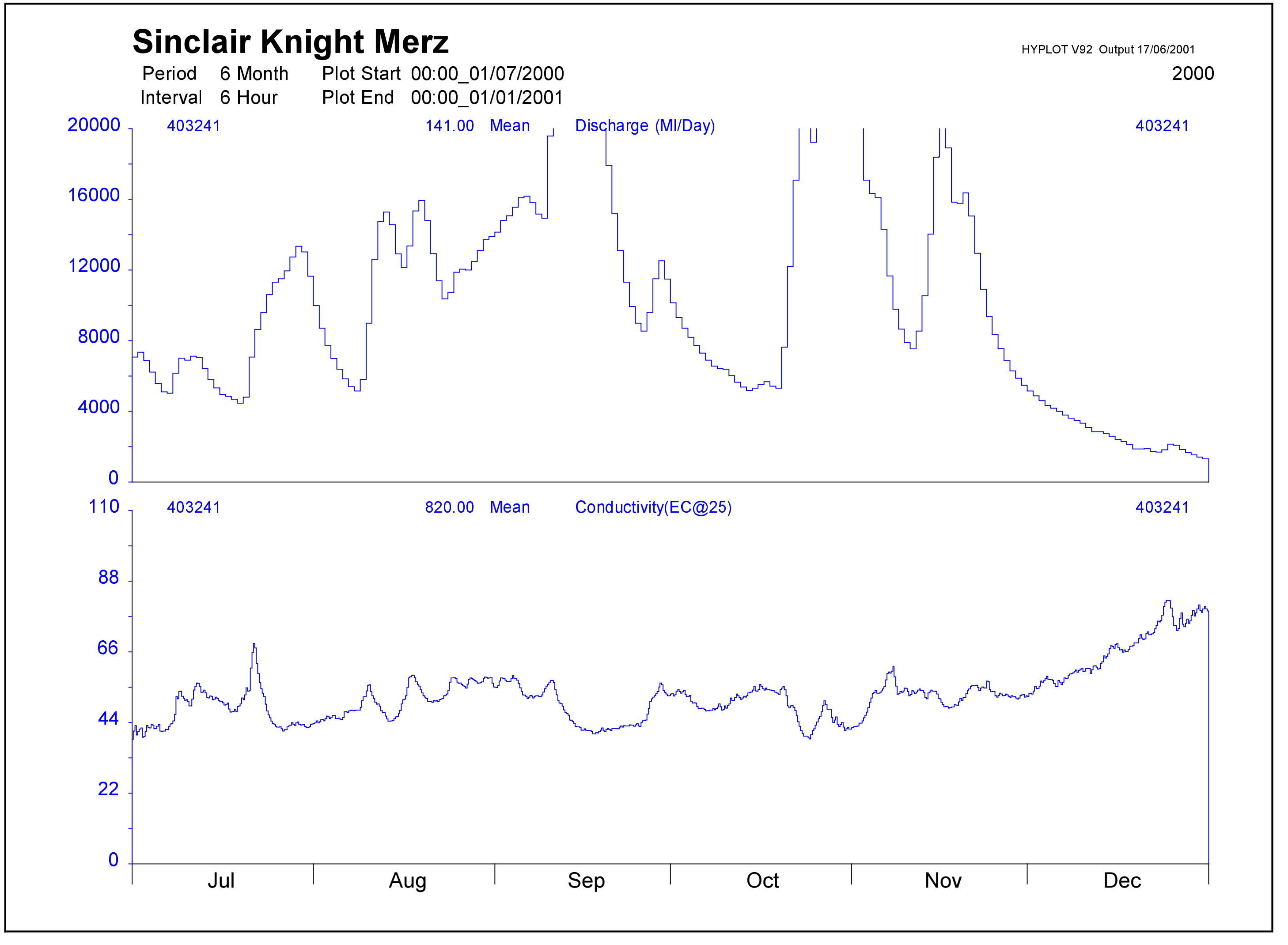
- **Figure 6-1 Ovens River – Station 403241 Flow and Salinity 2000**



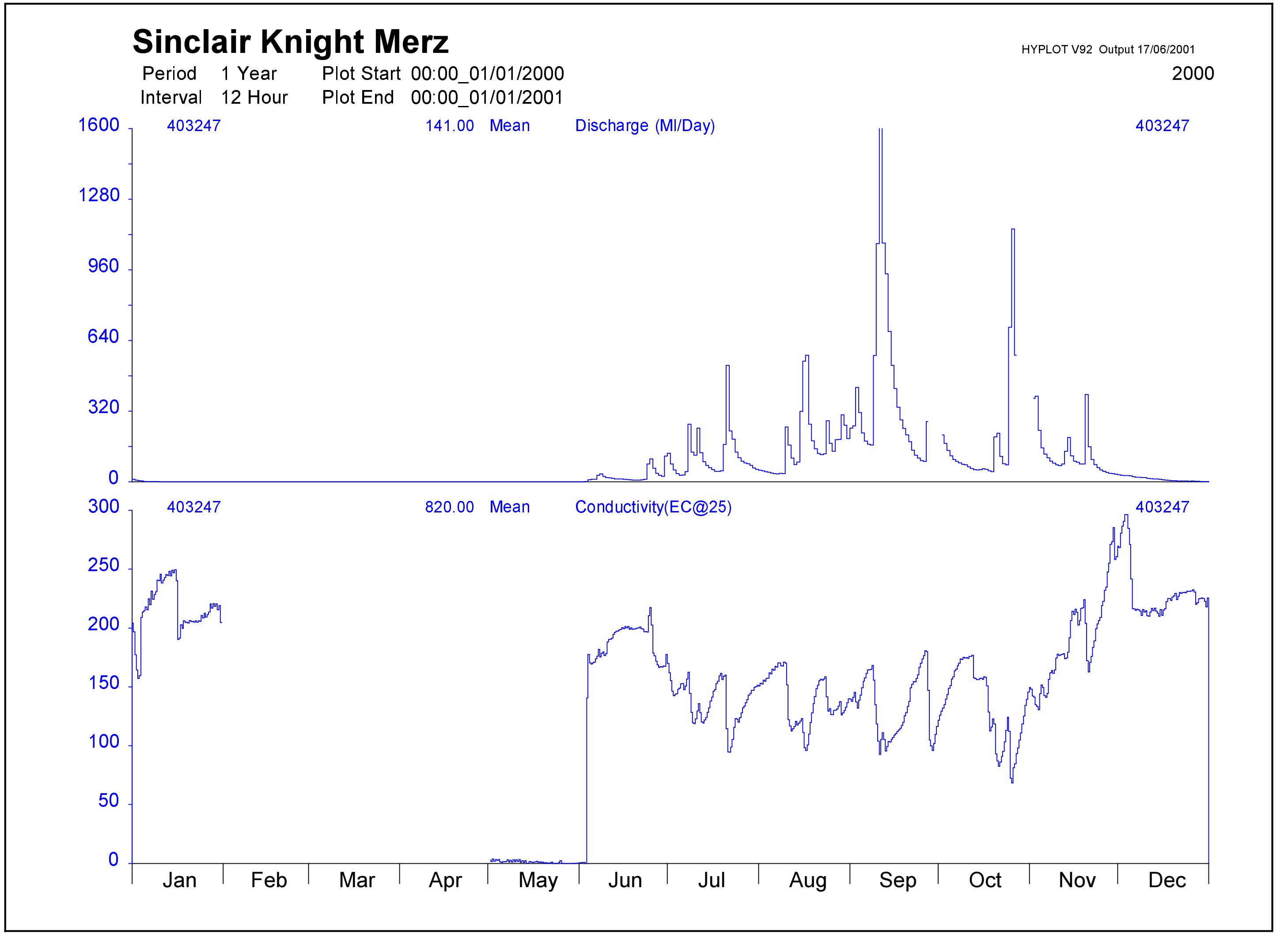
- **Figure 6-2 Ovens River - Station 403241 Flow and Salinity (January to June 2000)**



■ **Figure 6-3 Ovens River - Station 403241 Flow and Salinity (July to December 2000)**

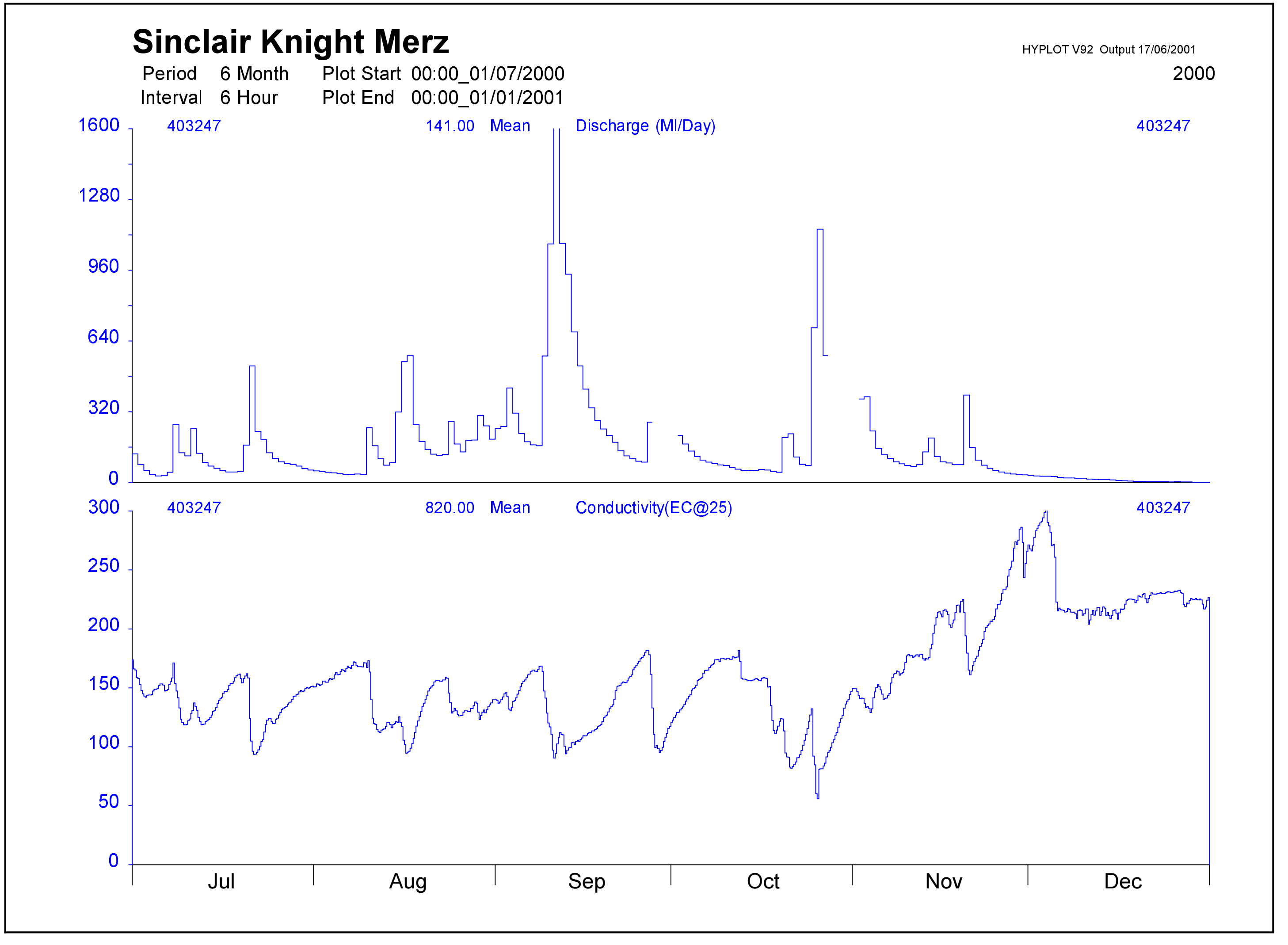


- **Figure 6-4 Black Dog Creek – Station 403247 Flow and Salinity 2000**

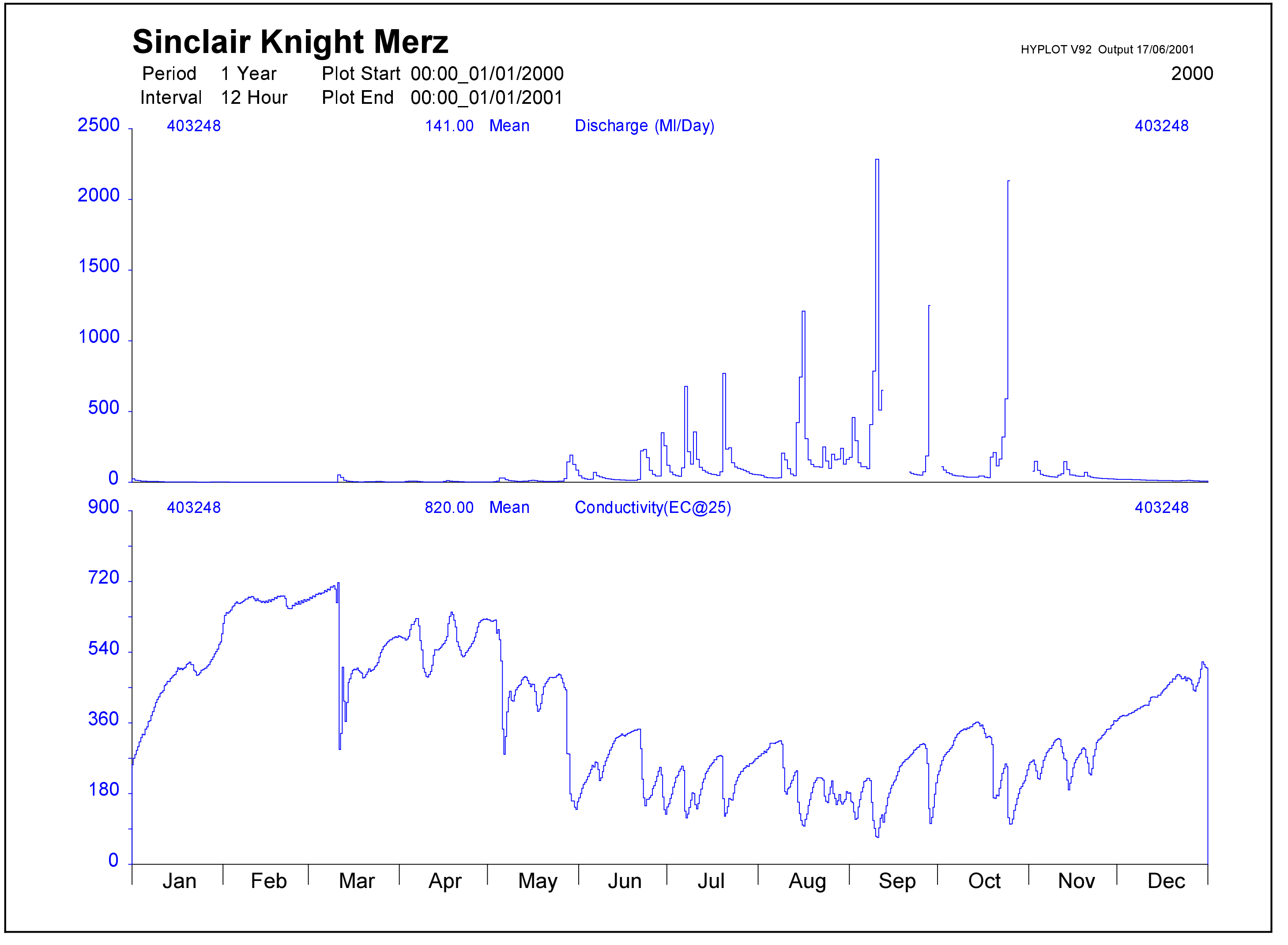


- **Figure 6-5 Black Dog Creek – Station 403247 Flow and Salinity (January to June 2000)**

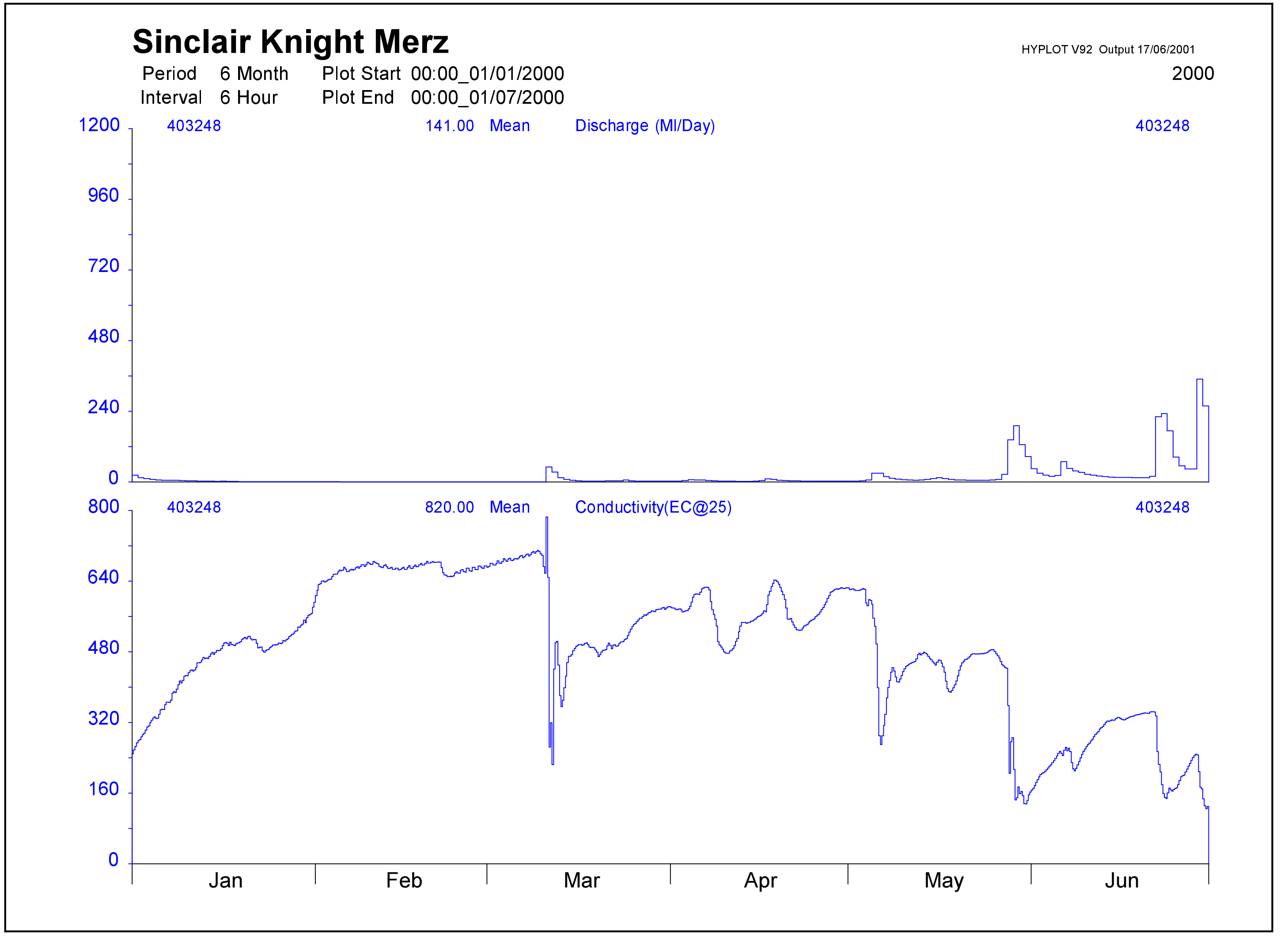
■ **Figure 6-6 Black Dog Creek – Station 403247 Flow and Salinity (July to December 2000)**



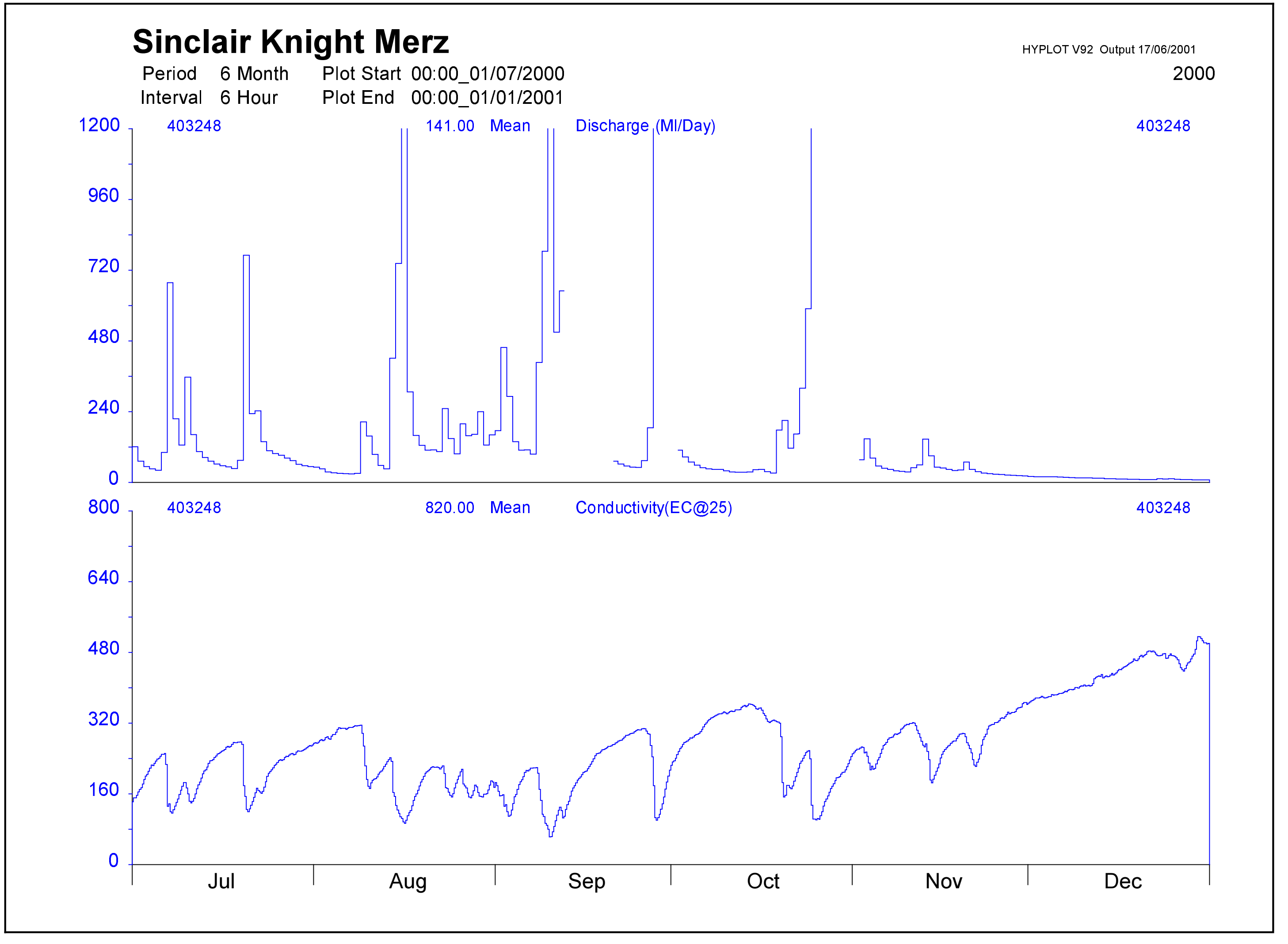
■ **Figure 6-7 Indigo Creek – Station 403248 Flow and Salinity 2000**



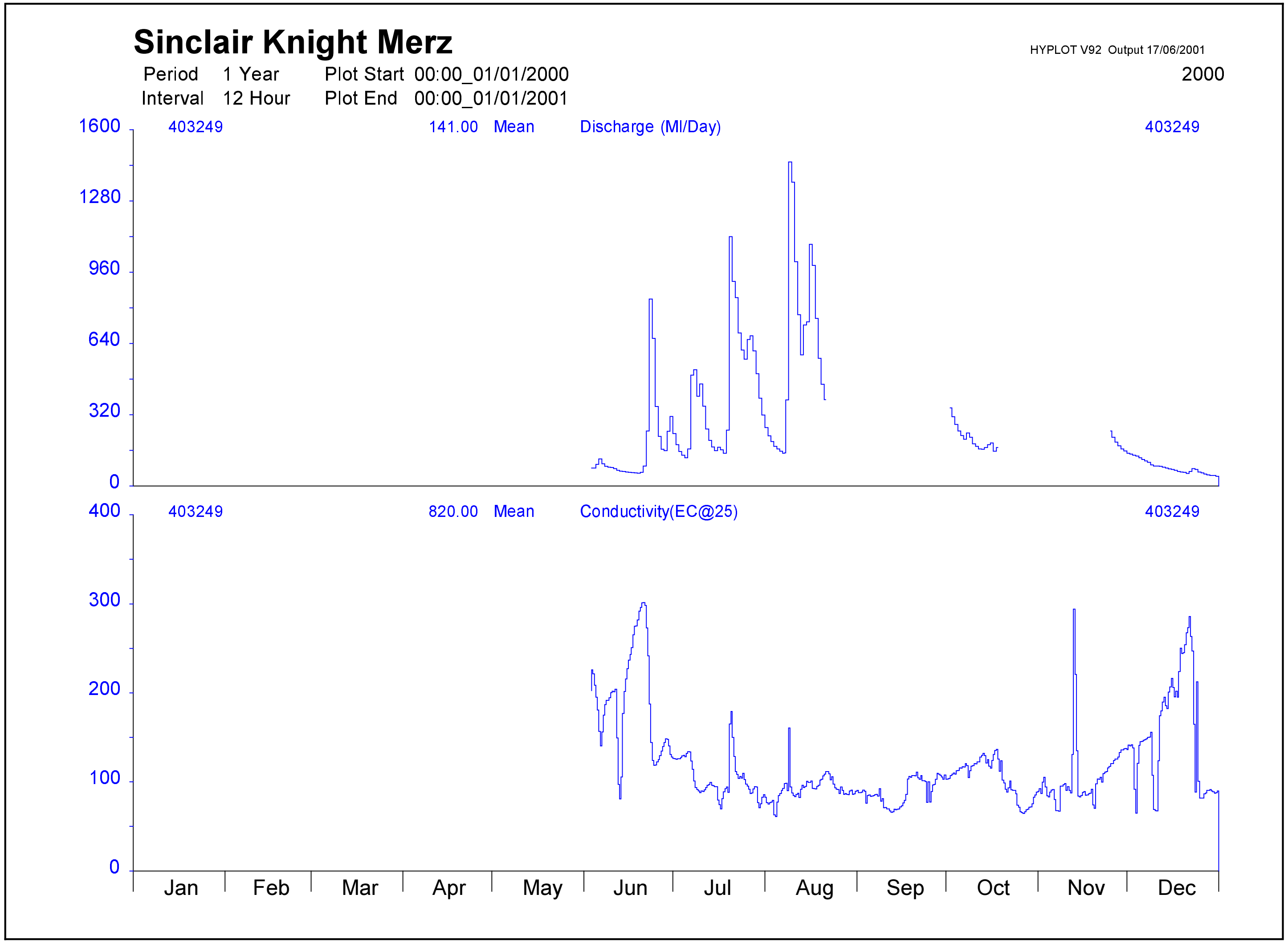
■ **Figure 6-8 Indigo Creek – Station 403248 Flow and Salinity (January to June 2000)**



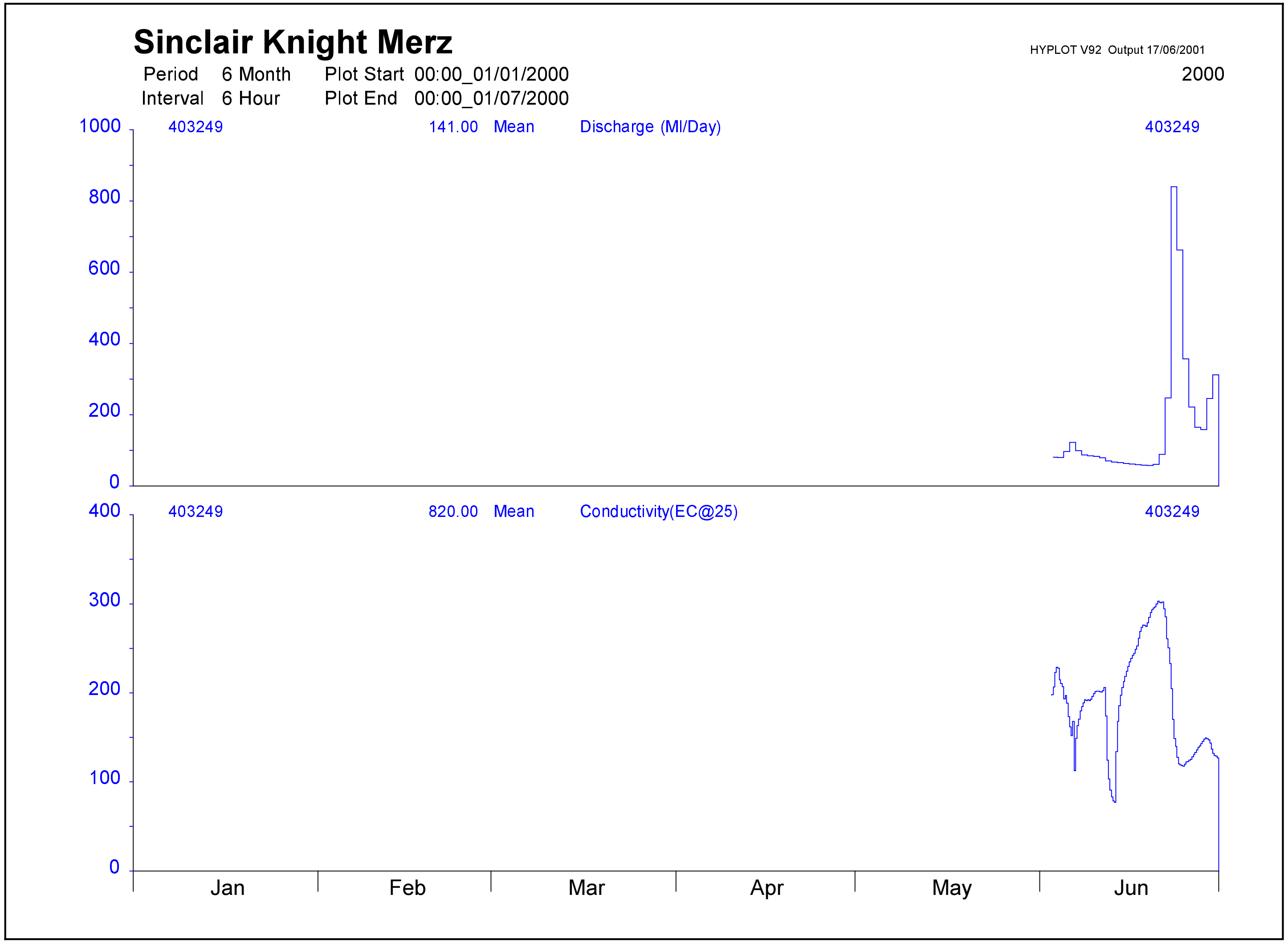
- **Figure 6-9 Indigo Creek – Station 403248 Flow and Salinity (July to December 2000)**



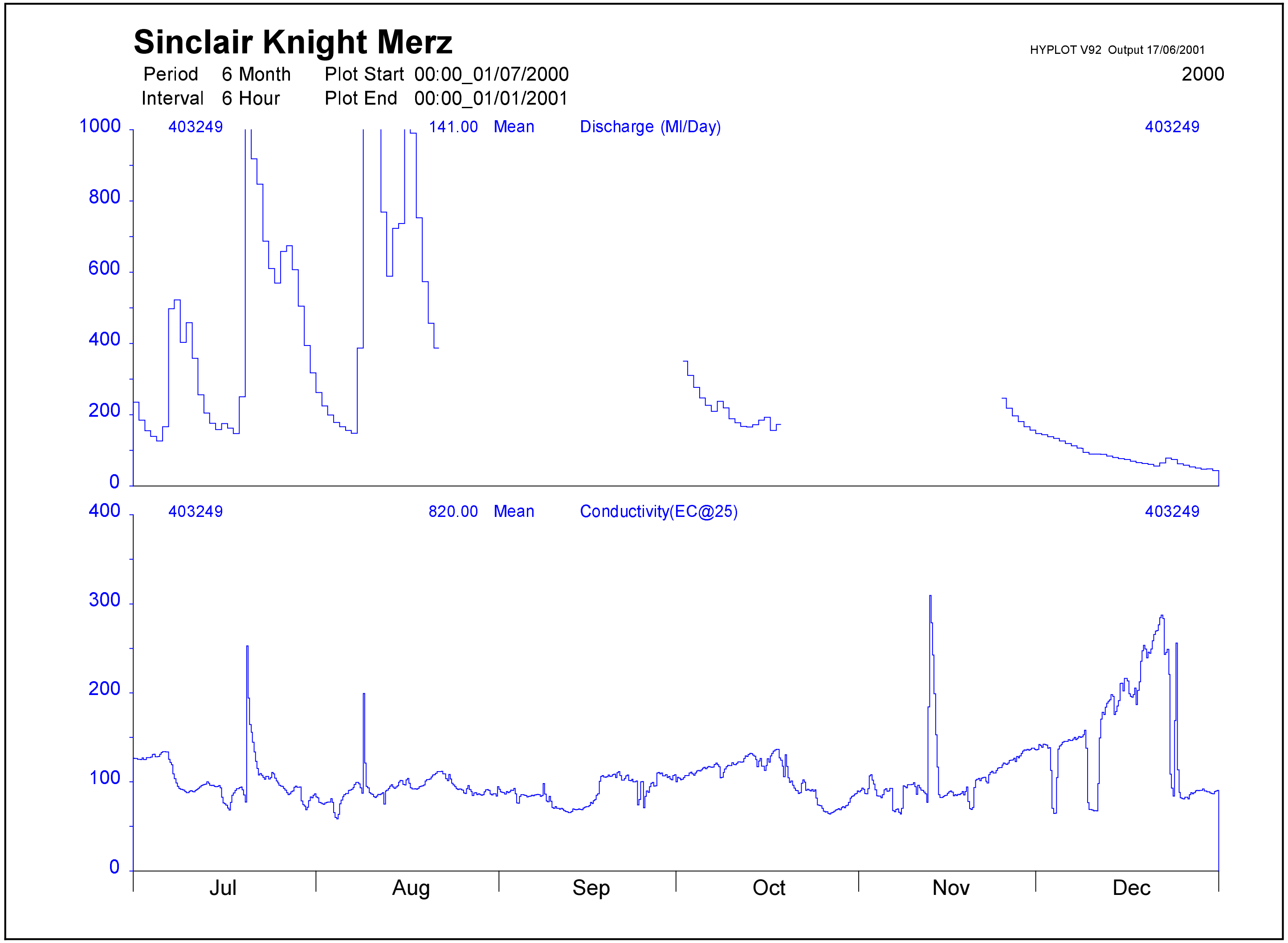
- **Figure 6-10 Three Mile Creek – Station 403249 Flow and Salinity 2000**



- **Figure 6-11 Three Mile Creek – Station 403249 Flow and Salinity (January to June 2000)**



- **Figure 6-12 Three Mile Creek – Station 403249 Flow and Salinity (July to December 2000)**



Appendix B Missing Data

▪ Table 6-1 Missing Data Summary - 2000

Station Name	Station Number	Parameter Measured	Raw Data Missing (1)	Estimated During Processing (2)	Final Data Missing (3)	Comment
Ovens River @ Peechelba	403241	Flow	0	0	0	-
		Salinity	0	0	0	-
Black Dog Creek @ Parris Rd, Brimin	403247	Flow	11	0	11	Backup from River Murray
		Salinity	0	0	0	-
Indigo Creek	403248	Flow	87	66	21	Backup from River Murray and additional gauging required
		Salinity	0	0	0	-
Three Mile Creek	403249	Flow	80	0	80	Backup from Ovens River
		Salinity	0	0	0	-

Note : Missing salinity data during periods of no flow were not included in the above table, as salinity data is not expected in a dry stream.

(1) Raw data missing - is classed as the data obtained directly from the on site logger.

(2) Estimated during processing - is classed as the data which has been estimated by Thiess during initial processing.

(3) Final data missing - is classed as the data which cannot easily be estimated and is classed as missing.

The following data is not classed as missing from the raw data set:
Estimated data with a quality code of 15* or less is considered good quality data.

Appendix C Estimated Data

■ **Table 6-2 Estimated Data Summary**

Station Name	Station Number	Parameter	Code			Flow QC 2-99	Flow QC 100-150	Salinity QC 2-99	Salinity QC 100-150
			2	15	150				
Ovens River @ Peechelba	403241	Flow	274	0	0	274	0	-	-
		Salinity	250	0	0	-	-	250	0
Black Dog Creek @ Parris Rd, Brimin	403247	Flow	289	0	0	289	0	-	-
		Salinity	198	10	0	-	-	208	0
Indigo Creek	403248	Flow	166	8	66	174	66	-	-
		Salinity	248	0	0	-	-	248	0
Three Mile Creek	403249	Flow	121	0	0	121	0	-	-
		Salinity	212	0	0	-	-	212	0

2 Good quality edited data
15 Minor Editing of record
150 Rating extrapolated due to insufficient gaugings

Comments

The quality code (QC) is used to represent the accuracy of the data. The higher the QC the less accurate the data is. QC's between 1 and 99 are classed as good reliable data with QC's from 100 to 150 classed as estimated data of less accuracy. Users need to be aware that data with quality codes higher than 99 should be re-examined before use in any important study.

The following comments are made regarding the estimated data presented in Table 6-2:

- A quality code of 150 indicates that insufficient measurements at high flows have been taken. Although this is the best estimate of flow at present, further high flow measurements will improve the accuracy of high flow records.

Appendix D Infilling Techniques

The only infilling required to produce salt loads was for the data that were lost due to backup and flooding of the gauge. Backup is generally identified when the rating obtained when the peak flow is receding is different to that obtained when the flow is rising to a peak. The point at which the backup began to affect the flow measurement is determined by Thiess and is generally an interpretation by the operator (pers comm B Mitchell – Thiess Wangaratta).

In most instances, the effect of backup has been interpreted to occur following the peak flow. In these cases, the gaps were infilled using a decay (exponential) function in excel to fill the data series.

There was one instance where this did not apply and the correlation shown in Figure 6-13 was used to infill the flow record. Whilst the correlation is not strong, the function is a good representation over the salinity range for which flows are missing. An examination of other infilling techniques showed that this was the best available method with the available data. A review of this infilling should be undertaken when better information is available.

- **Figure 6-13 Salinity-Flow Correlation for Site 403249**